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Research Article

STUDIES ON THE IMPACT OF INVASIVE ALIEN SPECIES OF FAMILY SOLANACEAE IN RAJOURI DISTRICT OF JAMMU AND KASHMIR

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ABSTRACT

The present study aims to deal with impact of invasive alien plants species of family Solanaceae in Rajouri district (J&K, India) with background information on habit and nativity. A total of 03 invasive alien plant species have been recorded, which include *Physalis angulata* L., *Solanum viarum* Dunal and *Datura stramonium* L. The result reveals that most species have been introduced unintentionally through trade, agriculture and other anthropogenic activities. The nativity of *Physalis angulata* L. is of American and that of *Datura stramonium* L. is of Mexico and Tropical America while the origin of *Solanum viarum* Dunal is from Argentina and Brazil . Addressing the problem of invasive alien species is urgent because the threat is growing daily, and the economic and environmental impacts are severe. There is utmost need of proper methods for early detection to control and reporting of infestations of spread of new and naturalized weeds.

INTRODUCTION

Invasive alien species are a growing threat throughout the world, causing losses in biodiversity, changes in ecosystems and impacts to economic enterprises such as agriculture, forestry, fisheries, power production and international trade. Those alien species that become established in a new environment, then proliferate and spread in ways that are destructive to human interests are considered "Invasive Alien Species"(IAS). Under the Convention on Biological Diversity, CBD (2002), invasive alien species "means an alien species whose introduction and/or spread threatens biological diversity/causes or is likely to cause economic or environmental harm or harm to human health. "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). These organisms are sometimes called "exotic", "non-native" or "non-indigenous species."

The scope of biological invasions is global and the cost is enormous, in both environmental and economic terms. Invasive alien species have invaded and affected native biota in virtually every ecosystem type on earth. These species have contributed to many hundreds of extinctions. The environmental cost is the irretrievable loss of native species and ecosystems. Most nations are already grappling with complex and costly invasive species problems. Examples include: zebra mussels (*Dreissena polymorpha*) affecting fisheries, mollusc diversity, and electric power generation in Canada and the USA; water hyacinth (*Eichornia crassipes*) choking African waterways; rats exterminating native birds on Pacific islands and deadly new disease organisms attacking human, animal and plant populations in both temperate and tropical countries. Addressing the problem of invasive alien species is urgent because the threat is growing daily, and the economic and environmental impacts are severe.

MATERIALS AND METHODS

Study Area

Jammu and Kashmir is the northern most state of India. It is located between 32° 17' to 37° 5' north latitude and 73° 26' to 80° 30'east longitude, occupying central position in the Asian continent.

The state is divided into three divisions: Jammu, Kashmir and Ladakh. The state ranks 6th in area and 17th in population among the states and union territories of India. The state consists of 22 districts, 59 tehsils, 119 blocks, 3 municipalities,

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54 towns and notified area committee, 6477 inhabited villages and 281 uninhabited villages.

It 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 28,250 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 1,115.9 mm in Jammu. A large part of the state forms part of the western Himalayas.

The present work is carried by the author in the Rajouri district of which is situated in the west of Jammu division. It is bounded by Poonch district in the north, Jammu district in the south, Udhampur district in the east and Pak occupied Kashmir (Mirpur area) in the west. It is located in the foothills of Pir Panjal Range. The general elevation of the district is in the range of 562-4800 m above mean sea level. Rajouri is the district headquarter, which is 160 km from Jammu, the winter capital of Jammu and Kashmir. This part of Jammu region encompasses extraordinary biotic communities which is attracting people from different regions and is being promoted as a tourist destination.

The scenic beauty of this biodiversity rich region has attracted people of all walks of life and also from far off regions of the country. This fragile Himalayan ecosystem has witnessed intentional and unintentional introduction of varying floral elements from different phytogeographical regions of the world. With the operationalization of improved roads and highways and better connectivity, the influx of traders, tourists, businessmen has increased manifold, thereby raising the threat of invasive alien species even more into this Pir Panjal range.

The present study aims to act as a foundation stone for the advanced studies in invasion ecology and biology and would serve a benchmark for future assessment of extent of invasion not only in this biodiversity rich region of J&K state but also the rest of the country.

The main objectives of the present study are

1. Documentation and inventorisation of the alien flora of Rajouri district.
2. To record their origin, spread, introduction pathway and invasion status.
3. To spread public awareness on the impact of invasive alien species on environment and economy.

Extensive survey was carried out in Rajouri district during 2012 -2013. The field studies for documenting the spread of invasive alien species belonging to family Solanaceae in Rajouri district of Jammu Division were conducted in all the seven tehsils of the district viz. Rajouri, Nowshera, Kalakote, Sunderbani, Koteranka, Thannamandi and Darhal.

The present investigation aims to identify and document the invasive alien species present in the Rajouri district of the Jammu region of J&K state. During the course of field study the authors have selected different tehsils and blocks of Rajouri district viz; Rajouri, Nowshera, Kalakote, Sunderbani, Budhal, Thannamandi, Darhal, Koteranka and Manjakote and the following steps were followed: visit to study sites, sample collection, preservation and identification. During this period enquiries were conducted from farmers and agriculturalists of each site about the invasive biota. Every site was divided into different land use types, and the division was made as follows: agricultural fields, forest areas, roadsides, fallow land, along the banks of water bodies, residential areas, low land, water bodies, waste lands, etc.

Each study site was intensively sampled for the invasive species, their numbers and other characters. The survey and data collection on the invasive alien species of Rajouri district 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 and stored for identification. Existing literature and information from web based data, online identification system and ISSG database were used to determine the alien origin of the species.

Survey and Collection: A comprehensive survey was conducted by the author in various locations in Rajouri district for invasive plant species. Periodic surveywere conducted during premonsoon, monsoon and postmonsoon seasons. All the available plant species were recorded and collected. 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 Sony DSC-T20 digital still camera.

Preservation and Herbarium Records: The plant species collected during every field trip were carried to the laboratory and were properly pressed, dried and properly preserved and herbarium sheets were made using conventional methods of processing and drying.

Identification: After an extensive review of literature on global invasive species (Mooney and Drake,1987; Heywood, 1989; Cox, 1999, 2004; Cracraft and Francesca, 1999; D'Antonio and Vitousek, 1992; Drake *et al.*,1989; Randall *et al.*,1997; Huxel,1999; Jenkins, 1999; Lonsdale, 1999; Mooney, 1999; Elton, 2000; Mooney and Hobbs, 2000; Almeilla and Freitas, 2001;Cowie, 2001; McNeely *et al.*, 2005) and of India and their spread based on history, species origin, species behaviour and field observations, a list of 03 species plant invasives belonging to family Solanaceae 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. Existing literature and information from web based data, online identification system and ISSG database were used to determine the alien origin of the species.

The identified voucher specimens were mounted in the herbarium file of the size 41.5 cm x 28.5 cm along with photographs and deposited in the museum of the Department of Zoology, University of Jammu, Jammu. Each plant species was provided with its botanical name, author citation and brief

morphological description. Besides, help from other agencies were also undertaken.

RESULTS AND DISCUSSION

In view of the immediate importance of Invasive Alien Species, there is an apparent need for a regional and national authentic database for monitoring the spread and impact in various regions and for devising appropriate management strategies. The present study records first ever database on the invasive alien species of family Solanaceae. Rajouri district of Jammu division of J&K state. The survey yielded a total of 03 species of invasive alien plants belonging to family Solanaceae in Rajouri district. They include *Physalis angulata* (Linnaeus), *Solanum viarum (Dunal)* and *Datura stramonium* (Linnaeus). Of these, *Physalis angulata* L., *Solanum viarum* Dunal are herbs and *Datura stramonium* L. is a shrub**.** However, many more species have also been recorded from different parts of Rajouri but their taxonomic status have so far not been determined. Efforts are on to get them identified and will be included in the database shortly. About 80% of these alien species were introduced from Europe, followed by North America.

Contemplating the importance of studies on invasive alien species, especially in the areas the of high anthropogenic interference, present study was aimed at compiling the first ever inventorisation of the alien flora of Rajouri district, along with supplementation of each species with information on origin, habit, spread, introduction pathway and the invasion status.

***Physalis angulata* (Linnaeus)**

Order: Solanales **Family:** Solanaceae

Common Name: Cutleaf groundcherry, Wild tomato, Camapu and Winter cherry, Wild gooseberry, Bladder cherry, Bush tomato, Chinese lantern, Husk tomato, Indian goose berry weed.

Short Description: Branched, erect herbaceous shrub which can reach up to 2 m in height. It has a characteristic angled hollow stem; leaves are dark green and roughly oval, often with tooth shape around the edge; pale yellow flowers are five-sided and its edible yellow-orange fruit are surrounded by a balloon-like calyx. Seeds about 1.7 mm long, flat and yellowish.

Habitat: Crop field, grass farm, along road sides, nurseries, ruderal and edge of forests. It grows best in moist, fertile soils and is tolerant of partial shade.

Biology/Ecology

Dispersal Mechanism: It is spread by seeds. Animals often consume berries and disperse seeds in their droppings.

Reproduction: Reproduces by seeds, prolific seed producer.
Native Range: It is native to tropical America.

Introduced Range: It is naturalised in South America, Europe, Asia and Eastern Africa.

Distribution in India: Throughout.

Distribution in Jammu Division and Rajouri: Widespread.

Introduction Pathway: Accidentally introduced with agriculture material. It is also introduced to new places by water, wind agency and by animals.

Impact: It is a weed of cropland, gardens, waste lands, forest fringes, and plantations. It is an alternate host to many viruses of lucerne, tobacco, potato, capsicum, sweet pepper and okra. Alves *et al.* (2008) reported its genotoxic effect on human lympocytes treated in vitro. It has prolific seed production capacity, through which it is considered as highly invasive species. It vigorously grows and spreads under unfavorable conditions. It also has the ability to compete with the native species**.**

Threat Level: Moderate to High.

***Solanum viarum* (Dunal)**

Order: Solanales **Family**: Solanaceae

Common Name: Tropical soda apple.

Short Description: Mature plants are 3 to 6 ft tall and are armed on the leaves, stems, pedicles, petioles, and calyxes with broad based white to yellowish thorn-like prickles up to ¾ inch long. The leaves and stems are pubescent. Flowers are white. Immature fruits are mottled whitish to light green and dark green, like a watermelon. The mature fruits are smooth, round, yellow and ¾ to 1 ¼ inches in diameter with a leathery-skin surrounding a thin-layered, pale green, scented pulp and 180 to 420 flattened, reddish brown seeds. Each plant is capable of producing 200 or more fruit per year.

Habitat: A weed in agricultural fields, pastures, ditches, disturbed sites and natural areas.

Biology/Ecology

Dispersal Mechanism: The sweet smell of the fruit attracts livestock and wildlife that eat and spread the seed. Each plant can produce approximately 50,000 seeds.

Reproduction: It reproduces primarily by seed, but can also spread by roots. Seedling emergence has been observed to primarily occur during the dry season.

Native Range: Native to Argentina and Brazil.

Introduced Range: Widely spread across South America, Africa, India, Nepal, West Indies, Honduras, Mexico (Bryson *et al.*, 2002).

Distribution in India: Throughout.

Distribution in Jammu Division and Rajouri: Widespread.

Introduction Pathway: Contaminated hay, seeds and bags of manure for composting also serve as a means of its dispersal.

Impact: It is a noxious weed of croplands, forestlands and natural habitats. It reduces biological diversity in natural areas by displacing native plants and disrupting ecological integrity. Plant prickles can restrict wildlife grazing and create a physical barrier to animals, preventing movement through infested areas. It contains solasodine, which is poisonous to humans. It is a threat to the vegetable crop field as a competitive weed and because it is an alternate host for numerous pathogens that cause disease in eggplant, peppers, potatoes, tomatoes, etc. These vegetable crop pathogens include the Cucumber Mosaic

Virus, Gemini Virus, Potato Leafroll Virus, Potato Virus Y, Tobacco Etch Virus, Tomato Mosaic Virus, Tomato Mottle Virus and the fungal pathogen, *Alternaria solani*.

Threat Level*:* High.

***Datura stramonium* (Linnaeus)**

Order*:* Solanales ***Family****:* Solanaceae

Common Name*:* Common thorn apple, Jimson weed, Devil's trumpet, Devil's weed, Stinkweed, Datura, Pricklyburr, Devil's cucumber, Moonflower, False Castor-oil, Mad apple, Devil's apple.

Short Description*:* It is an erect annual plant forming a bush up to 3-5 ft tall. The stem is stout, erect, leafy, smooth, and pale yellow-green. The leaves are soft, irregularly undulate and toothed. The upper surface of the leaves is a darker green, and the bottom is a light green. The leaves have a bitter and nauseating taste. It generally flowers throughout the summer. The fragrant flowers are trumpet-shaped, white to creamy or violet and 6–9 cm long. The flowers open at night, emitting a pleasant fragrance and is fed upon by nocturnal moths. The elliptic seed capsule is 1 to 3 inches in diameter and either covered with spines. At maturity it splits into four chambers, each with dozens of small black seeds.

Habitat*:* The weed requires disturbed sites for establishment and thus is found on cultivated land, in animal camps, barnyards, along roadsides and in areas laid waste by man's activities. It prefers rich soil and plentiful rainfall but can survive in sandy pastures and many such difficult places (Holm *et al.*,1997).

Biology/Ecology

Dispersal Mechanism*:* The seed is thought to be carried by birds and spread in their droppings and can lay dormant underground for years and germinate when the soil is disturbed.

Reproduction*:* Reproduces by seeds. Seeds long-lived with 91% germination after 39 years of burial (Motooka *et al.*, 2003).

Native Range*:* Mexico and Tropical America.

Introduced Range*:* Australia, Asia, North and South America.

Distribution in India*:* Throughout.

Distribution in Jammu Division and Rajouri*:* Widespread.

Introduction Pathway*:* Through farm machinery, fur of animals, human activities and by birds.

Impact*:* It is one of the world's most widespread weeds and has been recorded from over 100 countries. It is a poisonous weed that competes aggressively with crops in the field and pasture. All parts of this plant contain dangerous levels of poison and may be fatal if ingested by humans and other animals, including livestock and pets. This weed competes strongly with summer crops in many areas of the world.

Threat Level*:* High.

CONCLUSION

In conclusion, our study indicates that such anthropogenic influences along with wanton axing of forests, unregulated grazing, pollution, climate change etc, have promoted invasion by non-native species

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