Pure Appl. Biol., 11(1):1-10, March, 2022
http://dx.doi.org/10.19045/bspab.2022.110001

Research Article

Eco-floristic study of weed flora of wheat crop under edaphic variation in tehsil Razar district Swabi, Khyber Pakhtunkhwa, Pakistan

Maqsood Anwar[1*], Naveed Akhtar[1], Shah Khalid[1] and Sumbul Qadar[1]
1. Department of Botany, Islamia College Peshawar, Pakistan
**Corresponding author's email: maqsoodanwarbot@yahoo.com*

Citation
Maqsood Anwar, Naveed Akhtar, Shah Khalid and Sumbul Qadar. Eco-floristic study of weed flora of wheat crop under edaphic variation in tehsil Razar district Swabi, Khyber Pakhtunkhwa, Pakistan. Pure and Applied Biology. Vol. 11, Issue 1, pp1-10. http://dx.doi.org/10.19045/bspab.2022.110001

Received: 04/01/2021 Revised: 26/03/2021 Accepted: 05/04/2021 Online First: 17/05/2021

Abstract

Eco-floristic study of weed flora of wheat crop under edaphic variation was conducted in tehsil Razar district Swabi, Khyber Pakhtunkhwa, Pakistan during February-April 2016. A total of 90 weed species distributed in 72 genera and 26 families were reported from 20 selected wheat fields/sites of the study area. Out of 26 families, 23 were dicots having (58 genera & 76 species) and 3 were monocots having (14 genera & 14 species). Fabaceae (14 species), Asteraceae (13 species) and Poaceae (11 species) were dominant families. They were followed by Brassicaceae (7 species), Caryophyllaceae (6 species) and Polygonaceae (5 species). The rest of families were represented by 4 or less than 4 species each. Annuals contributed 82 (91.1%) species while perennials shared 8 (8.9%) species. Therophytes and Nanophylls were dominant life form and leaf size contributed 80 (88.9%) and 42 (46.7%) species respectively. There were 63 (70%) species with simple leaves, 16 (17.8%) species with compound leaves and 11(12.2%) species were represented by dissected or decompound leaves. Physico-chemical analysis of soil revealed that soil texture varied from sandy-loam to sandy-clay-loam, silt-loam, loam, sandy or loamy-sand. Soil pH ranged from 5.8 to 8.1. Soil Electrical conductivity (EC) varied from 0.06 dsm^{-1} to 0.23 dsm^{-1}. Soil Calcium carbonates (CaCO3) ranged from 5.5% to 23.5%. While soil organic matter (OM) varied from 0.15% to 1.94%. It was concluded that soil texture, pH, electrical conductivity, organic matter and Calcium carbonates were strong edaphic variables that gives rise to diverse weed species composition.

Keywords: Floristic composition; Life form; Razar; Soil; Weeds; Wheat

Introduction

Razar is a tehsil of district Swabi Khyber Pakhtunkhwa, Pakistan. It is lies from 34° 6' 0" to 34° 23' 0" North latitudes and 72° 12' 0" to 72° 27' 0" East longitudes. The total area of tehsil Razar is approximately 385 Km^2 and its population is 583,936 as per census of 2017. Soil of the area is fertile and used for general cropping. It shows great variation in color and texture. Tehsil Razar has extreme climate. Summer is long and very hot. June, July and August records quite high temperature. Dust storms are very frequent at night during summer. A rapid fall in temperature recorded from October onwards. Winter is very cold. January is coldest month. July and August (monsoon) receive maximum rainfall during which the weather become hot and

humid. Maximum humidity has been recorded in monsoon and in the month of December [1].

Weeds are those plants which grows so plentifully or luxuriantly that are harmful to crops, human and animals. Weeds are unwanted plants growing in cultivated as well as in domesticated areas and adapted to various edaphic and climatic conditions. Plant species of family Asteraceae, Brassicaceae, Papilionaceae and Poaceae constitutes major weed flora in cultivated agricultural crops. There are almost 30,000 weed plants in worlds, of them, more than 50 causing significant damage to agricultural crops [2]. Weeds are hidden enemies and strong competitors of crops, competes with crops mainly for water, light, nutrients and space and decreases quality as well as quantity of crop [3]. Some weeds secrete certain allelochemicals which affect the germination and growth of agricultural crops [4]. Floristic composition is a characteristic set of plant species within a plant community. Floristic list is valuable because each species has relation to the environment and other species and has its own ecological amplitude and good indicator value in a community. A lot of climatic, edaphic and biological factors influence the floristic composition. The general appearance of the plant body is referred to its life form. Relative proportion or percentage expression of distribution of different life forms and leaf size in the flora of an area is termed as "biological spectrum" and "leaf size spectrum". Life form and leaf size spectra are two physiognomic attributes and indicators of climate of an area that have been generally used in vegetation analysis [5]. The present study aimed Eco-floristic analysis of weeds of wheat crop under edaphic variation in tehsil Razar district Swabi, Khyber Pakhtunkhwa, Pakistan.

Materials and Methods

Plant collection, drying, mounting and identification

Floristic study of weeds was conducted in wheat fields during February-April, 2016. Weed plants were thoroughly collected from 20 selected wheat fields. The collected specimens were dried in papers, preserved properly and then mounted on standard herbarium sheets. All these plants were identified with the help of Flora of Pakistan [6-8]. The identification was later on confirmed by using online Flora of Pakistan-Tropicos (www.tropicos.org/Project/Pakistan) and The Plant List (www.theplantlist.org.). The voucher specimens after identification were numbered and submitted for future references in the herbarium, Department of Botany, Islamia College Peshawar.

Ecological attributes and soil analysis

Weed plants were then classified into various life form and leaf size classes following [5, 9, 10]. A complete floristic list of weeds with ecological attributes was compiled alphabetically. Soil samples were collected from 0-20 cm depth at all 20 selected wheat fields. Soil texture was determined by Hydrometer method [11]. Texture triangle of [12] was used for determination of texture classes. Soil pH was determined with the help of pH meter [13, 14]. Electrical conductivity (EC) was determined with the help of electrical conductivity meter [14]. Soil organic matter was determined following method of [15]. Calcium carbonate was determined by acid neutralization method [16].

Results and Discussion

Floristic composition

The weed flora of wheat in study area consisted of 90 species distributed in 72 genera and 26 families. Out of 26 families, 3 were monocots having (14 genera and 14 species) and 23 were dicots having (58 genera and 76 species) (Table 1). Annuals shared 82 (91.1%) species while perennials contributed 8 (8.9%) species (Table 2). Fabaceae (14 species), Asteraceae (13 species) and Poaceae (11 species) were dominant families. They were followed by Brassicaceae (7 species), Caryophyllaceae (6 species) and Polygonaceae (5 species) (Table 1; Fig. 1). The present results are in line with [17] who recorded 83 weed

species distributed in 26 families from three wheat growing areas of Quetta, Pakistan. **[18]** recorded 93 weed species distributed in 34 families from FR Bannu, Pakistan. **[19]** listed 91 weeds from wheat fields of district Bannu, Pakistan. While studying diversity of weeds in Rabi Wheat crops, **[20]** reported 76 weed species distributed in 27 families. In the present work, the dominant families were Fabaceae, Asteraceae, Poaceae, Brassicaceae, Caryophyllaceae and Polygonaceae. **[21]** reported Fabaceae, Asteraceae, Poaceae, Brassicaceae and Caryophyllaceae as dominant families from Dera Ismail Khan, Pakistan while working on weeds of wheat. In the study of **[22]**, Fabacae was dominant family in district Khairpur, Sindh, Pakistan.

Life form spectra/Biological spectra

Life form spectra revealed that therophytes were dominant life form comprised 80 (88.9%) species. Hemicryptophytes shared 7 (7.8%) species followed by geophytes 2 (2.2%) species and chamaephytes 1 (1.1%) species (Table 2; Fig. 2). Our results are in line with the studies of other workers **[17, 23-25]** who recorded therophytes as dominant group followed by hemicryptophytes, chamaephytes and geophytes. In the study of **[26, 27]** therophytes were dominant life form which support the present findings. Similarly, in the study of **[28, 29]** therophytes were dominant life form followed by geophytes.

Leaf size spectra

Leaf size spectra indicated that nanophylls were dominant group (42 spp; 46.7%) followed by microphylls (32 spp; 35.6%), leptophylls (13 spp; 14.4%) and mesophylls (3 spp; 3.3%) (Table 2; Fig. 3). The present results support the finding of **[26, 27]** who recorded nanophylls as major group. The present findings are in contrast with **[24, 29]** who recorded microphylls as a major leaf size class followed by nanophylls and leptophylls.

Lamina shape/Leaf types

Leaves are the most important organs of most vascular plants. There are so many types of leaves in nature. Flowering plants have either simple, compound or dissected leaves. There were 63 (70%) species with simple leaves, 16 (17.8%) species with compound leaves and 11(12.2%) species were represented by dissected or decompound leaves (Table 2).

Soil analysis

Physico-chemical analysis of soil revealed that texture varied from sandy-loam to sandy-clay-loam, silt-loam, loam, sandy or loamy-sand. Soil pH ranged from 5.8 to 8.1. Electrical conductivity (EC) ranged from 0.06 dsm-1 to 0.23 dsm-1. Calcium carbonates (CaCO3) varied from 5.5% to 23.5%. While organic matter (OM) varied from 0.15% to 1.94% (Table 3). Soil is main abiotic ecological factor that play important role in the distribution of plant species composition in particular area. In the present study soil texture, pH, electrical conductivity, organic matter and Calcium carbonates were strong edaphic variables that gives rise to diverse weed species composition. Soil texture, pH, electrical conductivity, organic matter and carbonates play key role in weed species diversity. **[30]** stated that texture, pH, electrical conductivity, organic matter and carbonates play an important role in weed species diversity. **[31]** described that soil organic matter is main soil fertility factor that affects the distribution of plant diversity. Furthermore, **[32]** reported that soil texture control infiltration rate, water holding capacity, availability of moisture and plant nutrition. Soil texture, organic carbon and salinity are main three factors for weed species composition **[33-35]**. Generally, the soil of the research area is basic and rarely acidic. Compare to **[36]** who found same type of soil pH ranges 6.5-7.5 from Doon Valley India while studying weeds of wheat crop, which is according to our findings. **[37]** analyzed three soil series for texture, pH, electrical conductivity and organic matter. Similarly, **[38]** conducted phytosociological study of weeds of wheat crop under edaphic variations i.e. soil texture, pH, electrical conductivity and organic matter.

Table 1. Floristic list with ecological characteristics of weed flora of wheat crop in tehsil Razar district Swabi, Pakistan

S. No.	Divisions/Families/Species	LF	LS	Life span	Lamina
A. MONOCOTYLEDONAE					
1. Cyperaceae					
1	*Cyperus rotundus* L.	Ge	Nan	Perennial	Simple
2	*Schoenoplectus triqueter* (L.) Palla	Ge	Nan	Perennial	Simple
2. Juncaceae					
3	*Juncus bufonius* L.	Th	Lep	Annual	Simple
3. Poaceae					
4	*Alopecurus myosuroides* Huds.	Th	Mic	Annual	Simple
5	*Avena sativa* L.	Th	Mic	Annual	Simple
6	*Bromus pectinatus* Thunb.	Th	Nan	Annual	Simple
7	*Cynodon dactylon* (L.) Pers.	Hc	Lep	Perennial	Simple
8	*Desmostachya bipinnata* (L.) Stapf	Hc	Mic	Perennial	Simple
9	*Phalaris minor* Retz.	Th	Mic	Annual	Simple
10	*Phleum paniculatum* Huds.	Th	Mic	Annual	Simple
11	*Poa annua* L.	Th	Lep	Annual	Simple
12	*Polypogon monspeliensis* (L.) Desf.	Th	Nan	Annual	Simple
13	*Rostraria cristata* (L.) Tzvelev	Th	Nan	Annual	Simple
14	*Saccharum ravennae* (L.) L.	Hc	Nan	Perennial	Simple
B. DICOTYLEDONAE					
4. Amaranthaceae					
15	*Amaranthus viridis* L.	Th	Mic	Annual	Simple
16	*Chenopodium album* L.	Th	Mic	Annual	Simple
17	*C. murale* L.	Th	Mic	Annual	Simple
18	*C. strictum* Roth.	Th	Nan	Annual	Simple
5. Apiaceae					
19	*Scandix pecten-veneris* L.	Th	Mic	Annual	Dissected
20	*Torilis leptophylla* (L.) Rchb.f.	Th	Mic	Annual	Dissected
6. Asteraceae					
21	*Calendula arvensis* L.	Th	Nan	Annual	Simple
22	*Carthamus lanatus* L.	Th	Mic	Annual	Dissected
23	*C. oxyacantha* M.Bieb.	Th	Mic	Annual	Simple
24	*Centaurea iberica* Trevir. ex Spreng.	Th	Mic	Annual	Dissected
25	*Cirsium arvense* (L.) Scop.	Th	Mic	Annual	Simple
26	*Conyza canadensis* (L.) Cronquist	Th	Mic	Annual	Simple
27	*C. sumatrensis* (S.F.Blake) Pruski & G.Sancho	Th	Mic	Annual	Simple
28	*Gamochaeta pensylvanica* (Willd.) Cabrera	Th	Nan	Annual	Simple
29	*Parthenium hysterophorus* L.	Th	Mes	Annual	Dissected
30	*Silybum marianum* (L.) Gaertn.	Th	Mes	Annual	Simple
31	*Sonchus oleraceus* (L.) L.	Th	Mic	Annual	Dissected
32	*Taraxacum officinale* (L.) Weber ex F.H.Wigg.	Hc	Mic	Annual	Dissected
33	*Xanthium strumarium* L.	Th	Mes	Annual	Simple
7. Boraginaceae					

34	*Buglossoides arvensis* (L.) I.M.Johnst.	Th	Nan	Annual	Simple
35	*Bothriospermum tenellum* (Hornem.) Fisch. & C.A.Mey.	Th	Nan	Annual	Simple
8. Brassicaceae					
36	*Brassica campestris* L.	Th	Mic	Annual	Dissected
37	*Capsella bursa-pastoris* (L.) Medik.	Th	Mic	Annual	Simple
38	*Cardaria chalepensis* (L.) Hand-Mazz.	Th	Mic	Annual	Simple
39	*Coronopus didymus* (L.) Sm.	Hc	Nan	Annual	Dissected
40	*Malcolmia cabulica* (Boiss.) Hook. f. & Thomson	Th	Nan	Annual	Simple
41	*Nasturtium officinale* W.T. Aiton	Th	Nan	Annual	Simple
42	*Neslia apiculata* Fisch., C.A.Mey. & Avé-Lall.	Th	Mic	Annual	Simple
9. Cannabaceae					
43	*Cannabis sativa* L.	Th	Nan	Annual	Compound
10. Caryophyllaceae					
44	*Arenaria serpyllifolia* Bourg. ex Willk. & Lange	Th	Lep	Annual	Simple
45	*Cerastium dichotomum* L.	Th	Nan	Annual	Simple
46	*C. glomeratum* Thuill.	Th	Nan	Annual	Simple
47	*Silene conoidea* L.	Th	Mic	Annual	Simple
48	*Spergula arvensis* L.	Th	Lep	Annual	Simple
49	*Stellaria media* (L.) Vill.	Th	Nan	Annual	Simple
11. Convolvulaceae					
50	*Convolvulus arvensis* L.	Th	Nan	Annual	Simple
12. Euphorbiaceae					
51	*Euphorbia esula* L.	Th	Lep	Annual	Simple
52	*E. helioscopia* L.	Th	Nan	Annual	Simple
53	*E. prostrata* Aiton	Th	Lep	Annual	Simple
13. Fabaceae					
54	*Astragalus hamosus* Bal. ex Bunge	Th	Nan	Annual	Compound
55	*Lathyrus aphaca* L.	Th	Nan	Annual	Compound
56	*Medicago laciniata* (L.) Mill. Var. *brachycantha* Boiss.	Th	Nan	Annual	Compound
57	*M. lupulina* L.	Th	Nan	Annual	Compound
58	*M. minima* (L.) L.	Th	Lep	Annual	Compound
59	*M. polymorpha* L.	Th	Nan	Annual	Compound
60	*Melilotus indica* (L.) All.	Th	Nan	Annual	Compound
61	*Trifolium resupinatum* L.	Th	Nan	Annual	Compound
62	*Trigonella monantha* C.A. Mey.	Th	Nan	Annual	Compound
63	*Vicia bithynica* (L.) L.	Th	Nan	Annual	Compound
64	*V. hirsuta* (L.) Gray	Th	Lep	Annual	Compound
65	*V. peregrina* L.	Th	Nan	Annual	Compound
66	*V. sativa* L.	Th	Nan	Annual	Compound
67	*V. tetrasperma* (L.) Schreb.	Th	Lep	Annual	Compound
14. Fumariaceae					
68	*Fumaria indica* Pugsley	Th	Lep	Annual	Dissected
15. Gentianaceae					

69	*Centaurium pulchellum* (Sw.) Druce	Th	Nan	Annual	Simple
16. Illecebraceae					
70	*Herniaria hirsuta* L.	Th	Lep	Annual	Simple
17. Lamiaceae					
71	*Mentha longifolia* (L.) L.	Hc	Mic	Perennial	Simple
72	*Salvia plebeia* R. Br.	Th	Mic	Annual	Simple
18. Malvaceae					
73	*Malva neglecta* Wallr.	Th	Mic	Annual	Simple
19. Oxalidaceae					
74	*Oxalis corniculata* L.	Th	Nan	Annual	Compound
20. Papaveraceae					
75	*Papaver hybridum* L.	Th	Nan	Annual	Dissected
21. Polygonaceae					
76	*Emex spinosa* (L.) Campd.	Th	Nan	Annual	Simple
77	*Persicaria barbata* (L.) H. Hara	Th	Mic	Annual	Simple
78	*Polygonum plebeium* R.Br.	Th	Nan	Annual	Simple
79	*Rumex chalepensis* Mill.	Ch	Mic	Perennial	Simple
80	*R. dentatus* L.	Th	Mic	Annual	Simple
22. Primulaceae					
81	*Anagallis arvensis* L.	Th	Nan	Annual	Simple
23. Ranunculaceae					
82	*Ranunculus arvensis* L.	Th	Mic	Annual	Simple
83	*R. cantoniensis* DC.	Th	Mic	Annual	Simple
84	*R. muricatus* L.	Th	Mic	Annual	Simple
24. Rubiaceae					
85	*Galium aparine* L.	Th	Lep	Annual	Simple
25. Scrophulariaceae					
86	*Mazus pumilus* (Burm.f.) Steenis	Th	Nan	Annual	Simple
87	*Misopates orontium* (L.) Raf.	Th	Nan	Annual	Simple
88	*Veronica anagallis-aquatica* L.	Th	Nan	Annual	Simple
89	*V. persica* Poir.	Th	Nan	Annual	Simple
26. Verbenaceae					
90	*Phyla nodiflora* (L.) Greene	Hc	Nan	Perennial	Simple

Key: LF: Life form, LS: Leaf Size, Th: Therophytes, Hc: Hemicryptophytes, Ge: Geophytes, Ch: Chamaephytes, Lep: Leptophylls, Mic: Microphylls, Mes: Mesophylls, Nan: Nanophylls

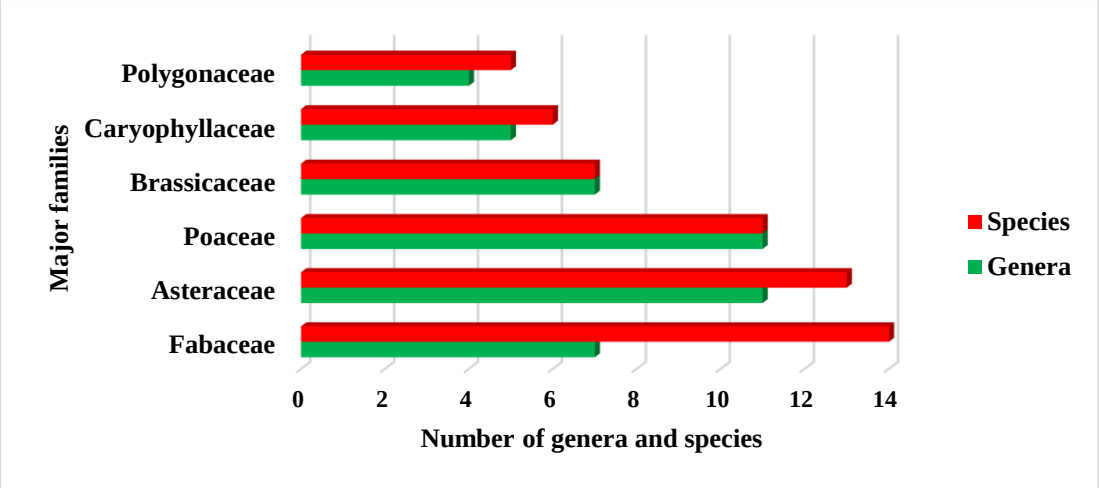

Figure 1. Distribution of genera and species in major families.

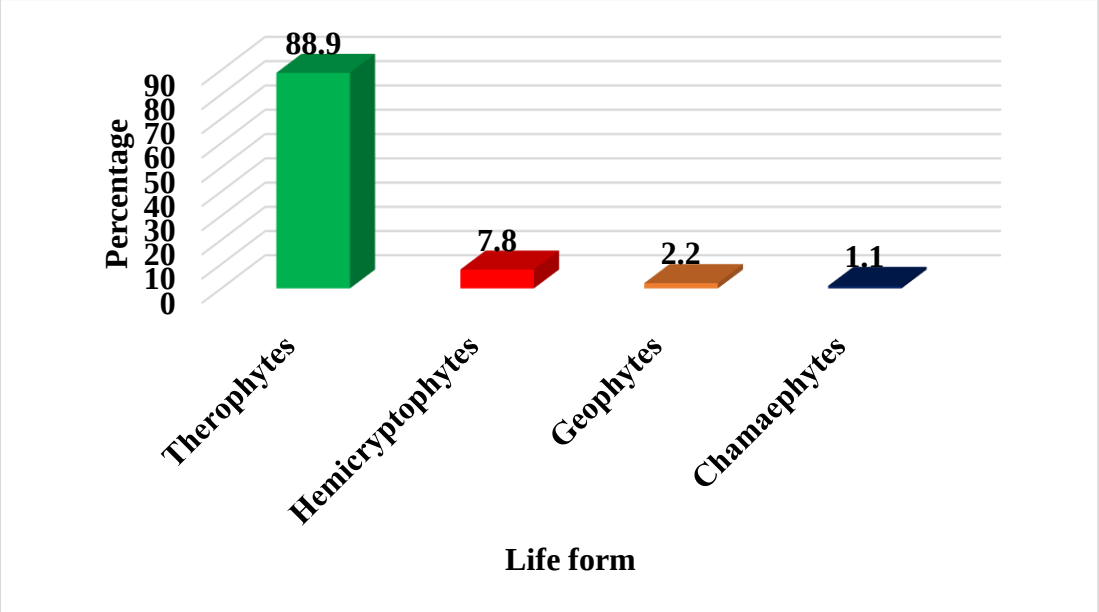

Figure 2. Life form spectra of weed species of wheat crop.

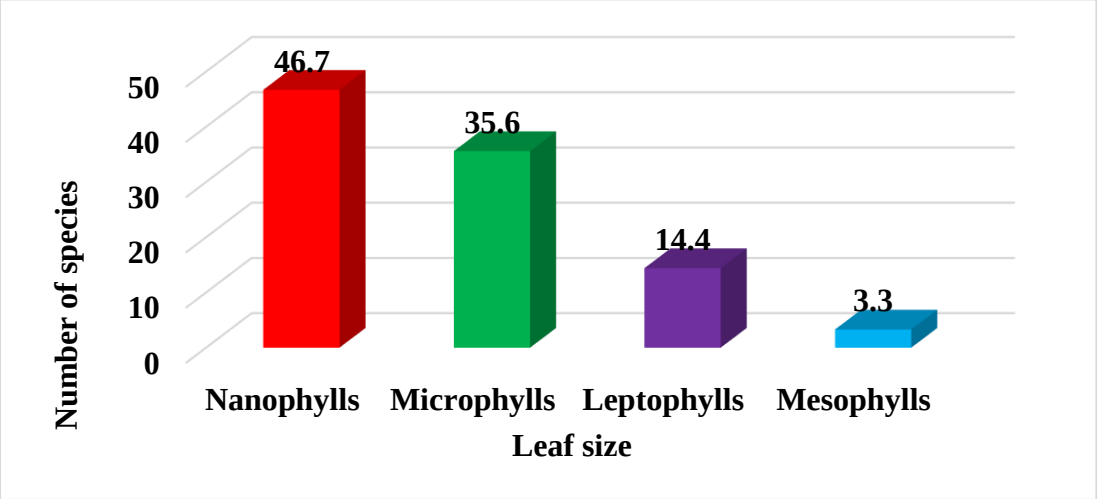

Figure 3. Life size spectra of weed species of wheat crop.

Table 2. Summary of floristic composition, life form spectra, leaf size spectra and leaf types of weeds of wheat crop in tehsil Razar district Swabi, Pakistan

S. No.	Ecological characteristics	Number of Species	Percentage
Weed flora			
I	Total species	90	---
II	Total genera	72	---
III	Total families	26	---
Life span			
I	Annuals	82	91.1
II	Perennials	08	8.9
Life form spectra			
I	Therophytes	80	88.9
II	Hemicryptophytes	07	7.8
III	Chamaephytes	02	2.2
IV	Geophytes	01	1.1
Leaf size spectra			
I	Nanophylls	42	46.7
II	Microphylls	32	35.6
III	Leptophylls	13	14.4
IV	Mesophylls	03	3.3
Lamina shape/Leaf types			
I	Simple	63	70.0
II	Compound	16	17.8
III	Dissected/Decompound	11	12.2

Table 3. Physico-chemical characteristics of soil of different wheat fields/sites in tehsil Razar, district Swabi, Pakistan

Sites	pH (1:5)	EC (1:5)	$CaCO_3$	O.M	Clay	Silt	Sand	Textural class
		dsm^{-1}	%		%			
Site-1	7.8	0.13	18.5	0.77	15.2	22.6	62.2	Sandy loam
Site-2	7.7	0.12	19.5	1.03	19.2	28.6	52.2	Sandy loam
Site-3	7.4	0.15	17.2	0.25	3.2	18.8	78.0	Loamy sand
Site-4	7.3	0.16	16.6	1.13	9.2	1.4	89.4	Sandy
Site-5	5.8	0.14	12.5	1.81	23.2	27.2	49.6	Sandy clay loam
Site-6	7.6	0.20	16.8	1.03	17.2	8.8	74.0	Sandy loam
Site-7	7.8	0.11	22.2	1.29	17.2	14.0	68.8	Sandy loam
Site-8	8.1	0.08	18.7	1.03	13.4	4.2	82.4	Loamy sand
Site-9	6.9	0.13	5.5	0.51	11.8	54.8	33.4	Silt loam
Site-10	7.4	0.06	11.0	0.51	13.2	5.4	81.4	Sandy loam
Site-11	7.4	0.15	6.5	0.77	17.0	29.8	53.2	Sandy loam
Site-12	6.0	0.14	10.7	1.38	20.6	26.0	53.4	Sandy clay loam
Site-13	7.2	0.16	23.5	0.25	8.6	49.8	41.6	Loam
Site-14	7.3	0.14	10.5	1.03	17.2	4.6	78.2	Sandy loam
Site-15	6.5	0.12	10.5	1.24	16.0	8.6	75.4	Sandy loam
Site-16	6.8	0.10	6.5	1.94	12.2	4.4	83.4	Loamy sand
Site-17	7.8	0.10	14.2	0.39	3.8	48.6	47.6	Sandy loam
Site-18	7.6	0.15	13.0	1.60	9.2	2.0	88.8	Loamy sand
Site-19	7.6	0.23	14.6	1.03	23.2	6.8	70.0	Sandy clay loam
Site-20	7.9	0.17	16.0	0.15	4.6	52.0	43.4	Silt loam

Conclusion

The present findings suggest that a large number of weed plants infesting wheat crop in the study area may causes loss to crop yields. For acquiring better yield, it is important to take appropriate biological, chemical and mechanical measurement for weed control.

Authors' contributions

Conceived and designed the experiments: N Akhtar, Performed the experiments: M Anwar, Analyzed the data: M Anwar, Contributed reagents/ materials/ analysis tools: S Khalid & S Qadar, Wrote the paper: M Anwar.

References

1. Anwar M, Khan WM, Khan MS, Murad W & Ali S (2015). Taxonomic study of Family Papilionaceae of District Swabi, Khyber Pakhtunkhwa, Pakistan. *Pure Appl Biol* 4(1):125-128.
2. Mahmood TZ & Niaz SA (1992). "Weeds in Cropped Land at Islamabad," NARC, Identification and control of weeds manual, national training course, Pakistan Agriculture Research Council, Islamabad. pp.79.
3. Dangwal LR, Singh A, Singh T, Sharma A & Sharma C (2010). Common weeds of Rabi (winter) crops of Tehsil Nowshera, District Rajouri (Jammu & Kashmir), India. *Pak J Weed Sci Res* 16(1): 39-45
4. Oudhia P & Tripathi RS (1998). Allelopathic effects of *Parthenium hysterophorus* L. on kodo, mustard and problematic weeds. 1st Int. Conf. *Parthenium* management UAS, Dhaward, India. 6-8 Oct., 1997: 136-139.
5. Cain SA & Castro GM (1959). Manual of Vegetation Analysis. Harper & Brothers, New York, USA.
6. Nasir E & Ali SI (Eds.) (1970-1989). Flora of Pakistan (Fascicles series 1-190). Islamabad, Karachi.
7. Nasir E & Ali SI (Eds.) (1972). Flora of West Pakistan: An annotated catalogue of the vascular plants of West Pakistan and Kashmir. Fakhri printing Press Karachi.
8. Ali SI & Nasir YJ (Eds.) (1989-1991). Flora of Pakistan (Fascicle series). Islamabad, Karachi.
9. Raunkiaer C (1934). The life form of plants and statistical plant geography. The Clarendon Press, Oxford.
10. Hussain F (1989). Field and Laboratory Manual for Plant Ecology. University Grants Commission, Islamabad.
11. Bouyoucos GJ (1936). Directions for making mechanical analysis of soils by the hydrometer method. *Soil Sci* 42: 225-228.
12. Brady NC (1990). The Nature and Properties of Soils. 10th Ed. Macmillan Publishing Co. New York. pp. 621
13. Jackson ML (1962). Soil chemical Analysis. Constable & Co., Ltd., London. pp. 406-407.
14. Rhoades JD, Miyamoto S & Westerman RL (1990). Testing soils for salinity and sodicity. Soil Test. *Plant Anal* 299-336.
15. Black CA (1965). Methods of Soil Analysis. Agron Inc. Madison Wisconsin, USA.
16. Richard LA (1954). Diagnoses and improvement of saline and alkali soils. Agriculture Hand Book, 60: USDA, USA.
17. Hussain F, Rehman SU & Dasti AA (1985). Studies on weeds of wheat in Quetta. *Pak J Agri Res* 6(1): 1-7.
18. Ihsanullah, Wazir SM, Farooq A, Khan SU & Hussain Z (2011). Identification of common weeds and its distribution pattern in wheat fields of FR Bannu, Khyber Pakhtunkhwa, Pakistan. *Pak J Weed Sci Res* 17(4): 407-416.
19. Khan RU, Mehmood S, Khan SU, Muhammad A & Hussain Z (2013). Camparative study of weed species recorded in different field crops of Bannu, Khyber Pakhtunkhwa, Pakistan. *Pak J Weed Sci Res* 20(4): 489-504.
20. Khobragade DP & Sathawane KN (2014). Weed diversity in Rabi wheat crop of Bhandara District (MS), India. *Int J Life Sci* Special Issue. 2: 128-131.

21. Marwat SK, Usman K, Khan NU, Khan MU, Khan EA, Khan MA & Rehman AU (2013). Weeds of Wheat Crop and Their Control Strategies in Dera Ismail Khan District, Khyber Pakhtunkhwa, Pakistan. *Amer J Plant Sci* 4: 66-76.
22. Memon RA, Bhatti GR & Khalid S (2003). Weed diversity of wheat crop in Khairpur district, Sindh. *Pak J Weed Sci Res* 9(1-2): 99-103.
23. Malik ZH, Awan AA & Murtaza G (1992). Weeds of wheat fields around Muzaffarabad, Azad Jammu and Kashmir. *Pak J Agric Sci* 29(1): 61-64.
24. Sher Z, Hussain F, Badshah L & Wahab M (2011). Floristic composition, communities and ecological characteristics of weeds of wheat fields of Lahor, District Swabi, Pakistan. *Pak J Bot* 43(6): 2817-2820.
25. Inayat N, Asadullah & Rashid A (2014). Floristic composition and ecological prevalence of the weed species growing in wheat and sugarcane fields of district Charsadda, Khyber Pakhtunkhwa, Pakistan. *Pak J Weed Sci Res* 20(3): 405-415.
26. Nasir ZA & Sultan S (2002). Floristic, biological and leaf size spectra of weeds in Gram, Lentil, Mustard and Wheat fields of district Chakwal, Pakistan. *Pak J Biol Sci* 5(7): 758-762.
27. Hussain F, Shah SM, Hadi F & Asadullah (2009). Diversity and Ecological characteristics of weeds of wheat fields of University of Peshawar Botanical Garden at Azakhel, district Nowshera, Pakistan. *Pak J Weed Sci Res* 15(4): 283-294.
28. Shah SM, Asadullah & Hadi F (2014). Ecological characteristics of weed flora in the wheat crop of Mastuj valley, district Chitral, Khyber Pakhtunkhwa, Pakistan. *Pak J Weed Sci Res* 20(4): 479-487.
29. Hadi F & Ibrar M (2015). Ecology of weeds in wheat crops of Kalash valley, district Chitral, Hindukush range, Pakistan. *Pak J Weed Sci Res* 21(3): 425-43
30. Gomaa NH (2012). Composition and diversity of weed communities in Al Jouf Province, Northern Saudi Arabia. *Saudi J Biol Sci* 19: 369-376.
31. Zhang K, Dang H, Tan SH, Wang ZH & Zhang Q (2010). Vegetation community and soil characteristics of abandoned agricultural land and pine plantation in the Qinling Mountains, China. *Forest Ecol Manage* 259: 2036-2047.
32. Sperry JS & Hacke UG (2002). Desert shrub water relations with respect to soil characteristics and plant functional type. *Funct Ecol* 16: 367-378.
33. Fried G, Norton LR & Reboud X (2008). Environmental and management factors determining weed species composition and diversity in France. *Agric Ecosyst Environ* 128: 68-76.
34. Andreasen C & Skovgaard IM (2009). Crop and soil factors of importance for the distribution of plant species on arable fields in Denmark. *Agr Ecosyst Environ* 133: 61-67.
35. Pinke G, Pal R & Botta-Dukat Z (2010). Effects of environmental factors on weed species composition of cereal and stubble fields in western Hungary. *Cent Eur J Biol* 5(2): 283-292.
36. Gupta A, Joshi SP & Manhas RK (2008). Multivariate analysis of diversity and composition of weed communities of wheat fields in Doon Valley, India. *Trop Eco* 49(2): 103-112.
37. Jakhar GS, Mahar AQ, Abro SA & Qureshi R (2005). Weed communities of wheat crop under diverse Edaphography of District Khairpur. *Pak J Bot* 37(3): 709-714.
38. Malik ZH, Amjad MS, Rafique S & Malik NZ (2013). Phytosociology of some weeds of wheat communities around Kotli fields, Western Himalaya. *J Eco Nat Envi* 5(11): 340-34.