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Original article

Eco-Floristic studies of native plants of the Beer Hills along the Indus River in the districts Haripur and Abbottabad, Pakistan

Saira Bano [a], Shujaul Mulk Khan [b,*], Jan Alam [a], Abdulaziz A. Alqarawi [c], Elsayed Fathi Abd_Allah [c,*], Zeeshan Ahmad [b], Inayat Ur Rahman [a], Habib Ahmad [d], Abdullah Aldubise [c], Abeer Hashem [e]

[a] Department of Botany, Hazara University Mansehra, Pakistan
[b] Department of Plant Sciences, Quaid-i-Azam University Islamabad, Pakistan
[c] Department of Plant Production, Collage of Food & Agricultural Sciences, King Saud University, P.O. Box. 2460, Riyadh 11451, Saudi Arabia
[d] Islamia College University Peshawar, Pakistan
[e] Botany and Microbiology Department, College of Science, King Saud University, P.O. Box. 2460 Riyadh 11451, Saudi Arabia

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ABSTRACT

The present study was conducted to elaborate vegetation composition structure to analyze role of edaphic and topographic factors on plant species distribution and community formation during 2013–14. A mixture of quadrat and transect methods were used. The size of quadrat for trees shrubs and herbs were 10 × 5, 5 × 2, 1 × 1 meter square respectively. Different phytosociological attribute were measured at each station. Primary results reported 123 plant species belong to 46 families. Asteraceae and Lamiaceae were dominant families with 8 species each. PCORD version 5 were used for Cluster and Two Way Cluster Analyses that initiated 4 plant communities within elevation range of 529–700 m from sea level. Indicator species analyses (ISA) were used to identify indicator species of each community. CANOCO Software (version 4.5) was used to measure the influence of edaphic and topographic variables on species composition, diversity and community formation. Whereas Canonical Correspondence Analysis (CCA) was used to measure the effect of environmental variables which showed elevation and aspect were the stronger environmental variable among topographic and $CaCO_3$ contents, electric conductivity, soil pH were the stronger edaphic factors in determination of vegetation and communities of the Bheer Hills. Grazing pressure was one of the main anthropogenic factors in this regard.

1. Introduction

The plant communities are a complex quantitative hierarchy in the vegetation science that always depends on species richness, distribution and associated ecological factors (Gaston, 2000; Maurer, 1999). These have previously been described floristically as well as physiognomically in number of ways. They have a demarcated structure in an area in relation to biotic and a biotic variation (Kent and Coker, 1992; Van Rooyen et al., 1981; Roberts and Wuest, 1999; Tainton et al., 1996; Cleaver et al., 2005; Brown and Bezuidenhout, 2005). Vegetation structure is usually influenced by environmental gradient and anthropogenic activates. In addition the edaphic and topographic factors also play a vital role in communities formation that ultimately leads to specific phytogeographic regions (Rohde, 1992). Ecological researches always tend to understand and quantify the relationship between biotic and a biotic components of an ecosystem (Tavili and Jafari, 2009). Various floristic analyses are used to identify the plant communities habitat types and important characteristic plant species (Katsuno, 1977; Fujiwara, 1987). In each sort of habitat each plant species has a microclimate and play its role in habitat formation (Duigan and Bredenkamp, 2003) and relations among populations (Scheiner, 1993). It is essential to measure and develop a suitable model to capture the natural features of

Abbreviations: ISA, Indicator Species Analysis; CCA, Canonical Correspondence Analysis; DBH, diameter at breast height; CA, Cluster Analysis; TWCA, Two Way Cluster Analysis; IVI, Importance Value Index; T, transect; S, station.

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* Corresponding authors.
E-mail addresses: smkhan@qau.edu.pk (S.M. Khan), eabdallah@ksu.edu.sa (E.F. Abd_Allah).

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an ecosystem for its sustainable use. Floristic analyses are the prerequisites for conservation of plant species. Therefore, current project was conducted to comprehend the role of such factor in the establishment of plant communities and its application in future conservation studies.

The Beer Hills along the Indus River have not been studied using recently developed analytical methods for vegetation characterization. The current study was therefore conducted to find out the floristic composition and vegetation structure of plant communities in the targeted region using modern tools. For this purpose plant species composition, abundance and the environmental variability, with special reference to gradient analyses were taken into consideration during 2012–2013.

2. Materials and methods

The Beer Hills are located at the bank of Indus River in two districts of Khyber Pakhtunkhwa province of Pakistan i.e., District Abbottabad and District Haripur at 34°10′ North latitude and 72°58′ East longitude with elevation 529–700 m at sea level. The temperature and precipitation equally distributed throughout the year with humid subtropical sort of climate. A total of seven transects were established at 3 km distance and within each transect five stations were recognized at 200 m interval randomly along with elevation gradient. In this a total of 34 stations with three hundred and six (306) quadrats were established using GPS (Global Positioning system) (Khan et al., 2013b). Quadrat and transect methods were used on hill slopes at all stations. Sizes of the quadrates for trees, shrubs and herbs were 10×5 m, 5×2 m and 1×1 m respectively (Salzer and Willoughby, 2004). Data attributes i.e., density, relative density, cover, relative cover, frequency, relative frequency and Importance Values Index (IVI) were measured at each station. The diameters of trees were measured at breast height (DBH) to find out its cover value for trees. The biological spectrum was determined using Raunkiaer Life form classification (Raunkiaer, 1934). The plant specimens were collected in each quadrat, labeled with tags, and pressed with plant presser in the field. Specimens were poisoned using 3% solution of Mercuric Chloride and Ethyl Alcohol solution and mounted on standard size herbarium sheets having a size of ($17.5'' \times 11.5''$). All specimens were identified with the help of flora of Pakistan and other available literature (Khan et al., 2013a).

2.1. Soil analyses

The soil samples were collected up to 45 cm depth from each station through soil sampling tube. The samples were sieved to remove large particles. The soil physiochemical analyses i.e., Soil Texture, Calcium, Carbonate, Organic Matter concentration, Soil pH, Electrical Conductivity (E.C), Phosphorus and Potassium were measured in Agriculture research station Baffa Mansehra. The soil texture and pH were measured through hydrometer and pH meter respectively (Khan et al., 2012a,b; Koehler et al., 1984). While, soil organic matters were determined by standardized solution of $FeSO_4$ and $K_2Cr_2O_7$ (Nelson et al., 1996). Whereas $CaCO_3$ concentration were determined by acid neutralization method (Black et al., 1965). AB-DTPA extractable P and K was determined in samples through method described by Soltanpour (1991).

2.2. Data analyses

The data were statistically analyzed to find out the relationship between plant species composition and various ecological variables. For the data analysis we put the data of seven transect (34 stations and 306 quadrates) in MS EXCEL and prepared presence absence (1, 0) data sheet for CA (Cluster Analysis) and TWCA (Two Way Cluster Analysis). The plant species data were arranged horizontally and quadrates data were arranged vertically according to the software (PC-ORD version 5 software) requirement (Lepš and Šmilauer, 2003). The species and environmental data matrices were analyzed in CANOCO software version 4.5 to find the effect of environmental variables on species composition and distribution pattern.

3. Results

A research study was conducted in Beers Hills to find out plant species distribution pattern, composition and abundance in relation to environmental variables and edaphic factors.

3.1. Species composition of the Beer Hills

A total of 123 plant species were collected belong to 46 families distributed in 34 stations included 27 trees, 23 shrubs and 73 herbs species of all the vegetation. The topmost dominant families were Asteraceae and Lamiaceae having eight plant species, 13% of all species. The Amranathaceae, Moraceae and Poaceae have seven species each. While Malvaceae and Solanaceae with six species each respectively.

3.2. Raunkier life form

The plant species were classified through Raunkiaer (1934) classification into 5 various life form classes. The Phanerophytes was the most dominant class with 52 plant species (42%) followed by Therophytes with 37 species (30%), Hemicryptophytes with 24 species (20%), Cryptophytes with 7 species (6%) and Chemaephytes having 3 species (2%) respectively (Table 2).

3.3. Abundant and less abundant plant species of the Beer Hills

The abundant and less abundant plant species were found on the basis of Importance Values Index (IVI). The topmost abundant tree species of the study area was *Mallotus philippensis, Acacia nilotica, Acacia modista, Ziziphus jujuba, Ficus benghalensis, Ficus carica, Broussonetia papyrifera, Pistacia integerrima, Dalbergia sissoo* and *Morus nigra* with high IVI. While *Punica granatum, Ailanthus altissima, Citrus aurantium, Pterospermum acerifolium, Eriobatrya japonica, Ceiba pentandra, Cassia fistula, Syzygium cumimi, Juglans regia,* and *Ficus religiosa* were recorded as less abundant trees with minimum IVI in the study area. In shruby layer the most dominant species were *Dodonaea viscosa, Justicia adhatoda, Otostegia limbata, Berberis lyceum, Cotoneaster dammeri, Sageretia brendrethiana, Ziziphus nummularia, Marrubium supinum, Nerium oleander* and *Periploca aphylla* with IVI above than 800 in the region. The top ten rare shrub species were *Lantana camara, Ipomoea carnea, Clerodendrum philippinum, Parthenocissus semicordata, Rubus fruticosa, Aera javanica, Ricinus communis, Jasminum nudiforum, Jasminum officinale* and *Calotropis procera* having low Importance values in the Beer Hills along with Indus River. In addition to, the *Cynodon dactylon, Avena barbata, Medicogo denculatus, Parthenium hysterophorus, Cannabis sativa, Euphorbia helioscopia, Euphorbia hirta, Nasturtium officinale, Malva neglecta,* and *Melica persica* were the most abundant species in herbaceous layer of the region. The uppermost rare herbs recorded with minimum IVI were *Datura alba, Brassica compestris, Alternanthera philoxeroides, Physalis angulate, Phegoteris connectilies, Achyranthes aspera, Diclipter roxburghiana, Cypres routundes, Oxalis corniculata* and *Cyprus niveus.* Most of the rare species present in the area were palatable which faces great pressure of grazing.

Table 1
Data summary table of 123 plant species in relations with all he environmental variables.

Axis	1	2	3	4	TI
EV (eigen values)	0.363	0.165	0.105	0.096	2.216
SEC (species-environment correlations)	0.962	0.910	0.906	0.915	
CPVSP (cumulative percentage variance of species data)	16.4	23.8	28.6	32.9	
SER (species-environment relation)	33.0	47.9	57.5	66.2	
SMC test					
TSFCA (test of significance of first canonical axis)		TSACA (test of significance of all canonical axes)			
EV (eigen value)	0.363	(Trace)			1.102
FR (F-ratio)	4.121	FR (F-ratio)			1.730
PV (P-value)	0.0020	PV (P-value)			0.0020

3.4. Species area curve

Initially PC-ORD version 5 were used to draw species area curves and compositional area curves to recognize either the quadrates size was adequate or not through abundance data combined with Sorensen distance values (Ahmad et al., 2016a,b). It also comprehends the vegetation relation with environmental variables. It results that the transect number 25 show maximum number of plant species and appearing new species continuously up to station number 31 (Fig. 1).

3.5. Results of Cluster Analysis

The Cluster Analyses using PCORD version 5 clustered 34 stations (306 quadrats) into 4 plant communities or habitats (Fig. 2).

3.6. Two Way Cluster Analysis (TWCA)

The Two Way Cluster analysis showed distribution of plant species in sampling stations. It was constructed with the help of presence and absence (1, 0) data sheet by Soresen measures. The black bubbles/dots represented the presence whereas white bubbles indicated the absence of plant species in the region. Four plant communities were recognized through grouping of various stations (Fig. 3).

3.7. Classification of plant communities

3.7.1. Ficus beghalensis-Nerium oleander-Euphorbia heterophylla community

The community name was given based on Indicator species analyses (ISA). This community was observed at elevation of 432–583 m. *Ficus beghalensis, Nerium oleander* and *Euphorbia heterophylla* were the characteristics species of tree, shrub and herb layer respectively. The other dominant species of tree layer with high IVI values included *Mallotus philippensis, Broussonetia papyrifera, Ficus carica, Dalbergia sissoo* and *Mangifera indica.* While the rare tree species were *Ceiba pentandra, Cassia fistula, Syzgium cumini, Juglans regia, Ficus religiosa* and *Olea ferruginea* with minimum IVI in the region. Whereas shrub layer was dominated by *Justicia adhatoda, Otostegia limbata, Nerium oleander, Dodonaea viscosa, Cotoneaster dammeri, Marrubium supinum,* with rare species *Carissa opaca, Sageretia brendrethiana, Jasminum nudiforum, Ricinas comunnis, Jasminum officinale, Calotropis procera.* Although the dominant herbaceous layer included *Cynodon dactylon, Cannabis sativa, Avena barbata, Nasturtium officinale, Parthenium hysterophorus, Euphorbia helioscopia, Mediogo denculatus, Malva neglecta, Euphorbia heterophylla* and *Rumex dentatus*. Whereas *Physalia angulata, Hybisus caesium, Phegopteris connectilis, Achyranthes aspera, Delphinium bicolar, Dicolipter roxburghiana, Argemome Mexicana, Artemisia absinthium* and *oxalis corymbosa* are rare herbs species in the region with low IVI values.

The characteristic plant species in community i.e., *Ficus beghalensis* having important value 78 and p value 0.02, *Euphorbia helerophylla* having IVI 71 and with p value 0.03. In addition to the data attribute plot of *Ficus beghalensis* that show the grazing pressure has no effect on this species because tree layer was not affected by grazing pressure but greatly affected by high altitude as a result it was mostly observed in lower altitude of the region. While the electrical conductivity of community soil was measured between 0.16 and 0.25 dsm^{-1}, Calcium carbonate was 2.4–6.2%, Potassium 90–130 ppm and Phosphorus 5.6–8.4 ppm respectively.

3.7.2. Ficus carica - Justicia adhatoda - Parthinium hysterophorus community

This community was found between elevations of 557–640 m. The *Ficus carica, Justicia adhatoda, and Parthinium hysterophorus* were the dominant characteristic tree, shrub and herb. The other dominant species of the tree layer included *Acacia nilotica, Acacia modista, Ziziphus jujuba, Olea ferruginea* and *Ficus carica.* While, the rare tree species were *Punica granatum, Broussonetia papyrifera, Melia azedarach, Morus nigra* and *Dalbergia sissoo*. Regarding the shruby layer *Dodonia viscosa, Justicia adhatoda, Otostegia limbata, Sageretia brenrerthiana, Colebrookea opposifolia* was the most dominant and *Marrubium supinum, Gymnosporia royleane, Cotoneaster dammeri, Ricinus communis* and *Calotropis procera* was the rare plant species in the region. The characteristic species of herbaceous layer was *Cynodon dactylon, Solanum surattense, Parthenium hysterophous, Medicogo denculatus, Avena barbata, Euphorbia hirta, Euphorbia helioscopia, Rumex dentatus, Delphinium bicolor, Amaranthus viridis* and the characteristic rare species of community was *Mirabilis jalapa, Convolvulus arvensis, Solanum pseudocapsium, Bidens pilosa, Conyza Canadensis, Ranunculus muricatus, Cichorium intybus, Achyranthus aspera, Phegopteris connectilis* and *Physalis angulate* with minimum IVI.

Regarding the soil analyses of community electrical conductivity was 0.15–0.25 dsm^{-1}, Calcium carbonate was 5.2–7.2%, Potassium was 100–125 ppm and Phosphorus 6.4–7.5 ppm was recorded.

3.7.3. Melia azedarach - Dodonaea viscosa – Polygonum avicula community

This community was found at the elevation of 572–645 m. The recorded Characteristic species of tree layer was *Mallotus philippensis, Pistacia integerrima, Acacia modista, Ziziphus jujuba* and *Acacia nilotica*. While rare trees were *Olea ferruginea, Broussonetia papyrifera, Ficus racemosa, Morus alba* and *Melia azedarach* with minimum IVI in the region. While, the dominant species of shruby vegetation in community included *Dodonaea viscosa, Berberis lyceum, Otostegia limbata, Carissa opaca* and *Sageretia brendrethiana*. In addition to,

Table 2
Plant species and Family names with Raunkiaer Life form classes.

NO. SO	*Botanical name of Plants*	Family name	Life forms
1	*Acacia modista* (Wall.)	Fabaceae	Ph
2	*Acacia nilotica* (L.)Del.	Fabaceae	Ph
3	*Ailanthus altissima* (Mill) Swingle	Simaroubaceae	Ph
4	*Broussonetia papyrifera* (L.) vent	Moraceae	Ph
5	*Cassia fistula* L.	Fabaceae	Ph
6	*Ceiba pentandra* (L.) Gaerth.	Malvaceae	Ph
7	*Citrus aurantium* L.	Rutaceae	Ph
8	*Dalbergia sissoo* Roxb.ex.DC.	Fabaceae	Ph
9	*Eriobatrya japonica* (Thunb.) lindl.	Rosaceae	Ph
10	*Eucalyptus camaldulensis* Dehnh.	Myrtaceae	Ph
11	*Ficus benghalensis* L.	Moraceae	Ph
12	*Ficus carica* L.	Moraceae	Ph
13	*Ficus racemosa* L.	Moraceae	Ph
14	*Ficus religiosa* L.	Moraceae	Ph
15	*Juglans regia* L.	Juglandaceae	Ph
16	*Mallotus philippensis* (Lam.) Muell.	Euphorbiaceae	Ph
17	*Mangifera indica* L.	Anacardiaceae	Ph
18	*Melia azedarach* L.	Meliaceae	Ph
19	*Morus alba* L.	Moraceae	Ph
20	*Morus nigra* L.	Moraceae	Ph
21	*Olea ferruginea* Royle.	Oleaceae	Ph
22	*Papulus ciliata* Wall.ex.Royle	Salicaceae	Ph
23	*Pistacia integerrima* J.L.Stewart ex Brandis	Anacardiaceae	Ph
24	*Pterospermum acerifolium* (L.) Willd.	Malvaceae	Ph
25	*Punica granatum L.*	Lythraceac	Ph
26	*Syzygium cumini* (L.) Skeels	Myrtaceae	Ph
27	*Ziziphus jujuba* Milli.	Rhamnaceae	Ph
28	*Aerva javanica* (Burm.f.)shult	Amaranthaceae	Ch
29	*Berberis lycium* Royle.	Berberidaceae	Ph
30	*Calotropis procera* (L.)	Asclapiadaceae	Ph
31	*Colebrookea opposifolia* Sm	Labiatae	Ph
32	*Clerodendrum Philippinum multiplex.* JPG	Verbenaceae	Ph
33	*Carissa opaca* L.	Apocynaceae	Ph
34	*Cotoneaster dammeri* C.K.Schneid.	Rosaceae	Ph
35	*Dodonaea viscose* (L.) Jacq.	Sapindaceae	Ph
36	*Gymnosporia royleana* Wall.	Celastraceae	Ph
37	*Ipomoea carnea* Jace.	Convolvulaceae	Cr
38	*Jasminum nudiforum* Lindl.	Oleaceae	Ph
39	*Jasminum officinale* L.	Oleaceae	Ph
40	*Justicia adhatoda* L.	Acanthaceae	Ph
41	*Lantana camara* L.	Verbenaceae	Ch
42	*Marrubium supinum* L.	Lamiaceae	Ph
43	*Nerium oleander* L.	Apocynaceae	Ph
44	*Otostegia limbata* (Beth.) Boiss	Lamiaceae	Ph
45	*Parthenocissus semicordata* Wall.	Vitaceae	Ph
46	*Periploca aphylla* Decne.	Asclepiadaceae	Ph
47	*Ricinus communis* L.	Euphorbiaceae	Ph
48	*Rubus fruticosus* L.	Rosaceae	Ph
49	*Sageretia brendrethiana* J.Linn.	Rhamnaceae	Ph
50	*Woodfordia fruticosa* (L.) Kurz	Lythraceac	Ph
51	*Ziziphus nummularia* Burm.f.	Rhamnaceae	Ph
52	*Achyranthes asperaL.*	Amaranthaceae	He
53	*Adiantum caudatum* Klotzsch	Pteridaceae	Th
54	*Ajuga bracteosa* Wall.	Lamiaceae	He
55	*Alternanthera hirtula* (Mart.)	Amaranthaceae	Th
56	*Alternanthera philoxeroides* Griseb.	Amaranthaceae	Th
57	*Amaranthus spinosus* L.	Amaranthaceae	Th
58	*Amaranthus viridis* L.	Amaranthaceae	Th
59	*Anthriscus sylvestris* L.	Apiaceae	Th
60	*Argemone mexicana* L.	Papaveraceae	Th
61	*Artemisia absinthium* L.	Asteraceae	Th
62	*Arundo donax* L.	Poaceae	Ph
63	*Avena barbata* Pott ex Link	Poaceae	Th
64	*Barleria cristata* L.	Acanthaceae	He
65	*Bidens pilosa* L.	Asteraceae	He
66	*Brassica compestris* L.	Brassicaceae	Th
67	*Cannabis sativa L.*	Cannabaceae	Th
68	*Celosia argentea* L.	Amaranthaceae	Th
69	*Chenopodium album* L.	Chenopodiaceae	He
70	*Cichorium intybus* L.	Asteraceae	Th
71	*Commelina communis* L.	Commelinaceae	Cr
72	*Convolvulus arvensis* L.	Convolvulaceae	Cr
73	*Conyza bonariensis* L.	Asteraceae	Th
74	*Conyza canadensis* (L.) Cronquist	Asteraceae	Th
75	*Corchorus olitorius* L.	Malvaceae	Th
76	*Cynodon dactylon* (L.)Pers.	Poaceae	He
77	*Cynoglossum zeylanicum (*Lehm.) Brand	Boraginaceae	He
78	*Cyperus niveus* Retz.	Cyperaceae	He
79	*Cyperus rotundus* L.	Cyperaceae	He
80	*Datura alba* L.	Solanaceae	Th
81	*Debregeasia salicifolia* N/A	Urticaceae	Ph
82	*Delphinium bicolor* Nutt.	Ranunculaceae	Th
83	*Diclipter roxburghiana* T.Anders.	Acanthaceae	Th
84	*Echinochloa colona* (L.) link.	Poaceae	He
85	*Euphorbia helerophylla* L.	Euphorbiaceae	Th
86	*Euphorbia helioscopia* L.	Euphorbiaceae	Th
87	*Euphorbia hirta* L.	Euphorbiaceae	Th
88	*Hybiscus caesius* Garcke var caesius	Malvaceae	Ph
89	*Ipomoea hederacea* Jaeq.	Convolvulaceae	Cr
90	*Ipomoea purpurea (*L.) Rath	Convolvulaceae	Cr
91	*Lepidium virginicum* L.	Brassicaceae	He
92	*Leucas cephalota* (Roth) Spreng.	Lamiaceae	Th
93	*Malva neglecta* Wallr.	Malvaceae	He
94	*Malvastrum coromandelianum* L.	Malvaceae	He
95	*Marsilea villosa* Kanlf.	Marsileaceae	Cr
96	*Medico denculatus* L.	Fabaceae	He
97	*Melica persica* Kunth	Poaceae	He
98	*Mentha longiafolia* (L.) Huds.	Lamiaceae	He
99	*Mentha piperita* L.	Lamiaceae	He
100	*Mirabilis jalapa* L.	Nyctaginaceae	Th
101	*Nasturtium officinale* W.T.Aiton	Brassicaceae	Th
102	*Oxalis corniculata* L.	Oxalidaceae	He
103	*Oxalis corymbosa* DC.	Oxalidaceae	He
104	*Parthenium hysterophorus* L.	Asteraceae	He
105	*Pastinaca sativa* L.	Apiaceae	Th
106	*Pentanema indicum* (L.)Ling	Asteraceae	Th
107	*Persicaria globra* Willd.	Polygonaceae	Th
108	*Phegopteris connectilis* (Michx.) Wall	Thelypteridaceae	Cr
109	*Physalis angulata* L.	Solanaceae	Ph
110	*Polygonum aviculare* L.	Polygonaceae	He
111	*Ranunculus muricatus* L.	Ranunculaceae	He
112	*Rumex dentatus* L.	Polygonaceae	He
113	*Salvia coccinea* Buc.	Lamiaceae	Th
114	*Solanum nigrum* L.	Solanaceae	Th
115	*Solanum pseudocapsicum* L.	Solanaceae	Th
116	*Solanum surattense* L.	Solanaceae	Th
117	*Solanum virginanum* L.	Solanaceae	Th
118	*Sorghum vulgare* L.	Poaceae	Th
119	*Triticum aestivum* L.	Poaceae	Th
120	*Urtica dioica* L.	Urticaceae	Th
121	*Vaccaria pyramidata* Medik.	Caryophyllaceae	Th
122	*Verbascum thapsus* L.	Scrophulariaceae	He
123	*Xanthium strumarium* L.	Asteraceae	Ch

Ph = Phanerophyte; Ch = Chamaephytes; He = Hemicryptophytes; Cr = Cryptophytes; Th = Therophytes.

Periploca aphylla, Gymnosporia royleana, Aerva javanica, Marrubium supinum, Polygonum avicular and *Colebrookea opposifolia* was the rare shrubs recorded with low IVI in the region. The characteristic herbaceous species are *Avena barbata*, *Melica persica, Medicogo denculatus, Artemisia absinthium, Parthenium hysterophous, Argemone Mexicana, Euphorbia hirta, Euphorbia helioscopia* and *Polygonum aviculare*. The community has rare herb species with minimum IVI was *Ajuga bracteosa, Malva neglecta, Arundo donax, Hybiscus caesius, Vaccaria pyramidata, Urtica dioica, Ipomoea hederacea, Ipomoea purpurea, Physalis angulata* and *Solanum virginanum.*

The soil analyses resulted that the community has Electrical conductivity between 0.17 and 0.23 dsm^{-1}, Calcium carbonate

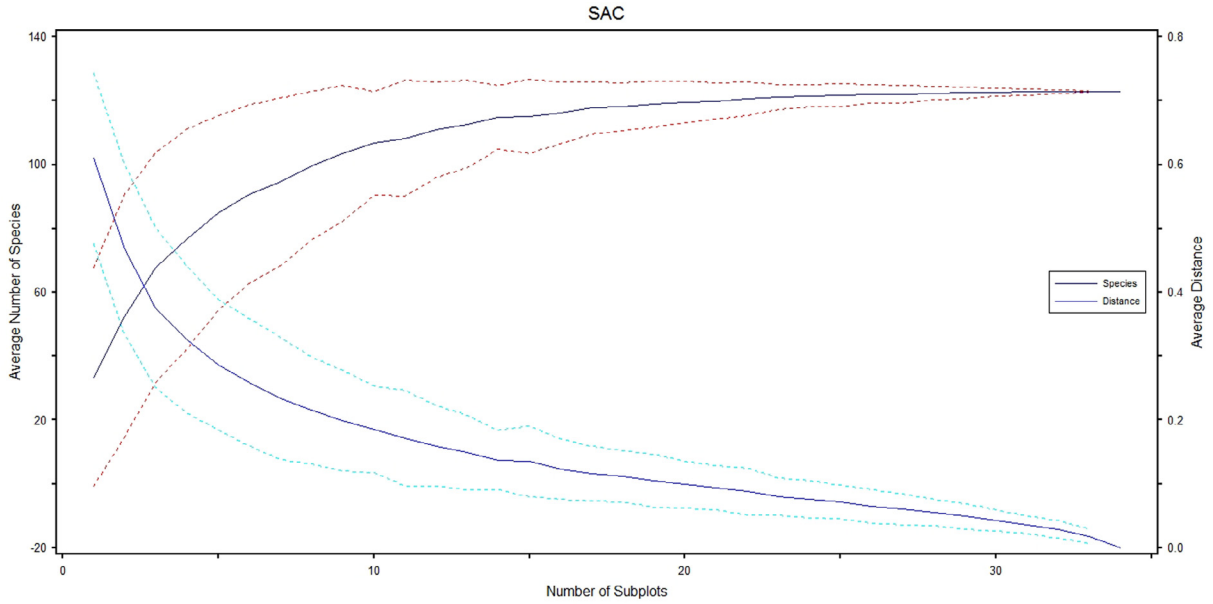

Fig. 1. The Specie area curves showing adequacy of sampling in the studied area.

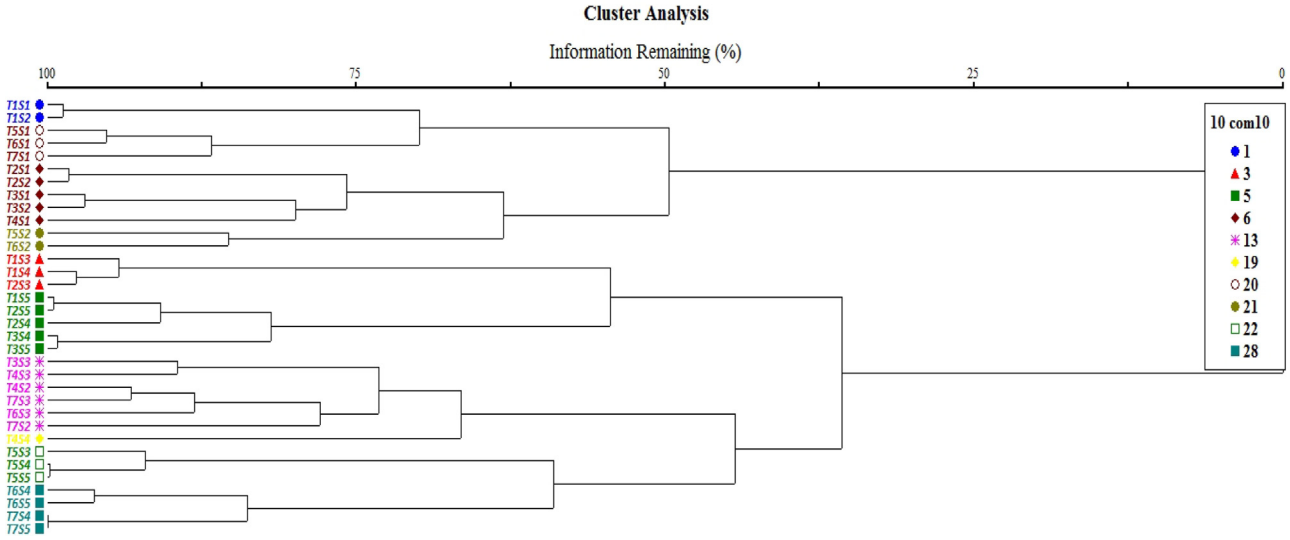

Fig. 2. Cluster dendrogram classified 34 sampled stations into 4 habitat types/plant communities.

2.4 and 6.5%, Potassium 100 and 130 ppm and Phosphorus 7.3 and 8.2 ppm respectively.

3.7.4. Acacia nilotica - Berberis lycium - Echinochloa colona community

This community initiated at the elevation of 2485–2937 m. The dominant tree species were *Acacia modista, Ziziphus jujuba, Mallotus philippensis* with rare species *Morus nigra, Ficus carica* and *Broussonetia papyrifera*. The characteristic shrub species of the community were *Indigofera heterantha* and *Plectranthus rugosus*. While dominant species were *Berberis lycium, Dodonaea viscosa*, *Periploca aphylla*, *Justicia adhatoda, Ziziphus nummularia* and rare species included *Cotoneaster dammeri, Sageretia brendrethiana, Carissa opaca* and *Gymnosporia royleana.* Among the characteristic herbaceous species *Cynodon dactylon, Avena barbata, Euphorbia hirta, Mediocogo denculatus, Delphinium bicolor, Melica persica, Conyza bonariensis, Conyza Canadensis, Echinochloa colona* and *Solanum surattens*. Whereas *Argemone mexicaca, Parthenium hysterophorous, Saliva coccinea, Chenopodium album, Leucas cephalota, Ajuga bracteosa, Barleria cristata, Sorghum vulgare, Oxalis corniculata,* and *Xanthium strumarium* were recorded as rare herbs with minimum IVI in the region.

The soil analyses of this habitat show the electrical conductivity between 0.16 and 0.22 dsm^{-1}, Calcium carbonate 4 and 6.4%, Potassium 100 and 130 ppm and Phosphorus 6 and 9 pp, which play a significant key role in distribution of plant species of present community.

3.8. Environmental gradient

The Species and environmental data matrices were put together in CANOCO software version 4.5. All environmental variables as

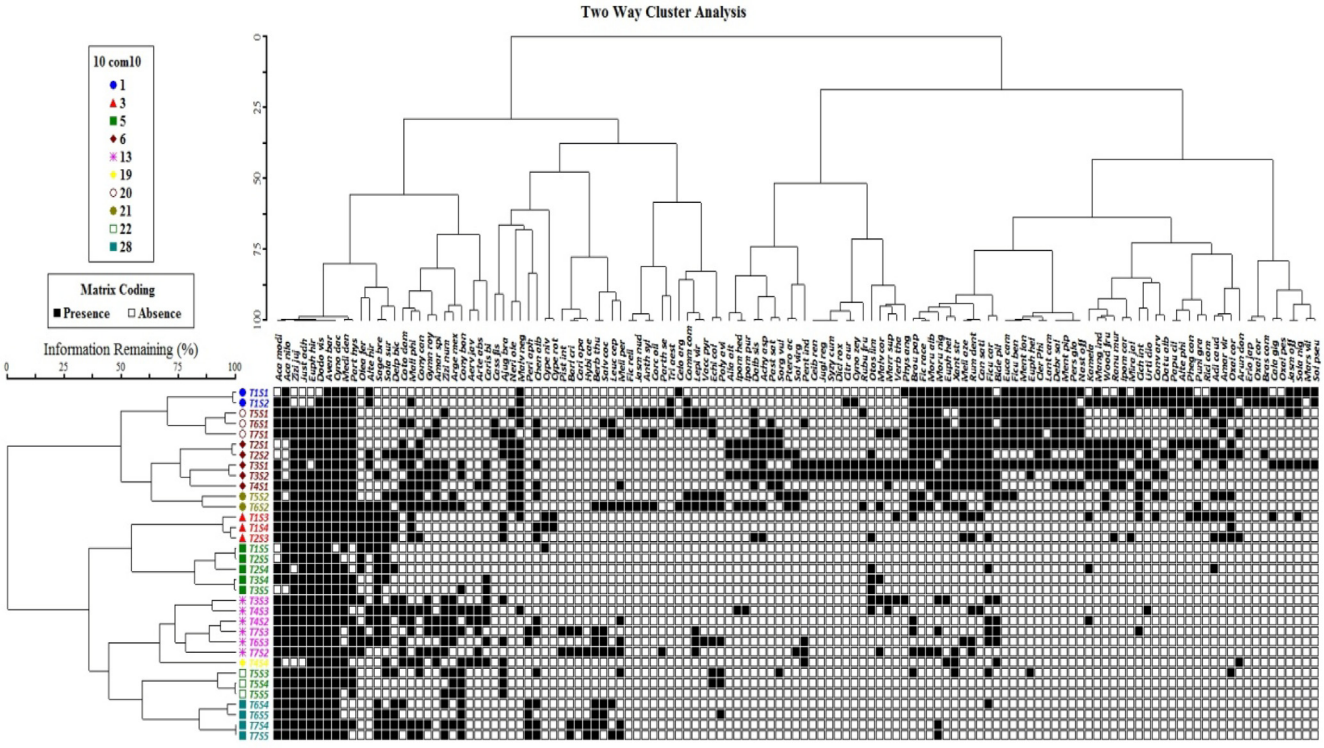

Fig. 3. Two Way Cluster dendogram showing distribution of 123 species in 306 quadrats.

biotic factors (grazing pressure) and abiotic factors (edaphic and topographic) show significant effect on plant species composition, distribution pattern and abundance with p value ($p \leq 0.002$) (Table 1).

In ordination of various plant species each cross in the figure represented a plant species and the distance between them show the similarity and differences index. All the plant species were compared with environmental gradient and soil data through CANOCO software. The treated environmental variables were altitude, aspect, grazing pressure, organic matter, phosphorous, potassium, pH, deep soil, silt and rocky soil. The CCA (bi-plot diagram) of first quadrant indicated most of the plants were assembled under the influence of $CaCO_3$ and sandy nature of soil. While going through 3rd quadrant most of the environmental variables clustered around phosphorous, pH, organic matter concentration, potassium, high elevation rang and clay nature of soil. Furthermore on the 4th quadrant most of the plants are assembled under the influence of electrical conductivity and grazing pressure (Fig. 4).

3.9. Ordination of different stations under the influence of environmental gradient

The CCA ordination bi-plot based on edaphic and topographic factors data presents the first quadrant was preliminary related with $CoCO_3$ and sandy nature of soil (Fig. 5). The 3rd quadrants was mainly correlated with phosphorous, pH, organic matter concentration, potassium, high elevation rang and clay nature of soil having T2S2, T3S2, T4S2, T5S, T5S4, T6S2 and T6S3 (T = transect, S = station). While the 4rt quadrant show aspect of electrical conductivity and grazing pressure that clustered T4S1, T5S1, T5S2, T6S1 and T7S1 respectively (Fig. 5).

3.10. Discussion

The current study revealed a total of 123 plant species of the Beer Hills along Indus River belong to 46 families. The 27 tree species (22%), 23 shrubs (19%) and 73 herbs (59%) were recorded. The study area revealed the herb species were in maximum number with greater cover, followed by trees and shrubs. Physiographic factors such as slope angle, different edaphic factors and altitudinal rang effect the vegetation composition and distribution pattern. Furthermore, at higher altitude vegetation layer became decrease due to physical and biological factors that affect plant growth. The same results were reported by Haq et al. (2011) that showed

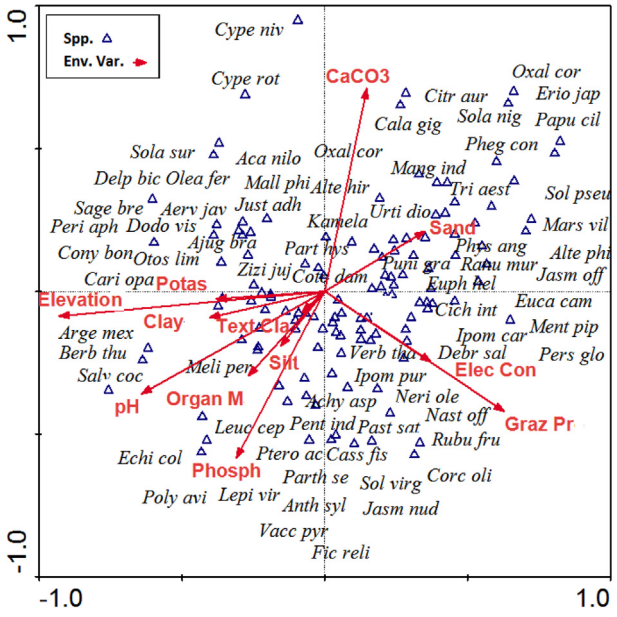

Fig. 4. CCA diagram showing the species distribution under the influence of various environmental variables. Spp = Species, Env Var = Environmental factors, Phosph = Phosphorus, Potas = Potassium, Elec Con = Electrical Conductivity, Organ M = Organic Matter, Text Cla = Texture Class, Graz Pr = Grazing Pressure.

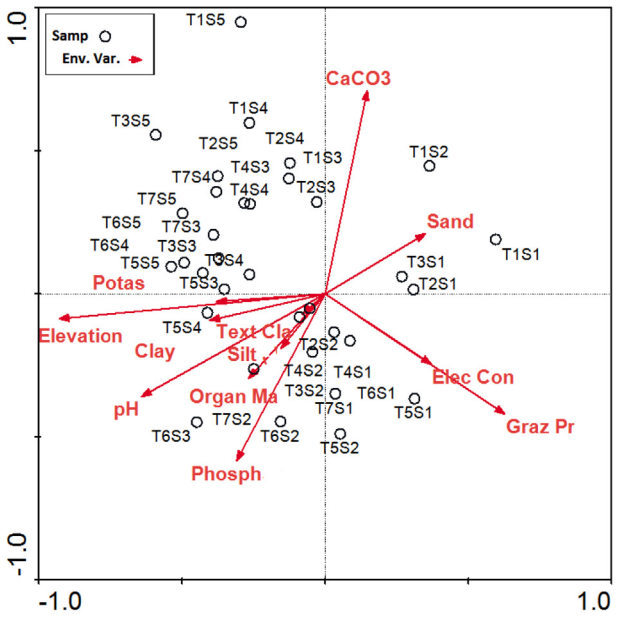

Fig. 5. CCA bi-plot diagram showing the distribution of sampled stations in relation to various environmental variables. T = Transect, S = Station, Samp = Sample, Env Var = Environmental factors, Phosph = Phosphorus, Potas = Potassium, Elec Con = Electrical Conductivity, Organ M = Organic Matter, Text Cla = Texture Class, Graz Pr = Grazing Pressure.

the vegetation was rich at lower elevation as compared to higher elevation range. The flora of Beer Hills result Asteraceae, Lamiaceae, Moraceae, Amaranthaceae and Poaceae was the most dominant families of the region. Similarly Asteraceae and Lamiaceae were proved well established and largest families in flora of Pakistan by Ali and Qaiser (1995) and Stewart (1972). Plus in other adjacent locations Dar et al., 2012 reported one hundred and three families at Machiara national park Muzaffarabad. The dominant families of the investigated area were Balsaminaceae, Ranunculaceae and Asclepiadaceae. While Pant and Samant (2007) described forest plant biodiversity of the Western Himalaya. Similar to our results Perveen and Hussain (2007) work out on species density, cover and frequency of Gorakh hills and reported seventy-four plant species distributed in thirty-four families. Plants play a vital role in economy of a country. It was used as food, fruit, medicines, forage, timber wood, fire wood, etc. (Durrani, 2000; Malik, 2005; Shinwari et al., 1996). This research project also resulted various plant species i.e., *Medicogo denculatud*, *Malva neglecta* were edible species, *Mentha* species, *Justicia adhatoda* and *Acacia* were medicinally use, *Morus* species, *Melia azedarach* were used as a timber and *Dadonia vescosa* were used as a fuel wood in the Beer Hills area. Flora of an area represents the particular species of an area which are qualitatively and quantitatively analyzed. Floristic structure of a region was very important to relate it with environmental gradient. It depends upon biotic and abiotic factors of an environment and can be affected by deforestation and over grazing particularly (Longhi et al., 1992). Similar were also reported in present work that grazing pressure effect on plant species distribution and composition. A total of 4 plant communities were identified through PCORD version 5 in study area. (Moinuddin et al., 2006: Ahmad et al., 2016a) studied the Phyto-sociological analysis of Himalayan forests of Pakistan, described twenty-four different communities and four monophonic specific forests vegetation as well as labeled the species composition and IVI values. While CANOCO Software version 4.5 was used to measure the influence of edaphic and topographic variables on species composition and diversity and community formation. Similar techniques were also applied by Khan et al. (2012b) for proper documentation of plant species. Whereas Borcard et al., 1992 performed Canonical Correspondence Analysis (CCA) by using a quantitative statistical approach to categorize among various variables. Brown and Bezuidenhout (2005) investigated National park (De mountain zebra National park, South Africa) and find out fourteen communities consuming TWINSPAN grouping. The soil pH ranges from 7.2 to 7.8; organic matter concentration from 0.52% to 0.85%, calcium carbonate amount is 2.38% to 7.2%, sand concentration was 28.6% to 58.6%, Phosphorous was 5.6 ppm to 9 ppm, potassium ranges 130 ppm to 90 ppm. Similarly (Khan et al., 2012a,b, 2014, 2016; Nazir et al., 2012; Shaheen et al., 2011; Iqbal et al., 2015; Ahmad et al., 2016a) also found out various plant communities in relation to environmental gradients. Furthermore, Noureen et al., 2008 investigated Cholistan desert, vegetation on the basis of environmental factors. Whereas, Yimer, 2007, defined that soil disturb the structure of the plant community and ground cover, amount of plant development, capability of natural regeneration and additional critical factors. In study area grazing pressure was observed higher at lower elevation range of the Beer Hills. It was also reported by Pennings and Silliman (2005) that grazing pressure was high at lower elevation. Whereas, Sakya and Bania (1998) describes, elevation play an important role in the community formation. Shank and Noorie (1950) find out that temperature and atmospheric pressure changed with increasing height other factors like soil pH, soil moisture, soil nutrients and biotic factors also take part in the formation of plant communities. Life forms of the plants were very important to describe the vegetation structure. The plant species collected in the study area were classified into five Raunkiaer classes. It was resulted that Phanerophytes was the dominant class followed by the Therophytes, Hiemicryptophytes, Cryptophytes, and Chamaephytes respectively. A similar result was described by Malik and Malik (2004) in Kotli Hill Kashmir. Whereas Hadi et al. (2009) reported a phytosociological effort on weed flora in the vegetable fields of (Botanical Garden, Azakhel in summer season 2009) which consist of 30 weed species in different vegetables fields with dominant Therophytes life form class.

4. Conclusion

It was concluded that $CaCO_3$ contents, electrical conductivity, soil pH, organic matter concentration, phosphorous and silty nature of soil were the stronger edaphic factors. While, among topographic factor the elevation and aspect were the significant environmental variables that affect the distribution pattern, composition and diversity of plant species and communities of Beer Hills. Identification of indicator and rare plant species in the specific micro-habitat can further be used for conservation management purposes.

Acknowledgment

The authors would like to extend their sincere appreciation to the Deanship of Scientific Research at king Saud University for its funding this Research group NO (RG-1435-014).

Appendix A.

See Appendix A.

Appendix A

Importance value index (IVI) of each plant species in the studied area.

No. S	Plant name		Plant name		Plant name		Plant name	
	Plant name	T IVI 1		T IVI 2	Plant name	T IVI 3	Plant name	T IVI 4
1	*Ficus benghalensis*	279.9	*Acacia nilotica*	173.8	*Mallotus philippensis*	286.9	*Acacia modista*	68.8
2	*Mallotus philippensis*	263.2	*Acacia modista*	123.3	*Pistacia integerrima*	151.8	*Ziziphus jujuba*	62.2
3	*Broussonetia papyrifera*	208.2	*Ziziphus jujube*	96.6	*Acacia modista*	69.5	*Mallotus philippensis*	61.4
4	*Ficus carica*	181.5	*Olea ferruginea*	67	*Ziziphus jujube*	69.2	*Acacia nilotica*	52.3
5	*Dalbergia sissoo*	179.7	*Ficus carica*	32.4	*Acacia nilotica*	68.8	*Morus nigra*	24.6
6	*Mangifera indica*	165.3	*Mallotus philippensis*	32	*Ficus carica*	57.4	*Ficus carica*	14.3
7	*Ziziphus jujube*	129	*Punica granatum*	29	*Morus nigra*	38.8	*Broussonetia papyrifera*	6.2
8	*Eucalyptus camaldulensis*	125	*Broussonetia papyrifera*	12	*Olea ferruginea*	37.8	*Ailanthus altissima*	0
9	*Morus alba*	121.7	*Melia azedarach*	12	*Broussonetia papyrifera*	27.7	*Cassia fistula*	0
10	*Acacia modista*	121.4	*Morus nigra*	9.9	*Ficus racemosa*	6	*Ceiba pentandra*	0
11	*Morus nigra*	119.9	*Dalbergia sissoo*	9	*Morus alba*	4.6	*Citrus aurantium*	0
12	*Ficus racemosa*	115.5	*Ailanthus altissima*	0	*Melia azedarach*	3.8	*Dalbergia sissoo*	0
13	*Populus ciliata*	112.6	*Cassia fistula*	0	*Ailanthus altissima*	0	*Eriobatrya japonica*	0
14	*Acacia nilotica*	108.5	*Ceiba pentandra*	0	*Cassia fistula*	0	*Eucalyptus camaldulensis*	0
15	*Melia azedarach*	95.4	*Citrus aurantium*	0	*Ceiba pentandra*	0	*Ficus benghalensis*	0
16	*Ailanthus altissima*	62.1	*Eriobatrya japonica*	0	*Citrus aurantium*	0	*Ficus racemosa*	0
17	*Punica granatum*	58.9	*Eucalyptus camaldulensis*	0	*Dalbergia sissoo*	0	*Ficus religiosa*	0
18	*Pistacia integerrima*	56.4	*Ficus benghalensis*	0	*Eriobatrya japonica*	0	*Juglans regia*	0
19	*Citrus aurantium*	55	*Ficus racemosa*	0	*Eucalyptus camaldulensis*	0	*Mangifera indica*	0
20	*Pterospermum acerifolium*	34.1	*Ficus religiosa*	0	*Ficus benghalensis*	0	*Melia azedarach*	0
21	*Eriobatrya japonica*	30	*Juglans regia*	0	*Ficus religiosa*	0	*Morus alba*	0
22	*Ceiba pentandra*	29.9	*Mangifera indica*	0	*Juglans regia*	0	*Olea ferruginea*	0
23	*Cassia fistula*	25.6	*Morus alba*	0	*Mangifera indica*	0	*Populus ciliata*	0
24	*Syzygium cumini*	22.5	*Populus ciliata*	0	*Populus ciliata*	0	*Pistacia integerrima*	0
25	*Juglans regia*	17.3	*Pistacia integerrima*	0	*Pterospermum acerifolium*	0	*Pterospermum acerifolium*	0
26	*Ficus religiosa*	15.4	*Pterospermum acerifolium*	0	*Punica granatum*	0	*Punica granatum*	0
27	*Olea ferruginea*	14.8	*Syzygium cumini*	0	*Syzygium cumini*	0	*Syzygium cumini*	0
28	*Justicia adhatoda*	259.1	*Dodonaea viscosa*	194.15	*Dodonaea viscosa*	366.8	*Berberis lycium*	140.6
29	*Otostegia limbata*	198.7	*Justicia adhatoda*	190.55	*Berberis lyceum*	185.3	*Dodonaea viscosa*	133.9
30	*Nerium oleander*	179	*Otostegia limbata*	94.4	*Otostegia limbata*	162.5	*Periploca aphylla*	104.4
31	*Dodonaea viscosa*	174.6	*Sageretia brendrethiana*	85.5	*Carissa opaca*	117.8	*Justicia adhatoda*	89.5
32	*Cotoneaster dammeri*	167.7	*Colebrookea opposifolia*	29	*Sageretia brendrethiana*	93.3	*Ziziphus nummularia*	48.1
33	*Marrubium supinum*	161	*Ziziphus nummularia*	14.4	*Cotoneaster dammeri*	87	*Cotoneaster dammeri*	30.6
34	*Colebrookea opposifolia*	112.9	*Marrubium supinum*	13	*Justicia adhatoda*	72.2	*Sageretia brendrethiana*	26.2
35	*Ziziphus nummularia*	86.9	*Gymnosporia royleana*	12	*Ziziphus nummularia*	70.5	*Otostegia limbata*	25
36	*Woodfordia fruticosa*	86.3	*Cotoneaster dammeri*	11.6	*Periploca aphylla*	58.6	*Carissa opaca*	15
37	*Gymnosporia royleana*	79.3	*Ricinus communis*	1.4	*Gymnosporia royleana*	57.1	*Gymnosporia royleana*	13.7
38	*Lantana camara*	76.05	*Calotropis procera*	1.03	*Aerva javanica*	28.4	*Aerva javanica*	0
39	*Ipomoea carnea*	75.15	*Aerva javanica*	0	*Marrubium supinum*	28	*Calotropis procera*	0
40	*Berberis lyceum*	75	*Berberis lyceum*	0	*Colebrookea opposifolia*	17.3	*Clerodendrum Philippinum*	0
41	*Clerodendrum Philippinum*	62.79	*Carissa opaca*	0	*Calotropis procera*	0	*Colebrookea opposifolia*	0
42	*Parthenocissus semicordata*	62	*Clerodendrum Philippinum*	0	*Clerodendrum Philippinum*	0	*Ipomoea carnea*	0
43	*Rubus fruticosus*	53	*Ipomoea carnea*	0	*Ipomoea carnea*	0	*Jasminum nudiforum*	0
44	*Carissa opaca*	28.9	*Jasminum nudiforum*	0	*Jasminum nudiforum*	0	*Jasminum officinale*	0
45	*Sageretia brendrethiana*	23.9	*Jasminum officinale*	0	*Jasminum officinale*	0	*Lantana camara*	0
46	*Jasminum nudiforum*	17	*Lantana camara*	0	*Lantana camara*	0	*Marrubium supinum*	0
47	*Ricinus communis*	16.1	*Nerium oleander*	0	*Nerium oleander*	0	*Nerium oleander*	0
48	*Jasminum officinale*	14.1	*Parthenocissus semicordata*	0	*Parthenocissus semicordata*	0	*Parthenocissus semicordata*	0
49	*Calotropis procera*	8.75	*Periploca aphylla*	0	*Ricinus communis*	0	*Ricinus communis*	0
50	*Aerva javanica*	0	*Rubus fruticosus*	0	*Rubus fruticosus*	0	*Rubus fruticosus*	0
51	*Periploca aphylla*	0	*Woodfordia fruticosa*	0	*Woodfordia fruticosa*	0	*Woodfordia fruticosa*	0
52	*Cynodon dactylon*	1145	*Cynodon dactylon*	302	*Cynodon dactylon*	525	*Cynodon dactylon*	560
53	*Cannabis sativa*	800	*Solanum surattense*	220	*Avena barbata*	264	*Avena barbata*	198
54	*Avena barbata*	651	*Parthenium hysterophorus*	215	*Melica persica*	221	*Euphorbia hirta*	190
55	*Nasturtium officinale*	646	*Medicogo denculatus*	203	*Medicogo denculatus*	202	*Medicogo denculatus*	160
56	*Parthenium hysterophorus*	643	*Avena barbata*	187	*Artemisia absinthium*	190	*Delphinium bicolor*	149
57	*Euphorbia helioscopia*	640	*Euphorbia hirta*	93	*Parthenium hysterophorus*	168	*Melica persica*	145
58	*Medicogo denculatus*	605	*Euphorbia helioscopia*	74	*Argemone mexicana*	159	*Conyza bonariensis*	125
59	*Malva neglecta*	574	*Rumex dentatus*	73	*Euphorbia hirta*	144	*Conyza canadensis*	111
60	*Euphorbia helerophylla*	548	*Delphinium bicolor*	67	*Euphorbia helioscopia*	127	*Echinochloa colona*	92
61	*Rumex dentatus*	434	*Amaranthus viridis*	64	*Polygonum aviculare*	121	*Solanum surattense*	92
62	*Mentha piperita*	428	*Ajuga bracteosa*	55	*Salvia coccinea*	121	*Polygonum aviculare*	79
63	*Xanthium strumarium*	414	*Alternanthera hirtula*	51	*Solanum surattense*	121	*Hybiscus caesius*	68
64	*Persicaria globra*	385	*Adiantum caudatum*	46.05	*Lepidium virginicum*	115	*Argemone mexicana*	62
65	*Amaranthus viridis*	322	*Oxalis corniculata*	45	*Barleria cristata*	113	*Parthenium hysterophorus*	62
66	*Euphorbia hirta*	316	*Malvastrum coromandelianum*	44	*Alternanthera hirtula*	103	*Salvia coccinea*	60
67	*Sorghum vulgare*	316	*Verbascum Thapsus*	44	*Xanthium strumarium*	102	*Chenopodium album*	59
68	*Mentha longiafolia*	300	*Cyperus rotundus*	43	*Bidens pilosa*	96	*Leucas cephalota*	57
69	*Melica persica*	263	*Arundo donax*	36	*Cannabis sativa*	72	*Ajuga bracteosa*	54
70	*Celosia argentea*	259	*Chenopodium album*	32	*Conyza canadensis*	71	*Barleria cristata*	36
71	*Cichorium intybus*	258	*Argemone mexicana*	30	*Conyza bonariensis*	67	*Sorghum vulgare*	34

Appendix A (*continued*)

No. S	Plant name		Plant name		Plant name		Plant name	
	Plant name	T IVI 1		T IVI 2	Plant name	T IVI 3	Plant name	T IVI 4
72	*Mirabilis jalapa*	244	*Cannabis sativa*	30	*Delphinium bicolor*	64	*Oxalis corniculata*	32
73	*Conyza canadensis*	227	*Cyperus niveus*	21	*Amaranthus spinosus*	62	*Xanthium strumarium*	30
74	*Arundo donax*	220	*Solanum nigrum*	19	*Rumex dentatus*	62	*Achyranthes aspera*	0
75	*Bidens pilosa*	211	*Malva neglecta*	18	*Pentanema indicum*	58	*Adiantum caudatum*	0
76	*Commelina communis*	211	*Mirabilis jalapa*	18	*Cichorium intybus*	55	*Alternanthera hirtula*	0
77	*Solanum nigrum*	208	*Convolvulus arvensis*	16	*Malvastrum coromandelianum*	55	*Alternanthera philoxeroides*	0
78	*Chenopodium album*	202	*Solanum pseudocapsicum*	15	*Leucas cephalota*	49	*Amaranthus spinosus*	0
79	*Ranunculus muricatus*	202	*Bidens pilosa*	13	*Chenopodium album*	46	*Amaranthus viridis*	0
80	*Pastinaca sativa*	196	*Conyza Canadensis*	13	*Echinochloa colona*	43	*Anthriscus sylvestris*	0
81	*Echinochloa colona*	182	*Ranunculus muricatus*	8	*Verbascum thapsus*	39	*Artemisia absinthium*	0
82	*Anthriscus sylvestris*	160	*Cichorium intybus*	7	*Ajuga bracteosa*	38.08	*Arundo donax*	0
83	*Lepidium virginicum*	160	*Achyranthes aspera*	6.05	*Malva neglecta*	37	*Bidens pilosa*	0
84	*Leucas cephalota*	157	*Phegopteris connectilis*	6	*Arundo donax*	34	*Brassica compestris*	0
85	*Amaranthus spinosus*	155	*Physalis angulata*	1	*Hybiscus caesius*	34	*Cannabis sativa*	0
86	*Malvastrum coromandelianum*	153	*Alternanthera philoxeroides*	0	*Vaccaria pyramidata*	29	*Celosia argentea*	0
87	*Verbascum thapsus*	149	*Amaranthus spinosus*	0	*Urtica dioica*	10	*Cichorium intybus*	0
88	*Corchorus olitorius*	145	*Anthriscus sylvestris*	0	*Ipomoea hederacea*	6	*Commelina communis*	0
89	*Oxalis corniculata*	140	*Artemisia absinthium*	0	*Ipomoea purpurea*	6	*Convolvulus arvensis*	0
90	*Solanum virginanum*	130	*Barleria cristata*	0	*Physalis angulata*	1	*Corchorus olitorius*	0
91	*Vaccaria pyramidata*	128	*Brassica compestris*	0	*Solanum virginanum*	1	*Cynoglossum zeylanicum*	0
92	*Urtica dioica*	121	*Celosia argentea*	0	*Achyranthes aspera*	0	*Cyperus niveus*	0
93	*Alternanthera hirtula*	120	*Commelina communis*	0	*Adiantum caudatum*	0	*Cyperus rotundus*	0
94	*Marsilea villosa*	118	*Conyza bonariensis*	0	*Alternanthera philoxeroides*	0	*Datura alba*	0
95	*Debregeasia salicifolia*	110.3	*Corchorus olitorius*	0	*Amaranthus viridis*	0	*Debregeasia salicifolia*	0
96	*Triticum aestivum*	108	*Cynoglossum zeylanicum*	0	*Anthriscus sylvestris*	0	*Diclipter roxburghiana*	0
97	*Adiantum caudatum*	107.65	*Datura alba*	0	*Brassica compestris*	0	*Euphorbia helerophylla*	0
98	*Convolvulus arvensis*	106	*Debregeasia salicifolia*	0	*Celosia argentea*	0	*Euphorbia helioscopia*	0
99	*Cynoglossum zeylanicum*	103	*Diclipter roxburghiana*	0	*Commelina communis*	0	*Ipomoea hederacea*	0
100	*Pentanema indicum*	100	*Echinochloa colona*	0	*Convolvulus arvensis*	0	*Ipomoea purpurea*	0
101	*Solanum pseudocapsicum*	99	*Euphorbia helerophylla*	0	*Corchorus olitorius*	0	*Lepidium virginicum*	0
102	*Solanum surattense*	99	*Hybiscus caesius*	0	*Cynoglossum zeylanicum*	0	*Malva neglecta*	0
103	*Ipomoea hederacea*	93	*Ipomoea hederacea*	0	*Cyperus niveus*	0	*Malvastrum coromandelianum*	0
104	*Ipomoea purpurea*	93	*Ipomoea purpurea*	0	*Cyperus rotundus*	0	*Marsilea villosa*	0
105	*Ajuga bracteosa*	87	*Lepidium virginicum*	0	*Datura alba*	0	*Mentha longiafolia*	0
106	*Datura alba*	85	*Leucas cephalota*	0	*Debregeasia salicifolia*	0	*Mentha piperita*	0
107	*Polygonum aviculare*	82	*Marsilea villosa*	0	*Diclipter roxburghiana*	0	*Mirabilis jalapa*	0
108	*Barleria cristata*	80	*Melica persica*	0	*Euphorbia helerophylla*	0	*Nasturtium officinale*	0
109	*Brassica compestris*	79	*Mentha longiafolia*	0	*Marsilea villosa*	0	*Oxalis corymbosa*	0
110	*Alternanthera philoxeroides*	78	*Mentha piperita*	0	*Mentha longiafolia*	0	*Pastinaca sativa*	0
111	*Conyza bonariensis*	76	*Nasturtium officinale*	0	*Mentha piperita*	0	*Pentanema indicum*	0
112	*Physalis angulata*	72	*Oxalis corymbosa*	0	*Mirabilis jalapa*	0	*Persicaria globra*	0
113	*Hybiscus caesius*	71	*Pastinaca sativa*	0	*Nasturtium officinale*	0	*Phegopteris connectilis*	0
114	*Salvia coccinea*	60	*Pentanema indicum*	0	*Oxalis corniculata*	0	*Physalis angulata*	0
115	*Phegopteris connectilis*	59	*Persicaria globra*	0	*Oxalis corymbosa*	0	*Ranunculus muricatus*	0
116	*Achyranthes aspera*	57.83	*Polygonum aviculare*	0	*Pastinaca sativa*	0	*Rumex dentatus*	0
117	*Delphinium bicolor*	57	*Salvia coccinea*	0	*Persicaria globra*	0	*Solanum nigrum*	0
118	*Diclipter roxburghiana*	52	*Solanum virginanum*	0	*Phegopteris connectilis*	0	*Solanum pseudocapsicum*	0
119	*Argemone mexicana*	50	*Sorghum vulgare*	0	*Ranunculus muricatus*	0	*Solanum virginanum*	0
120	*Artemisia absinthium*	43	*Triticum aestivum*	0	*Solanum nigrum*	0	*Triticum aestivum*	0
121	*Oxalis corymbosa*	30	*Urtica dioica*	0	*Solanum pseudocapsicum*	0	*Urtica dioica*	0
122	*Cyperus niveus*	0	*Vaccaria pyramidata*	0	*Sorghum vulgare*	0	*Vaccaria pyramidata*	0
123	*Cyperus rotundus*	0	*Xanthium strumarium*	0	*Triticum aestivum*	0	*Verbascum thapsus*	0

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