

## FLORISTIC DIVERSITY OF SANTH SAROOLA, KOTLI SATTIAN, RAWALPINDI, PAKISTAN

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### Abstract

The objective of present study was to record the existing flora of Santh Saroola, Kotli Sattian, Pakistan. For this purpose, field surveys were conducted in August 2009 to July, 2010. A total of 186 plants species belonging to 148 genera and 63 families were identified. The largest number of species was contributed by Poaceae (24 spp., 12.90%), followed by Asteraceae with 20 species (10.75%), Fabaceae (16 spp., 8.60%), Euphorbiaceae (8 spp., 4.30%), Lamiaceae & Solanaceae (7 spp., 3.76% each) and Brassicaceae (6 spp., 3.23%); while rest of 56 families possessed species with the range of 1-5. With reference to life forms, Therophytes were found very frequent in terms of flora (45.99%), followed by Phanerophytes (29.95%), Hemicryptophytes (18.18%), Chaemophytes (4.81%) and Cryptophytes (1.07%). Most of the plants present in this area were herbaceous (89) natured, follow by shrub (38), grasses (24), trees (17) and climbers (11).

**Key words:** Floristic diversity, Santh Saroola, Kotli Sattian, Life forms.

### Introduction

A flora consists of description of all the wild or cultivated plants contained in the country in question, so drawn up and arranged that the student may identify with the corresponding description any individual specimen which he may gather (Hooker, 1897). The correct identification of every plant is very important, since it is the key to its literature (Steenis, 1957). There are various types of flora such as native flora, agricultural flora or garden flora, weed flora, etc. The main objective of the flora is to afford the means of determining any plant growing in the area. It is usually accompanied by combinations of keys and description. A good Flora is one that provides work for correct identification of plant and their utilization could be taken on scientific and systematic basis. Since plants of the world are extremely variable, therefore a wide range of Floras are available ranging from concise or field Flora to research Flora (Ali, 2008).

Various studies have been done to explore the world flora, however there are many areas still unexplored. 97 species belonging to 43 families were reported during the floristic survey of Pirghar hill (Badshah *et al.*, 1996). Botanical information was given on all plant species and related taxa of about 4,730 present in Pacific Northwest (Kistritz *et al.*, 1977). The Flora of Australia is a 59 volumes series describing the vascular plants, bryophytes and lichens, present in Australia. These volumes contain 20,000 plant species (Orchard, 1999). The Flora of Iran was reported by (Noroozi *et al.*, 2007) showing vascular flora comprising of 682 species belonging to 193 genera and 39 families in the alpine zone.

The flora of Balkdami wetland and its surrounding areas was written by (Koyuncu & Ebru, 2008). They identified 51 families, 250 taxa belonging to 173 genera and 247 species. A floristic study of Bikaner

(North-West Rajasthan) India was done by (Singh & Sindhu, 1991). They reported a total of 512 plant species belonging to 310 genera distributed among 85 families of flowering plants. The herbaceous flora of Black land Prairie Remnants explored by (Baron & Hill, 2007). They reported a total of 196 species out of which 168 are native species. Collected species include grasses and herbs from 19 different sites in a year.

Pakistan has rich diversity in the flora. There are around 5,700 species of vascular plants which include both indigenous and alien species (Stewart, 1972). Various studies reporting floristic lists have been conducted from different corners of the country (Ansari *et al.*, 1993; Ali, 1986 & 1991; Khan, 1962; Malik, 1985; Chaudhri & Arshad, 1987; Chaudhri, 1960 & 1966; Chaudhri & Chuttar, 1966; Bhatti *et al.*, 1999; Bhatti *et al.*, 2001; Qureshi & Bhatti, 2005; Parveen & Hussain, 2007; Hussain *et al.*, 2008; Qureshi, 2008; Qureshi, 2009; Qureshi, 2012; Qureshi *et al.*, 2014; Shaheen *et al.*, 2014; Wariss *et al.*, 2014).

From Rawalpindi and adjoining areas, sporadic information is available on the flora of the study area. However, from the adjoining areas few studies were carried out (Stewart, 1957; Ahmad, 1964). Therefore, present study was designed to record all plants covering all seasonal variations.

### Materials and Methods

**Study area:** Santh Saroola is a large village of the of Kotli Sattian and is situated 50 km in northeast of Islamabad. It is surrounded by Dheerkot Sattian, Malot Sattian, Darnoian and Kotli Sattian (city). It is 7,500 ft above sea level. It lies between 33° 04"-34° 01" north latitude and 72° 38"-73° 37" east longitude. There is harsh environment in the winter and mild in summer. The annual rainfall is 990 mm. The temperature ranges from 117 °F to -25 °F (Anon., 2008).

**Floristic survey:** The whole study area was thoroughly surveyed for the collection of plant specimens during 2009-2010. These specimens were pressed, dried and mounted on herbarium sheets and identified with the help of floristic literature (Nasir & Ali 1970-1989; Jafri, 1966; Ali & Nasir 1989-1991; Ali & Qaiser, 1993-1995, 2000-2009). These were also matched with already identified in herbarium of Quaid-i-Azam University, Islamabad. The fully determined specimens were deposited in the Department of Botany, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi.

**Life-form spectra:** Life-form classes were determined by following Raunkiaer (1934) and Abd el-ghani (2000). The local people were asked to get vernacular names of species and provided in Table 1.

**Diversity Index ( $\alpha$ ,  $\beta$  and  $\gamma$ -diversity):** The Alpha ( $\alpha$ ), Beta ( $\beta$ ) and Gamma ( $\gamma$ ) diversity were measured showing species richness. An  $\alpha$  – diversity is number of species in one habitat, however  $\gamma$ -diversity was calculated by adding the three  $\alpha$  diversities (number of species in each habitat) but avoiding duplicate counting of species common to two or more habitats (Al-Sheikh & Ghnaim, 2004; Jafari *et al.*, 2004, Qureshi & Bhatti, 2010). The similarity index (CC) between locality pairs was calculated by the formula:

$$CC = 2Ss / S_j + S_k \text{ (Sørensen, 1948)}$$

where, Ss is the number of species common to both the habitats, while S<sub>j</sub> and S<sub>k</sub> are the number of species in habitat 1 and habitat 2, respectively.

**Results and Discussion**

**Flora:** A total of 186 plants species belonging to 148 genera and 63 families were identified (Table 1). Grasses were very common that were contributed by Poaceae (24 spp., 12.90%), followed by Asteraceae with 20 species (10.75%), Fabaceae (16 spp., 8.60%), Euphorbiaceae (8 spp., 4.30%), Lamiaceae & Solanaceae (7 spp., 3.76% each) and Brassicaceae (6 spp., 3.23%); while rest of 56 families possessed species with the range of 1-5 (Table 2).

Most of the flora comprised annual plants and herbs were found as the common fraction with the percentage of 43.36 (Fig. 1). It was followed by shrubs (24.48%), grasses (13.29%) and trees (9.79%), whereas, rest of plant habits were in negligible proportion.

**Micro-habitats:** Three habitats were determined based on topography of the area. Six species viz., *Adiantum capillus-veneris*, *Capsella bursa-pastoris*, *Oxalis corniculata*, *Saccharum bengalense*, *Stellaria media* and *Tribulus terrestris* were uniformly present in all microhabitats; whereas, 73 species were observed growing in two microhabitats (Table 1). There were 64 plant species which were narrowly distributed and can

be regarded as habitat indicators. The microhabitats are as follows:

- a. **Foothills:** The soil of this microhabitat was gravelly sandy in nature. In total, 112 species are reported from this habitat (Fig. 2). Of them, 38 species are found growing in this habitat not recorded from rest of the habitats.
- b. **Slope:** The soil of this habitat was gravelly. There were 88 species in this habitat (Fig. 2). Out of which 14 species were habitat indicators.
- c. **River Side:** There was silty loam soil with high humidity conditions. Less diversity of species recorded from this microhabitat. In all, 28 species were recorded from this habitat along with 11 species unique to this habitat.

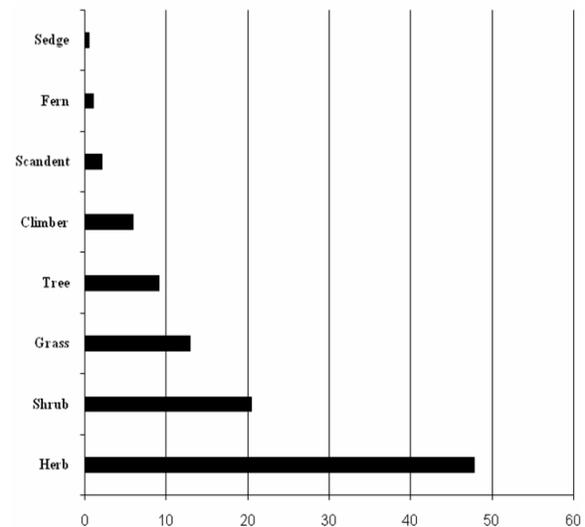


Fig. 1. Showing plant habits of the flora of Kotli Sathian.

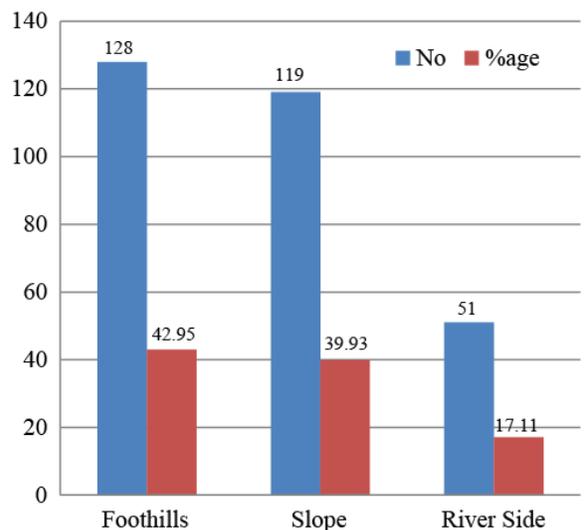


Fig. 2. Showing plant habits of the flora of Kotli Sathian.

Table 1. Showing list of plant species, families, common names, habitat, life form, distributed in various microhabitats of Santh Saroola.

S. No	Botanical Name	Common name	Family	Habitat	Life form	Micro-habitats		
						Foothills	Slope	River side
1.	<i>Abutilon bidentatum</i> Hochst. ex Rich.	-	Malvaceae	Shrub	Therophyte	+	-	+
2.	<i>Acacia modesta</i> Wall.	Phulai	Mimosaceae	Tree	Phanerophyte	+	+	-
3.	<i>Achyranthus aspera</i> L.	Put kanda	Amaranthaceae	Shrub	Therophyte	+	+	-
4.	<i>Adhatoda zeylanica</i> Medic.	Baikar	Acanthaceae	Shrub	Phanerophyte	+	+	+
5.	<i>Adiantum capillus-veneris</i> L.	Persiaon shan	Adiantaceae	Shrub	Cryptophyte	+	+	+
6.	<i>Ailanthus altissima</i> (Mill.) Swingle	Dhuravia	Simarubaceae	Tree	Phanerophyte	+	+	-
7.	<i>Ajuga bracteosa</i> Wall. ex Bth.	-	Lamiaceae	Herb	Therophyte	-	-	+
8.	<i>Ajuga parviflora</i> Bth.	-	Lamiaceae	Herb	Therophyte	-	-	+
9.	<i>Alternanthera pungens</i> Kunth.	Kabli Kaidr	Amaranthaceae	Herb	Hemiterophyte	+	-	-
10.	<i>Amaranthus hybridus</i> L.	Choleri	Amaranthaceae	Herb	Therophyte	+	+	-
11.	<i>Albizia lebeck</i> (L.) Benth.	Shrinh	Mimosaceae	Tree	Phanerophyte	+	-	-
12.	<i>Amaranthus viridis</i> L.	Cholai	Amaranthaceae	Herb	Therophyte	+	+	-
13.	<i>Amaranthus spinosus</i> L.	Cholahi	Amaranthaceae	Herb	Therophyte	+	+	-
14.	<i>Anagallis arvensis</i> L.	Bili boote	Primulaceae	Herb	Therophyte	+	+	-
15.	<i>Argyrobium roseum</i> (Camb.) Jaub & Spach	-	Fabaceae	Herb	Chamaephyte	+	-	+
16.	<i>Arundo donax</i> L.	Nara, Sukna	Poaceae	Herb	Hemiterophyte	-	-	+
17.	<i>Astragalus squarrosus</i> Bunge	Kikri	Fabaceae	Grass	Phanerophyte	-	+	-
18.	<i>Arabis himalaica</i> (Edgew.) O.E. Schulz	-	Brassicaceae	Herb	Therophyte	+	-	+
19.	<i>Argyrobium roseum</i> (Camb.) Jaub & Spach	-	Fabaceae	Herb	Hemiterophyte	+	+	-
20.	<i>Aristida cyanantha</i> Nees ex Steud.	-	Poaceae	Grass	Hemiterophyte	+	+	+
21.	<i>Asparagus gracilis</i> Royle	Chou	Asparagaceae	Scandent	Phanerophyte	+	+	-
22.	<i>Asphodelus tenuifolius</i> Cavan.	Bhagat/Piazi	Liliaceae	Herb	Therophyte	-	-	+
23.	<i>Avena fatua</i> L.	Jangli Jai	Poaceae	Grass	Therophyte	+	+	-
24.	<i>Barleria acanthoides</i> Vahl	-	Acanthaceae	Shrub	Chamaephyte	+	-	-
25.	<i>Barleria cristata</i> L.	Bansa-Siya	Acanthaceae	Shrub	Therophyte	-	-	+
26.	<i>Berberis lycium</i> Royle.	Sumbul	Berberidaceae	Shrub	Phanerophyte	-	+	-
27.	<i>Boerhavia procumbens</i> Banks ex Roxb.	Isit	Nyctaginaceae	Herb	Cryptophyte	-	-	+
28.	<i>Calotropis procera</i> (Willd.) R.Br.	Aak, Mudar	Asclepiadaceae	Shrub	Phanerophyte	+	+	-
29.	<i>Cannabis sativa</i> L.	Bhang	Cannabaceae	Herb	Therophyte	+	+	-
30.	<i>Capsella bursa-pastoris</i> (L.) Medik	Shepherd,s Purse	Brassicaceae	Herb	Therophyte	+	+	+
31.	<i>Cardiospermum halicacabum</i> L.	-	Sapindaceae	Climber	Phanerophyte	+	-	-
32.	<i>Carissa opaca</i> Stapf ex Haines	Grinda	Apocynaceae	Shrub	Phanerophyte	-	+	-
33.	<i>Carthamus oxycantha</i> M. Bieb	-	Asteraceae	Herb	Phanerophyte	-	+	-
34.	<i>Cenchrus ciliaris</i> L.	Dhaman, Salat	Poaceae	Grass	Hemiterophyte	+	+	-
35.	<i>Cenchrus pennisetiformis</i> Hochst. & Steud.	Khurnal, Sitti	Poaceae	Grass	Hemiterophyte	+	+	-
36.	<i>Cenchrus setigerus</i> Vahl	Buth	Poaceae	Grass	Hemiterophyte	+	+	-
37.	<i>Chenopodium album</i> L.	Bathu	Chenopodiaceae	Herb	Therophyte	+	-	-

Table 1. (Cont'd.).

S. No	Botanical Name	Common name	Family	Habitat	Life form	Micro-habitats		
						Foothills	Slope	River side
38.	<i>Chenopodium ambrosioides</i> L.	Chandan Bathwa	Chenopodiaceae	Shrub	Hemipterophyte	-	-	+
39.	<i>Chrysopogon aucheri</i> (Boiss.) Stapf.	-	Poaceae	Grass	Hemipterophyte	+	+	-
40.	<i>Cirsium arvense</i> (L.) Scop.	Lch	Asteraceae	Herb	Therophyte	-	+	+
41.	<i>Clematis montana</i> Bueh.	-	Ranunculaceae	Climber	Phanerophyte	+	-	-
42.	<i>Clematis napaulensis</i> Royle	-	Ranunculaceae	Climber	Phanerophyte	+	-	-
43.	<i>Colechicum atchisonii</i> (Hook. f.) E. Nasir	Suranjan	Liliaceae	Herb	Therophyte	+	+	-
44.	<i>Colebrookia oppositifolia</i> Sm.	Shakar Danna	Lamiaceae	Shrub	Phanerophyte	+	-	-
45.	<i>Coniogramme rosthornii</i> Hieron.	Fern	Coniogrammaceae	Fern	Phanerophyte	-	-	+
46.	<i>Convolvulus arvensis</i> L.	Hiram khuri, Leli	Convolvulaceae	Climber	Hemipterophyte	+	+	-
47.	<i>Conyza aegyptica</i> Ait.	-	Asteraceae	Herb	Therophyte	-	+	+
48.	<i>Conyza bonariensis</i> L.	Gidar Buti	Asteraceae	Herb	Therophyte	+	+	-
49.	<i>Conyza canadensis</i> L.	Paleet	Asteraceae	Shrub	Therophyte	-	+	+
50.	<i>Coronopus didymus</i> (L.) Sm.	Jangli haloon	Brassicaceae	Herb	Therophyte	-	+	-
51.	<i>Crotalaria medicaginea</i> Lam.	-	Fabaceae	Herb	Hemipterophyte	+	-	-
52.	<i>Cuscuta reflexa</i> Roxb.	Akash Bail	Cuscutaceae	Parasite	Therophyte	+	+	-
53.	<i>Cynodon dactylon</i> L. Pers.	Khubbal Ghas	Poaceae	Grass	Hemipterophyte	+	-	-
54.	<i>Cyperus rotundus</i> L.	Sedge Muther	Cyperaceae	Sedge	Hemipterophyte	-	+	+
55.	<i>Dactyloctenium aegyptium</i> L.	Gandee	Poaceae	Grass	Hemipterophyte	+	+	-
56.	<i>Datura stramonium</i> L.	Dhatura	Solanaceae	Shrub	Phanerophyte	+	-	-
57.	<i>Desmostachya bipinnata</i> (L.) Stapf	Dab, Drab	Poaceae	Grass	Hemipterophyte	+	-	-
58.	<i>Dicanthium annulatum</i> (Forssk.) Stapf	Palwan Murgha	Poaceae	Grass	Hemipterophyte	-	+	-
59.	<i>Dicliptera roxburghiana</i> Nees	Somni	Acanthaceae	Herb	Chamaephyte	+	-	+
60.	<i>Dioscorea deltoidea</i> Wall. ex Kunth	-	Dioscoreaceae	Climber	Hemipterophyte	+	-	-
61.	<i>Diospyros lotus</i> L.	-	Ebenaceae	Tree	Phanerophyte	-	+	-
62.	<i>Dodonaea viscosa</i> (L.) Jacq.	Sanatha	Sapindaceae	Shrub	Phanerophyte	-	+	-
63.	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Bara sawank	Poaceae	Grass	Therophyte	+	+	+
64.	<i>Echinops echinatus</i> Roxb.	Kaindara	Asteraceae	Herb	Therophyte	-	+	-
65.	<i>Eclipta prostrata</i> (L.) L.	Bhangra	Asteraceae	Herb	Hemipterophyte	-	-	+
66.	<i>Equisetum ramosissimum</i> (Desf.)	-	Equisetaceae	Herb	Hemipterophyte	-	-	+
67.	<i>Eragrostis aetioviensis</i> (Desf.) Trin. ex Nees	-	Poaceae	Grass	Therophyte	+	+	-
68.	<i>Eragrostis minor</i> Host.	Kusum	Poaceae	Grass	Therophyte	+	+	-
69.	<i>Eruca sativa</i> L.	Tara mira	Brassicaceae	Herb	Phanerophyte	+	-	-
70.	<i>Euphorbia clarkeana</i> Hkt.	-	Euphorbiaceae	Herb	Therophyte	+	-	+
71.	<i>Euphorbia granulata</i> Forssk.	Sheer Bar	Euphorbiaceae	Herb	Therophyte	+	+	-
72.	<i>Euphorbia helioscopia</i> Mewski.	Chattri dodak	Euphorbiaceae	Herb	Therophyte	+	+	-
73.	<i>Euphorbia hirta</i> L.	Dudhi	Euphorbiaceae	Herb	Therophyte	+	+	-
74.	<i>Euphorbia indica</i> Lam.	-	Euphorbiaceae	Herb	Therophyte	+	+	-

Table 1. (Cont'd.).

S. No	Botanical Name	Common name	Family	Habitat	Life form	Micro-habitats		
						Foothills	Slope	River side
75.	<i>Euphorbia prostrata</i> (L.) Ait	-	Euphorbiaceae	Herb	Chamaephyte	-	+	+
76.	<i>Euphrasia himalayica</i> Wettst.	-	Scrophulariaceae	Herb	Therophyte	-	+	-
77.	<i>Ficus carica</i> L.	Anjeer	Moraceae	Shrub	Phanerophyte	+	+	-
78.	<i>Ficus palmata</i> Forssk.	Phagwara	Moraceae	Tree	Phanerophyte	+	-	-
79.	<i>Ficus roxburghii</i> Wall. ex Brand.	Dusi	Moraceae	Tree	Phanerophyte	-	+	-
80.	<i>Flacourtia indica</i> (Burm. f.) Merr.	Kakoh	Flacourtiaceae	Tree	Phanerophyte	+	+	-
81.	<i>Foeniculum vulgare</i> (Miller)	Sonf	Apiaceae	Herb	Therophyte	-	+	-
82.	<i>Fumaria indica</i> (Hausskn.) H.N. Pugsley	Shahtra, Papra	Fumariaceae	Herb	Therophyte	+	+	-
83.	<i>Gallium aparine</i> L.	-	Rubiaceae	Climber	Therophyte	-	+	-
84.	<i>Geranium rotundifolium</i> L.	-	Geraniaceae	Herb	Therophyte	+	-	+
85.	<i>Grewia optiva</i> Drum. ex Burret.	Dhaman, Salat	Tiliaceae	Tree	Therophyte	+	-	-
86.	<i>Heliotropium crispum</i> Stocks	Marand	Boraginaceae	Shrub	Therophyte	+	+	-
87.	<i>Imperata cylindrica</i> (L.) Raetuschel	Cotton grass	Poaceae	Grass	Hemicryptophyte	+	+	-
88.	<i>Indigofera himalayensis</i> Ali	-	Fabaceae	Shrub	Phanerophyte	-	+	-
89.	<i>Indigofera linifolia</i> (L. f) Retz	Torki	Fabaceae	Herb	Therophyte	+	+	-
90.	<i>Indigofera sessiliflora</i> DC.	-	Fabaceae	Herb	Therophyte	+	+	-
91.	<i>Ipomoea carnea</i> Jacq.	-	Convolvulaceae	Shrub	Phanerophyte	+	+	-
92.	<i>Ipomoea hederacea</i> (L.) Jacq.	Akri	Convolvulaceae	Shrub	Phanerophyte	+	+	-
93.	<i>Ipomoea nil</i> (L.) Roth	Wilayati Ak	Convolvulaceae	Climber	Phanerophyte	+	+	-
94.	<i>Kickxia ramosissima</i> (Wall.) Janchen	-	Convolvulaceae	Climber	Phanerophyte	+	+	-
95.	<i>Lactuca auriculata</i> (Wall. ex DC.)	-	Scrophulariaceae	Herb	Therophyte	-	+	-
96.	<i>Lactuca dissecta</i> D. Don.	-	Asteraceae	Herb	Therophyte	-	+	-
97.	<i>Lactuca serriola</i> L.	-	Asteraceae	Herb	Therophyte	+	-	-
98.	<i>Lantana camara</i> L.	-	Asteraceae	Herb	Therophyte	+	-	-
99.	<i>Lathyrus aphaca</i> L.	Panch phul	Verbenaceae	Shrub	Phanerophyte	+	-	-
100.	<i>Lamaea procumbens</i> (Roxb.) Ram. & Rajgo.	Jangali matar	Fabaceae	Climber	Therophyte	+	+	-
101.	<i>Lepidium sativum</i> L.	-	Asteraceae	Herb	Chamaephyte	+	-	-
102.	<i>Lotus corniculatus</i> (Wald. & Kit. ex Willd.) Briq. & Rech. f.	Haleon	Brassicaceae	Herb	Therophyte	+	-	-
103.	<i>Mallotus philipensis</i> (Lam.) Muell.	-	Fabaceae	Herb	Therophyte	-	-	+
104.	<i>Malva neglecta</i> Waller.	Kameela	Euphorbiaceae	Tree	Phanerophyte	+	+	-
105.	<i>Malvastrum coronandellianum</i> L.	Saunchal	Malvaceae	Herb	Therophyte	+	+	-
106.	<i>Mrytenus royleanus</i> (Wall. ex Lawson) Cufodontis	Malvestrum	Malvaceae	Herb	Chamaephyte	+	+	-
107.	<i>Medicago denticulata</i> Willd.	Pataki	Celastraceae	Shrub	Phanerophyte	-	+	-
108.	<i>Medicago laciniata</i> (L.) Mill.	Maina	Fabaceae	Herb	Phanerophyte	+	-	+
109.	<i>Medicago polymorpha</i> L.	-	Fabaceae	Herb	Therophyte	+	+	-
110.	<i>Melia azedarach</i> L.	Maina	Fabaceae	Herb	Therophyte	-	+	+
111.	<i>Mellilotus indica</i> (L.) All.	Bakain, Dharek	Meliaceae	Tree	Therophyte	+	+	-
		Sinji	Fabaceae	Herb	Therophyte	+	-	-

Table 1. (Cont'd.).

S. No	Botanical Name	Common name	Family	Habitat	Life form	Micro-habitats		
						Foothills	Slope	River side
112.	<i>Mentha longifolia</i> (L.) Huds	Pahari Poodina	Lamiaceae	Herb	Hemicryptophyte	+		
113.	<i>Micromeria biflora</i> (Ham.) Bth.	-	Lamiaceae	Herb	Therophyte	+		
114.	<i>Morus alba</i> L.	Tut	Moraceae	Tree	Phanerophyte	+		
115.	<i>Morus nigra</i> L.	Tute	Moraceae	Shrub	Phanerophyte	+		
116.	<i>Myrsine africana</i> L.	Khokhal	Myrsinaceae	Shrub	Phanerophyte	+		
117.	<i>Olea europaea</i> L.	-	Oleaceae	Tree	Phanerophyte	+		
118.	<i>Olea ferruginea</i> Royle	Kahu	Oleaceae	Shrub	Phanerophyte	+		+
119.	<i>Origanum vulgare</i> L.	-	Lamiaceae	Herb	Therophyte	+		
120.	<i>Orostegia limbata</i> (Benth.) Boiss.	-	Lamiaceae	Shrub	Phanerophyte	+		
121.	<i>Oxalis corniculata</i> L.	Khati Buti	Oxalidaceae	Herb	Hemicryptophyte	+		+
122.	<i>Parthenium hysterophorus</i> L.	-	Asteraceae	Herb	Therophyte	+		
123.	<i>Peganum harmala</i> L.	Harmal	Zygophyllaceae	Herb	Therophyte	+		
124.	<i>Phalaris minor</i> Retz.	Dhombi siti	Poaceae	Grass	Therophyte	+		
125.	<i>Physalis minima</i> L.	-	Poaceae	Grass	Therophyte	+		+
126.	<i>Pinus roxburghii</i> Sargent	Chir Naikhar	Pinaceae	Tree	Phanerophyte	+		
127.	<i>Plantago lanceolata</i> L.	Isab-Gol	Plantaginaceae	Herb	Therophyte	+		
128.	<i>Plantago major</i> L.	-	Plantaginaceae	Herb	Therophyte	+		
129.	<i>Plantago ovata</i> Frossk.	-	Plantaginaceae	Herb	Therophyte	+		
130.	<i>Polygonum barbatum</i> L.	-	Plantaginaceae	Herb	Therophyte	+		
131.	<i>Polygonum plebejum</i> R. Br.	-	Polygonaceae	Shrub	Phanerophyte	-		+
132.	<i>Polygonum fugax</i> Nees ex Steud.	-	Poaceae	Herb	Hemicryptophyte	+		
133.	<i>Populus deltoides</i> Bartram ex Marsh.	Sufeid poplar	Salicaceae	Tree	Hemicryptophyte	+		
134.	<i>Pteridium aquilinum</i> (L.) Kuhn	-	Pteridaceae	Fern	Hemicryptophyte	-		+
135.	<i>Punica granatum</i> L.	Daruna, Daruni	Punicaceae	Shrub	Phanerophyte	+		
136.	<i>Quercus dilatata</i> Lindley	Barungi	Fagaceae	Tree	Phanerophyte	+		
137.	<i>Quercus incana</i> Roxb.	-	Fagaceae	Tree	Phanerophyte	+		
138.	<i>Ranunculus sceleratus</i> L.	-	Fagaceae	Herb	Therophyte	+		
139.	<i>Ranunculus arvensis</i> L.	-	Ranunculaceae	Herb	Therophyte	+		
140.	<i>Rhynchosia minima</i> (L.) DC.	-	Fabaceae	Herb	Therophyte	+		
141.	<i>Ricinus communis</i> L.	Arund	Fabaceae	Climber	Hemicryptophyte	+		
142.	<i>Rosa brunonii</i> Lindl.	-	Euphorbiaceae	Shrub	Phanerophyte	+		
143.	<i>Rubia cordifolia</i> L.	-	Rosaceae	Shrub	Phanerophyte	+		
144.	<i>Rubia ellipticus</i> Smith	Aakhra	Rubiaceae	Climber	Therophyte	+		
145.	<i>Rumex dentatus</i> L.	Jangli palak	Rubiaceae	Scandent	Phanerophyte	+		+
146.	<i>Rumex hastatus</i> D. Don	Khatimber/Chuki	Polygonaceae	Herb	Phanerophyte	-		
147.	<i>Rumex nepalensis</i> Spreng.	-	Polygonaceae	Herb	Hemicryptophyte	+		
148.	<i>Saccharum bengalense</i> Retz.	Kana	Poaceae	Grass	Phanerophyte	+		+

Table 1. (Cont'd.).

S. No	Botanical Name	Common name	Family	Habitat	Life form	Micro-habitats		
						Foothills	Slope	River side
149.	<i>Saccharum spontaneum</i> L.	Kana	Poaceae	Grass	Phanerophyte	-	+	-
150.	<i>Saussurea albescens</i> (DC.) Schr. Bip.	-	Asteraceae	Herb	Therophyte	-	+	-
151.	<i>Saussurea atkinsonii</i> Clarke	-	Asteraceae	Herb	Therophyte	-	+	-
152.	<i>Saussurea heteromalla</i> DC.	Kali jiri	Asteraceae	Herb	Therophyte	-	+	-
153.	<i>Sageretia theezans</i> (L.) Brongn.	Gang-gher	Rhamnaceae	Shrub	Phanerophyte	+	-	-
154.	<i>Setaria glauca</i> (L.) P.Beauv	Ban-Kangni	Poaceae	Grass	Therophyte	+	-	-
155.	<i>Sida cordata</i> (Burm. f.) Bors.-Waalkes	-	Malvaceae	Herb	Hemipterophyte	+	-	-
156.	<i>Silene conoidea</i> L.	-	Malvaceae	Herb	Therophyte	-	-	+
157.	<i>Silybum marianum</i> (L.) Gaertn	Kandiari	Asteraceae	Herb	Therophyte	-	+	+
158.	<i>Sisymbrium irio</i> L.	Khub Kallan	Brassicaceae	Herb	Therophyte	+	-	-
159.	<i>Solanum nigrum</i> L.	Kuch mich	Solanaceae	Shrub	Therophyte	+	+	-
160.	<i>Solanum pseudocapsicum</i> L.	Jangli mirch	Solanaceae	Shrub	Phanerophyte	+	+	-
161.	<i>Solanum surattense</i> Burm.f.	Kandiali	Solanaceae	Shrub	Phanerophyte	-	+	-
162.	<i>Solanum villosum</i> (L.) Moench	Peelean	Solanaceae	Herb	Therophyte	+	-	-
163.	<i>Sonchus asper</i> (L.) Hill.	Dodak Machal	Solanaceae	Herb	Therophyte	-	-	+
164.	<i>Sorghum bicolor</i> (L.) Moench.	Jawar/Churi	Poaceae	Grass	Therophyte	-	+	-
165.	<i>Sorghum halepense</i> (L.) Bern.	Baru	Poaceae	Grass	Hemipterophyte	+	+	-
166.	<i>Stellaria media</i> (L.) Cry.	-	Caryophyllaceae	Herb	Therophyte	+	+	+
167.	<i>Tagetes minuta</i> L.	Sadbarga	Asteraceae	Herb	Therophyte	-	+	+
168.	<i>Taraxacum officinale</i> Weber.	Dodak	Asteraceae	Herb	Therophyte	+	+	+
169.	<i>Taraxacum wallichii</i> DC.	-	Asteraceae	Herb	Therophyte	+	+	+
170.	<i>Themeda anathera</i> (Nees) Haack	Loonder, Lunji	Poaceae	Grass	Hemipterophyte	+	-	-
171.	<i>Trianthema portulacastrum</i> L.	It-Sit	Aizoaceae	Herb	Therophyte	+	-	-
172.	<i>Tribulus terrestris</i> L.	Gokhru, Bhakhra	Zygophyllaceae	Herb	Therophyte	+	+	+
173.	<i>Trichodesma indicum</i> (L.) R. Br.	Gao Zeban	Boraginaceae	Herb	Hemipterophyte	+	+	-
174.	<i>Trifolium repens</i> L.	-	Fabaceae	Herb	Therophyte	+	-	-
175.	<i>Urtica pilulifera</i> L.	Bichu boti	Urticaceae	Herb	Hemipterophyte	-	-	+
176.	<i>Valeriana wallichii</i> DC.	-	Valerianaceae	Herb	Hemipterophyte	+	+	+
177.	<i>Verbascum thapsus</i> L.	Jangli tambako	Scrophulariaceae	Herb	Chamaephyte	-	+	+
178.	<i>Verbena officinalis</i> L.	-	Valerianaceae	Herb	Therophyte	-	+	+
179.	<i>Vicia faba</i> L.	Matri, Bakala	Fabaceae	Climber	Therophyte	+	+	-
180.	<i>Viola canescens</i> Wall. ex Roxb.	Banafsha	Violaceae	Herb	Therophyte	+	+	-
181.	<i>Withania somnifera</i> (L.) Dunal.	Asghand/Aksan	Solanaceae	Shrub	Phanerophyte	+	-	-
182.	<i>Woodfordia fruticosa</i> (L.) S. Kurz	Tavi	Vitaceae	Shrub	Phanerophyte	-	+	-
183.	<i>Xanthium strumarium</i> L.	Bhurt	Asteraceae	Shrub	Phanerophyte	-	+	+
184.	<i>Zanthoxylum alatum</i> Roxb.	Timbar	Rutaceae	Shrub	Phanerophyte	-	+	-
185.	<i>Zizyphus mauritiana</i> Mill.	Beri, Jhari	Rhamnaceae	Tree	Phanerophyte	+	+	-
186.	<i>Zizyphus oxyphylla</i> Edgew.	Bheer moloki	Rhamnaceae	Shrub	Phanerophyte	+	+	-

**Table 2. Shows the Size of the families in terms of number of species and percentage.**

S. No.	Family	No. of spp.	Percentage
1.	Poaceae	24	12.90
2.	Asteraceae	20	10.75
3.	Fabaceae	16	8.60
4.	Euphorbiaceae	8	4.30
5.	Lamiaceae	7	3.76
6.	Solanaceae	7	3.76
7.	Brassicaceae	6	3.23
8.	Amaranthaceae	5	2.69
9.	Malvaceae	5	2.69
10.	Moraceae	5	2.69
11.	Polygonaceae	5	2.69
12.	Acanthaceae	4	2.15
13.	Convulvulaceae	4	2.15
14.	Fagaceae	3	1.61
15.	Plantaginaceae	3	1.61
16.	Ranunculaceae	3	1.61
17.	Rhamnaceae	3	1.61
18.	Rubiaceae	3	1.61
19.	Scrophulariaceae	3	1.61
20.	Boraginaceae	2	1.08
21.	Chenopodiaceae	2	1.08
22.	Liliaceae	2	1.08
23.	Mimosaceae	2	1.08
24.	Oleaceae	2	1.08
25.	Sapindaceae	2	1.08
26.	Valerianaceae	2	1.08
27.	Zygophyllaceae	2	1.08
28.	Adiantaceae	1	0.54
29.	Aizoaceae	1	0.54
30.	Apiaceae	1	0.54
31.	Apocynaceae	1	0.54
32.	Asclepiadaceae	1	0.54
33.	Asparagaceae	1	0.54
34.	Berberidaceae	1	0.54
35.	Cannabaceae	1	0.54
36.	Caryophyllaceae	1	0.54
37.	Celastraceae	1	0.54
38.	Coniogrammeaceae	1	0.54
39.	Cuscutaceae	1	0.54
40.	Cyperaceae	1	0.54
41.	Dioscoreaceae	1	0.54
42.	Ebenaceae	1	0.54
43.	Equistaceae	1	0.54
44.	Flacourtiaceae	1	0.54
45.	Fumariaceae	1	0.54
46.	Geraniaceae	1	0.54
47.	Meliaceae	1	0.54
48.	Myrsinaceae	1	0.54
49.	Nyctaginaceae	1	0.54
50.	Oxalidaceae	1	0.54
51.	Pinaceae	1	0.54
52.	Primulaceae	1	0.54
53.	Pteridaceae	1	0.54
54.	Punicaceae	1	0.54
55.	Rosaceae	1	0.54
56.	Rutaceae	1	0.54
57.	Salicaceae	1	0.54
58.	Simarubaceae	1	0.54
59.	Tiliaceae	1	0.54
60.	Urticaceae	1	0.54
61.	Verbenaceae	1	0.54
62.	Violaceae	1	0.54
63.	Vitaceae	1	0.54

**Life form spectra:** The most common life form spectrum of the existing flora was Therorophyte with the large number of species (63 spp.), followed by Phanerophyte (42 spp.), Hemicryptophyte (28 spp.) and Cryptophyte (10 spp.) (Fig. 3).

**Species richness and similarity index:** The highest  $\alpha$ -diversity in terms of flora was recorded from Foothills (128 spp.), followed by Slope (119 spp.) and River Side (51 spp.). The overall species from all habitats ( $\gamma$ -diversity) were recorded as 186 distributed across 148 genera and 63 families. The couplet of habitat pairs which shared common species and Similarity Index (CC) is given in Table 3. Amongst habitat pairs, Foothills-Slope had highest value of Similarity Index (0.62) with low Beta diversity followed by Slope-River side (0.3) and River Side-Foothills (0.212).

**Table 3. Similarity Index (CC) and  $\beta$ -diversity (BD) from three habitats of Kotli Sathian.**

S. No.	Habitat pairs	Shared species	CC	BD
1.	Foothills-Slope	77	0.62	0.68
2.	Slope-River side	26	0.3	1.06
3.	River Side-Foothills	19	0.212	0.27

## Discussion

Most of the flora comprised on annual herbs and were found as the common fraction with the percentage of 43.36. It was followed by shrubs (24.48%), grasses (13.29%) and trees (9.79%) (Fig. 2), whereas, rest of plant habits were in negligible proportion.

This study provides floristic account of plant species found in Santh Saroola, Kotli Sattian (Table 1). Along the foothills and slopes, vegetation comprised shrubs and grasses. Since, the area receives sufficient rains therefore much of the area was occupied by annuals and grasses. This vegetation can utilize the transient water stored in the upper soil synchronic with precipitation. The upper dry layer of the surface deposits acts as a protective layer, moisture is stored in subsurface layers and the underlying sandstone provides added water storage capacity. All collected plant species are native to the area except few ones. Most of the flora was indigenous with few exceptions like *Parthenium hysterophorus*. This species is an exotic weed infesting a large area in the farm. This is a problematic weed that infested many countries (Williams & Grovers, 1980). No endemic species has been recorded from the study area; however this has never been explored before and this research provides baseline information about the flora of Santh Saroola.

Most of the area was occupied by Therephytes that indicates a typical subtropical to tropical life-form spectrum in the study area. The dominance of both therophytes and phanaerophytes reflects a response to the harsh climate and anthropogenic pressure on the flora by human as well as animals (Qureshi *et al.*, 2011). The area receives plentiful rainfall; therefore it could be other possible reason for aggregation of aforesaid life forms.

Like other Asteraceous species, *Carthamus oxycantha*, *Cirsium arvense*, *Conyza* spp., *Echinops echinatus*, *Saussurea* spp., *Lactuca* spp., *Parthenium hytserophorus*, *Silybum marianum*, *Tagetes minuta*, *Taraxacum officinale* have minute seeds armed with hairy appendages that facilitate their dispersal through wind. Therefore, they are spreading at an alarming pace in the study area.

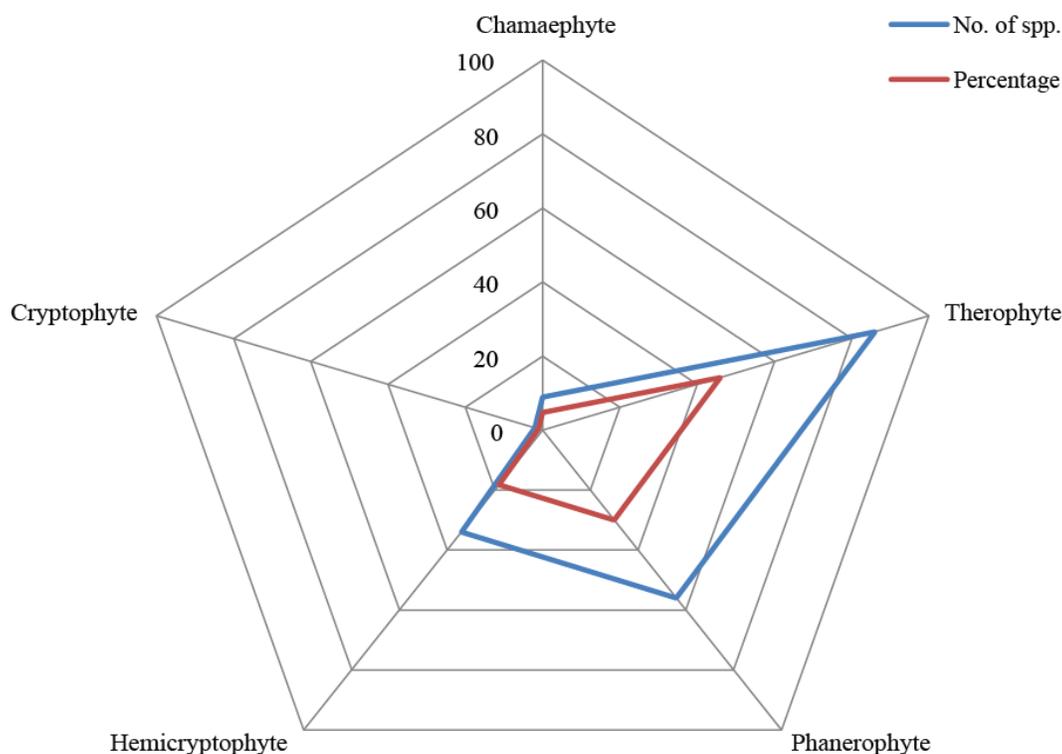


Fig. 3. Showing plant life form of the flora of Kotli Sattian.

## References

- Abd el-ghani, M.M. 2000. Floristics and environmental relations in two extreme desert zones of western Egypt. *Global Ecology & Biogeography*, 9: 499-516.
- Ahmed, I. 1964. Vegetation of the salt range. *Pak. J. For.*, 14: 36-62.
- Ali, S.I. 1986. Under exploited economic plants of Pakistan. *J. Arid Environ.*, 11:17-25.
- Ali, S.I. 2008. Significance of flora with special reference to Pakistan. *Pak. J. Bot.*, 40(3): 967-971.
- Ali, S.I. and M. Qaiser. 1993-1995, 2000-2009. Flora of Pakistan (Fascicle series). Islamabad, Karachi.
- Ali, S.I. and Y.J. Nasir. 1989-1991. Flora of Pakistan (Fascicle series). Islamabad, Karachi.
- Al-Sheikh, A.E.M. and A. Ghanim. Abbadi. 2004. Biodiversity of plant communities in the Jal Az-Zor National Park, Kuwait. *Kuwait J. Sci. Eng.*, 31(1):77-105.
- Anonymous. 2008. Government of Pakistan District Census Report (G.O.P). Federal Beuro of Statistics.
- Ansari, K.A., A.R. Malik and A.Q. Mahar. 1993. Floristic list of district Khairpur. *Ann. J. Res. Sci. Sindh*, 1: 11-18.
- Badshah, L., F. Hussain and Z. Mohammad. 1996. Floristic and ethnoecological studies on some plants of Pirghar hills, S. Waziristan, Pakistan. *Pak. J. Pl. Sci.*, (2): 167-177.
- Barone, J.A. and J.G. Hill. 2007. Herbaceous flora of blackland prairie remnants in Mississippi and western Alabama. *Castanea*, 72: 226-234.
- Bhatti, G.R., R. Qureshi and R.A. Ramon. 1999. Flora of Rohri Hills. *Ancient Sindh*, 7-22.
- Bhatti, G.R., S. Muqarrab and R. Qureshi. 2001. Floristic study of Arid Zone (Desert Nara Region), Sindh, Pakistan. Final technical report, Pakistan Science Foundation Project, (45).
- Chaudhari, I.I. and M.S. Chuttar. 1966. The vegetation and range flora of Thar Desert. Pakistan. Forest Department, Haiderabad.
- Chaudhri, I.I. 1960. Succession of vegetation in the arid region. Symposium on soil erosion and its control in the arid and semi arid zones. UNESCO and F. A. C. P.
- Chaudhri, M.S. and M. Arshad. 1987. Some medicinal plants of Cholistan. Cholistan Institute of Desert Studies, Islamia University, Bahawalpur.
- Hooker, J.D. 1872-1897. Flora of British India. W. Clows and co. London, 1-7.
- Hussain, K., A. Shahzad and Z. Hussain. 2008. Ethnobotanical survey of important wild plants of hotter district Haripur Pakistan, 26.
- Jafari, M., M.A. Zare Chahouki, A. Tavili, H. Azarnivand and Gh. Zahedi Amin. 2004. Effective environmental factors in the distribution of vegetation types in Poshtkouh rangelands of Yazd Province (Iran). *Jour. Arid Env.*, 56(4): 627-641.
- Jafri, S.M.H. 1966. Flora of Karachi (Coastal West Pakistan). The Book Corporation Karachi, 1-4, 207.
- Khan, A.K. 1962. Studies on growth and cultivation characteristics of medicinal and other economic plants under semi-temperate condition. *Pak. J. For.*, 12: 236-273.
- Kistriz, R.V., C. Hitchcock and A. Cronquist. 1977. Flora of Pacific Northwest. University of Washington press.
- Kouyuni, O. and A. Ebru. 2008. Flora of Balikdami wetland and its surroundings (Sivrihisar Eskischir), 13(1): 33-37.
- Malik, A.R. 1985. Arid Zone Research II, Pattern exhibited by some desert species from dist. Khairpur, Sind, Pakistan. *Sindh, Uni. Res. J. (Sci. Ser.)*, 17 (2): 73-85.
- Nasir, E. and S.I. Ali. 1970-1989. Flora of Pakistan (fascicles series). Department of Botany, University of Karachi.
- Noroozi, J., H. Akhiani and S. Breckle. 2007. Biodiversity and phytosociology of the alpine flora of Iran, 17(3): 493-521.

- Orchard, A.E. 1999. Introduction. In: *Flora of Australia*, (Ed.): A.E. Orchard. 2<sup>nd</sup> edition. Australian biological resources study ISBN 0-643-0596 5-2, 1-9.
- Parveen, A. and M.I. Hussain. 2007. Plant biodiversity and phytosociological attributes of Gorakh hill. *Pak. J. Bot.*, 38(3): 691-698.
- Qureshi, R. 2008. Preliminary floristic list of Chotiari Wetland Complex, Nawab Shah, Sindh, Pakistan. *Pak. J. Bot.*, 40 (5): 2281-2288.
- Qureshi, R. 2012. *The Flora of Nara Desert, Pakistan*. Nova Science Publishers, N. York, USA.
- Qureshi, R. and G.R. Bhatti. 2005. Nara Desert, Pakistan: Part 1: Soils, Climate and Vegetation. *Rangeland*, 27(5): 27-31.
- Qureshi, R. and G.R. Bhatti. 2010. Floristic inventory of Pai Forest, Nawab shah, Sindh, Pakistan *Pak. J. Bot.*, 42(4): 2215-2224.
- Qureshi, R. and G.R. Bhatti. 2010. Floristic inventory of Pai Forest, Nawab Shah, Sindh, Pakistan. *Pak. J. Bot.*, 42(4): 2215-2224.
- Qureshi, R., G.R. Bhatti and G. Shabbir. 2011. Floristic inventory of Pir Mehr Ali Shah Arid Agriculture University Research Farm at Koont and its surrounding areas. *Pak. J. Bot.*, 43(3): 1679-1684.
- Qureshi, R., H. Shaheen, M. Ilyas, M. Wasim and M. Munir. 2014. Phytodiversity and plant life of Khanpur Dam, Khyber Pakhtunkhwa, Pakistan. *Pak. J. Bot.*, 46(3): 841-849.
- Rankiaer, C. 1934. Life form of Plants and Statistical Plant Geography. Clarendon press, Oxford.
- Shaheen, H., R. Qureshi, A. Akram, M. Gulfranz and D. Potter. 2014. A preliminary floristic checklist of Thal Desert Punjab, Pakistan. *Pak. J. Bot.*, 46(1): 13-18.
- Singh, A.P. and T.S. Sindhu. 1991. An analysis of the flora of Bikaner (North-West Rajasthan) India, 16-26.
- Smith, R.L. and T.M. Smith. 1998. *Elements of ecology*. Addison Wesley Longman, Inc. pp. 269-278.
- Sørensen, T.A. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content, and its application to analyses of the vegetation on Danish commons. *Biol. Skr. K. Danske Vidensk. Selsk.*, 5 (4): 1-34.
- Steenis, V.C.G.G. J. 1957. Specific and intraspecific delimitation flora of Malaysia. *Ser. I.*, 5(3): 17-30.
- Stewart, R.R. 1957. The Flora of Rawalpindi District, West Pakistan. E. E. Press, Rawalpindi. Wodehouse.
- Stewart, R.R. 1972. An Annotated Catalogue to the Vascular Plants of West Pakistan and Kashmir. Fakhri Printing Press, Karachi, 532.
- Wariss, H.M., S.A. Pirzada, K. Alam, S. Anjum and R. Qureshi. 2014. Flora of Lal Suhanra National Park, Bahawalpur, Punjab, Pakistan. *Pak. J. Bot.*, 46(4): 1331-1341.
- William, D.J. and R.H. Groves. 1980. The influence of temperature and photoperiod on growth and development of *Parthenium hysterophorus* L. *Weed Research*, 20 (1): 47-52.

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