

## ALIEN PLANT SPECIES IN DELHI FLORA

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### ABSTRACT

The present study deals with comprehensive list of invasive alien species in the flora of Delhi with background information on family, habit and nativity. A total of 102 alien plant species belonging to 69 genera and 33 families were documented based on secondary data and field observations. Literature and websites were consulted extensively for relevant information. About 61.76% are distributed to Tropical America and Tropical Africa (9.80%), contributed maximum proportion to the invasive alien flora of India. Habit-wise analysis shows that herbaceous species are dominant (85) followed by shrubs (8), grasses (4) sedges and climber (2) each. Maximum number of these alien species belong to Family Amaranthaceae (14 species) followed by Asteraceae and Fabaceae 13 species each.

**Keywords:** Alien Species; Nativity; List; Delhi Flora

### INTRODUCTION

Many different words like ‘alien’, ‘exotic’, non-indigenous’, ‘non-native’, ‘foreign’ etc are used to explain species occurring in ecosystems to which they are not indigenous. IUCN the World Conservation Union (2002) uses the term ‘alien; encompassing all the terms (Shine *et al.*, 2000). The Convention on Biological Diversity (CBD, 1992) in its “Interim Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species”, defines alien species as “a species occurring outside its normal distribution”. When alien species starts proliferating and spreading beyond its definite limits, it is said to be invasive. Important attributes that make an alien species invasive include, its widespread geographical range, wide range of tolerance for temperature, precipitation and other weather extremes, ability to modify growth and development in response to changing environment, large reproductive output, short juvenile period, fast growth, capability of vegetative reproduction, fire resistance, better competitive ability, allelopathic nature, strong coppicing power, colonizing nature, various dispersal modes etc. Likewise, there are many attributes that make a habitat susceptible to invasive such as species poverty, poorly adapted native species, gaps created by disturbances, constant harvesting of indigenous vegetation for various purposes, presence of empty niches (Mantri *et al.*, 2002). Invasion is usually noticed once the plant has already naturalized. As a result, the introduction of alien species has been recognized as one of the most serious threats to our ecological, social and economic well-being (Shine *et al.*, 2000).

As in other parts of the world, a wide spectrum of plants has been introduced to India through international trade and travel. Of the total plant species recorded from India, about 40 % have been identified as being alien (Saxena, 1991). About 25 % of the introduced species in India became invasive in a short period of time of 50-100 years (Murphy, 2001). *Lantana camara*, *Ipomoea carnea* and *Cassia tora* have established permanently as weeds in almost all parts of the country (Niraj, 2005). Outstanding studies related to alien plants in India are assigned by various workers such as Nair and Daspande (1960); Jain (1960, 1963); Nair (1961); Maheshwari (1960, 1962); Sahni (1965); Mehra (1966); McMillan (1967); Maheshwari and Paul (1975); Sharma and Panday (1984); Rawat *et al.*, (1994); Fensham (1994); Prakash (2001); Kshirsagar and Patil (2002); Kshirsagar (2005), Raghubanshi *et al.*, (2005); Singh and Chowdhary (2005); Sharma *et al.*, (2005, 2007); Khuroo *et al.*, (2006); Negi and Hajra (2007); Shah and Rashi (2007); Murthy *et al.*, (2007); Srinivasan *et al.*, (2007); Mathew and Habeeburrahman (2008); Raizada *et al.*, (2008); Sahu and Singh (2008); Reddy (2008(a)); Reddy (2008(b)); Reddy *et al.*, (2008), Singh *et al.*, (2010) and Sekar (2013).

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The National capital territory of Delhi is a narrow strip of the Indo-gangetic plains which occupies characteristic position between Thar desert, Aravali range and the Himalayas. The tract is located in the northwest indo-gangetic plains (Kumar and Yadav, 2005). It comes under trans gangetic plains region. Delhi is located in northern India between the latitudes of 28°-24'-17" and 28°- 53'-00" North and longitudes of 76°-50'-24" and 77°-20'-37" East (figure 1.1). Delhi shares borders with the States of Uttar Pradesh and Haryana (Economic Survey of Delhi, 2001). Delhi has an area of 1,483 sq. Kms. Its maximum length is 51.90 kms and greatest width is 48.48 kms (Economy Survey Report of Delhi 2001). Monsoon arrives in Delhi in the last week of June or first week of July. The average annual rainfall in is 66.6 cm. Delhi contains mean annual maximum temperature is 46<sup>0</sup> C as well minimum is 4<sup>0</sup> C due to which December is coldest and June is hottest and month. The Present paper focus upon a complied record of alien (invasive) plant species present in Delhi flora along with their habit composition and nativity.

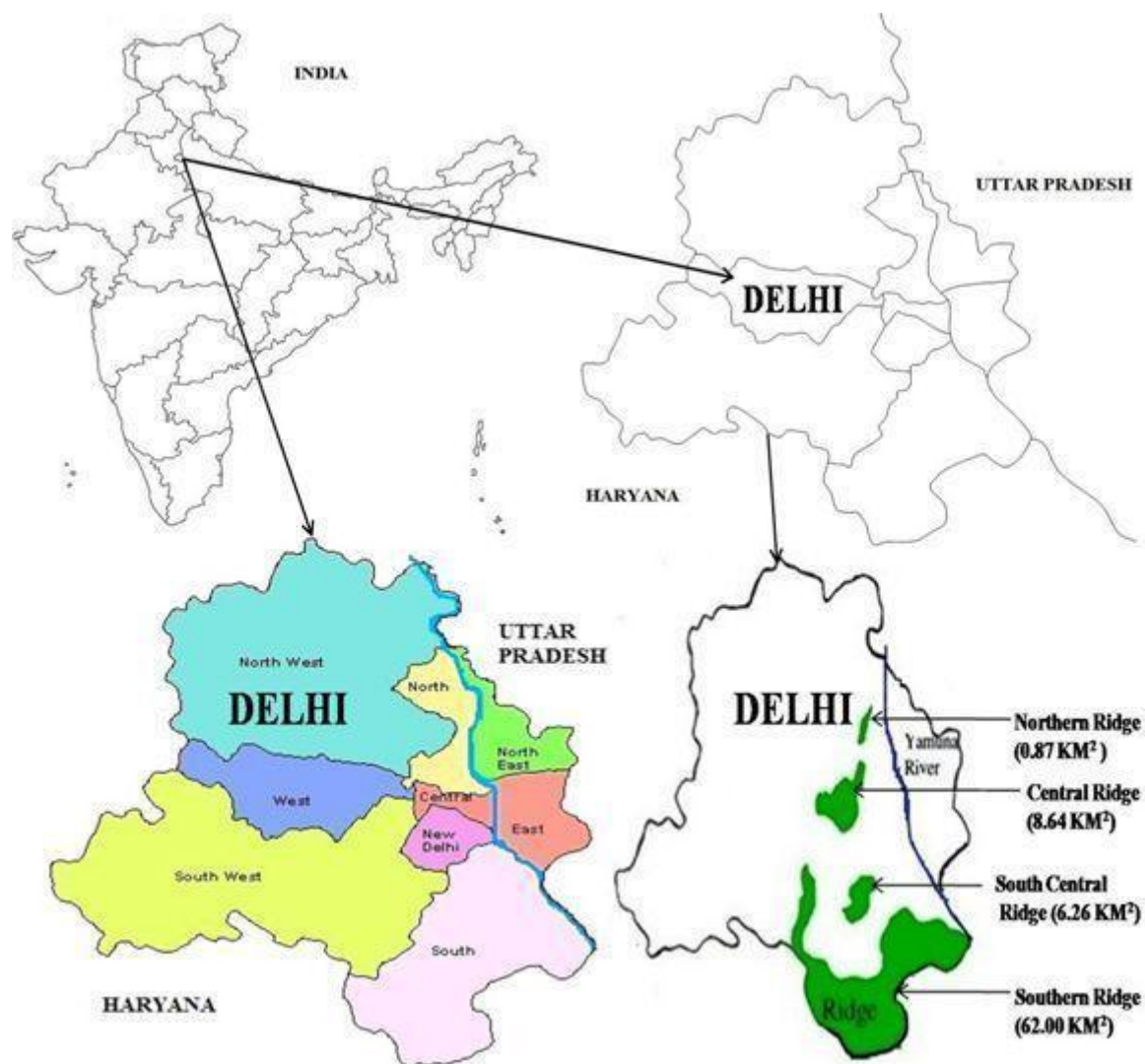


Figure 1.1: Map of Study Area

## MATERIALS AND METHODS

Intensive field studies were conducted to record the number of alien species in different habitats, i.e. Ridge, Yamuna river bank, agricultural lands, wastelands, railway lines, forests (figure 1.2).



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**Ridge**



**Yamuna River banks**



**Agricultural fields**



**Wasteland**



**Forests**



**Railway lines**

**Figure 1.2: Various habitats of alien diversity in Delhi Flora**

The information were also collected from available literature (Duthie, 1929; Maheshwari, 1963; Sharma *et al.*, 1984; Srivastava, 1993; Panday and Parmar, 1994; Singh and Srivastav, 1999; Shulka and Sinha, 2004; Naithani *et al.*, 2007). The nativity of the alien plants was recorded from the published literature (Bailey, 1949; Matthew, 1969; Maheshwari and Paul, 1975; Nayar, 1977; Hajra and Das, 1982; Saxena, 1991; Sharma and Paday, 1984; Pandey and Parmar, 1994; Wasson, 2003; Weber, 2003; Murthy *et al.*, 2007; Khuroo *et al.*, 2007; Bentley and Trimen, 2008; Reddy, 2008; Singh *et al.*, 2010; Dogra *et al.*,

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2010; Sood *et al.*, 2011; Sekar, 2012). Plants were categorized by life form (herb, shrub, climber and tree) and habit (annual and perennial). Habitat (Ridge, Yamuna River bank, wasteland, agricultural fields, forest, road-side etc.) of the species was also recorded along with the parasitic plants. The alien species are enumerated alphabetically in tabular form, followed by author's citation, name of the Family, nativity, life form, habit and habitat. Updated Nomenclature of plant species ([www.theplantlist.org](http://www.theplantlist.org)) was also undertaken.

## RESULTS AND DISCUSSION

### Observations and Results

The study brought to light catalogue of alien (invasive) species in Delhi. A total of 102 species belonging to 69 genera and 33 families were categorized as alien species following the literature of Raghubanshi *et al.*, (2005); Khuroo *et al.*, (2006); Reddy *et al.*, (2008) and Singh *et al.*, (2010). These species constitute 0.58% of the Indian flora and 16.88% of total Delhi flora (Table 1.1).

**Table 1.1: Alien plant diversity in Delhi Flora**

S. No.	Plant name	Family	Nativity	Life form	Habitat
1	<i>Aerva javanica</i> (Burm.f.) Juss. ex. Schult.	Amranthaceae	Trop. America	H	R
2	<i>Ageratum conyzoides</i> (L.) L.	Asteraceae	Trop. America	H	Ca, W & Ra
3	<i>Alternanthera ficoidea</i> (L.) Sm.	Amranthaceae	Trop. America	H	Ra & W
4	<i>Alternanthera paronychioides</i> A.St. Hil.	Amranthaceae	Trop. America	H	Y
5	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Amranthaceae	Trop. America	H	Y
6	<i>Alternanthera pungens</i> Kunth.	Amranthaceae	Trop. America	H	R & W
7	<i>Alternanthera sessilis</i> (L.) R. Br. ex DC.	Amranthaceae	Trop. America	H	Y
8	<i>Amaranthus spinosus</i> L.	Amranthaceae	Trop. America	H	Ra & Ro
9	<i>Amaranthus cruentus</i> L.	Amranthaceae	Trop. America	H	Ro. & Ga.
10	<i>Anagallis arvensis</i> L.	Primulaceae	Europe	H	Ag
11	<i>Antigonon leptopus</i> Hook. & Arn.	Polygonaceae	Trop. America	C	Ro
12	<i>Argemone maxicana</i> L.	Papaveraceae	Trop. Central & South America	H	W
13	<i>Asphodelus tenuifolius</i> Cav.	Xanthorrhoeaceae	Trop. America	H	Ag
14	<i>Bidens biternata</i> (Lour.) Merr. & Sherff	Asteraceae	Trop. America	H	W
15	<i>Blainvillea acmella</i> L. Philipson	Asteraceae	Trop. America	H	R
16	<i>Blumea lacera</i> (Burm.f.) DC.	Asteraceae	Trop. America	H	Ro
17	<i>Borassus flabellifer</i> L.	Arecaceae	Trop. Africa	S	Ro
18	<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae	Trop. Africa	S	Ro
19	<i>Calotropis procera</i> (Aiton) Dryand	Apocynaceae	Trop. Africa	S	Ra & W

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20	<i>Cannabis sativa</i> L.	Cannabaceae	Central Africa	H	Y & W
21	<i>Celosia argentea</i> L.	Amranthaceae	Trop. Africa	H	R
22	<i>Chamaecrista absus</i> (L.) H.S.Irwin & Barneby	Fabaceae	Trop. America	H	R
23	<i>Chamaecrista pumila</i> (Lam.) K.Larsen	Fabaceae	Trop. America	H	R
24	<i>Chenopodium album</i> L.	Amranthaceae	Europe	H	Ra & Ro
25	<i>Chenopodium murale</i> L.	Amranthaceae	Trop. America	H	Ag
26	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob	Asteraceae	Trop. America	H	Ya
27	<i>Chloris barbata</i> Sw.	Poaceae	Trop. America	G	R & Ra
28	<i>Cleome gynandra</i> L.	Capparaceae	Trop. America	H	R & W
29	<i>Cleome viscosa</i> L.	Capparaceae	Trop. America	H	R & Ra
30	<i>Corchorus aestuans</i> L.	Malvaceae	Trop. America	H	Ro
31	<i>Corchorus tridens</i> L.	Malvaceae	Trop. America	H	R
32	<i>Croton bonplandianus</i> Baill.	Euphorbiaceae	Temperate South America	H	Ra & W
33	<i>Cuscuta chinensis</i> Lam.	Cuscutaceae	Mediterranean	H	R & Ro
34	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	Mediterranean	H	Ro
35	<i>Cyperus difformis</i> L.	Cyperaceae	Trop. America	Se	Y
36	<i>Cyperus iria</i> L.	Cyperaceae	Trop. America	Se	R
37	<i>Datura innoxia</i> Mill.	Solanaceae	Trop. America	S	W
38	<i>Datura metel</i> L.	Solanaceae	Trop. America	S	W
39	<i>Dicliptera paniculata</i> (Forssk.) I. Darbysh.	Acanthaceae	Trop. America	H	R & Ro
40	<i>Digera muricata</i> (L.) Mart.	Amranthaceae	South West Asia	H	R & Ag
41	<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Amranthaceae	Trop. America	H	Y
42	<i>Echinochloa colona</i> (L.) Link.	Poaceae	Trop. South America	G	Ra & Ca
43	<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Poaceae	Trop. South America	G	Ra & Ro
44	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	Trop. South America	H	R & W
45	<i>Eichhornia crassipes</i> (C. Martius) Solms.	Pontederiaceae	Trop. America	H	Ca & Y
46	<i>Euphorbia cyathophora</i> Murray	Euphorbiaceae	Trop. America	H	Ro
47	<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	Trop. America	H	Ro & R
48	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Trop. America	H	R & Ag
49	<i>Evolvulus nummularius</i> (L.) L.	Convolvulaceae	Trop. America	H	R & La
50	<i>Gnaphalium pensylvanicum</i> Willd.	Asteraceae	Trop. America	H	Y
51	<i>Gomphrena serrata</i> L.	Amranthaceae	Trop. America	H	R
52	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	Trop. America	H	R & Ra
53	<i>Indigofera linnaei</i> Ali	Fabaceae	Trop. Africa	H	R
54	<i>Indigofera astragalina</i> DC.	Fabaceae	Trop. America	H	R
55	<i>Indigofera linifolia</i> (L.f.) Retz.	Fabaceae	Trop. South America	H	W
56	<i>Ipomoea carnea</i> Jacq.	Convolvulaceae	Trop. America	S	Ra
57	<i>Ipomoea eriocarpa</i> R.Br.	Convolvulaceae	Trop. Africa	C	R



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58	<i>Ipomoea hederifolia</i> L.	Convolvulaceae	Trop. America	H	W
59	<i>Ipomoea obscura</i> (L.) Ker Gawl.	Convolvulaceae	Trop. Africa	H	R
60	<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae	Trop. East Africa	H	R
61	<i>Lantana x aculeata</i> L.	Verbenaceae	Trop. America	H	R & W
62	<i>Lathyrus aphaca</i> L.	Fabaceae	Europe	H	Ag
63	<i>Leucaena leucocephala</i> (Lam.) de.Wit.	Fabaceae	Trop. America	S	R & Ro
64	<i>Ludwigia adscendens</i> (L.) H. Hara.	Onagraceae	Trop. America	H	Y
65	<i>Ludwigia octovalvis</i> (Jacq.) P. H. Raven.	Onagraceae	Trop. Africa	H	Y
66	<i>Ludwigia perennis</i> L.	Onagraceae	Trop. Africa	H	Y
67	<i>Malvastrum coromandelianum</i> (L.) Garcke	Malvaceae	Trop. America	H	W
68	<i>Mazus pumilus</i> (Burm. f.) Steenis	Phrymaceae	Asia	H	Ya & Ga
69	<i>Martynia annua</i> L.	Martyniaceae	Trop. America	H	R
70	<i>Melilotus officinalis</i> subsp. <i>alba</i> (Medik.) H. Ohashi & Tateishi	Fabaceae	Europe	H	Y
71	<i>Melochia corchorifolia</i> L.	Malvaceae	Trop. America	H	R
72	<i>Merremia aegyptia</i> (L.) Urb.	Convolvulaceae	Trop. America	H	R
73	<i>Nicotiana plumbaginifolia</i> Viv.	Solanaceae	Trop. America	H	Y
74	<i>Ocimum americanum</i> L.	Lamiaceae	Trop. America	H	R
75	<i>Oxalis corniculata</i> L.	Oxalidaceae	Europe	H	Ag, Ga & W
76	<i>Parthenium hysterophorus</i> L.	Asteraceae	Trop. North America	H	R, W & Y
77	<i>Physalis angulata</i> L.	Solanaceae	Trop. America	H	Ro
78	<i>Pistia stratiotes</i> L.	Araceae	Trop. America	H	Y
79	<i>Portulaca oleracea</i> L.	Portulacaceae	Trop. South America	H	Ag & Ga
80	<i>Portulaca quadrifida</i> L.	Portulacaceae	Trop. America	H	Ag
81	<i>Prosopis juliflora</i> (Sw.) DC.	Fabaceae	Mexico	T	Ra, R & Y
82	<i>Saccharum spontaneum</i> L.	Poaceae	Trop. West Asia	G	Y
83	<i>Scoparia dulcis</i> L.	Plantaginaceae	Trop. America	H	Y
84	<i>Senna occidentalis</i> (L.) Link.	Fabaceae	Trop. South America	H	W
85	<i>Senna tora</i> (L.) Roxb.	Fabaceae	Trop. South America	H	Ra & Ro
86	<i>Senna alata</i> L. (Roxb.)	Fabaceae	West Indies	H	W
87	<i>Sesbania bispinosa</i> (Jacq.) W. Wight.	Fabaceae	Trop. America	S	Y & W
88	<i>Sida acuta</i> Burm.f.	Malvaceae	Trop. America	H	Ro & W
89	<i>Sida cordata</i> L.	Malvaceae	Trop. America	H	R & Ro
90	<i>Solanum americanum</i> Mill.	Solanaceae	Trop. America	H	Ro, Ga & W
91	<i>Solanum viarum</i> Dunal	Solanaceae	Trop. America	H	R.
92	<i>Sonchus asper</i> (L.) Hill.	Asteraceae	Mediterranean	H	W

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93	<i>Sonchus oleraceus</i> (L.) L.	Asteraceae	Mediterranean	H	Ag
94	<i>Spermacoce hispida</i> L.	Rubiaceae	Trop. America	H	R
95	<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae	West Indies	H	R
96	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Trop. America	H	R & Ro
97	<i>Tridax procumbens</i> (L.) L.	Asteraceae	Trop. Central America	H	R, Ra, Ro & W
98	<i>Triumfetta rhomboidea</i> Jacq.	Malvaceae	Trop. America	H	R & Ro
99	<i>Verbascum thapsus</i> L.	Scrophulariaceae	Europe	H	Ag.
100	<i>Typha domingensis</i> Pers.	Typhaceae	Trop. America	H	Y
101	<i>Urena lobata</i> L.	Malvaceae	Trop. Africa	H	W
102	<i>Xanthium strumarium</i> Mill.	Asteraceae	Trop. America	H	W

## Abbreviation Used

**Habit:** H- Herb; S-Shrub; T-Tree; Se-Sedge, Cl-Climber

**Habitat-** R-Ridge; Y-Yamuna River bank, Ag.-Agricultural fields; W-Wasteland; Ro-Roadside; Ra-Railwayline; Ga-Garden; Ca-Canal bank; La-Lawn.

Of these, 26 families, 60 genera and 91 species belong to dicotyledons and 7 families, 9 genera and 11 species belong to monocotyledons. Herbs contributed maximum with 85 species (83.33%) followed by shrubs with 8 species (7.84 %), grasses 4 species (3.96%), climbers and sedges 2 species each (1.96%) and 1 species (0.98%) tree (figure 1.3). Maximum number of these alien species belong to Family Amaranthaceae (14 species) followed by Asteraceae and Fabaceae (13 species each) and Malvaceae (8 species) while Convolvulaceae obtained 7 species (figure 1.4).

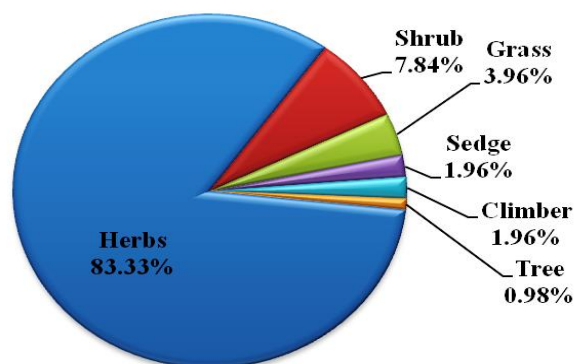


Figure 1.3: Pie chart showing the habit wise distribution of alien species in Delhi

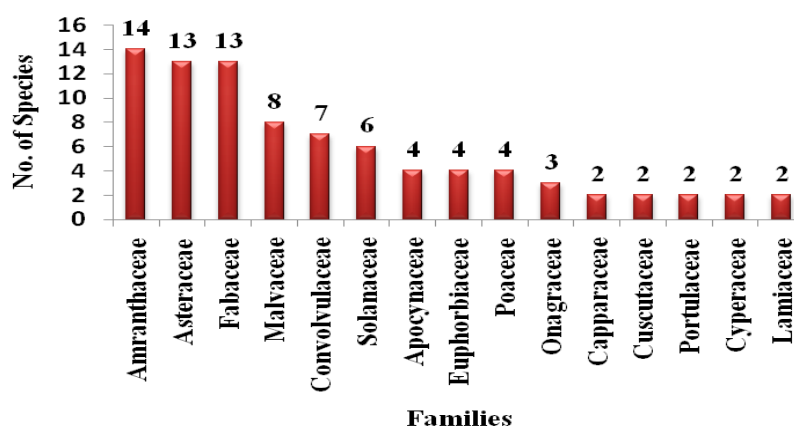


Figure 1.4: Bar diagram showing distribution of alien taxa of various families in Delhi

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Most of the alien plant species (74.50%) trace their origin to America, followed by Africa (12.87 %), Europe (5.88 %), Mediterranean (3.92%) and Asia (2.94 %) (figure 1.5). The genera with the highest number of alien taxa in Delhi are *Alternanthera* and *Ipomoea* (5 species each) followed by *Corchorus*, *Indigofera*, *Ludwigia*, and *Senna* (3 species each) (figure 1.6). 19.85% of these alien species were found at ridge, while Yamuna, wasteland and road constituted 14.85%, 11.88% and 8.91% respectively (figure 1.7).

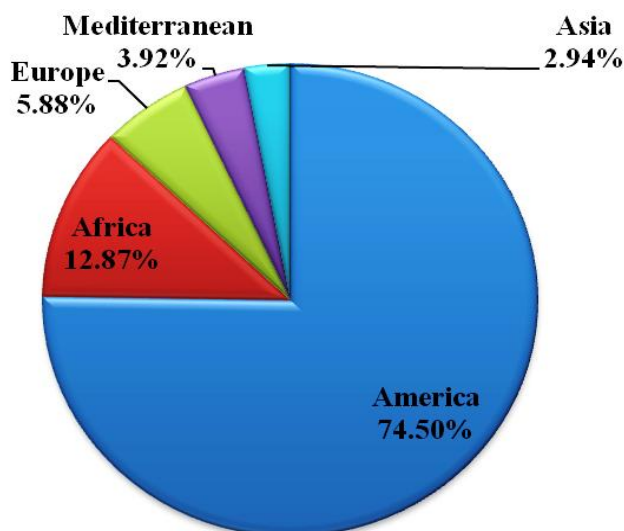


Figure 1.5: Pie chart showing the contribution of different geographical regions to the alien flora of Delhi

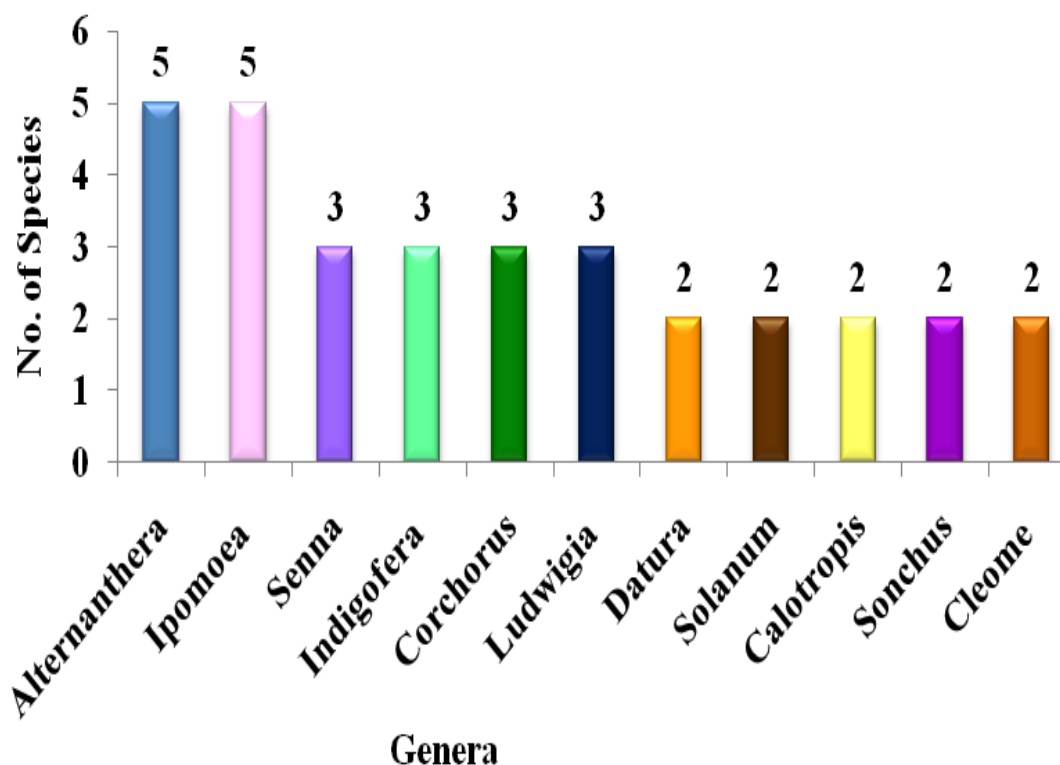
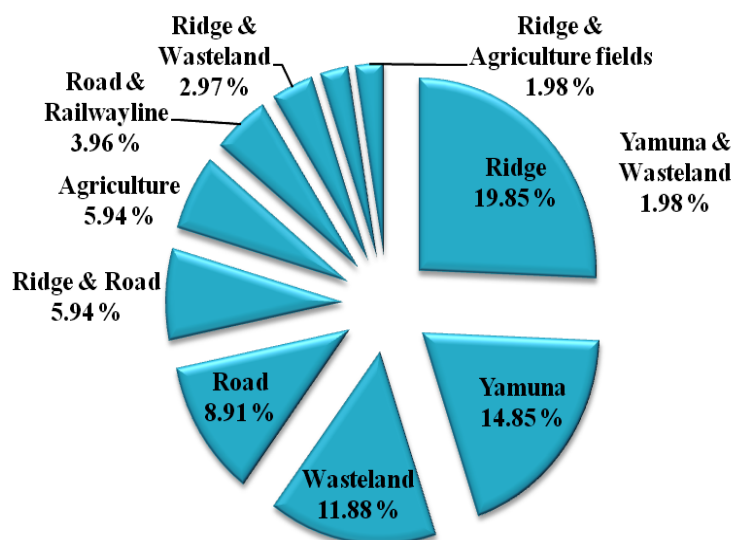


Figure 1.6: Bar diagram showing distribution of genera with two or more species in the alien flora of Delhi



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Among these alien species of Delhi, 63 species (61.76%) are native to Tropical America and 10 species (9.80%) to Tropical Africa, 6 species (5.58%) to Europe and South America each. Mediterranean region consisted the nativity of 4 species (3.92%) and Trop. Central America, West Indies contained 2 species (1.96% each) respectively. Annuals are recorded the predominant invasive flora of Delhi constituting 65.68% (67 species.) followed by perennials 34.31% (35 species). 5 invasive taxa collected here (*Alternanthera philoxeroides* (Mart.) Griseb., *Ageratum conyzoides* L., *Eichhornia crassipes* (Mart.) Solms, *Ipomoea cairica* (L.) Sweet, *Pistia stratiotes* L. were also documented in other Asian countries as invasive (Huang *et al.*, 2009). 41 species, reported in our case, have also been documented in the alien flora of Taiwan (Wu *et al.*, 2004).



**Figure 1.7: Pie chart showing the habitat wise classification of Delhi Flora**

Similar types of studies were also carried out by different workers in India. Reddy *et al.*, (2008) reported 173 alien species from different regions of India. Khuroo *et al.*, (2006) explored the Kashmir Himalayas and reported 571 alien plant species; while Singh *et al.*, (2010) reported 152 alien species from Uttar Pradesh. Dogra *et al.*, (2011) reported 159 species from temple courtyard of Himachal Pradesh. Sekar (2012) found 190 alien plant species from Indian Himalayan regions. The invasion by *Prosopis juliflora* also influenced the floral diversity of Delhi. This species is native of arid region of Mexico and Central America. It was first introduced into India in 1877 from England (Maheshwari, 1963). It is a fast growing and drought resistance species. This affects the plant biodiversity by creating a physical barrier on seedlings of other plant species, preventing sunlight to reach the vegetation under canopy, lowering the water table and by releasing various chemicals that may have negative effects on the native plant species (Getachew *et al.*, 2012).

## Discussion and Conclusion

The invasive species cause loss of biodiversity including species extinctions, and changes in hydrology and ecosystem function. Invasive species are thus a serious hindrance to conservation and sustainable use of biodiversity, with significant undesirable impacts on the goods and services provided by ecosystems. Biological invasions now operate on a global scale and will undergo rapid increase in this century due to interaction with other changes such as increasing globalization of markets, rise in global trade, travel and tourism. For effective management of invasive species, knowledge about their ecology, morphology, phenology, reproductive biology, physiology and phytochemistry is essential. Monitoring of invasion can be done through qualitative approach like species inventory (seasonally) and quantitative approach using phytosociological methods and mapping using ground-based methods (via map overlays or GPS), remotely-sensed images (aerial photos, high resolution multi-spectral digital data).

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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 in Delhi by establishing communication links between taxonomists, ecologists and land managers to monitor and control. Besides there should be a proper quarantine that will check the infusion of these species by tourists.

### **ACKNOWLEDGEMENT**

Authors are thankful to the National institute of science communication and information resources for plant identification process. Authors are also thankful to UGC for financial assistance during the study.

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