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The Terrestrial Alien Invasives of Family Asteraceae in Punjab (India) & their Ecology

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ABSTRACT

Punjab, a northwestern state of India, is one of the main agricultural states of the country which produces wheat, rice, and sugarcane in massive scale every year. The state is rich in terms of biological diversity. However, the invasion of alien species is posing a risk not only to the community composition but also to the agricultural economy of the state. Among several terrestrial invasiveness of India, mainly two species of family Asteraceae, *Ageratum conyzoides*, and *Parthenium hysterophorus* that are native to South America are considered as the most obnoxious weeds to agriculture, ecology, and economy of the state of Punjab. These alien invasives are known for their persistence, adaptability, competitive exclusion and reproductive capabilities. All of these unique characteristics have made these species establish successfully in this new ecological region outside their native ranges.

Keywords: Terrestrial Invasives, *Ageratum Conyzoides*, *Parthenium Hysterophorus*, Punjab (India).

1. INTRODUCTION

Alien invasives is those species that are not native to an ecosystem, however, when introduced in any ecosystem, these may eliminate native species through competition, predation or transmission of pathogens, hence disrupt the local ecosystem and its functions. An introduced species might become invasives if it can out-compete native species for resources such as nutrients, light, physical space, water or food and may adversely impact the environment and human health through its quick proliferation in any new ecosystem.

Punjab is one of the premiere agricultural states in northwest India that has approximately 84% of its area (Total area 50,362 sq. km) under agriculture. The state is rich in biological diversity (1897 Angiosperms, 48 Pteridophytes, 34 Bryophytes, 948 Fungi and 397 Algae) that faces threat from several established alien invasives species. Punjab Biodiversity Board, Botanical Survey of India, Zoological Survey of India and Forest Department have identified several invasiveness of different families in India (*Lantana camara*, *Parthenium hysterophorus*, *Ageratum conyzoides*, *Ricinus communis*, *Eupatorium odoratum*, *Artemisia scoparia*, *Datura stramonium*, *Chenopodium ambrosioides*, *Cassia occidentalis* and *Bidens pilosa*). Among all these groups of invaders of the country, *Ageratum conyzoides* and *Parthenium hysterophorus* of family Asteraceae have been identified as the most problematic invasives of the terrestrial ecosystem of the state (Biogeographic distribution, figure 1) in Punjab. This terrestrial invasiveness (Table 1) have established themselves not only in the plains but also in hilly areas of Punjab that make part of the Himalayan ecosystem. This article aims to discuss the ecology of these alien invasives and their management.

2. PARTHENIUM HYSTEROPHORUS

Parthenium hysterophorus is one of the most aggressive weeds observed in wheat fields of Punjab. Commonly known with several names, congress grass, carrot grass, carrot weed, white top, star weed, Gajar Ghas, the annual herb is a native to Tropical America that was accidentally introduced into several countries in Asia, Africa, and Australia during the last 50 years. It was first reported in Maharashtra in the 1950s and noticed for the first time in Khanna (Punjab) in 1976. Since then, it has invaded the entire state along with the road sides, around the agricultural fields and on waste lands, which is considered to be no man's land in the state.

The spread of *Parthenium* is aided by the poisonous characteristics of their leaves that repel the animals from feeding on the plant. There are three major reasons that have caused the weed to quickly establish itself in Punjab: One, extensive seed production by the plant; Two, their persistence for a long time in the environment and Three, the Allelopathy. The tall (1-2m) deep rooted plants of *Parthenium* that resemble carrot plant bear white flowers can produce a large number of seeds. Each plant is capable of producing about 25,000 to 100,000 seeds that are easily dispersed by wind or water from one place to another. Moreover, the seeds are very persistent in soil. They can stay in the soil for a long duration of time, between 6 months to 2 years.

When the seeds stay on the surface, they do not survive for more than six months. However, if the seeds are buried at 5cm below the soil surface, they can stay dormant for at least 2 years. The seeds can germinate across a wide range of temperature, from 8 to 30° C, but the optimum germination temperature is 22 to 25° C. The germination rate of *Parthenium* weed seeds is also significantly faster than that of all other species present. As soon as the winter season is over i.e. at the end of February, this weed starts appearing and continues to appear until October-November. This weed appears in four to five flushes or even more depending upon the rainfall pattern of the year in one year. However, during the rainy season i.e. July and August, nuisance value of *Parthenium* is at the top. Allelopathy is another major reason that *Parthenium* outcompetes several native species and the only factor that can curb its growth is stagnant waters as the weed do not grow well in flooded conditions.

For the presence of chemicals like parthenin, hysterin, hymenin, and abborsin, the weed exerts strong allelopathic effects on different crops grown in terms of poor germination and crop growth. Its infestation has been noticed in agricultural crop fields of wheat, sugarcane, and vegetable crops, etc. Due to its numerous adaptive capabilities, *Parthenium* can also colonize aggressively any disturbed sites. The weed has spread mainly in uncultivated lands, unbuilt or developing residential colonies around the towns, railway tracks, roads, drainage and irrigation canals, etc. The extent of economic losses the presence of weed has caused to the agriculture in Punjab (India) has not been yet estimated, however its implications on the health of humans and cattle are also noteworthy.

Parthenium hysterophorus (Gajar Ghas) has emerged as a great health hazard to human beings and livestock. Frequent contact with the weed causes allergy, dermatitis, eczema, asthma, pollentonsis, and gangrene, etc. Even dried plant material may induce dermatitis in sensitive persons who do not have direct exposure to the plants. It can also prove harmful and even fatal to cattle grazing in the infested area. If cattle are fed on grass mixed with this weed, somewhat bitter taste in milk develops. The toxin 'parthenin' has been detected in the milk of cattle grazing in areas with *parthenium*. Considering the various ecological, economical and health impacts of one of the most noxious weeds in the world, its management in the area is necessary.

Parthenium weed can be managed using a combination of methods depending on the site, including biological control agents, pasture management, cultivation, and chemicals. The weed can be ploughed under before the setting of flowers where ploughing is possible i.e. in gardens, tree plantations, roadsides, open wasteland, etc. Repeated mowing in playgrounds, lawns and levelled wastelands also provide good control of *parthenium*. If mowing is not properly done the stumps sprout again and produce profuse growth. Hence, care should be taken that the mower is operated at the ground level. If ploughing/mowing is not possible, the weed can be uprooted before flowering. Manual removal is an effective method but the persons engaged in uprooting should not be allergic to *parthenium*. The cut plants should be stacked in one place and burnt. It has also been observed that burning of plants in the highly infested areas during the October or early November, when the plants mature and become dry, can also help in controlling this weed to a large extent as this method helps in reducing seed bank of *parthenium*. Application of Atrataf (50 per cent atrazine) at the rate of 1 kg/acre or Round Up/Glycil (glyphosate) @ 1.01/acre can provide a very effective control of this weed. Any of the herbicides must be dissolved in 200 litres of water and sprayed uniformly over the area infested with this weed. Glyphosate is non-residual herbicide so any ornamental, vegetable, fruit or other economical plants can be sown when weed plants dry up. However, residues of atrazine remain for a long time in the soil. These herbicides must be sprayed when weed plants are very young i.e. when leaves are tender and it has not flowered. On grown-up plants, the dose of Atrataf should be increased from 1 to 1.5 kg/acre. To have effective control of this weed it is of utmost importance that the people are made aware of this weed, particularly its harmful effects and its growth behaviour. This will help in promoting the community or public participation to eradicate this weed.

3. AGERATUM CONYZOIDES

Ageratum is an established difficult to control weed in many annual and perennial crops in the Himalayas and Shiwalik ranges of Punjab and Himachal Pradesh. Shiwalik is the mountain range that forms part of the North Indian Himalayas, also known for rich floral diversity, where *Ageratum* is replacing native grasses and medicinally important herbs and posing a threat to the structure of natural plant grassland and forest communities in the adjoining states of Punjab and Himachal Pradesh. Its strong invasiveness ability (almost 1000 plants per meter square) is challenging the dynamics of natural ecosystem processes of the region by lowering the biodiversity and creating a homogenous monospecific stand.

Ageratum conyzoides is an erect, herbaceous annual with pink, white or violet flowers that can stand 30 to 80 cms tall. In Shiwalik hills, it has been found to attain 2m height. *A. conyzoides* has the potential to produce tremendous seeds (almost 94,000 seeds per plant) that may remain viable for almost a year. The plant can shed seeds over an extended period of time for about 5 to 8 months. The seeds that have extraordinary physiological plasticity, can persist in arable fields and germinate under the temperature ranging from 20 to 25°C. *Ageratum conyzoides* grows in moist mineral soils from sea level to at least 2400 m in altitude in tropical and subtropical environments. It has been found upto 1800 m in Himachal Pradesh. Generally, it is found in grasslands, forests and agricultural fields. It does not grow well in less fertile soils but it can tolerate shade.

Annual plants appear to have two great advantages: they reproduce early, so they have the potential for the very high intrinsic rate of increase, and they can survive adverse condition as dormant seeds in the soil. The species appears to be highly adaptable to different ecological conditions and also bears a great morphological variation.

Though widely known for its medicinal, biocidal and herbicidal properties, *Ageratum* has been known to interfere with the growth and production of several crops. In wheat (*Triticum aestivum*) and rice seeds (*Oryza sativa*), *A. conyzoides* inhibits germination and growth of the seeds and reduces the crop yield of crops. *A. conyzoides* exerts a phytotoxic effect on wheat by releasing water-soluble phenolics into the soil. Infestations of *A. conyzoides* can reduce the rice grain production by 25-47% and this loss in rice produce can be attributed to the presence of phenolics present in the leaf extracts and residues of *Ageratum* that interfere with the growth and development of crops. Similarly, *A. conyzoides* inhibits seedling growth in peanut, redroot amaranth, cucumber, and ryegrass. In chickpea (*Cicer arietinum*), *A. conyzoides* causes reduction in growth, and nodulation whereas it strongly inhibits germination in radish (*Raphanus sativus*). The plant is a major weed of sugarcane and maize as well where it has been observed to grow in high densities (250-1000 plants/ m²). For Punjab being the food basket of India and one of the largest contributor of wheat and rice, and a major producer of maize and sugarcane, the presence of weed like *Ageratum* is an ecological and economic threat to the farmers. Moreover, its ability to act as a host of many crop diseases can significantly change the vegetation community structure and modify the soil regime. Any economic loss that the state of Punjab faces due to invasives *Ageratum* has not been estimated yet.

Considering the ecological and economic impact *Ageratum* can potentially exert in the agricultural state of Punjab, it is important to keep a check on the weed in the state. Two strategies can be applied to control the weed in the region. One, application of any of these chemicals; simazine, atrazine, diuron, oxadiazon, oxyfluorfen, methazole or metribuzin provides excellent control to the weed. Two, Plant extracts of parthenin and eucalyptus (volatile essential oils) offer an environmentally friendly strategy in controlling *A. conyzoides*. Monoterpenes (cineole and citronellol) affect the germination, seedling growth, chlorophyll content and respiratory activity of *A. conyzoides*. Cineole is more toxic of the two monoterpenes. It is advisable that comprehensive information on the invasives plant species be compiled, modes of entry be determined, the biological and ecological attributes of the invasives plants be understood, the socio-economic and ecological impact of the invasives plants be determined, information be disseminated to general public because the problems associated with invasives species are aggravated due to lack of awareness, insufficient information on the species and its dimensions of the spread in the Shiwalik region.

4. CONCLUSION

Ageratum conyzoides & *Parthenium hysterophorus*, are the two most obnoxious terrestrial weeds in the agricultural state of Punjab that have spread their ranges through a wide variety of habitats adversely affecting the ecology of the region. Several physiological and ecological features of these have helped them in successful invasion of the state and their growing ranges need serious efforts on the part of public to manage the weed effectively through various management strategies and

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Table1. Phylogenetic Classification of Terrestrial Invasives of Punjab (India)

Classification	<i>Ageratum conyzoides</i>	<i>Parthenium hysterophorus</i>
Kingdom	Plantae	Plantae
Phylum	Magnoliophyta	Magnoliophyta
Class	Magnoliopsida	Magnoliopsida
Order	Asterales	Asterales
Family	Asteraceae	Asteraceae
Common Names	Neela Phulnu gundhaubon mahakaua Phulkuri, mother brinkly goat weed billy goat weed winter weed tropical whiteweed budbuda	Congress grass, fausse camomille, Karottenkraut, parthenium weed, ragweed parthenium, Santa Maria feverfew, whiteweed

