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THREATS TO RAINFED AND CANAL IRRIGATED AGRO-ECOSYSTEMS OF THE PUNJAB, PAKISTAN BY WEED INFESTATION

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Abstract

To record the weed flora infesting the rainfed and canal irrigated arable fields in the Punjab province, three districts viz. Chakwal, Jhelum and Rawalpindi in rainfed agro-ecosystem, while three districts in canal irrigated wheat fields i.e., Sahiwal, Qasoor and Gujrat were surveyed comprehensively to examine weed spectra. Weeds occurring in various localities largely varied with the variation in the mode of irrigation i.e., Barani areas and Canal irrigated area. In Rainfed (Barani) areas *Fumeria parviflora* and *Asphodelus tenuifolius* were noted frequently while their representation was very rare or even absent in canal irrigated areas. *Carthamus oxayacantha* was also observed at some sites there. The only weeds growing infrequently were hardy grasses like *Cynodon dactylon* and *Cyperus rotundus*. None of the weed could cross the limits of occasional frequency level. Nevertheless, in canal irrigated areas *Convolvulus arvensis, Anagalus arvensis, Chenopodium* sp., *Melilotus alba, Lepidium sativum, Lathyrus aphaca, Medicago denticulata, Rumex dentatus* and *Cynodon dactylon* were frequently observed. *Phalaris minor* and *Avena fatua* formed very dense stands in many areas. *Carthamus oxayacantha, Poa annua, Sonchus asper* and *Vicia sativa* were recorded infrequently. The farmers of Sahiwal and Qasoor districts seem well informed about the importance and use of weedicides as a result the spectrum of weeds growing there was quite low and none of them could establish dense stands.

Introduction

The Punjab province of Pakistan is the most populous and developed region that contributes 59% share to the GDP and 76% to annual food grain production in the country (Anon., 2011). Owing to its vast plain land a canal irrigation system very unique in the world has been established in the province. Some sparse deserts like Cholistan near Indian border and Thal can be found inside the province. Besides some undulating lands like Salt Range and Suleiman Range, also exist inside the bounds of the Punjab province. As such the cropping system in the province has been classified into two major agro-ecosystems i.e., Canal Irrigated and Rainfed Agro-ecosystem also commonly known as Barani (arid) Agro-ecosystem (Saeed & Hussain, 1986**;** Razzaq *et al*., 2002; Khaliq *et al*., 2007; Hameed *et al.,* 2011). The rain-fed (Barani) agriculture makes about 15 per cent of the total cropped area of the Punjab where about one-third of the wheat crop is grown every year but its yield remains extremely low due to scarcity soil moisture and soil fertility as well dense weed infestation (Razzaq *et al*., 2002; Naz *et al*., 2010a; Ahmad *et al*., 2011).

Both agro-ecosystems in the Punjab greatly vary in their cropping pattern. Due to ensured water availability the canal irrigated ecosystem remain under cultivation almost round the year. However, depending upon the temperature regime, relative humidity and water availability areas have been specified for growing cash crops like rice, cotton, maize and sugarcane (Zahid *et al.,* 1991; Khaliq *et al*., 2007). In each crop growing zone relevant research stations also have been established for providing research oriented extension facilities to the farmers. The scarcity of rain water proves main limitation for crop cultivation in the Rainfed agro-ecosystem. Therefore short duration crops like chickpea, groundnut, barley and millets are preferably grown only during winter season in the Rainfed agro-ecosystem (Zahid *et al*., 1991; Naz *et al*., 2010b).

Based on variation in the irrigation system, the mode of cultivation and crops selected for cultivation, the weed spectra infesting the crops also greatly differ in both agro-ecosystems. A major cause of variation in the weed spectra of both agro-ecosystems may be regarded the mechanism of weed seed dispersal resulting from different modes of irrigation (Razzaq *et al*., 2002). Hydrochory seems the main seed dispersal mechanism in canal irrigated area besides anemochory and zoochory. Nevertheless in rainfed areas anemochory and zoochory (through ungulates and other grazing animals) remain the major weed seed dispersal mechanisms. The scarcity of soil moisture also determines a major role in the reproduction and dispersal of weed seeds **(**Bruce & Ghersa, 1992; Ahmad *et al*., 2010).

Weeds compete with main crop plants for macro- and micro-nutrients, soil moisture, space and solar radiation. They act as alternate host for several insect-pests and diseases, weaken the crop plant and considerably deteriorate both the quality and quantity of the produce (Hussain *et al.,* 1991; 1987; Lehoezky & Reisinger, 2003). They also impede cultural operations and hinder cultivation, hoeing, spraying, irrigation and harvesting of crops. They clog irrigation channels reducing efficiency of irrigation systems. Some weeds also release toxic chemicals (allelo-chemicals) which hamper growth and development of crop plants (Weston & Duke, 2003; Belz, 2007; Jabeen & Ahmed, 2009). Therefore farming community is currently spending more money on weed control than other crop inputs to improve their crop production by reducing yield losses caused through weeds infesting the arable fields. Currently a number of herbicides are being used to control weed infestation in the arable fields (Hussain *et al*., 1997; Marshall, 2001). The introductions of modern weed control techniques along with different cropping patterns have steadily increased crop yields. Simultaneously a number of weeds have declined markedly, and become extinct in some regions resulting from these weed control efforts (Sutcliffe & Kay, 2000; Marshall, 2001; 2003).

For a better weed management, an understanding of the prevailing cropping system and weed spectra infesting the crop is considered essential. Keeping it in view, this study was performed under a Higher Education Commission (HEC) sponsored project to examine the weed spectra infesting the wheat fields in Barani/Rainfed and canal irrigated ecosystems.

Materials and Methods

A wide variety of environmental conditions prevail in the Punjab Province of Pakistan. However, based on irrigation system, the Punjab province of Pakistan has been divided into two major agro-ecosystems i.e., canal irrigated and rainfed areas. Keeping this aspect in view three major wheat growing districts (Chakwal, Jhelum and Rawalpindi) in rainfed area and three districts (Sahiwal, Qasoor and Gujrat) in canal irrigated area were surveyed to determine the variation in the weed spectra of both agro-ecosystems. Four reprehensive sites were earmarked in each district surveyed. From each site 25 quadrates each measuring $1m^2$ were randomly selected and the number of individuals of each weed species was counted. The density and frequency of weeds were determined using the following formula:

$$\text{Weed density (\%)} = \frac{\text{Number of individuals of each weed species}}{\text{Total number of individuals of all weed species}} \times 100$$

$$\text{Weed Frequency (\%)} = \frac{\text{Number of quadrates in which a weed species was examined}}{\text{Total number of quadrates taken}} \times 100$$

For the interpretation of frequency of weeds the following classification (McIntosh, 1962; Ahmad *et al.*, 2009) was used:

i. Rare 0-20%
ii. Infrequent 21-40%
iii. Occasional 41-60%
iv. Frequent 61-80%
v. Common 81-100%

Results

Weed infestation in rainfed wheat fields: For determining the weed spectra infesting the wheat field in rainfed agro-ecosystem different sites in Chakwal, Jhelum and Rawalpindi districts were surveyed. Wheat fields in Chakwal district were very rich in weed diversity (Table 1). *Fumeria indica* had its representation in all the fields of Chakwal district. At Kallar Kahar site, it formed 45% portion of weed flora. *Carthamus oxayacantha, Convolvulus arvensis, Malva neglecta* and *Medicago denticulata* were seen abundantly but none of them achieved high density level. Among them the highest density figure of 8% appeared for *Malva neglecta*. The other weed species *Vicia sativa, Saponaria, Cannabis sativus, Anagalus arvensis* and *Tribulus terrestris* also represented this site but those all formed poor stands. At BARI, *Chenopodium album* attained the highest frequency (100%) and density (44%) than the other seven weed species infesting wheat fields at that place. The other frequently occurring weeds in these fields with a density level slight above 10% were *Convolvulus arvensis Fumeria indica* and *Malva neglecta. Vicia sativa, Saponaria* and *Cynodon dactylon* emerged sparsely at this site. At Dhudhian, single dominant species at 77% density and 76% frequency was *Medicago denticulate.* Weed *Asphodelus tenuifolius* had its presentation in 100% fields but its density ranged upto 5% only. The other noteworthy weeds were *Anagalus arvensis* (68%), *Chenopodium album* (96%), *Convolvulus arvensis* (72%), *Fumeria indica* (60%) and *Vicia sativa* occurred rarely. At Balkassar, in contrast to three towns of Chakwal, no single weed could surpass to dominate all other weeds. Prominent position was occupied by very abundantly occurring *Chenopodium album* and *Fumeria indica* at densities of 24% and 21% respectively, shared with frequently emerging *Convolvulus arvensis* and *Vicia sativa* at density levels of 20% and 19% respectively. Chakwal being a part of Barani belt, the weed flora differed somewhat from canal irrigated areas. *Fumeria indica* topped the list of prominent weeds. It was followed by *Chenopodium album* and *Convolvulus arvensis*. A unique feature of this area was representation of *Vicia sativa* in all the sites of this district along with *Carthamus oxayacantha, Asphodelus tenuifolius, Malva neglecta* and *Saponaria* in fields of some towns.

In Jhelum district wheat fields were infested by six frequently occurring weed species. Out of these six weeds, comparatively more frequent ones were *Medicago denticulata, Asphodelus tenuifolius, Anagallis arvensis* and *Fumaria indica*. The next two weeds having slightly less frequency were *Euphorbia helioscopia, Chenopodium album.* Regarding the density of plant species, the densest strands were observed for *Chenopodium album, Euphorbia helioscopia, Medicago sativa* and *Anagallis arvensis*. At Kharian site of district Jhelum, three weed species were represented commonly at the study sites. These three in order of their frequency were *Convolvulus arvensis* (68%), *Fumaria indica* (60%) and *Medicago denticulata* (52%). The densest strands were also formed by same three species and they occurred at the density of 23%, 30% and 26% respectively. At Dina site, four weed species *Asphodelus tenuifolius*, *Medicago denticulata*, *Fumaria indica* and Daucus sp., were commonly seen in the wheat fields while *Convolvulus arvensis* and *Avena fatua* were comparatively less frequent. The densest strands at this site were formed by *Fumaria indica* (30%), *Asphodelus tenuifolius* (26%) and *Medicago denticulata* at 22% level. On the whole in Jhelum district wheat fields were covered commonly by 5 weed species namely *Asphodelus tenuifolius*, *Chenopodium album*, *Convolvulus arvensis*, *Fumaria indica* and *Medicago denticulata*.

Table 1. Density (%) and frequency (%) of weeds infesting the wheat field in the Chakwal and Jhelum districts.

Weed species	Local names	Chakwal								Jhelum					
		Kalar Kahar		BARI		Dhudhian more		Balkassar		Jhelum		Kharian		Dina	
		D	F	D	F	D	F	D	F	D	F	D	F	D	F
Anagalus arvensis	B. booti	7.22	42	0	0	2.21	68	4.33	12	13.22	68	0.00	0	0.00	0
Asphodelus tenuifolius	Piazi	0	0	0	0	5.13	100	4.33	16	9.64	68	3.75	12	25.72	84
Avena fatua	Jun Javi	0	0	0	0	0	0	0	0	0.00	0	0.00	0	1.70	20
Cannabis sativus	Bhang	1.03	12	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Carthamus oxayacantha	Pohli	5.84	80	0	0	0	0	7.74	76	0.00	0	0.00	0	0.00	0
Chenopodium album	Bathu	4.47	48	44.30	100	6.55	96	23.53	100	19.70	40	0.94	12	0.00	0
Chenopodium morale	Karund	0	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Cirsium arvensis	Leih	0	0	0	0	0	0	0	0	0.17	4	0.00	0	16.66	60
Convolvulus arvensis	Lehli	4.98	88	19.01	48	3.01	72	19.81	60	0.33	12	23.19	68	2.48	28
Cynodon dactylon	Khabbal	0	0	3.80	80	0	0	0	0	0.00	0	0.00	0	0.00	0
Daucus Carrota L.	Gajar Like	0	0	0	0	0	0	0	0	0.17	4	0.00	0	16.66	60
Euphorbia granulata L.	Dodhak	0	0	0	0	1.24	44	0	0	18.04	48	0.00	0	0.00	0
Fumeria indica	Shahtara	44.85	100	11.70	76	4.60	60	21.36	88	16.21	68	29.98	60	30.00	84
Galium aparine	*Galium*	11.68	44	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Lathyrus aphaca	Dokanni	0	0	0	0	0	0	0	0	0.25	8	0.00	0	0.00	0
Lepidium sativum	Haloon	0.52	8	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Malva neglecta	Sonshal	8.08	92	14.18	64	0	0	0	0	0.00	0	2.58	16	0.00	0
Medicago denticulata	Maina	4.81	80	5.56	80	76.90	76	0	0	14.46	80	25.76	52	21.49	88
Melilotus indica	Sinji	0	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Phalaris minor	Dumbi sitti	0	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Poa annua	Poa	0	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Rumex dentatus	J. Palak	0.86	8	0	0	0	0	0	0	0.25	8	0.00	0	1.96	32
Saponaria vaccaria	Takla	3.61	48	0.88	24	0	0	0	0	0.00	0	0.00	0	0.00	0
Spergula arvensis	Spergula	0	0	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Tribulus trestris	Bhakra	0.69	12	0	0	0	0	0	0	0.00	0	0.00	0	0.00	0
Vicia sativa	Revari	1.37	24	0.58	16	0.35	12	18.89	76	7.73	52	13.82	40	0.00	0

*D=Density, *F=Frequency

Wheat fields of Rawalpindi district possessed a very rich diversity of weed flora comprising of 19 weed species (Table 2). These could be arranged in a number of groups. *Convolvulus arvensis* was the only species found distributed at all sites of this district. It occurred frequently or abundantly at various fields but did not form dense stands. The second group was constituted of five species that represented in 80% areas of this district. Although frequency of all these weeds was very high, yet there was great difference in their density levels. According to descending density levels these were *Cirsium arvensis, Chenopodium album, Euphorbia granulata* L., *Fumeria indica* and *Vicia sativa*. The third group included four member species which emerged frequently in 60% areas of this district. *Medicago denticulata* stood at the top of this group according to dominance due to thick density reaching upto 32% at some sites. Next comparatively less dense weeds were *Carthamus oxayacantha, Anagalus arvensis* and *Canabbis sativus*. The fourth group was formed by those weed species that represented in up to 40% areas of the district. The frequency levels varied from rare to frequent. Important ones which achieved more than 10% density level were *Avena fatua, Lepidium sativum, Phalaris minor, Poa annua* and *Rumex dentatus*. The rest of the weed species formed very sparse stands.

A resembling trend in the distribution pattern of weeds in the canal irrigated areas was recorded during a compressive survey of weeds of wheat fields in the Punjab province conducted under a "National Weed Control Research Program" sponsored jointly by Pakistan Agricultural Research Council (PARC) and USAID (Saeed & Hussain, 1986; Saeed *et al.*, 1987a, b) and. During a similar study conducted by Muhammad *et al*., (2009) to record the distribution of weeds in wheat, maize and potato crop fields of Tehsil Gojra, District Toba Tek Singh, Punjab with the exception of a few weeds a resembling trend has been noted.

The main reason for this discrepancy is that the arable lands of canal irrigated areas due to intensive agriculture do not remain fallow but get cultivated round the year. As such cultivation f wheat crop in canal irrigated areas starts very late during the months of December/January when the majority of early season weeds having ephemeral nature either cannot properly germinate and if germinate, they fail to compete with cultivated crops and complete their life cycle. Owing to this shift in agronomic practices some weeds like *Asphodelus tenuifolius, Carthamus oxyacantha* and *Fumaria indica* have become either totally extinct from the canal irrigated agro-ecosystem or become confided sandy patches.

Weed infestation in irrigated wheat fields: Gujrat, Sahiwal and Qasoor districts were surveyed for determining the degree of weed infestatation in canal irrigated agro-ecosystem. At Bhimber road site in district Gujrat (Table 3), the most frequent weeds were *Anagallis arvensis*, *Daucus* sp., *Phalaris minor*, *Avena sativa* and *Medicago denticulata*. Three of these species i.e., *Anagallis arvensis*, *Phalaris minor* and *Daucus* sp., formed notable trends at densities of 29, 28 and 23% respectively while the other two species existed at less dense level.

At Lala Musa site, *Daucus* sp., was the most common weed of wheat field and was found in all study samples. The next frequent species occurring in 80% samples was *Anagallis arvensis* while *Avena fatua* and *Medicago denticulata* both occurred at a frequency of 56%. The remaining species such as *Convolvulus arvensis, Lathyrus aphaca, Fumaria indica, Lepidium sativum* and *Euphorbia helioscopia* were seen comparatively less frequently. The densest strands at 29%, 28% and 23% were formed by *Anagallis arvensis, Phalaris minor* and *Daucus* sp., respectively.

At Gujrat site the frequently occurring weeds in wheat field were *Poa annua, Malva neglecta, Lepidium sativum* and *Daucus* sp., while *Phalaris minor* and *Lathyrus aphaca* were observed rarely. At this site the prominent dense strand was formed by *Poa annua* only. Nevertheless, *Lathyrus aphaca* (12%), *Lepidium sativum* (8%), *Malva neglecta* (6%) and *Phalaris minor* (3%) existed in low density in wheat fields in Gujrat.

At Wazirabad site *Phalaris minor* was the most common weed and represented itself in all the fields surveyed. The next frequent weed species were *Lepidium sativum, Lathyrus aphaca, Melilotus indica* and *Euphorbia helioscopia*. The density of *Phalaris minor* dominated the fields forming 44% weed population. It was followed by *Euphorbia helioscopia, Lathyrus aphaca* and *Lepidium sativum.*

In Sahiwal district *Chenopodium album* occurred throughout this area while all other weeds remained restricted to few sites only (Table 4). At Yousuf Wala, most frequent weeds were *Fumeria indica* (84%), *Rumex dentatus* (76%) and *Chenopodium album* (56%) while *Chenopodium album* formed very dense stands. At Harrappa site, four weeds (*Convolvulus arvensis, Fumeria indica, Lathyrus aphaca* and *Melilotus indica)* grew very commonly having frequency level above 80% and all of them formed good stands achieving density levels from 11% to 21%. *Tribulus trestris* and *Chenopodium album* were frequently observed. *Anagalus arvensis* emerged at 76% frequency but its stands were sparse. At Sahiwal site *Anagalus arvensis, Chenopodium album* and *Medicago denticulata* emerged as the major weeds of the area having frequency level above 60 % and density levels of 25 %, 29 % and 22 % respectively. *Vicia sativa* and *Rumex dentatus* were noted rarely but *Vicia* formed relatively good stands.

In district Qasoor, wheat fields possessed a very rich weed flora (Table 4). Almost all the weeds of the winter season emerged there except a few ones. All the weed species had a middle order frequency and density levels and none of them became very prominent. At Korhay Sial, the most abundant weed was *Chenopodium album* but it grew sparsely forming only 12% density position. *Asphodelus tenuifolius, Lepidium sati* and *Galium* formed comparatively dense stands to reach 25%, 22% and 15% density levels respectively. *Asphodelus tenuifolius, Saponaria , Tribulus trestris* and *Vicia sativa* also showed rare representation. At Allahabad, *Asphodelus tenuifolius* and *Avena fatua* could claim to be the major weeds of the area and attained a density level of 42% and 23% respectively. Other common weeds were *Fumeria indica* and *Phalaris minor* both being represented by 88% frequency level. In spite of same occurrence level *Fumeria* excelled *Phalaris minor* in forming better stands at 19% density level as against 6% density of counterpart species.

Table 2. Density (%) and frequency (%) of weeds infesting the wheat fields in the Rawalpindi district.

Weed species	Local name	Rawalpindi									
		Chakri		Hassan Abdal		Kalyal		Rawat		Mandra	
		D	F	D	F	D	F	D	F	D	F
Anagalus arvensis	B. booti	0	0	4.78	36	12.41	100	0	0	11.25	88
Asphodelus tenuifolius	Piazi	0	0	0	0	0	0	0	0	3.32	96
Avena fatua	Jun Javi	0	0	14.12	100	9.23	100	0	0	0	0
Cannabis sativus	Bhang	0	0	0	0	12.73	76	3.95	72	1.89	76
Carthamus oxayacantha	Pohli	8.35	48	5.69	80	15.27	88	0	0	0	0
Chenopodium album	Bathu	7.53	82	0	0	5.83	82	1.97	76	26.36	76
Chenopodium morale	Karund	0	0	0	0	0	0	0	0	0	0
Cirsium arvensis	Leih	31.86	100	0	0	1.48	28	19.24	84	19.79	56
Convolvulus arvensis	Lehli	9.50	100	8.43	48	3.29	88	1.76	84	2.49	52
Cynodon dactylon	Khabbal	0	0	0	0	0	0	0	0	0	0
Euphorbia granulata L.	Dodhak	3.69	80	0	0	9.01	44	5.71	82	3.32	100
Fumeria indica	Shahtara	5.32	100	0	0	0.85	24	10.85	86	2.04	76
Galium aparine	*Galium*	0	0	0	0	3.39	76	0.42	20	28.55	68
Lathyrus aphaca	Dokanni	0	0	0	0	0	0	0	0	0	0
Lepidium sativum	Haloon	0	0	0	0	0	0	35.80	48	0	0
Malva neglecta		0	0	0	0	0.64	20	0	0	0	0
Medicago denticulata	Maina	31.53	48	0	0	11.56	100	20.30	56	0	0
Melilotus indica	Sinji	0	0	0	0	0	0	0	0	0	0
Phalaris minor	Dumbi sitti	0	0	10.48	96	5.20	100	0	0	0	0
Poa annua	Poa	0	0	38.95	76	8.17	100	0	0	0	0
Rumex dentatus	J. palak	0	0	10.48	84	0	0	0	0	0.53	20
Saponaria vaccaria	Takla	0	0	0	0	0	0	0	0	0	0
Spergula arvensis	Spergula	0	0	0	0	0	0	0	0	0	0
Tribulus trestris	Bhakra	0	0	0	0	0	0	0	0	0	0
Vicia sativa	Revari	2.21	76	7.06	96	0.95	28	0	0	0.45	20

*D=Density, *F=Frequency

Table 3. Density (%) and frequency (%) of weeds infesting the wheat field in the Sahiwal and Qasoor districts.

Weed species	Local names	Sahiwal						Qasoor							
		Yousaf Wala		Harappa		Sahiwal		Koray Sial		Allah Abad (Theeng more)		Choonian		Pattoki	
		D	F	D	F	D	F	D	F	D	F	D	F	D	F
Anagalus arvensis	B. booti	0	0	5.27	76	25.25	88	0	0	0	0	0	0	0	
Asphodelus tenuifolius	Piazi	0	0	0	0	0	0	24.52	24	42.17	84	7.00	25	4.00	7
Avena fatua	Jun Javi	0	0	0	0	0	0	0	0	23.17	48	0	0	4.50	33
Cannabis sativus	Bhang	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carthamus oxayacantha	Pohli	0	0	0	0	0	0	0	0	0	0	6.00	75	0	0
Chenopodium album	Bathu	5.45	56	14.00	56	28.68	64	11.96	96	3.76	60	0	0	0	0
Chenopodium morale	Karund	60.26	36	3.34	44	0	0	0	0	0	0	0	0	0	0
Cirsium arvensis	Leih	0	0	0	0	0	0	0	0	0	0	2.50	11	0	0
Convolvulus arvensis	Lehli	0	0	20.67	88	0	0	0	0	0	0	8.00	15	0	0
Cynodon dactylon	Khabbal	0	0	0	0	3.19	48	0.60	20	0	0	11.00	57	11.00	7
Euphorbia granulata L.	Dodhak	0	0	0	0	0	0	0	0	0	0	3.00	16	0	0
Fumeria indica	Shahtara	9.94	84	20.25	96	0	0	6.93	47	18.58	88	4.50	21	0	0
Galium aparine	*Galium*	0	0	0	0	0	0	14.50	56	4.59	72	3.50	16	5.00	6
Lathyrus aphaca	Dokanni	0	0	14.59	96	0	0	0	0	0	0	4.00	18	5.00	45
Lepidium sativum	Haloon	11.22	40	0	0	0	0	21.71	80	0	0	4.00	80	11.00	25
Malva neglecta		0	0	0	0	0	0	0	0	0	0	7.00	11	22.00	6
Medicago denticulata	Maina	0	0	0	0	21.89	75	0	0	1.46	20	0	0	3.00	15
Melilotus indica	Sinji	5.45	48	10.64	96	0	0	0	0	0	0	11.00	37	0	0
Phalaris minor	Dumbi sitti	0	0	0	0	0	0	0	0	6.26	88	11.00	33	5.00	25
Poa annua	Poa	0	0	0	0	0	0	0	0	0	0	5.00	37	15.00	11
Rumex dentatus	J. palak	7.69	76	0	0	7.00	11	6.77	60	0	0	4.00	19	0	0
Saponaria vaccaria	Takla	0	0	0	0	0	0	5.00	25	0	0	2.50	15	5.00	21
Spergula arvensis	Spergula	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribulus trestris	Bhakra	0	0	11.25	48	0	0	6.00	21	0	0	0	0	0	0
Vicia sativa	Revari	0	0	0	0	14.00	20	2.00	11	0	0	0	0	3.50	15

*D=Density, *F=Frequency

Table 4. Density (%) and frequency (%) of weeds infesting the wheat field in the Gujrat district.

Weed species	Local name	Gujrat							
		Bhimber Road		Lala Musa		Gujrat		Wazirabad	
		D	F	D	F	D	F	D	F
Asphodelus tenuifolius Cav.	Piazi	0.00	0	0.00	0	0	0	0.00	0
Anagallis arvensis L.	Billi booti	28.84	92	28.85	80	0.00	0	0.00	0
Avena fatua L.	Jangli javi	1.74	56	1.74	56	0.00	0	0.00	0
Carthamus oxayacantha Bieb.	Pohli	0.00	0	0.00	0	0.00	0	0.00	0
Chenopodium album L.	Bathoo	0.00	0	0.00	0	0.00	0	0.00	0
Convolvulus arvensis L.	Lehli	0.97	32	0.97	32	0.00	0	0.00	0
Cynodon dactylon (L.) Pers.	Khabbal	0.00	0	0.00	0	0.00	0	0.00	0
Daucus carrota L.	Gajar like	23.14	88	23.14	100	9.62	48	0.00	0
Euphorbia helioscopia L.	Dodhak	0.10	4	0.10	4	0.00	0	11.51	20
Fumaria indica (Hausskn.) Pugsley	Shahtara	0.48	16	0.48	16	0.00	0	0.00	0
Lathyrus aphaca L.	Dokanni	0.77	28	0.77	28	11.51	20	8.25	60
Lepidium sativum L. Cress.	Haloon	0.48	16	0.48	16	8.25	60	5.67	68
Malva neglecta Wallr.	Sonchal	0.00	0	0.00	0	5.67	68	0.00	0
Medicago denticulata (L.)	Maina	4.74	56	4.74	56	0.00	0	0.00	0
Melilotus indica L.	Sinji	0.00	0	0.00	0	0.00	0	2.58	28
Phalaris minor Retz.	Dumbi sitti	27.78	84	27.78	60	2.58	28	43.81	100
Poa annua L.	Poa	0.00	0	0.00	0	43.81	88	0.00	0
Rumex dentatus L.	Jungli palak	0.00	0	0.00	0	0.00	0	18.56	76
Sonchus asper (L.) Hill.	Leih	23.14	88	23.14	100	9.62	48	0.00	0
Vicia sativa L.	Revari	9.87	92	9.87	100	18.56	76	9.62	48

A vast majority of seventeen weeds infested wheat fields at Choonian but none of them gained prominent position. *Lepidium sativum* occurred at highest frequency of 80 % but formed very sparse stands and got limited to 4% density position. It was followed by *Carthamus oxayacantha* at 75% frequency and 6% density levels. The highest density of 11% at this site was earned by three spices *Cynodon dactylon*, *Melilotus indica* and *Phalaris minor*. The rest of the weeds grew occasionally or rarely and contributed a minor portion to the weed flora at this site.

Pattoki site resembled Choonian site for lacking prominent weed species where none of the weeds could attain a frequency level beyond 45%. *Malva neglecta* with 22% density topped the weeds of this town, followed by *Poa annua* (15%), *Cynodon dactylon* (11%) and *Lepidium sativum* (11%). The other nine species were occasional or rare. *Asphodelus tenuifolius* was the single species that got representation in the whole district and formed very reasonably prominent stands in fields of at least two towns. *Phalaris minor, Avena fatua* and *Vicia sativa* appeared at some sites of this district.

Resembling results have been previously reported by Saeed *et al*., (1988) who studied the rainfed wheat fields of the Punjab province of Pakistan. However they reported *Asphodelus tenuifolius*, *Carthamus oxyacantha* and *Fumaria indica* as the prominent weeds even at that time which have now become almost extinct from the canal irrigated wheat fields. Ullah *et al*., (2011) conducted a study for the identification of weed spectra of wheat fields and for determining their distribution pattern in some barani/rainfed wheat fields of Khyber Pakhtunkhwa, Pakistan, very close and having high ecological resemblance with our study area and recorded a resembling trend in the distribution pattern of weeds as examined during this study (Van der Putten *et al*., 2000).

It was examined that some weed species which have totally gone extinct in a number of canal irrigated arable fields still exist in the barani/rainfed regions of Pakistan. The main reason is the change in the cultivation pattern. In the rainfed areas cultivated lands remain undisturbed round the year lacking appropriate soil moisture and exposure to suitable light and temperature which could favor their germination. Moreover during autumn weed seeds get exposed well in time during the wheat growing season and under the preserved soil moisture rarely get disturbed till they complete their life cycle well before wheat crop get harvested. Hence the weed spectra infesting the rainfed wheat fields can not be expected to indicate critical temporal changes as compared to canal irrigated wheat fields as examined during this study.

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