Volume 15, Number 4, 2009 ISSN 1815-1094

Pakistan Journal

of

WEED SCIENCE RESEARCH

A quarterly research journal of weeds and medicinal herbs

Weed Science Society of Pakistan
Department of Weed Science
NWFP Agricultural University, Peshawar-25130, Pakistan
Ph.92-91-9216542/9218206/5842589; Fax: 92-91-9216520
website:www.wssp.org.pk/

Pak. J. Weed Sci. Res. 15(4): 283-294, 2009

DIVERSITY AND ECOLOGICAL CHARACTERISTICS OF WEEDS OF WHEAT FIELDS OF UNIVERSITY OF PESHAWAR BOTANICAL GARDEN AT AZAKHEL, DISTRICT NOWSHERA, PAKISTAN

Farrukh Hussain[1], Syed Mukaram Shah, Fazal-e-Hadi and Asadullah

ABSTRACT

Sixty two species of weeds including 15 monocots and one pteridophyte of 24 families were recorded for the first time as weeds of wheat in the University of Peshawar Botanical Garden at Azakhel, District Nowshera, Pakistan. Poaceae had the highest number of species (15 sp., 24.19%), followed by Asteraceae (8 sp., 12.90%), Brassicaceae and Papilionaceae (each with 5 sp.). The remaining families had 4 or less than 4 species. Therophytes (53 sp, 85.48) and nanophylls (25 sp., 40.32%) were the major life form and leaf size classes. Phenological studies indicated that 95% weeds were in vegetative phase during January while almost 61 and 26% were in flowering and fruiting stage, respectively during March. All species were in fruiting/dispersal phase during April. Soils in various sites were silty-loam to loam in texture.

Keywords: Biodiversity, weed diversity, wheat fields, ecological characteristics, Azakhel, Botanical Garden, Pakistan.

INTRODUCTION

The 87 acres original Azakhel Park built during 1993 was handed over to the University of Peshawar Pakistan in September 2005 to establish Botanical Garden. Prior to establishment of park, the area was mostly barren due to salinity and water logging. The park was completely covered with *Desmostachya bipinnata, Imperata cylindrica, Phragmites karka, Saccharun spontaneum, Suaeda fruiticosa* and many other halophytes due to poor management. Therefore, to clear the land from these weedy plants, 4-5 times thorough plowing by Chisel plow (Raja hal), followed by rotavator plowing and collection of plant material, cut root stocks and rhizomes was done.

Wheat was sown during late November, 2008 with the aim to offer competition to the aforementioned weed species and to get some

[1] Centre of Plant Biodiversity, University of Peshawar, Pakistan E-mail: farrukhbotany@yahoo.com

return from the land. Weeds invariably appeared in the wheat fields. Since this was the first ever cultivation of any crop, it was considered appropriate to enlist the weeds as a first ever record.

Weeds offer competition, allelopathy, habitats for harmful organisms, problems during harvesting, plowing and management of land. All these factors lead to the overall reduction in the quality and quantity of wheat production. For any ecological management, the proper identification and assessment of flora has always been a pre-requisite. Therefore, weeds of wheat fields from Peshawar Valley (Ayaz *et al.* 1993; Hussain *et al.* 1985,1993,2004; Hanif *et al.* 2004; Shah *et al.* 2008) and other parts of the country have been reported (Hussain *et al.* 1998; Murad *et al.* 1995; Malik and Hussain, 1990; Qureshi *et al.* 2009; Ayaz *et al.* 1993; Akhtar and Hussain, 2007; Waheed *et al.* 2009; Jakhar *et al.* 2005; Marwat *et al.* 2008; Mohammad *et al.* 2005; Qureshi and Bhatti, 2001 a, b; Shah and Khan, 2006).

As the present report is the first ever record of weeds found in the first ever cultivated wheat fields from this garden, besides, adding knowledge to the existing weed ecology, it will serve as first hand base line data for future scientists working on the management and dynamics of weeds in this garden and its adjoining areas.

MATERIALS AND METHODS

Location, Climate and Soil

University of Peshawar's Botanical Garden is located at Azakhel, District Nowshera, NWFP, Pakistan between latitudes 34°-15' and 34°-31' and longitudes 71.43 to 44 E at an altitude of 290 m. It is bounded by Nowshera on East, Peshawar on West, Chirat hills on south and Charsadda on North. Since the climate is similar to Peshawar and Nowshera, therefore, the climatic data of Peshawar for 2008 was taken as representative (Table-1) for the area. The annual average rainfall was 34.9 mm, with the highest in August (136.3mm), followed by April (107.1 mm), January (63.5mm) and July (63.3mm). May (2.7mm) October (00m) and November (1mm) had the lowest occurrence (Table-1). The average annual temperature was 29.8°C with high remaining above 38°C during May and June and lowest during December to February (3.6-9.9°C). The relative humidity averaged 78 and 51% at 8am and 5pm, respectively, with maximum humidity during rainy season. Soils are silty-loam at two sites and loamy at other three sites (Table-2). The pH ranged from 8.4 to 8.8; $CaCO_3$ 10.25 to 14.00%, organic matter 0.75 to 1.20%, N from 0.29 to 0.06 ppm, P from 0.86 to 6.35 ppm, K from 90 to 320 ppm, Ec from 0.20 to 0.74 and TSS 0.64 to 0.704% with in the investigated sites.

Table-1. Climatic data of Peshawar during 2008.

Months	Total Rain (mm)	Mean Min. Temp.(°C)	Mean Max. Temp.(°C)	Humidity at 8 AM (%)	Humidity at 5 PM (%)
Jan.	63.5	3.6	15.6	83	49
Feb.	8.9	6.4	21.2	72	39
Mar.	10.6	14.3	29.5	73	42
April	107.1	17.0	28.3	79	58
May	2.7	22.0	38.5	64	43
June	9.6	26.7	38.7	71	49
July	63.3	26.4	36.9	79	56
Aug.	136.3	25.2	35.0	86	61
Sept.	12.0	22.0	34.0	82	52
Oct.	0.0	18.2	32.9	82	52
Nov.	1.6	9.9	25.9	82	57
Dec.	13.8	6.8	21.8	81	59
Avg.	34.9	16.5	29.8	78	51

Five varieties of wheat namely: Ghaznavi, Tatara, Bhakar, Pirsabak-2005 and Sirin-2007 were experimentally cultivated during November and early December, 2008 by broadcast method following standard agronomic practices. Weed flora was recoded monthly from January to April 2009 in each of the varieties. The phenology (vegetative, flowering, fruiting stages) was recorded. Weeds were classified into various life forms and leaf sizes classes after Raunkiaer (1934) and Hussain (1989). Soil samples were collected up to the depth of 15 cm and analyzed for physico-chemical features at Agricultural Research Institute, Tarnab, Peshawar. Plants were identified with the help of Flora of Pakistan (Nasir and Ali, 1971-1995; Ali and Nasir, 1971-1995; Ali and Qaiser, 1995-2007).

Table-2. Physio-Chemical analysis of soil of wheat fields of Botanical Garden, Azakhel, District Nowshera

Wheat Varieties	Soil texture				Chemical Characteristics							
	Clay %	Silt %	Sand %	Textu. Class	$CaCO_3$	Organic Matter (%)	N (ppm)	P (ppm)	K (ppm)	pH	ECX 10^{-3}	TSS%
Ghaznavi	17.0	52.0	31.0	Silt loam	12.25	0.79	0.039	0.86	250	8.8	2.20	0.704
Tatara	20.6	50.0	29.4	Silt loam	10.25	1.20	0.060	6.35	250	8.4	0.74	0.237
Bhakkar	18.6	42.0	39.0	Loam	11.50	0.58	0.029	0.57	190	8.8	0.22	0.070
Pirsabak -2005	24.0	38.0	38.0	Loam	18.00	0.89	0.044	5.20	320	8.6	0.54	0.173
Sirin-2007	22.0	46.0	32.0	Loam	14.00	0.75	0.037	6.35	280	8.6	0.20	0.064

RESULTS AND DISCUSSION

Sixty-two species of 24 families including one monocot family (with 15 species) and one Pteridophytic family (with one species) were recoded as weeds from five wheat growing sites of Botanical Garden (Table-3). Poaceae (15 sp. 24.19%), Asteraceae (8 sp. 12.06%), Brassicaceae and Papilionaceae (each with 5 sp. 8.06%) and Chenopodiaceae (4 sp. 6.45%) were the leading families. Caryophyllaceae and Polygonaceae had 3 species each (4.83%) while Euphorbiaceae and Scrophulariaceae each had 2 species (3.22%). Each of the remaining 15 families was represented by single species. The present findings agree with many other workers (Akhtar and Hussain, 2007; Jakhar *et al.* 2005; Mohammad *et al.* 2005; Qureshi & Bhatti, 2001 a,b; Shah and Khan, 2006; Shah *et al.* 2008; Waheed *et al.* 2009), who reported that Poaceae, Asteraceae and Papilionceae were leading weed families in their studies.

Life form spectra (Tables-3 and 4) indicated that there were 53 (84.48%) therophytes, 5 (8.06%) hemicryplophytes, 2 (3.22%) chamaephytes and 2 (3.22%) geophytes. Therophytes dominate in disturbed and cultivated habitats. The findings agree with those of Hussain *et al.* (2004), Waheed *et al.* (2009) and Akhtar and Hussain (2007), who also observed dominance of therophytic weeds in cultivated fields including wheat. Weeds enter the fields through wind, water, animals and as contamination in seeds. Therefore, it becomes difficult to completely eliminate them. Since annuals survive only through seeds therefore these might be controlled better than perennial weeds by suppressing their flowering and fruiting. However, even under best management weed seeds persists due to their longevity and long viability in the soil. Chamaephytes, hemicryptophytes and geophytes have an added advantage of regenerating from underground parts. It is interesting to note that *Desmostachya bipinnata* and *Imperata cylindrica* were non-existent in wheat fields. It suggests that both these plants could not compete well with wheat. *Phragmites karka* has strong rhizome systems that penetrate to more than 4-5 ft depth in soil. The left over rhizome fragments give rise to new plants due to long viability. Furthermore, *Phragmites* has more than 6m long sprawling runners that roots out at each node. It was also observed that *Phragmites* appeared more competitive against wheat in the absence of *Desmostachy, Imperata cylindrica*, another rhizomatous grass, persists due to production of enormous seeds, extensive rhizomes with strong competition and allelopathy (Hussain and Abidi, 1991; Hussain *et al.* 1992). All these plants are adapted to saline and water logged vegetation in the Botanical Garden and in the adjacent areas (Shah and Hussain, 2007).

Leaf size spectra (Table-4) indicated the dominance of nanophylls (25 sp., 40.32%), followed by microphylls (17 sp., 27.41%), mesophylls (12 sp., 19.35%) and leptophylls (8 sp., 12.90%). Our findings in this respect agree with other workers (Hussain *et al.* 1993; Shah *et al.* 2008; Akhtar and Hussain, 2007), who also concluded that most species of weeds have small leaves. A plant passes through different phenological stages during its life cycle with changing environmental condition especially thermoperiod and photoperiod. Phenological studies help in predicting time of germination, vegetative growth, flowering, time of harvesting fruits/seeds or crops. The present study showed (Table-5) that 95% species were vegetative during January, 69%, 29% and 2% were in vegetative, flowering and fruiting stages, respectively. While 13%, 61% and 26% species were in vegetative, flowering and fruiting stages in March. During April 19% and 81% were respectively in flowering and fruiting/dispersal phase (Tables-3 and 5). It was obvious that with the increasing temperature from January to April (Table-1), the weeds passed on to fruiting and dispersal stage. The phenological results suggest that most weeds must be checked at an early stage before they could produce seeds. Once seeds are dispersed and deposited in the soil, then there are more chances of emergence of weeds in the next season.

Although the presence of weeds was recorded in various varieties of wheat but there was no difference in species, therefore distribution of weeds were not considered in separate cultivars. Most of these weeds like *Convolvulus arvensis, Stellaria media, Coronopus didyma, Cynodon dactylon, Imperata cylindrica, Poa* sp., *Silybum marianum, Imperata cylindrica, Sisymbrium irio, Melilotus indica, Medicago polymorpha, Anagallis arvensis* and many others are invariably known weeds of wheat fields from other parts of the country (Hussain *et al.* 1985 a, b;1993, 2004; Qureshi and Bhatti, 2001 a, b; Jakkar *et al.* 2005; Mohammad *et al.* 2005; Shah and Khan, 2006; Marwat *et al.* 2006; Akhtar and Hussain, 2007; Shah *et al.* 2008).

It is also stated that some of these weeds such as *Anagallis arvensis, Phalaris minor* and *Silybum marianum* etc were not present in the Botanical Garden. It is quite possible that some of the recorded weeds might have come with the wheat seeds. It is the first report of weeds of wheat that makes a base line data for future dynamics of these weeds in crops sown in Garden. Further study is required for distribution and quantification of weeds for ecological management.

ACKNOWLEDGMENT

We are thankful to Syed Mushtaq Ali Shah, Director and Mr. Imtiaz Ahmed, Meteorologist, Regional Meteorological Centre, Peshawar for providing climatic data.

REFERENCES CITED

Akhtar, N. and F. Hussain. 2007. Weeds of wheat fields of village Qamber, District Swat, Pakistan. Pak. J. Pl. Sci., 13:31-35

Ali, S.I. and M. Qaiser. 1995-2007. Flora of Pakistan. University of Karachi.

Ayaz, S., F. Hussain and Z. H. Malik. 1993. Distribution and population of weeds in the wheat fields of Mayar-Jandool, District Dir. Sci. Khyber, 6: 43-57

Hanif, Z., S.A. Khan,K.B.Marwat, I.A. Khan and Ikramullah. 2004. Important weeds of wheat crop of Malkandher Farm, NWFP., Agricultral University, Peshawar. Pak. J. Weed Sci. Res., 10:109-112.

Hussain, F., K.B. Marwat and K. Ahmed. 1985a. Ecotaxonomic studies on the weeds of wheat fields in Peshawar Valley. Gomal Univ. J. Res., 5:27-35

Hussain, F., S. R. Chughtai and A.A. Dasti. 1985b. Studies on weeds of wheat in Quetta. Pak.J. Agric. Res., 6:1-7.

Hussain, F. and N. Abidi. 1991 Allelopathy exhibited by *Imperata cylindrica* (L.). P. Beauv. Pak. J. Bot., 23:15-25

Hussain, F., M. Ayaz, S. Hyat and A.R. Saljoqi. 1993. Life form, leaf spectra, seed output and biomass of weeds in the wheat fields of Mayar-Jandool, District Dir. Sarhad J. Agric., 9(6): 539-542.

Hussain, F., N. Abidi, S. Ayaz and A.R. Saljoqi. 1992. Allelopathic suppression of wheat and maize seedling growth by *Imperata cylindrica* (Linn.) P. Beauv. Sarhad J. Agric., 8(4): 433-439.

Hussain, F., A. Murad and M. J. Durrani. 2004. Weed communities in the wheat fields of Mastuj, District Chitral, Pakistan. Pak. J. Weed Sci. Res., 10:101-108

Hussain, F. 1989. Field and laboratory manual of Plant Ecology. UGC, Islamabad

Jakhar, G.S., A.Q Mahar, S.A. Abro and R.Qureshi 2005. Weed communities of wheat crop under diverse edaphology of District Khairpur. Pak. J. Bot., 37:709-714.

Malik, Z.H. and F. Hussain. 1990. The distribution of some weeds in wheat fields of Kotli, Azad Kashmir. Sarhad J. Agric., 6: 1-4.

Marwat, K.B., Z. Hussain, B. Gul, M. Saeed and S. Din 2008. Survey on weed problem in wheat crop in District Mardan. Pak. J. Weed. Sci. Res., 12:353-358

Murad, A., F. Hussain, Q. Marwat and Z. Mohammed. 1995. Floristic composition, life form and leaf size spectra of some weeds of wheat, maize and potato fields of Mustuj, District Chitral. Pak. J. Pl. Sci., 1:153-164.

Nasir, E. and S.I. Ali. 1971-1995. Flora of Pakistan. PARC, Islamabad.

Mohammad, S, T., A. Cheema, Z. Bashir and R. Mehmood. 2005. Analytical characteristics of weeds of wheat crop of Tehsil Gojra, Toba Tek Singh, Pakistan. Pak. J. Pl. Sci., 52-6.

Qureshi, R. and G. R. Bhatti. 2001a. Determination of weed communities in wheat (*Triticum aestivum* L.) field of District Sukkhar. Pak. J. Bot., 33:109-113.

Qureshi, R. and G. R. Bhatti. 2001b. Floristic study of weeds of wheat. Pak. J. Biol. Sci., 1:63-66.

Qureshi, R., A.Waheed and M. Arshad. 2009. Weed communities of wheat crop in District Toba Tek Singh, Pakistan. Pak. J. Bot., 41: 239-245

Raunkiaer, C. 1934. The life forms of plants and Statistical Plant Geography. Clrendon Press, Oxford.

Shah, G.M. and M. A. Khan 2006. Checklist of noxious weeds of District Mansehra, Pakistan. Pak. J. Weed Sci. Res., 12:213-219.

Shah, S. M. and F. Hussain. 2008. Ecology of wetlands of Akberpura, district Nowshera, Pakistan. Pak. J. Pl. Sci., 14:47-57

Shah, S.M., F. Hadi and F. Hussain. 2008. A check list of weeds of wheat fields of Palosi, District Peshawar, Pakistan. Pesh. Univ-Teachers Assoc. J. (Science), 15: 9-16

Waheed, A., R. Qureshi, G.S. Jakhar and H.Tareen. 2009. Weed community dynamics in wheat crop of District Rahim Yar Khan, Pakistan. Pak. J. Bot., 41: 247-254.

Table-3. Floristic composition, Life-form, Leaf-size and Phenology of weeds of Wheat grown in experimental fields of Botanical Garden, Azakhel, District Nowshera.

S.No	Plant species	Life-form	Leaf size	Phenology			
				Jan.	Feb.	March	April
A.	**Pteridophyta**						
	1.Family Equisetaceae						
1.	*Equisetum arvense* L.	G	L	V	V	V	V
B.	**Monocotyledonae**						
	2. Family Poaceae						
2.	*Aegilops tauschii Cosson*	Th	N	V	V	Fl	Fr
3.	*Alopecurus myosuroides* Huds.	Th	Mic	V	Fl	Fr	Fr
4.	*Avena sativa* L.	Th	Mic	V	Fl	Fr	Fr
5.	*Bromus gracillimus* Bunge.	Th	Mic	V	Fl	Fr	Fr
6.	*Cynodon dactylon* (L.) Pers.	H	N	V	V	Fl	Fl/Fr
7.	*Desmostachya bipinnata* (L.) Stapf.	H	Mic	V	V	V	Fl
8.	*Dichanthium annulatum* (Forssk.) Stapf.	H	Mic	Fl	Fr	Fr	Fr
9.	*Eragrostris poaoides* Roem & Schult.	Th	N	V	V	Fl	Fl/Fr
10.	*Hordeum murinum* L.	Th	N	V	V	Fl	Fr
11.	*Imperata cylindrica* (L.) P.Beauv.	H	Mic	Fl	Fl	Fr	Fl/Fr
12.	*Phalaris minor* Retz.	Th	N	V	V	Fl	Fl/Fr
13.	*Phragmites karka* (Retz.) Trin ex Steud.	G	Mes	V	V	V	V
14.	*Poa annua* L.	Th	N	V	Fl	Fr	Fr
15.	*Polypogon monspeliensis* (L.) Desf.	Th	Mes	V	V	Fl	Fr
16.	*Sporobolus arabicus* Boiss.	Th	N	V	V	Fl	Fr
C.	**Dicotyledonae**						
	3. Family Apiaceae						
17.	*Torilis leptophylla* (L.) Reich.	Th	Mic	V	V	Fl	Fl/Fr
	4. Family Asteraceae						

S.No	Plant species	Life-form	Leaf size	Phenology			
				Jan.	Feb.	March	April
18.	*Centurea iberica* Trev ex Spring.	Th	Mes	V	V	Fl	Fl
19.	*Cnicus arvense Graeb*	Th	Mes	V	V	Fl	Fl/Fr
20.	*Launaea procumbens* Roxb.	Th	Mic	V	V	Fl	Fr
21.	*Parthenium hysterophorus* L.	Th	Mes	Fl	Fl	Fr	Fr
22.	*Silybum marianum* Gaertn.	Th	Mes	V	V	Fl	Fr
23.	*Sonchus arvensis* (DC) Kirp.	Th	Mic	V	V	Fl	Fr
24.	*Taraxicum officinale* Weber.	Th	Mes	V	Fl	Fl/Fr	Fr
25.	*Xanthium strumarium* L.	Th	Mes	V	V	V	Fl
	5. Family Brassicaceae						
26.	*Brassica campestris* L.	Th	Mes	V	Fl	Fr	Fr
27.	*Capsella bursa-pastoris* (L.) Medic.	Th	Mic	V	V	Fl	Fl
28.	*Coronopus didymus* (L.) Sm.	Th	N	V	Fl	Fr	Fr
29.	*Malcolmia cabulica* (Boiss.) Hook.	Th	Mes	V	V	Fl	Fl
30.	*Sisymbrium irio* L.	Th	N	V	Fl	Fr	Fr
	6. Family Cannabinaceae						
31.	*Cannabis sativa* L.	Th	N	V	V	Fl	Fl/Fr
	7. Family Caryophyllaceae						
32.	*Cerastium dichotomum* L.	Th	N	V	V	Fl/F	Fr
33.	*Spergula arvensis* L.	Th	L	V	Fl	Fl/Fr	Fr
34.	*Stellaria media* L.	Th	N	V	V	Fl/F	Fr
	8. Family Chenopodiaceae						
35.	*Chenopodium album* L.	Th	N	V	Fl	Fr	Fr
36.	*Chenopodium murale* L.	Th	Mic	V	V	Fl/Fr	Fr
37.	*Kochia indica* Wight.	Ch	N	V	V	Fl/F	Fr
38.	*Suaeda fruticosa* (L.) Forssk.	Ch	N	V	V	V	Fl
	9. Family Convolvulaceae						
39.	*Convolvulus arvensis* L.	Th	Mic	V	V	V	Fl

S.No	Plant species	Life-form	Leaf size	Phenology			
				Jan.	Feb.	March	April
	10. Family Cuscutaceae						
40.	*Cuscuta reflexa* Roxb.	Th	L	V	V	V	Fl
	11. Family Euphorbiaceae						
41.	*Euphorbia granulata* Forssk.	Th	L	V	Fl	Fr	Fr
42.	*Euphorbia helioscopia* L.	Th	N	V	V	Fl	Fl/Fr
	12. Family Fumariaceae						
43.	*Fumaria indica* (Hausskn.) Pugsley.	Th	L	V	Fl	Fr	Fr
	13. Family Lamiaceae						
44.	*Salvia plebeia* R.Br.	Th	Mic	V	Fl	Fr	Fr
	14. Linaceae						
45.	*Linum corymbulosum* Reichenb.	Th	N	V	V	V	Fl
	15. Family Malvaceae						
46.	*Malva neglecta* Wallr.	Th	Mic	V	V	Fl	Fr
	16. Family Oxalidaceae						
47.	*Oxalis corniculata* L.	Th	L	V	V	Fl	Fr
	17. Family Papilionaceae						
48.	*Lotus corniculatus* L	Th	L	V	V	Fl	Fr
49.	*Medicago aschersonianna* Urb.	Th	N	V	V	Fl	Fr
50.	*Medicago polymorpha* L.	Th	N	V	V	Fl	Fr
51.	*Melilotus indica* (L.) All.	Th	N	V	Fl	Fr	Fr
52.	*Vicia sativa* L.	Th	N	V	V	Fl	Fr
	18. Family Plantaginaceae						
53.	*Plantago lanceolata* L.	Th	Mes	V	V	Fl	Fr
	19. Family Polygonaceae						
54.	*Polygonum afghanicum* Meissn.	Th	N	V	V	Fl	Fr
55.	*Polygonum plebejium* R.Br.	Th	L	V	V	Fl	Fr

S.No	Plant species	Life-form	Leaf size	Phenology			
				Jan.	Feb.	March	April
56.	*Rumex dentatus* L.	Th	Mes	V	V	Fl	Fl/Fr
	20. Family Primulaceae						
57.	*Anagallis arvensis* L.	Th	N	V	V	Fl/Fr	Fr
	21. Family Ranunculaceae						
58.	*Ranunculus arvensis* L.	Th	Mic	V	V	Fl/Fr	Fr
	22. Rubiaceae						
59.	*Galium aparine* L.	Th	N	V	V	Fl/Fr	Fr
	23. Family Scrophulariaceae						
60.	*Veronica biloba* L.	Th	N	V	Fl	Fr	Fr
61.	*Veronica anagalus-aquatica* L.	Th	Mic	V	V	Fl/Fr	Fr
	24. Family Verbenaceae						
62.	*Verbena officinalis* L.	H	Mic	V	Fl	Fl/Fr	Fr

Keys:

Life-form classes: 1. Th. Therophytes 2. G. Geophytes 3. H. Hemicryptophytes 4. Ch. Chamaephytes

Leaf-size classes: 1. L. Leptophylls 2. N. Nannophylls 3. Mic. Microphylls 4. Mes. Mesophylls

Phenological classes: 1. V. Vegetative stage 2. Fl. Flowering stage 3. Fr. Fruiting stage

Table-4. Life-form and Leaf-size and of Weeds of Wheat fields of Botanical Garden, Azakhel, District Nowshera.

S. No.	Parameter	No. of species	Percentage
A. Life-form classes			
1.	Therophytes	53	85.48
2.	Hemicryptophytes	5	8.06
3.	Chamaephytes	2	3.22
4.	Geophytes	2	3.22
B. Leaf-size classes			
1.	Nanophylls	25	40.32
2.	Microphylls	17	27.41
3.	Mesophylls	12	19.35
4.	Leptophylls	8	12.90

Table-5. Phenology of Weeds of Wheat fields of Botanical Garden, Azakhel, District Nowshera.

Phenological Stage	Months (2009)							
	January		February		March		April	
	No.	%	No.	%	No.	%	No.	%
1. Vegetative	59	95.16	43	69.35	8	12.90	--	--
2. Flowering	3	4.84	18	29.03	38	61.29	12	19.358
3. Fruiting	-	-	1	1.61	16	25.80	50	0.65