J. Mountain Res. P-ISSN: 0974-3030, E-ISSN: 2582-5011 DOI: https://doi.org/10.51220/jmr.v19i1.34
Vol. 19(1), (2024), 329-343

Alien Species of Family Asteraceae and their Indigenous Uses in Tarai and Bhabar Region of Uttarakhand

Sheetal Sharma • Sneh Lata*

Department of Botany, R.H. Govt. P.G. College, Kashipur, Udham Singh Nagar, Uttarakhand

*Corresponding Author Email id: dr.snehlata@rhgpgckashipur.ac.in

Received:26.12.2023; Revised: 11.06.2024; Accepted: 14.06.2024

Abstract: Uttarakhand with degraded lands, diverse topography and climatic variations is a treasure of non-native i.e., exotic or alien plants. Asteraceae represents a dominant family having a large number of alien plants. During the present study, frequent regular field visits were organized and a total of 51 alien plant species belonging to 37 genera and 10 tribes of Asteraceae family were collected from different sites. There were 88% (45 species) herbs, 4% (02 species) shrubs, 4% (02 species) undershrubs, 2% (01 species) climber and 2% (01 species) tree. A comparison of present data with previous literature revealed that Jaccard index ranges between 3.92% to 22.38%. Local people were interviewed and discussed to record their indigenous uses for medicine, food, oil, fodder, compost etc. Majority of plant species were useful as medicine (23 species) in different diseases e.g., cut and wounds (15 species), diabetes (2 species), earache (2 species), jaundice (1 species), toothache (2 species) etc. Two species were noted to be harmful and one species play both harmful and beneficial roles.

Keywords: alien • Asteraceae • indigenous uses • Tarai and bhabar • Uttarakhand.

Introduction

India is the most diversified country and known amongst one of the 17 mega diversity centers of the world. Due to its diverse climatic and environment conditions, it is highly susceptible to biotic invasion (Kohli et al., 2012). Out of the world's 36 biodiversity hotspots, four are found in India and the Himalaya region is one of them. The state Uttarakhand lies in the Northern part of the country between 28°43'-31°28' N latitude and 77°34'- 81°03' E longitude and it sprawls over 53483 km² area. It is bounded by two international boundaries i.e., China in North and Nepal in the East and also shares the state boundaries i.e., Himachal Pradesh in West and Uttar Pradesh in South. On the basis of evolutionary history, Uttarakhand is divided into four geographical zones i.e. The Trans Himalaya, The Greater Himalaya, The Lesser Himalaya, The Siwalik ranges. Tarai and Bhabar is a part of the foothills which lies in the southern part of the state (Uniyal et al., 2007). The state with diverse topography and varied climate is a treasure of rich flora. Asteraceae, the most diversified family among dicot, is represented by 370 species under 134 genera in Uttarakhand (Pushalkar and Srivastava, 2018). It occurs in various life forms such as herb, shrub, undershrub, climber and tree. Family Asteraceae produces a special type of seed called cypsela, which is very adaptive in nature, so these plant species have high potential to reproduce and disperse minute seeds through air and water into the new area. Due to its advanced characteristics, it can adopt all types of environment and climatic changes.

Alien plant species are also known as exotic plants, introduced plants, non-native plants, or non-indigenous plants. According to Convention of Biological Diversity - alien plant species are those species, subspecies or lower taxon, introduced outside its natural past or present distribution; including any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce. On the basis of their invasion status, alien species have been classified into three main categories i.e., casual, naturalized and Invasive. These alien groups are defined in the following manner- "Casual alien plants are those species which may flourish and even reproduce occasionally in an area but which do not form self-replacing populations, and which rely on repeated introduction for their persistence. Whereas, Naturalized plants are alien plants that reproduce consistently and sustain populations over many life cycles without direct intervention by humans; they often recruit offspring freely, usually close to adult plants and do not necessarily invade natural semi natural or human made ecosystems. Invasive plants are those naturalized plants that produce reproductive offspring, often in very large numbers at considerable distances from parent plants, and thus have the potential to spread over a considerable area" (Richardson et al., 2000). In addition, Khuroo et al. (2012) recognized some more categories of alien plants i.e., Casual or naturalized (C/N), naturalized or invasive (N/I) and cultivated (Cl). Invasive plants have high reproductive potential, fast seed dispersal ability, growth and adaptation to new environment, and the area where these species invade; soil changes their property in many ways (Rastogi et al., 2015). Thus, invasive plant species spread easily or dominantly in various new areas. Due to international marketing and globalization, alien species are increasing day by day. Biological invasion of alien species, a global problem, is imposing adverse effects on the agricultural production and natural ecosystem. Convention on Biological diversity (1992) reported "biological invasion of alien species as the second worst threat". It is recorded that around 40% of the species in the Indian flora are alien and out of these 25% are Invasive (Raghuvanshi et al., 2005). Reddy (2008) has prepared first inventory of invasive alien plants in India (Pathak et al., 2019).

Literature survey shows that several researchers (Khuroo et al., 2012; Wani and Mushtaq 2012; Jariyan et al., 2013; Tripathi et al., 2021) have studied alien plants species from different regions of India and reported maximum number of Asteraceous plant species while various others (Singh, 2020; Nayak et al., 2020; Khuroo et al., 2007) have found Asteraceae as the second largest family in their study areas. During various studies on invasive alien plant species, Reddy (2008), Reddy et al. (2008), Lal et al. (2012), Sekar (2012), Sekar et al. (2015), Wagh and Jain (2015), Kumari et al. (2016), Prakash and Balasubramanian (2018), Narayan et al. (2019) and Singh and Khare (2020) have reported Asteraceae as the most dominant family having maximum number of invasive alien plant species among all other families.

In Uttarakhand, a total of 163 species belonging to 105 genera and 46 families have been reported as naturalised non-native species (Pushalkar and Srivastava, 2018). During various studies on diversity of alien plants in Uttarakhand, considerable authors (Negi and Hajra, 2007; Sekar et al., 2012; Rastogi et al., 2015; Rawat et al., 2016;

Khanduri et al., 2017; Mamgain and Joshi, 2017; Singh and Joshi, 2022; Verma et al., 2022) have also reported Asteraceae as dominant family.

Some authors have paid special attention to study invasive alien species of family Asteraceae in different regions of India (Bhutiyal and Bhatia, 2014; Kaur et al., 2014; Dhami, 2018a&b; Singh and Narain, 2018). In Uttarakhand, Gaur and Rawat (2013) have reported Diversity and Nativity of Invasive alien species of Asteraceae in Pantnagar. Some authors have recorded various uses of invasive alien plants including Asteraceous plant species growing in Uttarakhand and its nearby areas (Singh et al., 2010; Sekar et al., 2015; Rawat et al. 2016; Rastogi and Rana, 2018; Singh and Kumari, 2019; Tripathi et al., 2020). But still very little information is available on local uses of alien plants of family Asteraceae. Therefore, the present study was conducted to explore Asteraceous alien plant diversity and their indigenous uses in the tarai and bhabar region of Uttarakhand.

Materials and methods

Study area: The present study was carried out in tarai and bhabar belt which lies in foothills of Uttarakhand Himalayan Region. Bhabar is a narrow belt between Siwalik and Tarai area which has highly porous substratum with scarcity of surface water while in Tarai there is abundance of surface water. The study sites cover Udham Singh Nagar district, Nainital district (Ramnagar, Haldwani, Kaldhungi), Champawat district (Tanakpur), Haridwar district, Pauri Garhwal district (Kotdwar), Dehradun district (Vikas Nagar, Sahaspur, Raiwala, Rishikesh, Kalsi) (Fig. 1).

Field study and herbarium preparation: Extensive and intensive field surveys were conducted from July 2019 to June 2022 to collect alien species from various habitats such as waste lands, croplands, gardens, road side areas, etc. Botanical characters of plant species such as habit, colour of flowers, specific odour (if any), etc. were noted down in the field book. A questionnaire was prepared with the aid of Jain and Mudgal (1999) and used for interviews with local people to record indigenous uses of collected alien plant species.

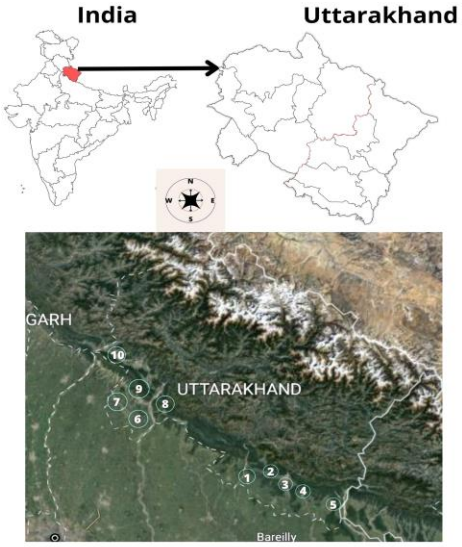

Fig 1. Location map of study area [Udham Singh Nagar (1), Nainital (2,3,4), Champawat (5), Haridwar (6,7), Pauri (8), Dehradun (9-10)]

Collected plant species were carefully examined and identified with the help of regional as well as Indian floras such as Hooker (1882), Duthie (1903-1929), Osmaston (1927), Gupta 1968, Babu (1977), Pant (1986), Gaur (1999), Hajra et al. (1995 a & b), Uniyal et al. (2007) & Agarwal (2017) and also compared with herbarium specimens of various research institutions i.e., Botanical survey of India, Dehradun (BSD), Forest research institute, Dehradun

(DD) and National Botanical Research Institute, Lucknow (LWG). These plants were processed, poisoned and preserved following protocols suggested by Jain and Rao (1977), and then mounted on standard herbarium sheets. Voucher specimens were deposited in the herbarium (GPGCKSP) of the Department of Botany, R.H. Government P.G. College, Kashipur, Uttarakhand. Nativity of the alien species were recorded from an open access database - Plant of the world online (POWO).

Data analysis: Collected data were compared with existing literature and analyzed for Jaccard index. Jaccard index is a statistics measurement used to study the similarities between two sets of data and its value ranges from 0 to 100%. More value represents more similarities or vice versa. It is also called similarly coefficient and represented by JI (Gonzalez-Tejero et al., 2008).

JI= c×100/a+b-c

Where,

a= Total number of plant species of family Asteraceae reported in present study

b= Total number of plant species of family Asteraceae present in particular previous study.

c= Total number of common plant species present in both studies.

For the calculation of JI, present data were compared with existing literature on alien plants, published by various authors (Table 2). These authors have reported uses of Asteraceous plant species along with various other alien plants at different places of India.

Results

During field study, a total of 51 alien species belonging to 37 genera under 10 tribes were collected, which are used by local people in one or another way. Maximum number of alien plant species were invasive (47.05%) followed by cultivated (33.33%), naturalized or invasive (7.84%), naturalized (5.88%), casual (3.92%) and casual or naturalized (1.96%) (Fig. 2). Out of these, 45 (88%) plants were herbs, 2 (4%) shrubs, 02 (4%) undershrub, 1(2%) climber and 1 (2%) tree (Fig. 3). Heliantheae tribe contributed 50.98% (26 spp.) of total Alien flora followed by Eupatorieae (11.76% - 06 spp.) and Astereae (9.80% - 05 spp.). It was also observed that some plant species e.g. *Ageratum houstonianum* Mill., *Bidens pilosa* L., *Parthenium hysterophorus* L., *Tridax procumbens* L. were highly invasive and commonly spread not only on road side, waste lands but also in cropland and forests of the study area (Fig. 4 A -D). During field study and interview, it was also recorded that tribal and local peoples use these plants in their daily life for various purposes such as medicine, food, fodder, worship, composting etc (Table 1). Fifteen species e.g. *Acmella radicans* (Jacq.) R.K. Jansen, *Ageratina adenophora* (Spreng.) R.M. King & H. Rob., *Ageratum conyzoides* L., *Ageratum houstonianum* Mill., *Bidens pilosa* L., *Chromolaena odorata* (L.) R.M.King & H.Rob. etc were used for cuts and wounds. *Acmella* species were used for jaundice and toothache. Two plant species i.e., *Gymnanthemum amygdalinum* (Delile) Sch. Bip. and *Stevia rebaudiana* (Bertoni) Bertoni were useful for diabetic patients. *Cosmos sulphureus* Cav. and *Tagetes erecta* L. were useful in earache. Fig. 5 depicting plant parts used for various purposes exhibits that the whole plant (22) as such is used for maximum number of diseases and other uses followed by leaf (16), flower head and twig (8 each).

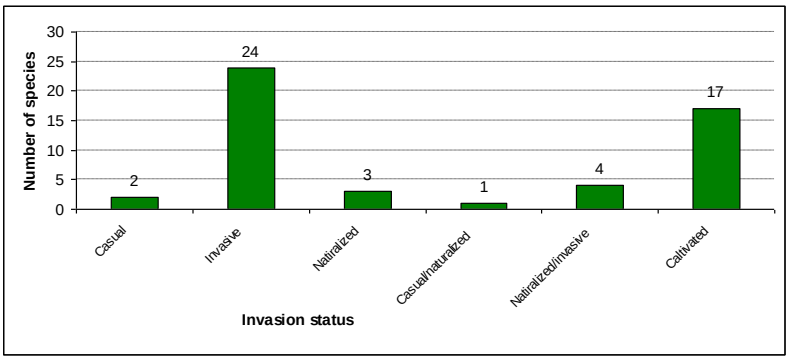

Fig. 2. Invasion status of family Asteraceae

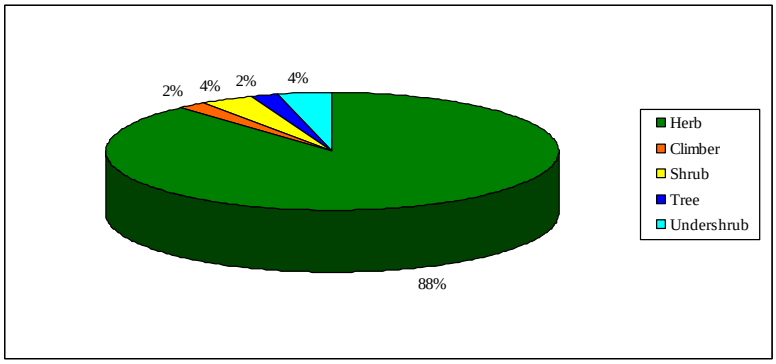

Fig. 3. Percent contribution of habit of collected alien plant species**.**

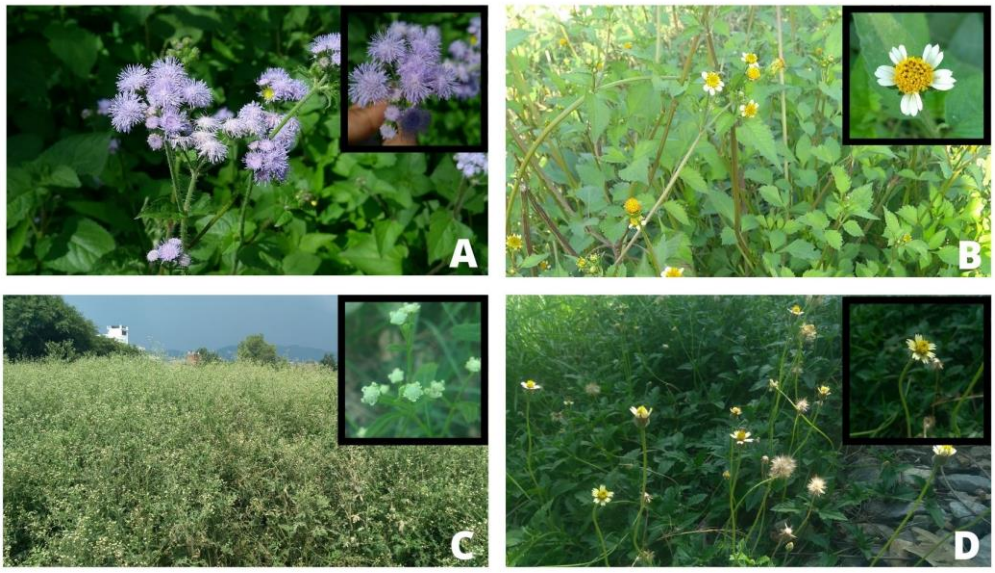

Fig. 4. A-D Invasion of plant species in different places of study area (A) *Ageratum houstonianum* Mill. at vacant land in Kathgodam, (B) *Bidens pilosa* L. at road side in Kashipur (C) *Parthenium hysterophorus* L. at vacant land in Tanakpur, (D) *Tridax procumbens* L. in vacant field in Kashipur

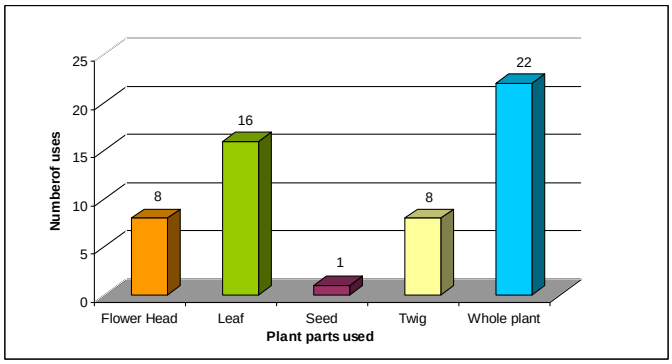

Fig. 5. Plant parts used for different indigenous uses

Three plant species, *Calyptocarpus vialis* Less. *Parthenium hysterophorus* L and *Synedrella nodiflora* (L.) Gaertn. were found to be very harmful for mankind as well as animals. During the interview, it was noted that these plant species are very allergic in nature and cause various diseases such as sinuses, skin itching, eye irritation etc. However, some people still used *Parthenium hysterophorus* L to make broomstick. Comparison of present data with existing literature revealed that the JI ranges between 3.92% to 22.38% and maximum value of similarity index is 22.38% followed by 20.96% and 20.89% (Table 2.)

Table 1. Alien plant species of family Asteraceae

S. No.	Botanical Name	Tribe	Nativity	Invasive status	Life Forms	Habitat	Part used	Uses
1	*Acmella ciliata (*Kunth) Cass. A.N. GPGCKSP-354	Hel	S Tropical America	In	H	Moist place, roadside, waste land	Tw	Jaundice
2	*Acmella oleracea* (L.) R.K. Jansen A.N. GPGCKSP-343	Hel	Brazil Southeast	Cl	H	Garden, moist place	FH	Toothache
3	*Acmella radicans* (Jacq.) R.K. Jansen A.N. GPGCKSP-108	Hel	Mexico to Venezuela and Bolivia, Caribbean	In	H	Crop land, road side	WP, Lf	Fodder, Cut and wounds
4	*Acmella uliginosa* (Sw.) Cass. A.N. GPGCKSP-355	Hel	Tropical America	In	H	Crop land, road side, moist place	FH	Toothache
5	*Ageratina adenophora* (Spreng.) R.M. King & H. Rob. A.N. GPGCKSP-363	Eup	Mexico	In	H	Road side, Moist place	Lf	Cut and Wounds
6	*Ageratina lingustrina* (DC.) R.M. King & H. Rob. A.N. GPGCKSP-556	Eup	Mexico to Central America	N/I	US	Road side	WP	Fencing
7	*Ageratum conyzoides* L. A.N. GPGCKSP-226	Eup	Mexico	In	H	Moist place, waste land	Lf	Cut and wounds
8	*Ageratum houstonianum* Mill. A.N. GPGCKSP-362	Eup	Mexico to Central America	In	H	Road side, crop land	Lf	Cut and wounds
9	*Bidens pilosa* L. A.N. GPGCKSP-364	Hel	Tropical and subtropical America	In	H	Crop land, Waste land	Lf	Cut and wounds
10	*Calendula officinalis* L. A.N. GPGCKSP-368	Cal	Spain	Cl	H	Garden	FH	Worship, ornamental
11	*Calyptocarpus vialis* Less. A.N. GPGCKSP-557	Hel	SE USA to Belze, Caribbean to Venezuela	In	H	Waste land	WP	Noxius
12	*Chromolaena odorata* (L.) R.M.King & H.Rob. A.N. GPGCKSP-358	Eup	Trop. & Subtropical America	In	S	Road side, forest	Lf	Cut and wounds
13	*Chrysanthemum morifolium* (Ramat.) Hemsl. A.N. GPGCKSP-369	Ant	SE China	Cl	H	Garden	FH	Ornamental, Worship

14	*Coreopsis auriculata* L. A.N. GPGCKSP-371	Hel	East Central & SE USA	Cl	H	Garden	WP	Ornamental
15	*Coreopsis lanceolata* L. Ac. No. GPGCKSP-558	Hel	SE Canada to Central & East USA	Cl	H	Garden	WP	Ornamental
16	*Coreopsis tinctoria* Nutt. Ac.No. GPGCKSP-559	Hel	Canada to East Mexico	Cl	H	Garden	WP	Ornamental
17	*Cosmos sulphureus* Cav. A.N. GPGCKSP-104	Hel	Mexico to Central America	Nt	H	Road side	FH	Earache, Worship
18	*Crassocephalum crepidioides* (Benth.) S. Moore. A.N. GPGCKSP-373	Sen	Tropi. & S Africa, Madagascar	In	H	Road side, moist place	Lf	Cut and wounds
19	*Dahlia pinnata* Cav. A.N. GPGCKSP-375	Hel	Mexico	Cl	H	Garden	FH	Ornamental, Worship
20	*Eclipta prostrata* (L.) L. A.N. GPGCKSP-252	Hel	Temperate & subtropical America	In	H	Moist land, Crop land	Tw	Hair care, Foot Scabs, Cut and Wound
21	*Erigeron bonariensis* L. A.N. GPGCKSP-378	Ast	Mexico to tropical America	In	H	Waste land	WP	Compost
22	*Erigeron canadensis* L. A.N. GPGCKSP-107	Ast	New World	In	H	Crop land	WP	Compost
23	*Erigeron karvinskianus* DC. A.N. GPGCKSP-567	Ast	Mexico to Venezuela	In	H	Moist place	FH	Cut and wound, worship
24	*Erigeron sumatrensis* Retz. A.N. GPGCKSP-339	Ast	Mexico to S. Tropical America	N/I	H	Road side	Tw	Heat strokes
25	*Gaillardia pulchella* Foug. A.N. GPGCKSP-345	Hel	Central USA to North Mexico	Cs	H	Garden, Road side	WP	Ornamental
26	*Galinsoga parviflora* Cav. A.N. GPGCKSP-568	Hel	Mexico to Tropical America	In	H	Moist place	WP	Cut and wounds, fodder
27	*Galinsoga quadriradiata* Ruiz & Pav. A.N. GPGCKSP-569	Hel	Mexico to south Tropical America	In	H	Road side	Lf	Cut and wounds
28	*Gamochaeta pensylvanica* (Willd.) Cabrera A.N. GPGCKSP-105	Inu	Tropical & subtropical America	In	H	Crop land, Moist place	WP	Fodder
29	*Gamochaeta purpurea* (L.)	Inu	E. Canada to Tropical	In	H	Moist place	Lf	Cut and wounds

	Cabrera A.N. GPGCKSP-571		America					
30	*Gazania rigens* (L.) Gaertn. A.N. GPGCKSP-350	Hel	Northern Prov. to KwaZulu-Natal	Cl	H	Garden	WP	Ornamental
31	*Glebionis coronaria* (L.) Cass. ex Spach A.N. GPGCKSP-381	Ant	Medit to Central Asia and Arabian Peninsula	Cl	H	Garden, Road side	WP	Ornamental
32	*Gymnanthemum amygdalinum* (Delile) Sch. Bip. A.N. GPGCKSP-405	Ver	East Bolivia to Brazil, Tropical Africa to West Yemen	Cl	T	Road side	Lf	Diabetes control
33	*Helianthus annuus* L. A.N. GPGCKSP-346	Hel	SW. USA to Mexico	Cl	H	Crop land, Garden	Sd, WP	Food, ornamental
34	*Helianthus debilis* Nutt. A.N. GPGCKSP-383	Hel	Florida	Nt	H	Road side, Garden	WP	Ornamental, Fencing
35	*Lactuca sativa* L. A.N. GPGCKSP-387	Cic	Iraq	Cl	H	Crop land	Lf	Vegetable
36	*Lagascea mollis* Cav. A.N. GPGCKSP-555	Hel	Mexico to Tropical America	N/I	H	Road Side	Lf	Cut and wounds
37	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal A.N. GPGCKSP-389	Cic	Egypt to central Asia and Myanmar, Arabian Peninsula	In	H	Waste land, Road side, forest	WP	Fodder
38	*Parthenium hysterophorus* L A.N. GPGCKSP-100	Hel	Tropical and subtropical America	In	H	Waste land, Road side	WP	Broomstick, Noxious
39	*Solidago canadensis* L. A.N. GPGCKSP-561	Ast	Subarctic America to Mexico	Cs	S	Road side	Tw	Vegetable
40	*Soliva anthemifolia* (Juss.) Sweet A.N. GPGCKSP-390	Hel	S. tropical America	In	H	Crop land	Tw	Vegetable, Fodder
41	*Sonchus arvensis* L. A.N. GPGCKSP-562	Cic	Europe to Siberia and Caucasus	Nt	H	Crop land, Waste land	Lf	Cut and wounds
42	*Sonchus oleraceus* L. A.N. GPGCKSP-396	Cic	Macaronesia, Europe to Medit., Sahara to Arabian Peninsula	In	H	Waste land, Moist place	Tw	Fodder
43	*Sphagneticola trilobata* (L.) Pruski	Hel	Mexico to S. Tropical America and Trinidad.	N/I	H	Road side, Waste land	WP	Prevent soil erosion

	A.N. GPGCKSP-398							
44	*Stevia rebaudiana* (Bertoni) Bertoni A.N. GPGCKSP-570	Eup	Brazil to Paraguay	Cl	H	Garden	Lf	Diabetes control
45	*Synedrella nodiflora* (L.) Gaertn. A.N. GPGCKSP-560	Hel	Tropical and subtropical America	In	H	Road side, Old Rocks	Tw	Noxious, Toxic to animal
46	*Tagetes erecta* L. A.N. GPGCKSP-347	Tag	Mexico to Guatemala	Cl	H	Garden, Road side	Lf, FH	Earache, worship
47	*Tarlmounia elliptica* (DC.) H.Rob. A.N. GPGCKSP-564	Ver	China to Malaya	Cl	C	Wall	WP	Ornamental
48	*Tithonia diversifolia* (Hemsl.) A. Gray A.N. GPGCKSP-563	Hel	Mexico to Central America	C/N	US	Waste land, Road side	WP	Fencing
49	*Tridax procumbens* L. A.N. GPGCKSP-399	Hel	Maxico to tropical America	In	H	Waste land, Road side	Lf, Tw	Cut and wounds, eye disorder, Fodder
50	*Xerochrysum bracteatum* (Vent.) Tzvelev A.N. GPGCKSP-565	Inu	New South Wales, Victoria	Cl	H	Garden	WP	Ornamental
51	*Zinnia elegans* Jacq. A.N. GPGCKSP-566	Hel	Mexico to Nicaragua	Cl	H	Garden	WP	Ornamental

Abbreviations

A.N.- Accession Number, Ant- Anthemideae, Ast- Astereae, Cal- Calenduleae, Cic- Cichorieae, Eup- Eupatorieae, Hel- Heliantheae, Inu- Inuleae, Sen- Senecioneae, Tag- Tageteae, Ver- Vernonieae,

Cl- Cultivated, Cs- Casual, C/N- Casual or Naturalized, In- Invasive, Nt- Naturalized,

N/I- Naturalized or Invasive.

Lf- Leaf, FH- Flower head, Sd- Seed, Tw- Twig, WP- Whole plant, C- Climber, H- Herb, S- Shrub, T- Tree, US- Under Shrub.

Table 2. Similarity index or JI value of collected data

S. No.	References	Study area	Total taxa in present study (a)	Total taxa present in previous study	Total taxa of Asteraceae present in previous study (b)	Common taxa in both study (c)	JI
1	Narayan et al. (2019)	Rourkela, Orissa	51	165	24	10	15.38
2	Prakash and Balasubramanian (2018)	Southern Eastern Ghat India	51	107	16	9	15.51
3	Rastogi and Rana (2018)	Pantnagar Utttarakhand	51	26	2	2	3.92
4	Rawat et al. (2016)	Ramganga valley, Uttarakhand	51	48	09	8	15.38
5	Sekar (2012)	Indian Himalayan Region	51	190	31	15	22.38
6	Sekar et al. (2012)	Uttarakhand Himalaya	51	163	26	13	20.31
7	Sekar et al. (2015)	Himachal Pradesh	51	125	24	13	20.96
8	Singh and Kumari (2019)	J.P. Nagar Uttar Pradesh	51	24	06	4	7.54
9	Singh et al. (2010)	Uttar Pradesh	51	152	30	14	20.89
10	Somkumar et al. (2013)	Akola M.S.	51	51	13	5	8.47
11	Tripathi et al. (2020)	Kumaun Himalaya	51	48	11	6	10.71
12	Wagh and Jain (2015)	Jhabua, M.P.	51	102	15	7	11.86

Discussion

Invasive plants are spreading at an alarming rate which is due to three main regions i.e., migration of excessive human population from one region to another, disturbed habitats favorable environmental and climatic conditions (Kohli et al., 2012). Asteraceae, one of the largest angiosperm families, includes a large number of alien plants. In India, Khuroo et al. (2012) have reported 134 species of Asteraceae, out of these 43 (32.089%) were invasive, 9 (06.71%) casual, 25 (18.656%) naturalized, 06 (04.47%) casual or naturalized, 26 (19.402%) naturalized or invasive, and 25 (18.656%) cultivated plants of family Asteraceae. But in the present study, 24 (47.05%) invasive species, 02 (3.92%) casual, 03 (5.88%) naturalized, 01 (1.96%) casual or naturalized, 04 (7.84%) naturalized or invasive, 17 (33.33%) cultivated plants of family Asteraceae were observed (Fig.2). In Doon valley, Negi and Hajra (2007) have reported 436 alien plant species (308 woody and 128 herbaceous) out of these 26 plants belong to Asteraceae family.

Alien species are not totally harmful to mankind, but several of them are useful for various purposes. Most of the species found in the study area were useful to indigenous

peoples. In the present study, out of 51 collected plant species, 48 species were found to be useful; while 02 found as noxious and 01 species has both harmful and useful aspects. Some tribals and local people are still finding out some useful outcomes of these rapidly growing species.

In Uttarakhand Himalaya region, Sekar et al. (2012) have reported 26 plant species out of these 18 plant species were useful. Tripathi et al. (2020) reported 11 Asteraceous plants growing in Kumaun Himalaya region their folk medicinal uses. In western Ramganga valley Uttarakhand, Rawat et al. (2016) reported 09 invasive alien species of family Asteraceae but they found only 4 species were useful for different purposes. Rastogi and Rana (2018) in Pantnagar reported two plant species with various uses.

Several researchers reported indigenous uses of alien species of Asteraceae along with others but they mainly emphasize their attention on invasive species. But present study documented uses of various categories of alien plant species of family Asteraceae. In the present study, a total of 05 species were found with lesser-known uses such as *Ageratina lingustrina* (DC.) R.M. King & H. Rob., *Erigeron karvinskianus* DC., *Erigeron sumatrensis* Retz. *Gamochaeta purpurea* (L.) Cabrera, and *Gymnanthemum amygdalinum* (Delile) Sch. Bip. which were not much known among the indigenous people in earlier study.

Due to easy spread, overproduction and invasive nature of alien plant species, there is a perception among people that it is harmful to us, but present study enlightened the usefulness of alien species which will be a new area of research opportunities for future researchers. Invasive alien plants can be a substitute medicine for those which were produced by endangered plant species. After this survey-based study, further phytochemical analysis can be done for pharmaceutical validation and new drugs discovery.

Acknowledgments

Authors are indebted to the Head, Department of Botany, R.H. Govt. P.G. College, Kashipur, Uttarakhand for support and encouragement. Thanks goes to all ethnic and local people of the study area for their kind cooperation during field study. They are also thankful to the Director, NBRI Lucknow, FRI Dehradun and Deputy Director, BSI, Dehradun for providing facilities to consult Herbarium.

References

Agarwal SK (2017) Flora of Jaunsar Bawar (Chakrata Hills, Western Himalaya): with Ethnobotanical Notes. Bishen Singh Mahendra Pal Singh, Dehradun.

Babu CR (1977) Herbaceous Flora of Dehra Dun, Council of Scientific & Industrial Research, New Delhi.

Bhutiyal R and Bhatia S (2014) Documentation of invasive Alien weeds of family Asteraceae from Kishtwar (Jammu and Kashmir), India. IJIMS, 2(2):49-54.

Dhami KK (2018a) Alien invasives of family Asteraceae in Punjab (India). IJIRAS, 5(1):312-315.

Dhami KK (2018b) The Terrestrial alien invasives of family Asteraceae in Punjab (India) and their ecology. IJARIIT, 4 (1):282-285.

Duthie JF (1903-1929) Flora of the Upper Gangetic Plain and of the adjacent Siwalik and sub -Himalayan tracts, Bishen Singh Mahendra Pal Singh, Dehradun.

Gaur RD (1999) Flora of the District Garhwal, North West Himalaya (with Ethnobotanical notes), Trans Media Srinagar, Garhwal.

Gaur T and Rawat DS (2013) Diversity, nativity flowering phenology and invasive alien species of Asteraceae in Pantnagar. PJR, 11(3):409-416.

Gonzalez-Tejero MR, Casares-Porcel M, Sanchez-Rojas CP., Ramiro-Gutierrez JM, Molero-Mesa J, Pieroni A, Giusti ME, Censorii E, de Pasquale C, Della A, Paraskeva Hadijchambi D, Hadjichambis A, Houmani Z, El-Demerdash M, El-Zayatf M, Hmamouchi M, ElJohrig S (2008) Medicinal plants in the Mediterranean area: Synthesis of the results of the project Rubia. J. Ethnopharmacol. 116: 341–357.

Gupta RK (1968) Flora Nainitalensis, Navayug Traders, New Delhi.

Hajra PK, Rao RR, Singh DK and Uniyal BP (1995a) Flora of India (Anthemideae-Heliantheae). BSI, Calcutta. Vol. 12. 1-454 Pages.

Hajra PK, Rao RR, Singh DK and Uniyal BP (1995b) Flora of India (Inuleae-Vernonieae). BSI, Calcutta. Vol. 13. 1-411 Pages.

Hooker JD (1882) Flora of British India. Vol III. London.

Jain SK and Mudgal V (1999) A Hand Book of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun, India.

Jain SK and Rao RR (1977) A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.

Jaryan V, Uniyal SK, Gupta RC and Singh RD (2013) Alien flora of Indian Himalayan state of Himachal Pradesh. Environ. Monit. Assess. 185:6129-6153.

Kaur B, Bhatia S and Sharma KK (2014). Diversity and impact of invasive alien plant species of family Asteraceae in Jammu District (Jammu and Kashmir, India). IJIMS, 1(8):51-62.

Khanduri Arti, Biswas S, Vashisht H.B. Rathod Digvijay Singh and Jha Suman Kumar (2017) A status of invasive Alien Species plant diversity in tehri District Forest ecosystem of Garhwal Himalayan region. Curr. World Environ., 12(2): 377-388.

Khuroo AA, Rashid I, Reshi Z, Dar GH, Wafai BA (2007) The Alien flora of Kashmir Himalaya. Biol. Invasions. 9:269-292.

Khuroo AA, Reshi ZA, Malik Akhtar H, Weber E, Irfan R, Dar GH (2012) Alien flora of India: taxonomic composition invasion status and biogeographic affiliations. Biol. Invasions. 14:99-173.

Kohli RK, Batish DR, Singh JS, Singh HP and Bhatt JR (2012) Plant invasion in India: An overview. In Bhatt JR, Singh JS, Singh SP, Tripathi RS and Kohli RK (Eds) Invasive alien plants- an ecological appraisal for the Indian subcontinent, CABI, Oxfordshire, UK.

Kumari B, Singh SP, Singh AP, Kumar R and Verma S (2016) Alien Angiosperms of Rohilkhand Region (U.P.) India. Plant Arch. 16(1):45-50.

Lal HS, Singh S, Kumar A, Mishra PK and Mishra K. (2012) Study of Invasive and Alien species in Jharkhand India and its impact on environment. The Journal of Ethnobiology and Traditional Medicine. 117:167-177.

Mamgain S and Joshi SP (2017) Exotic species diversity in a famous picnic

spot of Doon valley. Environ. Conserv. J. 18 (1&2):239-246

Narayan Mallick Samarendra, Ekka Nirius Xenan, Kumar Sanjeet, Sahu Sudam C (2019) Invasive Alien Flora in and around an Urban Area of India. In: Diversity and Ecology of Invasive Plants. IntechOpen. doi:10.5772/intechopen.88725. https://www.intechopen.com/chapters/68780

Nayak Rashmi, Verma AK, Manika N, Bargali Kiran, Pande VN, Behera SK and Chaudhary LB (2020) Alien species in the flora of Sikkim Himalaya, India. JETB, 44(1-2):119-137.

Negi PS and Hajra PK (2007) Alien flora of Doon Valley, Northwest Himalaya. Curr. Sci, 92 (7): 968-978

Osmaston AE (1927) A Forest Flora for Kumaon, Bishen Singh Mahendra Pal Singh, Dehra Dun.

Pant PC (1986) Flora of Corbett National Park. Botanical Survey of India, Howrah.

Pathak R, Negi VS, Rawal RS, Bhatt ID (2019) Alien plant invasion in the Indian Himalayan Region: state of knowledge and research priorities. Biodiversity and conservation.

Prakash L and Balasubramanian P (2018) Invasive alien flora of Sathyamangalam tiger reserve in Southern eastern Ghat, India. Indian Forester. 144(9):857-862.

Pusalkar, PK and SK Srivastava (2018) Flora of Uttarakhand, Vol 1, BSI, 1099 Pages.

Raghuvanshi AS, Rai LC, Gaur JP and Singh JS (2005) Invasive alien species and Biodiversity in India. Curr. Sci. 88(4):539-540.

Rastogi J and Rana S (2018) Economic importance of some Invasive Alien species reported in the Tarai belt of Uttarakhand, India. Advances in Bioresearch. 9(1):67-73.

Rastogi J, Rawat DS and Chandra S (2015) Diversity of invasive alien species in Pantnagar flora. Trop. Plant Res. 2(3):282-287.

Rawat DS, Tiwari JK and Tiwari P (2016) Invasive alien flora of Western Ramganga Valley, Uttarakhand. Phytotaxonomy. 16 111-114.

Reddy CS, Bagyanarayana G, Reddy, KN, Raju Vatsavaya S (2008) Invasive alien flora of India. National Biological Information Infrastructure US Geological Survey, USA.

Reddy CS (2008) Catalogue of invasive alien flora of India. Life Sci. J. 5(2):84-89.

Richardson DM, Pysek P, Rejmánek M, Barbour MG, Panetta FD, West CJ (2000) Naturalisation and invasion of alien plants concepts and definitions. Diversity and Distributions. 6: 93-107.

Sekar KC (2012). Invasive Alien Plants of Indian Himalayan region diversity and implication. Am. J. Plant Sci. 3:177-184.

Sekar KC, Manikandan R and Srivastava SK (2012) Invasive Alien plants of Uttarakhand Himalaya. Proceedings of the National Academy of Sciences, India. Sect. B Biol. Sci. 82(3):375-383.

Sekar KC, Pandey A, Srivastava SK and Giri L (2015). Invasive alien plants of Himachal Pradesh India. Indian For. 141(5): 520-527.

Singh Arvind (2020) Exotic Floristic composition of the Varanasi District of Uttar Pradesh, India. JPS, 41(2):73-84.

Singh D and Khare AK (2020) studies on the occurrence and distribution of the invasive alien angiospermic plant species in Pilibhit tiger reserve Pilibhit, U.P., (India). Plant Arch. 20(2):4782-4786.

Singh K and Joshi SP (2022) diversity and distribution pattern of alien plant species along the altitudinal gradient in District Pauri, Uttarakhand India. Plant Arch. 22(1): 195-202.

Singh KP, Shukla AN and Singh JS (2010) State level inventory of invasive alien plants, their source regions and use potential. Curr. Sci. 99(1):107-114.

Singh SP and Kumari B (2019) Distribution and beneficial uses of invasive alien angiosperms in the roadside area of JP Nagar Uttar Pradesh. J. Med. Plants Stud. 7(3): 08-11.

Singh PK and Narain S (2018) Invasive alien species of family Asteraceae in India. Phytotaxonomy. 18:129-135.

Somkumar SR Mahakhode RH and Chaudhary RR (2013) An Ethnomedicinal survey of exotic Medicinal plants in Akola region I (M.S.) India. Multilogic in Science 2(5):65-69.

Tripathi AK, Sharma JK and Ahmed Mohd. (2021) A preponderance of Alien species in Delhi NCR of Western Uttar Pradesh: Possible impacts on ecosystem. Trop. Plant Res. 8(1):5 0-62.

Tripathi AN, Kumar P and Sati SC (2020) Uses of Invasive Alien Plants in Kumaun Himalayan folk medicine system. Int. J. Herb. Med. 8 (1):27-31.

Uniyal BP, Sharma JR, Choudhery U and Singh DK (2007) Flowering Plants of Uttarakhand. (A Checklist) Bishen Singh Mahendra Pal Singh, Dehradun. 1-307 Pages.

Verma SR, Joshi S and Rawat DS (2022) Diversity of Invasive Alien dicot species in Pantnagar Uttarakhand, India. Asian J. Biol. 16(1):7-19.

Wagh, VV and Jain AK (2015). Invasive Alien flora of Jhabua district, Madhya Pradesh, India. Inte. J. Biodivers. Conserv.7(4):227-237.

Wani NR and Mushtaq SM (2012) Status of Exotic Flora in Kashmir Valley. J. For. Sci. 28(1):8-11.