



# A PRELIMINARY SURVEY OF INVASIVE ALIEN ANGIOSPERMS OF ROHILKHAND REGION (U.P.), INDIA

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## Abstract

A survey of invasive alien plant species of Rohilkhand region was made and we found a total richness of 79 species belonging to 29 families. Dicots represented 72 species and monocots 7 species. About 70.88% of these alien species were introduced from tropical America including South America, followed by tropical Africa (11.39%). Maximum number of species (21) were from the family Asteraceae, followed by Amaranthaceae (7), Euphorbiaceae (5) and then Papilionaceae and Caesalpiniaceae with four species. Herbs accounted for 58 species, undershrubs 6 species, shrubs 6 species, climbers 2 species, and Trees 2 species whereas Grasses and Sedges represented 3 and 2 species respectively. The data revealed that both aquatic and terrestrial invasive plant species are becoming threat to the native flora as they reproduce rapidly and crowding out native species.

**Key words :** Invasive Alien species, Rohilkhand region, U.P.

## Introduction

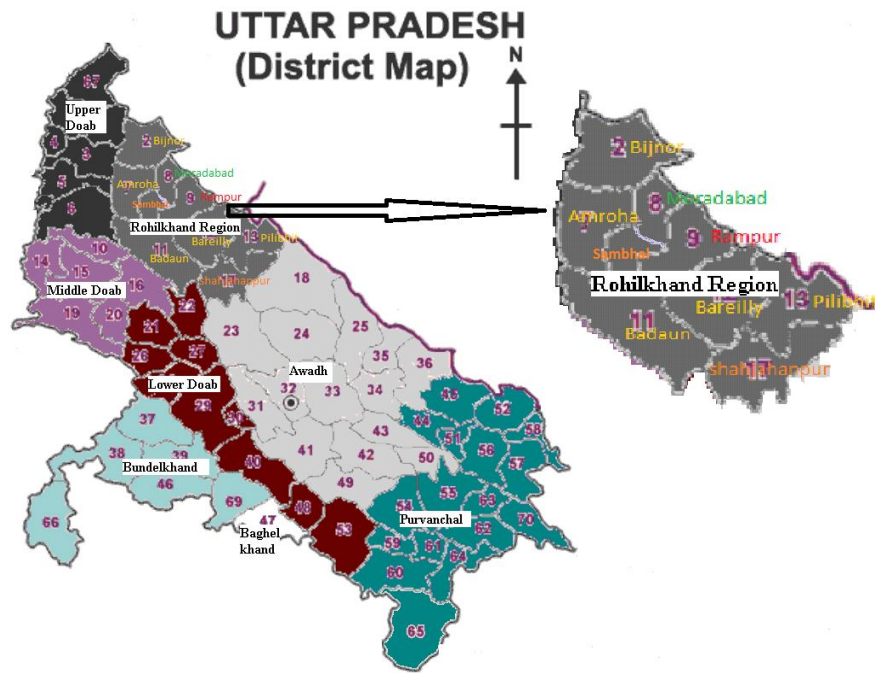
Invasive species are a major threat to global biodiversity and an important cause of biotic homogenization of ecosystems. Invasive species are one of our most pressing environmental concerns (Cox, 2004; Charles *et al.*, 2005) and humans have been identified as a major vector in the dispersal of invasive species throughout the world (Sharma *et al.*, 2005). After introduction they can expand their population and create monospecific thickets. These alien invasive species not only compete for nutrients, moisture and light but for space too. In this way these non- indigenous species can affect biodiversity patterns and community structure (Huxel, 1999). Increasing organic pollution also favoured growth of certain types of alien species with high nutrient demand. The problem of invasive aliens has attracted much attention both at the international and national levels (Maheshwari and Paul, 1975; Nair, 1988; Drake *et al.*, 1989; Pandey and Parmar, 1994; Huxel, 1999; Meyer, 2000; Mooney and Hobbs, 2000; Almeilla & Freitas, 2001; Hall, 2003; Kohli *et al.*, 2004; Cox, 2004; Sharma *et al.*, 2005; Rai and Gaur, 2006; Khuroo *et al.*, 2007; Negi and Hajra, 2007; Reddy, 2008; Qian *et al.*, 2008; Khanna, 2009; Beena kumari, 2009; Joshi & Rawat, 2011; Chandra Sekar, 2012; Gaur and Rawat, 2013; Rastogi *et al.*, 2015; Wagh & Jain, 2015).

The name Rohilkhand was given by Ahmad Shah Abdali in 1748. Rohilkhand is a region of northwestern Uttar Pradesh state of India and the area consists of Bijnor, J. P. Nagar, Moradabad, Smbhal, Rampur, Budaun, Bareilly, Pilibhit and Shahjahanpur districts. Rohilkhand lies on the upper Ganges alluvial plain and has an area of about 25,000 km<sup>2</sup> (10,000 square miles). It is bounded by the Ganges river on the south and the west by Uttarakhand and Nepal on the north and by the Awadh region to the east. It has 2.8% land under forest cover now. The climate of Rohilkhand Region is predominantly subtropical, but weather conditions change significantly with location and seasons. Large scale invasion of the Rohilkhand region by alien plant species over the past 20 years has become a cause of serious concern from the ecological, biodiversity, socio-economic and health point of view. Invasive alien species of Rohilkhand region has not been studied so far and there is no comprehensive programme for monitoring the presence of these species. In view of this, the present study attempted to prepare a complete list of invasive alien species of the area.

## Materials and Methods

Intensive field studies were carried out in a planned manner repeatedly in different seasons from 2012 to 2015 in order to get maximum representation of invasive alien species. Almost the entire geographical area (9 districts)

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Map : District map of Uttar Pradesh.

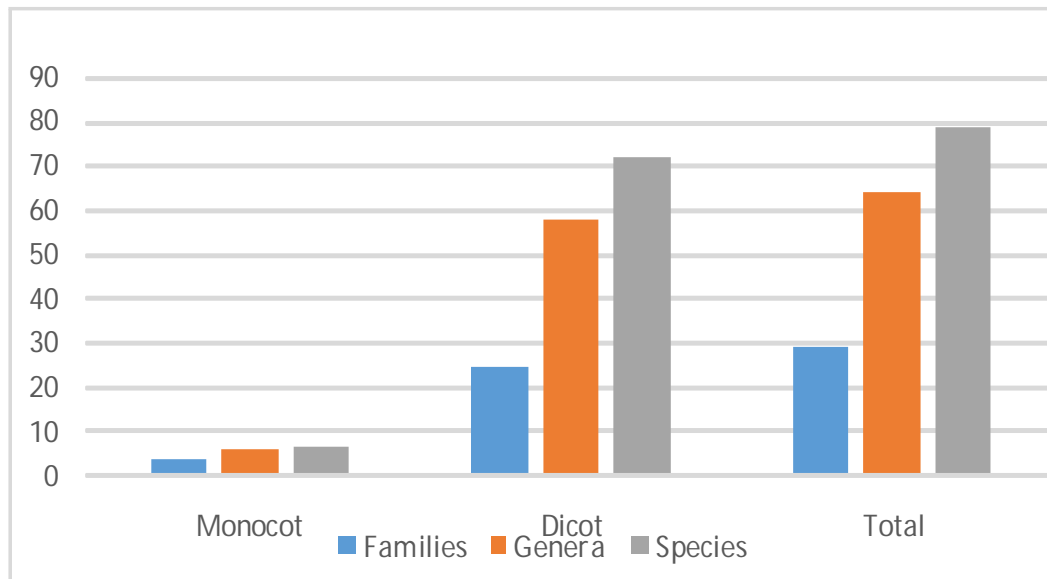


Fig. 1 : Families, Genera and Species of IAS in Rohilkhand Region.

was surveyed. Plant samples were collected from natural habitats, forest lands, agricultural lands, wastelands aquatic bodies along the railway tracks, protected areas, river banks etc. to document almost all the floristic components including invasive alien species of the study area. The specimens were identified using regional floras and literature (Duthie, 1903-29; Maheswari, 1963; Babu, 1977; Sharma & Pandey, 1984; Raghuvanshi *et al.*, 2005; Khuroo *et al.*, 2006; Raizada, 2007; Negi & Hajra, 2007; Balakrishna *et al.*, 2012; Rastogi *et al.*, 2015) and preserved according to standard herbarium techniques

in the department of botany, Hindu College, Moradabad. The websites were also examined extensively for background information and nativity of the species. The information available in the literature and in different herbaria like National Botanical Research Institute, Lucknow, BSI at Allahabad and Dehradun, Forest Research Institute, Dehradun has also been incorporated while documenting the invasive alien species.

### Results and Discussion

The present communication is an effort to list invasive

**Table 1** : List of Invasive Alien Angiosperms in Rohilkhand region (Uttar Pradesh), India.

S. no.	Species	Family	Life form	Fl. & Fr.	Nativity
1.	<i>Acacia farnesiana</i> (L.) Willd.	Mimosaceae	T	Aug – Mar	Trop. South America
2.	<i>Acanthospermum hispidum</i> DC.	Asteraceae	H	Jul – Jan	Brazil
3.	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Amaranthaceae	H	Aug – Feb	Trop. America
4.	<i>Ageratum conyzoides</i> (L.) L.	Asteraceae	H	Jul – Jan	Trop. America
5.	<i>Ageratum houstonianum</i> Mill.	Asteraceae	H	Jul – Feb	Trop. America
6.	<i>Alternanthera paronychioides</i> A.St.-Hil.	Amaranthaceae	H	Aug – Nov	Trop. America
7.	<i>Alternanthera pungens</i> Kunth.	Amaranthaceae	H	Aug – Dec	Trop. America
8.	<i>Alternanthera ficoidea</i> (L.) Sm.	Amaranthaceae	H	Jul – Jan	Trop. America
9.	<i>Anagallis arvensis</i> L.	Primulaceae	H	Dec – Apr	Europe
10.	<i>Antigonon leptopus</i> Hook. & Arn.	Polygonaceae	Cl	Mar – Dec	Trop. America
11.	<i>Argemone mexicana</i> L.	Papaveraceae	H	Sept – Jan	Trop. Central & South America
12.	<i>Bidens pilosa</i> L.	Asteraceae	H	Jul – Dec	Trop. America
13.	<i>Blainvillea acmella</i> (L.) Philipson	Asteraceae	H	Aug – Dec	Trop. America
14.	<i>Blumea eriantha</i> DC.	Asteraceae	H	Aug – Dec	Trop. America
15.	<i>Blumea lacera</i> (Burm.f.) DC.	Asteraceae	H	Aug – Feb	Trop. America
16.	<i>Calotropis gigantea</i> (L.) Dryand.	Asclepiadaceae	S	Throughout the year	Trop. Africa
17.	<i>Calotropis procera</i> (Aiton) Dryand.	Asclepiadaceae	S	Mar – Dec	Trop. Africa
18.	<i>Cardamine trichocarpa</i> Hochst. ex A.Rich.	Brassicaceae	H	Jul – Dec	Trop. America
19.	<i>Celosia argentea</i> L.	Amaranthaceae	H	Sept – Dec	Trop. Africa
20.	<i>Chloris barbata</i> Sw.	Poaceae	G	Sept – Jan	Trop. America
21.	<i>Chrozophora rotleri</i> (Geiseler) A.Juss. ex Spreng.	Euphorbiaceae	H	Sept – Feb	Trop. Africa
22.	<i>Cleome gynandra</i> L.	Cleomaceae	H	Sept – Dec	Trop. America
23.	<i>Cleome viscosa</i> L.	Cleomaceae	H	Aug – Dec	Trop. America
24.	<i>Corchorus tridens</i> L.	Tiliaceae	H	Aug – Dec	Trop. Africa and Australia
25.	<i>Crotalaria pallida</i> Aiton	Papilionaceae	US	Aug – Mar	Trop. America
26.	<i>Crotalaria retusa</i> L.	Papilionaceae	US	Aug – Feb	Trop. America
27.	<i>Croton bonplandianus</i> Baill.	Euphorbiaceae	H	Aug – Dec	Temperate South America
28.	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Cl	Aug – Dec	Mediterranean region
29.	<i>Cyperus difformis</i> L.	Cyperaceae	Sg	Aug – Dec	Trop. America
30.	<i>Cyperus iria</i> L.	Cyperaceae	Sg	Aug – Jan	Trop. America
31.	<i>Digera muricata</i> (L.) Mart.	Amaranthaceae	H	Aug – Jan	North America
32.	<i>Echinochloa colona</i> (L.) Link	Poaceae	G	Aug – Mar	Trop. South America
33.	<i>Echinops echinatus</i> Roxb.	Asteraceae	H	Aug – Dec	Afghanistan
34.	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	H	Jun – Mar	Trop. America

Table 1 continued....

Table 1 continued....

35.	<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae	H	Aug – Dec	Trop. America
36.	<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Asteraceae	H	Aug – Mar	Trop. Africa
37.	<i>Erigeron Canadensis</i> L.	Asteraceae	H	Jun- Dec	South America
38.	<i>Euphorbia cyathophora</i> Murray	Euphorbiaceae	US	Jun – Dec	Trop. America
39.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	H	Aug – Dec	Trop. America
40.	<i>Galinosoga parviflora</i> Cav.	Asteraceae	H	Aug – Jan	Trop. America
41.	<i>Gomphrena serrata</i> L.	Amaranthaceae	H	Jun – Dec	Trop. America
42.	<i>Gnaphalium polycaulon</i> Pers.	Asteraceae	H	Aug – Dec	Trop. America
43.	<i>Grangea maderaspatana</i> (L.) Poir.	Asteraceae	H	Aug – Dec	Trop. S. America
44.	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	S	Throughout the year	Trop. America
45.	<i>Ipomoea eriocarpa</i> R. Br.	Convolvulaceae	H	Jul – Dec	Trop. Africa
46.	<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae	H	Jul – Feb	Trop. E. Africa
47.	<i>Lantana camara</i> L.	Verbenaceae	S	Throughout the year	Trop. America
48.	<i>Melilotus albus</i> Medik.	Papilionaceae	H	Aug – Dec	Europe
49.	<i>Mikania micrantha</i> Kunth	Asteraceae	H	Dec – Apr	Trop. America
50.	<i>Mimosa pudica</i> L.	Mimosaceae	H	Jul – Feb	Brazil
51.	<i>Mirabilis jalapa</i> L.	Nyctaginaceae	H	Aug – Dec	Peru
52.	<i>Parthenium hysterophorus</i> L.	Asteraceae	H	Jul – Feb	Trop. N. America
53.	<i>Dicliptera paniculata</i> (Forssk.) I.Darbysh.	Acanthaceae	H	Aug – Jan	Trop. America
54.	<i>Phyllanthus tenellus</i> Roxb.	Euphorbiaceae	H	Aug – Dec	Mascarene Islands
55.	<i>Portulaca oleracea</i> L.	Portulacaceae	H	Aug – Dec	Trop. C. America
56.	<i>Portulaca quadrifida</i> L.	Portulacaceae	H	Aug – Sept	Trop. S. America
57.	<i>Prosopis juliflora</i> (Sw.) DC.	Mimosaceae	T	Sept – Mar	Mexico
58.	<i>Ruellia tuberosa</i> L.	Acanthaceae.	H	Apr –Oct	Trop. America
59.	<i>Saccharum spontaneum</i> L.	Poaceae	G	Sept – Jan	Trop. W. Asia
60.	<i>Senna alata</i> (L.) Roxb.	Caesalpinaceae	S	May – Dec	West Indies
61.	<i>Senna obtusifolia</i> (L.) H.S.Irwin & Barneby	Caesalpinaceae	US	Aug – Dec	Trop America
62.	<i>Senna occidentalis</i> (L.) Link.	Caesalpinaceae	US	Jul – Dec	South America
63.	<i>Senna tora</i> (L.) Roxb.	Caesalpinaceae	H	Aug – Dec	Trop. S. America
64.	<i>Sesbania bispinosa</i> (Jacq.) W.Wight	Papilionaceae	H	Jun – Dec	Trop America
65.	<i>Sida acuta</i> Burm.f.	Malvaceae	H	Jul – Dec	Trop. America
66.	<i>Solanum americanum</i> Mill.	Solanaceae	H	Jun – Dec	Trop. America
67.	<i>Solanum torvum</i> Sw.	Solanaceae	S	Oct – Mar	West Indies
68.	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	H	Aug – Feb	Mediterranean region
69.	<i>Spermocoe hispida</i> L.	Rubiaceae	H	Jun – Dec	Trop. America
70.	<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae	H	Aug – Jan	West Indies
71.	<i>Tribulus terrestris</i> L.	Zygophyllaceae	H	Throughout the year	Trop America

Table 1 continued....

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72.	<i>Tridax procumbens</i> (L.) L.	Asteraceae	H	Throughout the year	Trop. C. America
73.	<i>Triumfetta rhomboidea</i> Jacq.	Tiliaceae	H	Jun – Dec	Trop. America
74.	<i>Typha angustifolia</i> L.	Typhaceae	H	May – Dec	Trop. America
75.	<i>Urena lobata</i> L.	Malvaceae	H	Jul – Dec	Trop. America
76.	<i>Veronica anagallis-aquatica</i> L.	Scrophulariaceae	H	Feb – Jun	Africa, Eurasia
77.	<i>Waltheria indica</i> L.	Sterculiaceae	US	Jul. – Dec.	Trop. America
78.	<i>Xanthium strumarium</i> L.	Asteraceae	H	Aug. – Mar	Trop. America
79.	<i>Youngia japonica</i> (L.) DC.	Asteraceae	H	Aug – Dec	Trop. S. America

Life Form H = Herb, S = Shrub, US = Undershrub, Cl = Climber, T = Tree, Sg = Sedge, G = Grass.

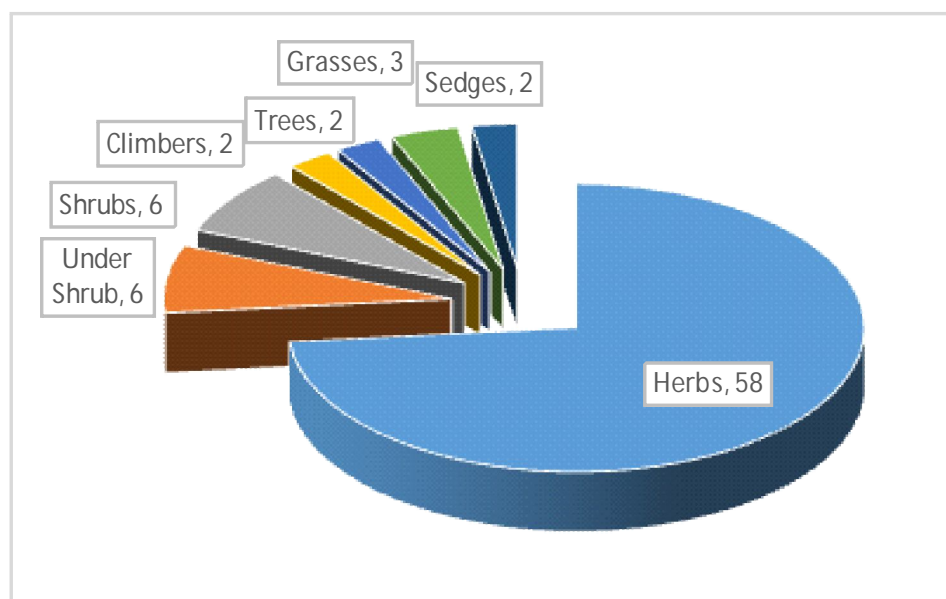


Fig. 2 : Life Form of IAS in Rohilkhand Region.

alien plant species of Rohilkhand Region. Total 79 species belonging to 29 families are documented in Table 1. Dicots represented by 72 species under 58 genera and monocots by 7 species under 6 genera (fig. 1). About 70.88% of these alien species were introduced from tropical America including South America, followed by tropical Africa (11.39%). Maximum number of species (21) were from the family Asteraceae, followed by Amaranthaceae (7), Euphorbiaceae (5) and then Papilionaceae and Caesalpiniaceae with four species each. Herbs accounted for 58 species, undershrubs 6 species, shrubs 6 species, climbers 2 species and Trees 2 species whereas Grasses and Sedges represented 3 and 2 species respectively (fig. 2). It has been observed that few species like *Parthenium hysterophorus*, *Lantana camara var. aculeata*, *Ageratum conyzoides*, *Prosopis juliflora*, *Eichhornia*

*crassipes*, *Tridax procumbens*, *Ipomoea carnea* and *Xanthium indicum* are highly invasive and have invaded not only the non-forested areas but also the forested areas including protected ones. In addition, these species have been noticed both on the outskirts of forests as well as inside the forests.

## References

- Almeilla, I. D. and H. Freitas (2001). The exotic and invasive flora of Portugal. *Bot. Complutensis*, **25** : 317-327.
- Babu, C. R. (1977). *Herbaceous Flora of Dehradun*. CSIR, New Delhi.
- Balakrishnan, N. P., T. Chakarbarti, M. Sanjappu, P. Lakshminarsimhan and P. Singh (2012). *Flora of India*, vol-23, Botanical Survey of India, Kolkata.
- Beena Kumari (2009). Alien invasive plant species of district

- Moradabad (UP), India. *Plant Archives*, **9**(2) : 723-724.
- Charles, F. M., S. J. Milton and G. W. Davis (2005). The threat of alien invasive grasses to lowland Cape floral diversity: an empirical appraisal of the effectiveness of practical control strategies. *South African Journal of Science*, **101** : 337-344.
- Cox, G. W. (2004). Alien Species and Evolution: The Evolutionary Ecology of Alien Plants, Animals, Microbes and Interacting Native Species. Island Press, Washington, D.C.
- Chandra Sekar, K. (2012). Invasive Alien Plants of Indian Himalayan Region- Diversity and Implication. *American Journal of Plant Sciences*, **3**(2) : 177-184.
- Chandra Sekar, K., R. Manikandan and S. K. Srivastava (2012). Invasive Alien plants of Uttarakhand Himalaya. *Proceeding of the National Academy of sciences, India section B: Biological Sciences*, **82**(3) : 375-383.
- Drake, J. A., H. A. Mooney, F. di Castri, R. Groves, F. Kruger, M. Rejmanek and M. Williamson (eds.) (1989). *Biological Invasions : A Global Perspective*. John Wiley and Sons, New York.
- Duthie, J. F. (1903-1929). Flora of the Upper Gangetic plain and of the adjacent Siwalik and Sub-Himalayan tracts. Calcutta.
- Gaur, T. and D. S. Rawat (2013). Diversity, nativity, flowering phenology and invasive alien species of Asteraceae in Pantnagar. *Pantnagar Journal of Research*, **11**(3) : 409-416.
- Huxel, G. R. (1999). Rapid Displacement of Native Species by Invasive Species : Effects of Hybridization. *Biological Conservation*, **89** : 143-152.
- Hall, J. (2003). *Southern Africa : Alien plant species invade region*. Inter Press Service, Norway.
- Joshi, K. and D. S. Rawat (2011). A Preliminary Investigation on Alien and Native Elements in the Flora of Pantnagar, Uttarakhand, India. *Journal of Indian Botanical Society*, **90** : 66-74.
- Khanna, K. K. (2009). Invasive Alien Angiosperms of Uttar Pradesh. *An International Journal*, **1**(2) : 41-46.
- Khuroo, A. A., I. Rashid, R. Zafar, G. H. Dar and B. A. Wafai (2007). The Alien flora of Kashmir Himalaya. *Biological Invasions*, **9** : 269-292.
- Kohli, R. K., K. S. Dogra, D. R. Batish and H. P. Singh (2004). Impact of invasive plants on the structure and composition of natural vegetation of North-western Indian Himalayas. *Weed Technology*, **18** : 1296-1300.
- Maheshwari, J. K. (1963). *The flora of Delhi*. CSIR, New Delhi.
- Maheshwari, J. K. and S. R. Paul (1975). The Alien flora of Ranchi. *J. Bombay Nat. Hist. Soc.*, **72**(1) : 158-188.
- Meyer, J. Y. (2000). *Preliminary review of the invasive plants in the Pacific islands*. In: Sherley, G. (Ed.). *Invasive Species in the Pacific: A Technical Review and Draft Regional Strategy*. South Pacific Regional Environmental Programme, Samoa. pp. 85- 114.
- Mooney, H. A. and R. J. Hobbs (2000). *Invasive Species in a Changing World*. Island Press, Washington, D.C.
- Nair, K. K. N. (1988). Mikania micrantha H. B. K. – A noxious weed in the forests of Kerala. *Evergreen*, **20** : 13-14.
- Negi, P. S. and P. K. Hajra (2007). Alien flora of Doonvalley, North west Himalaya. *Current Science*, **92**(7) : 968-978.
- Pandey, R. P. and P. J. Parmar (1994). The Alien flora of Rajasthan. *J. Econ. Tax. Bot.*, **18**(1) : 105-121.
- Qian Z., R. Yang, J. Tang and Xin Chen (2008). Competitive interaction between the invasive *Solidago canadensis* and native *Kummerowia striata* in lead contaminated soil. *Botanical Studies*, **49** : 385-391.
- Raizada, P. (2007). Invasive species: The concept, invasion process and impact & management of invaders. *Environews*, **13**(3) : 07-09.
- Raghuvanshi, A. S., L. C. Rai, J. P. Gaur and J. S. Singh (2005). Invasive Alien species and biodiversity in India. *Current Science*, **88**(4):
- Rastogi J., D. S. Rawat and S. Chandra (2015). Diversity of invasive alien species in Pantnagar flora. *Tropical Plant Research*, **2**(3) : 282-287.
- Reddy C. S. (2008). Catalogue of Invasive Alien Flora of India. *Life Science Journal*, **5**(2) : 84-89.
- Sharma, G. P., J. S. Singh and A. S. Raghuvanshi (2005). Plant invasions: Emerging trends and future implications. *Current Science*, **88**(5) : 726-734.
- Wagh, V. V. and A. K. Jain (2015). Invasive alien flora of Jhabua district, Madhya Pradesh, India. *International Journal of Biodiversity and Conservation*, **7**(4) : 227-237.