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Diversity of invasive alien species of Jammu district (Jammu and Kashmir)

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Abstract

The present study deals with comprehensive list of Invasive alien plants of Indian Himalayan Region with background information on family, habit and nativity. A total of 60 invasive alien species under 51 genera, belonging to 33 families have been recorded. Among these, the dicotyledons represent by 28 families and 52 species; monocotyledons represent by 5 families and 8 species. The analysis of invasive species reveals that most species have been introduced unintentionally through trade while only 11 species intentionally introduced. Most of the species are of American origin. While in life form analysis, the herbs (45 species) are dominant, followed by shrubs (6 species), Grass (3 species), Trees, sedges and climbers (2 species each). Most of the invasive species are annual habit (57%). 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

Those alien species that become established in a new environment then proliferate and spread in ways that are destructive to human interests and natural systems are considered “Invasive Alien Species” or IAS. 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”. Invasive species occur in all major taxonomic groups, including viruses, fungi, algae, mosses, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals. Even though perhaps only a small percentage of species that are moved across borders become invasive, these may have extensive and long-lasting impacts. Biological invasions may be considered as a form of biological pollution and significant component on human-caused global environmental change and one of the major causes of species extinction. The opportunity of accidental introductions will become more with rapidly increasing global commerce^{1,2}. These species are causing enormous damage to biodiversity and the valuable natural agricultural systems upon which we depend. 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. Globalisation of the Earth’s biota, due to drastic breaching of the biogeographic barriers that isolated continental biotas for millions of years, is transforming local and regional floras and faunas³. 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}. 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} and the same demands

active collaboration between taxonomists and ecologists¹². Despite the recent recognition of the impacts caused by invasive plants worldwide¹³, there are still many regions in the world where basic information on naturalized plant taxa and plant invasions is only anecdotal or completely lacking, e.g. Asia and neighbouring regions^{14,15,16}. Present study aims to inventorise a database of invasive alien species 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, 2009 - April, 2012. 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 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^{1,17,18,19,20,22,21,13,22,23} 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.

Results

A total of 60 species belonging to 51 genera and 33 families recorded as invasive alien in Jammu district (**Table 1**). Among these, the dicotyledons are represented by 28 families and 52 species; monocotyledons represented by 5 families and 8 species. Only 11 species namely, *Ageratum conyzoides*, *Canna indica*, *Chenopodium album*, *Eichhornia crassipes*, *Impatiens balsamina*, *Ipomoea quamoclit*, *Lantana camara*, *Leucaena leucocephala*, *Mirabilis jalapa*, *Portulaca oleracea*, *Rumex dentatus* are seen to have been introduced deliberately the rest of them unintentionally through trade exchange including grain import. A total of 13 different geographic regions in terms of nativity are recorded in the present study. Among these, more than 90% are contributed by four major geographical regions, viz., continent of America, Africa, Europe and Mediterranean. The American continents contributed majority of noxious invasive plants in Jammu district followed by the Africa and Europe respectively. Annuals comprise about 57% (34 sp.) and the remaining are perennials. Herbs constitute 75% (45 plants), whereas trees were represented by only 2 species viz., *Acacia farnesiana*, *Leucaena leucocephala*; two climbers namely, *Antigonon leptopus* and *Cuscuta reflexa* have been recorded apart from 6 Shrubs (**Table 1 and Figure 1**). Two species of sedges and 3 species of grass are recorded. The genera with the highest number of alien invasive species in Jammu are *Ipomoea* (4 species). The family Asteraceae is the most dominant family with 8 species; followed by Amaranthaceae (5 species), Convolvulaceae and Solanaceae (4sp. each); and Fabaceae, Malvaceae and Poaceae (3 sp. each) and rest of the families represented by 2 or 1 species. The dominant of the families are represented in (**Figure 2**).

Discussion

Those alien species that become established in a new environment then proliferate and spread in ways that are destructive to human interests and natural systems are considered "Invasive Alien Species" or IAS. Many alien species support our farming and forestry system in a big way. The integrity of natural ecological systems worldwide is increasingly being jeopardised due to large - scale introductions of alien plants, animals and micro-organisms. This process is rapidly breaching biogeographic barriers that are responsible for global biodiversity maintenance leading to the 'McDonaldisation'²⁴, or increasing homogenisation^{25,26}, of the earth's biota. Globalisation of the Earth's biota, due

to drastic breaching of the biogeographic barriers that isolated continental biotas for millions of years, is transforming local and regional floras and faunas³. 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^{5,8}. 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. Habitat destruction, an inevitable consequence of the modern land use, renders ecosystems vulnerable to invasion by the species that are transported intentionally or unintentionally by humans²⁷. They are thus a serious impediment to conservation and sustainable use of global, regional and local biodiversity with significant undesirable impacts on the goods and service provided by ecosystems; and it has already had devastating consequences for the planet and challenges for the conservation managers. They are major problems for national development and economic planning. Invasive species pose an enormous, and accelerating, cost to economies, societies and ecosystems around the world. Elton's prophecy of an imminent ecological explosion of invasive species has almost come true²⁸.

Of the 60 species listed as invasive alien species in Jammu, 75% are herbs, 10% shrubs, 5% grasses, 4% trees and 3% climbers and sedges. Maximum contribution to the invasive alien species is from American region. Although IAS is a growing reality in India, they are still largely ignored and unnoticed, thus getting a good opportunity to expand all over the country. A very few isolated accounts of IAS in India are available: ^{29,30,31,32,33,34,35,36,37,38,39,40,41}. Jammu is situated on a hillock, on the bank of river Tawi and is bound by Udhampur district in the north and northeast, Kathua district in the east and southeast, Pakistan (Sialkote) in west and Rajouri district and POK (Bhimber) in the northwest. Jammu also serves as base camp for the religious tourism attracting people from nation and world. Jammu is also the Railhead of the state. The breathtaking landscape of this biodiversity rich region has attracted people of all walks of life, and also from far off regions of the world and its promotion as a global tourist destination, the region has witnessed intentional or unintentional introduction of varying faunal and floral elements from different phytogeographical regions of the world. Such anthropogenic influences along with wanton axing of forests, unregulated grazing, pollution of freshwater ecosystems, burgeoning urbanization, etc, have promoted invasion of these disturbed habitats by non-native species. Taking note of the importance of studies on the alien invasive species, particularly in areas of high anthropogenic interference, present study was aimed at compiling the first ever inventorisation of the alien fauna and flora of Jammu district. Such inventorisation will help in monitoring of invasion. A better planning is needed for early detection and reporting of infestations of spread of new and naturalized weeds by creation of plant detection network. This is the first report of Invasive alien species in Jammu district (J&K). With further research the addition of new invasive alien species would be made to the list.

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Table 1. Invasive species of Jammu district (J&K)

S.No.	Name of Species	Family	Nativity	Life Form	Habit	Habitat	Mode of Introduction
1	<i>Acacia farnesia</i> (L.) Wild	Fabaceae	South America	T	P	AR	Ui
2	<i>Achyranthes aspera</i> L. var. <i>pubescens</i>	Amaranthaceae	North America	H	P	W, AR	Ui
3	<i>Ageratum conyzoides</i> L.	Asteraceae	Trop. America	H	A	W	O
4	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Amaranthaceae	Trop. America	H	P	RB	Ui
5	<i>Alternanthera pungens</i> Kunth	Amaranthaceae	Trop. America	H	P	W	Ui
6	<i>Amaranthus viridis</i> L.	Amaranthaceae	Trop. America	H	A	CF	Ui
7	<i>Anagallis arvensis</i> L.	Primulaceae	Europe	H	A	CF	Ui
8	<i>Antigonon leptopus</i> Hook. & Arn.	Polygonaceae	Trop. America	C	P	AR	Ui
9	<i>Argemone mexicana</i> L.	Papaveraceae	S. America	H	A	W	Ui
10	<i>Bidens pilosa</i> L.	Asteraceae	Trop. America	H	A	CF	Ui
11	<i>Calotropis procera</i> (Ait.) R. Br.	Asclepiadaceae	Trop. Africa	S	P	W	Ui
12	<i>Canna indica</i> L.	Cannaceae	Tropical America	H	P	W	O
13	<i>Cannabis sativa</i> L.	Cannabaceae	Central Asia	H	P	AR, W	Ui
14	<i>Cassia occidentalis</i> L.	Caesalpiniaceae	S. America	H	P	W	Ui
15	<i>Cassia tora</i> L.	Caesalpiniaceae	S. America	H	A	W	Ui
16	<i>Chenopodium album</i> L.	Chenopodiaceae	Europe	H	A	CF	Fd
17	<i>Cleome viscosa</i> L.	Capparaceae	Trop. America	H	A	W	Ui
18	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Mediterranean	C	A	P	Ui
19	<i>Cyperus difformis</i> L.	Cyperaceae	Trop. America	SE	A	CF	Ui
20	<i>Cyperus iria</i> L.	Cyperaceae	Trop. America	SE	A	CF	Ui
21	<i>Datura innoxia</i> Mill.	Solanaceae	Trop. America	S	P	W	Ui
22	<i>Echinochloa colona</i> (L.) Link	Poaceae	S. America	G	A	RB	Ui
23	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Poaceae	S. America	G	A	RB	Ui
24	<i>Eclipta prostrata</i> (L.) Mant.	Asteraceae	Trop. America	H	A	AR	Ui
25	<i>Eichhornia crassipes</i> (C. Martius) Solms.	Pontederiaceae	Trop. America	H	P	A	O
26	<i>Emilia sonchifolia</i> (L.) DC.	Asteraceae	Trop. America	H	A	RB	Ui
27	<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	Trop. America	H	A	CF	Ui
28	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Trop. America	H	A	CF	Ui
29	<i>Gomphrena serrata</i> L.	Amaranthaceae	Trop. America	H	A	CF	Ui
30	<i>Impatiens balsamina</i> L.	Balsaminaceae	Trop. America	H	A	RB	O
31	<i>Imperata cylindrical</i> (L.) Raesch.	Poaceae	Trop. America	G	P	W	Ui
32	<i>Ipomoea carnea</i> Jacq. subsp. <i>Fistulosa</i> (Mart. ex Choisy) Austin	Convolvulaceae	Trop. America	S	P	W	Ui
33	<i>Ipomoea nil</i> (L.) Roth	Convolvulaceae	N. America	H	A	F, W	Ui

34	<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae	Trop. East Africa	H	A	W	Ui
35	<i>Ipomoea quamoclit</i> L.	Convolvulaceae	Trop. America	H	P	W	O
36	<i>Lantana camara</i> L.	Verbenaceae	Trop. America	H	P	F	O
37	<i>Leucaena leucocephala</i> (Lam.) de Wit	Fabaceae	Trop. America	T	P	W, F,	Af
38	<i>Malvastrum coromandelianum</i> (L.) Garcke	Malvaceae	Trop. America	H	A	W	Ui
39	<i>Martynia annua</i> L.	Pedaliaceae	Trop. America	H	P	W	Ui
40	<i>Melochia corchorifolia</i> L.	Sterculiaceae	Trop. America	H	P	F	Ui
41	<i>Mirabilis jalapa</i>	Nyctaginaceae	Peru	H	A	W	O
42	<i>Opuntia stricta</i> Haw. (Haw.)	Cactaceae	Trop. America	S	P	W	Ui
43	<i>Oxalis corniculata</i> L.	Oxalidaceae	Europe	H	P	CF	Ui
44	<i>Parthenium hysterophorus</i> L.	Asteraceae	N. America	H	A	W	Ui
45	<i>Physalis angulata</i> L.	Solanaceae	Trop. America	H	A	W	Ui
46	<i>Portulaca oleracea</i> L.	Portulacaceae	S. America	H	A	W	Fd
47	<i>Rumex dentatus</i> L.	Polygonaceae	Africa Europe	H	A	W, CF	Md
48	<i>Salvinia molesta</i> D. S. Mitch.	Salviniaceae	Brazil	H	A	A	Ui
49	<i>Sesbania bispinosa</i> (Jacq.) W. F. Wight	Fabaceae	Trop. America	S	A	RB	Ui
50	<i>Sida acuta</i> Burm.f.	Malvaceae	Trop. America	H	A	W	Ui
51	<i>Solanum nigrum</i> L.	Solanaceae	Trop. America	H	A	CF	Ui
52	<i>Solanum viarum</i> Dunal	Solanaceae	Trop. America	H	P	F	Ui
53	<i>Torenia fournieri</i> Linden ex E. Fourn.	Scrophulariaceae	Australia	H	P	W	Ui
54	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Trop. America	H	P	W	Ui
55	<i>Tridax procumbens</i> L.	Asteraceae	Central America	H	P	CF	Ui
56	<i>Triumfetta rhomboidea</i> Jacq.	Tiliaceae	Trop. America	H	A	W	Ui
57	<i>Typha angustifolia</i> L.	Typhaceae	Trop. America	H	P	RB	Ui
58	<i>Urena lobata</i> L.	Malvaceae	Trop. Africa	S	P	W	Ui
59	<i>Xanthium strumarium</i> L.	Asteraceae	Trop. America	H	A	AR, W	Ui
60	<i>Youngia japonica</i> (L.) DC.	Asteraceae	S. America	H	A	AR	Ui

Life form: H-Herb; C-Climber; US-Undershrub; S-Shrub; SE-Sedges; T-Tree; G-Grass.

Habit: A-Annual; P-Perennial.

Habitat: W-Wastelands; CF-Cultivated fields; F-Forests; AR-Along roadside; A-Aquatic; P-Parasites; RB-River beds.

Mode of introduction: Af-Agroforestry; Fd-Food; Md- Medicinal; O-Ornamental; Ui-Unintentional.

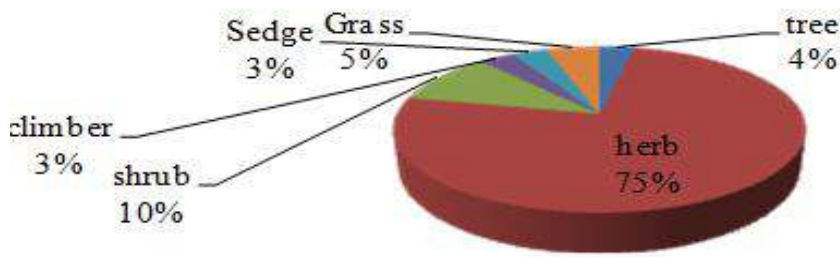


Figure 1: Life forms of Invasive Species of Jammu district (J&K)

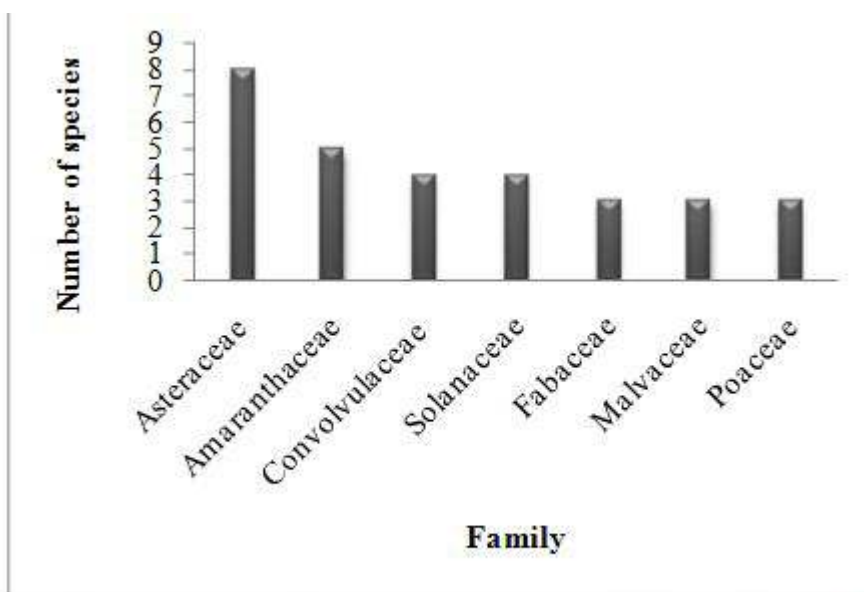


Figure2: Dominant families of invasive species of Jammu district (J&K)