
ORIGINAL ARTICLE

Economic Importance of Some Invasive Alien Species reported in the Tarai Belt of Uttarakhand, India

Jyostna Rastogi and Sumita Rana*

Department of Biological Sciences, College of Basic Sciences and Humanities, G. B. Pant

University of Agriculture and Technology, Pantnagar - 263145, Uttarakhand, India

Email Id: sumitarana64@gmail.com

ABSTRACT

Introduction of a plant in an area may be natural or in a planned manner. Some species become established in a new environment outside their natural range, spread rapidly and cause harm to other species, communities or entire ecosystem and to human well beings. Such species are considered as invasive alien species (IAS). They are known by several other names such as non native, introduced, non indigenous, exotic and foreign species. Invasive alien species occur in all groups of plants and animals. IAS are widely distributed in all type of ecosystem throughout the world and include all categories of living organism. "Invasive alien plants are the subset of naturalized plant that produce reproductive off springs, often in a very large numbers, at considerable distances from the parent plants, and thus have the potential to spread over a large areas". In addition to negative impacts, some invasive alien species are used for the different purposes such as herbal medicine, fodder, fuel, food, oil, leafy vegetables etc. The present communication deals with the taxonomic description, botanical illustrations and economic importance of some invasive alien species reported in the tarai belt of uttarakhand, india. The study area is the land area covered by G. B. Pant University of Agriculture and Technology having a perimeter of 28.52 km and 10,000 acres of land area mainly occupied by agriculture fields, roads, grounds, plantation, building, lawns and parks etc. It is rich in terms of its floristic diversity especially angiosperm diversity. The University area is a unique place in tarai region of Uttrakhand, where natural stands of vegetation are completely removed for cultivation or activities related with urbanization. As such this area presents a good example of removal of native flora, partially or completely, and invasion of vegetation by alien elements.

Key words: non native, illustrations, urbanization, native flora, invasion.

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INTRODUCTION

Due to day by day globalization activities by human beings, invasive species are introduced in an area which creates the serious effect on native flora and fauna. The successful invasion of these species is due to anthropogenic activities and the absence of the natural enemy in new habitat. IAS are dominating day by day and destroying the biodiversity and other ecosystems processes in that area, so there is an urgent need of a strategy to study these species in a well planned manner. The presence of invasive species in an area affects the native plant communities which play an important role in diversification. Generally the movement of plants and animals across habitats and ecosystem is a natural process. The ecosystems are inherently dynamic, losing some species, gaining others. It is the constantly accelerating rate of invasion that looms large over the world economy today and of immediate concern. Human actions are the primary means of invasive species introductions.

Invasive alien species are one of the most significant drivers of environmental change worldwide [35, 56]. The invasive species generally have dramatic and negative effect on the other species and even entire ecosystem to the extent that it includes the extinction of species or sometimes even the hydrology and nutrition cycles of entire ecosystems have changed. Invasive species have the ability to change many of the habitats function. Invasive alien species are equally ancient as human civilization and are chronologically indistinguishable by man. The movement of people, commodities have established these

unwanted species in an area and then these species occupy that area in a large way. Many IAS grow faster than native plants, reproduce quickly and completely alter the composition of that area they have colonized. The spread of IAS is now considered as one of the greatest threats on the diversity. These species are impacting the valuable natural and agricultural ecosystem upon which we all depend. The cost of negligence and avoidance to control the spread and impact of invasive species grows higher with time and pose serious threat to biodiversity. A number of global and regional policies are already addressing the problem of IAS but these species are still proliferating and spreading in a large manner. Invasive alien species can transform the structure and species composition of ecosystems by repressing or excluding native species, either directly by out-competing them for resources or indirectly by changing the way nutrients are cycled through the system.

A new challenge is to identifying these alien species and removal or control of these species in that area. Most of the countries facing the problem of invasion and the impact of invasion is mostly irreversible. In addition to their negative effect some invasive species may have positive traits. Some IAS are being used for different purposes like, medicinal, insecticidal, ornamental, compost, fodder, manure, fibres, etc. Many alien species support farming and forestry system in a big way. For example 70% of the world's food comes from just nine crops that are wheat, rice, potato, cassava, soyabean, sugarcane, and oats each of which is cultivated far beyond its place of origin.

MATERIALS AND METHODS

The present work will involve exploration of invasive flora in the entire area of Pantnagar in different seasons. Previous floristic literature and reports about flowering plants of Pantnagar, herbarium specimens available in G.B. Pant University Herbarium Pantnagar (GBPUH) and study of eflorapantnagar [48] will also be checked to compile the information during this period

Study Area

The study area is the campus of G. B. Pant University of Agriculture and Technology having a perimeter of 28.52 km and 10,000 acres of land area. It is the first Agriculture University of India established on 17 November 1960 by the first Prime Minister of India Pt. Jawaharlal Nehru. Govind Ballabh Pant University is a unique place in tarai region of Uttarakhand. Tarai region is situated near the outer hills of Himalaya. These outer hills of Himalaya are known as Shivalik Range. Geographically the land area covered by the University lies in between the latitudes N 28° 59' 36" – 29° 02' 34" and longitude E 79° 28' 33" - 79° 31' 12" with an altitude range of 213 to 238 m. above the sea level [approx; based on [16]. The exposure of slope is towards Southern direction. Nainital, Haldwani, Kichcha and Rudrapur are the major adjoining cities of Pantnagar.

In Pantnagar area natural stands of Tarai forest vegetation are completely removed for cultivation or activities related with urbanization. As such this area presents a good example of removal of native flora partially or completely and invasion of vegetation by alien elements.

Floristic Account

A tentative list of IAS species based on Sekar [57], Reddy [54], Sekar *et al.*, [58] was compiled and attempts were made to search these species in the study area. Plants of the invasive alien species were collected from the different localities in Pantnagar. These localities were visited in different seasons to find out the exact flowering and fruiting time of these plants. The members of invasive alien species include mainly wild taxa and few medicinal and ornamentals, therefore, different gardens, parks, and research centre of the university were visited for plant collection regularly. Plants specimen with flowers and fruits were collected for studies. Collected specimens were accompanied with information on locality, date, and other important information as suggested by Jain and Rao [25], Simpson [65]. Later on, plant specimens were identified with the help of different floras relevant to this area like Duthie [13], Babu [3], Gaur [15], Maheshwari [34], Osmaston [43], Raizada [47], Flora of India vol. 1-5,12,13,23 [60-62, 19, 20, 5, 66] and other important taxonomic documents. The origin and invasive nature of the plants were mainly determined according to Babu [3]; Bailey [4]; Duthie [13]; Gaur [15]; Graf [17]; Khuroo *et al.* [28]; Negi and Hajra [39]; Rao [48]; Reddy [54]; Sharma and Pandey [6]; Sekar *et al.* [58], eflora of china [72], eflora of Pakistan [72], eflora of North America [72], Global compendium of weeds [73] and the literature available on internet.

Plant Collection

Plants of the Invasive alien species were collected from different localities in Pantnagar including different research centers, gardens, residential areas, wastelands, areas along roads of University, Nagla bypass, NH – 109 in different seasons of the year. Field trips were regularly made in different parts of study area and observations were made on habit, habitat, colour of flower and other morphological character of the plant species with special attentions on abundance, flowering and fruiting and other

important information as suggested by Jain and Rao [25], Simpson [65]. With the help of the field press fresh plant specimens were dried to prepare herbarium specimens.

Plant Identification and Nomenclature

Plants specimens were primarily identified with the help of available regional floras like *Flora of Upper Gangetic plain* [13], *Flora of Delhi* [34], *Supplement to Duthie's Flora of Upper Gangetic Plain* [47], *Herbaceous Flora of Dehradun* [3], *Flora of Chamoli*, [37, 38] and *Flora of District Garhwal Northwest Himalayas* [15]. More recently, few important international floras like *Flora of China*, *Flora of Pakistan*, *Flora of North America* are now freely available online at www.efloras.org [72]. These are also used, wherever needed, for confirmation of identity. In addition to conventional floras a new web source 'eflora of India' [74] having multiple images of large number of species of India which are also used for identification of species. The fresh plant specimens were also compared with the plant images available in *eflorapantnagar* [52] having identified images of more than 425 flowering plant species of Pantnagar area.

After identification of species their names were checked with International Plant Name Index (IPNI) [76] and The Plant List [75] for up to date nomenclature of the taxa.

RESULTS AND DISCUSSION

Invasive alien species (IAS) are extremely successful in the area due to many specific characters. In Pantnagar Invasive alien flora is represented by 91 species belonging 70 genera under 30 families. Dicotyledons are represented by 82 species belonging to 63 genera under 25 families and Monocotyledons are represented by 9 species belonging to 7 genera under 5 families [50]. Out of these 91 species some have their economic importance of some invasive alien species are give below.

Economic importance of invasive alien species

Though the IAS are abused for their harmful effects, many of them are utilized in one or the others ways for the benefit of human beings. In different parts of the world these species are being used as elaborated below:

As food

Alternanthera sessilis (L.) R. Br. ex DC. (Amaranthaceae)- Leaves and young shoots are eaten as a vegetable in Southeast Asia [18]. This species is also commonly used in aquarium as an aquatic plant.

Alternanthera philoxeroides (Mart.) Griseb. (Amaranthaceae)- Green leaves of this plant are used as pot herb in different parts of India.

Amaranthus spinosus L. (Amaranthaceae) is used as a valued food plant in many parts of Africa. The plant is rich source of protein and calcium. Young shoots are used as salads and also contain large amount of oxalates which may actually inhibit calcium absorption [33].

Celosia argentea L. (Amaranthaceae) is used as edible herb. The leaves and flowers are edible [18].

Chenopodium album L. (Amaranthaceae)- In India it is popularly known as 'bathua' and used as a leafy vegetable. The leaves and young shoots contain high levels of oxalic acid and used in several dishes such as soups, curries, stuffed bread etc. Seeds are also rich source of protein, vitamin A, calcium, phosphorus, and potassium [26, 9].

Cleome viscosa L. (Cleomaceae)-Leaves and young shoots are consumed as vegetable. The seeds are used as mustard substitute in curries [7].

Echinochloa colona (L.) Link. (Poaceae) Seeds are used to prepare edible dishes and utilised during fasting days [68, 14].

Peperomia pellucida (L.) Kunth (Piperaceae)- Plant parts are used in salads or cooked in many parts of the tropics.

Portulaca oleracea L. (Portulacaceae) is eaten as a leafy vegetable and a rich source of omega 3-fatty acid, vitamins and minerals. The stem, leaves, and flower buds are all edible and may be used as salad, fried or cooked as spinach [42, 69].

Solanum americanum L. (Solanaceae)- The ripe berries are edible in India but in other countries like China, Ethiopia boiled leaves are also consumed as vegetable [23, 53].

As Medicine

Antigonon leptopus Hook. & Arn. (Polygonaceae)- Tea prepared from the aerial parts of plant is used as a remedy for cold and pain relief [35, 36].

Argemone maxicana L. (Papaveraceae)- The plant is diuretic, purgative and kills worms. It cures leprosy, skin-diseases, inflammations and bilious fevers. Roots are anthelmintic [41]. Juice is used to cure ophthalmic and opacity of cornea. Seeds are purgative and sedative [51, 36].

Bidens pilosa L. (Asteraceae)- Roots, leaves and seeds have been reported to possess antibacterial, anti dysenteric, antimicrobial and antimalarial character. Leaves are used to speed up clotting in fresh wounds and also helpful in treatment of arthritis [8, 32, 71].

Calotropis procera (Aiton) Dryand. (Apocynaceae)- It is a traditional medicinal plant with a number of unique properties [44, 45, 50]. It is used in the treatment of common disease such as fever, cough, cold, eczema, rheumatism, indigestion, vomiting, diarrhoea etc, the dried plant parts are used as a tonic [12].

Celosia argentea L. (Amaranthaceae)- Seeds used in blood disease and mouth sores [1].

Digera muricata (L.) Mart. (Amaranthaceae)- Flowers and seeds used in urinary troubles [1].

Eclipta prostrata (L.) L. (Asteraceae)- It is used in ayurveda. It is basically used to improve hair growth and colour. Other uses are also reported such as for treating skin disease and eye infection [30, 31, 11, 48].

Mimosa pudica L. (Fabaceae)- Roots are used as antidote to snake bite and as remedy of digestive troubles. The extracts of roots is used in the treatment of dysentery, fever, syphilis, leprosy, stomach worms, venereal diseases, insomnia, nervousness, and piles [67, 46, 10].

Ocimum americanum L. (Lamiaceae)- Whole plant is used in fever [1].

Peperomia pellucida (L.) Kunth (Piperaceae)- The plant is used in abdominal pain, fatigue, headache, renal disorder and rheumatic joint pain. The aerial parts of plant are used for dressing the wounds [6, 2, 27].

Physalis minima L. (Solanaceae)- The fruit is used in the treatment of cancer and also having other important activities like diuretic, laxative, anti-inflammatory, anti-microbial etc [29, 59]. Leaf juice used in ear ache [1].

Oxalis corniculata L. (Oxalidaceae)- The whole plant is used in the treatment of fever, diarrhoea, injuries, poisonous snake bite. The juice of plant parts is used in muscular swelling and pimples. The plant is a rich source of vitamin C so used in the treatment of scurvy [30,22].

Senna occidentalis L. (Fabaceae)- Leaves are used in skin diseases and fruit is an antidote of snakebite [64, 70].

Senna tora L. (Fabaceae)- Leaves are used in skin diseases, cuts and wound and in bone fracture [24].

As fodder

Echinochola colona (L) Link. (Poaceae) produce a highly palatable fodder that is relished by animals and is considered to be one of the finest fodder grasses.

Melilotus albus Medik. (Fabaceae) is cultivated as fodder crop.

As Fibre

Corchorus olitorius L. (Malvaceae) is an important fibre crop from which Jute is obtained from the phloem fibres. It is the second largest vegetable fibre.

Cannabis sativa L. (Cannabaceae) also yields hemp fibre.

As ornamental

Asclepias curassavica L., (Apocynaceae) is used as ornamental plant because of its beautiful flowers.

Antigonon leptopus Hook. & Arn., (Polygonaceae) is used as ornamental plant because of its beautiful flowers [21].

Peperomia pellucida (L.) Kunth (Piperaceae) is some time used as ornamental plant because of the presence of the beautiful leaves.

As oil

Cannabis sativa L. (Cannabaceae)- Seeds are chiefly used to make hempseed oil which can be used for cooking, lamps, lacquers, or paints. Seeds are edible [40].

CONCLUSION

Species which are introduced to a new geographic area other than its natural home range are called as alien, exotic or non- native species. Some of the alien species invade the natural vegetation and called invasive alien species. These species are introduced in any area both accidentally or intentionally. The presence of these species in that area modifies the structure and the function of the ecosystems. The introduction of such species is rising sharply throughout the world due to increased mobility, trade, travel and tourism and the unprecedented accessibility of goods resulting from globalisation.

Many invasive species are used for different purposes such as herbal medicine, fodder, fuel, food, ornamental etc. At global scale invasive alien species have become a problem and causing a huge loss in agriculture sectors and decrease the native species diversity.

Results of this study clearly indicate presence of of Amaranthaceae family as in IAS flora of Uttarakhand in such a small area of Pantnagar shows its major economic importance contain 5 species followed by Fabaceae having 4 species.

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