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Exotic plant species in irrigated parts of Division Bikaner (Rajasthan)

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ABSTRACT

The division Bikaner is a part of the Thar desert. Indira Gandhi canal, Gang canal and Bharkha canal systems have been introduced in the Thar desert to enhance irrigation in this area. Due to extensive irrigation facilities there has been considerable destruction of the natural vegetation and tremendous increase in the exotic plant species. The present study deals with listing of exotic plant species in irrigated parts of division Bikaner with information on habits, composition and nativity. A total of 142 exotic plant species belong to 123 genera and 53 families were documented based on field observation for two years. Dicotoylendons show maximum (73%) contribution as compare to monocotyledons (23%), Bryophytes (2%) and Pteridophytes (2%) were also recorded. Habit wise analysis reveals that herbaceous species were dominant (67%) followed by grasses (15%), shrubs (8%), aquatic herbs (7%), trees (2%) and climbers (1%). Among these exotic plant species of division Bikaner (31%) were native to America followed by Asia (26%), Europe (16%), Eurasia (12%), Africa (11%) and Mediterranean region (4%). Highest genera were documented in family Poaceae (18 genera) followed by Asteraceae (16 genera) and Fabaceae (8 genera). Among districts of Bikaner division 140 species (35%) were reported from Ganganagar district followed by Hanumangarh 130 species (32%), Bikaner 95 species (23%) and Churu with 39 species (10%).

KEYWORD: Thar Desert, Division Bikaner, Exotic plant species, Irrigated parts

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INTRODUCTION

Study area is division Bikaner a part of the Thar desert lies between Latitude 28° 01' 0.12" N & Longitude 73° 19' 0.12" E' **(Figure: 1).**

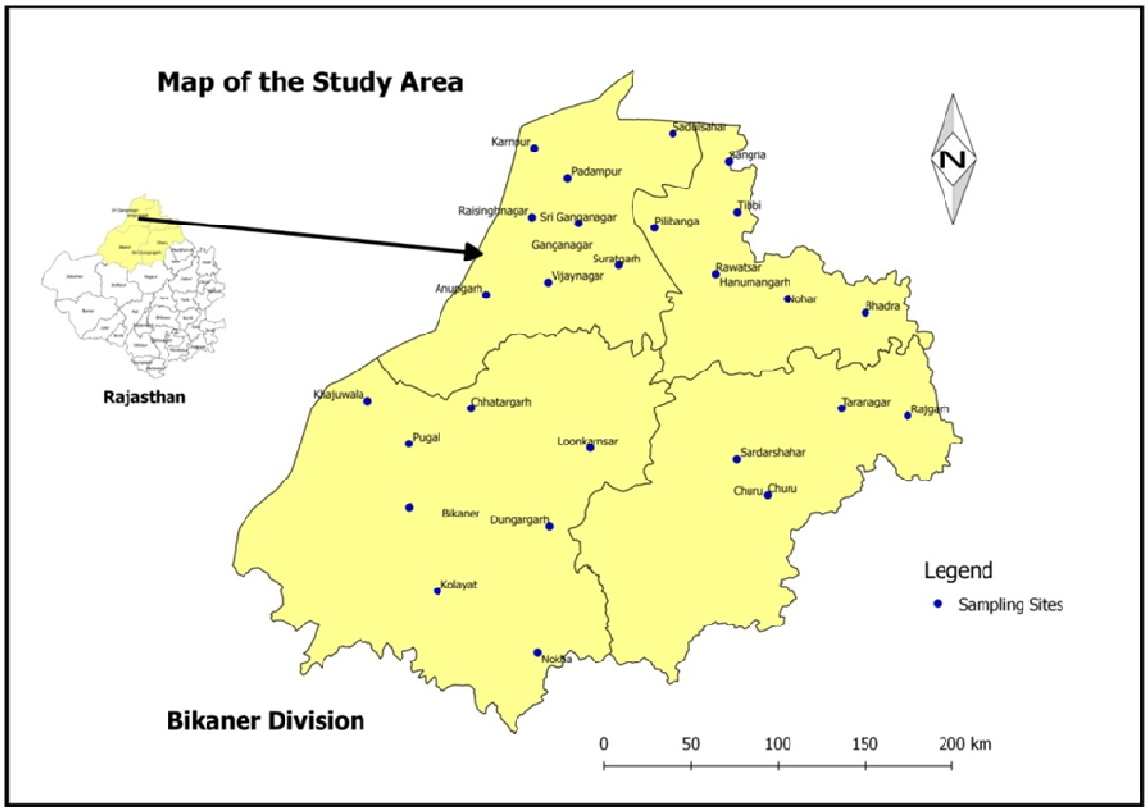

Figure 1: Map of study area Bikaner Division

The climatic condition of division Bikaner is arid and semi- arid types and soil is sandy. The Normal Annual average Rainfall of division Bikaner during the period 2012-2017 has been recorded 336.4 mm (Indian metrological Department ministry of Earth Science, New Delhi) **(Figure: 2).**

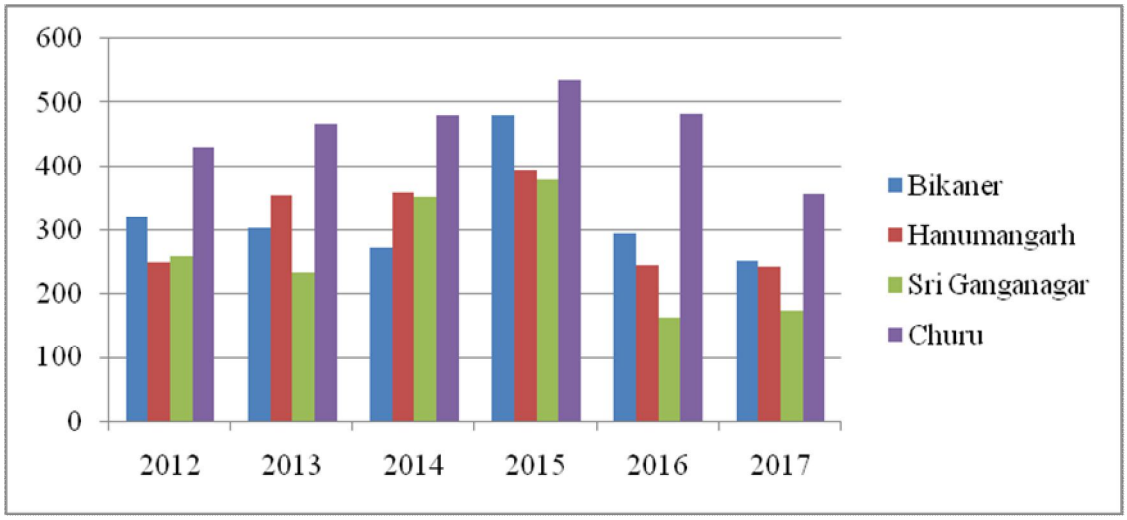

Figure 2: Rainfall data of last six years (Indian metrological Department ministry of Earth Science, New Delhi)

The division is a part of the Thar Desert and is covered by thick layer of alluvium and windblown sand. Generally sand dunes are 4 to 5 m in height. Regional elevation of ground ranges from 100 to 300 meters above mean sea level. The climate of the study area is semi-arid to arid except southwest monsoon season during the period July to mid of September, which is followed by post monsoon period till the end of November. The winter season is from December to February and is followed by summer from March to June. Climatic condition for vegetation is inhospitable in summers temperature goes up to 49°C and winter remains cool some time falls below freezing point. Daily and annual temperature fluctuation is common feature of the area. Rainfall is of unreliable nature. In general the vegetation in this arid and semi-arid region is sparse. Plants with only xerophytic adaptation are able to survive without irrigation facilities. The bulk of vegetation consists of stunted, thorny or prickly trees, shrubs and perennial herbs capable to drought resistance. In the semi-arid region the vegetation mainly consists of dwarf grasses interspersed with few characteristics desert shrubs. Bikaner division includes four districts viz. Bikaner, Ganganagar, Hanumangarh and Churu and 26 tehsiles.

Indira Gandhi canal, Gang canal system and Bhakhra canal system have been introduced as a boon for the Thar Desert. The Indira Gandhi Canal project, which is one of the largest canal systems of the world, has a great influence on the ecosystems of the north- western portion of the Thar Desert. Prior to the arrival of the canal, there were mainly vast expanses of undulating, barren sand dunes interspersed with sandy plains with extremely meargre rainfall. The area to be covered by this

project falls mainly in the districts Hanumangarh, Ganganagar, Bikaner and some part of Churu. District churu has also been irrigated by shawa lift canal and sidhmukh -Nohar canal project, whereas, district Ganganagar receive irrigation facilities through Gang canal mainly.

These Canals would have already generated an enormous amount of wealth for the nation as well as Rajasthan. Due to the extensive irrigation facilities provided to Bikaner division there has been considerable destruction of the natural vegetation and tremendous increase in the weed flora due to large scale cultivation of land. Pandey and Singh (2001) studied the Phytodiversity of the Indira Gandhi canal command area in North-west Rajasthan and found that it has lead to depletion and destruction of natural vegetation[1]. The word exotic is used to explain species occurring in ecosystem to which they are not indigenous. The introduction of exotic species has been recognized as one of the most serious threats to our ecological, social and well-being (Shine *et al.* 2000). A large number of plant species has been introduced in India through international trade and travel[2]. According to Saxena (1991) about 40% of the total plant species recorded from India have identified as being alien[3]. Roy and Shetty (1980) have discussed about the impact of canal irrigation on the flora of Ganganagar district[4]. Sidhu (1990) have made a comparison of the flora of irrigated regions (Ganganagar and Bikaner districts) with that of rest of the Rajasthan desert and pointed out that quite a number of species which have invaded irrigated areas have not been reported from the other parts of the Rajasthan desert[5].

The present paper focus upon a compiled record of exotic plant species present in irrigated part of division Bikaner along with their habit, composition and nativity.

MATERIAL AND METHOD

Field trips were conducted from month of 01 July, 2015 to 30 June, 2017 for collection of plant specimen growing in rainy season, winter season and summer season at selected sites. Preliminary identification was made at the spot and all information about the plants was noted in the field diary. The plant specimens collected during field visits were identified and preserved in the form of herbarium after drying in the folds of blotting sheets. The collected plant specimens were treated with 2% mercuric chloride solution to provide protection against insects and fungal attack. The collected plants species were identified by using of flora of Rajasthan Vol. I, II, III by Shetty and Singh, (1987, 1991, 1993)[6-8], Flora of Indian Desert by Bhandari (1978) and with the help of the Dehradun and desert area herbarium of the BSI Jodhpur[9].

All the plant specimens have been deposited in Department of Environmental Science, Maharaja Ganga Singh University, Bikaner. The taxa are arranged alphabetically under their respective families which are arranged according to the classification of Bentham and Hooker (1862-1883).

RESULTS AND DISCUSSION

A total of 142 species belong to 123 genera and 53 families of which 136 species belong to 117 genera and 47 families of higher plant groups (Angiosperms), and 6 species belong to 6 genera and 6 families of Cryptogamous (Bryophytes and Pteridophytes) have been recorded as exotic plant species in four districts of Bikaner division **(Table: 1 & 2).**

Table 1: "Exotic Cryptogamous plant species in irrigated parts of Bikaner Division"

S. No.	*Botanical name*	Common name	Family	Plant Group
1.	*Funeria hygrometrica*	Bonfire moss	Funariaceae	Broyphyta
2.	*Marchantia palmata*	liverwort	Marchantiaceae	Broyphyta
3.	*Riccia robusta*	liverwort	Ricciaceae	Broyphyta
4.	*Adiantum capillus-veneris*	walking fern	Pteridaceae	Pteridophyta
5.	*Equisetum arvense L.*	Horsetail	Equisetaceae	Pteridophyta
6.	*Marsilea minuta*	Pepperwort	Marsileaceae	Pteridophyta

Table 2: "Exotic higher (Angiosperms) plant species in irrigated parts of Bikaner Division"

S. No.	*Botanical name*	Common name	Family	Nativity	Dicot/Monocot	Habits
1.	*Acanthospermum hispidum*	Kantagokharu	Asteraceae	Trop. America	DC	H
2.	*Ageratum conyzoides*	Jangli pudina	Asteraceae	Trop. America	DC	H
3.	*Alternanthera tenella* Colla	Garundi, Guroo	Amaranthaceae	Trop. America	DC	H
4.	*Amaranthus viridis* L.	Sandalio	Amaranthaceae	South America	DC	H
5.	*Ammi majus L.*	Bishop's weed	Apiaceae	North eastern Africa	DC	H
6.	*Anagallis arvensis*	Blue-scarlet pimpernel	Primulaceae	Europe	DC	H
7.	*Anethum graveolens L.*	Soya	Apiaceae	Eurasia	DC	H
8.	*Antirrhinum orontium L.*	Dragon flowers	Plantaginaceae	Europe	DC	H
9.	*Arenaria serpyllifolia*	Thyme-leaf sandwort	Caryophyllaceae	Europe	DC	H
10.	*Argemone ochroleuca Sweet*	Prickly poppies	Papaveraceae	Mexico	DC	H
11.	*Aristida plumosa L.*	Desert grass	Poaceae	America	MC	G
12.	*Asphodelus tenuifolius*	Pyazi	Asphodelaceae	Mediterranean region, Asia	MC	H

13.	*Astragalus subumellatus Klotzsch*	Milkvetch	Fabaceae	North America	DC	H
14.	*Astragalus tribuloides*		Fabaceae	Asia	DC	H
15.	*Bacopa monnieri*	Brahmi	Plantaginaceae	Southern and Eastern India	DC	H
16.	*Bidens biternata*	Chirchitta	Asteraceae	Trop. America	DC	H
17.	*Blumea lacera* (Burm.f.) DC.	Jangli Muda	Asteraceae	Trop. America	DC	H
18.	*Boerhavia diffusa*	Santhi, Punarnava	Nycataginaceae	Africa	DC	H
19.	*Carex fedia Nees*	Motha Ghash	Cyperaceae	South east Asia	MC	H
20.	*Carthamus oxycantha DC.*	Wild Safflower	Asteraceae	Europe	DC	H
21.	*Catabrosa aquatic (L.) P. Beauv.*	Water WhirlGrass	Poaceae	Europe	MC	H
22.	*Centaurium centaurioides*	Lesser centaury	Gentianaceae	Europe	DC	H
23.	*Centella asiatica (L.) Urban*	Indian pennywort	Apiaceae	Asia	DC	H
24.	*Chenopodium giganteum*	Tree Spinach	Amaranthaceae	Mountainous regions of India	DC	H
25.	*Chenopodium murale*	Nettle-leaved Goosefoot	Amaranthaceae	Europe	DC	H
26.	*Chloris barbata* Sw.	Shiyad Punch	Poaceae	Trop. America	MC	H
27.	*Chrozophora oblongifolia (Del.) A. Juss.*	Chrozophora	Euphorbiaceae	East Africa	DC	H
28.	*Chrozophora Prostrata Dalz.*	Dalchini	Onagraceae	Asia	DC	H
29.	*Cichorium intybus L.*	Common chicory	Asteraceae	Europe	DC	H
30.	*Cirsium wallichii DC.*	Bungsee	Asteraceae	Eurasia	DC	H
31.	*Commelina diffusa Burm. f.*	climbing dayflower	Commelinaceae	West Indies	MC	H
32.	*Convolvulus arvensis*	Morning glory	Convolvulaceae	Europe	DC	C
33.	*Coronopus didymus*	Swine Wartcress	Brassicaceae	South America	DC	H
34.	*Cotula anthemoides L.*	Babuna	Compositae	Africa	DC	H
35.	*Cuscuta capitata Roxb.*	Amer bel	Convolvulaceae	Temperate South America	DC	C
36.	*Cyperus exaltatus Retz.*	Giant Sedge	Cyperaceae	Asia	MC	H
37.	*Cyperus iria* L.	Moth	Cyperaceae	Trop. America	MC	H
38.	*Dichanthium odoratum (Lisbosa) Jain*		Poaceae	Trop. Africa	MC	G
39.	*Digitaria bicornis (Lam.) Roem.*	Asian crabgrass	Poaceae	Trop. and temperate America	MC	G
40.	*Digitaria stricta Roth ex Roem.*		Poaceae	Trop. and temperate America	MC	G
41.	*Dilophia salsa Thoms.*		Brassicaceae	Asia-trop.	DC	H
42.	*Diplachne fusca (L.) P.Beauv*		Poaceae	North America	MC	G
43.	*Eclipta alba*	Bhringraj	Asteraceae	Trop. America	DC	H
44.	*Eclipta prostrata*	Jal Bhangro	Asteraceae	Trop. South	DC	H

				America		
45.	*Eichhornia crassipes*	Jal Kumbhi	Pontederiaceae	Amazon basin	MC	Aq
46.	*Eleocharis dulcis (Burn.) Henschel*		Cyperaceae	Asia	MC	Aq
47.	*Eleusine indica (L.)Gaertn.*	Indian Crowfoot Grass	Poaceae	Cosmopolitan trop. ,subtrop.	MC	G
48.	*Emex spinosa*	Devil's thorn	Polygonaceae	Mediterranean Africa	DC	H
49.	*Emilia sonchifolia* (L.) DC.	Hirankhuri	Asteraceae	Trop. America	DC	H
50.	*Eragrostis nutans (Retz.) Nees ex Steud.*		Poaceae	Africa	MC	G
51.	*Euphorbia geniculata*	Desert spurge	Euphorbiaceae	Trop. America	DC	H
52.	*Euphorbia helioscopia L.*	Sun Spurge	Euphorbiaceae	Europe	DC	H
53.	*Euphorbia parviflora L.*	Dudhi	Euphorbiaceae	Asia-Trop.	DC	H
54.	*Euphorbia serpens H.B. &K.*		Euphorbiaceae	South America	DC	H
55.	*Farsetia jacquemontii Hook. F. & Thoms.*		Cruciferae	Asia	DC	S
56.	*Ficus palmata Forssk.*	Punjab Fig	Moraceae	Africa	DC	S
57.	*Fimbristylis diphylla (Retz.) Vahl*		Cyperaceae	Asia	MC	G
58.	*Fimbristylis woodrowii C.B. Clarke*		Cyperaceae	India	MC	H
59.	*Fumaria indica*	Indian Fumitory	Papaveraceae	Europe	DC	H
60.	*Gastrocotyle hispida (Forssk.) Bunge*		Boraginaceae	Mediterranean basin	DC	H
61.	*Gnaphalium luteo-album*	Bal Raksha	Asteraceae	North and South America	DC	H
62.	*Heliotropium currasavicum L.*	Seaside Heliotrope	Boraginaceae	America	DC	H
63.	*Hypecoum procumbens L.*		Papaveraceae	Southern Europe	DC	H
64.	*Imperata cylindrica Linn. P. Beauv.*	Satintail	Poaceae	Southeast Asia	MC	G
65.	*Kochia indica Wt.*	Kochia	Amaranthaceae	North America	DC	S
66.	*Koeleria argentea Griseb.*	Silver hairgrass	Poaceae	Himalayas	MC	G
67.	*Lactula serriola L.*	Milk thistle	Asteraceae	Europe	DC	H
68.	*Lantana camara L.*	Raimuniya	Verbenaceae	Central and South America	DC	S
69.	*Launaea fallax*		Asteraceae	Eurasia	DC	H
70.	*Launaea procumbens*	Jangi gobi	Asteraceae	Asia	DC	H
71.	*Lemna trisulca L.*	Star duck weed	Araceae	North America	MC	H
72.	*Leptochloa chenensis (L.) Nees*	Red sprangletop	Poaceae	Africa	MC	G
73.	*Linum usitatissimum*	Alsi	Linaceae	Asia	DC	H
74.	*Lolium temulentum L.*	Darnel	Poaceae	Asia	MC	G
75.	*Lophochloa phleoides Vill.*		Poaceae	Eurasia	MC	G
76.	*Lophochloa pumila (Desf.) Bor*		Poaceae	South America	MC	G
77.	*Lotus corniculatus L.*	Bird's-foot	Fabaceae	Eurasia and	DC	H

		trefoil		North Africa		
78.	*Lycium europaeum L.*	European matrimon	Solanaceae	Europe	DC	S
79.	*Malcolmia Africana R. Br.*	Turkish mustard	Brassicaceae	Africa	DC	H
80.	*Malva sylvestris Linn.*	Blue mallow	Malvaceae	Western Europe	DC	H
81.	*Martynia annua* (Houstoun inMartyn) L.	Bagh-nakkhi	Pedaliaceae	Trop. America	DC	S
82.	*Mazus pumilus (Burm. F.) van Steenis*	Mazus	Scrophulariaceae	Asia	DC	H
83.	*Medicago lupulina*	Hop clover	Fabaceae	Mediterranean Basin	DC	H
84.	*Medicago minima Lam.*	Small medick	Leguminosae	Mediterranean Basin	DC	H
85.	*Medicago polymorpha Linn.*	Toothed bur clove	Fabaceae	Mediterranean Basin	DC	H
86.	*Myriophyllum spicatum L.*	Spiked water-milfoil	Haloragaceae	Europe	DC	Aq
87.	*Nelumbo nucifera Gaertn.*	Indian lotus	Nelumbonaceae	Asia	DC	Aq
88.	*Nymphaea stellata willd.*	Neelkamal	Nymphaeaceae	Southern and eastern parts of Asia	DC	Aq
89.	*Ocimum americanum* L.	Bapji, Rantulsi	Lamiaceae	Trop. America	DC	H
90.	*Oenanthe javanica (Bl.) DC.*	Indian pennywort	Apiaceae	East Asia	DC	H
91.	*Oligomeris linifolia (Vahl) Macbride*	Lineleaf whitepuff	Resedaceae	Indian subcontinent	DC	H
92.	*Orobanche aegyptiaca Pers.*	Egyptian broomrape	Orobanchaceae	Asia	DC	H
93.	*Oxalis latifolia H.B. & K.*	Roadleaf woodsorrel	Oxalidaceae	Mexico	DC	H
94.	*Panicum austroasiaticum Ohwi*	Panicgrass	Poaceae	Eurasia	MC	G
95.	*Panicum miliaceum L.*	Broomcorn millet	Poaceae	Asia	MC	G
96.	*Parkinsonia aculeata*	Mexican palo verde	Fabaceae	Asia	DC	T
97.	*Parthenium hysterophours L.*	Congress grass	Asteraceae	N. America	DC	H
98.	*Phalaris minor Retz.*	canary grass	Poaceae	North Africa	MC	G
99.	*Phragmites karka (L.) Steud.*	Narkul	Poaceae	Eurasia	MC	G
100	*Phyllanthus niruri*	Stonebreaker	Phyllanthaceae	Trop. America	DC	H
101	*Plantago amplexicaulis Cav.,*	Plantains or fleawort	Plantaginaceae	Eurasia	DC	H
102	*Polygonum lanigerum R. Br.*	Knotweed, knotgrass	Polygonaceae	Eurasia	DC	H
103	*Portulaca grandiflora Hook.*	Rose moss	Portulacaceae	Trop. America	DC	H
104	*Portulaca pilosa L.*	Hairy pigweed	Portulacaceae	America	DC	H
105	*Potamogeton nodosus Poir.*		Potamogetonaceae	Eurasia	MC	Aq
106	*Pouzolzia pentandra*		Urticaceae	Asia ,trop.	DC	H

	(Roxb.) Benn.					
107	*Prosopis juliflora*	Vilayati babool	Fabaceae	Mexico	DC	S
108	*Psammogeton canescens (DC.) Vatke*		Apiaceae	Eurasia	DC	H
109	*Pycreus polystachyos P. Beauv.*		Cyperaceae	Eurasia	MC	Aq
110	*Ranunculus aquatilis*	Water crowfoots	Ranunculaceae	Europe	DC	Aq
111	*Ranunculus cantoniensis DC.*	Water crowfoots	Ranunculaceae	Asia	DC	Aq
112	*Ranunculus scleratus L.*	Cursed buttercup	Ranunculaceae	America	DC	H
113	*Rhynchosia capitata DC.*	Least snout-bean	Fabaceae	India	DC	S
114	*Rumex dentatus*	Toothed dock	Polygonaceae	Eurasia	DC	H
115	*Salsola baryosma*	Saltwort	Amaranthaceae	Africa	DC	S
116	*Salvia plebeian R. Br.*		Lamiaceae	Asia	DC	H
117	*Setaria homonyma (Steud.) Chiov.*		Poaceae	Asia-trop.	MC	G
118	*Silene conoidea*	Weed silene	Caryophyllaceae	Eurasia	DC	H
119	*Solanum nigrum*	Black nightshad	Solanaceae	Eurasia	DC	S
120	*Soliva anthemoides (Juss.) R.Br.*		Asteraceae	America	DC	H
121	*Sonchus oleraceus*	Milky tassel, milk thistle	Asteraceae	Europe	DC	H
122	*Sonchus asper*	Prickly Sow Thistle	Asteraceae	Europe	DC	H
123	*Spergula arvensis*	Jangli dhania	Caryophyllaceae	North America	DC	H
124	*Sphenoclea zeylanica Gaertn.*	Chicken spike	Sphenocleaceae	Asia	DC	H
125	*Sporobolus fertilis (Steud.) Clayton*	Giant Parramatta Grass	Poaceae	Indian sub-continent	MC	G
126	*Stellaria media*	Chickweed	Caryophyllaceae	Europe	DC	H
127	*Tamarix aphylla*	Athel tamarisk	Tamaricaceae	North, East and Central Africa	DC	T
128	*Tamarix passerinoides*	Salt cedar	Tamaricaceae	Africa	DC	T
129	*Trachyspermum ammi (L.) Spreng.*	Ajwain	Apiaceae	India	DC	H
130	*Trigonella pubescens Edgew.*		Fabaceae	Indian oriental	DC	H
131	*Utricularia inflexa Forssk.*		Lentibulariaceae	Africa	DC	H
132	*Vaccaria pyramidata Medik.*	Cowherb	Caryophyllaceae	Eurasia	DC	H
133	*Verbesina encelioides*	Crownbeard	Asteraceae	Trop. America	DC	S
134	*Verbscum thapsus L.*	Common mullein	Scrophulariaceae	Europe	DC	H
135	*Vernonica cinerea*	Sahdevi	Asteraceae	Eastern Mediterranean to Turkey	DC	H
136	*Vicia sativa*	Common Vetch	Fabaceae	Europe	DC	H

Abbrevation Used:- H- Herb; S-Shrub; T-Tree; C-Climber; Aq- Aquatic plant ; Trop. –Tropical; DC- Dicot ; MC- Monocot

Among Angiosperms 40 families, 89 Genera and 104 species belong to dicotoylendons (73%) and 7 families, 28 Genera and 32 species, belong to monocotyledons (23%). Cryptogamous consists of 3 species, belong to 3 genera and 3 families of Bryophytes (2%) and 3 species belong to 3 genera and 3 families of Pteridophytes (2%) **(Figure: 3, & Figure: 4).**

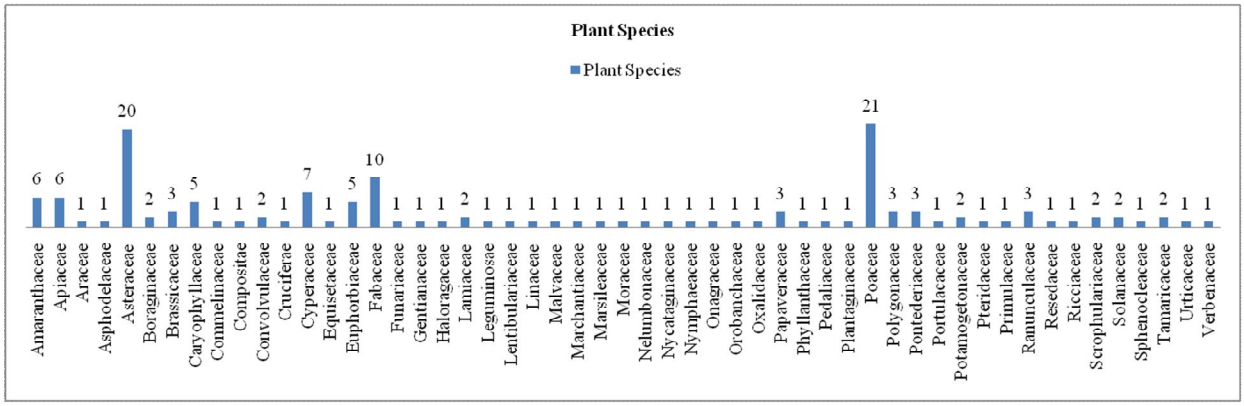

Figure 3: Showing distribution of exotic plant species in various families

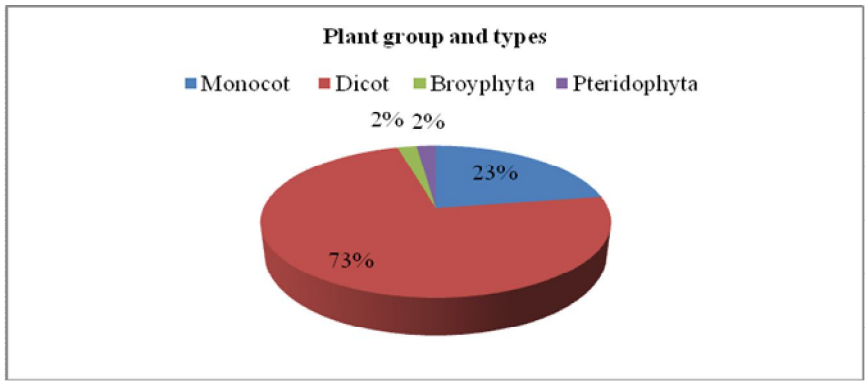

Figure 4: Showing percentage contribution of exotic plant species in various plant group and type

Maximum number of these exotic species belong to family Poaceae (21species) followed by Asteraceae (20 species), Fabaceae (10 species) and Cyperaceae (7 species).

Highest genera are in family Poaceae (18 genera) followed by Asteraceae (16 genera) and Fabaceae (8 genera) **(Figure:5).**

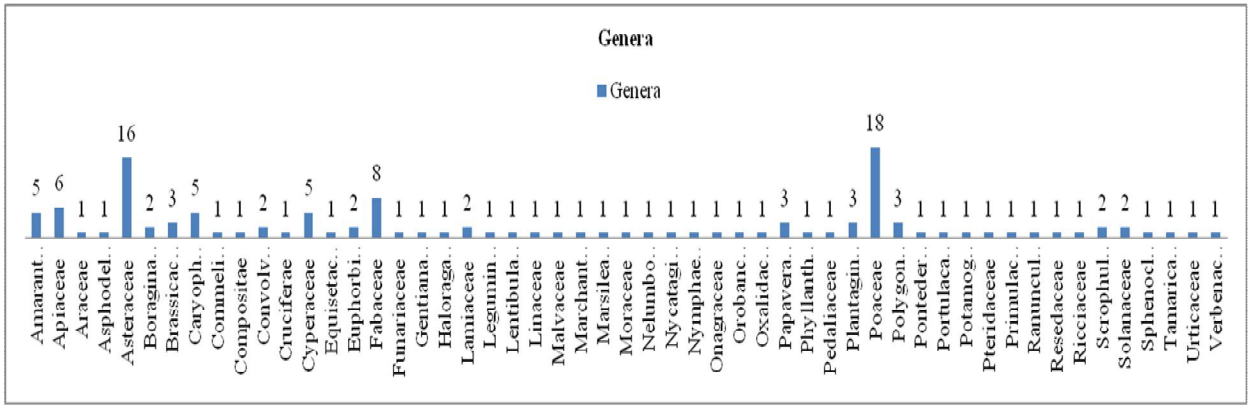

Figure 5:Showing distribution of various Genera in families

The genera with the highest number of exotic plant in division Bikaner are *Euphorbia* (4 species), followed by *Medicago and Ranunculus* (3 species each). Herbs contribute maximum with 91 species (67%), followed by 9 species of aquatic herb (7%), 11 species of Shrubs (8%), 3 species of tree (2%), 20 species of grasses (15%) and two species of Climbers (1%) **(Figure: 6).**

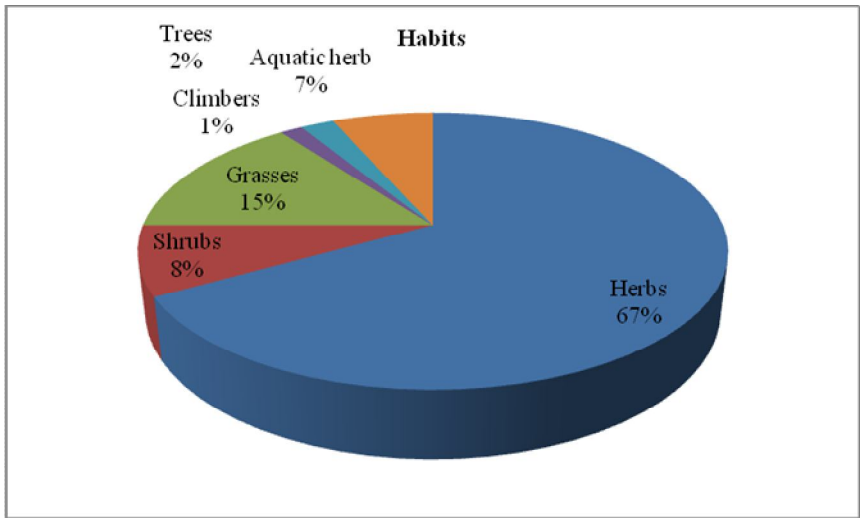

Figure 6: Showing percentage contibution of exotic plant species in various habits

Among these exotic plant species of division Bikaner, 42 species (31%) are native to America and 36 species (26%) to Asia, 22 species (16%) to Europe, 16 species (12%) Eurasia, 15 species (11%) Africa and 5 species (4%) Mediterranean region **(Figure: 7).**

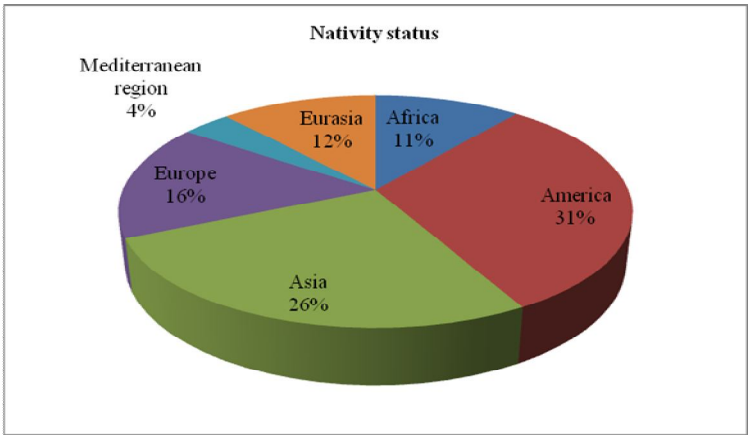

Figure 7: Showing percentage contibution of exotic plant species of nativity

As far as district, wise analysis of exotic plant species is concern it reveals that 140 species (35%) were reported from Ganganagar district followed by Hanumangarh 130 species (32%), Bikaner 95 species (23%) and Churu with 39 species (10%). Irrigation practices are at it high rate in Ganganagar and Hanumangarh district as compare to Churu district hence, number of exotic plant species found maximum in these two districts **(Table: 3).**

Table 3: "District wise distribution of Exotic plant species in Bikaner Division"

S.No.	*Botanical name*	Ganganagar	Hanumangarh	Bikaner	Churu
1.	*Acanthospermum hispidum*	+	+	+	-
2.	*Adiantum capillus-veneris*	+	-	-	-
3.	*Ageratum conyzoides*	+	+	+	+
4.	*Alternanthera tenella* Colla	+	+	-	-
5.	*Amaranthus viridis* L.	+	+	-	-
6.	*Ammi majus L.*	+	+	+	-
7.	*Anagallis arvensis*	+	+	+	+
8.	*Anethum graveolens L.*	+	+	+	+
9.	*Antirrhinum orontium L.*	+	+	+	-
10.	*Arenaria serpyllifolia*	+	+	+	-
11.	*Argemone ochroleuca Sweet*	+	+	+	-
12.	*Aristida plumosa L.*	+	+	+	+
13.	*Asphodelus tenuifolius*	+	+	+	+
14.	*Astragalus subumellatus Klotzsch*	+	+	+	-
15.	*Astragalus tribuloides*	+	-	-	-
16.	*Bacopa monnieri*	+	+	+	-
17.	*Bidens biternata*	+	+	+	-
18.	*Blumea lacera* (Burm.f.) DC.	+	+	+	+

19.	*Boerhavia diffusa*	+	+	+	+
20.	*Carex fedia Nees*	+	+	-	-
21.	*Carthamus oxycantha DC.*	+	+	+	-
22.	*Catabrosa aquatic (L.) P. Beauv.*	+	+	-	-
23.	*Centaurium centaurioides*	+	+	-	-
24.	*Centella asiatica (L.) Urban*	+	+	+	-
25.	*Chenopodium giganteum*	+	+	-	-
26.	*Chenopodium murale*	+	+	+	+
27.	*Chloris barbata* Sw.	+	+	+	-
28.	*Chrozophora oblongifolia (Del.) A. Juss.*	+	+	+	+
29.	*Chrozophora Prostrata Dalz.*	+	+	-	-
30.	*Cichorium intybus L.*	+	+	+	-
31.	*Cirsium wallichii DC.*	+	+	+	-
32.	*Commelina diffusa Burm. f.*	+	+	+	-
33.	*Convolvulus arvensis*	+	+	+	+
34.	*Coronopus didymus*	+	+	+	-
35.	*Cotula anthemoides L.*	+	+	-	-
36.	*Cuscuta capitata Roxb.*	+	+	-	+
37.	*Cyperus exaltatus Retz.*	+	+	+	-
38.	*Cyperus iria* L.	+	+	+	-
39.	*Dichanthium odoratum (Lisbosa) Jain*	+	+	-	-
40.	*Digitaria bicornis (Lam.) Roem.*	+	+	+	+
41.	*Digitaria stricta Roth ex Roem.*	+	+	-	-
42.	*Dilophia salsa Thoms.*	+	-	-	-
43.	*Diplachne fusca (L.) P. Beauv*	+	+	+	+
44.	*Eclipta alba*	+	+	+	+
45.	*Eclipta prostrata*	+	+	-	-
46.	*Eichhornia crassipes*	+	+	+	-
47.	*Eleocharis dulcis (Burn.) Henschel*	+	+	-	-
48.	*Eleusine indica (L.) Gaertn.*	+	+	+	-
49.	*Emex spinosa*	+	+	-	-
50.	*Emilia sonchifolia* (L.) DC.	+	-	-	-
51.	*Eragrostis nutans (Retz.) Nees ex Steud.*	+	+	-	-
52.	*Euphorbia geniculata*	+	+	-	-
53.	*Euphorbia helioscopia L.*	+	+	-	-
54.	*Euphorbia parviflora L.*	+	+	+	+
55.	*Euphorbia serpens H.B. & K.*	+	+	+	-
56.	*Equisetum arvense L.*	+	+	-	-
57.	*Farsetia jacquemontii Hook. F. & Thoms.*	+	+	+	+
58.	*Ficus palmata Forssk.*	+	+	-	-
59.	*Fimbristylis diphylla (Retz.) Vahl*	+	+	+	-
60.	*Fimbristylis woodrowii C.B. Clarke*	+	+	-	-
61.	*Funeria hygrometrica*	+	+	-	-
62.	*Fumaria indica*	+	+	+	+
63.	*Gastrocotyle hispida (Forssk.) Bunge*	+	+	+	-

64.	*Gnaphalium luteo-album*	+	+	-	-
65.	*Heliotropium currasavicum L.*	+	+	+	+
66.	*Hypecoum procumbens L.*	+	+	-	-
67.	*Imperata cylindrica Linn. P. Beauv.*	+	+	-	-
68.	*Kochia indica Wt.*	+	+	+	-
69.	*Koeleria argentea Griseb.*	+	-	+	-
70.	*Lactula serriola L.*	+	+	+	-
71.	*Lantana camara L.*	+	+	+	+
72.	*Launaea fallax*	+	+	+	+
73.	*Launaea procumbens*	+	+	+	-
74.	*Lemna trisulca L.*	+	+	+	+
75.	*Leptochloa chenensis (L.) Nees*	+	+	+	-
76.	*Linum usitatissimum*	+	-	-	-
77.	*Lolium temulentum L.*	+	+	-	-
78.	*Lophochloa phleoides Vill.*	+	+	+	-
79.	*Lophochloa pumila (Desf.) Bor*	+	+	-	-
80.	*Lotus corniculatus L.*	+	+	-	-
81.	*Lycium europaeum L.*	+	+	+	-
82.	*Malcolmia Africana R. Br.*	+	+	+	-
83.	*Malva sylvestris Linn.*	+	-	-	-
84.	*Martynia annua* (Houstoun in Martyn) L.	+	+	-	-
85.	*Marchantia palmata*	+	-	-	-
86.	*Marsilea minuta*	+	+	+	-
87.	*Mazus pumilus (Burm. F.) van Steenis*	+	+	+	-
88.	*Medicago lupulina*	+	+	+	-
89.	*Medicago minima Lam.*	+	+	+	-
90.	*Medicago polymorpha Linn.*	+	+	+	-
91.	*Myriophyllum spicatum L.*	+	+	+	-
92.	*Nelumbo nucifera Gaertn.*	+	+	+	+
93.	*Nymphaea stellata willd.*	+	+	+	-
94.	*Ocimum americanum* L.	+	-	-	-
95.	*Oenanthe javanica (BI.) DC.*	+	+	+	-
96.	*Oligomeris linifolia (Vahl) Macbride*	+	+	+	-
97.	*Orobanche aegyptiaca Pers.*	+	+	+	+
98.	*Oxalis latifolia H.B. & K.*	+	+	+	+
99.	*Panicum austroasiaticum Ohwi*	+	+	+	-
100	*Panicum miliaceum L.*	+	+	+	+
101	*Parkinsonia aculeata*	+	+	-	-
102	*Parthenium hysterophours L.*	+	+	+	+
103	*Phalaris minor Retz.*	+	+	+	-
104	*Phragmites karka (L.) Steud.*	-	-	+	+
105	*Phyllanthus niruri*	+	-	-	-
106	*Plantago amplexicaulis Cav.*	+	+	+	-
107	*Polygonum lanigerum R. Br.*	+	+	+	+
108	*Portulaca grandiflora Hook.*	+	+	+	+
109	*Portulaca pilosa L.*	+	+	-	-
110	*Potamogeton nodosus Poir.*	-	+	+	-

111	*Pouzolzia pentandra (Roxb.) Benn.*	+	-	+	-
112	*Prosopis juliflora*	+	+	+	+
113	*Psammogeton canescens (DC.) Vatke*	+	+	+	-
114	*Pycreus polystachyos P. Beauv.*	+	+	-	-
115	*Ranunculus aquatilis*	+	+	-	-
116	*Ranunculus cantoniensis DC.*	+	+	+	-
117	*Ranunculus scleratus L.*	+	+	+	-
118	*Rhynchosia capitata DC.*	+	+	+	-
119	*Riccia robusta*	+	+	+	-
120	*Rumex dentatus*	+	+	-	-
121	*Salsola baryosma*	+	+	+	+
122	*Salvia plebeian R. Br.*	+	+	+	-
123	*Setaria homonyma (Steud.) Chiov.*	+	+	-	-
124	*Silene conoidea*	+	+	-	-
125	*Solanum nigrum*	+	+	+	+
126	*Soliva anthemoides (Juss.) R.Br.*	+	+	+	-
127	*Sonchus oleraceus*	+	+	+	+
128	*Sonchus asper*	+	+	+	+
129	*Spergula arvensis*	+	+	+	+
130	*Sphenoclea zeylanica Gaertn.*	+	-	-	-
131	*Sporobolus fertilis (Steud.) Clayton*	+	+	-	-
132	*Stellaria media*	+	+	+	+
133	*Tamarix aphylla*	+	+	+	-
134	*Tamarix passerinoides*	+	+	+	-
135	*Trachyspermum ammi (L.) Spreng.*	+	+	-	-
136	*Trigonella pubescens Edgew.*	+	+	+	-
137	*Utricularia inflexa Forssk.*	+	+	-	-
138	*Vaccaria pyramidata Medik.*	+	+	+	-
139	*Verbesina encelioides*	+	+	+	+
140	*Verbscum thapsus L.*	+	+	+	-
141	*Vernonica cinerea*	+	+	-	-
142	*Vicia sativa*	+	+	-	+

Abbrevation Used:- (+ Present; - Absent

In irrigated areas most of exotic plants found with crops as a weeds or on the banks of water reservoir or banks of canals and their distributaries. Some plants are common weeds on road side (*Verbesina encelioides*) found throughout the year. Bryophytes were reported from the moist habitat of Ganganagar district and phyterdophytes were reported near the canals.

The canal system plays an important role in introducing species from neighbouring areas is evident in present study. These 142 species were earlier not reported from the study area, are now found there quite common specially in irrigated areas. These exotic species cause loss of biodiversity including species extinction and change in ecosystem of the area. Similar type of study was also carried out by many workers in India (Khuroo *et al.* 2007 from Kashmir Himalayas, Singh *et al.* 2010 from Uttar pardesh, Dogra *et al.* 2011 from Himachal Pradesh and Mishra *et al.* 2015 from Delhi)[10-13]. The invasion by *Prosopis juliflora* and *Parthenium hysterophours,* which have spread in

the entire irrigated parts of Bikaner division, is creating many problems for the local inhabitants. *Prosopis juliflora* is native of arid region of Mexico and Central America, was first introduced in India in 1877 from England. It is a fast growing and drought resistance species which affects the plant biodiversity by creating a physical barrier on seedling of other plant species. It affects the native species of area by releasing various chemicals (Getachew *et al.* 2012)[14]. On the other hand *Parthenium hysterophours* is found to be responsible not only for allelopathic effect but also cause respiratory and skin diseases in local resident and livestock. It is native to America tropics and introduced in India in 1984. *Verbesina encelioides* a relatively recent introduction to study area is perennial weed that interfere with growth and establishment of crop species in irrigated parts of Bikaner division.

Biological invasion now operate at vast scale and will undergo rapid increase in recent future due to the changes in global scenario. A better planning is urgent need for early detection and reporting of infestation of spread of exotic plant species in Bikaner division by establishing resource centers and communication link between taxonomists, ecologists and agriculturists for management to monitor and control along with proper local quarantine systems that will check the introduction of exotic plant species.

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