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Major weeds and their management in Jammu and Kashmir

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Abstract
The state of Jammu & Kashmir lies in north-western part of the country has a total geographical area of 22.2 mha excluding the area that is under POK situated along trans-himalayan region that lies between 32°17' and 36°58' North latitude, and between 37°26' and 80°30' East longitude. The weed flora that pose serious threats to endemic biological diversity and are of very offensive nature whether native or of exotic origin are highlighted in this study [1]. The findings were presented in one of the annual review meetings of AICRP on weed management for the first time in order to highlight the scenario of weed infestation in the region. Prominant weed species that are found in various agro-ecosystems of J&K particularly are summarised as follows:

Cultivated fields: Lowland rice- *Eichnochloa colonum / crus galli; Fimbristylis miliacea; Ammannia baccifera; Cyperus iria / rotundus; Marsilea Quadrifolia; Potamogeton distinctus; Salvinia Auriculata; Lemna Minor; Kickxia Subsessilis; Erigeron bonariensis. Cyperus, Geranium, Epilobium, Caucalis, Trifolium, Prunella, Lactuca* and *Cynoglossum.* Upland crops- *Papaver dubium, Ranunculus arvensis, Lolium Temulentum, Bromus japonicas, Poa pratensis, Cynodon Dactylon, Vulpia Myuros, Polygonum tubulosum, Convolvulus arvensis* and *Galium aparine*. *Trianthema Monogyna; Portulaca Oleracea; Ipomoea carnea / hispida; Eleusine Indica; Panicum repens; Sorghum halepense/nitidum; Poa annua; Setaria Glauca; Amaranthus hybridus / graecizans; Euphorbia hirta/emodi; Paspalum conjugatum; Silene conoidea;* species of *Malva, Geranium, Lycopsis; Cotula anthemoides; Cichorium Intybus; Taraxacum officinale; Fumaria parviflora; Hibiscus trionum; Tribulus Terrestris.*

Tourist spots, fruit orchards and grass fields: *Robus, Rosa, Rubia, Hedera* and *Spiraea Oxalis corniculatus, Tribulus Terrestris; Erodium Cicutarium, Gallium aparine, Bellis perennis, Stellaria media, Anagallis arvensis, Eruca sativa, Convolvulus arvensis, Poa Annua / pratensis, Bromus japonicus, Eragrostis spp.; Malva Rotundifolia; Setaria Viridis* and *Phleum Paniculatum.* During summer months *Lotus corniculatus, Melilotus alba;* species of *Trifolium, Lathyrus, Medicago, Sisymbrium, Erigeron, Astragalus; Geranium ocellatum / pratense; Calamintha Clinopodium; Nepeta cataria; Fragaria Vesca; Thymus serpyllum; Rumex Nepalensis* and *Taraxacum officinale* predominate these land pockets. Moreover, dominance of *Impatiens amphorata, Rubia cardifolia, Plantago Lanceolata /major, Daucus Carota, Caucalis leptophylla, Cyperus rotundus, Myriactis nepalensis, Siegesbeckia Orientalis* and species of *Rumex, Polygonum, Abutilon and Viola.*

Waste lands: *Ranunculus arvensis/ falcatum, Conium maculatum, Silene conoidea, Capsella Bursa Pastoris, Cynoglossum denticulatum, Goldbachia laevigata, Polygonum tubulosum* and *Anagallis arvensis. Verbascum Thapsus, Cichorium Intybus, Euphorbia helioscopia / thymifolia, Xanthium strumarium, Sisymbrium Loeselii / Sophia, Bupleurum lanceolatum, Galinsoga parviflora, Urtica Dioica, Marrubium vulgare, Cousinia Microcarpa, Centaurea iberica, Digitaria Marginata, Setaria Verticillata* and *Eragrostis nigra, Coronopus Didymus, Tribulus Terrestris* and species of *Oxalis, Herniaria, Geranium* and *Veronica.* During August –September, waste lands are full of *Artemisia, Cannabis, Caucalis, Chenopodium, Chrozophora, Plantago, Trifolium, Euphorbia, Epilobium, Hartmannia, Gnaphalium, Hypericum, Hibiscus, Datura, Solanum, Amaranthus, Erigeron* and *Mentha.*

Water bodies: Submerged weeds in lakes are *Potamogeton Lucens /pectinatus/crispus, Hydrilla verticillata, Myriophyllum spicatum, Ceratophyllum Demersum* and *Chara spp.* Free floating water ferns are *Salvinia natans* and *Lemna spp.* Towards the water margins a free floating herb *Nymphoides Peltatum* with small lotus like leaves is predominant. Besides the side projections and shallow portions are full of tall reeds and cat-tails like that of *Phragmites communis* and *Typha angustata.*

Chemical control recommendations have been in vague only for some cultivated crops due to lack of appropriate R & D backup and negligible involvement of stakeholders. However, some of the herbicidal management measures practised in the state are:

Rice: *Chemical methods:* 1) Butachlor granules 5 G @ 30 kg/ha at 4-6 days after transplanting in standing water 2-3 cm deep and do not drain the field for one week. 2) Anilophos + Ethoxy sulfuron @ 0.375+0.015 kg a.i/ha at 10 DAT. 3) Add 3 lt of Butachlor 50 EC in 150 kg sand and broad cast in standing water within 2 DAT.

Maize: *Chemical methods:* 1) Atrazine @1.0 kg a.i./ha in 800-1000 lts of water should be soil applied just after sowing in sole maize crop; 2) For maize+pulse mixed cropping, apply pre-emergence pendimethalin@ 1.0 kg a.i./ha or pre-plant incorporated fluchloralin@0.75 kg a.i./ha.
Wheat: *Chemical methods:* for broad spectrum weed control Isoproturon@0.75 kg a.i. + 2,4-D ethyl ester@500 ml/ha may be sprayed with 500-600 lts of water at 30-35 days after sowing; 2) Metribuzin @ 200-250 g a.i./ha should be sprayed at 30-35 DAS where isoproturon is not able to control *sitti*.
Rapeseed and Mustard: Fluchloralin 0.70 kg\ha ppi, isoproturon 1.0 kg\ha pre-em, pendimethalin 1.0 kg\ha pre-em. *Marigold:* 2 hand weedings at 20 and 40 days after transplanting or application of trifluralin @ 1.0 kga.i/ha pre plant incorporation (PPI)+1HW (46.2q/ha). *Gladiolus:* 2 hand weedings at 20 and 40 days after transplanting or application of pendimethalin @ 2kg a.i /ha +1HW. *Okra:* Fluchlorian @1.0kg a.i/ha PPI, Alachlor @2.0kg a.i/ha pre emergence application (PRE), Trifluralin @ 1.0 kga.i/ha PPI and Oxyflorafen @0.35 kg a.i/ha PRE along with 1-hand weeding.

Key words: Major weed flora of J&K, different ecosystems, herbicidal weed management

Introduction

Montane climatic regions of India comprising of Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Sikkim and Arunachal Pradesh are located latitudinally in the North Temperate

Zone comprising of large area having temperate like conditions due to altitudinal variations ranging between 1500 to 2500 m above the mean sea level. In the Himalayan mountains the temperature falls by 0.6 °C for every 100 m rise in altitude and this gives rise to a variety of climates from nearly tropical in the foothills to tundra type above the snow line. One can also observe sharp contrast between temperatures of the sunny and shady slopes, high diurnal range of temperature, inversion of temperature, and variability of rainfall based on altitude. The great Himalayan range witness's heavy snowfall during winter months of December to February at altitudes above 1500m. The changes in these regions between summer and winter are generally subtle, warm or cool, rather than extreme. However, a temperate climate can have very unpredictable weather. The states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand and Sikkim experience this kind of weather.

The Western Himalayan region extends from Kashmir to Kumaon. This temperate zone abounds in dense forests of conifers and several other species of broad-leaved temperate trees. The most prominent species are Deodar, Blue pine, Spruce Juniper and Silver Fir. The alpine zone extends from 4,750 metres to the higher reaches of the Himalayas. The states of Jammu & Kashmir and Himachal Pradesh are literally the *fruits baskets* of India; their produce range from apples, cherries, strawberries, pears and peaches to walnuts, pine nuts, almonds, apricots and more. The exceptional and precious saffron is also grown in the Kashmir valley. The high mountain zone comprising the Kashmir Valley, Pir Panchal range and its off-shoots including Doda, Poonch and Rajouri districts and part of Kathua and Udhampur districts.

The eastern Himalayan region extends from Sikkim and northernmost parts of West Bengal. This zone has forests of Oaks, Laurels, Maples, Rhododendrons, Alder, Birch, Junipers and Dwarf Willows. Sikkim is a haven for highly colourful orchids. The hill slopes in and around Darjeeling in the northern part of West Bengal are extensively utilized for the cultivation of tea. Compilation of alien flora from phyto geographically distinct regions is of immediate relevance not only for better understanding the patterns of plant invasion but also for explicating the processes promoting invasion at local, regional or global scales. Despite being at higher risk of invasion by plants because of its European colonial past, south Asia has received very little attention in respect of characterization of its alien flora. This paucity of baseline data necessitated compilation of the first catalogue of alien flora from the Kashmir Himalaya—a phytogeographical distinct south Asian region nestled in the north-western folds of Himalayan biodiversity hotspot. Total alien flora of the region is represented by 571 plant species, belonging to 352 genera and 104 families. It constitutes a relatively higher (29%) proportion of the total flora of the region. Families with largest number of alien representatives are Poaceae (60 species), Asteraceae (54 species), and Brassicaceae (30 species). However, families such as Amaranthaceae (83%) and Chenopodiaceae (71%) show higher percentage of aliens relative to their total number of plant species in the region. Most of the alien plant species (38%) trace their origin to Europe, followed by Asia (27%) and Africa (15%). Present study also reports, for the first time, occurrence of seven plant species in this region. Each alien plant species is provided with information on the origin, habit, mode/purpose of introduction, current invasion status, altitudinal range and the primary published source (Khuroo *et al.* 2007; Nayar, 1977; Rapoport, 1991) [11, 13,14].

Like other parts of the world these invasive species are a growing problem for Himalayan region, both ecologically and economically. The impact of invasive species on native flora and eco-system has been immense. Although defined differently by different workers, the one which fits best for alien invasive species is the one given by GISP (2003) [8] as most pertinent and suitable. It says "invasive alien species are non-native organisms that cause, or have the potential to cause harm to the environment, economies, or human health". Thus establishment and spread of these species threatens ecosystems, habitats or species with economic/environmental harm (GISP, 2001; Daehler and Carino, 2000) [7, 4].

Major Weed Flora of Trans and Greater Himalayan Region

With its varied climate, and wide range of physical features, India is the home of an amazing array of species. The Himalayas are a treasure trove of weed flora many of which grow all over the northern temperate zone too. Some of them are unique to the Himalayas while others are very alpine in character. The lower hills have a mixture of temperate and subtropical flora. The plains and the scrub deserts have distinctly different weeds, while hot and humid areas have flora that is specific to their condition. The weed spectrum, in these areas is a threat to endemic types (Gurevitch, and Padilla, 2004) [9] because of their exotic origins. Some of the weed flora of trans and greater Himalayan region are enlisted below (Handa, N. 2003) [10].

Himalayan Musk Rose Rosa brunanii Rosaceae

Wild rose is the most commonly seen all along the northern hills growing at heights of 1200-2400 m. During may all the musk rose bushes burst into bloom, clothing trees, running wild over hedges and tumbling precariously over cliffs and boulders. The air is heady with their scent and honeybees and nectar-loving insects have a field day. The flowers are white

and about 3-4 cm across, filled with a mass of yellow stamens. The stems are prickly and the leaves are finely-toothed ovals with pointed tips. The R. moschata found in the western Himalayas is very similar, the main difference being that its branches are smooth and the leaf stalks are without prickles. Several other varieties of wild white roses grow in the hills. Wild, pink roses or *R. macrophylla*, arc also common and can be seen growing side by side with the white ones. When the wild rose withers away, its place is taken by a red rounded fruit known as a rose-hip. In the autumn, a rose bush hung with rose-hips is a very pretty sight. In Hindi, the musk rose is known as Kuji, Kunja or Karer. Sometimes the wood is used to make walking sticks. An attar is extracted from the flowers. Asoothing cough syrup is made out of the hips; these have a high vitamin C content. Akind of a marmalade can also be made of the hips by boiling them and passing the pulp through a sieve; to each 1/2 kg of pulp add an equal amount of sugar and boil till it jells.

***Chickweed Stellaria media* Caryophyllaceous**

The chickweed is one of the most easily seen wild flowers of the winter all over north India The tiny, white, star-shaped flower grows rampant in cool, moist areas in parks, woodlands and gardens. In the summer it is found growing all over the hills to a height of about 2500 m. The chickweed is found all over Europe and North America. The plant is about 10-15 cm high, and the oval-pointed leaves which grow opposite each other are long petioled, that is, with long stalks. The chickweed contains saponin, calcium and potassium salts and is used in traditional medicines. Crushed chickweed was once rubbed on arthritic joints to relieve the pain. It is used homeopathically for rheumatism. In Hindi it is called, Buch bucha. Herb al'oiseae is the French name for this plant; Vogelmiere, in German and Morsus Gallinae [hen's-bite] in medieval Latin. All the names associate the chickweed with birds. It has long been used as birdfeed; geese are said to greatly relish the seeds. Humans use the tender leaves in salads or cook them as a vegetable with a knob of butter added on top.

***Datura Datura metal* Solanaceae**

In the mountains the daturais found to a height of about 2200 m., the varieties at higher altitudes are different. The plant has an unpleasant odour and grows freely on dry, waste ground, amidst rubble or in the ruins of old buildings. Very often it does not look attractive because it is covered with dust. The fruit of the datura is a marble-sized oval covered with prickles, rather likea miniature hedgehog, with wrinkled seeds nestling inside. The name, thorn-apple arises from the shape of the seed. Dhatura is the Indian name. It has sinister connotations as at one time thugs used a drug from the plant to stupefy their victims. Eating the seed can cause severe hallucinations and even death. All the parts of the plant are narcotic, but its medicinal virtues have been appreciated of old. The dried stalks and leaves are used in asthma cigarettes. It is used in hysteria and neuralgia as well.

***Indian Lily-Of-The-Valley Ophiopogon intermedius* Haemodoraceae**

The Indian lily-of-the-valley grows in shady forest banks all over the Himalayas, and it may be seen from May to early September. This delicate wild flower is about 10-15 cm high. The flowers are white, tinged with pink on the outside. They look like small white bells with heads hanging downwards and grow in a spike-like cluster. The stems are leafless. The little bells are scented and their light fragrance carries in the breeze when a lot of them grow together. The leaves are grass-like and of a deep green hue. The fruit of this wild flower consists of half a dozen berry-like bright blue seeds. The tubers of the Indian lily-of-the-valley are used as a herbal treatment for dropsy.

***Sweet Snow Hedychium spicatum* Zingiberaceae**

In July and August whole hillsides in the Himalayas are covered with these fragrant, white flowers, touched with orange at the base. The plant belongs to the same family as ginger and is found in the Himalayas from Himachal to Arunachal, at heights of 1800-2800 m. mostly in shaded banks and shrubberies. The fragrant flowers grow along the stem in a dense spike. The long, narrow petals are a creamy white with orange-red bases with long protruding filaments. The robust leaves are alternate and broadly lanceolate with clasp-ing foot stalks; the leaves remind one of canna leaves. Each dark green leaf can be about 30 cm by 4-12 cm broad. The plant has a round fruit with three sections, which when ripe, opens to show its orange-red lining with black seeds nestling inside. In turn, these seeds are enclosed in their own covering of red. After the plant has finished flowering these red seeds can be seen studding the plant. Sweet snow is a hardy plant and does particularly well on the slopes of Simla and Kasauli. In the winter it dies down, for this gives the rhizomes a rest. Aperfume known as abir is obtained from the rootstock. The roots are dried and powdered and then used for perfuming tobacco. The roots are used medicinally because they are carminative and stimulant. The leaves are woven into mats. In Hindi, the plant is known as Sitruti or Kapurkachri.

***Cobralilyor Jack-In-The-Pulpit Arisaema concinnum* Araceae'**

One cannot help noticing these singular plants with their pointed hoods and protruding snaky tongues. The hood has given rise to the name of the cobra lily. Avery similar plant called Jack-in-the-pulpit or cuckoo-pint or lords and ladies, which also belongs to the Arum family, grows in Europe. The cobra lily stands about 30-50 cm tall and is found all over the Himalayas extending from Himachal to Burma. There are several varieties and all of them can be seen from June to September. This curious flower has palmate leaves with seven or more leaflets spreading finger-like from the tip of the leafstalk. The spathe, or the snake hood is dark green with a purple tip, it is marked with white stripes and purple pencilling at the base. The spadix, or the central stalk encased in the hood, is covered with tiny male and female flowers. It has a foetid smell and attracts flies and other insects. When the plant has finished flowering, a stalk covered with bright red berries comes up in its place in early autumn, creating a splash of colour in the woods. The generic name, *Arisaema*, signifies bloody arum, and refers to the purple stains on the spathe. Legend has it that these lilies were received at the Crucifixion. One of the many names of the cobra lily is Samp-ki-Khumb. The tuberous roots of many types of cobra lilies can be boiled and then ground into a flour and eaten. The American Indians used to greatly relish the boiled scarlet berries of the closely related Jack-in-the-pulpit that grows in North America. It was known as the Indian turnip in that country, for the tubers were boiled and eaten.

Stinging Nettle Urthicadiaica **Urticaceae**
Anyone who has walked in the hills is sure to have experienced being stung by nettles. Widespread all over the temperate Himalayas this plant is completely covered with hollow stinging hairs full of formic acid. The brittle end of the hair breaks when one brushes against the plant, and the contents are ejected into the skin causing discomfort andrash. The stinging nettle is very easy to recognise with its dark green, large, hairy and coarsely-toothed spear-shaped leaves that grow opposite each other on a robust, grooved stem. Both the stem and the leaves are clothed with stinging hairs. This plant has tiny, green petal-less flowers growing in long, tassel-like clusters. Male and female flowers grow on different plants. In Hindi this pliant is well known as Bichu Buti. It is used to treat rheumatism and sometimes even to activate paralysed limbs. *U. parviflora* a closely related variety is found both in the Himalayas and the Nilgiris.

Shepherd's Purse Capsella bursa-pastoris **Cruciferae**
The shepherd's purse is a cosmopolitan wild flower found all over the temperate areas of the world. It grows along waste ground, ditches and grassy places. In the hills it grows from April to October and in the northern plains from December to March. The shepherd's purse is a medicinal plant and has been used as a drug as far back as the middle Ages. The planthas haemostatic properties. For a long time it was used instead of quinine to treat malaria. Homeopathy makes use of the plant in treating nose-bleeds and urinary calculosis. Extracts from the plant are used in cosmetic preparations. The young leaves can be used in salads. Another name for this plant is pickpocket.

Mistletoe Viscum album **Loranthaceae**
Everyone has heard of the mistletoe but very few have actually seen this semi-parasitic, evergreen shrub. The reason for this is that the mistletoe grows upon the branches of trees. It is commonly found all along the temperate Himalayas from Kashmir to Nepal at heights of 1000-2700 m. The mistletoe has yellow-green branches and leathery, narrow leaves with blunt ends, rather like the handles of spoons. The branches fork repeatedly and tiny yellowish-green flowers cluster at the fork. Male and female flowers grow on different bushes in the early summer. The berries ripen early in the winter of the following year and the seeds are distributed by birds. The mistletoe grows on walnut, apricot, poplar, chestnut and old apple trees. The plant is known as Ban or Banda in Hindi.

Wind Flower Anemone vitifolia **Ranunculaceae**
The wild anemone commonly known as the wind flower, has large white flowers of 3.5-5 cm across, filled with yellow stamens and tinged with pink on the reverse. The stalks are soft and silky, long and erect. The round flower buds are white and woolly. The large leaves are five-lobed like a palm, toothed, with a smooth upper surface and woolly beneath and they grow in a cluster. The leaves just below the flower head are much smaller and grow on smaller stalks. The wind flower is a perennial and is about 30-90 cm high and can be seen from quite a distance where it grows in the mountains. The anemone is found all over the temperate Himalayas at heights of 2100-3000 m. and is in flower from July to September. We have several species of anemones in the hills. Some flower in the spring and some in the autumn. Anemones flourish in dry, open woodland and a porous, chalky soil.

Mazus Mazus japonicus **Scrophulariaceae**
The plant is about 6-8 cm high, lower leaves are small and oblong, about 2-3 cm long and coarsely toothed; they narrow down into a stalk-like base. The tiny flowers are actually whitish, faintly shaded with blue-purple and yellow with a darker upper lip. The calyx is lobed half way down. The mazus is found all over the northern plains and in the hills to about a height of 1500 m. where it flowers in the summer. In the plains it flowers in the winter, though some flowers can be found the year around. It is a great favourite with honey bees. In January when not many annuals are in bloom they look to the mazus flower dotting the grass, for nectar.

Globe Thistle Echinops cornigerus **Compositae**
The globe thistles are distinctly noticeable and rather handsome plants that grow all over the western Himalayas from 2400-3300 m. They can be seen blooming just after the rains until the beginning of autumn. The flower heads are almost perfect spheres and made up of small closely packed blue flowers. In between these closely packed flowers sharp spines jut out. They are a little longer than the flowers and can prick your finger very sharply. The silvery-green leaves are pinnately divided into many segments. The edges of the leaves have sharp spines all along. Another variety of the globe thistle, *E. niveus*, also grows in the hills. This one is almost white but otherwise very similar. This plant is known as the Oontkatela in Hindi.

Wild Delphinium Delphinium denudatum **Ranunculaceae**
Delphiniums are found growing all over the Himalayas from Kashmir in the west to Nepal at heights of 1500-2700 m. The blue flowers grow along the stalk in spike-like clusters. They are rather irregular in shape, with five outer petals and four shorter inner petals which curve inwards for the nectar is secreted within these. The leaves are divided into narrow segments, so they look rather fern-like. There are several types of delphiniums found in the hills and most of them flower in the summer roughly between June and August. Delphiniums grow in a chalky and weedy soil in grassy banks and along the margins of fields. In Hindi this flower is known as Nirbishi, or without poison. The roots are used to treat toothaches. The other varieties of wild delphiniums also have medicinal qualities; they are used to heal animal wounds and to kill their ticks and lice.

Dog Violet Viola canescens **Violaceae**
Violets can be found growing in shady places in woodlands from 1500-2500 m. in the northern hills. The stems are about 6-10 cms and the leaves are heart-shaped or kidney-shaped, of a grey-green hue and covered with palehair. The plant sends out runners which root to form new plants. The violet is an old medicinal plant, and a very effective cough mixture called Banapsha is made from it. In the Ayurvedic and Unani systems of medicine, violet flowers are used for treating several diseases. Homeopathic remedies for skin, eye and ear troubles also use the violet plant.

Common Speedwell Veronica spp. **Scrophulariaceae**
There are many types of speedwells found all over the north Indian hills growing from 1500-5000 m. They can be white, lilac, purple-blue or a clear blue, which gives rise to the saying/eyes as blue as speedwells'. The four-petalled blue flowers grow in short racemes, each petal veined with a darker blue. The stems and leaves are covered with soft hair.

The leaves are small ovals, serrated at the edges. The plants are about 30 cmtall. Speedwells grow in mixed weed-lands, as well as sparse meadows and they like a sandy, loamy and rather acid soil. The botanical name Veronica, is named after St. Veronica.

Floss Flower Ageratum conzoides **Compositae**
Originally from tropical America, this is another wild flower which has spread all over India. It grows to a height of 2000 m. In the winter, parks and roadsides are carpeted thickly with ageratum. At higher altitudes it flowers from the early summer right up to the autumn. The plant stands erect and is covered with soft hair all over its stem and leaves. Each flower head looks like amop and is composed of very tiny florets. The fruit is black, angled and crowned with a ring of three to five minute lybarbed, slender scales. Ageratum can also be white. In Hindi is known as Nilam and for some reason it is also known as Tambaku. The botanical name Ageratum comes from the Greek a, without, and gems, age referring to the long lasting flowers.

Lesser Periwinkle Vinca minor **Apocynaceae**
While walking through shady woodland slopes of hill stations of north India one sees banks of purple-blue periwinkles. It was originally a garden plant but is truly wild now in the Simla and Mussoorie areas, where it was introduced over a hundred years ago. It tumbles over tree-shaded slopes which it covers with its dark green, oval-pointed leaves. The periwinkle is a perennial plant with a creeping rootstock, which roots at the nodes and throws up short, erect flowering stems. The purple-blue flowers with five petals, are borne on short stems. The petals are united for half their length to form a tube, and then open out which makes the flower look trumpet-like when it is viewed sideways. The leaves of the periwinkle grow opposite each other.

Commelina Commelinaforkalii **Commelinaceae**
The beautiful commelina belongs to the spiderwort family. This is an unusually pretty blue wild flower and can be seen in the rains till the beginning of the winter. There are several different varieties of commelinas found all over India, growing at a height of up to 3500 m. The stems are fleshy, tinged with pink and the leaves are narrowly oblong, with pointed tips. The petals are a beautiful sky-blue and have an orchid-like appearance, with one petal being lighter than the others. When the flower withers away, its place is taken by a capsule which has three smooth seeds in it. The shape of the seed case is clearly divided into three sections, when viewed from the outside. This plant flowers in the summer and the rains. Look for it in fields, gardens and wasteland. Animals like to graze on this plant and the young shoots are eaten as a vegetable. Kankawa, as the plant is commonly known is very good for making, 'pakoras'. The other names which are used often are Kana and Kanteri. The commelina is used in herbal medicine for remedies for inflammation of the skin.

Wild Chicory Cichorium intybus **Compositae**
Achicory plant can grow to about a metre in height and is found around the edges of fields and verges of country roads. It blooms in the north-western plains in the winter and in the hills, where it grows to about 2400 m. all through the summer. This is a somewhat rough textured, erect plant with many branches. The stem is grooved and the large lower leaves are coarsely lobed and grow in a rosette at the base of the plant. The upper leaves are small, linear and covered with downy hair. The flowers are large and have petals that fan out from the centre like blue rays. The chicory plant has a long taproot that is dried and roasted and added to coffee to improve the flavour. We call the plant Kasni, and it is used as a salad and vegetable.

Blue Pimpernel Anagallis arvensis **Primulaceae**
The plant is about 10 -12 cm high, and grows in the winter over the cooler parts of India to about 2500 m. It has a square stem, which lies along the ground, and sends up many erect branches. The oval- pointed leaves are stalk less and they grow opposite each other. The fruit is shaped like a tiny closed urn, the upper half of which opens like a lid to release its tiny seeds. The pimpernel is found in cornfields, ditches, flowerbeds and sometimes even takes root in flower pots. There is a red variety which grows in the hills of the north. This form is found all over Europe and as far as north America and the famous book takes its name from this scarlet pimpernel. In Hindi, it is called, Dharti-dhak or Buchbucha.

Apple of Peru Nicandra physalodes **Solanaceae**
The dried, papery, inflated pods of this plant growing along a stem of about a metre high catch one's attention while walking in the hills from 800-2300 m. The apple of Peru, in spite of its name comes originally from Mexico but has naturalised well all over the northern hills. This plant has beautiful, bell-shaped blue flowers of about 2-4 cm across, with white centres. The flowers stay open only for part of the day. The large stalked leaves are ovate with irregular lobes. The flowers have a five-lobed calyx which is very noticeable. This calyx grows into a papery, net-veined lantern to enclose the green berry of the plant. The berry is like a round, green marble full of tiny seeds and is quite sour. Birds and other animals of the forest eat it. This plant can be seen growing along verges of roads, in cultivated areas and neglected corners of gardens. It is quite striking when it is in bloom from May to November though it has a foetid smell.

Kashmir Gentian Gentiana cachemirica **Gentianaceae**
There are many varieties of gentians growing in the Himalayas. This intensely blue flower ranges from sapphire tosky blue and cerulean to a deep purple-blue. It is a family of flowers that is spread widely across the cooler parts of the world. Gentians grow close to the ground and have flowers that are trumpet-shaped. One of the more easily seen gentians is the Kashmir gentian which grows at heights of about 2500-4000 m. in the western part of the Himalayas. This flower likes rocky, exposed slopes. The small ovate leaves grow on spreading stems. The flowers are funnel-shaped. Gentians open their blue faces to the sun from about the end of July and stay in flower till autumn. Many gentians share similar properties and are used in herbal medicine in the hills. The roots of *G. kurmo*, known as Kam are used for stomach problems and urinary infections.

Cranesbill Geranium wallichianum **Geraniaceae**
The cranesbill or the wild geranium, blooms just before the rains in the north Indian hills from 2400-3600 m. and continues to be in flower right up to September. This is a perennial that grows from 30 -120 cm tall. The purple-blue flowers are about 3-4 cm across. The leaves are palmately

divided into 3-5 lobes and toothed around the outer edges. The stems are slightly hairy and the plant has large, ovate, coloured stipules. Some of the flowers are a deep pink and the others are blue-purple and veined with a deep purple; the newly opened blooms are the ones with the pink flush. The fruit is full of seeds. When the seeds are ripe they are thrown out with great force when the outer covering bursts. The seeds are ejected to a distance of about several metres away, and so the plant spreads if the conditions are favourable. The wild geranium is known as Ratijari in Hindi and is used in herbal medicine for rheumatism and to cure headaches. There are roughly about ten different types of geraniums found in our hills.

Butterfly bush Buddleja crispa **Loganiaceae**

As the name suggests, the butterfly bush is a great favourite with butterflies in the temperate Himalayas. It grows from about 900-2400 m. and flowers from February to June. Butterflies such as, Tortoiseshells, Painted Ladies and Red Admirals flock around the tiny flowers which grow densely in spikes. The fragrant flowers are a pale mauve and about 8 mm long. The corolla tube opens out into four lobes. The throat of each flower is orangey-yellow. The leaves are oblong lances with toothed edges. The young leaves and branches are covered with rusty hairs. The bush has a peeling bark.

Wild Primula Primula denticulate **Primulaceae**

If all the wildflowers in the hills, primulas are among the first to bloom. They flower as early as April and continue well into July. They are found all over the Himalayas at heights of 1500-4500 m. Primulas are very easy to spot in meadows, slopes and shrubberies, on account of the rounded flowering tops. From a distance a meadow of primulas looks as though it is carpeted with purple, lilac and sometimes white golfballs fluttering in the mountain breeze. Come closer and you see that each flower head is composed of many small,
five-petalled flowers, each petal is heart-shaped and each flower has a long corolla tube. The leaves of the primula grow in a rosette at the base of the stalk. They are oblong, narrowing at the base, with toothed edges. The texture of the leaves is wavy and wrinkled and slightly mealy with veining. The flower grows ona single stalk that is not branched. It is about 18-20 cm high. The name, primula comes from the Latin primus, first, referring to the early flowering of many species. In fact, the greatest concentration of primula species is found in the Himalayas.

Himalayan Fritillary Fritilaiaroylei **Liliaceae**

The fritillary is an unusually pretty lily that grows in the north-western Himalayas, from Kashmir to the Kumaonhills. If you are walking at altitudes of 2700-4000 m. you may come across these drooping, chequered flower snodding on tall stems. Fritillaries grow on grassy slopes, forest glades and in between rocks, at one time they were widespread on the slopes of Gulmarg in Kashmir. These lilies grow from bulbs and can grow to about 60 cm tall. The longish leaves rather like lances, begin a little higher up on the stem. Three to six leaves grow in a whorl and the upper leaves are opposite each other. The purple-brown or yellow-green flowers are like inverted bells painted in a chequered pattern of purple. The bulbs are pounded, boiled with orange peel and sugar and used for the treatment of chest problems by hillfolk.

IRIS Iriskemaonensis **Iridaceae**

The iris is found in the Himalayas from the west to the east. It grows at heights of 2800-4000 m. on open slopes and grazing grounds. Very often it grows in large clumps and from a distance makes a pretty picture when it flowers in early April to July. The flowers are a very bright lilac-purple and have yellow-tipped beards or combs on the outer petals. Darkpurple mottling on the petals makes the flowers look a deeper colour. When iris bloom in early April they stand about 15 cm high massed in banks. At this stage they have very few leaves. Later on, the sword-shaped leaves come up and are taller than the flowers. The iris grows from an underground rhizome, and likes wet ground. The capsule which contains the seeds is longish with a pointed end; when the seeds are ripe, it splits open. There are more than a dozen varieties of iris in the mountains. *I. germanica or Keoreka-mul*, is cultivated in the hills, especially in Kashmir, for an oil known as orris oil is which is obtained from the root. This oil used in perfumes and smells of violets. The roots of *I. nepalensis*, or Chiluchi, are used in medicines as a diuretic and for bilious complaints.

Columbine Aquilegia pubiflora **Ranunculaceae**

Columbines grow at a height of 2500-3300 m. on open slopes and semi-shaded groves in the Himalayas all a long from the west to the east. They bloom from early June to August. Columbines are very elegantly formed and coloured in shades of lilac, purple and pinky-violet. The flower is very easy to distinguish because of the five backward projecting spurs of the inner petals. The spurs are full of nectar. A row of inner and outer petals forms the columbine, which grows in a drooping fashion. The leaves are divided into three lobes with crenate edges and look rather ferny. The columbine was once used as a medicinal plant in the past centuries in Europe and was used as a garnish for food. There are several varieties of this flower found in the Himalayas.

Roscoea Roscoea alpine **Zingberaceae**

This is among the most common wild flowers of the north Indian hills and grows best during the rainy season at height of about 2500-4000 m. The Roscoeaalpina grows about 20 cm high and has linear leaves 6-10 cm long. Sometimes the plant flowers without leaves, which come out later, giving the leafless bloom the look of an orchid. The flower is of a deep purple colour, though sometimes white ones are also seen. It has an interesting appearance with its upper petals arching in helmet-like structure, and the modified stamen forming a large petal-like lip. *R. purpurea* is taller and with much larger flowers and grows in the Uttarakhand hills and further east and has roots that are used in veterinary medicine.

Wild Indian Tulip Tulipa stellata

Travellers are sometimes surprised to find wild tulips in the Himalayas. Tulips are generally associated with Holland and most people think that they originated there. Actually, it was only in the sixteenth century that bulbs were taken from Turkey to Holland, where the flowers were adapted for the garden. Tulips originated in the highlands of central Asia extending all the way down to the Himalayas. We have only one wild variety that grows from Kashmir to Uttar Pradesh at a height of 1500-3300 m. This beautiful flower is white with a broad pinkish stripe on the outer side of the elliptic petals. Each flower is solitary on a hollow stem of 15-40 cm. At first

the flowers are bell-shaped but later the petals open out. The leave sare linear, about 15-20 cm long and of a grey-green colour. Tulips grow in April and May in fields of young wheat. Whole hillsides are carpeted by them. Another form of the same variety with yellow and red flowers grows at greater heights.

Field Bindweed Convolvulus arvensis **Convolvulaceae**
Many different kinds of bindweed grow in the plains and the hills. In the hills they can be found up to 4000 m. The field bindweed grows in fields, gardens and wastelands and can be found twining over fences and hedges. This climbing plant has a delicate and slender appearance with its twining stem and distinctive arrow-shapedleaves, which grow opposite each other. Bindweed flowers can be plain pink or striped pink and white. They are shaped like little trumpets and are lightly scented. The flowers open in the morning and close in the afternoon and each flower lasts for a day. Another surprising fact about this plant is that the tip of the stem, in about an hour and a half, completes a full anti-clockwise rotation of several centimetres in diameter. The bindweed is an old medicinal plant and is used as a purgative and to increase the flow of bile. It is used as fodder and is known as Hirankhuri in Hindi.

Knotweed Bistorta amplexicaulis **Polygonaceae**
When the rains come in July, the thickly packed, deep pink, red and sometimes white flower spikes of the knotweed spring up all over the temperate Himalayas. The knotweed grows at heights of about 2000-4500 m. It is a slender, erect plant with ovate, heart-shaped, clasping upper leaves. The leaves have pointed edges and are dark green. The solitary flower spikes are 5-15 cm long and densely packed with little flowers 3-6 mm long. The lower leaves are long-stalked. The rootstock of the knotweed is used in the tanning process and the plant is used as fodder.

Wild Field Thistle Crisum arvense **Compositae**
This wild thistle flowers from the winter through to April. It is found all over central and north India growing up to a height of 3600 m. in the northern hills and in all of temperate Eurasia. In the hills the thistle is in flower from the early summer to early autumn. Thistle flowers are a deep pink. The leaves are oblong-linear and coarsely pinnate. They have wavy margins which are tipped with spines along the edges. If you turn the leaf over you will see that it is soft and woolly beneath. When the thistle flower dies its place is taken by a ball of fluff; these are actually seed heads, or achene' s, which are light enough to float in the wind and be carried to new places for the plant to seed. Different varieties of thistles grow all over the world in temperate areas.

Wild Strawberry Fragaria nubicola **Rosaceae**
The plant grows all over the northern temperate regions of the world. In India several varieties grow in the northern hills at heights of 1800-3800 m in forests, shrubberies and shady banks. The strawberry plant is a small, silky-haired perennial with trifoliate leaves, with long runners which hroot at intervals as they creep along the ground. The small flowers have five white petals, and each flower gives way to a red, succulent strawberry whose surface is dotted with tiny seeds. The several varieties of strawberries growing in the Himalayas are all a great treat for fruit-loving animals and birds. In the northern hills this fruit is known as Kiphalia or Kulachnia.

Black Nightshade Solanum nigrum **Solanaceae**
This variety of the night shade grows all over India to a height of about 2500 m. It is more prolific in warmer places. Perhaps the nightshade is better known by its small, red, tomato- like berries- in fact, it comes from the same family as the tomato. The nightshade grows to about 30-50 cm in height. The flowers appear all through the year and the nripen into red berries. This very well-known plant of the countryside is known as Makoi in Hindi.

Sheep's Sorrel Rumex hastatus **Polygonaceae**
Sheep's sorrel grows in the Himalayas at about heights of 2000 -3000 m. on stony slopes, banks and in between crevices of walls. It looks for dry areas and is a bushy plant with many stems and arrow-shaped leaves which are sour in taste. The tiny flowers are greenish-white and the fruit is a papery, pink, three-angled nutlet. The plant is covered with these nutlets which look like tiny rose-pink flowers. Several varieties which look alike are common in the northern hills from west to the east. It can be seen all over the hills from April to September. The young leaves have a piquant flavour and are eaten in salads or as a saag. In Hindi it is known as Bhilmom.

Crimson Cinquefoil Potentilla nepalensis **Rosaceae**
This flower grows atheights of 2100-2700 m. from Kashmir to Nepal and is in flower from about early June to September. Look for it in meadows, light forests and verges of paths and fields. There are more than a dozen varieties of potentillas growing in the hills, most of them yellow, orange or dark red. The crimson cinquefoil has five heart-shaped petals of a deep rose-crimson and measures about 1-2 cmacross. Amass of stamens crowds the centre of the flower. The plant is between 20-90cm high and has slightly hairy stems. The five ovate, toothed leaflets are arranged finger- fashion or digitately. The upper leaves are com-posed of three leaflets. The colour of this flower varies from crimson to rose to orange in some areas.

Indian Wood Sorrel Oxalis corniculata O. maritiana Oxalidaceae
Sorrel forms a dainty carpet where it grows in dappled sunlight, in patches in the grass. It likes moist places and has a stem that creeps along the ground and sends up shoots from this stem. It is found over most of India to a height of about 2500 m. There is also a larger pink variety with bigger leaves, *O. martiana*. This is seen frequently in shady places in gardens, fruit orchards and nurseries. This is commonly known by children as Khat-mith and the leaves have a sour taste. The yellow oxalis isknown as Champa- methi, Teepatiya, Khat-mithi and Nonki.

Buttercup Ranunculus repens **Ranunculaceae**
There are several varieties of buttercups growing in the temperate Himalayas, from heights of 1500-5000 m. They can be annual or perennial. In the summer if you see a meadow blanketed with yellow or a stream with burnished yellow flowers along the edge, more likely than not, they will be buttercups. The golden yellow flowers are about 1-2 cm across, with a mass of stamens in the centre. The petals shaped like shallow cups, shine as though they are varnished;

this is because of light reflecting from a special layer of starch grains just below the surface. There are more than half a dozen species of buttercups to be found in the Himalayas and one in the plains. Buttercups contain ancmoine and protoanemoine and are somewhat poisonous and are avoided by grazing cattle. This is one of the reasons that they grow in such profusion.

ST. John's Wort Hypericum cernuum **Hypericaceae**
St. John's Wort is a shrubby plant about 1-2 m. tall; old plants are more bushy and taller. The long oval leaves grow opposite each other and are dotted with red if you look closely. This striking flower grows at heights of 800-2500 m. in the western Himalayas. It is in flower from April to September, though the odd flower can be seen almost throughout the year. There are several varieties found all over the Himalayas. H. mysorense grows in the Nilgiris and looks quite similar. Here it is commonly known as Basant, because it is yellow. The leaves have etherealoil which is used as a solvent and anaesthetic. The flowers are used in an ointment to cure wounds. The plant is also called Fugadaemonum, as it was once considered a remedy for melancholia. Homeopathically, bruises and nerve injuries are treated with Hypericum.

Wild Peaor the Yellow Vetchling Lathyrusaphaca **Papilionaceae**
They grow on long climbing stems of about 15 -30 cms. The leaves of the wild pea are either oval with pointed tips or heart-shaped and grow opposite each other. Long tendrils curve out from between the leaves. The leaves and the stem are of a delicate grey-green colour. After the plant has finished flowering, small pods with seeds which are smaller than mustard seeds, appear on the plant. The seeds are actually minute peas. The wild pea grows in cornfields, weedy places gardens and wastelands from December to early April. In the hills it grows to about 2500 m. from April to June.

Sow Thistle Sonchus oleraceus **Compositae**
The sow-thistle is 60-100 cm tall and the flower opens only in sunny weather. The sow-thistle is a wild flower of the winter and spring and is found all over north India to a height of 2000 m. It flourishes in vegetable fields, gardens, roadside verges and wasteland. It prefers nitrogenous soil. The sow-thistle is found all over the temperate areas of Europe and Asia. In Hindi this plant is known as Pili Dhudhi.

Common Barberry Berberis lyceum **Berberidaceae**
This thorny bush with its pale brown bark and racemes of small yellow flowers is one of the best known bushes of the north-western temperate Himalayas. It flowers in May and June adding splashes of colour to the hillsides. Many different varieties of berberis grow in the hills from 1500-3000 m. and are separated from each other by small botanical differences. *B. aristata* or the Indian Barberry commonly known as Darhald or Rasaut is found widely over the Himalayasat a height of 1200-2500 m.

Wild Fenugreek Trigonella corniculata **Papilionaceae**
The wild fenugreek is widespread over the plains of north India and flowers in the winter. It grows in the western Himalayas to about 3000 m. and flowers in the summer. The plant is about 30-40 cm tall. The leaves are made up of three leaflets which are toothed along the edges. There are several stems and two or more yellow flowers grow at the end of the stalk in close racemes. This plant is found in fields, lawns and waste places. Junglimethi, as it is commonly known, is eaten in times of scarcity. Another close cousin *T. incisa* also grows wild at the same time; it tastes better and is known as Chanihari.

Common Melilot melilotusindica **Papilionaceae**
The common melilot grows all over the temperate regions of the Old World. It flowers in the winter in moist waste places, especially in cultivated fields and sometimes in flower pots. The plant is about 20-45 cm tall and has leaves that are made up of three ovate leaflets with small teeth around the top edges. The yellow flowers are tiny and grow densely in spike-like racemes. The Hindi name for this plant is Banmethi or Senji.

Dandelion Taraxacum officinale **Compositae**
Dandelions arc found in the temperate hill regions of both north and south India. The narrow and numerous ray-shaped petals fan out into a circle. The stems are leafless and hollow with latex which leaves brown stains on the skin. The narrowly-oblong leaves with jagged edges form a rosette at the base of the plant. Dandelions grow in fields, verges and lawns, in short, anywhere and everywhere. Each seed is carried away by its own little parachute. The plant contains an alkaloid which is slightly poisonous. In India it is called Dalai or Barau.

Marsh Marigold Caltha palustris **Ranunculaceae**
The marsh marigold is also known as the kingcup. Marsh marigolds are seen very commonly near brooks, streams, damp meadows and marshy places in the Himalayas. They grow between heights of 2400-4000 m. Meadows and sides of streams are covered with swathes of yellow which are actually masses of kingcups growing together. The richly golden-yellow flower has five to eight highly burnished petals; strictly-speaking these are not petals but enlarged sepals. The centre of the cup is crow dedwith stamens and carpels. The flowers are about 2-3 cm across and can be white sometimes. The stem is hollow and the broadly heart-shaped, glossy leaves have toothed edges. The leaves increase in size when the plant has finished flowering. These flowers are at their best from May to late August.

Great Mullein or Aaron's Rod Verbascum thapsus **Scrophulaiaceae**
It grows in the Himalayas from Kashmir to Sikkim and stands erect, about 1-2 m. high, with the torches about 10-30 cm long. The large, oblong leaves are broader near the apex, a silvery-grey and have a distinct woolly texture on both sides. The five-petalled, yellow flowers grow along the spike, and each flower is about 2 cm across. The flowers are delicately scented and leave a coating of pollen on the nose when you bend down to smell them. It is found all along the northern hillsat heights of 1800-4000 m. and flowers from May to September. In Hindi, the Mullein is known as Ban-tamakhu or Gidar-tamakhu or even Phulla. The dried leaves are rolled into cigarettes and smoked to give relief from asthmatic attacks and spasmodic coughs. The leaves can also be chopped into compresses for local application to ease neuralgic pains. The seeds are narcotic. An essential oil made from the roots is used for frost bite and bruises.

***Common Broom Sarothamnus scoparius* Scrophulaiaceae**
This shrub is very easy to recognise with its cloud of pea-like, bright yellow flowers. The 15-25 mm long flowers grow in ones or twos on small stalks; they have a vertical standard petal two wings and a keel. The common broom grows up to a height of about a metre and a half and old plants can even reach five metres. The broom flowers in the summer in the Himalayan hills at a height of 1500-3500m. It was introduced by the British here and in the northern hills. The heartlands of central Europe are its original home.

Jammu & Kashmir has three distinct regions viz. Ladakh, Jammu and Kashmir valley offering a rich diversity in landscapes, religions and people. The state comprises of 22 districts with 10 districts of Kashmir valley having temperate climate covered by forested mountains, lakes, waterways and terraced fields. The Jammu region comprises of plains, mountains and foothills boasting of famous hill top shrine of Mata Vaishno Devi and temperate pockets in Doda, Poonch, Rajouri, Kistawar and parts of Kathua, Reasi, Ramban and Udhampur. There are many low lying valleys viz. Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley and Liddar Valley, but the main Valley is the valley of Kashmir which is 100 kms wide and 15520.3 sq. kms in area. The average height of valley is about 1700 metres above sea level (Anonymous, 2008) [1].

The soils of Jammu & Kashmir are generally loamy with little clay contents comprising of illite type of clay rich in K naturally. Most of the people of temperate areas of J & K are agricultural-dependent producing crops like rice, maize, pulses (green gram and cowpea), oilseeds (mustard) vegetables(knol-khol, cabbage, cauliflower, turnip, raddish, spinach, tomatoes, potatoes, chillies, all cucurbits,), fodders (barley, oats, jowar, turnip, cowpea), high value-low volume crop like all famous saffron, *kala zeera* and horticultural crops like apple, pear, peach, cherry, plum, chestnut, areca nut, pecan nut, almonds and walnut etc. Weeds pose some of the serious threats to biological diversity. These silent green invaders constantly encroach in the crop and non-crop areas as well as the water bodies especially so in the temperate areas where the main land utility is for aesthetic beauty for tourism. Some weed species are of very offensive in nature whether native or of exotic (invasive weeds) in origin that erode the native biodiversity and eventually result in extinctions of endemic strains. The impacts of these species are vast, subtle and usually irreversible. They may be as damaging to native species and eco-systems on a global scale as the loss and degradation of habitats. Over the past several years, there has been a heightened concern at the national and international levels about the impacts of habitat destruction on biodiversity. In recent years the impact of invasive species has also become a major concern (Evans, 2003) [6].

***Invasive species are of mainly two types* (Curtis and Carino, 1999) [3].**

1. Native invasive: these species are of either native or of old world having an offensive behaviour over the habitat where they grow and do not allow other vegetation to flourish.
2. Alien invasive: these species which become established in natural or semi-natural eco-systems or habitat, as an agent of change and threaten native biological diversity.
3. Major invasive species found in Indian temperate regions (Dutt *et al.*, 1963) [5]. and in J&K particularly are:

Cultivated Fields

Lowland rice: Ggrown in summer (May to September) being the main staple food crop of the regions comprises of aggressive weeds like *Eichnochloa colonum/ crus galli; Fimbristylis miliacea; Ammannia baccifera; Cyperus iria / rotundus; Marsilea Quadrifolia; Potamogeton distinctus; Salvinia Auriculata; Lemma minor; Kickxia Subsessilis; Erigeron bonariensis.* During the months of August and September the rice fields are invaded by *Cyperus, Geranium, Epilobium, Caucalis, Trifolium, Prunella, Lactuca* and *Cynoglossum.*

Upland crops: Dominating species which grow in mustard, wheat and barley in early spring are *Papaver dubium, Ranunculus arvensis, Lolium Temulentum, Bromus japonicas, Poa pratensis, Cynodon Dactylon, Vulpia myuros, Polygonum tubulosum, Convolvulus arvensis* and *Galium aparine*. In June various invasive weeds flower in April-May planted crops like maize, vegetables, moong and cowpea which include *Trianthema Monogyna; Portulaca Oleracea; Ipomoea carnea/hispida; Eleusine Indica; Panicum repens; Sorghum halepense/nitidum; Poa Annua; Setaria Glauca; Amaranthus hybridus/graecizans; Euphorbia hirta/emodi; Paspalum conjugatum; Silene conoidea;* species of *Malva, Geranium, Lycopsis; Cotula anthemoides; Cichorium Intybus; Taraxacum officinale; Fumaria parviflora; Hibiscus trionum; Tribulus Terrestris.* Most of these weeds survive upto fall months i.e October-November.

Tourist spots, Fruit orchards and Grass fields: Temperate tourist resorts of J&K (Gulmarg, Pahalgam, Sonmarg, Mughal gardens, Patnitop, Sanasar, Noori-Chhamb, Dehragali, Bani, Bhadarwah, Mantalai), Sikkim, Meghalaya and Uttrakhand are famous for their beauty besides being known for valuable orchards of high value crops. But these areas have been invaded by numerous invasive weeds in last 30-40 years which not only have deteriorated their aesthetic value but also cause huge economic losses to horticultural produce. Some of these invaders are shrubs like *Robus, Rosa, Rubia, Hedera* and *Spiraea*besides annual and perennial herbaceous weeds during spring like that of *Oxalis corniculatus, Tribulus Terrestris; Erodium cicutarium, Gallium aparine, Bellis perennis, Stellaria media, Anagallis arvensis, Eruca sativa, Convolvulus arvensis, Poa Annua/pratensis, Bromus japonicus, Eragrostis spp.; Malva Rotundifolia; Setaria Viridis* and *Phleum Paniculatum.* During summer months *Lotus corniculatus, Melilotus alba;* species of *Trifolium, Lathyrus, Medicago, Sisymbrium, Erigeron, Astragalus; Geranium ocellatum/pratense; Calamintha Clinopodium; Nepeta cataria; Fragaria vesc; Thymus serpyllum; Rumex Nepalensis* and *Taraxacum officinale* predominate these land pockets. Moreover, dominance of *Impatiens amphorata, Rubia cordifolia, Plantago lanceolata / major, Daucus Carota, Caucalis leptophylla, Cyperus rotundus, Myriactis nepalensis, Siegesbeckia Orientalis* and species of *Rumex, Polygonum, Abutilon and Viola* can be observed in late September.

Waste Lands: Vegetation in these less disturbed areas is more or less similar in nature with poor soil types and not much of moisture supply. The flora is dominated by semi-xerophytic and dry meadow herbs. In spring season major weeds that come up are *Ranunculus arvensis/ falcatum,*

Conium maculatum, Silene conoidea, Capsella Bursa Pastoris, Cynoglossum denticulatum, Goldbachia laevigata, Polygonum tubulosum and *Anagallis arvensis.* Summer invaders are *Verbascum Thapsus, Cichorium Intybus, Euphorbia helioscopia/thymifolia, Xanthium strumarium, Sisymbrium Loeselii / Sophia, Bupleurum lanceolatum, Galinsoga parviflora, Utrica dioica, Marrubium vulgare, Cousinia Microcarpa, Centaurea iberica, Digitaria Marginata, Setaria Verticillata* and *Eragrostis nigra.* In moist localities ground cover is dominated by *Coronopus Didymus, Tribulus Terrestris* and species of *Oxalis, Herniaria, Geranium* and *Veronica.* During August –September, waste lands are full of *Artemisia, Cannabis, Caucalis, Chenopodium, Chrozophora, Plantago, Trifolium, Euphorbia, Epilobium, Hartmannia, Gnaphalium, Hypericum, Hibiscus, Datura, Solanum, Amaranthus, Erigeron* and *Mentha.*

Water Bodies: Water bodies form the back-bone of temperate eco-systems, be it the crop production, flora-fauna bio-diversity or by enormously adding to the aesthetic beauty of these regions for tourist attractions. Who can imagine J&K state without its natural lakes (*Dal, Wular, Manasbal, Mansar, Sruinsar, Sanasar, Nandansar*), springs (*Varinaag, Achhabal, Kokurnaag, Lidder, Noori-Chhamb, Vasuki-Naag*) and rivers (*Jehlum, Chenab, Indus*). Similarly water bodies in other similar areas of country are the great cultural heritage. Unfortunately, some of our lakes of late have been shrinking due to invasion of obnoxious weeds (floating, submerged, growing on marshy banks) which have destroyed their aesthetic value, reduced boat/shikara traffic and are posing threat to endemic aquatic flora and fauna. *Sanasar* lake is one casuality due to weeds and this lake is reduced to a 500 sq m ditch. *Dal, Wular, Manasbal, Mansar, Sruinsar* are suffocated and it will not take long when we shall remember these lakes only by their remains. Specii composition of most of these lakes is similar and a typical example is that of *Dal* which gets more attention due to its location in Srinagar city. More than 500 crores of rupees have been spent so far since 1988 towards de-weeding this lake and recently another £180m has been released by Environment Minister, Jairam Ramesh for weeding job of the lake that has shrunk to half its original size whose tranquillity has lured everyone from Mughal emperors to George Harrison and Ravi Shankar. *Dal, Wular, Manasbal, Mansar, Sruinsar, Sanasar, Nandansar* make one of the largest freshwater bodies in Asia which are in great danger due to invasive weed threat. Submerged weeds in these lakes are *Potamogeton Lucens / pectinatus/crispus, Hydrilla verticillata, Myriophyllum spicatum, Ceratophyllum Demersum* and *Chara spp.* whose only flowering terminal spikes are above the water level, rest of the plant remains submerged. Free floating water ferns are *Salvinia natans* and *Lemna spp.* Towards the water margins a free floating herb *Nymphoides Peltatum* with small lotus like leaves is predominant. Besides the side projections and shallow portions are full of tall reeds and cat-tails like that of *Phragmites cummunis* and *Typha angustata.* Also the floating gardens and islands support almost all the cultivated weeds (Zutshi, 1987) [15].

Flora of Dal Lake (Zutshi, 1987) [15].

- **Emerged macrophytes:** *Typha angustifolia, Phragmites australis.*
- **Floating macrophytes:** *Salvinia natans, Hydrocharis dubia, Nymphoides peltata, Nymphaea* sp., *Nelumbo nucifela, Potamogeton natans.*
- **Submerged macrophytes:** *Myriophyllum spicatum, Ceratophyllum demersum, Potamogeton crispus, P. lucens.*
- **Phytoplankton:** *Navicula radiosa, Nitzschia accicularis, Fragilaria crotonensis, Diatoma elongatum, Scenedesmus bijuga, Pediastrum duplex, Tetraedron minimum, Microcystis aeruginosa, Merismopedia elegans.*

Some of the wild flowers (weeds) which grow round Srinagar and their indigenous use (Koul, 2005) [10].

Pegasus Hermala

Kashmiri name	**Isband**
English name	Rue
Family	Malvaceae
Locality	MallaKhah

Uses-It has a white flower. The ashes of this plan used in washing the hair and the leaves are fatal to bugs. The seeds are burnt on wedding days to avert the evil eye.

Malva Sylvestris

Kashmiri name	**Sotsal**
English name	Mallow
Family	Malvaceae
Locality	Waste lands; Also cultivated

Uses-It is a pot-herb. The seeds are used in decoction (sherbat). The root has a lubricating value and is used in anaemia.

Cannabis Sativa

Kashmiri name	**Bhanga**
English name	Hemp
Family	Labiatae
Locality	River banks

Uses-It grows mostly above pampor on both the banks of the Vetasta. Its fibre is used for making ropes and for sankering boats. The cheras, an intoxicating drug, is made from this plant in three ways:

1. The live plant is rubbed by hands and sticky substance is collected.
2. The pollen dust.
3. The dry plant is pounded and sifted. The material is placed in the maize-cob sheath, or paper or birch bark and well-wrapped in rush and baked in hot ashes. It is then smoked mixed with tobacco.

Lanatuma Marrubrium

Kashmiri name	**Tropor**
Family	Labiatae
Locality	Waste lands

Uses-It bears a white flower. It is boiled in kanja and applied to a rheumatic limb.

Melilotus Alba

Family	**Labiatae**
Locality	Shankarachar

Uses-The flowers which are on a raceme are white. The flowering season is August, September. The leaves have delicious fragrance.

Salvia Moorcroftiana

Kashmiri name	**Sholur**
Family	Labiatae
Locality	Hari Parbat and Shankarachar

Uses-It has bluish white flowers.

Mentha Sylvestus

Kashmiri name	**Wena**
English name	Horse-mint
Family	Labiatae

Uses-The leaves have an acute fragrance and are used as flowers in worship by the Hindus. Mixed with salt and chilli, it is eaten as chetni, and is considered very stimulating.

Plectranthus Rugosus

Kashmiri name	**Midal**
Family	Labiatae
Locality	Shankarachar and sandy soil

Uses-It has grey-white flowers and sweet fragrance. The leaves are used in worship by Hindus. A decoction of leaves is given to a person fallen from height.

Thymus Serphyllum

Kashmiri name	**Jawen**
English name	Thyme
Family	Labiatae
Locality	Hari Parbat, Shankarachar and sandy soil

Uses-The plant bears pink flowers in clusters. Their jam is an excellent stomach tonic. It is also put in Kanja (sadurkonz). It is good for weak sight, stomach and liver troubles. It can be used to flavour vegetable or fish.

Artemisa Moorcroftiana

Kashmiri name	**Tethawen**
Family	Compositae
Locality	MallaKhah

Uses-The leaves are made into a pill as a medicine for worms. It is also used to protect clothes and paper against fish insects.

Cardius Nutans

Kashmiri name	**Kond posh**
English name	Thistle
Family	Compositae
Locality	Gardens and waste lands

Uses-It is a thistle with a crimson flower. Its root dug in autumn mixed with cane-sugar, half and half, is taken as medicine for neural diseases.

Taraxacum Officinale

Kashmiri name *Exglish name*	**Maidan hand** **Dandelion**
Family	Compositae
Locality	Outside Srinagar

Uses-It has a yellow flower. It is a potherb. When dried, it is well cooked and applied to a sprained limb.

Cicchorium Intybus

Kashmiri name	**Won hand**
English name	Chicory
Family	Compositae

Uses-It has a beautiful blue flower. It is used as a vegetable and is given to women after child-birth.

Datura Stramonium

Kashmiri name	**Datur**
Family	Solanaceae
Locality	Waste lands

Uses-It bears a white trumpetlike flower which is highly prized for uses in worship. The seeds which have a narcotic effect are found in a thorny capsule. The leaf, lubricated with warm rape-seed oil, is applied to a diseased eye.

Daphne Oleodes

Kashmiri name	**Gandalun**
English name	Daphne
Family	Thymelaceae
Locality	Shankarachar

Uses-It is a shrub bearing creamy white flowers. The leaves are used for some neural diseases and nausea.

Caucalis Leptophylla

Kashmiri name	**MohoraKach**
Family	Umbelliferae
Locality	Waste lands

Uses-It has white flowers. The seeds are used as medicine.

Achillia Millifollium

Kashmiri name	**Phal gasa**
English name	Milfoil
Family	Umbelliferae
Locality	Round fields

Uses-It has white flowers. The leaves are used in preparing medicine for stomach affections and the root for toothache.

Feniculum Valgare

Kashmiri name	**Phakazur**
English name	Fennel
Family	Umbelliferae
Locality	In fields (rare)

Uses-It is a beautiful plant. In some European countries it is used as a spice. 'As much as eight and a half pounds of fennel was brought for King Edward I's household for one month's supply'.

Rumex

Kashmiri name	**Oboj**
English name	Dock
Family	Polygonaceae
Locality	In fidds and gardens

Uses-It is a potherb. It has a little sour taste. It is cooked widh or without fishes. The root pounded and mixed with oil or ghee is used for boils.

Rubus Niveus

Kashmiri name	Chanch
English name	Raspberry
Family	Rosaceae
Locality	Shankarachar, Zaberwon

Uses-It is a shrub. The fruit is edible. It is good for blood.

Altnea Officenalis

Kashmiri name	**Saza posh**
English name	Holly hock
Family	Malvaceae
Locality	Gardens

Uses-The flower, along widhdle wheat bran, is used in washing the feet of a sick person. The seeds form the chief ingredient in decoction of sherbat. The root has a lubricating effect used for anaemia.

Urtica Dioica

Kashmiri name	**Soai**
English name	Stinging nettle
Family	Urticeae
Locality	Waste lands

Uses-The leaves are pounded and applied to wounds. The root boiled in tea and sugar is believed to cure malaria. In old schools (maktabs) this plant was thrashed on the naked boys as a punishment for bad behaviour.

Amaranthus Frumentacus

Kashmiri name	**Ganhar, lisa**
Locality	Fields, also cultivated

Uses-The seeds are eaten mixed with sugar. The ashes of this plant are used as saz, in soap preparation.

Oxalis Corniculuta

Kashmiri name	**Sebargi**
English name	Sorrel
Family	Geraminaceae
Locality	Fields

Uses-It has a yellow flower. The leaves are used in chetni. It is good for eye-sight. A medicine for eyes prepared from the juice of the plant.

Gagea-Kashmiriana

Family	**Liliaceae**
Locality	Mallakhah

Uses-It has a yellow flower like a star. It is one of the first flowers to bloom.

Acorus Calamus

Kashmiri name	**Vai**
English name	Sweet flag
Family	Araideae
Locality	In swampy places outside Srinagar

Uses-It is used on New Year's day. It is good for memory. Jam is prepared from it.

Solanum Nigrum

Kashmiri name	**Kambai**
Family	Solanaceae
Locality	In waste lands

Uses-It has a white flower. The seeds are used in decoctions. The juice of the plant mixed with butter is applied to a swollen limb.

Capsella Bursa-Pastoris

Kashmiri name	**Kralamond**
English name	Shepherd's purse
Family	Cruciferae
Locality	In all places

Uses-It has a white flower. The Plant is eaten raw.

Verbacum Thapsus

Kashmiri name	**Bolarkon**
English name	Mullein
Family	Scrophularineae
Locality	In waste lands

Uses-It has a light yellow flower. The leaves mixed with oil or butter are used for itches.

Chenopodium Blitum

Kashmiri name	**Wan palak**
English name	Goose foot
Family	Chenopodiaceae
Locality	Shankarachar

Uses-The fruit and leaves are eaten.

Berbebis Lycium

Kashmiri name	**Kava dach**
Family	Berberideae
Locality	Shankarachar, Zaberwon

Uses-It is a shrub. The fruit is eaten and is a blood purifier. The root is used in preparing medicine for eyes. It is said to be a remedy for cholera.

Fumaria Paviflora

Kashmiri name	**Shahtar**
Family	Fumariacea
Locality	In fields

Uses-The juice of the plant is taken internally along with whey to give a cooling effect.

Dioscorea Deltoidea

Kashmiri name	**Krats**
Locality	In fields

Uses-In spring the leaves are eaten as a vegetable and are supposed good for eye-sight.

Management and future strategies

The invasive weeds in various hill-ecosystems cause huge losses to the already fragile natural resources, floral biodiversity and scenic beauty besides enormous amount of money being spent in their removal predominantly through manual or mechanical means in the areas with altitudinal variations ranging from 1500 to 2300 m above MSL. Chemical control recommendations have been in vague only for some cultivated crops due to lack of appropriate R & D backup and negligible involvement of stakeholders. Some of the herbicidal management measures practised in the state as per the recommendations of SKUAST-J are:

Rice: *Cultural method:* Two hand weedings are recommended at 15 and 30 days after transplanting; *Chemical methods:* 1) Butachlor granules 5 G @ 30 kg/ha at 4-6 days after transplanting in standing water 2-3 cm deep and do not drain the field for one week. 2) Anilophos + Ethoxy sulfuron @ 0.375+0.015 kg a.i/ha at 10 DAT. 3) Add 3 lt of Butachlor 50 EC in 150 kg sand and broad cast in standing water within 2 DAT.

Maize: *Cultural methods:* 1)Keep weed free upto 40 DAS with two hand hoeings at 15 and 30 DAS followed by earthing up at knee-high stage (at 30 DAS when second hoeing is done). No interculture should be done after 6 weeks after sowing which leads to pruning of fine roots and yield reduction. *Chemical methods:* 1) Atrazine @1.0 kg a.i./ha in 800-1000 lts of water should be soil applied just after sowing in sole maize crop; 2) For maize+pulse mixed cropping, apply pre-emergence pendimethalin@ 1.0 kg a.i./ha or pre-plant incorporated fluchloralin@0.75 kg a.i./ha.

Wheat: *Chemical methods:* for broad spectrum weed control Isoproturon@0.75 kg a.i. + 2,4-D ethyl ester@500 ml/ha may be sprayed with 500-600 lts of water at 30-35 days after sowing; 2) Metribuzin @ 200-250 g a.i./ha should be sprayed at 30-35 DAS where isoproturon is not able to control *sitti*.

Rapeseed and Mustard: Fluchloralin0.70 kg\ha ppi, isoproturon 1.0 kg\ha pre-em, pendimethalin 1.0 kg\ha pre-em.

Marigold: 2 hand weedings at 20 and 40 days after transplanting or application of trifluralin @ 1.0 kga.i/ha pre plant incorporation (PPI)+1HW (46.2q/ha).

Gladiolus: 2 hand weedings at 20 and 40 days after transplanting or application of pendimethalin @ 2kg a.i /ha +1HW.

Okra: Fluchlorian @1.0kg a.i/ha PPI, Alachlor @2.0kg a.i/ha pre emergence application (PRE), Trifluralin @ 1.0 kga.i/ha PPI and Oxyflorafen @0.35 kg a.i/ha PRE along with 1-hand weeding.

Lantana: cut the bushes in April and apply 1% glyphosate on fresh re-growth prior to monsoon showers preferably in first fortnight of June.

Saccharumspontaneum: manual cutting in winter followed by 0.75% glyphosateon fresh re-growth prior to monsoon showers preferably in first fortnight of June.

Parthenium: 0.5% atrazine or 0.5% 2,4-D or 1% glyphosate in April or 0.5% metribuzin on seedlings along with spread of beetle.

Moong& Mash: 0.75 kg PPI fluchloralin/trifluralin or PRE 1 kg pendimethalin.

Chickpea: PRE 1 kg pendimethalin or 40 g POE imazathapyr.

Sugarcane: PRE atrazine 2.0 kg/ha application. Inhabitants of these areas have also evolved some indigenous ways and means to keep some check on invasion of weeds on short term basis through their utilization for medicinal properties, as organic manures and as raw material to the rural small scale industry for local consumption. Floating gardens use weed species collected from lakes for manurial purposes besides providing bedding material for growing seasonal vegetables in spring.

Long-term strategies are required for checking the ever increasing menace of weed invasion. For this various biological, mechanical, chemical and cultural methods can be tried for their control. However, integrated approach including effective community participation could be very useful for their management (Batish, 2003) [2]. Moreover, the battle with these silent invaders in frontier states can only be won with research activities identified as a priority focus area within integrated ecosystems research along with adequate funding readily made available to the research institutes.

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