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Diversity and impact of invasive alien plant species of family Asteraceae in Jammu district (Jammu and Kashmir, India)

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Abstract

The present study deals with comprehensive list and impact of invasive alien plants species of family Asteraceae in Jammu district (J&K, India) with background information on habit and nativity. A total of 15 invasive alien plant species under have been recorded. These include *Ageratum conyzoides* L., *Anthemis tinctoria* L., *Aster pilosum* Willd., *Bidens pilosa* L., *Cichorium intibus* L., *Cirsium arvense* (L.) Scop., *Eclipta prostrata* (L.) L., *Emilia sonchifolia* (L.) DC., *Parthenium hysterophorus* L., *Silybum marianum* (L.) Gaertn., *Sonchus arvensis* L., *Sonchus asper* (L.) Hill, *Tridax procumbens* L., *Xanthium strumarium* L., *Youngia japonica* (L.) DC. The analysis of invasive species reveals that most species have been introduced unintentionally through trade while only 2 species intentionally introduced. Most of the species are of American origin. A better planning is needed for early detection to control and reporting of infestations of spread of new and naturalized weeds to be monitored.

Keywords: Invasive alien species; Jammu district; Nativity; IAS

Introduction

Under the Convention on Biological Diversity, CBD (2002), *invasive alien species* “means an alien species whose introduction and/or spread threaten biological diversity.” These species are introduced from outside their natural range of distribution (other countries or other regions of the country) by either intentional or unintentional human activity, has established self-reproducing populations in the wild and has caused obvious changes in the local, artificial or natural ecosystems. Convention for Biological Diversity (1992) visualize “biological invasion of alien species as the second worst threat after habitat destruction”. An *alien species* “refers to a species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce” (CBD, 2002). Once unappreciated as “sleeper environmental issue”, invasions are now considered as one of our most serious environmental and economic problems worldwide. These species are causing enormous damage to biodiversity and the valuable natural agricultural systems upon which we depend. Today, alien invasion is second only to habitat loss as a cause of species endangerment and extinction. Direct and indirect health effects are increasingly serious and the damage to nature is often irreversible. The effects are exacerbated by global change and chemical and physical disturbance to species and ecosystems. Continuing globalisation, with increasing trade, travel, and transport of goods across borders, has brought tremendous benefits to many people. It has, however, also facilitated the spread of IAS with increasing negative impacts. The scope of

biological invasions is global and the cost is enormous, in both environmental and economic terms. The opportunity of accidental introductions will become more with rapidly increasing global commerce^{1,2}. Such biotic homogenisation is a result of increasing global trade and transport because of which the number of plant and animal species translocated by humans, either deliberately or by accident, has drastically increased^{2,4,5,6,7} and such invasions have the potential of altering the composition of the Earth's biodiversity^{8,5} and such invasions have the potential of altering the composition of the Earth's biodiversity^{8,5}. Besides ethical and aesthetic concerns, the altered biodiversity can severely impair the life-sustaining ecosystem goods and services which in turn can adversely jeopardize the human welfare⁹. Alarmed by the harmful fallout of alien invasive plants, efforts all over the world are directed at inventorizing the alien floras of different affected region at the earliest possible^{10,11}. Present study aims to inventorise a database of invasive alien species in Jammu district (J&K, India) as the first step in the development of invasion biology. This will also serve as a stepping-stone for further detailed studies on the biology and impact of individual species.

Materials and Methods

Study area

The State of Jammu and Kashmir is the northern most state of India covering an area of 2,22,236 sq. Km. The state lies between 32°17' to 36°58' North latitude and 73°26' to 80°30' East latitude. It has four geographical zones of:

- 1) Sub-mountain and semi-mountain plain known as kandi or dry belt
- 2) The Shivalik ranges
- 3) The high mountain zone constituting the Kashmir Valley, Pir Panchal range and its off-shoots including Doda, Poonch and Rajouri districts and part of Kathua and Udhampur districts
- 4) The middle run of the Indus river comprising Leh and Kargil

The state is divided into three divisions: Jammu, Kashmir and Ladakh.

The state has three distinct climatic regions viz. Arctic cold desert areas of Ladakh, temperate Kashmir valley and sub-tropical region of Jammu. There is a sharp rise of altitude from 1000 feet to 28250 feet above the sea level within State's four degree of latitude.

The climate varies from tropical in Jammu plains to semi-arctic cold in Ladakh with Kashmir and Jammu mountainous tracts having temperate climatic conditions. The annual rainfall also varies from region to region with 92.6 mm in Leh, 650.5 mm in Srinagar and 1115.9 mm in Jammu. A large part of the State forms part of the Himalayan mountains. The state is geologically constituted of rocks varying from the oldest period of the earth's history to the youngest present day river and lake deposits. Jammu district is one of the administrative districts of Jammu and Kashmir. Jammu district serves as the winter capital of the state from November to April. It is known for the temples that attract the people from different parts of the country. Jammu is located 74°24' and 75°18' East longitude and 32°50' and 33°30' North latitude. The altitude varies 320 m to 1,675 m above sea level. Jammu district falls in sub-mountainous region at the foothills of Himalayan mountains. Shivalik Hills rises gradually in the north part of the district and merges with the Indo-Gangetic plain in the south. Jammu city is at an elevation of 1,030 feet above the sea level. Jammu district has a sub-tropical climate with hot and dry climate in summer; a warm and humid monsoon; and dry and cold climate in winter. Being in the foothills of the mountains, nights are generally cooler than the neighbouring areas of the

Punjab. Minimum and Maximum temperature is around 4 degree Celsius and 47 degree Celsius respectively. Rainy season usually starts from the end of June or the beginning of July. Average rainfall in the district is about 1,246 mm. Owing to the vast variety of edapho-climatic and physiographic heterogeneity; the district harbours diverse habitats, including swamps, marshes, rivers, streams, cultivated fields, orchards, wetlands and lakes which support equally diverse faunistic and floristic elements.

Methods

The present work aims to inventorise and identify the invasive alien species of Jammu district of Jammu region of J&K state. The survey areas were selected at different tehsils and blocks of Jammu district. These sites were Akhnoor, Bhalwal, Bishnah, Dansal, Khore, Marh, R.S. Pura, Satwari. During this work the following steps were followed: visit to the study sites, sample collection and identification. Each of the sites was divided into different land use types, the following were recognised: roadside; low land; fallow land; railway tracks; along the banks of water bodies, agricultural fields; forestry areas; water bodies etc. Each study site was intensively sampled for the invasive species, their numbers and other characters. The survey and data collection on the invasive species of Jammu district was carried out from March, 2011 - April, 2013. The study followed a random sampling method so that no bias is introduced. The field books were maintained to record the following information: collection number, date of collection, local name, family, habit, habitat and impacts. The species were collected systematically, preserved, stored for identification. Existing literature and information from web based data; online identification system, CABI Invasive Species Compendium and ISSG database were used to determine the alien origin of the species. Observations were made regarding occurrence, distribution of plant species, colonization modes and damage or changes to the ecosystem caused by the invasive plants. Field observations regarding individual plant species, site where it is growing and the potential damage it is causing to the ecosystem was recorded in the field notebook and photography of it was done with Sony DSC-T20 digital camera. The plant material collected during each visit was carried to the laboratory and was properly preserved and herbarium sheets were made using conventional methods of processing and drying. After an extensive review of literature on global invasive species^{1, 2}, and of India and their spread based on history, species origin, species behaviour and field observations, a list of 60 species of plant invasive was prepared. The websites were also examined extensively for background information. Of these, some species may have invaded only a restricted region, but have a huge probability of expanding and causing great damage.

Result

The survey yielded a total of 15 species of invasive alien plants belonging to family Asteraceae in Jammu district (**Table 1**). They include *Ageratum conyzoides* L., *Anthemis tinctoria* L., *Aster pilosum* Willd., *Bidens pilosa* L., *Cichorium intibus* L., *Cirsium arvense* (L.) Scop., *Eclipta prostrata* (L.) L., *Emilia sonchifolia* (L.) DC., *Parthenium hysterophorus* L., *Silybum marianum* (L.) Gaertn., *Sonchus arvensis* L., *Sonchus asper* (L.) Hill, *Tridax procumbens* L., *Xanthium strumarium* L., *Youngia japonica* (L.) DC.

1. *Ageratum conyzoides* L. It is commonly known as Billy goat weed. *Ageratum conyzoides* ranges from Southeastern North America to Central America, but the centre of origin is in Central America and the Caribbean.

Ageratum conyzoides is an erect, herbaceous annual, 30 to 80 cm tall; stems are covered with fine white hair, leaves are opposite, pubescent with long petioles and glandular trichomes¹². It can gain height up to 2

m in the Shivalik hills^{13,14,15}. The inflorescence contains 30 to 50 self-incompatible pink, white or violet flowers arranged as a corymb (Ming, 1999). The fruit is an achene with an aristate pappus and is easily dispersed by wind^{16,17,18,19,20,21,22}. The species has great morphological variation, and appears highly adaptable to different ecological conditions. Agricultural areas, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, water courses, wetlands.

Ageratum conyzoides is a weed in many annual and perennial crops and has been reported as host of many crop diseases²³. Weeds interfere with growth and production of crops and therefore exert significant ecological and economic impacts²⁴. *A. conyzoides* causes allergic reactions in some humans²⁵.

2. *Anthemis tinctoria* L. It is also known as Yellow Chamomile, Golden chamomile. It is native of Europe.

It is perennial 0.3m tall, with yellow flower heads, pinnate lobed leaves. Leaves are 2-5cm long and toothed to shallow lobed. The upper stems terminate in individual flowerheads about 1½-2" across. Each flowerhead consists of 20-32 yellow ray florets that surround a large dome-like cluster of golden yellow disk florets. The florets are replaced by narrowly oblongoid achenes about 2 mm. in length.

It grows in Waste ground, fields, moist woods, also cultivated. It prefers full sun and regular garden soil but also grows in waste lands. It is a seed contaminant.

3. *Aster pilosum* Willd. It is commonly known as white heath aster. It is native to Canada and USA.

The stems, branches and often the leaves of this stout, leafy, much-branched aster are frequently covered with white hairs. The leaves are stiff and narrow, and the flower heads are scattered throughout the upper half of the 3 ft. perennial. Showy, white ray flowers surround yellow disks.

It commonly grows in Fields and Open Areas; Moist low areas, fields or wooded. The broad range of temperature over which high rates of photosynthesis occur in both seedlings and mature plants also indicates that Aster is well-adapted to maintain productivity in the variable environment of an early successional community. *Aster pilosus* is well-adapted as a colonizer in early successional fields. Aster is an early midsuccessional plant that keys in on disturbance. It does not compete well with 1st-yr annuals in growth from seed. However, the perennial habit provides it with a competitive advantage over the annuals in subsequent years. Although early re production may be sacrificed by Aster under resource-limited conditions, investment of energy in overwintering rosettes guarantees continued establishment in the site and future opportunities for reproduction by seed²⁶.

4. *Bidens pilosa* L. It is commonly known as Spanish needle, beggar's tick, cobbler's pegs. It is native to Tropical America.

An erect annual or perennial herb with branching habit to about 1m high. Leaves are deeply divided into three toothed lobes, with the terminal lobe larger than the other two. Individual flowers are yellow but are tiny and held in dense terminal clusters in a widely branching flowering head. Each flower cluster has four or five short, broad, white 'petals' but these do not persist for very long. The seeds are black, about 1 cm long, with 2 or 3 barbed awns at the tip. Cobbler's pegs or beggar's ticks is a prolific ephemeral herb. It occurs as a major weed of vegetables and other crops; it is common in pastures, plantations, along roadsides and on wasteland throughout the region. It thrives best in full sun, where the soil is relatively dry and infertile²⁷. It forms a dense ground cover that prevents regeneration of other species. In northern India this species is growing at an alarming rate.

Bidens pilosa can invade roadsides, crops, pastures, gardens, disturbed areas, fallow lands and urban open space. A troublesome weed to at least 30 crops in over 40 countries, *B. pilosa* is known to significantly reduce crop yields. It forms dense stands that can outcompete, out grow and eliminate crop and native vegetation, specifically the lower vegetative strata, over large areas. *B. pilosa* prevents the regeneration of these plants as well, given its allelopathic properties. Leaf and root extracts are known to significantly suppress germination and seedling growth of many plants and are believed to remain active throughout decomposition. Furthermore, *B. pilosa* grows three times faster than similar plant species. All of these properties render it a quite formidable competitor. *Bidens pilosa* is also a host and vector to harmful parasites i.e. Root knot nematodes (*Meloidogyne* sp.) and Tomato Spotted Wilt Virus (*Schlerotinia sclerotiorum*)^{28,29}.

5. *Cichorium intibus* L. It is commonly known as chicory, coffee chicory, coffee weed. It is native to Europe, Central Russia, Western Asia.

When flowering, chicory has a tough, grooved, and more or less hairy stem, from 30 to 100 centimetres (10 to 40 in) tall. The leaves are stalked, lanceolate and unlobed. The flower heads are 2 to 4 centimetres (0.79 to 1.6 in) wide, and usually bright blue, rarely white or pink. There are two rows of involucre bracts; the inner are longer and erect, the outer are shorter and spreading. The achenes have no pappus, but do have toothed scales on top. It inhabits roadsides, waste land and sometimes cultivated land.

Chicory can survive dry, infertile conditions. Mowing of the plant will cause the stems to dry out leaving a very hard twiggy stump that is quite unfriendly to bare feet. Dairy products from cows that eat chicory may taste bitter. It invades disturbed areas as well as native plant communities. The milky latex may cause dermatitis in humans³⁰.

6. *Cirsium arvense* (L.) Scop. It is Commonly known as Californian thistle, Canada thistle is native to southeastern Europe, the eastern Mediterranean, and possibly northern Europe, western Asia, and northern Africa.

Canada thistle is a perennial plant with deep and extensive horizontal roots that can form new shoots. Stems usually grow 30½ to 122 cm tall and branch above. Leaves are alternate, sessile, and shallowly to deeply pinnatifid or lobed with spiny margins. The lower surfaces of leaves are often covered with soft, woolly hairs. Male and female flower heads appear on separate plants. Flower heads measure 13 to 19 cm in diameter. Flowers are purple and almost exclusively insect pollinated. Seeds are brownish with a tuft of hairs at the top. It inhabits Forests, grassland, riparian habitats, lakeshores and marshes, sand dunes.

Canada thistle threatens natural communities by competing for water and nutrients, displacing native vegetation, and decreasing species diversity. It produces allelopathic chemicals that assist in displacing competing plant species (Hayden 1934, Evans 1984). Pollinating insects appear to be drawn away from native species to visit Canada thistle³¹. This species has been reported to accumulate nitrates that cause poisoning in animals. The spiny leaves scratch skin, sometimes causing infections. Canada thistle is a host for bean aphid, stalk borer, and sod-web worm³². Canada thistle can increase fire frequency and severity because of its abundant, readily ignited litter³¹.

7. *Eclipta prostrata* (L.) L. It is commonly known as False daisy. It is a native to Tropical America.

E. prostrata is a prostrate or reclining to erect, often branched, annual or perennial herb, 30-100 cm tall. Stem cylindrical, green or purplish, rooting at basal nodes, and often covered with long white hairs. Leaf oblong to lance-shaped, opposite, sessile or short-stalked, with more or less coarse hairs; margins entire or slightly

toothed, up to 2-16 cm long. Inflorescence terminal and axillary, about 1 cm across, white or cream, on peduncles to 7 cm long. Fruit achene, densely warted, either brown or black, 2-3 mm long.

It inhabits favoured habitats are poorly drained areas such as along streams, in ditches, marshes, wetlands and on dikes of rice paddies. It is also common in lawns, pasture, waste areas, and crops and can grow in open areas of forest and in estuaries³³. It can grow under wet, saline conditions but is often a weed of drier sites in plantation crops. A common weed of rainfed lowland rice in the Philippines, Indonesia, and India, and other crops, including sugarcane, flax, taro, papaya, banana, soybean, vegetables, and cotton. *Eclipta prostrata* is an alternate host of root-knot nematodes (*Meloidogyne* spp.)³⁴. *E. prostrata* is reported to be a host of rice sheath blight *Rhizoctonia solani* [*Thanatephorus cucumeris*]^{35,36}; Sclerotinia blight of groundnut, *Sclerotinia minor*³⁷; dry root rot of chickpea, *Macrophomina phaseolina*³⁸; and tobacco necrosis satellite virus which also causes tulip necrotic disease³⁹.

8. *Emilia sonchifolia* (L.) DC. It is commonly known as red tasselflower. It is a native of Central and South America.

E. sonchifolia is an erect to ascending, smooth or sparingly hairy soft stemmed, slenderly branched annual herb, growing 20 to 70 cm tall with a branched tap root. The leaves are alternate. Those on the lower stem are deeply and irregularly toothed, being nearly round, kidney shaped, ovate, triangular-ovate or obovate, 4 to 16 cm long, 1 to 8 cm wide, with narrowly winged petioles. The upper, lanceolate leaves are sessile, with bases which encircle the stem. They are smaller than the lower leaves, usually entire but sometimes coarsely toothed. The inflorescence is terminal, usually dichotomously branched, flat-topped and composed of 3 to 6 stalked flower heads, each with a whorl of bracts beneath. Each urn-shaped flower head, a composite of numerous tubular florets which protrude by 1 mm above a single ring of outer green involucre bracts, is 12 to 14 mm long by 4 to 5 mm wide. There are 30-60 florets per head, the outer ones female and the inner ones with both stamens and stigmas. The flowers may be purple, scarlet, red, pink, orange, white or lilac. The fruit is an oblong dry indehiscent ribbed achene, 2.4 to 3 mm long, reddish brown or off-white with a papus.

E. sonchifolia thrives under a wide range of conditions in the tropics and sub-tropics from the full sunlight of open grassland, waste areas, and roadsides or wide spaced arable crops, to the partial shade⁴⁰. *E. sonchifolia* has been reported as a weed of 29 crops, but although extremely common, do not consider it to be troublesome⁴¹. However, they do report that the species is a serious or principal weed in some areas, for example in cassava in Brazil and India; in cotton, maize and lowland rice in Brazil; in oil palm and rubber in South East Asia; in papaya, groundnut, sweet potato and tomato in Hawaii, USA; in pineapple in Hawaii, USA and Malaysia; and in taro (*Colocasia esculenta*) in Samoa. It has also been identified as one of the most problematic weeds in the cotton-producing areas of Nicaragua. *E. sonchifolia* is associated with tomato spotted wilt tospovirus (TSWV) which causes wilt disease of pawpaw⁴²; *Xanthomonas campestris* pv. *phaseoli* [*X. axonopodis* pv. *phaseoli*], which causes bacterial infection of beans (*Phaseolus vulgaris*) in Brazil and Cuba. It is also a host of *Liriomyza huidobrensis*, an insect pest of onion (*Allium cepa*) in Colombia⁴³.

9. *Parthenium hysterophorus* L. It is commonly Bitterweed, carrot grass, false ragweed, feverfew, parthenium weed, ragweed parthenium, Santa Maria, whitetop, congress grass and is native to Mexico, Central and South America.

An erect ephemeral herb known for its vigorous growth. It is light green with branching stems, finely lobed leaves and grows up to 1.5 metres, occasionally reaching 2 m in deep rich soils. Young plants form a basal

rosette of strongly dissected leaves that are up to 30 cm in length. Once stem elongation is initiated, smaller leaves are produced and the plant becomes much-branched in its extremities^{44,45}.

Parthenium hysterophorus is a weed of semi-arid, subtropical, tropical and warmer temperate regions. It is found in riparian zones (banks of watercourses), on roadsides, along railways and in pastures, seasonal floodplains, grasslands, open woodlands, waste areas, disturbed sites, lawns, gardens and crops. It is particularly aggressive in degraded or disturbed pastures in semi-arid environments. Infestations of *Parthenium* can degrade natural ecosystems. *Parthenium* aggressively colonises disturbed sites and has major impacts on pasture and cropping industries, spreading to and impacting on new areas. Out competes native species, in part due to allelopathy. Regular contact with the plant, usually over a prolonged period, produces allergic dermatitis and asthma in humans. Cattle may also be affected and pass the toxic principle into their milk. Meat from livestock that has eaten the weed is badly tainted and not fit for consumption.

10. *Silybum marianum* (L.) Gaertn. It is commonly known as milk thistle, spotted thistle, variegated thistle. This species originated in the Mediterranean region, south-western Europe, Asia Minor and Russia (i.e. Eurasia)⁴⁶.

A stout herb with glabrous stems of 20-250 cm height, and spiny dentate leaves. Leaves are alternate, glabrous, coarsely lobed, and dark green with white blotches. The basal leaves are 20-25 cm long and 12-25 cm wide, and have a winged petiole. Stem leaves are sessile, smaller and less deeply divided, with yellowish white spines upto 8 mm length. Flowerheads are glabrous, 2-6 cm in diameter and borne on long peduncles. Involucral bracts are tapering into spines of 2-5 cm in length. Florets are pink to purple. Fruits are black achenes of 6-8 mm length and 2.5-4 mm width. The pappus is 15-20 mm long. A weed of crops and cultivation, pastures, forestry plantations, roadsides, disturbed sites and waste areas in temperate, sub-tropical and sometimes also semi-arid regions.

This plant competes with native plants, sometimes to the point of exclusion. Variegated Thistle is a highly competitive weed once it starts to establish in pastures. Due to the size of its rosette and its ability to compete for light, nutrients and moisture it shades out more desirable pasture species. When the thistle plants die in summer the ground is left bare and open for re-establishment of the weed in autumn. Where established in areas cut for hay it will contaminate the fodder reducing its value and enabling further dispersal of the weed. Where Variegated Thistle can get established in natural plant communities it is also able to displace native species through its competitive ability. Its prickly nature and its ability to form a dense sward make access and control using hand tools difficult, and can also deter stock and wildlife while harbouring vermin like rabbits⁴⁷. Because of potassium nitrate content, the plant has been found to be toxic to cattle and sheep. When potassium nitrate is eaten by ruminants, the bacteria in an animal's stomach break the chemical down, producing a nitrite ion. Nitrite ion then combines with hemoglobin to produce methaemoglobin, blocking the transport of oxygen. The result is a form of oxygen deprivation.

11. *Sonchus arvensis* L. It is commonly called perennial sow thistle and is a native of Europe. Perennial sow thistle is a succulent, rhizomatous, perennial plant that grows up to 122 cm tall with extensive root system that grow down to 3 m deep. All parts of the plant contain a white, milky juice. Leaves are alternate, lanceolate, and 6 ½ to 40 ½ cm long with clasping bases and soft prickly margins that vary from deeply toothed to nearly entire. Flower heads are bright yellow and 2½ to 5 cm wide. Involucral bracts and flower stalks are covered with

yellow gland-tipped hairs. Seeds are dark brown, prominently ridged, and wrinkled with tufts of soft, white bristles^{48,49}.

It invades disturbed sites with damp soils. At high densities, perennial sowthistle drastically reduces water resources and possibly decreases the number of plant species in communities⁵⁰. It is a known host for a number of plant pests. Perennial sowthistle is acceptable feed for rabbits and other foraging animals⁵¹. Perennial sowthistle may modify or retard the successional establishment of native species⁵⁰. *S. arvensis* is reported as a weed in 59 countries, and is most often mentioned as a serious weed in cereal crops⁴¹. It is listed as a serious or principle weed in 15 countries. 3-15 shoots per square metre of this species reduced wheat yields by 4.5-7%⁵². Yields of oats in Canada can be reduced by 58%⁴¹. In forage crops it is harmful mainly because it is not palatable⁵³. In crops sown at wide row spacings (which are therefore weakly competitive) it severely reduces yields by competition if not effectively controlled.

12. *Sonchus asper* (L.) Hill It is commonly known as prickly sow thistle and is a native of Mediterranean.

Sonchus asper is a dicotyledonous annual or biennial herb in the family Asteraceae⁵⁴. Plants can grow up to 2 metres in height. It has a ridged, glabrous (hairless) central stem that is simple or branched and is pentagonal in cross section. Egg-shaped cotyledons are borne on petioles and are approximately 3 to 8mm long. Cotyledons and young leaves have a whitish coating. Young leaves form a basal rosette, sometimes causing them to be confused with thistles. Mature leaves that occur on the flowering stem are alternate and have rounded lobes that clasp the stem and measure 4-30cm x 1-9cm. All leaves are glabrous, oblanceolate in shape, bluish green in colour and have prickly margins. Leaves and stems emit a milky sap (latex) when damaged. Inflorescences are 4-5mm in diameter, yellow in colour and occur in clusters at the end of stems. Each capitulum contains 25-150 ligulate bisexual yellow florets⁵⁵. Fruits are brown, wrinkled achenes 2.5-4mm long and 1.5mm wide. Achenes have 3 (or rarely 4-5) longitudinal ribs on each face. Mature seeds have a white feathery pappus (8mm long) that collectively form a white puff ball, similar to dandelion⁵⁴.

Invades disturbed sites. Plants tolerate saline soils, but not moisture stress⁴¹. *S. asper* is also an important alternative host of pests and diseases of crops⁴¹. In Canada *S. asper* acts as an alternate summer host to economically important aphids, which are vectors of "yellows" virus diseases. They may also serve as hosts for nematodes which attack cultivated plants⁵¹. It is also likely to be an important host for downy mildew (*Bremia lactucae*), one of the worst diseases of lettuce which is an important vegetable crop worldwide⁵⁶.

13. *Tridax procumbens* L. It is commonly known as Mexican Daisy, coat buttons and is a native to Tropical America.

The plant bears daisy like yellow-centered white or yellow flowers with three-toothed ray florets. The leaves are toothed and generally arrowhead-shaped. Its fruit is a hard achene covered with stiff hair and having a feathery, plumelike white pappus at one end. The plant is invasive in part because it produces so many of these achenes, up to 1500 per plant, and each achene can catch the wind in its pappus and be carried some distance. This weed can be found in fields, meadows, croplands, disturbed areas, lawns, and roadsides in areas with tropical or semi-tropical climates Occurs throughout the tropical and subtropical belt of the world and is frequently found in annual crops, roadsides, pastures, fallow land and waste areas, and occasionally in lawns, perennial crops and nurseries.

T. procumbens is a weed of 21 crops in 30 countries and is frequently reported in rice, maize, cotton, sugarcane and pastures. It is a principal weed of cassava in Ghana and India; cotton in India, Morocco and Mozambique, Thailand, and Tanzania; dryland crops, jute and wheat in India; sugarcane in India and Kenya.

14. *Xanthium strumarium* L. It is commonly known as Cocklebur and is native to Tropical America.

They are coarse, herbaceous annual plants growing to 19.69-47.24 in tall. The leaves are spirally arranged, with a deeply toothed margin. The flowers are of two types; One, in short terminal branches, produces only pollen. The other, in clusters in the axils of the leaves, produces seed. Unlike many other members of the family Asteraceae, whose seeds are airborne with a plume of silky hair resembling miniature parachutes, cocklebur seeds are produced in a hard, spiny, globose or oval double-chambered, single-seeded bur 0.32 -0.79 in long. It is covered with stiff, hooked spines, which sticks to fur and clothing and can be quite difficult to extract. These remarkable burred seeds have allowed this plant to be carried all over the world by unsuspecting travellers. This plant reproduces only by means of its seed.

Xanthium strumarium invades farmland, old lands, roadsides, wastelands, riverbanks and overgrazed pasturelands. It is considered a ruderal weed of maize farms in Western Kenya.

X. strumarium is a noxious weed. This heat-loving and drought-resistant plant grows among habitations, along roads, on waste grounds, dumps, along ditches and river banks and in crops. It is a wide spread invasive weed in India. It has developed herbicide resistance.

The plant is rough to touch. Its hair and dust cause itching. The mechanical irritation of mouth happens if burs are ingested. A weeping eczema and dermatitis can result from handling the plant. A fatal outbreak of toxicity from consuming *Xanthium strumarium* seedlings in large quantities during food scarcity in Bangladesh has been recorded. The consumption of *Xanthium strumarium* seedlings in large quantities, due to inaccessibility of other foods, caused this outbreak. The toxic chemical in the plant, carboxyatratyloside, has been previously described and eating *X. strumarium* seeds and seedlings has been associated with fatalities in humans and livestock. Unless people are able to meet their nutritional requirements with safe foods, they will continue to be at risk for poor health outcomes beyond undernutrition⁵⁷.

15. *Youngia japonica* (L.) DC. It is commonly known as Oriental False Hawksbeard and is native to South America.

It is an erect annual herb to 60 cm high, hairy at base. Leaves basal and cauline, oblong or obovate, usually lyrate-pinnatifid, with large terminal segment, 1.5–12 cm long, 1–5 cm wide, margins finely toothed, surfaces glabrous. Heads numerous, in loose corymbose panicles; heads 2–3 mm diam.; outer involucre bracts minute, inner ones lanceolate, c. 5 mm long. Florets yellow. Achenes 1.5–2 mm long with slightly expanded pappus-disc, 11–13-ribbed with 2–4 stronger ones; pappus 3 mm long, bristles united at the base.

It inhabits disturbed forests, old fields, clearings, roadsides, and other disturbed, open or shaded habitats. It is a weed of lawns, roadsides and orchards. It will grow in almost any soil types, in semi-shade or no shade, and requires moist soil.

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Table 1. Invasive alien plant species of Jammu district (J&K, India)

S.No	Name of Species	Nativity	Life Form	Mode of Introduction
1	<i>Ageratum conyzoides</i> L.	Tropical America	H	O
2	<i>Anthemis tinctoria</i> L.,	Europe	H	Ui
3	<i>Aster pilosum</i> Willd.,	North America (Canada, USA)	H	Ui
4	<i>Bidens pilosa</i> L.	Tropical America	H	O
5	<i>Cichorium intibus</i> L.	Europe, Central Russia, Western Asia	H	Ui
6	<i>Cirsium arvense</i> (L.) Scop	Europe, Mediterranean	H	Ui
7	<i>Eclipta prostrata</i> (L.) L.,	Tropical America	H	Ui
8	<i>Emilia sonchifolia</i> (L.) DC.,	Central and South America	H	Ui
9	<i>Parthenium hysterophorus</i> L.,	Mexico, Central and South America	H	Ui
10	<i>Silybum marianum</i> (L.) Gaertn.,	Mediterranean region, south-western Europe, Asia Minor and Russia	H	Ui
11	<i>Sonchus arvensis</i> L.,	Europe	H	Ui
12	<i>Sonchus asper</i> (L.) Hill	Mediterranean	H	Ui
13	<i>Tridax procumbens</i> L	Tropical America	H	Ui
14	<i>Xanthium strumarium</i> L.,	Tropical America	H	Ui
15	<i>Youngia japonica</i> (L.) DC.	South America	H	Ui

Life form: H-Herb

Mode of introduction: O-Ornamental; Ui-Unintentional.