Phytosociological Analysis of Herbaceous Plants of District Sonipat

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Abstract

In the present study, community analysis of herb species in terms of diversity, density, frequency and abundance in District Sonipat, Haryana has been done by quadrat method. At every study site, 50 quadrats of 1m x 1m (1sq m) size were laid. In the findings, 28 families of herbs (25 dicots and 3 monocots) have been documented, belonging to 62 genera and 68 species (58 dicots and 10 monocots. Asteraceae has been found to be the dominating family followed by Poaceae and Amaranthaceae. In comparative analysis of average density, frequency and abundance of herb vegetation, the Maximum value has been documented of *Oxalis corniculata* (density 5.2, abundance 5.9, frequency 87%) followed by *Cynodon dactylon* (density 5.1, abundance 5.5, frequency 90 %) and *Chenopodium album* (density 4.7, abundance 5.2). Minimum value has been recorded of *Boerhaavia diffusa* (density 0.4 , abundance 2.1, frequency 20%) followed by *Ipomoea carnea(* density 0.3, abundance 2.2 , frequency 20%) and *Ranunculus sceleratus* (density 0.4, abundance 1.9, frequency 20%). In distribution pattern analysis, in 58 documented species contagious and in the rest ten species random pattern has been recognized. The match of class distribution of herb vegetation of district Sonipat with Raunkiaer frequency law diagram document the homogenous nature of herb community.

Keywords: Herbs, Sonipat, density, frequency, abundance, A/F ratio

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Introduction

The growth and development of plants occur in the form of communities in the existing environment. Species diversity, structure and growth forms are characteristic of every community. To know the structure and composition of plant community, analytical and synthetic characters are studied. Analytical characters in terms of qualitative (floristic composition and physiognomy etc.) and quantitative (density, frequency and abundance) are crucial in identifying the community structure and are studied in open field. Density, frequency, abundance can be recorded by laying down quadrats and numerical data calculation is done [1]. Density gives an idea about degree of association and competition in a given community, whereas Frequency helps us to find the degree of dispersion of species in any area. Synthetic characters (presence, constancy, dominance) are studied with the help of data obtained from analytical characters. Based on relative density, relative frequency, relative dominance and IVI value we can identify richly and poorly established plant species [2].

The study of quantitative characters (density, frequency, diversity and richness) of plants is helpful to us in understanding the vegetation structure, composition and distribution pattern. In the current study, an attempt has been made on phytosociological analysis of herbaceous plants of District Sonipat according to their current status.

Material and methods

Geographical location and climatic condition of study area*:* The District Sonipat is positioned in the south-east of state Haryana and is bounded by the districts Rohtak, Jind and Panipat. It is located at the latitude and longitude of 28° 55' 42.8664'' N and 77° 5' 29.3712'' E respectively. The district shares its inter-state boundary with district Meerut of Uttar Pradesh. The river Yamuna flows along the eastern boundary of the Sonipat district, which separate it from Uttar Pradesh. The climate of this area is dry with hot summers and very cold winters. During rainy season, the weather is very nice for growing vegetation from July to September. October and November is a time period when it is neither too hot nor too cold. In the district Sonipat, the soil is a fine loamy, however, some areas have sandy soil too [3].

Study sites and field visits

For community analysis of herbs, the study area was divided into different small zones as area I (Gohana and adjoining villages), area II (Pinana and adjoining villages), and area III (Sonipat city and adjoining villages) covering all parts of Sonipat. Chosen study sites were from agricultural lands, natural habitats, ponds, park, lawns and other localities in order to get maximum representation of the different herb plant species. Regular field trips were performed throughout the year (November, 2020 - June, 2022) during pre- monsoon, monsoon and post-monsoon seasons when the majority of the plants were at peak of their growth. All herb plants were photographed in the field and were collected too for identification. For authentication of identification, the help of Professor B.D. Vashistha (Department of Botany, Kurukshetra University) was taken. The herbaceous species were studied by laying down 50 quadrats of 1m x 1m (1sq m) size randomly in each study site.

Phytosociological analysis

For doing phytosociological analysis, the analytical characters (density, frequency, and abundance) were studied by using standard methodologies[4]& [5] and were calculated by applying the given below formulas:

(a) Density

Density expresses the number of a species where the total number of individuals of species in all the quadrats divided by the total number of quadrats studied.

$$\text{Density} = \frac{\text{Total number of individuals of a species in all sampling units}}{\text{Total no. of sampling units studied}}$$

(b) Abundance

Abundance expresses the number of individuals of different species in a community per unit area. It is studied by the number of individuals of each species in all quadrats divided by total no of quadrats in which species occurred.

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all sampling units}}{\text{Total number of sampling units in which species occurred}}$$

(c) Frequency

Frequency is the expression of dispersion of individuals in a study area and usually expressed in terms of percentage occurrence. It was studied by total no of quadrats in which species occurred divided by total no of quadrats studied multiplied by hundred.

$$\text{Frequency} = \frac{\text{Total number of in sampling units which species occurred}}{\text{Total no. of sampling units studied}} \times 100$$

(a) Relative Density

Relative density is helpful to study the numerical value of a species in relation to the total number of individuals of all the species.

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Total density of all the species}} \times 100$$

(b) Relative Frequency

It shows the degree of distribution of individual species in a given area in relation to the number of all the species that occurred.

$$\text{Relative Frequency} = \frac{\text{Frequency of a species}}{\text{Total frequency of all the species}} \times 100$$

Results and Discussion:

Data generated has been represented in the form of tables, graphs and charts. Name and total number of species as per family has been represented in table 1.

Table 1. List of herbs species documented at study site

Sr. no.	Family	Species
1	Aizoaceae	*Trianthema portulacastrum* L.
2	Amaranthaceae	*Achyranthes aspera var.barbonica*(willd. ex Schult) C. C. Towns , *Alternanthera pungens* Kunth , *Amaranthus viridis* L. *Amaranthus spinosus* L., *Gomphrena celosioides* L.
3	Asteraceae	*Ageratum conyzoides* (L.) L., *Cirsium arvensis* (L.) Scop. , *Eclipta prostrata* L.,*Erigeron bonariensis* L.,*Gnaphalium polycephalum* Michx., *Launaea nudicaulis* (L.) Hook.f., *Parthenium hysterophorus* L., *Sonchus asper* L.,*Tridax procumbens*(L.) L.,*Vernonia cinerea* L.,*Xanthium strumarium* L.,*Verbesina encelioides* (Cav.) Benth.& Hook.f.ex A.Gray.
4	Brassicaceae	*Lepidium didymum* L., *Sisymbrium irio* L.
5	Cannabaceae	*Cannabis sativa* L.
6	Caryophyllaceae	*Spergula arvensis* L., *Stellaria media* (L.) Vill,
7	Chenopodiaceae	*Chenopodium album* L.,*Chenopodium murale* L.
8	Cleomaceae	*Cleome viscosa* L.
9	Convolvulaceae	*Convolvulus arvensis* L.,*Ipomoea cairica* (L.), *Ipomoea carnea* Jacq.
10	Euphorbiaceae	*Croton bonplandianum* Baill. ,*Euphorbia hirta* L., *Euphorbia prostrata* Aiton
11	Fabaceae	*Cassia occidentalis* L.,*Melilotus indica* (L.),*Trifolium alexandrinum* L., *Vicia sativa* L.
12	Malvaceae	*Malva parviflora* L., *Malvastrum coromandelianum* (L.), *Sida acuta* Burm.f., *Sida rhombifolia* L.
13	Mazaceae	*Mazus pumilus* (Burm.f.) Steenis
14	Nyctaginaceae	*Boerhaavia diffusa* DC.
15	Oxalidaceae	*Oxalis corniculata* L.
16	Papaveraceae	*Argemone mexicana* L. , *Fumaria officinalis* L.
17	Pedaliaceae	*Sesamum indicum* subsp. *malabaricum* Brum.
18	Phyllanthaceae	*Phyllanthus fraternus* G.L Webster
19	Polygonaceae	*Rumex dentatus* L., *Polygonum plebeium* R.Br.
20	Portulacaceae	*Portulaca oleracea* L.
21	Primulaceae	*Anagallis arvensis* L.
22	Solanaceae	*Datura innoxia* Mill., *Nicotiana plumbaginifolia* Viv., *Solanum nigrum* L, *Solanum virginianum* L.
23	Ranunculaceae	*Ranunculus sceleratus* L.
24	Verbenaceae	*Phyla nodiflora* (L.)Greene
25	Zygophyllaceae	*Tribulus terrestris* L.
	MONOCOTS	
26	Commelinaceae	*Commelina benghalensis* L.
27	Cyperaceae	*Cyperus rotundus* L.
28	Poaceae	*Cenchrus ciliaris* L. *Cynodon dactylon* (L.) Pers.(Doob), *Dactyloctenium aegyptium* (L.)Willd, ,*Digitaria ciliaris* (Retz.), Crabgrass), *Echinochloa, colonum* (L.), , *Imperata cylindrica* (L.) Raeusch., *Phalaris minor* Retz.(Bluri),*Poa annua* L.

In the present study, 28 families of herbs (25 dicots and 3 monocots) have been documented, belonging to 62 genera and 68 species (58 dicots and 10 monocots). Asteraceae has found to be the dominating family (12 species) followed by Poaceae (7 species) and Amaranthaceae (5 species) (Table 1 & Fig. 1).

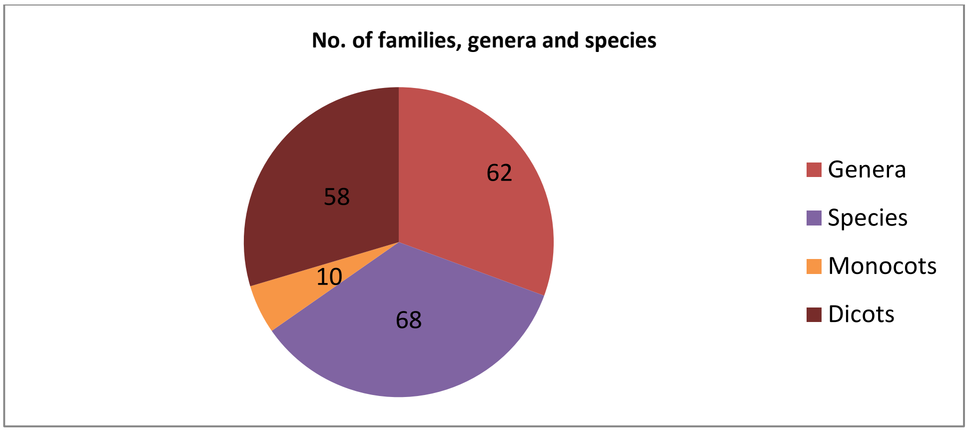

Figure 1: Representing no. of families, genera and species of Dicots and Monocots

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Table 2. Average density, frequency, abundance, relative value, A/F ratio and frequency class of herb species of District Sonipat

Sr. no.	Name of species	Density	Frequency (%)	Abundance	RD	RF	A/F	Frequency class
1	*Achyranthes asper*	3.7	90	3.8	2.8	2.7	0.04	E
2	*Ageratum conyzoides*	4	82	4.8	3.0	2.5	0.06	E
3	*Alternanthera pungens*	1.5	50	3	1.1	1.5	0.06	C
4	*Amaranthus spinosus*	0.5	20	2.8	0.4	0.6	0.14	A
5	*Amaranthus viridis*	4.4	90	4.9	3.3	2.7	0.05	E
6	*Anagallis arvensis*	1.6	46	3.3	1.2	1.4	0.07	C
7	*Argemone mexicana*	0.5	20	2.6	0.4	0.6	0.13	A
8	*Boerhaavia diffusa*	0.4	20	2.1	0.3	0.6	0.11	A
9	*Cannabis sativa*	4.3	74	5.7	3.3	2.2	0.08	D
10	*Cassia occidentalis*	0.6	20	2.9	0.5	0.6	0.15	A
11	*Cenchrus ciliaris*	2.8	90	3.1	2.1	2.7	0.03	E
12	*Chenopodium album*	4.7	90	5.2	3.6	2.7	0.06	E
13	*Chenopodium murale*	0.5	20	2.4	0.4	0.6	0.12	A
14	*Cleome viscosa*	0.5	20	2.4	0.4	0.6	0.12	A
15	*Commelina benghalensis*	0.6	20	2.8	0.5	0.6	0.14	A
16	*Croton bonplandianum*	2.9	63	4.8	2.2	1.9	0.08	D
17	*Cynodon dactylon*	5.1	90	5.5	3.9	2.7	0.06	E
18	*Cirsium arvense*	0.5	20	2.3	0.4	0.6	0.12	A
19	*Convolvulus arvensis*	3.3	90	3.9	2.5	2.7	0.04	E
20	*Cyperus rotundus*	1.1	34	3.1	0.8	1.0	0.09	B
21	*Datura innoxia*	1.6	40	4	1.2	1.2	0.10	B
22	*Dactyloctenium aegyptium*	1.9	50	4	1.4	1.5	0.08	C
23	*Digitaria ciliaris*	1.5	39	3.8	1.1	1.2	0.10	B
24	*Echinochloa colonum*	0.8	36	2.4	0.6	1.1	0.07	B
25	*Eclipta prostrata*	1.1	35	3.1	0.8	1.1	0.09	B
26	*Erigeron bonariensis*	2.9	73	4	2.2	2.2	0.05	D
27	*Euphorbia hirta*	4.1	91	4.4	3.1	2.8	0.05	E

28	*Euphorbia prostrata*	4.4	90	5	3.3	2.7	0.06	E
29	*Fumaria officinalis*	1	35	2.9	0.8	1.1	0.08	B
30	*Gnaphalium polycephalum*	0.6	20	3	0.5	0.6	0.15	A
31	*Gomphrena celosioides*	2.1	58	3.6	1.6	1.8	0.06	C
32	*Imperata cylindrica*	2.1	50	4.2	1.6	1.5	0.08	C
33	*Ipomoea cairica*	0.6	20	2.9	0.5	0.6	0.15	A
34	*Ipomoea carnea*	0.3	20	2.2	0.2	0.6	0.11	A
35	*Launaea nudicaulis*	1.2	35	2.7	0.9	1.1	0.08	B
36	*Lepidium didymium*	2	56	3.5	1.5	1.7	0.06	C
37	*Malva parviflora*	4	74	5.3	3.0	2.2	0.07	D
38	*Malvastrum coromandelianum*	0.5	20	2.5	0.4	0.6	0.13	A
39	*Mazus pumilus*	0.6	20	2.7	0.5	0.6	0.14	A
40	*Melilotus indica*	1.4	39	3.3	1.1	1.2	0.08	B
41	*Nicotiana plumbaginifolia*	2.9	74	3.5	2.2	2.2	0.05	D
42	*Oxalis corniculata*	5.2	87	5.9	4.0	2.6	0.07	E
43	*Parthenium hysterophorus*	2.9	56	5.1	2.2	1.7	0.09	C
44	*Phyla nodiflora*	0.8	31	2.6	0.6	0.9	0.08	B
45	*Phalaris minor*	2.5	70	3.3	1.9	2.1	0.05	D
46	*Phyllanthus fraternus*	4.3	90	4.8	3.3	2.7	0.05	E
47	*Poa annua*	0.5	20	2.6	0.4	0.6	0.13	A
48	*Polygonum plebeium*	0.5	20	2.5	0.4	0.6	0.13	A
49	*Portulaca oleracea*	1.4	37	4	1.1	1.1	0.11	B
50	*Ranunculus sceleratus*	0.4	20	1.9	0.3	0.6	0.10	A
51	*Rumex dentatus*	0.5	20	2.5	0.4	0.6	0.13	A
52	*Sesamum indicum*	0.9	34	2.6	0.7	1.0	0.08	B
53	*Sida acuta*	1	37	2.7	0.8	1.1	0.07	B
54	*Sida rhombifolia*	0.4	20	2	0.3	0.6	0.10	A
55	*Sisymbrium irio*	4.4	90	4.9	3.3	2.7	0.05	E
56	*Solanum nigrum*	2.1	54	3.8	1.6	1.6	0.07	C
57	*Solanum virginianum*	0.4	20	2	0.3	0.6	0.10	A
58	*Sonchus asper*	3.3	74	4.5	2.5	2.2	0.06	D
59	*Spergula arvensis*	2.1	52	4.1	1.6	1.6	0.08	C
60	*Stellaria media*	4.6	90	5.3	3.5	2.7	0.06	E
61	*Trianthema portulacastrum*	3.4	91	4	2.6	2.8	0.04	E
62	*Tribulus terrestris*	1.1	40	2.9	0.8	1.2	0.07	B
63	*Tridax procumbenz*	1.6	36	2.9	1.2	1.1	0.08	B
64	*Trifolium alexandrinum*	1.2	37	3.2	0.9	1.1	0.09	B
65	*Verbesina encelioides*	1.7	53	3.3	1.3	1.6	0.06	C
66	*Vernonia cinerea*	1	33	2.9	0.8	1.0	0.09	B
67	*Viccia sativa*	1.6	51	3.1	1.2	1.5	0.06	C
68	*Xanthium strumarium*	0.5	20	2.4	0.4	0.6	0.12	A

Table 3: Comparison of density, frequency and abundance of four dominant species present in three areas of District Sonipat

Name of species	Density, frequency and abundance	Villages of district Sonipat(Area I,II and III)		
		Gohana, Barota, Baroda and Butana	Pinana, Mohana and Khanpur	Sonipat, Murthal and Barwasni
Oxalis corniculata	D	5.2	5.4	4.9
	F	87.5	96.7	73.3
	A	6.3	5.8	5.4
Cynodon dactylon	D	5.4	5.1	4.6
	F	90	90	90
	A	6	5.2	5.1
Chenopodium album	D	5	4.9	4.3
	F	90	90	90
	A	5.5	5.4	4.8
Ageratum conyzoides	D	5	3.8	3
	F	90	83.3	70
	A	5.5	4.4	4.3

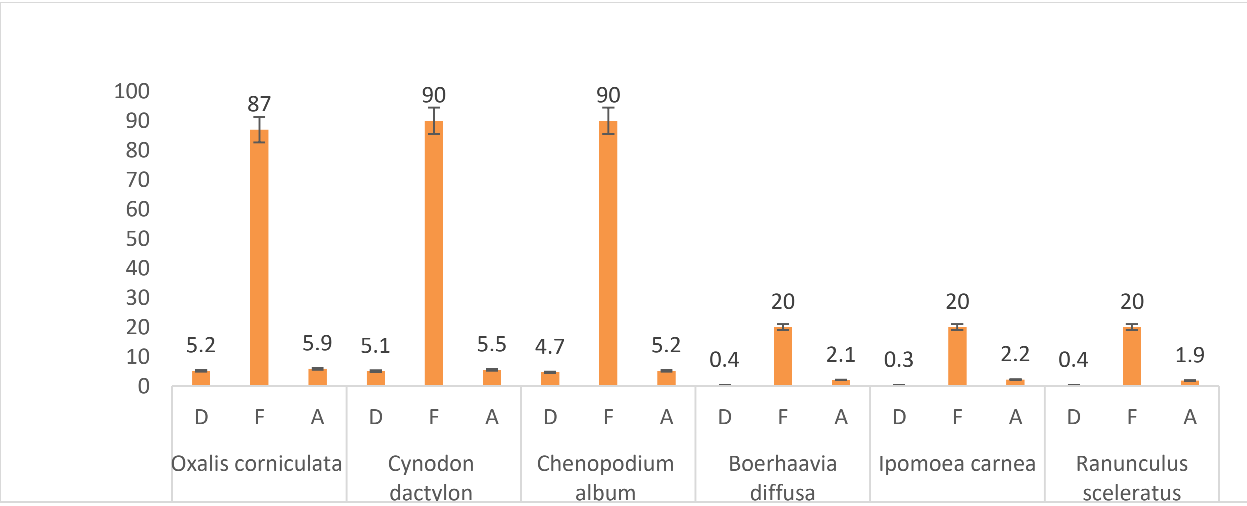
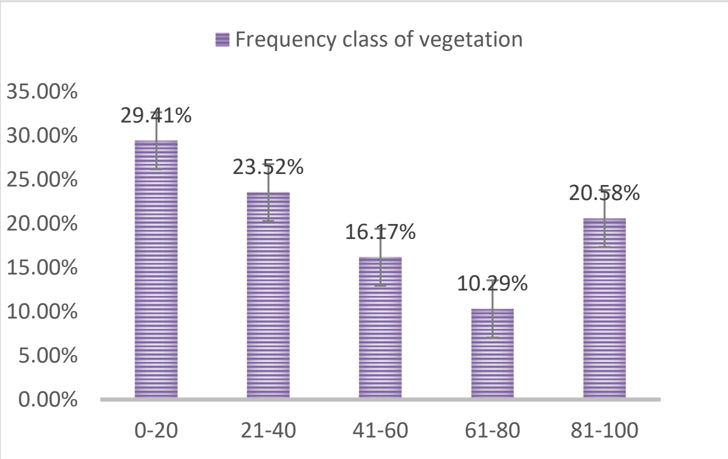


Fig. 2: Comparison of Average Density (D), Average Frequency (F) and Abundance (A) of dominating herb Species of District Sonipat

The average density, frequency, abundance, relative value, A/F ratio and frequency class of herb species of District Sonipat has been calculated and presented of found herb species of district Sonipat (Table 2). The comparative study of four dominating species has been represented (Table 3& fig 2) and assessment of maximum and minimum value of average density, frequency and abundance has been done of District Sonipat (Sonipat city and adjoining 9 villages) on the basis of data generated by quadrat laying. Maximum value has been documented of *Oxalis corniculata* (density 5.2, abundance 5.9, frequency 87%) followed by *Cynodon dactylon* (density 5.1, abundance 5.5, frequency 90 %) and *Chenopodium album* (density 4.7, abundance 5.2, frequency 90%). Minimum value has been recorded of *Boerhaavia diffusa* (density 0.4 , abundance 2.1, frequency 20%) followed by *Ipomoea carnea(* density 0.3, abundance 2.2 , frequency 20%) and *Ranunculus sceleratus* (density 0.4, abundance 1.9, frequency 20%).



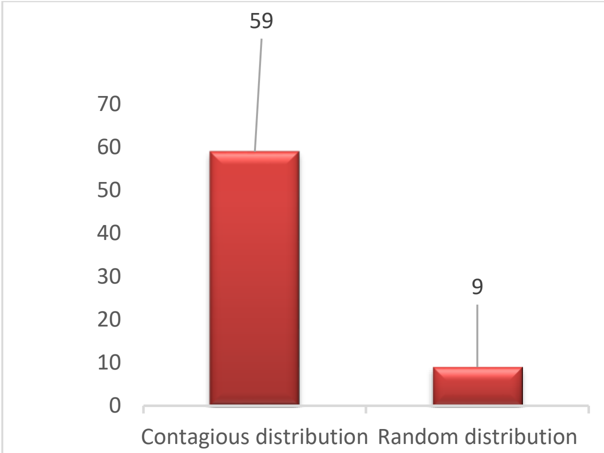


Fig 3 and 4: Comparison of frequency of herb vegetation with Ranunkier frequency diagram; distribution pattern of herb species

On the basis of Raunkiaer frequency law diagram (based on the number of species and species percentage) five frequency classes has been recognized in a community of plant species(A=1-20% ,B=21-40%, ,C=41-60%,,D=61-80%, and E= 81-100%)[6]. The normal value of species occurrence ratio according to Raunkiaer is A>B>C>=< D<E. In the current study, the match of class distribution of herb vegetation of district Sonipat with Raunkiaer frequency law diagram document the homogenous nature of the herb community. Similarly, the observed value of E+D/B+C has been found less than one showing the nature of herb vegetation community as homogenous in nature (Fig.4).

Abundance to Frequency (A/ F) ratio is used to show the distribution patterns of different species. Distribution pattern of a species depends upon the ratio which may be contagious (> 0.05), random (0.025-0.05), and regular (<0.025).In natural conditions, due to variation in environmental conditions, contagious distribution pattern is common [7]. In the present study, 59 species showed distribution pattern contagious and remaining nine random (Fig 4). Similarly two different Semi-arid sites has been studied at phytosociological attributes and it has been found that both sites have low productivity and diversity [8]. Phytodiversity analysis of tree species of Kuldiha wildlife sanctuary (KWLS) Odisha, India has been done and 118 tree species belonging to 95 Genera have been recorded from this area. About 80% of species found in this area are showing the contiguous distribution [9]. By studying the vegetation composition in North-Western India, it was found that *Verbesina enceliodes*, known as wild sunflower or golden crownbeard is the fast growing wild species in arid and semi-arid region of Haryana, Punjab, Chandigarh and Rajasthan [10]. By Phytosociological study in Gonda district Uttar Pradesh, it has been found that the dominant tree species is *Albizia* spp. *Albizia* spp. (53.86) has the value of highest Important Value Index among tree species, and *Amaranthus viridis* (52.34) has value among herbs [11]. In IVI value based phytosociological study of Kanayannur, Kannur district Kerala, *Ludwigia grandiflora* has been recorded with highest value of 16.33 and has been found as the highest developed species [12].

Conclusion:

Depending upon the area accommodated, the communities are variable in size and are generally dynamic in nature. Density, frequency and abundance of species vary in a population. The species which live in harmony with changing environments are dominant in nature and tend to exert a controlling influence on the other members of community. In the current study Asteraceae has found to be the dominating family followed by Poaceae and Amaranthaceae. For better understanding, the quantitative and qualitative character must be studied at different times. In the current study, along with herbs floristic composition, frequency, diversity and abundance has also been studied to give a clear picture of herb species community of district Sonipat, Haryana, India. In the present study, contagious distribution pattern and homogenous nature of community has been observed. This kind of study can provide a better knowledge of the herb community structure of district Sonipat and will be helpful in conserving this diversity too.

Conflict of interests: Authors declare no conflict of interests.

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