

**Flora of Cold Deserts
of
Western Himalaya**

**Volume 1
(Monocotyledons)**

S.K.Murti

BOTANICAL SURVEY OF INDIA
Ministry of Environment and Forests

FLORA OF COLD DESERTS OF WESTERN HIMALAYA

Volume I

(Monocotyledons)

S.K. Murti



भारतीय वनस्पति सर्वेक्षण
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Foreword

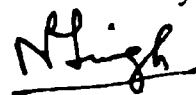
The Rio conference on biodiversity, better known as "The Earth Summit", was held in Rio de Janeiro, Brazil in June, 1992. In this conference the most important issue resolved was the "Convention on Biological Diversity", which highlighted 3 basic objectives viz., the conservation, the sustainable use and the fair and equitable sharing of the benefits arising out of the utilization of biological resources. The Botanical Survey of India, since its inception, has been engaged in survey, study and inventorisation of the phytodiversity of the country, which are prerequisites to achieve these objectives.

During the successive plan periods, the functional base of the Botanical Survey of India was further expanded to include various new areas such as inventorying of endemic, rare and threatened plant species; studies on fragile ecosystems and protected areas, etc. Exploration and inventorisation of phytodiversity of fragile ecosystems have been included as one of the primary objectives of B.S.I.

The cold desert ecosystem of North-West Himalaya is recognised as one of the very important fragile ecosystems of India. Due to opening of these cold desert areas to tourism and related developmental activities, this fragile ecosystem of cold desert has become a matter of serious concern. Any change or disturbance in the biotic and abiotic components of this unique ecosystem is bound to cause imbalance in the ecosystem. The Botanical Survey of India, thus, has taken up the task of survey, study and inventorisation of the flora of cold desert on priority.

In the above context, the present work by Dr. S.K. Murti is a welcome step. The floristic account deals with 347 species, belonging to 103 genera under 16 families of monocotyledonous group of Angiosperms and is being published under the Flora of India-Series II.

It is hoped that the account will be useful to students, botanists, foresters, environmentalists, planners and others who are interested in the peculiar and fascinating floristic wealth of cold deserts of Himalayas.



N.P. Singh
Director

Botanical Survey of India
Calcutta - 700 001

Preface

The Himalayan ranges by their location at the boundary of so many biogeographical regions such as Palaearctic, Mediterranean, Indo-Chinese, Indo-Malayan and Peninsular India, are one of the richest areas of India in terms of habitat and species diversity. The cold deserts of India come under the trans-Himalayan zone and constitute a unique ecosystem.

The cold desert ecosystem of North-West Himalaya is characterised by extremes of climatic conditions such as sub-zero temperature with great diurnal fluctuations, scanty and erratic rainfall, heavy snowfall, howling winds, ultraviolet radiation and desiccating exposure to the sun. The soil is unable to hold water. The cold desert areas have low productivity. It is a fact that number of species decreases as one moves to higher latitudes and altitudes. As a result, the plant and animal species occur in low densities and need relatively larger areas to maintain viable populations. Though, by and large, these species are adaptive in nature, increasing human pressure and activities pose serious threat to the survival of this ecosystem and its constituent animals and plants. The mounting human pressure and over exploitation of natural resources have made the trans-Himalayan cold deserts one of the world's most fragile and threatened ecosystems.

Value of any ecosystem depends on the value of its constituent biotic and abiotic units. If a qualitative as well as quantitative analysis of physiography, diverse and specialised flora, economically useful species of plants, rare elements of flora, the genetic diversity, high degree of endemism, presence of alien species not only from the neighbouring regions/countries like Tibet, Siberia, Turkestan, Afghanistan, China, etc., but also from far off regions like Europe and Eastern U.S.A. and the remarkable adaptations shown by the plants due to harsh climatic conditions, are made, the value and uniqueness of this cold desert ecosystem become more apparent. Botanically the area is of great interest, the vegetation being a sparse alpine steppe.

The cold desert areas are under increasing pressure of the recent rapidly expanding tourism industry. These areas are also one of the least

protected regions of India, as only about 4% of these is covered under national network of protected areas.

Further, for a proper utilization of the vegetable raw material in a developing country like India, the need for surveying the plant resources for developing rural as well as urban economy is often emphasised. For this we need factual data about vegetation, flora and economic plants of a region to plan and execute development-programmes. For drawing up rational social forestry schemes also, such assessments of floristic component of a region is essential.

In the wake of recent awareness about the role of plants and plant-covers in preserving an ecosystem, the floristically interesting and fragile ecosystem of cold desert areas has attracted the attention of quite a few workers.

Charged by the foregoing and related exigencies, the task of surveying the high altitude cold desert areas was undertaken by the scientists of the Northern Circle, Botanical Survey of India, Dehra Dun, including the author. The present Flora is an outcome of this extensive and intensive survey and study of the plants of this region. The present work deals with 347 species, belonging to 103 genera under 16 families of monocot group of Angiosperms. The work on dicot group of Angiosperms is under preparation, which comprises about 850 species belonging to about 295 genera under 72 families.

The work is divided into 2 major parts. The first part deals comprehensively with area and drainage system, physical features, geology, soil, climate, vegetation, floristic diversity, agricultural practices and cultivation of economic plants, introduced phytodiversity, phytogeographical affinities, earlier botanical work in the region, and materials methods and style of the presentation of the Flora. The second part deals with the taxonomic treatment of the plant taxa. A comprehensive bibliography is provided. An index to the botanical names is provided at the end of the Flora.

I express my indebtedness and gratitude to the Director, Botanical Survey of India for allotting this project to me and providing all the facilities

for fieldwork and herbarium study. I am grateful to Dr. D.K. Singh, Joint Director, Botanical Survey of India for showing keen interest and time to time giving helpful suggestions for completion of the project.

I am also grateful to Shri B.P. Uniyal, Botanist and Shri Surendra Singh, Scientific Assistant, Botanical Survey of India for their active, untiring and selfless help in identification of specimens, supervising the preparation of plant drawings, checking of the manuscript and many helpful suggestions. Grateful thanks are also due to the supporting staff of Botanical Survey of India, Northern Circle, Dehra Dun for their active cooperation during the field survey. Thanks are due to Shri Devraj Agarwal, Photographer, Shri Bhola Ram and Shri Anil Kharey, Artists, Botanical Survey of India for their assistance in providing photographs and preparation of line drawings.

I am also grateful to Dr. P.S.N. Rao, in-charge Publication Section and Shri S.K. Sur, Sr. Proof Reader, Botanical Survey of India for going through the type-script and making necessary changes to conform to the style of B.S.I.'s publications.

The herbarium and library facilities provided by the Director General, Indian Council of Forestry Research and Education, Dehra Dun and the Director, Royal Botanic Gardens, Kew, London are gratefully acknowledged.

The active cooperation and help rendered in various ways by the State Forest Department personnel of Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh during field survey and exploration work are also gratefully acknowledged.

Last but not the least, grateful thanks are also due to Shri Sanjay Uniyal, Data Entry Operator, Botanical Survey of India, Dehradun for performing the tough computer typing work.

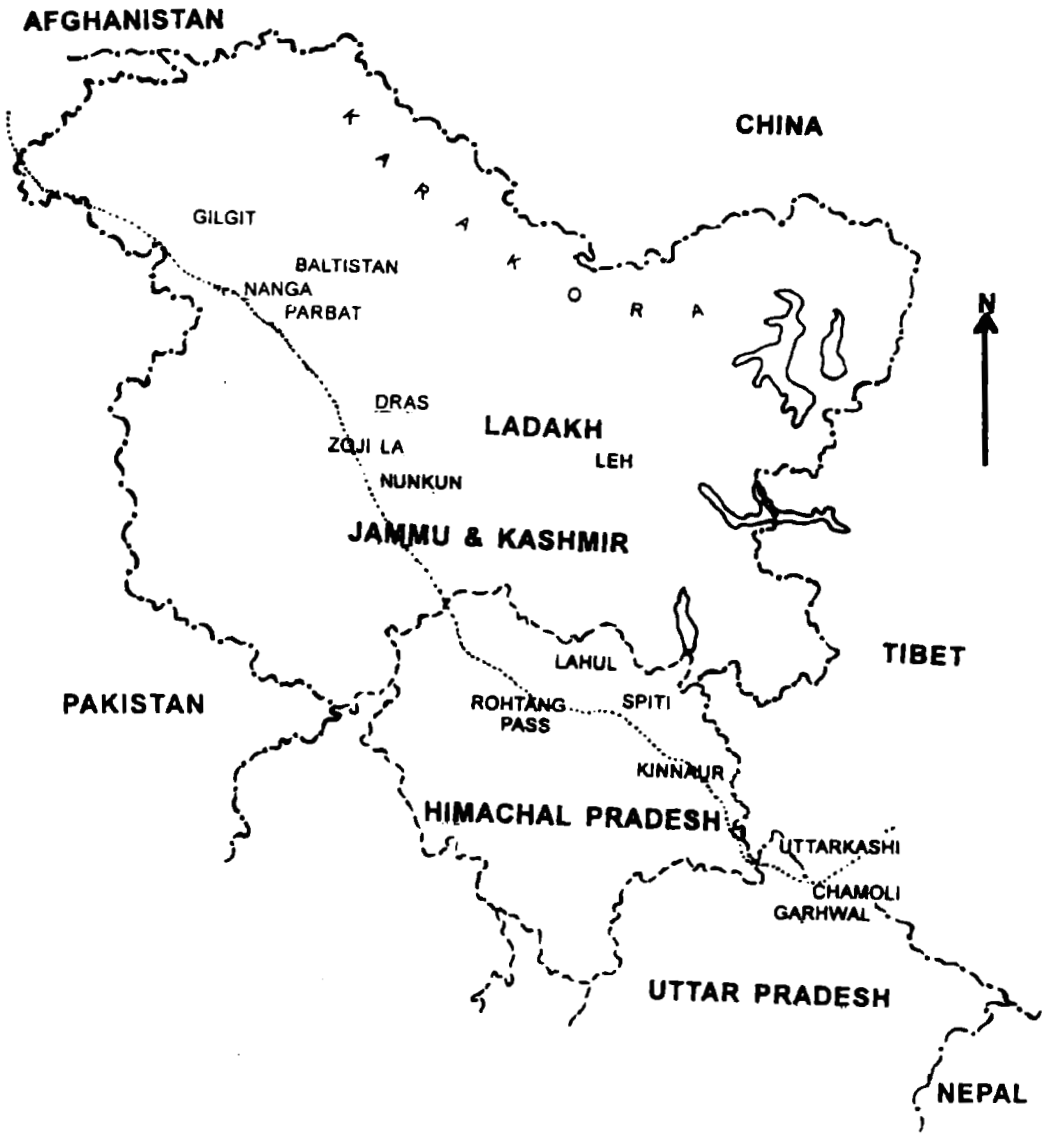
The author will welcome any suggestions to improve this work.

Dehradun

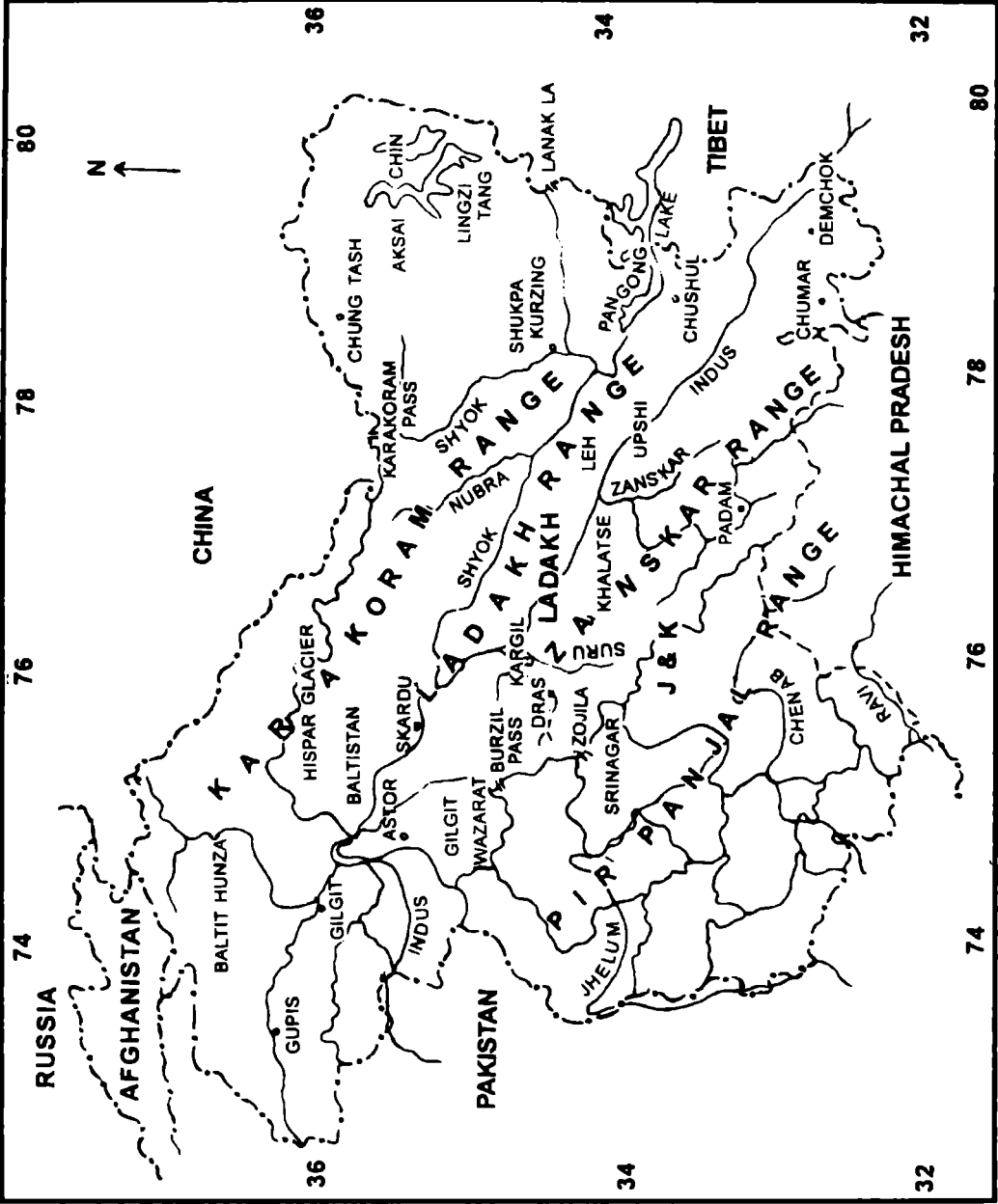
Sri Krishna Murti

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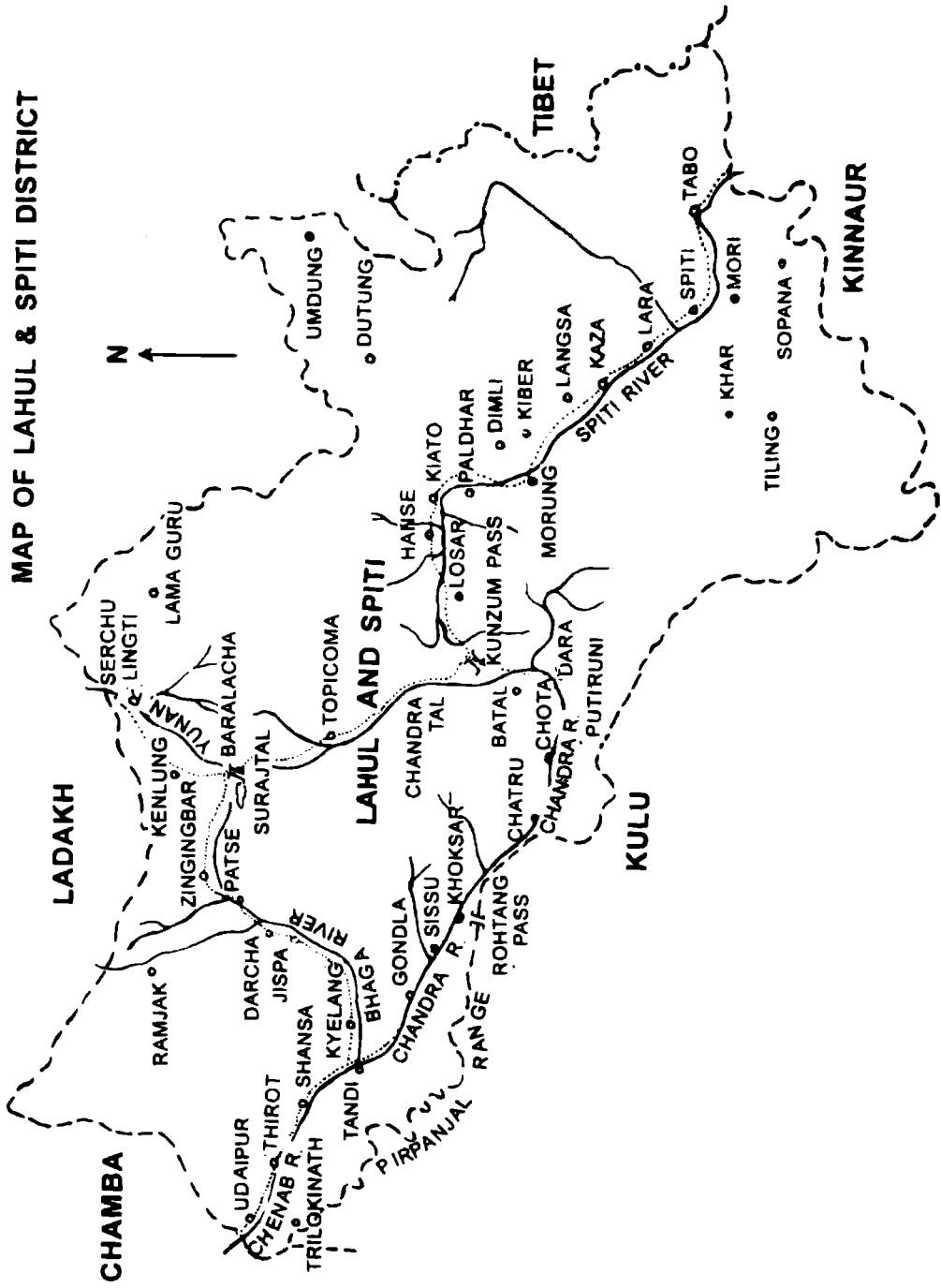


Map 1 : Cold desert areas of Western Himalaya (Not to the scale)

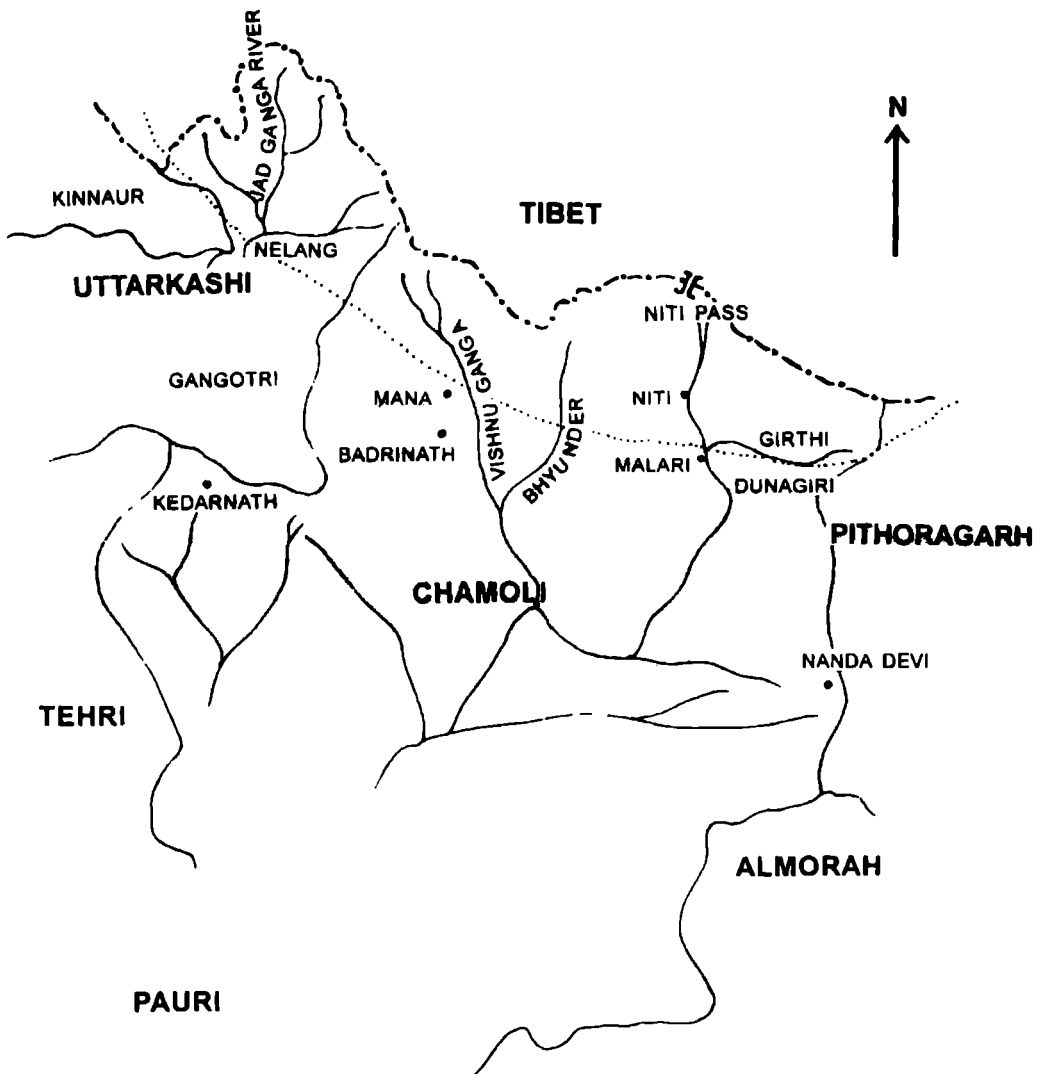


Map 2 : Cold desert area of Jammu & Kashmir (Not to the scale)

MAP OF LAHUL & SPITI DISTRICT



Map 3 : Cold desert area of Lahul & Spiti in Himachal Pradesh (Not to the scale)



Map 4 : Cold desert areas of Uttarkashi and Chamoli, Uttarakhand
(Not to the scale)

INTRODUCTION

A desert is any of the several biomes (communities of distinctive plant and animal life) occurring on all continents at the dry end of climatic gradients of decreasing water availability. Successively distributed along these gradients are such other biomes as forest, prairies, grassland and steppes, beyond which lie the arid deserts. Aridity, although extreme in many ways, is as favourable to the biological assemblage and associated with it as those of any other biomes.

When these arid areas occur in high latitude, mainly poleward and away from Equator and the landmass is very high in altitudinal aspects, these are termed as cold desert, a unique ecosystem, different from hot deserts, which are low land arid areas, confined mostly within the tropics. Deficiency of biologically usable water results primarily from physiological drought imposed by low temperature.

In India, the Trans-Himalayan zone lies in the rain shadow of the main Himalayan range and is usually described as 'High Altitude Cold Desert'. It is more extensive outside the Indian territory adjoining Tibet and in India it covers only about 2% of total land surface. Within Indian limits bulk of the cold desert lies in Ladakh region, in Jammu & Kashmir, Lahul & Spiti, and Kinnaur (small northern portion of Kalpa and Baspa valleys) in Himachal Pradesh and small portions of Uttarkashi (Nelang valley) and Chamoli (Mana and beyond and Niti beyond Malari) districts in Uttar Pradesh i.e. northern tip of Garhwal Himalaya. The total area of cold desert in India is approximately 98,660 sq. km i.e. about 82,665 sq. km in J. & K., about 15,000 sq. km in H.P. and about 1000 sq. km. in U.P.

AREA AND DRAINAGE SYSTEM

The cold desert areas in India comes under the Trans Himalayan Zone. It is confined to Ladakh region in J. & K., Lahul & Spiti and Kinnaur (small portion) in H.P. and northern tip of Garhwal Himalaya i.e. Nelang Valley (Uttarkashi district), Mana, Niti Valley beyond Malari area (both in Chamoli district) in U.P. In J. & K. the area lies between 32°15'-

37°20' N and 72°30'-80°15' E and covers approximately 82,665 sq. km. Approximately 37,500 sq. km is under illegal occupation of Pakistan and China. In H.P. the area lies between 31°10'-33°57' N and 76°46'-79° E and covers approximately 15,000 sq. km. In U.P. the area lies between 30°64'-31°46' N and 79°-80° E and covers approximately 1000 sq. km. Thus total area under the cold desert ecosystem is approximately 98,660 sq. km and lies between 30°64'-37°20' N 72°30'-80°15' E.

Western Himalaya stretches from the vicinity of Upper Nepal in the east to an area in North where Kashmir meets China, Pakistan and Afghanistan. The two biggest ranges are the Great Himalayan range and the Mid Himalayan range (Lesser Himalayan range) which run parallel to each other and enclose between them an interminable land of plateau and valleys, narrow, winding high and extremely arid. This land would be a continuous strip, were it not cut by lofty off shoots transversely thrown out here and there by the two ranges, meeting each other across a landscape of snow and boulders. In the inter-stices of this mesh lie the cold deserts of Ladakh in J. & K., Lahul and Spiti, and Kinnaur (part) in H.P. and Uttarkashi (part) and Chamoli (part) in U.P. The individual ranges generally present a steep slope towards the plains of India and a more gentle inclined slope towards Tibet.

Cold Desert areas of Jammu & Kashmir :

Ladakh region :

Ladakh, the largest, the loftiest and remotest district in the Indian republic is often referred to as Dust Bowl of Earth or a Land of Rock-ruins. It is the northernmost district of J. & K. It is one of the most elevated inhabited regions of the earth (2900 m to 5900 m). The greatest extent is from northwest to southeast, being about 360 km and the widest distance is 335 km from Karakoram pass in the north to Rohtang Pass in the south. Despite its enormous size it is among the least populated areas in the country (3 persons per sq. km)

The natural features of Ladakh are best explained by a native term "Changthang", meaning the predominant high plain in the east and deep valleys in the west. Its boundary is extremely irregular in outline. It is bounded in the north and north east with Tibet, in the north west with



Thylacospermum caespitosum (Camb.) Schischk.
- a cushion forming species, typical of cold deserts.



Acantholimon lycopodioides Boiss - another cushion
forming species in cold deserts.



Arenaria bryophylla Fernald.
- a cushion forming species in cold desert regions.



Thermopsis inflata Camb. - a typical cold desert species.



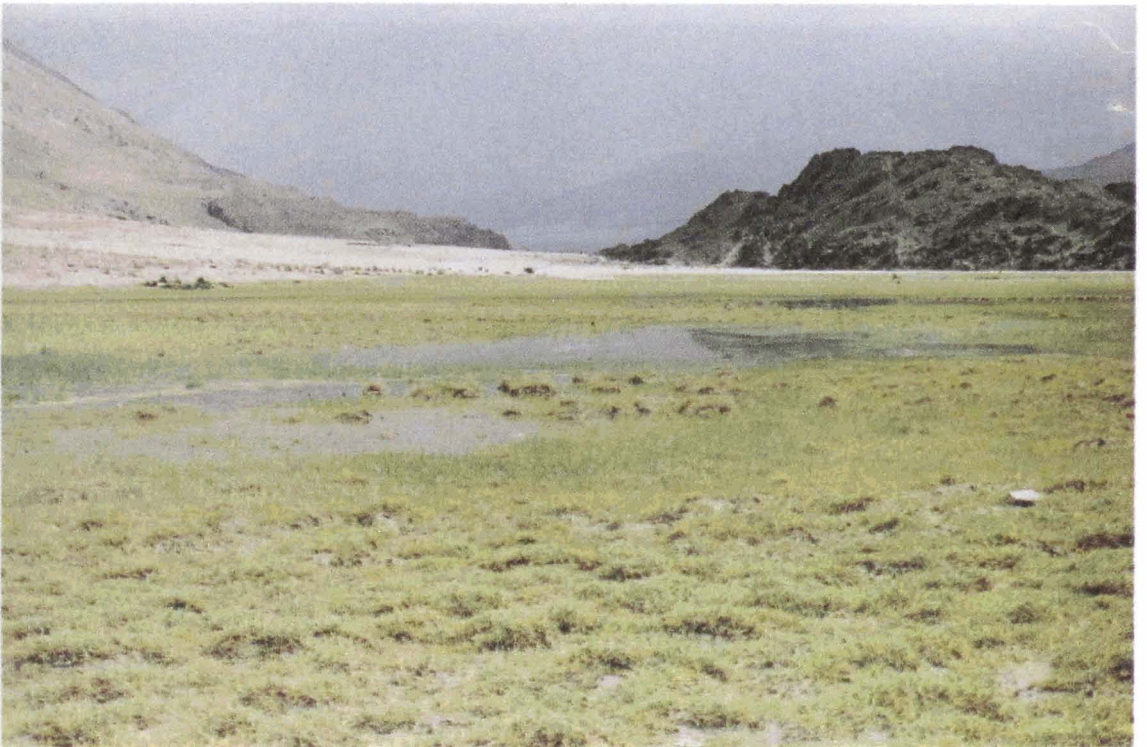
Chang La, Ladakh - high mountain pass.



Kunzum Pass, Spiti.



Pangong Lake, Ladakh - one of the world's highest and largest brackish water lake.



Nubra Valley, Ladakh - typical cold desert marsh.



Along Indus - bushy vegetation of *Myricaria* and associates on flatter embankment.



Spiti river gushing through gorge.



Tandi - confluence of Chandra and Bhaga rivers, Lahul valley.



Nubra Valley, Ladakh - planted *Populus* spp. and *Salix* spp.



Alpine meadows in transition zone - on way to Baralacha La, Ladakh



Upper Chenab Valley in Lahul-coniferous forests in the gullies and 'Hop' cultivation in the foreground.



Tanglang La, Ladakh



Pin Valley, Spiti



Aconitum heterophyllum Wall. ex Royle
- medicinally important Aconite.



Saussurea costus (Falc.) Lipsch.
- 'Kuth', an important medicinal and aromatic plant.



Humulus lupulus L.
- common under cultivation, used in 'beer' - industry



Allium stracheyi Baker - frequently seen on slopes.



Allium carolinianum DC. - common on moist slopes.



Hyoscyamus niger L. - an important medicinal plant.



Hippophae rhamnoides L.
- a very useful plant to the people, living in cold deserts.



Melica persica Kunth - growing amidst boulders.



Dactylorhiza hatagirea (D. Don) Soo.
- a medicinally important ground orchid.



Gentiana algida Pall. var. *nubigena* (Edgew.) Kusn.
- frequently seen in cold deserts.



Astragalus rhizanthus Royle ex Benth.
commonly seen between rock boulder.



Echinops cornigerus DC. - a deep rooted cold desert species.



Lamium rhomboideum (Benth.) Benth.
- a rare species on rocky slopes.

Baltistan, in the west with Gilgit, Baramula, Srinagar, Anantnag and Doda districts of J. & K. and in south with Himachal Pradesh. Most of the areas of the district lie in the Great Himalayan zone and three principal mountain ranges of the Great Himalayan range stretch from south east to north west in a parallel sequence. From the north to south these are Karakoram range, Kailash range and Ladakh range. The Zaskar range is the fourth range, running parallel to these ranges and belongs to the lesser or middle Himalayan zone. It forms the southern limit of Ladakh district. More than 85% of the area lies at 5000 metres or more above mean sea level. The parallel nature of these ranges determines the course of the rivers and natural divisions of the district.

The region is approachable through high mountain passes called 'La'. The important ones are Zoji La (3510 m), situated about 96 km north east of Srinagar in Zaskar range; Namika La (3900 m), Fotu La (4000 m), Khardung La (5500 m), Tanglang La (5250 m), and Baralacha La (5300 m). Physiographically the region can be distinguished into 5 divisions.

1. Nubra : It is the northernmost region, about 192 km long and 118 km wide, bounded by Karakoram range on the north and Kailash range on the south.
 2. Ladakh : This is the central region, about 180 km long and 55 km wide.
 3. Zaskar : It is 108 km long and 84 km wide. It is bounded by Ladakh on the north, Rupshu in the east, Lahul (HP) on the south and Purik and Warle on the west.
 4. Rupshu : It is the most elevated region, and bounded by Spiti (HP) on the south, Zaskar on the west and China in the east. It is almost 15 km long and 93 km wide.
- ↓
5. Dras, Purik and Suru : This is situated in the west of Zaskar and together being about 136 km long and 75 km wide.

Drainage system :

The main valleys lie along the water heads of Indus, Shyok, Nubra, Zaskar, Dras and Suru rivers, which are also the main rivers of the district. The principal part of the country is that which follows the course of Indus from south east to north west through the greater part of the country. Indus, the principal river of Ladakh, locally known as Singe Chhu (lion river) has two main tributaries - Shyok on the north and Zaskar on the south. The main tributaries of Shyok are Nubra, Changi, Chemo and Lungchu, and of Zaskar are Sungal, Tsarap and Serchu. Thus Indus, Shyok and Zaskar, with their tributaries, form the drainage system of the district. There are number of lakes, viz. Tso Morari, Tsokar, Pangong etc. Pangong is about 60 km long and about 3.5 km wide. Lakes are land locked and water is brackish. Hot spring abound in Ladakh, of which Puga and Panamig are well known. Of the several valleys the Indus valley, covering more than half of the area of the district is the most famous. Other valleys are Suru, Zaskar, Nubra and Dras.

Cold Desert areas of Himachal Pradesh :

Lahul & Spiti :

The two different geographical units beyond Rohtang and Kunzam passes on Indo-Tibetan border were put together to form a new district of Himachal Pradesh in 1960. Prior to this the region was part of Kangra district of Punjab. It comprises vast mountanous area, lying south of Ladakh. The great Divide or the Pir Panjal range separates it from the district of Kulu. The district comprises two sub-divisions, viz. Lahul, the physically more accessible western part and Spiti, a less accessible eastern part.

The district is separated in the north from Ladakh by Baralacha range and bounded in the east by Tibet. In the south and west lie Kulu and Chamba districts of Himachal Pradesh respectively. Spiti is separated from Lahul by a high mountain range, the Kunzum range running towards the north from the Mid Himalayan range. The two valleys of Lahul and Spiti have a tenuous link over the Kunzum pass (4500 m). The sole access to Lahul lies over the 4200 m high Rohtang pass. The Lahul-Spiti district occupies an are of about 12,210 sq. km.

The average elevation of the peaks in Lahul is between 4550 and 5400 m. The lowest point is about 2450 m where river Chenab makes its exit from the district. Lahul is really three valleys in one : those of Chandra river valley, Bhaga river valley and their joint stream Chandra-Bhaga river valley, which is better known outside Lahul as Chenab river. The valley of river Chandra, locally called Rangoli, has a considerable portion comprising just snow bed near Baralacha Pass and is uninhabited. Khoksar is the first village.

The valley of river Bhaga is locally called Gara. The upper region of this valley also presents a deserted look. The valley of the united rivers Chandra and Bhaga i.e. Chandra-Bhaga valley is locally known as Patan or Manchat. This is comparatively wider, fertile and thickly populated.

The mountain land mass between the rivers Chandra and Bhaga forms the centre of this region and contains most of the glaciers and torrential nullahs with intervening valleys. The region has Baralacha Pass where roads from Zanskar, Ladakh, Spiti and Lahul meet. This is the region where three rivers, viz. Chandra, Bhaga and Yunan rise in north east, north west and north respectively.

Lingti plains is the uninhabited, uncultivated and deserted area of some 260 sq. km which is situated across the Baralacha Pass towards the north. It has the lowest elevation of 4270 m. The streams of Lingti and Yunan flow here before entering into Zanskar.

Spiti, in comparison to Lahul, is higher in elevation with more rugged and difficult terrain. The average elevation is about 4600 m. All around Spiti are lofty mountain ranges and peaks-in the north Chocho Lang Kilta peak (6400 m), in the east main Himalayan range, in the south Manirang peak (4600 m), and in the West separated from Lahul by the Kunzum range. Situated in the high altitude cold arid zone, Spiti region has very little vegetation. It is a typical mountain desert.

Across a broad saddle between Lahul Spiti and the routes to Tibet, near the north eastern face of the arc, lies the Baralacha La (5300 m), which gives both Lahul and Spiti access into each other and into Ladakh.

Closer to the middle of the arc, Lahul and Spiti are separated from each other by a short offshoot of the mid Himalayan range the Kunzam ridge with Kunzam Pass (4500 m). Across the mid Himalayas themselves are two passes, the Hamptu Pass (4500 m) and the Rohtang Pass (4200 m). Both these passes lead into a backyard of Lahul.

Drainage system :

Three major rivers - Chandra, Bhaga and Spiti, with their tributaries, constitute the drainage system of Lahul & Spiti. There are about 20 big and small glaciers, including the famous Bara Shigri, Chhota Shigri, Gangstang and Sonapani. There are three prominent lakes viz., Chandra Tal, Suraj Tal and Sissu Tal. Chandra and Bhaga rivers arise in Baralacha Pass area and flow in opposite directions. Chandra flows to the South-east for about 85 km to a place Tandi, where it meets Bhaga. Bhaga, flowing north west, enters the Suraj Tal Lake (5000 m), and setting out of the lake it flows nearly 16 km in a most barren tract, then it takes a south-westerly direction and reaches Dharcha village where it is joined by the Zanskar river. From here, passing through Kyelong it reaches Tandi where it meets Chandra and thereafter the combined river is known as Chandra-Bhaga or Chenab river. It passes through Patan Valley to Chamba, a distance of about 24 km. The chief tributaries of Bhaga are Zanskar, Milang and Baechung.

Spiti river has its source in the Kunzum range which divides Lahul from Spiti. After about 16 km. in a south easterly direction it is joined by a stream which drains the mountain range on either side of the Kunzum pass. Spiti river enters into Kinnaur district where it meets Sutlej river. The river Pin is the important tributary of Spiti. In an uninhabited region of Spiti a small river Tsarab runs in the north west direction and enters into Zanskar in Ladakh (J. & K.).

Kinnaur :

The rain shadow areas of Kinnaur lie in Kalpa-Pangi valley towards Murang, Jangi, leading to Shipki La and Baspa valley beyond Sangla towards Chitkul. The northern side of Sangla is dominated by two great

peaks, the first (6157 m) above Sangla village and the second (6610 m) about 18 km from further on. From Sangla, Rupin Pass (4688 m) is quite near and crossing it one can reach the Pabar valley. Another pass over the Sangla mountain leads to Shongtong on the Sutlej. A third pass crosses the Dhauladhar range above Chitkul to join Rupin route. At the end of the Baspa valley one pass leads to Gangotri in Garhwal Himalaya. Near Wangtoo the river Bhaba from Spiti joins Sutlej. From Wangtoo a path leads to Spiti valley along the Bhaba river. The Sutlej river which originates near the source of Indus in Tibet, enters Kinnaur district near Shipki La. The Baspa river has a glacial origin and passes through Chitkul and Sangla. It joins Sutlej near Karcham. These rivers form the main drainage system of this area.

Cold Desert areas of Uttaranchal :

Garhwal Himalaya :

The Nelang valley (Uttarkashi district), Mana and beyond and Niti valley beyond Malari (Chamoli district) are in Zaskar range of middle Himalayan range (Lesser Himalayan range). The average elevation of the area is between 4000 and 6000 m. Mana and Kamet peaks are respectively 6273 m and 6756 m in height. The Niti and Malari areas are situated in the rain-shadow areas of Dhauliganga valley, consequently the region receives very low percentage of precipitation and remains dry and dusty. Mana is also very dry. Mana pass (5608 m) and Niti pass (5044 m) lead to Tibet. Vishnuganga, Girthi, Dhauliganga, Alaknanda and Jalganga rivers along with their tributaries form the drainage system of Mana, Malari, Niti and Nelang areas.

Physical features :

The physical features of the extremely rugged, wind-swept and frost bitten cold desert areas do not vary much in character. These present an aspect of desolate, ice bound altitudes and long dreary wastes of valley and depressed lands totally different from the soft harmony of the greener areas. Due to almost total absence of any precipitation in these areas, their bleakness and barrenness partake of the character of Tibet. In consequence of the great insolation and the absence of any water-action,

there has accumulated an abundance of detrital products on the dry uplands and valleys, forming a peculiar kind of mantle rock or regolith of fresh, undecomposed rock fragments. The barren mountains, which rise from them, exhibit the exquisite desert coloration of the rocks due to the peculiar solar weathering. Most glaciers have undergone a remarkable retreat during the last 100 years or more and consequently have left great bare tracts of ground behind them, covered in boulders and glacial morainic debris.

Geology :

A part of the Himalaya has been formed from a geosyncline and the main mountain ridge arose out of an activated area of the Indus Shield (Gansser, 1965). According to Gansser (1965) in the territory of the Himalaya outside the extremely northern zone and the region of Kashmir, definite post-Precambrian pre-Gondwana deposits are known to exist just at a few sites, the remaining part of the Himalaya is made up of metamorphic strata, in part pre-Cambrian. However, in the extreme northern zone i.e. Tibet Himalaya along the boundary line of Karakoram and Tibet a complete sequence of Palaeozoic and Mesozoic deposits are known to exist. It exhibits almost total absence of volcanic and magmatic deposits except some zone of the Indus (Kaila & Narain, 1976). Crawford (1974) states that India and Tibet are to be regarded for most of Phanerozoic time as one huge crustal unit.

Himalaya was once occupied by the Tethys Sea (Burrard & Heydon, 1907). De Terra (1934) has estimated its width to be about 1,485 km, separating India, lying south of the equator, from the Eurasian land-mass in the north. Kashmir is believed to be connected with Eurasia by an isthmus (Wadia, 1936). Himalaya was elevated in late Pliocene and Pleistocene and the Pamirs and Hindukush and the mountains of Asia Minor even later (Schwarz, 1938). Geologically the Himalayas fall into 3 series -the northern, central and southern. The northern series is called the Tibetan zone, which includes the trans-Himalayan cold arid areas of the western Himalaya.

Pande & Gupta (1972) divided the north-west Himalaya into four broad zones:

1. The Nimadric Geosyncline including Patwar Plateau, with Miocene and Pleistocene fresh water sediments.
2. The Himalayan zone including outer Himalaya and foothills, with Tertiary, Mesozoic and Palaeozoic rocks.
3. The main crystalline axis separating the Himalayan zone from the northern Tethyan zone. It shares elements of both the Himalayan nappes and also trans-Himalayan zone.
4. Tethyan zone of Kashmir, which is subdivided into two - the valley of Kashrnir, with fossiliferous marine deposits, Karewas and crystalline rocks to the north and the Karakoram including Ladakh.

Ladakh lies behind the line of the highest elevations and is a zone composed of a continuous series of highly fossiliferous margin sedimentary rocks, ranging in age from the earliest Palaeozoic to the Eocene. As a tectonic unit, the great Himalayan range, of which Ladakh forms a part, is made up of the roots of Kashmir nappe, the principal geanticline within the main Himalayan geosyncline, consisting of the Archean and Precambrian sedimentary rocks together with large bodies of intrusive granites and basic masses.

With the exception of a part of Ladakh, which consists of tertiary rocks and a basin of Mesozoic sedimentary rocks on the northern flanks of Zanskar mountain, by far the larger part of the inner mountains is composed of igneous and metamorphic rocks, granites, gneisses and schists. In the Spiti area, which forms the south-eastern extension of Zanskar, Giurnal sandstones of Cretaceous, Spiti shales and Kito limestones of Jurassic and Monotis shales of Triassic period are found. A similar sequence is found in the central and southern parts of Ladakh, resting on upper Triassic limestone. These outcrops form part of a broad basin of marine Mesozoic rocks situated upon the inner flanks of Zanskar range. The lower parts of a number of outcrops, which include about 170 m of dolomitic limestone. At another locality this group is succeeded by light blue limestones of Tagling stage of Jurassic periods, represented by black, thin bedded carbonaceous and micaceous shales rich in fossils of Megalodon, Avicula, Pecten, Cerithium, Nerinea, Pleurotomaria, Ammonites etc.

The evidence for the existence of Cretaceous series is obtained from *Gryphae vesiculosa* fossils on Leh-Yarkand road, consisting of calcareous sandstone.

During the Tertiary period Ladakh was occupied by retreating water of Tethys Sea which left a basin of lower Tertiary deposits from Rupshu to Kargil and Drass. The Tethyan Sea more or less completely disappeared in late Eocene, leaving a few lakes as its remnants. The tertiaries of Ladakh rest over gneissic and metamorphic rocks. The base is of coarse felspathic grits and conglomerates followed by brown calcareous and green purple shales which are overlain by thick bed of blue shelly limestone. On either side of this sedimentary basin there is a large portion of igneous rocks including both erupted dark basalt with ash and tuff beds. Besides, they contain dyke and sills of intrusive granite, quartz and antiteporphyres together with peridites and gabbros. In the north-west of Kargil and Drass, volcanic ash beds, lavas, angiteporphyres with limestone beds rich in fossils come across.

The salt lakes of Ladakh bear evidence of a progressive desiccation of the Changcheno, Dipsang and Lingzhitang at an elevation of 5000-5500 m and may be regarded as of locustrine origin, produced by the desiccation and silting up of saline lake basin without any outlet (Wadia, 1957).

Geologically, Lahul-Spiti is unique in the sense that it presents a complete sequence of geological formations dating from the Precambrian to the Cretaceous period with short breaks in carboniferous and Jurassic periods. These formations can be distinguished into two groups viz., Schistose group and Calcareous group. The Schistose group comprises biotite schists, schistose phyllites, phyllites, slates, paragneissic bands, quartzites and quartz-mica-schists. The calcareous group consists of white and greyish black crystalline limestones, flaggy and slaty limestones, calcareous phyllites, calcareous gneiss, carbonaceous schists, dark grey phyllites interbedded with limestones.

Kinnaur, as in the adjoining Spiti area, affords an almost unbroken sequence of sedimentary deposits ranging from Cambrian to Cretaceous. The oldest belts are slates and quartzites which are mostly non-fossiliferous. These are overlain by conglomerates, followed by red quartzite of lower Silurian, passing into limestone. The limestones are replaced by quartzite which are overlain by beds of upper Permian. This is followed by

conglomerates overlain by calcareous sandstone and micaceous shale of Permian. Above these shales lie the limestone intercalated by shale and representing the Triassic and lower and middle Jurassic. All these are fossiliferous. These are followed by Spiti shales with ammonites fossils of upper Jurassic age and overlain by the Giupal sandstone and Chikkim limestone and shales of Cretaceous period.

Soil :

The soils of Ladakh have been classified as grey, light arid soils of low fertility status. The soils are mainly sandy or sandy-loam with appreciable quantities of clay at some places. The pH ranges between 7-11 (Bhat, 1965). The soil, in general, is poor in organic matter and nitrogen content. The plant nutrients however, are sufficiently available in the soil of Kargil and Ladakh due to almost nil weathering of the rocks which is due to extremely low precipitation and temperature. The soils are rich in potassium and its availability to plants is also high, since the weathered complex containing potash cannot be leached under low precipitation. Calcium status is good but magnesium content is comparatively low and in the absence of organic matter, the soil tend towards alkalinity. In the absence of any substantial leaching of the minerals from the soil, bases are continuously being added to the soil complex, resulting an increase in pH value.

Table 1: Mechanical analysis of soil of Ladakh.

Place	Percentage of		Gilt	Clay	Texture class
	Coarse sand	Fine sand			
Leh	4.17	24.83	2.5	8.5	Loamy sand
Zanskar	3.77	54.82	15.0	25.5	Sandy clay
Kargil	6.44	61.10	3.3	20.5	Loamy clay
Suru	1.0	58.55	28.5	12.0	Loam
Dras	0.88	19.82	53.9	25.0	Silty clay

Table 2: Chemical analysis of soil of Ladakh.

Place	Percentage of		Phos-	Potash	Nitro-	Carbon	Orga	pH
	Calcium	Magn-	phorus		gen		nic	
	oxide	ecium					matter	
		oxide						
Leh	2.9	0.5	0.18	0.01	0.14	0.01	0.01	7.8
Kargil	2.0	1.8	0.12	0.03	0.18	0.01	0.018	7.0
Zanskar	3.7	0.4	0.25	0.03	0.07	0.67	1.56	7.0
Saspol	0.3	0.02	0.21	0.01	0.05	0.69	0.68	7.5
Chang- thang	1.2	1.1	0.19	0.006	0.034	0.33	0.56	8.0

The soil of Dras valley is mainly morainic, brought by the glaciers. The soil of Suru valley is black due to grey shale. The rocks in Pugga valley are of various colours viz. red, black, brown etc. The valley is famous for its sulphur and borax deposits. The soil of Nubra valley is morainic. The soils of arid regions of Lahul & Spiti are of almost similar nature, texture and quality. The soil is alpine sward as the upper stratum of the earth and vegetable mould is filled with incompletely decomposed roots of herbaceous plants.

Climate :

The climate is characterised by great extremes of heat and cold, coupled with excessive dryness. Absence of humidity helps to keep the atmosphere clear. The dry and highly evaporative breezes exhaust the little moisture held in the atmosphere and the clear dry air becomes intensely cold by the terrestrial radiation. In the summer, the heat during day time is so intense and it is so cold at night that the mountains crack and crumble. The dryness is of two kinds, one is physical due to the paucity of precipitation during the summer and autumn, and the second is physiological, caused by the temperature below 0°C, inhibiting absorption of water by the roots in the winter and early spring when a slight

precipitation occurs. The rainfall and moisture, which have made the Kashmir valley or similar areas in Himachal Pradesh such a comfort to the eye, are stopped by the great Himalayan range from entering into these areas of cold deserts.

The highly rarified atmosphere offers so slight a check to the transmission of sun rays that the noon temperature often becomes 25°C more than it is in any part of India, while during night the temperature falls below freezing point. The rarity of atmosphere is due, chiefly, to elevation by which air is so rarified as to be incapable of holding sufficient moisture by suspension. It is also partly due to the great radiation of heat from the bare soil by which moisture rapidly evaporates.

The temperature shows great fluctuation during the different months of the year. The summer months are brief, while the winter months are long with the temperature going as low as -75°C (Lowest record of Drass) and -13°C to -14°C at Kargil and Leh. In winter the rivers freeze and form natural roads. Generally the temperature at Leh during summer goes up to 26°C during day and scales down to -18°C during night in winter. The lowest recorded temperature during winter at different localities is as under :

Dras : -75°C

Nyoma (Changthang) : -35°C

Kargil : -15°C

Diskit (Nubra) : -45°C

In Leh, the average difference between morning and afternoon temperature is as high as 30°. The mean annual temperature at Leh is 5°C and rises from March to July up to 17.5°C. In winter the temperature drops to -23°C in Leh and Zanskar.

At Keylong, in Lahul & Spiti, the maximum temperature ranges from 7°C in February to 23°C in August and the minimum ranges from -12°C in January to 16°C in July. At Kaza, the maximum temperature recorded is 30.5°C and minimum -19.5°C.

Table 3: Monthly distribution of Temperature in Ladakh (in °C)

Month	Dras			Leh			Kargil		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
January	-9.0	-22.0	-15.6	-2.8	-14.0	08.4	-4.2	-13.3	-8.7
February	-6.7	21.4	-14.0	0.8	-11.8	-5.5	-1.6	-12.1	-6.0
March	-2.0	-15.0	-8.5	-6.4	-6.3	0.5	4.7	-5.3	-3.0
April	-5.4	-5.4	0.1	12.4	-1.2	5.7	14.0	3.4	8.7
May	15.1	1.5	8.3	17.1	2.8	9.9	21.6	9.4	15.5
June	20.5	5.6	13.5	21.1	6.7	13.9	25.7	13.4	19.5
July	23.7	10.6	17.1	24.7	10.2	17.4	29.7	17.7	23.7
August	23.6	10.5	17.0	24.2	9.6	16.0	28.9	17.2	23.0
September	19.6	5.9	12.7	20.9	5.4	13.1	24.9	12.5	18.7
October	12.8	-1.1	5.8	14.2	-0.7	6.6	18.5	5.5 ^d	11.9
November	4.3	-8.6	-2.1	7.8	-6.6	0.6	10.4	-1.3	8.5
December	-0.5	-16.9	-10.4	-1.6	-11.1	-4.6	1.2	-7.9	-3.3

Source : Metereological observatory, Govt. of India, New Delhi for the period 1941-1960.

The rain and snowfall in these areas of cold deserts are meagre. In Dras and Zoji La areas the snowfall is heaviest. In other areas of cold deserts in Jammu & Kashmir and Himachal Pradesh there is very little snowfall due to lack of precipitation or moisture. Absence of humidity helps to keep the atmosphere clear. Average rainfall fluctuates between 5-8 cm at different places in Ladakh and Lahul & Spiti. The humidity fluctuates between 50-65% from May to October at various places. At Leh the frost begins early in September and continues until May. Usually the precipitation occurs at night.

Table 4: Monthly average rainfall in Ladakh (in mm)

Month	Leh	Dras	Kargil
January	11.1	126.3	45.2
February	8.6	129.9	51.6

Month	Leh	Dras	Kargil
March	11.9	173.4	86.3
April	6.5	110.6	31.2
May	6.5	64.0	23.6
June	4.3	21.4	10.3
July	15.7	13.5	5.6
August	19.2	14.6	10.2
September	10.1	16.0	7.6
October	7.1	17.8	4.8
November	2.9	22.9	4.3
December	8.5	56.5	25.8

Source : Metereological Observatory, Govt. of India, New Delhi for the period 1941-1960.

High velocity winds blow all the year round. Generally the wind is northerly to north-easterly in summer and westerly to north-westerly during the remaining period of the year. The cumulative effect of elevation, check of moisture laden air and rainfall by very high ranges of Great Himalaya to enter into these isolated snowy regions, produce perhaps the most singular climate known in the world. The barrier that shuts them out can be clearly visualised at the main gate which pierces it, the Zoji La. This pass is only about 3900 m high, not a great height, as hights go in these parts. In fact proceeding north and eastwards from Zoji La beyond the Spanggur Lake one has to cross several passes which are still higher e.g. Fatu La, which is nearly 900 m higher or Chang La which is about 2000 m higher; but neither of them is as deeply snow bound as Zoji La because they are situated in the arid zone of low precipitation.

Usually the humidity is very low. The rarified atmosphere and strong wind are the main causes for low humidity. Nubra and Rupshu are the driest areas in Ladakh. Due to slightly higher humidity, Dras experiences heaviest snowfall. Spiti is comparatively more dry than Lahul.

Vertually there are two seasons and a transitional period. October to almost middle of April are winter months; when these trans-himalayan areas are cut off from adjoining Himalayan areas due to very heavy

snowfall in various passes, which lead to these cold deserts. From middle of April to July are summer months; when snow starts melting and flowering of the plants sets in. August and September may be said as transition period. Summer is almost rainless. There are occasional scanty monsoon showers.

In the geologic past the climate of Ladakh was much milder than it is at present. This is evidenced by the presence of fossils of fresh water shells in the sandy alluvium above the level of the present brackish lakes of Ladakh.

Vegetation :

In view of the agreement among the geologists, the elevation of the Himalayas has taken place in recent times. Thus the flora is not considered as ancient one. The whole of Tibet, including Ladakh, was under a sea, which piled up huge sedimentary deposits until the tertiary period (Stewart, 1916). However, Maximowics (1884) is of the view that the flora is very ancient.

Ladakh :

In spite of the fact that the soils are rich in nutritive minerals, Ladakh is devoid of any forest due to extreme water shortage, temperature fluctuations and peculiar climatic conditions. Scarcity of water and poor sandy soil do not allow any natural forest to develop. The growing season in Ladakh is very short one and one can find in July and August the great majority to the species. There is no rainy season to give birth to an ephemeral desert flora. Plants that are in fruit at one altitude, can be found in flower at higher altitude, Further, most of the wild flora, excluding the annual weeds, is perennial and the leaves can be found even if the flowers are missing. Since the growing season is very short, the new growth on each plant is very small. The annuals complete their life cycle in a very short time and consequently remain very small and sometimes minute.

Only a few pockets of willow, poplar, mulberry, apricot and apple trees stand to represent the so called forests. These are confined to the

river banks and nullah beds. These are of special significance to the local population as a source of fodder, fuel and timber. Important species are - *Salix elegans*, *S. alba*, *S. sclerophylla*, *S. fragilis*, *Populus caspica*, *P. euphratica*, *P. candicans*, *P. nigra*, *P. ciliata*, *P. angustifolia*, *P. balsamifera*, *Juniperus macropoda*, *J. communis*, *Myricaria prostrata*, *Hipophae rhamnoides*, *Rosa webbiana*, *Tamarix gallica*, *Elaeagnus hortensis*, *Caragana pygmaea*, *Ephedra gerardiana* and *Atriplex crassifolia*.

The most conspicuous character of the vegetation is the cushion like habit of plants. The compact cushion like habit protects these plants from the intensely cold dry winds which would otherwise kill them by their great drying power. As a rule most of these plants have spinous tipped leaves and in some, like, *Caragana*, the shoots are modified into Spines.

Sapru & Kachroo (1979) have done biospectral analysis of Ladakh vegetation. According to this study the life-forms of Ladakh vegetation reveal a geo-chamaephytic phytoclimate with a high proportion of therophytes, which is in good agreement with the prevailing climate and therefore with Raunkiaer's (1934) system. Therophytes reflect the aridity of the region whereas geophytes-chamaephytes the cold winter.

The vegetation can be classified into following three categories :

1. Alpine mesophytes
2. Oasitic vegetation
3. Desert vegetation

Alpine mesophytes :

Between Kashmir and Ladakh proper there is a transition zone, which is possibly widest in the Suru region and in this zone such alpine mesophytes are found which are common with Kashmir (Table 11). This region receives a little more rainfall as compared to Central Ladakh and beyond. The area is more humid. There is a sharp contrast between the flora of transition zone and Ladakh proper. This is due not to altitude but entirely by water relations. The high mountains stop the rain-laden clouds

and very little moisture gets across. The flora on the western side of the Great Range of the Himalayas is luxuriant and abundant but the opposite is true on the other side. In Kashmir, forests with *Betula utilis* at the upper limit are found up to about 4000 m but there is no forest in Ladakh. Trees are only planted and irrigated.

Across Zoji La on way to Drass one comes across with green patches of herbaceous elements in moist shady places. Suru valley is characteristic of having alpine mesophytes. Along this transition zone almost any plant from Kashmir that can survive above 2500 m may be found growing. Only about 10% of these are typical of cold desert locality e.g. Rupshu. These may include species like *Delphinium brunonianum*, *Potentilla bifurca*, *Aster flaccidus* and species of *Leontopodium*, *Taraxacum*, etc., which are widespread in the cold desert localities of high altitude. Mesophytic elements include some typical Kashmir elements like *Podophyllum hexandrum*, *Lavatera kashmiriana*, *Impatiens glandulifera*, *Lotus corniculatus*, *Astragalus rhizanthus*, *Rosa brunonii*, *Verbascum thapsus*, *Poa annua*, *Setaria viridis* etc.

Along river courses and in marshy depressions *Salix daphnoides*, *Morus alba*, *Myricaria elegans* are found. Along the sandy banks of the Drass river and other streams there is a rich growth of *Phragmites karka* associated with *Equisetum* spp. and *Sonchus oleraceus*. The slopes are covered with plants like *Polygonum affine*, *Potentilla bifurca*, *Pedicularis hookeriana*, *Parnassia laxmanni*, *Geranium pratense*, *Bupleurum gracillimum*, *Stachys bikramii*, *Brachyactis roylei*, *B. pubescens*, *Origanum vulgare*, *Gentiana tianshanica*, *Anaphalis nepalensis*, *Galium boreale*, *Mentha longifolia*, *Euphrasia vulgaris*, *Lactuca tatarica*, *Cirsium arvense*, *Swertia thomsoni*, *Agrostis vinealis* etc. Such green patches are found all along Suru Valley, Rusi La, Sapi La, Baralacha La area.

Though alpine vegetation on Ladakh side of Zoji La up to Dras is similar to alpine vegetation on Kashmir side of the pass, the former exhibits the total absence of tree species and gradual disappearance of tall herbaceous species and shrubs. Isolated patches of *Juniperus recurva* are found but these slowly disappear towards Dras. The typical mesophytic vegetation as observed at Gumri comprises *Polygonum affine*, *Trollius*

acaulis, *Primula rosea*, *Taraxacum officinale*, *Anaphalis nepalensis*, *Anemone* spp. etc. From Dras onwards the vegetation becomes more xerophytic. The tract between Kargil and Leh consists of a most barren land with scattered patches of *Chenopodium botrys*, *Potentilla bifurca*, *Dianthus anatolicus*, *Artemisia edgeworthii*, *Heracleum pinnatum*, *Heracleum thomsonii*, *Stachys tibetica*, *Kraschiennikovia cerastioides*, *Salsola collina*, etc. There is a gradual decrease in number of species. At Fotu La there is slight increase in the vegetational cover due to local precipitation.

Oasitic vegetation :

The flora of Oasis represents vegetation near habitations and is cosmopolitan. The Oasitic elements comprise a variety of exotic as well as indigenous species, growing near habitations, along water courses, streams, nullaha and in moist places. A few common elements are - *Lancea tibetica*, *Pedicularis longiflora*, *Gentiana* spp., *Arabidopsis himalaica*, *Ranunculus pulchellus*, *Geranium collinum*, *G. sibiricum*, *Medicago lupulina*, *Astragalus densiflorus*, *Rosa eglantaria*, *Rubus saxatilis*, *Sedum quadrifidum*, *Lomatogonium carinthiacum*, *Dracocephalum moldavicum*, *Chenopodium foliosum*, *Primula sibirica*, *Mentha longifolia*, *Lycium ruthenicum*, *Cuscuta europea*, *Epilobium roseum*, *Dianthus anatolicus*, *Vaccaria pyramidata*, *Trifolium pratense*, *Sophora alopecuroides*, *Melilotus alba*, *M. officinalis*, *Potentilla ambigua*, *P. bifurca*, *Stachys tibetica*, *Elsholtzia densa*, *Nepeta tibetica*, *N. botryoides* etc.

The trees, with the exception of *Hippophae*, are practically all introduced. The commonest species are *Salix*, *Populus*, *Juglans*, *Morus*, *Pyrus* and *Prunus*. Small groves of *Juniperus recurva* are sometimes found here and there. Most of the species, growing in the villages are mesophytes. The number of truly xerophytic species is not proportionately large.

Desert vegetation :

Typical desertic elements are found in the areas beyond the transition zone. These areas receive none or very scanty rainfall. There is extreme fluctuation of diurnal temperature. The long stretches of Ladakh plateau

are characterised by stunted, cushion type desert vegetation of tufted plants. In central Ladakh, Nubra, Rupshu, these desertic elements are confined. The species are very hardy. the herbaceous elements show a mixture of Tibetan, Siberian, Chinese and Afghanistanean elements. Due to high velocity winds, which are constantly blowing in these high altitude areas, the plants tend to become prostrate, thick woolly, cushion forming, bushy, hardy, spiny and with long roots and small leaves.

Some common typical desert species are : *Thylacospermum rupifragrum*, *Acantholimon lycopodioides*, *Myricaria elegans*, *Echinops cornigerus*, *Capsella bursa-pastoris*, *Lindelofia anchusoides*, *Tanacetum tibeticum*, *Nepeta floccosa*, *Arnebia guttata*, *Potentilla nivea*, *Euphorbia tibetica*, *Lancea tibetica*, *Iris ensata*, *Carum carvi*, *Lepidium apetalum*, *Elaeagnus angustifolia*, *Potentilla anserina*, *Peganum harmala*, *Stachys tibetica*, *Silene gonosperma*, *Draba glomerata*, *Astragalus* spp. *Carex nivalis*, *Oxyria digyna*, *Polygonum islandicum*, *Sedum ewersii*, *Saxifraga sibirica*, *Waldheimia tomentosa*, *Dianthus anatolicus*, *Oxytropis lapponica*, *Potentilla multifida*, *Nepeta tibetica*, *Plantago minima*, *Delphinium brunonianum*, *Polygonum sibiricum*, *Sedum tibeticum*, *Arabis tibetica*, *Braya thomsonii*, *Corydalis crassifolia*, etc.

Rupshu is the highest inhabited place in the world, which is approachable through Tanglang La (5844 m). All along the valley, *Caragana pygmaea* is conspicuous. In Rupshu, species of *Oxytropis*, *Potentilla*, *Nepeta*, alongwith *Sedum tibeticum*, *Aster flaccidus*, *Elsholtzia eriostachya*, *Delphinium brunonianum* and *Caragana pygmaea* grow at the upper limit of plant life. On hillsides *Caragana* is the most conspicuous and abundant, spreading like *Juniperus*. It furnishes the chief fuel in these lofty regions. *Delphinium* is also a conspicuous plant with much larger leaves. *Rheum* is the only plant with good sized leaves.

Some other species from Rupshu include *Potamogeton pectinatus*, *Triglochin maritima*, *Stipa caucasica*, *Deschampsia caespitosa*, *Poa pratensis*, *Festuca rubra*, *Carex melanantha* *Urtica hyperborea*, *Rheum spiciforme*, *Polygonum tortuosum*, *P. sibiricum*, *Chenopodium album*, *Atriplex crassifolia*, *Eurotia ceratoides*, *Salsola collina*, *Stellaria graminea*, *Arenaria* spp. *Silene gonosperma* subsp. *himalayensis*,

Paraquilegia microphylla, *Aquilegia moorcroftiana*, *Ranunculus pulchellus*, *Corydalis stricta*, *Lepidium capitatum*, *Arabis tibetica*, *Brya thomsonii*, *Christolea crassifolia*, *Sedum tibeticum*, *Potentilla ambigua*, *P. bifurca*, *P. sericea*, *Oxytropis tatarica*, *O. lapponica*, *nepeta longibracteata*, *N. nivalis*, *N. tibetica*, *Dracocephalum heterophyllum*, *Thymus linearis*, *Rubia tibetica*, *Artemisia minor*, *Cremanthodium arnicoides* and *Saussurea bracteata*.

Further east in Baralacha La, where Rupshu joins Lahul, the plant life is very scanty. Some common species in this area are - *Carex nivalis*, *Oxyria digyna*, *Polygonum congratum*, *P. affine*, *Ranunculus hirtellus*, *Rhodiola imbricata*, *Potentilla arbuscula*, *P. atrisanguinea*, *Nepeta glutinosa*, *Waldheimia tomentosa*, *Corydalis meifolia*, *Draba glomerata*, *Stellaria cherleriae*, *Silene moorcroftiana*, *Dianthus anatolicus*, *Meconopsis aculeata*, *Saxifraga sibirica*, etc.

Some common plants growing in and around barren Fotu La and Namika La are *Triglochin palustris*, *T. maritima*, *Pennisetum flaccidum*, *Agrostis gigantea*, *Bromus tectorum*, *Polygonum aviculare*, *Atriplex crassifolia*, *Eurotia ceratoides*, *Kochia prostrata*, *Silene moorcroftiana*, *Halerpestis tricuspis*, *Corydalis* spp., *Lepidium latifolium*, *Sisymbrium brassiciforme*, *Christolea crassifolia*, *Potentilla anserina*, *P. multifida*, *Rosularia alpestris*, *Rosa webbiana*, *Caragana pygmaea*, *Astragalus nivalis*, *Oxytropis cachemiriana*, *Epilobium royleanum*, *Ligusticum thomsonii*, *Primula sibirica*, *Androsace villosa*, etc.

Most of the cold desert areas are covered by open desert association with bare grounds between the individual plants. Occasionally we find a modification of the desert flora. Where there is a spring on the mountain side and the water cannot drain away readily, we get a continuous sod and a typical association of *Pedicularis longiflora* and species of *Triglochin*, *Carex*, *Gentiana* and *Taraxacum*. The ground is often boggy in such situations and the water may be alkaline. Alpine meadows are rare.

Although there are no forests in Ladakh, there are frequently thickets along streams and on little islands in the rivers. These have a typical

association of *Myricaria*, *Hippophae*, *Rosa* and *Clematis orientalis*. These furnish shade for more delicate species like *Veronica* spp., *Epilobium* spp., etc.

Chumathan range includes areas like Puga valley, Rupshu valley, Neuma, Chumathan, Tanglang La, Tsokar Lake, Jara, Khamal, Leuma, Skitiang etc. Kaul (1983) made a detailed study of vegetation at Tsokar Lake and Puga valley. He recognised six habitat types with their typical plant association.

On rocky and gravelly sites the common plants are *Ephedra gerardiana*, *Caragana pygmaea*, *Eurotia ceratoides*, *Rosa webbiana*, *Physochlaina praealta*, *Nepeta floccosa* and *Stachys tibetica*. In areas with alkaline swamps and borax deposits, *Triglochin palustris*, *T. maritima*, *Carex stenocarpa*, *C. alpina*, *Polygonum sibiricum* etc. are commonly growing. *Triglochin* is quite luxuriant on borax deposits. The species of *Potentilla*, *Oxytropis*, *Polygonum* and species belonging to Brassicaceae and Poaceae are more common at silty and clay sites. In a few cultivated sites some common weeds are *Chenopodium album*, *Melilotus alba*, *Ranunculus sceleratus*, *R. pulchellus*, *Descurainia sophia*, *Artemisia sieversiana*, *Kochia prostrata*, *Triglochin palustris*, *Convolvulus arvensis* etc. Along streams *Myricaria elegans*, *M germanica*, *Hippophae rhamnoides*, *Rosa webbiana*, *Salix fragilis*, *S. alba*, *Halerpestis tricuspis*, *Potentilla anserina*, *Oxytropis microphylla*, *Corydalis* spp., *Lancea tibetica*, *Pedicularis longiflora* etc. form conspicuous association. Along the Puga river grows *Myricaria* bushes. The upper portion of the Indus valley is full of silt and almost without any vegetation. The only vegetation is found on the mountain ridges or along water courses. The common elements are the species of *Nepeta*, *Chenopodium*, *Artemisia*, *Caragana*, *Ranunculus*, *Polygonum*, *Ephedra*, *Physochlaina*, etc. *Salix* is found planted.

Leh range includes areas like Fotu La, Lamayuru, Khalsi, Saspol, Nemu, Likir, Phiang, Taro, Sabu, Khardung La, Nemisa, Karoo, Upshi, Shay, Thiksay, Leh etc. This is the main region of Ladakh situated on either side of river Indus. The floristic elements are of desert type. The common species are *Echinops cornigerus*, *Peganum harmala*, *Tribulus terrestris*, *Capparis spinosa*, *Nepeta longibracteata*, *N. tibetica*, *Ephedra*

gerardiana, *Iris ensata*, *Thalictrum minus* and species of *Astragalus*, *Medicago*, *Pedicularis*, *Delphinium* etc. In aquatic and muddy situations are found species of *Scirpus*, *Polygonum*, *Utricularia*, *Hydrilla* and *Vallisneria*.

Lahul & Spiti, Kinnaur and Garhwal Himalaya :

In Lahul & Spiti, the three main rivers Spiti, Chandra and Bhaga form four main valleys, i.e. Spiti valley, Chandra valley, Bhaga valley and Chandra-Bhaga, the combined river valley (also called the Chenab valley, Manchat or Patan) beyond their meeting point at Tandi. While Chandra-Bhaga (Chenab) valley presents a more greener look with considerable number of plant species, terrace cultivation, planted salices, poplars etc., the Chandra, Bhaga and Spiti valleys present a very desolate and bleak picture. The vegetation is very scanty and typical desert type. The Pir Panjal range stops moisture laden air entering Lahul & Spiti and the Kunzum range of the Great Himalaya almost completely stops any moisture laden air entering into Spiti region.

The Baspa valley and beyond, Sangla towards Chitkul and Kalpa towards Murang, Jangi, leading to Shipki La in Kinnaur district and Mana, Niti beyond Malari and Nelang valley in Garhwal Himalaya are also very dry, being situated in the rain shadow area.

The vegetation of these cold desert areas is quite similar to that of Ladakh region; although the three categories of the vegetation types i.e. mesophytic, oasisitic and desertic, may not be clearly marked. The vegetation of these regions has its own peculiarities. Whereas in Ladakh the natural vegetation lacks tree species, except the planted *Salix* and *Populus*, the Lahul sub-division, the Baspa valley and areas beyond Kalpa in Sutlej valley: Nelang valley, Jadganga valley and Malari area of Garhwal Himalaya show some good natural temperate forests of *Pinus wallichiana*, *Cedrus deodara*, *Picea smithiana*, *Juniperus recurva*, *J. communis* and *Betula utilis*. Further, as in Ladakh, in Lahul & Spiti also and more especially in the inner higher barren and arid areas of Spiti valley *Salix* and *Populus* are planted along river beds, streams, mullah beds, water channels, moist places and near habitations for fodder and fuel needs. Apart from planted species

like *Populus caspica*, *P. nigra*, *P. euphratica*, *P. candicans*, *P. ciliata*, *P. angustifolia*, *P. balsamifera*, *Salix elegans*, *S. alba*, *S. sclerophylla*, and *S. fragilis*, there are also some naturally occurring species of *Salix* in Lahul & Spiti e.g. *S. acmophylla*, *S. daphnoides*, *S. denticulata*, *S. flagellaris*, *S. karelinii*, *S. lindleyana*, *S. oxycarpa*, *S. pycnostachya* and *S. tetrasperma*. These are of special significance to the local population, who use these species for fodder and fuel.

Generally the vegetation is of dry temperate to dry alpine type. Moist temperate vegetation is also met with in some areas between Thiro and Raulu. The flora is of steppe type and is rich at the lower elevations. The vegetation can be divided into two broad categories:

1. Temperate vegetation
2. Alpine vegetation

Temperate vegetation :

This vegetation consists of woody elements. *Pinus wallichiana*, *Juniperus recurva*, *Picea smithiana*, *Cedrus deodara*, *Betula utilis* form the natural forest. *Hippophae rhamnoides*, *Juniperus communis*, *J. indica*, *Rosa webbiana*, *R. macrophylla*, *Berberis pachyacantha*, *Fraxinus xanthoxyloides*, *Viburnum cotinifolium*, *Lonicera* spp., *Cotoneaster* spp. etc. form the shrubby growth. *Myricaria germanica* frequently grows along riverside.

The herbaceous elements include *Anemone* spp., *Aquilegia fragrans*, *A. pubiflora*, *Codonopsis ovata*, *Galium aparine*, *Geranium pratense*, *Inula grandiflora*, *Podophyllum hexandrum*, *Primula denticulata*, *Ranunculus laetus*, *Rheum* spp., *Oxyria digyna*, *Rumex nepalensis*, *Achillea millifolium*, *Capsella bursa-pastoris*, etc. Some other important herbaceous elements of meadows and slopes are *Anemone rivularis*, *Brachyactis roylei*, *Cirsium wallichii*, *Heracleum lanatum*, *Thymus linearis*, *Phlomis bracteosa*, *Origanum vulgare* and species of *Anaphalis*, *Arenaria*, *Astragalus*, *Chenopodium*, *Geranium*, *Impatiens*, *Lepidium*, *Medicago*, *Melilotus*, *Pedicularis*, *Silene*, *Trifolium*, *Trigonella*, *Senecio* etc. The common herbaceous elements in marshy places and along streams include

Deschampsia caespitosa, *Halerpestis sarmentosa*, *Danthonia cachemyriana*, *Elaeocharis palustris*, *Polygonum hydropiper*, *Ranunculus natans*, *Carex* spp., *Juncus* spp., *Veronica* spp., *Kobresia* spp., *Astragalus melanostachys*, *Caltha palustris*, *Parnassia laxmanii*, *Sagina saginoides*, *Epilobium* spp., etc. Occasionally some tufted plants, typical of cold desert areas are also found. Some important ones are *Arenaria festucoides*, *Cerastium cerastioids*, *Dianthus angulatus*, *Minuartia kashmirica*, *Rosularia alpestris*, *Silene stewartii*, *Senecio krascheninnikovii*, etc.

Alpine vegetation :

It can be broadly subdivided into three groups viz.

- a. Alpine forests
- b. Alpine scrubs
- c. Alpine meadows

Pinus wallichiana, *Rhododendron campanulatum* alongwith the tree-line species *Betula utilis* form the scattered alpine forests. These are the extension of the temperate forests.

Generally above the tree line, the scrubby vegetation is found on ridges, and rocky slopes e.g. *Juniperus communis*, *J. indica*, *J. recurva*, *Cotoneaster falconeri*, *Lonicera* spp., etc. The herbaceous elements include species of *Anaphalis*, *Anemone*, *Aster*, *Astragalus*, *Bupleurum*, *Gentiana*, *Geranium*, *Oxytropis*, *Polygonum*, *Potentilla*, *Primula*, *Saxifraga*, *Sedum*, *Selinum*, *Silene*, *Stellaria*, etc.

The alpine meadows are long undulating grassy plains or pasture lands. At certain places these are replaced by glacial moraines. The common elements include *Aconitum violaceum*, *Anemone rupicola*, *Arabis tibetica*, *Arnebia euchroma*, *Astragalus webbianus*, *Delphinium brunonianum*, *Dracocephalum heterophyllum*, *Lagotis kunawurensis*, *Picrorhiza kurrooa*, *Swertia petiolata*, *Thalictrum alpinum*, *Pedicularis* spp., *Polygonum* spp., *Potentilla* spp., *Primula* spp., *Ranunculus* spp., *Saxifraga* spp., *Bromus* spp., *Elymus nutans*, *Pennisetium lanatum*, *Phleum alpinum*, *Poa alpina*, *P. tibetica*, etc.

Rohtang Pass (4200 m.) is the gateway to Lahul & Spiti. Near Rohtang Pass *Primula rosea* appears very prominent. Along the Rohtang pass itself, the exposed rock surfaces are covered by a great profusion of herbs like *Primula*, *Pedicularis*, *Androsace*, *Anemone*, *Trollius* etc. *Lagotis glauca* is a characteristic plant in this place. *Gaultheria trichophylla*, *Cassiope fastigiata*, *Sedum* spp. and *Thalictrum alpinum* grow in rock crevices and on hill slopes along the pass.

Crossing the Rohtang Pass, one gets a panoramic view of the Chandra valley of Lahul, which is also called Lahul valley, with the Chandra river rushing deep below between lofty mountain ranges. Khoksar (3200 m.) is the first village on the bank of Chandra river after crossing the Rohtang Pass. The hill-slopes near the village present a lush appearance with well laid terrace cultivation. In other places the slopes are covered by a great variety of temperate and alpine herbs. *Allium victorialis*, *Gagea lutea*, *Rheum webbianum*, and species of *Iris* and *Nepeta* are quite common. *Rumex* and *Hyoscyamus* are found under cultivation. From Khoksar towards east the road follows along the Chandra river towards Chhatru (3300 m.), Chotadara (3100 m.), Batal (3800 m.) on way to Kunzum range, Kunzum Pass (4500 m.), leading to Spiti valley. The whole area is barren, desolate and rocky. From Khoksar towards west also to Sissu and beyond up to Gondla the area is quite dry and barren but Gondla and beyond towards Tandi the aspect changes gradually towards more greener outlook.

From its place of origin at Baralacha La area to Tandi, the Bhaga valley is quite narrow and very rugged. Vegetation is very sparse due to very low rainfall, dryness, the low capacity of the substratum to retain moisture and excessive grazing by sheep. Only those plants which possess adaptations to withstand all these adverse conditions can survive. These adaptations include succulency (e.g. *Sedum*), perennation by underground organs (e.g. *Lactuca macrorrhiza*), propagation by suckers (e.g. *Saxifraga flagellaris*), cushiony and matted habit (e.g. *Arabis pterosperma* and *Polygonum affine*) etc. The leaf bases of *Bergenia stracheyi* protect its stem. The herbaceous elements shed their seeds by late September or early October.

In the crevices are found tufted plants of *Sedum ewersii*, *S. acuminatum*, *Cerastium cerastioides*, *Arenaria festucoides*, *A. kashmirica*, *Dianthus angulatus*, *Bupleurum falcatum*, *Senecio pedunculatus*, *Crepis flexuosus* etc. *Polygonum affine* forms thick mats over rocks. *Draba oreades*, *D. radicans*, *D. setosa* and *D. stenocarpa* are the other prominent plants of the rocky substratum. These taxa exhibit an interesting cushiony growth habit and possess strong root system.

In sheltered niches where there is some soil and where the moisture is augmented by run off from the rock faces are present a good number of herbaceous mesophytes such as *Achillea millefolium*, *Anaphalis busua*, *Trigonella emodi*, *Taraxacum officinale*, *Polygonum aviculare*, *Lactuca macrorhiza*, *Elymus longi-aristatus ssp. canaliculatus*, *Agrostis vinealis*, *Calamagrostis pseudophragmites*, *Phleum alpinum* etc. The herbaceous mesophytic elements along streams include *Impatiens thomsonii*, *Ranunculus muricatus*, *Aconitum violaceum*, *Caltha palustris*, *Astragalus melanostachys*, *Rorippa indica* etc. On the sandy banks are found *Pennisetum lanatum*, *Agrostis vinealis*, *Juncus bufonius*, *Bromus japonicus*, *Gnaphalium thomsonii*, *Calamagrostis pulchella* etc.

The barrenness of Bhaga valley is broken near Keylong, where the entire aspect is changed due to extensive cultivation carried on terraces on the hill slopes. Between Keylong and Tandi, again the hill slopes are quite bare and show only sparse vegetation except a thick grove of *Salix* at Tandi.

The Chandra river valley from its origin in Baralacha area to Tandi the point where it meets Bhaga river, also presents a typical desert look. The general aspect of the vegetation is same as of the upper reaches of Bhaga valley and is of complete desert type. Vegetation is very sparse. From Rohtang to Khoksar and beyond to Sissoo up to Gondla the extremely dry mountain slopes show dwarf form of *Scabiosa speciosa* and *Nepeta eriostachya*. In the crevices are found tufted species of *Sedum*, *Arenaria*, *Cerastium* etc. *Draba oreades*, *D. radicans*, *D. setosa* and *D. stenocarpa* are common in dry rocky places. *Causinia thomsoni* is quite common at Sissu. Other elements include species of *Arabis*, *Barbarea*, *Sisymbrium*

etc. *Caltha pabustris* is frequent near streams. Species of *Anaphalis*, *Polygonum* and *Pedicularis* are also common along water margins. *Scrophularia scabisaefolia* is quite common on dry slopes. Between Sissu and Gondla *Morina coulteriana* and *Berberis jaeschkaeana* are quite common on drier hill slopes.

In moist and sheltered places a few common herbaceous species are found which include *Anaphalis busua*, *Trigonella emodi*, *Elymus longiaristatus*, *Taraxacum officinale*, *Agrostis vinealis*, *Rorippa indica*, *Sagina saginoides*, *Phleum alpinum* and species of *Juncus*, *Polygonum*, *Galium* etc. On sandy banks are found *Bromus japonicus*, *Pennisetum lanatum*, *Gnaphalium thomsonii*, *Calamagrostis pulchella*, *C. pseudophragmitis*, *Agrostis vanialis*, *Juncus bufonius* etc. In marshy places are seen *Veronica beccabunga*, *Rorippa indica*, *Isolepis setaceus*, *Juncus membranaceus*, *Kobresia schoenoides* etc. The vegetation around Chandratall lake includes *Aconitum violaceum* and species of *Gentiana*, *Potentilla* etc. The lake has no aquatic plants.

A remarkable feature of the vegetation of the Lahul & Spiti valley is that the south and east facing hill slopes are practically devoid of any vegetation and the north and west facing slopes show growth of plants. In sheltered gullies and hollows between Chhatru and Khoksar, vegetation is dominated by trees and shrubs. Often the vegetation is a pure community of *Betula utilis*. The common associates are *Rhododendron anthopogon*, *Juniperus indica*, *Cassiope fastigiata*, *Gaultheria trichophylla* etc. which manage to survive in spite of the strong winds. Only stray herbaceous elements are seen, which include *Geranium collinum*, *Rhodiola heterodonta*, *Leontopodium himalayanum*, *Taraxacum officinale*, *Rosularia alpestris*, *Primula* spp. etc. The bare slopes often show clumps of *Ephedra gerardiana*.

The hills around Tandi, where the two rivers Chandra and Bhaga meet, shows plants like *Physochlaena praealta*, *Cortusa brotheri*, *Paraquilegia uniflora*, *Rhodiola imbricata*, *Mertensia echioides*, *Allium jacquemontii*, the parasitic *Orobanche alba* etc. Near cultivated fields and irrigated meadows were seen *Codonopsis ovata*, *Gentianopsis detonsa*, *Pedicularis pectinata* and *Triglochin palustris*.

Beyond Tandi, the valley of combined river Chandra and Bhaga is known as Chandra-Bhaga valley or better known as Chenab valley. This is most thickly populated area in Lahul with extensive cultivated lands. One finds the dark green *Pinus wallichiana* and *Picea smithiana* on the north facing slopes and yellowish green *Juniperus recurva* on the opposite slopes. On the upper reaches of the slope *Polygonum affine* forms a reddish carpet. *Salix* are found planted.

On sheltered sandy slopes plants like *Heracleum thomsoni*, *Galium verum* and *Heteropappus holoharmaphroditus* are found. *Saussurea jacea* is an interesting plant, forming green patches on the west facing slopes near Tandi. On eroded slopes and cuttings *Astragalus bicuspis*, *Androsace rotundifolia*, *Leptorhabdos parvisflora*, *Ribes alpestre*, *Hyoscyamus niger*, *Cotoneaster falconeri*, *Scorzonera virgata* occur. Scattered bushes of *Rosa webbiana* are common on dry open slopes. Occasional bushes of *Berberis jaeschkeana* also occur in *Salix* groves. Beyond Kirting, *Pinus wallichiana* and *Picea smithiana* on the steep rock is replaced by dense forests of *Juniperus communis* and *Salix denticulata*.

There are several mountain streams of varying magnitudes which meet the Chenab river here and there. Several of these flow through villages. These greatly influence the vegetation around villages and along their course. Along these torrents one finds a lush growth of *Hippophae rhamnoides* and *Salix oxycarpa*. The slopes show growth of *Polygonum polystachyum*, *Impatiens sulcata*, *Cirsium wallichii*, *Datisca cannabina*, *Mentha longifolia*, *Aster indamellus*, *Epilobium angustifolium*, *Juncus himalensis*, *Plantago major*, *Parnassia laxmanni*, *Ranunculus hirtellus*, *Erigeron alpinus*, *Medicago lupulina* etc. The herbaceous and shrubby members on irrigated slopes and around cultivated fields show plants like *Nepeta laevigata*, *Medicago sativa*, *Silene vulgaris*, *Senecio laetus*, *Heracleum lanatum*, *Swertia cordata*, *Jaeschkea oligosperma*, *Pedicularis pectinata*, *Polygonum alpinum* etc. The herbaceous elements growing along the canal banks include species like *Impatiens brachycentra*, *Elsholtzia ciliata*, *Chenopodium botrys*, *Cannabis sativa* etc. There are planted trees of *Pyrus malus*, *Prunus armeniaca*, *Populus* spp. On the slopes near Shansha grow some typical species like *Halerpestis tricuspis*, *Mariscus squarrosus*, *Calamagrostis pseudo-phragmites*, *Lotus corniculatus*, *Plantago*

major, *Melilotus officinalis* etc. On the sandy bank of Chenab grow *Hippophae rhamnoides* and *Myricaria germanica*, apart from planted *Salix*. *Polygonum dumetorum* is seen twining on these bushes. Comparatively drier marginal areas have *Dianthus angulatus*, *Polygonum paronychioides*, *P. tubulosum*, *Heracleum thomsonii*, *Galium verum*, *Lindelofia anchusoides*, *Astragalus amherstianus* etc.

Unlike complete barren look of the slopes between Kirting and Tandi, the south facing slopes around Sansha show a profuse growth of *Rosa webbiana* and *R. macrophylla*. At some places *R. eglanteria* is occasionally met with on hedges. Among herbaceous perennials pioneering on the slopes are *Artemisia maritima*, *A. dracunculus*, *Origanum vulgare* and *Verbascum thapsus*. The vegetation above 3000 m on the east facing slopes is very poor. These slopes have extensive growth of *Cousinia thomsoni*. The semicushion forming *Minuartia kashmirica* is the most successful survivor. Gentle troughs have a thick covering of *Iris kumaonensis* and *Taraxacum officinale*. Along dry gullies some interesting species are *Scutellaria prostrata*, *Galium serpylloides*, *Androsace rotundifolia*, *Rosularia alpestris*, *Astragalus bicuspis*, etc.

Near villages Rappe and Rasse species like *Hyssopus officinalis*, *Anaphalis stoliczkai*, *Pimpinella diversifolia*, *Senecio karascheninnikovii*, *Medicago sativa*, *Polygonum alpinum*, *Thalictrum minus*, *Jaeschkea oligosperma*, *Heracleum lanatum*, *Silene vulgaris*, *Swertia cordata*, *Nepeta laevigata*, *Pedicularis pectinata*, *Senecio laetus*, *Dactylis glomerata* form rich herbaceous component of the vegetation. In the moraine at higher elevations *Stipa sibirica*, *Galium verum*, *Anemone rupicola*, *Oxytropis mollis*, *Impatiens thomsoni*, *Oxyria digyna*, *Epilobium alpinum*, *Crepis multicaulis*, *Gnaphalium thomsoni*, *Taraxacum officinale*, *Silene persica* and *Potentilla curviseta* occur.

Up to this part of Chenab valley the tree limit consists of *Pinus wallichiana*, associated with *Juniperus communis*, *Lonicera obovata*, *Syringa emodi*, *Viburnum continifolium* and *Salix denticulata*. On dry shady slopes *Ephedra gerardiana*, *Bergenia stracheyi*, *Potentilla curviseta* and *Polygonum affine* are the main herbaceous elements at higher reaches.

Thick plantations of *Salix oxycarpa* along the road from Kirting to Jahlman provide greenery within the village. Thickets of *Rosa webbiana*, *R. macrophylla* associated with *Artemisia maritima* extend over large areas on dry south facing slopes. Stunted *Juniperus recurva* appear again at Junde. Undergrowth in this forest is poor and *Artemisia maritima* is the only common species. Other herbaceous elements include *Origanum vulgare*, *Artemisia dracunculus*, *A. gmelinii*, *Thymus linearis*, *Chenopodium botrys*, *Malva neglecta*, *Scutellaria prostrata* and *Rosa webbiana*. Near Kamring *Cymbopogon jwarancusa* is an important undergrowth element in *Juniperus* forest. In some of the forest clearings *Sorbaria tomentosa* is found. These are often infested with *Cuscuta reflexa*.

Around Thirot one finds a similar plant community seen earlier at Kirting. Common bushy elements are *Salix oxycarpa*, *Hippophae rhamnoides*, *Lonicera quinquelocularis*, *Viburnum cotinifolium* etc. The herbaceous growth includes *Pedicularis punctata*, *Impatiens thomsonii*, *Datisca cannabina*, *Ranunculus hirtellus* and *Aster indamellus* etc. Some other typical plant compositions at Pangi towards the eastern vicinity of Thirot include *Fraxinus xanthoxyloides*, *Berberis pseudoumbellata*, *Rosa webbiana*, *R. macrophylla*, *Cotoneaster pangiensis*, *C. rosea* and *C. gilgitensis*. From Thirot to Trilokinath *Pinus wallichiana* and *Picea smithiana* are dominant on the north facing slope. Few huge and wild trees of *Juglans regia* form conspicuous green patches. *Crataegus songarica* and *Pyrus jacquemontii* are common bushes. The herbaceous growth under the dry shrubby vegetation is poor. However, the common species are *Artemisia maritima*, *A. gmelinii*, *Origanum vulgare*, *Rumex nepalensis*, *Crepis sancta* subsp. *falconeri*, *Verbascum thapsus*, *Thymus linearis*, *Chenopodium botrys*, *Scrophularia koelzii*, *Datisca cannabina* and *Herniaria hirsuta* etc. On dry inaccessible cliffs grow *Seseli libanotis*, *Spiraea canescens* and *Solidago virga-aurea*.

At Trilokinath around Kishori village the planted trees of *Salix oxycarpa* and bushes of *Plectranthus rugosus* and *Sorbaria tomentosa* alongwith *Impatiens glandulifera* and *Inula grandiflora* on moist slopes present a changed vegetation composition. Due to irrigation facilities a considerable area is under cultivation. Potato and Buckwheat are commonly

cultivated. In pools along shady river banks aquatic plants such as *Polygonum hydropiper*, *Elaecharis palustris*, *Limosella aquatica*, *Callitriche palustris*, *Triglochin palustris* and *Halerpestis sarmentosa* are common. *Carrum carvi*, *Corydalis vaginans*, *Dactylis glomerata*, *Geranium aconitifolium*, *Medicago sativa*, *Nepeta laevigata*, *Senecio laetus*, *Swertia cordata*, *Trifolium repens*, *Urtica dioica*, *Veronica persica* etc. are common on moist slopes and in the waste lands around cultivated fields.

A lush and interesting vegetation has developed on the north bank of Chenab near Kishori village due to low height (2400 m.). *Salvia nubicola*, *Sium sisarum*, *Campanula latifolia*, *Codonopsis rotundifolia*, *Lespedeza juncea*, *Medicago lupulina*, *Nepeta linearis*, *Elscholtzia ciliata*, *Allium jacquemontii*, *A. stracheyi*, *Jurinea ceratocarpa*, *Leibnitzia nepalensis*, *Bothriochloa ischaemum*, *Phragmites australis* etc. present a characteristic vegetation on the shady riverbank. The slopes above Trilokinath have thick forest of *Pinus wallichiana* and *Picea smithiana*. The moist irrigated north facing slopes have *Anaphalis nepalensis* var. *cuneifolia*, *Astragalus himalayanus*, *Bupleurum jucundum*, *B. falcatum*, *Galium boreale*, *Pedicularis pectinata*, *Polygonum alpinum*, *P. polystachyum*, *P. nepalense*, *P. hydropiper*, *Corydalis vaginans*, *Valeriana hardwickii*, *Dactylorhiza hatgirea*, *Herminium monorchis*, *Polygonatum geminiflorum*, *Phlomis bracteosa* etc.

The Chenab valley widens considerably towards west of Trilokinath and a remarkable change in the vegetation is noticed by the appearance of *Cedrus deodara* on both sides of the valley. The shrubby vegetation is represented by stunted *Fraxilms*, *Cotoneaster*, *Berberis*, *Ribes* and *Rosa*. In the undergrowth and on barren slopes the species like *Artemisia maritima* and stunted *Juniperus communis* var. *saxatilis* are common. *Populus alba*, *Salix oxycarpa*, *Juglans regia* and *Prunus armeniaca* are commonly planted.

The alpine zone (above 3500 m.) of the arid regions of Kinnaur shows almost similar type of plant associations as seen in Lahul and Spiti. The alpine meadows show prostrate *Juniperus communis* var. *saxatilis*,

J. squamata, *Rhododendron anthopogon*, *R. lepidotum*, *Cassiope fastigiata* etc. as common shrubby elements. The herbaceous elements include *Primula obtusifolia*, *P. munroi*, *P. minutissima*, *Leontopodium himalayanum*, *Corydalis govaniana*, *Pleurospermum candollii*, *P. stellatum*, *Selinum coniifolium*, *Anaphalis nepalensis*, *Saussurea gossypiphora*, *S. graminifolia*, *S. obvallata*, *S. piptathera*, *Synotis kunthiana*, *Poa nepalensis*, *Polygonum delicatulum*. *Cotoneaster microphylla*, *C. prostratus*, *Draba lasiophylla* etc. assume cushiony appearance. In drier areas *Bergenia stracheyii*, *Rhodiola sinnuata*, *R. wallichiana*, *Sedum trullipetalum*, *Primula munroi* are common. Many of these become cushiony.

The moist alpine scrub vegetation is dominated by *Rhododendron anthopogon*. The common associates are species of *Cotoneaster*, *Corydalis*, *Astragalus*, *Potentilla*, *Sedum*, *Rhodiola*, *Rheum*, *Caltha*, *Cassiope*, *Lonicera* etc. In dry alpine scrub vegetation *Juniperus* spp. is predominant. The common associates are species of *Artemisia*, *Draba*, *Meconopsis*, *Potentilla*, *Carex*, *Caragana*, etc.

Floristic diversity :

The flora of the western Himalaya is controlled broadly by altitude and climate, and more significantly by the soil, drainage, aspect and microclimate. The vegetation of the cold arid regions in the Trans-Himalayan Zone consists of a highly specialised group of plants with metabolic and reproductive strategies suited for maximising their activity in specialised harsh climatic conditions. Very scanty rainfall, extreme diurnal fluctuations of temperature, meagre humidity, snowfall, ultraviolet radiations, soil texture are some of the factors, the impact of which are clearly felt in the flora in cold deserts. There is a high percentage of polyploidy and hybridisation through mutations in species. This has also resulted in the existence of endemic species. The vegetation is not compact but is very typical. The number of species decreases as one moves towards high cold arid regions due to harsh climatic factors. The following tables give a glimpse of a very diverse but typical and specialised flora of this peculiar land mass.

Table 5: Statistical analysis of Flora of Cold Desert

Sl. No.	Name of Group	Family	Number of Genera	Species
1.	Angiosperms			
	i. Dicotyledons	72*	295*	850*
	ii. Monocotyledons	16	103	347
2.	Gymnosperms	2	4	8

*Tentative

Table 6: Dominant families of monocot in cold deserts

Sl. No.	Name of the family	Number of Genera	Species
1.	Poaceae	61	198
2.	Cyperaceae	12	64
3.	Alliaceae	2	20
4.	Liliaceae	9	14
5.	Orchidaceae	7	13
6.	Juncaceae	2	12
7.	Potamogetonaceae	1	10

**Table 7: Families represented by single genus
(number of species in parenthesis)**

Typhaceae (2)	Fumariaceae (9)	Araceae (1)
Betulaceae (1)	Iridaceae (6)	Lemnaceae (1)
Ulmaceae (1)	Moraceae (1)	Najadaceae (1)
Euphorbiaceae (4)	Selaginaceae (2)	Juncaginaceae (2)
Lentibulariaceae (1)	Orobanchaceae (4)	Zannichelliaceae (1)
Cuscutaceae (4)	Valerianaceae (3)	Potamogetonaceae (10)
Haloragidaceae (1)	Dioscoreaceae (1)	Santalaceae (1)
Ceratophyllaceae (1)	Trilliaceae (1)	Elaeagnaceae (2)

Table 8: Dominant genera of monocot in cold desert

Sl. No.	Name of genera	Number of species (including varieties)	Name of Family
1.	Carex	38	Cyperaceae
2.	Poa	28	Poaceae
3.	Allium	19	Alliaceae
4.	Elymus	15	Poaceae
5.	Stipa	15	Poaceae
6.	Festuca	13	Poaceae
7.	Kobresia	13	Cyperaceae
8.	Juncus	12	Juncaceae
9.	Bromus	11	Poaceae
10.	Calamagrostis	10	Poaceae
11.	Potamogeton	10	Potamogetonaceae

Table 9: Endemic Species

Sl. No.	Name of species	Family
1.	<i>Actinocarya tibetica</i>	Boraginaceae
2.	<i>Allium loratum</i>	Alliaceae
4.	<i>Anaphalis royleana</i>	Asteraceae
5.	<i>Anoplocaryum brandisii</i>	Boraginaceae
6.	<i>Arenaria polytrichoides</i>	Caryophyllaceae
7.	<i>A. stracheyi</i>	Caryophyllaceae
8.	<i>Astragalus ciliolatus</i>	Fabaceae
9.	<i>A. falconeri</i>	Fabaceae
10.	<i>A. grahamianus</i>	Fabaceae
11.	<i>A. hoffmeisteri</i>	Fabaceae
12.	<i>A. melanostachys</i>	Fabaceae
13.	<i>A. munroi</i>	Fabaceae
14.	<i>A. webbianus</i>	Fabaceae
15.	<i>A. zanskarensis</i>	Fabaceae
16.	<i>Berberis ulcina</i>	Berberidaceae
17.	<i>Braya thomsonii</i>	Brassicaceae

18.	<i>Calamagrostis decora</i>	Poaceae
19.	<i>C. holciformis</i>	Poaceae
20.	<i>C. stoliczkai</i>	Poaceae
21.	<i>Carex borii</i> var. <i>lutea</i>	Cyperaceae
22.	<i>C. haematostoma</i> var. <i>submacrogya</i>	Cyperaceae
23.	<i>C. oligocarya</i>	Cyperaceae
24.	<i>C. stenophylla</i> var. <i>longipedicellata</i>	Cyperaceae
25.	<i>Christolea crassifolia</i>	Brassicaceae
26.	<i>C. stewartii</i>	Brassicaceae
27.	<i>Colpodium himalaicum</i>	Poaceae
28.	<i>Corydalis crassifolia</i>	Fumariaceae
29.	<i>C. hendersonii</i>	Fumariaceae
30.	<i>Cousinia falconeri</i>	Asteraceae
31.	<i>Dactylorhiza hatagirea</i>	Orchidaceae
32.	<i>Draba cachemirica</i>	Brassicaceae
33.	<i>D. lasiophylla</i>	Brassicaceae
34.	<i>D. tenerrima</i>	Brassicaceae
35.	<i>Elymus dentatus</i>	Poaceae
36.	<i>E. jacquemontii</i>	Poaceae
37.	<i>E. russellii</i>	Poaceae
38.	<i>Eriocyclus thomsonii</i>	Apiaceae
39.	<i>Eritrichium fruticosum</i>	Boraginaceae
40.	<i>Euonymus monbeigii</i>	Celastraceae
41.	<i>Euphorbia tibetica</i>	Euphorbiaceae
42.	<i>Euphrasia alba</i>	Scrophulariaceae
43.	<i>E. jaeschkei</i>	Scrophulariaceae
44.	<i>E. kashmiriana</i>	Scrophulariaceae
45.	<i>E. laxa</i>	Scrophulariaceae
46.	<i>E. pauciflora</i>	Scrophulariaceae
47.	<i>E. platyphylla</i>	Scrophulariaceae
48.	<i>Ferula jaeschkeana</i>	Apiaceae
49.	<i>Galium serpylloides</i>	Rubiaceae
50.	<i>Gnaphalium thomsonii</i>	Asteraceae
51.	<i>Hedysarum astragaloides</i>	Fabaceae
52.	<i>Heracleum thomsonii</i>	Apiaceae
53.	<i>Heteropappus holohermaphroditus</i>	Asteraceae
54.	<i>H. semiprostratus</i>	Asteraceae
55.	<i>Juncus rohtangensis</i>	Juncaceae
57.	<i>Lancea tibetica</i>	Scrophulariaceae
58.	<i>Lasiocaryum densiflorum</i>	Boraginaceae
59.	<i>Mattiastrum thomsonii</i>	Boraginaceae

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60.	<i>Meconopsis bikramii</i>	Papaveraceae
61.	<i>Microsymbrium axillare</i> ssp. <i>brevipedicellatum</i>	Brassicaceae
62.	<i>Microula tibetica</i>	Boraginaceae
64.	<i>Pedicularis albida</i>	Scrophulariaceae
65.	<i>P. purpurea</i>	Scrophulariaceae
66.	<i>P. pycnantha</i> ssp. <i>cuspidata</i>	Scrophulariaceae
67.	<i>P. svenhedinii</i>	Scrophulariaceae
68.	<i>Poa koelzii</i>	Poaceae
69.	<i>P. ladakhensis</i>	Poaceae
70.	<i>P. lahulensis</i>	Poaceae
71.	<i>P. markgrafii</i>	Poaceae
72.	<i>P. suruana</i>	Poaceae
73.	<i>Potentilla curviseta</i>	Rosaceae
74.	<i>P. thomsonii</i>	Rosaceae
75.	<i>Primula heydeii</i>	Primulaceae
76.	<i>Pseudomertensia lahulensis</i>	Boraginaceae
77.	<i>Puccinellia stapfiana</i>	Poaceae
78.	<i>P. thomsonii</i>	Poaceae
79.	<i>Ranunculus bikramii</i>	Ranunculaceae
80.	<i>R. involucratus</i>	Ranunculaceae
81.	<i>R. lobatus</i>	Ranunculaceae
82.	<i>R. palifolius</i>	Ranunculaceae
83.	<i>Rhodiola wallichiana</i>	Crassulaceae
84.	<i>Saussurea candolleana</i>	Asteraceae
85.	<i>S. glanduligera</i>	Asteraceae
86.	<i>S. graminifolia</i>	Asteraceae
87.	<i>S. jacea</i>	Asteraceae
88.	<i>Scrophularia koelzii</i>	Scrophulariaceae
89.	<i>S. suffruticosa</i>	Scrophulariaceae
90.	<i>Sedum jaeschkei</i>	Crassulaceae
91.	<i>Seseli trilobum</i>	Apiaceae
92.	<i>Silene edoardi</i>	Caryophyllaceae
93.	<i>S. laxantha</i>	Caryophyllaceae
94.	<i>S. stewartii</i>	Caryophyllaceae
95.	<i>Stachys tibetica</i>	Lamiaceae
96.	<i>Tanacetum tibeticum</i>	Asteraceae
97.	<i>Thalictrum rutaefolium</i>	Ranunculaceae
98.	<i>Veronica biloba</i> var. <i>minima</i>	Scrophulariaceae
99.	<i>V. hirta</i>	Scrophulariaceae
100.	<i>V. koelzii</i>	Scrophulariaceae

101.	<i>Waldhemia stoliczkei</i>	Asteraceae
102.	<i>W. vestita</i>	Asteraceae

Table 10: Rare species from cold deserts

Sl. No.	Name of species	Family
1.	<i>Aconitum laeve</i>	Ranunculaceae
2.	<i>Actaea acuminata</i>	Ranunculaceae
3.	<i>Actinocarya tibetica</i>	Boraginaceae
4.	<i>Adonis aestivalis</i>	Ranunculaceae
5.	<i>Allium jacquemontii</i>	Alliaceae
6.	<i>A. stracheyi</i>	Alliaceae
7.	<i>Androsace mucronifolia</i>	Primulaceae
8.	<i>Anemone rupicola</i>	Ranunculaceae
9.	<i>Arceuthobium oxycedri</i>	Loranthaceae
10.	<i>Artemisia minor</i>	Asteraceae
11.	<i>A. gmelinii</i>	Asteraceae
12.	<i>Astragalus malacophyllus</i>	Fabaceae
13.	<i>A. melanostachys</i>	Fabaceae
14.	<i>A. munroi</i>	Fabaceae
15.	<i>Braya thomsonii</i>	Brassicaceae
16.	<i>B. tibetica</i>	Brassicaceae
17.	<i>Christolea stewartii</i>	Brassicaceae
18.	<i>Cortusa brotheri</i>	Primulaceae
19.	<i>C. matthiori</i>	Primulaceae
20.	<i>Corydalis crassifolia</i>	Fumariaceae
21.	<i>C. tibetica</i>	Fumariaceae
22.	<i>Cremanthodium decaisnei</i>	Asteraceae
23.	<i>Dilophila salsa</i>	Brassicaceae
24.	<i>Dioscorea deltoidea</i>	Dioscoreaceae
25.	<i>Draba altaica</i>	Brassicaceae
26.	<i>D. cachemirica</i>	Brassicaceae
27.	<i>Dracocephalum heterophyllum</i>	Lamiaceae
28.	<i>Epilobium brevifolium</i>	Onagraceae
29.	<i>E. leiophyllum</i>	Onagraceae
30.	<i>Eremurus himalaicus</i>	Liliaceae
31.	<i>Eriocycla thomsonii</i>	Apiaceae
32.	<i>Eritrichium nanum</i>	Boraginaceae

33.	<i>Erodium stephanianum</i>	Geraniaceae
34.	<i>Erophila verna</i>	Brassicaceae
35.	<i>Galium tibeticum</i>	Rubiaceae
36.	<i>Gentiana crassuloides</i>	Gentianaceae
37.	<i>G. leucomelana</i>	Gentianaceae
38.	<i>G. nubigena</i>	Gentianaceae
39.	<i>Geranium pseudo-aconitifolium</i>	Geraniaceae
40.	<i>Juncus leucanthus</i>	Juncaceae
41.	<i>J. rohtangensis</i>	Juncaceae
42.	<i>J. thomsonii</i>	Juncaceae
43.	<i>Kengia mutica</i>	Poaceae
44.	<i>Kobresia macrantha</i>	Cyperaceae
45.	<i>Lancea tibetica</i>	Scrophulariaceae
46.	<i>Leontopodium fimbrilligerum</i>	Asteraceae
47.	<i>Limosella aquatica</i>	Scrophulariaceae
48.	<i>Lithospermum arvensis</i>	Boraginaceae
49.	<i>Lloydia serotina</i>	Liliaceae
50.	<i>Lonicera semenovii</i>	Caprifoliaceae
51.	<i>L. spinosa</i>	Caprifoliaceae
52.	<i>Milula spicata</i>	Alliaceae
53.	<i>Orobanche hansii</i>	Orobanchaceae
54.	<i>Oxytropis sericopetala</i>	Fabaceae
55.	<i>Paraquilegia microphylla</i>	Ranunculaceae
56.	<i>Pedicularis albida</i>	Scrophulariaceae
57.	<i>P. pycnantha</i>	Scrophulariaceae
58.	<i>P. rhizanthoides</i>	Scrophulariaceae
59.	<i>P. roylei</i>	Scrophulariaceae
60.	<i>Poa ladakhensis</i>	Poaceae
61.	<i>Potentilla curviseta</i>	Rosaceae
62.	<i>Primula heydei</i>	Primulaceae
63.	<i>P. minutissima</i>	Primulaceae
64.	<i>P. obtusiloba</i>	Primulaceae
65.	<i>P. schlagintweitiana</i>	Primulaceae
66.	<i>Ranunculus muricatus</i>	Ranunculaceae
67.	<i>Rhodiola brunonii</i>	Crassulaceae
68.	<i>R. imbricata</i>	Crassulaceae
69.	<i>R. quadrifida</i>	Crassulaceae
70.	<i>Saussurea bracteata</i>	Asteraceae
71.	<i>S. glanduligera</i>	Asteraceae
72.	<i>S. gnaphalodes</i>	Asteraceae
73.	<i>S. gossypiphora</i>	Asteraceae

74.	<i>Scrophularia dentata</i>	Scrophulariaceae
75.	<i>Sedum jaeschkei</i>	Crassulaceae
76.	<i>S. oreades</i>	Crassulaceae
77.	<i>Seseli trilobum</i>	Apiaceae
78.	<i>Silen viscosa</i>	Caryophyllaceae
79.	<i>Sorosaris glomerata</i>	Asteraceae
80.	<i>Stachys tibetica</i>	Lamiaceae
81.	<i>Stellaria pusilla</i>	Caryophyllaceae
82.	<i>Thermopsis inflata</i>	Fabaceae
83.	<i>Thlaspi cochlearioides</i>	Brassicaceae
84.	<i>Thylacospermum caespitosum</i>	Caryophyllaceae
85.	<i>Thymus linearis</i> var. <i>album</i>	Lamiaceae
86.	<i>Tillaea pharnaceoides</i>	Crassulaceae
87.	<i>Valeriana jaeschkei</i>	Valerianaceae
88.	<i>Veronica biloba</i> var. <i>minima</i>	Scrophulariaceae
89.	<i>V. koelzii</i>	Scrophulariaceae
90.	<i>Viola kunawarensis</i>	Violaceae
91.	<i>Waldheimia stoliczkei</i>	Asteraceae
92.	<i>Wulfenia amherstiana</i>	Scrophulariaceae

Table 11: Important alpine mesophytes common to cold desert and rest of Western Himalaya

Sl. No.	Name of species	Family
1.	<i>Achillea millefolium</i>	Asteraceae
2.	<i>Aconitum chasmanthum</i>	Ranunculaceae
3.	<i>A. heterophyllum</i>	Ranunculaceae
4.	<i>A. laeve</i>	Ranunculaceae
5.	<i>A. rotundifolium</i>	Ranunculaceae
6.	<i>A. violaceum</i>	Ranunculaceae
7.	<i>Actaea acuminata</i>	Ranunculaceae
8.	<i>Actinocarya tibetica</i>	Boraginaceae
9.	<i>Adonis aestivalis</i>	Ranunculaceae
10.	<i>A. chrysocyathus</i>	Ranunculaceae
11.	<i>Agrostis pilosula</i>	Poaceae
12.	<i>A. stolonifera</i>	Poaceae
13.	<i>A. vinealis</i>	Poaceae
14.	<i>Ajuga bracteosa</i>	Lamiaceae

15.	<i>Allium consanguineum</i>	Alliaceae
16.	<i>A. humile</i>	Alliaceae
17.	<i>A. jacquemontii</i>	Alliaceae
18.	<i>A. stracheyi</i>	Alliaceae
19.	<i>A. victorialis</i>	Alliaceae
20.	<i>Alopecurus arundinaceus</i>	Poaceae
21.	<i>A. himalaicus</i>	Poaceae
22.	<i>Alyssum dsertorum</i>	Brassicaceae
23.	<i>Anaphalis busua</i>	Asteraceae
24.	<i>A. contorta</i>	Asteraceae
25.	<i>A. nepalensis</i>	Asteraceae
26.	<i>A. royleana</i>	Asteraceae
27.	<i>A. virgata</i>	Asteraceae
28.	<i>Androsace mucronifolia</i>	Primulaceae
29.	<i>A. rotundifolia</i>	Primulaceae
30.	<i>A. sarmentosa</i>	Primulaceae
31.	<i>A. sempervivoides</i>	Primulaceae
32.	<i>Anemone coronaria</i> var. <i>biflora</i>	Ranunculaceae
33.	<i>A. falconeri</i>	Ranunculaceae
34.	<i>A. obtusiloba</i>	Ranunculaceae
35.	<i>A. polyanthes</i>	Ranunculaceae
36.	<i>A. rupicola</i>	Ranunculaceae
37.	<i>Anthemis cotula</i>	Asteraceae
38.	<i>Aphragmus oxycarpus</i>	Brassicaceae
39.	<i>Aquilegia fragrans</i>	Ranunculaceae
40.	<i>A. moorcroftiana</i>	Ranunculaceae
41.	<i>A. pubiflora</i>	Ranunculaceae
42.	<i>Arabidopsis himalaica</i>	Brassicaceae
43.	<i>A. mollissima</i>	Brassicaceae
44.	<i>A. pumila</i>	Brassicaceae
45.	<i>A. stricta</i>	Brassicaceae
46.	<i>A. thaliana</i>	Brassicaceae
47.	<i>A. wallichii</i>	Brassicaceae
48.	<i>Arabis amplexicaulis</i>	Brassicaceae
49.	<i>A. nova</i>	Brassicaceae
50.	<i>A. pterosperma</i>	Brassicaceae
51.	<i>A. tenuirostris</i>	Brassicaceae
52.	<i>Arctium lappa</i>	Asteraceae
53.	<i>Arenaria festucoides</i>	Caryophyllaceae
54.	<i>A. glanduligera</i>	Caryophyllaceae
55.	<i>A. neelgherrensis</i>	Caryophyllaceae

56.	<i>A. serpyllifolia</i>	Caryophyllaceae
57.	<i>Arisaema jacquemontii</i>	Araceae
58.	<i>Arnebia benthamii</i>	Boraginaceae
59.	<i>Artemisia hiensis</i>	Asteraceae
60.	<i>A. dracunculus</i>	Asteraceae
61.	<i>A. gmelinii</i>	Asteraceae
62.	<i>A. indica</i>	Asteraceae
63.	<i>A. maritima</i>	Asteraceae
64.	<i>A. nilagirica</i>	Asteraceae
65.	<i>A. parviflora</i>	Asteraceae
66.	<i>A. persica</i>	Asteraceae
67.	<i>A. salsoloides</i>	Asteraceae
68.	<i>A. sieversiana</i>	Asteraceae
69.	<i>A. tournefortiana</i>	Asteraceae
70.	<i>Arthraxon prionodes</i>	Poaceae
71.	<i>Asperugo procumbens</i>	Boraginaceae
72.	<i>Asperula oppositifolia</i>	Rubiaceae
73.	<i>Aster falconeri</i>	Asteraceae
74.	<i>A. flaccidus</i>	Asteraceae
75.	<i>A. indamelus</i>	Asteraceae
76.	<i>A. thomsonii</i>	Asteraceae
77.	<i>Astragalus anherstianus</i>	Fabaceae
78.	<i>A. candolleanus</i>	Fabaceae
79.	<i>A. chlorostachys</i>	Fabaceae
80.	<i>A. coluteocarpus</i>	Fabaceae
81.	<i>A. densiflorus</i>	Fabaceae
82.	<i>A. frigidus</i>	Fabaceae
83.	<i>A. grahamianus</i>	Fabaceae
84.	<i>A. himalayanus</i>	Fabaceae
85.	<i>A. ladakensis</i>	Fabaceae
86.	<i>A. malacophyllus</i>	Fabaceae
87.	<i>A. melanostachys</i>	Fabaceae
88.	<i>A. munroi</i>	Fabaceae
89.	<i>A. peduncularis</i>	Fabaceae
90.	<i>A. rhizanthus</i>	Fabaceae
91.	<i>A. subuliformis</i>	Fabaceae
92.	<i>A. webbianus</i>	Fabaceae
93.	<i>Atriplex crassifolia</i>	Chenopodiaceae
94.	<i>Avena fatua</i>	Poaceae
95.	<i>Baeothryon pumilum</i>	Cyperaceae
96.	<i>Barbarea intermedia</i>	Brassicaceae

97. <i>B. vulgaris</i>	Brassicaceae
98. <i>Berberis glaucocarpa</i>	Berberidaceae
99. <i>B. jaeschkeana</i>	Berberidaceae
100. <i>B. pachyacantha</i>	Berberidaceae
101. <i>B. pseudoumbellata</i>	Berberidaceae
102. <i>B. ulcina</i>	Berberidaceae
103. <i>Bergenia stracheyi</i>	Saxifragaceae
104. <i>Betula utilis</i>	Betulaceae
105. <i>Bieberstainia odora</i>	Geraniaceae
106. <i>Bothriochloa ischaemum</i>	Poaceae
107. <i>Brachyactis pubescens</i>	Asteraceae
108. <i>B. roylei</i>	Asteraceae
109. <i>Braya tibetica</i>	Brassicaceae
110. <i>Breea japonicus</i>	Asteraceae
111. <i>Bunium cylindricum</i>	Apiaceae
112. <i>B. persicum</i>	Apiaceae
113. <i>Bupleurum aitchisonii</i>	Apiaceae
114. <i>B. candollii</i>	Apiaceae
115. <i>B. falcatum</i>	Apiaceae
116. <i>B. gracillimum</i>	Apiaceae
117. <i>B. himalayense</i>	Apiaceae
118. <i>B. jucundum</i>	Apiaceae
119. <i>B. thomsonii</i>	Apiaceae
120. <i>Calamagrostis emodensis</i>	Poaceae
121. <i>Callitriche intermedia</i>	Callitrichaceae
122. <i>C. palustris</i>	Callitrichaceae
123. <i>C. stagnalis</i>	Callitrichaceae
124. <i>Caltha palustris</i>	Ranunculaceae
125. <i>Campanula alsinoides</i>	Campanulaceae
126. <i>C. argyrotricha</i>	Campanulaceae
127. <i>C. aristata</i>	Campanulaceae
128. <i>C. cashmeriana</i>	Campanulaceae
129. <i>C. latifolia</i>	Campanulaceae
130. <i>C. pallida</i>	Campanulaceae
131. <i>Cannabis sativa</i>	Cannabaceae
132. <i>Capsella bursa-pastoris</i>	Brassicaceae
133. <i>Caragana versicolor</i>	Fabaceae
134. <i>Cardamine flexuosa</i>	Brassicaceae
135. <i>C. hirsuta</i>	Brassicaceae
136. <i>C. impatiens</i>	Brassicaceae
137. <i>C. macrophylla</i>	Brassicaceae

138.	<i>Cardus edelbergii</i>	Asteraceae
139.	<i>Carex nivalis</i>	Cyperaceae
140.	<i>C. obscura</i>	Cyperaceae
141.	<i>C. stenophylla</i>	Cyperaceae
142.	<i>C. vulpinaris</i>	Cyperaceae
143.	<i>Carpesium abrotanoides</i>	Asteraceae
144.	<i>Carum carvi</i>	Apiaceae
145.	<i>Cassiope fastigiata</i>	Ericaceae
146.	<i>Cerastium cerastoides</i>	Caryophyllaceae
147.	<i>C. vulgatum</i>	Caryophyllaceae
148.	<i>Chaerophyllum aromaticum</i>	Apiaceae
149.	<i>C. reflexum</i>	Apiaceae
150.	<i>C. villosum</i>	Apiaceae
151.	<i>Chenopodium album</i>	Chenopodiaceae
152.	<i>C. botrys</i>	Chenopodiaceae
153.	<i>C. foliosum</i>	Chenopodiaceae
154.	<i>C. glaucum</i>	Chenopodiaceae
155.	<i>C. hybridum</i>	Chenopodiaceae
156.	<i>Chesneya cuneata</i>	Fabaceae
157.	<i>Chorispora sabulosa</i>	Brassicaceae
158.	<i>Christolea crassifolia</i>	Brassicaceae
159.	<i>C. himalayensis</i>	Brassicaceae
160.	<i>Chrysanthemum pyrethroides</i>	Asteraceae
161.	<i>Chrysopogon gryllus</i>	Poaceae
162.	<i>Circaea alpina</i>	Onagraceae
163.	<i>C. cordata</i>	Onagraceae
164.	<i>Cirsium wallichii</i>	Asteraceae
165.	<i>Clinopodium umbrosum</i>	Lamiaceae
166.	<i>C. vulgare</i>	Lamiaceae
167.	<i>Codonopsis clematidea</i>	Campanulaceae
168.	<i>C. ovata</i>	Campanulaceae
169.	<i>C. rotundifolia</i>	Campanulaceae
170.	<i>Convolvulus arvensis</i>	Convolvulaceae
171.	<i>Cortusa brotheri</i>	Primulaceae
172.	<i>Corydalis cashmeriana</i>	Fumariaceae
173.	<i>C. cornuta</i>	Fumariaceae
174.	<i>C. govaniana</i>	Fumariaceae
175.	<i>C. moorcroftiana</i>	Fumariaceae
176.	<i>C. stricta</i>	Fumariaceae
177.	<i>C. thyrsiflora</i>	Fumariaceae
178.	<i>C. vaginans</i>	Fumariaceae

179. <i>Cotoneaster aitchisoni</i>	Rosaceae
180. <i>C. falconeri</i>	Rosaceae
181. <i>C. microphylla</i>	Rosaceae
182. <i>C. obovatus</i>	Rosaceae
183. <i>C. rosea</i>	Rosaceae
184. <i>Cousinia falconeri</i>	Asteraceae
185. <i>C. thomsoni</i>	Asteraceae
186. <i>Cremanthodium amicoides</i>	Asteraceae
187. <i>C. decaisnei</i>	Asteraceae
188. <i>C. plantagineum</i>	Asteraceae
189. <i>Crepis multicaulis</i>	Asteraceae
190. <i>C. sancta</i>	Asteraceae
191. <i>Cuscuta approximata</i>	Cuscutaceae
192. <i>C. brevistyla</i>	Cuscutaceae
193. <i>C. capitata</i>	Cuscutaceae
194. <i>C. europaea</i>	Cuscutaceae
195. <i>Cynoglossum lanceolatum</i>	Boraginaceae
196. <i>C. microglochis</i>	Boraginaceae
197. <i>C. nervosum</i>	Boraginaceae
198. <i>C. petiolatum</i>	Boraginaceae
199. <i>C. wallichii</i>	Boraginaceae
200. <i>Dactylis glomerata</i>	Poaceae
201. <i>Dactylorhiza hatagirea</i>	Orchidaceae
202. <i>Datisca cannabina</i>	Datisceae
203. <i>Delphinium brunonianum</i>	Ranunculaceae
204. <i>D. cashmerianum</i>	Ranunculaceae
205. <i>D. vestitum</i>	Ranunculaceae
206. <i>Dianthus anatolicus</i>	Caryophyllaceae
207. <i>Dilophila salsa</i>	Brassicaceae
208. <i>Discorea deltoidea</i>	Dioscoreaceae
209. <i>Dipsacus mitis</i>	Dipsacaceae
210. <i>Dontostemon glandulosus</i>	Brassicaceae
211. <i>Draba altaica</i>	Brassicaceae
212. <i>D. cachemirica</i>	Brassicaceae
213. <i>D. glomerata</i>	Brassicaceae
214. <i>D. lanceolata</i>	Brassicaceae
215. <i>D. lasiophylla</i>	Brassicaceae
216. <i>D. oreades</i>	Brassicaceae
217. <i>D. stenocarpa</i>	Brassicaceae
218. <i>Dracocephalum heterophyllum</i>	Lamiaceae
219. <i>Echinochloa crusgalli</i>	Poaceae

220.	<i>Echinops cornigerus</i>	Asteraceae
221.	<i>E. echinatus</i>	Asteraceae
222.	<i>Eleocharis atropurpurea</i>	Cyperaceae
223.	<i>E. palustris</i>	Cyperaceae
224.	<i>E. quinqueflora</i>	Cyperaceae
225.	<i>Elsholtzia ciliata</i>	Lamiaceae
226.	<i>E. densa</i>	Lamiaceae
227.	<i>E. eriostachya</i>	Lamiaceae
228.	<i>E. strobilifera</i>	Lamiaceae
229.	<i>Ephedra gerardiana</i>	Ephedraceae
230.	<i>Epilobium amurense</i>	Onagraceae
231.	<i>E. angustifolium</i>	Onagraceae
232.	<i>E. cylindricum</i>	Onagraceae
233.	<i>E. latifolium</i>	Onagraceae
234.	<i>E. laxum</i>	Onagraceae
235.	<i>E. minutiflorum</i>	Onagraceae
236.	<i>E. palustre</i>	Onagraceae
237.	<i>E. royleanum</i>	Onagraceae
238.	<i>Epipactis helleborine</i>	Orchidaceae
239.	<i>Eragrostis minor</i>	Poaceae
240.	<i>Eremurus himalaicus</i>	Liliaceae
241.	<i>Erigeron alpinus</i>	Asteraceae
242.	<i>E. bellidioides</i>	Asteraceae
243.	<i>E. multiradiatus</i>	Asteraceae
244.	<i>E. roylei</i>	Asteraceae
245.	<i>E. uniflorus</i>	Asteraceae
246.	<i>Eritrichium canum</i>	Boraginaceae
248.	<i>E. fruticosum</i>	Boraginaceae
249.	<i>E. nanum</i>	Boraginaceae
250.	<i>E. spathulatum</i>	Boraginaceae
251.	<i>Erophila verna</i>	Brassicaceae
252.	<i>Erysimum hieraciifolium</i>	Brassicaceae
253.	<i>E. melicentae</i>	Brassicaceae
254.	<i>Euclidium syriacum</i>	Brassicaceae
255.	<i>Euonymus fimbriatus</i>	Celastraceae
256.	<i>Euphorbia hispida</i>	Euphorbiaceae
257.	<i>Euphrasia foliosa</i>	Scrophulariaceae
258.	<i>E. jaeschkei</i>	Scrophulariaceae
259.	<i>E. kashmiriana</i>	Scrophulariaceae
260.	<i>E. pauciflora</i>	Scrophulariaceae
261.	<i>E. platyphylla</i>	Scrophulariaceae

262. <i>Fagopyrum esculentum</i>	Polygonaceae
263. <i>F. tataricum</i>	Polygonaceae
264. <i>Ferula jaeschkeana</i>	Apiaceae
265. <i>Filago arvensis</i>	Asteraceae
266. <i>Filipendula vestita</i>	Rosaceae
267. <i>Fragaria vesca</i>	Rosaceae
268. <i>Fraxinus xanthoxyloides</i>	Oleaceae
269. <i>Gagea kunawarensis</i>	Liliaceae
270. <i>G. lutea</i>	Liliaceae
271. <i>Galium aparine</i>	Rubiaceae
272. <i>G. asperifolium</i>	Rubiaceae
273. <i>G. asperuloides</i>	Rubiaceae
274. <i>G. boreale</i>	Rubiaceae
275. <i>G. serpylloides</i>	Rubiaceae
276. <i>G. verum</i>	Rubiaceae
277. <i>Gaultheria trichophylla</i>	Ericaceae
278. <i>Gentiana aquatica</i>	Gentianaceae
279. <i>G. argentea</i>	Gentianaceae
280. <i>G. coronata</i>	Gentianaceae
281. <i>G. kurroo</i>	Gentianaceae
282. <i>G. leucomelaena</i>	Gentianaceae
283. <i>G. marginata</i>	Gentianaceae
284. <i>G. nubigena</i>	Gentianaceae
285. <i>G. prostrata</i>	Gentianaceae
286. <i>G. tianshanika</i>	Gentianaceae
287. <i>G. venusta</i>	Gentianaceae
288. <i>Gentianella aurea</i>	Gentianaceae
289. <i>G. borealis</i>	Gentianaceae
290. <i>G. moorcoftiana</i>	Gentianaceae
291. <i>G. tenella</i>	Gentianaceae
292. <i>Geranium collinum</i>	Geraniaceae
293. <i>G. himalayense</i>	Geraniaceae
294. <i>G. nepalense</i>	Geraniaceae
295. <i>G. pratense</i>	Geraniaceae
296. <i>G. pseudoaconitifolium</i>	Geraniaceae
297. <i>G. wallichianum</i>	Geraniaceae
298. <i>Geum elatum</i>	Rosaceae
399. <i>G. roylei</i>	Rosaceae
300. <i>Gnaphalium thomsonii</i>	Asteraceae
301. <i>Goodyera repens</i>	Orchidaceae
302. <i>Gypsophila cerastoides</i>	Caryophyllaceae

303.	<i>Hackelia uncinata</i>	Boraginaceae
304.	<i>Hedysarum astragaloides</i>	Fabaceae
305.	<i>H. microcalyx</i>	Fabaceae
306.	<i>Heracleum lanatum</i>	Apiaceae
307.	<i>H. thomsonii</i>	Apiaceae
308.	<i>Herminium monorchis</i>	Orchidaceae
309.	<i>Herniaria hirsuta</i>	Illecebraceae
310.	<i>Hieracium umbellatum</i>	Asteraceae
311.	<i>Hierochloe laxa</i>	Poaceae
312.	<i>Hippophae rhamnoides</i>	Elaeagnaceae
313.	<i>Hippuris vulgaris</i>	Hippuridaceae
314.	<i>Hylotelephium ewersii</i>	Crassulaceae
315.	<i>Hyoscyamus niger</i>	Solanaceae
316.	<i>Hypericum perforatum</i>	Hypericaceae
317.	<i>Impatiens bicolor</i>	Balsaminaceae
318.	<i>I. brachycentra</i>	Balsaminaceae
319.	<i>I. glandulifera</i>	Balsaminaceae
320.	<i>I. thomsonii</i>	Balsaminaceae
321.	<i>Inula grandiflora</i>	Asteraceae
322.	<i>I. obtusifolia</i>	Asteraceae
323.	<i>I. racemosa</i>	Asteraceae
324.	<i>I. royleana</i>	Asteraceae
325.	<i>Iris ensata</i>	Iridaceae
326.	<i>I. kemaonensis</i>	Iridaceae
327.	<i>Isolepis setacea</i>	Cyperaceae
328.	<i>Jaeschkea oligosperma</i>	Gentariaceae
329.	<i>Jasminum humile</i>	Oleaceae
330.	<i>Juncus articulatus</i>	Juncaceae
331.	<i>J. bufonius</i>	Juncaceae
332.	<i>J. leucomelas</i>	Juncaceae
333.	<i>J. membranaceus</i>	Juncaceae
334.	<i>J. sphacelastus</i> var. <i>himalensis</i>	Juncaceae
335.	<i>J. thomsonii</i>	Juncaceae
336.	<i>Juniperus recurva</i>	Cupressaceae
337.	<i>Jurinea ceratocarpa</i>	Asteraceae
338.	<i>Jurinella macrocephala</i>	Asteraceae
339.	<i>Kobresia capillifolia</i>	Cyperaceae
340.	<i>K. duthiei</i>	Cyperaceae
341.	<i>K. laxa</i>	Cyperaceae
342.	<i>K. macrantha</i>	Cyperaceae
343.	<i>K. nepalensis</i>	Cyperaceae

344. <i>K. nitens</i>	Cyperaceae
345. <i>K. pygmaea</i>	Cyperaceae
346. <i>K. royleana</i>	Cyperaceae
347. <i>Kochia stellaris</i>	Chenopodiaceae
348. <i>Koeleria macrantha</i>	Poaceae
349. <i>Koelpinia linearis</i>	Asteraceae
350. <i>Kyllinga squamulata</i>	Cyperaceae
351. <i>Lactuca brunoniana</i>	Asteraceae
352. <i>L. decipiens</i>	Asteraceae
353. <i>L. dissecta</i>	Asteraceae
354. <i>L. dolichophylla</i>	Asteraceae
355. <i>L. lessertiana</i>	Asteraceae
356. <i>L. orientalis</i>	Asteraceae
357. <i>L. rapunculoides</i>	Asteraceae
358. <i>Lagotis cashmeriana</i>	Selaginaceae
359. <i>L. kunawurensis</i>	Selaginaceae
360. <i>Lamium amplexicaule</i>	Lamiaceae
361. <i>L. rhomboideum</i>	Lamiaceae
362. <i>Lancea tibetica</i>	Scrophulariaceae
363. <i>Lappula barbata</i>	Boraginaceae
364. <i>L. microcarpa</i>	Boraginaceae
365. <i>Lasiocaryum diffusum</i>	Boraginaceae
366. <i>L. munroi</i>	Boraginaceae
367. <i>Lathyrus emodi</i>	Fabaceae
368. <i>L. sativus</i>	Fabaceae
369. <i>Leibnitzia nepalensis</i>	Asteraceae
370. <i>Leontopodium brachyactis</i>	Asteraceae
371. <i>L. himalayanum</i>	Asteraceae
372. <i>L. monocephalum</i>	Asteraceae
373. <i>Lepidium apetalum</i>	Brassicaceae
374. <i>L. capitatum</i>	Brassicaceae
375. <i>L. latifolium</i>	Brassicaceae
376. <i>Leptorhabdos parviflora</i>	Scrophulariaceae
377. <i>Lepyrodiclis holosteoides</i>	Caryophyllaceae
378. <i>Lespedeza juncea</i>	Fabaceae
379. <i>Limosella aquatica</i>	Scrophulariaceae
380. <i>Lindelofia anchusoides</i>	Boraginaceae
381. <i>L. longiflora</i>	Boraginaceae
382. <i>L. stylosa</i>	Boraginaceae
383. <i>Lithospermum arvensis</i>	Boraginaceae
384. <i>Lloydia serotina</i>	Liliaceae

385.	<i>Lomatogonium carinthiacum</i>	Gentianaceae
386.	<i>L. spathulata</i>	Gentianaceae
387.	<i>Lonicera asperifolia</i>	Caprifoliaceae
388.	<i>L. discolor</i>	Caprifoliaceae
389.	<i>L. hispida</i>	Caprifoliaceae
390.	<i>L. myrtillos</i>	Caprifoliaceae
391.	<i>L. obovata</i>	Caprifoliaceae
392.	<i>L. quinquelocularis</i>	Caprifoliaceae
393.	<i>L. semenovii</i>	Caprifoliaceae
394.	<i>L. spinosa</i>	Caprifoliaceae
395.	<i>L. webbiana</i>	Caprifoliaceae
396.	<i>Lotus corniculatus</i>	Fabaceae
397.	<i>Luzula spicata</i>	Junaceae
398.	<i>Malaxis muscifera</i>	Orchidaceae
399.	<i>Malva neglecta</i>	Malvaceae
400.	<i>Mariscus squarrosus</i>	Cyperaceae
401.	<i>Matthiola flavida</i>	Brassicaceae
402.	<i>Meconopsis aculeata</i>	Papaveraceae
403.	<i>Medicago falcata</i>	Fabaceae
404.	<i>M. lupulina</i>	Fabaceae
405.	<i>M. sativa</i>	Fabaceae
406.	<i>Melilotus alba</i>	Fabaceae
407.	<i>M. indica</i>	Fabaceae
408.	<i>M. officinalis</i>	Fabaceae
409.	<i>Mentha longifolia</i>	Lamiaceae
410.	<i>Minuartia biflora</i>	Caryophyllaceae
411.	<i>M. kashmirica</i>	Caryophyllaceae
412.	<i>Myosotis silvatica</i>	Boraginaceae
413.	<i>M. stricta</i>	Boraginaceae
414.	<i>Myricaria germanica</i>	Tamaricaceae
415.	<i>Nepeta eriostachya</i>	Lamiaceae
416.	<i>N. floccosa</i>	Lamiaceae
417.	<i>N. glutinosa</i>	Lamiaceae
418.	<i>N. laevigata</i>	Lamiaceae
419.	<i>N. linearis</i>	Lamiaceae
420.	<i>N. nivalis</i>	Lamiaceae
421.	<i>Onosma hispidum</i>	Boraginaceae
422.	<i>Origanum vulgare</i>	Lamiaceae
423.	<i>Orobanche alba</i>	Orobanchaceae
424.	<i>O. caesia</i>	Orobanchaceae
425.	<i>Oxytropis cachemiriana</i>	Fabaceae

426. <i>O. humifusa</i>	Fabaceae
427. <i>O. lapponica</i>	Fabaceae
428. <i>O. microphylla</i>	Fabaceae
429. <i>O. mollis</i>	Fabaceae
430. <i>Paraquilegia anemonoides</i>	Ranunculaceae
431. <i>Parietaria micrantha</i>	Urticaceae
432. <i>Parnassia laxmanni</i>	Parnassiaceae
433. <i>P. nubicola</i>	Parnassiaceae
434. <i>Pedicularis albida</i>	Scrophulariaceae
435. <i>P. bicornuta</i>	Scrophulariaceae
436. <i>P. hoffmeisteri</i>	Scrophulariaceae
437. <i>P. hookeriana</i>	Scrophulariaceae
438. <i>P. longiflora</i>	Scrophulariaceae
439. <i>P. oederi</i>	Scrophulariaceae
440. <i>P. pectinata</i>	Scrophullariaceae
441. <i>P. pennelliana</i>	Scrophulariaceae
442. <i>P. punctata</i>	Scrophulariaceae
443. <i>P. purpurea</i>	Scrophulariaceae
444. <i>P. rhinanthoides</i>	Scrophulariaceae
445. <i>P. roylei</i>	Scrophulariaceae
446. <i>P. tenuirosteris</i>	Scrophulariaceae
447. <i>Peganum harmala</i>	Zygophyllaceae
448. <i>Pennisetum flaccidum</i>	Poaceae
449. <i>Phacelurus speciosus</i>	Poaceae
450. <i>Phleum alpinum</i>	Poaceae
451. <i>Phlomis bracteosa</i>	Lamiaceae
452. <i>Phragmitis australis</i>	Poaceae
453. <i>Physochlaena praealta</i>	Solanaceae
454. <i>Picrorhiza kurrooa</i>	Scrophulariaceae
455. <i>Pimpinella diversifolia</i>	Apiaceae
456. <i>Plantago depressa</i>	Plantaginaceae
457. <i>P. himalaica</i>	Plantaginaceae
458. <i>P. lanceolata</i>	Plantaginaceae
459. <i>P. major</i>	Plantaginaceae
460. <i>Pleurospermum brunonis</i>	Apiaceae
461. <i>P. candollii</i>	Apiaceae
462. <i>P. govanianum</i>	Apiaceae
463. <i>P. hookeri</i>	Apiaceae
464. <i>P. stellatum</i>	Apiaceae
465. <i>Poa annua</i>	Poaceae
466. <i>P. bulbosa</i>	Poaceae

467.	<i>P. sterilis</i>	Poaceae
468.	<i>P. stewartiana</i>	Poaceae
469.	<i>Podophyllum hexandrum</i>	Podophyllaceae
470.	<i>Polemonium caeruleum</i>	Polemoniaceae
471.	<i>Polygonatum multiflorum</i>	Liliaceae
472.	<i>P. verticillatum</i>	Liliaceae
473.	<i>Polygonum affine</i>	Polygonaceae
474.	<i>P. alpinum</i>	Polygonaceae
475.	<i>P. amphibium</i>	Polygonaceae
476.	<i>P. amplexicaule</i>	Polygonaceae
477.	<i>P. aviculare</i>	Polygonaceae
478.	<i>P. cognatum</i>	Polygonaceae
479.	<i>P. delicatulum</i>	Polygonaceae
480.	<i>P. dumetorum</i>	Polygonaceae
481.	<i>P. filicaule</i>	Polygonaceae
482.	<i>P. glaciale</i>	Polygonaceae
483.	<i>P. hydropiper</i>	Polygonaceae
484.	<i>P. islandicum</i>	Polygonaceae
485.	<i>P. nepalense</i>	Polygonaceae
486.	<i>P. sibiricum</i>	Polygonaceae
487.	<i>P. tortuosum</i>	Polygonaceae
488.	<i>P. viviparum</i>	Polygonaceae
489.	<i>Ponerorchis chusua</i>	Orchidaceae
490.	<i>P. nana</i>	Orchidaceae
491.	<i>Potamogeton pectinatus</i>	Potamogetonaceae
492.	<i>Potentilla anserina</i>	Rosaceae
493.	<i>P. atrisanguinea</i>	Rosaceae
494.	<i>P. biflora</i>	Rosaceae
495.	<i>P. bifurca</i>	Rosaceae
496.	<i>P. cuneata</i>	Rosaceae
497.	<i>P. curviseta</i>	Rosaceae
498.	<i>P. desertorum</i>	Rosaceae
499.	<i>P. doubjouneana</i>	Rosaceae
500.	<i>P. eriocarpa</i>	Rosaceae
501.	<i>P. gelida</i>	Rosaceae
502.	<i>P. monanthes</i>	Rosaceae
503.	<i>P. multifida</i>	Rosaceae
504.	<i>P. nepalensis</i>	Rosaceae
505.	<i>P. salesoviana</i>	Rosaceae
506.	<i>P. sericea</i>	Rosaceae
507.	<i>P. supina</i>	Rosaceae

508. <i>Prangos pabularia</i>	Apiaceae
509. <i>Primula denticulata</i>	Primulaceae
510. <i>P. elliptica</i>	Primulaceae
511. <i>P. heydei</i>	Primulaceae
512. <i>P. macrophylla</i>	Primulaceae
513. <i>P. minutissima</i>	Primulaceae
514. <i>P. moorcroftiana</i>	Primulaceae
515. <i>P. obtusifolia</i>	Primulaceae
516. <i>P. reptans</i>	Primulaceae
517. <i>P. rosea</i>	Primulaceae
518. <i>P. sibirica</i>	Primulaceae
519. <i>Prunella vulgaris</i>	Lamiaceae
520. <i>Pseudomertensia echioides</i>	Boraginaceae
521. <i>Psychrogeton andryaloides</i>	Asteraceae
522. <i>Ranunculus brotherusii</i>	Ranunculaceae
523. <i>R. falcatus</i>	Ranunculaceae
524. <i>R. hirtellus</i>	Ranunculaceae
525. <i>R. laetus</i>	Ranunculaceae
526. <i>R. muricatus</i>	Ranunculaceae
527. <i>R. pulchellus</i>	Ranunculaceae
528. <i>R. trichophyllus</i>	Ranunculaceae
529. <i>Rheum emodi</i>	Polygonaceae
530. <i>R. spiciforme</i>	Polygonaceae
531. <i>R. webbianum</i>	Polygonaceae
532. <i>Rhodiola sinuata</i>	Crassulaceae
533. <i>R. tibetica</i>	Crassulaceae
534. <i>R. wallichiana</i>	Crassulaceae
535. <i>Ribes alpestri</i>	Grossulariaceae
536. <i>R. glaciale</i>	Grossulariaceae
537. <i>R. orientale</i>	Grossulariaceae
538. <i>Rorippa islandica</i>	Brassicaceae
539. <i>R. nasturtium-aquaticum</i>	Brassicaceae
540. <i>Rosa brunonii</i>	Rosaceae
541. <i>R. macrophylla</i>	Rosaceae
542. <i>R. webbiana</i>	Rosaceae
543. <i>Rosularia alpestris</i>	Crassulaceae
544. <i>Rubia cordifolia</i>	Rubiaceae
545. <i>Rubus saxatilis</i>	Rosaceae
546. <i>Rumex acetosa</i>	Polygonaceae
547. <i>R. nepalensis</i>	Polygonaceae
548. <i>Sagina saginoides</i>	Caryophyllaceae

549. <i>Salvia nubicola</i>	Lamiaceae
550. <i>Saussurea albescens</i>	Asteraceae
551. <i>S. bracteata</i>	Asteraceae
552. <i>S. candolleana</i>	Asteraceae
553. <i>S. glanduligera</i>	Asteraceae
554. <i>S. gnaphalodes</i>	Asteraceae
555. <i>S. jacea</i>	Asteraceae
556. <i>S. lappa</i>	Asteraceae
557. <i>Saxifraga cernua</i>	Saxifragaceae
558. <i>S. flagellaris</i>	Saxifragaceae
559. <i>S. hirculus</i>	Saxifragaceae
560. <i>S. jacquemontiana</i>	Saxifragaceae
561. <i>S. moorcroftiana</i>	Saxifragaceae
562. <i>S. pallida</i>	Saxifragaceae
563. <i>S. pulvinaria</i>	Saxifragaceae
564. <i>Scrophularia dentata</i>	Scrophulariaceae
565. <i>S. koelzii</i>	Scrophulariaceae
566. <i>S. scabiosaefolia</i>	Scrophulariaceae
567. <i>Scutellaria prostrata</i>	Lamiaceae
568. <i>Sedum jaeschkei</i>	Crassulaceae
569. <i>S. oreades</i>	Crassulaceae
570. <i>S. trullipetalum</i>	Crassulaceae
571. <i>S. wallichianum</i>	Crassulaceae
572. <i>Selinum coniifolium</i>	Apiaceae
573. <i>S. papyraceum</i>	Apiaceae
574. <i>S. vaginatum</i>	Apiaceae
575. <i>Senecio krascheninnikovii</i>	Asteraceae
576. <i>S. laetus</i>	Asteraceae
577. <i>Seseli libanotis</i>	Apiaceae
578. <i>Setaria viridis</i>	Poaceae
579. <i>Sibaldia parviflora</i>	Rosaceae
580. <i>S. purpurea</i>	Rosaceae
581. <i>Silene gonosperma</i>	Caryophyllaceae
582. <i>S. indica</i>	Caryophyllaceae
583. <i>S. moorcroftiana</i>	Caryophyllaceae
584. <i>S. tenuis</i>	Caryophyllaceae
585. <i>S. viscosa</i>	Caryophyllaceae
586. <i>S. vulgaris</i>	Caryophyllaceae
587. <i>Sisymbrium brassiciforme</i>	Brassicaceae
588. <i>S. loeselii</i>	Brassicaceae
589. <i>Sium sisarum</i>	Apiaceae

590. <i>Solidago virg-aurea</i>	Asteraceae
591. <i>Sonchus oleraceus</i>	Asteraceae
592. <i>Sorbaria tomentosa</i>	Rosaceae
593. <i>Spiraea canescens</i>	Rosaceae
594. <i>Stachys melissaefolia</i>	Lamiaceae
595. <i>Stellaria cherleriae</i>	Caryophyllaceae
596. <i>S. media</i>	Caryophyllaceae
597. <i>S. monosperma</i>	Caryophyllaceae
598. <i>S. palustris</i>	Caryophyllaceae
599. <i>Swertia ciliata</i>	Gentianaceae
600. <i>S. cordata</i>	Gentianaceae
601. <i>S. petiolata</i>	Gentianaceae
602. <i>Syringa emodi</i>	Oleaceae
603. <i>Tanacetum falconeri</i>	Asteraceae
604. <i>T. tibeticum</i>	Asteraceae
605. <i>T. tomentosum</i>	Asteraceae
606. <i>Taraxacum officinale</i>	Asteraceae
607. <i>Thalictrum alpinum</i>	Ranunculaceae
608. <i>T. secundum</i>	Ranunculaceae
609. <i>Thermopsis barbata</i>	Fabaceae
610. <i>T. inflata</i>	Fabaceae
611. <i>Thlaspi andersonii</i>	Brassicaceae
612. <i>T. arvense</i>	Brassicaceae
613. <i>T. cochlearioides</i>	Brassicaceae
614. <i>Thylacospermum caespitosum</i>	Caryophyllaceae
615. <i>Trachydium roylei</i>	Apiaceae
616. <i>Tragopogon gracilis</i>	Asteraceae
617. <i>T. pratense</i>	Asteraceae
618. <i>Tribulus terrestris</i>	Zygophyllaceae
619. <i>Trifolium pratense</i>	Fabaceae
620. <i>Triglochin maritimum</i>	Juncaginaceae
621. <i>T. palustris</i>	Juncaginaceae
622. <i>Trigonella emodi</i>	Fabaceae
623. <i>Trillium govanianum</i>	Trilliaceae
624. <i>Trisetum spicatum</i>	Poaceae
625. <i>Trollius acaulis</i>	Ranunculaceae
626. <i>Turritis glabra</i>	Brassicaceae
627. <i>Tussilago farfara</i>	Asteraceae
628. <i>Urtica dioica</i>	Urticaceae
629. <i>Valeriana dioica</i>	Valerianaceae
630. <i>V. hardwickii</i>	Valerianaceae

631. <i>V. jatamansi</i>	Valerianaceae
632. <i>Verbascum thapsus</i>	Scrophulariaceae
633. <i>Veronica anagalis-aquatica</i>	Scrophulariaceae
634. <i>V. beccabunga</i>	Scrophulariaceae
635. <i>V. biloba</i>	Scrophulariaceae
636. <i>V. hirta</i>	Scrophulariaceae
637. <i>V. koelzii</i>	Scrophulariaceae
638. <i>V. lanosa</i>	Scrophulariaceae
639. <i>V. lasiocarpa</i>	Scrophulariaceae
640. <i>V. perpusilla</i>	Scrophulariaceae
641. <i>V. persica</i>	Scrophulariaceae
642. <i>V. serpyllifolia</i>	Scrophulariaceae
643. <i>Viburnum cotinifolium</i>	Caprifoliaceae
644. <i>Vicatia coniiifolia</i>	Apiaceae
645. <i>Viola biflora</i>	Violaceae
646. <i>V. sylvatica</i>	Violaceae
647. <i>Waldheimia glabra</i>	Asteraceae
648. <i>W. stoliczkai</i>	Asteraceae
649. <i>W. tomentosa</i>	Asteraceae
650. <i>Wulfenia amherstiana</i>	Scrophulariaceae
651. <i>Youngia glauca</i>	Asteraceae
652. <i>Y. tenuifolia</i>	Asteraceae
653. <i>Zannichellia palustris</i>	Zannichelliaceae

Agriculture and cultivation of economic plants:

Agriculture is practical even in these inhospitable areas. In spite of scanty rainfall, dry cold climate, limited agricultural land and meagre irrigation facilities, the people are predominantly farmers. Mostly terrace-cultivation is practised and cultivation is carried out up to the height of about 3500 m. Cultivation usually commences from middle of April or May and the crops are harvested during September.

Wheat, barley, huskless barley (Grim or Grisham), buckwheat (*Fagopyrum* spp.), rye (*Secale cereale*), and millets (*Panicum miliaceum*, *Setaria italica*) are the main cereal crops. Among the pulse crops, *Lathyrus aphaca*, *L. sativus*, *Lens culineris*, *Vicia faba* and beans are commonly grown. The principal vegetable crops include peas, cabbage, cauliflower,

carrot, lettuce, radish, turnip, beans, onion, garlic, tomato, beat etc. Potato is an important cash crop. Mustard is grown for oil. Tobacco and maize are also grown to some extent in Lahul valley. For fodder purposes *Medicago falcata*, *M. sativa* are commonly cultivated. Some naturally growing plants like *Melilotus officinalis*, *M. alba*, *M. indica*, *Astragalus densiflorus* etc. are also encouraged in the fields along with *Medicago* spp. The common fruit trees are apple, apricot, pear and plum. *Humulus lupulus* (hop), *Inula racemosa* (manu kuth) and *Saussurea lappa* (kuth) are grown in extensive areas in Lahul valley as very important economic medicinal cash crops.

Under agro-forestry practices a number of woody shrubs and trees, both indigenous and exotic, have been introduced and planted along river banks, water channels, nallah beds, roads etc. These are of special significance to the local population as a source of fodder, fuel and timber. The important species are *Salix elegans*, *S. alba*, *S. daphnoides*, *S. sclerophylla*, *S. fragilis*, *Populus caspica*, *P. euphratica*, *P. candicans*, *P. nigra*, *P. ciliata*, *P. angustifolia*, *P. balsamifera*, *Robinia pseudoacacia*, *Juniperus* spp., *Tamarix gallica* and *Myricaria prostrata*.

Common economic plants of cold deserts :

Sarin (1967) and Kapahi & Sarin (1979) conducted a survey of economic plants in Lahul and discussed in detail about the economic uses of plants. Several species, commonly growing in the area, are used by local people for various purposes. Some such important species are enumerated below:

A. Cereals and millets

- | | |
|----------------------------|----------------------------------|
| 1. <i>Avena barbata</i> | 4. <i>E. nutans</i> |
| 2. <i>A. fatua</i> | 5. <i>Hordeum brevisubulatum</i> |
| 3. <i>Elymus dahuricus</i> | spp. <i>turkestanicum</i> |
| | 6. <i>Pennisetum orientale</i> |

B. Fruits

- | | |
|-------------------------------|----------------------------|
| 1. <i>Berberis petiolaris</i> | 2. <i>Capparis spinosa</i> |
|-------------------------------|----------------------------|

- | | |
|---------------------------------|----------------------------|
| 3. <i>Cotoneaster falconeri</i> | 9. <i>Ribes alpestre</i> |
| 4. <i>Elaeagnus hortensis</i> | 10. <i>R. himalense</i> |
| 5. <i>Ephedra gerardiana</i> | 11. <i>R. nigrum</i> |
| 6. <i>Fragaria vesca</i> | 12. <i>R. orientale</i> |
| 7. <i>Hippophae rhamnoides</i> | 13. <i>Rosa webbiana</i> |
| 8. <i>Malus baccata</i> | 14. <i>Rubus saxatilis</i> |

C. Vegetables and wild edibles

- | | |
|-------------------------------------|----------------------------------|
| 1. <i>Allium carolinianum</i> | 18. <i>Elsholtzia densa</i> |
| 2. <i>A. humile</i> | 19. <i>Eremurus himalaicus</i> |
| 3. <i>A. jacquemontii</i> | 20. <i>Ferula narthax</i> |
| 4. <i>A. stoliczki</i> | 21. <i>Heracleum lanatum</i> |
| 5. <i>A. tuberosum</i> | 22. <i>Lactuca dolichophylla</i> |
| 6. <i>A. victorialis</i> | 23. <i>Mentha longifolia</i> |
| 7. <i>Amaranthus cruentus</i> | 24. <i>Milula spicata</i> |
| 8. <i>Arenaria holosteoides</i> | 25. <i>Nepeta longibracteata</i> |
| 9. <i>Bunium cylindricum</i> | 26. <i>Oxyria digyna</i> |
| 10. <i>B. persicum</i> | 27. <i>Polygonum alpinum</i> |
| 11. <i>Carum carvi</i> | 28. <i>P. polystachyum</i> |
| 12. <i>Chaerophyllum acuminatum</i> | 29. <i>P. viviparum</i> |
| 13. <i>C. villosum</i> | 30. <i>Rheum palmatum</i> |
| 14. <i>Chenopodium album</i> | 31. <i>Rumex acetosa</i> |
| 15. <i>C. botrys</i> | 32. <i>R. nepalensis</i> |
| 16. <i>Cicer microphyllum</i> | 33. <i>Taraxacum officinale</i> |
| 17. <i>Cousinia thomsonii</i> | 34. <i>Tribulus terrestris</i> |

D. Fodder and fuel:

- | | |
|------------------------------------|--|
| 1. <i>Astragalus chlorostachys</i> | 9. <i>Fraxinus xanthoxyloides</i> |
| 2. <i>A. peduncularis</i> | 10. <i>Heracleum lanatum</i> |
| 3. <i>Caragana pygmaea</i> | 11. <i>Hippophae rhamnoides</i> spp.
<i>turkestanicum</i> |
| 4. <i>Cicer microphyllum</i> | 12. <i>H. salicifolia</i> |
| 5. <i>Cotoneaster obovatus</i> | 13. <i>Juniperus communis</i> |
| 6. <i>Crataegus songarica</i> | 14. <i>J. recurva</i> |
| 7. <i>Elaeagnus hortensis</i> | 15. <i>Medicago falcata</i> |
| 8. <i>Ephedra gerardiana</i> | |

- | | |
|----------------------------------|-----------------------------|
| 16. <i>Medicago sativa</i> | 30. <i>S. daphnoides</i> |
| 17. <i>Myricaria prostrata</i> | 31. <i>S. denticulata</i> |
| 18. <i>Polygonum alpinum</i> | 32. <i>S. elegans</i> |
| 19. <i>Populus angustifolius</i> | 33. <i>S. flagellaris</i> |
| 20. <i>P. balsamifera</i> | 34. <i>S. fragilis</i> |
| 21. <i>P. candicans</i> | 35. <i>S. karelinii</i> |
| 22. <i>P. caspica</i> | 36. <i>S. lindleyana</i> |
| 23. <i>P. ciliata</i> | 37. <i>S. oxycarpa</i> |
| 24. <i>P. euphratica</i> | 38. <i>S. pycnostachya</i> |
| 25. <i>P. nigra</i> | 39. <i>S. sclerophylla</i> |
| 26. <i>Prangos pabularia</i> | 40. <i>S. tetrasperma</i> |
| 27. <i>Prunus cornuta</i> | 41. <i>Tamarix gallica</i> |
| 28. <i>Salix acmophylla</i> | 42. <i>Trigonella emodi</i> |
| 29. <i>S. alba</i> | |

E. Timber and implements

- | | |
|-------------------------------|-------------------------------------|
| 1. <i>Betula utilis</i> | 5. <i>Populus ciliata</i> |
| 2. <i>Crataegus songarica</i> | 6. <i>Salix denticulata</i> |
| 3. <i>Juniperus recurva</i> | 7. <i>Rhododendron campanulatum</i> |
| 4. <i>Lonicera discolor</i> | |

F. Dye

- | | |
|---------------------------------|----------------------------------|
| 1. <i>Arnebia euchroma</i> | 4. <i>Geranium pratense</i> |
| 2. <i>Berberis pachyacantha</i> | 5. <i>Impatiens glanduligera</i> |
| 3. <i>Datisca canabina</i> | 6. <i>Onosma hispidum</i> |

G. Incense and perfumes

- | | |
|--------------------------------------|------------------------------------|
| 1. <i>Cassiope fastigiata</i> | 8. <i>Morina coulteriana</i> |
| 2. <i>Chrysanthemum pyrethroides</i> | 9. <i>Pinus wallichiana</i> |
| 3. <i>Delphinium brunonianum</i> | 10. <i>Rhododendron anthopogon</i> |
| 4. <i>Inula racemosa</i> | 11. <i>Saussurea lappa</i> |
| 5. <i>Juniperus communis</i> | 12. <i>Tanacetum himachalensis</i> |
| var. <i>saxatilis</i> | |
| 6. <i>Jurinella macrocephala</i> | 13. <i>Trigonella emodi</i> |
| 7. <i>Lonicera obovata</i> | 14. <i>Waldheimia glabra</i> |

H. Poisonous plants

- | | |
|--------------------------------|---------------------------------|
| 1. <i>Corydalis flabellata</i> | 3. <i>Morina persica</i> |
| 2. <i>Hyoscyamus niger</i> | 4. <i>Physochlaina praealta</i> |

I. Plants for improvement of soil substratum

- | | |
|---------------------------------|-----------------------------|
| 1. <i>Alopecurus himalaicus</i> | 5. <i>Festuca olgae</i> |
| 2. <i>Dactylis glomerata</i> | 6. <i>Panicum miliaceum</i> |
| 3. <i>Digitaria ischaemum</i> | 7. <i>Poa alpina</i> |
| 4. <i>Eremopoa persica</i> | |

J. Medicinal Plants

- | | |
|------------------------------------|--|
| 1. <i>Achillea millefolium</i> | 25. <i>Bunium persicum</i> |
| 2. <i>Aconitum chasmanthum</i> | 26. <i>Bupleurum marginatum</i> |
| 3. <i>A. heterophyllum</i> | 27. <i>Capparis spinosa</i> |
| 4. <i>A. violaceum</i> | 28. <i>Carum carvi</i> |
| 5. <i>Actaea acuminata</i> | 29. <i>Chaerophyllum villosum</i> |
| 6. <i>Allium humile</i> | 30. <i>Chesneya cuneata</i> |
| 7. <i>A. stracheyi</i> | 31. <i>Cicer microphyllum</i> |
| 8. <i>Arabis tibetica</i> | 32. <i>Cichorium intybus</i> |
| 9. <i>Arctium lappa</i> | 33. <i>Clematis orientalis</i> |
| 10. <i>Arenaria serpyllifolia</i> | 34. <i>Codonopsis ovata</i> |
| 11. <i>Arnebia benthamii</i> | 35. <i>Colchicum luteum</i> |
| 12. <i>A. euchroma</i> | 36. <i>Cotoneaster obovatus</i> |
| 13. <i>Artemisia dracunculus</i> | 37. <i>Dactylorhiza hatagirea</i> |
| 14. <i>A. maritima</i> | 38. <i>Datura stramonium</i> |
| 15. <i>A. parviflora</i> | 39. <i>Delphinium brunonianum</i> |
| 16. <i>A. sieversiana</i> | 40. <i>Dracocephalum heterophyllum</i> |
| 17. <i>Astragalus candolleanus</i> | 41. <i>Elaeagnus angustifolius</i> |
| 18. <i>A. munroi</i> | 42. <i>Ephedra gerardiana</i> |
| 19. <i>Axyris amaranthoides</i> | 43. <i>Fagopyrum tataricum</i> |
| 20. <i>Berberis jaeschkeana</i> | 44. <i>Ferula jaeschkeana</i> |
| 21. <i>B. pseudoumbellata</i> | 45. <i>Galium verum</i> |
| 22. <i>B. ulicina</i> | 46. <i>Gentiana kurroo</i> |
| 23. <i>Bergenia stracheyi</i> | 47. <i>G. tenella</i> |
| 24. <i>Betula utilis</i> | 48. <i>Geranium nepalense</i> |

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|--|----------------------------------|
| 49. <i>Heracleum canescens</i> | 82. <i>P. fruticosa</i> |
| 50. <i>H. lanatum</i> | 83. <i>Prangos pabularia</i> |
| 51. <i>H. thomsonii</i> | 84. <i>Prunella vulgaris</i> |
| 52. <i>Hippophae rhamnoides</i> | 85. <i>Rheum emodi</i> |
| 53. <i>Humulus lupulus</i> | 86. <i>R. moorcroftianum</i> |
| 54. <i>Hyoscyamus niger</i> | 87. <i>R. palmatum</i> |
| 55. <i>Inula racemosa</i> | 88. <i>R. spiciforme</i> |
| 56. <i>I. royleana</i> | 89. <i>R. webbianum</i> |
| 57. <i>Juniperus communis</i>
var. <i>saxatilis</i> | 90. <i>Rhodiola quadrifida</i> |
| 58. <i>J. recurva</i> | 91. <i>R. wallichiana</i> |
| 59. <i>Jurinella macropoda</i> | 92. <i>Saponeria vaccaria</i> |
| 60. <i>Lactuca scariola</i> | 93. <i>Saussurea albescens</i> |
| 61. <i>Lepidium capitatum</i> | 94. <i>S. bracteata</i> |
| 62. <i>L. latifolium</i> | 95. <i>S. lappa</i> |
| 63. <i>Leptorhabdos parviflora</i> | 96. <i>Scrophularia koelzii</i> |
| 64. <i>Lespedeza juncea</i> | 97. <i>Selinum vaginatum</i> |
| 65. <i>Lotus corniculatus</i>
var. <i>japonicus</i> | 98. <i>Senecio kunthianus</i> |
| 66. <i>Mecanopsis aculeata</i> | 99. <i>Swertia chirata</i> |
| 67. <i>Mentha arvensis</i> | 100. <i>S. cordata</i> |
| 68. <i>Morina coulteriana</i> | 101. <i>Tamarix gallica</i> |
| 69. <i>Myricaria germanica</i> | 102. <i>Tanacetum falconeri</i> |
| 70. <i>Nepeta eriostachya</i> | 103. <i>T. himachalensis</i> |
| 71. <i>Onosma hispidum</i> | 104. <i>Taraxacum officinale</i> |
| 72. <i>Pedicularis hookeriana</i> | 105. <i>Thalictrum foetidum</i> |
| 73. <i>Peganum harmala</i> | 106. <i>Thermopsis barbata</i> |
| 74. <i>Physochlaina praealta</i> | 107. <i>Thymus linearis</i> |
| 75. <i>Picrorhiza kurrooa</i> | 108. <i>Tribulus terrestris</i> |
| 76. <i>Plantago major</i> | 109. <i>Trigonella emodi</i> |
| 77. <i>Podophyllum hexandrum</i> | 110. <i>Trillium govanianum</i> |
| 78. <i>Polygonatum cirrhifolium</i> | 111. <i>Valeriana hardwickii</i> |
| 79. <i>Polygonum amphibium</i> | 112. <i>V. jatamansi</i> |
| 80. <i>P. amplexicaule</i> | 113. <i>Viola biflora</i> |
| 81. <i>Potentilla anserina</i> | 114. <i>Waldheimia glabra</i> |
| | 115. <i>W. tomentosa</i> |

Wild relatives of cultivated plant species :

The wild relatives of crop plants together with related species constitute gene pools which are a rich source of many important and desirable traits. The 'Hindustani Centre of Diversity' (Zeven & Zhukovsky, 1975) is known for its genetic wealth of about 152 species of cultivated plants. Western Himalaya as a whole contains rich genetic diversity of Triticeae and Rosaceous taxa (Arora, Mehra & Nayar, 1983).

Some important wild relatives of cultivated species include *Hordeum murinum*, *H. aegiceras*, *H. brevisubulatum* ssp. *turkestanicum*, *Elymus dahuricus*, *E. dasystachys*, *Pennisetum orientale*, *Secale cereale*, *Cicer microphyllum*, *Lepidium capitatum*, *L. ruderale*, *Lathyrus luteus*, *Allium jacquemontii*, *A. oreoprasum*, *A. tuberosum*, *A. humile*, *A. atrosanguineum*, *A. auriculatum*, *A. carolinianum*, *A. stoliczki* and species of *Prunus*, *Pyrus*, *Ribes*, *Rubus* etc.

Several species, having germ-plasm potential are found in cold arid regions. Many such wild relatives of present day cultivated species can be studied and experimented with for improving our cultivated species with regard to high yield and cold resistance. *Allium* spp. have got germ-plasm value in the field of species and condiments. *Cicer microphyllum* is related to the cultivated grain (*Cicer arietinum*). Leaves of wild *Potentilla fruticosa* are used as a substitute for tea. Species of *Lathyrus*, *Vicia*, *Agrostis*, *Bromus*, *Calamagrostis*, *Panicum*, *Triticum*, *Hordeum* etc. should be studied for their genetic behaviour and germ-plasm value. Plant breeding and crop improvement programme are needs of the hour.

SURVIVAL STRATEGIES OF COLD DESERT PLANTS : SPECIAL FEATURES OF BIODIVERSITY

The plants of cold deserts exhibit a number of ecological, morphological and physiological adaptations which help them to counteract the impact of harsh climate prevailing in these regions. These plants are capable of establishing themselves in cold arid regions as far as there is dry soil or substratum available to provide them anchorage and also remains free from ice or snow just for few

weeks in a year. Some peculiar adaptation techniques of these plants are discussed below.

Habit :

(i) *Cushion-forming habit :*

Cushion, clump or mat-forming habit is very common in cold desert plants. Such plants are perennial, short and sturdy with woody stem and deep root system capable of penetrating rock crevices and fissures to provide firm anchorage and nutrition to the plant. The heavily lignified stem gives out numerous short, creeping branches just above the ground level which get repeatedly branched and densely packed with leaves and flowers forming dense hemispheric cushion habit. Such a habit protects from the strong wind action and its drying effects, strong thermal radiations, loss of water through transpiration, in maintaining the balance of temperature fluctuations between air and soil and from the continuous pressure of snow layer which may be several feet thick for months together e.g. *Acantholimon lycopodioides*, *Thylacospermum caespitosum*, *Arenaria bryophylla*, and species of *Astragalus*, *Androsace*, *Draba Paraquilegia*, *Sedum*, *Saxifraga* etc. The large tap root system and their high carbohydrate reserves enable these plants to survive year after year. *Astragalus oplites*, *A. webbianus* and *Caragana versicolor* form variously shaped spiny cushion on the rocky ground. Species of *Arenaria*, *Artemisia*, *Astragalus*, *Oxytropis*, *Stellaria*, *Urtica*, etc. form rigid mat on the substratum.

(ii) *Diminutive or miniature habit :*

Although the cold desert plants are generally dwarf and stunted, some of them are so significantly reduced, that one may not even notice them in fields. Species like *Pleurogyne brachyanthera*, *Gentiana thomsonii*, *G. aquatica* and *Taraxacum bicolor* are often barely 1-2 cm tall with a solitary flower. In contrast to the aerial portion the underground tap root may be as long as 30 cm. *Ranunculus tricuspis*, *R. similis*, *R. involucratus*, *Anemone imbricata*, *Corydalis boweri*, *Arenaria littedalei*, *Lancea tibetica*, *Saxifraga parva*, *Sedum przewalskii* are some other small sized species. The genus *Saussurea* may be cited as an example of diminutive plants of cold desert. Several species of the

genus range from hardly 2 cm to 10 cm in height. In case of *Astragalus heydei*, *Corydalis crassissima*, *Hedinia tibetica*, *Cochlearia scapiflora*, *Brya sinensis*, *Thermopsis inflata*, *Microula tibetica* and *Dracocephalum heterophyllum*, the plants develop deep penetrating permanent root-stocks from which annual branches are produced down among the rocks or stones and they bear leaves and flowers in clusters just above the stones or rocks.

(iii) *Bushy habit* :

The number of woody tall plants in cold arid region is exceedingly low. Whatever woody elements occur are in the form of bushes only and not growing taller than 30-160 cm. *Caragana pygmaea*, *Ephedra gerardiana*, *Hippophae rhamnoides*, *Myricaria prostrata* and *Lonicera hispida* form dense bushy habit with woody branches barely attaining 30-150 cm.

(iv) *Protective covering of hairs* :

These hairs are very dense and form a felt like coating on the entire surface of the exposed plant and acts as a thermal blanket. Apart from providing thermal security these hairs impart a silver-grey or white appearance to the plant which helps in reflecting the solar radiations reducing thereby the harsh impact of sun's rays. *Astragalus munroi*, *Saussurea gossypiphora*, *S. gnaphalodes* and *Sorosseris glomerata* are such plants in which there is profuse wool coating on the vegetative and floral parts.

Reproductive strategies :

The ecological conditions to which the plants of cold-deserts are exposed would have threatened their existence but for their very short life cycle. The cold desert plants have to complete the entire reproductive cycle right from the opening of buds to sprouting the leaves and flowers, fruiting and even dispersal of seeds. Thus reproduction and dispersal among the plants inhabiting the cold deserts is an important aspect which maintains the population of this scanty vegetation under the existing adverse conditions. The reproduction is accomplished both by seed formation and by the vegetative propagation. Obviously in a region where carbohydrates, the basic source of energy is a limiting factor vegetative

reproduction is very common. It is reported that those species which reproduce by seeds take several years longer to reach the seed producing stage than the same species growing in hotter climate. Some of the cold desert plants are annual or monocarpic i.e. producing the fruits and seeds only once. *Hypocoum leptocarpum*, *Pleurogyne brachyanthera*, *Gentiana tenella*, *G. aquatica*, *G. humilis*, *Salsola collina*, *S. kali*, *Halogeton glomeratus*, etc. belong to this category. Some perennial species are also monocarpic but survive only for 2-3 seasons. They have large tap-roots full of stored food material collected in the first season for flowering and fruiting in the next year. Cold climate is not favourable for sexual reproduction due to very low temperatures, short growing season and poor nutrient availability. In order to make sexual reproduction process easy and effective, these plants therefore have evolved certain physiological adaptations which help them during the various stages of reproduction like, development and formation of ovule, pollen, attracting the pollinating agents etc. for successful pollination and seed formation.

The green leaves of plants make use of sunlight for producing carbohydrates etc. through the process of photosynthesis. At the same time the flowers use this energy for heating purposes which accelerates the growth of pollen and seeds. Some of the flowers also have ultra-violet patterns which attract the pollinators. The bowl or saucer shaped flowers of *Anemone*, *Ranunculus*, *Saxifraga* and many other is usually heliotropic and have highly reflective inner surface of petals; in the central region of these flowers lie carpels and many stamens. This shape acts as small dish antenna focussing the reflected light and heat on the centre of the flower where stamens and carpels effectively retain the heat gained through such radiations. This energy accumulation by flowers helps in pollination. It has also been reported that the visiting insects on a flower for nector feeding also absorb and accumulate heat from flowers and through this process these insects develop temperature as high as 30-32 degrees in excess of the atmospheric temperature. Thus, the heat so acquired enhances their metabolic activities including reproduction and obviously insects seek out the warm flowers in cold desert areas. On the other hand plants could conserve energy by accomplishing pollination at the same time providing less food in the form of nector. In this way a sort of symbiotic relationship is formed between the insect and plants in cold desert area.

Flower colour also plays an important role in the process of sexual reproduction as brilliantly coloured flowers can attract insects for pollination. Most of the cold desert plants like *Delphinium*, *Aconitum*, *Meconopsis*, *Corydalis*, *Geranium*, *Astragalus*, *Oxytropis*, *Potentilla*, *Saxifraga*, *Primula*, *Taraxacum*, *Gentiana* etc., produce bright, sparkling flowers of red, yellow, blue, violet or purple. These plants spend much of their energy to produce large, attractive flowers, no matter how big the plant is. Gentians, saxifragas, campanulas, anemones, primulas, *Crocus*, *Soldanella* etc. have large flowers as compared to the size of the plant.

The great intensity of colours exhibited by the alpine species is due to the luminous climate which facilitates the assimilation of sugars and the cool nights which inhibit the transformation of sugars into starch. Thus overproduction of sugars results in the active synthesis of pigments which in turn causes even the stalks and leaves to exhibit colours. Further, the richness of the cellulose in the sugars renders the tissues more resistant to the action of frost, and the excess of carbohydrates are utilised in the speedy development of underground organs resulting in the stiff anchorage of plants. Thus even the small plant has deep and spreading root-system (Dhar & Kachroo, 1983).

Seed production is also quite enormous in cold desert species to overcome the perennial drought, heavy snowfall, eroding slopes with shifting sands and stones, and over grazing. Only a few seeds ultimately succeed in establishing. Therefore most of the species have switched over to vegetative reproduction through bulbs, bulbils, runners, stolons, offsets, and through production of the branches from rootstocks.

Temperature also induces certain physiological specialization in cold desert plants. The plants of cold arid regions are able to survive in very low temperatures as they have a higher rate of metabolic activity at low temperature. But at the same time this ability has a great disadvantage to them because the metabolic activity increases with the rise in temperature which leads to the depletion of hardly produced carbohydrates or the so called energy at a very fast rate. This rapid utilization rate of carbohydrate reserves due to higher respiration rate in warm climates has been reported to be limiting factor in the extension of the cold desert species to warmer regions.

These plants are capable of storing the products of photosynthesis-carbohydrates in their underground organs. The extensive root system of these plants stores considerable amount of carbohydrate reserves to survive during the unfavourable period.

Resistance to injuries caused by freezing temperature is a characteristic feature of cold desert plants. The low temperature and short photoperiods are two main climatic factors responsible to induce frost hardiness among these plants. The freezing injury is mainly caused by the formation of ice crystals within the cell and less frequently by dehydration of tissues by extracellular ice crystal formation. Therefore, the freezing resistance may be either in the form of inhibition or reduction in the ice crystal formation or a sort of increased resistance of the protoplasm against in the deformation caused by the formation of ice crystals.

The starch grains are accumulated in the chloroplasts by the process of photosynthesis during day time and as night falls, this starch is converted into sugar or often they even produce soluble sugars directly through photosynthesis instead of starch. This sugar remains in the plant-cells and increases the concentration of the cell sap. This increased cell sap concentration lowers the freezing point by several degrees. This is how the cold desert plants survive temperatures as low as -15 to -20°C .

Introduced Phytodiversity :

Man has always tried to modify the surrounding ecosystem to satisfy his needs and in this process an introduced biodiversity has resulted. Often the changes were advertant but those also brought about inadvertant changes in the ecosystem. The extreme conditions of climate and soil has given rise to a very peculiar ecosystem with a peculiar type of vegetation cover in the cold desert areas of our country. To meet their needs for food, fodder, fuel, timber, vegetables, herbal medicines, etc. local people have introduced several plant-species, thereby bringing a remarkable diversity in the floristic components of this area.

Recently a cold tolerent and fast growing European *Populus* has been introduced to meet the increased demand of fuel and fodder. For fodder a

perennial grass called 'Yarkandi' has also been introduced in the area on experimental basis. In cold desert areas, only bushy growths like *Myricaria elegans*, *M. prostrata*, *Caragana pygmaea*, *Juniperus macropoda*, *Rosa webbiana*, *Hippophae rhamnoides*, and species of *Tamarix*, *Astragalus* etc. are found and there are no tree species, occurring naturally in the area. There is an acute shortage of fuel and fodder during long winter months.

Along river courses, in marshy depressions and near habitations several species have been introduced. These are of special significance to the local populations as a source of fuel, fodder, food, timber, etc. These have affected to a great extent the economic scenario of the region. These species include *Salix alba*, *S. daphnoides*, *S. elegans*, *S. sclerophylla*, *S. fragilis*, *Populus alba*, *P. angustifolia*, *P. candicans*, *P. ciliata*, *P. euphratica*, *P. nigra*, *Tamarix gallica*, *Elaeagnus hortensis*, *Robbinia pseudoacacia*, *Juniperus* spp., *Morus alba*, *Juglans regia*, *Prunus dasycarpa*, *P. persica*, *P. armeniaca* and species of *Pyrus*. These planted trees stand to represent the so called forest in this region of cold desert.

Several species have been selected for improvement of soil substratum viz., *Digitaria ischaemum*, *Panicum miliaceum*, *Festuca sibirica*, *Poa alpina* and *Dactylis glomerata*. Thus we find that these introduced species have also contributed to this unique biodiversity.

Phytogeographical affinities :

The cold deserts of Trans-Himalayan zone belong to a larger phytogeographic zone, comprising Tibetan Plateau and Central Asia including Siberia. The flora shows affinity with the flora of Middle and Northern Asia, north temperate and arctic Eurasia, Chinese mountains, Tibet Plateau and the Mediterranean regions. Dhar & Kachroo (1983) and Kachroo, Sapru & Dhar (1977) have discussed in detail about the phytogeographical affinities of Ladakh flora with other neighbouring countries. Stewart (1916) records as many as 140 species common to Ladakh and Eastern U.S.A. but a species belonging to *Allardia* and *Saussurea* are not represented in the flora of Eastern U.S.A. There are no native species of *Dianthus*

or *Nepeta* in Eastern U.S.A. The genera such as *Tanacetum*, *Artemisia*, *Astragalus*, *Oxytropis* etc. which are more numerous in Ladakh than in Eastern U.S.A. are genera which are common in Central Asia.

The floristic survey and analysis of species collected from the region reveal that the flora contains, apart from indigenous elements, also species which are cosmopolitan or are common with adjoining and far off countries. However the desert flora is most closely related to the Tibetan and Turkish floristic elements. The cosmopolitan elements are represented by *Capsella bursa-pastoris*, *Chenopodium album*, *Ergrostis minor*, *Erigeron canadensis*, *Juncus bufonius*, *Lotus corniculatus*, *Medicago sativa*, *Phleum alpinum*, *Pisum sativum*, *Poa annua*, *Polygonum aviculare*, *Solanum nigrum*, *Sonchus oleraceus*, *Stellaria media*, *Taraxacum officinale*, *Thlaspi arvense*, *Trifolium pratense*, *T. repens*, *Verbascum thaspus* etc.

The boreo-alpine elements of northern arctic Europe and Southern European mountains find their extreme eastern range of distribution in the west Himalaya. Species of *Aconitum*, *Actaea*, *Agrostis*, *Anemone*, *Aquilegia*, *Arabis*, *Aster*, *Arena*, *Brachypodium*, *Bromus*, *Caltha*, *Draba*, *Epilobium*, *Festuca*, *Gentiana*, *Oxyria*, *Pedicularis*, *Poa*, *Polygonum*, *Potentilla*, *Primula*, *Ranunculus*, *Saxifraga*, *Sedum*, *Silene*, *Sisymbrium*, *Stellaria*, *Thalictrum*, *Thlaspi* etc. represent such elements.

A few species, which are widely distributed in the Alps, Central Europe, extending eastwards to the Caucasus, the Hindukush and Pamirs, find their way to Himalayas, extending further to Tien Shan, the Altai mountains. These are Euro-Siberian elements. These species belong to *Adonis*, *Allium*, *Alyssum*, *Androsace*, *Bupleurum*, *Calamagrostis*, *Crepis*, *Elymus*, *Eurotia*, *Gagea*, *Geranium*, *Geum*, *Hieracium*, *Inula*, *Koeleria*, *Leontopodium*, *Lloydia*, *Lonicera*, *Oxytropis*, *Pimpinella*, *Polygonatum*, *Scrophularia*, *Stipa*, *Trollius* etc. The Mediterranean genera, which are widely distributed in Southern Europe, North Africa, Western Asia, find their extension eastwards to Turkestan, Afghanistan, Western Himalaya and Alai mountains. In Indian cold deserts these species belong to the genera like *Arctium*, *Arenaria*, *Arnebia*, *Artemisia*, *Barbarea*, *Capsella*,

Carduus, Delphinium, Echinops, Heracleum, Kochia, Myosotis, Myricaria, Nepeta, Onosma, Origanum, Polypogon, Rochellia, Scabiosa, Senecio, Thymus, Trifolium etc.

A few genera like *Astragalus, Caragana, Carex, Chorispora, Cousinia, Eremurus, Kobresia, Lagotis, Saussurea, Tanacetum, Taraxacum, Thermopsis, Thylacospermum, Waldheimia* etc. are distributed in comparatively smaller area from Siberia to Mongolia, the Altai mountains, central Tien Shan, the Alai Pamirs and the West Himalaya including Ladakh and Lahul Spiti.

Table 12 to 18 give an idea of species occurring in cold desert, which are common to different geographical regions.

Table 12: Species common with Tibet

Sl. No.	Name of species	Family
1.	<i>Aconitum rotundifolium</i>	Ranunculaceae
2.	<i>A. violaceum</i>	Ranunculaceae
3.	<i>Anaphalis virgata</i>	Asteraceae
4.	<i>Anemone rupicola</i>	Ranunculaceae
5.	<i>Aphragmus oxycarpus</i>	Brassicaceae
6.	<i>Aquilegia moorcroftiana</i>	Ranunculaceae
7.	<i>A. pubiflora</i>	Ranunculaceae
8.	<i>Arabidopsis taraxacifolia</i>	Brassicaceae
9.	<i>A. thaliana</i>	Brassicaceae
10.	<i>Arabis tibetica</i>	Brassicaceae
11.	<i>Arenaria festucoides</i>	Caryophyllaceae
12.	<i>Arnebia guttata</i>	Boraginaceae
13.	<i>Artemisia macrocephala</i>	Asteraceae
14.	<i>A. maritima</i>	Asteraceae
15.	<i>Astragalus confertus</i>	Fabaceae
16.	<i>A. gracilipes</i>	Fabaceae
17.	<i>A. oxyodon</i>	Fabaceae
18.	<i>A. tribulifolius</i>	Fabaceae

19.	<i>A. zanskarensis</i>	Fabaceae
20.	<i>Atriplex crassifolia</i>	Chenopodiaceae
21.	<i>Barbarea vulgaris</i>	Brassicaceae
22.	<i>Braya thomsonii</i>	Brassicaceae
23.	<i>Caragana gerardiana</i>	Fabaceae
24.	<i>Carex borii</i>	Cyperaceae
25.	<i>C. nivalis</i>	Cyperaceae
26.	<i>C. pamirensis</i>	Cyperaceae
27.	<i>Carum carvi</i>	Apiaceae
28.	<i>Christolea crassifolia</i>	Brassicaceae
29.	<i>Chrysanthemum tibeticum</i>	Asteraceae
30.	<i>Corydalis crassifolia</i>	Fumariaceae
31.	<i>Crepis multicaulis</i>	Asteraceae
32.	<i>Delphinium brunonianum</i>	Ranunculaceae
33.	<i>Draba altaica</i>	Brassicaceae
34.	<i>D. stenocarpa</i>	Brassicaceae
35.	<i>Elsholtzia densa</i>	Lamiaceae
36.	<i>Elymus dahuricus</i>	Poaceae
37.	<i>Eritrichium spathulatum</i>	Boraginaceae
38.	<i>Festuca olgae</i>	Poaceae
39.	<i>F. tibetica</i>	Poaceae
40.	<i>Hippuris vulgaris</i>	Hippuridaceae
41.	<i>Lindelofia anchusoides</i>	Boraginaceae
42.	<i>Minuartia biflora</i>	Caryophyllaceae
43.	<i>Nepeta tibetica</i>	Lamiaceae
44.	<i>Onosma hispidum</i>	Boraginaceae
45.	<i>Oxytropis lapponica</i>	Fabaceae
46.	<i>O. microphylla</i>	Fabaceae
47.	<i>O. tatarica</i>	Fabaceae
48.	<i>Parnasia laxmanni</i>	Saxifragaceae
49.	<i>Poa pratensis</i>	Poaceae
50.	<i>P. tibetica</i>	Poaceae
51.	<i>Polygonum sibiricum</i>	Polygonaceae
52.	<i>Potentilla multifida</i>	Rosaceae
53.	<i>Primula elliptica</i>	Primulaceae
54.	<i>Rhodiola tibetica</i>	Crassulaceae
55.	<i>Rubia tibetica</i>	Rubiaceae
56.	<i>Sagina saginoides</i>	Caryophyllaceae

57.	<i>Silene gonosperma</i>	Caryophyllaceae
58.	<i>Stachys tibetica</i>	Lamiaceae
59.	<i>Stipa jacquemontii</i>	Poaceae
60.	<i>Tanacetum tibeticum</i>	Asteraceae
61.	<i>Thylacospermum caespitosum</i>	Caryophyllaceae
62.	<i>Waldheimia stoliczkai</i>	Asteraceae

Table 13: Species common with Afghanistan

Sl. No.	Name of species	Family
1.	<i>Actaea acuminata</i>	Ranunculaceae
2.	<i>Anaphalis contorta</i>	Asteraceae
3.	<i>A. virgata</i>	Asteraceae
4.	<i>Androsace rotundifolia</i>	Primulaceae
5.	<i>Arabidopsis thaliana</i>	Brassicaceae
6.	<i>Artemisia gmelinii</i>	Asteraceae
7.	<i>Aster flaccidus</i>	Asteraceae
8.	<i>Astragalus coluteocarpus</i>	Fabaceae
9.	<i>A. rhizanthus</i>	Fabaceae
10.	<i>Barbarea vulgaris</i>	Brassicaceae
11.	<i>Bergenia stracheyi</i>	Saxifragaceae
12.	<i>Brachyactis roylei</i>	Asteraceae
13.	<i>Brassica nigra</i>	Brassicaceae
14.	<i>Campanula aristata</i>	Campanulaceae
15.	<i>Carex oliveri</i>	Cyperaceae
16.	<i>C. pamirensis</i>	Cyperaceae
17.	<i>C. songorica</i>	Cyperaceae
18.	<i>C. vulpinaris</i>	Cyperaceae
19.	<i>Carum carvi</i>	Apiaceae
20.	<i>Chorispora sabulosa</i>	Brassicaceae
21.	<i>Clematis orientalis</i>	Ranunculaceae
22.	<i>Codonopsis ovata</i>	Campanulaceae
23.	<i>Cousinia thomsonii</i>	Asteraceae
24.	<i>Dianthus anatolicus</i>	Caryophyllaceae
25.	<i>Dipsacus mitis</i>	Dipsacaceae

26.	<i>Draba oreades</i>	Brassicaceae
27.	<i>D. stenocarpa</i>	Brassicaceae
28.	<i>Echinops cornigerus</i>	Asteraceae
29.	<i>Erigeron multiradiatus</i>	Asteraceae
30.	<i>Eritrichium canum</i>	Boraginaceae
31.	<i>E. spathulatum</i> var. <i>thomsoni</i>	Boraginaceae
32.	<i>Ferula jaeschkeana</i>	Apiaceae
33.	<i>Galium aparine</i>	Rubiaceae
34.	<i>G. asperifolium</i>	Rubiaceae
35.	<i>G. verum</i>	Rubiaceae
36.	<i>Geranium collinum</i>	Geraniaceae
37.	<i>Gnaphalium luteo-album</i>	Asteraceae
38.	<i>Indigofera heterantha</i>	Fabaceae
39.	<i>Iris ensata</i>	Iridaceae
40.	<i>Kobresia laxa</i>	Cyperaceae
41.	<i>Koelpinia linearis</i>	Asteraceae
42.	<i>Lactuca brunoniana</i>	Asteraceae
43.	<i>L. decipiens</i>	Asteraceae
44.	<i>L. macrorhiza</i>	Asteraceae
45.	<i>Lappula barbata</i>	Boraginaceae
46.	<i>L. microcarpa</i>	Boraginaceae
47.	<i>Lepidium ruderales</i>	Brassicaceae
48.	<i>Ligusticum thomsonii</i>	Apiaceae
49.	<i>Lonicera asperifolia</i>	Caprifoliaceae
50.	<i>L. heterophylla</i>	Caprifoliaceae
51.	<i>L. seminovii</i>	Caprifoliaceae
52.	<i>Melilotus officinalis</i>	Fabaceae
53.	<i>Nepeta floccosa</i>	Lamiaceae
54.	<i>N. glutinosa</i>	Lamiaceae
55.	<i>Paraquilegia anemonoides</i>	Ranunculaceae
56.	<i>Pedicularis bicornuta</i>	Scrophulariaceae
57.	<i>Potentilla atrisanguinea</i>	Rosaceae
58.	<i>P. multifida</i>	Rosaceae
59.	<i>P. sericea</i>	Rosaceae
60.	<i>Prangos pabularia</i>	Apiaceae
61.	<i>Rosa eglanteria</i>	Rosaceae
62.	<i>R. webbiana</i>	Rosaceae
63.	<i>Scrophularia dentata</i>	Scrophulariaceae

64.	<i>Senecio krascheninnikovii</i>	Asteraceae
65.	<i>Sibbaldia parviflora</i>	Rosaceae
66.	<i>Silene vulgaris</i>	Caryophyllaceae
67.	<i>Sisymbrium brassiciforme</i>	Brassicaceae
68.	<i>S. loeselii</i>	Brassicaceae
69.	<i>Stellaria palustris</i>	Caryophyllaceae
70.	<i>Swertia petiolata</i>	Gentianaceae
71.	<i>Tragopogon gracilis</i>	Asteraceae
72.	<i>Trigonella corniculata</i>	Fabaceae
73.	<i>T. emodi</i>	Fabaceae
74.	<i>Turritis glabra</i>	Brassicaceae
75.	<i>Valeriana hardwickii</i>	Valerianaceae
76.	<i>V. himalayana</i>	Valerianaceae
77.	<i>Veronica perpusilla</i>	Scrophulariaceae
78.	<i>Viburnum cotinifolium</i>	Caprifoliaceae

Table 14: Species common with Turkestan

Sl. No.	Name of species	Family
1.	<i>Arenaria serpyllifolia</i>	Caryophyllaceae
2.	<i>Artemisia laciniata</i>	Asteraceae
3.	<i>Chenopodium album</i>	Chenopodiaceae
4.	<i>C. botrys</i>	Chenopodiaceae
5.	<i>C. hybridum</i>	Chenopodiaceae
6.	<i>Dianthus anatolicus</i>	Caryophyllaceae
7.	<i>Gagea kunawarensis</i>	Liliaceae
8.	<i>Geranium collinum</i>	Geraniaceae
9.	<i>G. pratense</i>	Geraniaceae
10.	<i>Lomatogonium carinthiacum</i>	Gentianaceae
11.	<i>Melilotus alba</i>	Fabaceae
12.	<i>M. officinalis</i>	Fabaceae
13.	<i>Sagina saginoides</i>	Caryophyllaceae
14.	<i>Trifolium pratense</i>	Fabaceae
15.	<i>Vaccaria pyramidata</i>	Caryophyllaceae

Table 15: Species common with China

Sl. No.	Name of species	Family
1.	<i>Aletris pauciflora</i>	Liliaceae
2.	<i>Anaphalis busua</i>	Asteraceae
3.	<i>A. contorta</i>	Asteraceae
4.	<i>A. nepalensis</i>	Asteraceae
5.	<i>Androsace mucronifolia</i>	Caryophyllaceae
6.	<i>Anemone rivularis</i>	Ranunculaceae
7.	<i>A. rupicola</i>	Ranunculaceae
8.	<i>Aphragmus oxycarpus</i>	oxycarpus Brassicaceae
9.	<i>Arabidopsis mollisima</i>	Brassicaceae
10.	<i>Arabis glandulosa</i>	Brassicaceae
11.	<i>Artemisia sieversiana</i>	Asteraceae
12.	<i>Bromus pectinatus</i>	Poaceae
13.	<i>Caragana versicolor</i>	Fabaceae
14.	<i>Cardamine macrophylla</i>	Brassicaceae
15.	<i>Chaerophyllum reflexum</i>	Apiaceae
16.	<i>Corydalis flabellata</i>	Fumariaceae
17.	<i>C. meifolia</i>	Fumariaceae
18.	<i>Cotoneaster duthieanus</i>	Rosaceae
19.	<i>Elymus nutans</i>	Poaceae
20.	<i>Galium tibeticum</i>	Rubiaceae
21.	<i>Gentiana argentea</i>	Gentianaceae
22.	<i>G. leucomelaena</i>	Gentianaceae
23.	<i>G. marginata</i>	Gentianaceae
24.	<i>G. prostrata</i>	Gentianaceae
25.	<i>G. tianshanica</i>	Gentianaceae
26.	<i>Heracleum lanatum</i>	Apiaceae
27.	<i>Iris decora</i>	Iridaceae
28.	<i>Kengia mutica</i>	Poaceae
29.	<i>Kobresia capillifolia</i>	Cyperaceae
30.	<i>Lactuca dissecta</i>	Asteraceae
31.	<i>L. dolichophylla</i>	Asteraceae
32.	<i>Lepidium apetalum</i>	Brassicaceae
33.	<i>Meconopsis aculeata</i>	Papaveraceae

34.	<i>Lonicera asperifolia</i>	Caprifoliaceae
35.	<i>L. hispida</i> var. <i>bracteata</i>	Caprifoliaceae
36.	<i>L. webbiana</i>	Caprifoliaceae
37.	<i>Podophyllum hexandrum</i>	Podophyllaceae
38.	<i>Potentilla bifurca</i>	Rosaceae
39.	<i>P. cuneata</i>	Rosaceae
40.	<i>P. salessoviana</i>	Rosaceae
41.	<i>Primula denticulata</i>	Primulaceae
42.	<i>P. munroi</i>	Primulaceae
43.	<i>P. obtusifolia</i>	Primulaceae
44.	<i>Ranunculus laetus</i>	Ranunculaceae
45.	<i>Ribes alpestre</i>	Grossulariaceae
46.	<i>Sedum oreades</i>	Crassulaceae
47.	<i>Senecio krascheninnikovii</i>	Asteraceae
48.	<i>Viola biflora</i>	Violaceae

Table 16: Species common with Siberia

Sl. No.	Name of species	Family
1.	<i>Arabidopsis himalaica</i>	Brassicaceae
3.	<i>A. mollissima</i>	Brassicaceae
4.	<i>Artemisia dracunculus</i>	Asteraceae
5.	<i>A. maritima</i>	Asteraceae
6.	<i>A. salsoloides</i>	Asteraceae
7.	<i>Aster flaccidus</i>	Asteraceae
8.	<i>Astragalus densiflorus</i>	Fabaceae
9.	<i>A. nivalis</i>	Fabaceae
10.	<i>A. subuliformis</i>	Fabaceae
11.	<i>Bromus oxyodon</i>	Poaceae
12.	<i>Calamagrostis pseudophragmites</i>	Poaceae
13.	<i>Chenopodium foliosum</i>	Chenopodiaceae
14.	<i>Erodium stephanianum</i>	Geraniaceae
15.	<i>Erysimum hieracifolium</i>	Brassicaceae
16.	<i>Festuca valesiaca</i>	Poaceae
17.	<i>Gentiana aquatica</i>	Gentianaceae

18.	<i>Geranium collimlm</i>	Geraniaceae
19.	<i>Halerpestis sarmentosa</i>	Ranunculaceae
20.	<i>Lactuca scariola</i>	Asteraceae
21.	<i>Lomatogonium carinthiacum</i>	Gentianaceae
22.	<i>Medicago lupulina</i>	Fabaceae
23.	<i>Oxytropis lapponica</i>	Fabaceae
24.	<i>Paraquilegia anemonoides</i>	Ranunculaceae
25.	<i>P. microphylla</i>	Ranunculaceae
26.	<i>Polygonum islandicum</i>	Polygonaceae
27.	<i>P. viviparum</i>	Polygonaceae
28.	<i>Potentilla biflora</i>	Rosaceae
29.	<i>P. multifida</i>	Rosaceae
30.	<i>Ranunculus pulchellus</i>	Ranunculaceae
31.	<i>Rhodiola quadrifida</i>	Crassulaceae
32.	<i>Rosa eglentaria</i>	Rosaceae
33.	<i>Rubus saxatilis</i>	Rosaceae
34.	<i>Saxifraga sibirica</i>	Saxifragaceae
35.	<i>Stellaria uliginosa</i>	Caryophyllaceae
36.	<i>Stipa mongholica</i>	Poaceae
37.	<i>Torularia humilis</i>	Brassicaceae
38.	<i>Tussilago farfara</i>	Asteraceae

Table 17: Species common with Europe

Sl. No.	Name of species	Family
1.	<i>Adonis aestivalis</i>	Ranunculaceae
2.	<i>Arenaria serpyllifolia</i>	Caryophyllaceae
3.	<i>Artemisia maritima</i>	Asteraceae
4.	<i>Asperugo procumbens</i>	Boraginaceae
5.	<i>Bupleurum falcatum</i>	Apiaceae
6.	<i>Callitriche palustris</i>	Callitrichaceae
7.	<i>Campanula latifolia</i>	Campanulaceae
8.	<i>Cardamine impatiens</i>	Brassicaceae
9.	<i>Carduus edelbergii</i>	Asteraceae
10.	<i>Carex curta</i>	Cyperaceae

11.	<i>C. nigerrima</i>	Cyperaceae
12.	<i>Chenopodium glaucum</i>	Chenopodiaceae
13.	<i>Cuscuta europea</i>	Cuscutaceae
14.	<i>Eleocharis palustris</i>	Cyperaceae
15.	<i>Epilobium roseum</i>	Onagraceae
16.	<i>Galium boreale</i>	Rubiaceae
17.	<i>Geranium pratense</i>	Geraniaceae
18.	<i>Iris spuria</i>	Iridaceae
19.	<i>Juncus bufonius</i>	Juncaceae
20.	<i>Lamium amplexicaule</i>	Lamiaceae
21.	<i>Mentha longifolia</i>	Lamiaceae
22.	<i>Origanum vulgare</i>	Lamiaceae
23.	<i>Oxyria digyna</i>	Polygonaceae
24.	<i>Polygonum hydropiper</i>	Polygonaceae
25.	<i>P. viviparum</i>	Polygonaceae
26.	<i>Potentilla anserina</i>	Rosaceae
27.	<i>P. multifida</i>	Rosaceae
28.	<i>P. supina</i>	Rosaceae
29.	<i>Primula sibirica</i>	Primulaceae
30.	<i>Prunella vulgaris</i>	Lamiaceae
31.	<i>Ribes alpestre</i>	Grossulariaceae
32.	<i>Thalictrum alpinum</i>	Ranunculaceae
33.	<i>T. foetidum</i>	Ranunculaceae
34.	<i>Thlaspi arvense</i>	Brassicaceae

Table 18: Species common with Eastern U.S.A.

Sl. No.	Name of species	Family
1.	<i>Agrostis stolonifera</i>	Poaceae
2.	<i>A. vinealis</i>	Poaceae
3.	<i>Aquilegia fragrans</i>	Ranunculaceae
4.	<i>Arabidopsis thaliana</i>	Brassicaceae
5.	<i>Arenaria serpyllifolia</i>	Caryophyllaceae
6.	<i>Avena fatua</i>	Poaceae
7.	<i>Barbarea vulgaris</i>	Brassicaceae
8.	<i>Briza media</i>	Poaceae

9.	<i>Bromus japonicus</i>	Poaceae
10.	<i>B. tectorum</i>	Poaceae
11.	<i>Carduus edelbergii</i>	Asteraceae
12.	<i>Carex orbicularis</i>	Cyperaceae
13.	<i>C. stenophylla</i>	Cyperaceae
14.	<i>Carum carvi</i>	Apiaceae
15.	<i>Cerastium vulgatum</i>	Caryophyllaceae
16.	<i>Chenopodium album</i>	Chenopodiaceae
17.	<i>C. botrys</i>	Chenopodiaceae
18.	<i>C. glaucum</i>	Chenopodiaceae
19.	<i>C. hybridum</i>	Chenopodiaceae
20.	<i>Convolvulus arvensis</i>	Convolvulaceae
21.	<i>Cuscuta europea</i>	Cuscutaceae
22.	<i>Dactylis glomerata</i>	Poaceae
23.	<i>Deschampsia caespitosa</i>	Poaceae
24.	<i>Eleocharis palustris</i>	Cyperaceae
25.	<i>E. quinqueflora</i>	Cyperaceae
26.	<i>Elymus repens</i>	Poaceae
27.	<i>Epilobium angustifolium</i>	Onagraceae
28.	<i>Eragrostis minor</i>	Poaceae
29.	<i>Festuca rubra</i>	Poaceae
30.	<i>Galium aparine</i>	Rubiaceae
31.	<i>G. boreale</i>	Rubiaceae
32.	<i>G. verum</i>	Rubiaceae
33.	<i>Geranium pratense</i>	Geraniaceae
34.	<i>Hippuris vulgaris</i>	Hippuridaceae
35.	<i>Koeleria macrantha</i>	Poaceae
36.	<i>Lamium amplexicaule</i>	Lamiaceae
37.	<i>Lemna minor</i>	Lemnaceae
38.	<i>Lepidium apetalum</i>	Brassicaceae
39.	<i>Limosella aquatica</i>	Scrophulariaceae
40.	<i>Lithospermum arvensis</i>	Boraginaceae
41.	<i>Lotus corniculatus</i>	Fabaceae
42.	<i>Malva verticillata</i>	Malvaceae
43.	<i>Medicago falcata</i>	Fabaceae
44.	<i>M. lupulina</i>	Fabaceae
45.	<i>M. sativa</i>	Fabaceae
46.	<i>Melilotus officinalis</i>	Fabaceae

47.	<i>Mentha longifolia</i>	Lamiaceae
48.	<i>Morus alba</i>	Moraceae
49.	<i>Oxyria digyna</i>	Polygonaceae
50.	<i>Phragmitis australis</i>	Poaceae
51.	<i>Plantago major</i>	Plantaginaceae
52.	<i>Poa alpina</i>	Poaceae
53.	<i>P. nemoralis</i>	Poaceae
54.	<i>P. pratensis</i>	Poaceae
55.	<i>Polygonum aviculare</i>	Polygonaceae
56.	<i>P. hydropiper</i>	Polygonaceae
57.	<i>P. lapathifolium</i>	Polygonaceae
58.	<i>P. viviparum</i>	Polygonaceae
59.	<i>Polypogon monspeliensis</i>	Poaceae
60.	<i>Populus alba</i>	Salicaceae
61.	<i>P. candicans</i>	Salicaceae
62.	<i>P. nigra</i>	Salicaceae
63.	<i>Potamogeton pectinatus</i>	Potamogetonaceae
64.	<i>Potentilla anserina</i>	Rosaceae
65.	<i>P. arbuscula</i>	Rosaceae
66.	<i>Rhodiola imbricata</i>	Crassulaceae
67.	<i>Ribes alpestre</i>	Grossulariaceae
68.	<i>Rumex acetosa</i>	Polygonaceae
69.	<i>Sagina saginoides</i>	Caryophyllaceae
70.	<i>Salix alba</i>	Salicaceae
71.	<i>S. fragilis</i>	Salicaceae
72.	<i>Setaria viridis</i>	Poaceae
73.	<i>Stellaria media</i>	Caryophyllaceae
74.	<i>Taraxacum officinale</i>	Asteraceae
75.	<i>Thymus linearis</i>	Lamiaceae
76.	<i>Tragopogon pratense</i>	Asteraceae
77.	<i>Tribulus terrestris</i>	Zygophyllaceae
78.	<i>Trifolium pratense</i>	Fabaceae
79.	<i>Triglochin maritima</i>	Juncaginaceae
80.	<i>Tussilago farfara</i>	Asteraceae
81.	<i>Urtica dioica</i>	Urticaceae
82.	<i>Utricularia minor</i>	Lentibulariaceae
83.	<i>Veronica anagallis-aquatica</i>	Scrophulariaceae
84.	<i>Zannichellia palustris</i>	Zannichelliaceae

Earlier Botanical Work

The history of botanical exploration in Kashmir dates back to 1831 when V. Jacquemont (1801-1832) collected plants from Kashmir. His collections were studied and published by J. Cambessedes and F. Decaisne in 1845. Jacquemont was followed by Baron Von Huegel (1835) and Godfrey Thomas Vigne (1835-36), who explored the Kashmir valley. Vigne collected from Kashmir and Deosai Plains in 1835. Hugh Falconer joined Vigne in Skardu in 1837 and made collections in Dras and Baltistan. W. Moorcroft collected specimens in Ladakh regions and sent his collections to Wallich and Royle. He also made collections in Niti Pass area. Falconer also obtained plants from Kashmir probably in the year 1839. J.F. Royle made extensive collections in Bashahr and Kinnaur around 1830 and sent collectors to Kashmir during 1833-1839. R. Strachey and J.E. Winterbottom collected widely in western Himalaya from 1847-49 and there are specimens at Kew - collected in Deotsu', the old name of Deosai. They also collected in Kumaon, Garhwal and Tibet. Thomas Thomson was another pioneer collector who collected in Kashmir during 1848. Schlagintweit (1855-57), William Hay (1862), J.L. Stewart (1868) and Henderson and Hume (1873) also explored different areas of Kashmir. C.B. Clarke visited Kashmir in 1876 and crossed Deosai on his journey to Karakoram. He also visited Kishanganga valley. J.F. Duthie explored Baltistan and Gilgit during 1892-93. He visited Deosai while travelling from Dras to Skardu and Astor. W. Gollam and Inayat, as Duthie's collectors, collected in Kashmir in 1889 and 1891 respectively. G.A. Gammie collected in Kashmir in the year 1891 and 1893. Alfred Meebold crossed Deosai and explored surrounding areas in 1905. Keshavanand collected in Kashmir from 1906 to 1909 especially in Kishanganga valley. Filippo De Filippi of the Abruzzi Expedition to the Karakoram mountains in 1909 published a list of plants which he collected in Deosai. W. Koelz collected in Kashmir from 1931-1936. He visited Deosai and surrounding areas in Kashmir. R.R. Stewart collected plants in Deosai in 1940 and 1946 and explored Gilgit, Dras, Baltistan, Tilel, Kamri Pass etc. of Kashmir. In 1955 Grady Webster and E. Nasir explored Satpura La, Skardu and Deosai to Chillam.

Simla and Kinnaur was visited by Jacquemont, Inglis, William Hay, Madden, Hoffmeister and T. Thomson. In 1864 E. Egerton explored Chandra valley and north-west areas facing Bara Shigri Glacier in Lahul & Spiti. Towards the close of the century, D. Brandis and J.L. Stewart explored Bashahr and Kinnaur. Lahul & Spiti was explored also, among others, by William Hay, J.D. Cunningham, T. Thomson, J.D. Herbert, G. Watt, Rev. H.A. Jaeschke, A. W. Hedge, Lance, Stoliczka and J.R. Drummond during the 19th century. In the first half of the 20th century, notable explorers and collectors in this region were R.N. Parker, R.R. Stewart, W. Koelz, N.L. Bor, S.R. Kashyap, Thakur Roopchand etc. After re-organisation of Botanical Survey of India in 1957, the scientists of Northern Circle, Dehradun of B.S.I. made systematic and extensive survey of the cold desert areas of J. & K., H.P. and U.P. (Garhwal Himalaya). Notable among these were M.A. Rau, T.A. Rao, N.C. Nair, U.C. Bhattacharyya, B.M. Wadhwa, M.V. Viswanathan, P.K. Hajra, B.D. Naithani, B.P. Uniyal, H.J. Chowdhery etc. Scientists from Regional Research Laboratory, Jammu and Srinagar University like Y.K. Sarin, B.K. Kapahi, S.P. Sethi, A.K. Kaul, R.N. Gohil, Gurcharan Singh, Upendra Dhar, B.L. Sapru were also engaged in exploration of these areas independently. Burkill (1965) and Stewart (1982) have given a very exhaustive historical account of explorations in these areas.

The first systematic account of the flora and vegetable products of Lahul dates back to 1868 when Aitchison (1868) published -"Lahul- Its Flora and Vegetable Products" based on the collections of Rev. H.A. Jaeschke of the Moravian Mission. In 1881 G. Watt published a brief account of the vegetation of Chamba State and British Lahul. Nair (1977) published Flora of Bashahr Himalaya in which he included plants from the cold desert areas of Kinnaur. Kachroo, Sapru & Dhar (1977) published Flora of Ladakh and Dhar & Kachroo (1983) published Alpine Flora of Kashmir Himalaya. Naithani (1984) published Flora of Chamoli which included also the plants of Mana, Niti and Malari areas. Recently Aswal & Mehrotra (1994) have published Flora of Lahaul-Spiti. Apart from this there are many scientific papers on the floristics of these regions which are cited in the bibliography.

Materials, methods and style of presentation of Flora :

More than 20,000 plant specimens belonging to more than 4,000 field numbers and collected by the scientists of Botanical Survey of India during a span of about 15 years since 1975 form the basis of the present work. These materials are deposited in the herbarium of Botanical Survey of India at Dehradun (BSD). There are also some collections from the cold desert areas housed in the herbaria of Central National Herbarium, Howrah (CAL), Forest Research Institute Herbarium, Dehradun (DD), National Botanical Research Institute Herbarium, Lucknow (LWG) and Central Drug Research Institute Herbarium, Lucknow. Table 18 shows the itinerary of plant collection tours conducted by the scientists of Botanical Survey of India, Northern Circle, Dehradun.

Standard procedures were followed for collection, processing and preservation of specimens in the herbarium. Established practices were followed for identification of specimens viz., checking of specimens with the help of treatises on Indian flora, monographs, revisionary works and comparison of specimens with existing collections.

The total number of species dealt with in the present work is 347 (Table 5). These belong to 103 genera under 16 families of monocot group. Table 6 and 8 shows the dominant families and genera in the cold desert flora. Families Dioscoreaceae, Trilliaceae, Araceae, Lemnaceae, Najadaceae and Zannichelliaceae are represented by single genus with single species. The families are arranged according to Bentham & Hooker's classification (1862-1883) with some modifications based on recent knowledge.

Table 19: Itinerary of plant collection tours in cold deserts

Name of Collector	Locality	Period	Field Number		Total
			From	To	
M.V. Viswanathan	Ladakh (J. & K.)	Aug.-Sept. 1975	54601	54800	200
- do -	- do -	- do -	55001	55100	100
- do -	- do -	- do -	55601	55700	100
B.D. Naithani	Niti, Malari (Chamoli, U.P.)	- do -	55901	56300	400

Name of Collector	Locality	Period	Field Number		Total
			From	To	
B.M. Wadhwa	Ladakh (J. & K.)	July- Sept. 1976	58501	59000	500
- do -	- do -	- do -	59201	60200	1000
U.C. Bhattacharyya	- do -	July- Aug. 1980	71201	71816	616
B. Balodi & S. Singh	Lahul & Spiti (H.P.)	Aug. 1984	75670	75731	61
B.D. Naithani	Nelang Valley (Uttarkashi, U.P.)	Aug. -Sept. 1988	66476	66500	25
- do -	- do -	-do -	70784	70800	16
- do -	- do -	-do -	74214	74300	86
- do -	- do -	-do -	74734	74800	66
- do -	- do -	-do -	75462	75500	38
- do -	- do -	-do -	86801	86900	100
H.J. Chowdhery & B.P. Uniyal	Ladakh (J. & K.)	July- Aug. 1988	85701	86300	600
S.K. Murti & S. Singh	Lahul & Spiti (H.P.)	Aug. 1994	88101	88300	200
- do -	- do -	- do -	88401	88500	100
- do -	- do -	- do -	90401	90440	40
- do -	Kinnaur (H.P.)	- do -	81575	81600	25
- do -	- do -	- do -	82665	82700	35
TOTAL					4308

The Flora is presented in two parts. The first part deals with the general considerations, which include introduction and general account dealing with area, physical features, geology, soil, climate, general vegetation, floristic diversity, survival strategies and adaptive features of the flora, introduced flora, phytogeographical affinities and earlier botanical explorations and works. A comprehensive bibliography is added at the end. The second part deals with the systematic account of monocot species, which includes dichotomous keys from the rank of family to infraspecific level and descriptions of family, genus and species. Full citations of the species are provided. Notes on habitat with localities, flowering and fruiting

time and distributional data are provided with each species. Total number of genera and species in the world, India and area under study are provided at the end of family-description and total number of species in the world, India and area under study are given at the end of genus-description. Short notes on affinities, distribution, economic importance, nomenclature etc. are given at appropriate places. The genera under a family and species and infraspecific taxa under a genus are arranged alphabetically. Nomenclature has been brought up to date in accordance with I.C.B.N. as far as practicable.

KEY TO THE FAMILIES

- 1a. Leaves usually net-veined, alternate or opposite. Flowers usually 4- or 5-merous; (3-merous in Menispermaceae) DICOT FAMILIES
- b. Leaves usually parallel-veined, usually alternate. Flowers usually 3-merous, rarely 6-merous 2
- 2a. Ovary superior 3
- b. Ovary inferior 15
- 3a. Perianth dry and glumaceous or represented by hypogynous setae, scales, hairs, bristles or lodicules 4
- b. Perianth well developed or absent 6
- 4a. Ovary 3-carpelled. Fruit a dehiscent capsule JUNCACEAE
- b. Ovary 1-carpelled. Fruit an indehiscent caryopsis or achene (nut) 5
- 5a. Stem usually solid and triquetrous. Leaves usually with closed sheaths. Flowers in the axils of a single bract. Anthers basifixed CYPERACEAE
- b. Stem usually with hollow internodes and usually terete. Flowers enclosed within a bract and bracteole (lemma and palea). Anthers usually dorsifixed POACEAE
- 6a. Flowers arranged in spadix ARACEAE
- b. Flowers not arranged in spadix 7
- 7a. Carpels free or only slightly united at base or gynoecium reduced to 1 carpel. Aquatic or marshy herbs 8
- b. Carpels completely united into an ovary 13
- 8a. Free floating, stemless herbs LEMNACEAE
- b. Rooted herbs, with stems 9
- 9a. Flowers bracteate JUNCAGINACEAE
- b. Flowers ebracteate 10
- 10a. Flowers in spikes. Stamens 2-6 11
- b. Flowers axillary. Stamens 1 12

- 11a. Flowers bisexual. carpels 4 POTAMOGETONACEAE
- b. Flowers unisexual. Carpel 1 TYPHACEAE

- 12a. Leaf-margin denticulate NAJADACEAE
- b. Leaf-margin entire ZANNICHELLIACEAE

- 13a. Leaves in a terminal whorl TRILLIACEAE
- b. Leaves not in a terminal whorl 14

- 14a. Flowers in scapose umbel subtended by membranous spathaceous bracts.
Strongly aromatic herbs ALLIACEAE
- b. Flowers not in umbels or if rarely subumbellate or in head then bracts not
spathaceous. Not aromatic herbs LILIACEAE

- 15a. Twining herbs DIOSCOREACEAE
- b. Erect terrestrial or epiphytic herbs 16

- 16a. Flowers actinomorphic. Stamens 3. Ovary not twisted IRIDACEAE
- b. Flowers zygomorphic. Stamens 2 or 1. Ovary spirally twisted
..... ORCHIDACEAE

ORCHIDACEAE

Terrestrial or epiphytic perennial herbs. Flowers variously shaped; petals dissimilar, one petal modified into lip. Stamens and style united in a column opposite the lip; anther usually solitary, free or adnate to column.

More than 750 genera and 17,000 species in the world, cosmopolitan, abundant in tropics, more than 150 genera and 950 species in India; 7 genera and 13 species in the cold desert.

- 1a. Plant without leaf NEOTTIA
- b. Plant with leaf 2

- 2a. Anthers attached by its top, operculate 3
- b. Anthers attached by its base, confluent with column, not operculate 4

- 3a. Decumbent herbs. Flowers sessile GOODYERA
- b. Erect herbs. Flowers stalked EPIPACTIS

- 4a. Lip without spur 5
 b. Lip with a spur 6
- 5a. Lip flat at the base MALAXIS
 b. Lip concave at the base HERMINIUM
- 6a. Plants with segmented tubers. Leaves many DACTYLORHIZA
 b. Plants with undivided tubers. Leaf solitary or 2-3 Ponerorchis

DACTYLORHIZA Neck. ex Nevski

Terrestrial orchid with palmately divided tuberous roots. Stem leafy. Inflorescence dense flowered raceme. The dorsal sepal forming a hood with the petals. Lip with cylindric spur; column short.

The genus comprises about 30 species; N. Africa, temperate Eurasia, Alaska; 2 species in India and also in cold desert.

- 1a. Robust herb. Laves oblong-lanceolate. Inflorescence dense. Lip broader than long *D. hatagirea*
 b. Slender herb. Leaves linear or lanceolate. Inflorescence lax. Lip longer than broad *D. kafiriana*

Dactylorhiza hatagirea (D. Don) Soo (Ann. Univ. Scient. Budapest Sec. Biol. 3: 341. 1960 *nom. illegt.*) Gen. *Dactylorhiza* 4: 1962. *Orchis latifolia sensu* Hook.f. Fl. Brit. India 6: 127. 1890. *non* L. 1753. *O. hatagirea* D. Don, Prodr. Fl. Nepal. 23. 1825.

Erect terrestrial orchid 20-50 cm tall. Root tuberous, divided into 2-4 finger like processes. Stem usually fistular, leafy upward. Leaves 3-6, variable, oblong, lanceolate, oblong or oblong-lanceolate, 6-15 x 3-5 cm. Inflorescence dense, cylindric. Flowers pink or purple, variable in size; lateral sepals ovate, reflexed, dorsal ovate-oblong, upto 10 mm long; petals 6-8 mm long, obliquely ovate or broadly lanceolate; lip almost flat, entire or obscurely 3-lobed, 10-12 mm long.

Common in damp places at Gilgit, Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, South-west Tibet, Nepal; India from Kashmir to Garhwal and Kumaon region of U.P.

Note : Plant is very variable. In drier conditions and at alpine heights the plants are slender with smaller leaves mostly near the base but in humid conditions the plants are robust with well developed leaves. The inflorescence also may be few to many-flowered spikes.

The tubers are highly medicinal. *Orchis latifolia* L. has long been considered the well known 'Hatha Jari' or 'Salam Panja' of indigenous system of medicine but this is an European species.

***Dactylorhiza kafiriana* Renz in Rech.f., Fl. Iranica 126: 125. t. 54. 1978.**

Slender terrestrial orchid, 20-30 cm tall. Root tuberous, divided into 2-4 finger like processes. Stem leafy mainly towards the base. Leaves linear or lanceolate, acuminate, 10-15 x 1.5-2 cm. Inflorescence lax, few-to several-flowered; flowers pale purple. The dorsal sepal converging with the petal and forming a hood, 8-10 mm long; the lateral sepals obliquely oblong-lanceolate, petals as long as or shorter than the sepals; lip 8-10 mm long, obovate or rhomboidal, entire or obscurely 3-lobed, papillose at base and centre.

Occasionally found at Gilgit.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, India from Kashmir.

Note : Hybridization occurs with *D. hatagirea* in areas where both grow together, giving rise to intermediate populations (Somdeva & Naithani, 1986). The plant can be expected in Lahul.

EPIPACTIS Zinn *nom. cons.*

Terrestrial, rhizomatous, leafy herb. Leaves sessile, plicate. Inflorescence racemose, drooping. Bracts often leafy. Sepals and petals

broad, prominently veined; lip sessile and adnate to the base of the column, distinctly divided into concave or saccate hypochile and cordate epichile; column short, with a shallow cup at its tip. Pollinia 2, bipartite.

The genus comprises *ca* 25 species; widely distributed; 4 species in India; 3 species in cold desert.

- 1a. Sepals and petals about 15 mm long. Epichile trilobed, margin entire *E. gigantea*
- b. Sepals and petals upto 10 mm long. Epichile simple; margin erose..... 2
- 2a. Rostellum well developed, with a persistent globose viscid gland *E. helleborine*
- b. Rostellum reduced, viscid gland not persistent..... *E. persica*

Epipactis gigantea Dougl. ex Hook., Fl. Bor.-Americ. 2: 202. 1839.
E. royleana Lindl. in Royle, Ill. Bot. Himal. Mount. 368. 1839 *nom. nud.*;
 Gen. Sp. Orchid 461. 1840; Hook.f., Fl. Brit. India 6: 126. 1890.

Terrestrial orchid, erect up to 90 cm tall rhizome creeping, stoloniferous; stem with broad loose sheaths at base. Leaves ovate or ovate-lanceolate, acute or acuminate, 10-15 x 2.5-3 cm. Racemes 10-30 cm long, lax, many-flowered. Flowers drooping, 2.5 cm across, green veined red with reddish-yellow lip; bracts longer than than flower. Sepals spreading, ovate-lanceolate or ovate, upto 20 mm long; petals shorter, ovate; lip longer than the sepals, hypochile broader than long, strongly many-nerved, base cuneate.

Occasionally found in damp places at Gilgit, Baltistan, Skardo.

Fl. & Fr. : July - August.

Distrib. : Afghanistan; Pakistan; India, from Kashmir to Bhutan.

E. helleborine (L.) Crantz, Stirp. Austr. 2. ed. 2: 467. 1769. *E. latifolia* (L.) All. Fl. Pedemont 2: 152. 1785; Hook.f., Fl. Brit. Ind. 6: 125. 1890. *Serapias helleborine* L. Sp. Pl. 949. 1753.

Terrestrial orchid; erect up to 70 cm tall; rhizome short, woody. Stems leafy. Leaves elliptic to lanceolate, acute, gradually decreasing in size upward, upper ones bract like, 6-12 x 4-7 cm. Raceme 20-30 cm long. Flowers greenish white, 1.5-2 cm across. Sepals often brownish veined, ovate-lanceolate; petals ovate; hypochile cup shaped, green outside and shining brownish within.

Frequently seen in damp places in Lahul.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Europe, N. Africa, Japan, Myanmar, Pakistan, India from Kashmir to Bhutan.

Note : It is a very variable species. Hooker (l.c.) has recognised three varieties viz. *herbacea*, *thomsoni* and *intrusa* on the basis of size and shape of leaves, dense or lax inflorescence etc. but there are specimens with intermediate characters.

Epipactis persica (Soo) Nannfeldt, Bot. Not. 1946. 11: 1946. *Helleborine persica* Soo, Fedd. Repert. 24: 37. 1927.

Slender, terrestrial orchid, 40-50 cm tall. Stem 3-4 foliate. Leaves in the middle of the stem, elliptic or ovate-lanceolate, 6-8 x 3-5 cm. Raceme lax, few-to several-flowered. Flowers green; bracts gradually decreasing in size, lower ones leaf like, upper lanceolate. Sepals ovate-lanceolate, 8-10 mm long; petals 6-8 mm long, ovate; lip with a cup shaped hypochile; hypochile greenish outside, brownish-green and shining within.

Rare in moist places at Gilgit.

Fl. & Fr. : July - August.

Distrib. : Iran, Afghanistan, Pakistan; India from Kashmir.

Doubtful species

Stewart (1972) in his catalogue has included *Epipactis veratrifolia* Boiss & Hohen. (= *E. wallichii* Schltr, *E. consimilis* Wall. ex Hook.f.) from Gilgit, Baltistan but no specimens seen from cold desert areas. The species is found in Garhwal, Kumaon regions of U.P., Himachal Pradesh and Kashmir between 300-1000 m. altitudes.

GOODYERA R. Br.

Erect, perennial, terrestrial orchid with subradical, petioled leaves. Stem from a creeping base. Flowers small, in twisted spikes. Sepals subequal, dorsal forming a hood with petals, the laterals free, covering the sac of the lip. Lip inferior, sessile at the base of the column, hollow or saccate.

The genus comprises about 50 species in the world, distributed in temperate Eurasia, tropical Asia, Australia, Polynesia, temperate N. America, Mascarene Islands; about 14 species in India; 2 species in cold desert.

- 1a. Sac of the lip with two ridges inside *G. fusca*
 b. Sac of the lip without any ridge..... *G. repens*

Godyera fusca (Lindl.) Hook.f., Fl. Brit. India 6: 112. 1890. *Aetheria fusca* Lindl., Gen. Sp. Orchid 491. 1840.

Robust terrestrial orchid, 20-35 cm tall. Roots densely tufted. Stem with radical leaves. Leaves fleshy, broadly ovate, 5-veined, margins revolute, sub-acute, 2.5-3.5 x 1.5-2.5 cm; petiole short and broad, sheathing at base. Inflorescence pubescent, dense, many flowered, longer than stem. Flowers flushed green, 5-6 mm across; bracts cymbiform, ovate-oblong; sepals subequal, oblong, dorsal 1-veined, lateral obscurely 3-veined; petals gibbously falcate or sigmoid; lip as long as the sepals, deeply saccate with a decurved linear beak, beak ridged within.

Frequently seen in humid conditions in Lahul.

Fl. & Fr. : July - August.

Distrib. : S.E. Tibet, N. Myanmar, India from Himachal Pradesh to Arunachal Pradesh.

Note : The species is closely allied to *G. repens*. (L.) R. Br.

Goodyera repens (L.) R. Br. in Ait., Hort. Kew. ed. 2. 5: 198. 1813; Hook.f., Fl. Brit. India 6: 111, 1890. *Satyrium repens* L. Sp. Pl. 945. 1753.

Erect, terrestrial orchid with stoloniferous, creeping rhizome. Stem with radical leaves. Leaves shortly petioled, elliptic or ovate-elliptic, dark green with whitish-green spots, 1-2.5 x 0.5-1.5 cm. Inflorescence a raceme, 2-5 cm long, densely many-flowered. Flowers white, tinged with pink-brownish, 3-3.5 mm across; sepals sub-equal, ovate; petals lanceolate, as long as the sepals, falcate; lip entire, ovate, edges more or less undulate.

Frequently seen in humid conditions in Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, E. Tibet, Myanmar, China, Japan, Europe, N. America; India from Kashmir to Arunachal Pradesh.

HABENARIA Willd.

Erect terrestrial orchid. Root tuberous. Stem leafy. Leaves with sheathing base. Flowers in terminal spike or raceme. Sepals sub-equal, free. Petals simple or cleft, often forming a hood with dorsal sepals. Lip entire, lobed or 3-partite, base spurred. Anther united with the column. Rostellum trilobed.

The genus comprises about 600 species in the world; cosmopolitan, chiefly in tropical and warm countries; about 100 species in India.

Aswal & Mehrotra (1994) reports *H. plantaginea* Lindl. from Rohtang-Khoksar in Lahul but Somdeva & Naithani (1986) are of the

opinion that this could be a mistake since this species does not grow at such a height. This species is distributed up to 1000 m height from Jammu to Arunachal Pradesh, Bihar, Orissa, Bengal, Madhya Pradesh, W. Ghats, N. Kanara; Sri Lanka, Myanmar.

HERMINIUM L.

Slender, terrestrial, tuberous orchid. Tubers oblong, undivided. Leaves solitary or few, cauline or basal. Flowers small, in dense, many-flowered, elongated spike, greenish. Sepals free or connate in a hood, lateral spreading. Lip continuous with base of the column, entire, 3-lobed or dentate, not spurred. Column very short.

The genus comprises about 30 species in the world; distributed in temperate Eurasia, Thailand, Philipines, Java; 13 species in India; 2 species in cold desert.

- 1a. Leaves 2-3, from near the base. Lip 3-partite *H. monorchis*
 b. Leaf solitary, near the base. Lip simple *H. pugioniforme*

Stewart (1972) in his catalogue records *H. lanceum* (Thunb. ex Sw.) Vuijk (= *H. angustifolium* (Lindl.) Benth. & Hook.f., *Spiranthes lancea* (Thunb. ex Sw.) Backer, Bakh.f. & V. steenis) from Gilgit, Baltistan in J. & K. but no specimens seen.

Herminium monorchis (L.) R. Br. in Ait., Hort. Kew. ed. 2. 5: 191. 1813; Hook.f., Fl. Brit. India 6: 128. 1890. *Ophrys monorchis* L., Sp. Pl. 947. 1753. Fig. 1.

Erect, terrestrial orchid, 10-20 cm tall. Tuber ellipsoid. Stem with 2-3 leaves near the base. Leaves linear-oblong or oblong-lanceolate, acute, 2.5-10 x 1-4 cm. Inflorescence terminal, dense-flowered, cylindric or subsecund spike, 2-5 cm long. Flowers decurved, yellowish-green, 4-6 mm across; sepals oblong, obtuse or sub-acute; petals ovate, connivent with the sepals. Lip concave at base, 3-lobed.

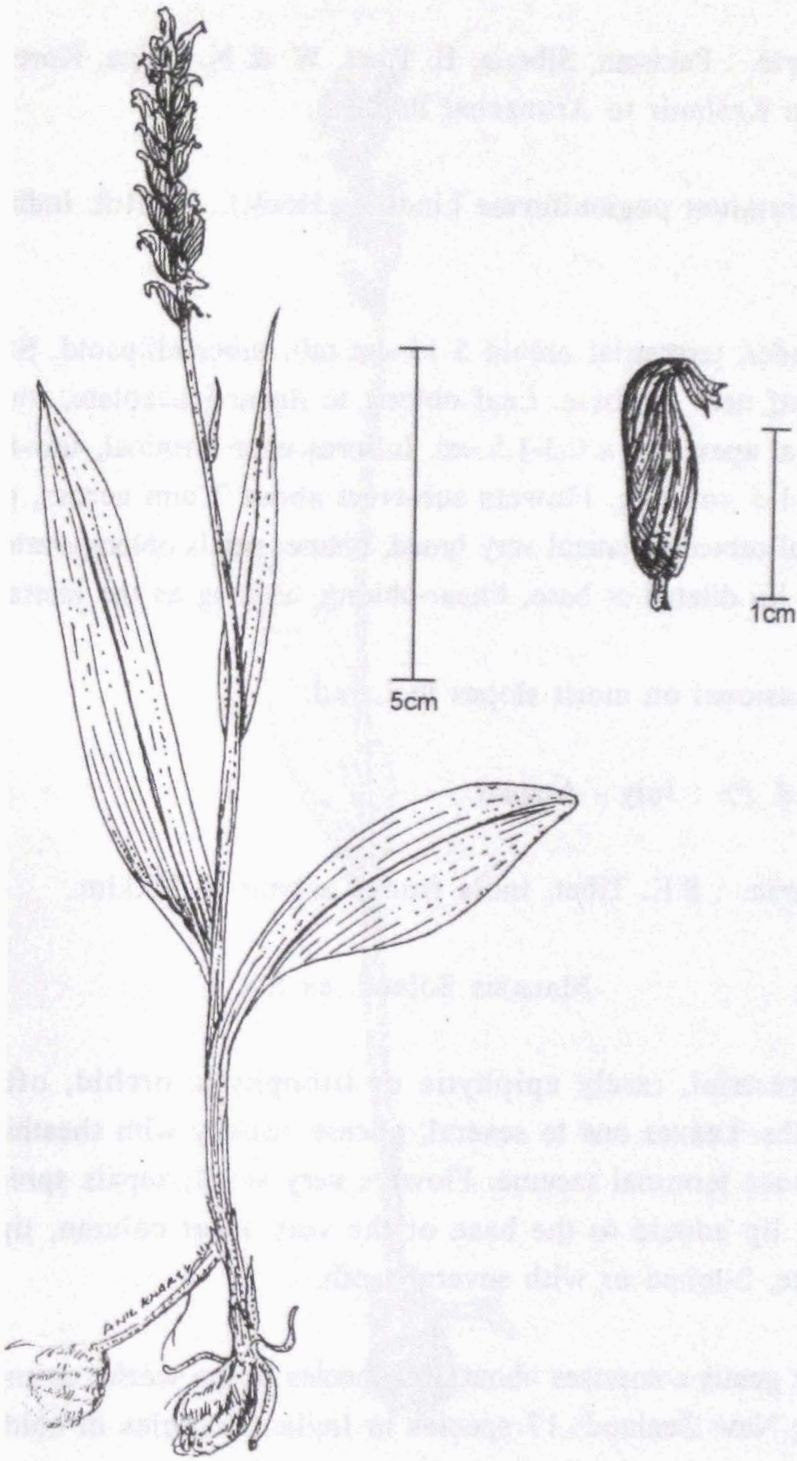


Fig. 1. *Herminium monorchis* (L.) R. Br.

Frequent in damp places on slopes in Nubra valley, Gilgit, Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Siberia, E. Tibet, W. & N. China, Korea, Japan; India from Kashmir to Arunachal Pradesh.

Herminium pugioniforme Lindl. ex Hook.f., Fl. Brit. India 6: 130. 1890. Fig. 2.

Slender, terrestrial orchid 5-15 cm tall. tuber ellipsoid. Stem with solitary leaf near the base. Leaf oblong to linear-lanceolate, rounded or sub-acute at apex, 2-6 x 0.3-1.5 cm. Inflorescence terminal, few-flowered, lax spike 1-5 cm long. Flowers sub-erect about 2 mm across, greenish, dorsal sepal orbicular, lateral very broad, obtuse; petals oblong-ovate, margin crenulate; lip dilated at base, linear-oblong, as long as the lateral sepals.

Occasional on moist slopes in Lahul.

Fl. & Fr. : July - August.

Distrib. : S.E. Tibet, India from Kashmir to Sikkim.

MALAXIS Soland. ex Sw.

Terrestrial, rarely epiphytic or lithophytic orchid, often with pseudobulbs. Leaves one to several, plicate, usually with sheathing base. Inflorescence terminal raceme. Flowers very small; sepals spreading or recurved; lip adnate to the base of the very short column, tip entire, emarginate, 2-lobed or with several teeth.

The genus comprises about 300 species in the world; cosmopolitan, excluding New Zealand; 17 species in India; 1 species in cold desert.

Malaxis muscifera (Lindl.) O. Ktz., Rev. Gen. Pl. 2: 673. 1891.
Microstylis muscifera (Lindl.) Ridley in J. Linn. Soc. Bot. 24: 333. 1888;

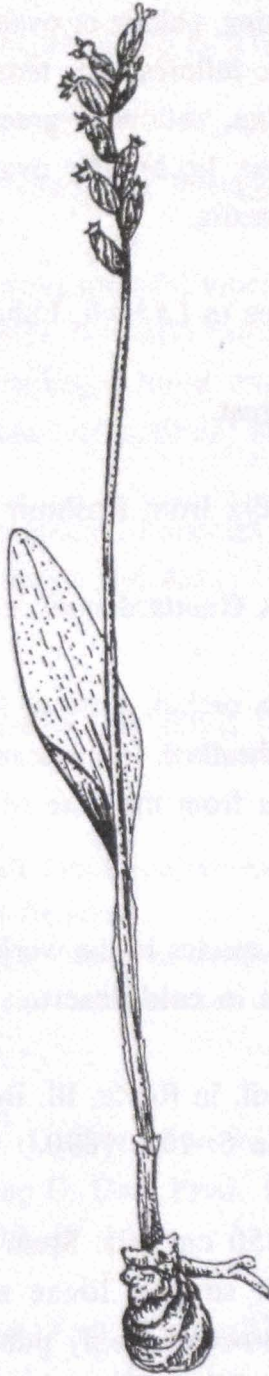


Fig. 2. *Herminium pugioniforme* Lindl. ex Hook.f.

Hook.f., Fl. Brit. India 5: 689. 1890. *Dienia muscifera* Lindl., Gen. Sp. Orchid 23. 1830.

Terrestrial orchid 5-20 cm tall. Pseudobulb ovoid. Stem sheathed at base. Leaves 2, base sheathing, oblong or ovate to orbicular-ovate, obtuse or subacute, 2.5-8 x 1.5-3 cm. Inflorescence terminal, lax-flowered raceme, 9-23 cm long. Flowers minute, yellowish-green, 2-3 mm across; sepals oblong-lanceolate; petals linear; lip broadly ovate, acute, beaked, margins thickened; column fleshy, sessile.

Occasional in meadows in Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India from Kashmir to Arunachal Pradesh.

NEOTTIA Guettard *nom. cons.*

Erect, terrestrial, leafless orchid, more or less mycotrophic. Rhizome with fleshy root-fibres. Stem sheathed. Inflorescence many-flowered raceme. Flowers fleshy; lip pendulous from the base of the column, tip entire or 2-lobed.

The genus comprises 9 species in the world; temperate Europe, Asia; 5 species in India, 1 species in cold desert.

Neottia listeroides Lindl. in Royle, Ill. Bot. Himal. Mount. 1: 368. 1839; Hook.f., Fl. Brit. India 6: 103. 1890.

Terrestrial orchid 35-50 cm tall. Stem with fleshy root-fibres, brownish-olive-green, with several loose sheaths. Leaves absent. Inflorescence terminal, lax-flowered, laxly pubescent raceme, 20-25 cm long. Flowers reddish-brown, brownish-olive green or dark green, 8-12 mm across; sepals ovate-oblong, reflexed, spreading, 5-6 mm long; petals linear, falcate; lip narrowly obovate-oblong, 1-1.5 cm long, tip bifid.

Occasional in humid meadows in shade in Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Myanmar, S.E. Tibet, India from Kashmir to Himachal Pradesh.

PONERORCHIS Reichb.f.

Erect, terrestrial, tuberous orchids; tubers ovoid or cylindrical. Stem with 1-3 leaves. Inflorescence 1-several-flowered spike. Flowers purple, spurred. Dorsal sepal forming a hood over the column. Rostellum inconspicuous. Viscidia (glands of pollinia) enclosed in a pouch.

The genus comprises about 10 species in the world, distributed in N.E. Canada, temperate Europe and Asia; 3 species in India; 2 species in cold desert.

Airy Shaw (1973) treats this genus synonymous to *Gymnadenia* R. Br.

- 1a. Lip deeply 3-lobed, all lobes similar. Leaves usually more than one. Inflorescence 2-several flowered..... *P. chusua*
- b. Lip shallowly 3-lobed, so much so that tip looks truncate with crenate margins. Leaf usually one. Inflorescence usually single-flowered.....
..... *P. nana*

Ponerorchis chusua (D. Don) Soo in Acta Bot. Acad. Sci. Hung. 12: 352. 1966. *Orchis chusua* D. Don, Prodr. Fl. Nepal. 23. 1825; Hook.f., Fl. Brit. India 6: 127. 1890.

Slender, terrestrial orchid 10-35 cm tall. Tubers oblong, entire. Stem sheathed at base. Leaves 2-3, linear, linear-lanceolate or linear-oblong, acute; 4-10 x 1-2 cm. Inflorescence 2-several flowered spike, lax, 2-8 cm long. Flowers purple, rarely whitish purple, 1-2 cm across. Bracts lanceolate, equalling ovary or longer. Lateral sepals oblong or oblong-lanceolate.

reflexed, dorsal sepal orbicular. Petals broadly ovoid, truncate at base. Lip longer than the sepals, spurred, lateral lobes diverging; spur cylindrical, as long as and adpressed to ovary.

Occasional in meadows in Rohtang Pass area in Lahul.

Fl. & Fr. : July - August.

Distrib. : Himalayas from Himachal Pradesh to Arunachal Pradesh; Tibet.

Ponerorchis nana (King & Pantl.) Soo in Acta Bot. Acad. Sci. Hung. 12: 353. 1966. *Orchis chusua* D. Don var. *nana* King & Pantl. in Ann. Roy. Bot. Gard. Calcutta 8: 303. t. 402. A. 1898.

Slender terrestrial orchid. Tuber oblong or elliptic, bilobed. Stem sheathed at base. Leaf usually one, linear-lanceolate, acute, 2-3 x 0.5-1 cm. Flowers usually solitary, rarely two, purple or white, 0.5-1cm across. Bract lanceolate, equalling the ovary. Lateral sepal spreading, oblong, Petals ovoid. Lip spurred, margins crenate. Spur cylindrical, not adpressed to ovary.

Rare on alpine slopes in Rohtang Pass area of Lahul.

Fl. & Fr. : July - August.

Distrib. : Himalayas from Himachal Pradesh to Sikkim.

IRIDACEAE

Perennial herbs. Rootstock bulbous rhizomatous or cormous. Stems usually tufted, with fibrous sheaths at base. Leaves radical or cauline, linear or ensiform, equitant. Inflorescence sheathed in a leaf-like spathe, deeply divided into 2 long narrow lanceolate segments; spathe 1-several-flowered. Flowers 2-bracteate, showy; perianth superior, base tubular; limb 6-parted, segments all petal-like, in 2 series, the outer reflexed, crested or bearded inside. Stamens 3, simple or petaloid. Style 3-armed. Capsule 3-or 6-ribbed, enclosed in the persistent spathe, loculicidal.

About 92 genera and more than 1800 species in the world, distributed chiefly in tropical and temperate regions; 10 genera and about 30 species in India; 1 genus and 6 species in cold desert.

IRIS L.

Perennial herbs. Rootstock rhizomatous or bulbous. Leaves equitant, linear or ensiform. Scape simple or branched. Flowers one or few in a head, subtended by 2 bracts (spathe); perianth tubular; outer tepals (falls) 3, larger, reflexed; inner tepals 3, narrower, unguiculate, usually erect. Stamens 3, opposite to falls; anthers linear, basifixed. Ovary trigonous; style divided into 3 petaloid style-arms; style-arms bilobed, arching over the stamens; stigma pendant immediately below the style-lobes. Fruits a loculicidal capsule, 3- or 6-ribbed. Seeds flat or globose.

The genus comprises about 300 species in the world, distributed chiefly in North temperate regions; 18 species in India; 6 species in the cold desert.

- 1a. Falls (outer perianth segments) smooth, without beard or crest 2
- b. Falls (outer perianth segments) with raised ridge or crest or bearded with white or yellow hairs 3

- 2a. Leaves linear, 3-5 mm broad. Perianth tube absent *I. ensata*
- b. Leaves ensiform, 6-10 mm broad. Perianth-tube well developed, long *I. spuria*

- 3a. Falls (outer perianth segments) with raised ridge or crest *I. decora*
- b. Falls (outer perianth segments) bearded with white or yellow hairs 4

- 4a. Spathe 1-flowered, flower stemless or so. Outer perianth segments bearded with yellow hairs *I. kemaonensis*
- b. Spathe 2-3-flowered. Flowers on leafy stem. Outer perianth segments bearded with white hairs 5

- 5a. Perianth tube long; blade of outer perianth segments narrow oblong much shorter than the bearded claw *I. gilgitensis*

- b. Perianth-tube short; blade of outer perianth segments obovate-cuneate, gradually tapering into the bearded claw *I. hookeriana*

Iris decora Wall., Pl. As. Rar. 1: 77. t. 86. 1830. *Iris nepalensis* D. Don, Prodr. Fl. Nep. 54. 1825, non Wall. ex Lindl. 1824; Hook.f., Fl. Brit. India 6: 273. 1892.

Slender perennial herb; rootstock with swollen roots, with densely fibrous sheaths. Stem 20-30 cm long. Leaves linear, 12-15 cm long at the time of flowering, at length upto 50 cm long. Spathe 3-7 cm long, 2-3-flowered. Flowers shortly pedicelled, pale lilac, in a branched sometimes long stalked clusters, perianth-tube 3-4 cm long; segments 6, outer segments oblong, as long as claw; inner segments narrowly oblong; stamens 3, inserted at the base of outer segments; style arms linear, about 2.5 cm long, deeply 2-lobed, margins toothed. Capsule trigonous, with broad flat sides, beaked, 2-4 cm long.

Common in dry inner valley in Ladakh.

Fl. & Fr. : April - July.

Distrib. : Pakistan, S. W. China; India temperate Himalaya from Kashmir to Arunachal Pradesh.

I. ensata Thunb. in Trans. Linn. Soc. 2: 328. 1794; Hook.f., Fl. Brit. India 6: 272. 1892.

Perennial herb with stout rootstock. Stems tufted with fibrous sheaths. Leaves linear, rigid, 20-60 cm long, grooved, glaucous. Spathe 8-10 cm long, valves lanceolate, green, 2-3-flowered. Flowers pedicelled, pale mauve or lilac; perianth-segments 6, outer reflexed, rhomboidly ovate obtuse, shorter than claw; inner segments oblanceolate, perianth tube absent; style arms linear, tip acutely 2-fid; ovary 3-gonous. Capsule cylindrical, 4-8 cm long, 6-ribbed, beaked.

Common along irrigation channels, edge of cultivated fields escape from cultivation in Gilgit, Baltistan, Suru, Purig.

Fl. & Fr. : April - June.

Distrib. : Central Asia, Pakistan, Japan, India from western Himalaya.

Note : Pollunin & Stainton (1985) consider this species synonymous to *I. lactea* Pallas.

***Iris gilgitensis* Baker ex Hook.f., Fl. Brit. India 6: 274. 1892.**

Small perennial herb with stout creeping rootstock. Stems tufted, 10-15 cm long, basal sheaths entire. Leaves flaccid, linear, 15-25 cm long. Spathe 3-5 cm long, 2-flowered, valves lanceolate, green, margins pale. Flowers bright lilac, shortly pedicelled; perianth segments 6, outer segments narrow oblong, much shorter than the claw; inner segments oblong, clawed; perianth tube 1.5-2 cm long; stamens 3, inserted at the base of outer segments; style arms linear, 2-fid; stigmas petaloid, arching over the stamens; ovary trigonous. Capsule trigonous, 2-5 cm long, narrowed at both ends.

Occasionally found in damp place at Gilgit.

Fl. & Fr. : April - June.

Distrib. : Gilgit (Endemic).

Note : According to Dykes (1913) this is synonymous to *I. hookeriana*. He treats it a weaker form of *hookeriana*.

***I. hookeriana* Foster in Gard. Chron. 1: 611. 1887; Hook.f., Fl. Brit. India 6: 275. 1892.**

Small perennial herb with creeping gnarled rootstock. Stems tufted, 15-20 cm long, basal sheath fibrous. Leaves linear, small at the time of flowering but at length long upto 50 cm, pale green. Spathe 6-8 cm long, broader than leaves, 2-flowered, valves ventricose. Flowers purplish blue, blotched with dark purple, claw white with violet veins; perianth segments

6, outer segments obovate-cuneate, inner segments narrowly obovate, suddenly narrowed into the channelled claw, perianth tube about 4-5 cm long; stamens 3, inserted at the base of outer perianth segments; style-arms convex dorsally, linear, 2-fid, stigmas petaloid; ovary trigonous. Capsule 3-5 cm long, trigonous, oblong, beaked.

Common purple Iris of alpine meadows, open grassy slopes, grazing grounds, forming large clumps at Hemis, Dras, Gilgit. It is relished as hay in winters.

Fl. & Fr. : May - July.

Distrib. : Pakistan, India from N.W. Kashmir.

Iris kemaonensis D. Don ex Royle, Ill. Bot. Himal. 1: 372. 1839; Hook.f., Fl. Brit. India 6: 274. 1892. Fig. 3.

Small tufted perennial herb with thick, creeping rootstock. Stems reduced or absent; outer basal sheaths fibrous. Leaves linear, 10-30 cm long at the time of flowering, at length longer and overtopping the flowers. Spathe 6-8 cm long, 1-flowered, often enveloped by the uppermost leaf, valves lanceolate. Flowers solitary, bright lilac to purple with darker spots and blotches, perianth-tube 5-8 cm long; perianth-segments 6, outer reflexed, cuneate obovate, as long as the bearded claw, inner segments oblong; stamens 3, inserted at the base of outer perianth segments; style-arms linear, margins entire, the tip deeply 2-lobed and toothed, ovary trigonous. Capsule 3-5 cm long, ovoid, narrowed at both ends.

Common on grazing grounds, alpine slopes, often in large clumps in Lahul & Spiti.

Fl. & Fr. : April - July.

Distrib. : India from Himachal Pradesh to Arunachal Pradesh.

Note : The seeds are used in epilepsy and roots and leaves are used in fever.

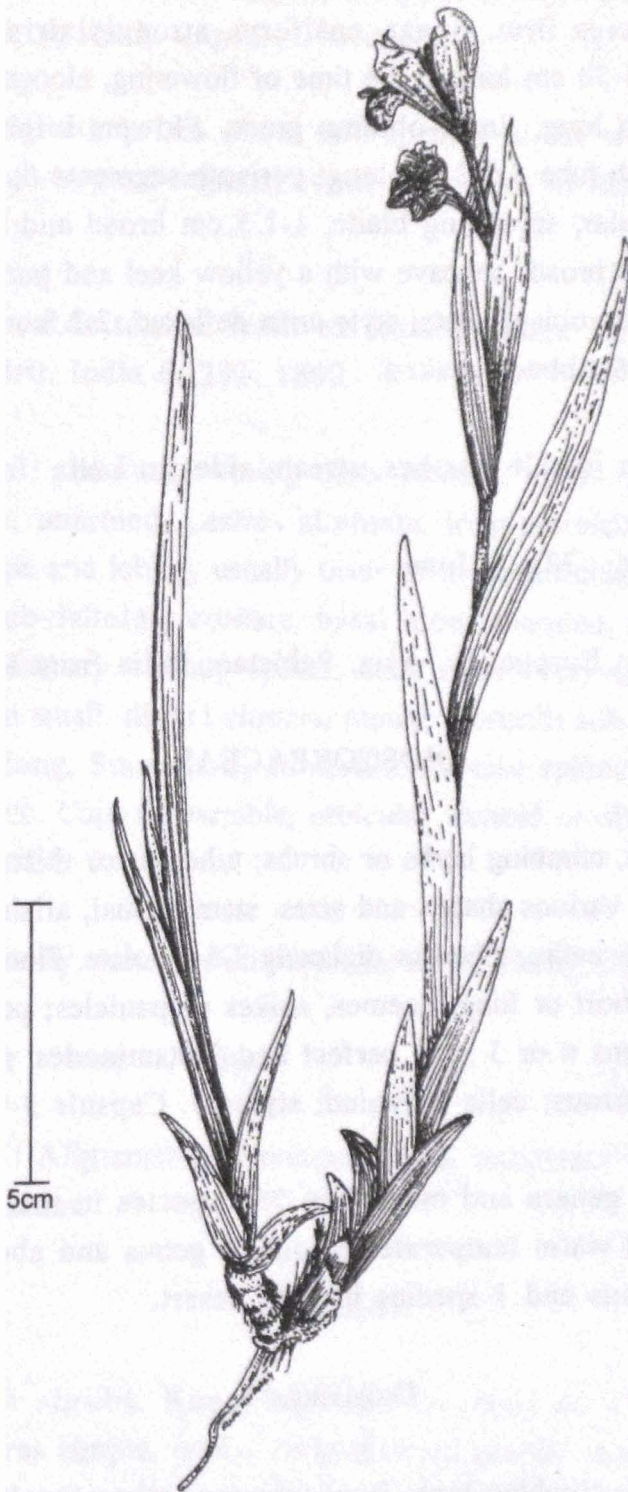


Fig. 3. *Iris kemaonensis* D. Don ex Royle

***Iris spuria* L., Sp. Pl. 39. 1753; Hook.f., Fl. Brit. India 6: 272. 1892.**

Stout perennial herb with creeping root stock. Stems 40-70 cm long, sheathed. Leaves firm, linear, ensiform, strongly striate, coriaceous, glaucescent, 25-30 cm long at the time of flowering, elongating afterwards. Spathe 5-8 cm long, linear-oblong, green. Flowers bright lilac, 5-8 cm across; perianth-tube 1.5-2 cm long; perianth-segments 6, outer segments with an orbicular, spreading blade, 1-1.5 cm broad and half as long as the claw; claws broad, concave with a yellow keel and purple veins; inner segments shorter, oblanceolate; style arms deflexed, 2-2.5 cm long. Capsule 2-5 cm long, 6-ribbed, beaked.

Common in salt marshes, stream sides in Leh.

Fl. & Fr. : May - June.

Distrib. : Europe, W. Asia, Pakistan; India from Kashmir.

DIOSCOREACEAE

Perennial, climbing herbs or shrubs; tuberous or rhizomatous. Tubers or rhizomes of various shapes and sizes. stem annual, arising from tubers, branched. leaves entire, lobed or digitately 3-5-foliolate. Flowers very small, unisexual, in short or long racemes, spikes or panicles; perianth tubular, 6-lobed. Stamens 6 or 3 or 3 perfect and 3 staminodes. Ovary inferior, 3-celled, 3-quetrous; cells 2-ovuled; styles 3. Capsule 3-valved.

About 5 genera and more than 750 species in the world; chiefly in tropical and warm temperate regions; 1 genus and about 50 species in India; 1 genus and 1 species in cold desert.

DIOSCOREA L.

Perennial, climbing herb. Root tuberous; tubers small to very large. Stem annual, climbing, sometimes prickly. Leaves alternate, long-petioled, simple or lobed or digitately 3-5-foliolate, 5-9-veined. Flowers minute,

bracteate, unisexual, in slender axillary spikes or racemes, male and female usually on different plants; perianth 6-partite, segments nearly equal, in 2 series. Stamens 6, occasionally only 3 fertile. Ovary 3-quetrous, 3-celled, cells 2-ovuled; styles 3. Capsule 3-winged.

The genus comprises about 600 species in the world; chiefly in tropical and sub-tropical regions; about 50 species in India; 1 species in cold desert.

Dioscorea deltoidea Wall. ex Kunth, Enum. Pl. 5: 340. 1850; Hook.f., Fl. Brit. India 6: 291. 1892.

Perennial, glabrous, twining herb. Root tuberous. Stem branched, slender, terete, unarmed. Leaves alternate, long-petioled, membranous, variable in shape and lobing, usually ovate or ovate-lanceolate, long pointed, hastately or sub-deltoidly cordate, basal lobes rounded, 5-20 x 3-6 cm. Inflorescence axillary, solitary spikes; male spikes very slender, 6-30 cm long, flowers in small, distant clusters, minute; perianth sub-rotate, segments 6, broadly oblong. Stamens 6, all fertile. Female spikes 8-12 cm long; pistillode minute. Capsule variable, orbicular, deltoid or obtusely quadrate, base rounded, 2-3 cm across.

Occasionally seen in *Juniperus* forest at Thirotdaipur in Lahul

Fl. & Fr. : June - August.

Distrib. : Afghanistan, Pakistan; India, temperate Himalaya from Kashmir to Sikkim.

LILIACEAE

Herbs or shrubs. Roots bulbous, tuberous or with a creeping rootstock. Leaves simple, entire. Inflorescence usually racemose. Flowers bisexual, rarely unisexual, perianth inferior, 6-merous, usually in 2 series, usually petaloid. Stamens 6, rarely 3 or fewer. Ovary 3-locular. Fruit a capsule or a berry.

About 105 genera and more than 950 species in the world; cosmopolitan; about 36 genera and more than 150 species in India; 9 genera and 14 species in cold desert.

- 1a. Ovary inferior ALETRIS
 b. Ovary superior 2
- 2a. Rootstock creeping. Inflorescence axillary, drooping raceme .. POLYGONATUM
 b. Rootstock tunicate corm or a bulb. Inflorescence terminal erect raceme or flowers terminal solitary to few 3
- 3a. Rootstock a tunicate corm. Capsule septicial COLCHICUM
 b. Rootstock a bulb. Capsule loculicidal 4
- 4a. Flowers in terminal, erect dense raceme 5
 b. Flowers terminal, solitary or few 6
- 5a. Capsule 3-angled ASPHODELUS
 b. Capsule 3-winged EREMURUS
- 6a. Flowers yellow or yellowish green 7
 b. Flowers white or pale white with yellow or brown blotch at base or greenish at base 8
- 7a. Stems scape like. Leaves radical. Flowers yellow GAGEA
 b. Stems not scape like. Leaves cauline. Flowers yellowish-green FRITILLARIA
- 8a. Perianth funnel shaped, lobes spreading LLOYDIA
 b. Perianth campanulate, lobes not spreading TULIPA

ALETRIS L.

Perennial scapose herbs. Stem very short or absent. Leaves radical. Scape leafless. Flowers small, in terminal raceme or spike. Bracts 1-2, leaf-like. Perianth tubular, lobes oblong, obtuse. Stamens 6; opposite the perianth lobes, included. Ovary half adnate to perianth tube, 3-celled, cells many ovuled. Fruit a capsule, loculicidally 3-valved.

The genus comprises about 25 species in the world; chiefly distributed in north America, Eastern Asia; 4 species in India; 1 species in cold desert.

The genus is included by some in Haemodoraceae.

Aletris pauciflora (Klotz.) Hand.-Mazz., Symb. Sin. 7: 1220, 1936.
A. nepalensis Hook.f., Fl. Brit. India 6: 264. 1892. *Stachypogon pauciflorus*
 Klotz. in Bot. Erg. Waldem. 49. t. 94. 1862.

Erect, perennial herb. Roots fibrous. Stem very short. Leaves radical, linear or linear-lanceolate, strongly veined, 5-15 cm long. Scape slender, 3-20 cm long, slightly hairy and with 1-2 leaf-like bracts, glabrous below. Flowers white or pale pink in terminal short raceme; perianth-tube 4-5 mm long, sub-campanulate, 6-lobed, lobes oblong, obtuse, recurved. Stamens 6, inserted at the base of perianth, filaments very sharp. Ovary half adnate to the perianth-tube, 3-celled, cells many-ovuled; style shorter than stamens, slightly 3-lobed. Capsule globose, loculicidally 3-valved.

Common in alpine meadows and slopes in Rohtang Pass area in Lahul.

Fl. & Fr. : July - August.

Distrib. : India in temperate and alpine Himalayas from Kashmir to Sikkim; Bhutan, extending to China.

ASPHODELUS L.

Erect annual or perennial, scapose herbs. Leaves radical, isobilateral linear, triquetrous or terete, fistular. Inflorescence terminal, lax-flowered, paniced raceme. Flowers white, solitary in the bracts; perianth 6-partite, tubular below. Stamens 6. Ovary 3-celled, each cell 2-ovuled; style filiform. Capsule loculicidal, usually 1-seeded. Seeds triquetrous.

The genus comprises about 15 species in the world; distributed from the mediterranean region to Himalayas; 2 species in India; 1 species in the cold desert.

Asphodelus comosus Baker in Gard. Chron. 1: 799. 1887; Hook.f., Fl. Brit. India 6: 332. 1892.

Erect scapose herb. Leaves radical, isobilateral, linear, ensiform, 30-45 x 2-4 cm. Inflorescence terminal, lax-flowered panicle; about 30 cm long; scape stout, terete, about 60 cm long, often scopariously branched. Flowers white, 2.5-4 cm across; bracts scarious, perianth 6-partite, connate below to form a tube, segments linear-oblong perianth white with a green keel. Stamens 6, longer than filaments, dilated below. Ovary 3-celled, each cell 2-ovuled; style filiform; stigma slightly 3-lobed. Capsule 3-angled, loculicidal, 1-seeded.

Occasional on slopes in Lahul.

Fl. & Fr. : July - September.

Distrib. : Western Himalaya in Himachal Pradesh, from Rohtang Pass in Lahul.

COLCHICUM L.

Annual herb up to 30 cm tall. Rootstock a tunicate corm. Leaves radical. Scape very short, 1-3-flowered. Flowers large, appearing from the ground with young leaves. Perianth funnel shaped, lobes 6. Stamens 6, included. ovary sessile, 3-celled; styles 3, longer than perianth, filiform. Capsule chartaceous, septicidal, with recurved beak. Seeds brownish, subglobose or ovoid.

The genus comprises about 70 species in the world, distributed in Europe, Mediterranean region to central Asia and Northern India; 1 species in India and in cold desert.

Colchicum luteum Baker in Gard. Chron. 33. 1874; Hook.f., Fl. Brit. India 6: 356. 1892.

Annual herb upto 30 cm tall. Rootstock a tunicate corm, cylindrical conical or broadly gibbously ovoid, flat on one side, covered with dark brown scales, 1.5-3.5 cm long. Leaves few, lorate, radical, appearing with flowers. linear-oblong or oblanceolate, obtuse, 15-30 cm long in fruits.

Scape very short, sessile, 2-flowered. Flowers appearing from the ground with young leaves, golden yellow, 2-4 cm across; perianth funnel shaped, tube 7-10 cm long entire, lobes 6, sub-equal, oblong or oblanceolate, 1.5-2 cm long, Stamens 6, included, inserted at the base of perianth segments. Capsule chartaceous, with recurved beak, 2.5-4 cm long, septicial.

Occasional on open slopes, pasture lands, outskirts of forests in Dras, Gilgit, Baltistan.

Fl. & Fr. : February - June.

Distrib. : Turkestan, Afghanistan, Pakistan, India in north west Himalaya from Kashmir to Himachal Pradesh.

Note : The corm contains the active principle colchicin. The seeds, chiefly seed-coat (rind) also contain colchicin. It is used as carminative laxative, aphrodisiac and in rheumatism and diseases of liver and spleen. The effect of colchicin on cancerous tissues has also been tested and it has been shown that the drug arrests division of cells of cancerous tissues and also makes them more susceptible to x-ray treatments (Jain 1968). Colchicin is also used in scientific researches. It induces polyploidy.

EREMURUS M. Bieb.

Erect, perennial, scapose, herbs. Leaves radical, linear, terete and fistular. Inflorescence terminal dense racemes. Flowers white, solitary in the bracts; perianth 6-partite, tubular below. Stamens 6. Ovary 3-celled, cells many-ovuled. Capsule loculicidal. Seeds triquetous.

The genus comprises about 50 species in the world, distributed in alpine western and central Asia; 2 species in India; 1 species in cold desert.

Eremurus himalaicus Baker in J. Linn. Soc. 15: 283. 1876; Hook.f. Fl. Brit. India 6: 332. 1892. Fig. 4.

Erect glabrous, scapose herbs up to 2 m tall, elegant looking. Leaves radical, linear, terete, fistular, 50-60 x 4-6 cm. Inflorescence terminal, dense,

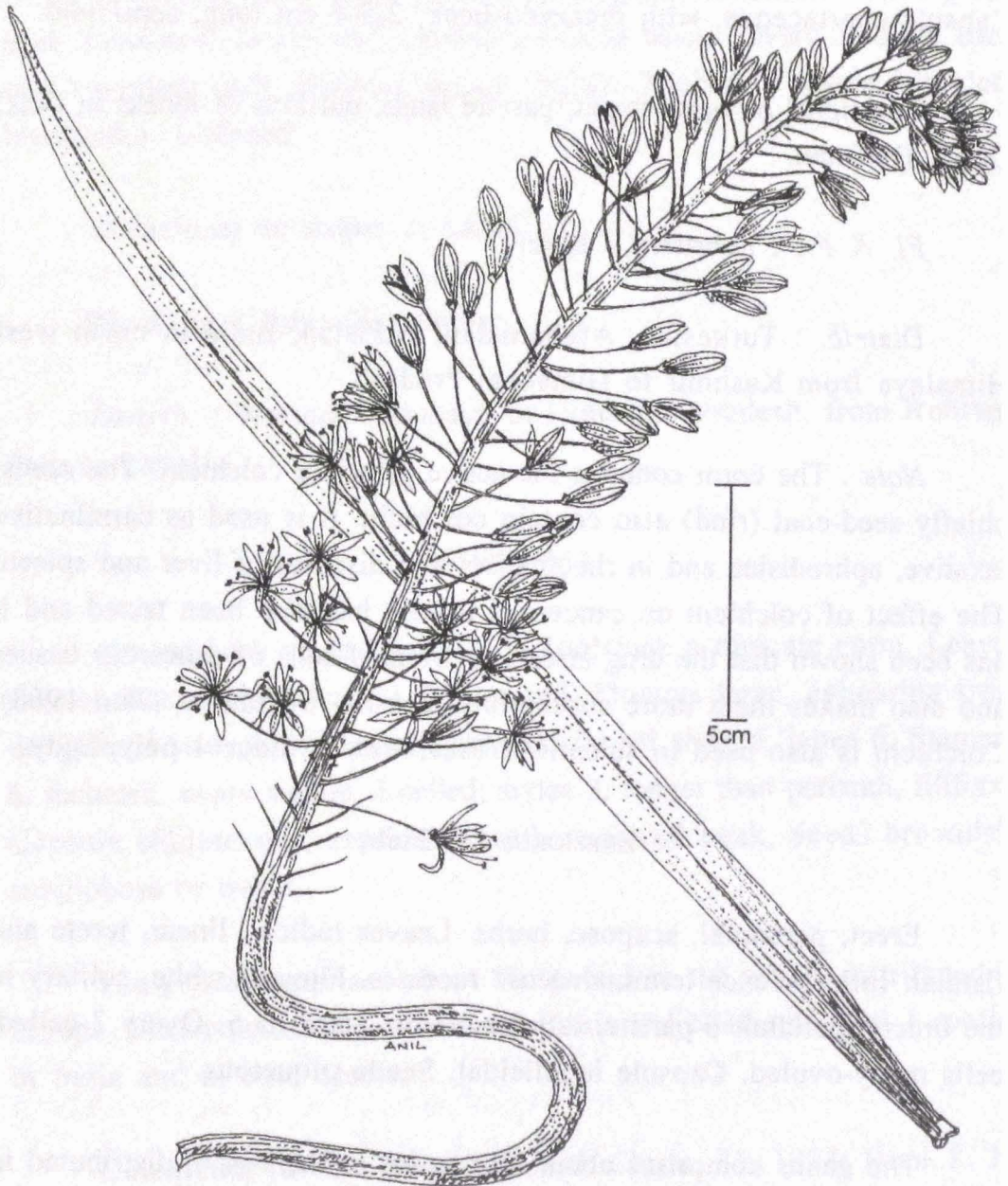


Fig. 4. *Eremurus himalaicus* Baker

stout raceme, 40-50 cm long. Scapes stout. Flowers white, 2-3 cm across, solitary in the bracts. Bracts subulate-lanceolate or filiform, equalling the pedicels. Perianth 6-partite, segments oblong, almost as long as the filament, conniving below in a tube. Stamens 6; filaments dilated at the base. Ovary 3-celled; style filiform, stigma slightly 3-lobed. Capsule rugose, about 1 cm across, loculicidal.

Common on dry slopes in Dras, Gilgit, Lahul.

Fl. & Fr. : July - September.

Distrib. : Turkestan, Pakistan, India, in western Himalaya from Kashmir to Himachal Pradesh.

Note : The young leaves and tender shoots are eaten as vegetable locally. This is a curious, very elegant and stately looking plant of dry alpine areas.

FRITILLARIA L.

Erect perennial bulbous herbs. Root stock a bulb. Stem unbranched, leafy except below. Leaves linear-lanceolate or elliptic-oblong. Flowers solitary or few to several, nodding, axillary, terminal or racemed; perianth campanulate or with segments spreading from near the base; large nectaries at the base of perianth. Stamens 6. Ovary oblong, 3-celled; stigma 3-lobed or lobed, rarely capitate. Capsule loculicidal angled or winged.

The genus comprises about 85 species; distributed in north temperate regions of the world; 4 species in India; 1 species in the cold desert.

Fritillaria roylei Hook., Ic. Pl. t. 860. 1852; Hook.f., Fl. Brit. Ind. 6: 353. 1892.

Erect, perennial herb. Rootstock a bulb, depressed, covered with membranous scales. Stem erect, unbranched, 20-60 cm long, leafy except

on lower portion. Leaves 3-6 in a whorl or upper opposite, linear-lanceolate, acuminate, 5-12 x 1-1.5 cm, tips of upper leaves often hooked. Flowers solitary or 2-4 in a short raceme, 3-5 cm across, campanulate, yellowish-green, tessellated with dull purple; bud erect but open flower nodding and pendulous; perianth-segments 6, each with a broad, viscid nectary at the base. Stamens 6, at the base of the segments, shorter than segments, anthers linear-oblong, basifixed. Ovary oblong, 3-celled; style thick, straight, 3-lobed. Capsule obovoid, 1-2 cm long, obtusely 6-angled, loculicidal.

Common on slopes, sheltered places in Dras valley.

Fl. & Fr. : June - August.

Distrib. : Western Himalaya from Kashmir to Kumaon.

GAGEA Salisb.

Small bulbous herb. Stem short, naked, bearing leafy cyme or umbel of flowers. Leaf solitary from the base of the bulb, rarely 2, overtopping the inflorescence. Flowers with nectary, usually yellow; perianth segments 6, nearly equal, distinct. Stamens 6, at the base of the segments; anthers erect, basifixed. Ovary 3-angled, 3-celled, style tapering downward; stigma entire. Capsule oblong, 3-grooved.

The genus comprises about 70 species in the world, distributed in temperate Europe and Asia; 8 species in India; 2 species in cold desert.

- 1a. Flowers usually 3, rarely upto 10, subumbellate. Capsule half as long as the perianth, broader than long..... *G. lutea*
 b. Flowers many, in unilateral dicholomous cymes. Capsule as long as the perianth, longer than broad..... *G. kunawarensis*

Gagea kunawarensis (D. Don) Greuter in Isreal J. Bot. 19: 155. 1970. *Lloydia kunawarensis* D. Don in Royle, Ill. Bot. Himal. 388. t. 93.f.3. 1840. *Gagea persica*. Boiss., Diagn. Pl. Or. 1, 7: 108. 1846 et Fl. Orient. 5: 210. 1882; Hook.f., Fl. Brit. India 6: 355. 1892.

Small glabrous herbs 5-20 cm tall. Rootstock bulbous. Stem short, terminating in the inflorescence. Leaf solitary, from the base of the bulb, linear or linear-lanceolate, acute, as long as the inflorescence. Cauline leaves 2, alternate, linear or linear-lanceolate. Flowers many; in unilateral dichotomous cymes, yellow or white with in and greenish-pinkish outside; bracts short, linear, each bearing a flower or a bulbil in its axils; perianth-segments 6, linear obtuse; stamens 6, at the base of the segments; filaments nearly as long as the segments. Ovary 3-angled, 3-celled, stigma entire. Capsule nearly as long as the perianth, oblong.

Occasional amidst boulders in Nubra valley and Baralacha La area.

Fl. & Fr. : July - August.

Distrib. : Persia, Turkestan, India from Kashmir to Himachal Pradesh.

Gagea lutea (L.) Ker.-Gawl. in Curtis Bot. Mag. 30: t. 1200. 1809; Hook.f., Fl. Brit. India 6: 355. 1892. *Ornithogalum luteum* L., Sp. Pl. 306. 1753. Fig. 5.

Small glabrous herbs 5-15 cm tall. Rootstock bulbous. Stem short, terminating in the inflorescence. Leaf solitary, from the base of the bulbs, linear to broadly lanceolate, acute, overtopping the inflorescence, 8-30 x 0.3-1.5 cm. Flowers usually 3-4, in sub-umbellate scorpioid cyme, yellow; bracts 2, leaf-like, nearly opposite; perianth-segments 6, linear-oblong, acute or obtuse, stellate when fully expanded. Stamens 6, at the base of the perianth segments, filaments about half as long as the segments. Ovary 3-angled, 3-celled style tapering downward; stigma entire. Capsule oblong, 3-grooved, broader than long.

Rare amidst boulders in Gilgit, Baltistan and Khoksar, Lahul.

Fl. & Fr. : July - August.

Distrib. : Northern Asia, Europe, India, western Himalaya from Kashmir to Kumaon.

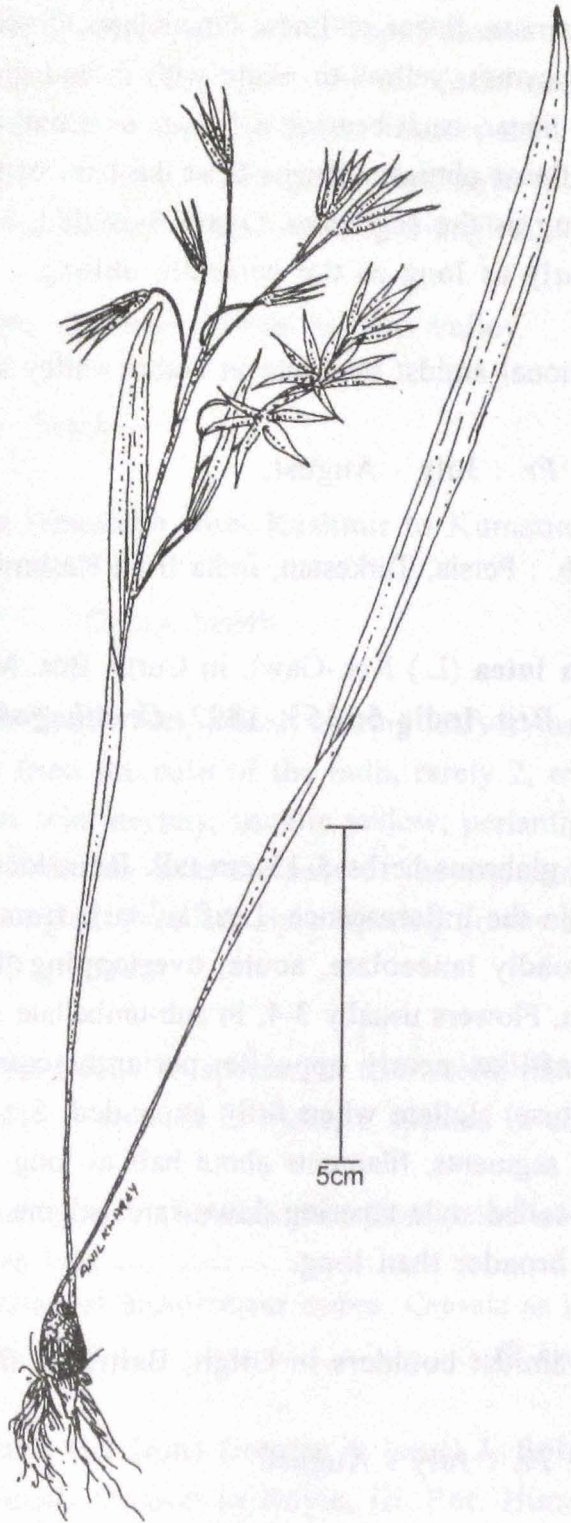


Fig. 5. *Gagea lutea* (L.) Ker.-Gawl.

LLOYDIA Salisb. ex Reichb. *nom. cons.*

Erect, slender herbs. Rootstock bulbous; bulbs elongate, base rhizomatous, coats membranous. Stem slender, leafy, ending in inflorescence. Leaves radical and cauline, linear to lanceolate. Flowers solitary or few, white or yellow, in nodding racemes; perianth funnel shaped, segments 6, with small, green nectary. Stamens 6, shorter than the perianth. Ovary triquetrous; stigma capitate. Capsule ovoid, loculicidal.

The genus comprises about 20 species in the world, distributed in north temperate regions; 7 species in India; 2 species in the cold desert.

- 1a. Perianth-segments green at base. Filaments glabrous *L. serotina*
 b. Perianth-segments with yellow or brown blotch at base. Filaments pilose
 *L. longiscapa*

Lloydia longiscapa Hook., Ic. Pl. 9: t. 834. 1852. *L. serotina* Sensu Hook.f., Fl. Brit. India 6: 354. 1892. pro part. *non* Reichb. 1830.

Erect, slender, glabrous bulbous herb, up to 30 cm tall. Bulbs narrowly ovoid, neck long, coats membranous. Stem usually unbranched. Radical leaves 1-3, linear 5-15 cm long; cauline leaves 3-4 on the upper part of the stem, lanceolate, slightly hairy. Flowers 1-3, in terminal raceme, nodding, campanulate; perianth-segments 6, distinct, stellate, oblanceolate or spatulate, pale white with yellow blotch at the base inside and brownish-orange outside. Stamens 6, filaments filiform, pilose; anthers basifixed. Ovary triquetrous, oblong. Capsule globose or ovoid, 3-valved.

Rare on slopes, in glacial morains in Rohtang Pass area of Lahul.

Fl. & Fr. : July - August.

Distrib. : Temperate Europe, Asia, America; India in Western Himalayas from Kashmir to Himachal Pradesh.

Lloydia serotina (L.) Reichb. Fl. Germ. Excurs. 102. 1830; Hook.f., Fl. Brit. India 6: 354. 1892 *pro part.* *Bulbodium serotinum* L., Sp. Pl. 294. 1753. Fig. 6.

Erect slender glabrous herbs up to 30 cm tall. Rootstock a bulb; bulb elongate, neck elongate, coats membranous. Stem usually unbranched. Radical leaves 1-3, linear, 5-18 cm long; cauline leaves few, linear, on the upper part of the stem. Flowers 1-4, in terminal raceme, nodding, campanulate; perianth-segments 6, distinct, ultimately spreading, white with pink, brown or red streaks outside and green at base inside, segments oblanceolate acute or obtuse. Stamens 6, filaments filiform, glabrous; anthers basifixed. Ovary oblong, triquetrous, 3-celled; stigma capitate or minutely 3-lobed. Capsule globose or oblong, 3-valved. Seeds compressed.

Rare in rock crevices in Baltistan, Rupshu and Zanskar areas of Ladakh, Chhatru in Lahul.

Fl. & Fr. : July - August.

Distrib. : Temperate regions of Asia, N. America, Europe, India in Western Himalaya from Kashmir to Sikkim.

POLYGONATUM P. Mill.

Erect or decumbent perennial herbs. Rootstocks a thick fleshy creeping sympodial rhizome. Stem unbranched, leafy above. Leaves alternate, opposite or whorled. Flowers drooping, in axillary 1- to several-flowered short loose corymbose racemes; pedicels jointed at the top. Perianth tubular, 6-lobed. Stamens 6; filaments very short; anthers included. Ovary 3-celled, ovules 2 in each cell. Fruit a berry, blue-black, globose.

The genus comprises about 50 species in the world; distributed in north temperate region; 16 species in India; 4 species in cold desert.

- 1a. Stem angled and grooved. Leaves 4-8-nately whorled *P. verticillatum*
- b. Stem round, terete. Leaves alterante, opposite or 3-nately whorled 2

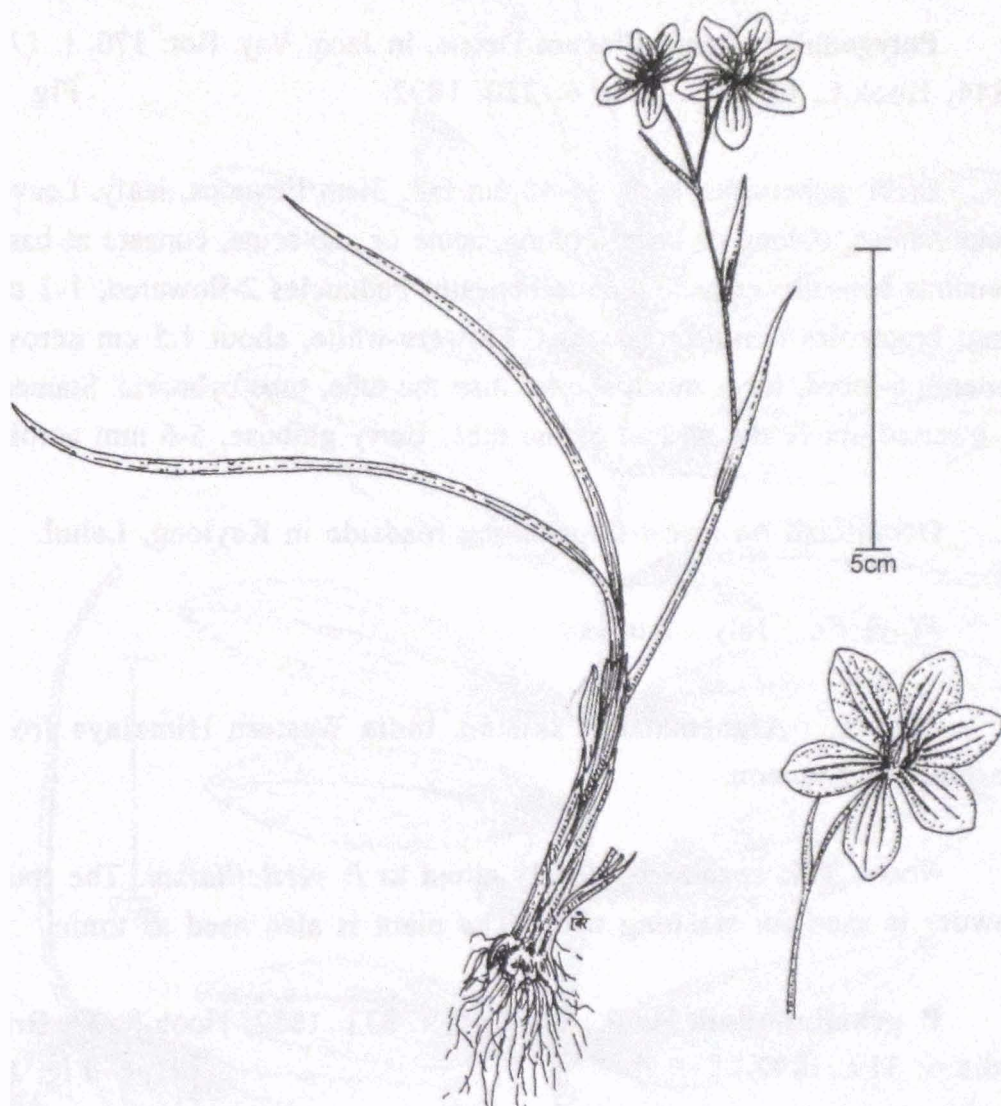


Fig. 6. *Lloydia serotina* (L.) Reichb.

- 2a. Leaves alternate. Peduncles usually 3-5-flowered, rarely 1-flowered. Perianth tube constricted in the middle *P. multiflorum*
- b. Leaves opposite or 3-nately whorled. Peduncles usually 2-flowered. Perianth tube cylindrical 3
- 3a. Flowers violet. Perianth-lobes almost equalling the tube .. *P. graminifolium*
- b. Flowers white. Perianth-lobes much shorter than tube ... *P. geminiflorum*

Polygonatum geminiflorum Decne. in Jacq. Voy. Bot. 170. t. 170. 1844; Hook.f., Fl. Brit. India 6: 320. 1892. Fig. 7.

Erect, puberulous herb, 35-40 cm tall. Stem flexuous, leafy. Leaves membranous, oblong or linear-oblong, acute or sub-acute, cuneate at base, glaucous beneath, veins ciliolate beneath. Peduncles 2-flowered, 1-2 cm long; bracteoles minute, caducous. Flowers white, about 1.5 cm across; perianth 6-lobed, lobes much shorter than the tube, tube cylindrical. Stamens 6, inserted above the middle of the tube. Berry globose, 5-6 mm across.

Occasional on forest-floor, along roadside in Keylong, Lahul.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, India Western Himalaya from Kashmir to Kumaon.

Note : This species is closely allied to *P. verticillatum*. The root-powder is used for washing wool. The plant is also used as tonic.

P. graminifolium Hook., Ic. Pl. 9. t. 833. 1852; Hook.f., Fl. Brit. India 6: 319. 1892. Fig. 8.

Small, slender herb up to 15 cm tall. Stem terete, grooved, unbranched. Leaves crowded, membranous, linear, obtuse, 3-5 cm long. Peduncles 2-flowered. 1.5-2.5 cm long. Flowers violet, 6-8 mm across; perianth-tube cylindrical, 5-7 mm long; lobes 6, oblong, almost equalling the tube. Stamens 6, anthers inserted near the mouth of perianth-tube. Berry globose or ellipsoid, 8-10 mm long.

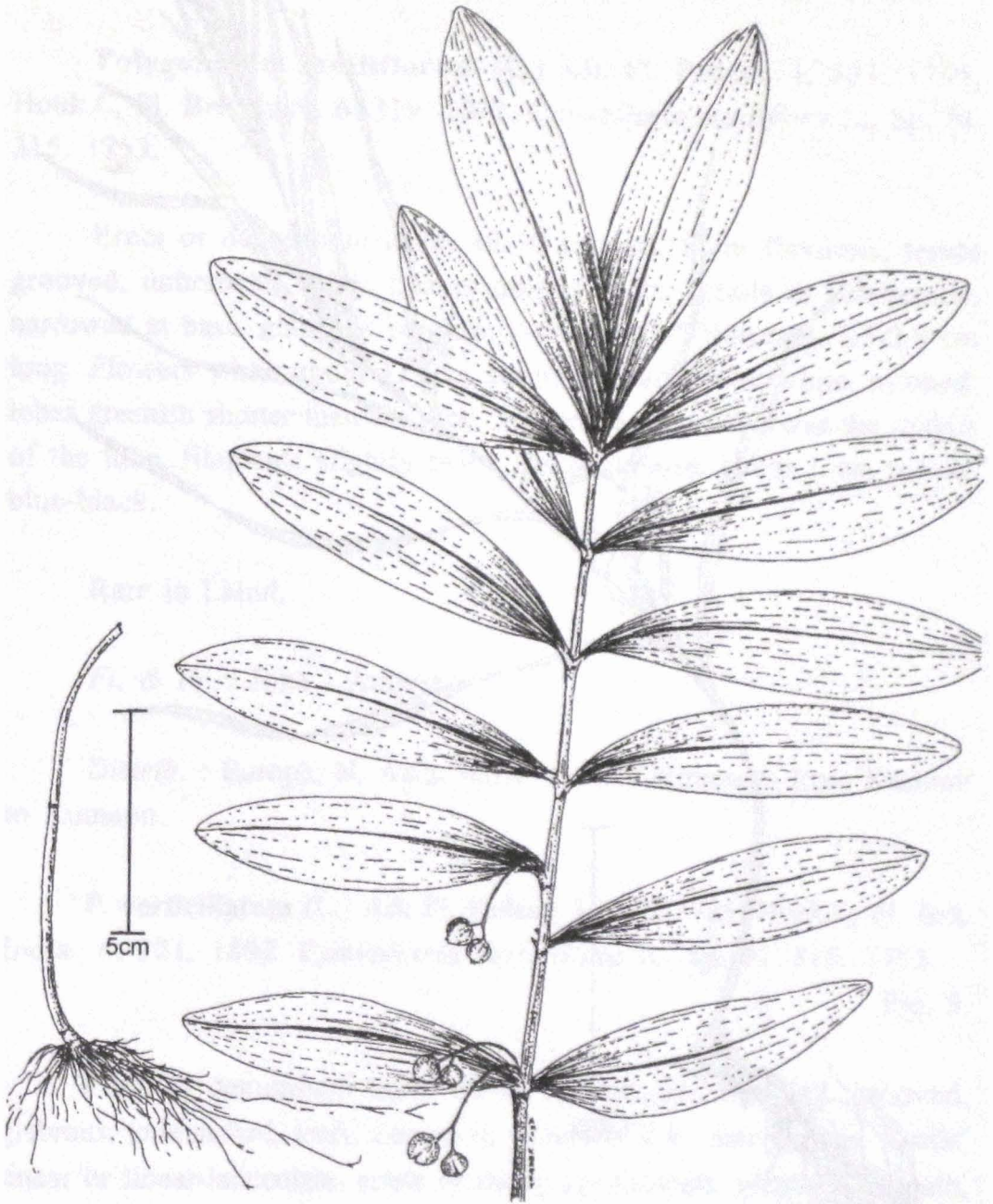


Fig. 7. *Polygonatum geminiflorum* Decne.



Fig. 8. *Polygonatum graminifolium* Hook.

Rare in Lahul.

Fl. & Fr. : July - August.

Distrib. : Western Himalaya.

Polygonatum multiflorum (L.) All. Fl. Pedem. 1: 131. 1785; Hook.f., Fl. Brit. India 6: 319. 1892. *Convallaria multiflora* L., Sp. Pl. 315. 1753.

Erect or decumbent herb, 30-70 cm tall. Stem flexuous, terete grooved, unbranchd, leafy. Leaves oblong-ovate, sessile or sub-sessile, narrowed at base, glaucous beneath, Peduncles 1-5-flowered, 1.5-2.5 cm long. Flowers white about 1.5 cm across; perianth-tube white, 6-lobed; lobes greenish shorter than the tube. Stamens 6, inserted above the middle of the tube, filaments slightly hairy. Berry globose, about 1 cm across, blue-black.

Rare in Lahul.

Fl. & Fr. : June - August.

Distrib. : Europe, N. Asia, India Western Himalaya from Kashmir to Kumaon.

P. verticillatum (L.) All. Fl. Pedem. 1: 131. 1785; Hook.f., Fl. Brit. India 6: 321. 1892. *Convallaria verticillata* L., Sp. Pl. 315. 1753.

Fig. 9.

Erect or decumbent herb, 60-80 cm tall. Stem angled, grooved, glabrous, unbranched, leafy. Leaves in whorls of 4-8, membranous, sessile, linear or linear-lanceolate, acute or rarely tip circinate, glaucous beneath, occasionally ciliolate on margins and veins. Peduncles 2-3-flowered, whorled, 1-2 cm long. Flowers yellowish-green, rarely lilac; perianth-tube constricted in the middle, 6-lobed, lobes shorter or as long as the tube. Stamens 6, inserted above the middle of the tube, filaments very short. Berry globose, about 1 cm across, blue-black.

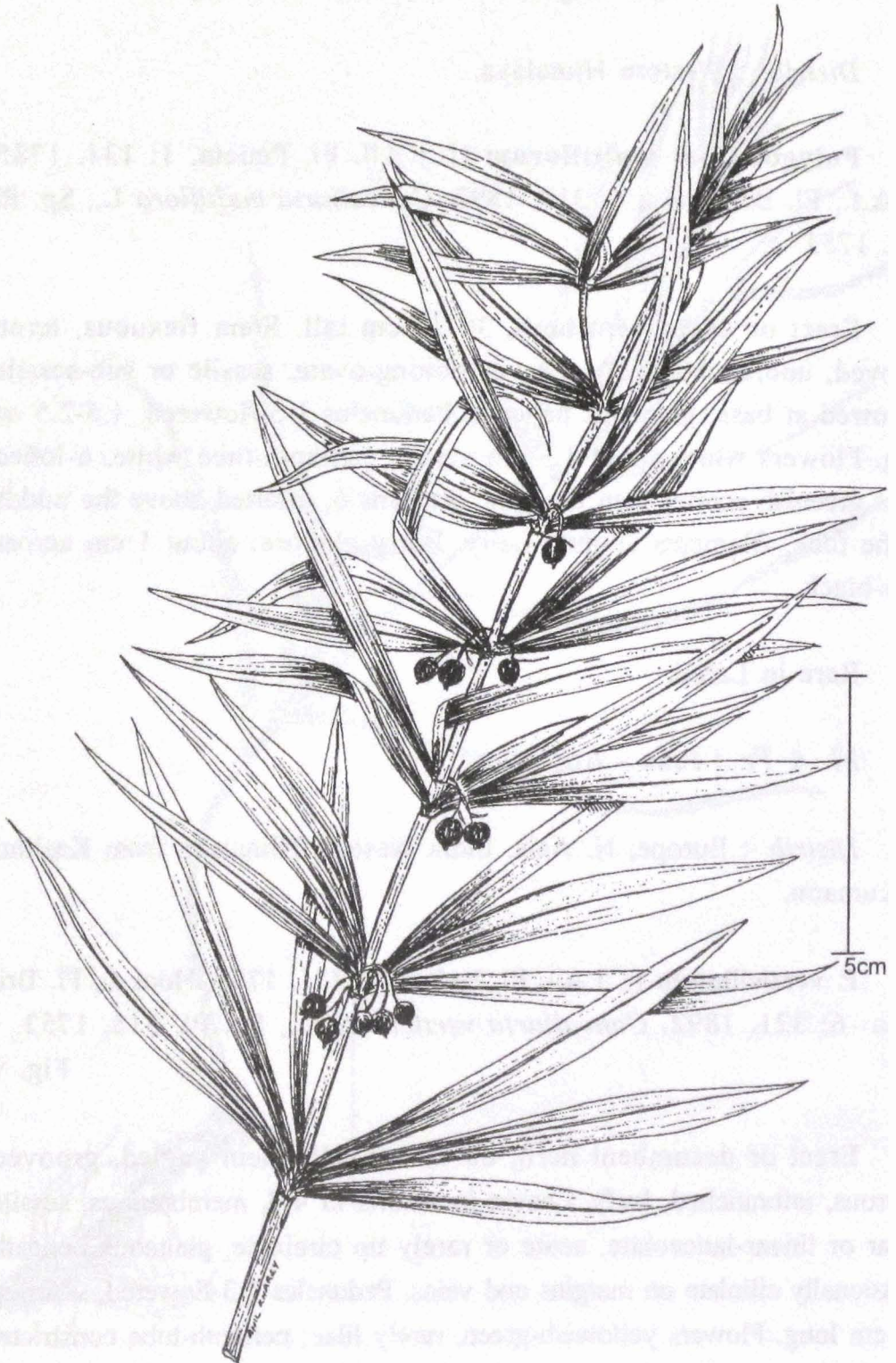


Fig. 9. *Polygonatum verticillatum* (L.) All.

Frequent in *Juniperus* forest in Lahul, also in Gilgit, Baltistan.

Fl. & Fr. : June - August.

Distrib. : Europe, N. Asia, Afghanistan, Pakistan, India, Temperate Himalaya from Kashmir to Sikkim.

Note : Rhizome is used in Kidney trouble. Plant is also used as a tonic.

TULIPA L.

Perennial scapigerous herb. Root stock bulbous. Scape leafy or not. Leaves alternate on the lowerpart of the stem, linear, channelled and sheathing towards the base. Scape 1-3-flowered, occasionally flower solitary, terminal. Flowers campanulate. Stamens 6, included. Ovary oblong, 3-celled; Style very short; stigma 3-lobed. Capsule oblong loculicidal; seeds numerous, small, flat.

The genus comprises over 100 species in the world; distributed in temperate Europe, N. Africa, Asia, India; 4 species in India; 1 species in cold desert.

Tulipa stellata Hook. in Bot. Mag. 64: t. 2762. 1827; Hook.f., Fl. Brit. India 6: 355. 1892.

Erect or decumbent glabrous, herb, 20-40 cm tall. Bulb coated, ovoid or ellipsoid; outer coats brown, hairy at the apex within. Stem glabrous, 20-40 cm long. Leaves 4-6, alternate or occasionally crowded, linear or linear-lanceolate, gradually smaller upward, acute or acuminate, entire or undulate at margin, channelled and sheathing towards base, 5-20 x 0.3-1.5 cm. Flowers usually solitary, terminal, campanulate on 10-30 cm long peduncle, pale yellow or white, tinged with red, occasionally deeper yellow at base inside, 2-3 cm across, perianth segments 6, elliptic or obovate, dissimilar, 2-3 cm long, spreading when fully expanded. Stamens 6, much shorter than the perianth, attached at the base of the perianth; filaments

often yellow, subulate. Capsule globose or oblong, beaked or so, 2-2.5 cm long.

Common on damp rocky slope, grassy slopes in Drass, Gilgit, Suru in Ladakh.

Fl. & Fr. : March - June

Distrib. : Afghanistan, Pakistan, India, Western Himalaya from Kashmir to Kumaon.

Note : Bulbs are consumed as vegetable by locals. The species is very variable. Dasgupta & Deb (Candollea 40: 165. 1985) recognised several forms under *T. clusiana* DC. and reduced *T. stellata* Hk. as *T. clusiana* DC. f. *stellata* (Hk.) Dasgupta & Deb. They treated plants with different colours of the flower as different forms.

ALLIACEAE

Perennial, bulbous, scapigerous herbs, with or without rhizome. Leaves mostly radical, cylindrical or not, filiform to lanceolate or oval, fistular or not, leaf-base sheathing. Inflorescence an umbel, enclosed in a spathe when young. Perianth 6, in 2 whorls. Stamens 6, Ovary superior, trilocular. Fruit a capsule, loculicidally dehiscent.

More than 30 genera and 500 species in the world; cosmopolitan; 3 genera and about 32 species in India; 2 genera and 20 species in cold desert.

Some people include ALLIUM in Liliaceae or Amaryllidaceae.

- 1a. Inflorescence an umbellate cyme ALLIUM
 b. Inflorescence an oblong spike MILULA

ALLIUM L.

Perennial, bulbous herb. Bulbs solitary or clustered. Leaves radical, sheathing, fistular or not. Perianth 1-veined, stamens included or exerted.

The genus comprises about 600 species in the world; cosmopolitan; about 30 species in India; 19 species in cold desert.

- 1a. Bulbs with distinct rhizome 2
- b. Bulbs without distinct rhizome 17

- 2a. Bulbs with membranous, scaly or coriaceous, striate coats 3
- b. Bulbs with distinct fibrous, reticulate coats 9

- 3a. Filaments shorter than tepals 4
- b. Filaments as long as or longer than tepals 6

- 4a. Leaves flat *A. wallichii*
- b. Leaves fistular 5
- 5a. Tepals pink. All filaments entire, connate for 1/3 to 1/4 of their length
..... *A. schoenoprasum*
- b. Tepals yellow. Inner filaments slightly obtusely toothed, connate for more
than half their length *A. fedtschenkoanum*

- 6a. Inner filaments 2-toothed at the base *A. roylei*
- b. All filaments entire 7

- 7a. Outer scales of bulbs fibrous. Leaves linear, 2-3 mm broad. Tepals golden
yellow or pale yellow, rarely pink 8
- b. Outer scales of bulbs entire. Leaves broadly linear, 5-15 mm broad. Tepals
red-purple *A. carolinianum*

- 8a. Tepals golden yellow. Pedicels as long as or longer than the flowers
..... *A. consanguineum*
- b. Tepals pale yellow, rarely pink. Pedicels shorter than the flowers *A. stracheyi*

- 9a. Filaments exerted 10
- b. Filaments not exerted 12

- 10a. Leaves elliptic to oblong lanceolate. Flowers greenish-white or yellowish.
Filaments simple *A. victorialis*
- b. Leaves filiform or narrowly linear. Flowers lilak, purple or pink. Inner
filaments toothed or auricled 11

- 11a. Filaments as long as the tepals, inserted at the base of tepals . *A. auriculatum*
 b. Filaments longer than the tepals, inserted much above the base of the tepals
 *A. stoliczki*
- 12a. Leaves 1-2 cm broad *A. gilgiticum*
 b. Leaves less than 1 cm broad 13
- 13a. Tepals acuminate or mucronate. Filaments 1/2 to 3/4 the length of the
 tepals 14
 b. Tepals acute or obtuse. Filaments upto 1/2 the length of the tepals 15
- 14a. Tepals white, rarely pink. Inner filaments narrowly triangular .. *A. tuberosum*
 b. Tepals pink. Inner filaments broadly flattened to oblong .. *A. oreoprasum*
- 15a. Tepals white, filaments linear, rarely narrowly triangular *A. humile*
 b. Tepals dark purple. Filaments triangular 16
- 16a. Leaves filiform, convolute, acute. Filaments half the length of the tepals;
 anthers mucronate *A. tenuicaule*
 b. Leaves cylindrical, fistular, obtuse. Filaments less than half the length of
 the tepals; anthers not mucronate *A. atosanguineum*
- 17a. Leaves linear-lanceolate, flat, margin ciliolate. flowers white *A. loratum*
 b. Leaves filiform or linear, half terete or fistular, margin not ciliolate. Flowers
 rosy or purple 18
- 18a. Outer coats of bulbs black-brown, coriaceous, striate. Inner filaments toothed.
 *A. caesioides*
 b. Outer coats of bulbs white, membranous. Filaments all simple
 *A. jacquemontii*

Allium atosanguineum Schrenk in Bull. Sci. Acad. Imp. Sci. St. Petersburg. 10: 355. 1842; Hook.f., in Fl. Brit. India 6: 338. 1892.

Foetid, scapigerous herbs; bulbs cylindrical, 4-5 cm long; coats brownish, membranous, at length fibrous. Leaves 2-3, stout, fistular, as long as the scape. Heads dense flowered, sub-globose, 2-2.5 cm across; spathe persistent. Flowers dark purple, sometimes red; tepals 6, lanceolate or oblong-lanceolate, acute, 6-7 mm long; filaments shorter than the tepals,

triangular subulate; connate at the base; Ovary globose, trigonous, style short. Capsule loculicidal.

Frequently seen on slopes in rocky gravelly soil near streams in Gilgit, Deosai.

Fl. & Fr. : May - June.

Distrib. : Central Asia, Pakistan, India, Western Himalaya.

Note : Plant is quite similar to *A. fedtschenkoanum* Regal.

Allium auriculatum Kunth Enum. 4: 418. 1843; Hook.f., Fl. Brit. India 6: 342. 1892. Fig. 10.

Scapigerous herb; bulb elongate, narrow, 1.5-2 cm long; coats brown, fibrous, reticulate. Leaves 3-5, linear, flat, shorter than scape, margins erose, 15-20 cm long. Scape terete, striate. Heads dense flowered, globose, about 2 cm across; spaths 2-3; flowers purplish, campanulate, 3-4 mm long; tepals 6, oblong or ovate, obtuse or acute, 3-4 mm long; filaments on the base of tepals, outer shorter, ovary trigonous; stigma penicillate. Capsule sub-globose, loculicidal.

Rooting in rock crevices on rocky soil near streams in Pensi La in Ladakh and Lahul & Spiti.

Fl. & Fr. : May - July.

Distrib. : India, Western Himalaya.

A. caesioides Wendelbo in Bot. Not. 122. 29. 1969.

Scapigerous herbs; bulbs ovoid, 1-1.5 cm across; coats membranous, scaly, white. Leaves 2-3, linear, semi-cylindrical, fistular. Scape 15-30 cm long. Heads dense flowered, hemispherical; spathes about 8 mm long, persistent. Flowers purple, campanulate, 5-6 mm long; tepals 6, elliptic-

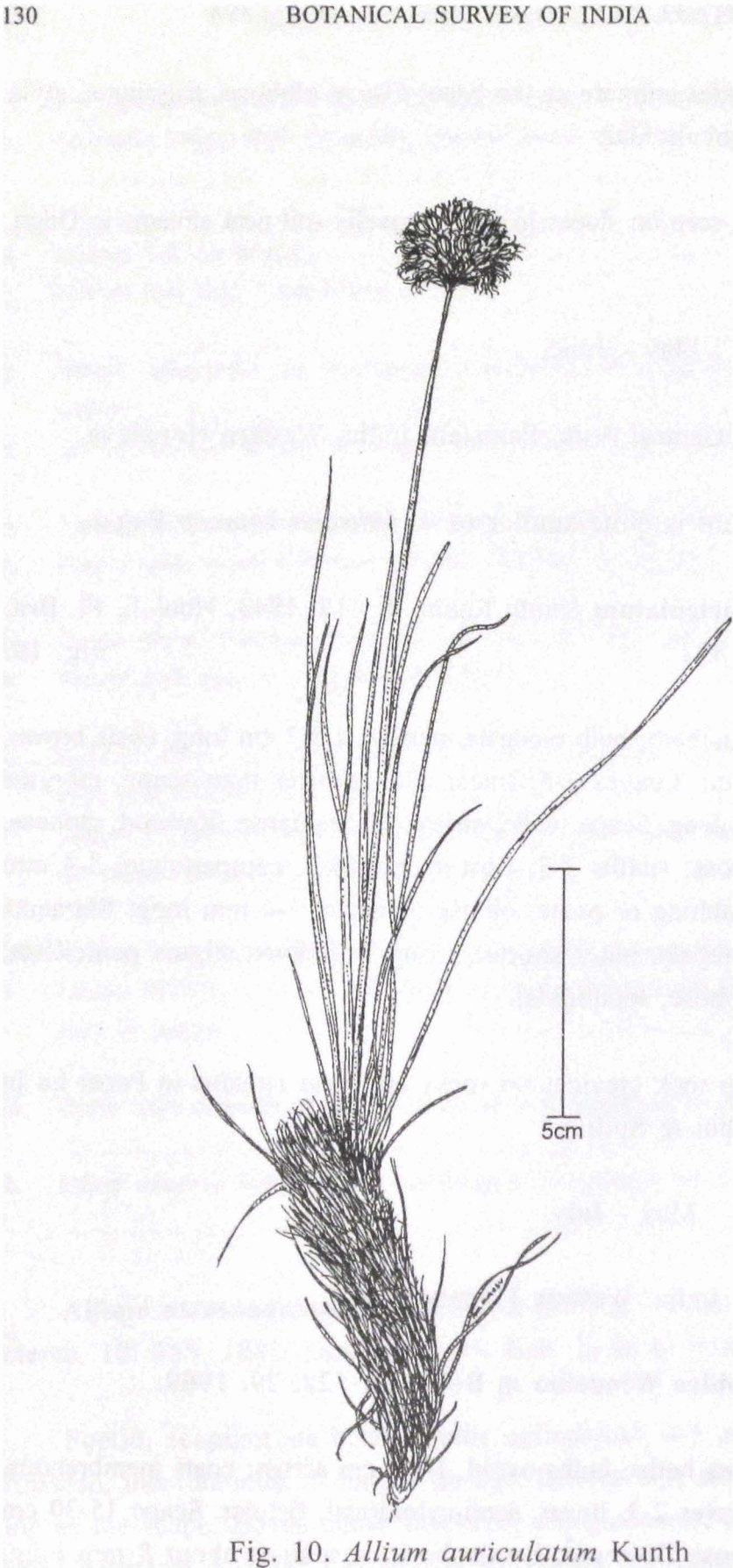


Fig. 10. *Allium auriculatum* Kunth

oblong to lanceolate, sub-acute; filaments almost half as long as tepals, connate at the base, outer entire, narrowly triangular, inner with broad toothed triangular base; ovary trigonous. Capsule loculicidal.

Rooting in rock crevices in Gilgit, Ladakh.

Fl. & Fr. : May - July

Distrib. : Afghanistan, Pakistan, India, Western Himalaya.

Allium carolinianum DC. in Redoute Les Liliacees 2. t. 101. 1804.
A. blandum Wall., Pl. As. Rar. 3. 38 t. 260. 1832; Hook.f., Fl. Brit. India 6: 339. 1892. *A. thomsonii* Baker Jaur. Bot. 3: 294. 1874; Hook.f., Fl. Brit. India 6: 340. 1892. Fig. 11.

Scapigerous herbs; bulbs tufted, narrowly ovoid to cylindrical, 5-10 cm across, with erect or creeping root stock; outer coats coriaceous, brownish, entire, inner coats membranous. Leaves 4-6, stout, flat, broadly linear to lanceolate, ensiform, recurved, 15-50 cm long. Scape stout, terete, 15-40 cm long, base covered with leaf-bases. Heads dense flowered, 2-4 cm across, globose. Spathes ovate, obtuse, deltoid. Flowers reddish purple to pink, campanulate, 5-8 mm long; tepals 6, oblong to oblong lanceolate, acute or obtuse, filaments simple, inserted near the base of tepals, connate at the base, exerted; ovary globose, trigonous; style exerted, stigma capitate. Capsule globose, loculicidal.

Common in rocky gravelly soil, rock crevices, near streams in Gilgit, Zoji La, Shyok Valley, Baltistan.

Fl. & Fr. : May - July

Distrib. : Afghanistan, Pakistan, Nepal, Tien Shan, India, Western Himalaya.

Note : The leaves and bulbs are used as flavouring material.

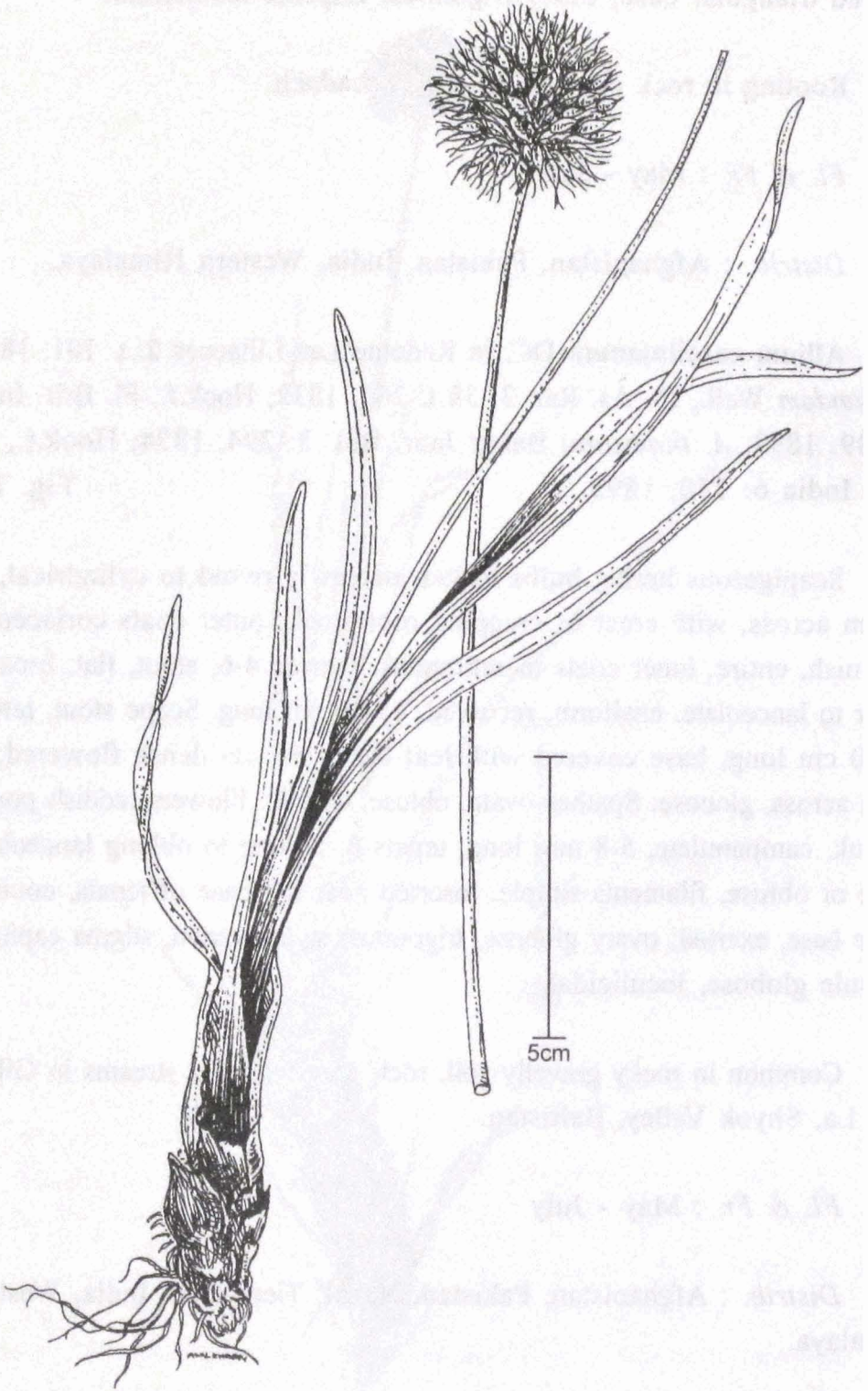


Fig. 11. *Allium carolinianum* DC.

Allium consanguineum Kunth Enum. 4: 431. 1843; Hook.f., Fl. Brit. India 6: 340. 1892. Fig. 12.

Scapigerous herbs up to 35 cm tall; bulbs tufted, ovoid to cylindrical, with erect or creeping rootstock, outer coats coriaceous, brown, produced into a neck. Leaves 3-4, stout, linear, flat, obtuse, 20-30 cm long, base sheathing. Scape stout, terete, about 20 cm long. Heads hemispherical, dense flowered. Flowers golden yellow, campanulate, 5-7 mm long, tepals 6, oblong, obtuse or acute, 5-7 mm long; filaments simple, filiform, inserted on the base of tepals, free, long exerted; ovary globose, trigonous; style slender, long exerted. Capsule loculicidal.

Common in rock crevices, sandy soil along rivers in Gilgit, Zoji La Baltistan.

Fl. & Fr. : May - June

Distrib. : Pakistan, India, W. Himalaya from Kashmir.

Note : Plant is quite similar to *A. stracheyi* Baker, differing in colour of the flower and size.

A. fedtschenkoanum Regel in Acta Horti. Petrop. 3.2: 82. 1875; Hook.f., Fl. Brit. India 6: 338. 1892. *A. semenovii sensu* Wendelbo, Dan. Biol. Skr. 10. 3: 183. 1958, *non* Regel in Bull. Soc. Mosc. 41(i): 449. 1868; Hook.f., Fl. Brit. India 6: 338. 1892.

Scapigerous herbs, bulbs solitary or clustered, cylindrical, 4-5 cm long, without a rootstock; outer coats coriaceous, blackish. Leaves 2-3, stout, fistular, cylindrical, 10-15 cm long; sheath very long, margin membranous. Scape stout, fistular, 30-50 cm long. Heads globose, 2-3 cm across, dense flowered. Flowers pale yellow, campanulate, 1-1.5 cm long; tepals 6, oval to elliptic-oblong or oblong-lanceolate, acute or acuminate, united below; filaments inserted much above the base of tepals, included, connate at the base, inner with dilated toothed base. Ovary

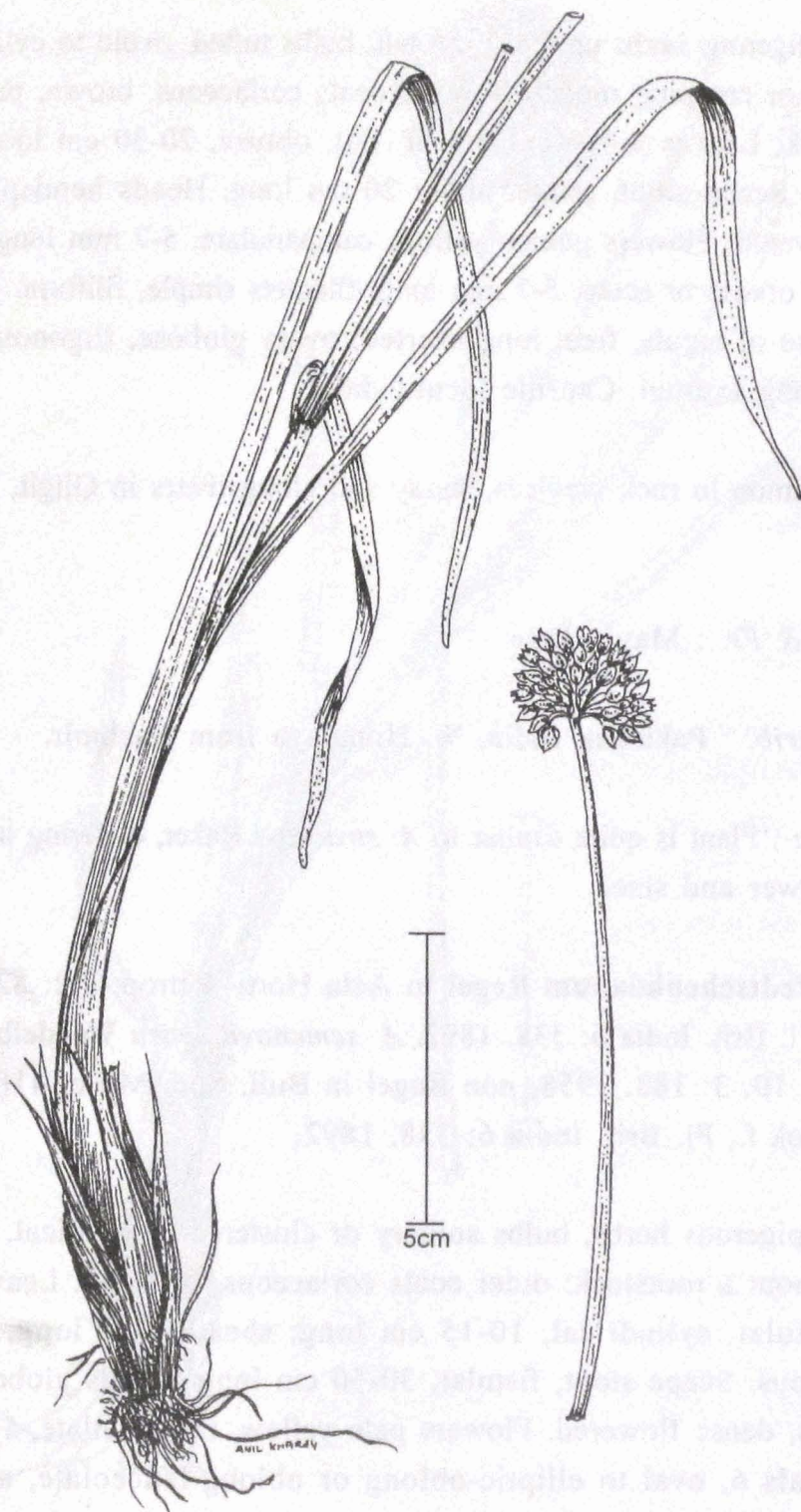


Fig. 12. *Allium consanguineum* Kunth

globose; style very short; stigma 3-lobed. Capsule globose or oblong, about 6 mm long.

Common in rocky sandy soil near streams, on slopes in Baltistan, Deosai, Gilgit, Dras, Zanskar, Suru, Zoji La.

Fl. & Fr. : May - July.

Distrib. : Afghanistan, Pakistan, India, Western Himalayas in Kashmir.

Allium gilgiticum Wang & Tang in Bull. Fam. Mem. Inst. Biol. Bot. Peking (Peiping) 7: 294. 1937.

Scapigerous herbs; bulbs cylindrical, about 3 cm long, with a narrow rhizome; coats fibrous. Leaves 5-6, linear, 25-30 cm long, glabrous, obtuse. Scape stout, fistular, cylindrical, 40-50 cm long. Heads hemispherical, 5-6 cm across, laxly flowered. Flowers purple, campanulate, 1-1.5 cm long; tepals 6, lanceolate, acute; stamens included; filaments entire; ovary globose. Stigma 3-lobed, recurved. Capsule globose or oblong.

Rare on slopes in Gilgit.

Fl. & Fr. : May - June.

Distrib. : India, Kashmir, Gilgit (Endemic)

A. humile Kunth Enum. 4: 443. 1843. *A. govonianum* Wall. ex Baker in Jour. Bot. 293. 1874; Hook.f., Fl. Brit. India 6: 344. 1892.

Scapigerous herbs; bulbs clustered on oblique jointed rootstocks, sub-cylindric or conic; coats reticulate fibrous, light brown. Leaves 4-6, basal, sub-distichous, linear, flat, apex obtuse, 5-20 cm long. Scape acutely angled, 5-25 cm long, base covered with leaf-bases. Heads hemispherical, 2-3.5 cm across, many flowered. Flowers laxly arranged, white, stellate; tepals 6, lanceolate, rotate 7-10 mm long, filaments about half as long

as the tepals, connate at the base; stamens included; ovary globose, trigonous. Capsule loculicidal, sub-globose.

Common on slopes, rocky morains in Gilgit, Zanskar, Leh.

Fl. & Fr. : May - June.

Distrib. : Temperate Himalayas, from Kumaon westward in India and Pakistan.

Allium jacquemontii Kunth Enum. 4: 399. 1843. *A. rubellum* auct. non M. Bieb. Fl. Taur. Cauc. 1: 264. 1808; Hook.f., Fl. Brit. India 6: 339. 1892. Fig. 13.

Scapigerous herbs; bulb solitary, ovoid-oblong, about 1 cm broad; outer coats coriaceous, striate, brownish black; inner membranous. Leaves 4-6, linear, flattish, occasionally fistular, margins erose, 15-50 cm long. Scape terete, 15-40 cm long. Heads sub-globose, dense-flowered, 2.5-3 cm across, flowers campanulate, pink or rosy; tepals 6, oval, oblong or elliptic-oblong, acute or acuminate, 4-5 mm long; filaments about 3 mm long, connate at base, inner broader; anthers dark coloured; style included; ovary globose, trigonous. Capsule loculicidal about 3 mm long.

Occasional on slopes in Zanskar, Ladakh.

Fl. & Fr. : May - June.

Distrib. : Central Asia, Afghanistan, Pakistan, India.

A. loratum Baker in Jour. Bot. 3: 290. 1874; Hook.f., Fl. Brit. India 6: 345. 1892.

Scapigerous herbs; bulb ovoid, not seated on a rootstock; outer coats membranous, grey. Leaves 2-5, linear-lanceolate, flat, ciliolate, narrowed from the base, 15-25 cm long. Scape slender, terete, 8-10 cm long. Heads many, dens-flowered, 5-7 cm across; spathes 2, shorter than the head.

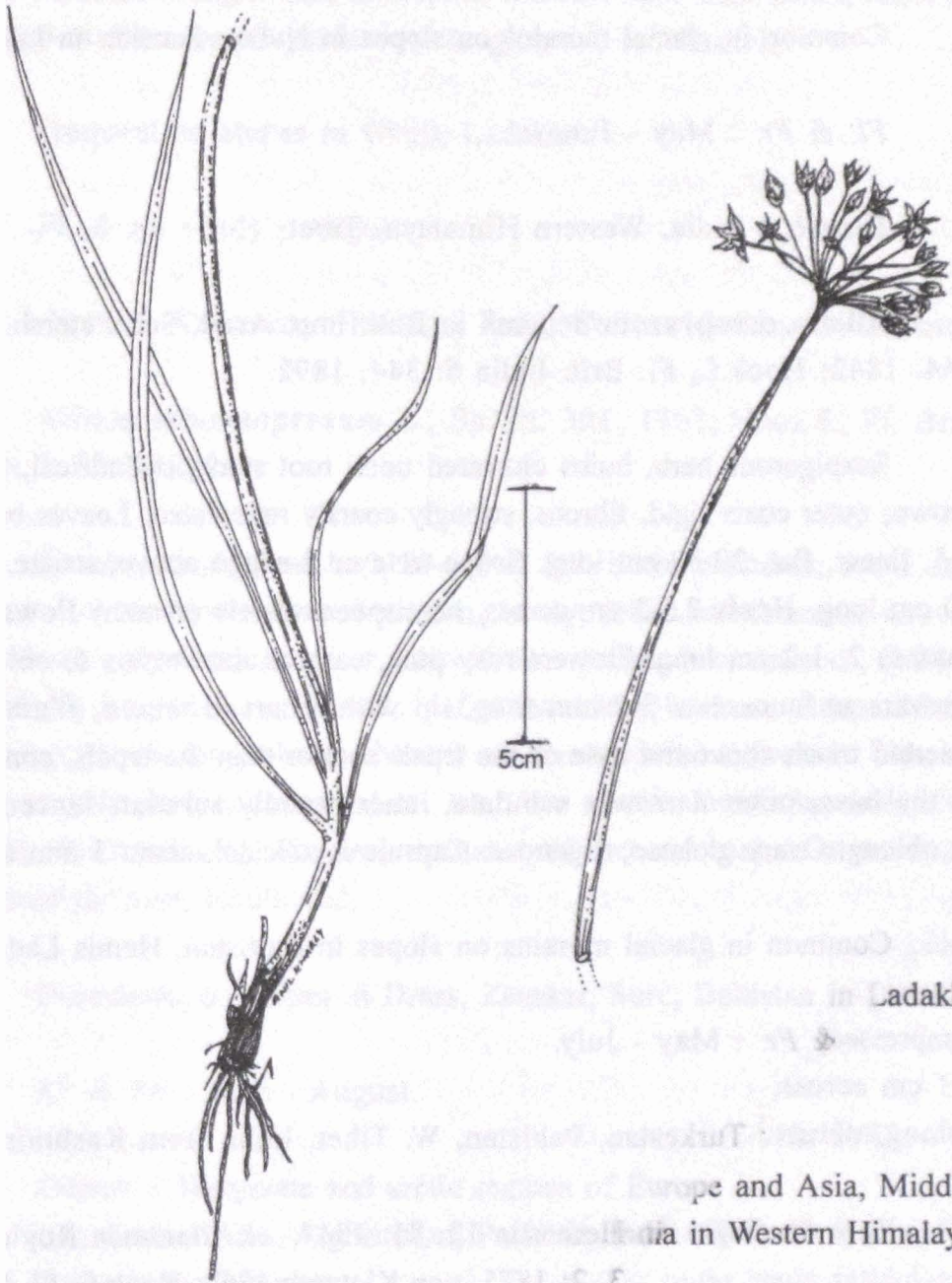


Fig. 13. *Allium rotundifolium*, non Kunth 1843; Hook.f., Fl. Brit. Ind. 1: 107. 1842. Horti Petrop. 3. 2: 160. 1875. A.

Flowers white, campanulate; tepals 6, lanceolate, acute, 2-3 mm long; filaments inserted at the base of tepals, equalling, inner subulate, outer linear with subulate tips; ovary globose-triangular; style very short. Capsule loculicidal, about 2 mm long.

Common in glacial morains on slopes in Nubra, Zaskar in Ladakh

Fl. & Fr. : May - June.

Distrib. : India, Western Himalaya, Tibet.

Allium oreoprasum Schrenk in Bull. Imp. Acad. Sci. Petersb. 10: 354. 1842; Hook.f., Fl. Brit. India 6: 344. 1892.

Scapigerous herb, bulbs clustered upon root stock, cylindrical, light brown; outer coats rigid, fibrous, strongly coarsely reticulated. Leaves basal, 3-5, linear, flat, 20-30 cm long. Scape terete or 2-edged above, striate, 30-40 cm long. Heads 2.5-3 cm across, hemispherical few or many-flowered; spathes 2, 1-2 cm long. Flowers rosy pink, campanulate tepals 6, oblong, obovate to lanceolate 5-7 mm long, tip with recurved mucro; filaments inserted much above the base of the tepals shorter than the tepals, connate at the base, outer narrowly subulate, inner broadly subulate-lanceolate or oblong. Ovary globose, trigonous. Capsule loculicidal, about 3 mm long.

Common in glacial morains on slopes in Baltistan, Hemis Ladakh.

Fl. & Fr. : May - July.

Distrib.

Turkestan, Pakistan, W. Tibet, India from Kashmir.

A. loratum

6: 345. 1892. in *Herbertia* 12: 75. 1947. *A. lilacinum* Royle ex
? 2: 1875, *non* Klotzsch 1862; Hook.f., Fl. Brit.

Scapigerous herbs; bulb obovate.
membranous, grey. Leaves 2-5, linear,
from the base, 15-25 cm long. Scape striate. Bulbs ovoid, 2-3 cm long, not
many, dens-flowered, 5-7 cm across; spathes reddish-brown. Leaves 1-3,

linear, terete, grooved, 15-40 cm long, 1-2 mm broad. Scape 20-40 cm long, fistular, base covered with leaf-bases. Head hemispherical, 2-3 cm across; spathes 2, acuminate. Flowers small campanulate, pale red, about 1 cm across. Tepals oval or ovate lanceolate, acute or obtuse, 6-8 mm long. Filaments longer than the tepals, inserted near their bases, inner 2-toothed at the base. Capsule oval or globose, loculicidal.

Frequent on slopes in Gilgit, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, India, Western Himalaya in Kashmir.

Allium schoenoprasum L., Sp. Pl. 301. 1753; Hook.f., Fl. Brit. India 2: 338. 1892.

Slender, scapigerous herb 20-30 cm tall. Bulbs clustered, ovoid, not seated on a rootstock, about 2 cm long, scaly; scales membranous. Leaves 1-2, linear, cylindrical, terete or grooved above, smooth or scarios, fistular, 10-15 cm long, 1-2 mm broad; leaf-sheaths membranous. Scape 20-35 cm long. Heads sub-globose, about 3 cm across, dense flowered. Flowers pink or pale-purple, campanulate, 1-1.5 cm across. Tepals lanceolate or linear, 10-12 mm long. Filaments included, dilated and connate at the base. Capsule globose, loculicidal.

Occasional on slopes in Drass, Zaskar, Suru, Baltistan in Ladakh.

Fl. & Fr. : June - August.

Distrib. : Temperate and arctic regions of Europe and Asia, Middle East, Iran, Central Asia, Afghanistan, Pakistan, India in Western Himalaya from Kashmir to Kumaon.

A. stoliczki Regel in Acta Horti Petrop. 3. 2: 160. 1875. *A. jacquemontii* Regel l.c. 162. 1875, non Kunth 1843; Hook.f., Fl. Brit. India 6: 342. 1892.

Scapigerous herbs 15-35 cm tall. Bulbs tufted, cylindric, ovoid, elongate, 4-5 cm long, seated on an erect rootstock; coats reticulately fibrous, reddish brown. Leaves 3-6, basal, filiform or linear, acute, shorter or equalling the scape. Scape slender, up to 35 cm long, spathers 2, scarious. Heads globose, dense-flowered, 2-3 cm across. Flowers pink or purple, campanulate, 6-8 mm across. Tepals oblong-lanceolate, obtuse or acute, 5-7 mm, long. Filaments exerted, inserted above the base of the tepals, connate at the base, inner 2-toothed at base. Capsule globose or ovoid.

Common on slopes, near water channels in Ladakh, Shyok valley, Baltistan.

Fl. & Fr. : June - August.

Distrib. : Western Tibet, Pakistan, India Western Himalaya in Kashmir.

Note : Used as vegetable in Ladakh.

Allium stracheyi Baker in Jour. Bot. 3: 293. 1874; Hook.f., Fl. Brit. India 6: 340. 1892.

Slender scapigerous herb up to 25 cm tall. Bulbs small, clustered, ovoid; outer coats fibrous, coriaceous, brown, striate, produced into a neck. Leaves 3-5, linear, obtuse, flattened, 20-30 x 1-2 cm. Scape slender, compressed, 25-30 cm long. Heads globose or hemispheric, dense-flowered 2-3 cm across. Flowers light yellow or pink, 5-7 mm across. Tepals 6, oblong, obtuse, 5-7 mm long. Filaments exerted. Capsules loculicidal.

Rare on slopes in Lahul, Gilgit, Baltistan.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India Western Himalayas from Kashmir to Kumaon.

Note : Plant is quite similar to *A. consanguineum* Kunth except in size and colour of the flower.

Allium tuberosum Rottl. ex Spreng. Syst. 2: 38. 1825. *A. odorum* auct. non L., Mant. Pl. 62. 1767; Hook.f., Fl. Brit. India 6: 343. 1892. *A. tuberosum* Roxb. Fl. Ind. 2: 141. 1832; Hook.f., Fl. Brit. India 6: 343. 1892. *A. clarkei* Hook.f., Fl. Brit. India 6: 344. 1892.

Scapigerous herb up to 60 cm tall. Bulbs elongate, cylindrical or conic, brownish, clustered on an oblique jointed rootstock, 4-6 cm long, root fibres fleshy; outer coats reticulately fibrous, brownish or blackish, rarely pale or greyish. Leaves usually many, basal, linear or filiform, shorter than the scape. Scape terete, 30-60 cm long. Heads several-to many-flowered, lax, hemispheric, 3-4 cm across. Flowers white or pinkish-white, about 1 cm across, pedicels much longer than the flowers. Tepals oblong-lanceolate to elliptic, acute or obtuse, at length reflexed, 6-8 mm long. Filaments included, connate below, outer dilated at base, inner broadly ovate with a subulate tip. Capsule obcordate or subglobose.

Common on slopes in Gilgit, Skardo, Baltistan.

Fl. & Fr. : June - August.

Distrib. : Japan, China, Pakistan, India Western Himalaya, Kashmir.

Note : Used as vegetable in Ladakh.

A. tenuicaule Regel in Acta Horti. Petrop. 10: 348. 1887.

Slender scapigerous herbs up to 20 cm tall. Bulbs 2-6, ovoid to conical, clustered, seated on an erect rootstock; outer coats reticulately fibrous. Leaves 2-3, linear or filiform, convolute, margin scabrid. Scape terete, 10-20 cm long. Heads hemispheric, 2-3 cm across; spathe purplish. Flowers dark purple, campanulate, 6-8 mm across. Tepals lanceolate, obtuse to acute, 5-7 mm long. Filaments half the length of the tepals, connate

at base, outer narrowly triangular, inner broadly triangular; anthers mucronate. Style with toothed crown at base.

Rare on slopes in Gilgit, Deosai Plains, Zoji La.

Fl. & Fr. : July - August.

Distrib. : Central Asia, Afghanistan, Pakistan, India Western Himalaya from Kashmir.

Allium victorialis L., Sp. Pl. 295. 1753; Hook.f., Fl. Brit. India. 6: 342. 1892. Fig. 14.

Scapigerous herb, 30-40 cm tall. Bulbs cylindrical, clustered, 4-6 cm long, seated on an oblique rootstock; coats reticulately fibrous. Stem leafy. Leaves 3-6, petiolate, elliptic-lanceolate or oblong-lanceolate, obtuse or acute, base narrowed into a petiole, 10-20 x 4-6 cm. Scape terete, 20-35 cm long. Head drooping in bud, then erect, lax-flowered, 2-3 cm across. Flowers greenish-white, white or yellowish-white, 5-8 mm across. Tepals 4-6 mm long, oblong, reflexed. Filaments longer than the tepals, entire, outer narrower, subulate, inner broader. Capsule cuneately obcordate.

Rare in moist situations in Lahul at Tandi, Gilgit in Ladakh.

Fl. & Fr. : June - August.

Distrib. : Europe, temperate Asia to Japan, N.W. America, Pakistan, India temperate Himalaya from Kashmir to Sikkim.

Note : The leaves and scapes are used as vegetable. It is also used for food in USSR and is said to have anti-scorbutic properties.

A. wallichii Kunth Enum. 4: 443. 1843; Hook.f., Fl. Brit. India 6: 341. 1892.

Scapigerous herb. Bulbs small, clustered; stem thickened at base and sheathed. Leaves 4-6, linear, ensiform, flat, longer than scape,

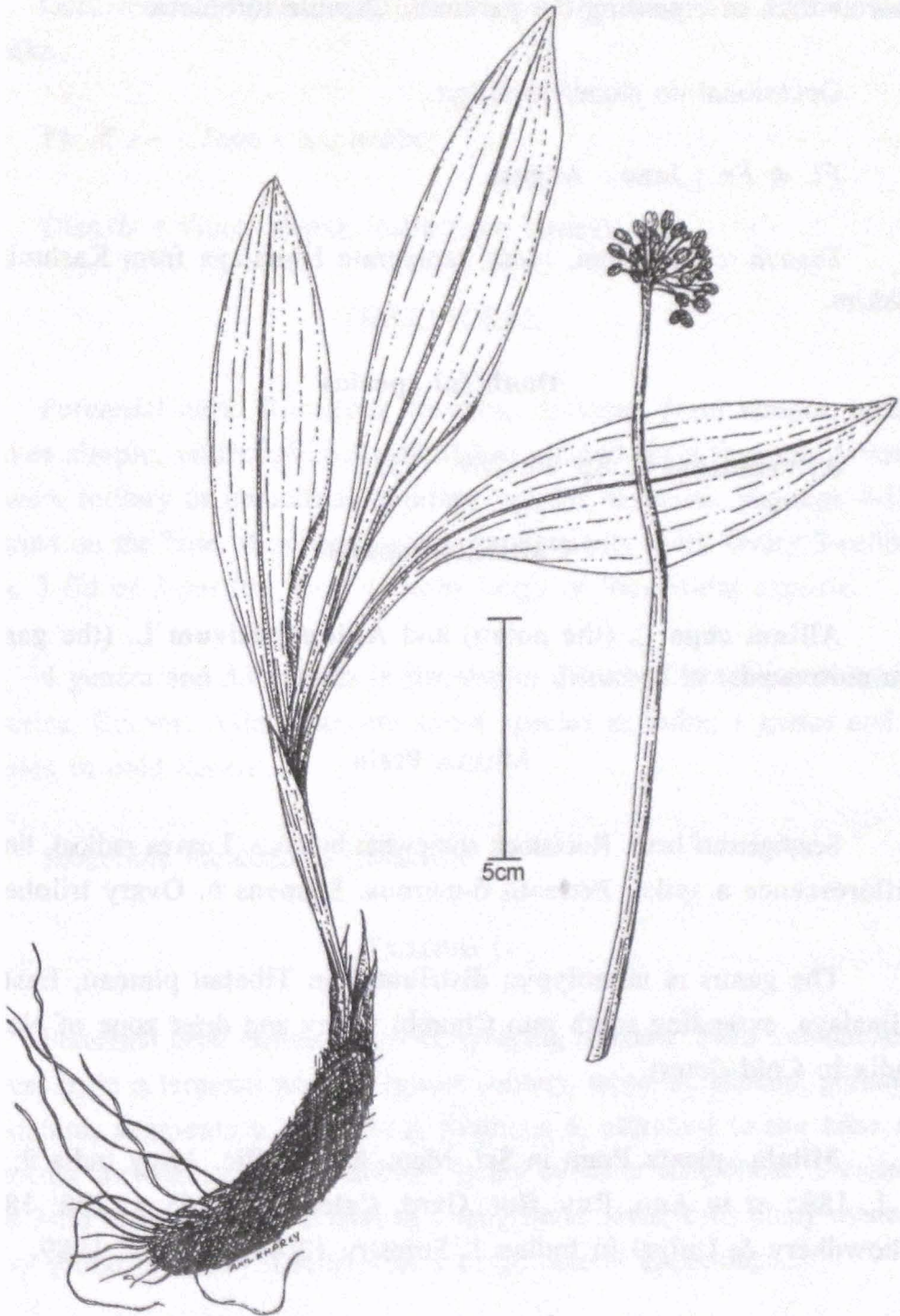


Fig. 14. *Allium victorialis* L.

40-75 x 2-4 cm. Scope stout, triquetrous, 30-45 cm long. Head lax-flowered, 4-7 cm across; spathes caducous. Flowers purple; perianth rotate, segments linear reflexed, longer than the filament, 1.5-2 cm long. Stamens shorter than or equalling the perianth. Capsule turbinate.

Occasional on slopes in Gilgit.

Fl. & Fr. : June - August.

Distrib. : Turkestan, India, temperate Himalaya from Kashmir to Sikkim.

Doubtful species

A. ramosum L. Sp. Pl. 269. 1753.

Cultivated species

Allium cepa L. (the onion) and **Allium sativum** L. (the garlic) are cultivated.

MILULA Prain

Scapigerous herb. Rootstock somewhat bulbous. Leaves radical, linear. Inflorescence a spike. Perianth 6-merous. Stamens 6. Ovary trilobed.

The genus is monotypic; distributed in Tibetan plateau, Eastern Himalaya, extending south into Chumbi valley and drier zone of Nepal, India in Cold desert.

Milula spicata Prain in Sci. Mem. Med. Offic. Army India 9: 57. t. 1. 1895 et in Ann. Roy. Bot. Gard. Calcutta 5: 165. t. 200. 1896; Chowdhery & Uniyal in Indian J. Forestry 12(4): 323-324. 1989.

Scapigerous herbs up to 25 cm tall. Rootstock bulbous, covered with fibrous sheaths. Leaves radical, flat, not fistular, linear, base sheathing. Scape up to 23 cm long. Inflorescence an oblong spike, 3-4 cm long, with

a single, purple, membranous spathe. Perianth lobes 6, in one series. Stamens broadened in the lower portion. bidentate. Ovary trilobed.

Occasional in open sandy places along the streams at Nyoma Rap Ladakh.

Fl. & Fr. : June - September.

Distrib. : Tibet, Nepal; India from Ladakh.

TRILLIACEAE

Perennial herb. Rootstock creeping rhizome. Stem simple, erect. Leaves simple, entire, almost reticulately veined, in a terminal whorl. Flowers solitary or umbellate, terminal, regular, bisexual. Stamens 4-12, inserted on the base of perianth-segments; filaments short. Ovary 3-celled; style 3-fid or 3-partite. Fruit a fleshy berry or loculicidal capsule.

4 genera and 53 species in the world; disturbed in temperate north America, Europe, Asia; 2 genera and 4 species in India; 1 genus and 1 species in cold desert.

Sometime included in Liliaceae.

TRILLIUM L.

Perennial herb. Rootstock short, creeping rhizome. Stem unbranched. Leaves 3, in a terminal whorl. Flowers solitary, terminal, stalked; perianth persistent, segments 6, spreading. Stamens 6, attached to the base of segments, included; anthers basifixed. Ovary ovoid or subglobose, 3-celled; style 3-fid or divided to the base in 3 long linear arms; cells many ovuled. Berry globose, fleshy. Seeds with a pulpy lateral appendage.

The genus comprises 30 species in the world, distributed in N. America, India (W. Himalaya) to Japan; 2 species in India; 1 species in cold desert.

Trillium govanianum Wall. ex D. Don in Royle, Ill. Bot. Himal. 384. t. 93. f. 1. 1839; Hook.f., Fl. Brit. India 6: 361. 1892. Fig. 15.

Erect, perennial, rhizomatous herb up to 20 cm tall. Rhizomes short, thick. Stem erect, unbranched. Leaves 3, in a terminal whorl, shortly petioled, ovate or ovate-cordate, acute, reticulately veined, 3.5-6 x 3-5 cm. Flower solitary, terminal, purple; perianth-segments 6, lanceolate, 2-2.5 cm long, spreading. Stamens 6, inserted at the base of the perianth-segments, filaments short, included; anthers basifixed. Ovary ovoid, 3-celled; style purple, divided to the base into 3 long linear arms; cells many ovuled. Berry fleshy, globose, 1-2 cm across. Seeds ovoid, with a lateral pulpy appendage.

Rare amidst rock boulders at Khoksar in Lahul.

Fl. & Fr. : July - August.

Distrib. : Temperate Himalaya from Kashmir to Sikkim.

JUNCACEAE

Usually rhizomatous tufted herbs in damp places. Inflorescence usually a terminal cluster of flowers; sepals and petals undifferentiated.

9 Genera, with about 400 species in the world; cosmopolitan, tropics to arctic regions; 2 genera and *ca.* 32 species in India; 2 genera and 12 species in the cold desert.

- 1a. Plants glabrous. Capsule beaked, many seeded JUNCUS
- b. Plants pubescent. Capsule not beaked, 3-seeded LUZULA

JUNCUS L.

Erect perennial, usually rhizomatous herbs. Stems tufted. Leaves radical and/or cauline, or reduced to sheaths. Inflorescence a cyme, terminal or appearing lateral due to basal bract. Flowers small, greenish - white or white. Perianth segments 6, in two series, glumaceous.

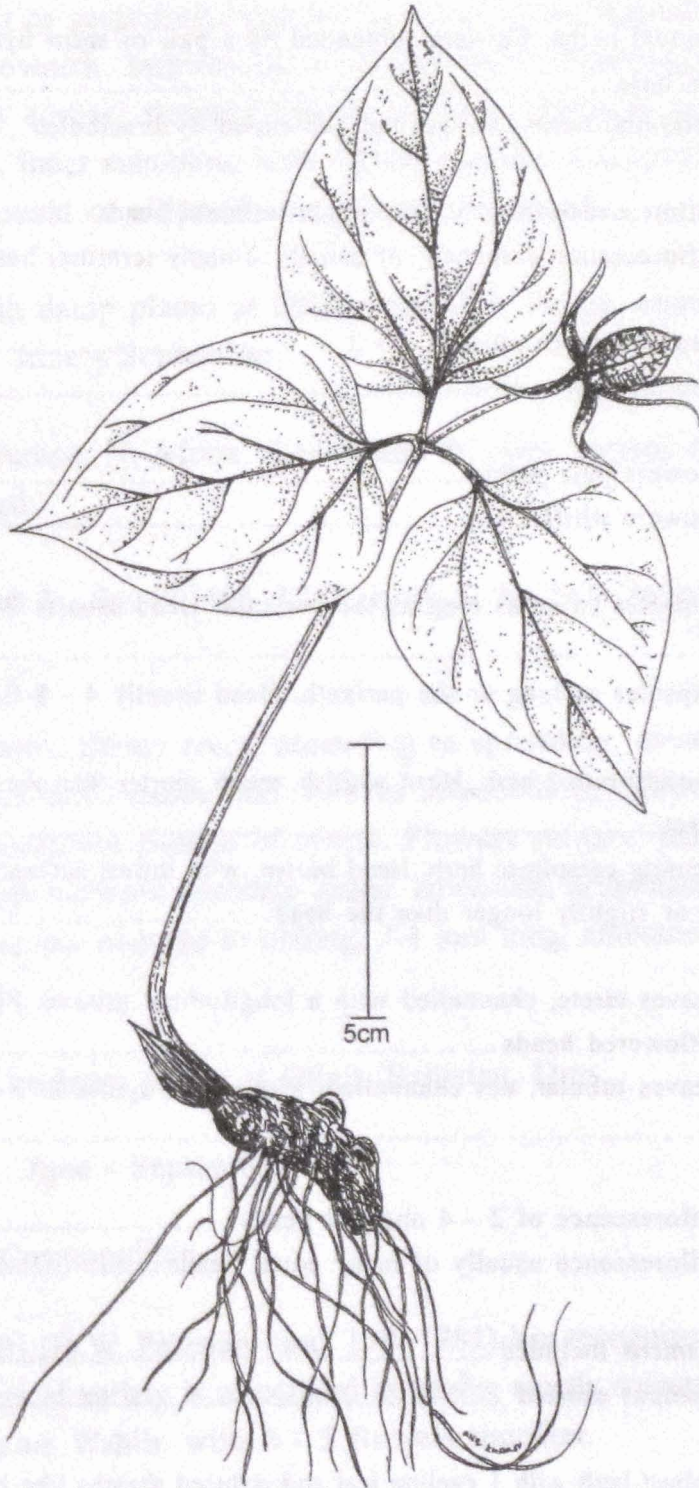


Fig. 15. *Trillium govanianum* Wall. ex D. Don

The genus comprises over 300 species; cosmopolitan, chiefly in cold and wet places; about 28 species in India; 11 species in cold desert.

- 1a. Annual herbs. Flowers subtended by a pair of short hyaline bracteoles at the base *J. bufonius*
- b. Perennial herbs. Flower not subtended by bracteoles 2
- 2a. Inflorescence usually of a single terminal heads 3
- b. Inflorescence branched, of usually 2-many terminal head 8
- 3a. Cauline leaves present, 1 - 3 4
- b. Cauline leaves absent 5
- 4a. Flowers pale yellow *J. leucanthus*
- b. Flowers white *J. membranaceous*
- 5a. Capsules twice as long as the perianth. Head usually 2-3-flowered
..... *J. triglumis*
- b. Capsules as long as the perianth. Head usually 4 - 8-flowered 6
- 6a. Loosely tufted herb. Head whitish, much shorter than the lowest subtending bract *J. leucomelas*
- b. Densely caespitose herb. Head brown, with lowest subtending bracts as long as or slightly longer than the head 7
- 7a. Leaves terete, channelled with a longitudinal groove. Flowers in cyme of 2-flowered heads *J. rohtangensis*
- b. Leaves tubular, not channelled. Flowers in cymes of 3-8-flowered heads *J. thomsonii*
- 8a. Inflorescence of 2 - 4 unequal heads 9
- b. Inflorescence usually of many equal heads 10
- 9a. Stamens included *J. sphacelatus*
- b. Stamens exerted *J. concinus*
- 10a. Robust herb with 1 cauline leaf and reduced sheaths like basal leaves. Heads 20 - 40-flowered *J. punctorius*
- b. Slender herb with 2 - 10 cauline leaves and well developed basal leaves. Heads 4 - 12- flowered *J. articulatus*

Juncus articulatus L., Sp. Pl. 327. 1853. *J. lampocarpus* Ehrh. ex Hoffm. Dentsch. Fl. 125. 1791; Hook.f., Fl. Brit. India 6: 395. 1892.

Stems erect or ascending, with 2-10 cauline leaves. Leaves linear; basal sheaths brownish. Inflorescence subumbellately branched cymes. Heads 5-10 mm across; flowers brownish green; perianth segments lanceolate, acute, inner subobtusate with whitish margins. Capsule 3-4 mm long, oblong-obovoid or ellipsoid, exceeding the perianth.

Common in damp places at Gilgit, Baltistan, Nubra, Dras.

Fl. & Fr.: June - September.

Distrib.: Europe, N. Africa, Central and W. Asia, eastern America, widely distributed.

J. bufonius L., Sp. Pl. 466. 1753; Hook.f., Fl. Brit. India 6: 392. 1892. Fig. 16.

Annual herbs. Stems erect, ascending to spreading, usually with several basal and one cauline leaf. Leaves setaceous or filiform, base sheathing. Inflorescence panicle of cymes. Flowers solitary, pale green, 5-7 mm long; outer perianth segments longer, lanceolate, acuminate, margin membranous. Capsule obovoid to oblong, 3-4 mm long, embraced by the perianth.

Common in damp places at Gilgit, Baltistan, Dras.

Fl. & Fr.: June - September.

Distrib.: Cosmopolitan.

Note : Jafri (Fl.W. Pakistan Fasc. 138. 1981) has recognised several varieties. The typical variety is recognised as having mostly solitary flowers and var. *congestus* Wahlb. with 2 - 3 flowers together.

J. concinus D.Don, Prodr. Fl. Nep. 44. 1825; Hook.f., Fl. Brit. India 6: 399. 1892.

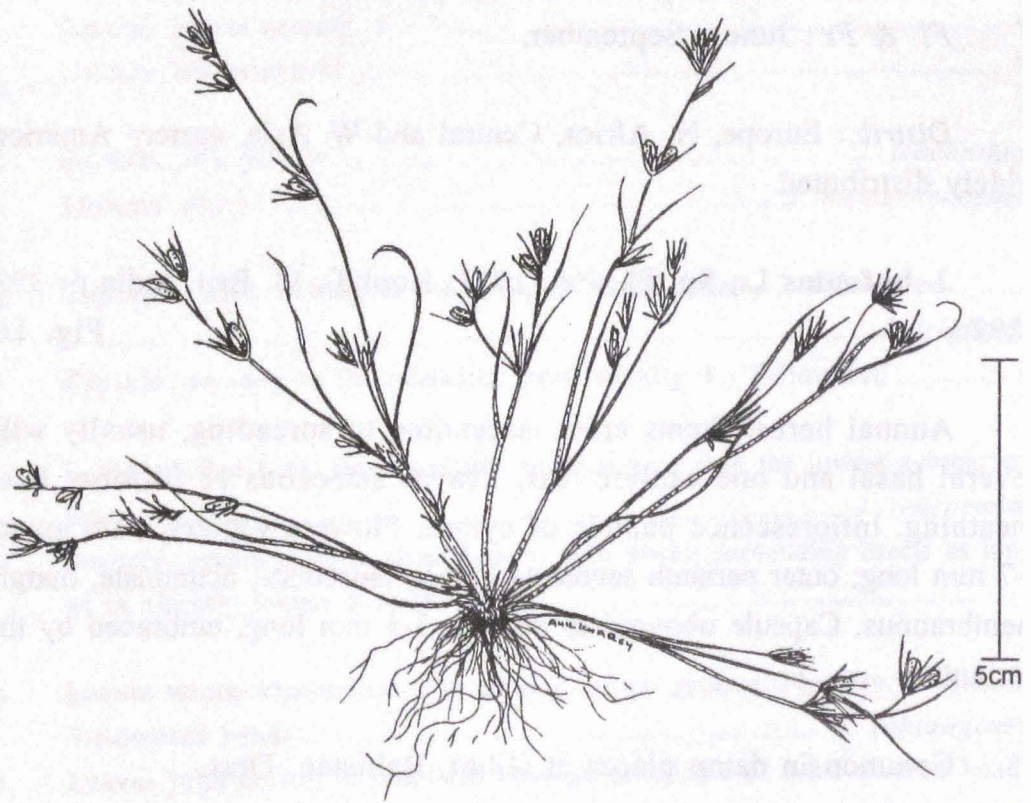


Fig. 16. *Juncus bufonius* L.

Slender herbs with tuberous rootstock. Leaves few, filiform or involute, sheath membranous. Inflorescence of branched cymes; heads upto 9 cm across, 6 - 15-flowered; lowest bract equalling or exceeding the head. Flowers white or yellowish, 6 - 7 mm long; perianth segments subequal, oblong-lanceolate, acute, membranous. Capsules ovoid, pale, shining, almost arcuate, exerted.

In damp places at Gilgit.

Fl. & Fr.: July - August.

Distrib.: Temperate and alpine Himalaya from Kashmir to Sikkim.

Note : It is closely allied to *J. membranaceus* Royle ex D. Don.

Juncus leucanthus Royle ex D. Don in Trans. Linn. Soc. 18: 318. 1840; Hook.f., Fl. Brit. India 6: 397. 1892. Fig. 17.

Tufted herb with short rootstock. Stem at length hollow with basal sheaths hard, brown. Leaves filiform, slender, uppermost equalling the stem. Inflorescence a terminal cyme, 6-10-flowered, pale yellow; bracts ovate-oblong, acute, brown, lowermost equalling the flowers. Flowers shortly pedicelled, 4-5 mm long; perianth-segments oblong-lanceolate, sub-acute, membranous. Stamens exerted; anthers half as long as the filaments. Style long, exerted. Capsule obovoid-oblong, beaked.

Occasional in moist places on slopes in Rohtang Pass in Lahul.

Fl. & Fr. : June - September.

Distrib. : Temperate and alpine Himalayas from Himachal Pradesh to Sikkim.

J. leucomelas Royle ex D. Don in Trans. Linn. Soc. 18: 320. 1840; Hook.f., Fl. Brit. India 6: 397. 1892, *pro part. excl. syn.*

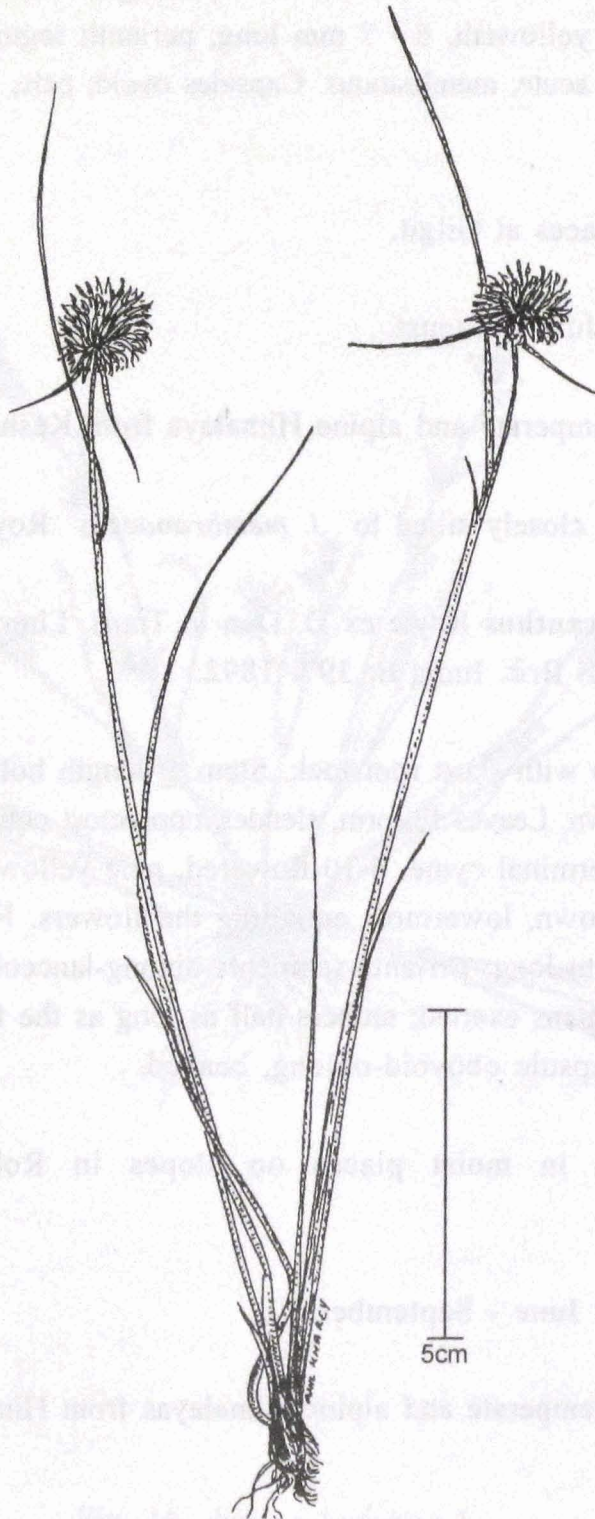


Fig. 17. *Juncus leucanthus* Royle ex D. Don

Tufted herbs with short rootstock. Stem hollow, without cauline leaves. basal leaves 1 - 2, filiform, tubular. Inflorescence a terminal white head; upper bracts pale, membranous; lower bracts as long as or exceeding the heads. Flowers 4-5 mm long; perianth segments linear, obtuse, membranous. Capsule ovoid-oblong, 4-5 mm long.

Common in damp places and brackish marshes at Rupshu.

Fl. & Fr.: June to September.

Distrib.: Temperate and alpine Himalayas from Kashmir to Sikkim.

Note : This species is quite similar to *J. thomsonii* except for difference in the colour of flowers which is brownish in the latter.

Juncus membranaceus Royle ex D. Don in Trans. Linn. Soc. 18(3): 320. 1840; Hook.f., Fl. Brit. India 6: 397. Fig. 18.

Stoloniferous, tufted herbs. Stem with 1 - 3 cauline leaves. Leaves filiform, sheath long auricled. Inflorescence a simple terminal head, white, 8 - 20-flowered; lowest bract as long as or exceeding the head; floral bracts ovate-lanceolate, hyaline. Flowers 6-7 mm long; perianth segments oblong-lanceolate, inner slightly longer than outer. Capsule ovoid-lanceolate, dark brown, long beaked, usually exerted.

Common in damp places at Baltistan, Rusi La, Sapi La.

Fl. & Fr.: May - October.

Distrib.: Temperate and alpine Himalaya from Afghanistan to Sikkim.

J. punctorius L.f., Suppl. 208. 1781; Hook.f., Fl. Brit. India 6: 395. 1892.

Tall, robust herbs with creeping rootstock. Stem leafy. Leaf as long as the stem; basal leaves reduced to sheath. Inflorescence a terminal,

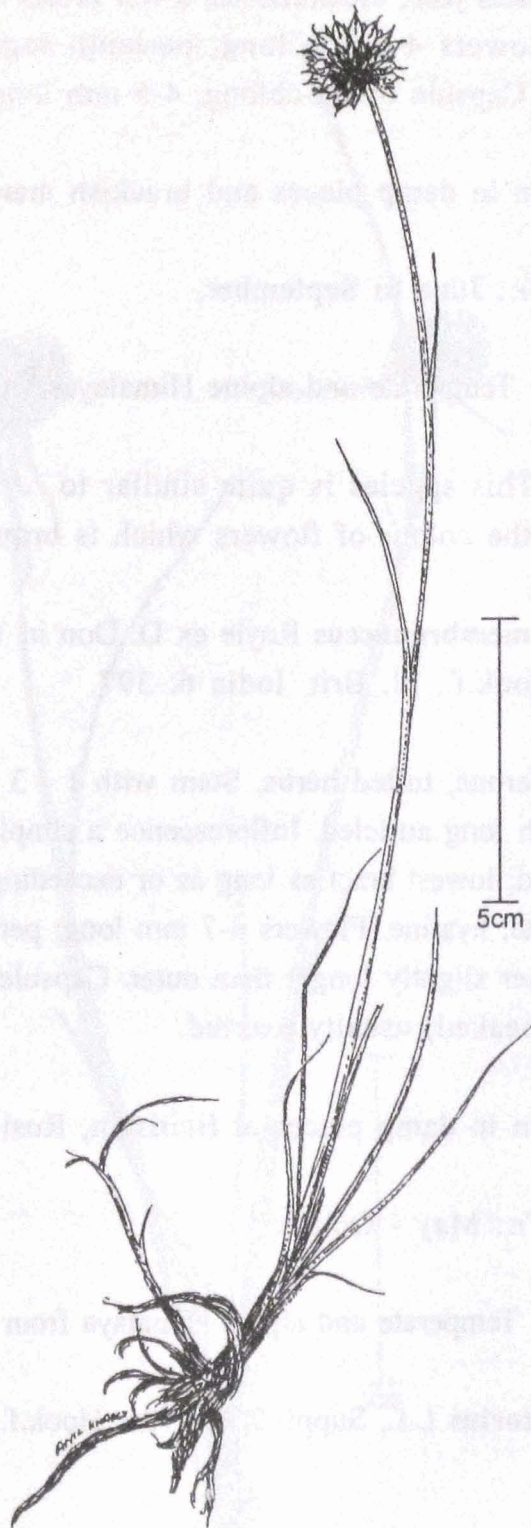


Fig. 18. *Juncus membranaceus* Royle ex D. Don

umbellately compound cyme, 10 cm long, branches divaricate; heads globose, 15 - 40, hyaline. Flowers brownish; outer perianth segments oblong-lanceolate, acute, inner ovate-oblong, sub acute. Capsule ovoid, mucronate, as long as the perianth, brown, shining.

Common in marshy places at Baltistan, Zanskar.

Fl. & Fr.: May - September.

Distrib.: North and South Africa, Arabia, Pakistan, India.

Juncus rohtangensis Goel et Aswal in Indian J. Forestry 10(4): 262. 1987.

Densely caespitose herb. Stem hollow, without cauline leaves. Leaves radical, usually 1, rarely 3, linear, sheathing at base, more than half the length of stem. Inflorescence a solitary, unilateral 2-flowered cymes, dark brown; lower bracts foliaceous, with broad brown margins; upper bracts glumaceous, brown, equalling or longer than flowers. Flowers stalked; perianth-segments 6, in two whorls, 4.5-6.5 mm long, stamens included; anthers longer than filaments. Capsule oblong, triquetrous.

Occasional amidst rock boulders, on moist slopes in Rohtang Pass in Lahul.

Fl. & Fr. : July - August.

Distrib. : Himachal Pradesh in Rohtang Pass in Lahul Spiti (Endemic).

Note : Noltie (*Edinburgh J. Bot.* 51: 134. 1994) considers this as conspecific with *J. duthiei* (C.B. Clarke) Noltie (= *Microschoenus duthiei* C.B. Clarke - a species belonging to the family Cyperaceae).

J. sphacelatus Decne. in Jacq. Voy. Bot. 172. t. 172. 1844; Hook.f., Fl. Brit. India 6: 398. 1892. Fig. 19.

Stoloniferous, tufted herbs with creeping rootstock. Stem with 1 - 2 cauline leaves. Leaves filiform or involute tubular; sheaths brownish. Inflorescence a cyme of 2-5 clustered or distant, superposed or corymbosely

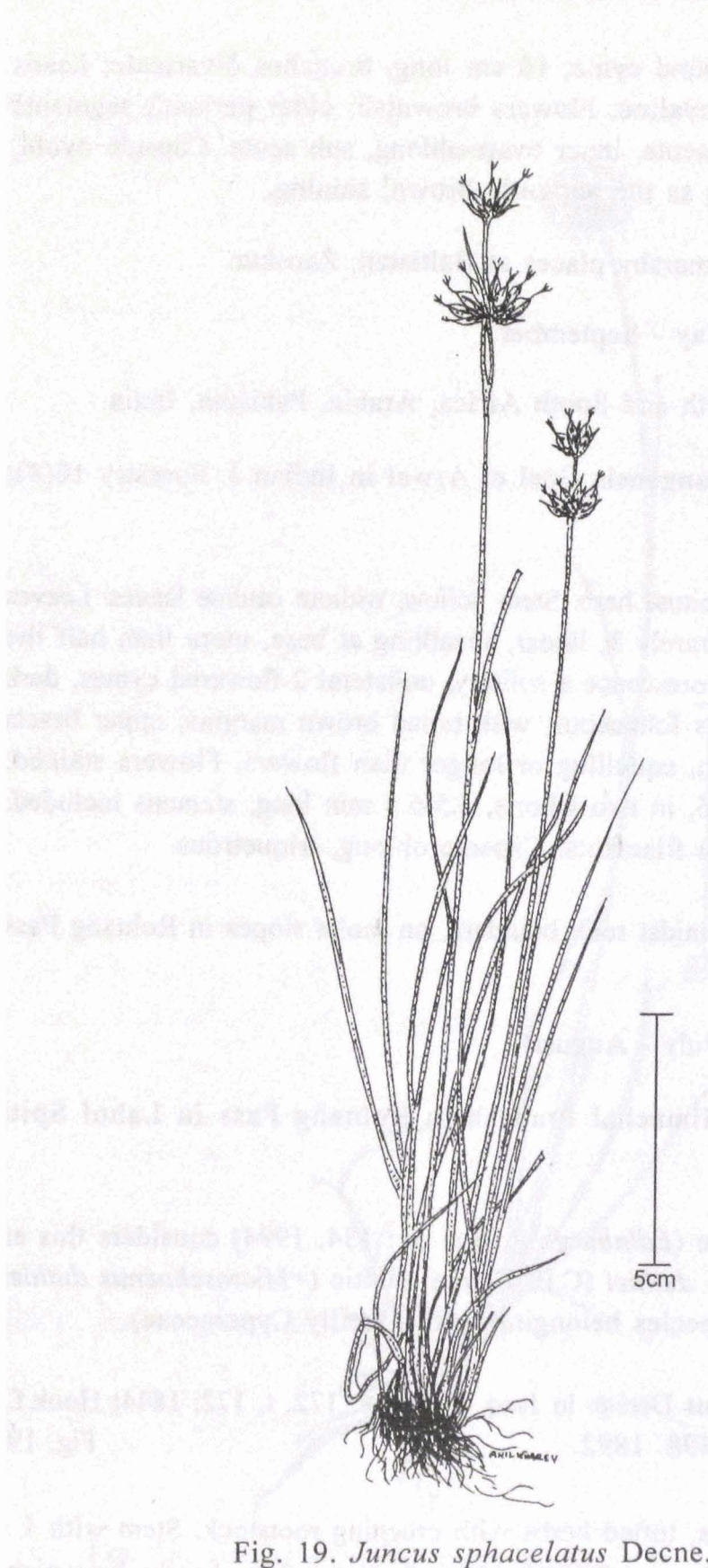


Fig. 19. *Juncus sphacelatus* Decne.

to sub corymbosely arranged heads; heads 3 - 8-flowered, brown; lowest bracts as long as or exceeding the heads; floral bracts lanceolate, acuminate. Outer perianth segments lanceolate, glumaceous, inner oblong, hyaline. Capsule 5 - 9 mm long, oblong-ovate, long beaked or mucronate, dark brown, shining.

Common in marshy places.

Fl. & Fr.: May - October.

Distrib.: Afghanistan, Pakistan, India.

- 1a. Inflorescence of 2 - 5 superposed heads var. *sphacelatus*
 b. Inflorescence of 2-5 congested, corymbosely or subcorymbosely arranged heads var. *himalensis*

var. *sphacelatus*

Plant is rather stout, pale green.

Zanskar, Deosai Plains, Astor.

var. *himalensis* (Klotzsch & Garcke) Jafri in Fl. West Pakistan Fasc. 138: 12. 1981. *Juncus himalensis* Klotzsch and Garcke, Bot. Ergeb. Reise Prinz Waldem 60. t. 97. 1862; Hook.f., Fl. Brit. India 6: 398. 1892.

Plants is rather slender, green.

Gilgit, Baltistan, Zanskar, eastward to Lahul and Spiti.

Juncus thomsonii Buchen in Bot. Zeit 25: 148. 1867. *J. leucomelas sensu* Hook.f., Fl. Brit. India 6: 397. 1892. *ex part non* D. Don 1840.

Densely caespitose, green herbs with short rootstock. Stem without cauline leaves; basal leaves 1 - 2, filiform. Inflorescence a terminal, brownish head, 3 - 8-flowered; upper bracts pale, membranous; lower

bracts shorter than the heads. Perianth segments linear, obtuse, membranous, brown. Capsule ovoid-trigonous.

Common in damp places in alpine bogs and meadows at Deosai Plains, Baltistan, Pangong Lake, Rupshu.

Fl. & Fr.: June - September.

Distrib.: C. Asia, Tibet, India in N.W. Himalaya.

Note : This species is quite similar to *J. leucomelas* and *J. triglumis*. However, it differs from the former in having brownish head and short subtending bracts not exceeding the head, and from the latter in having exerted anthers and ovoid-trigonous, exerted capsules.

Juncus triglumis L., Sp. Pl. 328. 1753; Hook.f., Fl. Brit. India 6: 396. 1892.

Tufted green herbs, with short, non-stoloniferous rootstock. Stem stiff, without cauline leaves. Basal leaves stiff, half as long as the stem; basal sheaths obtusely auricled, reddish. Inflorescence a solitary, terminal head, 3 - 4-flowered, dark-green; bracts dark brown, lowest much shorter than the head. perianth segments ovate-lanceolate obtuse brown. Capsule ovate oblong, mucronate. Seeds with long tails.

Common in moist rocky places at Ladakh.

Fl. & Fr.: July - August.

Distrib.: Arctic and alpine regions in Europe, N. & C. Asia, N.W. Himalayas in India.

Note : The species is closely allied to *J. leucomelas* and *J. thomsonii*.

LUZULA DC. *nom. cons.*

Perennial, rhizomatous, tufted herb. Leaves radical and cauline, flat, hairy, basal sheath closed and without auricles. Inflorescence cymes. Flowers solitary or clustered in glomerules, brownish. The genus comprises about 75 species, cosmopolitan, chiefly in colder regions; 4 species in India; 1 species in cold deserts.

Luzula spicata (L.) DC. in Lam. & DC. Fl. France ed. 3. 161. 1805; Hook.f., Fl. Brit. India 6: 401. 1892. Fig. 20.

Perennial, tufted, stoloniferous herbs; rootstock clothed with persistent brownish sheaths. Radical leaves linear, recurved, 2 - 8 cm long, cauline leaves few, shorter and narrower. Inflorescence a spicate cymes, terminal, delicate, nodding, brown; lower bracts leafy; floral lanceolate, brown, with white, membranous, ciliate margins. Flowers brown, 2-3 mm long, crowded in glomerules; perianth segments lanceolate, acute to subobtuse, aristate. Stamens 6, included. Capsules broadly ellipsoid or oblong, obtuse, included.

Common in moist places at Satpura La above Skardu, Deosai Plains, Baltistan.

Fl. & Fr.: May - August.

Distrib.: Europe, C. & N. Asia, N. America, Pakistan, India in N.W. Himalaya, Kashmir.

TYPHACEAE

Aquatic or marshy, rhizomatous herbs. Leaf spongy. Inflorescence dense, cylindrical spike. Flowers unisexual, male in upper part of spike, female in lower part of spike; perianth of slender hairs or absent in males. Stamens 1 or more. Ovary often reduced to a clavate tipped hair, on a capillary stipe. Fruits membranous.

One genus and 10-20 species in the world; distributed in temperate and tropical regions; 3 species in India; 2 species in cold desert.

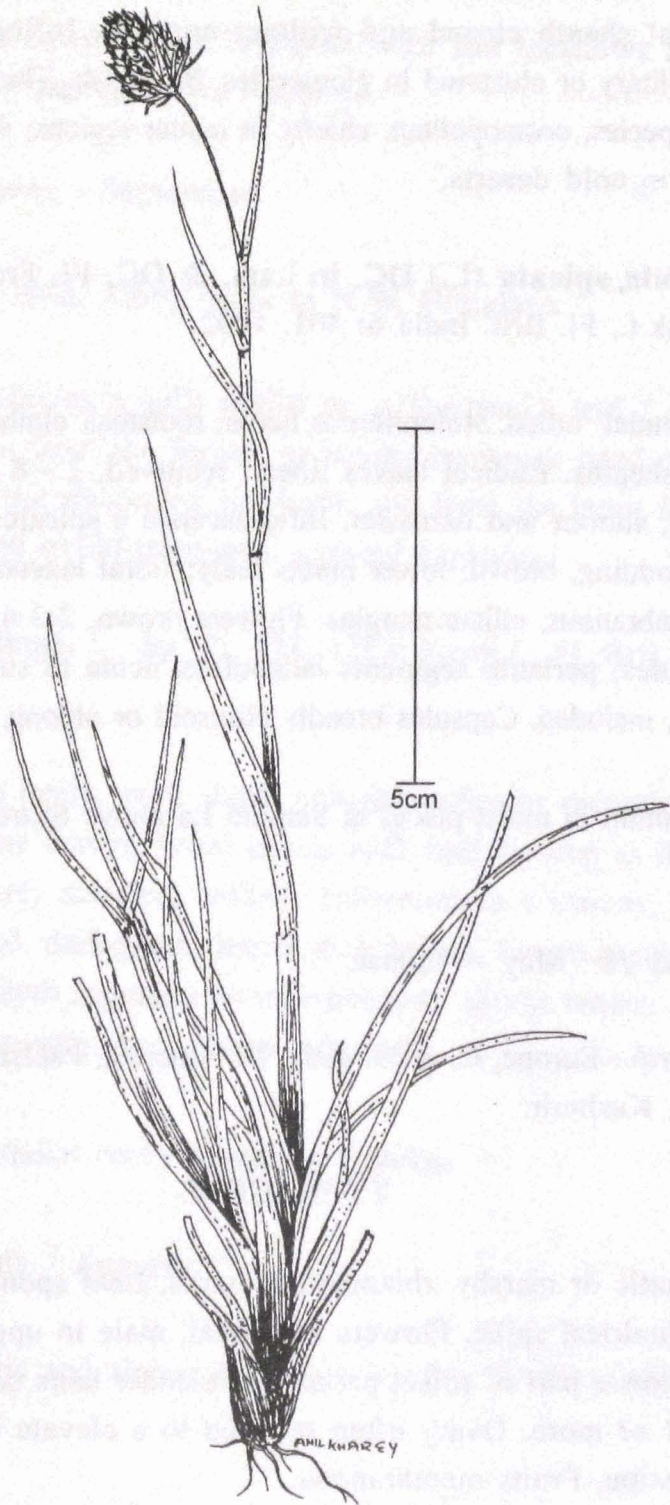


Fig. 20. *Luzula spicata* (L.) DC.

TYPHA L.

Character as that of the family.

The genus comprises 10-20 species in the world; in temperate and tropical regions; 3 species in India; 2 species in cold desert.

- 1a. Slender herb up to 30 cm tall. Female flowers ebracteolate. *T. laxmannii*
 b. Robust herb 1-2 m tall. Female flowers bracteolate *T. australis*

Typha australis Schum. & Thonn. Danske Vidensk. Selsk. Afhandl. 4. Ser. 4. 175. 1829. *T. angustata* Bory. & Chaub. in Bory Exped. Sci. Moree Bot. 2. 1: 338. 1832; Hook.f., Fl. Brit. India 6: 489. 1893. *T. angustifolia auct non.* L. 1753.

Tall robust, marshy, rhizomatous herb up to 2 m tall. Leaves with semicylindrical blade, radical. Flowers monoecious, yellow, lower female, upper male. Bracteoles of female flowers spatulate, almost as long as the stigma, longer than the hairs. Male perianth of 3 hairs, female perianth of several capillary bristles. Stigma linear, longer than hairs. Fruits drupaceous.

Common in marshy places at Gilgit.

Fl. & Fr. : April - December.

Distrib. : N. Africa, Europe, India.

T. laxmannii Lepechin in Nova Act. Acad. Petrop. 12: 84. 335. t. 4. 1801, Hook.f., Fl. Brit. India 6: 489. 1893.

Small slender marshy rhizomatous herb, 10-30 cm tall. Leaves slender, semicylindric at the sheath. Flowers monoecious, yellowish, lower female, upper male. Stigma sub-obtuse.

Common in marshy places in Baltistan.

Fl. & Fr. : April - December.

Distrib. : Europe, Asia, India in Kashmir.

ARACEAE

Perennial herbs of various habitats. Rootstock tuberous, thick and creeping. Leaves various, radical or alternate. Flowers numerous uni-or bisexual, sessile on a spadix; spadix enclosed in spathe. In unisexual flowers, the male flowers in the upper part of spadix. Spadix in some genera prolonged into barren tail-like appendage. Perianth absent. Anthers 2-4. Ovary globose or ovoid, 1-3-celled. Fruit a berry, arranged in compact spike or head, which is often enveloped in the persistent spathe tube.

115 genera and over 2000 species in the world; distributed in tropical and temperate regions; about 24 genera and more than 135 species in India; 1 genus and 1 species in cold desert.

ARISAEMA Mart.

Erect, perennial herb. Root tuberous. Stem sheathed at the base by membranous scales. Leaves 1-2, digitately or pedately compound. Inflorescence of numerous, small, unisexual flowers, crowded on a fleshy spadix terminating the stem; spadix prolonged into a short or long tail-like appendage. Spadix enclosed in a spathe, included or exerted; spathe deciduous; lower portion of spathe folded like tube, margin free, overlapping; limb open, arching over the mouth of the tube. Male and female flowers usually on different plants or if on the same spadix then both type of flowers contiguous and not separated by barren neutral organ. Male flowers usually stipitate head of 3-5 anthers. Female flowers of 1-celled ovary; style short or absent; stigma disciform. Fruiting spike naked. Berries red, usually 1-seeded.

The genus comprises 156 species in the world; distributed in north America, temperate and tropical Asia, E. Africa; 45 species in India; 1 species in cold desert.

Arisaema jacquemontii Bl., Rumph. 1: 95. 1836; Hook.f., Fl. Brit. India 6: 505. 1893. Fig. 21.

Erect, dioecious herb up to 60 cm tall. Tuber subglobose. Stem sometimes mottled. Leaves 1-2, digitately compound, petiole 15-20 cm long; leaflets 5-7, unequal, elliptic or obovate-lanceolate, caudate-acuminate, 7-20 x 2-5 cm. Spathe green, striped with white; tube 3-5 cm long, limb as long or longer, oblong or ovate-lanceolate, narrowed into a long, green or purple, thread like 4-7 cm long tail. Spadix prolonged into a tapering appendage, shorter than spathe, tip curved forward and protruding to one side. Male flowers a stipitate head of 3 anthers. Ovary 1-celled. Berries globose, 4-4.5 mm across, red.

Occasional on forest-floor in Lahul.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, India, Temperate Himalaya from Kashmir to Sikkim.

LEMNACEAE

Minute or small, free-floating annual herbs. Monoecious. Flowers 1-3, naked or in a spathe. Perianth absent. Fruit an utricle.

6 genera with about 30 species in the world; cosmopolitan; 4 genera and about 12 species in India; 1 genus and species in cold desert.

LEMNA L.

Free floating herbs, consisting of leaf-like fronds, either separate or 2-3 together and usually with one or several root-fibres from their lower surface. Male and female flowers on same plant. Flowers enclosed in spathe and consist of stamen and ovary.

The genus comprises about 15 species in the world; cosmopolitan; 4 species in India; 1 species in cold desert.

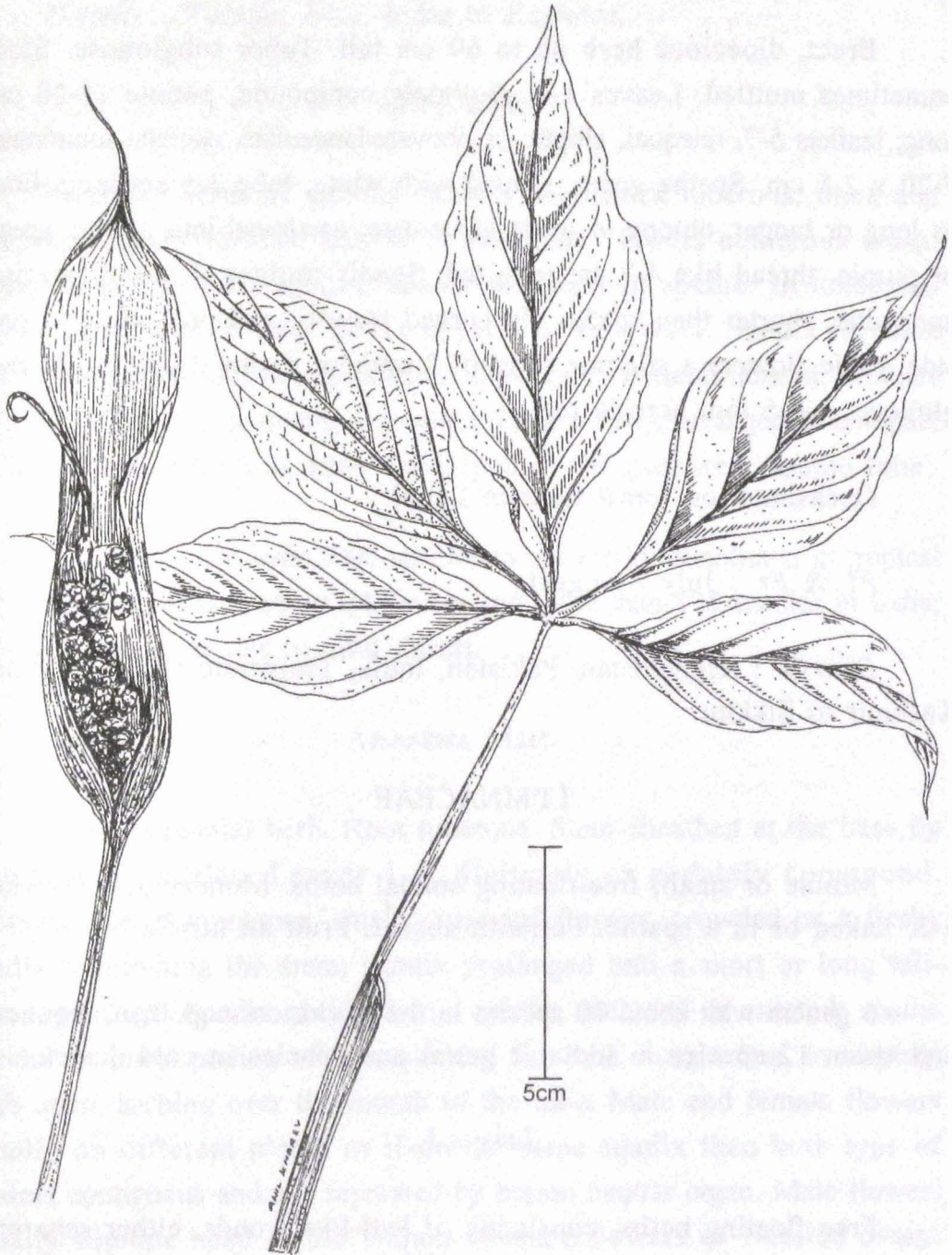


Fig. 21. *Arisaema jacquemontii* Bl.

Lemna minor L., Sp. Pl. 970. 1753; Hook.f., Fl. Brit. India 6: 556. 1893.

Minute, floating herb consisting of leaf-like fronds. Fronds with single root fibre, obovoid or oblong, both surfaces nearly flat, 2-4 mm long. Flowers unisexual, male and female on the same plant, in marginal clefts of the frond, at first enclosed in a minute spathe. Perianth absent; stamens 2; ovary 1-celled; style long. Fruit a bottle-shaped utricle.

Common in stagnant water in Ladakh.

Fl. & Fr. : Throughout the year.

Distrib. : Cosmopolitan.

NAJADACEAE

Submerged herb. Stem branched, filiform, smooth or muricate. Leaves alternate, opposite or whorled, linear, entire or toothed, base auricled or slightly dilated. Flowers minute, axillary, unisexual; male perianth consists of an outer entire or 4-fid tube and an inner hyaline tube. Stamen 1, apiculate or cuspidate; female perianth absent or hyaline and adherent to the carpel. Ovary of a single carpel; stigma 3. Carpel 1, sessile. Fruit an achene.

One genus comprising about 50 species in the world; cosmopolitan; about 15 species in India.

NAJAS L.

Character as that of the family

The genus comprises about 50 species in the world; 15 species in India; 1 species in the cold Desert.

Najas marina L., Sp. Pl. 1015. 1753. *N. major* All. Fl. Pedem. 2: 221. 1785; Hook.f., Fl. Brit. India 6: 569. 1893.

Slender aquatic herb. Stem submerged, terete, rough with short outgrowths. Leaves opposite or whorled, linear, deeply and shortly toothed, base sheathing. Flowers minute, solitary axillary, sessile, dioecious, male and female on different plants. Male flower-perianth tubular, 2-3-toothed; anther 1, sessile, adnate to perianth. Female flower-perianth absent; ovary of a single carpel; stigma 3, thread like. Achene oblong.

Common in marshes and ponds in Shyok valley, Baltistan.

Fl. & Fr. : May - October.

Distrib. : Cosmopolitan.

JUNCAGINACEAE

Perennial marshy herbs, scapigerous. Leaves mostly linear, radical, sheathing at base. Inflorescence a raceme or spike. Flowers bisexual; perianth segments herbaceous, biseriate. Fruits of 3 or 6 free or connate achenes or follicles with recurved tips.

3 genera and about 25 species in the world; chiefly in N. and S. temperate regions; 1 genus and 2 species in India and cold desert.

TRIGLOCHIN L.

Perennial, marshy herbs. Tuberos or rhizomatous. Stem scapigerous. Leaves radical, linear, fleshy, slightly terete, sheathing at base. Inflorescence a scapigeorus raceme. Scape leafless, many-flowered. Flowers bisexual, 3-merous, bracteate; perianth segments 6, in 2 series, deciduous. Stamens 6, subsessile, inserted on the base of the perianth segemnts. Carpels 6, all fertile or rarely alternate 3 sterile, connate, separating at maturity. Fruit of 6 or 3 free achenes or follicles.

The genus comprises about 15 species; cosmopolitan, especially Australia and temperate S. America; 2 species in India and in cold desert.

- 1a. Fruit 6-carpellary, with angular edges, 3-4 mm long, oblong, ovoid. Carpels separating entirely *T. maritima*
 b. Fruit 3-carpellary, with rounded edges, 6-10 mm long, linear or oblong-linear. Carpels connate with stigma *T. palustris*

Triglochin maritima L., Sp. Pl. 338. 1753; Hook.f., Fl. Brit. India 6: 563. 1893. Fig. 22.

Perennial, marshy scapigerous herb with short rhizome. Stem tuberous and stoloniferous. Scapes 20-60 cm long, curved. Leaves linear-subulate, terete but slightly flattened at the tip, 10-25 cm long. Racemes 20-35 cm long, slightly elongating in fruits. Flowers greenish, 2-3 mm across; perianth segments 6, 2-2.5 mm long, ovate-elliptic, tip rounded, deciduous; stamens 6, inserted on the base of the perianth segments; carpels 6, fertile, Fruit achenes, 3-4 mm long, oblong-ovoid.

Common in brackish or salty marshy places in Rupshu, Zanskar, Ladakh.

Fl. & Fr. : May - October.

Distrib. : Europe, Asia, N. Africa, N. America.

Note : A fairly good forage plant and yields sodium carbonate from its ash, used for soap making (Jafri, Fl. West Pakistan No. 48. 1773).

T. palustris L., Sp. Pl. 338. 1753; Hook.f., Fl. Brit. India 6: 563. 1893. Fig. 23.

Perennial scapigerous marshy herb with long slender rhizome. Stem tuberous and stoloniferous. Scape slender, 15-40 cm long. Leaves linear,

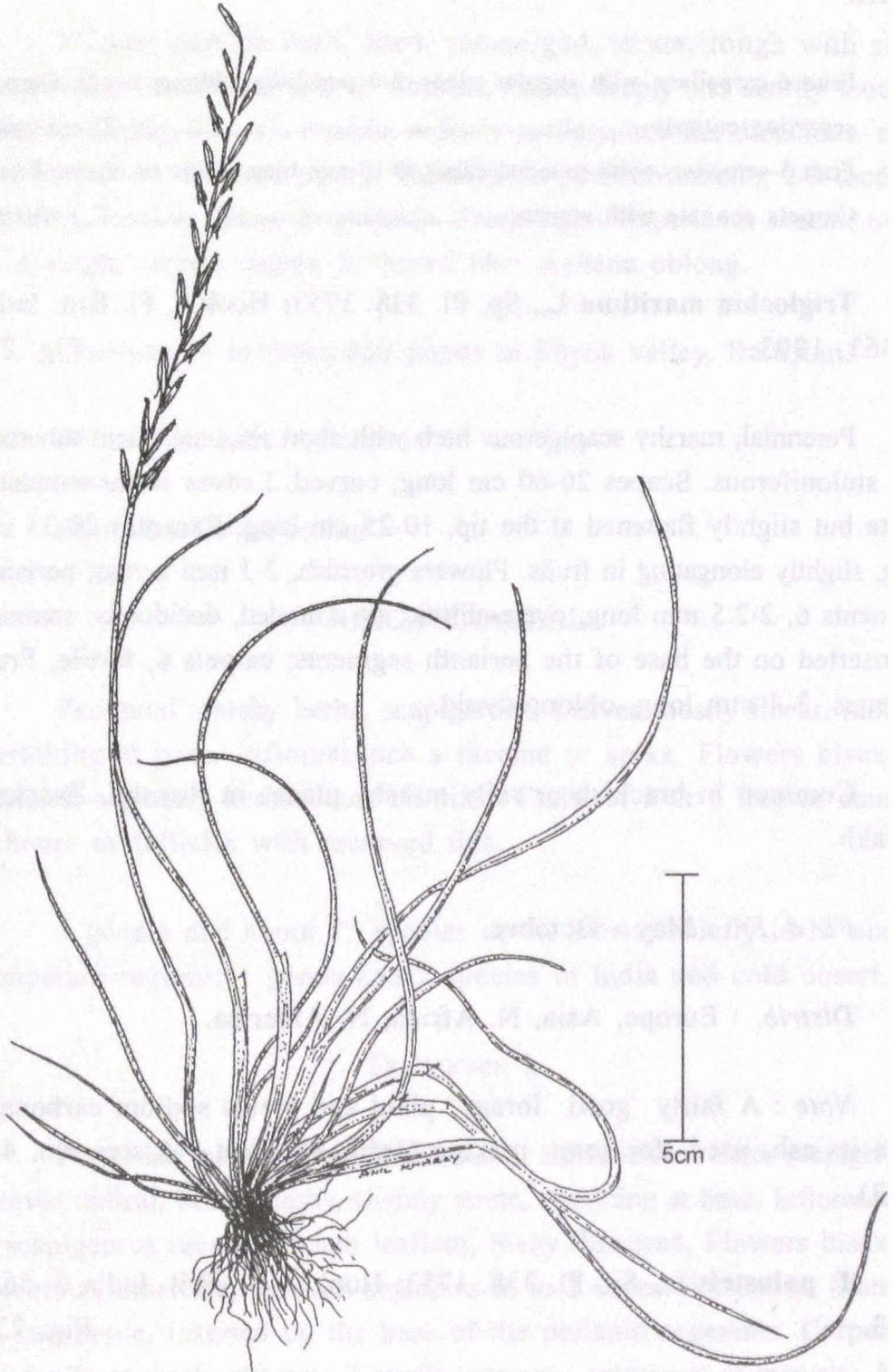


Fig. 22. *Triglochin maritima* L.

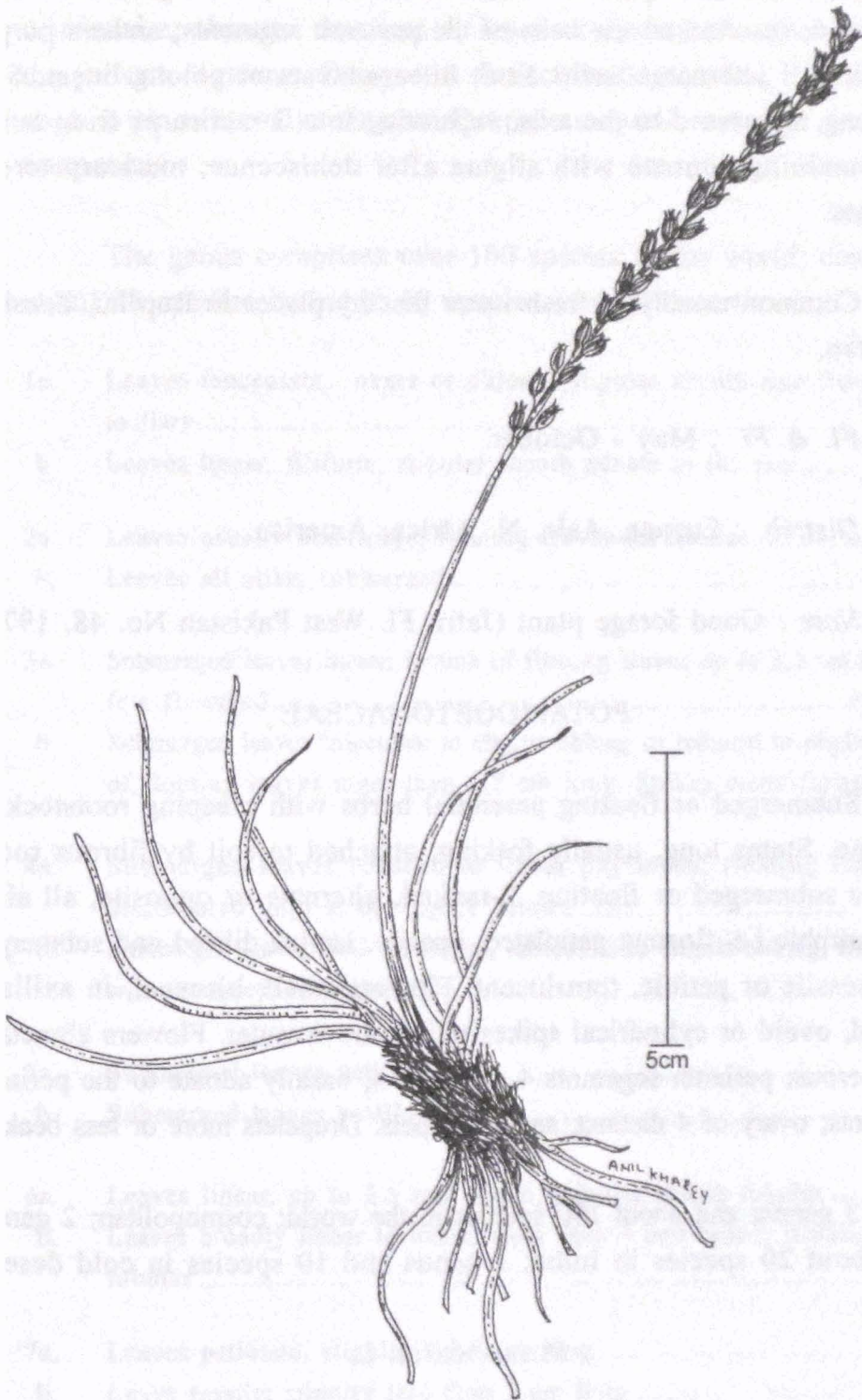


Fig. 23. *Triglochin palustris* L.

flaccid, sheathing at the base, 8-20 cm long. Racemes 15-25 cm long, much elongating in fruit. Flowers about 3 mm across; perianth segments 6, 1.5-2 mm long, elliptic-ovate, greenish, with purple margins, deciduous; stamens 6, inserted on the base of the perianth segments; anthers purple; carpels 6, 3 alternate sterile. Fruit linear-clavate or oblong-linear, 6-10 mm long, appressed to the axis, separating into 3 mericarps from below but remaining connate with stigma after dehiscence; mericarp terete, subulate.

Common usually in fresh water marshy places in Rupshu, Zanskar, Baltistan.

Fl. & Fr. : May - October.

Distrib. : Europe, Asia, N. Africa, America.

Note : Good forage plant (Jafri, Fl. West Pakistan No. 48. 1973).

POTAMOGETONACEAE

Submerged or floating perennial herbs with creeping rootstock or rhizome. Stems long, usually forking, attached to soil by fibrous roots. Leaves submerged or floating, 2-ranked, alternate or opposite, all alike or dimorphic i.e. floating petiolated, opaque, lamina dilated and submerged ones sessile or petiole, translucent. Flowers small, bisexual, in axillary, stalked, ovoid or cylindrical spikes rising above water. Flowers ebractate, tetramerous; perianth segments 4, stamens 4, basally adnate to the perianth segments; ovary of 4 distinct, sessile carpels. Drupelets more or less beaked.

3 genera and about 100 species in the world; cosmopolitan; 2 genera and about 20 species in India; 1 genus and 10 species in cold desert.

POTAMOGETON L.

Submerged, perennial herb with creeping rootstock. Stem long, usually forking, attached to soil by fibrous roots. Leaves often dimorphic, stipulate,

alternate or opposite, opaque or translucent, entire or finely toothed, sessile or stalked. Inflorescence axillary, ovoid or cylindrical spikes, rising above the water. Flowers small, bisexual, greenish, tetramerous; perianth segments 4, concave, obovate. Stamens 4, sessile or subsessile, basally adnate to the perianth segments. Ovary of 4 distinct, sessile, 1-celled, 1-ovuled carpels, each with subsessile stigma. Drupelets small, more or less beaked, coriaceous.

The genus comprises over 100 species in the world; cosmopolitan; about 20 species in India; 10 species in cold desert.

- 1a. Leaves lanceolate, ovate or oblong; stipular sheath free from leaf-base, axillary..... 2
- b. Leaves linear, filiform; stipular sheath adnate to the leaf..... 9
- 2a. Leaves usually dimorphic; floating leaves coriaceous..... 3
- b. Leaves all alike, submerged 6
- 3a. Submerged leaves linear; lamina of floating leaves up to 3.5 cm long. Spikes few flowered *P. octandrus*
- b. Submerged leaves lanceolate to elliptic-oblong or reduced to phyllodes; lamina of floating leaves more than 3.5 cm long. Spikes many-flowered 4
- 4a. Submerged leaves reduced to linear phyllodes; floating leaves with a discoloured joint at the top of petiole *P. natans*
- b. Submerged leaves well developed, lanceolate to elliptic-oblong; floating leaves without discoloured joint..... 5
- 5a. Submerged leaves petiolate *P. nodosus*
- b. Submerged leaves sessile..... *P. alpinus*
- 6a. Leaves linear, up to 2.5 mm broad; stipular sheath tubular.... *P. pusillus*
- b. Leaves broadly linear to ovate, more than 3 mm broad; stipular sheath not tubular 7
- 7a. Leaves petiolate; stipules 2.5-6 cm long..... *P. lucens*
- b. Leaves sessile; stipules less than 2 cm long..... 8
- 8a. Leaves amplexicaul; nuts 2-3 mm long, smooth..... *P. perfoliatus*
- b. Leaves not amplexicaul; nuts 4-5 mm long, warty..... *P. crispus*

- 9a. Stipular sheath open and convolute. Nuts 3-5 mm long..... *P. pectinatus*
 b. Stipular sheath tubular towards the base. Nuts 2-2.5 mm long .. *P. filiformis*

Potamogeton alpinus Balbis in Mem. Acad. Sc. Turin Ann. 10-11. Sci. Phys. Math. 1: 329. 1804.

Perennial rhizomatous aquatic herb. Leaves heterophyllous; submerged leaves narrowly lanceolate to elliptic oblong, cuneate or semi-amplexicaul at the base, tip rounded or obtuse; floating leaves ovate, elliptic, cuneate, coriaceous, petiolate, 6-9 cm long, 1.5-1.8 cm broad. Flowers in whorls, sessile. Perianth segments about 1.5 mm long. Fruitlets 2.5-3 mm long.

Occasional in ditches, ponds and water accumulations in Baltistan.

Fl. & Fr. : April - August.

Distrib. : Temperate and arctic regions of Asia, Europe and N. America.

P. crispus L., Sp. Pl. 120. 1753; Hook.f., Fl. Brit. India 6: 566. 1893.

Slender, perennial, rhizomatous aquatic herb. Leaves all alike, submerged, alternate and sessile or the upper ones opposite and some times stem-clasping, linear-oblong, margin undulate, serrate; stipules small, caducous, 2-8 mm long. Spikes ovoid-oblong, 5-8 cm long, lax. Fruitlets 4-5 mm long, obliquely ovoid, beaked.

Common in ponds and ditches in Ladakh.

Fl. & Fr. : April - October.

Distrib. : Europe, Asia, Africa and Australia.

P. filiformis Pers., Syn. Pl. 1: 152. 1805.

Slender, perennial, rhizomatous, aquatic herb with tuberous winter buds. Stems filiform, profusely branched. Leaves submerged, alternate, linear, about 1 mm broad, tip rounded or obtuse. Stipular sheath adnate to the leaf-base, 2-6 mm long, tubular towards the base. Spikes cylindrical, interrupted, 1.5-2 cm long. Fruitlets 2-2.5 mm long, obliquely obovoid.

Occasional in ponds, ditches, water accumulations in Baltistan, Skardu.

Fl. & Fr. : May - October.

Distrib. : Temperate and arctic regions of Europe, Asia and N. America.

Potamogeton lucens L., Sp. Pl. 126. 1753; Hook.f., Fl. Brit. India 6: 567. 1893.

Rubust perennial, rhizomatous, aquatic herb. Stem branched. Leaves all alike, submerged, linear-lanceolate, ovate, alternate or the upper ones opposite, 6-9 cm long, 2-3 cm broad, acute or acuminate; stipules free, 2-5.5 cm long, 2-winged or keeled Spikes cylindrical, dense, 3-8 cm long. Fruitlets 2-4 mm long, shortly beaked.

Occasional in ponds, stagnant water in Baltistan, Satpura Lake.

Fl. & Fr. : May - October.

Distrib. : Europe, N. Africa and temperate Asia.

Note : In Kashmir the plants are used for manuring.

P. natans L., Sp. Pl. 126. 1753; Hook.f., Fl. Brit. India 6: 565. 1893.

Perennial, rhizomatous aquatic herb. Leaves alternate or upper ones opposite, usually dimorphic; submerged leaves reduced to linear phyllodes;

floating leaves long petioled, ovate to lanceolate, 5-9 x 3-4.5 cm. Stipules free, 5-9 cm long. Spikes 5-10 cm long, dense. Fruitlets obovoid, 3.5-4 mm long, dorsally keeled shortly beaked.

Rare in ditches, ponds in E. Ladakh, Dras, Baltistan, Skardu.

Fl. & Fr. : May - October.

Distrib. : Temperate and arctic regions of Europe, Asia and N. America.

Potamogeton nodosus Poir. in Lam. Encycl. Meth. Bot. Suppl. 4: 535. 1816. *P. indicus auct non.* Roth ex Roem. & Sch. 1818 nec. Roxb. 1832; Hook.f., Fl. Brit. India 6: 565. 1893.

Perennial, rhizomatous, aquatic herb. Stem branched, terete. Leaves dimorphic, submerged leaves petiolate, broadly lanceolate to oblong, 5.5-10.5 cm long; floating leaves broadly ovate, elliptic, coriaceous, 5-15.5 cm, 2-4 cm broad. Stipules free, keeled, lanceolate, 2-10 cm long. Spikes cylindrical, 4-10 cm long. Flowers sessile, in whorls. Perianth segments about 1.5 mm long. Fruitlets 3-4 mm long, obliquely obovoid, shortly beaked.

Common in ditches, stagnant water, water accumulations near cultivated fields in Baltistan, Gilgit, Rupshu, Satpura Lake.

Fl. & Fr. : April - October.

Distrib. : Warmer regions of Europe, N. & C. America, Africa, Asia.

Note : Plant is quite similar to *P. natans* L. but can be distinguished by its well developed submerged leaves and petiole being without discoloured joints at the tip.

P. octandrus Poir. in Lam. Encycl. Meth. Bot. Suppl. 4: 534. 1816. *P. javanicus* Hassk. in Act. Soc. Sci. India Neerl. 1. 8: 26. 1856; Hook.f., Fl. Brit. India 6: 566. 1893.

Slender aquatic herb. Stem filiform, branched. Leaves usually dimorphic, alternate or upper ones opposite; submerged leaves linear, sessile; floating leaves ovate-oblong, petioled, coriaceous, 3-3.5 cm long. Stipules free, lanceolate ovate, 1-1.5 cm long, membranous, caducous. Spikes 1-1.5 cm long, globose, interrupted, few-flowered. Fruitlets about 1.5 mm long, obovoid, beaked.

Occasional in ponds, ditches, water accumulations in Baltistan, Skardu.

Fl. & Fr. : May - October.

Distrib. : Tropical and N.E. Africa, Madagascar, S.E. Asia and N.E. Australia.

Potamogeton pectinatus L., Sp. Pl. 127. 1753; Hook.f., Fl. Brit. India 6: 567. 1893. Fig. 24.

Slender, aquatic, perennial, rhizomatous herb with tuberous winter buds. Stem filiform, profusely branched. Leaves submerged, alternate, linear, acute to mucronate, base sheathing. Stipular sheath adnate to the leaf-base, 2-8 cm long, acute or mucronate, margins white open to the base. Spikes cylindric, 1.5-2 cm long, interrupted in fruits. Fruitlets 3-4 mm long, obliquely obovoid.

Common in ponds, ditches, water accumulations near fields in Zanskar, Swat, Pitug.

Fl. & Fr. : May - October.

Distrib. : Cosmopolitan.

Note : In Kashmir it is used as manure.

P. perfoliatus L., Sp. Pl. 126. 1753; Hook.f., Fl. Brit. India 6: 566. 1893. Fig. 25.

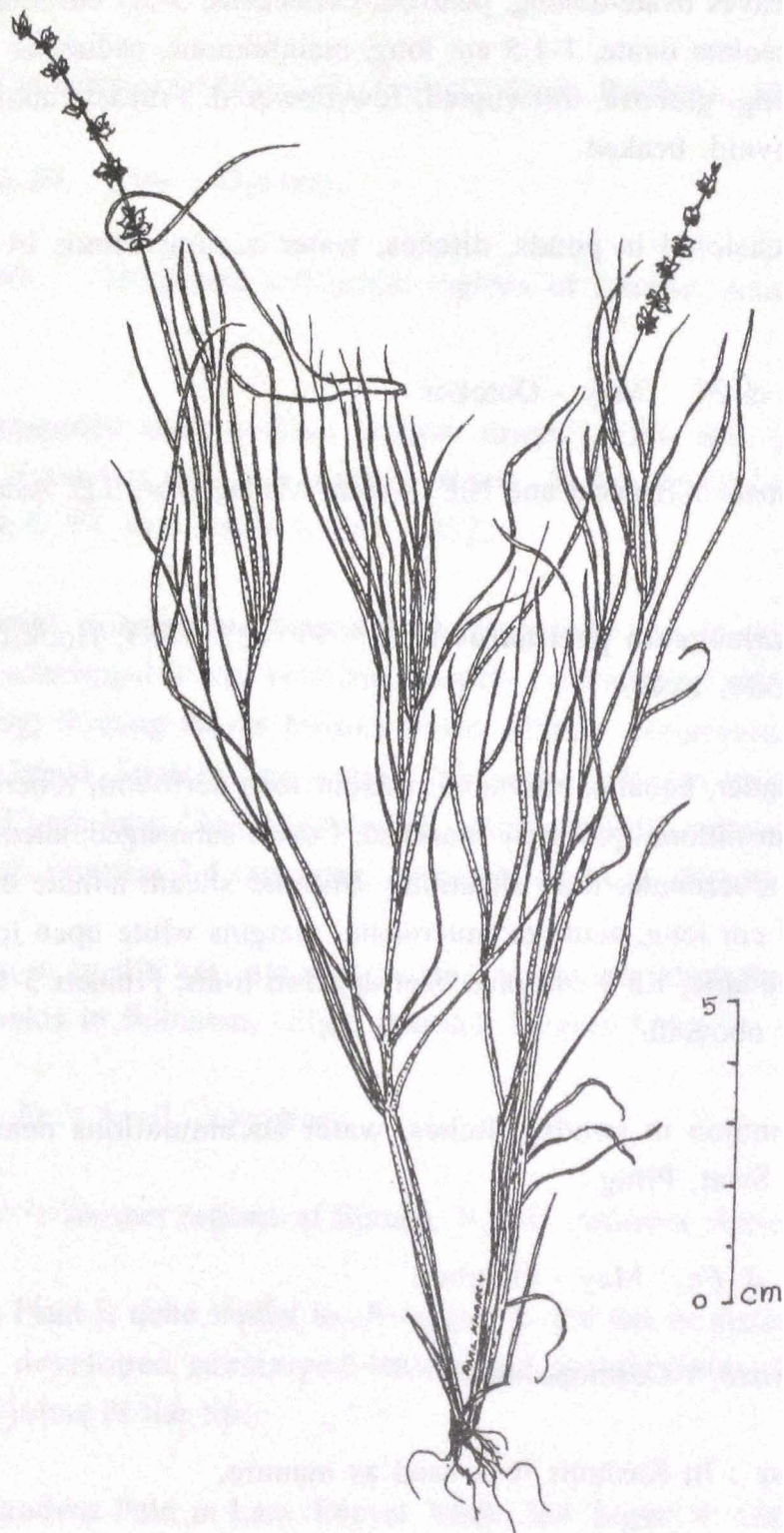


Fig. 24. *Potamogeton pectinatus* L.

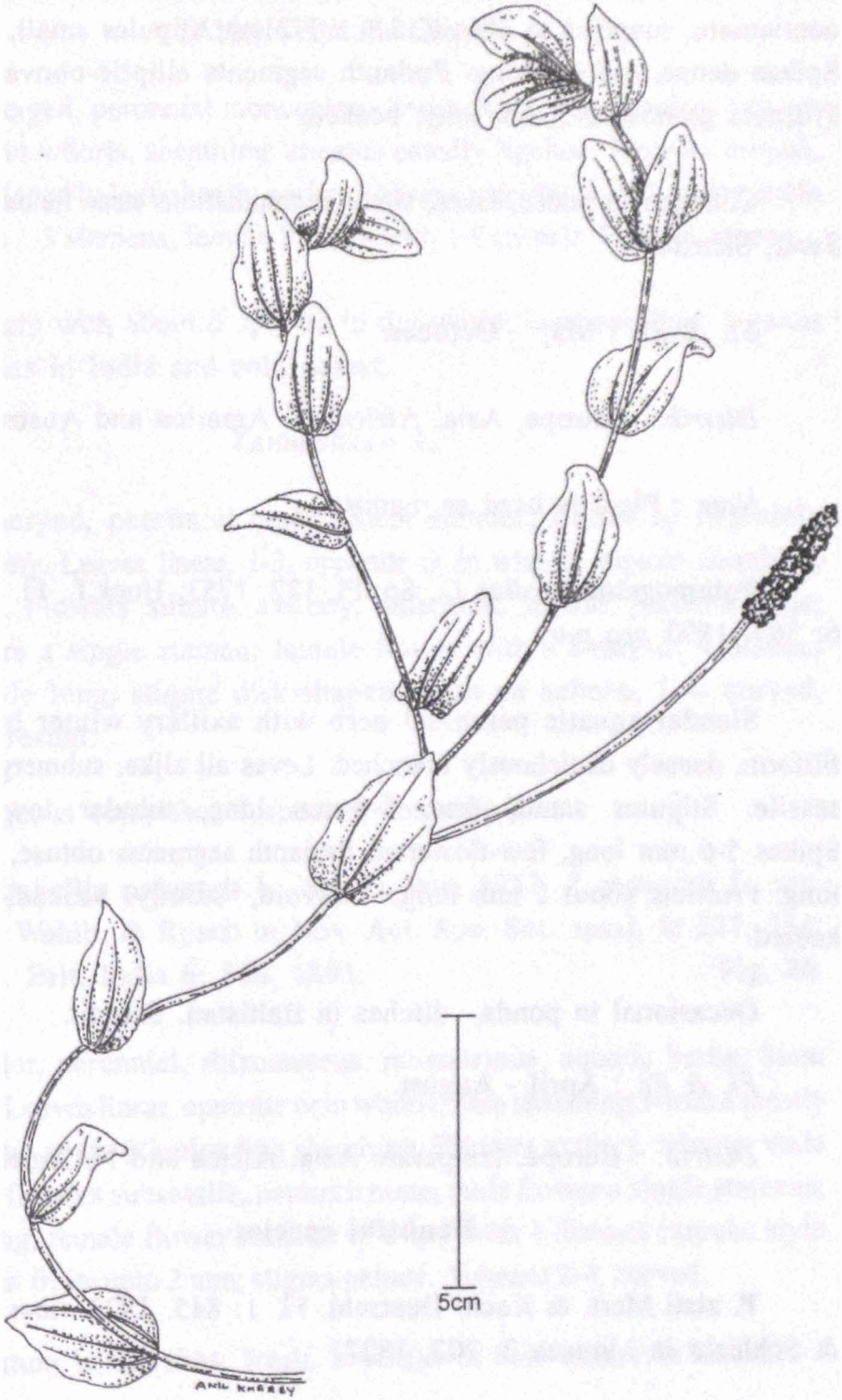


Fig. 25. *Potamogeton perfoliatus* L.

Robust, perennial, aquatic herb. Stem simple or branched, terete. Leaves all alike, submerged, alternate or the upper ones opposite, broadly ovate to broadly lanceolate, cordate-amplexicaul at base, entire or minutely denticulate, rounded to obtuse, 2-6 x 1-2 cm; stipules small, caducous. Spikes dense, 4-5 cm long. Perianth segments elliptic-obovate clawed. Fruitlets globose 2-3 mm long, beaked.

Common in ponds, lakes, water accumulations near fields, Baltistan, Swat, Skardu.

Fl. & Fr. : May - October.

Distrib. : Europe, Asia, Africa, N. America and Australia.

Note : Plant is used as manure.

Potamogeton pusilus L., Sp. Pl. 127. 1753; Hook.f., Fl. Brit. India 6: 567. 1893 *pro part.*

Slender aquatic perennial herb with axillary winter buds. Stem filiform, densely distichously branched. Leaves all alike, submerged, linear, sessile. Stipules small, free, 6-8 mm long, tubular towards base. Spikes 5-6 mm long, few-flowered. Perianth segments obtuse, 1-1.5 mm long. Fruitlets about 2 mm long, obovoid, stoutly beaked, obtusely keeled.

Occasional in ponds, ditches in Baltistan, Skardu.

Fl. & Fr. : April - August.

Distrib. : Europe, temperate Asia, Africa and N. America.

Doubtful species

P. zizii Mert. & Koch. Dentschl. Fl. 1: 845. 1823. *nom ex Chem.* & Schlecht in Linnaea 2: 202, 1827.

R.R. Stewart (Cat. of Vascular Plant of Pakistan) reported from Tibet stating "Probably Ladakh". No specimen seen.

Khadija Aziz & S.M.H. Jafra (Fl. West Pakistan, No. 79. 1975) consider *P. zizii* as a fertile hybrid of *P. gramineus* and *P. lucens*.

ZANNICHELLIACEAE

Submerged, perennial monoecious herbs. Rhizome creeping. Leaves opposite or in whorls, sheathing; sheaths usually ligulate. Flowers minute, axillary, enclosed in leaf-sheath; perianth absent, cupular or of 3 scales; male flowers with 1-3 stamens; female flowers with 1-9 carpels. Fruit an achene.

3 genera with about 6 species in the world; cosmopolitan; 1 genus and 1 species in India and cold desert.

ZANNICHELLIA L.

Submerged, perennial herbs. Stem slender, simple or cymosely branched, leafy. Leaves linear, 1-3, opposite or in whorls; stipules sheathing, membranous. Flowers minute, axillary, unisexual, sessile; perianth none; male flowers a single stamen; female flower with a ovary of 4 distinct carpels; style long, stigma disk-shaped. Fruit an achene, 2-4, curved, flattened, crested.

The genus comprises 1 species; cosmopolitan.

Zannichellia palustris L., Sp. Pl. 969. 1753. *Z. palustris* L. spp. *pedicellata* Wahlb. & Rosen in Nov. Act. Soc. Sci. upsal. 8: 227, 254; Hook.f., Fl. Brit. India 6: 568. 1893. Fig. 26.

Slender, perennial, rhizomatous, monoecious, aquatic herbs. Stem submerged. Leaves linear, opposite or in whorls, base sheathing; sheaths mostly ligulate at the apex. Stipules free sheathing. Flowers axillary, minute, male and female flowers subsessile, perianth none; male flower a single stamens; filament long; female flower consists of ovary with 4 distinct carpels; style elongating in fruits upto 2 mm; stigma peltate. Achenes 2-4, curved.

Common in marshes, fresh, brackish or salt waters in Ladakh.

Fl. & Fr. : May - October.

Distrib. : Cosmopolitan.

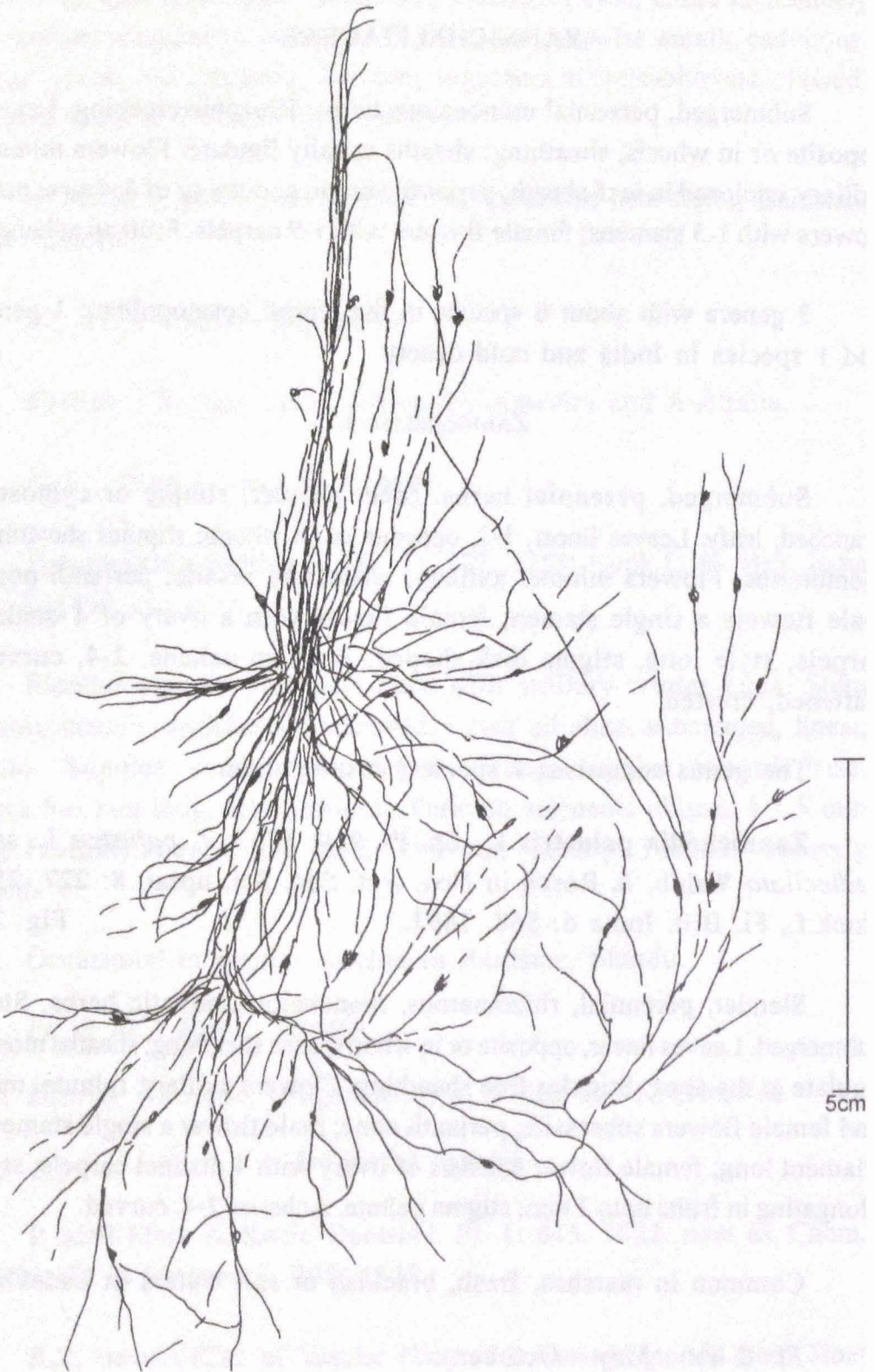


Fig. 26. *Zannichellia palustris* L.

CYPERACEAE

Annual, biennial or perennial herb. Rhizome, if present, monopodial or sympodial, short or long. Stems usually trigonous or triquetrous, mostly unbranched and nodeless below inflorescence. Leaves usually all clustered at base, sometimes all or some scattered all along stem or sometimes absent; sheathing, usually 3-ranked, setaceous, linear or lanceolate. Inflorescence terminal or subterminal due to erect posture of stem like bract; umbellate, paniculate, racemose, spikate, fasciculate, capitate or reduced to a solitary spikelet, subtended by one to several foliaceous or setaceous bracts. Spikelets compressed, terete or polygonal with few-many glumes. Flowers bisexual or unisexual; perianth of 2-several bristle-like or scale-like segments or absent; male flowers consist of 1-3 stamens; female flowers of 1-celled ovary; style 2-3, in some genera ovary surrounded by an utricle. Nut sessile or stipitate, linear, oblong-ovoid or globose, flattened or trigonous, smooth or variously sculptured.

More than 90 genera and over 4000 species in the world; cosmopolitan; more than 20 genera and 350 species in India; 12 genera and 64 species in cold desert.

- 1a. Nuts enclosed in utricle 2
- b. Nuts not enclosed in utricle 3

- 2a. Utricles perfect and completely enclosing the nut *CAREX*
- b. Utricles imperfect, split down one side and nut partially enclosed *Kobresia*

- 3a. Flower-glumes distichous 4
- b. Flower-glumes spirally arranged, rarely lowest sub distichous 7

- 4a. Rhachilla of spikelets articulated and deciduous 5
- b. Rhachilla not articulated, persistent 6

- 5a. Spikes sessile, Style 2-fid. Nuts laterally flattened with one angle facing rhachilla *KYLLINGA*
- b. Spikes stalked. Styles 3-fid. Nuts triquetrous with one side (not angle) facing rhachilla *MARISCUS*

- 6a. Style 3-fid. Nuts trigonous or if flattened then one edge not against rhachilla CYPERUS
 b. Style 2-fid. Nuts flattened with one edge against rhachilla PYCREUS
- 7a. Style-base swollen rarely passing into nut as in *Eleocharis quinqueflora*. Inflorescence terminal. ELEOCHARIS
 b. Style-base not swollen, gradually passing into nut. Inflorescence pseudolateral due to stem like prolongation of bract 8
- 8a. Hypogynous bristles usually absent 9
 b. Hypogynous bristles present 11
- 9a. Style 2-fid. Nut ovoid, acute SCIRPUS
 b. Style 3-fid. Nut trigonous obovoid. 10
- 10a. Spikelets usually solitary, few-flowered. Nut smooth BAEOTHRYON
 b. Spikelets usually more than one, forming clusters, many-flowered. Nut longitudinally striate and transversely trabeculate ISOLEPIS
- 11a. Spikelets closely spikate. Glumes acute or sub-acute at tip. Nut ashy-black BLYSMUS
 b. Spikelets not spikate. Glumes notched at tip. Nut brown or black
 SCHOENOPLECTUS

BAEOTHRYON A. Dietr.

Perennial herbs. Stem setaceous. Leaves setaceous, very short, green. Inflorescence terminal, subtended by the outer caducous, often mucronate glumes. Spikelets few-flowered; lower glumes sub-distichous, hypogynous bristles absent. Stamens 1-3. Style not swollen at base, 3-fid. Nut trigonous obovoid.

The genus comprises 3 or 4 species in the world; distributed in tropical and warm temperate regions 2 species in India; 1 species in cold desert.

Baeothryon pumilum (Vahl) T. Koyama in Hara *et al.*, Enum. Fl. Pl. Nepal 1: 97. 1978. *Scirpus pumilus* Vahl, Enum. Pl. 2: 243. 1806; C.B. Clarke in Hook.f., Fl. Brit. India 6: 654. 1893.

Slender, stoloniferous herb up to 7 cm tall. Rhizome wiry, black, creeping. Stem setaceous. Leaves short, setaceous, 8-15 mm long. Inflorescence quasiterminal. Spikelets few-flowered, ovoid, glumes ovate, obtuse, brownish-red; hypogynous bristles absent. Nut trigonous, obovoid, shining black, smooth.

Occasional on slopes in Gilgit, Rupshu, Zanskar, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, Siberia, Afghanistan, Pakistan, Tibet, India from J. & K. to Himachal Pradesh.

BLYSMUS Panz. ex J.A. Schultes *nom. cons.*

Perennial herbs. Rhizome creeping, divided. Stem leafy below, angular, striate or terete. Leaves linear. Inflorescence terminal spike, dense; lowest bract short or long. Spikelets subdistichously closely spikate or densely subpaniculate; glumes ovate-triangular, subacute, spirally arranged; hypogynous bristles inconspicuous or very slender, minutely retrorse-scabrous, reddish-brown. Stamens 3; style long, 2-fid, not swollen at base. Nut smooth, compressed or plano-convex, narrowed at both ends.

The genus comprises 4 species in the world, distributed in temperate Europe, Asia, 1 species in India and in cold desert.

Blysmus compressus (L.) Panz. ex Link, Hort. Bot. Berol. 1: 278. 1827. *Schoenus compressus* L., Sp. Pl. 43. 1753. *Scirpus planifolius* Grimm. in Nov. Act. Cur. 3. App. 259. 1767. *Scirpus caricis* Retz. Fl. Scand. 11. 1799; C.B. Clarke in Hook.f., Fl. Brit. India 6: 660. 1893. Fig. 27.

Perennial, rhizomatous herbs up to 30 cm tall. Rhizome long creeping, covered with brownish scales. Stem solitary or tufted, trigonous above, terete below. Leaves basal or sub-basal, rarely cauline, linear, obtuse, 5-20 cm long. Inflorescence spike, dense, 2-3.5 cm long. Spikelets 5-15, closely spikate, bracteate, usually distichous, 5-10-flowered, ovoid-



Fig. 27. *Blysmus compressus* (L.) Panz. ex Link

lanceolate, 5-10 mm long; glumes ovate or ovate-lanceolate, acute or acuminate, yellow to reddish-brown, 3-6 mm long, lowest sterile, hypogynous bristles 5-6, retrose-scabrous, as long as to longer than nut; style 2-fid, 3-3.5 mm long. Nut ellipsoid, plano-convex, smooth, ashy-black to blackish-brown.

Occasional in moist places, marshy areas, dried-up water channels in Leh, Rupshu, Zanskar, Zoji La in Ladakh, Khoksar in Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Europe, N. Iran, Central Asia, Afghanistan, India from J. & K. to Sikkim.

CAREX L.

Perennial herb. Rhizome short or long, creeping. Stem trigonous or triquetrous. Leaves clustered at the base or scattered all along the stem, linear. Inflorescence paniculate, racemose, spicate or reduced to a solitary spikelet, wholly male, wholly female or bisexual; bracts foliaceous or glumaceous; spikelets 1-many, few to many-flowered. Flowers unisexual; perianth absent; male flowers of 2-3 stamens; female flowers of ovary, enclosed in bottle shaped utricle. Nuts sessile or stipitate, trigonous or lenticular, enclosed in the utricle.

The genus comprises 1500-2000 species in the world; cosmopolitan but chiefly temperate; about 140 species in India; 34 species in the cold desert.

- | | | |
|-----|---|------------------------|
| 1a. | Inflorescence a solitary or paired spikelets..... | 2 |
| b. | Inflorescence of more than 2 spikelets..... | 4 |
| 2a. | Rhachilla within utricle absent | <i>C. borii</i> |
| b. | Rhachilla within utricle present..... | 3 |
| 3a. | Utricle 3.5-4.5 mm long. Rhachilla exerted from the utricle ... | <i>C. microglochis</i> |
| b. | Utricle 7.5-8 mm long. Rhachilla not exerted from the utricle.. | <i>C. parva</i> |

- 4a. Cladophylls absent. Style 2-fid..... 5
 b. Cladophylls present. Style 3-fid, rarely 2-fid 10
- 5a. Spikelets gynæcandrous *C. curta*
 b. Spikelets androgynous..... 6
- 6a. Utricle coriaceous, margins setulose above 7
 b. Utricle membranous, margins glabrous or finely hispidulous 8
- 7a. Spikelets 2-4. Utricles not inflated *C. stenophylla*
 b. Spikelets 5-7, rarely 4. Utricles inflated *C. maritima*
- 8a. Inflorescence linear, cylindric *C. polyphylla*
 b. Inflorescence an ovate capitulum..... 9
- 9a. Stem terete, compressed, glabrous. Spikelets 1 cm long. Utricles glabrous on margins..... *C. pseudofœtida*
 b. Stem trigonous, scaberulous above. Spikelets 1.5-3 cm long. Utricles hispidulous-scabrid on margins *C. vulpinaris*
- 10a. Utricle plano or biconvex 11
 b. Utricle triquetrous or trigonous 13
- 11a. Base of the stem covered by blade-bearing sheaths *C. orbicularis*
 b. Base of the stem covered by bladeless sheaths 12
- 12a. Rhizome creeping. Female spikelets narrow, lax-flowered at the base *C. notha*
 b. Rhizome caespitose. Female spikelets broader, dense-flowered at the base *C. dimorpholepis*
- 13a. Utricle beakless or shortly beaked, mouth truncate or emarginate, rarely bidentate 14
 b. Utricle long-beaked, mouth bidentate 20
- 14a. Female spikelets lax-flowered. Bracts always sheathing *C. oligocarya*
 b. Female spikelets dense-flowered. Bracts never sheathing 15
- 15a. Female glumes acute, cuspidate or obtuse. Utricles 2-3.5 mm long, base cuneate 16
 b. Female glumes acuminate. Utricles 4-5 mm long, base rounded 18

- 16a. Spikelets oblong or cylindric, 15-30 mm long. Rhizome not stoloniferous *C. obscura*
 b. Spikelets ovate or subglobose, 5-7 mm long. Rhizome stoloniferous .. 17
- 17a. Lateral spikelets sessile. Utricles membranaceous..... *C. infuscata*
 b. Lateral spikelets stalked. Utricles coriaceous *C. lehmannii*
- 18a. Stem rigid. Spikelets sessile..... *C. melanantha*
 b. Stem gracile. Spikelets stalked 19
- 19a. Female glumes ovate or oblong, 2.5-3 mm long..... *C. duthiei*
 b. Female glumes lanceolate, 4.5-5 mm long *C. nigerrima*
- 20a. Leaves septate-nodulose..... 21
 b. Leaves not septate-nodulose..... 23
- 21a. Utricle membranaceous *C. pamirensis*
 b. Utricle coriaceous 22
- 22a. Female spikelets subclavate..... *C. acutiformis*
 b. Female spikelets oblong..... *C. heterostachya*
- 23a. Bracts not sheathing *C. psychrophila*
 b. Bracts sheathing..... 24
- 24a. Female glumes purplish-black or brown 25
 b. Female glumes pale, rarely ferruginous 32
- 25a. Spikelets many, 2-12 arising from a single bract-axil, rarely solitary in the
 bract axil *C. longicuspis*
 b. Spikelets few, solitary at each node, rarely paired..... 26
- 26a. Terminal spikelets gynaecandrous. Utricles glabrous 27
 b. Terminal spikelets male, rarely gynaecandrus. Utricle adpressed-hirtous...29
- 27a. Spikelets approximate, oblong..... *C. cruenta*
 b. Spikelets fastigiate, clavate cylindric 28
- 28a. Terminal spikelets male. Utricles shortly beaked *C. gilesii*
 b. Terminal spikelets gynaecandrous. Utricle beakless *C. nivalis*

- 29a. Rhizome covered with brown fibrous remains of leaf-sheaths..... 30
 b. Rhizome not covered with remains of leaf-sheaths 31
- 30a. Female glumes dark-brown. Utricles shortly beaked *C. haematostoma*
 b. Female glumes castaneous. Utricles long-beaked *C. plectobasis*
- 31a. Female spikelets linear or oblong. Utricle narrow, elliptic, 3-3.5 mm long
 *C. setosa*
 b. Female spikelets cylindric. Utricle oblong, 6-7 mm long..... *C. tristis*
- 32a. Beak of utricule entire, rarely bidentate *C. karoii*
 b. Beak of utricule bidentate..... 33
- 33a. Upper spikelets sessile, lower stalked. Bracts not sheathing .. *C. serotina*
 b. Spikelets stalked. Bracts sheathing *C. diluta*

Carex acutiformis Ehrh., *Bietr.* 4: 43. 1789; C.B. Clarke in Hook.f., *Fl. Brit. India* 6: 740. 1894 *pro part.* excl. syn.

Perennial, stoloniferous herb up to 10 cm tall. Stem triquetrous. Leaves flat, almost equalling the stem. Inflorescence raceme; bracts foliaceous. Spikelets 5-7, upper 2-3 male; female glumes oblong-ovate or lanceolate, mucronate or aristate, reddish-brown; style slender; stigmas 3. Utricle obliquely erect, membranous, inflated, trigonous, oblong-ovate, 3.5-4 mm long, beak bifid. Nuts obovate, trigonous.

Rare in marshy situations in Gilgit.

Fl. & Fr. : April - May.

Distrib. : America, Africa, Siberia, Syria, Pakistan, India from Kashmir to Himachal Pradesh.

C. borii Nelmes in *Kew Bull.* 1948: 18. 1949.

Fig. 28.

Perennial, rhizomatous herb up to 6 cm tall. Rhizome woody, creeping. Stem trigonous. leaves filiform, as long as or longer than stem.

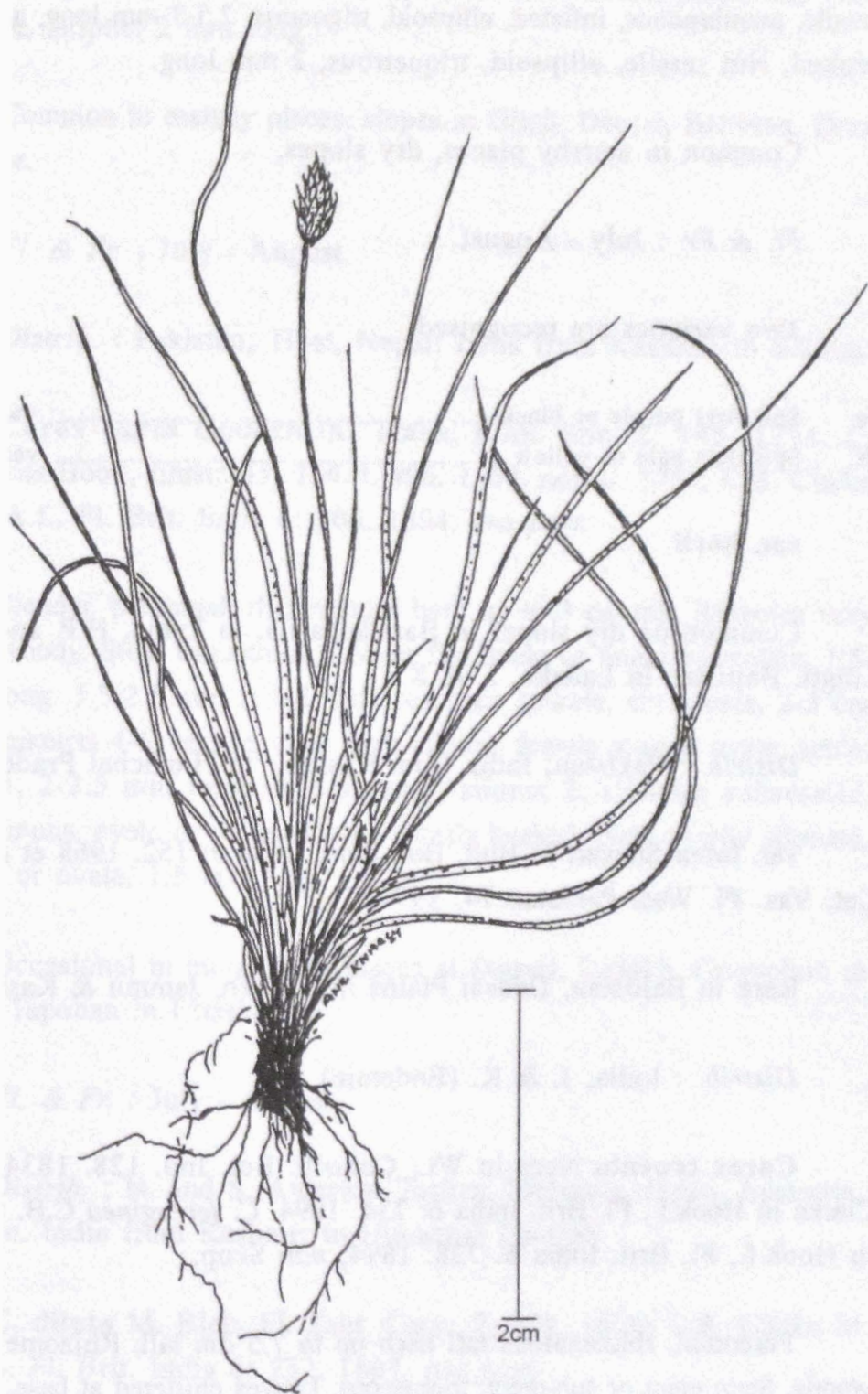


Fig. 28. *Carex borii* Nelmes

Inflorescence raceme, solitary or paired, 7-10 mm long, androgynous; female glumes ovate, obtuse, 2-2.5 mm long style slender; stigmas 3. Utricle sessile, membranous, inflated, ellipsoid, trigonous, 2.5-3 mm long, abruptly beaked. Nut sessile, ellipsoid, triquetrous, 2 mm long.

Common in marshy places, dry slopes.

Fl. & Fr. : July - August.

Two varieties are recognised.

- 1a. Spikelets purple or black var. *borii*
 b. Spikelets pale or yellow var. *lutea*

var. borii

Common on dry slopes in Baralacha La, in Lahul, H.P. and Leh, Lingti, Baltistan in Ladakh, J. & K.

Distrib. : Pakistan; India from Kashmir to Himachal Pradesh.

var. *lutea* Stewart in Bull. Bot. Surv. India 9: 152. 1968 et Annot. Cat. Vas. Pl. West Pakistan 74. 1972.

Rare in Baltistan, Deosai Plains in Ladakh, Jammu & Kashmir.

Distrib. : India, J. & K. (Endemic)

Carex cruenta Nees in Wt., Contrib. Bot. Ind. 128. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 6: 734. 1894. *C. ferruginea* C.B. Clarke in Hook.f., Fl. Brit. India 6: 738. 1894, *non* Scop.

Perennial, rhizomatous tall herb up to 7.5 dm tall. Rhizome short, woody. Stem erect or sub-erect, triquetrous. Leaves clustered at base, linear. Inflorescence raceme, 10-25 cm long, lower bracts foliaceous. Spikelets 3-6; upper 1-4 male, linear-oblong, 1.5-2.5 cm long; lateral female, long

peduncled; glumes ovate-lanceolate, 4 mm long, reddish-brown; style slender, stigmas 3. Utricle sub-sessile, lanceolate, beaked, beak bifid. Nuts stipitate, elliptic, 2 mm long

Common in marshy places, slopes in Gilgit, Deosai, Baltistan, Dras, Zaskar.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Tibet, Nepal; India from Kashmir to Sikkim.

Carex curta Gooden in Trans. Linn. Soc. 2: 145. 1794. *C. canescens* Boott, Illustr. 11: 154. t. 496. 1867, non L. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 6: 706. 1894, *pro part.*

Slender, perennial, rhizomatous herb up to 3 cm tall. Rhizome very short, woody. Stem triquetrous. Leaves flat linear or linear-lanceolate, 1.5-2 cm long. 1.5-2.5 mm broad. Inflorescence spikate, ebracteate, 2-3 cm long; spikelets 4-6, sessile, male very minute; female glumes ovate, acute, whitish, 2-2.5 mm long style slender; stigma 2. Utricles subsessile, membranous, ovate or ovate-elliptic, shortly beaked. Nuts shortly stipitate, elliptic or ovate, 1.5 mm long

Occasional in moist open places at Deosai, Ladakh, Gramphoo in Lahul, Tapoban in Uttarkashi.

Fl. & Fr. : July - August.

Distrib. : N. and S. America, Turkey, Malaysia, Japan, Australia, Pakistan. India from Kashmir to Himachal Pradesh.

C. diluta M. Bieb. Fl. Taur. Cauc. 2: 388. 1808; C.B. Clarke in Hook.f., Fl. Brit. India 6: 737. 1897, *pro part.*

Perennial, rhizomatous herb up to 4 cm tall. Rhizome elongated, woody. Stem trigonous. Leaves flat, shorter than stem, linear or linear-

lanceolate. Inflorescence raceme, 10-20 cm long; lower bracts foliaceous, exceeding the stem. Spikelets 3-5, cylindric; terminal male, oblong, 1.5-2 cm long; laterals female, female glumes ovate, acute, whitish, punctulate, 2-2.5 mm long; style slender; stigmas 3. Utricles sessile, inflated, trigonous, 3-3.5 mm long, abruptly beaked. Nut stipitate, ovate-obovate, trigonous, 1.5-2 mm long.

Occasional on slopes in Baltistan, Dras in Ladakh.

Fl. & Fr. : July - August.

Distrib. : South-east Europe, Central Asia, Pakistan; India from Kashmir to Sikkim.

Carex dimorpholepis Steud. Synop. Cyp. 214. 1855, *pro part.* *C. cernua* Boott, Illustr. 4: 171. t. 578. 1868; C.B. Clarke in Hook.f., Fl. Brit. India 6: 708. 1894. *C. praelonga* sensu Wadhwa et Chowdhery in Chowdhery et Wadhwa, Fl. Himachal Pradesh 3: 742. 1984. *non* C.B. Clarke 1894.

Perennial, stoloniferous herb up to 6 dm tall. Stem triquetrous. Leaves clustered at the base, flat, linear or linear-lanceolate. Inflorescence raceme, 10-15 cm long; lower 2-6 bracts foliaceous, exceeding the stem. Spikelets 3-8; female glumes oblong, tip bilobed, emarginate 2.5-3 mm long, stramineous, reddish-brown dotted; style slender; stigmas 2. Utricle stipitate, membranous, elliptic-ovate, 3-3.5 mm long, ferruginous. Nuts stipitate, ovoid or orbicular, 2-2.5 mm across, punctulate, brownish.

Common on slopes in Lahul.

Fl. & Fr. : June - August.

Distrib. : Pakistan, Nepal, Myanmar, China, Japan, Korea, Malaysia, India from Kashmir to Sikkim, Assam.

Note : *C. praelonga* C.B. Clarke is endemic to sikkim. It can be distinguished from *C. dimorpholepis* by its creeping rhizome. narrow female

spikelets, which are lax-flowered at the base. In *C. dimorpholepis* rhizome is caespitose and female spikelets are broader and dense flowered at base.

Carex duthiei C.B. Clarke in Hook.f., Fl. Brit. India 6: 731. 1894.
C. atrata C.B. Clarke in Hook.f., Fl. Brit. India 6: 731. 1894, *pro part.*
non L. 1753.

Perennial, rhizomatous herb up to 10 cm tall. Rhizome slender, creeping. Stem triquetrous. Leaves flat, linear-lanceolate. Inflorescence raceme, 6-10 cm long; lower bracts foliaceous, as long as or longer than the stem. Spikelets 4-5, cylindrical, upper fastigate; terminal gynaeandrous, cylindrical or globose, 15-20 mm long; laterals female, 10-25 mm long; female glumes ovate, acuminate 3-3.5 mm long, dark brown; style slender; stigmas 3. Utricles membranous, inflated, oblong-ellipsoid, trigonous, about 3 mm long, abruptly beaked, punctulate, golden yellow, turning brown. Nuts stipitate, oblong-ellipsoid, triquetrous.

Occasional amidst grasses on slopes in Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Nepal, India from Kashmir to Sikkim.

Note : *C. duthiei* is allied to *C. atrata* L., which is an extra Indian species and can be distinguished by its acuminate female glumes and oblong-ellipsoid utricles.

C. gilesii Nelves in Kew Bull. 1939: 306. 1940.

Perennial, stoloniferous herb up to 6 cm tall. Rhizome short, woody. Stem trigonous. Leaves clustered at base, also 1 or 2 cauline, flat or margin slightly involute, linear-lanceolate. Inflorescence raceme; lower bracts foliaceous. Spikelets 4; upper 1-2 male, 1-1.5 mm long; lower female, clavate-cylindrical, 2.5-3.5 mm long, female glumes oblong, acuminate 3.5-4 mm long, purplish-brown; style slender; stigmas 3. Utricle sessile,

compressed, trigonous, elliptic-ovate, 3.5-4 mm long, abruptly beaked. Nut stipitate, elliptic.

Occasional on grassy slopes at Gilgit.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India from Kashmir.

Carex haematostoma Nees in Wt., Contrib. Bot. Ind. 125. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 6: 744. 1894.

Perennial, rhizomatous herb up to 8 cm tall. Rhizome short, woody. Stem trigonous. Leaves clustered at the base, flat or conduplicate, shorter or longer than the stem. Inflorescence raceme, 15-30 cm long; lower bracts foliaceous, longer than stem. Spikelets 4-8, solitary or upper nodes with 2, upper 1-3 approximate, lower distant on long peduncles; terminal male or androgynous; lateral female; female glumes ovate, cuspidate or mucronate, 3-3.5 mm long, brownish, margins hyaline; style thickened at base; stigmas 3. Utricle sessile, membranous, oblong-elliptic, compressed, 5-6.5 mm long, abruptly beaked. Nuts obovate, oblong, trigonous, beaked, yellowish brown.

- 1a. Spikelets 5-8, Female glumes cuspidate or mucronate var. *haematostoma*
 b. Spikelets 2-4, Female glumes obtuse var. *submacrogyne*

var. **haematostoma**

Occasional at Nubra in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Tibet, Nepal; India from Kashmir to Sikkim.

var. **submacrogyne** Kuekenth in Engl. Pflanzenr. Heft 38. 557. 1909.

Occasional at Nubra, Baltistan in Ladakh, and Lahul in Himachal Pradesh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Tibet, India from Kashmir to Himachal Pradesh.

Carex heterostachya Bunge Enum. Fl. Chin. bor. 69. 1832. *C. songorica* Kar. & Kir. in Bull. Soc. Natural. Moscou 15: 525. 1842; C.B. Clarke in Hook.f., Fl. Brit. India 6: 739. 1894.

Perennial, rhizomatous herb up to 5 dm high. Rhizome woody, creeping. Stem trigonous. Leaves flat, shorter than stem. Inflorescence raceme; bracts foliaceous, exceeding the stem. Spikelets 3-6, upper male, narrow, linear or oblong; lateral female, oblong; female glumes ovate, pale brown, margin hyaline, awned, 3.5 mm long; style cylindrical, stigmas 3. Utricle sessile, inflated, ovate, trigonous 3.5-4 mm long, abruptly beaked, shining reddish-brown. Nuts sessile, ovate, trigonous, 1.5-2 mm long.

Rare on grassy slopes, rocky moraines at Dras, Baltistan in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Siberia, Syria, Pakistan, China; India from Kashmir.

C. infuscata Nees in Wt., Contrib. Bot. Ind. 125. 1834, *pro part.* *C. pseudobicolor* Boeck. Cyper. Nov. 1: 44. 1888. *C. gracilentia* Boott. in Strachey, Cat. Pl. Kumaon 73. 1854. *C. alpina* Sw. var. *erostrata* Boott, Illustr. 1: 71. t. 194. f. 2. 1858; C.B. Clarke in Hook.f., Fl. Brit. India 6: 730. 1894. *C. alpina* Sw. var. *gracilentia* C.B. Clarke in Hook.f., Fl. Brit. India 6: 730. 1894. *C. alpina* Sw. var. *infuscata* (Nees) Boott., Illustr. 3: 113. t. 358. 1862, *pro part.* *C. alpina* Sw. in Liljeb. Svensk. Fl. ed. 2. 26. 1798; C.B. Clarke in Hook.f., Fl. Brit. India 6: 730. 1894.

Perennial, rhizomatous herb up to 2 dm tall. Rhizome short, creeping. Stem trigonous. Leaves flat, shorter than the stem. Inflorescence raceme,

1-1.5 cm long; lowest bracts subfoliaceous, spikelets 3-4, fastigiate; terminal gynaeandrous or female, oblong-ovate; lateral female; female glumes ovate or oblong, 2.5-3 mm long. Utricle abruptly beaked, rarely beakless, punctulate, stramineous. Nuts stipitate, obovate, triquetrous, 1.5-2 mm long.

Common on moist grassy slopes, rocky moraines in Astor, Gilgit, Baltistan in Ladakh, Khoksar in Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Tibet, Nepal; India from Kashmir to Sikkim.

Note : Very variable species.

Carex karoii Freyn. in Oesterr. Bot. Zeitschr. 40: 303. 1890.

Perennial, rhizomatous herb, up to 2.5 dm tall. Rhizome short, woody. Stem triquetrous. Leaves flat, shorter than stem. Inflorescence raceme, 10-12 cm long; lower bracts foliaceous. Spikelets 4-5, upper approximate, lowest distant; terminal male; lateral female; female glumes obovate, 2.5-3 mm long, pale; style slender stigmas 3. Utricle sessile, membranous, inflated, ovate, ellipsoid, trigonous, beaked, pale-brown. Nut sessile, ovate, triquetrous, 1.5-2 mm long, pale brown.

Rare in rocky morains in Gilgit, Baltistan, Suru in Ladakh.

Fl. & Fr. : July - August.

Distrib. : North America, U.S.S.R. Siberia, Tibet, Afghanistan, Pakistan, India from Kashmir.

C. lehmannii Drejer, Symb. Caric. 13. t. 2. 1844; C.B. Clarke in Hook.f., Fl. Brit. India 6: 730. 1894.

Slender, perennial, rhizomatous herb. Rhizome creeping. Stem trigonous. Leaves flat, exceeding the stem. Inflorescence raceme, 2-5 cm

long; bracts foliaceous, exceeding the stem. Spikelets 2-5, ovate or oblong; terminal gynaeandrous or female; lateral female; female glumes ovate or oblong, acute, brownish-black; style slender; stigmas 3. Utricle sessile, membranous, obovate, trigonous, abruptly beaked. Nuts obovate, trigonous.

Occasional on moist grassy slopes in Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Nepal, China, Japan, India from Kashmir to Sikkim.

Carex longicuspis Boeck. *Cyper.* Nov. 1: 49. 1888.

Perennial, rhizomatous herb up to 6 dm tall. Rhizome woody. Stem triquetrous. Leaves flat, linear-lanceolate. Inflorescence panicle of spikelets; bracts foliaceous. Spikelets numerous, linear; upper male, lower androgynous; laterals female; female glumes oblong, mucronate style thickened at base; stigmas 3. Utricle membranous, elliptic, trigonous, brownish, beaked. Nuts stipitate, obovate-oblong.

Rare in Baltistan.

Fl. & Fr. : July

Distrib. : Pakistan; India from Kashmir.

C. maritima Gunn. *Fl. Norv.* 2: 131. 1772. *C. incurva* Lightf. *Fl. Scot.* 2: 544. t. 24. t. 1. 1777; C.B. Clarke in *Hook.f., Fl. Brit. India* 6: 700. 1894.

Perennial, rhizomatous herb up to 10 cm tall. Rhizome woody, creeping. Stem trigonous, Leaves clustered at the base, flat or conduplicate, linear, Inflorescence spikate, ebracteate. Spikelets 3-5, in a globose-ovate capitulum, androgynous or female; female glumes ovate, acute or mucronulate, brown, margins hyaline, lower glumes shortly aristate, style

thickened at the base; stigmas 2. utricle sessile, membranous, 2-2.5 mm long, abruptly beaked, golden yellow. Nuts sessile, olivaceous.

Occasional in moist sandy soil, rocky moraines at Nubra, Baltistan, Zaskar in Ladakh, Baralacha La in Lahul.

Fl. & Fr. : July - August.

Distrib. : N. & S. America, Pakistan, Nepal; India from Kashmir to Himachal Pradesh.

Carex melanantha C.A. Mey in Ledeb., Fl. Alt. 4: 226. 1833; C.B. Clarke in Hook.f., Fl. Brit. India 6: 733. 1894. Fig. 29.

Perennial, rhizomatous herb up to 4 cm tall. Rhizome elongated. Stem trigonous. Leaves flat, linear. Inflorescence raceme, 4-5 cm long; lowest bract subfoliaceous, shorter than the stem. Spikelets 3-5, upper fastigate, 6-15 mm long; lateral female; female glumes ovate or lanceolate, acute or shortly acuminate, brown, margins hyaline, 4 mm long, style slender; stigmas 3. Utricle sessile, membranous, inflated, trigonous, obovate-elliptic, abruptly beaked, yellowish. Nuts sessile, obovate, trigonous, 2-2.5 mm long, brownish.

- 1a. Spikelets dull brownish-black; female glumes ovate var. *melanantha*
- b. Spikelets bright yellow; female glumes lanceolate..... var. *moorcroftii*

var. **melanantha**.

Common on moist sandy soil along streams, river, near cultivated fields in Gilgit, Zoji La, Deosai in Ladakh, Khoksar in Lahul.

Fl. & Fr. : July - August.

Distrib. : Turkey, Siberia, Afghanistan, Pakistan, Nepal, India from Kashmir to Sikkim.

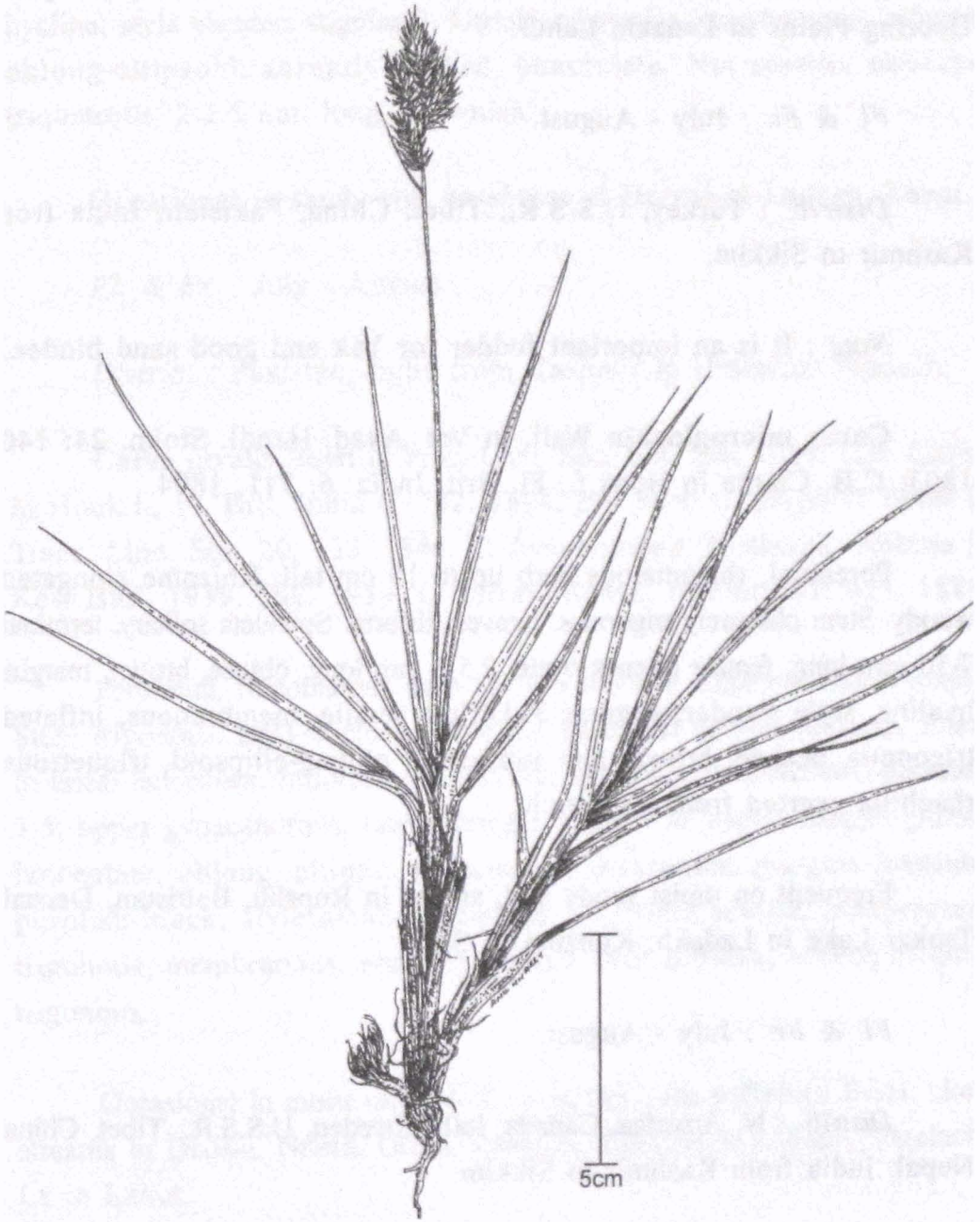


Fig. 29. *Carex melanantha* C.A. Mey

var. **moorcroftii** (Boott) Kuekenth. in Engl. Pflanzenr. Heft. 38: 392. 1909, *pro part.* *C. moorcroftii* Boott. in Proc. Linn. Soc. (Bot.) 1: 288. 1846. C.B. Clarke in Hook.f., Fl. Brit. India 6: 733. 1894.

Common on grassy slopes in Deosai Plains, Baltistan, Nubra, Rupshu, Debring Plains in Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : Turkey, U.S.S.R., Tibet, China, Pakistan; India from Kashmir to Sikkim.

Note : It is an important fodder for Yak and good sand binder.

Carex microglochin Wall. in Vet. Akad. Handl. Stokh. 24: 140. 1803; C.B. Clarke in Hook.f., Fl. Brit. India 6: 711. 1894.

Perennial, rhizomatous herb up to 15 cm tall. Rhizome elongated, woody. Stem obscurely trigonous. Leaves filiform. Spikelets solitary, terminal, 7-10 mm long; female glumes ovate, 2.5-3 mm long, obtuse, brown, margins hyaline, style slender; stigmas 3. Utricle sessile, membranous, inflated, trigonous, beaked, brown. Nut subsessile, oblong-ellipsoid, triquetrous; rhachilla exerted from the utricule.

Frequent on moist sandy soil, slopes in Rupshu, Baltistan, Deosai, Tsokar Lake in Ladakh, Kunzum in Spiti.

Fl. & Fr. : July - August.

Distrib. : N. America, Canada, Italy, Sweden, U.S.S.R., Tibet, China, Nepal, India from Kashmir to Sikkim.

C. nigerrima Nelmes in Kew Bull. 1939: 200. 1939. *C. atrata* sensu C.B. Clarke in Hook.f., Fl. Brit. India 6: 731. 1894, *pro part.*, non L. 1753. *C. atrata* L. ssp. *caucasica* (Stev.) Kuekenth. in Engl. Pflanzenr. Heft 38: 400. 19109. *pro part.*

Perennial, rhizomatous herb, up to 10 cm high. Rhizome elongated, woody. Stem triquetrous. Leaves flat, rarely involute, linear. Inflorescence raceme, 8-10 cm long; lowest bract-subfoliaceous. Spikelets peduncled, terminal gynaeandrous, 1.5-2.5 cm long; lateral female; female glumes ovate-lanceolate, 4.5-5 mm long, acute or acuminate, brown, margins hyaline; style slender; stigmas 3. Utricle sessile, membranous, inflated, oblong-ellipsoid, abruptly beaked, punctulate. Nut sessile, obovate, triquetrous, 2-2.5 mm long, brownish.

Occasional in sandy soil on slopes at Deosai in Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan; India from Kashmir to Himachal Pradesh.

Carex nivalis Boott in Proc. Linn. Soc. Bot. 256. 1846; C.B. Clarke in Hook.f., Fl. Brit. India 6: 732. 1894, *pro part.* *C. griffithii* Boott in Trans. Linn. Soc. 20: 138. 1846. *C. luteobrunnea* (Kuekenh) Nelmes in Kew Bull. 1939: 308. 1939. *C. oliveri* Boeck. in Flora 63: 455. 1880.

Perennial, rhizomatous herb up to 6 dm tall. Rhizome short, woody. Stem trigonous. Leaves clustered at the base, flat or conduplicate, linear to linear-lanceolate. Inflorescence raceme; lower bracts foliaceous. Spikelets 3-5; upper gynaeandrous; lateral female, solitary or paired; female glumes lanceolate, oblong, elliptic, muticous or mucronate, margins involute, purplish-black; style slender; stigmas 3. Utricle sessile, compressed, trigonous, membranous, abruptly beaked. Nut stipitate, oblong-elliptic, trigonous.

Occasional in moist sandy soil, on slopes, near cultivated fields, along streams in Deosai, Nubra, Gilgit, Zaskar, Baltistan in Ladakh, Baralacha La in Lahul.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, Nepal, Tibet; India from Kashmir to Sikkim.

Note : It is a very variable and polymorphic species, Kuekenth in Engl., Pflanzenr. Heft 38: 553. 1909 has recognised different forms on the basis of leaf-width, shape and colour of female glumes, shape and size of spikelets such as f. *nivalis*, *griffithii*, *cinnamomea*, *luteobrunnea*, but specimens of overlapping characters are also present.

Carex notha Kunth., Enum. Fl. 2: 421. 1837; C.B. Clarke in Hook.f., Fl. Brit. India 6: 709. 1894.

Perennial, stoloniferous herb up to 4.5 dm high. Stem trigonous. Leaves clustered at the base, linear-lanceolate, acuminate. Inflorescence raceme, 10-15 cm long; bracts foliaceous, shorter than the stems. Spikelets 4-5; terminal male; lateral female, rarely androgynous; female glumes oblong, acute or mucronulate, pale-brown; style slender; stigmas 2. Utricle sessile, membranous, sub-inflated, densely punctulate. Nut sessile, obovate, tip obtuse, 2 mm long.

Common on sandy slopes, along streams in Lahul.

Fl. & Fr. : July - August.

Distrib. : Nepal, Bhutan; India from Himachal Pradesh to Sikkim.

C. obscura Nees in Wt., Contrib. Bot. Ind. 126. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 6: 731. 1894. *C. infuscata* Nees in Wt. l.c. 125., *pro part.* *C. tibetica* Boeck. Cyp. Nov. 1: 46. 1888.

Perennial, stoloniferous herb up to 6 dm tall. Rhizome elongated, woody. Stem triquetrous. Leaves flat, linear-lanceolate. Inflorescence raceme, 3-5 cm long; lowest bracts foliaceous, shorter than the stem. Spikelets 3-8, upper fastigate, lowest remote; terminal gynaeandrous; lateral female; female glumes ovate, acute, brown, style slender; stigmas 3. Utricle subsessile, obovate-elliptic, abruptly beaked, greenish-brown, 2.5-3 mm long. Nut subsessile, obovate, trigonous, brownish.

Common on slopes in Lahul.

Fl. & Fr. : July - September.

Distrib. : Pakistan, Nepal, Tibet; India from Kashmir to Sikkim.

Carex oligocarya C.B. Clarke in Hook.f., Fl. Brit. India 6: 746. 1894. *C. oligocarya* C.B. Clarke var. *websteri* Raymond in Webster & Nasir, Pak. Jour. For. 15: 220. 1965.

Perennial, rhizomatous herb up to 25 cm tall. Rhizome short, woody. Stem obscurely triquetrous. Leaves linear, margin revolute. Inflorescence raceme; bracts foliaceous, shorter than the stem. Spikelets 1-4; terminal male or with one female flower at base; female glumes lanceolate, acuminate, brownish-green, margin hyaline, style thickened at base; stigmas 3. Utricle obovate, trigonous, inflated, membranous, 3.5-4 mm long, abruptly beaked. Nut obovate, trigonous.

· Rare in rocky sandy soil in Dras, Karakoram mountains Baltistan Huske Valley, Kashmir.

Fl. & Fr. : July - August.

Distrib. : Pakistan; India in Kashmir.

C. orbicularis Boott in Proc. Linn. Soc. Bot. 1: 254. 1845 et in Trans. Linn. Soc. Bot. 20: 134. 1846. *C. rigida sensu* C.B. Clarke in Hook.f., Fl. Brit. India 6: 711. 1894, *non* Gooden 1894. *C. erostrata* Boott ex C.B. Clarke in Hook.f., Fl. Brit. India 6: 711. 1894. *C. vulgaris sensu* C.B. Clarke in Hook.f., Fl. Brit. India 6: 711. 1894. *non* Fries 1842.

Perennial, stoloniferous herb up to 4 dm tall. Stem trigonous. Leaves flat, linear-lanceolate. Inflorescence raceme, 3-5 cm long; lowest bract foliaceous. Spikelets 3-5, oblong or globose, upper 2 approximate, lower distant; terminal male; lateral female; female glumes oblong-ovate, obtuse, blackish-brown; style thickened at base; stigmas 3. Utricle sessile, membranous, inflated, orbicular-ovate, plano-convex. Nut sessile, trigonous.

Occasional on slopes, in moist sandy soil in Zanskar, Zoji La, Rupshu in Ladakh, Lahul.

Fl. & Fr. : June - September.

Distrib. : West and Central Asia, southern Siberia; Pakistan; India from Kashmir to Sikkim.

Carex pamirensis C.B. Clarke ex Fedtsh. in J. Bot. St. Petersburg. 1: 19. 1906. *C. rostrata* sensu C.B. Clarke in Hook.f., Fl. Brit. India 6: 740. 1894, *non* Stokes 1787.

Perennial rhizomatous herb up to 5 dm tall. Rhizome short, woody. Stem trigonous. Leaves clustered at base, flat, linear-lanceolate. Inflorescence raceme, 10-15 cm long; lower bracts foliaceous, shorter or as long as the stem. Spikelets 3-5; upper 1-2 male; lateral female; female glumes ovate, acute, 3-3.5 mm long; style slender; stigma 3. Utricle sessile, ellipsoid, trigonous, inflated, 4-4.5 mm long, beaked. Nut sessile, obovate, 2-2.5 mm long.

Occasional on slopes in sandy soil in Baltistan, Dras, Zanskar in Ladakh.

Fl. & Fr. : June - July.

Distrib. : Afghanistan, Pakistan, Tibet, U.S.S.R., India from Kashmir to Garhwal Himalayas.

C. parva Nees in Wt., Contrib. Bot. Ind. 120. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 6: 712. 1914.

Perennial, rhizomatous herb up to 3 dm tall. Rhizome short, woody. Stem scarcely trigonous. Leaves flat or conduplicate. Spikelet solitary, terminal, oblong-ovate, androgynous; female glumes ovate, brown, 6-7 mm long, lowermost aristate; style slender, stigma 3. Utricle subsessile, membranous, subinflated, trigonous, beaked, yellowish brown, 7.5-8 mm

long. Nut sessile, linear-lanceolate, pale brown, trigonous, 4-4.5 mm long.

Occasional in sandy soil, on slopes in Baltistan, Skardu, Rupshu at Hanle in Ladakh.

Fl. & Fr. : July

Distrib. : Turkey, Pakistan, Nepal, China; India from Kashmir to Sikkim.

Carex plectobasis V. Krecz. in Not. Syst. Herb. Inst. Bot. Acad. Sci. URSS 9: 192. 1946. *C. hirtella* Drejer Symb. Caric. 21. 1844; C.B. Clarke in Hook.f., Fl. Brit. India 6: 744. 1894.

Perennial, rhizomatous herb up to 5 dm tall. Rhizome elongated, woody. Stem slightly trigonous. Leaves clustered at base, conduplicate, linear. Inflorescence raceme, 5-20 cm long; lower bracts foliaceous. Spikelets 4-6; upper male, approximate; lateral female; female glumes ovate, acute or cuspidate; style slender; stigma 3. Utricle subsessile, compressed, trigonous, oblong-elliptic, beaked, 6-7 mm long. Nuts stipitate, trigonous, oblong-obovate, pale.

Common amidst grasses, grassy slopes, near water channels, cultivated fields in Gilgit, Baltistan, Dras, Zanskar in Ladakh, Khoksar in Lahul.

Fl. & Fr. : June - August.

Distrib. : Afghanistan, Pakistan, Nepal; India from Kashmir to Garhwal Himalaya.

C. polyphylla Kar. & Kir. in Bull. Soc. Nat. Mosc. 859. 1841. *C. muricata sensu* C.B. Clarke in Hook.f., Fl. Brit. India 6: 703. 1894, *non* L. 1753.

Perennial, rhizomatous herb up to 7 dm tall. Rhizome short, woody. Stem compressed, trigonous. Leaves flat, linear or linear-lanceolate. Inflorescence spikate, 2-5 cm long, ebracteate. Spikelets many, globose-ovate, upper congested, lower distant; female glumes ovate, acute, 3-3.5 mm long; style thickened at base; stigma 2. Utricles stipitate, subinflated, beaked, 5-5.5 mm long, pale green. Nut shortly stipitate, pale brown, 2.5-3 mm long.

Occasional amidst grasses in Lahul.

Fl. & Fr. : June - July.

Distrib. : Pakistan, USSR, India from Kashmir to Himachal Pradesh.

Carex pseudofetida Kuekenh in Bot. Tidsskr. 28: 225. t. 1. 1907 et in Engl. Pflanzenr. Heft 38: 115. 1909.

Perennial, rhizomatous herb up to 10 cm tall. Rhizome elongated, creeping. Stem terete, compressed. Leaves mostly clustered at the base, flat or conduplicate, linear. Inflorescence spikate, 8-10 mm long; lower bracts glumaceous. Spikelets 3-4, androgynous; female glumes lanceolate-ovate, acute, brown, margin hyaline, 3.5-4 mm long; style thickened at base; stigmas 2. Utricle shortly stipitate, ellipsoid, membranous, beaked. Nuts stipitate, obovate-elliptic, brown, 1.5-2 mm long.

Occasional in moist sandy grassy places in Deosai, Baltistan, Rupshu, Zanskar, Pensi La, Khyung Tso in Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : Turkey, Siberia, Tibet, Pakistan, Nepal, India from Kashmir to Himachal Pradesh.

C. psychrophila Nees in Wt., Contrib. Bot. Ind. 127. 1834; C.B. Clarke in Hook.f., Fl. Brit. Ind. 6: 732. 1894.

Perennial, rhizomatous herb up to 5 dm tall. Rhizome short, woody. Stem compressed, trigonous. Leaves flat, linear. Inflorescence raceme, 4-8 cm long; lowest bract foliaceous. Spikelets 3-5, upper fastigiate, lower distant, terminal gynaeandrous or male; laterals female; female glumes ovate-lanceolate, acute, brown, 2.5-3 mm long; style slender; stigmas 3. Utricle sessile, membranous, inflated, trigonous, ellipsoid, beaked, 4-4.5 mm long. Nuts shortly stipitate, ovate-ellipsoid, triquetrous, 2 mm long.

Occasional on moist sandy soil along streams, near cultivated fields, grassy places in Zanskar in Ladakh.

Fl. & Fr. : June - July

Distrib. : Nepal, China, India from J.&K. to Himachal Pradesh.

Carex serotina Merat Nov. Fl. Env. Paris. ed. 2. 2: 54. 1821. *C. flava* sensu C.B. Clarke in Hook.f., Fl. Brit. India 6: 739. 1894, non L. 1753. *C. philocrena* krecz. in Komarov. Fl. USSR 3: 393. 1935.

Fig. 30.

Perennial, rhizomatous herb up to 3 dm tall. Rhizome short, woody. Stem trigonous. Leaves conduplicate, linear. Inflorescence racemose, 3-5 cm long; lower most bracts foliaceous, longer than stem. Spikelets 4-5, 1.5-2 cm long; terminal male; lateral female; female glumes ovate, acute, 2.5 mm long; style slender; stigmas 3. Utricle sessile, membranous, inflated, ellipsoid, trigonous, beaked, 4-4.5 mm long. Nuts stipitate, obovate, trigonous, 2-2.5 mm long.

Occasional in moist places in Drass in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Temperate regions of the world; India from Kashmir

C. setosa Boott, Illustr. 3: 108. t. 327, 329. 1862; C.B. Clarke in Hook.f., Fl. Brit. India 6: 745. 1894.

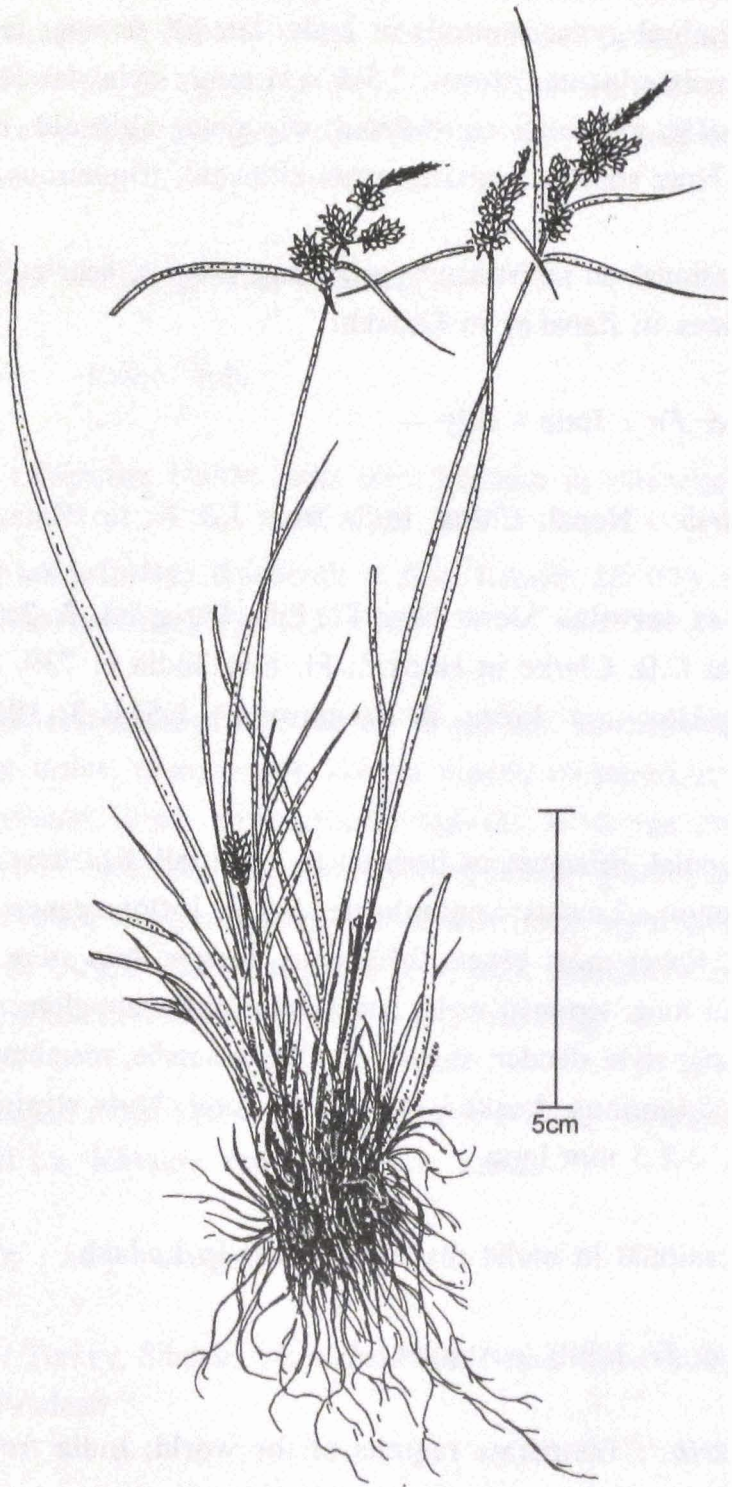


Fig. 30. *Carex serotina* Merat

Perennial, rhizomatous herb up to 3 dm tall. Rhizome elongated, woody. Stem obscurely trigonous. leaves clustered at the base, flat, linear. Inflorescence racemose; lower bracts foliaceous. Spikelets 2-6, terminal male, lateral female; female glumes oblong-ovate, brownish, 2.5-3 mm long; style slender; stigmas 3. Utricle subsessile, membranous, beaked. Nuts stipitate, oblong-ellipsoid, trigonous 2.5-3 mm long.

Common on rocky slopes at Gilgit in Ladakh, Khoksar in Lahul.

Fl. & Fr. : June - September.

Distrib. : Pakistan, Nepal, China; India from Kashmir to Garhwal Himalaya.

Carex stenophylla Wahl. in Vet. Acad. Nya Handl. Stockh. 24: 142. 1803; C.B. Clarke in Hook.f., Fl. Brit. India 6: 700. 1894, *pro part.*

Fig. 31.

Perennial, rhizomatous herb up to 20 cm long. Rhizome elongated, woody, creeping. Stem trigonous. Leaves flat, linear, as long as or longer than the stem. Inflorescence spikate, 7-15 cm long, ebracteate. Spikelets 5-6, contiguous in oblong capitulum, female or androgynous with reduced male portion; female glumes ovate-lanceolate, acute, brownish, margins hyaline, 3.5-4 mm long; style slender; stigmas 2. Utricles stipitate, subinflated, plano-convex, beaked, brown, turning black. Nuts. Stipitate, ovate-obovate, black, 2 mm long.

- 1a. Spikelets 5-6. Utricle many-veined, short stipitate var. *stenophylla*
 b. Spikelets 3. Utricle veinless, long stipitate..... var. *longipedicellata*

var. stenophylla

Common on moist sandy soil in Gilgit, Baltistan, Nubra, Rupshu, Zanskar in Ladakh.

Fl. & Fr. : July - September.

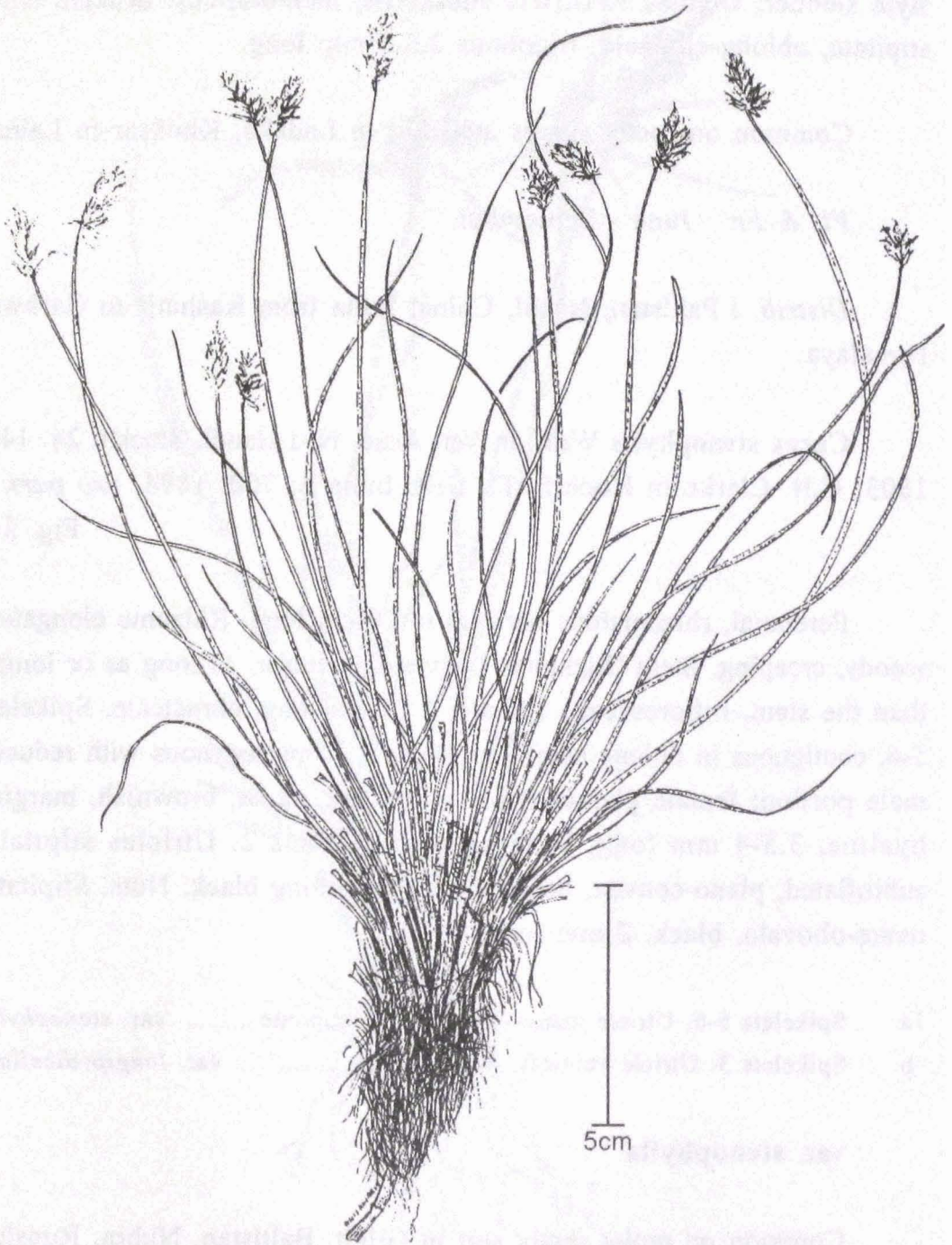


Fig. 31. *Carex stenophylla* Wahl.

Distrib. : North America, Syria, Europe, Afghanistan, China; India from Kashmir to Himachal Pradesh.

var. **longipedicellata** (Boeck.) Kuekenth. in Engl. Pflanzenr. Heft 38: 121. 1909. *C. longipedicellata* Boeck. Cyp. Nov. 1: 41. 1888.

Occasional in dry rocky sandy soil in Rupshu in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India from Kashmir to Himachal Pradesh.

Carex tristis M. Bieb. Fl. Taur. Cauc. 3: 615. 1819; C.B. Clarke in Hook.f., Fl. Brit. India 6: 738. 1894.

Perennial, rhizomatous herb up to 8 dm tall. Rhizome short, woody. Stem trigonous, smooth. Leaves clustered at base, flat, linear-lanceolate. Inflorescence racemose, 5-20 cm long, chestnut-purple; lowest bracts foliaceous, shorter than the stem; spikelets 3-10; upper male or androgynous, lateral female; female glumes ovate-lanceolate, obtuse or acute, brown, hyaline on margins, shorter than utricle 4.5-5 mm long; style slender; stigmas 3. Utricles sessile, membranous, compressed trigonous, sparsely hispidulous, 8-veined, beaked, 6-7 mm long. Nuts sessile, ellipsoid, trigonous, pale brown, 4 mm long.

Common on sandy and rocky soil in Baltistan, Deosai, Zaskar, Dras in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, USSR, China; India from Kashmir to Himachal Pradesh.

Carex vulpinaris Nees in Wt., Contrib. Bot. Ind 121. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 6: 702. 1894. *C. divisa* sensu C.B. Clarke in Hook.f., Fl. Brit. India 6: 701. 1894, *non* Huds. 1762.

Perennial, rhizomatous herb up to 7 dm tall. Rhizome short, woody. Stem obscurely trigonous. Leaves clustered at the base, flat, linear-lanceolate. Inflorescence spikate, ebracteate. Spikelets androgynous or female; upper approximate, lower 2 remote; female glumes lanceolate-ovate, acute, pale-brown, margins hyaline, 3-4 mm long; style slender; stigmas 2. Utricle subsessile, plano-convex, ovate-ellipsoid, beaked, 3.5-4 mm long. Nuts sessile, oblong-obovate, biconvex, brown, 1.5-2 mm long.

Common in moist sandy places, marshy situations, forming clumps in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Turkey, Afghanistan, Pakistan, India from Kashmir to Garhwal Himalaya.

Note : *Carex divisa* Huds. is a species from Eastern Himalaya.

Doubtful species

Carex atrofusca Schkhur. Riedgr. 1: 106. f. 82. 1801.

Carex divisa Huds var. *Coarcta* (Boott.) T. Koyama, Fl. Afghan. 49. 1960.

Carex hypobates Nelmes in Kew Bull. 1940: 272. 1940.

Carex stenophylla Wahl. var. *interrupta* Litv. Tran. Mus. Bot. St. Petersb. 7: 85. 1910.

CYPERUS L.

Perennial or annual herbs. Rhizome if present, short or long creeping. Stem terete, trigonous or triquetrous. Leaves usually clustered at base,

lowermost or sometimes all reduced to sheath. Inflorescence umbellate, simple or compound. Sometimes one or two of the central rays suppressed so the point of forking occupied with sessile clusters of spike or spikelets; sometimes all the rays suppressed and inflorescence becomes capitate. Bracts usually several, forming an involucre. Spikelets sessile or subsessile, digitately or spikately arranged. Flowers all bisexual or few upper one male or barren; perianth absent; stamens 1-3; style caducous; stigmas 2-3. Nuts ellipsoid-obovoid, lenticular, trigonous or triquetrous.

The genus comprises more than 550 species, distributed in the tropical and warm temperate regions of the world; more than 80 species in India; 1 species in cold desert.

Cyperus L. *sens. lat.* has been splitted into *Cyperus* L. *sens. str.*, *Juncellus* C.B. Clarke, *Kyllinga* Rottb., *Mariscus* Vahl, *Pycreus* P. Beauv., *Indocourtoisia* Raizada & Bennett (= *Courtoisia* Nees) etc. by various taxonomists. Such splitting is debatable and needs further study on a worldwide basis to establish divisions more broadly based than above, which depend much on embryo type and physiological studies for their distinction. Pending further revisionary work, Hooper, (in C.J. Saldanha & D.H. Nicolson, Flora of Hassan District, Karnataka, India 1976), Koyama (Gard. Bull. Singapore vol. 30. 1977) and Hara *et al.*, (Enumeration of the Flowering Plants of Nepal vol. I. 1978) have been followed for generic delimitations and 4 genera viz. *Cyperus*, *Kyllinga*, *Mariscus* and *Pycreus* are recognised. Kern (1974) in his treatment of family Cyperaceae in Flora Malaesiana. Ser. I. Vol. 7. 1974 has treated *Cyperus* as an inclusive genus.

***Cyperus halpan* L.**, Sp. Pl. 45. 1753 ('haspan'); C.B. Clarke in Hook.f., Fl. Brit. India 6: 600. 1893.

Perennial, rhizomatous herb up to 7 dm tall. Rhizome short or long creeping. Stem solitary or several together, 3-angled or 3-winged near the top. Leaves 3-7 or reduced to bladeless sheaths. Inflorescence umbel, small or large, compound or simple; bracts 2-3, foliaceous; rays 10-20, up to 10 cm long. Spikelets digitate, usually 3-6, linear-lanceolate, 10-50-flowered; glumes ovate-oblong, keeled, mucronulate, yellowish-red, 1-1.5 mm long.

Stamens 1-3. Styles short, 3-fid. Nuts shortly stipitate, broadly obovoid, trigonous, apiculate, yellowish or pale brown 0.4-0.5 mm long.

Occasional in moist sandy places, near cultivated fields, along streams in Gilgit.

Fl. & Fr. : Throughout the year.

Distrib. : Throughout India; cosmopolitan.

Note : It often flowers when the creeping rhizome is still not developed and only fibrous roots are there. In this state it is often confused with *Pycreus flavidus* (Retz.) T. Koyama; but the latter has ripe nut white.

ELEOCHARIS R. Br.

Annual or perennial, glabrous, herbs. Rhizome, if present, short or long creeping. Stem simple, erect, tufted, base sheathed by scales. Leaves reduced to basal sheaths; sheaths membranaceous, tubular, truncate or cuspidate; barren leaf-like stems often present. Inflorescence a solitary, terminal spikelet; bracts absent. Spikelets terete or angular, few-many-flowered; glumes membranaceous or coriaceous, densely imbricate all round the axis, lower 1-3 usually empty, others containing bisexual flowers; perianth of usually 5-7 retrorsely scabrid bristles. Stamens usually 3. Style usually dilated at base, with a constriction above the nut, rarely style-base gradually passing into nut, not dilated, base persistent. Nuts obovoid, orbicular or pyriform, crowned by the persistent style base.

The genus comprises about 200 species in the world; cosmopolitan; more than 15 species in India; 6 species in cold desert.

- | | | |
|-----|--|------------------------|
| 1a. | Style-base not swollen, gradually passing into nut | <i>E. quinqueflora</i> |
| b. | Style-base swollen, with a distinct constriction above the nut | 2 |
| 2a. | Style 3-fid | <i>E. retroflexa</i> |
| b. | Style 2-fid | 3 |

- 3a. Style-base very small, button like, depressed or disciform. Nuts black. Annual herbs *E. atropurpurea*
- b. Style-base large, bulbiform or mitriform. Nuts yellow or brown. Perennial, rhizomatous herb 4
- 4a. Style-base as broad as or broader than long, mitriform *E. mitracarpa*
- b. Style-base longer than broad, conical-ovoid or bulbiform 5
- 5a. Two lowest glumes sterile; lowest glume half encircling the base of spikelets *E. palustris*
- b. Lowest glume sterile, completely encircling the base of spikelets .. *E. uniglumis*

Elaeocharis atropurpurea (Retz.) J. & K. Presl, Rel. Haenk. 1; 196. 1828 *pro part.*; C.B. Clarke in Hook.f., Fl. Brit. India 6: 127. 1893. *Scripus atropurpureus* Retz., Obs. Bot. 5. 1788.

Annual, caespitose herbs up to 15 cm tall. Stems capillary. Leaf-sheaths obliquely truncate at the mouth, 5-15 mm long. Spikelets ovoid-oblong or sub-cylindric, sub-terete, 3-5 mm long, many flowered; glumes imbricate, elliptic-oblong, membranaceous, keel green, sides with purplish bands, 1-1.5 mm long; bristles 4-7, scaberulous, rarely reduced or absent. Stamens 1-2. Nuts obovoid, biconvex, smooth, shining brownish-black.

Frequent in marshy places, near cultivated fields, water channels in Sissoo in Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Wide spread in tropics and subtropics.

E. mitracarpa Steud. Syn. Cyp. 77. 1855.

Perennial rhizomatous herbs up to 35 cm tall. Stem flat or sub-terete. Uppermost leaf sheath almost transversely truncate. Leaf-sheaths and stem-base often reddish-purple. Spikelets many-flowered, dark brown; glumes with broad hyaline margin; hypogynous bristles 4, rarely 5, shorter or as long as nut. Stamens 3. Nut obovoid, biconvex, lenticular, finely punctate, yellowish-brown.

Rare in brackish marshes, wet meadows, near cultivated fields in Gilgit, Zanskar Ladakh.

Fl. & Fr. : June - September.

Distrib. : S. Russia, Iran, Afghanistan, India, Western Himalaya in Kashmir

Eleocharis palustris (L.) R. Br., Prodr. 224. 1810; C.B. Clarke in Hook.f., Fl. Brit. India 6: 628 1893. *Scripus palustris* L., Sp. Pl. 70. 1753. Fig. 32.

Perennial, rhizomatous herb up to 40 cm tall. Rhizome long, creeping. Stem smooth, terete. Leaf-sheath 2, upper one transversely truncate. Leaf-sheaths and stem-bases often reddish purple or brown. Spikelets ovoid, ellipsoid or cylindric, many-flowered, 5-15 mm long; glumes imbricate, ovate-lanceolate, muticous, membranaceous, brownish, perianth-bristles 4, rarely absent, sub-equal. Stamens 3. Style 1.5 mm long; stigmas 2, rarely 3. Nuts obovoid, biconvex, smooth, minutely punctate, 1-1.5 mm long.

Frequent in marshy places, dried up ditches, near cultivated fields in Baltistan, Zanskar, Suru, Nubra in Ladakh, Sissoo in Lahul & Spiti.

Fl. & Fr. : May - September.

Distrib. : Cosmopolitan.

E. quinquiflora (F.X. Hartm.) O. Schwarz in Mitt. Thur. Bot. Ges. 1: 89. 1949. *Scripus quinquiflorus* F.X. Hartm., Prim. Lin. Inst. Bot. 85. 1767. *S. pauciflorus* Lightf., Fl. Scot. 1078. 1778; C.B. Clarke in Hook.f., Fl. Brit. India 6: 654. 19893. *Eleocharis pauciflora* (Lightf.) Link. Hort. Bot. Berol. 1: 284. 1827.

Perennial, rhizomatous, tufted herbs up to 25 cm tall. Uppermost sheath transversely truncate. Leaves basal. Leaf-sheath and stem bases reddish purple, pale brown and stramineous. Spikelets terminal or sub-

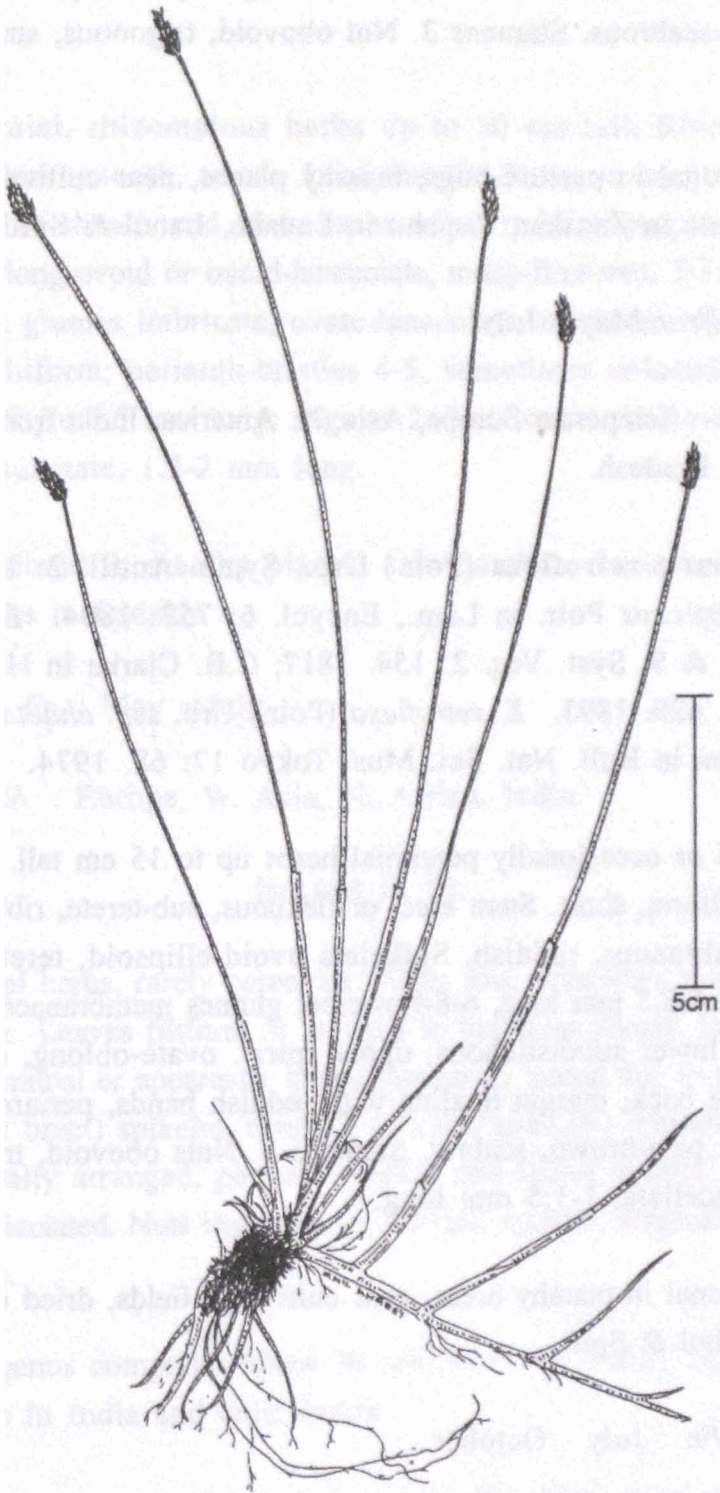


Fig. 32. *Eleocharis palustris* (L.) R. Br.

terminal, ovoid to subglobose, 4-8 mm long, 3-7-flowered, pale to dark brown; lowest glume half as long as spikelet and encircling its base; upper glumes ovate-lanceolate, acute or obtuse, margin hyaline; perianth-bristles 3-6, retrorse-scabrous. Stamens 3. Nut obovoid, trigonous, smooth, 1.5-2 mm long.

Occasional in pasture-bogs, marshy places, near cultivated fields, water channels in Zanskar, Rupshu in Ladakh, Lahul & Spiti.

Fl. & Fr. : May - July.

Distrib. : Temperate Europe, Asia, N. America, India from Kashmir to Himachal Pradesh.

Eleocharis retroflexa (Poir.) Urb., Symb. Antill. 2: 165. 1900. *Scripus retroflexus* Poir. in Lam., Encycl. 6: 753. 1804. *Eleocharis chaetaria* R. & S. Syst. Veg. 2: 154. 1817; C.B. Clarke in Hook.f., Fl. Brit. India 6: 629. 1893. *E. retroflexa* (Poir.) Urb. ssp. *chaetaria* (R. & S.) T. Koyama in Bull. Nat. Sci. Mus. Tokyo 17: 68. 1974.

Annual or occasionally perennial herbs up to 15 cm tall. Rhizome, if present, filiform, short. Stem erect or flexuous, sub-terete, ribbed. Leaf-sheaths membranous, reddish. Spikelets ovoid-ellipsoid, terete or sub-compressed 1.5-3.5 mm long, 6-8-flowered; glumes membranaceous, laxly imbricating, lower subdistichous, upper spiral, ovate-oblong, obtuse, 3-veined on the back, margin hyaline with reddish bands, perianth bristles 3-6, unequal, pale-brown, scabrid. Stamens 3. Nuts obovoid, triquetrous, truncate, cancellate, 1-1.5 mm long.

Occasional in marshy areas, near cultivated fields, dried up ditches in Sissoo Lahul & Spiti.

Fl. & Fr. : July - October.

Distrib. : Throughout tropics.

Eleocharis uniglumis (Link.) Schult., Mant. 2: 88. 1824. *Scirpus uniglumis* Link. in Jahrb. 1: 3. 77. 1820. *Eleocharis palustris sensu* C.B. Clarke in Hook.f., Fl. Brit. India 6: 628. 1893, *pro part. non* (L.) R. Br. 1810.

Perennial, rhizomatous herbs up to 30 cm tall. Rhizome long, creeping. Stem smooth, terete. Leaf sheaths 2; upper one transversely truncate. Leaf-sheath and stem bases often reddish-purple or brown. Spikelets oblong-ovoid or ovoid-lanceolate, many-flowered, 5-15 mm long, dark brown; glumes imbricate, ovate-lanceolate, membranaceous, lowest sterile, spathiform; perianth-bristles 4-5, sometimes reduced or absent. Stamens 3. Style 1.5 mm long; stigmas 2. Nuts ovoid, biconvex, smooth, lenticular, punctate, 1.5-2 mm long.

Occasional in marshy places, salt marshes, dried up ditches in Rupshu, Dras in Ladakh.

Fl. & Fr. : May - July.

Distrib. : Europe, W. Asia, N. Africa, India.

ISOLEPIS R. Br.

Annual herbs, rarely perennial. Stems low, setaceous, simple, tufted, almost terete. Leaves filiform or reduced to bladeless sheath. Inflorescence a solitary terminal or apparently lateral (appearing lateral due to prolongation of stem-like bract) spikelet, rarely 2 or more spikelets. Flowers bisexual; glumes spirally arranged, perianth-bristles and scales absent. Stamens 2-3. Styles articulated. Nuts trigonous or obovoid, smooth, longitudinally striate or punctate.

The genus comprises about 30 species in the world; cosmopolitan; one species in India and cold desert.

Isolepis setacea (L.) R. Br., Prodr. 222. 1810. *Scripus setaceous* L., Sp. Pl. 73. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 6: 654. 1893.

Fig. 33.

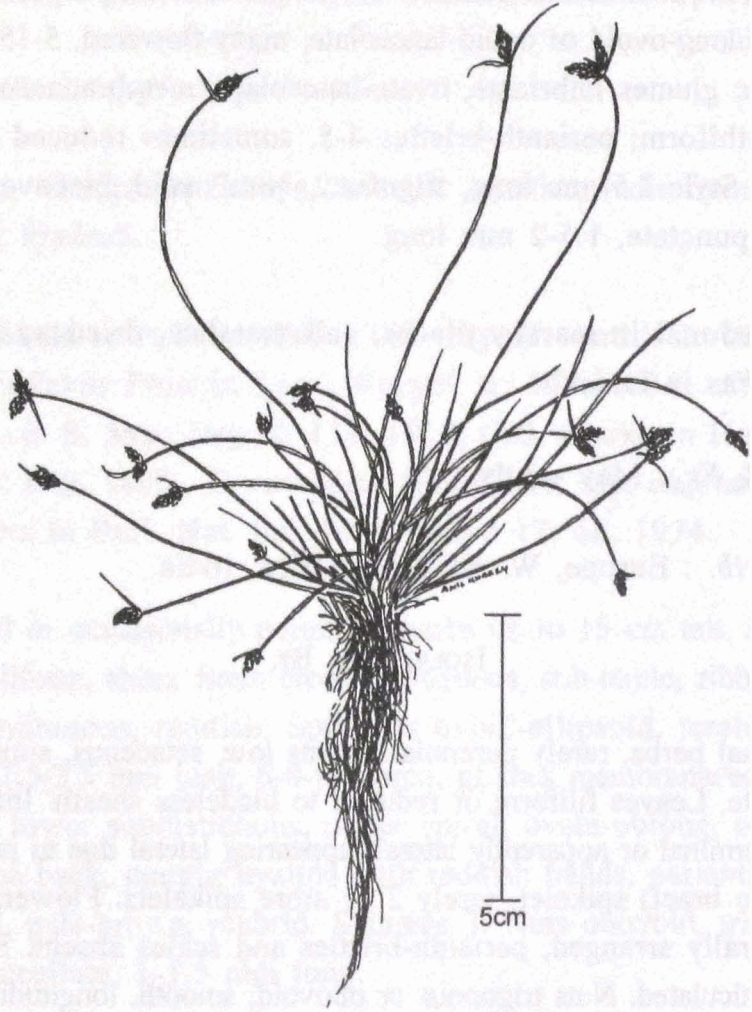


Fig. 33. *Isolepis setacea* (L.) R. Br.

Tufted, annual herb up to 15 cm tall. Stems striate, glaucous. Leaves linear, acute, setaceous, sheaths reddish or pale. Inflorescence of 1-2 (-3) spikelets, appearing lateral due to prolongation of stem-like bract; bract 1, lanceolate, longer than inflorescence. Spikelets ovoid, 2-3.5 mm long; glumes ovate, obtuse or acute, upper half reddish-brown, keel green, 1-1.5 mm long. Stamens 2. Style 3-fid. Nut elliptic-obovoid, longitudinally ribbed and transversely striate, reddish-brown.

Occasional in moist, swampy places in Astor, Swat, Baltistan, Skardu, Dras in Ladakh.

Fl. & Fr. : June - August.

Distrib. : Europe, Iran, E. & S. Africa, Afghanistan, Pakistan Australia, India, Western Himalaya Kashmir to Sikkim.

KOBRESIA Willd.

Perennial, rhizomatous herb, monoecious, rarely dioecious. Stems trigonous, smooth or scaberulous above. Leaves tristichous, linear or convolute, basal or cauline, scabrous on margins above. Inflorescence a simple or paniced spike, usually androgynous. Spikelets numerous; flowers 1-7 in each spikelet, male consists of 3 stamens, subtended by a glume, female consists of a naked pistil, subtended by a 2-keeled prophyll; stigmas 3, rarely 2. Nut trigonous, rarely biconvex or plano-convex.

The genus comprises over 50 species, chiefly in northern hemisphere, few in Europe and N. America; 25 species in India, 11 species in cold desert.

- | | | |
|-----|---|---------------------|
| 1a. | Stems covered by blade bearing sheaths at base | 2 |
| b. | Stems covered by bladeless sheaths at base | 4 |
| 2a. | Style 2-fid | <i>K. macrantha</i> |
| b. | Style 3-fid | 3 |
| 3a. | Spikes loose, subtended by leafy bracts | <i>K. laxa</i> |
| b. | Spikes congested, not subtended by leafy bracts | <i>K. royleana</i> |

- 4a. Lateral spikelets unisexual, 1-flowered. Style 3-fid..... 5
 b. Lateral spikelets androgynous, with rhachilla bearing 1-4 male flowers. Style 2-fid 8
- 5a. Leaves linear, convolute 6
 b. Leaves lanceolate, flat 7
- 6a. Slender herbs with stems 1-3 cm long. Spikes 5-8 mm long. Nut with a short beak *K. pygmaea*
 b. Stout herbs with stems 8-30 cm long. Spikes 10-60 mm long. Nut with a long exerted beak *K. nepalensis*
- 7a. Spikelets dense-flowered at the base. Nuts beakless *K. cerostachys*
 b. Spikelets lax-flowered at the base. Nuts with long, exerted beak *K. seticulmis*
- 8a. Lateral spikelets 2-flowered. Lower sheath not lacerate *K. duthiei*
 b. Lateral spikelets 3-5 flowered, rarely 1-flowered. Lower sheath lacerate and torn 9
- 9a. Spikes linear. Leaves setaceous, not channelled. Basal sheaths chestnut-couloured *K. capillifolia*
 b. Spikes broader, oblong or ellipsoid. Leaves channelled. Basal Sheaths brown 10
- 10a. Prophylls oblong, margin split down near to the base *K. schoenoides*
 b. Prophylls elliptic, margins connate *K. nitens*

Kobresia capillifolia (Decne.) C.B. Clarke in J. Linn. Soc. Bot. 20: 378. 1883 et in Hook.f., Fl. Brit. India 6: 697. 1894. *K. tibetica* Maxim. Melang. Biolog. 11: 864. 1884. *Elyna capillifolia* Decne. in Jacq. Voy. Bot. 4: 173. t. 174. 1844, *non* Henders. 1873. Fig. 34.

Perennial, rhizome short. Stem obscurely trigonous. Leaves linear. Inflorescence a linear-oblong spike, ebracteat. Spikelets many, terminal male, lateral androgynous; glumes ovate-oblong, obtuse, margins and tip hyaline, 4-5 mm long; style conic; stigmas 3. Prophylls oblong, 5-6 mm long, brown. Nuts stipitate, obovate, compressed trigonous, 3.5-4 mm long.

Common on moist soil in Deosai, Baltistan, Dras, Zanskar in Ladakh.

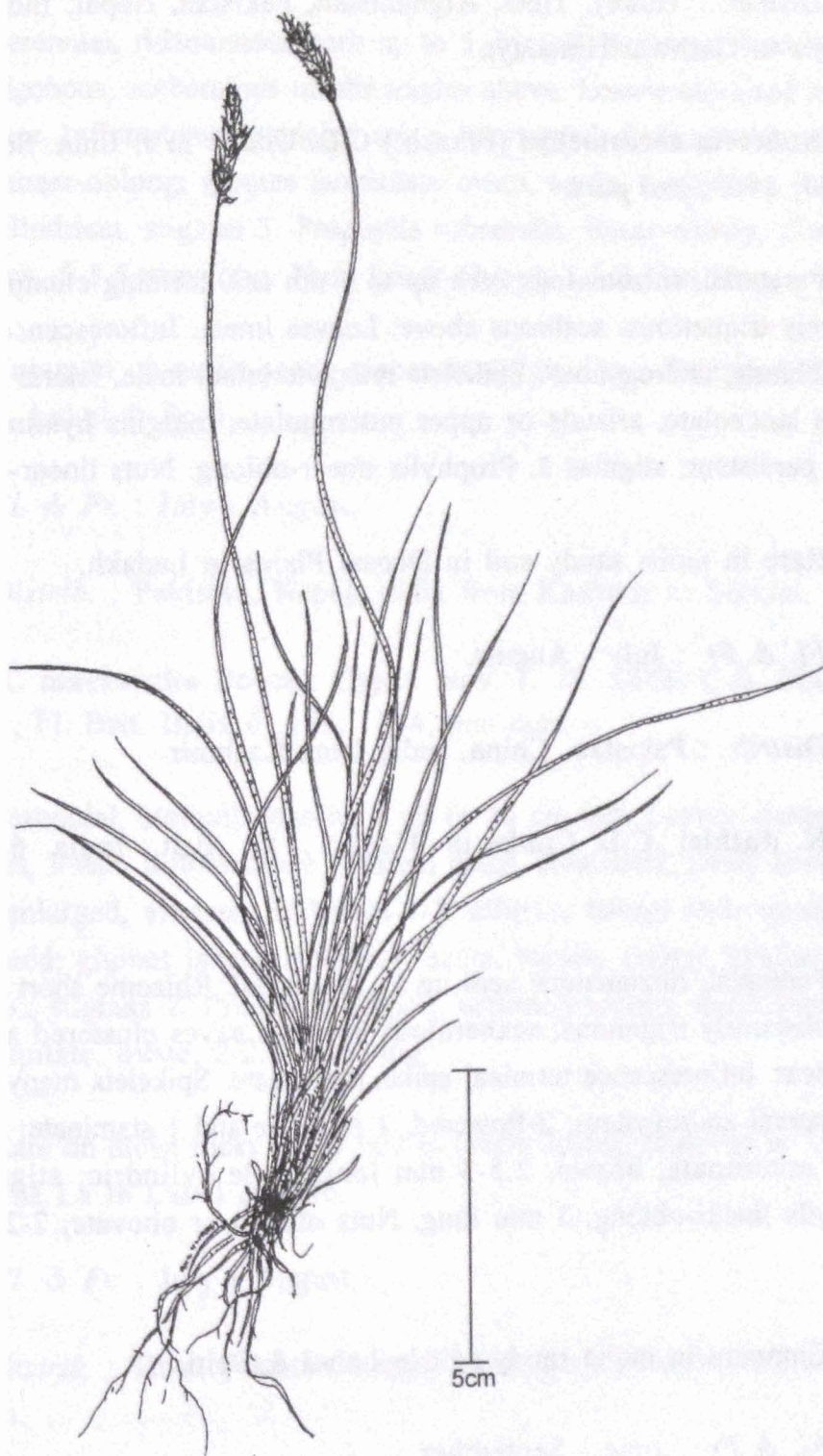


Fig. 34. *Kobresia capillifolia* (Decne.) C.B. Clarke

Fl. & Fr. : June - August.

Distrib. : Turkey, Tibet, Afghanistan, Pakistan, Nepal; India from Kashmir to Garhwal Himalaya.

Kobresia cerostachys (Franch.) C.B. Clarke in J. Linn. Soc. Bot. 36: 267. 1903, *pro part.*

Perennial, rhizomatous herb up to 4 dm tall, forming clumps. Stem obscurely triquetrous, scabrous above. Leaves linear. Inflorescence spike, linear oblong, androgynous. Spikelets many, terminal male, lateral female; glumes lanceolate, aristate or upper mucronulate, margins hyaline; style conic, persistent; stigmas 3. Prophylls linear-oblong. Nuts linear-oblong.

Rare in moist sandy soil in Deosai Plains in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, China, India from Kashmir

K. duthiei C.B. Clarke in Hook.f., Fl. Brit. India 6: 697. 1894.

Perennial, rhizomatous herb up to 15 cm tall. Rhizome short woody. Stem obscurely trigonous, scaberulous above. Leaves clustered at base, flat, linear. Inflorescence terminal spike, ebracteate. Spikelets many, upper male, lateral androgynous, 2-flowered, 1 pistillate and 1 staminate; glumes ovate, mucronate, brown, 2.5-3 mm long; style cylindrical; stigmas 3. Prophylls linear-oblong, 3 mm long. Nuts oblong or obovate, 2-2.5 mm long.

Common in moist sandy soil in Lahul & Spiti.

Fl. & Fr. : June - September.

Distrib. : Pakistan, Nepal, India from Kashmir to Sikkim.

Kobresia laxa Nees in Wt., Contrib. Bot. Ind. 246. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 6: 698. 1894.

Perennial, rhizomatous herb up to 5 dm tall. Rhizome short, woody. Stem trigonous, scaberulous on the angles above. Leaves clustered at base, flat, linear. Inflorescence paniced spike, interrupted. Spikes 6-10; spikelets many, linear-oblong; glumes lanceolate-ovate, acute, hyaline on margins; style cylindrical; stigmas 3. Prophylls sessile, linear-oblong, obscurely trigonous, 5-5.5 mm long. Nuts linear-oblong 2.5-3 mm long.

Common on moist sandy slopes in Gilgit, Dras, Baltistan, Suru in Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Nepal, India from Kashmir to Sikkim.

K. macrantha Boeck., Cyper. Nov. 1: 39. 1888; C.B. Clarke in Hook.f., Fl. Brit. India 6: 699. 1894, *pro part.*

Perennial, stoloniferous herb up to 10 cm tall. Leaves clustered at base, flat, linear. Inflorescence paniced spike, ebracteate, rarely lowermost glume enlarged, aristate. Spikelets 4-7, elliptic; lateral androgynous, 2-6-flowered; glumes lanceolate-ovate, acute, brown, margin hyaline; style cylindrical; stigmas 2. Prophylls elliptic, membranaceous, 4-4.5 mm long. Nuts stipitate, ovate, 2-2.5 mm long.

Rare on moist rocky sandy soil in Gilgit, Nubra, Baltistan in Ladakh, Baralacha La in Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Tibet, Pakistan, Nepal, India, from Kashmir to Himachal Pradesh.

K. nepalensis (Nees) Kuekenh. in Engl., Pflanzenr. Heft 38: 40. 1909. *Uncinia nepalensis* Nees in Wt., Contrib. Bot. Ind. 129. 1834. *Carex*

linearis Boott, Illustr. 1: 51. t. 136. 1858; C.B. Clarke in Hook.f., Fl. Brit. India 6: 712. 1894. *pro part.*

Perennial, monoecious or dioecious rhizomatous herb up to 3 dm tall. Rhizome short, woody. Stem obscurely trigonous, loosely tufted. Leaves clustered at the base, filiform, canaliculate, sheathing at base; sheath bladeless, pale brown. Inflorescence linear spike, ebracteate; dioecious or androgynous. Spikelets many, upper male; glumes oblong, mucronate, tip hyaline; style conic; stigmas 3. Prophylls linear-oblong, serrulate on margins. Nuts oblong, trigonous, pale brown, beaked.

- 1a. Plant monoecious. Spikes 5-6 cm long var. *nepalensis*
 b. Plant usually dioecious. Spikes 1-2 cm long. var. *vaginosa*

var. *nepalensis*

Common on sandy slopes, forming clumps in Lahul & Spiti in Himachal Pradesh.

Fl. & Fr. : July - September.

Distrib. : Pakistan, Nepal, India Kashmir to Sikkim.

var. *vaginosa* (C.B. Clarke) Kuekenth. in Engl. Pflanzenr. Heft 38: 40. 1909. *Kobresia vaginosa* C.B. Clarke in Hook.f., Fl. Brit. India 6: 695. 1894.

Rare on sandy slopes in Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India Kashmir to Sikkim.

Kobresia nitens C.B. Clarke in J. Linn. Soc. Bot. 20: 379. t. 30 f. 7. 1883 et in Hook.f., Fl. Brit. India 6: 697. 1894.

Perennial, rhizomatous herb up to 10 cm tall. Rhizome short, woody, Stem trigonous. Leaves clustered at the base, flat, linear. Inflorescence

simple, linear-oblong spike, 7-10 cm long, ebracteate. Spikelets 10-12, upper male; glumes ovate, acute or obtuse, hyaline on margins; style cylindrical; stigmas 3. Prophylls elliptic, shining black, tip hyaline, 5-6 mm long. Nuts obovoid, obtusely trigonous, 3-3.5 mm long.

Common on sandy soil, glacial morains in Gilgit, Deosai, Baltistan, Rupshu, Pangong lake, Tsokar lake in Ladakh, Lahul & Spiti in Himachal Pradesh

Fl. & Fr. : July - September.

Distrib. : Pakistan, Nepal; India, Kashmir to Garhwal Himalaya.

Kobresia pygmaea (C.B. Clarke) C.B. Clarke in Hook.f., Fl. Brit. India 6: 696. 1894. *Hemicarex pygmaea* C.B. Clarke in J. Linn. Soc. Bot. 20: 383. 1883. *Korbresia koelzii* Kuekenh. ex Ivanova in J. Bot. URSS 24: 498. 1939.

Perennial rhizomatous herb up to 3 cm tall forming clumps. Rhizome short, woody. Stem obscurely triquetrous, caespitose. Leaves filiform, convolute. Inflorescence compact spike, linear-oblong, 5-8 mm long, ebracteate. Spikelets many, terminal male, lateral female; glumes lanceolate-ovate, acute, brown; style conic; stigmas 3. Prophylls elliptic, margins connate at base. Nuts oblong-elliptic, 1-1.5 mm long, pale.

Common on sandy glacial moraines in Rupshu, Khyung Tso, Lanka La in Ladakh, Lahul & Spiti; Kinnaur in Himachal Pradesh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Tibet, India Kashmir to Sikkim.

K. royleana (Nees) Boeck. in Linnaea 31: 8. 1878; C.B. Clarke in Hook.f., Fl. Brit. India 6: 698. 1894. *Trilepis royleana* Nees in Edinb. New Philip. J. 17: 267. 1834 et in Wt., Contrib. Bot. Ind. 119. 1834.

Fig. 35.



Fig. 35. *Kobresia royleana* (Nees) Boeck.

Perennial, rhizomatous herb up to 20 cm tall. Rhizome short, woody. Stem densely tufted, obscurely trigonous, scaberulous above. Leaves clustered at base, flat or caniculate, linear, sheathed at base. Inflorescence spike, 4-6, spikelets many, terminal male; lateral 4-5, unisexual or androgynous with 1 pistillate and 3-4 male flowers; glumes broadly ovate, obtuse, 2 mm long; styles subconic; stigmas 3. Prophylls oblong, brown, 5 mm long. Nuts stipitate, oblong.

- 1a. Lateral spikelets androgynous var. *royleana*
 b. Lateral spikelets unisexual var. *paniculata*

var. royleana

Common on rocky slopes in Dras, Baltistan, Zanskar in Ladakh, Losar in Lahul & Spiti in Himachal Pradesh.

Fl. & Fr. : July - September.

Distrib. : Turkey, Tibet, Afghanistan, Pakistan, Nepal, China, India Kashmir to Sikkim.

var. *paniculata* (Regel) Kuekenh. in Engl., Pflanzenr. Heft 38: 46. 1909. *Carex paniculata* Regel in Acta Horti Petropol. 7: 566. 1880, *non* L. 1753. *C. royleana* Nees var. *parvinux* Koyama in Acta Phytotax. Geobot. 16: 168. 1956.

Occasional in sandy rocky soil in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Turkey Tibet, Pakistan, India Kashmir

Kobresia schoenoides Steud. Synop. Cyper. 246. 1855; C.B. Clarke in J. Linn. Soc. Bot. 20: 378. 1883 et in Hook.f., Fl. Brit. India 6: 697. 1894, *pro part. excl. syn. Elyna schoenoides* C.A. Mey in Ledeb. Fl. Act. 4: 235. 1833.

Perennial, rhizomatous herb up to 4 dm tall. Rhizome short, woody. Stem compressed trigonous. Leaves clustered at the base, flat or conduplicate, linear. Inflorescence a compound spike, terminal male, lateral androgynous, 3-5-flowered, 1 pistillate and others staminate; glumes oblong, obtuse, fuscous, margins hyaline; style cylindrical; stigmas 3. Prophylls oblong, obtuse, hyaline at apex, connate at base only. Nuts sessile, obovate, oblong, trigonous, 2.5-3 mm long.

Occasional on sandy glacial moraines in Losar in Lahul & Spiti in Himachal Pradesh.

Fl. & Fr. : July - August.

Distrib. : USSR, Siberia, Pakistan, Nepal, Bhutan, India from Kashmir to Sikkim.

Kobresia seticulmis Boeck. in *Linnaea* 39: 3. 1875; C.B. Clarke in *Hook.f., Fl. Brit. India* 6: 695. 1894. *K. filicina* (C.B. Clarke) C.B. Clarke in *Hook.f., Fl. Brit. India* 6: 696. 1894.

Perennial, rhizomatous herb up to 2 dm tall. Rhizome short, woody. Stem terete, scabrous above. Leaves clustered at base, flat, linear, base sheathing; sheaths membranous, brown. Inflorescence lax spike, androgynous, ebracteate. Spikelets many, terminal male, lateral androgynous; glumes elliptic-lanceolate, awned; style cylindrical; stigmas 3. Prophylls oblong, membranous, punctulate. Nuts stipitate, linear-oblong, 1.5-2 mm long.

Occasional on slopes in Lahul & Spiti in Himachal Pradesh.

Fl. & Fr. : July - August.

Distrib. : Nepal; India from Himachal Pradesh to Sikkim.

Doubtful species

K. deasyi C.B. Clarke in *Kew Bull. Addl. Ser.* 8: 68. 1908. *K. schoenoides sensu* C.B. Clarke in *Hook.f., Fl. Brit. India* 6: 697. 1894

pro part. non Boeck. 1875. *K. pamiroalaica* Ivanova in J. Bot. URSS. 1939: 24. 481. 1939 et in Schreder, Fl. Uzbek, 1: 347, 540. 1941.

Kobresia royleana (Nees) Boeck. var. *Kokanica* Kuekenth in Pflanzenr. Heft 38: 46. 1909.

KYLLINGA Rottb. *nom. cons.*

Annual or perennial herb. Rhizomes short or long creeping. Stem simple, erect. Leaves radical. Inflorescence spike, terminal. Spikes 1-3, sessile, capitate, ovoid or cylindric, dense. Bracts 3, unequal, spreading. Spikelets numerous, compressed; glumes 4-5, distichous, lowest 2 empty, others bisexual; rhachilla disarticulating and caducous; flowers bisexual; hypogynous bristles absent. Stamens 1-3. Style 2-fid. Nut laterally compressed.

The genus comprises 60 species in the world; distributed in tropical and sub tropical regions especially Africa; about 10 species in India; 1 species in cold desert.

Kyllinga squamulata Thorn. ex Vahl, Enum. Pl. 2: 381. 1806; C.B. Clarke in Hook.f., Fl. Brit. India 6; 589. 1893. *K. metzii* Hochst. ex Steud., Syn. Cyp. 70. 1855. *Cyperus metzii* (Hochst. ex Steud.) Mattf. & Kuekenth. in Pflanzenr. 101: 612. 1936.

Annual, glabrous tufted herbs up to 20 cm tall. Roots fibrous. Stem simple erect. Leaves radical, often longer than stem, linear. Spikes 1-3, crowded in ovoid terminal head, green or brownish; bracts 3, unequal, spreading. Spikelets many; glumes 4-5, distichous, lowest 2 empty; floral-glumes ovate, acute, keel toothed; hypogynous bristles absent. Stamens 3. Style 2-fid. Nut laterally compressed, circular, brown.

Common in marshy places, roadside ditches, moist sandy soil in Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Tropical and warm temperate regions; throughout India.

MARISCUS Vahl *nom. cons.*

Annual or perennial herbs. Rhizome if present, short. Stem erect, simple, often tufted. Leaves crowded near the base. Inflorescence umbel, simple or compound; rays 2-10, short. Bracts long. Spikelets linear, crowded in terminal spikes; rhachilla articulated above the two lowest empty glumes leaving a knob; glumes persistent, lowest 2 empty, rest 1-10 bisexual, distichous; hypogynous bristles absent. Stems 3. Style base continuous with nut; stigmas 3. Nut ovoid-oblong, trigonous, with a face towards rhachilla.

The genus comprises about 200 species in the world; distributed in tropical and subtropical regions; about 25 species in India; 1 species in cold desert.

Koyama in Dassan., Rev. Handb. Fl. Ceylon 5. 228. 1985 recognises *Mariscus* Vahl and *Cyperus* L. as two distinct genera as follows.

- 1a. Rhachilla not articulated, persistent, hence glumes falling apart from rhachilla CYPERUS L.
 b. Rhachilla articulated, hence spikelets falling entirely MARISCUS Vahl.

Mariscus squarrosus (L.) C.B. Clarke in Hook.f., Fl. Brit. India 6: 623. 1893. *Cyperus squarrosus* L. in Torner, Cent. Pl. 2: 6. 1756. *C. aristatus* Rottb. Descr. Pl. Rar. Progr. 22. 1772; C.B. Clarke in Hook.f., Fl. Brit. India 6: 608. 1893. *Mariscus aristatus* (Rottb.) Tang & Wang in Fl. Rep. Pop. Sin. 11: 178. t. 59.f. 12-13. 1961.

Slender, caespitose annual glabrous herbs up to 20 cm tall. Stem trigonous. Leaves basal, linear filiform, about as long as stem. Inflorescence a simple or compound umbel; rays 2-4, 2-5 cm long; bracts unequal, longer than the inflorescence, foliaceous. Spikelets 5-20, in loose, broad quadrate spikes, divaricate, 6-20-flowered; rhachilla above two lowest glumes articulate and caducous; glumes elliptic or ovate, with long, recurved mucro,

two lowest empty, others bisexual; hypogynous bristles absent. Stamen 1. Style 3-fid. Nut linear-oblong or obovoid, trigonous, pale brown.

Frequent in moist sandy soil along roadsides, on grassy slopes, near cultivated fields in Keylong in Lahul & Spiti.

Fl. & Fr. : June - September.

Distrib. : cosmopolitan in tropics and warm temperate regions; throughout India.

PYCREUS P. Beauv.

Caespitose annual or perennial herb. Stem erect or decumbent. Leaves basal or a few cauline, shorter than stem. Spikelets usually numerous, linear, flattened, in clusters or short spikes at the end of the unequal rays of a terminal umbel, or sometimes the rays are suppressed and the inflorescence becomes capitate; rhachilla persistent; bracts 3-4, unequal, spreading. Spikelets 10-many-flowered; glumes distichous, two lowest empty, succeeding ones bisexual, upper 1-3 empty or male; hypogynous bristles absent. Stamens 2-3. Style continuous with nuts; stigmas 2. Nut laterally compressed, circular or ovoid.

Koyama in Dassan., Rev. Handb. Fl. Ceylon 5: 222. 1985 treats *Pycreus* P. Beauv and *Cyperus* L. as two distinct genera as follows.

- 1a. Achenes triangular or dorsiventrally flattened with one side facing rhachilla CYPERUS L.
 1b. Achenes bilaterally flattened with one angle facing rhachilla PYCREUS P. Beauv.

The genus comprises about 100 species in the world; distributed in torpical and warm temperate regions; about 20 species in India; 3 species in cold desert.

- 1a. Perennial herb with distinct rhizome. Stem solitary, decumbent. Leaves at the base of stem and a few upwards..... *P. sanguinolentus*
 b. Annual herb, without rhizome. Stem tufted, erect. Leaves basal 2
- 2a. Glumes brown to chestnut brown *P. flavidus*
 b. Glumes yellow or pale *P. flavescens*

Pycneus flavescens (L.) Reichb., Fl. Germ. Excurs. 1: 72. 1830; C.B. Clarke in Hook.f., Fl. Brit. India 6: 589. 1893. *Cyperus flavescens* L., Sp. Pl. 68. 1753.

Annual, caespitose herbs up to 20 cm tall. Stems slender, erecto-patent. Leaves linear, acute, shorter than stems. Inflorescence of an almost lax head of sessile spikelets or a simple umbel of 1-3 rays; bracts 2-4, longer than inflorescence. Spikelets linear, 10-30-flowered; glumes ovate-elliptic, obtuse, pale or yellow, 1.5-2 mm long; keel greenish. Stamens 2-3. Nut broadly ovate elliptic-ovoid or obovoid, apiculate, compressed, with transverse white lines, shining black or blackish brown.

Occasional in moist sandy soil along river, streams, roadside ditches, near cultivated fields in Baltistan, Skardu in Ladakh.

Fl. & Fr. : August - October.

Distrib. : Europe, Africa, S.W. Asia, N. America; India Western Himalaya from Kashmir

P. flavidus (Retz.) Koyama in J. Jap. Bot. 51: 316. 1976. *Cyperus flavidus* Retz., Obs. Bot. 5: 13. 1789. *C. globosus* All., Fl. Pedem. 49. 1789, non Forssk. 1775. *C. capillaris* Koen. ex Roxb., Fl. Ind. 1: 198. 1820. *Pycneus globosus* (All.) Reichb., Fl. Germ. Excurs. 2: 140. 1830. *P. capillaris* (Koen. ex Roxb.) Nees ex C.B. Clarke in Hook.f., Fl. Brit. India 6: 591. 1893.

Annual, caespitose herbs up to 40 cm tall, rarely perennial with a very short rhizome. Stem slender, trigonous. leaves linear, acute, shorter than stem; lower sheaths reddish-brown. Inflorescence a dense head of

spikelets or simple or compound umbel; rays of umbel 1-4, 5-10 cm long. Spikelets numerous, congested, linear, compressed; glumes closely imbricating, ovate-oblong, obtuse to acute, brown, margin hyaline, keel green, 3-veined, 1.5-2.5 mm long. Stamens 2. Style 2-fid. Nuts ovate-oblong or obovoid, lenticular, apiculate, densely punctulate, blackish-brown, 0.5-1.5 mm long.

Frequent in moist places, near cultivated fields, roadside ditches in Gilgit, Baltistan, Skardu in Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, Asia; throughout India.

Pyereus sanguinolentus (Vahl) Nees ex C.B. Clarke in Hook.f., Fl. Brit. India 6: 590. 1893. *Cyperus sanguinolentus* Vahl, Enum. Pl. 2: 351. 1806.

Perennial, rhizomatous, decumbent herbs up to 40 cm tall. Rhizome slender, stem slender, compressed-trigonus. leaves 3-5, clustered at base, a few cauline, linear-lanceolate, attenuate-acute. Inflorescence umbel, evolute or capitately contracted; bracts 2-5, foliaceous, spreading. Spikelets congested, 3-20 together, ovate or oblong-lanceolate, compressed, 5-20 mm long, 8-20-flowered; rhachilla wingless; glumes laxly imbricate, ovate, obtuse, 2-2.5 mm long, margins reddish; keel green, 3-5-veined. Stamens 3. Style 2-fid, 1.5-2 mm long. Nuts broadly obovoid to sub-orbicular, apiculate, blackish-brown.

Frequent in moist sandy soil along streams, roadside ditches, near cultivated fields in Gilgit, Baltistan, Skardu in Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Asia, Africa; India from Kashmir to Sikkim, Assam, Arunachal Pradesh, Meghalaya.

Schoenoplectus (H.G.L. Reichb.) Palla *nom. cons.*

Perennial, rarely annual, rhizomatous herbs. Stem simple, trigonous or terete. Basal leaves bladeless or uppermost with short lamina. Inflorescence terminal, subtended by 1-2 bracts, lower bract looks like prolongation of stem. Spikelets terete, many-flowered. Flowers bisexual; glumes spirally arranged; hypogynous bristles 1-6, retrorsely scabrid or hairy, persistent. Stamens 3. Style slender, caducous; stigmas 2-3. Nut convex or trigonous, smooth or rugose.

The genus comprises about 25 species in the world; distributed in north temperate regions; about 18 species in India; 3 species in cold desert.

- 1a. Stem triquetrous *S. triqueter*
 b. Stem terete or obscurely trigonous..... 2
- 2a. Style 3-fid. Nut flattened-trigonous. Rays usually 3 in axil of lower bract
 *S. lacustris*
 b. Style 2-fid. Nut plano or biconvex. Rays usually 2 in axil of lower bract
 *S. tabernaemontani*

Schoenoplectus lacustris (L.) Palla in Bot. Jahrb. 10: 299. 1888.
Scirpus lacustris L., Sp. Pl. 72. 1753; C.B. Clarke in Hook.f., Fl. Brit. India 6: 658. 1893. Fig. 36.

Perennial, rhizomatous herbs up to 2 m tall. Rhizome creeping. Stems rigid, terete or obscurely trigonous above. Basal sheath brownish, membranous, bladeless; upper sheaths pale green or brownish. Leaves usually absent. Inflorescence terminal umbel, compound to decompound, 5-15 cm across, central spikelets in head-like clusters, rays unequal, bracts several glumaceous. Spikelets solitary or in clusters of 2-4, ovoid-oblong to ovoid, terete, 8-12 mm long, many-flowered; glumes tightly imbricating, ovate, or obovate, mucronate, notched at the tip, rufous glabrous or puberulous; perianth-bristles 5-6, linear, retrorsely scabrid. Stamens 3. Stigmas 3. Nuts sessile, obovoid, flattened, trigonous, 2-3 mm long, beaked, smooth, greyish-black.

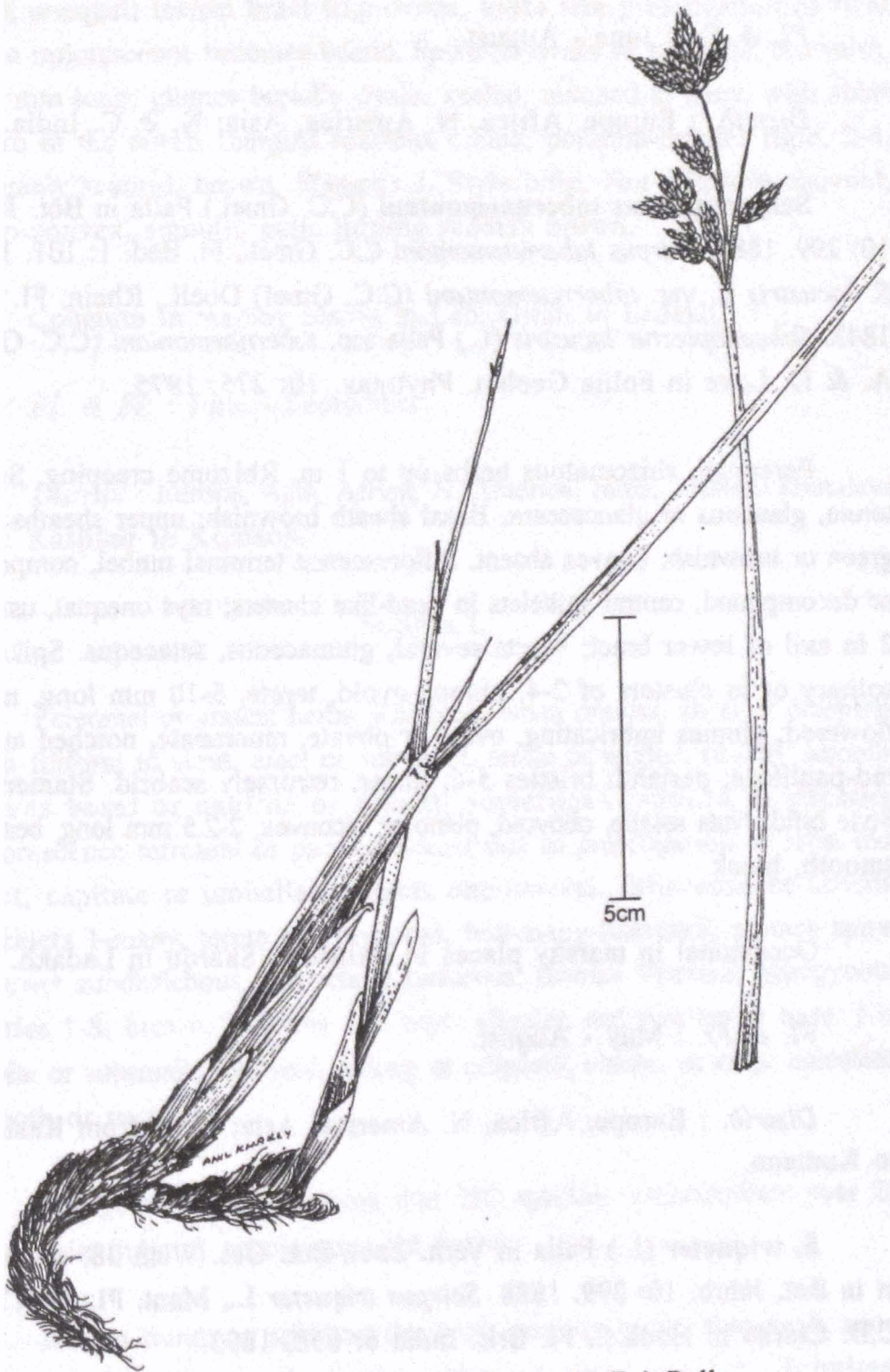


Fig. 36. *Schoenoplectus lacustris* (L.) Palla

Frequent in marshy places, edges of lakes, rivers, ditches in Baltistan, Nubra in Ladakh.

Fl. & Fr. : June - August.

Distrib. : Europe, Africa, N. America, Asia; N. & C. India.

Schoenoplectus tabernaemontani (C.C. Gmel.) Palla in Bot. Jahrb. 10: 299. 1888. *Scirpus tabernaemontani* C.C. Gmel., Fl. Bad. 1: 101. 1805. *S. lacustris* L. var. *tabernaemontani* (C.C. Gmel) Doell., Rhein. Fl. 165. 1843. *Schoenoplectus lacustris* (L.) Palla ssp. *tabernaemontani* (C.C. Gmel) A. & D. Love in Folia Geobot. Phytotax. 10: 275. 1975.

Perennial, rhizomatous herbs up to 1 m. Rhizome creeping. Stems terete, glaucous or glaucescent. Basal sheath brownish; upper sheaths pale green or brownish. Leaves absent. Inflorescence terminal umbel, compound or decomposed, central spikelets in head-like clusters; rays unequal, usually 2 in axil of lower bract; bracts several, glumaceous, setaceous. Spikelets solitary or in clusters of 2-4, oblong-ovoid, terete, 5-10 mm long, many flowered; glumes imbricating, ovate or obvate, mucronate, notched at tip, red-papillose; perianth bristles 5-6, linear, retrorsely scabrid. Stamens 3. Style bifid. Nuts sessile, obovoid, plano or biconvex, 2-2.5 mm long, beaked, smooth, black.

Occasional in marshy places in Baltistan, Skardu in Ladakh.

Fl. & Fr. : May - August.

Distrib. : Europe, Africa, N. America, Asia; India from Kashmir to Kumaon.

S. triqueter (L.) Palla in Verh. Zool.-Bot. Ges. Wien 38: 49. 1888 et in Bot. Jahrb. 10: 299. 1888. *Scirpus triqueter* L., Mant. Pl. 29. 1767; C.B. Clarke in Hook.f., Fl. Brit. India 6: 658. 1893.

Perennial, rhizomatous herb up to 1 m tall. Rhizome elongate, branching. Stem stout, triquetrous, glabrous. Basal sheaths reddish or pale-

brown, bladeless; upper sheaths with short blades. Leaves short or absent. Inflorescence an umbel, subsimple or umbel contracted into a head; rays short, unequal; lowest bract triquetrous, looks like prolongation of stem so the inflorescence becomes lateral. Spikelets ovoid or cylindric, brownish, 5-10 mm long; glumes broadly ovate, keeled, notched at apex, with short mucro in the notch, margins scarious ciliate; perianth-bristles rigid, 2-4, retrorsely scabrid, brown. Stamens 3. Style bifid. Nut ellipsoid-obovoid, plano-convex, smooth, pale, turning reddish brown.

Common in marshy places in Leh, Gilgit in Ladakh.

Fl. & Fr. : June - September.

Distrib. : Europe, Asia, Africa, N. America, India, Western Himalaya from Kashmir to Kumaon.

SCIRPUS L.

Perennial or annual herbs. Rhizome, when present, short or creeping. Stem filiform to stout, erect or sub-erect, terete or angled, usually smooth. Leaves basal or cauline or absent; sometimes reduced to sheaths. Inflorescence terminal or pseudolateral due to prolongation of stem like bract, capitate or umbellate; bracts one-several, foliaceous or absent. Spikelets 1-many, terete or polygonal, few-many-flowered; glumes spiral or lower subdistichous, acropetally caducous; flowers bisexual; hypogynous bristles 1-8, brown, Stamens 1-3. Style slender, not swollen at base. Nut sessile or subsessile, obovoid, oblong or ellipsoid, obtuse, acute or apiculate, smooth or rugulose.

The genus comprises more than 200 species; cosmopolitan; over 28 species in India; 1 species in cold desert.

Recent trends in splitting the heterogenous genus *Scirpus* L. *sens. lat.* into *Baeothryon* A. Dietr., *Blysmus* Panz. ex J.A. Schultes, *Hemicarpha* Nees, *Isolepis* R. Br., *Rikliella* J. Raynal *Schoenoplectus* (H.G.L. Reichb.) Palla, *Scirpus* L. etc. for the present, are accepted in

the present work but further study on a worldwide basis is necessary to establish satisfactory boundaries for some of these genera whose justification, at present, depends largely on differences in embryo structure. Vander Vaken (Bull. Jard. Bot. Bourse 35: 285-354. 1965) has discussed about the embryo types in detail.

Scirpus rufus Schrad., Fl. Germ. 1: 133. t. 1. f. 3. 1806; C.B. Clarke in Hook.f., Fl. Brit. India 6: 661. 1893.

Slender, perennial herbs up to 15 cm tall. Rhizome short, creeping. Stem terete, angular or striate, leafy below. Leaves linear, shorter than stem. Spikelets subdistichously closely spikate, dense; lowest bract short or long; glumes usually black, rarely brown, ovate-triangular, acute; perianth-bristles absent or very minute; bristles if present papillose and as long as the nut. Stamens 3. Style long, slender, bifid; stigmas 2. Nut sessile, ovoid, acute, compressed or plano-convex, smooth, ashy or brown.

Occasional in moist soil on slopes, in brackish marshes in Rupshu in Ladakh.

Fl. & Fr. : June - July.

Distrib. : Europe, N. America, Central Asia, Tibet, India Western Himalaya in Kashmir.

POACEAE

Annual or perennial herbs, shrubs or trees (bamboos). Stems erect, ascending or creeping; culms cylindrical, rarely flattened, usually hollow in the internodes. Leaves solitary at the nodes, sometimes crowded at base, alternate and 2-rowed, composed of sheath, ligule and blade. Spikelets in panicles, spikes or racemes; solitary, digitate or along a central axis; spikelets consist of 2 lowest empty bracts (glumes), succeeding 1 to several flowering bracts (lemmas), each with a flower, consisting of 2-3 reduced perianths (lodicules), stamens and ovary with usually plumose stigmas; lemma and flower opposed by hyaline scale (palea); rarely flowers unisexual. Fruits caryopsis, rarely a nut or berry.

About 650 genera and 10,000 species in the world; cosmopolitan. About 240 genera and 1200 species in India; 61 genera and 198 species in cold desert.

- 1a. Spikelets 1-many-flowered, breaking up at maturity above the glumes, or if falling entire then not 2-flowered, if 2-flowered then both bisexual or the upper barren..... 2
- b. Spikelets 2-flowered, falling entire at maturity; both florets bisexual or upper floret bisexual, lower floret male or barren 51

- 2a. Inflorescence an open or contracted or spike-like panicles, rarely racemes or spikes 3
- b. Inflorescence of digitate racemes or solitary spikes or panicles of spikes; spikelets secund on a tough rhachis or inflorescence of solitary spikes or spike-like racemes in which spikelets on opposite side of the rhachis. 47

- 3a. Spikelets usually with more than one fertile florets or if with one fertile floret then with sterile florets above it..... 4
- b. Spikelets with 1 fertile floret, with or without male or barren florets below it..... 34

- 4a. Lemma and rhachilla glabrous, if hairy then hairs not enveloping the lemma or if hairs long and enveloping the lemma then the lemma geniculately awned 5
- b. Lemmas or rhachilla long silky hairy, hairs enveloping lemmas. Tall grass with large plumose panicles..... 33

- 5a. Glumes usually shorter than the lowest floret and with the upper floret exerted, rarely longer 6
- b. Glumes usually as long as or longer than the lowest floret, enclosing the florets 23

- 6a. Lemmas 5-many-veined, awnless or awned..... 7
- b. Lemmas 1-3-veined, rarely 5-veined 20

- 7a. Lemmas with 1 awn, if more than 1 awn then tip of ovary hairy, rarely lemma awnless and then lemmas neither compressed nor 7-9-veined 8
- b. Lemmas 9-awned..... ENNEAPOGON

- 8a. Ovary with a hairy appendage at the tip..... 9
 b. Ovary glabrous at tip or if hairy then without a hairy appendage..... 10
- 9a. Inflorescence an open or contracted panicles. Awns inserted below the entire or 2-lobed tip..... BROMUS
 b. Inflorescence a raceme. Awn terminal..... BRACHYPODIUM
- 10a. Lemmas membranous and shining. Rhachilla terminating in a little clump of sterile lemma..... MELICA
 b. Lemmas coriaceous and dull. Rhachilla not as above..... 11
- 11a. Inflorescence an elongated, bilateral racemes, the spikelets edgeways on..... LOLIUM
 b. Inflorescence an open or contracted panicles, if racemes then the spikelets broad side on..... 12
- 12a. Lemmas firmly keeled on the back..... 13
 b. Lemmas rounded on the back..... 17
- 13a. Spikelets broadly ovate. Lemmas orbicular to oblate, with broad membranous margins appressed to florets..... BRIZA
 b. Spikelets narrower. Lemmas narrower, margins narrowly membranous, often inrolled..... 14
- 14a. Keel of palea smooth, hyaline at tip..... 15
 b. Keel of palea scaberulous to ciliolate, not hyaline at tip..... 16
- 15a. Lemma faintly 3-5-veined..... COLPODIUM
 b. Lemma prominently 3-veined, veins raised..... CATABROSA
- 16a. Spikelets borne in dense, one-sided clusters on the branches of a panicle. Lemma awned..... DACTYLIS
 b. Spikelets in open or contracted panicle. Lemma awnless..... POA
- 17a. Florets with one stamen. Inflorescence a pectinate raceme..... VULPIA
 b. Florets with 3 stamens. Inflorescence a panicle..... 18
- 18a. Delicate annual herbs. Lemmas obtuse to acuminate or mucronate, without hyaline tip..... EREMOPOA
 b. Perennial herbs. Lemmas acute or shortly awned, with hyaline tip..... 19

- 19a. Lemma hyaline at tip, obtuse, more or less erose..... PUCCINELLIA
 b. Lemma not hyaline at tip, tip acute or shortly awned, awn usually terminal FESTUCA
- 20a. Lemmas usually emarginate or 2-4-lobed or toothed at apex, rarely entire 21
 b. Lemmas usually entire at apex, obtuse, acute or acuminate 22
- 21a. Inflorescence of lax racemes on a central axis, always associated with axillary cleistogamous spikelets, concealed within the upper leaf-sheaths ... KENGIA
 b. Inflorescence a single unilateral raceme, spikelets in secund spikes TRIPOGON
- 22a. Inflorescence of racemes on a central axis. Lemmas softly villous all over ORINUS
 b. Inflorescence an open, contracted, spike-like or glomerate panicle. Lemmas usually glabrous to asperulous ERAGROSTIS
- 23a. Lemmas awned from the sinus between the two terminal lobes or lemma awnless and then glumes as long as or longer than lemma. Ligule a hairy rim 24
 b. Lemmas awned from the back, rarely from the tip, or lemma rarely awnless and then glumes shorter than lemma. Ligule membranous 25
- 24a. Glumes deciduous with spikelets. Lemmas notched, awnless SCHISMUS
 b. Glumes persistent on pedicle. Lemmas 2-lobed, awned DANTHONIA
- 25a. Lower floret barren ANTHOXANTHUM
 b. Lower floret bisexual 26
- 26a. Spikelets 2-flowered. Rhachilla not produced AIRA
 b. Spikelets 1-several flowered. Rhachilla produced 27
- 27a. Lemmas awned from between two lobes of the lemma DUTHIEA
 b. Lemmas awned from the back, rarely awnless 28
- 28a. Ovary hairy throughout or atleast at apex. Awns twisted at the base ... 29
 b. Ovary glabrous. Awns not twisted at the base 30
- 29a. Annual herbs. Spikelets nodding. Glumes 7-11-veined AVENA

- b. Perennial herbs. Spikelets erect. Glumes 1-6-veined HELICTOTRICHON
- 30a. Lemmas keeled 31
- b. Lemmas not keeled 32
- 31a. Lemmas dorsally awned TRISETUM
- b. Lemmas awnless or with a subapical mucro KOELERIA
- 32a. Spikelets 2-flowered DESCHAMPسيا
- b. Spikelets 3-flowered, the two lower male HIEROCHLOC
- 33a. Lowest florets bisexual ARUNDO
- b. Lowest florets male or barren PHRAGMITES
- 34a. Spikelets with 1 fertile floret and two lower barren represented by empty lemmas or lower lemma absent PHALARIS
- b. Spikelets with 1 fertile floret only 35
- 35a. Lemmas hyaline or membranous, rarely indurated and then laterally compressed 36
- b. Lemmas indurated or rigid, dorsally compressed 42
- 36a. Lemmas 1-veined, awnless. Glumes as long as lemma, rarely shorter. Pericarp free CRYPSIS
- b. Lemmas 3-5(-7)-veined, usually awned. Glumes usually longer than lemma. Pericarp not free 37
- 37a. Inflorescence dense spiciform cylindrical to capitate panicle 38
- b. Inflorescence loose panicle, if dense then not cylindric or spiciform . 39
- 38a. Glumes truncate at apex and mucronate. Lemma awnless PHLEUM
- b. Glumes pointed at apex. Lemma dorsally awned ALOPECURUS
- 39a. Spikelets articulate below glumes, falling entire. Glumes long-awned POLYPOGON
- b. Spikelets articulate above glumes or at the base of pedicel, not falling entire. Glumes shortly aristate 40
- 40a. Glumes usually shorter than lemma. Lemma usually 3-veined... MUHLENBERGIA
- b. Glumes longer than lemma. Lemma usually 5-veined, rarely 3-veined .. 41

- 41a. Lemma hyaline to cartilaginous. Callus glabrous to shortly pubescent AGROSTIS

 b. Lemma membranous to coriaceous. Callus bearded with long hairs CALAMAGROSTIS

- 42a. Spikelets not awned MILIUM
 b. Spikelets awned 43
- 43a. Awns simple 44
 b. Awns trifid 46
- 44a. Lemma bilobed, the lobes produced into 2 scabrid bristles TRIKERIA
 b. Lemma entire or bidentate 45
- 45a. Floret terete or laterally compressed. Lemma linear. Awns usually twisted below. Callus long and sharp pointed STIPA
 b. Floret dorsally compressed. Lemma elliptic. Awns not twisted but curved. Callus short obtuse ORYZOPSIS
- 46a. Awns glabrous ARISTIDA
 b. Awns or atleast the central one plumose STIPAGROSTIS
- 47a. Inflorescence a digitate raceme. Spikelets secund on a tough rachis ... 48
 b. Inflorescence of solitary, linear or oblong spikes or spike-like racemes. Spikelets on opposite sides of the tough rachis 49
- 48a. Spikes 1-3. Spikelets with 2-5 fertile florets TETRAPOGON
 b. Spikes 4 or more. Spikelets with 1 fertile floret CHLORIS
- 49a. Spikelets in triads of 1 central sessile, fertile and 2 lateral pedicelled male or barren spikelets HORDEUM
 b. Spikelets with 2-7 sessile, fertile florets 50
- 50a. Glumes lanceolate to oblong, 3-9 veined ELYMUS
 b. Glumes linear, 1-veined LEYMUS
- 51a. Spikelets usually paired, one sessile, the other pedicelled, rarely solitary. Glumes as long as the spikelets and enclosing the florets, more or less rigid. Upper lemma usually awned 52

- b. Spikelets usually solitary, rarely paired. Glumes membranous, the lower usually smaller or reduced. Upper lemma usually awnless 57
- 52a. Spikelets of each pair similar, the sessile and pedicelled usually bisexual. Joints of the panicle thin, linear or slightly expanded at the top... SACCHARUM
- b. Spikelets of each pair dissimilar, the sessile bisexual, the pedicelled male or barren or absent, rarely if similar then joints of the raceme and pedicel thick and swollen 53
- 53a. Joints of rhachis and pedicel of pedicelled spikelets swollen.. PHACELURUS
- b. Joints of rhachis and pedicel not swollen, occasionally with a translucent longitudinal groove 54
- 54a. Spikelets in racemes, not interrupted by spathes or solitary at the ends of the branches; the racemes collected into whorled panicles. ..CHRYSOPOGON
- b. Spikelets in panicles of racemes, interrupted by spathes or the espatheate racemes digitate or in pairs or solitary and terminal 55
- 55a. Upper lemma of the sessile spikelets with a basal awn. Sessile spikelets compressed from the side. Pedicelled spikelets reduced..... ARTHRAXON
- b. Upper lemma of the sessile spikelets awned from the tip or from the cleft or upper lemma reduced to the hyaline base of the awn 56
- 56a. Upper lemma of the sessile spikelet not cleft, often stipitate and passing into awn BOTHRIOCHLOA
- b. Upper lemma of the sessile spikelets 2-lobed or 2-cleft, awned in the sinus CYMBOPOGON
- 57a. Spikelets subtended by 1 or more bristles 58
- b. Spikelets not subtended by bristles 59
- 58a. Spikelets deciduous with bristles. Upper lemma smooth PENNISETUM
- b. Spikelets deciduous without bristles. Bristles persistent. Upper lemma transversely rugose SETARIA
- 59a. Spikelets arranged in more or less open panicles or panicles contracted and spikelike PANICUM
- b. Spikelets arranged in one-sided spikes or spike-like racemes; spikes or racemes digitate or scattered, rarely solitary 60

- 60a. Lemma of the upper floret crustaceous or coriaceous, usually with narrow inrolled margins..... ECHINOCHLOA
- b. Lemma of the upper floret thinly cartilaginous, usually with flat hyaline margins..... DIGITARIA

AGROSTIS L.

Annual or perennial herbs. Inflorescence panicle, usually diffuse, rarely spike-like. Spikelets linear-lanceolate to oblong, 1-flowered; rachilla not produced beyond lemma. Glumes equal or unequal, membranous, shining; lemma hyaline to cartilaginous, 5- or 3-veined, truncate to 4-dentate, awned or not; palea shorter than lemma, mostly covered by inrolled margin of lemma; callus glabrous or pubescent; lodicules 2; stamens 3. Grains free within the lemma.

The genus comprises about 220 species in the world; chiefly in cold and temperate regions; about 26 species in India; 9 species in cold desert.

Agrostis and **Calamagrostis** differ in habit, the former typically with an open panicle and a preference for drier habitats whereas the latter is with contracted to spiciform or capitate panicle and preferring damper habitats. They intergrade completely. *Agrostis* is best distinguished by its thinner lemmas.

- 1a. Lemma not awned..... 2
- b. Lemma awned..... 6
- 2a. Palea minute..... *A. vinealis*
- b. Palea half as long as the lemma or longer..... 3
- 3a. Panicle very dense, branches spiculate almost to the base..... 4
- b. Panicle very effuse, branches bare at base..... 5
- 4a. Rhizomatous herbs. Palea one-half to two-third the lemma..... *A. tenuis*
- b. Non rhizomatous herbs. Palea as long as lemma..... *A. viridis*
- 5a. Rhizomatous herbs. Ligule truncate, toothed. Panicles open in fruits.....
..... *A. gigantea*

- b. Non rhizomatous herbs. Ligule obtuse. Panicles closed in fruit *A. stolonifera*
- 6a. Lemma glabrous 7
- b. Lemma hairy 9
- 7a. Palea half as long as the lemma or longer *A. tenuis*
- b. Palea less than half the length of the lemma or absent 8
- 8a. Panicle lanceolate to ovate or oblong. Awns, when present, from below the middle of the lemma. Anthers 1-1.5 mm long *A. vinealis*
- b. Panicle linear, interrupted. Awns, when present, from above the middle of the lemma. Anthers 0.5-0.8 mm long *A. filipes*
- 9a. Palea less than half the length of lemma *A. pilosula*
- b. Palea almost as long as the lemma or slightly shorter 10
- 10a. Awns very short, not or hardly exerted beyond the glumes or absent. Anthers 0.5-0.7 mm long *A. munroana*
- b. Awns present, exerted beyond the glumes. Anthers more than 1 mm long *A. griffithiana*

Agrostis filipes Hook.f., Fl. Brit. India 7: 256. 1896; Bor. Grasses 387. 1960.

Slender, perennial, tufted herb up to 30 cm tall. Culms erect or geniculately ascending. Leaves radical and cauline, smooth or scaberulous above; ligule truncate, 1-2 mm long. Inflorescence a narrow interrupted panicle, 5-10 cm long, brownish or tinged with purple. Spikelets 2-2.5 cm long, 1-flowered, breaking up at maturity above the persistent glumes; glumes unequal, acute, awnless, keel scabrid; lemmas thin, truncate, 1.4-1.8 mm long, with a geniculate awn slightly above the middle; palea minute.

Rare on rocky slopes, drier open places in Khoksar, Lahul & Spiti, Kashmir.

Fl. & Fr. : June - August.

Distrib. : India : Himalayas; Kashmir to Himachal Pradesh, Khasi Hills, Assam.

Agrostis gigantea Roth, Tent. Fl. Germ. 1: 31. 1788. *A. alba sensu* Hook.f., Fl. Brit. India 7: 254. 1896. *pro part., non* L. 1753; Bor. Grasses 387. 1960.

Stout, rhizomatous herb up to 1 m tall. Culms erect or geniculately ascending from a tufted base, rooting and branching from the lower nodes. Leaf-blades rather short, flat; ligule blunt, 1.5-5 mm long. Inflorescence a loose, open, oblong to ovate panicle, 8-25 cm long. Spikelets green or purplish, shining, 2-3 mm long, breaking up at maturity above the persistent glumes; glumes subequal, acute, awnless, scabrid on the keel; lemmas 1.5-2.5 mm long, truncate at the tip, usually awnless, rarely awned from near the apex; palea half as long as lemma or longer.

Frequent on slopes, dry wastelands in Sissu, Lahul & Spiti, Gilgit, Baltistan in Ladakh.

Fl. & Fr. : June - August.

Distrib. : Europe, temperate Asia, Pakistan, India western Himalaya from Kashmir to Kumaon, Sikkim; introduced in N. America.

A. griffithiana (Hook.f.) Bor. Grasses 387. 1960. *Calamagrostis griffithiana* Hook.f., Fl. Brit. India 7: 263. 1896.

Erect perennial herbs up to 1 m tall. Leaves long, narrow, subcoriaceous; sheath smooth or scaberulous; ligule very short. Inflorescence a long narrow panicle, 6-15 cm long, branches suberect. Spikelets green or purplish, shortly pedicelled, 2-3 mm long; glumes subequal, lanceolate, acute; lemma hairy all over, lanceolate, truncate at apex, tip with short bristles, awn sessile to median, exerted; palea as long as the lemma.

Rare on slopes in Sissu, Lahul & Spiti.

Fl. & Fr. : July - September.

Distrib. India: western Himalayas from Himachal Pradesh to Kumaon, Khasi Hills.

Agrostis munroana Aitch. & Hemsl. in J. Linn. Bot. 19: 1882; Bor, Grasses 388. 1960. *Calamagrostis munroana* (Aitch. & Hemsl.) Boiss., Fl. Orient. 5: 523. 1884; Hook.f., Fl. Brit. India 7: 263. 1896.

Slender, tufted, annual herbs up to 50 cm tall. Culms erect or geniculately ascending. Leaf-blades flat, smooth or scaberulous; ligule 2.5-4 mm long, obtuse. Inflorescence broadly lanceolate to oblong, dense to effuse panicle, 5-15 cm long, usually tinged with purple, lower branches fascicled or 2-3-nate. Spikelets pedicelled, 1.5-2 mm long, breaking up at maturity above the persistent glumes; glumes subequal, oblong-lanceolate, acute, 1-veined, awnless, scaberulous on the keel; lemma hairy, 1-2 mm long, broadly truncate, crenate, awnless or with a fine awn arising at or below middle; palea as long as lemma; callus bearded.

Frequent on slopes in Khoksar, Lahul & Spiti and Ladakh.

Fl. & Fr. : June - September.

Distrib. : Afghanistan, Pakistan, India, from Western Himalayas.

A. pilosula Trin. in Mem. Acad. Sci. Petersb. ser. 6. 6: 372. 1841; Bor, Grasses 388. 1960. *Calamagrostis jacquemontii* Hook.f., Fl. Brit. India 7: 265. 1896. *C. pilosula* (Trin.) Hook.f., Fl. Brit. India 7: 263. 1896 incl. var. *wallichiana* (Steud.) Hook.f.

Slender, tufted annual herbs up to 1 m tall. Culms erect or geniculately ascending. Leaf-blades flat, scabrid; ligule 4-6 mm long, truncate. Inflorescence a broadly ovate to lanceolate, effuse or contracted panicles, 10-20 cm long, purplish. Spikelets 2.5-4 mm long, breaking up at maturity above the persistent glumes; glumes subequal, oblong-lanceolate, acute or acuminate, 1-veined, scabrid on keel, awnless; lemma oblong,

hairy, 2-3 mm long, acute or truncate, awn subbasal, 4-6 mm long, twisted below; palea less than half as long as lemma or minute.

Frequent on slopes in drier situations in Keylong, Lahul & Spiti and Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India, Western Himalaya.

Agrostis stolonifera L., Sp. Pl. 1:62. 1753. Bor, Grasses 390. 1960. *A. alba sensu* Hook.f., Fl. Brit. India 7: 254. 1896. *pro part., non* L. 1753.

Tufted, stoloniferous herbs up to 1 m tall. Culms erect or geniculately ascending. Leaf-blades flat, smooth or scaberulous; ligule blunt, 1.5-7 mm long. Inflorescence a loose, open, lanceolate to oblong panicle, 5-26 cm long, contracted after maturity, frequently lobed. Spikelets 2-3 mm long, green or purplish, usually shining, breaking up at maturity above the persistent glumes; glumes subequal, acute, awnless, scaberulous on the keel; lemma 1.5-2.5 mm long, usually awnless, or with a short, subapical awn; palea half as long as or slightly longer than lemma.

Common on alpine slopes and meadows forming a close turf in alpine pastures in Lahul & Spiti, Gilgit, Baltistan in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia, N. America; introduced in Australia, New Zealand, S. America; Pakistan, India, Western Himalaya.

Note : It is quite similar to *A. gigantea* but can be distinguished by presence of stolens and panicle being dense and contracted after anthesis.

A. tenuis Sibth., Fl. Oxen. 36. 1794; Bor, Grasses 391. 1960.

Slender, tufted, rhizomatous herbs up to 60 cm tall. Culms erect or geniculately ascending rooting and branching from the lower nodes. Leaf-blades flat, smooth or scaberulous; ligule blunt, 1.5-3 mm long.

Inflorescence a dense panicle, 5-10 cm long, branches spiculate almost to the base. Spikelets 3-3.5 mm long, breaking up at maturity; rhachilla not produced; glumes subequal, acute, awnless, scabrid on the keel; lemma glabrous, awnless or shortly awned from middle; palea half as long as lemma or more; callus shortly bearded.

Occasional on alpine slopes and meadows, forming a close turf in alpine pastures in Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia, India, Western Himalaya.

Agrostis vinealis Schreb., Spicil. Fl. Lips. 47. 1771. *A. canina sensu* Hook.f., Fl. Brit. India 7: 255. 1896, *non* L. 1753; Bor, Grasses 386. 1960.

Tufted perennial herbs with creeping rhizome; culms up to 60 cm tall. Leaves linear, radical convolute, cauline usually flat; ligule 1-5 mm long, oblong, acute or obtuse. Inflorescence a lanceolate to ovate or oblong panicle, 5-20 cm long, green purplish or brown, contracted and dense after anthesis. Spikelets 2-3.5 mm long, breaking up at maturity above the persistent glume; glumes unequal, lanceolate, acute or acuminate, awnless, scabrid on keel; lemma 1.5-2.5 mm long, tip truncate, 4-toothed, awnless or awned, awn median or subbasal, geniculate, exerted; palea minute or absent.

Common in moist situations in Khoksar, Lahul & Spiti, Gilgit, Baltistan, Ladakh.

Fl. & Fr. : July - September.

Distrib. : Europe, temperate Asia, India, Western Himalaya from Kashmir to Himachal Pradesh.

Note : It is often confused with *A. canina* L. which is non-rhizomatous. This is a draught resistant grass which spreads by means of creeping rhizome. It forms a fine, compact turf.

Agrostis viridis Gouan, Hort. Reg. Monsp. 546. 1762. *Phalaris semiverticillata* Forssk., Fl. Aegypt.-Arab. 17. 1776. *Agrostis verticillata* Vill., Prosp. Pl. Dauph. 16. 1779; Hook.f., Fl. Brit. India 7: 254. 1896. *A. semiverticillata* (Forssk.) Christ. in Dansk. Bot. Archiv. 4.3.12. 1922; Bor, Grasses 309. 1960.

Stoloniferous perennial herb up to 1 m tall. Culms geniculate ascending. Leaf-blades flat, scabrid; ligule 2-4 mm long, truncate. Inflorescence an ovate or oblong pyramidal, dense, lobed panicle, 5-15 cm long, the branches subverticillate, scabrid. Spikelets 1.5-2.5 mm long, green, falling entire attached to the pedicel; glumes subequal, subacute or obtuse, awnless, keel strongly scabrid; lemmas about 1 mm long, tip truncate, toothed, awnless; palea almost as long as lemma.

Common in moist situations in Gilgit, Baltistan in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Mediterranean regions eastward to southern Russia, Pakistan, India Western Himalaya.

Note : The species occupies an anomalous position in *Agrostis*, since its spikelets fall entire with pedicel.

AIRA L.

Annual or perennial herbs. Inflorescence a panicle, open or contracted. Spikelets ovoid, 2-flowered; rachilla jointed at the base, not produced beyond lemma. Glumes sub-equal, 3-veined, persistent; lemmas smaller, lanceolate, thinly coriaceous, 5-veined, often 2-lobed; awn dorsal, geniculate; palea hyaline, 2-veined; callus glabrous; lodicules 2; stamens 3. Grains fusiform, free or adhering to palea.

The genus comprises 8 species in the world; distributed in Europe and Mediterranean to Iran, now widespread as a weed; 1 species in India and cold desert.

Aira caryophyllea L., Sp. Pl. 1: 66. 1753; Hook.f., Fl. Brit. India 7: 272. 1896; Bor, Grasses 430. 1960.

Slender, annual herb up to 15 cm tall. Culms tufted, filiform. Leaves setaceous, obtuse; ligule lanceolate. Inflorescence an erect panicle, 3-5 cm long, branches capillary, trichotomously branched; rhachilla jointed at the base. Spikelets 2-flowered, long pedicelled, ovoid, shining; glumes subequal, 3-veined, ovate, acute, longer than lemmas, persistent; lemmas lanceolate, 5-veined, coriaceous, often 2-toothed; keels scabrid; awns dorsal, geniculate, almost twice as long as lemmas.

Occasional on loose stony slopes, forming clumps in Lahul, H.P.

Fl. & Fr. : May - August.

Distrib. : Europe, Western Asia, North Africa introduced into North and South America, India in Lahul & Spiti, Himachal Pradesh.

ALOPECURUS L.

Annual or perennial herbs. Inflorescence spiciform, cylindrical to capitate panicle. Spikelets laterally compressed, falling entire from the tumid tip of the short pedicels; rhachilla not produced beyond lemma. Glumes sub-equal, strongly compressed, membranous to thinly coriaceous, often connate along the margins below, strongly keeled, 3-veined, usually ciliate on the keels; lemma membranous or hyaline, margins often connate below, keeled, with usually a basal or median dorsal awn; palea and lodicules absent, stamens 2 or 3. Grains laterally compressed.

The genus comprises 36 species in the world; distributed in north temperate and cold regions; 6 species in India; 3 species in the cold desert.

- 1a. Panicles silky. Glumes aristately acuminate, hirsute with long hairs. Awns twice as long as the spikelets *A. himalaicus*
- b. Panicles not silky. Glumes obtuse or acute, ciliate on the veins and keels. Awns very short 2

- 2a. Annual herbs. Panicle cylindric. Spikelets up to 3 mm long. Glumes obtuse
 *A. aequalis*
- b. Perennial herbs. Panicle broadly oblong. Spikelets 4-6 mm long. Glumes acute
 *A. arundinaceus*

Alopecurus aequalis Sobol., Fl. Petrop. 16. 1799; Bor, Grasses 392. 1960. *A. aristulatus* Michx., Fl. Bor.-Amer. 1: 43. 1803; Hook.f., Fl. Brit. India 7: 238. 1896.

Annual or perennial herbs up to 40 cm tall; culms slender, geniculately ascending, occasionally rooting from the lower nodes. Leaves glaucous, linear, flat, upper sheath slightly inflated; ligule 2-5 mm long, obtuse. Inflorescence a cylindrical panicle, 2-6 cm long. Spikelets 1.5-3 mm long, oblong, green; glumes elliptic, obtuse, hyaline, free or connate at the base, ciliate on the keel, hairy on the sides; lemma obtuse, as long as or slightly longer than glume, the margins connate for half their length, awn median-dorsal.

Common in marshy places, watersides, ditches, shallow water, often forming swards on drying mud in Baltistan, Ladakh, Deosai Plains, Dras.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia, N. America, Pakistan, India, Western Himalaya from Kashmir to Himachal Pradesh.

Note : It is a common grass of watersides, ditches and shallow water, often forming swards on drying mud.

A. arundinaceus Poir. in Lam. Encycl. Meth. Bot. 8: 776. 1808; Hook.f., Fl. Brit. India 7: 238. 1896; Bor, Grasses 393. 1960.

Erect, perennial herbs up to 1 m tall; culms with creeping rhizomes. Leaves linear, blade flat, glabrous; upper sheath slightly inflated; ligule 2-4 mm long, obtuse. Inflorescence a broadly cylindrical, soft panicle, 2-

9 cm long, green. Spikelets 4-6 mm long, subsilky; glumes lanceolate, acute, connate below, keels and veins covered with silky hairs; lemma as long as or longer than glume, acute or truncate, the margins connate below, awn sub-basal, exceeding the tip of lemma.

Common in alpine pastures in Gilgit, Baltistan, Zanskar in Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia; introduced in N. America, India in Western Himalaya from Kashmir to Garhwal.

Alopecurus himalaicus Hook.f., Fl. Brit. India 7: 238. 1896; Bor, Grasses 393. 1960.

Erect, perennial herbs up to 80 cm tall, with short rhizome. Leaves erect or spreading, upper sheath inflated; ligule 2-3 mm long, scarious, obtuse, toothed. Inflorescence an ovoid-cylindrical panicle, 2-3.5 cm long, grey-green or purplish. Spikelets 3-5 mm long; glumes lanceolate, subaristately acuminate, connate at the base, densely hairy; lemma broadly acute or obtuse, margins connate, much shorter than glumes, awn exceeding the tip of lemma; palea absent.

Common in alpine pastures in Gilgit, Baltistan Thalla La, Skardu Dras, Zanskar, Suru, Rusi La, in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Iran, Afghanistan, Pakistan, India, Western Himalaya.

Note : It is grazed by sheep, cattle, yak and goats.

ANTHOXANTHUM L.

Annual or perennial herbs. Inflorescence a contracted to spiciform panicle. Spikelets 3-flowered; rhachilla disarticulating above the glumes,

not or scarcely produced. Glumes herbaceous, empty, persistent, lowest 1-veined, upper 3-veined; lemma hairy, bilobed, upper with a short awn from above the middle of the back, upper with a geniculate awn from below the middle, both empty, rarely 1 or both with male flower; uppermost lemma fertile, bisexual, margins convolute and covering the palea, emarginate, 5-7-veined; palea 1-veined; lodicules absent; stamens 2. Grains terete, free within the shining lemma and palea.

The genus comprises about 18 species; distributed in temperate Europe, Asia, Africa, the tropical mountains and C. America, introduced to other temperate regions; 5 species in India, 1 species in cold desert.

Anthoxanthum odoratum L., Sp. Pl. 1: 28. 1753; Hook.f., Fl. Brit. India 7: 222. 1896; Bor, Grasses 431. 1960.

Erect, tufted, perennial herbs 50-70 cm tall, sweet scented, especially when dry. Leaf-blades flat, glabrous to sparsely hairy; ligule 1.5 mm long. Inflorescence a dense or loose panicle, 2-8 cm long, green or purplish, pubescent or villous. Spikelets lanceolate, often fascicled, 3-flowered; the upper awn protruding; glumes ovate to lanceolate, slightly hairy, membranous, lower 3-5 mm long, 1-veined, mucronate, upper 6-10 mm long, 3-veined; sterile lemma 3-3.5 mm long, fertile lemma 1.5-2 mm long.

Occasional on stony slopes in Lahul & Spiti, Himachal Pradesh.

Fl. & Fr. : June - July.

Distrib. : Europe and temperate Asia, introduced to N. America; India Lahul & Spiti in Himachal Pradesh.

ARISTIDA L.

Annual or perennial herbs. Leaf-blades flat or convolute. Inflorescence a panicle, effuse, contracted or spike-like. Spikelets 1-flowered; rachilla articulate at the base. Glumes narrow, keeled, 1-veined or rarely lower 3-5-veined; lemma cylindrical or laterally compressed, convolute or involute,

indurated, glabrous or scabrid, tip produced into 3-branched awn; palea embraced by the lemma, rarely minute or absent; lodicules 2; stamens 3; callus well developed, acuminate or 2-fid. Grains free within the convolute lemma, terete or grooved.

The genus comprises about 250 species in the world; distributed in the tropics and sub-tropics; 16 species in India; 2 species in the cold desert.

- 1a. Tall robust perennial herb. Panicle effuse. Glumes awned *A. cyanantha*
 b. Short slender annual herb. Panicle contracted. Glumes mucronate or acuminate, not awned *A. adscensionis*

Aristida adscensionis L., Sp. Pl. 1: 82. 1753; Hook.f., Fl. Brit. India 7: 224. 1896; Bor, Grasses 407. 1960.

Annual or perennial herbs up to 1 m tall. Leaf blades linear, smooth or scaberulous, flat or folded. Inflorescence a contracted panicle, 15-20 cm long. Spikelets pallid, green or purple, 5-6 mm long; glumes unequal, linear or lanceolate, scaberulous on the keel, emarginate and mucronate or acute; upper 5-10 mm long, lower 1-3 mm long; lemma 5-15 mm long, laterally compressed, scabrid on the keel, passing into awn without constriction or articulation, central branch of the awn 5-20 mm long.

Common in drier situation in Gilgit, Baltistan, Skardu, Lahul & Spiti.

Fl. & Fr. : May - August.

Distrib. : Cosmopolitan.

A. cyanantha Nees ex Steud., Syn. Pl. Glum. 1: 141. 1854; Hook.f., Fl. Brit. India 7: 225. 1896; Bor, Grasses 409. 1960.

Stout, densely tufted, perennial herbs up to 1.5 m tall. Leaf-blades linear, flat, soon convolute. Inflorescence a loose, open panicle, 30-40 cm long, branches capillary, flexuous. Spikelets 6-8 mm long, rarely 1.5 cm long, purple; glumes unequal, lanceolate; keel smooth, lower 8-12 mm

long, gradually passing into awn, upper 10-15 mm long, bifid at apex with an awn 5 mm long in the sinus; lemma 8-10 mm long, awned; central branch of the awn 3-5 mm long.

Common in drier situation in Gilgit in Ladakh.

Fl. & Fr. : May - August.

Distrib. : Afghanistan, Pakistan, Nepal, India, Western Himalaya.

ARTHAXON P. Beauv.

Annual or perennial herbs. Culm slender, often trailing. Leaf-blades short, broadly lanceolate, cordate and amplexicaul at the base. Inflorescence a slender, terminal and axillary, subdigitate, rarely single raceme; sessile spikelets dorsally or laterally compressed, 1-flowered. Lowest glume membranous to coriaceous, often spinulose, scabrid or muricate, with or without lateral keels, upper lemma awned from low down on back; palea minute or absent; stamens 2-3; style short or absent; stigma laterally exerted. Grains terete. Pedicelled spikelets variable, as like as sessile or completely suppressed.

The genus comprises about 25 species in the world; distributed in Old World tropics, chiefly in India; 21 species in India; 1 species in the cold desert.

Arthraxon prionodes (Steud.) Dandy in Andrews Fl. Pl. Sudan 3: 399. 1956; Bor, Grasses 101. 1960. *Andropogon prionodes* Steud., Syn. Pl. Glum. 1. 383. 1854.

Perennial herbs up to 50 cm tall. Culms covered with silky scales at base. Leaf-blades lanceolate-ovate, tuberculate-ciliate on the margins, setaceously acuminate; ligule membranous. Inflorescence of 2-8 racemes; racemes 4-7 cm long. Spikelets paired, one sessile the other pedicelled, laterally compressed, 4-6 mm long, narrowly lanceolate; lower glume rounded on the back, keeled; keels spinously muricate; lower floret reduced

to a hyaline lemma; upper floret fertile, lemma hyaline, awn geniculate, 8-15 mm long; palea minute or absent.

Occasional in shady places on rocky slopes in Lahul, Himachal Pradesh.

Fl. & Fr. : June - September.

Distrib. : Tropical East Africa, Sudan, Pakistan, China, Thailand; India Lahul & Spiti in Himachal Pradesh

Note : The species is often confused with *A. lanceolatus* (Roxb.) Hochst, which is confined to South India. *A. lanceolatus* has the lower glume of sessile spikelet flat on the back.

ARUNDO L.

Tall, stout, rhizomatous, perennial herbs. Leaves cauline; blades broad and flat; ligule membranous, margin minutely ciliolate. Inflorescence a large, plumose, profusely branched panicle. Spikelets few-flowered; all florets fertile or upper reduced; rhachilla glabrous or shortly hairy, jointed at the base; glumes sub-equal, 3-5-veined, scarious; lemma membranous, 3-7-veined, plumose below middle, acuminate or 2-fid with a short awn in the sinus; palea hyaline, 2-veined, ciliate on the veins; lodicules 2; stamens 3; stigmas plumose. Grain oblong.

The genus comprises about 12 species in the world; distributed in the tropical and temperate regions; 1 species in India and also in the cold desert.

Arundo donax L., Sp. Pl. 1: 81. 1753; Hook.f., Fl. Brit. India 7: 302. 1896; Bor, Grasses 413. 1960.

Tall, robust perennial herbs up to 3 m tall, with creeping woody rhizome. Leaves distichous, linear-lanceolate, glabrous, smooth, base amplexicaul, tapering from base to the tip. Inflorescence large, decomposed thyriform panicle, 30-60 cm long, silky hairy. Spikelets green or yellowish,

3-4-flowered, 10-15 mm long; glumes subequal, oblong-lanceolate, 3-veined, 10-12 mm long; lemmas lanceolate, 3-5-veined, acuminate or 2-fid with a short awn in between, dorsally hairy below the middle; palea hyaline, 2-keeled, ciliate on the keels.

Occasional in moist places along roads, ditches, riverbanks in Ladakh and Lahul & Spiti.

Fl. & Fr. : May - October.

Distrib. : Tropical Asia, Mediterranean regions eastward to Burma, N. Africa; introduced into many parts of the world; India, from Kashmir to Himachal Pradesh.

Note : The species is quite similar to *Phragmites* which can be distinguished by the glabrous lemmas and the silky beard at the bases of the lowest panicle branches. The ligule in *Arundo* is membranous while in *Phragmites* it is a fringe of hairs.

AVENA L.

Annual herb. Leaves usually flat. Inflorescence an effuse, nodding panicle or contracted. Spikelets 2-6-flowered, lower 1-3 bisexual, upper reduced, terminal barren; rhachilla jointed at the base, disarticulating above the glumes; glumes subequal, herbaceous to membranous, 3-11-veined, rounded on the back; lemmas coriaceous, rounded on the back, 5-9-veined, 2-toothed or cleft, awned from the back; below the cleft, awn reduced or absent in cultivated species; palea 2-keeled; lodicules usually 2-fid; stamens 3; stigmas 2; ovary hairy. Grains free or adherent to the pales.

The genus comprises about 25 species in the world; chiefly Mediterranean and Middle East, extending to northern Europe and widely introduced to other temperate regions; 15 species in India; 3 species in cold desert.

It is allied to *Helictotrichon* Besses ex J.A. Schult & J.H. Schult. from which it can be distinguished by its annual habit and smooth rounded glumes.

- 1a. Lemmas with two apical awns or bristles *A. barbata*
 b. Lemmas without apical awns or bristles 2
- 2a. Rhachilla articulated between the florets *A. fatua*
 b. Rhachilla not articulated between the florets. *A. sterilis* ssp. *ludoviciana*

Avena barbata Pett. ex Link in J. Bot. Gottingen 2: 315. 1799; Bor, Grasses 433. 1960. *A. barbata* Brot., Fl. Lusit. 1: 108. 1804. *Nom illegit.*; Hook.f., Fl. Brit. India 7: 275. 1896.

Annual, softly tomentose herbs up to 1 m tall; culms erect or ascending. Leaf-blades sparsely hairy to ciliate; ligule 2-4 mm long, torn. Inflorescence a subsecund panicle, 20-30 cm long; branches smooth or faintly scaberulous. Spikelets 1.5-3 cm long, 2-flowered, the rhachilla articulated beneath each floret; glumes lanceolate, acuminate, 9-veined; lemmas 1-2 cm long, densely hairy below the middle, scabrid or asperulous on the veins above, 2-toothed at apex, teeth aristulate with bristles 3-12 mm long; awn 3-6 cm long, geniculate.

Common as weed of cultivation in Ladakh and Lahul & Spiti.

Fl. & Fr. : May - June.

Distrib. : Southern Europe, Mediterranean regions eastward to Nepal and southern Russia, Pakistan, India, Western Himalaya.

A. fatua L., Sp. Pl. 1: 60. 1753; Hook.f., Fl. Brit. India 7: 275. 1896; Bor, Grasses 434. 1960. *A. sativa* L. var. *sericea* Hook.f., Fl. Brit. India 7: 275. 1896.

Annual herbs up to 1 m tall; culms erect or geniculately ascending, stout; nodes hairy. Leaf-blades flat, scaberulous; ligule 2-5 cm long, torn. Inflorescence narrowly to broadly pyramidal, nodding panicles, sometimes subsecund, 10-40 cm long, branches spreading all round, scabrid. Spikelets pendulous, 2-2.5 cm long, 2-flowered; the rhachilla articulated beneath each floret; glumes lanceolate, acute, 9-veined; lemma 1-2.5 cm long,

bearded with long fulvous hairs, green and rough above, 2-toothed at apex; awn 2.5-4 cm long, geniculate, the column dark brown.

Common weed of cultivation in Ladakh and Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Europe, Western and central Asia; introduced to many countries; Pakistan, India, Western and eastern Himalaya.

Avena sterilis L. ssp. *ludoviciana* (Dur.) Gill & Magne, *Fl. Fr.*, ed. 3. 532. 1875. *A. ludoviciana* Dur. in *Bull. Soc. Linn. Bordeaux* 20: 41. 1855; Bor, *Grasses* 434. 1960.

Annual, tufted herbs up to 1 m tall; culms erect or ascending. Leaf-blades glabrous, rough; ligule 2-5 mm long, torn. Inflorescence a loose, subsecund panicle, 15-20 cm long; branches scabrid. Spikelets 2-3 cm long, 2-3-flowered; rachilla articulated above the glumes and not between the florets; glumes lanceolate, acute; lemmas 1.5-2 cm long, densely hairy with long stiff hairs and finally dark brown in the lower two-third, scaberulous above, 2-toothed at apex; awn 3-4 cm long, geniculate, the column dark brown to blackish.

Common weed of cultivation in Ladakh and Lahul & Spiti.

Fl. & Fr. : May - June.

Distrib. : Mediterranean region and the middle East, eastwards to Pakistan, India Western Himalaya.

BOTHRIOCHLOA O. Kuntze

Perennial herbs. Leaves often aromatic; blades flat; ligule membranous. Inflorescence digitate or sub digitate racemes, sometimes paniculate with simple or rarely subdivided branches and then the racemes with more than 8 sessile spikelets, without homogamous spikelet pairs;

internodes and pedicels linear, hyaline with thickened margins. Spikelets sessile and pedicelled, dorsally compressed; glumes broadly convex to concave, sometimes with 1-3 circular pits; lemma entire, rarely bilobed, with a glabrous awn, rarely awnless, stamens usually 3. Grains oblong, slightly dorsally compressed.

The genus comprises about 35 species in the world; distributed throughout the tropics; 16 species in India; 2 species in the cold desert.

- 1a. Lower glume of sessile spikelets with one or two pits..... *B. pertusa*
- b. Lower glume of sessile spikelets without pits *B. ischaemum*

Heslop-Harrison (Phytomorph. 11: 378-383. 1961) believes that the glume-pits play a part in cleistogamous flowering by obstructing the emergence of the anthers.

The boundaries between *Bothriochloa*, *Capillipedium* Stapf and *Dichanthium* Willemet. are somewhat blurred. De Wet & Harlan (Am. J. Bot. 53. 94-98. 1966; Taxon 19: 339-340. 1970) have advocated uniting the three genera and accepting the oldest name *Dichanthium*. Clayton (Kew Bull. 32: 1-4. 1977) and Jain & Deshpande (Bull. Bot. Surv. India 20; 133-135. 1978) supported this merger.

***Bothriochloa ischaemum* (L.) Keng** in Contr. Biol. Lab. Sci. Soc. China, Bot. Ser. 10: 201. 1936; Bor, Grasses 108. 1960. *Andropogon ischaemum* L., Sp. Pl. 2: 1047. 1753; Hook.f., Fl. Brit. India 7: 171. 1896.

Perennial, tufted herbs up to 60 cm tall; culms erect or geniculately ascending, nodes naked or bearded. Leaf-blades linear. Inflorescence composed of 5-15 subdigitate racemes; racemes silky, 4-6 cm long, rachis glabrous. Sessile spikelets 3-5 mm long, oblong-lanceolate; lower glume oblong, chartaceous, 5-7-veined, hairy below the middle, without pit, keels rigidly ciliate; upper glume lanceolate, mucronulate; lemma oblong-lanceolate, acute, ciliate; awn 1.5-2 cm long. Pedicelled spikelets darker than sessile; lower glume lanceolate, 5-veined; upper linear-lanceolate, 5-7-veined; lemma linear-oblong, obtuse, ciliate.

Common on slopes, along roads in Gilgit. Baltistan, Dras, Skardu in Ladakh, Gondhla in Lahul & Spiti.

Fl. & Fr. : May - October.

Distrib. : Southern Europe, N. Africa, eastward to Pakistan, India, Western Himalaya.

Note : This species is reported to introgress with *B. bladhii* (Retz.) Blake (De Wet & Harlan in Am. J. Bot. 53: 94-98. 1966) and the hybrid often resembles the southeast Asian var. *songorica*.

Bothriochloa pertusa (L.) A. Camus in Anals. Soc. Linn. Lyon, n.s. 76: 164. 1931; Bor, Grasses 109. 1960. *Holcus pertusus* L., Mant. Pl. 2: 301. 1771. *Andropogon pertusus* (L.) Willd., Sp. Pl. 4(2): 922. 1806; Hook.f., Fl. Brit. India 7: 173. 1896.

Stoloniferous, perennial herbs up to 40 cm tall; culms tufted, often creeping and rooting from lower nodes, usually ascending from a leafy base; nodes sometimes bearded. Leaves linear, acute or acuminate, glabrous except at the ciliate base, lower shorter than the upper and crowded at the base; ligule membranous truncate. Inflorescence of 3-8 subdigitate, shortly pedunculate racemes; racemes pale or purplish, 2.5-5 cm long, silky. Sessile spikelets narrowly elliptic, 3.5-4.5 mm long; lower glume cartilaginous, hairy below middle, pitted above the middle; awn 1.5-2 cm long; palea minute or absent. Pedicelled spikelets like the sessile, male or neuter; lower glume pitted or not; keel ciliolate, lower lemma linear oblong, upper lemma short or absent.

Common along roads, on grassy slopes in Ladakh, Dras and Lahul & Spiti; a sward-forming species.

Fl. & Fr. : July - August.

Distrib. : Tropical Asia, Africa, Australia, Pakistan, India.

Note : It is highly esteemed as a fodder and can also be made into hay. It will stand up to constant grazing and trampling and is drought resistant.

BRACHYPODIUM P. Beauv.

Rhizomatous, perennial herbs, rarely annual. Leaves flat or convolute. Inflorescence a linear, loose raceme; spikelets few, rarely 1, born single on divergent pedicels. Spikelets 5-20-flowered, subterete to slightly laterally compressed; rhachilla elongate and jointed below the lemma. Glumes opposite, herbaceous to membranous, 3-9-veined, rounded on back, obtuse to shortly awned; lemmas herbaceous to membranous, 7-9-veined, rounded on back, with a terminal awn or mucro; palea ciliolate on the keels; lodicules ciliate; stamens 2-3. Grains linear oblong, adherent to palea.

The genus comprises about 16 species in the world; mainly in the Mediterranean regions, extending into temperate Europe and Asia and tropical mountains of the both hemispheres; 3 species in India; 1 species in cold Desert.

Brachypodium sylvaticum (Huds.) P. Beauv. Ess. Agrost. 101. 155. 1812; Hook.f., Fl. Brit. India 7: 362. 1896; Bor, Grasses 450. 1960.

Slender, tufted, perennial herb up to 1 m tall. Leaf-blades flat, usually loosely hairy or scaberulous; sheaths loosely hairy; ligule short, obtuse. Inflorescence a raceme, 5-15 cm long, nodding. Spikelet cylindrical, oblong or lanceolate, 2-4 cm long, many-flowered; lower glume lanceolate, subulate, 6-8 mm long, shorter than upper; upper glume oblong-lanceolate, acute, acuminate or shortly awned; lemma 7-11 mm long, 7-veined gradually narrowed into a slender awn; awn 1-1.5 cm long.

Frequent along roads, on slopes in Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia and the mountains of tropical Asia, India, Western Himalaya.

BRIZA L.

Annual or perennial herbs. Leaf-blades flat or convolute. Inflorescence a lax or loosely contracted panicle. Spikelets many-flowered, laterally compressed or globose, pendulous, rhachilla jointed at the base. Glumes subequal, scarious, 3-9-veined, persistent; lemmas broader, acute or shortly awned, sometimes obtuse, cuspidate or bilobed, margin broad membranous on upper half or all along, clasping floret above and sometimes with basal auricles or lateral wings; palea hyaline, 2-keeled, keels often winged; lodicules 2; stamens 1-3. Grains ovoid, dorsally compressed, closely invested by the palea.

The genus comprises about 20 species in the world; distributed in temperate regions, chiefly in Europe and S. America, widely naturalised elsewhere; 3 species in India; 1 species in cold Desert.

Briza media L., Sp. Pl. 1: 70. 1753; Hook.f., Fl. Brit. India 7: 336. 1896; Bor, Grasses 528. 1960.

Tufted perennial herbs up to 50 cm tall; with short rhizome. Leaf-blades flat, scabrid on margins; upper sheath inflated; ligule very short. Inflorescence a loose, nodding panicle, 4-15 cm long; branches long, capillary, horizontal; spikelets borne on capillary pedicels. Spikelets broadly elliptic to ovate, 4-7 mm long, 4-12-flowered, green or purplish; glumes shorter than lemma, subequal, 3-5-veined; lemmas 3.5-4 mm long, very broad, deeply concave, obtuse, acute or shortly awned; palea often broad, flat, hyaline.

Rare on slopes in Baltistan, Ladakh, Rohtang slope, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Europe eastward to Pakistan, India Western Himalaya.

BROMUS L.

Annual or perennial herbs. Leaf-sheaths with margins connate for most of their length, usually hairy. Inflorescence a large and open panicle, sometimes dense and contracted. Spikelets many-flowered, laterally compressed; rhachilla jointed below the lemma, not produced beyond the lemma. Glumes herbaceous, unequal, 1-5-veined; lemmas herbaceous to sub-coriaceous, sometimes with membranous margins, well exerted from the glumes, entire, bidentate or bilobed, mucronate to long awned; palea 2-fid or 2-toothed, keeled, keel scabrid or ciliate; lodicules 2, entire or cleft; stamens usually 3; ovary hairy at the tip. Grains linear-oblong, adherent to palea.

The genus comprises about 150 species in the world; distributed in temperate regions of both hemispheres, chiefly in the north; 18 species in India; 11 species in cold desert.

- 1a. Lemmas or atleast upper lemma 3-awned, widened above the middle into a very distinct, obtuse angle *B. danthoniae*
- b. Lemma 1-awned or rarely awnless or 3-awned but then lemma not widened 2
- 2a. Spikelets ovate, lanceolate, or elliptic. Lower glume 3-7-veined; upper glume 5-9-veined 3
- b. Spikelets oblong or wedge-shaped. Lower glume 1-veined; upper glume 3-veined 7
- 3a. Panicle dense; branches and pedicels much shorter than the spikelets
..... *B. scoparius*
- b. Panicle lax, atleast some branches and pedicels as long as or longer than the spikelets 4
- 4a. Panicles erect; pedicels as long as the spikelets *B. lanceolatus*
- b. Panicles nodding; pedicels longer than their spikelets 5
- 5a. Spikelets 3-5 cm long. Lower glumes 9-11 mm long *B. oxyodon*
- b. Spikelets less than 3 cm long. Lower glumes less than 9 mm long 6

- 6a. Lemma coriaceous, with inconspicuous veins and blunt teeth. Awns usually strongly reflexed *B. japonicus*
 b. Lemma papery, with conspicuous veins and acuminate teeth. Awns usually straight and erect *B. pectinatus*
- 7a. Rhizomatous herbs 8
 b. Non-rhizomatous herbs 10
- 8a. Rhizome short. Plants densely tufted *B. ramosus*
 b. Rhizome long, creeping. Culms few or solitary 9
- 9a. Lemmas densely hairy on the back and on the side veins *B. confinis*
 b. Lemmas glabrous or scabrid with minute appressed bristles .. *B. inermis*
- 10a. Awns 4-6 times the length of the lemma *B. gracillimus*
 b. Awns 1-2 times the length of the lemma *B. tectorum*

Bromus confinis Nees ex Steud., Syn. Pl. Glum. 1: 310. 1854. *B. inermis* Leyss. var. *confinis* (Nees ex Steud.) Stapf in Hook.f., Fl. Brit. India 7: 358. 1896; Bor, Grasses 455. 1960.

Perennial herbs up to 1 m tall, with creeping rhizome. often stoloniferous; culms solitary or loosely tufted; nodes usually pubescent. Leaves pubescent, finely acuminate; sheaths striate, densely pubescent; ligule truncate toothed. Inflorescence usually a simple raceme, 8-12 cm long. Spikelets oblong-lanceolate, densely pubescent, purplish, several-flowered; glumes narrowly lanceolate, pubescent; lower 5-8 mm long, 1-veined; upper 7-10 mm long, 3-5-veined; lemmas oblong-lanceolate, the lower 5-7-veined, pubescent all over, slightly 2-toothed at apex, awned; palea ciliate on the back and keels.

Occasional on slopes in Gilgit, Dras, Baltistan, Ladakh, Keylong, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : South west Asia from Iran to India, Western Himalayas mainly at high altitudes.

Note : It is similar to and intergrades with *B. inermis*, differing mainly by the combination of long awn, hairy spikelets and pubescent sheaths and blades.

Bromus danthoniae Trin. in C.A. Mey., Verz. Pfl. Cauc. 24. 1831; Bor, Grasses 453, 1960. *B. macrostachys* Desf. var. *triaristatus* Hask. in Flora, Jena 62: 155. 1879; Hook.f., Fl. Brit. India 7: 362. 1896.

Fig. 37.

Annual herbs up to 45 cm tall; culms erect or geniculately ascending. Leaves linear, acute or subacute, hairy; sheaths pubescent; ligule ovate, lacerate. Inflorescence an ovate or obovate-oblong, loose or contracted panicle, 5-10 cm long, sometimes reduced. Spikelets elliptic to oblong, pale green, 6-8-flowered, 1.5-3.5 cm long; lower glume broadly lanceolate, 5-8 mm long, 3-5-veined; upper glume oblong, 6-9 mm long, 7-9-veined; lemmas elliptic to obovate-oblong, lower with hyaline margins, 9-11-veined, 1-awned, upper lemma 3-awned, awns from the back below the tip; usually purplish, the central 15-25 cm long, reflexed, the lateral 4-10 mm long; palea ciliolate on the keels.

Common in drier conditions in Ladakh, Lahul & Spiti.

Fl. & Fr. : June - July.

Distrib. : Middle east to southern Russia, Tibet, India, Western Himalaya.

Note : The grass looks very handsome with purple awns and pale green lemmas with silvery hyaline margins.

B. gracillimus Bunge in Mem. Acad. Sci. Petersb. Sav. etr. 7: 527. 1851; Bor, Grasses 454. 1960. *B. crinitus* Boiss. & Hohen in Boiss., Diagn., ser. 1.2 (13): 64. 1854; Hook.f., Fl. Brit. India 7: 359. 1896.

Erect annual herbs up to 45 cm tall. Leaves linear, flaccid, hairy; sheath pubescent; ligule ovate, lacerate. Inflorescence a stiff, ovate panicle,

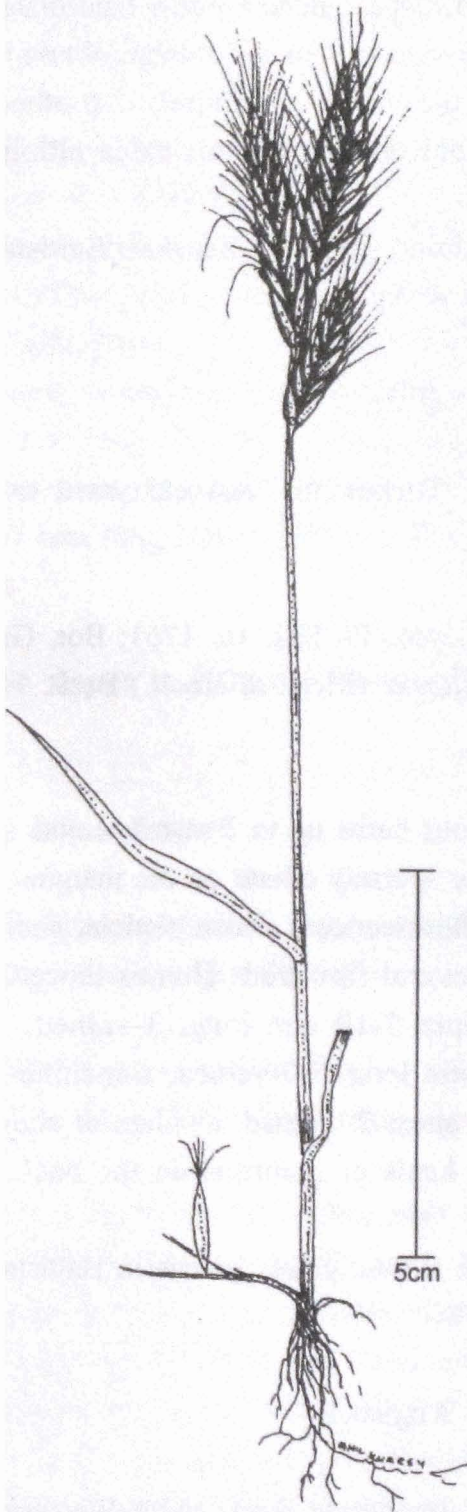


Fig. 37. *Bromus danthoniae* Trin.

4-10 cm long, loose and open, branches 3-5-nate. Spikelets pale green, elliptic, 4-6-flowered, 5.5-8.5 mm long; lower glume lanceolate, acute, hyaline on sides, 1-veined; upper glume broadly lanceolate, 4-5.5 mm long, tip and margins hyaline, 3-veined; lemmas oblong, obtuse, strongly involute, 5-7-veined, ciliolate on the margins, minutely 2-toothed with a straight awn 1-2 cm long, terminal or subterminal; palea ciliolate on the keels.

Common on dry alpine slopes in Zanskar, Baltistan, Dras, Rupshu Ladakh, Keylong, Lahul & Spiti.

Fl. & Fr. : April - July.

Distrib. : Persia, Turkestan, Iran eastward to India, Western Himalaya.

Bromus inermis Leyss., Fl. Hal. 16. 1761; Bor, Grasses 455, 1960. *B. inermis* Leyss. var. *villosus* (Mert. & Koch.) Beck, Fl. Nieder. Osterr. 1: 106. 1890.

Perennial rhizomatous herbs up to 1 m tall; culms solitary or loosely tufted. Leaves glabrous or sparsely ciliate on the margins; sheaths glabrous or shortly pubescent. Inflorescence a dense panicle, sometimes loose and open, 10-20 cm long, several-flowered; glumes lanceolate, lower 3.5-6 mm long, 1-veined, upper 5-10 mm long, 3-veined; lemmas oblong-lanceolate, lower 8-12 mm long, 5-7-veined, sometime sparsely hairy at the base, truncate at the apex, 2-toothed, awnless or shortly awned; palea ciliate on the back and keels or glabrous on the back.

Common on alpine slopes, grassy places in Baltistan, Dras, Ladakh, Sissu, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia, India Western Himalaya.

Note : It is an useful fodder grass.

Bromus japonicus Thunb. ex Murr., Syst. Veg. 119. 1784; Bor, Grasses 455. 1960. *B. patulus* Mert. & Koch. in Roehl., Deutsch. Fl., ed. 3. 1(2): 685. 1823; Hook.f., Fl. Brit. India 7: 361. 1896, incl. var. *microstachya* Stapf in Hook.f., l.c.

Annual herbs up to 60 cm tall; culms erect or geniculately ascending. Leaves linear, acute or subacute; sheaths pubescent; ligule ovate, toothed. Inflorescence a linear-oblong panicle, lax and spreading, 6-15 cm long, often nodding, branches and pedicels long filiform, flexuous. Spikelets oblong-lanceolate, pale green, 1.5-3 cm long, several-flowered; lower glume lanceolate, pubescent or scabrid, 4.5-6 mm long, 3-veined; upper oblong-lanceolate, 5-7.5 mm long, 7-veined; lemmas elliptic-oblong, lower 7.5-10 mm long, coriaceous, margins hyaline, 7-veined, 2-toothed at apex, awn subapical, 5-7 mm long; upper lemma with awns 8-10 mm long; palea ciliolate on keels.

Common on slopes in Baltistan, Skardu, Ladakh, Khoksar, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, eastward to Japan, introduced in N. America and else where; India, Western Himalaya.

B. lanceolatus Roth, Catalect. Bot. 1: 18. 1797. *B. macrostachys* Desf., Fl. Atlant. 1: 96. t. 19/2. 1798; Bor. Grasses 456. 1960.

Annual herbs up to 60 cm tall; culms erect or geniculately ascending. Leaves linear; sheaths pubescent; ligule ovate, lacerate. Inflorescence a narrow dense panicle, 5-15 cm long, branches short, erect. Spikelets elliptic-oblong, 2.5-4 cm long, several-flowered; lower glumes lanceolate, 7-9 mm long, 3-veined, upper oblong, 9-11 mm long, 5-veined; lemmas elliptic, lower herbaceous, 1-1.5 cm long, margins hyaline, 7-9-veined, 2-toothed at apex, awn subapical, 1.5-2.5 cm long, reflexed and twisted at maturity; palea ciliolate on the keels.

Common on slopes in Ladakh and Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, Mediterranean regions; Middle East, Central Asia; India, Western Himalaya.

Note : It is quite similar to *B. pectinatus* but in latter case panicle is quite open, and awns are straight. *B. lanceolatus* is also allied to *B. oxyodon*. Stapf (in Hook.f., Fl. Brit. India 7: 362. 1896) considers the plants occurring in Indian region as var. *triaristatus* and the type var. distributed in Mediterranean region, Persia.

Bromus oxyodon Schrenk in Bull. Scient. Acad. Sci. Petersb. 10: 355. 1842; Hook.f., Fl. Brit. India 7: 361. 1896; Bor, Grasses 455. 1960.

Annual herbs up to 60 cm tall; culms erect or geniculately ascending. Leaves linear, hairy; sheaths pubescent; ligule ovate, lacerate. Inflorescence a loose, spreading, stiff panicle, 5-20 cm long; branches 2-5-nate, scabrid, 1-4-spiculate. Spikelets pale green, linear-oblong, 3-5 cm long, 5-10-flowered; glumes scabrid with appressed hairs, lower lanceolate, 8-10 mm long, 3-veined; lemmas oblong-lanceolate, 9-12 mm long, 5-7-veined; lemmas oblong-lanceolate, herbaceous, margins hyaline, 7-veined, 2-toothed at apex, awn subapical, flattened at base, 1.5-3 cm long, reflexed and slightly twisted at maturity; palea ciliolate on keels.

Common on dry slopes in Dras, Baltistan, Zaskar, Ladakh, Gondhla in Lahul & Spiti.

Fl. & Fr. : May - August.

Distrib. : Central Asia from Afghanistan to Pamir, Tien Shan, Western Mongolia, India, Western Himalaya.

Note : It is quite similar to *B. pectinatus*, especially when young but can be distinguished by its longer glumes, longer and strongly reflexed awns and more open panicle suffused with pruple.

Bromus pectinatus Thunb., Prodr. Fl. Cap. 1: 22. 1794. *B. patulus* Mert. & Koch var. *falconeri* Stapf in Hook.f., Fl. Brit. India 7: 361. 1896. *B. patulus* Mert. & Koch var. *pectinatus* (Thunb.) Stapf in Hook.f., *l.c.* *B. gedrosianus* Penzes in Bot. Kozl. 33: 111. 1936; Bor, Grasses 454. 1960.

Annual herbs up to 60 cm tall; culms erect or ascending. Leaves linear, flaccid, hairy above; sheaths pubescent; ligule ovate, toothed. Inflorescence a very loose, nodding or erect panicle with ascending branches, villous, 5-20 cm long; branches and pedicels filiform and flexuous. Spikelets lanceolate, 4-10-flowered, 1.5-3 cm long, scaberulous or puberulous; lower glume lanceolate, 1-3-veined, 5-8 mm long; upper 3-5-veined, 7-10 mm long; lower lemma 8-15 mm long, herbaceous with hyaline margins, 5-7-veined, acutely 2-toothed, awn arising 2-3 mm below the hyaline tip, awn 7-15 mm long; palea with pectinate-ciliate keels.

Common on dry slopes in Gilgit, Baltistan, Ladakh; Mulbekh, Karakoram, Darcha in Lahul & Spiti.

Fl. & Fr. : June - September.

Distrib. : Europe, Sudan, Ethiopia to Egypt, Arabia, S. Africa, Iran, Afghanistan, Pakistan, India Western Himalaya.

B. ramosus Huds., Fl. Angl. 40. 1762; Bor, Grasses 456. 1960. *B. asper* Murr., Prodr. Stirp. Gotting. 42. 170. 1762; Hook.f., Fl. Brit. India 7: 358. 1996.

Perennial herbs up to 1.5 m tall; culms loosely tufted. Leaves flaccid, hairy above margins, scabrid; sheaths retrorsely hirsute; ligule obtuse ciliolate. Inflorescence a lax, nodding, very wide panicle, 15-40 cm long; branches 2-nate or lower 3-5-nate, lowest branches with a ciliate scale at the base; pedicels 5-30 mm long. Spikelets linear-oblong, green, 5-10-flowered, 2-4 cm long; lower glume linear-lanceolate, 6-8 mm long, 1-veined, upper glume broader, 9-11 mm long; 3-veined, mucronate or shortly awned; lower lemma 10-12 mm long, 7-veined, hairy on the margins and

veins, awned; awn 4-7 mm long, terminal or subterminal; palea obtuse, keels ciliate.

Common in shady places, alpine slopes in Gilgit, Ladakh, Tandi, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Europe, Western and Central Asia, India, Western Himalaya, Sikkim.

Bromus scoparius L. Cent. Pl. 1: 6. 1755; Hook.f., Fl. Brit. India 7: 360. 1896; Bor, Grasses 456. 1960.

Annual herbs up to 50 cm tall; culms usually erect. Leaves linear, with scattered stiff hairs; sheaths glabrous or hirsute; ligule truncate, toothed. Inflorescence a dense, oblong compact panicle, 4-7 cm long, occasionally interrupted. Spikelets elliptic-oblong, 7-10-flowered, 1-2.5 cm long, densely fasciated; lower glumes ovate-lanceolate, 4-7 mm long, 3-5-veined; upper glumes elliptic, 4.5-8 mm long, 5-7-veined; lower lemma 6-11 mm long, herbaceous with hyaline margins, 7-veined, 2-toothed, awned from between the tooth; awn 5-15 mm long, recurved at maturity, upper longer than the lower; palea obtuse, keel loosely long ciliate.

Common on slopes in Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : April - July.

Distrib. : Europe, Mediterranean region, eastward to India, Western Himalaya.

B. tectorum L., Sp. Pl. 1: 77. 1753; Hook.f., Fl. Brit. India 7: 359. 1896; Bor, Grasses 456. 1960. *B. abortiflorus* St. Amans, Fl. Agen. 44. 1821; Hook.f., Fl. Brit. India 7: 359. 1896.

Annual herbs up to 50 cm tall; culms erect or ascending. Leaves linear, acute, flaccid, hairy; sheaths pubescent; ligule ovate, lacerate.

Inflorescence a loose or dense, erect or nodding, often secund panicle, 1-2 cm long. Spikelets wedge-shaped, 4-8-flowered, upper 1-3 florets sometimes aborted, 2.5-4 cm long including the awns; lower glume lanceolate 5-8 mm long, margin silvery hyaline, usually 1-veined; lower lemma 1-1.5 cm long, involute, herbaceous with hyaline margins, 7-veined, 2-toothed at apex, awned from between the teeth; palea-keels ciliolate.

Common in waste places, drier slopes, on deserted walls and roofs in Gilgit, Zanskar, Namikala, Baltistan, Kharbu, Shyok in Ladakh.

Fl. & Fr. : April - June.

Distrib. : Central Europe, Mediterranean regions, throughout Middle East, Central Asia, Siberia, eastward to China, India, Western Himalaya.

CALAMAGROSTIS Adans.

Perennial herbs; often tufted. Leaf-blades flat or convolute. Inflorescence a contracted to spiciform or capitate panicle, rarely open. Spikelets 1-flowered, not jointed on the pedicels; rhachilla jointed at the base, produced or not beyond lemmas, disarticulating above the glumes. Glumes 2, equal or unequal, membranous, 1-veined, persistent; lemma 1, hyaline, membranous to coriaceous, rounded or keeled, 5-veined, truncate-denticulate or bifid, awned from the back or from the sinus of the lobes or from the tip; palea sometimes minute or absent; lodicules 2; callus bearded with white hairs, shorter than to longer than the florets; stamens 3. Grains free within the lemmas.

The genus comprises about 270 species in the world; distributed in temperate regions and tropical mountains; 20 species in India; 10 species in the cold desert.

The separation of *Calamagrostis* and *Deyeuxia* Clarion ex Pal on the basis of scabrid lemma and penicillate rhachilla extension is unreliable and the modern views (Tzvelev, Poceae, Flora URSS 297. 1976; G.C.S. Clarke in Tutin *et al.* Fl. Eur. 5.236, 1980) do not recognise them as distinct.

- 1a. Rhachilla not produced 2
 b. Rhachilla produced 5
- 2a. Awns of the lemma basal or median *C. epigejos*
 b. Awns of the lemma terminal or subterminal 3
- 3a. Awns exerted. Palea as long as or slightly shorter than lemma ... *C. emodensis*
 b. Awns included or very shortly exerted. Palea half as long as the lemma or slightly longer 4
- 4a. Panicle very lax, green or purplish, 12-40 cm long .. *C. pseudophragmites*
 b. Panicle very dense, dark purple or golden yellow, 4-10 cm long
 *C. pseudophragmites* var. *tartarica*
- 5a. Rhachilla very shortly produced, not penicellate *C. garhwalensis*
 b. Rhachilla well produced, penicellate 6
- 6a. Awns of the lemma basal 7
 b. Awns of the lemma from the middle of the dorsal surface or terminal .. 8
- 7a. Anthers 1.5-2 mm long *C. decora*
 b. Anthers 2.5-3.5 mm long *C. holciformis*
- 8a. Awns of the lemma terminal *C. stoliczkai*
 b. Awns of the lemma from the middle or slightly above it 9
- 9a. Lemma 2-toothed at the tip. Awn sub-median *C. scabrescens*
 b. Lemma 4-toothed or sub 4-aristate. Awn sub-terminal from the base of the tooth *C. pulchella*

Calamagrostis decora Hook.f., Fl. Brit. India 7: 260. 1896; Bor, Grasses 395. 1960.

Tufted perennial herbs up to 1 m tall; with creeping rhizome; culms slender. Leaves linear, long, flat; ligule 4-5 mm long, oblong, rounded; inflorescence a loosely branched, pale green panicle, 8-15 cm long. Spikelets 5-6 mm long; rhachilla prolonged beyond glumes and densely penicillate; glumes subequal, lanceolate, acuminate, scaberulous, 3-veined; lemma shorter than glumes, glabrous or scaberulous, 4-toothed at apex, awn

subbasal, exerted, 2.5-4 mm long; palea as long as the glumes; callus-hairs as long as the lemma.

Common on slopes in drier conditions in Gilgit Ladakh, Deosai Plains.

Fl. & Fr. : July - August.

Distrib. : Kashmir (Endemic).

Note : This species seems to be a transitional species between *Calamagrostis* and *Deyeuxia* by showing characters like long callus hairs, scaberulous lemma, and markedly prolonged penicillate rhachilla.

Calamagrostis emodensis Griseb. in Nachr. Ges. Wiss. Gottingen 1868: 80. 1868; Hook.f., Fl. Brit. India 7: 261. 1896; Bor, Grasses 395. 1960.

Tufted perennial herbs up to 1 m tall; with creeping rhizome; culms stout, erect. Leaves broadly lanceolate, flat, scabrid above, glaucous; ligule 1-3 mm long, oblong, membranous. Inflorescence a dense or effuse, much branched, ovate to lanceolate, nodding silvery panicle, 10-30 cm long, purplish. Spikelets 5-8 mm long; rhachilla sometimes prolonged beyond glumes; glumes subequal or unequal, subulate-lanceolate, glabrous or scaberulous on keel, lower 1-veined, upper 3-veined; lemma shorter than glumes, glabrous, hyaline, 2-toothed at apex, faintly 5-veined, awn 4-9 mm long, subterminal, exerted; palea shorter than lemma; callus-hairs longer than lemma.

Common on slopes in Zoji La, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India from Kashmir to Sikkim.

C. epigejos (L.) Roth, Tent. Fl. Germ. 1: 34. 1788; Hook.f., Fl. Brit. India 7: 260. 1896; Bor, Grasses 396. 1960.

Tufted perennial herbs up to 1 m tall; with creeping rhizome; culms stout, erect. Leaves linear, finely acuminate, blades flat or convolute, scaberulous, glaucous; ligule 4-10 mm long, acute. Inflorescence an oblong or lanceolate, much branched, dense and spike-like panicle, 15-30 cm long, purplish. Spikelets 4.5-7 mm long; rhachilla not or rarely prolonged beyond glumes; glumes subequal, lanceolate, 1-veined or upper 3-veined, keel and margins scaberulous; lemma shorter than glumes, glabrous, 2-toothed at apex, awn arising at or near the middle of lemma, 1-2.5 mm long; palea shorter than lemma; callus-hairs as long as glumes.

Occasional on slopes in drier situations in Baltistan, Matayan, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Europe eastward to India, Western Himalaya.

Calamagrostis garhwalensis C.E. Hubbard et Bor in Indian For. 68: 355. 1942; Bor, Grasses 396. 1960.

Tufted, perennial herbs up to 1.5 m tall with creeping rhizome; culms erect or geniculately ascending. Leaves linear, acuminate, flat or convolute, margins scabrid. Inflorescence a dense panicle, 30-35 cm long, purplish or green; rhachilla usually produced, 0.5 mm long, penicillate or glabrous. Spikelets lanceolate, 8-10 mm long; lower glume 7-8 mm long, 1-veined; upper glume 5.5-6 mm long, 3-veined; lemma 3.5-4 mm long, hyaline, awned; callus bearded, 5-6 mm long; awn from dorsal side.

Occasional on alpine slopes in Dras, Matayan in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Iran, Pakistan, Nepal, India, Himalaya from Kashmir to Sikkim.

C. holciformis Jaub. & Spach, Ill. Pl. Or. 4: 61.t. 340. 1851.

Deyeuxia compacta Munro ex Hook.f., Fl. Brit. India 7: 267. 1896. *D. holciformis* (Jaub. & Spach) Bor, Grasses 398. 1960.

Tufted, perennial herbs up to 40 cm tall; with short rhizome; culms slender, erect smooth. Leaves linear, flat or convolute; ligule 2-3 mm long, obtuse or truncate. Inflorescence an erect, ovoid, dense, often lobed, purplish panicle, 2-6 cm long. Spikelets 4.5-6.5 mm long; rachilla prolonged beyond glumes, penicillate; glumes subequal, membranous, oblong-lanceolate; lemma shorter than lemma, scaberulous, strongly 4-veined, truncate-denticulate at apex; awn basal, twisted below and bent; palea almost as long as lemma; callus-hairs shorter than floret.

Common on slopes, waste places in Nubra, Rupshu, Zanskar, Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : India, Western Himalaya from Kashmir to Kumaon.

Calamagrostis pseudophragmites (Hall.f.) Koel., Descr. Gram. 106. 1802; Bor, Grasses 396. 1960. *Arundo pseudophragmites* Hall.f. in Arch. Bot. Leipzig 1(2): 11. 1797. *Calamagrostis laxa* Host, Gram. Austr. 4: 25. 1809. *C. littorea* (Schrad.) P. Beauv., Ess. Agrost. 15. 157. 1812; Hook.f., Fl. Brit. India 7: 261. 1896. Fig. 38.

Tufted, perennial herbs up to 1 m tall; with creeping rhizome; culms stout, erect. Leaves linear-lanceolate, smooth or scaberulous, flat; ligule 4-10 mm long, acute or lacerate. Inflorescence a lanceolate to oblong, large effuse, plumes-like, erect or nodding, green or purplish panicle, 12-40 cm long. Spikelets 5-9 mm long, rachilla rarely prolonged; glumes unequal, subulate-lanceolate, keel scaberulous, lower 1-veined, upper 3-veined; lemma shorter than glumes, truncate-denticulate; 1-3 mm long, terminal in the notch; palea almost as long as lemma; callus-hairs longer than florets.

Common on slopes in Gilgit, Baltistan, Skardu, Nubra, Zanskar, Ladakh, Lahul & Spiti.



Fig. 38. *Calamagrostis pseudophragmites* (Hall.f.) Koel.

Fl. & Fr. : June - August.

Distrib. : Europe, Mediterranean regions Pakistan, India Himalayas.

Calamagrostis pseudophragmites (Hall.f.) Koel ssp. **tartarica** (Hook.f.) Bor, Grasses 396. 1960; Tzvelev in Nov. Sist. Vyssh. Rast. 1965: 42. 1965. *C. littorea* (Schrad.) P. Beauv. var. *tartarica* Hook.f., Fl. Brit. India 7: 261. 1896.

Tufted, perennial herbs up to 50 cm tall; with creeping rhizome; culms stout, erect. Leaves linear, scaberulous, convolute; ligule 4-6 mm long, acute. Inflorescence a narrowly oblong, very dense, strict panicle, 4-10 cm long, dark purple or golden yellow. Spikelets dark purple, or golden yellow, 5-7 mm long; rhachilla rarely prolonged; glumes unequal, subulate-lanceolate, keel scaberulous, 1-3-veined; lemma shorter than glumes, truncate-denticulate at apex; awn 1-2 mm long, terminal in the notch, included or scarcely projected beyond the glume; palea slightly shorter than lemma; callus-hairs longer than the florets.

Common in drier conditions, on rocky slopes in Rupshu, Zanskar, Lahul & Spiti.

Fl. & Fr. : June - July.

Distrib. : Pakistan, India Western Himalaya.

C. pulchella Griseb. in Goett. Nachr. 78. 1868. *Deyeuxia pulchella* (Griseb.) Hook.f., Fl. Brit. India 7: 268. 1896; Bor, Grasses 399. 1960.

Tufted, perennial herbs up to 50 cm tall; culms stout, strict, erect. Leaves linear, usually flat, smooth or scaberulous; ligule membranous. Inflorescence a loose, open, oblong or ovate panicle, 4-7 cm long. Spikelets 3-4 mm long, crowded, dark purple; rhachilla produced beyond lemma, densely penicillate hairy, glumes unequal, scaberulous, acuminate; lemma scaberulous, irregularly 4-toothed, tip split into sectiform lobes; awn inserted

above the middle or subapical, included; callus shortly bearded; palea shorter to longer than lemma.

Common in grassy places, on slopes in Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India, alpine and subalpine Himalayas from Him. chal Pradesh to Sikkim.

Calamagrostis scabrescens Griseb. in Nachr. Ges. Wiss. Gottingen 1868: 79. 1868. *Deyeuxia filiformis* (Griseb.) Hook.f., Fl. Brit. India 7: 268. 1896. *D. scabrescens* (Griseb.) Munro. ex Duthie in Atkins., Gaz. N.W. Ind. 10: 628. 1882; Bor, Grasses 399. 1960.

Tufted, perennial herbs up to 70 cm tall; with short rhizome; culms slender, terete. Leaves linear, usually flat; ligule 3-4 mm long, membranous. Inflorescence a pyramidal panicle, 5-8 cm long, lax or dense. Spikelets 4-5 mm long, purplish; rhachilla prolonged and penicillate; glumes subequal, lanceolate, 1-3 veined, scabrid; lemma shorter than glumes, scaberulous, tip truncate. 4-toothed, rarely 2-toothed, 4-veined; awn arising from or near middle of lemma, exerted; palea shorter than lemma; callus-hairs shorter than the florets.

Occasional on slopes, in waste places in Zanskar, Leh, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India through Himalayas.

C. stoliczkai Hook.f., Fl. Brit. India 7: 262. 1896; Bor, Grasses 397. 1960.

Tufted perennial herbs up to 60 cm tall; with creeping rhizome; culms erect, stout. Leaves linear, convolute, scabrid; ligule 2-5 mm long, lacerate.

Inflorescence a lax or dense panicle, 7-15 cm long; branches erect or suberect, scabrid. Spikelets 4-7 mm long; rhachilla prolonged and hairy; glumes subequal, hyaline, scaberulous; lemma shorter than glumes, scaberulous, 4-toothed at apex, teeth articulate with bristles; awn arising from the base of teeth, exerted; palea as long as lemma; callus-hairs almost as long as the floret.

Occasional in drier situations, on slopes in Baltistan, Zanskar, Pensi La, Ladakh.

Fl. & Fr. : July - August.

Distrib. : India, Kashmir (Endemic).

CATABROSA P. Beauv.

Perennial herbs. Leaf-blades flat. Inflorescence a lax, open panicle. Spikelets small, usually 2-flowered, rarely 1- or 3-flowered, subarticulate on their pedicels; rhachilla jointed at the base, produced beyond the lemma. Glumes unequal, hyaline, lower obtuse or truncate, veinless, upper broadly obcuneate or orbicular, 3-veined; lemmas longer than glumes, broadly cuneate, rounded on the back, membranous with scarious or hyaline apex, keeled, 3-veined; palea 2-keeled; lodicules 2; stamens 3. Grains obovate or oblong, free.

The genus comprises 2 species in the world; distributed in north temperate zone; mainly in Europe and the mediterranean regions, extending eastwards to Himalayas, also in N. America; 2 species in India; 1 species in cold desert.

Catabrosa shows some similarity to *Colpodium nutans* (Stapf) Bor and the two genera are evidently related.

Catabrosa aquatica (L.) P. Beauv., Ess. Agrost. 57. 157. 1812; Hook.f., Fl. Brit. India 7: 310. 1896; Bor, Grasses 528. 1960. *Aira aquatica* L., Sp. Pl. 1: 64. 1753. *Catabrosa aquatica* (L.) P. Beauv. var. *angusta* Stapf in Hook.f., Fl. Brit. India 7: 311. 1896; Bor, Grasses 529. 1960.

Perennial herbs up to 60 cm tall; with creeping rhizome and often stoloniferous; culms erect geniculately ascending, succulent, smooth. Leaves linear or linear-lanceolate, obtuse, flat; ligule ovate or truncate, hyaline. Inflorescence an open, loose, ovate to oblong panicle, 5-30 cm long, lower branches 5-7-nate, deflexed. Spikelets 3-5 mm long, usually 2-flowered, pale green or yellowish, breaking up at maturity between the lemmas; glumes obovate, obtuse, 1-3-veined or veinless; lemma 2.5-3.5 mm long, obovate to oblong, truncate, shortly hairy below; palea broad, obtuse, keels hairy below.

Common in marshy places, along water margins, lakes in Zanskar, Lanak La, Leh, Tsokar, Rupshu, Ladakh.

Fl. & Fr. : May - August.

Distrib. : N. America, Europe, Mediterranean regions eastward to India, throughout the Himalayas.

CHLORIS O. Swartz

Annual or perennial herbs; rhizomatous or stoloniferous; often tufted. Leaf-blades flat or convolute; ligule membranous, ciliolate. Inflorescence a digitate spike. Spikelets 1-flowered, 2-seriate, unilateral, laterally compressed; rachilla jointed at the base, occasionally produced beyond the lemma. Glumes unequal, membranous, 1-veined, acute to acuminate, rarely bidenticulate and mucronate or upper shortly awned; lemma 1-3-veined, cartilaginous to coriaceous, often ciliate on the margins, entire or 2-lobed at tip, awned from tip or just below it; palea short, 2-veined; lodicules 2; callus rounded or pungent or inconspicuous; sterile lemmas variable, sometimes with male rarely bisexual florets. Grains ellipsoid to linear, trigonous to subterete.

The genus comprises about 55 species in the world; distributed in the tropical and warm temperate regions of both hemisphere; about 18 species in India; 1 species in cold desert.

Chloris virgata Sw., Fl. Ind. Occ. 1: 203. 1797; Hook.f., Fl. Brit. India 7: 291. 1896; Bor, Grasses 468. 1960.

Annual herbs up to 50 cm tall; culms erect or geniculately ascending, sometimes rooting at the lower nodes, much branched below. Leaves lanceolate, blades flat; basal sheaths strongly keeled, upper sheaths more or less inflated. Inflorescence of 6-9 digitate, spreading, feathery spikes, 2-10 cm long. Spikelets usually 3-flowered, 2-awned; lower glumes 1.5-2.5 mm long; upper glume 2.5-4.5 mm long, 2-fid, awned in sinus, lower lemma obovate, 2.5-4 mm long, ciliate along the margins and keels; awn 5-15 mm long; upper lemma oblong, 2-2.5 mm long, glabrous, awn 5-10 mm long.

Common in waste places in Ladakh.

Fl. & Fr. : April - October.

Distrib. : Throughout the tropics of both hemisphere; remarkably from sea-level to 3500 m.

Note : This is characteristic of the saline or usar soil and is reputed to be a good fodder grass.

CHRYSOPOGON Trin. *nom. cons.*

Perennial, usually tufted herbs. Ligules a short membrane or a line of hairs. Inflorescence a panicle with whorls of branches bearing terminal racemes; each raceme reduced to a triad of 1 sessile and 2 pedicelled spikelets. Sessile spikelets laterally compressed; callus elongated, acute to pungent. Lower glume cartilaginous, 4-veined, rounded on the back, often spinulose on the margins; upper glume 3-veined, often awned; lemas hyaline, upper bidentate or entire, with a glabrous or pubescent awn; palea hyaline, small or suppressed. Pedicelled spikelets male or barren, awned or awnless. Grains narrowly ellipsoid.

The genus comprises 26 species in the world; distributed in the tropical and warm temperate regions of Old World, chiefly Asia and Australia; 14 species in India; 2 species in cold desert.

- 1a. Panicles large, 20-30 cm long, open, with capillary branches. Awns stout, 2.5-3.5 cm long *C. gryllus*
- b. Panicles contracted, 5-15 cm long with firm branches. Awns slender, 1-2 cm long *C. gryllus* ssp. *echinulatus*

Chrysopogon gryllus (L.) Trin., Fund. Agrost. 188. 1820; Bor, Grasses 117. 1960. *Andropogon gryllus* L., Cent. Pl. 2: 32. 1756; Hook.f., Fl. Brit. India 7: 187. 19896.

Perennial herbs up to 1 m tall; culms forming dense tufts, stout, erect. Leaves linear, acute, glabrous or sparsely hairy; sheaths keeled above. Inflorescence an open, large, ovate panicle 20-30 cm long; branches long, capillary, spreadings, simple or branched. Spikelets in triads; sessile spikelets oblong, 6-8 mm long; lower glume coriaceous, margins involute; upper glume chartaceous, lanceolate, margins ciliate, hispidulous on keels towards tip, mucronate or with awn up to 10 mm long; upper lemma minutely 2-toothed, with a pubescent awn 2-3.5 cm long; palea small. Pedicelled spikelets longer than sessile, terete; lower glume acuminate, aristulate, 5-9 veined, awn 3.5-7 mm long; upper glume lanceolate, acuminate, lemmas ciliate, upper awned.

Common on slopes in Baltistan, Skardu, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : S.E. Europe, Mediterranean regions; eastwards to Afghanistan, Pakistan, India.

C. gryllus (L.) Trin. ssp. **echinulatus** (Nees) T.A. Cope in Kew Bull. 35: 701. 1980. *Rhaphis echinulata* Nees in Royle, Ill. Bot. Him. 417. 1840. *Andropogon echinulatus* (Nees) Steud., Syn. Pl. Glum. 1: 397. 1854. *Chrysopogon echinulatus* (Nees) Wats. in Atkins., Gaz. N.W. India. 10: 392. 1882; Bor, Grasses 116. 1960. *Andropogon gryllus* L. ssp. *echinulatus* (Nees) Hack. in DC. Monogr. Phan. 6: 552. 1889; Hook.f., Fl. Brit. India 7: 188. 1896.

Perennial herbs up to 70 cm tall; culms stout, erect. Leaves linear, acute, glabrous or sparsely hairy. Inflorescence a contracted panicles, 5-15 cm long; branches firm and erect. Sessile spikelets oblong. lower glume 5-8 mm long, laterally compressed to a broadly rounded keel; upper glume hispidulous on the keel towards tip, mucronate or shortly awned; lower lemma linear-oblong, veinless; upper lemma minutely 2-toothed, with a pubescent awn 1-2 cm long. Pedicelled spikelets 7-10 mm long; lower glume with an awn 3-7 mm long, upper glume ciliate; upper lemma awned.

Common on slopes in Baltistan, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : S.E. Europe, Mediterranean region eastward to Afghanistan, Pakistan, Nepal, India.

COLPODIUM Trin.

Perennial herbs; rhizomatous or not; often tufted. Culms often fibrous at base. Leaf-blades flat or convolute. Inflorescence a spreading or rarely contracted panicle. Spikelets 1-4-flowered; rachilla jointed at the base, produced beyond the lemma. Glumes unequal to sub-equal, obtuse to acute, shorter than or as long as lemma, 1-3-veined; lemmas thinly membranous, 3-5-veined, keeled below, glabrous or pubescent on the veins; palea as long as the lemma, keeled; lodicules 2, small or large, bilobed or irregularly toothed; callus glabrous or hairy; stigmas 3. Grains obovate or oblong, free or adherent to the palea.

The genus comprises 19 species in the world; distributed in the temperate regions, chiefly Turkey and Caucasus to Nepal and eastern Siberia; Kenya and Kilimanjaro mountains; 3 species in India and also in cold desert.

Colpodium is a high altitude segregate from *Poa* L. very similar to *Poa alpina* group but differing in fewer florets, thinner lemmas and non-scabrid palea-keels. *Colpodium*, *Paracolpodium* (Tzvelev) Tzvelev,

Catabrosella (Tzvelev) Tzvelev and *Hyalopoa* (Tzvelev) Tzvelev differ in a number of minor characters, hence included under *Colpodium*.

- 1a. Spikelets 1-flowered. Glumes almost as long as the lemma ... *C. leucolepis*
- b. Spikelets 2-9-flowered. Glumes about half as long as the lemma 2
- 2a. Inflorescence paniculate. Spikelets 8-10 mm long. Upper glume with rotund denticulate tip *C. nutans*
- b. Inflorescence spicate. Spikelets 2.5-6 mm long. Upper glume with blunt to subacute tip *C. himalaicum*

Colpodium himalaicum (Hook.f.,) Bor, Grasses 529. 1960. *Phippsia himalaica* Hook.f., Fl. Brit. India 7: 240. 1896. *Catabrosa himalaica* (Hook.f.,) Stapf in Hook.f., Fl. Brit. India 7: 311. 1896. *Catabrosella himalaica* (Hook.f.,) Tzvelev in Nov. Sist. Vyssh. Rast. 1966. 32. 1966.

Tufted, perennial, non-rhizomatous herbs up to 25 cm tall; culms often bulbous due to persistent basal sheaths; sheaths fibrous or reticulate. Leaves flat or folded. Inflorescence a spreading or contracted spiciform, dense-flowered panicle, 2.5-4 cm long. Spikelets 3-4 mm long, obovoid-oblong, variegated with yellow and purple, 1-2-flowered; glumes unequal much shorter than the lemmas, lower elliptic, 1-veined, upper ovate-elliptic, 1-3-veined; lemma 2.5-4 mm long, hairy on keel and veins; anthers brown or purple. Grains adherent to palea.

Frequent on alpine slopes in Baltistan, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India, western Himalaya.

C. leucolepis Nevski in Bull. Soc. Nat. Moscou 43: 224. 1934. *Paracolpodium altaicum* (Trin.) Tzvelev spp. *leucolepis* (Nevski) Tzvelev in Nov. Sist. Vyssh. Rast. 1966. 33. 1966.

Perennial herbs up to 20 cm tall; shortly rhizomatous; culms erect or ascending. Leaves linear, blades flat or folded; ligule 1-3 mm long.

Inflorescence a contracted, spiciform panicle, 2-7 cm long. Spikelets 3-4 mm long, yellow or tinged with purple, 1-flowered; glumes unequal, almost as long as the lemma, 1-veined, lower elliptic, 2.5-3 mm long, upper elliptic-lanceolate, 2.5-3.5 mm long; lemma 3-3.5 mm long; appressedly pubescent, denticulately obtuse; anthers deep violet. Grains free from palea.

Frequent on alpine slopes in Gilgit, Baltistan, Deosai Plains, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pamir, Pakistan, India, Western Himalaya.

Colpodium nutans (Stapf) Bor in Rech.f., Fl. Iran. 70: 54. 1970. *Catabrosa nutans* Stapf in Hook.f., Fl. Brit. India 7: 312. 1896, based on *Colpodium nutans* Griseb. in Nachr. Ges. Wisn. Göttingen 1868: 76. 1868, *nom. nud.*; Bor, Grasses 529. 1960. *Hyalopoa nutans* (Stapf) Alexeev ex T.A. Cope, Fl. West Pakistan Fasc. 143. 423. 1982.

Tufted perennial herbs up to 50 cm tall; with short rhizome; culms erect, fibrous at base. Leaves linear or lanceolate, flat, flaccid, sometimes short, broad and rounded at base; ligule 4-6 mm long. Inflorescence a spreading, open, rarely contracted panicle, 5-12 cm long, branches long, slender, flexuous or nodding, lowest 2-3-nate. Spikelets broadly obovate, 7-10 mm long, variegated with brown or purple, 3-4-flowered; glumes broadly elliptic, 1.5-3 mm long, 1-3-veined, obtuse and erose; lemma obovate, 3.5-4.5 mm long, denticulately obtuse, 3-5-veined; hairy on the veins; palea longer than lemma; anthers purple or brown. Grains free from palea.

Frequent on alpine slopes in Deosai Plains, Baltistan, Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : India, alpine western Himalaya.

CRYPSIS W. Ait. *nom. cons.*

Rigid annual or perennial herbs. Culms erect or prostrate ascending. Leaf-blades flat or convolute. Inflorescence a spiciform panicle, cylindrical and exserted or ovoid to capitate and then partially enclosed by 1-2 bract-like leaf-sheaths. Spikelets 1-flowered, laterally compressed; rachilla not produced beyond lemma. Glumes hyaline, sub-equal, shorter than lemma, keeled, 1-veined, acute or with a short awn point; lemma membranous, 1-veined, acute or with a short awn point; palea oblong, obtuse or 2-fid, 1-2-veined; lodicules absent; stamens 2-3. Grains ovoid or ellipsoid, loose in lemma and palea.

The genus comprises 8 species in the world; distributed in the Mediterranean regions and Middle East, S.W. Asia, extending to China and Central Africa; 1 species in India and also in cold desert.

Crypsis is related to *Sporobolus* R. Br., differing mainly in the laterally compressed spikelets.

Crypsis schoenoides (L.) Lam. Encycl. 1: 166. t. 42/1. 1791; Bor, Grasses 622. 1960. *Phleum schoenoides* L., Sp. Pl. 1: 60. 1753. *Heleochloa schoenoides* (L.) Host, Icon. Gram. Austr. 1: 23. 1801; Hook.f., Fl. Brit. India 7: 235. 1896. Fig. 39.

Annual herbs up to 20 cm tall; culms profusely branched at the base, prostrate but ascending. Leaves linear-lanceolate, acuminate, sheath deeply furrowed; ligule a ring of hairs. Inflorescence an ovoid-oblong, dense, spiciform, sessile panicle, embraced at base by 2 inflated distichous sheaths of uppermost leaf, 1-4 cm long. Spikelets lanceolate, 2-4 mm long, green; glumes lanceolate, 1-veined, keels ciliate, 2-2.5 mm long; lemma ovate-lanceolate, acuminate, 2.5-3.5 mm long; palea oblong, truncate, 2-veined; lodicules 2, cuneate.

Common in waste places, on slopes, in roadside ditches, along streams in Baltistan, Skardu, Ladakh.

Fl. & Fr. : July - August.



Fig. 39. *Cypripedium acaule* (L.) Lam.

Distrib. : Mediterranean regions, eastward to Pakistan, India.

Note : It is found in moist places, wastelands in mountains as well as in plains and shows great variability. Those in desert and saline places look depauperate with reduced leaves and stems and inflorescence hardly exerted from the leaf-sheaths but those in more favourable habitats look more luxuriant.

CYMBOPOGON K.P.J. Spreng.

Tall, perennial herbs, rarely annual. Leaves aromatic; ligule membranous or scarious. Inflorescence of paired racemes, borne on a short common peduncle and enclosed by a boat shaped spatheole, these densely crowded into a large leafy false panicle; racemes borne upon a short flattened base which is deflexed at maturity, the lowermost pair of spikelets in each raceme homogamous and resembling the pedicelled ones; sometimes the pedicel of the homogamous pair swollen and almost fused to the internode. Sessile spikelet concave on the back, 2-keeled, dorsally compressed; lower glume chartaceous, often streaked with oil glands, 2-keeled, the keels usually lateral and often winged near the tip; upper lemma bilobed, with or without a glabrous awn from the sinus; palea absent. Grains oblong, terete to plano-convex. Pedicelled spikelets more or less barren, not concave on the back.

The genus comprises about 40 species; distributed in Old World tropics and subtropics; 20 species in India; 3 species in cold desert.

The concave 2-keeled sessile spikelets of *Cymbopogon* shows an affinity with *Andropogon* L., from which it differs mainly in its compound panicle with deflexed raceme-bases.

- 1a. Rhachis internodes and pedicels glabrous on the back... *C. pospischilii*
- b. Rhachis internodes and pedicels pilose on the back 2
- 2a. Tall herb. Basal sheath coiled. Ligule usually less than 1 mm long.....
..... *C. jwarancusa*

- b. Small herb. Basal sheath not coiled. Ligule usually 2-4 mm long.....
 *C. jwarancusa* ssp. *olivieri*

Cymbopogon jwarancusa (Jones) Schult., Mant. 2: 458. 1824; Bor, Grasses 128. 1960. *Andropogon jwarancusa* Jones in Asiat. Res. 4: 109. 1795; Hook.f., Fl. Brit. India 7: 203. 1896.

Perennial herbs up to 1.5 m tall, pale or glaucous green; culms often tufted, erect or geniculately ascending. Leaves linear-lanceolate; blades flat or convolute, tip attenuate to filiform; oblong, membranous, ciliate. Inflorescence a false, decomposed, narrow panicle, 15-40 cm long; spatheoles lanceolate to elliptic, turning reddish, 1.5-2.5 cm long; racemes 15-20 mm long; internodes and pedicels densely ciliate along the margins and on the back. Sessile spikelets 4.5-5.5 mm long; lower glume slightly concave on the back, upper glume 3-veined; lower lemma 2-veined; upper lemma deeply bifid with an awn 7-10 mm long. Pedicelled spikelets purplish, slightly longer than sessile, lower glume 7-9-veined, keel scaberulous; upper glume ciliate on margins, lower lemma oblong, hyaline, fimbriate.

Common in moist places, along roads, near habitations in Baltistan, Gilgit, Ladakh, Lahul.

Fl. & Fr. : May - August.

Distrib. : Pakistan, Nepal, India, Western Himalaya from Kashmir to Kumaon.

Note : Leaves are lemon scented.

C. jwarancusa (Jones) Schult. ssp. *olivieri* (Boiss.) Soenarko in Reinwardtia 9: 307. 1977. *Andropogon olivieri* Boiss., Diagn., Ser. 1. 1(5): 76. 1844. *Cymbopogon ladakhensis* Gupta in Proc. Indian Acad. Sci. Sect. B. 71(1): 11. 1970. *C. schoenanthus sensu* Bor, Grasses 131. 1960. non (L.) Spreng. 1815. *Andropogon laniger auct. non* Desf. 1799. *A. jwarancusa* (Jones) Schult. ssp. *laniger sensu* Hook.f., Fl. Brit. India 7: 203. 1896.

Perennial herbs up to 50 cm tall; culms short, subsimple, usually erect. Leaves linear, often convolute; basal sheaths hardened, not coiled; ligule 2-4 mm long. Inflorescence a false, subsimple panicle, 10-20 cm long; spatheole elliptic-lanceolate, 1-1.5 cm long; racemes 10-15 mm long; internodes and pedicels densely ciliate. Sessile spikelets 4-5 mm long; other characters as in *ssp. jwarancusa*.

Common in drier situations in Gilgit, Ladakh, Lahul.

Fl. & Fr. : April - September.

Distrib. : Pakistan, Nepal, India Western Himalaya from Kashmir to Kumaon.

Note : The leaves are lemon scented. Leaves and roots yield a scented oil used in perfumery and medicines.

Cymbopogon pospischilii (K. Schum.) C.E. Hubbard in Kew Bull. 4: 175. 1949. *Andropogon pospischilii* K. Schum. in Bot. Jb. 24: 328. 1897. *A. nardus* L. var. *stracheyi* Hook.f., Fl. Brit. India 7: 207. 1896; Bor, Grasses 131. 1960.

Perennial herbs up to 1 m tall; culms slender, erect or geniculately ascending. Leaves long, narrow, blades flat or convolute, glaucous, tip attenuate or filiform; basal sheaths pubescent. Inflorescence a narrow, strict, erect, lax-flowered, false panicle, 10-30 cm long; spatheoles elliptic, 2.5-3 cm long; racemes 10-20 mm long; internodes and pedicels ciliate along the margins, glabrous on the back. Sessile spikelets lanceolate, 4-6 mm long; lower glume concave below the middle or sometimes flat; upper glume lanceolate, 3-veined, ciliate; lower lemma oblong, ciliate; upper lemma deeply 2-fid, with an awn 10-20 mm long.

Occasional on slopes, waste land, near habitation in Gilgit, Baltistan, Ladakh, Lahul & Spiti, Kinnaur.

Fl. & Fr. : July - August.

Distrib. : E. Africa eastward to Pakistan, Nepal, India western Himalaya from Kashmir to Kumaon.

DACTYLIS L.

Perennial herbs; often tufted. Culms laterally compressed. Leaf-blades flat. Inflorescence a contracted, lobed, 1-sided panicle; the spikelets crowded in compact fascicles at the end of short main branches. Spikelets 2-5-flowered, strongly laterally compressed, subsessile; rhachilla continuous. Glumes persistent, unequal, scarious, keeled, 1-3-veined, acuminate or mucronate; lemma longer, thinly coriaceous, compressed, keeled, 5-veined, spinously ciliate on keel, entire or bidentate, mucronate or shortly awned; palea 2-fid, keeled, keel ciliolate; lodicules 2, 2-lobed. Grains oblong, trigonous, dorsally compressed, ventrally channelled.

The genus comprises 1 species in the world, which is quite variable, some people recognise 4-5 species; distributed in temperate Europe and Asia and introduced elsewhere; also found in India and cold desert.

Dactylis glomerata L., Sp. Pl. 1: 71. 1753; Hook.f., Fl. Brit. India 7: 335. 1896; Bor, Grasses 530. 1960.

Tufted, perennial herbs up to 1 m tall; culms slender to stout, erect, compressed. Leaves ultimately flat, linear, keeled, glabrous or hairy towards the base; sheath strongly compressed and keeled; ligule 2-10 mm long, acute or lacerate. Inflorescence an oblong-ovate, strict, green or purplish panicle, 2-20 cm long; branches short or the lower long, erectopate. Spikelets oblong or ovate, 5-9 mm long, borne in dense one-sided clusters on the branches, 2-5-flowered; glumes pale with green veins, lanceolate or ovate, ciliate on the keel, subaristately acuminate; lemma lanceolate-oblong, 4-7 mm long, 5-veined, keel ciliate or scabrid, awn 1-1.5 mm long; palea 2-fid, keels ciliolate; lodicules 2-lobed.

Common in alpine pasture and grassland in Gilgit, Baltistan, Lakakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Temperate Europe, Asia, Pakistan, India, Western Himalaya from Kashmir to Kumaon; introduced into many temperate countries.

Note : A very important pasture and hay grass.

DANTHONIA DC. *nom. cons.*

Perennial, tufted herbs. Leaves linear setaceous; leaf-blade rolled, rarely flat. Inflorescence an open or contracted panicle of few spikelets, sometimes a single raceme or reduced to single spikelets. Spikelets 2-5-flowered, the uppermost reduced, male; rhachilla hairy and jointed at the base, produced beyond the lemma; disarticulating above the glumes. Glumes equal or unequal, as long as the spikelets, herbaceous, margin hyaline, 3-9-veined; lemmas rounded on the back, membranous, 7-9-veined, pilose on the margins, 2-lobed, lobes often awned with geniculate central awn from the sinus; palea 2-toothed, 2-keeled, glabrous or puberulous on keels; lodicules 2, glabrous. Grains oblong or obovoid, free within palea.

The genus comprises about 20 species in the world; distributed in Europe, N. & S. America and other temperate region of the world; 2 species in India and also in cold desert.

- 1a. Slender herbs. Panicles short, congested. Glumes 10-12 mm long. Lemma with tufts of hairs between the veins *D. cachemyriana*
- b. Robust herbs. Panicles long, congested or racemose. Glumes 18-25 mm long. Lemma hairy on the margins or glabrous *D. schneideri*

Danthonia cachemyriana Jaub. & Spach., Ill. Pl. Or. 4: 46. t. 331. 1851; Bor, Grasses 478. 1960. *D. exilis* Hook.f., Fl. Brit India 7: 281. 1896.

Tufted, perennial herbs up to 20 cm tall; culms filiform, erect or decumbent. Leaves linear, acute, convolute, flexuous, wiry; sheath shining; ligule small. Inflorescence a contracted panicle, 1-3 cm long. Spikelets crowded, 10-12 mm long, 2-5-flowered, green or brownish, laterally

compressed; glumes unequal, membranous, lanceolate, lower 6-9 mm long, 3-5-veined, upper 8-10 mm long, 5-veined; lemma lanceolate, 7-5-veined, with tufts of hairs between the veins at the base, 2-lobed, awns of lobes up to 5 mm long and central awn from the sinus up to 1.5 cm long, twisted; palea 2-toothed, 2-keeled.

Common on dry rocky slopes in Gilgit, Baltistan, Zoji La, Matayan, Ladakh.

Fl. & Fr. : July - September.

Distrib. : India, Western Himalaya from Kashmir.

Danthonia schneideri Pilger in Feddes, Repert. 17: 131. 1921. *D. cachemeyriana sensu* Hook.f., Fl. Brit. India 7: 281. 1896, *non* Jaub. & Spach 1851. *D. cachemeyriana* Jaub. & Spach var. *minor* Hook.f., *l.c.* *D. cumminsii* Hook.f., *l.c.* *D. jacquemontii* Bor in Kew Bull. 1952: 80. 1952; Bor Grasses 579. 1960.

Tufted, perennial herbs up to 60 cm tall; culms robust, erect or ascending with woody rootstock. Leaves linear, convolute, flexuous; sheaths shining; ligule a pubescent ridge. Inflorescence a dense panicle, long or contracted, 10-15 cm long, with many spikelets or a raceme 4-6 cm long with few spikelets. Spikelets 15-25 cm long, 2-5-flowered, laterally compressed, pale; glumes subequal, membranous, lanceolate, acuminate or mucronate, 3-7-veined; lowest lemma elliptic, 5-veined, sparsely hairy along margins, 2-lobed, lobes awned, central awn from the sinus.

Common on rocky slopes, in rock crevices in Lahul, Ladakh.

Fl. & Fr. : July - September.

Distrib. : Pakistan, India Western Himalaya from Kashmir to Sikkim.

DESCHAMPSIA P. Beauv.

Annual or perennial herbs; often tufted. Leaf-blades flat or convolute. Inflorescence a panicle, usually open. Spikelets shining, usually 2-flowered;

rhachilla hairy, jointed at the base, produced beyond lemma as a bristle, disarticulating below each floret. Glumes equal or unequal, keeled, scarious to membranous, margins shining, 1-3-veined; lemma hyaline to polished, cartilaginous, tip toothed or lobed, awned from below middle; callus pubescent or bearded; palea 2-keeled; lodicules 2; stamens 3; stigmas 2. Grains oblong, free within the lemma.

The genus comprises about 40 species in the world; distributed in temperate regions throughout; 3 species in India; 2 species in cold desert.

The genus may be distinguished from *Helictotrichon* Besser ex J.A. Schult. & J.H. Schult. by its delicate spikelets and slender awns and from *Trisetum* Pers. by its rounded lemma-back, lemma tip and awn insertion.

- 1a. Panicle dense, contracted, spike-like, 2-5 cm long *D. koelerioides*
 b. Panicle effuse, spreading, 10-30 cm long *D. caespitosa*

Deschampsia caespitosa (L.) P. Beauv., Ess. Agrest. 91. 160. 1812; Hook.f., Fl. Brit. India 7; 273. 1896; Bor, Grasses 435. 1960. *Aira caespitosa* L., Sp. Pl. 1: 64. 1753. Fig. 40.

Tufted perennial herbs up to 1 m tall; culms stout or slender, smooth, shining. Leaves mostly basal, flat, coriaceous, coarsely rigid above, scabrid on ridges; ligule scarious, obtuse, 10-15 mm long. Inflorescence an oblong, contracted and dense-flowered or effuse and lax-flowered panicle, 10-30 cm long; branches and pedicels capillary. Spikelets oblong, 3-4 mm long, 2-3-flowered, white and silvery or fulvous purplish; glumes ovate-lanceolate, acute, veinless or upper 3-veined; lemma elliptic-oblong, 3-4.5 mm long, erose, truncate or 4-toothed, sometimes 2-lobed with lobes lacerate, awn dorsal, subbasal, straight, 3-5 mm long; palea 2-keeled.

Common in swampy and moist places at high altitudes in Baltistan, Dras, Deosai Plains, Rupshu, Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

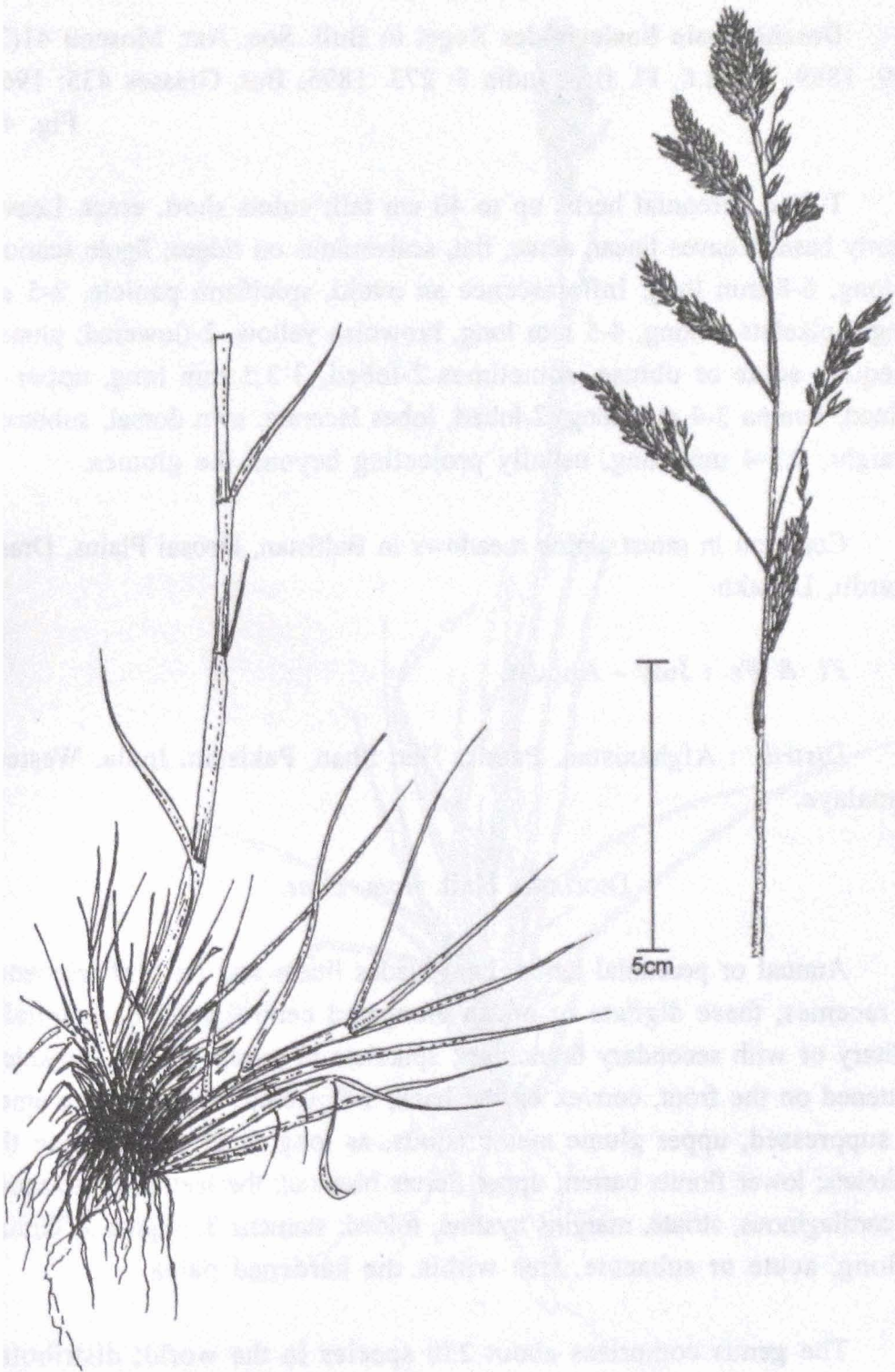


Fig. 40. *Deschampsia caespitosa* (L.) P. Beauv.

Distrib. : Temperate regions of both the hemispheres; India, Himalayas from Kashmir to Sikkim.

Deschampsia koelerioides Regel in Bull. Soc. Nat. Moscou 41(2): 299. 1869; Hook.f., Fl. Brit. India 7: 273. 1896; Bor, Grasses 435. 1960.

Fig. 41.

Tufted perennial herbs up to 40 cm tall; culms short, erect. Leaves mostly basal. Leaves linear, acute, flat, scaberulous on ridges; ligule scarious oblong, 6-8 mm long. Inflorescence an ovoid, spiciform panicle, 2-5 cm long. Spikelets oblong, 4-5 mm long, brownish yellow, 2-flowered; glumes unequal, acute or obtuse, sometimes 2-lobed, 3-3.5 mm long, upper 3-veined; lemma 3-4 mm long, 2-lobed, lobes lacerate, awn dorsal, subbasal, straight, 2.5-4 mm long, usually projecting beyond the glumes.

Common in moist alpine meadows in Baltistan, Deosai Plains, Drass, Skardu, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pamir, Tien Shan, Pakistan, India, Western Himalaya.

DIGITARIA Hall. *nom. cons.*

Annual or perennial herbs. Leaf-blades linear and flat. Inflorescence of racemes, these digitate or on an elongated central axis; occasionally solitary or with secondary branchlets; spikelets in groups of 2-3. Spikelets flattened on the front, convex on the back, 1-flowered. Lower glume small or suppressed, upper glume membranous, as long as or shorter than the spikelets; lower florets barren; upper florets bisexual, the lemma chartaceous to cartilaginous, striate, margins hyaline, folded; stamens 3; stigma 2. Grains oblong, acute or subacute, free within the hardened palea.

The genus comprises about 230 species in the world; distributed in tropical and warm temperate regions; 26 species in India; 3 species in the cold desert.

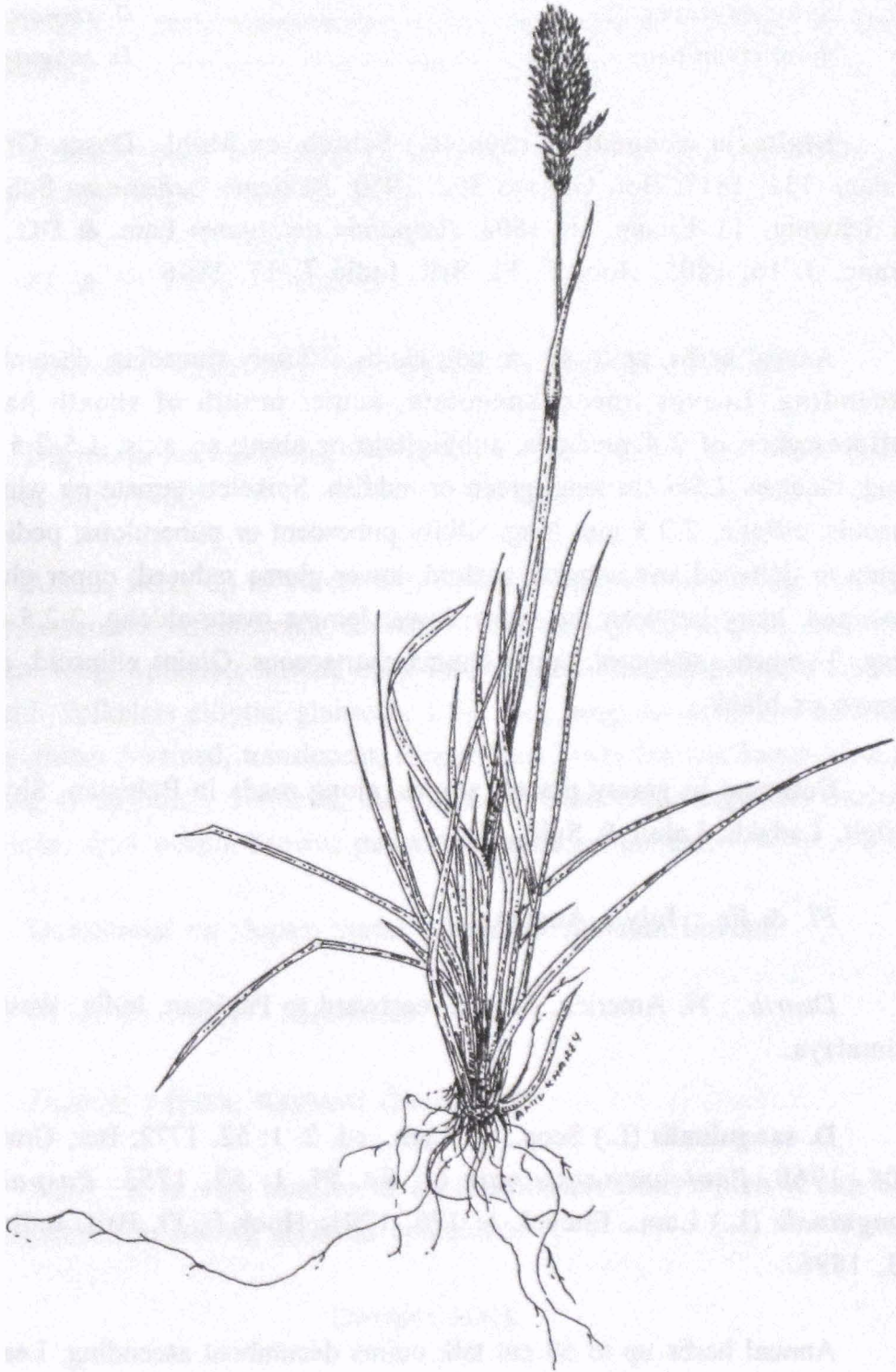


Fig. 41. *Deschampsia koelerioides* Regel

- 1a. Spikelets hairy with clavate hairs *D. ischaemum*
 b. Spikelets glabrous or if hairy then hairs not clavate 2
- 2a. Spikelets ternate *D. stewartiana*
 b. Spikelets in pairs *D. sanguinalis*

Digitaria ischaemum (Schreb.) Schreb. ex Muhl., Descr. Gram. Calam. 131. 1817; Bor, Grasses 302. 1960. *Panicum ischaemum* Schreb. in Schweig., Fl. Erlang. 16. 1804. *Paspalum ambiguum* Lam. & DC., Fl. Franc. 3: 16. 1805; Hook.f., Fl. Brit. India 7: 17. 1896.

Annual herbs, up to 40 cm tall; culms diffusely spreading, decumbent ascending. Leaves linear-lanceolate, acute; mouth of sheath hairy. Inflorescence of 2-4 racemes, subdigitate or along an axis, 1.5-2.5 cm long; racemes 2.5-6 cm long, green or reddish. Spikelets ternate on winged rhachis, elliptic, 2-2.5 mm long, silkily pubescent or puberulous; pedicels terete to flattened and winged; scabrid; lower glume reduced; upper glume 5-veined, hairy between the veins; lower lemma ovate-oblong, 2-2.5 mm long, 7-veined, pubescent, upper lemma chartaceous. Grains ellipsoid, dark brown or black.

Common in grassy places, slopes, along roads in Baltistan, Shyok, Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : N. America, Europe, eastward to Pakistan, India, Western Himalaya.

D. sanguinalis (L.) Scop., Fl. Carn., ed. 2. 1: 52. 1772; Bor, Grasses 304. 1960. *Panicum sanguinale* L., Sp. Pl. 1: 57. 1753. *Paspalum sanguinale* (L.) Lam., Encycl. 1: 176. 1791; Hook.f., Fl. Brit. India 7: 13. 1896.

Annual herbs up to 60 cm tall; culms decumbent ascending. Leaves linear-lanceolate; sheaths hairy at mouth. Inflorescence composed of few to many racemes, digitate or subdigitate; racemes stiff, 3-10 cm long;

rhachis trigonous or flattened. Spikelets binate and overlapping, elliptic to ovate, 2-3.5 mm long, acute; pedicels triquetrous, scabrid; lower glume reduced to an ovate scale; upper glume 3-veined; lower lemma lanceolate or oblong, 7-veined scaberulous on the veins; palea oblong-lanceolate, acuminate.

Common weed of cultivation, in grassy places, on slopes in Baltistan, Indus valley, Gilgit, Lahul & Spiti.

Fl. & Fr. : July - October.

Distrib. : Warm temperate regions throughout the world.

Digitaria stewartiana Bor in Kew Bull. 1951: 166. 1951; Bor, Grasses 305. 1960.

Annual herbs up to 30 cm tall; culms geniculately ascending. Leaves linear-lanceolate. Inflorescence consists of 2-3 sub-digitate racemes; racemes 4-5 cm long. Spikelets ternate on a flat, winged rhachis; pedicels terete, scabrid. Spikelets elliptic, glabrous, 1.5-2 mm long; lower glume absent; upper glume 3-veined, translucent, shorter than lower lemma; lower lemma as long as spikelets, 5-veined, the middle 3 veins close together. Grains ellipsoid, dark purple-brown; palea embraced by lemma.

Occasional on slopes, waste places in Baltistan Lakdah.

Fl. & Fr. : July - September.

Distrib. : India, Kashmir (Endemic).

Note : It is very similar to *D. ischaemum* from which it can be distinguished in having glabrous spikelets.

DUTHIEA Hack.

Annual tufted herbs. Leaf-blades flat or convolute. Inflorescence a simple, compact or elongated, unilateral, laterally compressed raceme, often

bracteate. Spikelets usually 2-3-flowered, sometimes up to 5-flowered; the florets similar, bisexual or the uppermost reduced; rhachilla hairy or glabrous, produced beyond lemma as a short stipe. Glumes subequal, herbaceous with hyaline margins, rounded on the back, 5-9-veined, acuminate or shortly awned; lemmas membranaceous to coriaceous, margins hyaline, 5-9-veined, bidentate to bifid, geniculately awned from the sinus; palea mucronate, 2-keeled, keels scabrid; lodicules absent. Grains oblong, shortly beaked.

The genus comprises 3 species, distributed from Afghanistan to western China, Nepal, India; 1 species in cold desert.

Duthiea bromoides Hack. in Verh. Zool.-Bot. Ges. Wien 45: 200. 1895; Hook.f., Fl. Brit. India 7: 282. 1896; Bor, Grasses 436. 1960. *Bromus membranaceous* Jacquem. ex Griseb. in Nachr. Ges. Wiss. Gottingen 1868: 74. 1868, *nom. nud.*; Hook.f., Fl. Brit. India 7: 362. 1896.

Tufted, perennial herbs up to 60 cm tall; culms slender, compressed, scabrid above. Leaves rigid, flat or convolute, cauline shorter, acute or pungent; sheaths compressed; ligule 5-7 mm long, lacerate. Inflorescence unilateral racemes, 2.5-5 cm long, 5-6-spiculate. Spikelets 1.5-2 cm long, laterally compressed, 3-6-flowered each subtended by a deciduous membranous scale; rhachilla hairy; glumes lanceolate, acuminate, mucronate or shortly awned, lower 7-veined, upper 8-11-veined; lower lemma 1-1.5 cm long, dorsally hairy below, 11-13-veined; awn 1.5-2.5 cm long; upper most floret consisting a lemma with an awn 4-8 mm long; palea as long as the lemma, 2-keeled.

Frequent in rock crevices, rocky slopes in Baltistan, Gilgit, Ladakh.

Fl. & Fr. : June - July.

Distrib. : Afghanistan, Pakistan, India, Western Himalaya.

ECHINOCHLOA P. Beauv.

Annual or perennial herbs. Leaf-blades flat; ligule often absent. Inflorescence a raceme, arranged along a central axis. Spikelets paired

or in short secondary racemelets, cuspidate or awned, arranged in usually 4 rows; narrowly elliptic to subrotund, flat on one side, gibbous on the other, often hispidulous. Glumes ovate; acute or acuminate, lower shorter and upper as long as the spikelets; lower lemma barren or male, upper lemma crustaceous, with a short membranous, laterally compressed, incurved beak; upper palea acute, the tip reflexed and protuberant from lemma; lodicules 2 or rarely absent; stamens 3, apically exerted. Crains broadly elliptic, dorsally flattened, free within the lemma.

The genus comprises about 30 species in the world; distributed in tropical and warm temperate regions; 8 species in India; 2 species in cold desert.

- 1a. Upper glume and lower lemma acute or cuspidate, not awned
 *E. colona*
 b. Upper glume and lower lemma acuminate or shortly awned ... *E. crusgalli*

Echinochloa colona (L.) Link, Hort. Berol. 2: 209. 1833; Bor, Grasses 308. 1960. *Panicum colonum* L., Syst. Nat. ed. 10. 2: 870. 1759; Hook.f., Fl. Brit. India 7: 32. 1896.

Annual herbs up to 1 m tall; culms slender, decumbent or shortly creeping below, ascending. Leaves linear-lanceolate, flat, glabrous or hairy; ligule absent. Inflorescence linear raceme, 1-15 cm long; raceme 4-rowed, 2.5-3 cm long, simple, contracted; rhachis pilose. Spikelets 2.5-3 mm long, ovate-elliptic, hispidulous; lower glume about half as long as lemma or shorter, acute, 3-5-veined; upper glume almost as long as lower lemma, acute; lower lemma acute to cuspidate; upper lemma 2-3 mm long, ovoid or oblong, obtuse or acute; palea coriaceous.

Common weed of cultivation, in moist places in Dras, Kargil, Ladakh, Lahul & Spiti.

Fl. & Fr. : May - October.

Distrib. : Throughout the tropics and subtropics.

Note : It is a very variable species and forms with elliptic pointed spikelets tend to intergrade with *E. crusgalli*. There is a gradual transition of one into the other. It is considered one of the finest fodder grasses and is eagerly grazed by cattle, while the grains are used as scarcity food by the poor. In young state the plant resembles young rice-plant. In damp places large amount of lush foliage is produced.

Echinochloa crusgalli (L.) P. Beauv., Ess. Agrost. 53. 161. 1812; Bor, Grasses 310. 1960. *Panicum crusgalli* L., Sp. Pl. 1: 56. 1753; Hook.f., Fl. Brit. India 7: 30. 1896.

Coarse annual herbs up to 1 m tall; culms erect or ascending. Leaves linear-lanceolate, flat, glabrous or scaberulous; sheaths glabrous; ligule absent. Inflorescence linear to ovate raceme, 6-20 cm long, contracted or pyramidal, racemes 2-several-rowed, the longest 2-10 cm long; rachis setulose. Spikelets ovate or sub-globose, 3-4 mm long, hispid; lower glume shorter than lemma, acute, 3-5-veined; upper glume as long as lemma, mucronate or shortly awned; lower lemma paleate, male or neuter, acuminate or awned; awn short or long up to 5 cm long, rigid, scabrid; upper lemma ovoid, obtuse or cuspidate, 2-3 mm long; palea coriaceous shining white.

Common weed of cultivation, in marshy and moist waste places, near habitations in Baltistan, Skardu, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - October.

Distrib. : Throughout warm temperate and subtropical regions of the world.

Note : It is a polymorphic species, whose numerous intergrading races are apparently the consequences of cleistogamous self-pollination. There are many forms which show similarity with *E. colona*. It is said to be a good fodder grass. The grains are consumed by poor in times of want.

ELYMUS L.

Perennial herbs; often tufted or rhizomatous. leaf-blades flat or convolute. Inflorescence a linear, dense spike. Spikelets usually in groups of 2-4 on each node of a tough rachis, rarely solitary, 2-many-flowered, sessile or subsessile, laterally compressed; rachilla jointed between lemmas, disarticulating above the glumes and between the florets; glumes opposite or side by side, membranous to coriaceous, 3-9- veined, obtuse or shortly awned, occasionally keeled towards tip; lemmas coriaceous, rounded on back or keeled at tip, 5-veined, obtuse, acute or bidentate, muticous or awned; palea 2-keeled, keel ciliate; lodicules entire or ciliate; stamens 3; ovary hispid at apex. Grains grooved in front, adherent to palea or not.

The genus comprises about 150 species; distributed in temperate regions, best represented in Asia; 21 species in India; 15 species in cold deserts.

- 1a. Spikelets more than one at each node in the middle part of the rachis..2
- b. Spikelets solitary at each node of the rachis 3

- 2a. Glumes as long as the lower floret, usually 3-5-veined..... *E. dahuricus*
- b. Glumes much shorter than the lower floret, usually 1-2-veined .. *E. nutans*

- 3a. Awn of lemma as long as the lemma or longer 4
- b. Lemma awn-less or shortly awned 11

- 4a. Awn of lemma erect or flexuous 5
- b. Awn of lemma curved..... 7

- 5a. Palea as long as the lemma or longer 6
- b. Palea considerably shorter than the lemma..... *E. semicostatus*

- 6a. Spike erect. Lemma silky hairy with long hairs *E. thomsonii*
- b. Spike more or less nodding. Lemma glabrous or minutely hairy
 *E. russellii*

- 7a. Glumes almost as long as the lower floret *E. fedtschenkoi*
- b. Glumes considerably shorter than the lower floret 8

- 8a. Rhachilla twisted above the glumes, florets dorsiventral to the spike-axis; midrib of lower glume not in line with that of lemma ... *E. schrenkianus*
- b. Rhachilla not twisted above the glumes; midrib of lower glume in line with that of lowest lemma 9
- 9a. Anthers 3-3.5 mm long *E. longi-aristatus* ssp. *canaliculatus*
- b. Anthers 1.5-2.5 mm long 10
- 10a. Leaf-blade flat or slightly rolled, shortly and densely pubescent on both the surfaces *E. schugnanicus*
- b. Leaf-blade tightly folded or convolute, glabrous beneath, pubescent or loosely hairy above *E. jacquemontii*
- 11a. Plants with long creeping rhizome 12
- b. Plants without rhizome 14
- 12a. Glumes usually toothed at the apex, rarely acuminate or shortly awned. Lemma minutely bristly. Anthers 2-2.5 mm long *E. dentatus*
- b. Glumes blunt or acuminate. Lemma hairy or glabrous. Anthers 3.5-7 mm long 13
- 13a. Leaf-sheaths ciliate on the margins. Glumes broad, obtuse, obliquely truncate at the tip *E. hispidus*
- b. Leaf-sheaths not ciliate. Glumes lanceolate, shortly awned or mucronate *E. repens*
- 14a. Anthers 2-2.5 mm long. Glumes scabreulous on the veins ... *E. stewartii*
- b. Anthers 3-5 mm long. Glumes smooth *E. cognatus*

Elymus cognatus (Hack.) T.A. Cope in Fl. West Pakistan Fasc.

143. 628. *Agropyron cognatum* Hack. in Allg. Bot. Z. 1904: 22. 1904; Bor, Grasses 660. 1960.

Tufted perennial herbs up to 60 cm tall; culms slender, erect or geniculately ascending. Leaves linear, blades flat or the margins inrolled, shortly hairy above, glabrous beneath. Inflorescence a spike, 6-10 cm long. Spikelets 3-5-flowered, 1-1.5 cm long; upper 6-8 mm long; lemma oblong-lanceolate, 8-10 mm long, emarginate or shortly awned at apex; palea as long as the lemma; 2-keeled, keel ciliate.

Common on slopes, grassy places in Dras, Zaskar, Baltistan, Gilgit, Karakoram, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Iran, Afghanistan, Pakistan, India, Western Himalaya.

Elymus dahuricus Turcz. ex Griseb. in Ledeb. Fl. Ross. 4: 331. 1852; Hook.f., Fl. Brit. India 7: 374. 1896; Bor, Grasses 669. 1960.

Tufted perennial herbs up to 1 m tall; culms stout and leafy or slender with mainly basal leaves. Leaves linear, finely acuminate, usually flat. Inflorescence a spike, erect or nodding, 7-20 cm long. Spikelets in pairs at each node of rhachis, 8-12 mm long, 2-3-flowered, green; glumes subequal, 5-10 mm long elliptic, strongly 3-5-veined, acute or shortly awned; lemma elliptic, 7-11 mm long, awn slightly curved, 8-15 mm long; palea obtuse, keel strongly ciliate.

Common in grassy places, alpine slopes in Rupshu, Suru, Skardu, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Central Asia from Afghanistan to Siberia, Mongolia and China; Pakistan, India, Western Himalaya.

E. dentatus (Hook.f.) T.A. Cope in Fl. West Pakistan Fasc. No. 143. 623. 1982. *Agropyron dentatum* Hook.f., Fl. Brit. India 7: 370. 1896, incl. var. *elatum* Hook.f., var. *scabrum* Nevski, var. *kashmiricum* Meld.; Bor, Grasses 661. 1960.

Tufted perennial herbs up to 60 cm tall; with creeping rhizome; culms erect or geniculately ascending. Leaves linear, flat, smooth or scabrid. Inflorescence a dense spike, 6-15 cm long, erect; rhachis-joints scabrid along the margins; spikelets closely imbricating, 12-15 mm long, 3-5-flowered, glabrous or sparsely pubescent; glumes subequal, oblong or elliptic

obliquely truncate, toothed at the apex or acuminate, sometimes shortly awned, strongly 7-9-veined; lemma oblong-lanceolate, 8-10 mm long, acute or shortly awned.

Common on grassy alpine slopes in Gilgit, Baltistan, Dras, Karakoram, Deosai Plains, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India, Western Himalaya (Endemic).

Note : It is a very variable species. There are awned (vars. *elatum* and *scabrum*) or awnless (var. *dentatum* and *kashmiricum*) lemmas; var. *dentatum* has glabrous sheaths but var. *kashmiricum* has hairy sheaths; var. *elatum* has longer spikelets than var. *scabrum*.

Elymus fedtschenkoi Tzvelev in Nov. Sist. Vyssh. Rast. 1973: 21. 1973. *Agropyron macrolepis sensu* Bor, Grasses 663. 1960, *non* Drobov 1925.

Tufted perennial herbs up to 1 m tall; culms stout, erect. Leaves linear-lanceolate, flat, scaberulous on both sides. Inflorescence a dense spike, 7-10 cm long, the spikelets often, secund; rachis joints scabrid along the margins. Spikelets 1.5-2 cm long, 4-6-flowered; glumes subequal, elliptic-oblong 1-1.5 cm long, scabrid, occasionally lobed or toothed at apex, abruptly acuminate; lemma elliptic-oblong, 10-12 mm long, scabrid or shortly pubescent on the back, awn strongly curved, 1.5-3.5 cm long.

Occasional on slopes in Gilgit, Baltistan, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Central Asia, Siberia eastward to Pakistan, India, Western Himalaya.

E. hispidus (Opiz) Meld. in J. Linn. Soc. Bot. 76. 380. 1978. *Agropyron hispidum* Opiz in Bercht. & Opiz, Oekon. Tech. Fl. Bohmen.

1: 413. 1836. *A. intermedium* (Host) P. Beauv., Ess. Agrost. 102. 146. 180. 1812; Bor, Grasses 663. 1960.

Tufted perennial herbs up to 1 m tall; with creeping rhizome; culms erect or ascending. Leaves linear, flat or convolute, scabrid and sparsely hairy above, glabrous beneath. Inflorescence an erect spike, 6-20 cm long; rhachis joints scabrid along the margins. Spikelets 1-1.5 cm long, 4-5-flowered, glabrous; glumes subequal, oblong to lanceolate, 7-9 mm long, obtuse, truncate, scabrid on keel towards apex, occasionally hairy on the back; lemma oblong-elliptic, 9-11 mm long, glabrous or puberulous, subobtusate, emarginate or apiculate.

Occasional on slopes in Zanskar Ladakh.

Fl. & Fr. : July - August.

Distrib. : Mediterranean region Central Europe eastward to southern Russia, Central Asia, Pakistan; India, Western Himalaya.

Elymus jacquemontii (Hook.f.) T.A. Cope in Fl. West Pakistan Fasc. 143. 622. *Agropyron jacquemontii* Hook.f., Fl. Brit. India 7: 369. 1896; Bor, Grasses 663. 1960.

Tufted perennial herbs up to 30 cm tall; culms erect or ascending, thickened at the base and covered with silvery hyaline basal sheaths. Leaves linear, flexuous, convolute, glabrous. Inflorescence a lax, erect or nodding spike, 3-5 cm long; rhachis joints smooth along the margins. Spikelets 1.5-2 cm long, cuneately obovate-4-6-flowered; glumes unequal, spreading, oblong-lanceolate, scabrid or smooth, acuminate or shortly awned, prominently veined; lower 4.5-6.5 mm long, upper 6-8 mm long; lemma oblong-lanceolate, 8-9 mm long, awn 1.5-4 cm long, recurved; palea-keel ciliolate.

Occasional on slopes in Baltistan, Nubra, Dras, Zanskar, Tso Murari Ladakh.

Fl. & Fr. : July - August.

Distrib. : India, Western Himalaya (Endemic).

Elymus longi-aristatus (Boiss.) Tzvelev ssp. **canaliculatus** (Nevski) Tzvelev in Nov. Sist. Vyssh. Rast. 1972. 62. 1972. *Agropyron canaliculatum* Nevski in Izv. glavn. bot. Sada SSSR 30. 509. 1932; Bor, Grasses 659. 1960. *A. longi-aristatum sensu* Hook.f., Fl. Brit. India 7: 368. 1896, non (Boiss.) Boiss. 1884.

Tufted, perennial herbs; culms stout or slender, erect, or ascending. Leaves linear, flat or convolute, puberulous or glabrous beneath. Inflorescence a lax spike, 8-15 cm long, erect or nodding; rachis joints scabrid along the margins; spikelets loosely imbricate, laterally flattened, green or bluish-purple, 1.5-3 cm long, 5-9-flowered; glumes unequal, elliptic or oblong, acuminate or shortly awned, 3-5-veined; lower 4-8 mm long; upper 5.5-9 mm long; lemma spreading, lanceolate, 8-11 mm long, 3-5-veined, towards apex, awn 2.5-4.5 long, recurved; pales coriaceous, keel ciliolate.

Common on slopes, in open grassy places in Gilgit, Baltistan, Khardon, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Central Asia from Iran, eastward to India, Western Himalaya.

E. nutans Griseb., Nachr. Ges. Wiss. Gottingen 1868: 72. 1868; Bor, Grasses 670. 1960. *E. sibiricus sensu* Hook.f., Fl. Brit. India 7: 373. 1896 *pro parte. non* L. 1753. Fig. 42.

Tufted perennial herbs up to 60 cm tall; culms erect or ascending, usually decurved below the spike. Leaves linear, flat, smooth or scaberulous. Inflorescence a flexuous, short or elongate, spike 5-15 cm long. Spikelets in pairs or in threes, sessile and pedicelled, 1.5-2.5 cm long; glumes elliptic

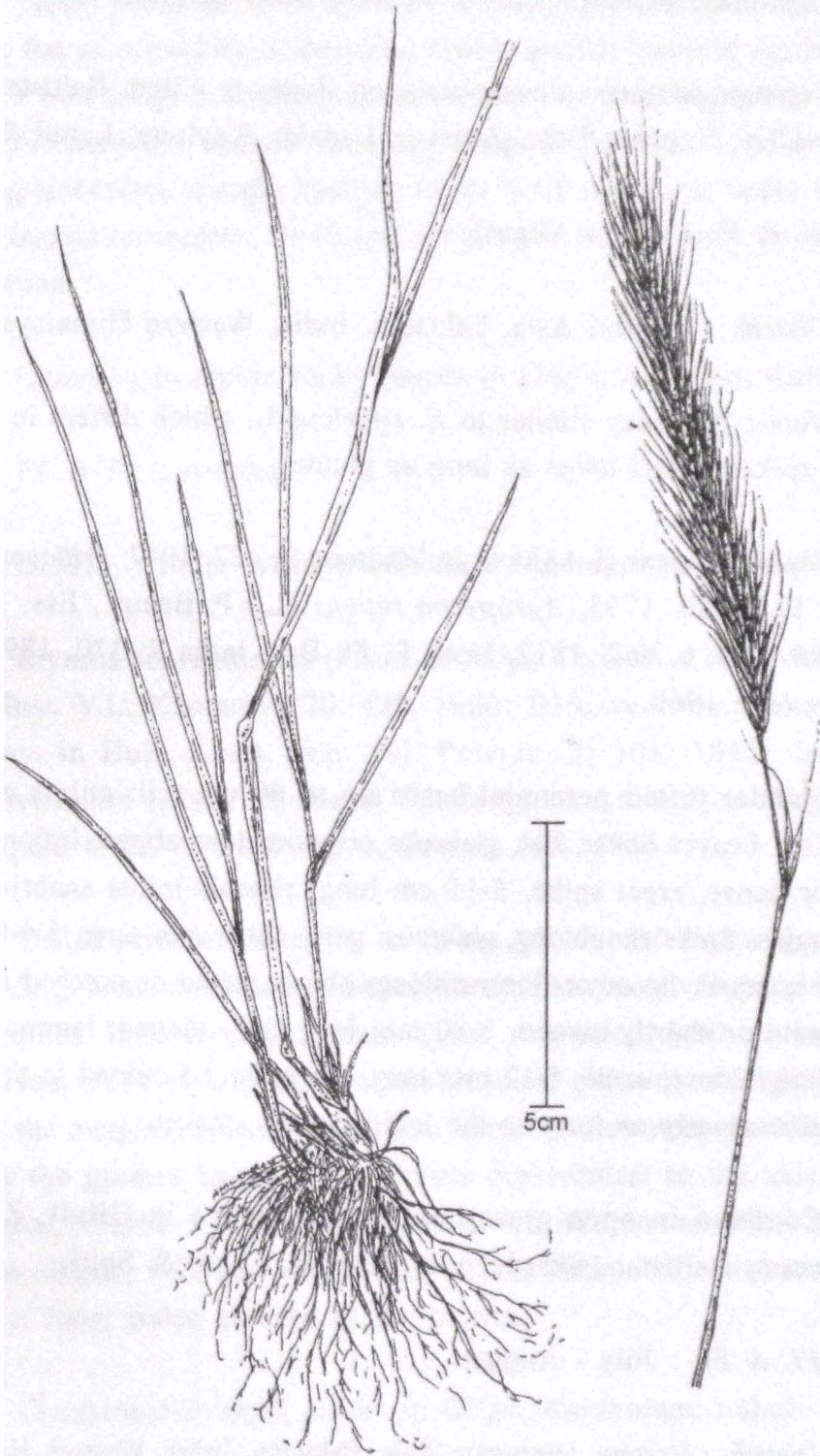


Fig. 42. *Elymus nutans* Griseb.

or lanceolate, 4-9 mm long, 1-3-veined, acute or shortly awned; upper sometimes setaceous; lemma lanceolate, 8-11 mm long, 5-veined scabrid or shortly hairy, narrowed into a flexuous awn 1.5-3 cm long.

Common in grassy open places, on slopes in Gilgit, Baltistan, Leh, Nubra valley, Rupshu, Dras, Zanskar, Ladakh, Keylong, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Central Asia, Pakistan, India, Western Himalaya.

Note : It is very similar to *E. sibiricus* L. which differs in having sessile spikelets and awns as long as glume.

Elymus repens (L.) Gould in Madrono 9: 127. 1947. *Triticum repens* L., Sp. Pl. 1: 86. 1753. *Agropyron repens* (L.) P. Beauv., Ess. Agrost. 102. 146. 180. t. 20/2. 1812, Hook.f., Fl. Brit. India 7: 370. 1896; Bor, Grasses 664. 1960.

Slender tufted perennial herbs up to 60 cm tall; culms erect or ascending. Leaves linear, flat, glabrous or puberulous above. Inflorescence a lax or dense, erect spike, 5-15 cm long; rachis-joints scabrid along the margins. Spikelets oblong, glabrous, pale, 12-16 mm long, 5-6-flowers; glumes unequal, linear or linear-oblong, obtuse, acute or notched at apex, mucronate or shortly awned, 5-10 mm long, 3-5-veined; lemma linear-lanceolate, obtuse, acute, 6-12 mm long, glabrous, 3-5-veined in the upper half; palea nearly as long as the lemma, keel smooth.

Common in open grassy places, on slopes in Gilgit, Zanskar, Karakoram, Baltistan, Skardu, Leh, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia, Pakistan, India, Western Himalaya.

E. russellii (Meld.) T.A. Cope in Fl. West Pakistan Fasc. 143. 618.

1982. *Agropyron russellii* Meld. in Bor, Grasses 665, 694. 1960.

Tufted perennial herbs up to 60 cm tall; culms slender, erect. Leaves linear, flat or convolute, scaberulous above, smooth beneath; ligule hyaline, 0.2-0.3 mm long. Inflorescence a lax, erect or nodding spike, 8-15 cm long; rhachis-joints scabrid along the margins. Spikelets 1.5-1.8 cm long, oblong-lanceolate, margin hyaline; lower 6.5-8 mm long; upper 8-11 mm long; lemma lanceolate, 10-12 mm long, awn, 1-2 cm long; palea as long as lemma.

Common in alpine rocky places in Gilgit, Baltistan, Karakoram.

Fl. & Fr. : August.

Distrib. : India Western Himalaya Kashmir (Endemic).

Elymus schrenkianus (Fisch. & Mey.) Tzvelev in Bot. Mater. Gerb. Bot. Inst. V.L. Komarova 20: 428. 1960. *Triticum schrenkianum* Fisch. & Mey. in Bull. Acad. Imp. Sci. Petersb. 3: 305: 1845. *Agropyron schrenkianum* (Fisch. & Mey.) Candargy in Arch. Biol. Veget. Pure appliquee 1: 22. 41. 1901; Bor, Grasses 665. 1960.

Tufted perennial herbs up to 70 cm tall; culms erect or geniculately ascending, slender or stout. Leaves linear, flat or convolute, glabrous or puberulous. Inflorescence a dense spike, one-sided, 5-10 cm long, erect or curved, suffused with purple; rhachis-joints glabrous or slightly scabrid along the margins. Spikelets 8-12 mm long, 3-5-flowered; rhachilla twisted above the glumes bringing the florets dorsiventral to the axis; glumes subequal, elliptic 3-4.5 mm long, narrowed into an awn 2-5 mm long; lemma elliptic, 9-11 mm long, bristly on the back, awn stout, curved, 1.5-2.5 cm long; palea as long as the lemma.

Occasional in open places in Gilgit, Karakoram, Lahul.

Fl. & Fr. : July - August.

Distrib. : Central Asia, eastward to India, Western Himalaya.

Elymus schugnanicus (Nevski) Tzvelev in Nov. Sist. Vyssh. Rast. 1972: 62. 1972. *Agropyron schugnanicum* Nevski in Izv. glavn bot. Sada SSR 30: 512. t. 4. 1932; Bor. Grasses, 665. 1960.

Tufted perennial herbs up to 60 cm tall; culms erect or ascending, slender. Leaves linear, flat or convolute, densely pubescent. Inflorescence a lax nodding spike, 7-10 cm long; rhachis joints smooth or scabrid along margins. Spikelets 1.5-2 cm long, 5-7-flowered; glumes unequal, oblong-lanceolate, acute, acuminate or shortly awned; lower 3.5-5 mm long; upper 5-6.5 mm long, lemma oblong-lanceolate, 8-10 mm long, scabrid on the back, awn stout, curved, 3-3.5 cm long.

Occasional on open slopes in Karakoram, Baltistan, Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India, Western Himalaya.

E. semicostatus (Nees ex Steud.) Meld. in Hara *et al.* Enum. Fl. Pl. Nepal 1: 132. 1978. *Triticum semicostatum* Nees ex Steud., Syn. Pl. Glum 1: 346. 1854. *T. striatum* Nees ex Steud. *l.c.* *Agropyron semicostatum* (Nees ex Steud.) Boiss., Fl. Orient. 5: 662. 1884; Hook.f., Fl. Brit. India 7: 369. 1896; Bor, Grasses 665. 1960. *A. striatum* (Nees ex Steud.) Hook.f., Fl. Brit. India 7: 369. 1896. *A. semicostatus* (Nees ex Steud.) Boiss. var. *thomsonii* Hook.f., *l.c.* *A. striatum* (Nees ex Steud.) Hook.f., var. *validum* Meld. in Bor, Grasses 667, 696. 1960.

Tufted, perennial herbs up to 1.5 m tall; culms stout or slender, erect or ascending. Leaves linear, flat, scaberulous or smooth. Inflorescence an erect, nodding or curved spike 8-20 cm long; rhachis joints scabrid along margins. Spikelets 2-5 cm long, 7-8-flowered; glumes unequal, lanceolate, acuminate, strongly 5-7-veined, scaberulous on veins; lower 1-1.5 cm long, upper 1-1.8 cm long; lemma lanceolate, 1-1.5 cm long, appressed, scabrid

or puberulous, awn erect or recurved, 1.5-2 cm long; palea shorter than lemma.

Common in open grassy places in Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, India western Himalaya.

Note : It is a very variable species.

Elymus stewartii (Meld.) T.A. Cope in Fl. West Pakistan Fasc. 143. 627. 1982. *Agropyron stewartii* Meld. in Bor, Grasses 666, 695. 1960.

Tufted perennial herbs up to 60 cm tall; culms smooth, erect. Leaves linear, flat, scaberulous above. Inflorescence a lax spike, 7-11 cm long, erect or flexuous; rhachis-joints scabrid along the margins. Spikelets lanceolate, 12-16 mm long, 3-4-flowered; glumes subequal, lanceolate, acuminate, 3-5-veined, scaberulous on the veins; lower 5-7.5 mm long; upper 6.5-8 mm long; lemma oblong-lanceolate, 8-10 mm long 5-veined, veins scabrid, awn erect, 1-2.5 mm long; palea emarginate at apex.

Occasional in open places in Baltistan, Shyok Valley Ladakh.

Fl. & Fr. : August.

Distrib. : India, western Himalaya, Kashmir (Endemic).

E. thomsonii (Hk.f.) Meld. in Hara *et al.* Enum. Fl. Pl. Nepal 1: 132. 1978. *Agropyron thomsonii* Hook.f., Fl. Brit. India 7: 370. 1896.

Densely tufted perennial herbs up to 70 cm tall; culms stout or slender. Leaves linear, flat or involute, upper glabrous, lower hairy; lower sheath villous. Inflorescence a spike, 7-15 cm long; rhachis pubescent on

the margins all over; internodes of rhachilla scaberulous. Spikelets ovoid, 10-15 mm long, 5-7-flowered; glumes erecto-patent, ovate-oblong, acute or acuminate, 5-7-veined, veins scaberulous, margin hyaline; upper sometimes toothed at apex and mucronate; lemma ovate-lanceolate, faintly veined, silky villous, narrowed into a slender awn, twice as long as the glumes or little shorter; keel of palea ciliolate.

Common on grassy slopes in Spiti, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India, Western Himalaya.

ENNEAPOGON Desv. ex P. Beauv.

Annual or perennial herbs. Leaf-blades linear, flat or convolute. Inflorescence a panicle, usually spiciform or capitate. Spikelets 3-5-flowered, the lowest bisexual, the upper 1 or 2 reduced or suppressed to a brush like appendage; rhachilla jointed at the base. Glumes subequal, membranous, keeled, 3-9-veined; lemmas broad, chartaceous, outer surface slightly hairy, sometimes lower half densely hairy, smooth or ribbed, with 9 ciliate awns, palea hyaline broad, 2-keeled; lodicules 2; stamens 3. Grains ovoid or oblong, free within the lemmas.

The genus comprises 28 species in the world; distributed in the tropics and subtropics, especially Australia and Africa; 4 species in India; 1 species in cold desert.

Enneapogon persicus Boiss. *Diagn.* 1(5): 71. 1844; *Bor., Grasses* 610. *Poppophorum aucheri* Jaub. & Spach, *Ill. Pl. Or.* 4: 32. t. 323. 1851; *Hook.f., Fl. Brit. India* 7: 301. 1896.

Tufted perennial herbs up to 50 cm tall; culms slender, wiry, erect or ascending, puberulous. Leaves linear, flat or convolute; ligule a pubescent ridge. Inflorescence a contracted, cylindrical, silvery yellow panicle, 10-15 cm long; spikelets 8-12 mm long, usually 3-flowered; glumes lanceolate,

pubescent, 6-7-veined; lower 5.5-10 mm long; upper 7-12 mm long; lemma much shorter, coriaceous, orbicular, villous; lower lemma 9-awned; awns softly hairy up to middle or little over, scaberulous above, 10-15 mm long; palea hyaline, 2-keeled, keels pubescent.

Common on dry slopes, arid wastelands in Gilgit Ladkakh.

Fl. & Fr. : May - July.

Distrib. : Persia to Pakistan, India western Himalaya.

ERAGROSTIS N.M. Wolf

Annual or perennial herbs; often glandular on leaf-sheath and inflorescence. Culms erect or geniculately ascending. Leaf-blades linear, flat or convolute, rarely pungent. Inflorescence an open, contracted, spiciform or glomerate panicle, rarely of racemes on central axis. Spikelets 2-many-flowered laterally compressed, variously disarticulating; rhachilla not produced beyond lemmas. Glumes subequal, 1-or rarely 3-veined, rarely awned, often deciduous; lemmas 3-veined, keeled or rounded, membranous to coriaceous, at length deciduous from the rhachilla; palea deciduous or persistent, broad, membranous, keeled, keel ciliate or winged; lodicules 2, minute; stamens 2 or 3. Grains globose oblong ovoid or obovoid, free within the lemmas.

The genus comprises about 350 species in the world; distributed throughout the tropics and subtropics; about 37 species in India; 2 species in the cold desert.

The name *Eragrostis* is sometimes wrongly ascribed to P. Beauv. but Wolf's work is earlier and validly published (see Ross in *Acta Bot. Neerl.* 15: 161. 1966).

- 1a. Palea deciduous with lemma..... *E. pilosa*
 b. Palea persistent..... *E. minor*

Eragrostis minor Host, Gram. Austr. 4: 15. 1809; Hook.f., Fl. Brit. India 7: 321. 1896. *E. poaeoides* P. Beauv., Ess. Agrost. 162. 1812, based on *Poa eragrostis* L., Sp. 1: 68. 1753; Bor, Grasses 512. 1960. Fig. 43.

Tufted annual herbs up to 25 cm tall; culms slender, ascending. Leaves linear-lanceolate, flat, margin glandular; sheath-mouth bearded. Inflorescence an ovate-oblong, dense or open panicle, 5-15 cm long; branches stiff. Spikelets linear to ovate, pale green to purplish, shining 5-8 mm long, many flowered; glumes subequal, ovate, or boat-shaped, acute, 1-veined, 1-1.5 mm long, keel scabrid; lemma broadly ovate, obtuse, 1.5-2 mm long, chartaceous, lateral veins strong; palea obovate-oblong, keel scabrid. Caryopsis globose.

Common as weed of gardens, cultivated fields, in open grassy places, on slopes, in waste places in Leh, Dras, Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : May - October.

Distrib. : Throughout warm temperate and sub-tropical regions.

E. pilosa (L.) P. Beauv., Ess. Agrost. 162. 175. 1812; Hook.f., Fl. Brit. India 7: 323. 1896; Bor, Grasses 512. 1960. *Poa pilosa* L., Sp. Pl. 1: 68. 1753.

Tufted annual herbs up to 80 cm tall; culms erect or ascending, usually slender and simple. Leaves linear, flat, flaccid or strict, sometimes convolute; mouth of sheath bearded. Inflorescence elliptic to oblong, open or contracted, erect, inclined or nodding panicle, 5-20 cm long. branches filiform or capillary, fascicled or sub-whorled. Spikelets usually grey, tipped with purple, linear, 4-6 mm long, 5-10-flowered; the florets appressed to the rachilla, breaking up from the base; glumes hyaline, unequal, ovate, 0.5-0.7 mm long, veinless or upper faintly 1-veined; lemma ovate, 1-1.5 mm long, acute; palea-keel scaberulous.

Common in alpine pastures, grassy slopes, ditches, grassy waste places in Dras, Ladakh, Lahul & Spiti.

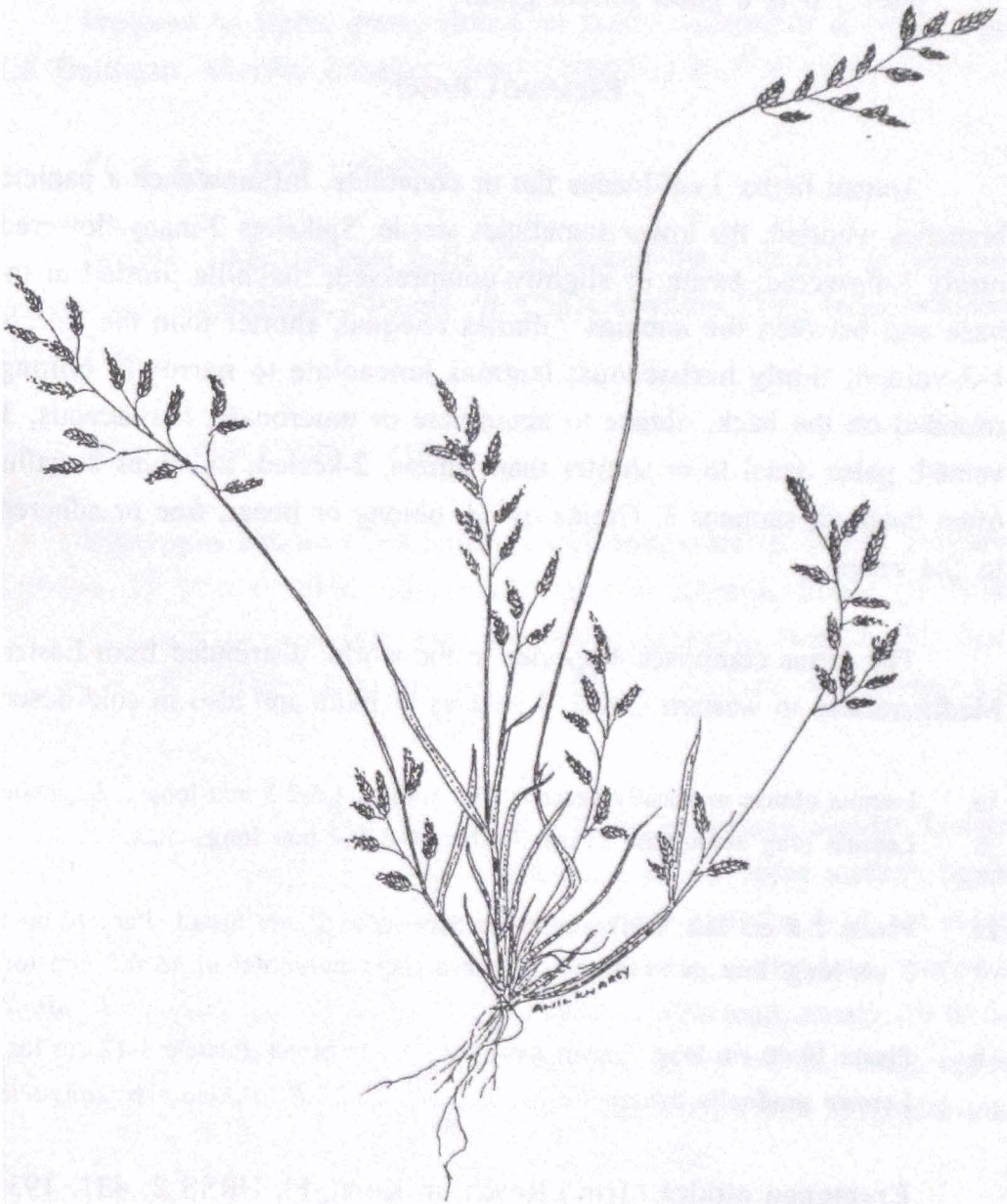


Fig. 43. *Eragrostis minor* Host

Fl. & Fr. : July - October.

Distrib. : Throughout tropical and warm temperate regions of the Old World; introduced in the New World.

Note : It is a good fodder grass.

EREMOPOA Rosch.

Annual herbs. Leaf-blades flat or convolute. Inflorescence a panicle, branches whorled, the lower sometimes sterile. Spikelets 2-many-flowered, rarely 1-flowered, terete or slightly compressed; rhachilla jointed at the base and between the lemmas. Glumes unequal, shorter than the florets, 1-3-veined, thinly herbaceous; lemmas lanceolate to narrowly oblong, rounded on the back, obtuse to acuminate or mucronate, herbaceous, 3-veined; palea equal to or shorter than lemma, 2-keeled; lodicules 2; callus often bearded; stamens 3. Grains ovoid, oblong or linear, free or adherent to the palea.

The genus comprises 4 species in the world; distributed from Eastern Mediterranean to western China; 3 species in India and also in cold desert.

- 1a. Lemma obtuse or abruptly acute at tip. Anthers 1.5-2.5 mm long .. *E. persica*
- b. Lemma long acuminate at tip. Anthers 0.3-0.7 mm long..... 2
- 2a. Plants 2-8 cm tall. Leaves very narrow up to 1 mm broad. Panicle up to 3 cm long. Lemma acute, often with a short awn-point up to 0.5 mm long *E. altaica*
- b. Plants 10-40 cm long. Leaves more than 1 mm broad. Panicle 4-12 cm long. Lemma gradually acuminate *E. altaica* ssp. *songarica*

Eremopoa altaica (Trin.) Rosch. in Kom., Fl. URSS 2: 431. 1934.
Aira altaica Trin. in Mem. Sav. Etr. Acad. Petersb. 2: 526. 1835.

Slender annual herbs up to 8 cm tall; culms slender, erect or ascending. Leaves linear, flat or convolute, scabrid above, smooth or scabrid beneath; ligule lanceolate, 1-2.5 mm long. Inflorescence ovate panicles,

up to 3 cm long, loose; braches capillary to stiff, subwhorled. Spikelets laterally compressed, green or purplish, 4-6 mm long, 2-4-flowered; lower glume lanceolate, acute, 1-2 mm long; upper glume ovate, acute or subacute, 1.5-2.5 mm long; lemmas elliptic, about 4 mm long, glabrous or minutely hairy on the keels and marginal veins, acute.

Frequent on alpine grassy slopes, in grassy wastelands in Gilgit, Zoji La, Baltistan, Skardu, Zanskar, Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : May - August.

Distrib. : Middle east from Turkey and the Caucasus mountains eastwards to Afghanistan, Pakistan, W. China, southern Urals, India, Western Himalaya.

Note : Very variable grass.

Eremopoa altaica (Trin.) Rosch. ssp. **songarica** (Schrenk) Tzvelev, Poaceae URSS 479. 1976. *Glyceria songarica* Schrenk, Enum. Pl. Nov. 1.1. 1841. *Poa persica* Trin. var. *songarica* (Schrenk) Hook.f., Fl. Brit. India 7: 337. 1896; *Eremopoa persica* (Trin.) Rozhev. var. *songarica* (Schrenk) Bor, Grasses 532. 1960.

Slender, annual herbs up to 40 cm tall; culms solitary, slender. Leaves linear, 1-1.5 mm broad, convolute, scaberulous on the upper surface; ligule 1-1.5 mm long. Inflorescence an oblong, loose panicle, 4-10 cm long, sometimes up to 12 cm long; branches very slender, scaberulous, whorled. Spikelets lanceolate, green, 3-5 mm long, 1-2-flowered, rarely up to 3-flowered; glumes lanceolate, acute or subacute, lower 1-2 mm long; upper 1.5-2.5 mm long; lemmas lanceolate, acuminate about 4 mm long, glabrous or minutely hairy on the keels and marginal veins.

Frequent in moist situations in Gilgit, Baltistan, Skardu, Zanskar, Dras, Ladakh.

Fl. & Fr. : May - August.

Distrib. : Middle east from Caucasus mountains, Central Asia eastward to India, Western Himalaya.

Eremopoa persica (Trin.) Rozhev. in Kom., Fl. URSS 2: 430. 1934; Bor, Grasses 532. 1960. *Poa persica* Trin. in Mem. Acad. Sci. Petersb., Ser. 6. 1: 373. 1830; Hook.f., Fl. Brit. India 7: 337. 1896. Fig. 44.

Tufted annual herbs up to 60 cm tall; culms slender, usually flaccid, erect or ascending. Leaves linear, flat or convolute, scabrid above, smooth beneath, ligule lanceolate, 2.5-3.5 mm long. Inflorescence an ovate panicle, 6.5-20 cm long, lax, branches capillary but stiff, subwhorled. Spikelets 4.5-10 mm long, several-flowered, uppermost floret often reduced; pedicels capillary, often very long; divaricate; glumes lanceolate; lower 1-2 mm long; upper 2-3 mm long, 3-veined; lemma oblong, 3-3.5 mm long, mucronate, smooth or puberulous on keels and veins; palea 2-toothed, keel scaberulous.

Common on grassy slopes, alpine pastures in Zanskar, Dras, Leh, Hemis, Ladakh, Lahul & Spiti.

Fl. & Fr. : April - June.

Distrib. : Mediterranean regions, Middle East from Turkey and Caucasus mountains eastwards to Afghanistan, Pakistan, India, Western Himalaya.

Note : Very variable grasses often forming gregarious masses.

FESTUCA L.

Annual or perennial herbs; often tufted; occasionally dioecious. Leaf-blades flat, convolute or setaceous. Inflorescence an open or contracted panicle. Spikelets 2-many-flowered; rachilla jointed below the lemmas, not produced beyond the uppermost imperfect florets. Glumes subequal or unequal, keeled, lower 1-3-veined, upper 3-5-veined, both membranous to herbaceous; lemmas membranous to thinly coriaceous, rounded on the back, acute, acuminate or awned; 5-veined; palea 2-keeled, keels

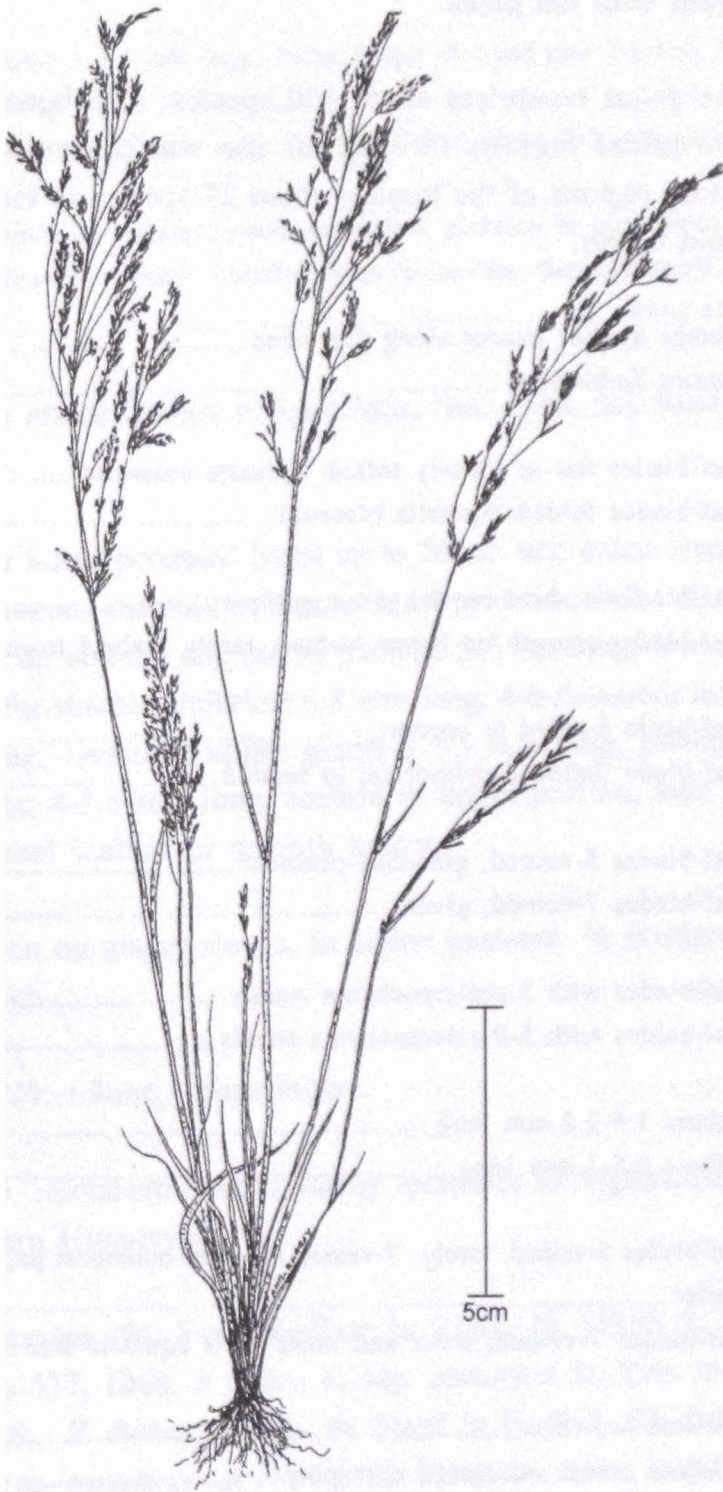


Fig. 44. *Eremopoa persica* (Trin.) Rozhev.

scaberulous; lodicules 2; stamens 3; ovary occasionally hairy at apex. Grains ventrally concave or grooved, rarely flat, glabrous or crown hairy, free or adherent with the palea.

The genus comprises about 450 species; distributed in temperate and subtropical regions throughout the world, extending into the mountainous regions of the tropics; about 27 species in India; 13 species in the cold desert.

- 1a. Glumes hyaline except along the veins..... 2
- b. Glumes herbaceous 3
- 2a. Leaf-blades flat or loosely rolled. Spikelets unisexual *F. olgae*
- b. Leaf-blades folded. Spikelets bisexual *F. alata*
- 3a. Leaf-blades scabrid on the lower surface 4
- b. Leaf-blades smooth on lower surface, rarely scabrid towards the apex 6
- 4a. Leaf-blade 6-sided in section *F. kashmiriana*
- b. Leaf-blade flattened-cylindrical in section 5
- 5a. Leaf-blades 5-veined, glaucous-pruinose *F. valesiaca*
- b. Leaf-blades 7-veined, green *F. alaica*
- 6a. Leaf-blades with 3 sclerenchyma stands 7
- b. Leaf-blades with 5-9 sclerenchyma stands 10
- 7a. Anthers 1.5-2.5 mm long *F. alaica*
- b. Anthers 0.5-1 mm long 8
- 8a. Leaf-blades 5-veined, rarely 7-veined but then outermost pair of veins much smaller *F. coelestis*
- b. Leaf-blades 7-veined, outer and inner pairs equal in size 9
- 9a. Spikelets brown *F. pamirica*
- b. Spikelets green, variegated with purple *F. tibetica*
- 10a. Anthers 0.5-0.8 mm long *F. nitidula*
- b. Anthers more than 1 mm long 11

- 11a. Leaf-blades flattened cylindrical in section *F. hartmannii*
 b. Leaf-blades flattish or folded, in the latter case angular and 4-many sided
 in section 12
- 12a. Upper glume 2.5-3 mm long. Palea deeply divided into 2-lobes. Anthers 1-
 1.5 mm long..... *F. polycolea*
 b. Upper glume 3.5-5 mm long. Palea 2-fid. Anthers 2-3 mm long 13
- 13a. Panicle-branches scabrid. Lemma lanceolate, glabrous or puberulous . *F. rubra*
 b. Panicle-branches hairy. Lemma ovate-lanceolate, densely hairy
 *F. rubra* ssp. *arctica*

Festuca altaica Drobov in Trav. Mus. Bot. Acad. Sci. Russ. 16: 134.
 t. 17/5. 1916.

Densely tufted perennial herbs up to 30 cm tall; culms slender, erect. Leaves setaceous, convolute; ligule a narrow rim, 0.3-0.6 mm long. Inflorescence an oblong, contracted panicle, 3-6 cm long; branches often appressed to the rachis. Spikelets 6-8 mm long, 4-6-flowered; lower glume 2.5-4 mm long, 1-veined; upper glume 3.5-5 mm long, 3-veined; lemma elliptic-oblong, 4-5.5 mm long, scabrid in upper portion, awn 1-1.5 mm long, palea-keel scabrid or smooth below.

Common on grassy slopes, in alpine pastures in Baltistan, Deosai Plains, Ladakh.

Fl. & Fr. : June - September.

Distrib. : Southern Russia; Turkey eastwards to Afghanistan, Pakistan, India, Western Himalaya.

F. alata (St. Yves) Rozhev. in Kom., Fl. URSS 2: 528. 1934; Bor, Grasses 537. 1960. *F. rubra* L. ssp. *alata* St.-Yves in Candollea 3: 393. 1928. *F. duthiei* Hack. ex Stapf in Hook.f., Fl. Brit. India 7: 352. 1896 (as synonym of *F. altaica*). *F. altaica sensu* Stapf in Hook.f., Fl. Brit. India 7: 351. 1896, *non* Trin. 1829; Bor, Grasses 537. 1960.

Densely tufted perennial herbs up to 70 cm tall; rhizome short, thick; culms slender or stout, smooth, erect or ascending. Leaves linear, rigid, convolute, prominently ribbed above; sheaths open to the middle, soon splitting to the base; ligule 0.5-0.8 mm long. Inflorescence an ovate panicle, 7-15 cm long, lax, few-spiculate, lower branches 2-nate. Spikelets 8-15 mm long, oblong, 4-6-flowered; glumes hyaline; lower 3-4 mm long, 1-veined; upper 4-5 mm long, 3-veined; lemma oblong-lanceolate, 6-8 mm long, acute, with a short awn-point faintly 5-veined; palea linear-oblong, keel scabreulous.

Common on grassy slopes, in alpine pastures in Dras, Baltistan, Gilgit, Karakoram in Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Central Asia, Pakistan, India, Western Himalaya.

Festuca coelestic (St.-Vyes) Krecz. & Bobrov in Kom., Fl. URSS 2: 514. 770. 1934. *F. ovina* L. ssp. *coelestis* St.- Vyes in Candollea 3: 376. 1928; Bor, Grasses 539. 1960.

Tufted, perennial herbs up to 30 cm tall; culms slender, erect. Leaves setaceous, convolute; ligule a narrow rim, 0.4-0.6 mm long. Inflorescence an oblong panicle, 1-5 cm long; branches almost appressed to the rachis, scabrid. Spikelets 5-6 mm long, 3-4-flowered; lower glume 1.8-2 mm long, 1-veined; upper glume 2.5-3 mm long, 3-veined; lemma oblong-elliptic, 3-4-mm long, scabrid towards apex, awn 1-2 mm long; palea-keel scabrid or smooth towards base.

Common in grassy places, on slopes in Gilgit, Baltistan Ladakh.

Fl. & Fr. : July - August.

Distrib. : Southern Russia, Pakistan, India, Western Himalaya.

F. hartmannii (Markgr.-Dannenb.) Alexeev in Byull. Mosk. Obshch.

Ispyt. Prior. 83(4): 121. 1978. *F. ovina* L. ssp. *coelestis* St.-Yves var. *hartmannii* Markgr.-Dannenb. in Bot. Jb. 85: 376. 1966.

Tufted perennial herbs up to 30 cm tall; culms slender, erect. Leaves setaceous, convolute; ligule a narrow rim, about 0.3 mm long. Inflorescence an oblong, contracted panicle, 2-6 cm long, branches almost appressed to the axis, scabrid. Spikelets 4.5-6.5 mm long, 3-5-flowered; lower glume 2.5-3 mm long, 1-veined; upper glume 3-4 mm long, 3-veined; lemma oblong-lanceolate, 3.5-4.5 mm long, scabrid towards apex, awn 1-2 mm long; palea-keel scabrid in the upper part.

Frequent on slopes, grassy places, alpine pastures in Baltistan, Dras, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India, Western Himalaya.

Festuca kashmiriana Stapf in Hook.f., Fl. Brit. India 7: 351. 1896. excl. var. *debilis* et var. *simlensis*; Bor, Grasses 538. 1960.

Tufted, perennial herbs up to 60 cm tall; culms erect or ascending. Leaves linear setaceous, convolute, scabrid on the lower surface; ligule a narrow rim, ciliolate, about 0.5 mm long. Inflorescence lanceolate to ovate panicle, 5-15 cm long, usually contracted, stiff or flexuous; branches ascending or spreading, scabrid. Spikelets green or tinged with purple or violet, 8-15 mm long, 4-6-flowered; glumes membranous; lower lanceolate, 4-5 mm long, 3-veined; lemma oblong-lanceolate or elliptic, 5.5-7 mm long, faintly 5-veined; awn 1.5-3 mm long; palea-keel scabrid.

Common in open grassy places, on slopes, in alpine pastures in Baltistan, Dras, Skardu, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, China, India, Western Himalaya.

Festuca nitidula Stapf in Hook.f., Fl. Brit. India 7: 350. 1896; Bor, Grasses 539. 1960.

Tufted perennial herbs with short rhizome, up to 40 cm tall; culms erect or ascending, nodes solitary near the base. Leaves linear setaceous, convolute, ribbed on the upper surface; ligule a narrow rim, about 0.5 mm long, ciliolate, more or less auricled. Inflorescence an ovate-lanceolate, lax, open or contracted panicle, 4-10 cm long; branches usually spreading, flexuous, smooth or scaberulous. Spikelets elliptic to lanceolate, 8-10 mm long, 3-6-flowered, green or purplish; glumes membranous margin hyaline; lower 2.5-4 mm long, 1-veined; upper 4-5 mm long, 3-veined; lemmas oblong-lanceolate, 5.5-6 mm long, smooth or scaberulous towards apex; awn 2-3 mm long; palea keels scabrid.

Common in alpine pastures in Nubra, Baltistan, Zanskar Ladakh.

Fl. & Fr. : July - August.

Distrib. : India Western Himalaya (Endemic).

F. olgae (Regel) Krivot. in Bot. Mater. Gerb. bot. Inst. V.L. Komarova 20: 56. 1960. *Molinia olgae* Regel in Acta Horti Petrop. 7: 625. 1881. *Festuca sibirica* Hack. ex Boiss., Fl. Orient. 5: 626. 1884; Stapf in Hook.f., Fl. Brit. India 7: 355. 1896. *F. lucida sensu* Bor, Grasses 538. 1960. *pro parte non* Stapf. 1896. *Leucopoa albida sensu* Bor l.c. 544. 1960, *non* Krecz. & Bobrov 1934.

Densely tufted, dioecious perennial herbs up to 80 cm tall; culms erect or ascending, slender, sheathed to the top. Leaves linear, flat or convolute, smooth or scabrid, veins prominent; ligule membranous, truncate, ciliate up to 1 mm long. Inflorescence an ovate to linear panicle, 7-15 cm long, loose or contracted. Spikelets 9-12 mm long, ovate-oblong, 4-6-flowered, pale green; lower glume ovate-lanceolate, 1-veined, white and hyaline except along the green vein, 4-4.5 mm long; upper ovate-oblong, 3-veined, 4-6 mm long; lemma ovate-oblong, subobtuse, scaberulous, 5-veined, broadly hyaline on margins and tip, apex times lacerate, awnless

or setiform; palea oblong, acute or minutely 2-dentate, keels scabrid; anthers reduced and empty in female flower; ovary densely hairy at apex; ovary aborted in male flowers; anthers 2.5-4 mm long.

Frequent in rock crevices, rocky slopes in Nubra, Rupshu, Zaskar, Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : Central Asia, Afghanistan, Baltistan, India, Western Himalaya.

Festuca pamirica Tzvelev in Bot. Mater. Gerb. bot. Inst. V.L. Komarova 20: 422. 1960. *F. rubra* L. ssp. *schlagintweitii* St.-Yves in Candollea 3: 389. 1928 *pro parte.*; Bor, Grasses 542. 1960 *F. alaica* Drobov ssp. *pamirica* (Tzvelev) Tzvelev in Bot. Zh. SSSR 56: 1254. 1971. *F. ovina sensu* Bor in Rech.f., Fl. Iran. 70: 77. 1970. *pro part. non* L. 1753.

Tufted perennial herbs up to 20 cm tall; culms slender, erect. Leaves linear, setaceous, convolute; ligule 0.3-0.5 mm long. Inflorescence a narrowly oblong, contracted panicle, 3-5 cm long; branches appressed to main axis, scabrid. Spikelets 5.5-8 mm long, brown, 3-6-flowered; lower glume 2-3 mm long, 1-veined; upper glume 3-4 mm long, 3-veined; lemmas oblong-elliptic, 3.5-5 mm long, scabrid towards apex; awn 1-2 mm long; palea-keel scabrid towards apex, smooth below.

Frequent on slopes, in grassy places in Gilgit, Baltistan, Dras Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pamirs, Pakistan, India, Western Himalaya.

F. polycolea Stapf in Hook.f., Fl. Brit. India 7: 349. 1896; Bor, Grasses 540. 1960. *F. ovina* L. ssp. *polycolea* (Stapf) St. Yves in Candollea 3: 373. 1928.

Densely tufted perennial herbs up to 30 cm tall; culms erect, smooth or scabrid below the inflorescence. Leaves linear, setaceous, rigid; sheaths persistent, pale, shining; ligule very small, obtusely auricled. Inflorescence an ovate to lanceolate, open or contracted, rigidly erect panicle, 5-8 cm long; lower branches scabrid; rhachis scabrid. Spikelets 8-12 mm long; glumes firmly membranous, scabrid; lower subulate-lanceolate, 2-3 mm long, 1-veined; upper lanceolate, acute, 4.5 mm long; lemma oblong-lanceolate, strongly involute, faintly 5-veined; awns as long as the lemma or little shorter; palea 2-fid, scabrid or puberulous.

Frequent on slopes in Zoji La, Astor, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Nepal, India, Himalayas.

Festuca rubra L., Sp. Pl. 1: 74. 1753; Stapf in Hook.f., Fl. Brit. India 7: 352. 1896; Bor, Grasses 540. 1960. *F. rubra* L. var. *villosa* Mert. & Koch ex Roehl., Deutsch. Fl. ed. 3. 1: 654. 1823 ssp. **rubra**.

Tufted perennial herbs up to 70 cm tall; rhizomatous; culms erect or geniculately ascending. Leaves linear, setaceous, convolute; ligule about 0.5 cm long, truncate. Inflorescence a panicle, 5-15 cm long, variable, lanceolate to oblong, erect or nodding, loose, open or contracted; branches and rhachis scabrid. Spikelets 5-10 mm long, rarely up to 15 mm long, oblong, loose, 4-9-flowered, green or variegated, glabrous or hairy; glumes lanceolate-ovate, acuminate; lower 2-3.5 mm long, 1-veined; upper 3.5-5 mm long; 3-veined, lemmas lanceolate, glabrous or hairy faintly 5-veined, margin broadly hyaline above, 4-6 mm long, scaberulous towards apex; awn slender, 1-3.5 mm long; palea scabrid along the keel, 2-fid.

Common on slopes in open, grassy places, alpine pastures in Gilgit, Baltistan, Dras, Satpura Lake, Mulbekh, Leh to Kalte, Zanskar, Nubra, Rupshu Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, Temperate Asia, North America; Pakistan, India, Western Himalaya.

Festuca rubra L. ssp. **arctica** (Hack.) Govar., Fl. Ural. 127. 1937.

Tufted perennial herbs up to 50 cm tall; rhizomatous; culms usually erect. Leaves linear, setaceous, convolute; ligule very short, truncate. Inflorescence a panicle, 5-10 cm long, variable, lanceolate to oblong, erect or nodding, loose, open or contracted; branches hairy. Spikelets 5-8 mm long, oblong, loose, 4-9-flowered, hairy; glumes lanceolate-ovate, acuminate; lower 2-3 mm long, 1-veined; upper 3-4 mm long, 3-veined, lemmas ovate-lanceolate, usually densely hairy, 3.5-5 mm long, faintly 5-veined, margin broadly hyaline at apex, awnless or shortly awned up to 1.5 mm long; palea 2-fid, scabrid along the keel.

Frequent on slopes in Baltistan, above Skardu, Gilgit, Dras, Rupshu.

Fl. & Fr. : July - August.

Distrib. : N. America, high mountains of northern Europe and Asia, southwards to Tibet, Pakistan, India, Western Himalaya.

F. tibetica (Stapf) Alexeev in Byull. mosk. Obshch. Ispyt. Prir. 83(4): 118. 1978. *F. valesiaca* Gaud. var. *tibetica* Stapf in Hook.f., Fl. Brit. India 7: 349. 1896; Bor, Grasses 542. 1960.

Tufted perennial herbs up to 10 cm tall; culms slender, rigid, erect. Leaves linear, setaceous, convolute, green or glaucous; ligule very short. Inflorescence an oblong, stiff, contracted panicle, 1.5-3 cm long; branches short, erect, solitary or 2-nate, appressed to the main axis. Spikelets oblong to broadly ovate, purplish, 4-6 mm long, 3-4-flowered; glumes lanceolate, acute or subacute; lower 1.5-3 mm long, 1-veined; upper 3-4 mm long, 3-veined; lemma oblong-elliptic, purplish black, scabrid towards apex, 5-veined; awn 1-2 mm long, palea oblong-lanceolate, obscurely 2-toothed, keel scabrid.

Common in rocky places at very high altitudes in Ladakh.

Fl. & Fr. : July - August.

Distrib. : Tibet, Nepal, India, Himalaya from Kashmir to Sikkim.

Festuca valesiaca Schleich. ex Gaud., *Agrost. Helv.* 1: 242. 1811;
Bor, *Grasses* 542. 1960. ssp. **valesiaca**

Tufted perennial herbs up to 40 cm tall; culms slender, erect. Leaves linear, setaceous, convolute, scabrid on the lower surface, glaucous-pruinose; ligule a narrow rim, 0.3-0.5 mm long, obscurely auricled. Inflorescence an oblong, stiff, contracted panicle, 4-10 cm long; branches ascending, appressed to the main axis, scabrid. Spikelets oblong to broadly ovate, pale green or purplish, 4-7 mm long, 4-6-flowered; glumes lanceolate, acute; lower 2-3.5 mm long, 1-veined; upper 3-5 mm long, 3-veined; lemma oblong-elliptic, 2.5-4.5 mm long, scabrid towards apex; awn 1-3 mm long; palea lanceolate, keel scabrid towards apex.

Common in high altitude alpine grassy slopes, alpine pastures in Gilgit, Baltistan, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Europe, Asia from Turkey and the Caucasus eastward to Siberia, Mongolia, North-west China, Tibet, Pakistan, India, Himalayas from Kashmir to Sikkim.

HELICTOTRICHON Besses ex J.A. Schult. & J.H. Schult.

Perennial herbs; caespitose. Leaf-blades flat, convolute or setaceous. Inflorescence a narrow and erect panicle, sometimes lax, rarely simple and raceme-like. Spikelets 2-6-flowered, the florets similar, bisexual or the uppermost almost reduced; rhachilla pilose, disarticulating above glumes, produced beyond lemma as a short bristle. Glumes unequal, hyaline to membranous, keeled, 1-5-veined, keel scaberulous; lemmas membranous

to coriaceous, rounded or faintly keeled, 2-4-dentate or bisetulate, 5-11-veined, geniculately awned from above the middle; palea enclosed by lemma, 2-keeled; stamens 3; ovary hairy. Grains adherent to the paleas.

The genus comprises about 100 species in the world; distributed in temperate Europe, Asia extending into the mountainous regions of the tropics; 6 species in India; 1 species in the cold desert.

Helictotrichon pratense (L.) Pilger in Fedde, *Repert.* 45: 6. 1938; Bor, *Grasses* 439. 1960. *Avena pratensis* L. *Sp. Pl.* 1: 80. 1753; Hook.f., *Fl. Brit. India* 7: 726. 1896.

Densely tufted perennial herbs up to 50 cm tall; culms stout, strict. Leaves linear, coriaceous, flat, scaberulous pruinose above; ligule oblong, lacerate, 2-5 mm long, Inflorescence a contracted, spiciform panicle, 5-15 cm long, erect or inclined; branches short and erect. Spikelets oblong, 1.4-2.8 cm long, glistening, green or brownish, 4-6-flowered; glumes lanceolate or oblong, 3-veined, hyaline on the margins and at apex; lower 1-1.5 cm long; upper 1.2-2 cm long; lemma subcoriaceous, margin hyaline. tip notched, 5-7-veined; awn from just above the middle, geniculate, 1-2 cm long; palea-keel smooth.

Common in alpine meadows, open grassy places in Zanskar, Gilgit, Baltistan, Karakoram.

Fl. & Fr. : July - August.

Distrib. : Europe, temperate Asia, India, western Himalaya.

Hierochloe R. Br. *nom. cons.*

Perennial herbs; tufted or rhizomatous. Leaf-blades flat. Inflorescence a panicle. Spikelets 2-3-flowered, laterally compressed; the lowest floret male with 3 stamens, the upper bisexual with 2 stamens; rhachilla disarticulating above the glumes, not produced beyond the lemmas. Glumes equal or unequal, hyaline to membranous, keeled, 1-3-veined; lemmas

membranous to coriaceous, hairy on the margins and on the back towards the apex, 5-veined, acute to bilobed, awnless or with subapical awn, fertile lemma cartilaginous, margin convolute; palea 1-3-veined; lodicules 2. Grains oblong to ellipsoid, free within the lemmas.

The genus comprises about 30 species in the world; distributed in temperate and arctic regions; 4 species in India; 1 species in cold desert.

Hierochloe laxa R. Br. ex Hook.f., Fl. Brit. India 7: 222. 1896; Bor, Grasses 441. 1960.

Perennial herbs up to 60 cm tall; rhizome stout, creeping; culms erect or ascending. Leaves ensiform acute, glabrous, smooth; ligule oblong, 1-2.5 mm long. Inflorescence an oblong, inclined, loose panicle, 5-15 cm long; branches capillary. Spikelets compressed, brown, 5-6 mm long; glumes equal or subequal, ovate, acute, 4-7 mm long, faintly 1-3-veined; male florets with lemma 4-5 mm long, truncate or shallowly toothed at apex, awned; awn 0.5-3 mm long; lemma of female spikelets 3-4 mm long, hairy above the middle, awnless or shortly awned.

Common in alpine meadows, on rock ledges in Dras, Baltistan, Gilgit in Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India, Western Himalaya.

HORDEUM L.

Annual, rarely perennial herbs. Leaf-blades usually flat. Inflorescence a linear to oblong spike. Spikelets 3 at each node, the triads arranged in 2 longitudinal rows with the fertile florets in 2, 4 or 6 longitudinal rows, each triad with a central bisexual spikelet and 2 lateral male or barren spikelets; rachilla jointed at the base of the lemmas and produced beyond it. glumes very narrow, rigid, awned, 3-veined, free to the base; lemmas rounded on the back, obscurely 5-veined, acuminate to shortly awned; palea 2-keeled; lodicules 2, ciliate; stamens 3. Grains grooved in front, tip usually villous, adherent to the palea or free.

The genus comprises about 40 species in the world; distributed in the temperate regions; 8 species in India; 3 species in the cold desert.

- 1a. Lemma of the central spikelet with 5-10 mm long awn *H. bogdani*
- b. Lemma of the central spikelet with 1-3 mm long awn 2
- 2a. Lemma glabrous *H. brevisubulatum*
- b. Lemma hairy *H. brevisubulatum* ssp. *turkestanicum*

Hordeum bogdani Wilensky in *Izv. saratov. Oblast. sel.-khoz. opyt. Sta. 1(2): 13. 1918; Bor, Grasses 676. 1960. *H. secalinum sensu* Hook.f., *Fl. Brit. India 7: 372. 1896 pro part. non* Schreb. 1771.*

Densely tufted perennial herbs up to 30 cm tall; culms stout or slender, erect or geniculately ascending, leafy. Leaves short, linear, flat, glabrous or hairy beneath; ligule small. Inflorescence a narrow, subcylindric, dense-flowered, erect or inclined spike, 4-8 cm long, glaucous or greenish violet; rhachis tough below but fragile above at maturity. Spikelets densely crowded, 3-nate; lateral pedicelled, male or neuter; central sessile; glumes setaceous, 5-10 mm long, scabrid; lemma lanceolate, 5-7.5 mm long, scabrid to appressed puberulous; awn 5-11 mm long; pedicelled spikelets; glumes setaceous, 6-10 mm long, scabrid; lemma 5-7 mm long.

Frequent in waste places near habitation, near cultivated fields in Gilgit, Baltistan, Karakoram, Ladakh.

Fl. & Fr. : July - September.

Distrib. : South east Europe, southern Russia, Mongolia, Northern China, Pakistan, India, Western Himalaya.

H. brevisubulatum (Trin.) Link in *Linnaea 17: 391. 1843; Bor, Grasses 699. 1960 (in Addenda) *H. secalinum sensu* Hook.f., *Fl. Brit. India 7: 372. 1896. pro part. non* Schreb. 1771.*

ssp. ***brevisubulatum***

Tufted, perennial herbs up to 70 cm tall; culms erect or geniculately ascending. Leaves short, linear, flat, scabrid. Inflorescence a slender,

subcylindric, dense-flowered, greenish to greyish-purple spike, 3-8 cm long; rhachis scabrid-hairy on the margins, fragile. Spikelets 3-nate; central sessile; glumes setaceous, 4-10 mm long, scabrid; lemma lanceolate, 5-8 mm long, glabrous or scaberulous towards apex; awn 1-5 mm long; lateral spikelets pedicelled, well developed, male; glumes setaceous, 4.5-10 mm long, scabrid; lemma 3.5-6.5 mm long.

Frequent in open grassy waste places in Gilgit, Leh, Ladakh.

Fl. & Fr. : July - September.

Distrib. : South-eastern Russia, S.E. Iran, Central Asia, Tibet, Eastern Turkestan, Manchuria, Mongolia, Pakistan, India, Western Himalaya.

Hordeum brevisubulatum (Trin.) Link ssp. ***turkestanicum*** (Nevski) Tzevelev in Nov. Sist. Vyssh. Rast. 1971: 66. 1971. *H. turkestanicum* Nevski in Acta Univ. Asiae mediae, ser. 8b. Bot. 17: 45. 1934; Bor, Grasses 677. 1960.

Tufted, perennial herbs up to 60 cm tall; culms erect or geniculately ascending. Leaves linear, flat, scabrid. Inflorescence a slender, subcylindric, usually greyish purple spike, 4-10 cm long; rhachis scabrid on the margins, fragile. Spikelets 3-nate; central sessile; glumes about as long as lemma, scabrid; lemma lanceolate, 5-8 mm long, densely hairy, hairs long and curled; awn 2-5 mm long; lateral spikelets pedicelled, usually abortive; glumes setaceous, longer than lemma.

Occasional in open grassy places in Baltistan, Nubra near Salt Lake, Rupshu Ladakh.

Fl. & Fr. : July - September.

Distrib. : Southern Russia, Central Asia, Western China, Pakistan, India, Western Himalaya.

KENGIA J.G. Packer

Perennial herbs. Leaf-blades flat, convolute when dry; ligule a ciliolate rim. Inflorescence an open or narrow panicle, lax raceme on a central

axis or a simple raceme; always associated with axillary cleistogamous spikelets concealed within the upper-sheaths. Spikelets 1-many-flowered, laterally compressed; rhachilla internodes pubescent. Glumes unequal, membranous, 1-5-veined, lemmas 3-5-veined, keeled, minutely 2-toothed, mucronate or awned from between the teeth, rarely entire, pubescent on the margin, rarely glabrous; palea 2-keeled, keels puberulous.

The genus comprises about 10 species in the world; distributed in southern Europe, Turkey, northern and central Asia through southern Russia and Pakistan to China and Japan; 2 species in India; 1 species in cold desert.

Kengia seems to be related to *Leptochloa* P. Beauv. but in *Kengia* there is a tendency to a paniculate inflorescence. In *Leptochloa* the inflorescence is of several to many slender racemes on a central axis or rarely subdigitate. Keng described this genus as *Cleistogenes* (*Sinensia* 5: 147. 1934) but this name is invalidated by its similarity to the technical term cleistogene.

Kengia mutica (Keng) Packer in Bot. Not. Lund. 113(3): 291. 1960.
Cleistogenes mutica Keng in J. Washington Acad. Sci. 28(7): 299-301.
 1938. Fig. 45.

Tufted perennial herb up to 40 cm tall. Culms simple, lower internodes covered by sheaths; sheaths enclosing cleistogamous spikelets in the upper part; ligule a ciliate rim. Inflorescence a panicle, 9 cm long, branches spreading. Spikelets up to 10 mm long, up to 8 flowered, greenish-purple; glumes unequal, lower 1.5 mm long, upper 3.5 mm long, 1-veined; lemmas 3.5 mm long, ciliate on the mid-vein and on the sides; palea 2-keeled, keels ciliate below, scabrid above.

Occasional on loose stony slopes, forming clumps in Upshi, Ladakh.

Fl. & Fr. : August.

Distrib. : China, Japan, Mongolia, Central Asia, India from Ladakh.

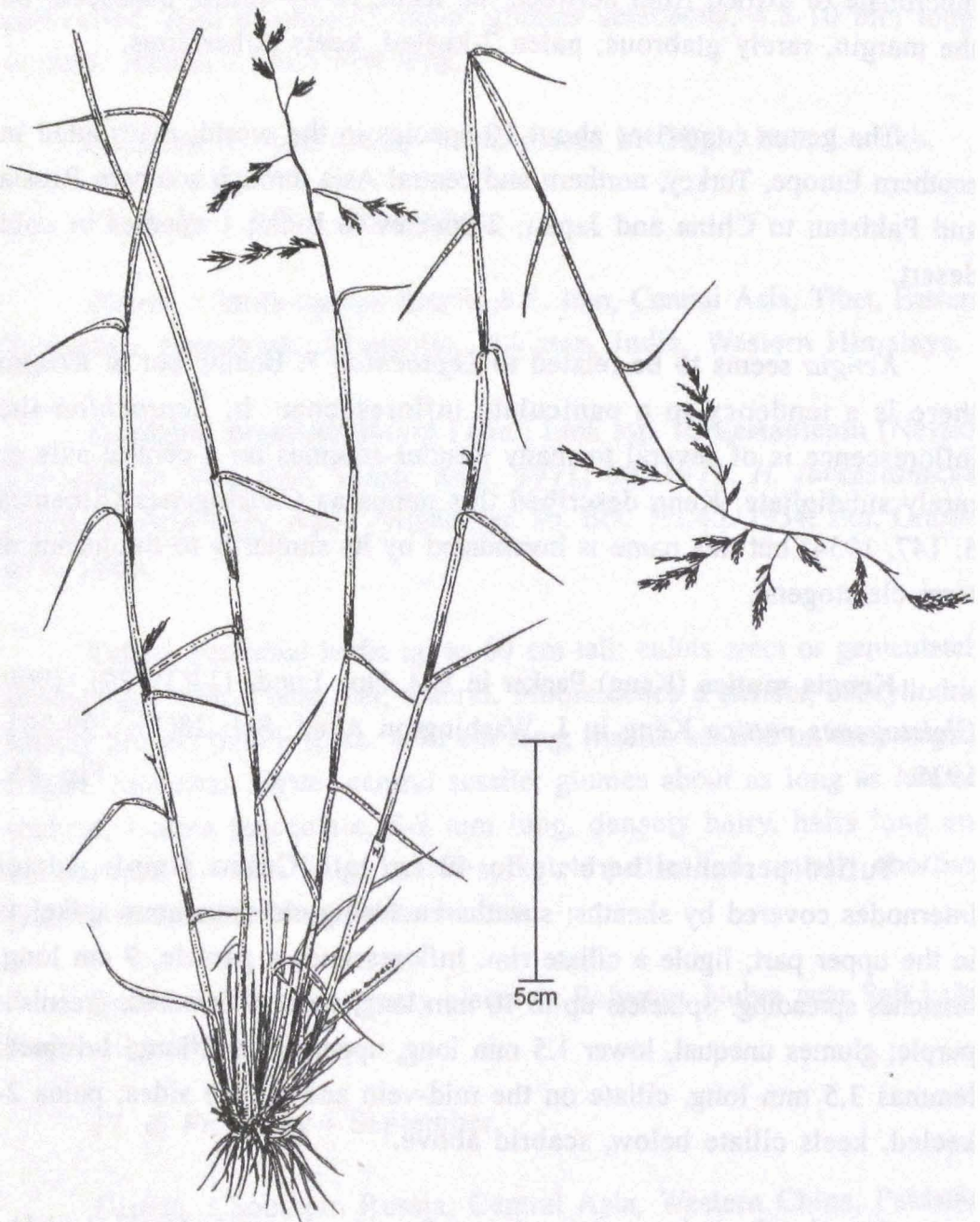


Fig. 45. *Kengia mutica* (Keng) Packer

Bhattacharya & Uniyal (J. Econ. Tax. Bot. 7(1): 235-236. 1985) recorded this species for the first time from India. This species is native to China.

KOELERIA Pers.

Annual or perennial herbs; tufted; with or without rhizomes; the basal sheaths sometimes swollen into bulbs. Leaf-blades narrow. Inflorescence a spiciform panicle, often lobed or interrupted, branches hispidulous. Spikelets 2-7-flowered, laterally compressed; rhachilla jointed between the lemma, produced beyond it, glabrous to puberulous. Glumes subequal or unequal, keeled, margin hyaline, acute or acuminate; lemmas membranous scarious, margins hyaline, obscurely 3-5-veined, acute to acuminate, with or without an awn; palea hyaline, 2-toothed, gaping; lodicules 2; stamens 3. Grains oblong, laterally compressed, free within the lemma.

The genus comprises about 35 species in the world; distributed in the temperate regions; 2 species in India and also in the cold desert.

- 1a. Lemma awned..... *K. argentea*
- b. Lemma awnless..... *K. macrantha*

Koeleria argentea Griseb., Goett. Nachr. 77. 1868; Hook.f., Fl. Brit. India 7: 309. 1896; Bor, Grasses 444. 1960.

Tufted perennial herbs up to 45 cm tall; culms simple, erect or geniculately ascending, hairy below the panicle. Leaves linear, flat or convolute, glabrous; ligule 1-2 mm long, lacerate. Inflorescence an oblong, interrupted, elongate panicle, 4-8 cm long; rhachis tomentose. Spikelets 2-3-flowered, silvery white shining, glabrous, 3-5 mm long; glumes subequal, 1-veined, acute, lower 2-toothed at apex, 4-5 mm long; upper 5-5.5 mm long; lemmas elliptic, 4.5-5 mm long, awn up to 1 mm long, from above the middle of lemma on dorsal surface.

Rare in open grassy places in Indus Valley from Upoli to Leh. Ladakh, Nubra, Fotu La, Upshi, Dras, Lahul.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, India, Western Himalaya.

Koeleria macrantha (Ledeb.) Schult., Mant. 2: 345. 1824. *Aira macrantha* Ledeb. in Mem. Acad. Sci. Petersb. 5: 515. 1812. *Koeleria cristata sensu* Hook.f., Fl. Brit. India 7: 308. 1896, *non* Pers. 1805; Bor, Grasses 444. 1960.

Densely tufted perennial herbs up to 60 cm tall; rhizome creeping; culms simple, erect or ascending, glabrous or pubescent. Leaves linear, flat or involute, glabrous or hairy; ligule 1 mm long, obscure. Inflorescence a narrowly oblong, shining, after interrupted panicle, 3-10 cm long; branches short, scabrid; panicle glabrous or tomentose; spikelets 2-4-flowered, shining, green, purplish or silvery with green keel; glumes subequal, acute or acuminate, mucronate or shortly aristulate, glabrous or hairy along the keel, 1-3-veined; lower 3-4- mm long; upper 4-5.5 mm long; lemma oblong-elliptic, 3.5-5.5 mm long, 3-veined, acute or mucronate, awnless.

Common in alpine meadows on dry slopes in Gilgit, Baltistan, Dras, Zoji La, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - September.

Distrib. : Throughout temperate regions of northern hemisphere.

LEYMUS Hochst.

Perennial herbs; rhizomatous. Leaf-blades flat or convolute, stiff, harsh, glaucous, tip pungent. Inflorescence a linear raceme or a spike, the spikelets borne in pairs or singly and appressed to a tough rachis. Spikelets 3-7-flowered, rhachilla disarticulating above the glumes and between the florets; glumes narrow linear or awn-like, opposite or side by side, 1-veined, occasionally lanceolate and 1-3-veined; lemmas lanceolate, 5-7-veined, awned or awnless, palea 2-keeled, keels often ciliate; lodicules entire or ciliate; stamens 3; ovary hispid at tip. Grains narrow, grooved in front, adherent to the paleas or not.

The genus comprises about 40 species in the world; distributed in Europe, north and central Asia and N. America, 1 species in India and also in cold desert.

Leymus secalinus (Georgi) Tzvelev, Pl. Asiat. Cent. 4: 209. 1968. *Triticum secalinum* Georgi, Bomer. einer Reise. 1: 198. 1775. *Elymus dasystachys* Trin. in Ledeb., Fl. Alt. 1: 120. 1829; Hook.f., Fl. Brit. India 7: 374. 1896; Bor, Grasses 669. 1960.

Tufted perennial herbs up to 1 m tall; rhizome creeping; culms erect, stout or slender. Leaves linear or linear-lanceolate, coriaceous, flat or with margins involute, smooth or scaberulous. Inflorescence a dense, stout, strict spike, 12-20 cm long. Spikelets 2-3-nate, greyish-green or glaucous, sometimes purplish, 2-4-flowered; glumes lanceolate, unequal, 1-3-veined, awned; awn 1-1.5 cm long; lemma lanceolate or elliptic, 8-12 mm long, acute, hairy, notched at apex; awned; awn terminal, 1-3 mm long; palea-keel stoutly ciliate.

Common in open places in Rupshu, Suru, Gilgit, Dras, Baltistan, Spitik, Leh, Shingo Valley, Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Central Asia, Eastern Turkestan, Siberia, Mongolia, China, Pakistan, India, Western Himalaya.

LOLIUM L.

Annual or perennial herbs. Leaf blades flat or convolute. Inflorescence a raceme or stiff 2-sided spike, the spikelets alternate in opposite rows with one edge sunk in hollows in the rachis. Spikelets many-flowered; rhachilla jointed. Lower glume present in only terminal spikelet, upper glume abaxial, shorter than lemma to as long as spikelet, coriaceous, persistent, 5-9-veined; lemmas rounded on the back, oblong, obtuse, acute or awned, 5-9-veined; palea keeled, keel ciliolate or serrulate; lodicules 2; stamens 3. Grains adherent to the paleas.

The genus comprises 8 species in the world; distributed in temperate Europe and Asia; 6 species in India; 1 species in the cold Desert.

Lolium perenne L., Sp. Pl. 1: 83. 1753; Hook.f., Fl. Brit. India 7: 365. 1896; Bor, Grasses 545. 1960.

Tufted perennial herbs up to 60 cm tall; stoloniferous; culms erect or ascending. Leaves linear, flat or convolute, with or without auricles at base. Inflorescence a stiff, 2-sided, erect or slightly curved spike, 8-20 cm long. Spikelets oblong, several-flowered, 5-20 mm long; glumes 3-5-ribbed; upper 3.5-15 mm long; lemmas oblong-lanceolate, obtuse or subacute, 5-veined, 3.5-9 mm long, awnless or with awn up to 8 mm long; palea almost as long as lemma, keel ciliolate or serrulate.

Common in alpine pastures in Ladakh.

Fl. & Fr. : May - August.

Distrib. : Europe, North Africa, temperate Asia, Pakistan, India from Kashmir to Sikkim.

Note : Extremely variable grass. It is grown as lawn grass, forage or soil binder. It is a valuable grazing and hay grass.

MELICA L.

Perennial herbs; rhizomatous; lowest culms often thickened or bulbous. Leaf-blades narrow, flat. Inflorescence a loose or dense, usually narrow panicle; sometimes scanty, raceme like. Spikelets 1-5-flowered, laterally compressed, terminating in a clavate clump of 2-3 rudimentary glumes; rachilla jointed, disarticulating below glumes or below lowest floret. Glumes shorter to as long as the spikelets, membranous and hyaline or with hyaline margins and tips, lower 1-3-veined, upper 3-5-veined; lemmas coriaceous or membranous, hyaline at tips, 5-9-veined, notched obtuse or acute, rarely awned; palea 2-keeled, keels ciliolate or scaberulous; lodicules 2 or absent; stamens 3. Grains oblong, fusiform or subcylindric.

The genus comprises about 80 species; distributed in temperate regions throughout the world except Australia; 9 species in India; 2 species in the cold desert.

- 1a. Inflorescence of congested, spike-like panicle. Lemma ciliate with long hairs *M. persica*
 b. Inflorescence with long spreading branches. Lemma glabrous .. *M. secunda*

Melica persica Kunth, Rev. Gram. 1: 122. 351. t. 89. 1830; Bor, Grasses 592. 1960. *M. jacquemontii* Decne. in Cambess., Pl. Rare. 174. t. 175. 1844; Bor, Grasses 590. 1960. *M. cupani sensu* Hook.f., Fl. Brit. India 7: 329. 1896, *non* Guss. 1832. *M. canescens* (Regel) Lavrenko in Kom., Fl. URSS. 2: 752. 1934; Bor, Grasses 590. 1960. Fig. 46.

Densely tufted perennial herbs up to 45 cm tall; rhizome creeping; culms erect or ascending. Leaves linear, thin or fleshy, flat or convolute, pubescent or glabrous; ligule obtuse, 0.5-3 mm long; sheaths glabrous, scaberulous or retrorsely pubescent. Inflorescence a spiciform panicle, 3.5-12 cm long. Spikelets more or less secund, gaping, pale straw coloured or suffused with purple, 5.5-10 mm long; lower glume ovate, acute, 1-3-veined, rarely 5-veined, 2.5-6.5 mm long; upper glume lanceolate, acute, 5-nerved; lower fertile lemma elliptic, 4-7.5 mm long, acute, 7-9-veined, hairy on dorsal surface; palea oblong, 2-toothed, scaberulous; keel ciliolate.

Frequent on rocky slopes in drier situations in Zanskar, Dras, Leh, Gilgit, Baltistan, Ladakh, Lahul & Spiti.

Fl. & Fr. : May - August.

Distrib. : Middle East from Turkey to Afghanistan, Southern Russia, Pakistan, India, Western Himalaya.

M. secunda Regel in Acta Horti Petrop. 7: 629. 1880; Bor, Grasses 592. 1960.

Rhizomatous perennial herbs up to 60 cm tall; culms slender, erect. Leaves linear, setaceous, flat or convolute, smooth, glabrous; ligule 3.5-

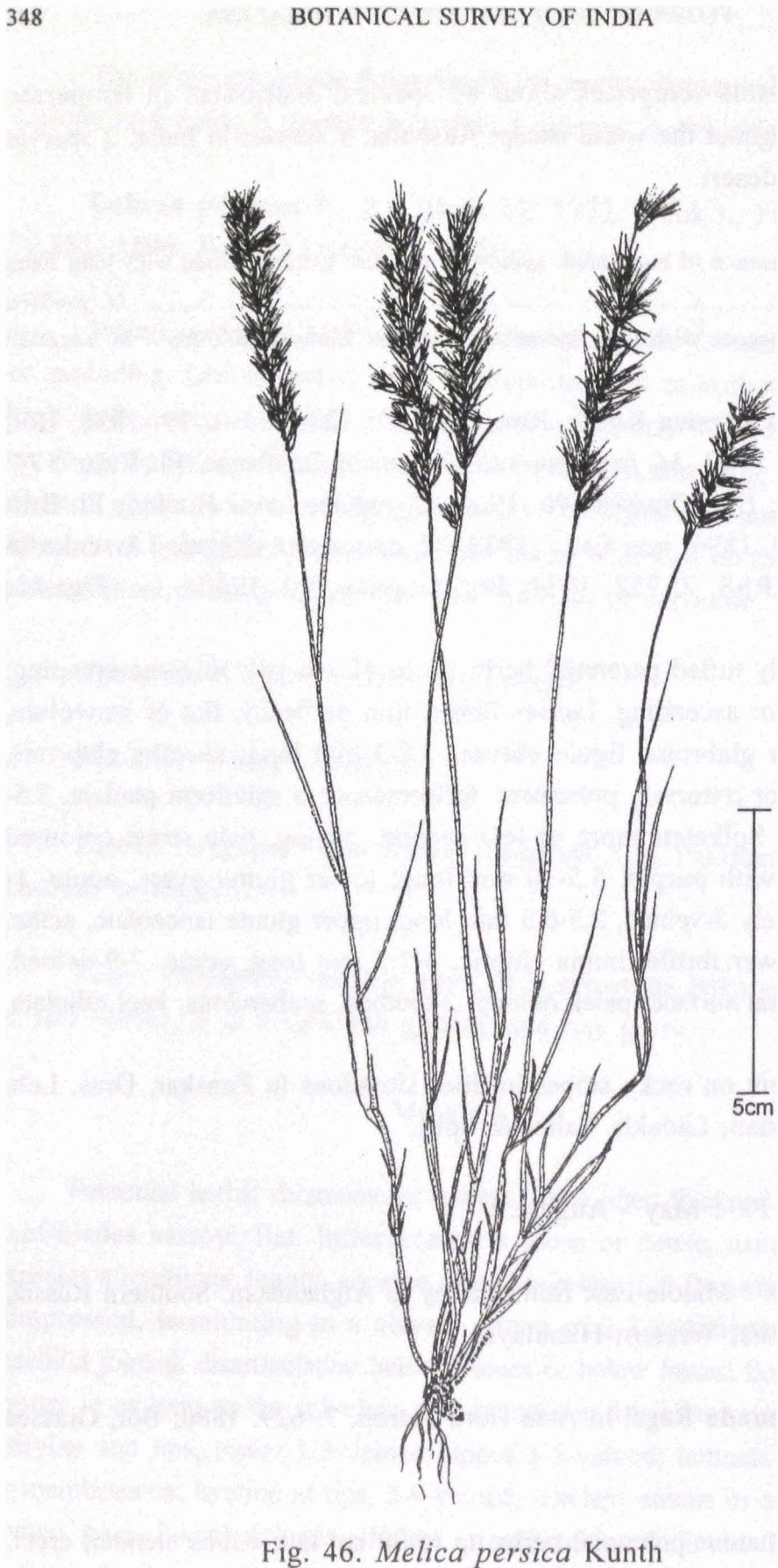


Fig. 46. *Melica persica* Kunth

5 mm long, 2-toothed. Inflorescence a lax, simple or sparingly branched panicle, 10-12 cm long; spikelets distant, secund. Spikelets broadly ovate, 7-8 mm long; with 3 fertile florets separated by internodes; glumes ovate-elliptic, subacute, broadly hyaline on margins and at apex; lower 5-5.5 mm long, the upper 6-6.5 mm long; lemma of fertile floret oblong, 5-5.5 mm long, obtuse or subacute, strongly 7-veined, scaberulous.

Frequent on cliffs and rocky slopes in Zoji La, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Southern Russia, Afghanistan, Pakistan, India, western Himalaya.

MILIUM L.

Annual or perennial herbs. Leaf-blades linear, flat. Inflorescence a loose open panicle. Spikelets ovate or elliptic, dorsally compressed, 1-flowered; rhachilla produced or not; callus very short and obtuse, glabrous. Glumes persistent, subequal, membranous, 3-veined; lemmas elliptic, coriaceous, shorter than to as long as the glumes, acute, shining and hard in fruits, margins not overlapping, without awn; palea coriaceous, 2-veined, without keels, obtuse, almost as long as the lemma; lodicules 2; stamens 3. Grains ovoid or oblong, free within the lemma and palea.

The genus comprises 4 species; distributed in the north temperate zone of the Old World, mostly in Europe and Asia; also in eastern N. America, 1 species in India and also in cold desert.

Milium effusum L., Sp. Pl. 1: 61. 1753; Hook.f., Fl. Brit. India 7: 235. 1896; Bor, Grasses 593. 1960.

Tufted perennial herbs up to 1 m tall; rhizome short; culms erect, smooth shining, leafy. Leaves linear-lanceolate, flat, scaberulous or glabrous; ligule oblong, truncate, lacerate. Inflorescence an effuse, ovate or pyramidal panicle, 10-40 cm long; branches flexuous, capillary, spreading or deflexed,

fascicled or subverticillate. Spikelets pale green or purple, glabrous, 3-4 mm long; glumes ovate or elliptic, subequal, membranous with hyaline margin, 3-veined; lemma oblong or obovoid, dorsally compressed, awnless.

Common in moist situations, grassy places in Ladakh.

Fl. & Fr. : July - August.

Distrib. : N. America, Europe, temperate Asia.

MUHLENBERGIA Schreb.

Slender, annual or perennial herb. Leaf-blades narrow, flat or convolute. Inflorescence an open, contracted or spiciform panicle or the spikelets clustered on the branches; spikelets lanceolate, laterally compressed, rounded or keeled, sometimes hairy, 1-3 flowered, not jointed on their pedicels; rhachilla jointed at the base, disarticulating above the glumes, not produced beyond lemma. Glumes persistent, equal or unequal, 1-veined, rarely 3-veined, sometimes awned or tridentate; lemmas as long as to longer than glumes, terete, membranous, acute obtuse or truncate, entire or bidenticulate, awnless or awned, 3-veined, slightly hairy below the middle; palea oblong, as long as to longer than lemma, 2-veined; lodicules 2, minute. Grains fusiform to elliptic, free within the lemma and palea with adherent pericarp.

The genus comprises about 150 species; mostly in the New World, especially southern USA, Mexico, also in the Himalayas, eastward to Japan; 4 species in India; 2 species in the cold desert.

The genus is allied to *Sporobolus*, from which it can be distinguished on the basis of ligule, caryopsis or 3-veined awned lemma; but all these quite variable characters.

- 1a. Lemma as long as or slightly longer than glumes..... *M. himalayensis*
- b. Lemma twice as long as or longer than glumes *M. huegelii*

Muhlenbergia himalayensis Hack. ex Hook.f., Fl. Brit. India 7: 259. 1896; Bor, grasses 401. 1960.

Tufted perennial herbs up to 45 cm tall; culms slender, decumbent or ascending. Leaves linear-lanceolate, flaccid, scaberulous; ligule oblong, obtuse, about 1 mm long. Inflorescence very narrow, slender, flexuous, nodding, loose, fastigiately branched interrupted panicle, 10-15 cm long. Spikelets, green, glistening, 3-4 mm long; glumes subequal, lanceolate, acuminate or subaristate, 1-veined 2.5-3.5 mm long; lemma as long as glumes or slightly longer, puberulous in the lower part, 3-veined, awn terminal, 1-2.5 cm long.

Common in moist shady places in Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India, Western Himalaya, Western Ghats.

Note : It is quite similar to *M. duthieana* but has more open panicle, longer spikelets, and shorter glumes. It differs from *M. huegelii* by its less robust habit and narrower leaves. It may be of use as a fodder.

M. huegelii Trin. in Mem. Acad. Sci. Petersb., ser. 6. 6(2): 293. 1841; Bor, Grasses 401. 1960. *M. viridissima* Nees ex Steud., Syn. Pl. Glum. 1: 178. 1854; Hook.f., Fl. Brit. India 7: 259. 1896.

Rhizomatous, perennial herbs up to 1 m tall; culms very slender, decumbent and ascending. Leaves linear-lanceolate, flat, smooth or scaberulous; ligule about 1 mm long, obtuse. Inflorescence a nodding, loose, interrupted, flexuous, fastigiately branched, bright green panicle, 15-30 cm long. Spikelets 2-3 mm long, shortly pedicelled; glumes subequal, ovate-lanceolate, acute or obtuse, 1-2 mm long, veinless or 1-veined; lemmas as long as the spikelets, hairy in the lower part, minutely notched at apex, awn from the sinus, 1.5-2.5 cm long.

Common in moist shady places in Gilgit, Baltistan, Kargil, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India, Western Himalaya.

ORINUS Hitchc.

Perennial herbs; rhizomatous. Leaf-blades linear, acuminate, the tip sharp and hard, rounded or truncate at the base, blades flat, finally convolute. Inflorescence a panicle of racemes on a central axis. Spikelets 4-5-flowered, wedge shaped. Glumes membranous, slightly villous or glabrous, acute, subequal, lower 1-veined, upper 3-veined; lemmas lanceolate-oblong, entire, acute to mucronate, pilose all over, keeled, 3-veined, slightly concave between the veins; palea almost as long as the lemma, villous, keeled, keels pilose; lodicules 2. Grains cylindrical.

The genus comprises 2 species; distributed in the Himalayas, Tibet, China; 1 species in India and also in Cold desert.

Orinus thoroldii (Stapf ex Hemsl.) Bor in Kew Bull. 6: 454. 1951; Bor, Grasses 519. 1960. *Diplachne thoroldii* Stapf ex Hemsl. in J. Linn. Soc. 30: 121. 1894. Fig. 47.

Perennial herbs up to 50 cm tall; rhizome creeping, scaly; culms erect, slender, glabrous, clothed with scarious sheaths at the base. Leaves linear, scabrid on the margins, flat or convolute; ligule a lacerate membrane. Inflorescence 10-15 cm long, consists of 4-8 ascending or spreading, sometimes drooping racemes; racemes 2-6 cm long. Spikelets wedge shaped, few-flowered, 6-9 mm long; lower glumes 2.5-5 mm long, membranous, 1-veined; upper glume 3.5-6 mm long, 3-veined; lemma 4.5-5.5 mm long, purplish or blackish, villous; palea villous.

Frequent in dry sandy places in Tsaka, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Nepal, Tibet, India, Western Himalaya from Ladakh.

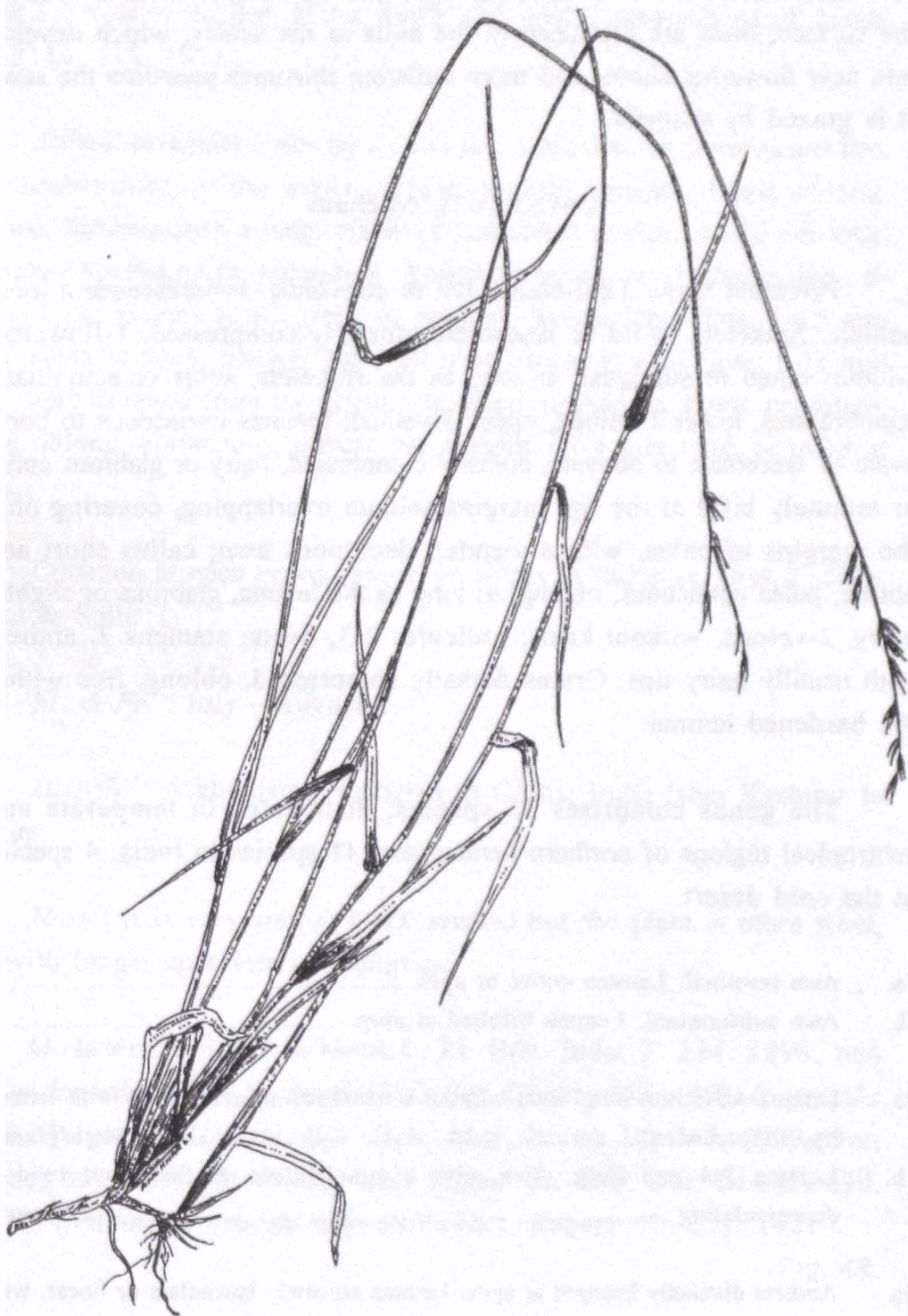


Fig. 47. *Orimus thoroldii* (Stapf ex Hemsl.) Bor

Note : It is important as a sand-binder and stabilizer of shifting sand. The underground network of roots, arising from widely spreading scaly rhizome, radiate in all directions, when the tip of the rhizome reaches the surface, buds are produced in the axils of the scales, which develop into new flowering shoots and more radiating rhizomes penetrate the sand. It is grazed by animals.

ORYZOPSIS A. Michaux

Perennial herbs. Leaf-blades flat or convolute. Inflorescence a loose panicle. Spikelets ovoid or lanceolate, dorsally compressed, 1-flowered. Glumes equal or subequal, as long as the spikelets, acute or acuminate, membranous, lower 1-veined, upper 3-veined; lemmas coriaceous to bony, ovate or lanceolate to obovate, dorsally compressed, hairy or glabrous entire or minutely bifid at the tip, margins seldom overlapping, covering only the margins of palea, with a slender, deciduous awn; callus short and obtuse; palea coriaceous, oblong, as long as the lemma, glabrous or slightly hairy, 2-veined, without keels; lodicules 2-3, ovate; stamens 3, anthers with usually hairy tips. Grains dorsally compressed, oblong, free within the hardened lemma.

The genus comprises 35 species; distributed in temperate and subtropical regions of northern hemisphere; 11 species in India; 4 species in the cold desert.

- 1a. Awn terminal. Lemma entire at apex 2
- b. Awn subterminal. Lemma bilobed at apex 3

- 2a. Lemma 4.5-5 mm long. Awn without a constriction, continuous with lemma tip, subpersistent *O. aequiglumis*
- b. Lemma 3-4 mm long. Awn with a constriction at the base, readily disarticulating *O. munroi*

- 3a. Anthers distinctly bearded at apex. Lemma narrowly lanceolate or linear, with long hairs concealing the lobes *O. lateralis*
- b. Anthers glabrous or with a few hairs at apex, not bearded. Lemma ovate to elliptic, with very short hairs *O. wendelboi*

Oryzopsis aequiglumis Duthie ex Hook.f., Fl. Brit. India 7: 234. 1896; Bor, Grasses 639. 1960. *O. fasciculata* Hack. in Ost. Bot. Z. 52: 10. 1902; Bor, Grasses 639. 1960. *Piptatherum aequiglume* (Duthie ex Hook.f.) Rozhev. in Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk. SSSR 14. 113. 1951.

Tufted, perennial herbs up to 1 m tall, stout. Leaves linear-lanceolate, flat, scaberulous on the upper surface, scabrid beneath; ligule oblong, hyaline. Inflorescence a long, effuse or contracted panicle, 15-30 cm long; branches spreading or ascending. Spikelets ovoid, rarely lanceolate, 6-9 mm long; glumes equal, green or purplish; lemma lanceolate, 5-6.5 mm long, acute at apex, densely hairy all over except at apex; awn 8-11 mm long, long exerted from the glumes, terminal, deciduous, rarely persistent; palea oblong, coriaceous, pubescent; anthers 3.5-4 mm long, bearded at apex.

Common in open grassy places, on slopes in Baltistan, Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan to China; India from Kashmir to Sikkim.

Note : It is very similar to *O. munroi* but the plant is more stout, tall with longer spikelets and lemmas.

O. lateralis Stapf in Hook.f., Fl. Brit. India 7: 234. 1896, non *Milium laterale* Munro ex Regel 1880; Bor, Grasses 640. 1960. *O. gracilis* (Mez.) Pilger in Notizbl. Bot. Gart. Mus. Berlin 14: 346. 1939; Bor, Grasses 639. 1960. *O. brachyclada* Pilger *l.c.* 345; Bor, Grasses 639. 1960. *Piptatherum gracile* Mez in Feddes, Repert. 17: 211. 1921.

Fig. 48.

Densely tufted perennial herbs up to 45 cm tall; culms slender, smooth. Leaves short, filiform flat or usually convolute, acuminate; ligule

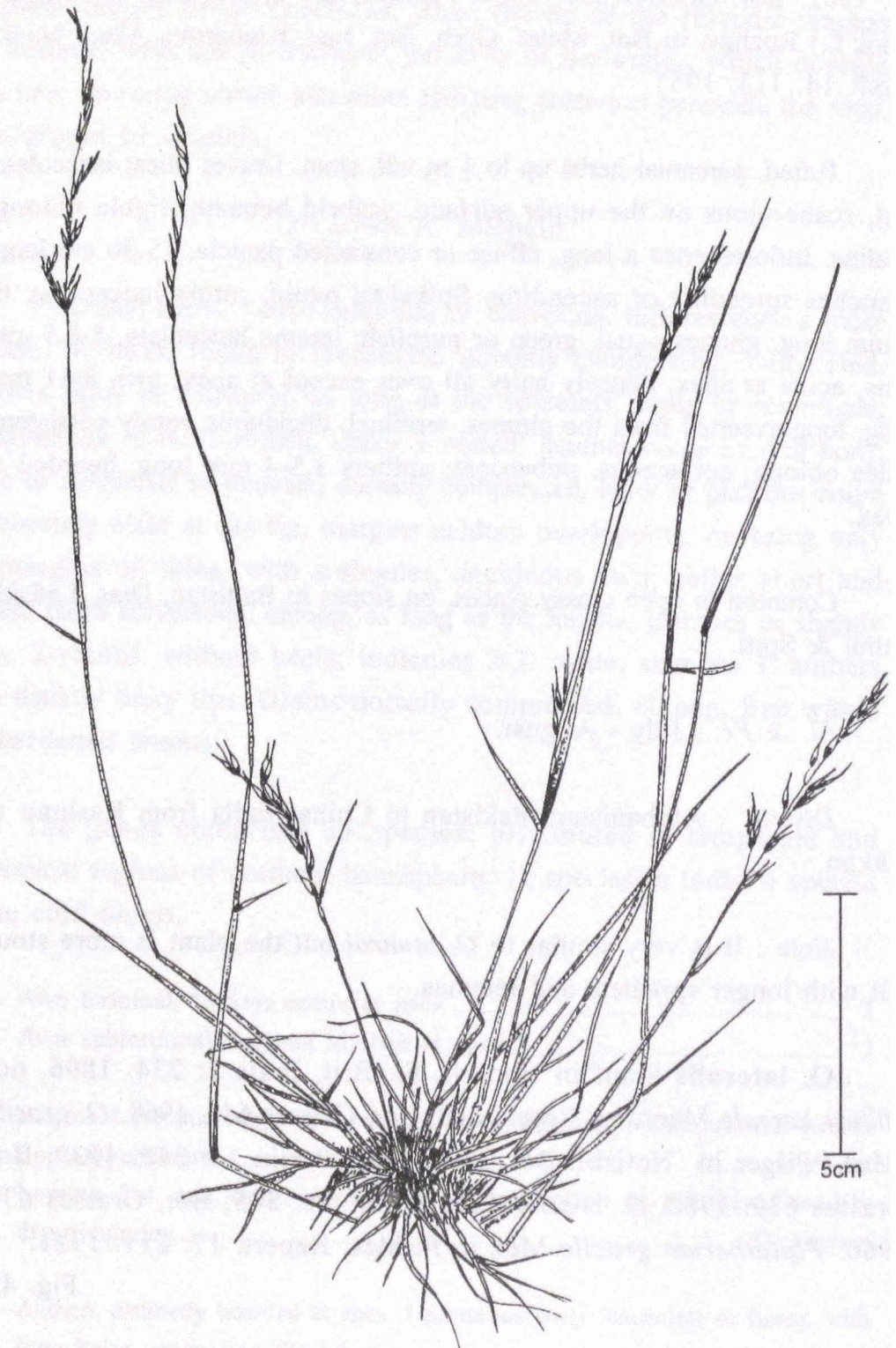


Fig. 48. *Oryzopsis laterelis* Stapf

oblong, hyaline. Inflorescence a narrow, strict, contracted panicle, 10-20 cm long; branches erect or ascending. Spikelets ovoid or ovate-lanceolate, green or tipped with red-purple, 4.5-8 mm long; glumes unequal, lower longer, faintly 3-5-veined; lemma linear-lanceolate, finely subsilkily pubescent, shorter than upper glume, 2-lobed at apex; awn 3-5 mm long, exserted from the glumes, subterminal, deciduous; palea oblong, coriaceous; anthers 1.5-2.5 mm long, tips densely bearded.

Common in open grassy places, alpine meadows in Gilgit, Baltistan, Leh, Dras, Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, Pamirs, Nepal, Tibet, India, Western Himalaya.

Oryzopsis munroi Stapf in Hook.f., Fl. Brit. India 7: 234. 1896; Bor, Grasses 640. 1960. *O. stewartiana* Bor in Kew Bull. 8: 272. 1953; Bor, Grasses 641. 1960. *Piptatherum munroi* (Stapf) Mez in Feddes, Repert. 17: 212. 1921.

Tufted perennial herbs up to 80 cm tall; culms stout or slender. Leaves linear-lanceolate, acuminate, flat, puberulous on the upper surface, glabrous beneath; ligule oblong, hyaline. Inflorescence an effuse panicle, 10-30 cm long; branches spreading or ascending, in distant pairs, filiform. Spikelets ovoid or lanceolate, rostrately acuminate, shortly pedicelled; glumes equal, green or purplish, 4-7 mm long; lemma lanceolate, 3-4 mm long, acute, hairy all over except at apex; awn 6-10 mm long, long exserted from the glumes, almost terminal, deciduous; palea oblong, coriaceous, pubescent; anthers about 2 mm long, tips bearded.

Common in open grassy places, slopes in Gilgit, Baltistan, Nubra, Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Afghanistan, Pakistan to China, India, Western Himalaya.

Note : It is very similar to *O. aequiglumis* but the plant is more slender, smaller in size with smaller spikelets and lemmas.

Oryzopsis wendelboi Bor in Nytt. Mag. Bot. 1: 16. 1952; Bor, Grasses 641. 1960. *O. humilis* Bor in Kew Bull. 6: 445. 1952; Bor, Grasses 639. 1960. *Piptatherum hilariae* Pazij in Bot. Mater. Gerb. Bot. Akad. Nauk. Uzbeksh SSSR 10: 20. 1948.

Tufted perennial herbs up to 45 cm tall. Leaves linear, flat or convolute. Inflorescence a lax or contracted panicle, 10-20 cm long; branches spreading at first, finally erect. Spikelets lanceolate, 4-8 mm long, dorsally compressed, 1-flowered; glumes subequal, as long as the spikelets; lower 5-veined; upper sub-3-veined; lemma ovate or elliptic, 2.5-4 mm long, hairy on the back below apex, 2-lobed at apex, each lobe with a tuft of stiff hairs; awn 2-4 mm long, included or slightly exerted from the glumes, subterminal, caducous; palea oblong, coriaceous, glabrous or hairy, as long as the glumes.

Common on slopes, rocky places, cliffs in Gilgit, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pamir, Pakistan, India, Western Himalaya.

PANICUM L.

Annual or perennial herb. Leaf-blade linear to ovate, flat or convolute. Inflorescence usually a branched panicle, sometimes primary branches condensed, rarely spiciform. Spikelets ovate-elliptic, terete or compressed, articulate on their pedicels, 1-2-flowered. Glumes hyaline to membranous, truncate to awned, unequal, lower smallest; lower lemma usually similar to upper glume, with or without a palea, upper lemma almost equalling the spikelet, crustaceous, clasping the margins of the palea, obtuse to acute or slightly apiculate, hardened in fruits; palea 2-veined, membranous to crustaceous; lodicules 2; stamens 3. Grain oblong, free within the lemma.

The genus comprises more than 470 species; pantropical, extending to temperate regions of N. America; 23 species in India; 1 species in the cold desert.

Panicum miliaceum L., Sp. Pl. 1: 58. 1753; Hook.f., Fl. Brit. India 7; 45. 1896; Bor, Grasses 327. 1960.

Tufted annual herbs up to 1 m tall; culms robust, sparsely to densely hispid, branched, leafy up to the panicle. Leaves linear-lanceolate, cordate to amplexicaul, acuminate; sheaths clothed with long spreading hairs; ligule of long hairs. Inflorescence a narrowly oblong to pyramidal, usually decurved or nodding panicle, 15-35 cm long; branches suberect, filiform, fascicled. Spikelets ovate-oblong cuspidately acuminate; pedicels shorter or longer than spikelets; glumes ovate; lower 5-veined, separated from the rest of the spikelet by a short internode; upper glume 7-11-veined; lower lemma almost as long as upper glume, 7-11-veined; palea reduced to a scale or absent; upper lemma broadly ovate, turgid, 3-5-veined, orange or yellowish shining.

Common as a weed of cultivated fields in Gilgit, Baltistan, Kargil, Leh, Suru, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - September.

Distrib. : Pakistan, India, introduced into Africa, Europe, N. & S. America, Australia, Central and Eastern Asia.

Note : It is also cultivated.

PENNISETUM L.C. Rich.

Annual or perennial herb, habit various. Leaf-blade linear to lanceolate, flat or convolute. Inflorescence spiciform, cylindrical to subglobose, terminal or axillary and then aggregated into a leafy false compound panicle, spikelets subtended by a deciduous involucre of bristles; bristles simple or branched, flexuous, filiform, plumose, free to the base.

Spikelets lanceolate to oblong, dorsally compressed, glabrous or sparsely hairy, 1-2-flowered. Glumes hyaline, lower smallest or sometimes absent, upper 5-veined, smaller to as long as the spikelets; lemma membranous, lower 5-veined, paleate or not, male or neuter, upper coriaceous, articulate at the base, deciduous, margins covering half the palea; stamens 3. Grains oblong, orbicular or pyriform, free within the lemma.

The genus comprises about 80 species in the world; distributed throughout the tropics and subtropics; 16 species in India; 3 species in the cold desert.

- 1a. Rhachis of the spikes glabrous *P. flaccidum*
- b. Rhachis of the spikes pubescent or villous 2
- 2a. Bristles of the involucre branched *P. lanatum*
- b. Bristles of the involucre unbranched *P. orientale*

Pennisetum flaccidum Griseb., Goett. Nachr. 86. 1868; Hook.f., Fl. Brit. India 7: 84. 1896; Bor, Grasses 344. 1960.

Tufted perennial herbs up to 50 cm tall; rhizome creeping, tough; culms branched at the base, erect. Leaves linear, flat or convolute, glabrous or sparsely hairy; sheath ciliate, mouth often bearded. Inflorescence spiciform linear, panicle, 5-20 cm long; involucre enclosing 1-4 spikelets, one of them sessile and bisexual and others shortly pedicelled and male, rarely one, bisexual; bristles glabrous, unbranched, longest 10-20 mm long. Spikelets lanceolate, 4.5-6.5 mm long; lower glume less than half the length of spikelet, subacute; upper glume acute or acuminate, 5-veined; lower lemma male; upper lemma coriaceous, bisexual.

Common in alpine grassy slopes in Gilgit, Baltistan, Lama Yuru, Fotula, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - October.

Distrib. : Afghanistan, Pakistan, Tibet, Southern China, India Western Himalaya.

Note : It is grazed by sheep and goats in the higher alpine slopes.

Pennisetum lanatum Klotzsch in Bot. Erg. Walden Reise 65. t. 99. 1862; Hook.f., Fl. Brit. India 7: 84. 1896; Bor, Grasses 345. 1960.

Tufted, perennial herbs up to 1 m tall; rhizome stout, woody creeping, branched, covered with coriaceous scales; culms erect. Leaves linear or lanceolate, flat, glabrous or hairy. Inflorescence a linear, spiciform panicle, 5-14 cm long; involucre enclosing 2-4-spikelets, each shortly pedicelled; bristles densely to sparsely ciliate, branched. Spikelets lanceolate, 4-5.5 mm long; glumes shorter than spikelets; lower subacute; upper obtuse, 3-veined; lower lemma lanceolate, acuminate, 5-veined, 3-4.5 mm long, male; upper lemma acute, firm, slightly shorter than lower.

Common in open places, sandy waste places in Gilgit, Baltistan, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Afghanistan, Pakistan, Tibet, India, Western Himalaya.

Note : It is useful as soil binder due to its extensive branched rhizomes and root system, which are sent in all directions. It is a valuable and abundant fodder grass.

P. orientale L. C. Rich in Pers., Syn. Pl. 1: 72. 1805; Hook.f., Fl. Brit. India 7: 86. 1896; Bor. Grasses 345. 1960.

Densely tufted perennial herbs, up to 2 m tall; rhizome stout, creeping; culms erect or ascending, woody and often densely fastigiately branched below. Leaves linear, flat or convolute, glabrous or hairy. Inflorescence linear, spiciform panicle, often interrupted, 8-30 cm long; involucre on a slender pubescent stipe 0.5-1.5 mm long, enclosing 1-4 spikelets, one of them sessile, others shortly pedicelled; bristles unbranched, inner plumose, longest 1.5-3 cm long. Spikelets lanceolate, 4.5-6.5 mm long; lower glume 1-1.5 mm long, obtuse or acute, rarely half as long

as spikelets and acuminate, 1-veined; upper glume 2-3.5 mm long, acute or acuminate, 3-veined; lower lemma 4-6 mm long, male, setaceously acuminate, 5-veined; upper lemma similar, aristate, shining.

Common in open grassy places in Baltistan, Gilgit, Zaskar, Leh, Kargil, Ladakh.

Fl. & Fr. : July - October.

Distrib. : North Africa, Arabia to central and S.E. Asia, Pakistan, Nepal, India, Western Himalaya.

Note : Due to its tough, branching rhizome and root-system, useful as soil binder. It is a very variable species ranging from small tufted plants 15-20 cm tall with short panicle to tall robust up to 2 m tall with panicle up to 30 cm long.

PHACELURUS Griseb.

Perennial herbs; rhizomatous. Leaf-blades linear, rarely terete, flat or convolute; ligule membranous. Inflorescence a terminal panicle of flattened, digitate racemes, rarely raceme single, often tardily disarticulating; internodes and pedicels clavate to inflated. Spikelets sessile and pedicelled, flat or convex on the back; callus truncate, with or without a central peg. Glumes membranous to coriaceous, lower 2-keeled, flat on the back, winged or not; lemma hyaline, lower male or neuter, upper entire, without awn. Pedicelled spikelets smaller than sessile, sometimes vestigial or with an elongated callus.

The genus comprises 9 species; distributed in Old World tropics, extending northward to the Mediterranean; 2 species in India; 1 species in the cold desert.

The genus is quite related to *Ischaemum* L.

Phacelurus speciosus (Steud.) C.E. Hubbard in Kew Bull. 1928: 35. 1928; Bor, Grasses 199. 1960. *Andropogon speciosus* Steud., Syn. Pl.

Glum. 1: 375. 1854. *Ischaemum robustum* Hook.f., Fl. Brit. India 7: 139. 1896.

Stout perennial herbs up to 1.5 m tall; rhizome hard; culms erect. Leaves lanceolate, flat, acuminate, sides incurved, midvein prominent, green or glaucous; sheath long, finely pubescent; ligule a ring of hairs. Inflorescence a raceme, solitary or 2-5, subdigitately or racemosely arranged, each 6-15 cm long, internodes and pedicels clavate. Sessile spikelets ovate-lanceolate, acute, coriaceous, 4-6 mm long; lower glume 4.5-8.5 mm long, flat on the back, glabrous to hirsute, ciliate along the margin; lower floret male; upper glume coriaceous, 7-9-veined; lemma 3-veined, male. Pedicelled spikelets shorter than sessile.

Frequent on slopes in Lahul & Spiti.

Fl. & Fr. : July - October.

Distrib. : Afghanistan, Pakistan, Nepal; India, Western Himalaya.

Note : It is a very variable polymorphic species.

PHALARIS L.

Annual or perennial herbs. Leaf-blades linear, flat. Inflorescence a spiciform to capitate panicle. Spikelets laterally compressed, usually 3-flowered with 2 lower florets reduced, disarticulating above the glumes at maturity. Glumes equal or subequal, persistent, exceeding and enclosing lemma, papery, boat-shaped, keeled, keel usually winged, lower lemma bisexual, coriaceous, margins not overlapping, acute, awnless, 3-5-veined; palea coriaceous, 2-veined, without keels; lodicules 2; stamens 3. Grains ovate or oblong, free with in the lemma.

The genus comprises 15 species; distributed in north temperate zone, mainly Mediterranean with a secondary centre in California, also in S. America; 5 species in India; 1 species in the cold desert.

Phalaris arundinacea L., Sp. Pl. 1: 55. 1753; Hook.f., Fl. Brit. India 7: 221. 1896; Bor, Grasses 615. 1960.

Perennial herbs up to 1 m tall; rhizome creeping, covered with scales; culms stout, erect. Leaves lanceolate, acuminate, flat. Inflorescence a thyriform panicle, 10-30 cm long, dense, lobed or interrupted; branches spreading at anthesis otherwise contracted about the main axis. Spikelets 4-5 mm long, densely crowded on the scabrid branchlets; glumes 3.5-7.5 mm long, lanceolate acute, wingless; upper 3-veined; sterile florets 2, 1-2 mm long, villous; fertile floret lanceolate, 2.5-4.5 mm long, dull yellow to brownish, pubescent.

Common along streams, in marshy places in Dras, Ladakh.

Fl. & Fr. : July - August.

Distrib. : North temperate regions, introduced to most part of the world; Pakistan, India, Western Himalaya.

PHLEUM L.

Annual or perennial herbs. Leaf-blades flat. Inflorescence a spiciform, cylindrical or capitate panicle. Spikelets laterally compressed, breaking up above the persistent glumes; rachilla produced or not. Glumes equal or subequal, longer than and enclosing floret, membranous, margins overlapping, 3-veined, keeled, keel often ciliolate, mucronate or awned; lemma hyaline, membranous, truncate or obtuse, 3-7-veined, keeled, mucronate or shortly awned; palea almost as long as lemma; lodicules 2; stamens 3. Grains compressed, free within the lemma and palea.

The genus comprises 15 species in the world; distributed in north temperate regions and S. America; 4 species in India; 1 species in the cold desert.

Phleum alpinum L., Sp. Pl. 1: 59. 1753; Hook.f., Fl. Brit. India 7: 236. 1896; Bor, Grasses 402. 1960.

Perennial herbs up to 45 cm tall; rhizome shortly creeping; culms often loosely tufted, erect or ascending. Leaves linear-lanceolate, gradually shorter upwards, flat; upper sheaths inflated; ligule 1.5-2 mm long, obtuse. Inflorescence broadly cylindrical to ovoid or oblong, usually purplish panicle, 2-5 cm long. Spikelets 3-5.5 mm long; glumes truncate, stiffly ciliate on the keel, scabrid on the sides, awn 1-4 mm long, glabrous or ciliate; lemma 2-3 mm long, 3-5-veined, hyaline, awnless, toothed; palea 2-2.5 mm long.

Common in moist places in alpine meadows in Baltistan, Suru, Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Throughout arctic and alpine regions; Pakistan, India, Western Himalaya.

PHRAGMITES Adans.

Tall, perennial, rhizomatous herb. Leaves cauline, blades linear to lanceolate, flat, deciduous. Inflorescence a large, plumose panicle, dense, silky hairy. bearded at the base of the lowest branches. Spikelets 3-11-flowered, the lowest floret male or barren, the middle ones bisexual, the uppermost reduced; rachilla jointed between the lemma, long silky hairy, not produced beyond the lemmas. Glumes unequal, oblong-lanceolate, 3-5-veined, membranous, persistent; callus linear, plumose; lemmas hyaline, rounded or keeled on the back, lowest longer than glumes, 3-veined, male or neuter, upper subulate-lanceolate, acuminate, 3-veined; palea much shorter than lemma; lodicules 2; stamens 3 or 2 in male floret. Grains oblong terete.

The genus comprises 4 species in the world; cosmopolitan; 2 species in India and also in the cold desert.

- 1a. Leaf-blades smooth beneath, the tip filiform and flexuous. Ligule 1-1.5 mm long *P. australis*
- b. Leaf-blades scabrid beneath, atleast in the upper half, the tip stiff. Ligule up to 0.5 mm long *P. karka*

Phragmites australis (Cav.) Trin. ex Steud., Nom. Bot., ed. 2. 2: 324. 1841. *Arundo australis* Cav. in Anales Hist. Nat. Madrid 1: 100. 1799. *Phragmites communis* Trin., Fund Agrost. 134. 1820; Hook.f., Fl. Brit. India 7: 303. 1896; Bor, Grasses 416. 1960.

Perennial herbs up to 3 m tall; rhizome stout, creeping; culms erect, stout, fistular, leafy up to the panicle. Leaves distichous, linear-lanceolate, tip subulate, filiform and flexuous, margins rough; ligule a ridge of short hairs. Inflorescence a subsecund, inclined panicle, 15-45 cm long, brownish purple; branches slender, smooth, hairy; peduncle often silkily hairy at the base. Spikelets 1.5-2 mm long; glumes spreading in fruits; lower 3-4.5 mm long; uppr 5-9 mm long, acute or apiculate, lowest lemma 8-15 mm long; fertile lemma 9-12 mm long, subaristate; palea much shorter.

Common in open forest, along road, near lakes, in drier situations in Nubra, Spituk, Hemis, Shupka Ladakh, Lahul & Spiti.

Fl. & Fr. : July - October.

Distrib. : Temperate regions of both hemispheres; Pakistan, India, western Himalaya.

P. karka (Retz.) Trin. ex Steud., Nom. Bot. ed. 2. 2: 324. 1841; Hook.f., Fl. Brit. India 7: 3-4. 1896; Bor, Grasses 416. 1960. *Arundo karka* Retz. Obs. Bot. 4: 21. 1786.

Robust perennial herbs up to 5 m tall; rhizome creeping; culms erect. Leaves lanceolate, scabrid beneath, tips attenuate and stiff. Inflorescence a subsecund panicle, 30-50 cm long branches widely spreading. Spikelets 9-12 mm long; lower glume 2-3 mm long; upper glume 4-6 mm long, acute or subacute; lowest lemma 7.5-12 mm long; fertile lemma very narrowly lanceolate, 8.5-11 mm long, 3-veined.

Common in marshy areas, in waste places, along roads, road side ditches in Dras, Gilgit, Baltistan, Ladakh, Lahul & Spiti.

Fl. & Fr. : May - October.

Distrib. : Tropical Africa, Asia, Pakistan, India.

Note : Very variable species.

POA L.

Annual or perennial herbs. Leaf-blades flat or convolute, setaceous, rarely pungent; the basal sheath sometimes thickened into a bulb. Inflorescence a loose or contracted panicle. Spikelets 2-6-flowered, laterally compressed; rachilla jointed at the base and between the lemmas, glabrous or sparsely hairy. Glumes subequal or unequal, herbaceous, 1-3-veined, keeled; lemmas herbaceous or membranous, sometimes margins hyaline, obtuse or acute, deeply concave, keeled on the back, 5-7-veined, keel glabrous or ciliate; callus often bearded with woolly hairs; palea shorter than lemma, 2-keeled, keels scaberulous or ciliolate or smooth; lodicules 2; stamens 3 rarely 1. Grains ovoid-oblong or linear, free or adherent to palea.

The genus comprises about 500 species in the world; cosmopolitan but mainly in the temperate regions extending through the tropics on mountains; 55 species in India; 28 species in the cold deserts.

The genus differs from *Festuca* mainly in its keeled lemma and rounded hilum.

- 1a. Basal sheaths with a bulbous thickening at the base 2
- b. Basal sheaths without any thickening 4
- 2a. Lemma hairy atleast on veins and keels..... *P. bulbosa*
- b. Lemma glabrous 3
- 3a. Inflorescence a contracted panicle 1.5-2 cm long *P. bactriana* var.
..... *glabriflora*
- b. Inflorescence a loose spreading panicle 4-6 cm long *P. bactriana*

- 4a. Lemmas hairy on the dorsal surface between the veins 5
 b. Lemmas glabrous on the dorsal surface between the veins 11
- 5a. Spikelets ovate *P. alpina*
 b. Spikelets oblong, elliptic, lanceolate or wedge-shaped 6
- 6a. Inflorescence a loose spreading panicle 7
 b. Inflorescence a contracted, dense panicle 10
- 7a. Lemmas scabrid on dorsal surface or ciliate on the keel and veins below.
 Ligule 2-3.5 mm long 8
 b. Lemma smooth. Ligule 5 mm long or more 9
- 8a. Slender herb with setaceous basal leaves. Rhachilla joints not conspicuous
 from the side. Upper glume 3-3.5 mm long *P. pagophila*
 b. Robust herb with flat basal leaves. Rhachilla joints very conspicuous from
 side. Upper glume 4.5-5 mm long *P. falconeri*
- 9a. Keel of palea ciliate *P. nepalensis*
 b. Keel of palea ciliate below and scabrid above *P. stapfiana*
- 10a. Lower lemma woolly at base *P. koelzii*
 b. Lower lemma not woolly at base *P. lahulensis*
- 11a. Anthers 2 mm long or more 12
 b. Anthers 1-1.5 mm long 13
- 12a. Inflorescence a contracted panicle with erect branches. Margins of upper
 glume ciliate below *P. tibetica*
 b. Inflorescence a loose panicle with spreading branches. Margins of upper glume
 without cilia *P. pagophila*
- 13a. Callus woolly 14
 b. Callus not woolly 23
- 14a. Ligule up to or less than 1 mm long 15
 b. Ligule more than 1 mm long 16
- 15a. Panicle 2-3 cm long. Glume 1-veined *P. markgrafii*
 b. Panicle 5-15 cm long. Glume 8-veined *P. nemoralis*

- 16a. Keel of palea ciliate below, scabrid above *P. stewartiana*
 b. Keel of palea ciliate or scabrid throughout 17
- 17a. Lower sheaths scabrid *P. trivialis*
 b. Lower sheaths smooth 18
- 18a. Lemmas very broad, rounded on the back or compressed... *P. calliopsis*
 b. Lemmas narrow, not rounded on the back 19
- 19a. Lowest branches of the panicle 3-5-nate 20
 b. Lowest branches of the panicle 2-nate, rarely 3-nate 21
- 20a. Basal leaves setaceous. Lemmas 2.5-3 mm long .. *P. pratensis* ssp. *angustifolia*
 b. Basal leaves broad, flat. Lemmas 3.5-4.5 mm long *P. pratensis*
- 21a. Panicle spreading *P. sterilis*
 b. Panicle narrow 22
- 22a. Plants glaucous *P. glauca* ssp. *litwinowiana*
 b. Plants not glaucous 23
- 23a. Plants with thick stout rhizome. Spikelets elliptic or lanceolate, usually suffused with violet *P. versicolor* ssp. *araratica*
 b. Plants without rhizome. Spikelets wedge-shaped, green or pale green
 *P. sterilis*
- 24a. Keel of palea ciliate below, scabrid above 25
 b. Keel of palea ciliate or scabrid throughout 27
- 25a. Ligule up to 1 mm long. Panicle up to 3 cm long *P. ladakhensis*
 b. Ligule 1.5-6 mm long. Panicle 7-15 cm long 26
- 26a. Ligule erose denticulate. Lower glume 1.5-2.5 mm long, 3-veined. Upper glume 2.5-3 mm long. Lemma 2.5-5 mm long *P. sikkimensis*
 b. Ligule lacerate. Lower glume 2.5-3.3 mm long, 1-veined. Upper glume 3.5-4.5 mm long; lemma 4-5.5 mm long *P. suruana*
- 27a. Keel of palea ciliate 28
 b. Keel of palea scabrid throughout 30

- 28a. Intermediate veins of lemma glabrous. Anthers more than 1 mm long....
 *P. supina*
- b. Lemma hairy on all veins. Anthers less than 1 mm long..... 29
- 29a. Upper and lower florets dissimilar. Anthers 0.2-0.3mm long .. *P. infirma*
- b. All florets simialr. Anthers 0.6-0.8 mm long..... *P. annua*
- 30a. Lemma without any wool at base..... *P. attenuata*
- b. Lemma with sparse wool at base..... 31
- 31a. Plants glaucous. Spikelets elliptic or lanceolate, in contracted crowded panicle
 *P. glauca* ssp. *litwinowiana*
- b. Plants green. Spikelets wedge-shaped, in loose, spreading panicle
 *P. sterilis*

***Poa alpina* L.**, Sp. Pl. 1: 67. 1753; Stapf in Hook.f., Fl. Brit. India 7: 338. 1896; Bor, Grasses 555. 1960.

Densely tufted perennial herbs up to 40 cm tall; culms erect or ascending, clothed at base with fibrous remains of distichous leaf sheaths. Leaves linear-lanceolate, firm, acute, margin rough, flat or plicate, mostly crowded at base; ligule of the lower leaves and surculi (leaf buds) short, ciliolate, truncate, 2-3 mm long, of the upper longer, 3-5 mm long, ovate, denticulate. Inflorescence ovate to pyramidal, lax or dense, compact or spreading panicle, 3-7 cm long; lower branches mostly binate, spreading. Spikelets broadly ovate, 4-7 mm long, 4-6-flowered, tinged with purple; glumes unequal, ovate to elliptic; lower 2.5-4 mm long, 1-3-veined; upper 3-4 mm long, 3-veined; lemmas ovate-oblong, subacute or obtuse, often emarginate, 3.5-5 mm long, ciliate on the keel and marginal veins, little hairy or woolly at base, palea-keel ciliate.

Common in alpine meadows, grassy slopes in Baltistan, Marpo La Dras, Deosai Plains, Matyan, Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - September.

Distrib. : N. America, Europe, Mediterranean region, Middle East to Central Asia, Pakistan, India, Western Himalaya.

Poa annua L., Sp. Pl. 1: 68. 1753; Stapf in Hook.f., Fl. Brit. India 7: 345. 1896; Bor, Grasses 555. 1960

Tufted annual or short lived perennial herb up to 90 cm tall; culms erect or shortly creeping and rooting at base, geniculately ascending, slightly compressed. Leaves linear, flat, flaccid, acute, scaberulous on the margin; ligule ovate or oblong, blunt, shorter in lower leaves, 2-5 mm long. Inflorescence ovate or pyramidal, loose or dense panicle, 3-9 cm long; lower branches usually 2-nate, at length spreading or deflexed. Spikelets crowded, sessile or shortly pedicelled, ovate or oblong, pale green, or purplish, 3-10 mm long, 3-7-flowered; glumes oblong-lanceolate, obtuse; lower 1.5-3 mm long, 1-veined; upper 2-4 mm long, 3-veined; lemma elliptic-oblong, 2.5-4.5 mm long, obtuse, 5-veined, margin and apex scarious, keels and veins sparsely to densely ciliate, no wool at base; palea-keel long ciliate, anther 0.5-0.8 mm long.

Common in alpine meadows; grassy places, slopes in Leh, Baltistan, Nubra valley, Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - September.

Distrib. : Cosmopolitan in cold and temperate regions.

Note : Very variable; true annuals and subperennials have a very different facies. Occasionally flowering specimens are found in plains in the cold weather, the plants do not survive in hot weather and places. The plant is quite similar to *P. supina* Schrad. but differs in its shorter anther.

P. attenuata Trin. in Mem. Acad. Sci. Petersb. Sav. Etrang. 2: 327. 1835 et in Bunge, Verg. Suppl. Fl. Alt. 9. 1836.

Tufted perennial herbs, up to 50 cm tall; culms erect. Leaves linear, folded or setaceous, involute, scabrid on the margins; ligule blunt, 1.5-2.5 mm long. Inflorescence an oblong, contracted panicle, 2.5-9 cm long; branches solitary or paired, ascending, scabrid. Spikelets ovate-elliptic, 4-5 mm long, 2-4-flowered, tinged with purple; glumes unequal, ovate,

3-veined; lower 2.5-3 mm long; upper broader, 3-3.5 mm long; lemmas oblong, 2.5-3 mm long, acute or subacute, ciliate on the keel and veins, no wool at base; palea scabrid on the keel.

Common on grassy slopes in Gilgit, Baltistan, Burji La, above Skardu, Leh, Khardong La, Zanskar, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Siberia, Mongolia, Central Asia; Pakistan, India, Western Himalaya.

Poa bactriana Rozhev. in Bot. Mater. Gerb. Glavn. Bot. Sada 4: 93. 1923; Bor, Grasses 556. 1960. ssp. ***bactriana***

Tufted perennial herbs up to 60 cm tall; culms erect or ascending, covered at base with hardened remains of old leaf-sheaths, forming a bulbous shape. Leaves mostly basal, linear, flat or convolute, long acuminate, scabrid on the margins; ligule blunt, 1.5-3 mm long. Inflorescence an oblong or pyramidal, somewhat dense or often loose and interrupted panicle 2-10 cm long; branches 2-3-nate at the lower nodes, ascending. Spikelets ovate-elliptic, 3.5-7 mm long, 2-5-flowered, green or tinged with purple; glumes subequal, 2-3 mm long; lower 1-veined; upper broader, 3-veined; lemmas elliptic-lanceolate, 2-3.5 mm long, glabrous, no wool at base; palea scabrid on the keels, anthers usually 1.5-2 mm long.

Occasional on grassy slopes along roadside in Baltistan, Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : April - June.

Distrib. : Southern Russia, Afghanistan, Pakistan, India, Western Himalaya.

P. bactriana Rozhev. ssp. ***glabriflora*** (Rozhev. ex Ovcz.) Tzvelev

in Nov. Sist. Vyssh. Rast. 1973. 96. 1973. *P. glabriflora* Rozhev. ex Ovcz. in Izv. Tadzhik. Bazy Bot. 1: 10. 14. 1933; Bor, Grasses 557. 1960.

Tufted perennial herbs up to 35 cm tall; culms erect or ascending, swollen at base due to hardened remains of leaf-sheaths. Leaves mostly basal, linear, flat or folded, scabrid on margins; ligule blunt 1.5-2 mm long. Inflorescence a dense, contracted panicle, 2-5 cm long. Spikelets ovate-elliptic, 3-5 mm long, 2-4-flowered, green or tinged with purple; glumes subequal, transparent, 2-3 mm long; lower 1-veined; upper 3-veined; lemmas 2-2.5 mm long, glabrous, no wool at base; palea scabrid on the keel; anthers 0.5-1 mm long.

Occasional in grassy places, roadside ditches, sandy places in Gilgit, Baltistan, Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - July.

Distrib. : Southern Russia, Central Asia; Pakistan, India, Western Himalaya.

Poa bulbosa L., Sp. Pl. 1; 70. 1753; Stapf in Hook.f., Fl. Brit. India 7: 338. 1896; Bor, Grasses 556. 1960.

Densely tufted perennial herbs up to 40 cm tall; culms erect or geniculately ascending, swollen at base with hardened remains of leaf-sheaths. Leaves mostly basal, linear, acute, flat, gradually shorter above; ligule ovate or oblong, acute, 1-3 mm long. Inflorescence an ovate or oblong, contracted, lobed panicle, 3-6 cm long; lower branches 2-nate. Spikelets ovate-oblong, shortly pedicelled or sessile, 3-6 mm long, 4-7-flowered, pale green, sometimes tinged with purple; glumes subequal, broadly ovate, 2-3 mm long lower acute, margin broadly hyaline, often denticulate, 1-3-veined; upper larger, acuminate, 3-veined; lemmas oblong, acute, 2.5-3.5 mm long; upper hyaline, silky hairy or slightly woolly below middle; palea scabrid on the keel.

Common in alpine meadows, moist grassy places in Zanskar, Gilgit, Baltistan, Matyan, Nubra, Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - July.

Distrib. : Temperate Europe, Asia, Pakistan, India western Himalaya.

Note : Spikelets often show vivipary when the glumes and lemma develop into miniature plant. In this case the lemmas are without wool at base.

Poa calliopsis Litw. ex Ovcz. in *Izv. tadjhik. Bazy Bot.* 1: 11. 18. 1933; Bor, *Grasses* 556. 1960.

Perennial herbs up to 15 cm tall; rhizomatous; culms erect, covered at base with fibrous remains of old leaf-sheaths. Leaves linear, acute, flat or folded; ligule blunt, 1.5-2 mm long. Inflorescence an oblong or pyramidal panicle 2-4.5 cm long; spikelets crowded at the tip of branches; branches solitary or paired, erect or flexuous, capillary, ultimately spreading or deflexed, smooth or scaberulous. Spikelets ovate elliptic, 3.5-4 mm long, 2-3-flowered, variegated with yellow and purple; glumes subequal, elliptic or ovate, 2.5-3 mm long; lower 1-3-veined; upper broader, 3-veined; lemmas purple with golden yellow tip, oblong, rounded at apex, 3-3.5 mm long, ciliate on the keel and veins, with copious wool at base; keel of palea smooth below and with a few teeth above.

Common at high altitude on slopes, grassy places in Baltistan, Shyok valley, Rupshu, Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Central Asia; Tibet, India western Himalaya.

P. falconeri Hook.f., *Fl. Brit. India* 7: 342. 1896; Bor, *Grasses* 556. 1960.

Perennial herbs up to 70 cm tall; culms loosely tufted, ascending, covered at base with remian of old leaf sheaths. Leaves linear-lanceolate,

flaccid, glabrous or scaberulous, flat or slightly plicate, upper leaves almost equalling their sheaths; lower sheath lax, upper sheaths adpressed; ligule 2.5-4 mm long. Inflorescence a narrow, lax panicle, 6-10 cm long, flexuous and flaccid; lower branches 2-nate, flexuous. Spikelets oblong-elliptic, 7-8 mm long, 2-3-flowered, green or purplish; florets widely diverging at maturity; lower glumes oblong-lanceolate, acute, margin broadly hyaline, 1-veined, 3.5-4 mm long; upper glume ovate-oblong, acute, 4.5-5 mm long, 3-veined; lemmas oblong or elliptic, acute, 4-5 mm long, pubescent at the base, ciliate on the keel, no wool at base, keel of palea serrulate.

Occasional in grassy places alpine meadows in Ladakh and Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India, Western Himalaya.

Poa glauca Vahl subsp. **litwinowiana** (Ovcz.) Tzvelev in Nov. Sist. Vyssh. Rast. 1974 : 32. 1974. *P. litwinowiana* Ovcz. in Izv. Tadzhik. Bazy Bot. 1: 22. 1933; Bor, Grasses 558. 1960.

Tufted perennial herbs up to 25 cm tall; culms erect, glaucous. Leaves linear, acute, stiff, scabrid on the margins, scaberulous, glaucous; ligule blunt or acute, ultimately lacerate, 2.5-3 mm long. Inflorescence a narrow, contracted panicle, 2-4 cm long; branches 2-nate, scabrid, ascending. Spikelets wedge-shaped, 3-4 mm long, 2-3-flowered, tinged with purple; glumes elliptic, 3-veined; lower 2.5-3 mm long; upper broader, 3-3.5 mm long; lemmas oblong, obtuse, 3.5-4 mm long, ciliate on the keel and veins, slightly woolly at base; keel of palea coarsely scabrid.

Occasional in grassy meadows at high altitude in Baltistan, Gilgit, Zaskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - July.

Distrib. : Central Asia, Russia, Tibet, Pakistan, India, Western Himalaya.

Poa infirma H.B.K. Nov. Gen. Sp. 1: 158. 1816; Bor, Grasses 557. 1960. *Catabrosa thomsoni* Hook.f., Fl. Brit. India 7: 311. 1896.

Tufted annual or short-lived perennial herbs up to 15 cm tall; culms slender, erect, somewhat compressed. Leaves linear, acute, flat; ligule broadly ovate, rounded, 2.5-3 mm long. Inflorescence an ovate, erect, open, lax-flowered panicle, 2-10 cm long; branches paired or solitary, spreading or deflexed, filiform, with few spikelets. Spikelets oblong or ovate, 2-4 mm long, pale green, 2-5-flowered; florets widely spaced; lower glume ovate, 1-1.5 mm long, 1-veined; upper glume elliptic or oblong, 1.5-2.5 mm long, 3-veined, lateral veins shorter; lemmas oblong, 2-2.5 mm long, faintly 5-veined, hairy on the keel, no wool at base; palea 2-fid, long hairy on the keel.

Rare in alpine meadows, grassy places in Nubra, Ladakh.

Fl. & Fr. : April - June.

Distrib. : S. America, S. Europe, Mediterranean regions, Pakistan, India, Western Himalaya.

P. koelzii Bor in Kew Bull. 3: 139. 1948; Bor, Grasses 557. 1960.

Densely tufted perennial herbs up to 10 cm tall; culms erect, green or glaucous, covered at base with scarious leaf-sheaths. Leaves linear, acute, stiff, folded, scabrid; ligule rounded, 1-3 mm long. Inflorescence a contracted panicle 1-2.5 cm long; branches usually in pairs, short, erect, scabrid. Spikelets elliptic-lanceolate, 4-6 mm long, 2-5-flowered, variegated with green and purple; glumes elliptic-lanceolate, 3-veined; lower 2-3 mm long; upper broader, 2.5-3.5 mm long; lemmas elliptic-oblong, obtuse, 3-3.5 mm long; ciliate on the keel and veins, hairy between the veins below, slightly woolly at base in lower lemma; keel of palea ciliate below, scabrid above.

Rare in grassy places at high altitude in arid conditions in Tsakzhun Tso, Tso Kyand, Rupshu, Ladakh, Lahul & Spiti.

Fl. & Fr. : July.

Distrib. : India, Ladakh, J. & K. (Endemic).

Poa ladakhensis Hartm. in *Candollea* 39: 510. 1984.

Tufted perennial herbs up to 15 cm tall; rhizome sheathed; culms erect or ascending; sheaths sub-swollen. Leaves linear setaceous, convolute, minutely denticulate on the margin; ligule round, shortly acute, fimbriate, about 1 mm long. Inflorescence a lax, laterally pyramidal panicle, 3 cm long; branchlets papillose or scabrid. Spikelets 4-7 mm long, lanceolate, usually 3-flowered; glumes subequal ovate-elliptic, acuminate, purple; lower 1.5-2 mm long, 1-veined, rarely 3-veined; upper 2-2.7 mm long, 3-veined; lemmas oblong-elliptic, glabrous, 5-veined, 3-3.5 mm long, veins violet, margin scarious towards apex, yellowish; palea lanceolate; keel glabrous towards apex, minutely scabrid below; anthers 0.7-1.2 mm long.

Rare along streams in Stock Phu, Indus valley Ladakh.

Fl. & Fr. : July - August.

Distrib. : India, Ladakh, J. & K. (Endemic).

P. lahulensis Bor in *Kew Bull.* 3: 138. 1948; Bor, *Grasses* 558. 1960. Fig. 49.

Tufted perennial herbs up to 30 cm tall; culms erect, covered at base with remains of old leaf-sheaths. Leaves linear, acute, flat, scabrid; ligule truncate, 2-4 mm long. Inflorescence a contracted panicle, 2-5 cm long; branches short, 2-3-nate, ascending, scabrid. Spikelets elliptic, ultimately wedge-shaped, 4-7 mm long, 2-4-flowered; tinged with purple; glumes oblong-elliptic, 3-veined; lower 2.5-3.5 mm long; upper broader, 3-4 mm long; lemmas oblong, obtuse, 3.5-4.5 mm long, ciliate on the keel and veins, hairy between veins, no wool at base; keel of palea shortly hairy below, scabrid above.

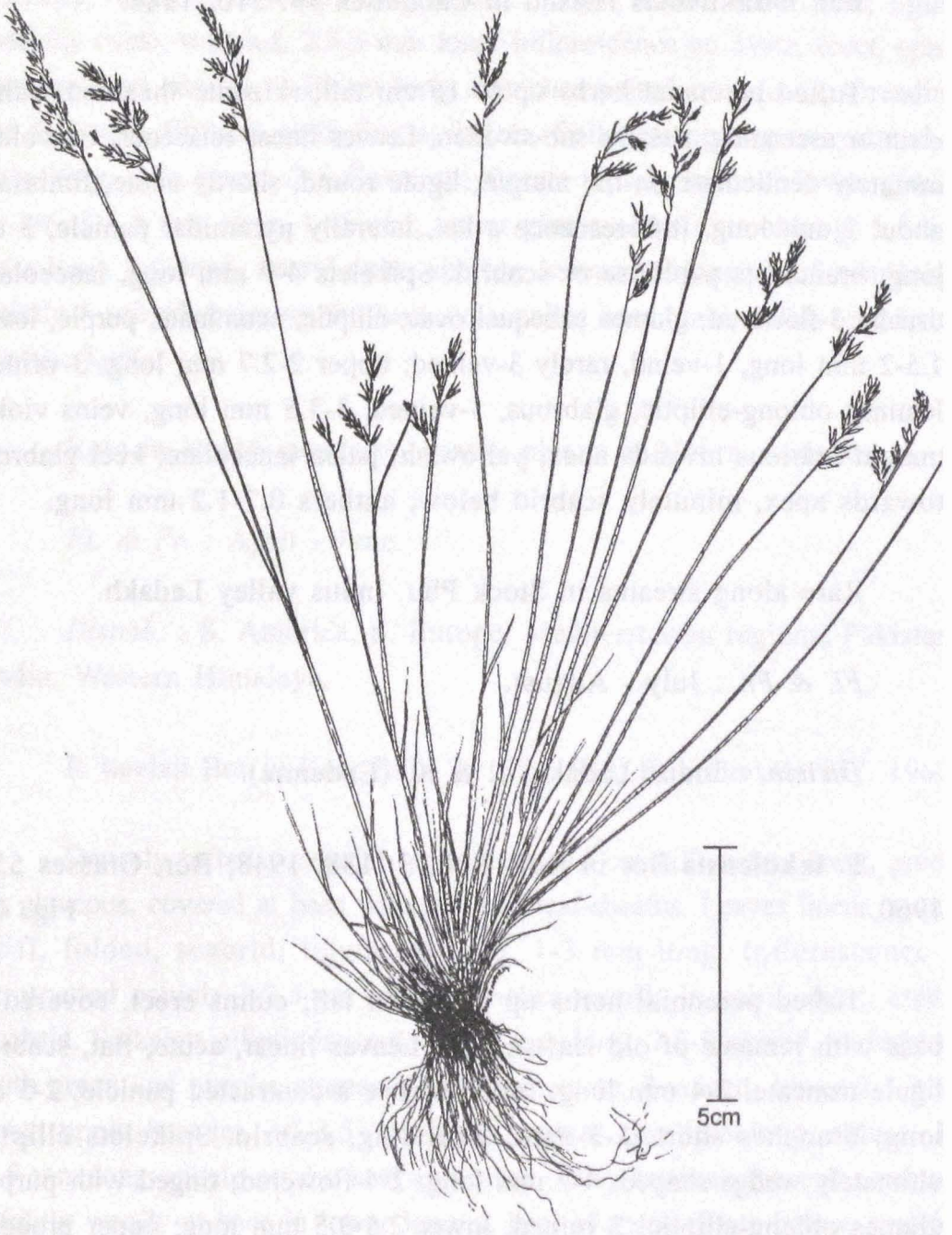


Fig. 49. *Poa lahulensis* Bor

Common in alpine meadows, grassy places in Gilgit, Baltistan,

Fl. & Fr. : June - September.

Distrib. : Pakistan, India, Western Himalaya.

Note : This species is quite similar to *P. attenuata* differing only in hairy lemma. In the latter species lemmas are not hairy between the veins.

Poa markgrafii Hartm. in *Candollea* 39: 514. 1984.

Tufted perennial herbs up to 15 cm tall, glaucous; culms erect or ascending. Leaves linear, setaceous, convolute or flat, glabrous, margin denticulate; ligule about 1 mm long, truncate. Inflorescence a contracted panicle, 2-3 cm long; branches short, straight, minutely denticulate. Spikelets ovate-elliptic, 2.5-5 mm long, 1-3-flowered; lower glume ovate-lanceolate, glabrous; 1.5-2.5 mm long, 1-veined, margin scariosus; upper glume broadly elliptic, broadly scariosus at the margin, 2-3 mm long, 3-veined, often purple; lemmas broadly elliptic or ovate, 5-veined, 2.5-3 mm long, curled woolly, scabrid on veins, suffused with purple; keel of palea with curved spines; anthers 1.4-1.9 mm long.

Rare along Chellong Nullah, Panikhar, Suru Valley, Ladakh.

Fl. & Fr. : July - August.

Distrib. : India, Ladakh, J. & K. (Endemic).

P. nemoralis L., *Sp. Pl.* 1: 69. 1753; Stapf in *Hook.f., Fl. Brit. India* 7: 341. 1896; Bor, *Grasses* 558. 1960.

Loosely tufted perennial herbs up to 60 cm tall; culms erect, rigid or flaccid, smooth or scaberulous above, with leaf buds (surculi) at base. Leaves linear, firm or flaccid, finely to abruptly pointed, flat, plicate or involute, erect or spreading; ligule truncate, often denticulate, 1-1.5 mm

long. Inflorescence a lax, narrowly ovate, contracted or open, rigid, flexuous or flaccid panicle, 5-15 cm long; branches solitary or 2-3-nate, slender, erect or spreading, scaberulous. Spikelets pedicelled, lanceolate-ovate, 3-5 mm long, 2-4-flowered, green or variegated; lower glumes ovate lanceolate, acuminate, 2-3 mm long, margins hyaline, 3-veined; upper broader, 2.5-3.5 mm long; lemmas oblong-lanceolate, 2.5-3.5 mm long, sub-obtuse, ciliate on the keel at base; occasionally woolly at base; keel of palea scaberulous.

Common in alpine meadows, grassy places, on rocky slopes in Gilgit, Baltistan, Rupshu, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : N. America, Europe, temperate Asia, Pakistan, India Western Himalaya.

Note : It is a shade loving or shade tolerant grass. Stapf *l.c.* has recognised plants with longer ligule as var. *ligulata*.

Poa nepalensis Wall. ex Duthie, Grasses N.W. India 40. 1883; Bor, Grasses 558. 1960. *P. annua* L. var. *nepalensis* Griseb. in Nachr. Ges. Wiss. Gottingen 1868: 75. 1868; Stapf in Hook.f., Fl. Brit. India 7: 346. 1896.

Perennial herbs up to 50 cm tall; rootstock creeping, stoloniferous; culms erect or ascending. Leaves linear, flaccid, acute, flat, scabrid; ligule truncate, 0.5-1.5 mm long. Inflorescence an ovate or pyramidal, loose panicle, 7-15 cm long; branches capillary, spreading or deflexed. Spikelets pedicelled, distant ovate or elliptic, 3.5-4 mm long, 3-4-flowered, glaucous green or whitish; lower glume lanceolate-ovate, acute, 1.5-2 mm long, 1-veined; upper glume ovate, 2-2.5 mm long, 3-veined; lemmas oblong-elliptic, obtuse 2.5-3 mm long, densely ciliate on the keel and veins, copious wool at base; keel of palea long ciliate.

Common in alpine meadows, grassy plains, along road in Lahul & Spiti.

Fl. & Fr. : April - June.

Distrib. : India, Western Himalaya.

Poa pagophila Bor in Kew Bull. 4: 239. 1949; Bor, Grasses 558. 1960. *P. flexuosa sensu* Stapf in Hook.f., Fl. Brit. India 7: 342. 1896 *non* J.E. Sm. 1800 *nec* Wahlb. 1814.

Loosely tufted perennial herbs up to 40 cm tall; culms erect, slender, stoloniferous, covered at base with scarious remains of old leaf-sheaths; often with geniculately ascending branches. Leaves linear, acute or acuminate, flat or folded, flaccid or firm, scabrid; ligule ovate, blunt, 1.5-3.5 mm long. Inflorescence a pyramidal, lax, erect or inclined panicle, 5-10 cm long; lower branches 2-nate or solitary, capillary, flexuous, spreading or deflexed. Spikelets pedicelled, ovate-elliptic, 4.5-5.5 mm long, green, suffused with purple, 2-3-flowered; lower glume oblong-lanceolate, subobtuse or subacute, margins broadly hyaline, 2.5-3 mm long, 1-3-veined; upper glume ovate-oblong, 3-3.5 mm long, subobtuse, 3-veined, lateral veins often short; lemmas broadly oblong, 3.5-4.5 mm long, blunt, hyaline, ciliate on the keel and veins, silky hairy at base, wool at base scanty or absent; keel of palea scabrid.

Common in alpine meadows, grassy plains and slopes in Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : N. temperate and Arctic regions, Tibet, Pakistan, India from Kashmir to Sikkim.

P. pratensis L., Sp. Pl. 1: 67. 1753; Stapf in Hook.f., Fl. Brit. India 7: 339. 1896; Bor, Grasses 559. 1960. *P. jaunsarensis auct non* Bor 1948. ssp. **pratensis**

Tufted perennial herbs up to 50 cm tall; green; rhizomatous, stoloniferous; culms erect or ascending. Leaves mostly basal, shorter than

culms, linear, acute, flat or folded; ligule blunt, 1-2 mm long, usually decurrent on the sheath-margin. Inflorescence ovate-oblong or pyramidal, loose and open or contracted and dense, erect or nodding panicle 6-12 cm long; lower branches 3-5-nate, erect or spreading, flexuous, scaberulous. Spikelets pedicelled, ovate, 4-6 mm long, 2-5-flowered, crowded, green; lower glume ovate-lanceolate, acute, 1.5-3.5 mm long, margin hyaline, denticulate, 1-3-veined; upper glume ovate or elliptic, 2-4 mm long, 3-veined; lemmas oblong or ovate, acute, 3-4 mm long, ciliate on the keel and veins, copious wool at base; keel of palea scabrid-serrate.

Common in alpine meadows and pastures in Gilgit, Dras, Baltistan, Nubra, Leh, Rupshu, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Throughout temperate regions of the Old World.

Note : It is a good fodder grass and makes good hay.

***Poa pratensis* L. ssp. *angustifolia* (L.) Gaud.**, *Agrost. Helv.* 1: 214. 1811. *Poa angustifolia* L., *Sp. Pl.* 1: 67. 1753; Bor, *Grasses* 555. 1960. *P. pratensis* L. var. *angustifolia* (L.) J.E. Sm., *Fl. Brit.* 105. 1800; Hook.f., *Fl. Brit. India* 7: 340. 1896.

Tufted perennial herbs up to 70 cm tall; greyish green; rhizomatous, stoloniferous; culms erect or ascending. Leaves setaceous, bristle like, mostly basal, almost as long as culms, upper shorter; ligule blunt, 2-2.5 mm long, not decurrent. Inflorescence ovate-oblong, loose and open or contracted and dense panicle, 6-20 cm long; lower branches 3-5-nate, erect or spreading, flexuous, scaberulous. Spikelets pedicelled, ovate, 2.5-5 mm long, 2-5-flowered, green; lower glume ovate lanceolate, acute, 1.5-3.5 mm long, margin hyaline, 1-3-veined; upper glume ovate or elliptic, 2-4 mm long, 3-veined; lemmas oblong or ovate, acute, 2-3 mm long, ciliate on the keel and veins, copious wool at base; keel of palea scabrid.

Common in alpine meadows, pastures in Gilgit, Baltistan, Dras, Nubra, Rupshu, Leh, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Throughout Europe, temperate Asia, widely introduced elsewhere; Pakistan, India, Western Himalaya.

Poa sikkimensis (Stapf) Bor, in kew Bull. 7: 130. 1952; Bor, Grasses 560. 1960. *P. annua* L. var. *sikkimensis* Stapf in Hook.f., Fl. Brit. India 7: 346. 1896.

Tufted perennial herbs up to 30 cm tall; culms erect or ascending, with leaf-buds (surculi) at base, often clothed at base with scarios remains of old leaf-sheaths. Leaves linear, acute, contracted at base, flaccid, flat or folded; ligule erose denticulate, 2.5-6 mm long. Inflorescence a pyramidal or oblong panicle, 7-15 cm long; branches slender, capillary, flexuous, ascending, spreading or deflexed. Spikelets oblong, 4-6 mm long, 3-5-flowered, suffused with purple; lower glume lanceolate-elliptic, 1.5-2.5 mm long, 3-veined; upper glume obovate-elliptic, 2.5-3 mm long, 3-veined, margin denticulate; lemma elliptic, 2.5-3 mm long, blunt, ciliate on the keel, occasionally marginal veins also ciliate, no wool at base; keel of palea ciliate below, scabrid above.

Rare in grassy places in Leh, Dras Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : India from Kashmir to Sikkim.

P. stapfiana Bor in Kew Bull. 4: 239. 1949; Bor, Grasses 560. 1960. *P. tremula* Stapf in Hook.f., Fl. Brit. India 7: 344. 1896, *non* Lam 1791.

Stoloniferous perennial herbs up to 50 cm tall; culms erect or ascending from a prostrate rooting base. Leaves linear, acute, flaccid, flat or plicate, scabrid on the margins; ligule oblong, blunt, 2.5-5 mm long. Inflorescence a pyramidal, loose, flaccid panicle, 10-25 cm long; branches solitary or 2-nate, capillary, flexuous. Spikelets distant, oblong, 4-6 mm long, green or glaucous, 3-6-flowered; lower glume oblong-lanceolate, acute

or acuminate, margin hyaline, 2.5-3.5 cm long, usually 3-veined; upper glume oblong to oblanceolate, acuminate, 3-4.5 mm long, 3-veined; lemmas oblong, 3-4.5 mm long, subacute, ciliate on the keel and veins, hairy between the veins, copious wool at base; keel of palea ciliate below, scabrid above.

Occasional in open grassy places in Ladakh and Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India, Western Himalaya.

Poa sterilis M. Bieb., *Fl. Taur.-Cauc.* 1: 62. 1808; Bor, *Grasses* 560. 1960. *P. attenuata sensu* Hook.f., *Fl. Brit. India* 7: 340. 1896. *pro. part., non* Trin. 1835.

Tufted perennial herbs up to 30 cm tall; culms erect, rigid. Leaves linear, sharp pointed, flaccid, flat or convolute; ligule ovate, truncate, 1.5-3 mm long. Inflorescence a narrow, few spiculate panicle, 7-15 cm long; branches 2-3-nate, ascending, flexuous, scabrid. Spikelets broadly wedge-shaped, 4-6 mm long, greenish or pallid and tinged with yellow or brown, 3-4-flowered; glumes subequal, elliptic to lanceolate, 3-4 mm long, 3-veined; lemmas oblong, obtuse, 2.5-4 mm long, ciliate on the keel and veins, scanty or no wool at base; palea finely pectinate along the keel.

Occasional in grassy places, pastures, alpine meadows in Gilgit, Zoji La, Baltistan, Zanskar, Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Caucasus, Southern Russia, Pakistan, India, Western Himalaya.

Note : It is a good fodder grass.

P. stewartiana Bor in *Kew Bull.* 6: 185. 1951; Bor, *Grasses* 561. 1960.

Slender annual herbs up to 60 cm tall; culms erect or geniculately ascending. Leaves linear, acute, rounded at base, flaccid, flat, scaberulous on margins; ligule blunt, 1-3 mm long. Inflorescence a pyramidal, lax, nodding panicle, 10-20 cm long; branches paired, erect, spreading or deflexed, scaberulous. Spikelets elliptic, ultimately broadly wedge-shaped, 3-5 mm long, green, 3-4-flowered; lower glume awl shaped, 2.5-3 mm long, 1-veined; upper glume elliptic or oblong, 2.5-4 mm long, 3-veined; lemmas oblong elliptic, 2.5-3.5 mm long, subacute, ciliate on the keel and veins or only on keel, copious wool at base; keel of palea ciliate below, scabrid above.

Occasional in alpine pastures in Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India Western Himalaya.

Poa supina Schrad., Fl. Germ. 1: 289. 1806; Bor, Grasses 561. 1960.

Tufted perennial herbs up to 25 cm tall; culms shortly creeping decumbent at base. Leaves linear, acute, flaccid, scabrid on margins, usually flat; ligule blunt, 1-1.5 mm long. Inflorescence a pyramidal, loose panicle, 2-3 cm long, spikelets usually crowded towards tip of branches; branches solitary or paired, lower widely spreading. Spikelets ovate, 3.5-5 mm long, 4-6-flowered, often tinged with purple; lower glumes oblong, 1.5-1.7 mm long, 1-veined; upper glume elliptic, 2-2.5 mm long, 3-veined; lemmas elliptic or oblong-ovate, 2.5-3.5 mm long, obtuse, ciliate on the keel and veins, no wool at base; keel of palea ciliate; anthers 1.5-2 mm long.

Common in grassy plains, slopes, roadside ditches in Gilgit, Baltistan, Skardu, Ladakh.

Fl. & Fr. : June - July.

Distrib. : Europe, Russia, Pakistan, India, Western Himalaya.

Note : This species is very similar to *P. annua* but differs in its longer anthers and spikelets crowded towards tip of branches. Frohner (Bot. Jb. 88: 437. 1968) treated Asiatic species distinct from European *P. supina* and treated them as *P. ustulata*. However the distinguishing characters not only overlap considerably but also are of cryptic nature.

Poa suruana Hartm. in Candollea 39: 516. 1984.

Tufted perennial herbs up to 80 cm tall, lightly glaucous; culms erect or ascending. Leaves linear, setaceous, flat or convolute; sheaths smooth, lower often suffused with purple; ligule round, deeply lacerate, 1.5-4 mm long. Inflorescence a panicle, 10-15 cm long, lax before anthesis; branchlets flexuous, scabrid. Spikelets 6-7 mm long, divergent before anthesis, 2-5-flowered; lower glume ovate-lanceolate, 2.5-3.5 mm long, glabrous, 1-veined; upper glume ovate or ovate-elliptic, 3.5-4.5 mm long, glabrous, 3-veined, green or suffused with purple; lemmas elliptic, 4-5.5 mm long, 5-veined, no wool at the base, green with purple; palea denticulate; anthers 2.2-3.3 mm long.

Rare on slopes in Suru Valley, Ladakh.

Fl. & Fr. : July - August.

Distrib. : India, Ladakh, J. & K. (Endemic).

P. tibetica Munro ex Stapf in Hook.f., Fl. Brit. India 7: 339. 1896; Bor, Grasses 561. 1960.

Tufted, rhizomatous, stoloniferous perennial herbs up to 50 cm tall; culms stout, terete, smooth, erect or geniculately ascending, covered at base with fibrous remains of old leaf-sheaths. Leaves linear, acute, firm, rolled, folded, often plicate, glabrous, smooth or scabrid on margins; ligule short, truncate, ciliolate, 2-4.5 mm long. Inflorescence a contracted or spiciform, narrow, interrupted panicle, 4-7 cm long; lower branches 2-4-nate, the longer appressed to rhachis. Spikelets pedicelled, crowded, oblong, 5-6 mm long, 4-5-flowered, pale green or pale pinkish; lower glume

ovate-lanceolate, 3-veined, lateral veins shorter; upper glume oblong, 3-4.5 mm long, ciliate on margins below, 3-veined; lemmas oblong, 3.5-4 mm long, tip hyaline, silky hairy on keel, no wool at base; keel of palea serrulate.

Frequent on grassy slopes at high altitude in Tsakzhun Tso, Lanak La, Wanla to Kalatze on the Indus, Rupshu, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Russia, Tibet, India, Western Himalaya.

Poa trivialis L., Sp. Pl. 1: 67. 1753; Bor, Grasses 561. 1960.

Tufted perennial herbs up to 1 m tall; stoloniferous with extensive creeping root-system; culms erect or spreading from a decumbent base. Leaves linear, acute, flaccid, flat, scabrid; leaf-sheaths scaberulous; ligule pointed, 3.5-10 mm long. Inflorescence a pyramidal or ovate, loose or contracted and dense, erect or nodding panicle, 15-20 cm long; branches 3-5-nate at the lower nodes, scabrid. Spikelets ovate or oblong, 3-4 mm long, 3-4-flowered, green, purplish or reddish; lower glume lanceolate, 2-3 mm long, 1-veined; upper glume ovate, 2.5-3.5 mm long, 3-veined; lemmas narrowly oblong, acute 2.5-3.5 mm long, ciliate on keel, woolly at base; keel of palea scabrid.

Frequent in grassy places, on slopes, in meadows in Zanskar, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Temperate regions of northern hemisphere; introduced elsewhere; Pakistan, India, Western Himalaya.

P. versicolor Bess. ssp. **araratica** (Trautv.) Tzvelev in Nov. Sist. Vyssh. Rast. 1974: 31. 1974. *P. araratica* Trautv. in Acta Horti Petrop. 2: 486. 1873; Bor, Grasses 555. 1960.

Densely tufted perennial herbs up to 50 cm tall; green or often glaucous; rhizome thick, woody; culms erect. Leaves filiform, flat or convolute, scabrid on the margins; ligule lacerate, 1.5-2.5 mm long. Inflorescence a narrow, dense or loose panicle, 4-10 cm long; branches usually paired, ascending, flexuous, scabrid. Spikelets broadly wedge-shaped, 4-6 mm long, 3-4-flowered, tinged with purple; lower glume oblong-elliptic, 3-4 mm long, 3-veined; upper glume broader, 3.5-4.5 mm long, 3-veined; lemmas oblong or elliptic, obtuse or subacute, 3-4.5 mm long, ciliate on the keel and veins, scanty wool at base; keel of palea scabrid.

Common in alpine meadows, grassy plains at high altitude in Gilgit, Baltistan, Skardu, Khardong La, Zanskar, Leh, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Middle East Turkey to Turkmenistan, Pakistan, India, Western Himalaya.

Note : This species is similar to *P. sterilis* but differs in having a short, thick woody rhizome and the uppermost node being near the base of the culm. It is also similar to *P. attenuata* but differs in longer spikelets and lemmas.

POLYPOGON Desf.

Annual or perennial herbs. Leaf-blades linear, flat. Inflorescence a contracted to spiciform or lobed panicle. Spikelets oblong, minute, laterally compressed, keeled, 1-flowered, falling entire together with the pedicel or part of it; rhachilla not produced beyond lemma, disarticulating below the floret. Glumes equal, longer than floret, chartaceous, scabrid, 1-veined, entire or bilobed, often with slender awn from the tip or between the lobes; lemma oblong, hyaline, shorter than the glumes, truncate, rounded on the back, 5-veined, awnless or with a short, subapical awn or a geniculate dorsal awn; palea shorter or as long as lemma, 2-veined; lodicules 2; stamens 1-3. Grains obovoid, free within the lemma and palea.

The genus comprises 18 species in the world; distributed in subtropical and warm temperate regions and on tropical mountains; 2 species in India and also in cold desert.

The genus closely approaches *Agrostis* and hybridises with it but it is distinguished by its deciduous spikelets with stipitate base.

- 1a. Awns as long or shorter than glumes *P. fugax*
 b. Awns 2-3 times the length of the glumes *P. monspeliensis*

Polypogon fugax Nees ex Steud., Syn. Pl. Glum. 1: 184. 1854; Bor, Grasses 403. 1960.

Annual herbs up to 60 cm long; culms erect or decumbent at the base and rooting from the lower nodes. Leaves linear, flat, rough; ligule 2-8 mm long. Inflorescence an ovate, oblong or cylindrical panicle, 5-15 cm long, lobed, pale green or yellowish. Spikelets 2-2.5 mm long, oblong; glumes subequal, 1-veined, membranous, slightly notched at apex, minutely hairy on margins; awn 0.6-3 mm long; lemma shorter than glumes, smooth, awnless or shortly awned up to 2 mm long; palea as long as the lemma or shorter, 2-veined.

Common in moist places near lakes, along streams in Gilgit, Dras, Leh, Ladakh.

Fl. & Fr. : June - August.

Distrib. : Pakistan; India, all along Himalayas.

P. monspeliensis (L.) Desf., Fl. Atlant. 1: 67. 1798; Hook.f., Fl. Brit. India 7: 245. 1896; Bor, Grasses 403. 1960. *Alopecurus monspeliensis* L., Sp. Pl. 1: 61. 1753.

Tufted annual herbs up to 60 cm tall; culms stout or slender, leafy erect or geniculately ascending. Leaves linear, flat, rough; ligule 3-15 mm long, oblong. Inflorescence an ovate to oblong, cylindrical or lobed spiciform

panicle, 2-15 cm long, pale yellowish green, silky. Spikelets 2-3 mm long; glumes oblong, scaberulous, apex notched or obtuse, keel scabrid, margins ciliate, awn from the sinus or beneath it, 4-7 mm long; lemma about half as long as glume. 2-toothed, awned or not; palea oblong, apex notched.

Common in cool shady moist places on slopes, near streams in Gilgit, Baltistan, Shyok, Skardu, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Europe, temperate Asia, Africa, introduced and naturalised in most warm temperate regions; Pakistan, India.

PUCGINELLIA Parl. *nom. cons.*

Annual or perennial herbs. Leaf-blades flat or convolute. Inflorescence an open or contracted panicle, rarely reduced and raceme-like. Spikelets 2-several-flowered, slightly compressed. Glumes unequal, shorter than the lemmas, 1-3-veined; lemmas membranous, thinly scarious or hyaline at tip, rounded on back, pubescent at base, 5-veined, smooth, obtuse or acute, almost erose or ciliolate at tip, awnless; floret callus glabrous; palea about as long as lemma, 2-keeled, keels scaberulous to ciliate; lodicules 2; stamens 3. Grains oblong.

The genus comprises about 80 species; distributed in temperate regions throughout the world, chiefly Asia; 7 species in India and also in the cold desert.

The genus is allied to *Poa*. It is also difficult to distinguish from *Festuca*.

- 1a. Lemma hairy at the base *P. distans*
- b. Lemma glabrous, sometimes puberulous on the margins or slightly serrulate-ciliolate at the apex..... 2
- 2a. Slender, small tufted herb. Lemmas up to 2.5 mm long *P. minuta*
- b. Tall robust herb. Lemmas 3-5 mm long..... 3

- 3a. Lemma acute at apex 4
 b. Lemma obtuse or rounded at apex 5
- 4a. Lemma 2.5-3 mm long. Anthers 0.5-0.8 mm long *P. kashmiriana*
 b. Lemma 4.5-5 mm long. Anthers 2.5-3 mm long *P. thomsonii*
- 5a. Lemma 3-3.5 mm long. Anthers 2 mm long or more *P. stapfiana*
 b. Lemma 1.5-2 mm long. Anthers 0.5-1.5 mm long 6
- 6a. Anthers 0.5-0.7 mm long *P. himalaica*
 b. Anthers 1-1.5 mm long *P. tenuiflora*

Puccinellia distans (Wahlb.) Parl., Fl. Ital. 1: 367. 1848; Bor, Grasses 562. 1960. *Glyceria distans* Wahlb., Fl. Ups. 36. 1820 based on *Poa distans* L., Mant. Pl. 1: 32. 1767, non Jacq 1764; Hook.f., Fl. Brit. India 7: 347. 1896. ssp. ***distans***

Densely tufted perennial herbs up to 60 cm tall; culms erect or decumbent, stout or slender, leafy throughout or at base only. Leaves linear, flat or convolute, smooth, sometimes scabrid above; lower sheath membranous, shining; ligule short, scarious. Inflorescence ovate or pyramidal, loose and open panicle, 5-15 cm long; lower branches 2-5-nate, ultimately deflexed. Spikelets 3-7 mm long, 4-8-flowered, green or tinged with purple, white or yellow; glumes unequal, ovate-elliptic, blunt, scarious; lower 0.5-1.5 mm long, 1-veined; upper 1-2.5 mm long, 1-3-veined; lemmas broadly ovate or oblong, blunt or retuse at apex, 5-veined, minutely hairy at base, margin and apex broadly hyaline; palea-keel ciliate.

Common on slopes, grassy places in Baltistan, Karakoram, Pangong Lake Ladakh.

Fl. & Fr. : July - August.

Distrib. : N. America, N. Africa, Europe, temperate Asia; Pakistan, India Western Himalaya.

Note : *Poa distans* L. is a later homonym of *P. distans* Jacq. Although the Linnaean epithet is illegitimate in *Poa*, it is legitimate in *Glyceria* R.Br. and acceptable as the basionym of *Puccinellia distans*.

Puccinellia himalaica Tzvelev in Bot. Mater. Gerb. Inst. V.L. Komarova 17.66.1955; Bor, Grasses 562. 1960. Fig. 50.

Tufted perennial herbs up to 20 cm tall; culms stout or slender, erect or ascending. Leaves linear, flat, folded or convolute, pallid or greyish green, smooth or scaberulous above. Inflorescence a narrow panicle, 4-9 cm long; branches smooth or faintly scaberulous, ascending at first, spreading at maturity. Spikelets 2.5-4 mm long, 2-4-flowered, green or tinged with purple; glumes unequal, ovate, subacute; lower 1-1.5 mm long, 1-veined; upper 1.5-2 mm long, 3-veined; lemmas 1.5-2 mm long, oblong or ovate, rounded, truncate or subacute at apex, almost glabrous, mucronate; palea-keels smooth or faintly scabrid above.

Occasional in moist places along lakes, sandy places in Tzakzhun Tso, Tso Morari, Rupshu, Nubra, Zanskar, Ladakh, Lahul.

Fl. & Fr. : July - August.

Distrib. : India, Kashmir to Himachal Pradesh.

P. kashmiriana Bor in Kew Bull. 8: 270. 1953; Bor, Grasses 562. 1960.

Tufted perennial herbs up to 20 cm tall; culms slender, erect or ascending. Leaves linear, flat or convolute, scaberulous above. Inflorescence a contracted panicle, 2-3.5 cm long, purplish; branches very short bearing 1 or 2 spikelets. Spikelets 4.5-5 mm long, 2-3-flowered, tinged with purple; glumes unequal, oblong-elliptic, acute or subacute; lower 1-1.5 mm long, 1-veined; upper 2-2.5 mm long, 3-veined; lemmas 3-3.5 mm long, oblong-elliptic, acute, apiculate at apex, glabrous; palea-keels smooth.

Occasional in moist sandy places in Rupshu, Ladakh, Lahul.

Fl. & Fr. July - August.

Distrib. : India, Western Himalaya from Kashmir to Himachal Pradesh.

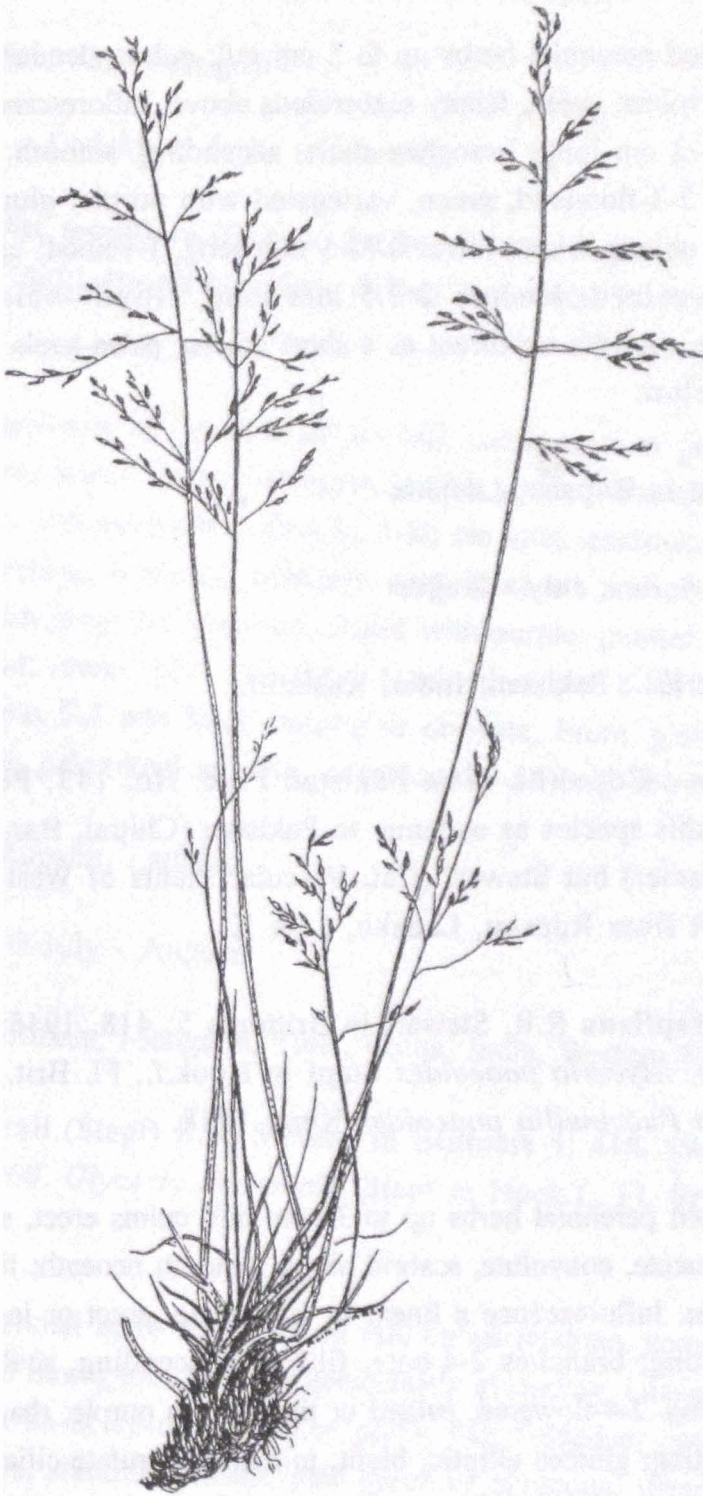


Fig. 50. *Puccinellia himalaica* Tzvelev

Puccinellia minuta Bor in Nytt Mag. Bot. 1: 19. 1952; Bor, Grasses 563. 1960.

Tufted perennial herbs up to 5 cm tall; culms slender, erect. Leaves linear, convolute, green, faintly scaberulous above. Inflorescence a contracted panicle, 1-2 cm long; branches short, ascending, smooth. Spikelets 3-4 mm long, 2-3-flowered, green, variegated with purple; glumes sub-equal, elliptic or oblong, blunt; lower 0.75-1 mm long, 1-veined; upper 1-1.5 mm long, 1-3-veined; lemmas 2-2.5 mm long, elliptic-oblong, minutely emarginate, midvein excurrent as a short mucro; palea-keels scabrid above, smooth below.

Rare in Rupshu, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Pakistan, India, Kashmir.

(*Note* : Cope (Fl. West Pakistan Fasc. No. 143. Poaceae, 1982) indicated this species as endemic to Pakistan (Chitral, Barum Gol, South Barum Glacier) but Stewart (Cat. Vascular Plants of West Pakistan) has reported it from Rupshu, Ladakh, J. & K.

P. stapfiana R.R. Stewart in Brittonia 5: 418. 1945; Bor, Grasses 563. 1960. *Glyceria poaeoides* Stapf in Hook.f., Fl. Brit. India 7: 348. 1896, *non Puccinellia poaeoides* Keng 1938.

Tufted perennial herbs up to 35 cm tall; culms erect, slender. Leaves linear, subacute, convolute, scabrid above, smooth beneath; ligule triangular ovate acute. Inflorescence a linear or lanceolate, erect or inclined panicle, 5-10 cm long; branches 2-4-nate, filiform, ascending, scabrid. Spikelets 5-6 mm long, 2-4-flowered, pallid or tinged with purple; rhachilla glabrous, disarticulating; glumes elliptic, blunt, minutely serrulate-ciliate on margins; lower 1.5-2 mm long, 1-3-veined; upper 2-3 mm long, 3-veined; lemmas elliptic-oblong, obtuse, dorsally rounded, broadly hyaline at apex; palea-keels scabrid above, smooth below.

Rare in wet sandy soil along the salt lake and neighbouring grassy plains in Rupshu Ladakh, Parang river to Lanak Pass.

Fl. & Fr. : July - August.

Distrib. : Ladakh J. & K. (Endemic).

Puccinellia tenuiflora (Griseb.) Scribn. & Merr. in Contr. U.S. Natn. Herb. 13: 78. 1910; *Atropis tenuiflora* Griseb. in Ledeb., Fl. Ross. 4: 389. 1852.

Tufted perennial herbs up to 60 cm tall; culms erect or geniculately ascending. Leaves linear, flat or convolute, greyish green, scaberulous above, smooth beneath. Inflorescence a panicle, 5-20 cm long, contracted at first, ultimately spreading; branches capillary, scabrid above and on pedicels. Spikelets 3-5 mm long, 2-5-flowered, tinged with purple; glumes subequal, lanceolate, blunt; lower 0.5-1 mm long, 1-veined; upper 1-1.8 mm long, 3-veined; lemmas 5-2 mm long, oblong or obovate, blunt, glabrous, tip minutely ciliate; palea-keel smooth, occasionally scabrid above.

Rare in Rupshu, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Russia, Mongolia, Tibet, China, India, Western Himalaya.

P. thomsonii (Stapf) R.R. Stewart in Brittonia 5: 418. 1945; Bor, Grasses 563. 1960. *Glyceria thomsonii* Stapf in Hook.f., Fl. Brit. India 7: 347. 1896.

Tufted perennial herbs up to 40 cm tall; culms medium, compressed, glabrous, sheathed throughout, erect or geniculately ascending. Leaves linear, rigid, tapering to an acute or subobtuse point, flat, folded or convolute, scaberulous above, smooth beneath, pale green or glaucous; sheath more or less compressed, smooth, striate, loose above; ligule broadly ovate, obtuse, scarious. Inflorescence a contracted or loose spreading panicle, 7-15 cm long; branches erect or ascending; rhachis smooth or scabrid

below. Spikelets 6-9 mm long, oblong, 3-5-flowered, pale green or variegated with purple; lower glume oblong-lanceolate, acute, 1-veined, 1.5-2.5 mm long, margin broadly hyaline; upper glume 2-3 mm long, elliptic-oblong, obtuse, 3-veined, margin and apex hyaline; lemmas 3.5-4.5 mm long, elliptic, acute, smooth, glabrous, 5-veined, margin hyaline yellow, outer veins shorter; palea-keel smooth below, scabrid above.

Rare in Rupshu, Puga, Leh, Zaskar, Ladakh.

Fl. & Fr. : July - August.

Distrib. : India, Ladakh, J. & K. (Endemic).

SACCHARUM L.

Tall perennial herbs, rhizomatous; culms solid. leaf-blades linear. Inflorescence a large, plumose, often silvery panicle, with numerous racemes on its branches, rachis fragile and bearing paired similar spikelets, one sessile, bisexual and other pedicelled, female; racemes usually flexuous. Spikelets lanceolate, enveloped in long silky hairs from the callus; callus short, truncate. Glumes membranous or lower cartilaginous to coriaceous, flat to broadly convex on the back; lower lemma lanceolate, shorter than the spikelet, hyaline; upper lemma with awn or awnless, entire or bilobed, sometimes suppressed; palea hyaline or absent; stamens 2-3. Pedicelled spikelets similar but more rounded on the back. Grains subglobose to narrowly oblong.

The genus comprises about 40 species in the world; distributed throughout the tropics and subtropics; 15 species in India, 4 species in the cold desert.

The division of *Saccharum* into awned (*Erianthus* Michx.) and awnless species seems artificial. There are some examples in *Saccharum* with whom *Narenga* Bor, with its coriaceous glumes shows similarity. *Saccharum* is also related to *Spodiopogon* Trin., *Miscanthus* Anders., *Imperata* Cyr. and *Eulalia* Kunth.

- 1a. Spikelets awned 2
 b. Spikelets unawned 4
- 2a. Panicles of short racemes of 4-8 joints borne on the long primary branches 3
 b. Panicles of long simple branches of many joints, sometimes in the lower part of the inflorescence the racemes are borne along primary panicle branches *S. filifolium*
- 3a. Panicle dense, uninterrupted, purplish, up to 40 cm long. Spikelets 3-4 mm long. Awns long exserted *S. ravennae*
 b. Panicle not dense, interrupted, creamy-white, up to 20 cm long. Spikelets 5-7 mm long. Awns short, included or slightly exerted *S. griffithii*
- 4a. Peduncles not hairy below the panicle. Lower glume of sessile spikelets hairy on the back *S. griffithii*
 b. Peduncles hairy below the panicle. Lower glume of sessile spikelets glabrous on the back *S. spontaneum*

Saccharum filifolium Nees ex Steud., Syn. Pl. Glum. 1: 409. 1855; Bor, Grasses 211. 1960. *Erianthus filifolius* (Nees ex Steud.) Jacks, Ind. Kew. 864. 1893; Hook.f., Fl. Brit. India 7: 123. 1896.

Perennial herbs up to 1.5 m tall; rootstock woody; culms stout, pubescent below panicle, nodes pubescent. Leaves filiform, semicylindrical, rigid, flexuous, convolute, long capillary tip; ligule very short, obtuse, ciliolate. Inflorescence a panicle of racemes, 5-8 cm long, borne directly on the axis of the panicle; internodes and pedicels hirsute with white silky hairs. Spikelets sessile and pedicelled, 4-7 mm long, lanceolate, surrounded with dense white hairs; lower glumes membranous, acute, ciliate on the margins, glabrous on the back, keel scabrid; upper glume 3-veined, keel often smooth; lower lemmas lanceolate, margin ciliate, inflexed; upper lemma lanceolate, 2-toothed or 2-lobed at apex, awned in the sinus with awn 1-3 cm long; palea short, lanceolate, glabrous; glume of pedicelled spikelet 6-7-veined.

Common in waste places, along roads, near streams, on slopes in Gilgit, Baltistan, Ladakh.

Fl. & Fr. : June - August.

Distrib. : Afghanistan, Pakistan, India, Western Himalaya.

Note : the very wiry leaves with long attenuate capillary tip is very characteristic.

Saccharum griffithii Munro ex Boiss., Fl. Or. 5: 453. 1884; Bor, Grasses 211, 1960. *Erianthus griffithii* (Munro ex Boiss.) Hook.f., Fl. Brit. India 7: 122. 1896.

Tufted perennial herbs up to 1.5 m tall; culms solid, glabrous, pale, shining. Leaves linear, rigid, coriaceous, dorsally rounded, upper surface concave, semiterete above, margins scaberulous, involute, glaucous, midrib thick, white; sheaths smooth, shining; ligule long, ciliate. Inflorescence an oblong, contracted, thyriform, inclined, pale yellow panicle of racemes, 15-30 cm long; peduncle glabrous; racemes 1.5-2.5 cm long; internodes and pedicels hirsute. Spikelets lanceolate, acuminate or acute, pale, often tipped with purple, 4-5 mm long; callus bearded with creamy or yellowish hairs; glumes subequal, membranous, hairy on the back, keel spinulose; lower 3-veined, margin narrowly incurved; upper 1-3-veined, acuminate; lower lemma lanceolate, hyaline, 1-veined, acute or shortly awned up to 4 mm long, margins ciliate; upper lemma ovate-lanceolate, 3-veined, shortly awned.

Common along roads, streams, on slopes in Gilgit, Baltistan, Ladakh.

Fl. & Fr. : June - August.

Distrib. : Afghanistan, Pakistan, India, Western Himalaya.

S. ravennae (L.) Murr., Syst. Veg. 88. 1774; Hook.f., Fl. Brit. India 7: 121. 1896; Bor, Grasses 213. 1960. *Andropogon ravennae* L., Sp. Pl. ed. 2. 2: 1481. 1763. *Erianthus ravennae* (L.) P. Beauv., Ess. Agrost. 14. 1812. *E. elephantinus* Hook.f., Fl. Brit. India 7: 122. 1896.

Perennial herbs up to 3 m tall; culms stout, smooth, glabrous. Leaves lanceolate, flat, smooth, margins serrulately scabrid; sheaths very long; ligule of long hairs. Inflorescence a very dense or sublobate, supradecomposed panicle of racemes, 20-50 cm long; branches many, lower fascicled and whorled; axis angular; peduncle glabrous; racemes 1.5-3 cm long; internodes and pedicels hirsute. Spikelets 3-6 mm long, pale; callus bearded with white, grey or yellowish hairs; glumes subequal, membranous, glabrous; lower lanceolate, acuminate, 1-veined; margin narrowly incurved; upper ciliate; lower lemma lanceolate, hyaline, stiff, 1-veined, ciliate, margins incurved; upper lemma narrow, glabrous, with awn 2.5-10 mm long; glumes of pedicelled spikelets hairy on the back.

Common near streams, waste sandy places, along roads, occasionally on slopes in Gilgit, Skardu, Baltistan Ladakh.

Fl. & Fr. : July - October.

Distrib. : South West Asia westward to the Mediterranean region; Pakistan, Northern India.

Saccharum spontaneum L., Mant. Pl. 2: 183. 1771; Hook.f., Fl. Brit. India 7: 118. 1896; Bor, Grasses 214. 1960.

Rhizomatous, perennial herbs up to 3 m tall; culms erect, silky hairy below the panicle. Leaves erect, linear-lanceolate, margin convolute or incurved, gradually tapering towards the base into a narrow wing on either side of the petiole, glaucous; mouth of sheath woolly; ligule membranous. Inflorescence a panicle of racemes, 20-60 cm long; peduncle usually hairy; branches whorled, spreading; branchlets fragile; internodes and pedicels hirsute. Spikelets 3-6 mm long, lanceolate; callus bearded with silky white hairs; glumes subequal, subcoriaceous in lower part, glabrous on the back, often ciliate on the margins above; lower 2-veined; lower lemma ovate-lanceolate, subacute, ciliate on the margins; upper lemma narrow, very shortly awned, sometimes absent.

Common near streams, in the dry river beds, along roads in waste sandy places in Baltistan, Gilgit, Ladakh.

Fl. & Fr. : June - September.

Distrib. : Warmer regions of the Old World.

Note : Due to its extensive rootsystem it is an excellent sand-binder.

SCHISMUS P. Beauv.

Annual or perennial herb. Leaf-blades setaceous, flat or convolute. Inflorescence a contracted or spiciform panicle. Spikelets many-flowered, laterally compressed, falling entire or upper florets falling singly and then lower florets, glumes and pedicel tardily deciduous together; rachilla elongate, jointed at the base and between the lemmas. Glumes subequal, almost as long as spikelets, membranous, margins hyaline, acute, concave, 5-7-veined persistent; lemmas membranous, rounded on the back, pilose on the back or margins, bilobed or bifid, margins hyaline, 7-9-veined, mucronate or shortly awned in the sinus; palea 2-keeled; lodicules 2, ciliate; stamens 3. Grains obovoid, compressed, free within the lemma and palea.

The genus comprises 5 species; distributed in Africa, Mediterranean region, Middle East to Himalayas; 2 species in India and also in the cold desert.

- 1a. Lemma acuminate. Palea shorter than lemma, rounded at apex
 *S. arabicus*
- b. Lemma acute. Palea almost as long as the lemma, acute at apex
 *S. barbatus*

Schismus arabicus Nees, Fl. Afr. Austr. 1: 422. 1841; Bor, Grasses 481. 1960.

Tufted annual herbs up to 15 cm tall; culms slender, filiform. Leaves linear, flat or convolute, setaceous. Inflorescence a contracted, narrow panicle, 2-3 cm long. Spikelets 5-7 mm long, 6-8-flowered; glumes lanceolate, acuminate; lower 5-7-veined, 4.5-6.5 mm long; lemmas rounded on the back, membranous, hyaline on margins; upper 5-veined, 5-7 mm long; lowest lemma 9-veined, 2.5-4 mm long, deeply 2-lobed, the lobes triangular, 1-2 mm long; palea 2-3 mm long, spathulate, obtuse.

Common in drier situations, on slopes in Skardu, Khalotse, Baltistan Ladakh.

Fl. & Fr. : June - July.

Distrib. : Australia, Greece, Libya, Arabia Mediterranean region to India, Western Himalaya.

Schismus barbatus (L.) Thell. in Bull. Herb. Boissier, ser. 2. 7: 391. 1907; Bor, Grasses 481. 1960. *Festuca barbata* L., Amoen. Acad. 3: 400. 1756. *Schismus marginatus* P. Beauv., Ess. Agrost. 177. t. 15/4. 1812; Hook.f., Fl. Brit. India 7; 336. 1896.

Densely tufted annual herbs up to 20 cm tall; culms slender, filiform. Leaves linear, setaceous, acuminate, flat or convolute, glabrous or sparsely hairy; ligule of hairs. Inflorescence a dense, contracted panicle, 2-5 cm long, green, glistening; pedicels scabrid. Spikelets 5-6 mm long, 5-10-flowered; glumes lanceolate, acute; lower 5-7-veined, 4-5 mm long; upper 5-veined, 4-6 mm long; lemma rounded on the back, membranous, hyaline on margins; lowest lemma 9-veined, 2-2.5 mm long, broadly ovate, 2-lobed, lobes broadly triangular; palea 1.5-2.5 mm long, spatulate, obtuse, often as long as or longer than lemma.

Common in dry situations, on slopes in Nubra, Dras, Skardu.

Fl. & Fr. : June - July.

Distrib. : S. Africa, Central Asia, introduced into N. America, Australia, Argentina; Mediterranean region to India, Western Himalaya.

SETARIA P. Beauv.

Annual or perennial herbs. Leaf-blades flat or convolute, sometimes plated; ligule usually a ciliate rim. Inflorescence an open or spike-like panicle or with spikelets contracted about primary branches. Spikelets 1-2-flowered, subtended by 1 or more scabrid, persistent bristles, oblong to ovate, awnless. Glumes shorter to as long as the spikelets, membranous

to herbaceous, lower abaxial, ovate from a clasping base; lemma coriaceous to crustaceous, lower sulcate, male or neuter, 5-7-veined, usually without palea, upper convex on the back, often rugose, clasping only the margins of the palea, bisexual; lodicules 2; stamens 3 or 2 in male. Grains oblong or ellipsoid, free within the hardened lemma and palea.

The genus comprises about 100 species in the world; distributed in the tropics and subtropics; 15 species in India; 2 species in the cold desert.

- 1a. Upper glume as long as the upper lemma. Upper lemma smooth or fine rugose *S. viridis*
 b. Upper glume shorter than the upper lemma. Upper lemma rugose to corrugate *S. pumila*

Setaria pumila (Poir.) Roem. & Schult., Syst. Veg. 2: 891. 1817.
Panicum pumilum Poir. in Lam. Encycl. Meth. Bot. Suppl. 4. 273. 1816.
Setaria pallide-fusca (K. Schum.) Stapf & C.E. Hubbard in Kew Bull. 1930: 259. 1930; Bor, Grasses 363. 1960. *S. glauca auct non* (L.) P. Beauv. 1812.

Loosely tufted annual herbs up to 60 cm tall; culms erect or ascending, simple or branched. Leaves linear or lanceolate, flat, glabrous or sparsely hairy, margins scabrid. Inflorescence a spiciform, cylindrical panicle, 5-15 cm long, dense flowered, usually yellow, rarely purplish or green; bristles of involucre 6-12, 3-12 mm long. Spikelets ovate, 1.5-2.5 mm long; lower glume minute; upper glume shorter than lemma, subacute, lower lemma usually empty, sometimes male; upper lemma rugose to corrugate, broadly ovoid.

Common in alpine and subalpine pastures in Baltistan, Skardu, Gilgit, Dras, Kargil, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - October.

Distrib. : Tropical and warm temperate regions of world; introduced to N. America.

Note : It is a polymorphic species. Terrell (Taxon 25: 297-304. 1976) has discussed its nomenclatural problem. *S. glauca* should be referred to *Pennisetum*.

This species is also closely related to *S. sphacelata* (K. Schum.) Moss (Native of tropical and South Africa) and *S. gracilis* Kunth (distributed in America and tropical Asia).

Setaria viridis (L.) P. Beauv., Ess. Agrost. 51. 171. 178. 1812; Hook.f., Fl. Brit. India 7: 80. 1896; Bor, Grasses 365. 1960. *Panicum viride* L., Syst. Nat. ed. 10.2: 870. 1759.

Loosely tufted annual herbs up to 60 cm tall; culms erect or geniculately ascending, simple or branched. Leaves linear or lanceolate, rounded at the base, flaccid, smooth or scaberulous; sheaths glabrous to pubescent. Inflorescence a spiciform, cylindrical, interrupted panicle, 2-12 cm long; rhachis puberulous to hispidulous; bristles of involucre 3-6, 3-12 mm long, antrorsely scabrid, green or reddish. Spikelets ovoid, 2-3 mm long; lower glume 6-8 mm long; upper glume 2-3 mm long, 5-7 veined; lower floret barren; upper lemma finely rugose.

Common in alpine and sub-alpine pastures, waste places, weed of cultivation in Gilgit, Baltistan, Skardu, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - September.

Distrib. : Temperate regions of the Old World; introduced to the New World; India Western Himalaya.

Note : It is close to the cultivated *S. italica* (L.) P. Beauv. but in *S. viridis* spikelets fall entire, whereas in *S. italica* the glumes and lower lemma are persistent, only the upper floret is shed.

STIPA L.

Usually perennial herbs; tufted. Leaf-blades harsh, linear, usually convolute. Inflorescence an open or contracted panicle. Spikelets terete,

1-flowered; rhachilla not produced, forming a thickened callus below lower lemma, disarticulating above glumes. Glumes persistent, acute, keeled, rarely awned, hyaline to membranous; 1-7-veined; lemma convolute or with the margins not overlapping at the base, membranous to coriaceous, entire, bifid or bilobed, with a long terminal, deciduous awn, rarely awn persistent; callus pungent; floret fusiform, terete; palea 2-veined, closely embraced by the lemma; lodicules 3; stamens 1-3, anthers tips bearded or not. Grains narrow, terete, free within the lemma and palea.

The genus comprises about 300 species in the world; distributed in temperate and warm temperate regions; 25 species in India; 15 species in the cold deserts.

- | | | |
|-----|--|---------------------------|
| 1a. | Callus obtuse or conical. Lemma 2-toothed at apex | 2 |
| b. | Callus acuminate, rarely blunt. Lemma entire at apex | 5 |
| 2a. | Awns glabrous or puberulous on the column | 3 |
| b. | Awns plumose..... | 4 |
| 3a. | Panicles effuse. Glumes unequal. Awns 5-12 mm long | <i>S. splendens</i> |
| b. | Panicles contracted. Glumes almost equal. Awns 20-35 mm long | <i>S. jacquemontii</i> |
| 4a. | Panicle effuse, branches capillary. Lemma hairy on the dorsal surface. Awn bigeniculate..... | <i>S. mongholica</i> |
| b. | Panicle contracted, branches not capillary. Lemma glabrous over most of the dorsal surface, pilose at the base only. Awn unigeniculate | <i>S. concinna</i> |
| 5a. | Glumes acute or shortly acuminate, slightly longer than lemma | 6 |
| b. | Glumes long acuminate, 2-4 times longer than lemma..... | 8 |
| 6a. | Leaf-blades flat. Spikelets pallid or green | <i>S. sibirica</i> |
| b. | Leaf-blades involute and setaceous. Spikelets deeply suffused with purple | 7 |
| 7a. | Glumes acute, upper glume 5-veined. Hairs of awns up to 1 mm long. Bristles shortly hairy | <i>S. regeliana</i> |
| b. | Glumes acuminate, upper glume 3-veined. Hairs of awns 2.5-3.5 mm long. Bristles scaberulous | <i>S. subsessiliflora</i> |

- 8a. Awns scabrid or shortly hairy 9
- b. Awns either plumose with long hairs throughout or partly plumose and partly smooth, scabrid or shortly hairy 11

- 9a. Awns at length entangled to form a tail at the top of the panicle.....
 *S. consanguinea*
- b. Awns not forming a tail 10

- 10a. Awns scabrid. Lemma 10-15 mm long, smooth at the tip ... *S. capillata*
- b. Awns shortly hairy. Lemma 5-7 mm long, spinulose-scabrid at the tip, with a crown of stiff hairs at the tip *S. breviflora*

- 11a. Awn unigeniculate. Bristles rigidly falcate *S. caucasica*
- b. Awn bigeniculate. Bristles flexuous or recurved 12

- 12a. Glumes lanceolate, shortly acuminate, deeply suffused with purple.....
 *S. purpurea*
- b. Glumes linear and long acuminate, green or silvery 13

- 13a. Awn plumose or shortly hairy throughout 14
- b. Awn with plumose bristles but smooth or acabrid column ... *S. kirghisorum*

- 14a. Awn 3.5-7 cm long *S. orientalis*
- b. Awn 10-20 cm long *S. himalaica*

Stipa breviflora Griseb. in Nachr. Ges. Wiss. Gottingen 1868; 82. 1868; Bor, Grasses 643. 1960.

Tufted perennial herbs up to 40 cm tall; culms slender, wiry. Leaves linear, setaceous, involute, smooth, glabrous on lower surface; ligule short up to 1 mm long. Inflorescence a narrow, contracted, dense panicle, 10-25 cm long. Spikelets terete, 1-flowered; glumes unequal, 10-25 mm long, lower a little longer than the upper, lanceolate, long acuminate, 3-veined; lemma terete, 5-7 mm long, hairy in lower part, spinulose-scabrid towards apex, apex with a crown of stiff hairs; callus pungent, 0.9-1.3 mm long; awn 5.5-8 cm long, articulated at base, plumose throughout; palea similar to lemma, 2-veined.

Occasional on slopes in Ladakh.

Fl. & Fr. : June - July.

Distrib. : Tian Shan, Pamir, Mongolia, Tibet, India Western Himalaya.

Stipa capillata L., Sp. Pl. ed. 2. 1: 116. 1762; Hook.f., Fl. Brit. India 7: 230. 1896; Bor, Grasses 644. 1960.

Tufted perennial herbs up to 1 m tall; culms stout, erect. Leaves filiform, convolute, scaberulous; ligule lanceolate, 3.5-15 mm long. Inflorescence a narrow, contracted panicle, 10-25 cm long, partially enclosed in the inflated sheath of the uppermost leaf. Spikelets 2-2.5 cm long, white, glistening; glumes subequal or unequal, lanceolate, acuminate, 2.5-3.5 cm long, lower 3-veined; upper 5-veined; lemma terete, 1-1.5 cm long, pubescent below; callus pungent, 2.5-4 mm long; awn bigeniculate, articulated at base, 1.5-1.8 cm long, scabrid; palea glabrous.

Occasional on slopes in Gilgit, Baltistan, Dras, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Mediterranean regions, temperate Europe, southern Russia, China, Japan, Pakistan; India, Western Himalaya.

S. caucasica Schmalh. in Ber. Deutsch Bot. Ges. 10: 293. 1892; Bor, Grasses 644. 1960.

Tufted perennial herbs up to 60 cm tall; culms medium; erect. Leaves linear, setaceous, convolute, stiff, pungent; ligule 0.5-0.7 mm long. Inflorescence a narrow, contracted panicle, 5-10 cm long, partially enclosed in the inflated sheaths of uppermost leaf. Spikelets 1-flowered, disarticulating above the glumes at maturity; glumes subequal, lanceolate, long acuminate, 2.5-5 cm long, 5-veined; lemma terete, 9-12 mm long, hairy, apex with a crown of short hairs; callus acuminate pungent, 2-3 mm long; awn unigeniculate, articulated at base, 8-12 cm long, column hairy; bristle rigidly falcate, plumose.

Common on slopes, near lakes, waste sandy places in Tsaka Lake Rupshu Ladakh.

Fl. & Fr. : July - August.

Distrib. : Caucasus, Pamir, India, Ladakh, Kashmir.

Stipa concinna Hook.f., Fl. Brit. India 7: 230. 1896; Bor, Grasses 644. 1960.

Tufted perennial herbs up to 30 cm tall; culms stout, erect. Leaves filiform, flexuous, involute; ligule 1.5-2 mm long. Inflorescence a narrow, contracted panicle, 2.5-5 cm long; branches and pedicels short, erect. Spikelets 5-6 mm long, ovoid, dorsally compressed, purple; glumes subequal, 4.5-6.5 mm long, ovate-elliptic, acute or subacute, rarely acuminate, hyaline at apex; lower 1-veined; upper 3-veined; lemma elliptic, 3.5-5 mm long, glabrous or hairy in lower part, apex 2-toothed; callus conical, blunt awn flexuous, unigeniculate, articulated at base, 1-1.5 cm long, plumose.

Occasional in high altitude areas on slopes, open grassy places in Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Tibet, southern Russia, India, Western Himalaya.

S. consanguinea Trin. & Rupr., Sp. Gram. Stip. 78. 1842; Bor, Grasses 644. 1960. *S. koelzii* R.R. Stewart in Brittonia 5: 441. 1945.

Tufted perennial herbs up to 30 cm tall; culms medium, erect. Leaves linear, flat or convolute, puberulous above, pubescent or glabrous beneath; ligule 1-1.5 mm long. Inflorescence a contracted panicle, 6-12 cm long, partially enclosed in the inflated sheath of uppermost leaf, ultimately exerted. Spikelets crowded, 1-flowered; glume subequal, 2-2.5 cm long, lanceolate, long acuminate, 3-veined; lemma almost terete, 8-10 mm long, pubescent to glabrous, apex with crown of stiff hairs; callus pungent, 1.5-2 mm long; awns bigeniculate, articulated at base, becoming entangled

at maturity to form a tail at the tip of the panicle, 5.5-9 cm long, hairy throughout.

Occasional on slopes, in open grassy places in Gya, Ladakh, Spiti.

Fl. & Fr. : July - August.

Distrib. : Southern Russia, Mongolia, Tibet, India, Western Himalaya.

Stipa himalaica Rozhev. in Bot. Mater. Gerb. Glavn. Bot, Sada 5: 11. 1924; Bor, Grasses 644. 1960. *S. pennata sensu* Hook.f., Fl. Brit. India 7: 230. 1896, *non* L. 1753.

Densely tufted perennial herbs up to 1 m tall; culms, medium erect. Leaves linear, setaceous, rigid, convolute, smooth or scabrid on lower surface; sheath smooth or rough; ligule oblong, 2-4 mm long. Inflorescence a contracted, narrow panicle, 5-10 cm long, few-flowered, partially enclosed in the inflated sheath of the uppermost leaf. Spikelets 2-2.5 cm long, 1-flowered, glumes hyaline, subequal, 2-3 cm long, lanceolate, long acuminate, almost capillary or cuspidately awned; lower 3-veined; upper 5-veined; lemma terete, 8-11 mm long, hairy throughout, apex with a crown of hairs; callus acuminate, pungent, 1.5-2 mm long; awn twisted, bigeniculate, articulated at base, 10-15 cm long, plumose with hairs 2-3 mm long, bristles plumose, occasionally awn plumose above the column only and glabrous below.

Common in open grassy places, on slopes in Gilgit, Baltistan, Shyok Valley Ladakh.

Fl. & Fr. : June - August.

Distrib. : Southern Russia, Tibet, India, Western Himalaya.

S. jacquemontii Jaub. & Spach. Ill. Pl. Or. 4: 60. t. 339. 1851; Hook.f., Fl. Brit. India 7: 232. 1896; Bor, Grasses 645. 1960.

Densely tufted perennial herbs up to 50 cm tall; culms very slender, erect. Leaves filiform, convolute, subflexuous; ligule membranous, 0.2-

0.4 mm long. Inflorescence a narrow, lax-flowered panicle, 5-15 cm long, erect or inclined; branches filiform, ascending, few-flowered. Spikelets 4-8 mm long, linear-lanceolate, green or purplish; glumes subequal, lanceolate or elliptic acute or acuminate, 3-veined; lemma elliptic, terete, 4-5 mm long, 2-fid or 2-toothed at apex, villous throughout; callus conical, blunt, 0.3-0.4 mm long villously bearded; awn 2.5-3 cm long, capillary, bigeniculate, villous at base or scaberulous throughout; anther-tips bearded.

Common in drier conditions, on slopes, rocky places rock crevices in Baltistan, Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - September.

Distrib. : Tibet, Afghanistan, Pakistan, India, Western Himalaya.

Stipa kirghisorum P. Smim. in Fedde, Report. 21: 232. 1925.

Tufted perennial herbs up to 60 cm tall; culms medium erect. Leaves linear, setaceous, convolute, scabrid on the lower surface; ligule 1.5-3.5 mm long. Inflorescence a narrow, few-flowered panicle, 10-20 cm long. Spikelets 3-4 cm long, lanceolate; glumes lanceolate, long acuminate, 2.5-4 cm long, 5-veined; lemma teret, 1.5-2 cm long, hairy in the lower part, glabrous at apex; callus acuminate, pungent, 2.5-4 mm long; awn bigeniculate, articulateed at base, 2-2.5 cm long, column glabrous bristle plumose.

Common in Baltistan Ladakh.

Fl. & Fr. : July - August.

Distrib. : Central and Southern Asia, Pakistan, India Western Himalaya.

S. mongholica Turcz. ex Trin. in Bull. Scient. Acad. Imp. Sci. St. Petersb. 1: 67. 1836; Hook.f., Fl. Brit. India 7: 229. 1896; Bor, Grasses 645. 1960.

Densely tufted perennial herbs up to 60 cm tall; culms very slender, erect. Leaves capillary, setaceous, convolute, flexuous; ligule 2-3 mm long. Inflorescence a loose, open panicle 5-15 cm long, branches few, distant, widely spreading, capillary, flexuous, few-flowered, spikelets borne on long capillary pedicels. Spikelets 3.5-4.5 mm long, ovate, dorsally compressed; glumes subequal, 4.5-6 mm long oblong-lanceolate or elliptic, acute or subacute, purple below the middle, hyaline above; lower 1-veined with shorter side veins; upper 3-5-veined, lemmas elliptic, hairy throughout, 5-5.5 mm long, 2-toothed at apex; callus conical, blunt 0.4-0.6 mm long; awn 1.5-3 cm long, plumose throughout, columns twisted; anther-tips bearded.

Occasional in drier areas, on slopes, rocky places in Rupshu, Shushal, Ladakh, Lahul & Spiti.

Fl. & Fr. : June - July.

Distrib. : Mongolia, southern Russia, Tibet, India Western Himalaya.

Stipa orientalis Trin. in Ledeb. Fl. Alt. 1: 83. 1829; Hook.f., Fl. Brit. India 7: 229. 1896; Bor, Grasses 645. 1960.

Densely tufted perennial herbs up to 40 cm tall; culms forming hard tufts, clothed below with shining sheaths. Leaves filiform, setaceous, long capillary; ligule 2-3 mm long. Inflorescence a contracted, narrow panicle, 5-10 cm long, partially enclosed in the inflated sheath of uppermost leaf. Spikelets 8-12 mm long; glumes lanceolate, long acuminate, 2-3.5 cm long, hyaline; lower 1-veined or with shorter side veins; upper 3-veined; lemma terete, 6-12 mm long, silky hairy, tip with crown of short hairs; callus acuminate, pungent, 1.5-2.5 mm long, bearded; awn bigeniculate, articulated at base, 3.5-7 cm long, plumose; column twisted.

Common in drier situation at high altitude on rocky slopes, rock crevices in Namika La, Kharbu Koma to Shaksi, Tog, Dras, Zanskar, Rupshu, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Southern Russia, Mongolia, Pamir, India, Western, Himalaya.

Note : It is a good fodder grass.

Stipa purpurea Griseb. in Nachr. Ges. Wiss. Gottingen 1868: 82. 1868; Hook.f., Fl. Brit. India 7: 229. 1896; Bor, Grasses 645. 1960.

Densely tufted perennial herbs up to 25 cm tall; culms slender, filiform. Leaves linear, filiform, setaceous, convolute; ligule elongate, 13.5-5 mm long. Inflorescence loose, few-flowered, paniculate, 5-10 cm long. Spikelets few, 2-2.5 cm long, dark purple, on long capillary sigmoidly flexuous pedicels; glumes lanceolate, shortly acuminate, 1.5-2.5 cm long, dark purple with slender hyaline apex; lower 3-veined; upper 5-veined; lemma terete, 6-10 mm long, softly hairy all over; callus acuminate, pungent, 1.5-2 mm long; awn bigeniculate, articulated at base, 6-8.5 cm long, plumose throughout; column twisted.

Occasional in drier areas at high altitudes on rocky slopes, crevices in Rupshu Ladakh.

Fl. & Fr. : July - August.

Distrib. : Southern Russia, Tibet, India, Western Himalaya.

S. regeliana Hack. in Sber. Akad. Wiss. Wien 89: 130. 1884; Bor, Grasses 646. 1960.

Tufted perennial herbs up to 30 cm tall; culms slender, erect. Leaves linear, setaceous, convolute, glabrous or faintly scaberulous on the lower surface; ligule elongate, 3.5-5 mm long. Inflorescence a narrow, contracted panicle, 5-10 cm long. Spikelets lanceolate, 1-1.5 cm long; glumes subequal, 9-12 mm long, lanceolate, acute or acuminate, 3-5-veined, purple; lemma elliptic, 6-8 mm long, hairy throughout; callus acuminate, pungent, 0.8-1.5 mm long; awn bigeniculate, 1.5-2.5 cm long, plumose.

Occasional in Gilgit, Baltistan Ladakh.

Fl. & Fr. : July - October.

Distrib. : Tian Shan, Tibet, India, Western Himalaya.

Stipa sibirica (L.) Lam., *Encycl.* 1: 158. 1791; Hook.f., *Fl. Brit. India* 7: 231. 1896; Bor, *Grasses* 646. 1960. *Avena sibirica* L., *Sp. Pl.* 1: 75. 1753. *Stipa brandisii* Mez in Fedde, *Report.* 17: 207. 1921.

Tufted perennial herbs up to 1 m tall, occasionally shortly rhizomatous; culms erect, simple or branched. Leaves linear, flat, glabrous beneath, scaberulous or puberulous above; ligule oblong, 0.4-0.9 mm long. Inflorescence a narrow, inclined panicle, 10-40 cm long; branches ascending, often appressed, rarely spreading. Spikelets 8-12 mm long, lanceolate, green; glumes subequal, 7.5-10 mm long, elliptic or oblong-lanceolate, sub-hyaline, 3-veined; lemma elliptic, terete or slightly dorsally flattened, 6-8 mm long, hairy throughout; callus conical, blunt or acuminate, pungent, 0.5-1 mm long; awn bigeniculate, 1.5-2 cm long, scaberulous or hairy towards base only; palea linear, dorsally hairy.

Common on slopes, waste places in Gilgit, Dras, Ladakh.

Fl. & Fr. : July - September.

Distrib. : Caucasus eastward to Afghanistan, Pakistan, Southern Russia, China, Mongolia, Korea, Japan, India Western Himalaya.

Note : It is poisonous to stock.

S. splendens Trin. in Spreng., *Neue Entdeck.* 2: 54. 1821; Hook.f., *Fl. Brit. India* 7: 232. 1896; Bor, *Grasses* 647. 1960. *S. splendens* Trin. var. *gracilis* Bor, *Grasses* 647. 1960.

Perennial herbs up to 2 m tall; roots stout; culms robust, stout, yellow, shining, covered with fibrous remains of old sheaths at base. leaves

flat or convolute; ligule 2.5-10 mm long. Inflorescence a narrow contracted, dense or large effuse panicle 15-45 cm long; branches semi-verticillate, capillary, simple below, branched above. Spikelets 5-7 mm long, sessile or shortly pedicelled, white or dull purplish; glumes unequal, oblong-lanceolate or elliptic, subacute; lower 4-4.5 mm long, 1-veined; upper 5-6 mm long; 3-veined; lemma elliptic, 4.5-5.5 mm long, villous throughout, 2-toothed at apex; callus conical, blunt, 0.3 mm long, awn 6-10 mm long, column not twisted.

Common in open grassy places, along streams, rivers, loose sandy soil, along roads in Baltistan, Skardu to Shigar, Spituk, Indus valley, Gilgit, Nubra, Leh, Zaskar, Hemis, Ladakh.

Fl. & Fr. : July - September.

Distrib. : Russia, Iran, Tibet, Pakistan, India, Western Himalaya.

Stipa subsessiliflora (Rupr.) Rozhev. in Fedtsch., Fl. Asiat. Ross. 12: 128. 1916. *Lasiagrostis subsessiliflora* Rupr. in Osten-Sacken & Rupr., Sert. Tiansch. 35. 1869; *Stipa basi-plumosa* Munro ex Hook.f., Fl. Brit. India 7: 229. 1896; Bor, Grasses 643. 1960.

Densely tufted perennial herbs up to 40 cm tall; culms slender, strict. Leaves filiform setaceous, convolute, faintly scaberulous on lower surface; ligule 2-4 mm long. Inflorescence a narrow contracted panicle 5-15 cm long; branches and pedicels very short. Spikelets 9-12 mm long, purple; glumes unequal, ovate-lanceolate, acute or acuminate, margins white, hyaline, 3-5-veined; lower 8.5-11 mm long; upper 7.5-9.5 mm long; lemma elliptic-oblong, 4-5.5 mm long, sparsely hairy throughout; callus acuminate, pungent, 0.5-0.7 mm long; awn bigeniculate, articulated at base, 1-3 cm long, plumose throughout, densely hairy or bearded at base; column slightly twisted.

Occasional in drier situations at high altitude on rocky slopes, rocky places, crevices in Tsakzhun Tso, Lanak La, Baltistan, Nubra, Rupshu, Ladakh.

Fl. & Fr. : July - August.

Distrib. : Southern Russia, Tibet, India, Western Himalaya.

STIPAGROSTIS Nees

Usually perennial herbs; tufted sometimes with a knotty rhizomatous base or suffrutescent. Leaf-blades linear or terete, usually convolute. Inflorescence an open or contracted panicle. Spikelets 1-flowered, laterally compressed or terete; rhachilla not produced beyond lemma, disarticulating above glumes. Glumes persistent, longer than lemma, scarious, acute to acuminate, 1-11-veined; floret callus long, pungent; lemma cylindrical, coriaceous, convolute, indurated, produced into a 3-branched awn, branches or the central one plumose, awn with or without a column, usually deciduous; palea shorter than lemma; lodicules 2; stamens 3, rarely 1. Grains fusiform.

The genus comprises 50 species in the world; distributed in dry or desert regions of Africa, Middle East, Central Asia to north-west India; 5 species in India; 1 species in the cold desert.

The genus is adapted to arid conditions, having harsh, linear leaves with thickened outer epidermis; the blades are sometimes short and soon deciduous. It is sometimes included in *Aristida* but has plumose awns.

***Stipagrostis plumosa* (L.) Munro ex T. Anders.** in J. Linn. Soc. Bot. Suppl. 1: 40. 1860. *Aristida plumosa* L., Sp. Pl. ed. 2. 2: 1666. 1763; Hook.f., Fl. Brit. India 7: 228. 1896; Bor, Grasses 411. 1960.

Tufted perennial herbs up to 60 cm tall; culms slender from a stout branched woody root-stock; lowest sheaths and internodes covered with a thick flocculent fugacious wool. Leaves rigid, pungent, filiform, convolute. Inflorescence a narrow, contracted panicle, 6-15 cm long. Spikelets pallid; glumes unequal or subequal; lower 9-14 mm long; upper 11-15 mm long; lemma 2.5-4 mm long, glabrous smooth, gradually passing into the awn; column of awn 5-10 mm long, central branch of awn 2.5-6 cm long,

plumose in the upper portion, lateral awn-branches naked up to 25 mm long.

Common in desert areas, in waste places, on dry slopes, along roads in Baltistan, Skardu, Gilgit, Shyok valley, Ladakh.

Fl. & Fr. : Almsot throughout the year.

Distrib. : Mediterranean region, Middle East, Afghanistan, Pakistan, India, Western Himalaya.

Note : Due to its branched, extensive root-system the species acts as a soil-binder. It is a valuable fodder grass.

TETRAPOGON Desf.

Annual or perennial herbs; tufted. Leaf-blades, flat or convolute; ligule membranous, ciliate; sheaths keeled, often flabellate. Inflorescence terminal, solitary or a pair of dense, often ciliate or villous spikes. Spikelets laterally compressed, cuneate, 2-9-flowered, alternate in 2 rows on a tough rhachis; rhachilla produced beyond the lemma, terminating in a clavate cluster of sterile, glabrous, rarely ciliate, clavate awned or awnless lemmas. Glumes persistent, broad, thinly membranous, 1-veined, acute, acuminate; lemma ovoid, rounded on the back, coriaceous, laterally compressed and keeled, usually ciliate on the lateral veins and keel, entire or bidentate, with subapical awn; callus acute, ciliate; palea ciliolate on the keels; lodicules 2. Grains ovate, obovate or oblong, dorsally or laterally compressed, the pericarp free.

The genus comprises 5 species; distributed in the tropics and subtropics of the Old World; 2 species in India; 1 species in the cold desert.

Tetrapogon villosus Desf., Fl. Atlant. 2: 389. t. 255. 1799; Bor, Grasses 475. 1960. *Chloris villosa* (Desf.) Pers., Syn. Pl. 1: 87. 1805; Hook.f., Fl. Brit. India 7: 251. 1896.

Densely tufted perennial herbs up to 30 cm tall; culms stout, erect from woody base, clothed with equitant leaf-sheaths, sheaths flabellate. Leaves linear, acute, flat or twisted, rigid; ligule obscure. Inflorescence a spike, usually paired, exerted, dorsally adpressed, rarely separating at maturity, 2-8 cm long, pale yellow or purple. Spikelets 4-6-flowered, usually 4-awned, lowest 1-3-florets fertile; lower glume ovate-lanceolate, 2-3 mm long, acuminate or shortly awned; upper ovate or elliptic oblong, 2-toothed at apex, 3-4 mm long; lowest lemma elliptic, 2.5-4 mm long, keel and lateral veins ciliate, margins hyaline, awn 8-10 mm long; upper lemma hirsute; upper 2-3-florets sterile and reduced to glabrous lemma.

Common on dry slopes, dry sandy soil along road, in waste places in Gilgit, Baltistan, Shyok river, Deosai Plain, Ladakh Lahul & Spiti.

Fl. & Fr. : June - October.

Distrib. : Tropical Africa, Pakistan, India.

TRIKERAIA BOR

Perennial herbs; tufted; rhizomatous. Leaf blades setaceous, flat or convolute. Inflorescence a contracted or spreading panicle. Spikelets 1-flowered, terete or laterally compressed; rachilla not produced, disarticulating above glumes. Glumes persistent, hyaline to membranous, 1-7-veined; lemma oblong elliptic, membranous, hyaline, dorsally compressed, hairy, covering only flanks of palea, bilobed, lobes setiform, with an awn produced from the back of the lemma, persistent, geniculate; floret lanceolate; callus obtuse, conical, bearded; palea 2-veined, without keels, acute; lodicules usually 3. Grains fusiform.

The genus comprises 2 species; distributed in Tibet and Himalayas; 1 species in India and also in cold desert.

Trikeria hookeri (Stapf) Bor in Kew Bull. 9: 555. 1955; Bor, Grasses 647. 1960. *Stipa hookeri* Stapf in J. Linn. Soc. Bot. 30: 120. 1894; Hook.f., Fl. Brit. India 7: 232. 1896.

Tufted, rhizomatous perennial herbs up to 1 m tall; culms robust, erect, leafy upwards. Leaves linear, setaceous, convolute, rarely flat, green or glaucous, smooth or scaberulous; ligule oblong, about 2 mm long. Inflorescence a contracted or spreading panicle, 10-15 cm long, inclined, branches 2-4-nate. Spikelets 4-6 mm long, yellowish or purplish; glumes subequal, oblong-lanceolate, acute, 7.5-8.4 mm long, 3-veined, minutely scaberulous; lower lemma 7-5 mm long, terete, hairy, 5-veined; awn almost curved, 12-15 mm long; palea hairy; upper lemma sparsely hairy or villous.

Common in alpine deserts, pastures, in waste places in Rupshu, Nubra Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Tibet, India, Western Himalaya,

TRIPOGON Roem. & Schult.

Slender perennial herbs; tufted. Leaves usually basal, blades filiform, convolute. Inflorescence a solitary, terminal, 2-seriate, unilateral spicate raceme; the spikelets overlapping and appressed to the rachis. Spikelets laterally compressed, many flowered, linear to elliptic, disarticulating between the florets; rachilla produced between the glumes, jointed at the base; Glumes persistent, unequal, narrow, membranous, 1-veined, or upper rarely 3-veined, keeled; lemma ovate, dorsally convex, 3-veined, keeled, bidentate or 4-fid, awned in the cleft; palea winged ciliolate on the margins; callus villous and bearded; lodicules 2; stamens 3. Grains narrow, terete, free within the lemma.

The genus comprises about 30 species; distributed chiefly in Old World tropics, also in tropical America; 13 species in India; 1 species in the cold desert.

The genus is quite closely related to *Leptochloa*.

Tripogon filiformis Nees ex Steud., Syn. Pl. Glum 1: 301. 1854; Hook.f., Fl. Brit. India 7: 288. 1896; Bor, Grasses 521. 1960.

Tufted perennial herbs up to 45 cm tall; culms slender, simple, erect. Leaves filiform, convolute. Inflorescence a straight or flexuous spike, 5-20 cm long. Spikelets 5-8-flowered, 4-10 mm long; lower glume lanceolate, asymmetrical with a rounded lobe on one side, 1.6-2 mm long, 1-veined; upper glume lanceolate, 2-toothed at apex, 1-veined, mucronate or shortly awned; lower lemma elliptic-lanceolate, 2-3.5 mm long, 4-fid or toothed at apex, outer teeth awned, awns 1-3 mm long, inner teeth short or long, obtuse, acute, sometimes with curved median awn 4-10 mm long; callus bearded in front.

Common on slopes in Lahul & Spiti, Ladakh.

Fl. & Fr. : July - August.

Distrib. : India, Kashmir to Sikkim, Assam, Meghalaya.

Trisetum Pers.

Perennial herbs. Leaf-blades flat or convolute. Inflorescence a spiciform dense panicle, rarely open. Spikelets 2-several-flowered; not jointed on their pedicels; rachilla jointed at the base, usually produced, hairy. Glumes mostly unequal, shorter than spikelets, dorsally rounded, persistent, keeled, broadly hyaline on the margins, lower 1-3-veined, upper 3-veined; lemmas membranous to coriaceous, strongly compressed, keeled, 5-veined, 2-toothed or bisetulate, dorsally awned from below middle; callus bearded, palea keeled, silvery, keel scabrid or ciliate; stamens 3; ovary glabrous. Grains fusiform, compressed.

The genus comprises 70 species in the world; distributed in the temperate regions and on mountains in the tropics; 8 species in India; 2 species in the cold desert.

- 1a. Panicle dense, spiciform, ovoid strict erect *T. spicatum*
- b. Panicle loose, interrupted, long and narrow *T. clarkei*

Trisetum clarkei (Hook.f.) R.R. Stewart in Brittonia 5: 431. 1945; Bor, Grasses 447. 1960. *Avena clarkei* Hook.f., Fl. Brit. India 7: 278. 1896.

Tufted perennial herbs up to 60 cm tall; culms slender, erect or geniculately ascending, puberulous below the panicle. Leaves linear, flaccid, hairy, flat; sheath with spreading or reflexed hairs. Inflorescence lanceolate or subcylindric loose or dense spiciform, interrupted panicle, 7-14 cm long, erect or inclined; axis and branches puberulous. Spikelets 2-3-flowered, 5-8.5 mm long; glumes unequal, lanceolate, acute; lower 3-veined, 4-6 mm long; upper 5.5-7.5 mm long; lemma lanceolate, acuminate, 5.5-7 mm long, 1-3-veined, apex 2- aristulate, awn 4-8 mm long, recurved, subterminal.

Common in alpine pastures in Baltistan, Astor, Gilgit, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - October.

Distrib. : Pakistan, Nepal, India, western Himalaya.

Trisetum spicatum (L.) Richt., Pl. Eur. 1: 59. 1890; Bor, Grasses 448. 1960. *Aira spicata* L., Sp. Pl. 1: 64. 1753. *Avena subspicata* Clairv., Man. Herbor. 17. 1811, based on *Aira spicata* L., Hook.f., Fl. Brit. India 7: 278. 1897.

Tufted perennial herbs up to 60 cm tall; culms pubescent or tomentose, medium, erect. Leaves linear, flat or convolute, hairy; lower sheath loose. Inflorescence ovoid to cylindrical, dense, interrupted, spiciform panicle, 2-9.5 cm long. Spikelets 2-3-flowered, 4-7.5 mm long, ovoid-oblong, yellowish-green, purplish or white; glumes subequal or unequal; lower 3.5-5 mm long, usually 1-veined; upper 5-6 mm long, 2-cuspidate or 2-aristate, 1-or faintly 3-veined, awn 2.5-6.5 mm long, strongly recurved, subterminal; palea-keel scabrid.

Common in alpine pastures in Gilgit, Baltistan, Ladakh, Lahul & Spiti.

Fl. & Fr. : July - August.

Distrib. : Arctic and alpine regions of Northern Hemisphere; Tibet, Pakistan, India, Western Himalaya.

VULPIA Gmel.

Annual herbs. Leaf-blades linear, flat, convolute or involute. Inflorescence a secund, contracted, spiciform or racemiform panicle. Spikelets several flowered, laterally compressed, disarticulating below florets and sometimes also below pedicels; pedicels clavate; rhachilla smooth or ciliate. Glumes unequal, lower veinless or 1-veined, sometimes minute or absent, upper 1-3-veined, acute to awned; lemmas coriaceous, rounded on the back, margins incurved, 3-5-veined, awned; palea 2-keeled, narrow; stamens 1-3. Grains linear, adherent to the palea.

The genus comprises 22 species; distributed in temperate, warm temperate and subtropical regions; 5 species in India; 1 species in the cold desert.

Vulpia myuros (L.) C.C. Gmel., Fl. Bad. 1: 8. 1805; Bor, Grasses 564. 1960. *Festuca myuros* L., Sp. Pl. 1: 74. 1753; Hook.f., Fl. Brit. India 7: 356. 1896.

Annual herbs up to 46 cm tall; culms slender, leafy, glabrous, erect. Leaves linear, setaceous, rough on the margins, shortly hairy above, upper with tumid sheaths embracing the base of panicle; ligule short, auricled. Inflorescence a sparingly branched, strict or flexuous, glabrous or puberulous panicle, or raceme 5-25 cm long; rhachis and branches smooth or scaberulous; pedicels up to 2.5 mm long. Spikelets 6-10.5 mm long, breaking up at maturity below each fertile floret; most florets fertile, upper 1 or 2 reduced and male or sterile; lower glume 0.4-2.5 mm long; upper glume 2.5-6.5 mm long, awned; fertile lemma 4.5-7.5 mm long, with an awn usually 1-2 times as long, 5-veined.

Common as weed of cultivation, in open grassy places in Gilgit, Baltistan, Nubra; Ladakh, Lahul & Spiti.

Fl. & Fr. : June - August.

Distrib. : Central and southern Europe, Mediterranean region eastwards through Middle East to Pakistan, India, western Himalaya.

Cultivated species

Avena sativa L.

A. byzantina C. Koch

Hordeum aegiceras Nees ex Royle

H. vulgare L.

Pennisetum glaucum (L.) R. Br.

Secale cereale L.

Triticum aestivum L.

Doubtful and excluded species

Agrostis micrantha Steud. - Species from eastern Himalaya.

Bromus arvensis L.

Bromus barbatus P. Beauv.

Chrysopogon fulvus Trin. - Species from S. India

Digitaria cruciata Nees - Eastern Himalaya to Simla; record by Aswal (1994) from Keylong - Kardang in Lahul (H.P.) doubtful.

Festuca cummunsii Stapf - Species from eastern Himalaya.

Oryzopsis molinoides (Boiss.) Hack. ex Paulsen - treated as synonym of *O. lateralis* Stapf by some

Stipa barbata Desf.

Stipa duthiei Hook.f.

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