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Cover: ***Pipistrellus tenuis*** **recorded during the small mammalian fauna study, Manipur, India. © Uttam Saikia.**

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COMMUNICATION

Invasive alien plant species of Hassan District, Karnataka, India

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Abstract: This study was undertaken to document alien and invasive flowering plant species in the Western Ghats (Hassan district, Karnataka, India), with background information on family, habit, habitat, longevity, nativity, and uses. A total of 312 alien species belonging to 236 genera in 79 families are listed. The majority belong to family Asteraceae (36 species), followed by Fabaceae (21 species), and Amaranthaceae (17 species). Herbs constitute the majority (59%) of alien species followed by shrubs (17 %). Around 36% the alien taxa are native to tropical America. Of 314 alien species, 122 were intentional introductions, with a majority (39%) introduced for ornamental purposes; 24% of species have naturalized, while 33% display as invasive. There is an urgent need to gather regional data on the diversity of invasive alien plant species in order to study the impact on native vegetation and biodiversity.

Keywords: Exotic, naturalized species, ornamental, plant diversity, threats, Western Ghats.

Editor: Anonymity requested.

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Author details: G.M. Prashanth Kumar has interest in plant taxonomy and ethnobotany. Shiddamallayya Nagayya is a higher plant taxonomist in the area of systematics and ethnobotany.

Author contribution: GMP carried out the floristic study, collected the data and wrote the manuscript. SN identified the species, interpreted the data and designed the manuscript. Both authors have read and approved the final manuscript.

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INTRODUCTION

The increase in human activity and increased international trade, travel, and transport beyond biogeographic barriers has led to the introduction and establishment of invasive alien species in new regions (Dawson et al. 2017). Biological invasions have received much consideration due to the potential threats they impose on native species, natural systems, ecosystem processes & functioning, environmental quality, and human health (Pyšek & Richardson 2010; Simberloff et al. 2013; Jones & McDermott 2018; Pearson et al. 2018; Petruzzella et al. 2018; Bartz & Kowarik 2019; Rai & Singh 2020). Successful plant invasions are attributed to the interaction between the exotic plants and resident plant communities (Gallien & Carboni 2017). Many factors influence invasion success, including phenotypic plasticity, dispersal benefits from destructive foraging activities, wide geographic range, vegetative reproduction, fire tolerance, and superior competitive ability compared to native flora (Sharma et al. 2005). Invasive alien plants may outperform native species due to the absence of natural enemies in the introduced range (Aguilera 2011). Moreover, invasive plants display characteristics such as high competitive ability and efficient resource utilization (Baker 1965; Levine 2000; Petruzzella et al. 2018).

The introduction of non-native species into new habitats is largely due to short-term economic benefits (MeNeely 2001), therefore, most of the issues related to invasive plants can be linked to the intended or unintended consequences of economic activities (Perrings et al. 2002). Globalization and rapid modification of natural habitats have triggered a massive spread of plant species to areas outside their native ranges (van Kleunen et al. 2015). On the continental and global scale, species invasions have diminished the regional distinctiveness of flora and fauna (Vitousek et al. 1997). At least 10% of the world's vascular plants (300,000) have the potential to invade other ecosystems and affect native biota in direct or indirect ways (Singh et al. 2006). About 18% of the Indian flora are aliens, of which 55% are native to the Americas, 30% to Asia, and to 15% Europe & central Asia (Nayar 1977; Singh et al. 2010). Many invasive alien plants confer economic benefits; for example, *Lantana camara* is used by several local villages in India who use it for furniture and pulp making (Kannan et al. 2014); however, it remains a serious invader causing problems for indigenous flora and significant losses of ecosystem services compared to benefits.

Many invasive species have severe negative impacts. For example, *Ageratum conyzoides, Chromolaena odorata*, and *Parthenium hysterophorus* are considered invasive transformer species that lack natural enemies and have fast-spreading ability, allelopathic effects on other plants, and strong competitiveness with crops, while posing health hazard to humans and animals (Raghubanshi et al. 2005; Suthari et al. 2016). Some cultivated alien species provide food, medicine, fuel, & fodder to local communities (Kull et al. 2007) and some are used in the preparation of Ayurvedic formulations (Shiddamallayya et al. 2010). It is estimated that as many as 50% of invasive species, in general, can be classified as ecologically harmful, based on their actual impacts (Richardson et al. 2000).

There is a need for an authoritative database on alien and invasive alien plant species to monitor the spread and impact in various regions and for plan appropriate management strategies. State and regional floras in the country rarely indicate the native or alien status of the species listed therein. In some cases, naturalized alien species are treated as native in floristic documents (Khuroo et al. 2012). Many species recorded as aliens in different regions of the country, but whose native range falls within the country's political boundary, have been excluded in the present study. Example is the Himalayan Chir Pine *Pinus roxburghi* recorded as 'exotic' in southern India (Matthew 1969). Similarly, *Nyctanthes arbor-tristis* is a Himalayan native introduced for various reasons to the rest of the country, and many other species that have a within-the-country origin should also be regarded as alien. The present study reports on alien and invasive flowering plant species in the Hassan district of Karnataka.

MATERIALS AND METHODS

Study area

Hassan district is located in the southern part of Karnataka state in India, situated between 12^0 13', 13^0 33' N & 75^0 33', 76^0 38' E. Hassan district begins at the base of the steep Western Ghats and continues into the gently rolling Deccan plateau. The district shows wide variations in climate and vegetation. The evergreen and semi-evergreen forests in the district are concentrated in the Western Ghats region of Yeslur and Sakaleshpura, and are commonly known as wet evergreen tropical rain forest. Dry deciduous forests dominate the plains, also known as Maidan area (Figure 1).

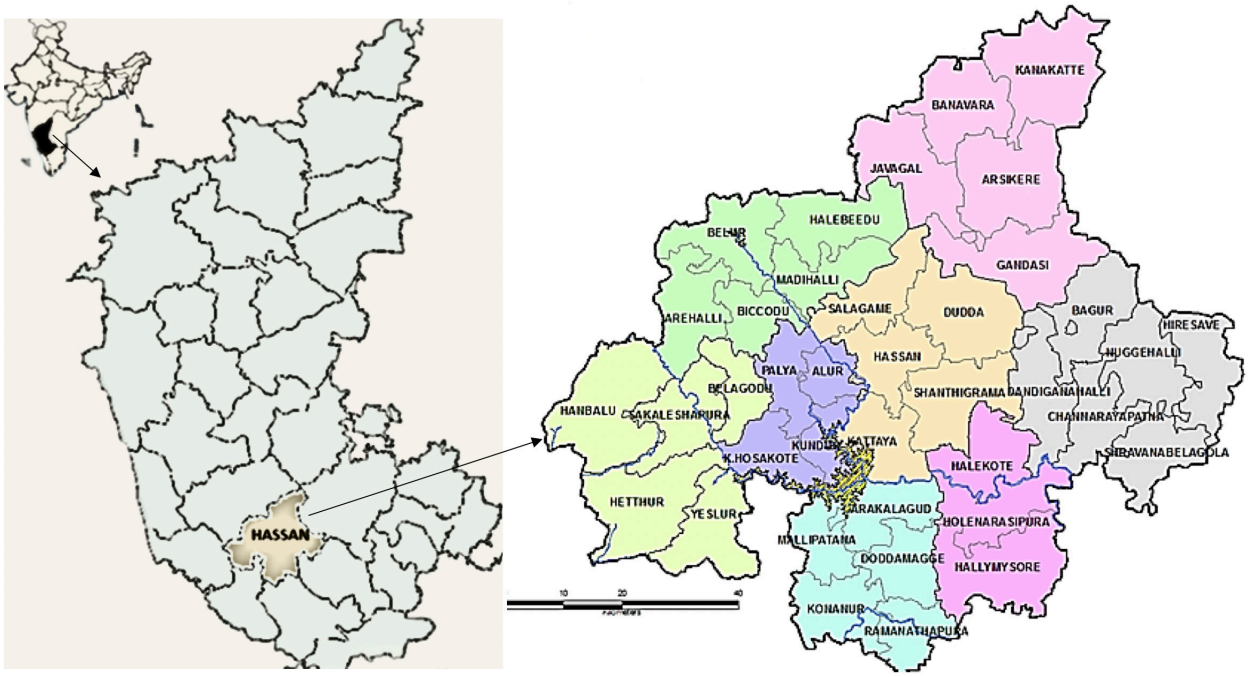

Figure 1. The study area of Hassan District of Karnataka.

Data collection

Extensive floristic surveys were conducted in a planned manner repeatedly in different seasons to get the maximum representation of alien and invasive alien species in Hassan District. Plant samples were collected from natural habitats, agricultural lands, aquatic, semi-aquatic habitats, marshes, open grasslands, wastelands, roadsides, village ponds, wetlands, railway tracks, riverbanks, reserve forests, slopes, and hilltops. The collected specimens were identified with the help of floras (Saldhana & Nicolson 1976; Saldhana 1984, 1996). Plants were categorized by habit (herb, shrub, climber, and tree) and by habitat (wasteland, cultivated field, aquatic, river & pond banks, forest, and roadside). The plant names were rechecked and authenticated using the plant list (www.theplantlist.org\) and GRIN taxonomy site (http://www.ars-grin.gov/npgs/aboutgrin.html), the synonyms were removed to avoid taxonomic inflation. We followed biogeographic approach in assigning the native ranges to all the species (Khuroo et al. 2012). Only those species whose native ranges fall outside the borders of the Indian subcontinent, namely 'alien' species (CBD 2000) were considered in this study. To minimize the error of judgement by earlier studies regarding the alien status, and to cross-check native range records, native ranges for all species were verified with data from the Germplasm Resources Information Network (www.grin.org, http://www.hear.org/pier/, http://www.iucngisd.org/gisd/) and some other published literature (Murthy et al. 2007; Negi & Hajra 2007; Reddy 2008; Reddy et al. 2008; Singh et al. 2010; Wu et al. 2010; Paul 2010; Khuroo et al. 2012; Pyšek et al. 2012).

To further document their status, alien plant species were categorized into casual (Ca), naturalized (Nt), invasive (In), casual or naturalized (Ca/Nt) and naturalized or invasive (Nt/In) as per the earlier studies (Richardson et al. 2000; Pysek et al. 2004; Khuroo et al. 2012). Alien species that may flourish and even reproduce occasionally in an area, but do not form self-replacing populations, and which rely on repeated introductions for their persistence are known as 'casual' (Ca). Alien species that reproduce and sustain populations over more than one life cycle and do not necessarily invade natural, semi-natural or human-made ecosystems are known as 'naturalized' (Nt). Naturalized alien species that produce reproductive offspring, often in large numbers, at considerable distances from parent plants and thus can spread over a considerable area are referred to as 'invasive' (In). Alien species grown or planted and have not yet escaped are referred to as 'cultivated' (Cl). Those casual alien species for which the current evidence is insufficient to be recognized as naturalized but have the potential to become naturalized in the near future are referred to as Ca/Nt. Those naturalized alien species for which the current evidence is insufficient to be recognized as invasive, but have the potential to become

invasive in the near future are referred to as Nt/In. The purpose of intentional introduction (food, fodder, ornamental, plantation, horticulture, and medicinal) of the alien species were recorded from relevant literature (Sharma & Pandey 1984; Khuroo et al. 2007; Jaryan et al. 2013). Species that have come unintentionally were categorized as 'unintentional introductions' (Ui). Literature including unpublished (Singh et al. 2010; Kambhar & Kotresha 2011; Prakash & Balasubramanian 2018) and local communities were consulted for uses. The alien species were analyzed for taxa statistics, habit, habitat, nativity, purpose of introduction, invasive status and use-values. For analysis of habit, the number of species in a particular habit has been divided by the total number of alien species and multiplied by 100. The same follows for habitat, nativity, and invasion status analyses. For analyzing the purpose of introduction, number of species introduced for a particular purpose was divided by the total number of species for which the purpose of introduction is known (122) and then multiplied by hundred. We used Microsoft Excel (version 2013) for the data processing.

RESULTS AND DISCUSSION

A total of 312 species in 236 genera and under 79 families were documented as invasive alien plant species. They are shown along with the family name, habit, habitat, nativity, mode of introduction, invasive status, and uses in Table 1 and Images 1–5. The habit-wise distribution of alien species is represented in Figure 2.

Of the species 48% (n = 152) belong to just 10 families. Asteraceae was the dominant family with 36 species (23%) followed by Fabaceae 21 species (13%), Amaranthaceae 17 species (11%), and Poaceae 16 species (10%). Due to their dominance, most of these families have a high number of herbs. The dominance of Fabaceae, which has the ability to fix nitrogen, would aid their colonisation of empty niches. The proportion of alien species to the total species in the respective family in Hassan district is highest for Amaranthaceae (85%) followed by Solanaceae (83.3%) and Asteraceae (47.3%) (Table 2). For India, this is in agreement with Khuroo et al. (2012) and Jaryan et al. (2013). Similar patterns of family dominance in alien floras have been reported in studies from Europe (Lambdon et al. 2008) and China (Weber et al. 2008; Wu et al. 2010). Pysek (1998) found that these families also have the majority of alien species on a worldwide scale. In addition, studies on agricultural weeds found that the Asteraceae and Poaceae families account for the majority of weeds in terms of numbers (Heywood 1989). This could be due to the fact that these families have some of the highest species richness (Rao 1994) and hence have a higher chance of harboring more alien species. Such a family dominance pattern, as Khuroo et al. (2012) pointed out, is more of a depiction of sampling effect. These families are known to have a large number of species, hence an increase in the number of alien species belonging to these families is expected (Khuroo et al. 2012). In Himachal Pradesh also, proportion of alien species relative to the total species in Amaranthaceae (53.3%) followed by Solanaceae (52.9%) and Convolvulaceae (44%) is highest (Jaryan et al. 2013). This is in agreement to the results of Khuroo et al. (2012) for India and Wu et al. (2010) for China. In Kashmir, proportion of alien species relative to the total species in Amaranthaceae (83%) is highest (Khuroo et al. 2007). Interestingly, the Asteraceae and Convolvulaceae families have the biggest numerical contributions (47.3%) in this ranking for Hassan district (Table 2). In the top 10 list of families, Poaceae (11.4%) has the lowest alien species (Table 2). Remarkably, some families comprise only invasive species in Hassan district (e.g., Balsaminaceae, *Impatiens balsamina*; Ceratophyllaceae, *Ceratophyllum demersum*; Martyniaceae, *Martynia annua*). The following genera had highest number of alien species in Hassan district, *Solanum* (8 species), *Ipomoea* (7 species), and *Euphorbia* (6 species), *Amaranthus*, *Alternanthera*, & *Hibiscus* (4 species each). These genera also contribute a good number to the alien flora of India, Europe, and China (Lambdon et al. 2008; Weber et al. 2008; Wu et al. 2010; Khuroo et al. 2012).

Out of the 36 plant species that are globally recognised as the 'World's worst invasive alien species' (Lowe et al. 2000), 17 are present in India (Khuroo et al. 2012), of which we report the presence of eight in Hassan district: *Eichhornia crassipes*, *Spathodea campanulata*, *Imperata*

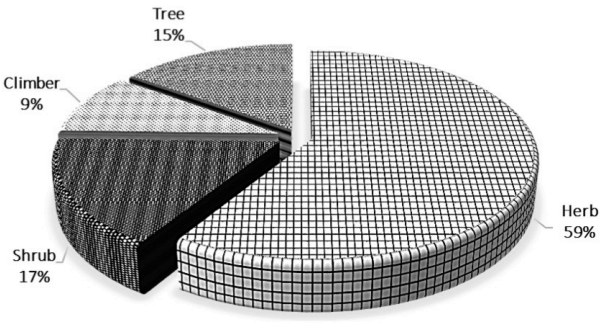

Figure 2. Habit-wise distribution of alien species of Hassan District.

Table 1. Alien plant species of Hassan District, their source region and uses.

	Accepted name of species	Family	Habit	Longevity	Habitat	Nativity	Purpose of introduction	Invasive status	Uses
1	*Abelmoschus esculentus* (L.) Moench	Malvaceae	H	A	CF	TAF	Fd	Cl	V
2	*Acacia auriculiformis* L.	Mimosaceae	T	P	AR	AU	Ui	Ca/Nt	W
3	*Acacia farnesiana* (L.) Willd.	Mimosaceae	T	P	AR	SAM	Ui	In	M
4	*Acanthospermum hispidum* DC.	Asteraceae	H	A	W	BR	Ui	In	M
5	*Achyranthes aspera* L.	Amaranthaceae	H	A	W	AS	Ui	In	M
6	*Achyranthes bidentata* Blume	Amaranthaceae	H	P	AR	AS	Ui	Nt	M
7	*Acmella uliginosa* (Sw.) Cass.	Asteraceae	H	A	W	TAM	Ui	Nt	Nk
8	*Adenostemma lavenia* (L.) Ktze.	Asteraceae	H	A	RB	SAM	Ui	In	Nk
9	*Aeschynomene indica* L.	Fabaceae	H	A	AQ	AU	Ui	In	Nk
10	*Agave americana* L.	Asparagaceae	S	P	AR	TAM	Ui	Nt	R
11	*Agave sisalana* Perrine.	Asparagaceae	S	P	W	MX	Ui	Cl	R
12	*Ageratum conyzoides* (L.) L.	Asteraceae	H	A	W	TAM	Or	In	M
13	*Ageratum houstonianum* Mill.	Asteraceae	H	A	W	TAM	Ui	In	Nk
14	*Albizia lebbeck* Benth.	Mimosaceae	T	P	F	AS	Pl	Nt	W
15	*Albizia saman* (Jacq.) Merr.	Mimosaceae	T	P	AR	TAM	Ui	Ca/Nt	W
16	*Allamanda cathartica* L.	Apocynaceae	C	P	CF	TAM	Or	Cl	Or
17	*Allium cepa* L.	Amaryllidaceae	H	A	CF	AS	Fd	Cl	V
18	*Allium sativum* L.	Amaryllidaceae	H	A	CF	AS	Fd	Cl	V
19	*Aloe vera* (L.) Burm.f.	Liliaceae	H	P	W	MR	M	Ca/Nt	M
20	*Alternanthera paronychioides* A.St.-Hil.	Amaranthaceae	H	P	RB	TAM	Ui	Nt/In	M
21	*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	H	P	W	TAM	Ui	Nt/In	Nk
22	*Alternanthera pungens* Kunth	Amaranthaceae	H	P	W	TAM	Ui	Nt/In	M
23	*Alternanthera sessilis* (L.) R.Br. ex DC.	Amaranthaceae	H	P	RB	TAM	Ui	Nt	V
24	*Amaranthus caudatus* L.	Amaranthaceae	H	A	CF	SAM	Fd	In	V
25	*Amaranthus spinosus* L.	Amaranthaceae	H	A	CF	TAM	Ui	In	V
26	*Amaranthus tricolor* L.	Amaranthaceae	H	A	CF	AS	Fd	Ca	V
27	*Amaranthus viridis* L.	Amaranthaceae	H	A	CF	TAM	Ui	In	V
28	*Ammannia baccifera* L.	Lythraceae	H	A	RB	AU	Ui	Nt	Nk
29	*Anacardium occidentale* L.	Anacardiaceae	T	P	W	BR	Ht	Nt	M
30	*Anagallis arvensis* L.	Primulaceae	H	A	RB	EU	Ui	In	Nk
31	*Ananas comosus* (L.) Merr.	Bromeliaceae	H	P	CF	SAM	Ht	Cl	Ef
32	*Anethum graveolens* L.	Apiaceae	H	A	CF	AS	Or	Nt	V
33	*Annona muricata* L.	Annonaceae	T	P	CF	TAM	Ht	Cl	Ef
34	*Annona reticulata* L.	Annonaceae	T	P	F	TAM	Ht	Cl	Ef
35	*Annona squamosa* L.	Annonaceae	T	P	F	WI	Ht	Cl	Ef
36	*Antigonon leptopus* Hook. & Arn.	Polygonaceae	C	P	AR	TAM	Or	Ca/Nt	Or
37	*Arachis hypogaea* L.	Fabaceae	H	A	CF	BR	Fd	Cl	Ol
38	*Areca catechu* L.	Arecaceae	T	P	CF	AS	Pl	Nt	En
39	*Argemone mexicana* L.	Papaveraceae	H	A	W	NAM	M	In	M
40	*Aristolochia littoralis* Parodi	Aristolochiaceae	H	P	W	BR	Ui	Cl	Or
41	*Arthraxon lancifolius* (Trin.) Hochst.	Poaceae	H	A	W	TAF	Ui	Nt	V
42	*Artocarpus altilis* (Parkinson ex F.A.Zorn) Fosberg	Moraceae	T	P	W	SEA	Fd	Cl	Ef
43	*Asclepias curassavica* L.	Apocynaceae	H	P	AR	TAM	Ui	Ca/Nt	Nk
44	*Averrhoa bilimbi* L.	Oxalidaceae	T	P	AR	TAM	Ui	Cl	Ef

	Accepted name of species	Family	Habit	Longevity	Habitat	Nativity	Purpose of introduction	Invasive status	Uses
45	*Averrhoa carambola* L.	Oxalidaceae	T	P	AR	TAM	Ui	Cl	Ef
46	*Bacopa monnieri* Pennell	Scrophulariaceae	H	A	RB	TAM	Ui	In	V
47	*Balanites aegyptiaca* (L.) Delile	Zygophyllaceae	S	P	F	TAF	Ui	Nt	M
48	*Bambusa vulgaris* Schrad.	Poaceae	S	P	AR	SEA	Or	Ca/Nt	Or
49	*Basella alba* L.	Basellaceae	C	A	CF	TAF	M	Nt	M
50	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitaceae	C	A	CF	SEA	Fd	Cl	V
51	*Beta vulgaris* L.	Amaranthaceae	H	A	CF	EU	Ht	Cl	V
52	*Bidens biternata* (Lour.) Merr. & Sherff	Asteraceae	H	A	CF	TAM	Ui	Ca/Nt	M
53	*Bidens pilosa* L.	Asteraceae	H	A	W	SAM	Ui	In	Nk
54	*Biophytum sensitivum* DC.	Oxalidaceae	H	A	W	SEA	Ui	In	M
55	*Bixa orellana* L.	Bixaceae	T	P	CF	BR	Ui	Cl	M
56	*Blainvillea acmella* (L.) Philipson	Asteraceae	H	A	W	TAM	Ui	In	M
57	*Blumea lacera* (Burm.f.) DC.	Asteraceae	H	A	W	TAM	Ui	In	M
58	*Blumea obliqua* (L.) Druce	Asteraceae	H	A	W	TAM	Ui	In	Nk
59	*Bougainvillea spectabilis* Willd.	Nyctaginaceae	S	P	AR	TAM	Or	Cl	Or
60	*Brassica nigra* (L.) K.Koch	Brassicaceae	H	A	CF	EU	Fd	Cl	Ol
61	*Brassica oleracea* L.	Brassicaceae	H	A	CF	EU	Fd	Cl	V
62	*Breynia vitis-idea* (Burn.f.) Fisch	Euphorbiaceae	S	A	CF	WI	Ui	Nt	Nk
63	*Brugmansia suaveolens* Bercht. & K.Presl.	Solanaceae	S	P	AR	BR	UI	Nt	Nk
64	*Bryophyllum pinnatum* (Lam.) Oken	Crassulaceae	H	A	W	TAF	Ui	Nt/In	M
65	*Caesalpinia pulcherrima* (L.) Sw.	Caesalpiniaceae	S	P	CF	TAM	Or	Cl	Or
66	*Cajanus cajan* (L.) Millsp.	Fabaceae	H	A	CF	TAF	Fd	Cl	ES
67	*Caladium bicolor* (Aiton) Vent.	Araceae	H	A	RB	TAM	Or	Cl	Or
68	*Callistemon viminalis* (Sol. ex Gaertn.) G.Don ex Loudon	Myrtaceae	T	P	CF	AU	Or	Ca/Nt	Or
69	*Calotropis gigantea* (L.) Dryand.	Apocynaceae	S	P	W	TAF	Ui	In	M
70	*Camellia sinensis* (L.) Kuntze	Theaceae	S	P	CF	AS	Fd	Ca/Nt	Br
71	*Canna indica* L.	Cannaceae	H	P	CF	TAM	M	Nt	M
72	*Capsicum annuum* L.	Solanaceae	H	P	CF	MX	Ht	Cl	V
73	*Cardiospermum halicacabum* L.	Sapindaceae	C	P	W	SAM	Ui	In	M
74	*Carica papaya* L.	Caricaceae	T	P	CF	SAM	Ht	Cl	Ef
75	*Carmona retusa* (Vahl) Masamune	Boraginaceae	H	A	F	SEA	Ui	Ca/Nt	M
76	*Cascabela thevetia* (L.) Lippold	Apocynaceae	T	P	CF	TAM	Or	Cl	Or
77	*Cassia fistula* L.	Caesalpiniaceae	T	P	F	AS	M	Nt	M
78	*Cassytha filiformis* L.	Lauraceae	C	P	P	AU	Ui	Nt	M
79	*Casuarina equisetifolia* L.	Casuarinaceae	T	P	CF	TAM	Ui	Nt	W
80	*Catharanthus pusillus* (Murray) G.Don	Apocynaceae	H	A	CF	TAM	Or	In	M
81	*Catharanthus roseus* (L.) G.Don	Apocynaceae	H	A	W	TAM	Or	In	M
82	*Celosia argentea* L.	Amaranthaceae	H	A	CF	TAM	Fd	Ca	V
83	*Ceratophyllum demersum* L.	Ceratophyllaceae	H	P	AQ	NAM	Ui	In	M
84	*Cereus repandus* (L.) Mill.	Cactaceae	S	P	AR	TAM	Ui	Nt	M
85	*Cestrum nocturnum* L.	Solanaceae	S	P	AR	WI	Or	Ca/Nt	Or
86	*Chenopodium album* L.	Amaranthaceae	H	A	CF	EU	Fd	In	V
87	*Chenopodium ambrosioides* L.	Amaranthaceae	H	A	W	TAM	Ui	In	Fo
88	*Chloris barbata* Sw.	Poaceae	H	A	W	TAM	Ui	Nt	Fo
89	*Chromolaena odorata* (L.) RM.King & H.Rob.	Asteraceae	H	P	W	TAM	Ui	In	M

	Accepted name of species	Family	Habit	Longevity	Habitat	Nativity	Purpose of introduction	Invasive status	Uses
90	*Cicer arietinum* L.	Fabaceae	H	A	CF	AS	Fd	Cl	Es
91	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	Cucurbitaceae	C	A	CF	SAM	Fd	Cl	Ef
92	*Cleome monophylla* L.	Cleomaceae	H	A	AR	TAF	Ui	Nt	M
93	*Cleome viscosa* L.	Cleomaceae	H	A	W	TAM	Ui	Nt	M
94	*Clidemia hirta* (L.) D. Don	Melastomataceae	H	P	W	TAM	Ui	Nt	M
95	*Clitoria ternatea* L.	Fabaceae	C	A	W	TAM	M	Nt	M
96	*Coffea arabica* L.	Rubiaceae	S	P	CF	TAF	Fd	Cl	Br
97	*Coldenia procumbens* L.	Boraginaceae	H	A	W	NAM	Ui	Nt/In	M
98	*Colocasia esculenta* (L.) Schott	Araceae	H	A	RB	AS	UI	Nt	V
99	*Corchorus aestuans* L.	Malvaceae	H	A	W	TAM	Ui	Nt	M
100	*Corchorus trilocularis* L.	Malvaceae	H	A	W	TAF	Ui	In	M
101	*Coriandrum sativum* L.	Apiaceae	H	A	CF	AS	Fd	Cl	V
102	*Cosmos bipinnatus* Cav.	Asteraceae	H	A	CF	TAM	Or	Nt/In	Nk
103	*Couroupita guianensis* Aubl.	Lecythidaceae	T	P	AR	SAM	Ui	Cl	M
104	*Crassocephalum crepidioides* (Benth.) S.Moore	Asteraceae	H	A	F	TAM	Ui	In	Nk
105	*Crotalaria pallida* Aiton	Fabaceae	H	A	CF	TAM	Ui	Nt	Nk
106	*Crotalaria retusa* L.	Fabaceae	H	A	CF	TAM	Ui	Nt	Nk
107	*Croton bonplandianus* Baill.	Euphorbiaceae	H	P	W	SAM	Ui	In	Nk
108	*Cucumis melo* L.	Cucurbitaceae	C	A	CF	AS	Fd	Cl	Ef
109	*Cucurbita maxima* Duchesne	Cucurbitaceae	C	A	CF	SAM	Fd	Cl	V
110	*Cucurbita pepo* L.	Cucurbitaceae	C	A	CF	SAM	Fd	Cl	V
111	*Cuscuta reflexa* Roxb.	Convolvulaceae	C	P	P	MR	Ui	In	M
112	*Cyanthillium cinereum* (L.) H.Rob.	Asteraceae	H	A	W	AS	Ui	Nt/In	M
113	*Cymbopogon citratus* (DC.) Stapf	Poaceae	H	A	CF	SEA	Ui	Ca	Ol
114	*Cyperus difformis* L.	Cyperaceae	H	A	CF	TAM	Ui	In	Nk
115	*Cyperus iria* L.	Cyperaceae	H	A	CF	TAM	Ui	Nt	Nk
116	*Cyperus rotundus* L.	Cyperaceae	H	A	CF	TAF	Ui	In	M
117	*Datura metel* L.	Solanaceae	S	P	W	TAM	Ui	Ca/Nt	M
118	*Datura stramonium* L.	Solanaceae	S	P	AR	TAM	Ui	In	M
119	*Daucus carota* L.	Apiaceae	H	A	CF	NAM	Fd	Cl	V
120	*Delonix regia* (Hook.) Raf.	Fabaceae	T	P	AR	TAF	Or	Cl	Or
121	*Dendrocalamus strictus* (Roxb.) Nees	Poaceae	S	P	F	AS	Ui	Nt	V
122	*Dentella repens* (L.) J.R.Forst. & G.Forst.	Rubiaceae	H	A	RB	AU	UI	Nt	Nk
123	*Dicoma tomentosa* Cass.	Asteraceae	H	A	W	TAM	Ui	In	M
124	*Digera muricata* (L.) Mart.	Amaranthaceae	H	A	CF	NAM	Ui	In	V
125	*Digitaria longiflora* (Retz.) Pers.	Poaceae	H	P	RB	TAF	Ui	Nt	Nk
126	*Dinebra retroflexa* (Vahl) Panz.	Poaceae	H	A	CF	TAM	Ui	Nt	NK
127	*Dioscorea bulbifera* L.	Dioscoreaceae	C	P	F	AS	M	Nt	V
128	*Duranta erecta* L.	Verbenaceae	S	P	CF	TAM	Or	Ca/Nt	Or
129	*Echinochloa colona* (L.) Link	Poaceae	H	A	W	EU	Fo	Nt	Fo
130	*Echinochloa crus-galli* (L.) P.Beauv.	Poaceae	H	A	CF	SAM	Fo	Nt	Fo
131	*Echinops echinatus* Roxb.	Asteraceae	H	A	W	TAF	Ui	Nt	M
132	*Eclipta prostrata* (L.) L.	Asteraceae	H	A	CF	TAM	Ui	In	M
133	*Eichhornia crassipes* (Mart.) Solms	Pontederiaceae	H	P	AQ	TAM	Or	In	Nk
134	*Eleocharis atropurpurea* (Retz.) J.Presl & C.Presl	Cyperaceae	H	A	AQ	SAM	Ui	Nt	Nk

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135	*Emilia sonchifolia* (L.) DC. ex DC.	Asteraceae	H	A	RB	TAM	Ui	In	M
136	*Eragrostis papposa* (Desf. ex Roem. & Schult.) Steud.	Poaceae	H	A	W	TAF	Ui	Nt	Nk
137	*Eryngium foetidum* L.	Apiaceae	H	A	W	TAM	UI	Nt/In	V
138	*Eucalyptus citriodora* Hk	Myrtaceae	T	P	W	AU	Pl	Cl	Ol
139	*Euphorbia heterophylla* L.	Euphorbiaceae	H	A	CF	TAM	Ui	In	Or
140	*Euphorbia hirta* L.	Euphorbiaceae	H	A	CF	TAM	Ui	In	M
141	*Euphorbia pulcherrima* Willd. ex Klotzsch	Euphorbiaceae	S	P	W	MX	Or	Ca/Nt	M
142	*Euphorbia thymifolia* L	Euphorbiaceae	H	A	W	SAM	Ui	In	Nk
143	*Euphorbia tirucalli* L.	Euphorbiaceae	S	P	AR	TAM	Ui	Ca/Nt	M
144	*Euphorbia umbellata* (Pax) Bruyns.	Euphorbiacaeae	S	P	W	TAM	Ui	In	M
145	*Ficus carica* L.	Moraceae	T	P	CF	EU	Fd	Nt	Ef
146	*Fimbristylis dichotoma* (L.) Vahl	Cyperaceae	H	A	RB	AS	Ui	Nt	Nk
147	*Foeniculum vulgare* Mill.	Apiaceae	H	A	CF	MR	Fd	Cl	Es
148	*Galinsoga parviflora* Cav.	Asteraceae	H	A	RB	TAM	Ui	In	M
149	*Glossocardia bosvallia* (L.f.) DC.	Asteraceae	H	A	F	WI	Ui	Nt	V
150	*Gnaphalium polycaulon* Pers.	Asteraceae	H	A	RB	TAM	Ui	In	Nk
151	*Gomphrena celosioides* Mart.	Amaranthaceae	H	A	W	TAM	Ui	Nt	Nk
152	*Gomphrena globosa* L.	Amaranthaceae	H	A	CF	TAM	Ui	In	Nk
153	*Grangea maderaspatana* (L.) Poir.	Asteraceae	H	A	RB	SAM	Ui	In	M
154	*Grevillea robusta* A.Cunn. ex R.Br.	Proteaceae	T	P	CF	AU	Pl	Cl	W
155	*Guizotia abyssinica* (L. f.) Cass.	Asteraceae	H	A	CF	TAF	Ui	Cl	Ol
156	*Hamelia patens* Jacq	Rubiaceae	S	P	AR	BR	Or	Cl	Or
157	*Harrisia bonplandii* (Parm.) Britton & Rose	Cactaceae	S	P	W	SAM	Ui	Nt	Nk
158	*Helianthus annuus* L.	Asteraceae	H	A	CF	NAM	Ui	Cl	Ol
159	*Hibiscus cannabinus* L.	Malvaceae	S	P	CF	SAM	Ui	In	V
160	*Hibiscus rosa-sinensis* L.	Malvaceae	S	P	CF	AS	Or	Ca	Or
161	*Hibiscus sabdariffa* L.	Malvaceae	H	P	CF	SAM	Ui	Ca/Nt	V
162	*Hibiscus trionum* L.	Malvaceae	H	P	W	TAF	Ui	Nt	Nk
163	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	H	P	AR	SAM	Ui	In	Nk
164	*Impatiens balsamina* L.	Balsaminaceae	H	A	RB	TAM	Or	Cl	Or
165	*Imperata cylindrica* (L.) Raeusch.	Poaceae	H	P	W	TAM	Ui	Nt	R
166	*Indigofera linifolia* (L.f.) Retz.	Fabaceae	H	A	RB	SAM	Ui	Nt	M
167	*Indigofera linnaei* Ali	Fabaceae	H	A	F	TAF	Ui	In	Nk
168	*Ipomoea alba* L.	Convolvulaceae	C	A	W	MX	Ui	Cl	Nk
169	*Ipomoea batatas* (L.) Lam.	Convolvulaceae	C	A	CF	BR	Fd	Cl	V
170	*Ipomoea cairica* (L.) Sweet	Convolvulaceae	C	A	W	TAF	Ui	Nt	Nk
171	*Ipomoea eriocarpa* R. Br.	Convolvulaceae	C	A	W	TAF	Or	Ca/Nt	Nk
172	*Ipomoea hederifolia* L.	Convolvulaceae	C	A	F	TAM	Ui	Nt	M
173	*Ipomoea nil* (L.) Roth	Convolvulaceae	C	A	W	NAM	Ui	In	Nk
174	*Ipomoea obscura* (L.) Ker Gawl.	Convolvulaceae	C	P	W	TAF	Ui	In	M
175	*Jatropha curcas* L.	Euphorbiaceae	S	P	AR	TAM	Or	Nt	Bf
176	*Jatropha gossypifolia* L.	Euphorbiaceae	S	P	W	TAM	Ui	Ca/Nt	Bf
177	*Kigelia pinnata* DC	Bignoniaceae	T	P	F	TAF	Or	Ca/Nt	Nk
178	*Lablab purpureus* (L.) Sweet	Fabaceae	H	A	CF	TAF	Fd	Cl	Ef
179	*Lagascea mollis* Cav.	Asteraceae	H	A	CF	TAM	Ui	In	Nk
180	*Lagenaria siceraria* (Molina) Standl.	Cucurbitaceae	C	A	AR	TAF	Ui	Nt	V

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181	*Lantana camara* L.	Verbenaceae	S	P	F	TAM	Or	In	M
182	*Lawsonia inermis* L.	Lythraceae	S	P	W	TAF	Ui	Nt	M
183	*Leonotis nepetifolia* (L.) R.Br.	Lamiaceae	H	A	W	TAF	Ui	In	M
184	*Linum usitatissimum* L.	Linaceae	H	A	CF	EU	Fd	Cl	Es
185	*Ludwigia adscendens* (L.) H.Hara	Onagraceae	H	A	AQ	TAM	Ui	Nt	Nk
186	*Ludwigia octovalvis* (Jacq.) P.H.Raven	Onagraceae	H	A	RB	TAF	Ui	Nt	M
187	*Ludwigia perennis* L.	Onagraceae	H	A	RB	TAF	Ui	Nt	M
188	*Macrotyloma uniflorum* (Lam.) Verdc.	Fabaceae	H	A	CF	TAF	Fd	Cl	V
189	*Malvastrum coromandelianum* (L.) Garcke	Malvaceae	H	A	W	TAM	Ui	In	M
190	*Manihot esculenta* Crantz.	Euphorbiaceae	T	P	CF	SAM	Fd	Cl	V
191	*Manihot glaziovii* Muell. Arg.	Euphorbiaceae	T	P	CF	BR	Ui	Ca/Nt	Nk
192	*Manilkara zapota* (L.) P.Royen	Sapotaceae	S	P	CF	TAM	Ht	Cl	Ef
193	*Martynia annua* L.	Martyniaceae	H	P	W	NAM	Or	In	M
194	*Mecardonia procumbens* (Mill.) Small	Plantaginaceae	H	A	W	TAM	Ui	In	Nk
195	*Melia azedarach* L.	Meliaceae	T	P	AR	AS	M	Nt	W
196	*Melochia corchorifolia* L.	Sterculiaceae	H	P	F	TAM	Ui	In	V
197	*Mentha arvensis* L.	Lamiaceae	H	A	W	AS	Ui	Ca/Nt	M
198	*Merremia gangetica* Cufod.	Convolvulaceae	H	A	W	TAF	Ui	Nt	M
199	*Millingtonia hortensis* L. f.	Bignoniaceae	T	P	AR	AS	Ui	Ca/Nt	Or
200	*Mimosa pudica* L.	Mimosaceae	H	P	CF	BR	Ui	In	M
201	*Mirabilis jalapa* L.	Nyctaginaceae	H	A	W	SAM	Or	Nt	Or
202	*Monochoria vaginalis* (Burm.f.) C.Presl.	Pontederiaceae	H	P	RB	TAM	Ui	In	M
203	*Moringa oleifera* Lam.	Moringaceae	T	P	CF	NAM	Ht	Ca/Nt	V
204	*Morus alba* L.	Moraceae	S	P	CF	AS	Ht	Nt	Ef
205	*Muntingia calabura* L.	Muntingiaceae	T	P	AR	TAM	Or	Cl	Ef
206	*Mussaenda frondosa* L.	Rubiaceae	S	P	F	TAF	Ui	Cl	M
207	*Nerium oleander* L.	Apocynaceae	S	P	CF	EU	Or	Ca/Nt	Or
208	*Nicandra physalodes* (L.) Gaertn.	Solanaceae	H	A	W	SAM	Or	Ca	M
209	*Ocimum americanum* L.	Lamiaceae	H	A	W	TAM	Ui	In	M
210	*Opuntia ficus-indica* (L.) Mill.	Cactaceae	S	P	F	NAM	Ui	Nt/In	Ef
211	*Opuntia stricta* Haw. Var. *dillenii* (Ker Gawl.)	Cactaceae	S	P	F	TAM	Ui	Ca/Nt	Ef
212	*Oxalis corniculata* L.	Oxalidiaceae	H	P	CF	EU	Ui	In	M
213	*Oxalis latifolia* Kunth	Oxalidaceae	H	A	W	BR	Ui	In	V
214	*Pandanus odorifer* (Forssk.) Kuntze	Pandanaceae	S	P	RB	SEA	Ui	Cl	M
215	*Parthenium hysterophorus* L.	Asteraceae	H	A	W	TAM	Ui	In	Nk
216	*Passiflora foetida* L.	Passifloraceae	C	P	W	SAM	Or	Cl	Or
217	*Passiflora subpeltata* Ortega	Passifloraceae	C	A	W	TAM	Ui	Nt	Nk
218	*Peltophorum pterocarpum* (DC.) Backer ex K. Heyne	Caesalpiniaceae	T	P	AR	AS	Ui	Ca/Nt	W
219	*Persicaria hydropiper* (L.) Delarbre	Polygonaceae	H	P	RB	EU	Fd	In	Nk
220	*Phaseolus vulgaris* L.	Fabaceae	H	A	CF	SAM	Fd	Cl	Es
221	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	T	P	RB	TAM	Ui	Ca/Nt	Ef
222	*Phyla nodiflora* (L.) Greene	Verbenaceae	H	A	AQ	SAM	Ui	Ca/Nt	Nk
223	*Phyllanthus acidus* (L.) Skeels	Phyllanthaceae	T	P	AR	BR	Ui	Cl	Ef
224	*Phyllanthus amarus* Schumach. & Thonn.	Phyllanthaceae	H	A	W	TAM	Ui	Nt	M
225	*Physalis minima* L.	Solanaceae	H	A	W	NAM	M	In	Ef
226	*Pistia stratiotes* L.	Araceae	H	P	AQ	TAM	Ui	In	M

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227	*Pisum sativum* L.	Fabaceae	H	A	CF	TAM	Ht	Cl	Es
228	*Pithecellobium dulce* (Roxb.) Benth.	Mimosaceae	T	P	W	TAM	Ui	Nt	Ef
229	*Plumbago zeylanica* L.	Plumbaginaceae	S	P	W	TAF	Or	Cl	M
230	*Plumeria alba* L.	Apocynaceae	T	P	W	TAM	Or	Cl	Or
231	*Portulaca oleracea* L	Portulacaceae	H	A	W	SAM	Fd	In	V
232	*Portulaca pilosa* L.	Portulacaceae	H	A	W	SAM	Or	In	M
233	*Portulaca quadrifida* L.	Portulacaceae	H	A	W	TAM	Ui	In	M
234	*Potamogeton nodosus* Poir.	Potamogetonaceae	H	P	AQ	TAM	Ui	Nt	V
235	*Prosopis juliflora* (S.w.) DC	Mimosaceae	T	P	W	TAM	UI	Nt	M
236	*Psidium guajava* L.	Myrtaceae	S	P	CF	SAM	Ht	Nt	Ef
237	*Punica granatum* L.	Lythraceae	T	P	CF	AS	Ht	Cl	Ef
238	*Pyrostegia venusta* (Ker Gawl.) Miers	Bignoniaceae	C	P	AR	BR	Or	Cl	Or
239	*Raphanus sativus* L.	Brassicaceae	H	A	CF	TAF	Fd	Cl	V
240	*Ricinus communis* L	Euphorbiaceae	S	A	W	TAF	Fd	In	Ol
241	*Rosa multiflora* Thunb.	Rosaceae	S	P	RB	AS	Or	Ca/Nt	M
242	*Rotala densiflora* (Roth) Koehne	Lythraceae	H	A	RB	AS	Ui	Nt	M
243	*Rubia cordifolia* L.	Rubiaceae	H	P	F	TAF	Ui	Nt	M
244	*Rubus ellipticus* Smith	Rosaceae	S	P	RB	TAM	Ui	Nt	Ef
245	*Ruellia prostrata* Poir.	Acanthaceae	H	A	W	TAF	Ui	In	M
246	*Ruta graveolens* L.	Rutaceae	H	A	W	MR	M	Cl	M
247	*Saccharum spontaneum* L.	Poaceae	S	P	RB	SEA	Ui	In	Fo
248	*Salvia coccinea* Buc'hoz ex Etl.	Lamiaceae	H	A	W	SAM	UI	Ca	Nk
249	*Scoparia dulcis* L.	Plantaginaceae	H	A	RB	TAM	M	In	Fo
250	*Sechium edule* (Jacq.) Sw.	Cucurbitaceae	C	A	CF	TAM	Ui	Cl	V
251	*Senna alata* (L.) Roxb.	Caesalpiniaceae	S	A	W	WI	Ui	In	M
252	*Senna occidentalis* (L.) Link	Caesalpiniaceae	S	P	W	SAM	Ui	In	M
253	*Senna sophera* (L.) Roxb.	Caesalpiniaceae	H	A	AR	WI	Ui	Nt/In	M
254	*Senna surattensis* (Burm.f.) H.S.Irwin & Barneby	Caesalpiniaceae	T	P	F	SEA	Ui	Cl	Nk
255	*Senna tora* (L.) Roxb.	Caesalpiniaceae	H	A	W	SAM	Ui	In	M
256	*Sesamum indicum* L.	Pedaliaceae	H	A	CF	TAF	Ui	Cl	Es
257	*Sesbania sesban* (L.)	Fabaceae	T	P	W	TAF	Ui	Nt	V
258	*Setaria italica* (L.) P.Beauv.	Poaceae	H	A	CF	TAF	Fo	In	Fo
259	*Sida acuta* Burm.f.	Malvaceae	H	A	W	TAM	Ui	Nt	M
260	*Sida cordata* (Burm. f.) Waalk.	Malvaceae	H	A	AR	SAM	Ui	Nt	M
261	*Siegesbeckia orientalis* L.	Asteraceae	H	A	AR	TAF	Ui	Ca/Nt	Nk
262	*Simarouba glauca* DC.	Simaroubaceae	T	P	AR	SAM	Pl	Cl	M
263	*Solanum americanum* Mill.	Solanaceae	H	A	CF	TAM	Ui	In	V
264	*Solanum erianthum* D.Don	Solanaceae	H	P	F	TAM	Ui	In	M
265	*Solanum lycopersicum* L.	Solanaceae	H	P	CF	TAM	Ui	In	V
266	*Solanum melongena* L.	Solanaceae	H	A	CF	TAF	Fd	Cl	V
267	*Solanum pimpinellifolium* L.	Solanaceae	H	A	W	SAM	Ui	Cl	V
268	*Solanum seaforthianum* Andrews	Solanaceae	C	P	W	BR	Ui	In	Nk
269	*Solanum torvum* Sw.	Solanaceae	S	P	AR	WI	Ui	In	M
270	*Solanum tuberosum* L.	Solanaceae	H	P	CF	SAM	Fd	Cl	V
271	*Sonchus oleraceus* (L.) L.	Asteraceae	H	A	AR	MR	Ui	In	Nk
272	*Sonchus wightianus* DC.	Asteraceae	H	A	W	EU	Ui	Nt/In	M

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273	*Spathodea campanulata* Beauv.	Bignoniaceae	T	P	AR	TAF	Or	Ca/Nt	Or
274	*Spermacoce hispida* L.	Rubiaceae	H	A	W	TAM	Ui	In	M
275	*Sphagneticola calendulacea* (L.) Pruski	Asteraceae	H	A	W	AU	Ui	Nt	Or
276	*Sporobolus diander* (Retz.) P. Beauv.	Poaceae	H	A	W	AS	Ui	In	Fo
277	*Stachytarpheta jamaicensis* (L.) Vahl	Verbenaceae	S	P	F	TAM	Ui	In	M
278	*Stachytarpheta mutabilis* (Jacq.) Vahl.	Verbenaceae	S	P	W	SAM	Ui	Ca/Nt	Nk
279	*Stylosanthes fruticosa* (Retz.) Alston	Fabaceae	H	P	W	TAM	Ui	In	Fo
280	*Swietenia mahagoni* (L.) Jack.	Meliaceae	T	P	AR	WI	Ui	Nt	M
281	*Synadenium grantii* Hook. f.	Euphorbiaceae	S	P	W	TAM	Or	In	M
282	*Synedrella nodiflora* (L.) Gaertn.	Asteraceae	H	A	W	WI	Ui	In	Nk
283	*Tabebuia aurea* (Silva Manso) Benth. & Hook.f. ex S.Moore	Bignoniaceae	T	P	AR	TAM	Or	Ca/Nt	Or
284	*Tabebuia rosea* (Bertol.) Bertero ex A.DC.	Bignoniaceae	T	P	AR	TAM	Or	Cl	Or
285	*Tagetes erecta* L.	Asteraceae	H	P	CF	TAM	Or	Cl	Or
286	*Tagetes patula* L.	Asteraceae	H	A	W	MX	Or	Ca	Or
287	*Talinum portulacifolium* (Forssk.) Asch. ex Schweinf.	Portulacaceae	H	A	W	TAM	Ui	Nt/In	V
288	*Tamarindus indica* L.	Fabaceae	T	P	AR	TAF	Ht	Ca/Nt	Ef
289	*Tecoma capensis* (Thunb.) Lindl.	Bignoniaceae	S	P	CF	EU	Or	Cl	Or
290	*Tecoma gaudichandi* DC.	Bignoniaceae	S	P	AR	SAM	Or	Cl	Or
291	*Tecoma stans* (L.) Juss. ex Kunth	Bignoniaceae	T	P	AR	TAM	Or	Cl	Or
292	*Thunbergia alata* Bojer ex Sims	Acanthaceae	C	P	AR	TAF	Or	In	Or
293	*Tithonia diversifolia* (Hemsl.) A.Gray	Asteraceae	S	A	W	MX	Or	In	Or
294	*Torenia fournieri* Linden ex E. Fourn.	Linderniaceae	H	P	W	AU	Ui	In	Or
295	*Tradescantia spathacea* Sw.	Commelinaceae	H	A	W	TAM	Ui	Cl	Or
296	*Trapa natans* L.	Lythraceae	H	P	AQ	EU	Fd	In	Ef
297	*Tribulus terrestris* L.	Zygophyllaceae	H	P	W	TAM	Ui	In	M
298	*Tridax procumbens* (L.) L.	Asteraceae	H	P	W	TAM	Ui	In	M
299	*Trigonella foenum-graecum* L.	Fabaceae	H	A	CF	MR	Fd	Cl	Es
300	*Triumfetta rhomboidea* Jacq.	Malvaceae	H	A	W	TAM	Ui	In	M
301	*Typha angustifolia* L.	Typhaceae	H	P	RB	EU	Ui	In	Fo
302	*Typha domingensis* Pers	Typhaceae	H	P	AQ	SAM	Ui	In	Nk
303	*Urena lobata* L.	Malvaceae	S	P	AR	TAF	Ui	Ca/Nt	M
304	*Urochloa panicoides* P. Beauv.	Poaceae	H	A	W	TAF	Ui	In	Fo
305	*Vallisneria spiralis* L.	Hydrocharitaceae	H	A	AQ	MR	Ui	Nt/In	Nk
306	*Vigna trilobata* (L.) Verdc.	Fabaceae	C	A	W	TAF	UI	Nt	M
307	*Vigna umbellata* (Thunb.) Ohwi & H.Ohashi	Fabaceae	C	A	CF	SEA	Ui	Nt/In	Es
308	*Vigna unguiculata* (L.) Walp.	Fabaceae	H	A	CF	TAM	Fd	Cl	V
309	*Vitex negundo* L.	Verbenaceae	S	P	W	AS	UI	Ca/Nt	M
310	*Waltheria indica* L.	Sterculiaceae	H	P	F	TAM	Ui	In	M
311	*Xanthium strumarium* L.	Asteraceae	H	A	AR	TAM	Ui	In	M
312	*Zea mays* L.	Poaceae	H	A	CF	SAM	Fd	Cl	Fo, V

Habit: H—Herb | S—Shrub | C—Climber | T—Tree | **Longevity:** A—Annual | P—Perennial | **Habitat:** W—Wasteland | CF—Cultivated fields | RB—River or pond banks | F—Forests | AR—Roadsides | AQ—Aquatic | P—Parasite | **Nativity:** AS—Tropical Asia | AU—Australia | BR—Brazil | EU—Europe | MG—Madagascar; MR—Mediterranean region | MX—Mexico | NAM—North America | SAM—South America | SEA—South East Asia (Including Malaysia, Philippines & Indonesia); TAF—Tropical Africa | TAM—Tropical America | WI—West Indies | **Mode of introduction to India**: Fd—Food | Fo—Fodder | M—Medicine | O—Ornamental | Pl—Plantation | Ht—Horticultural; Ui—Unintentional | **Status:** Cl—Cultivated | Ca—Casual | Nt—Naturalized | In—Invasive | Ca/Nt—Casual or Naturalized | Nt/In—Naturalized or Invasive | **Uses:** Bf—Biofuel | Br—Beverages | Ef—Edible fruit | Es—Edible seed | Fo—Fodder | M—Medicinal | Nk—Not known | Ol—Oil | Or—Ornamental; R—Rope making | V—Vegetable | W—Wood.

cylindrica, *Opuntia stricta*, *Clidemia hirta*, *Lantana camara*, *Chromolaena odorata*, and *Rubus ellipticus*. Pysek et al. (2017) have identified 11 alien plant species that occur on one-third or more of the globe in terms of the number of regions where they are naturalized, and on at least 35% of the Earth's land surface. Of these, eight plant species are widely distributed in Hassan district: *Bidens pilosa, Chenopodium album, Datura stramonium, Echinochloa crus-galli, Oxalis corniculata, Portulaca oleracea, Ricinus communis*, and *Sonchus oleraceus.* The impact of these species on indigenous flora and invading ecosystems, however, has yet to be studied. The distribution of alien plant species was most abundant in wastelands (34%), followed by cultivated fields (30%), roadsides (14%), river or pond banks (9%), forests (8%), and aquatic systems (4%) (Figure 3). This pattern could be caused by the relative degree of disturbance in various environments, as well as other abiotic and biotic factors. Disturbance alters the physical environment creating open regions and disturbed environmental factors, such as, elevated soil nitrate and increased light and temperature changes, boost seed germination for many species, including exotics. This could allow alien species to establish themselves in ecosystems. Several researchers have discovered that the species composition after disturbance is reasonably predicted based on the seed bank before disturbance. As a result, sampling the pre-disturbance seed bank can provide insight into whether exotics will become abundant at a site in the event of a predicted disturbance (D'antonio & Meyerson 2002).

We categorized the origin of the reported invasive species into 12 regions, of which tropical America was found to be the origin for 36% (113 species), followed by tropical Africa 15% (48 species), South America 13% (41 species), and tropical Asia (28 species). The other regions, contribibute 2–5 % each to the overall alien flora (Figure 4). The possible explanation for the maximum proportion of species from tropical America can be the higher propagule pressure from different countries, such as Brazil and Mexico, to India via historical trade routes through the human agency of European colonisers and traders, and more or less matching of similar tropical climate (Khuroo et al. 2012). Considering that 36% of species originate in the Americas, the findings of this study are comparable to those reported for China, where 58% of species originate in the Americas (Wu et al. 2010). However, compared to the current study, the percentage of American species in the alien flora of Europe is lower at 34.8% (Lambdon et al. 2008). Because tropical climates have a higher impact on India and China than on Europe, this distinct pattern can be explained.

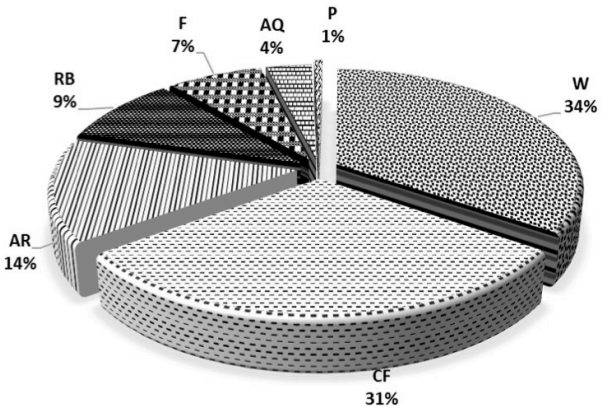

Figure 3. Habitat wise distribution of alien species in Hassan district. W—Wasteland | CF—Cultivated fields | RB—River or pond banks | F—Forests | AR—Roadsides | AQ—Aquatic | P—Parasite.

Table 2. Relative contribution of alien species in the top 10 alien species rich families in Hassan district of Karnataka.

	Family	Alien species	Total species in Hassan district	Alien plants (%)
1	Amaranthaceae	17	20	85
2	Solanaceae	15	18	83.3
3	Asteraceae	36	76	47.3
4	Convolvulaceae	9	19	47.3
5	Malvaceae	12	27	44.4
6	Caesalpinaceae	8	23	34.7
7	Fabaceae	21	97	33.3
8	Euphorbiaceae	14	51	27.4
9	Apocyanaceae	8	24	25
10	Poaceae	16	140	11.4

Some alien plant species, 36% of those listed for Hassan district, are used for medicinal purposes, followed by vegetables (16%), ornamentals (13%), edible fruits (8%), fodder (4%), timber (2%), and biofuel (1%). A large number of alien plant species benefit Indian agriculture, forestry, and pharmaceutical industries, as well as the Indian medical system (Ayurveda) (Shiddamallayya et al. 2010). Ornamental plants are an important component of the urban environment, as well as a substantial source of invasive species as a result of escapes from private or public gardens (Pyek & Chytr 2014; Pergl et al. 2016). Many taxa first escape and spread in spatially constrained areas around gardens, before spreading and colonising more distant vegetation. The combined impacts of local popularity of a specific taxon, regardless of invasion status, adequate natural & cultural conditions, abundant

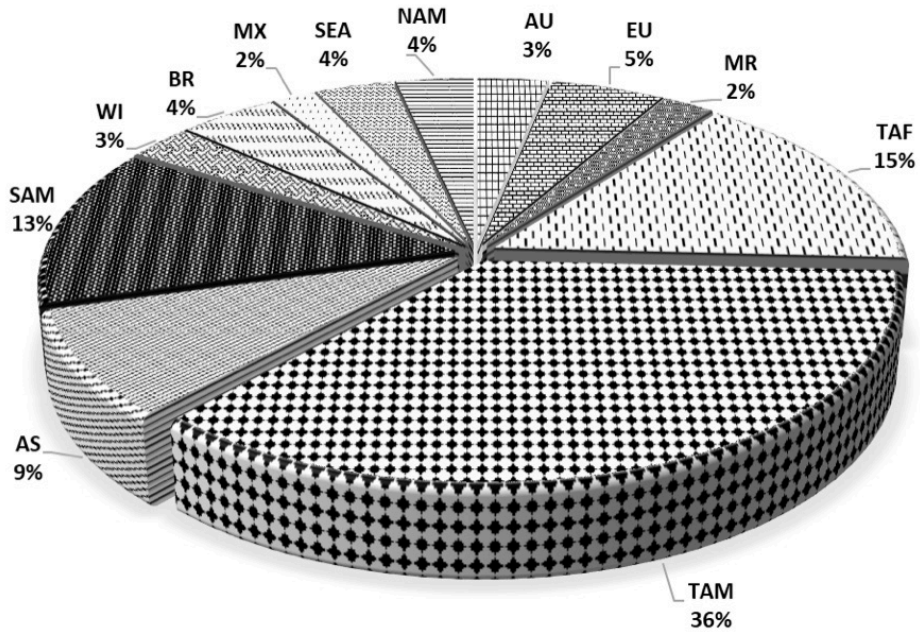

Figure 4. The Nativity of alien species of Hassan District.
SAM—South America | SEA—South East Asia | BR—Brazil | TAM—Tropical America | EU—Europe | TAF—Tropical Africa | AS—Tropical Asia | AU—Australia | WI—West Indies | MR—Mediterranean region | MX—Mexico | NAM—North America.

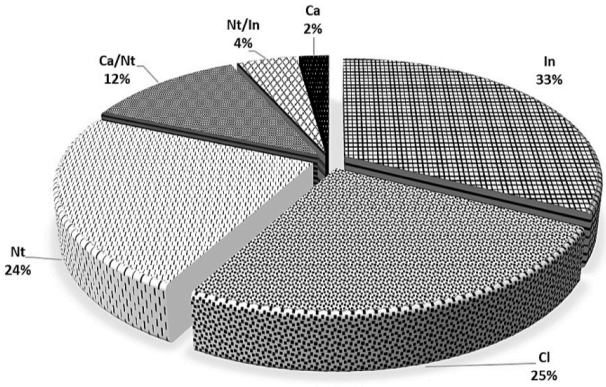

Figure 5. Invasive status of the alien species of Hassan district.
Cl—Cultivated | Ca—Casual | Nt—Naturalized | In—Invasive | Ca/Nt—Casual or Naturalized | Nt/In—Naturalized or Invasive.

propagation in cultivation, and easy semi-spontaneous establishment in gardens may result in naturalisation foci (Petrik et al. 2019). Although the majority of alien species grown as garden ornamentals can only survive when planted under careful management, a significant proportion of them manage to escape and establish themselves outside of human control (Pergl et al. 2016). Pyek et al. (2012) found that 56% of the taxa in the Czech Republic's alien flora were recruited from escaping ornamental plants. Similarly, in the Karnataka district of Gadag, roughly 15% of alien species are employed as ornamentals (Kambhar & Kotresha 2011).

We found that 122 species were intentionally introduced, while the rest are unintentional introductions. The majority of species were introduced for ornamental purposes (47%), followed by food (30%), horticulture (10%), medicinal (9%), fodder (4%), and plantation (2%). The invasion status categorization of Hassan is represented in Figure 5.

Hassan district is the reservoir of rich flora, and is a significant segment of the global biodiversity hotspot of Western Ghats. Approximately 1,700 vascular plant species found in Hassan district accounts for 75% of the plant species of Karnataka state and 10% of India, which indicates the richness of biological diversity (Saldhana & Nicolson 1978). However, almost 18.4% of Hassan district flora comprises of alien species, which is higher than the 8% of alien plants in Western Ghats region of Karnataka and 6.5% alien species of Karnataka state (Ganeshaiah et al. 2002; Rao 2012). The majority of the alien species belong to the family Asteraceae, and it also contributed most of the exotic weed species in India (Singh et al. 2010; Kambhar & Kotresha 2011; Khuroo et al. 2012).

In concordance with the alien floras of Europe (Lambdon et al. 2008) and China (Wu et al. 2010), Asteraceae is the most species-rich family in the alien flora of India. At the global level, Pysek (1998) found these families to be having the majority of alien species. Studies on agricultural weeds concluded that, numerically, most

weeds come from the families Asteraceae (Heywood 1989). Notably, Asteraceae is amongst the largest family in terms of species richness (Rao 1994). Hence, the possibility of contributing more to alien species is also higher (Mack & Erneberg 2002). The introduction of alien plants for ornamental purpose is common across the globe and especially species belongs to the genera *Amaranthus, Cascabela, Euphorbia, Ipomoea*, and *Solanum* are some of the commonly preferred ornamental alien species reported in India (Khuroo et al. 2012). *Alternanthera philoxeroides* powerful aquatic pest has been found in the lakes, ponds, puddles and waterways was considered a highly invasive and spread throughout the country (Maheshwari 1965). *Lantana camara, Chromolaena odorata,* and *Hyptis suaveolens* were the most concerning alien invasive plant species in terms of rapid growth, higher density, and frequency in forest areas.

Within the forest, these species were so gregarious in their growth and most ecologically destructive invaders in the Western Ghats region (Muniappan & Viraktamath 1993). The escape of these species into nature, on the other hand, may have serious consequences. *Chromolaena odorata* is an invasive transformer species in the Old World (Richardson et al. 2000), owing to its lack of natural enemies. It prefers areas of natural or human-induced disturbance, but it can even infiltrate untouched terrain. Subsistence and commercial agriculture, including crops and plantations, grazing pastures, and silviculture, are all affected by *Chromolaena odorata.* Awanyo et al. (2011) mentioned that the highly invasive *Chromolaena odorata* grows aggressively and suppresses other vegetation by easily forming a thick cover in a very short time. In another study, the high allelopathic properties of this weed support its gaining dominance in vegetation and in replacing other aggressive invaders such as *Lantana camara* and *Imperata cylindrica* in Asia and Africa (Mandal & Joshi 2014). The most common species of invasives in cultivated areas were *Celosia argentea* and *Argemone mexicana,* which were so aggressive and opportunistic in invasion that they could even penetrate flourishing crops if regular weeding was neglected. *Ageratum conyzoides, Cassia tora, Emilia sonchifolia, Oxalis corniculata, Scoparia dulci, Sonchus oleraceous*, and *Tridax procumbens* are some of the other invasive plant species commonly found in cultivated fields that require constant weeding in practices and act as vectors for transmitting pathogens. Parasitic dodders (*Cuscuta* spp.) are becoming a severe concern in south Indian agroecosystems, and are increasingly being detected on a wide range of plants across the country.

Ipomoea carnea, *Pistia stratiotes*, and *Eichhornia crassipes* have become a nuisance in aquatic ecosystems. They cause hindrance and block drainage and reduces the aesthetic value of open water bodies (Kambhar & Kotresha 2011). The invasion of *Eichhornia crassipes* into freshwater systems poses a threat to many human uses. Boating access, navigability, and recreation, as well as pipe systems for agriculture, industry, and municipal water supply, are the most direct impacts. Fish catchability and access to fishing grounds are also impacted. Furthermore, *Eichhornia crassipes* evapotranspiration rates can be higher than open-water evaporation rates. This can be a major issue in water-scarce places and small bodies of water. If it causes changes in fish community composition or modifies the catchability of fished species, it can have a significant impact on fishery (Villamagna & Murphy 2010).

Aside from the negative effects on native flora and the economy, certain alien species were useful to locals. Leafy vegetables included *Portulaca oleracea, Chenopodium album, Alternanthera sessilis, Amaranthus spinosus, Digera muricata*, and *Solanum americanum.* In its invaded area in India, *Prosopis juliflora* grows in forests, wastelands, and at the edges of crop fields, forming pure stands. Farmers retain trees in their fields because their crops grow better under them than in open fields, but they also provide fuel, fodder, charcoal, and lumber (Kaur et al. 2012). Invasive alien plant inventories are one of the most important components for assessing biodiversity and threats to endangered species, as well as providing source data for developing relevant indicators (Pyek et al. 2012; van Kleunen et al. 2015; Latombe et al. 2017). Identifying invasive alien plant species that pose prospective or future threats while they are still in the early stages of invasion is a serious prediction challenge (Lambdon et al. 2008). The findings of this study will raise awareness of invasive alien plants, and the release of this list will encourage more data collection so that the effects of these species can be minimized.

CONCLUSION

The present paper provides information on the status of alien plant species in Hassan district. It is revealed that over 18% of Hassan district flora comprises of alien species, which is higher than the 8% for the Western Ghats region of Karnataka and 6.5% of alien species in Karnataka state. A majority of the species are of South

Image 1. A—*Acanthospermum hispidum* DC | B—*Ageratum houstonianum* Mill. | C—*Alternanthera paronychioides* A.St.-Hil. | D—*Alternanthera philoxeroides* (Mart.) Griseb. | E—*Alternanthera pungens* Kunth | F—*Alternanthera sessilis* (L.) R.Br. ex DC. | G—*Amaranthus spinosus* L. | H—*Amaranthus viridis* L | I—*Argemone mexicana* L. | J—*Asclepias curassavica* L. | K—*Balanites aegyptiaca* (L.) Delile. | L—*Basella alba* L. © G M Prashanth Kumar.

Image 2. A—*Bixa orellana* L. | B—*Blainvillea acmella* (L.) Philipson | C—*Cardiospermum halicacabum* L. | D—*Cascabela thevetia* (L.) Lippold. | E—*elosia argentea* L. | F—*Chromolaena odorata* (L.) RM.King& H.Rob. | G—*Cleome viscosa* L. | H—*Clitoria ternatea* L. | I—*Corchorus aestuans* L. | J—*Cuscuta reflexa* Roxb. | K—*Datura metel* L. | L—*Dicoma tomentosa* Cass. © G M Prashanth Kumar.

Image 3. A—*Echinops echinatus* Roxb. | B—*Eclipta prostrata* (L.) L. | C—*Euphorbia heterophylla* L. | D—*Euphorbia hirta* L. | E—*Glossocardia bosvallia* (L.f.) DC | F—*Gnaphalium polycaulon Pers.* | G—*Hyptis suaveolens* (L.)Poit. | H—*Impatiens balsamina* L. | I—*Ipomoea cairica* (L.) Sweet | J—*Ipomoea hederifolia* L. | K—*Jatropha curcas* L. | L—*Jatropha gossypifolia* L. © G M Prashanth Kumar.

Image 4. A—*Lantana camara* L. | B—*Malvastrum coromandelianum* (L.) Garcke | C—*Martynia annua* L. | D—*Oxalis corniculata* L. | E—*Pandanus odorifer* (Forssk.) Kuntze | F—*Passiflora foetida* L. | G—*Phyllanthus amarus* Schumach. & Thonn. | H—*Physalis minima* L. | I—*Pistia stratiotes* L. | J—*Pithecellobium dulce* (Roxb.) Benth. | K—*Portulaca oleracea* L. | L—*Prosopis juliflora* (S.w.) DC. © G M Prashanth Kumar.

Image 5. A—*Scoparia dulcis* L. | B—*Senna occidentalis* (L.) Link | C—*Senna tora* (L.) Roxb. | D—*Solanum americanum* Mill. | E—*Solanum seaforthianum* Andrews | F—*Solanum torvum* Sw. | G—*Sonchus oleraceus* (L.) L. | H—*Stachytarpheta jamaicensis* (L.) Vahl | I—*Stylosanthes fruticosa* (Retz.) Alston. | J—*Thunbergia alata* Bojer ex | K—*Tribulus terrestris* L. | L—*Typha angustifolia* L. © G M Prashanth Kumar.

American origin and have been introduced for ornamental purposes. Our study indicated that the extent and present share of alien species and their naturalization cannot be considered safe for native and endemic flora. This is especially true of Hassan district, which is part of the Western Ghats 'hotspot' belt and is globally designated for priority of conservational activities. As most forests of the Western Ghats are already badly affected by the invasion of alien plant species, the need for effective control must be emphasized. This compiled work will fill a significant information gap regarding alien species, and will aid in the development of informed monitoring and management strategies, always preserving site biodiversity and peoples' cultural diversity in mind, rather than simply the scale of bio-invasion.

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