DISTRIBUTION PATTERN OF WEEDS IN WHEAT CROP GROWN IN DISTRICT KHANEWAL, PUNJAB, PAKISTAN

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https://doi.org/10.28941/26-1(2020)-4

ABSTRACT

Weed infestation is among the main biotic factors affecting growth and yield of various crops. This issue is more drastic for cereal crops like wheat which is the staple food crop of over 2.5 billion population of the world. One the control strategies is to investigate the distribution pattern of weeds under field conditions. In this regard, a survey study was conducted to investigate the distribution pattern of weed species in wheat crop during 2016-18 in district Khanewal, Punjab Pakistan. Thirty-six weed species distributed among fifteen different families were collected from the study area. Family Poaceae was the predominant with 10 species, while family Asteraceae was the second most dominant family with four weed species. Cynodon dactylon (L.) Pers. was the most frequently found specie with frequency value of 79.1% while Paspalum distichum had the highest importance value index (6.96) among the weeds of the study area. Based on these findings, it is recommended to create awareness among the farmers about the identified weeds so that weed infestation could be controlled with the recommended practices.

Keywords: Weeds, wheat; Khanewal, distribution, *Cynodon dactylon, Paspalum distichum*.

Citation: Usman, M., G. Murtaza, A. Ditta, T. Bakht, M. Asif, M. Nadir and S. Nawaz. 2020. Distribution pattern of weeds in wheat crop grown in District Khanewal, Punjab, Pakistan. Pak. J. Weed Sci. Res., 26 (1): 47-59.

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INTRODUCTION

Pakistan is an agricultural country and wheat is among the major cereal crops having major contribution in the economy of Pakistan. During 2018-19, wheat was cultivated on an area of 8.74 million ha with an average production of 2.882 metric tons ha^{-1} (Pakistan Bureau of Statistics, 2018-19). Pakistan ranked as 8th most wheat producing country of the world, producing about 3.35% of the world's wheat supply. There are various biotic and abiotic factors responsible for low production of wheat in the country; among those, weed infestation is among the most damaging ones (Memon *et al.,* 2013).

Weeds are the unwanted plants present in crops which invade and impart negative effects on crop yield as these compete with the main crop for nutrients, water, space and light (Dangwal *et al.,* 2010; Marwat *et al.,* 2013; Reddy and Reddi, 2011). Earlier, it has been estimated that weeds may cause an annual loss of 28 billion PKR to the wheat crop and an overall loss of 130 billion PKR in Pakistan (Hassan and Marwat, 2001). In Australia, an annual loss of $3.3 billion and $138 billion in USA was reported due to weed infestation in crops (Pimentel *et al.*, 2005; Adkin and Navie, 2006). It is also reported that our environment is exposed to alien species due to anthropogenic activities (Kowarik, 2003).

Distribution of weeds in wheat and other environments in relation to different crops has always been a complex phenomenon. Weeds grow everywhere, no more space remains without the growth of weeds. Weeds may be of grassy type belonging to monocot from Poaceae family or sedges from Cyperaceae, or dicot belonging to angiosperm families e.g. Fabaceae, Brassicacea and Convolvulaceae etc. (Tiwari *et al.,* 2014; Sosa *et al.,* 2016). Weeds found in the different crops impart their negative role in terms of competition for different resources mainly for nutrients, light, space and gases (Javaid *et al.,* 2010).

According to Shabbir and Bajwa (2006) weeds not only lower the crop production but also contribute towards an enhanced insect attack that can be more severe with time, give poor quality of the produce and water management problems. In this regard, various studies have been reported regarding the distribution of different weed species all over the country (Tauseef *et al.*, 2012; Kakhki *et al*., 2013; Ahmad *et al.*, 2016; Khan *et al.*, 2016; Ahmad *et al.*, 2019; Fazal *et al*., 2019). For example, Qureshi *et al*. (2009) reported sixty-seven weeds belong to twenty-nine different families in wheat, maize and potato fields of district Toba Tek Singh, Punjab. Out of those twenty-nine families, two were monocots, while all other families were dicots. Thirty-five weeds invading the wheat crop while thirty-four weeds in maize and twenty-four in potato crop were collected. Twenty-four weeds were common in case of wheat-maize, maize-potato or wheat-potato, causing negative effects on crop production as well as their growth. Similarly, Tahira *et al.* (2010) while working on turmeric field selected about twenty-six localities in two successive years and worked on weeds distribution in district Kasur. Eight families possessed about fourteen different species reported from the selected areas. *Chenopodium album* L., *Malvastrum coromandelianum* (L.) Garcke and *Cynodon dactylon* (L.) Pers. frequently occurred with frequency of about 80%.

Shedayi *et al.* (2011) selected ten different fields to study the pattern of weeds distribution in Gilgit-Baltistan, Pakistan recorded the density, frequency, and importance value and frequency classes of weeds. About 24 weeds were identified from the selected point which belonged to ten different families. Chenepodiaceae family was the most frequent in a sense with 100% frequency followed by less frequent families after Chenopodiaceae were Labiatae 85%, Asteraceaee, Papillionaceae, Poaceae and Polygoniaceae each 80%, while some other families were less frequently present in the study area. Jan *et al.* (2012) worked on weeds in wheat crop in ten villages of district Bannu and reported

about forty-three species belonging to 25 different families out of which two were monocots and twenty-three were dicot. Family Poaceae and Cyperaceae were monocots while the most dominant family in terms of species was Asteraceae with seven species followed by Brassicaceae with six species.

Khan *et al*. (2014) reported *Parthenium* weed the most dominant in four districts of KPK including Swabi, Mardan, Charsada and Peshawar mainly highlight *Parthenium* weed dominance. By using quadrat method found out percentage frequency, density, relative density, relative density, importance value, class constancy as well as some other parameters. *Parthenium* weed was the most dominant along roadside and agricultural area in terms of importance value and relative density causing severe threads to crops as well as thread to local species. *Cannabis sativa, Cynodon dactylon* (L.) Pers*., Cyperus rotundus* L. were also present in a great number. Bhaskar *et al.* (2016) highlight the weeds as major ecological problem causing serious threat to crops. Crop production reduced to 12-98% depending on cultivation area as a result of weeds. Mainly carried out their survey on rice, sugarcane and cotton and collected about 168 weed species from 50 different families. Dominant families included Poaeceae, Fabaceae, Amaranthaceae, Rubiaceae, Cyperaceae and Acanthaceae each having ten species and contributing mainly to weed flora of that region.

Based on the above discussion, it is need of the hour to control weed infestation in the crops in order to boost the productivity and quality of crops. Moreover, the distribution pattern, importance value index of each weed species and infestation intensity of each weed is different in different crops. Therefore, it is necessary to investigate the distribution pattern of different weeds among crops under different environmental conditions in order to understand and improve weed management. Based on this hypothesis, the present study was conducted to find out the distribution pattern and importance value index of different weed species in selected villages of District Khanewal. Up to our knowledge, no study has been conducted on determining the distribution pattern of weeds in wheat in Khanewal.

MATERIALS AND METHODS

The present study was carried out from March 2016 to May 2018 to find out the weeds in wheat (*Triticum aestivum*) fields of four villages (Chak No 15/v (Addhy wala), 16/v, 17/v and 18/v) in district Khanewal. The temperature of this region ranges from 30.8-47°C in summer and 15.6-25.7°C in winter.

Quadrate method was used for studying the distribution of weeds (Clements, 1905). Frequency percentage, density and cover percentage was calculated by taking each quadrate of 1 m^2 (Oasting, 1956). Sixty quadrants were taken from three villages (twenty quadrats from each of the three selected sites). The data were collected during the course of crop after every twenty days.

Weed species were identified with the help of Flora of Pakistan (Nasir and Ali, 1974-1991; Stewart, 1972) and by comparing the plants, already present in GCU Herbarium. The weed specimens collected from each quadrat were tagged, placed between newspaper and pressed in plant paper. Later on, each specimen was poisoned and mounted on the standard herbarium sheet. Then each weed species was deposited to Sultan Ahmad Herbarium GCU, Lahore. A checklist of all the weed specimens with details of scientific, vernacular and English names was made after interviewing the farmers and by consulting the scientific literature. The grasses were mostly identified within Poaceae (Cope, 1982). The nomenclature has been updated, following in general the Flora of Pakistan, and other taxonomic literature. Exact referencing of taxonomic names was considered from Universal Biological Indexer and Organizer (uBio) a Project by Marine Biological Laboratory (USA).

Weeds distribution parameters

Phytosociological attributes such as density, frequency, relative density, relative frequency and Importance Values were measured for each field (Oosting, 1956; Ambasht and Ambasht, 1969).

$$\text{Frequency percentage} = \frac{\text{No. of quadrats in which a species occur}}{\text{Total no. of quadrats study}} \times 100$$

s

$$\text{Density} = \frac{\text{Total no. of individuals of a species in all the quadrats}}{\text{Total no. of quadrats study}}$$

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

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

$$\text{Relative cover} = \frac{\text{Cover of individual species}}{\text{Total cover of all the species study}} \times 100$$

$$\text{Importance value} = \text{Relative frequency} + \text{relative density} + \text{relative cover}$$

Importance value index (IVI) is a reasonable measure to investigate the overall contribution of a species during weed infestation. IVI was calculated following Curtis and McIntosh (1950).

$$\text{Importance value index} = \frac{\text{Relative frequency} + \text{relative density} + \text{relative cover}}{3}$$

$$\text{Family importance value index} = \frac{\text{Sum of importance value index of all species in a family}}{\text{Number of species in the family}}$$

RESULTS AND DISCUSSION

Weeds ecological behavior

Thirty-six weed species were collected from the study area belonging to fifteen different families from the wheat crop in selected villages (Chak No 15/v (Addhy wala), 16/v, 17/v and 18/v) of District Khanewal (Fig. 1). Different weed species were found growing in wheat and some of them were common in all four villages. These 36 weed species distributed among 15 families, Poaceae was the most dominant family with 10 weed species including *Acrachne recemosa* (B. Heyne ex Roth) Ohwi, *Avena fatua* L., *Cynodone dactylon* L., *Dichanthium annulatum* (Forssk.) Stapf., *Paspalum distichum* L., *Polypogon monospeliensis* L., *Setaria glauca* (L.) Beauv., *Setaria pumila* (L.) Beauv., *Phalaris minor* Retz. *and Hordeum vulgare* L. while Asteraceae family was the second most dominant family with 4 species (*Carthamus oxyacantha* L., *Blumea membranacea* L., *Conyza canadensis* (L.) Cronq. and *Cirsium arvense* (L.) Scop.). Brassicaceae, Solanaceae and Fabaceae families contributed to weeds flora of the study sites represented with three species each.

A. *Cirsium arvense* with *Euphorbia prostrata*

B: *Cyperus rotundus*

C. *Setaria viridis*

D. *Eleusine indica*

E. *Chenopodium album*

F. *Lepidium didymum*

G. *Chenopodium murale*

H. *Hordeum vulgare*

J. *Phalaris minor*

Fig. 1. Photos of some predominant weeds collected from the field of wheat in District Khanewal, Pakistan.

Poaceae (true grasses) and others

Our results showed that monocots were the dominant weed species in the study area (Table-1). Earlier, various researchers have found the dominance of different weed families based on the location. For example, Muhammad *et al.* (2009) reported 67 weed species in wheat maize and potato from Tehsil Gojra, mostly (37 species) belonging to dicot weed species. Similarly, thirty-eight weed species across thirty-five genera and seventeen were reported by Qureshi *et al.* (2009). In contrast to our results, Asteraceae was the dominant family in the study area. Varying composition of biological spectra was reported by various researchers around the world (Jan *et al.,* 2012; Ahmad *et al.,* 2016; Bhaskar *et al.,* 2016; Ahmad *et al.,* 2019; Fazal *et al.,* 2019).

Parameters of weed distribution pattern

On the basis of percentage frequency *Cynodon dactylon* (L.) Pers. was the most frequent species with percentage frequency of 79.1% while *Chenopodium album* L. was the second most frequent species with frequency value of 70.8% (Table-1). *Paspalum distichum* L. had the highest density, cover density, relative density and relative cover values i.e. 2.29, 3.52, 10.9 and 6.13, respectively. The same species got the maximum importance value and importance value index (IVI) i.e. 20.9 and 6.96, respectively among all the weed species found in the study area.

Cyperaceae (Sedges) and others

The dominant weed species in the study area was *Cyperus rotundus* L. with highest importance value (Table-1). The results can also be compared with Ahmad *et al.* (2016) who reported twenty-nine weed species belonging to fifteen different families from maize field in District Mardan. Various other researchers have also reported similar results from different

locations (Malik *et al.,* 2002; Ahmed *et al.,* 2006; Shah *et al.,* 2006; Muhammad *et al.,* 2009; Farooq *et al.,* 2010; Hassan *et al.,* 2010; Jan *et al.,* 2010; Muhammad *et al.,* 2011; Khan *et al.,* 2014; Ullah *et al.,* 2014; Ali *et al.,* 2015; Hussain *et al.,* 2015; Khan *et al.,* 2016; Zeb *et al.,* 2016). Moreover, in a field survey carried out at the New Developmental Farm of the University of Agriculture, Peshawar, the highest relative weed density (50.16%) and relative weed frequency (86.6%) were recorded for *Trianthema portulacastrum* L. (Khan *et al.,* 2016) which is in contrast with the results noted in the present study. Also, the same species showed the highest IV (69.38) as clear from Figure 2.

Family importance value index (FIVI)

Family importance value index is an important parameter to understand the contribution of a weed family in the weeds' community. The data regarding family importance value index (FIVI) is presented in Figure 2. As it is clear from the Figure, family Cyperaceae had the maximum FIVI i.e. 5.06, followed by Convolvulaceae family with FIVI = 4.35. The minimum value of FIVI i.e. 1.07 was recorded in case of family Polygoniaceae. These results are supported by those of Tauseef *et al.* (2012) who found that *Cyperus rotundus* L. from family Cyperaceae had the maximum importance value index in the cotton fields.

Table-1. Different parameters of weed distribution pattern in the study area.

Family	Plant name	FP	D	CP	RF	RD	RC	IV	IVI
Aizoaceae	*Trianthema portulacastrum* L.	58.3	0.32	1.50	3.56	1.52	2.61	7.69	2.56
Amaranthaceae	*Amaranthus viridis* Hook	42.2	0.39	1.20	2.57	1.85	2.08	6.50	2.16
Asteraceae	*Carthamus oxyacantha* L.	36.6	0.23	2.72	2.23	1.09	4.73	8.05	2.68
	Blumea membranacea L.	26.6	0.35	0.92	1.62	1.66	1.60	4.34	1.44
	Conyza canadensis (L.) Cronq.	62.2	1.54	2.21	3.80	7.32	3.84	14.90	4.96
	Cirsium arvense (L.) Scop.)	36.8	0.42	1.33	2.25	1.99	2.31	6.55	2.18
Brassicaceae	*Lepidium didymum* L.	56.1	0.51	1.23	3.42	2.42	2.14	7.98	2.66
	Brassica campestris L.	62.2	0.71	1.98	3.80	3.38	3.44	10.60	3.54
	Sisymbrium irio L.	58.9	0.65	1.90	3.60	3.09	3.30	9.99	3.33
Chenopodiaceae	*Chenopodium album* L.	70.8	0.41	1.22	4.32	1.95	2.12	8.39	2.79
	Chenopodium murale L.	62.2	0.65	1.77	3.80	3.09	3.08	9.97	3.32
Cyperaceae	*Cyperus rotundus* L.	56.6	1.37	2.10	3.45	6.52	3.65	13.60	4.53
	Cyperus difformis L.	63.3	1.72	2.75	3.86	8.18	4.79	16.80	5.60
Euphorbiaceae	*Euphorbia prostrata* Ait.	27.7	0.29	1.73	1.70	1.38	3.01	6.09	2.03
Fabaceae	*Lathyrus aphaca* L.	44.2	0.56	1.87	2.70	2.66	3.25	8.61	2.87
	Melilotus indicus L.	23.2	0.66	0.95	1.41	3.14	1.65	6.20	2.06
	Medicago polymorpha L.	43.1	0.54	1.23	2.63	2.57	2.14	7.34	2.44
Laminiaceae	*Salvia plebeia* R. Brown	38.3	0.65	1.54	2.34	3.09	2.68	8.11	2.70
Marsiliaceae	*Marsilea minuta* L.	31.6	0.27	0.81	1.93	1.28	1.41	4.62	1.54
Poaceae	*Acrachne recemosa* L.	35.0	0.37	0.71	2.14	1.76	1.23	5.13	1.71
	Avena fatua L.	60.1	0.46	2.11	3.67	2.19	3.67	9.53	3.17
	Cynodon dactylon (L.) Pers.	**79.1**	0.47	0.89	**4.83**	2.23	1.55	8.61	2.87
	Dicanthium annulatum Forssk.	60.0	0.37	0.82	3.66	1.76	1.42	6.84	2.28
	Paspalum distichum L.	63.3	**2.29**	**3.52**	3.87	**10.9**	**6.13**	**20.9**	**6.96**
	Polypogon monospeliensis L.	16.0	0.31	1.17	0.97	1.47	2.03	4.47	1.49
	Setaria glauca L.	63.3	0.58	2.12	3.87	2.76	3.69	10.32	3.44
	Setaria pumila (L.) Beauv.,	45.0	0.42	0.98	2.75	1.99	1.70	6.44	2.14
	Phalaris minor Retz.	45.2	0.49	1.23	2.76	2.33	2.14	7.23	2.41
	Hordeum vulgare L.	28.6	0.13	1.02	1.74	0.62	1.77	4.13	1.37
Polygoniaceae	*Persicaria longiseta* L.	12.0	0.16	0.75	0.73	0.76	1.30	2.79	0.93
	Rumex dentatus L.	34.1	0.22	0.32	2.08	1.04	0.55	3.67	1.22
Solanaceae	*Nicotiana plumbaginifolia* L.	23.3	0.23	1.13	1.42	1.09	1.96	4.47	1.49
	Solanum nigrum L.	28.3	0.21	1.75	1.73	0.99	3.04	5.76	1.92
	Solanum surattense L.	21.6	0.28	3.11	1.32	1.33	5.41	8.06	2.68
Primulaceae	*Anagallis arvensis* L.	62.1	0.74	2.21	3.79	3.52	3.84	11.10	3.70
Convulvolaceae	*Convolvulus arvensis* L.	58.1	1.04	2.62	3.55	4.95	4.56	13.06	4.35

Note: FP= Frequency percentage; D= Density; CP= Cover percentage; RF = Relative Frequency; RD = Relative Density; RC = Relative Cover; IV= Importance value; IVI= Importance value index

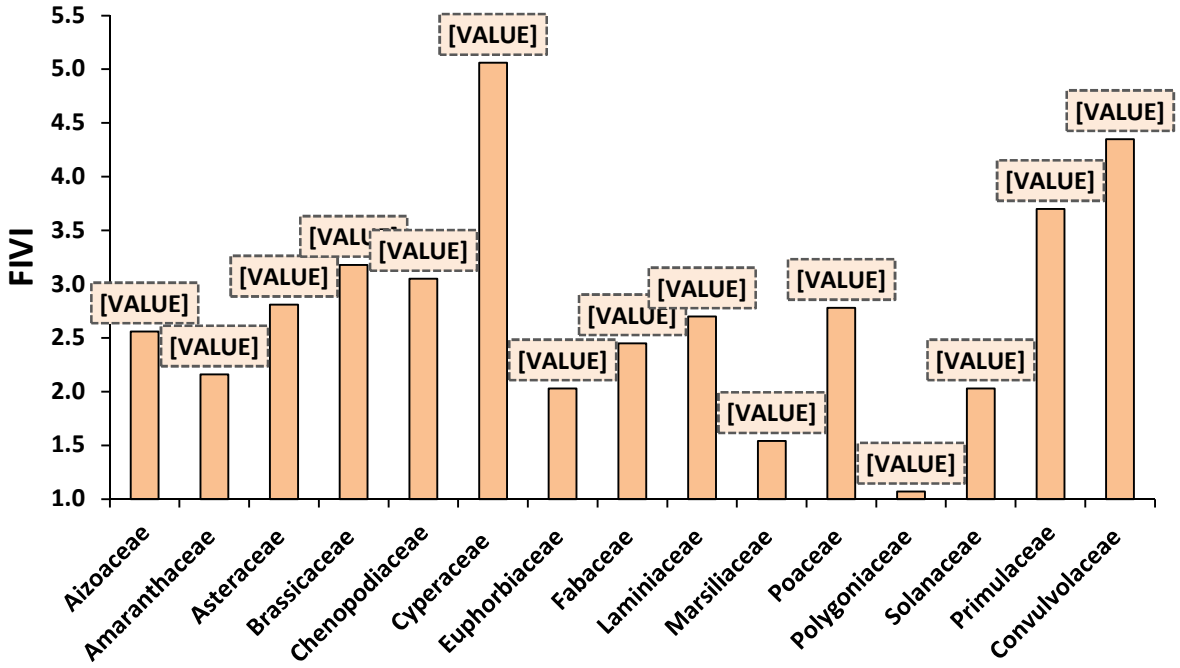

Fig. 2: Family importance value indices (FIVI) of different weed families in the study area

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