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Survey of Weeds in Mustard Fields of District Chakwal, Pakistan

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Abstract: A survey of mustard crop in District Chakwal was carried out during March, 2000 to determine the field uniformity, constancy, density, herbage coverage and importance values of weeds. A total of 42 weed species including 4 monocot were recorded. The species with 50-100% field uniformity were *Asphodelus tenuifolius*, *Convolvulus arvensis*, *Fumaria indica* and *Medicago denticulata*. While *Anagallis arvensis*, *A. tenuifolius*, *C. arvensis*, *F. indica*, *M. denticulata*, *Sorghum halepense* and *Trifolium polycerata* had high density than other species in the area. Species with better herbage coverage were *Artemisia scoparia*, *A. tenuifolius*, *C. arvensis*, *F. indica*, *M. denticulata*, *S. halepense* and *T. polycerata*. Most of the weed species fell in constancy class I (64.29%). In terms of importance value, *A. tenuifolius*, *C. arvensis*, *Vicia monantha*, *S. halepense* and *T. polycerata* were top ranking and most prevalent weeds associated with mustard crop. Although there is floristic heterogenity in the weed flora of the area but some weeds (*A. tenuifolius*, *C. arvensis*, *M. denticulata*, *Carthamus oxycantha*) had distribution through out the district. The prevalence of these weeds must be arrested to improve the mustard production.

Key words: Chakwal, mustard, Pakistan, weeds

INTRODUCTION

Mustard contributes 30% to the total oil production[1]. In Pakistan, with the increasing demand of oil, the area under this crop has increased. It stands second in contribution to winter crops of district Chakwal with a total of 33,200 acres[2]. Climatically the area is dry tropical and rainfed. The soils are generally homogenized with weak structure, moderately calcareous, with a pH value about 8.0. They are invariably low in organic matter. The shortage of moisture is key factor limiting the production[3]. Temperature varies from 25 to 40.7°C during the growth season of the crop. The mustard crop of the area received a rainfall of 250 mm. Mustard yield in rainfed conditions ranges from 75 to 400 kg ha^{-1} [4]. The yields are much less than the routinely obtained yields (800 to 1200 kg ha^{-1}) on research plots[5]. In addition to other factors such as use of marginal land, inadequate adoption of improved production technology, lack of plant protection measures and shortage of suitable machinery for planting, harvesting and threshing, weeds are major constraints hampering the yield of this important commodity[6]. Weeds are plants in the wrong place. Any plant competing with cultivated plants or that in some other way interfere with man's legitimate activities is considered to be a weed. They compete with crop plants for nutrients, moisture, light and space[7], exhibits allelopathy[8], harbour insects, pests and diseases[9] and thus drastically affect the yield of crops. The losses due to weeds in different oil seed crops have been reported to vary from 18-70% under dry land condition[10]. Proper weed management can significantly enhance the yield of oil seed crops. Weeds must be controlled in order to maintain yields of crops[11].

In order to pin point the serious and ecologically operative weeds it is important to document the distribution of individual weed species. Weed surveys are useful for determining the occurrence and relative importance of weed species in crop production system[12-14]. A countrywide survey of the distribution and abundance of weeds is required to provide information needed for weed status evaluation[15].

Owing to the aforesaid significance of weeds and weed surveys, the present study was undertaken, as a first step to record weeds, their distribution and importance values in mustard fields of district Chakwal during March, 2000. No such reference is available from the area. Thus the objectives of this study were:

a) to document the distribution and relative importance of weeds.
b) to identify the current and potential weed problems associated with the mustard crop of the area.

As well as providing base line information, the data can also facilitate the establishment of priorities for future research and extension activity. Thus, this survey provides a "snapshot" of the size and extent of weed

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population in mustard fields of agriculture ecoregions of Chakwal. These findings may also be helpful to agronomists, ecologists and scientists involved in weed crop management.

MATERIALS AND METHODS

The mustard production system involves 1 year cycle in which crop is sown in Nov./Dec. and harvested in May/June. To document the distribution and importance values of weeds in mustard fields of the area, a survey was carried out during March, 2000; when the crop was near the flowering stage.

Eleven mustard growing locations were chosen all over the district. Those sites were selected where mustard production was maximum for last five years and there was at least 100 cultivated fields of mustard were available. All these locations were rainfed. These includes, 1) Bhaun, 2) Kalar Kahar, 3) Bochal, 4) Dudyal, 5) Pindi Gugran, 6) Balkasar (Tehsil Chakwal, 7) Ratucha, 8) Dulmyal, (Tehsil Choa Saiden Shah), 9) Jahtla, 10) Kot Sarang, 11) Taman (Tehsil Tala Gang), all within radius of 40 Km from their respective tehsils. No herbicide was used at these sites throughout the growing season of crops. At each site 10 mustard fields were selected randomly and were surveyed following the methodology of Thomas[12] and McCully *et al.* [13] with some modifications. Five 1x1m quadrats were randomly placed along an inverted "W" pattern in each field. The first quadrat was placed after walking 20 paces from one corner along the edge of the field, turning 90° and then moving 10 paces into fields. This was to avoid edge effect. The distance between each quadrat depended upon the size and shape of the field and any obstructions that may have been present in the fields. The larger the field was, the greater was the distance between quadrats. The identification, field uniformity, density and herbage coverage of each weed was recorded within each quadrat. Herbage coverage was measured as field uniformity and density were not sufficient to give a clear picture of dominant species. Four quantitative measures were calculated for each weed at each location. Field uniformity and density were measured as outlined by Thomas[12], while herbage coverage and importance value were calculated following Smith and Smith[16].

Field uniformity (FU) was calculated as percentage of the total number of quadrats sampled in which a species occurred[12].

$$FUk = \frac{\sum_{1}^{n}\sum_{1}^{n} Xij}{5n} X100$$

Where FUk is the field uniformity for species k, Xij is the presence (1) or absence (0) of species k in quadrat j in field I and n is number of fields surveyed. Density (D) of each species in a field was calculated by summing the number of plants in all quadrats and dividing by area of 5 quadrats[12].

$$Dki = \frac{\sum_{1}^{5} Zj}{Ai}$$

Where Dki is density (in numbers m^{-2}) of species k in field I, Zj is the number of plants of a species in quadrat j and Ai is the area in m^2 of 5 quadrat in field I.

Herbage coverage was determined ensuing Smith and Smith[16] by estimating how much percent area of quadrat was covered by all individual of a species as viewed from above. Thus herbage cover of a weed in a field was calculated by summing % herbage coverage of species in all quadrats and dividing by number of quadrats.

$$Hcki = \frac{\sum_{1}^{5} Cj}{5n}$$

Where Hcki is the herbage coverage (in % m^{-2}) of species k in field I, Cj is the % herbage coverage of all individuals of a species in quadrat j and n is the number of fields.

The importance value of species was calculated following Smith and Smith[16]. These values compared the individual weed species relative to each other. The importance value of each species was calculated by assuming that the field uniformity, density and herbage coverage measures were equally important in deserib ing the relative importance of weed species. This was calculated as follow:

Relative field uniformity for species k (RUk) =

$$\frac{\text{Field uniformity value of species k}}{\text{Field uniformity for all species}} \times 100$$

Relative density for species k (RDk) =

$$\frac{\text{Density value of species k}}{\text{Density values for all the species}} \times 100$$

Relative herbage coverage of species k (RCk) =

$$\frac{\text{Herbage coverage values of species k}}{\text{Herbage coverage values for all the species}} \times 100$$

Each of these three relative values indicate one aspect of the importance of species in the community but a better comparative picture can be painted by adding these relative values for every species to get importance values.

Importance values of species k (IVk) = RUk + RDk + RCk

A maximum value of 300 would be possible if only one species found in all the fields that were surveyed.

Weeds were also classified into five constancy classes as given by Oosting[17]. The data was summarized and discussed on location basis and nomenclature followed here was that of Stewart[18] and Nasir and Ali[19].

RESULTS AND DISCUSSION

Forty-two species belonging to 22 families were recorded as weeds (Table 1). Out of the 42 species recorded, only 4 species (3 of Poaceae and 1 of Liliaceae) were monocotyledonous while the remaining species were dicotyledonous. The major families were Asteraceae and Papilionaceae with 10 and 6 species, respectively. Family Poaceae and Boraginaceae had 3 species each. Families with two species each were, Caryophyllaceae, Amaranthaceae and Chenopodiaceae, while the remaining families were represented by only single species (Table 1). The maximum number of species in Asteraceae and Papilionaceae might be due to better dispersal mechanism and high adaptability of weed species under prevailing environmental conditions. Those species that have effective dispersal mechanisms tend to be able to occupy habitats characteristic of the early stages of succession following disturbance[20]. According to Taylor[21] the members of Asteraceae generally establish in areas of disturbance such as cultivated fields. Bokhari *et al.*[22] stated that distribution of weeds depends upon the dissemination mechanism, structure, time of germination and viability of their seeds or fruits. Fruits of family Asteraceae possess different types of pappus which help their dispersal.

The field uniformity of weed species distributed in mustard fields ranged from 4-100% (Table 1). *A. tenuifolius*, *Convolvulus arvensis* and *M. denticulata* had 70-100% occurrence at different sites. They were followed by *Calendula arvensis*, *Carthamus oxycantha*, *Centaurea iberica*, *Cirsium arvense*, *F. indica*, *V. monantha* and *Orobanche aegyptiaca* with a value of 40-70% in different sites. The remaining species had field uniformity values less than 40%. *A. tenuifolius* had 100% field uniformity at Bhaun and Dudyal (Table 1). This reflected its high degree of tolerance to environmental conditions as distribution depends upon tolerance and environmental conditions. It was observed that the distribution of most of weeds was patchy. Similar observations were also obtained by Colbach *et al.*[23].

The species with high field uniformity shows their best adaptive characteristics to prevailing environment and wide ecological amplitude as distribution depends upon many factors including geographic, physiognomic, climatic and biotic factors of area[24]. Weed distribution can affect the decision of whether the weed density is severe enough to justify use of post herbicide or cultivation[25].

As for as constancy is concerned, there were 27 species in constancy class I (64.29%), 5 in class II (11.90%), 3 in class III (7.14), 2 in class IV (4.77%) and 5 in class V (11.90%) (Table 2). The presence of majority of weed species in constancy class I indicate their narrow range of ecological amplitude. Only 5 species (*Convolvulus arvensis*, *A. tenuifolius*, *F. indica*, *M. denticulata* and *C. oxycantha*) were constant species with constancy 80–100%. This indicates their high characteristic potentiality to establish in a wide range of environmental conditions. Greater proportion of weeds in constancy class I (64.29%) also suggested floristic heterogeneity and varied microhabitat features of the area. This might be due to variation in soil characteristics and agronomic practices. Hallgren *et al.*[26] reported significant differences in weed flora composition between geographic regions and soil types. Crop management practices also influence the species distribution[27].

Density, the numerical strength of weeds, roamed about 0.08-11.80 individuals m^{-2} at various sites (Table 1). The major contribution was made by *A. tenuifolius* and *Anagallis arvensis* (4-11.8 individuals m^{-2}). The following 17 species i.e. *Adhatoda vasica*, *A. scoparia*, *Buglossoides arvensis*, *C. oxycantha*, *Centauria iberica*, *Chenopodium album*, *Convolvulus arvensis*, *Cousinia thomsonii*, *Euphorbia helioscopia*, *F. indica*, *Lathyrus aphaca*, *Launaea nudicaulis*, *M. denticulata*, *Pentanema vestitum*, *Sorghum halepense*, *T. polycerata* and *Vicia monantha* had density of 2-4 individuals /m^2 at different localities (Table 1). The remaining species had density less than 1 individual m^{-2}. Highest density was recorded for *A. tenuifolius* at Bhaun and Dudyal, i.e., 11.82 and 7.04 individuals m^{-2}, respectively (Table 1). This might be due to its large seed bank as density of a weed is directly proportional to its seed bank provided the seeds are viable and conditions are favourable. *Convolulus arvensis* had 100% constancy but it had low density i.e., 0.85-2.9 individuals m^{-2} (Table 1).

High density of weeds might be the consequence of prolific seed production and high emergence potential.

Table 1: Field uniformity, constancy, density and herbage coverage of weeds in mustard fields of district Chakwal during March, 2000

Name of Species	Family	Field uniformity											
		Bh.	Ka.	Bo.	Dud.	Pi.	Ba.	Ra.	Dul.	Ja.	Ko.	Ta.	Con.
Achyranthus aspera L.	Amaranthaceae							5					9.1
Adhatoda vasica Nees.	Acanthaceae							20					9.1
Amaranthus viridis L.	Amaranthaceae							10					9.1
Anagallis arvensis L.	Primulaceae	16			36	26				10		20	45.5
Artemesia scoparia Waldst & Kit.	Asteraceae									5		15	18.2
Asphodelus tenuifolius Cavan.	Liliaceae	100	30	55	100	20	70	40	70	50	40		90.1
Astragalus auganus Burnge.	Papilionaceae	10					15			20			27.3
Boerhaavia diffusa Auct Plur.	Nyctaginaceae											5	9.1
Buglossoides arvensis (L.) Johnston.	Boraginaceae					10							9.1
Calendula arvensis L.	Asteraceae	48									35		18.2
Carthamus oxycantha M.B.	Asteraceae	32	20	25	32	25	30		10	40	30		81.8
Centaurea iberica Trev. ex Spreng.	Asteraceae							40	30				18.2
Chenopodium album L.	Chenopodiaceae	24		35				25	10			13	45.5
C. murale L.	Chenopodiaceae							10	15			15	27.3
Cirsium arvense (L.) Scop.	Asteraceae	46			8								18.2
Convolvulus arvensis L.	Convolvulaceae	48	35	45	80	80	40	50	20	30	65	20	100
Conyza ambigua D.C.	Asteraceae								5				9.1
Cousinea thomsonii C.B. Clarke.	Asteraceae											15	9.1
Dicanthium annulatum (Frossk) Stapf.	Poaceae						15						9.1
Emex australis Steinch.	Polygonaceae									15			9.1
Eragrostis poaeoides P.Beauv.	Poaceae											10	9.1
Euphorbia helioscopia L.	Euphorbiaceae	28	30			15	10	20					45.5
Fumaria indica (Hausskn.) H.N.	Fumariaceae	40	25	40	40	20	50		50		30	25	81.8
Galium aparine L.	Rubiaceae	15	25										18.2
Heliotropium europeaeum L.	Boraginaceae											10	9.1
Lathyrus aphaca L.	Papilionaceae					15		20					18.2
L. sativus L.	Papilionaceae	22											9.1
Launaea nudicaulis N.K.F.	Asteraceae		30	35	14	10	20	30		15			63.6
Malva parviflora L.	Malvaceae						17						9.1
Medicago denticulata Willd.	Papilionaceae	56		40	78	15	30	15	20	40	50	25	90.1
Orobanche aegyptiaca Pers.	Orobanchaceae	6			44	10							27.3
Oxalis pes-carpae L.	Oxalidaceae							5					9.1
Pentanema vestitum (Wall. ex.DC) Ling.	Asteraceae								40				9.1
Silene arenosa C.Koch.	Caryophyllaceae					15							9.1
Sisymbrium irio L.	Barassicaceae						20						9.1
Sonchus asper (L.) Pers.	Asteraceae						20						9.1
Sorghum halepense (L.) Pers.	Poaceae				34		20		30	30			36.4
Stellaria media (L.) Cyr.	Caryophyllaceae						10	30					18.2
Trichodesma indicum (L.) Cyr.	Boraginaceae	4											9.1
Trifolium polycerata L.	Papilionaceae	36				20		20			15		36.4
Veronica agrestis Auct. non.L.	Scrophulariaceae									5			9.1
Vicia monantha L.	Papilionaceae	24	40	30	30	30		15	15				63.6

Key: Bh (Bhaun), Ka (Kalar Khar), Bo (Bochal), Dud (Dudyal), Pi (Pindi Gugran), Ba (Balkasar), Ra (Ratuch), Dul (Dulmyal), Ja (Jahtla), Ko (Kot Sarang), Ta (Taman), Con (Contancy).

The large seed bank ensures their dense population as species with high seed out put have high capacity to colonize, perpetuates and establish themselves[22]. Therefore, density of weeds occupying a certain area depends upon many elements and varies according to season of the year, type of crops, climatic conditions, soil type, fertilizer level and its kind and method of crop management[28]. The density of weed seeds varies greatly and closely linked to cropping history of land. Cultural practices also influence the composition of weed seed bank in soil[29]. It was observed that weed densities were more variable across crop rows and patches were encountered along rows, probably due to planter spreading the weed seeds and rhizomes. Patches were more distinct for annual weeds. Colbach *et al.*[23] recorded the same observations

Herbage coverage of weed species at different sites varied from 0.1-27.1%. Species having 8-27.1% herbage coverage were, *A. scoparia*, *A. tenuifolius*, *Convolvulus arvensis*, *F. indica*, *M. denticulata*, *S. halepense* and *T. polycerata* (Table 1). The three species: *C. oxycantha*, *C. iberica* and *V. monantha* had hebage coverage 5-8%, while the remaining species exhibited cover below 5%. *A. tenuifolius* was at top position with 27.1% herbage coverage. Species high herbage coverage depends upon growth stage and growth in turn depends upon the ability of a species to utilize the available resources in prevailing environmental conditions. Weed over competing

Table 1: Continue

Name of Species	Family	Density											Herbage coverage									
		Bh.	Ka.	Bo.	Dud.	Pi.	Ba.	Ra.	Dul.	Ja.	Ko.	Ta.	Bh.	Ka.	Bo.	Dud.	Pi.	Ba.	Ra.	Dul.	Ja.	Ko.	Ta.
Achyranthus aspera L.	Amaranthaceae							0.5											1.9				
Adhatoda vasica Nees.	Acanthaceae							3.1											3.1				
Amaranthus viridis L.	Amaranthaceae							1.2											2.5				
Anagallis arvensis L.	Primulaceae	1.14			4.34	1.2				2.1		3.1	1.2			1.7	2.9				2.6		4.5
Artemesia scoparia Waldst & Kit.	Asteraceae									1.4		2.1									10.5		3.5
Asphodelus tenuifolius Cavan.	Liliaceae	11.82	0.7	1.8	7.04	2.7	5.1	2.9	3.4	2.3	0.95		27.1	2.5	7.5	17.1	3.4	12.1	3.1	5.2	2.5	5.75	
Astragalus auganus Burnge.	Papilionaceae	0.12					1.1			1.4			0.6					3.1			0.9		
Boerhaavia diffusa Auct Plur.	Nyctaginaceae											0.9											3.9
Buglossoides arvensis (L.) Johnston.	Boraginaceae					2.1											2.3						
Calendula arvensis L.	Asteraceae	0.66									0.8		3.3									4	
Carthamus oxycantha M.B.	Asteraceae	0.66	0.5	0.6	0.38	1.3	1.8		0.9	2.9	0.5		3.1	2.25	3	1.9	1.9	3.1		1.2	4.5	5	
Centaurea iberica Trev. ex Spreng.	Asteraceae							2.1	1.2										5.1	3.1			
Chenopodium album L.	Chenopodiaceae	0.38		1.32				1.4	0.7			2.1	1.7		3.25				2.1	1.2			2.1
C. murale L.	Chenopodiaceae							0.9	1.1			1.1							1.7	2.1			3.5
Cirsium arvense (L.) Scop.	Asteraceae	1.08			0.12								4.6			0.9							
Convolvulus arvensis L.	Convolvulaceae	1.06	0.85	1.8	2.1	2.9	2.1	2.9	1.2	1.6	1.2	2.5	5	4.9	5	12.7	8.2	4.1	3.9	3.4	3.4	9	1.9
Conyza ambigua D.C.	Asteraceae								0.2											0.9			
Cousinea thomsonii C.B. Clarke.	Asteraceae											3.1											3.5
Dicanthium annulatum (Frossk) Stapf.	Poaceae						0.9											1.7					
Emex australis Steinch.	Polygonaceae									1.4											0.9		
Eragrostis poaeoides P.Beauv.	Poaceae											0.7											1.5
Euphorbia helioscopia L.	Euphorbiaceae	0.44	0.6			2.1	0.9	1.2					2	2.5			3.4	2.1	3.1				
Fumaria indica (Hausskn.) H.N.	Fumariaceae	0.94	0.4	1.2	0.8	3.1	3.1		2.1		0.65	2.1	7	25	4	10.1	7.3	5.1		4.9		3.5	1.2
Galium aparine L.	Rubiaceae		0.65	0.9										1.75	2.5								
Heliotropium europeaeum L.	Boraginaceae											1.3											2.1
Lathyrus aphaca L.	Papilionaceae					1.9		2.1									1.7		3.7				
L. sativus L.	Papilionaceae	0.4											1.9										
Launcea nudicaulis N.K.F.	Asteraceae		0.75	1.05	0.22	1.1	1.1	3.1		0.9				3.5	2.5	0.9	2.3	2.8	4.9		0.3		
Malva parviflora L.	Malvaceae					0.9												2.1					
Medicago denticulata Willd.	Papilionaceae	1.22		0.4	1.06	3.1	2.7	1.2	0.9	1.9	1.15	1.2	5.9		2.25	12.8	2.1	4.7	5.1	3.1	2.6	6.5	1.7
Orobanche aegyptiaca Pers.	Orobanchaceae	0.08			0.7	0.9							0.3			1.9	1.7						
Oxalis pes-carpae L.	Oxalidaceae							0.9											4.5				
Pentanema vestitum (Wall. ex.DC) Ling.	Asteraceae								2.1											4.2			
Silene arenosa C.Koch.	Caryophyllaceae					0.8												1.9					
Sisymbrium irio L.	Barassicaceae						1.3												2.1				
Sonchus asper (L.) Pers.	Asteraceae						1.3												1.3				
Sorghum halepense (L.) Pers.	Poaceae				1.04		1.2		1.4	3.1							1.9		3.1		2.9	10.5	
Stellaria media (L.) Cyr.	Caryophyllaceae						0.9	2.2											4.7				
Trichodesma indicum (L.) Cyr.	Boraginaceae	0.06											0.3										
Trifolium polycerata L.	Papilionaceae	0.46				2.1		3.1			0.3		2.6					3.4		8.9			1.75
Veronica agrestis Auct. non.L.	Scrophulariaceae									0.19												0.1	
Vicia monantha L.	Papilionaceae	0.48	1.05	0.75	0.5	2.1		1.3	0.7				2.3	5	2.2	1.3	3.1		1.9	1.2			

Key: Bh (Bhaun), Ka (Kalar Khar), Bo (Bochal), Dud (Dudyal), Pi (Pindi Gugran), Ba (Balkasar), Ra (Ratuch), Dul (Dulmyal), Ja (Jahtla), Ko (Kot Sarang), Ta (Taman)

Table 2. % age of weed species in various constancy classes

Constancy class	No. of species	% age
I	27	64.29
II	5	11.90
III	3	7.14
IV	2	4.77
V	5	11.90

associated plants exhibits high herbage coverage than unsuccessful species[30]. Water use efficiency of weeds is high[28] which in dry environment would result in faster weed growth[31]. The magnitude of live biomass is associated positively with soil moisture content and precipitation. However, a time lag phenomenon is apparent i.e. the biomass maxima occur in months subsequent to that of the occurrence of precipitation[32]. Hence the species with high herbage coverage must have physiologically upperhand over other species.

The final quantitative measure computed was importance value of weed species at various sites and was determined by adding the relative values of their field uniformity, density and herbage coverage. The importance values of different species varied from 1.45 to 113.91 at different localities (Table 3). *A. tenuifolius* was top ranking at Bhaun (113.91), Bochal (58.22), Dudyal (85.5), Balkasar (86.92) and Dulmyal (59.1) while *Convolvulus arvensis* obtained first position at Pindi Gugran (51.52) and Kot Sarang (71.49) in terms of importance value. Whereas, at Kalar Khar, Ratucha, Jahtla and Taman, *Vicia* (57.28), *Trifolium* (30.95), *Sorghum* (54.74) and *Anagallis* had highest importance values, respectively (Table 3). These were the best-adapted species adjusted into agricultural "vacuum" of unused resources, created by current mustard cropping system of

Table 3: Importance Value (IV) of weeds in Mustard fields of district Chakwal

	Importance Value										
Name of species	Bh	Ka	Bo	Dud	Pi	Ba	Ra	Dul	Ja	Ko	Ta
Achyranthus aspera L.							6.26				
Adhatoda vasica Nees.							25.43				
Amaranthus viridis L.							11.01				
Anagallis arvensis L.	10.11			33.63	18				21.48		42.14
Artemesia scoparia Waldst & Kit.									36.37		30.96
Asphodelus tenuifolius Cavan.	113.9	36.29	58.22	85.5	22.6	86.92	30.4	59.1	37.65	31.63	
Astragalus auganus Burnge.	3.28					15.4			17.29		
Boerhaavia diffusa Auct Plur.											20.59
Buglossoides arvensis (L.) Johnston.					15.2						
Calendula arvensis L.	17.08								52.96		
Carthamus oxycantha M.B.	13.54	27.15	22.97	11.52	16	22.75		12.3	42.08	25.58	
Centaurea iberica Trev. ex Spreng.							26.84	26.3			
Chenopodium album L.	8.7		33.88				15.23	10.8			25.04
C. murale L.							8.67	17.9			26.01
Cirsium arvense (L.) Scop.	20.3			3.68							
Convolvulus arvensis L.	21.16	51.03	47.42	47.59	51.72	8.97	30.29	24	28.62	71.49	30.39
Conyza ambigua D.C.								54			
Cousinea thomsonii C.B. Clarke.											35.91
Dicanthium annulatum (Frossk) Stapf.						15.13					
Emex australis Steinch.									15.36		
Eragrostis poaeoides P.Beauv.											14.34
Euphorbia helioscopia L.	10.16	34.47			19.03	11.05	19.12				
Fumaria indica (Hausskn.) H.N.	21.96	28.62	36.72	28.33	32.4	38.21		43.7		21.41	28.92
Galium aparine L.		25.04	24.97								
Heliotropium europeaeum L.											19.35
Lathyrus aphaca L.					14.72		18.85				
L. sativus L.	8.71										
Launaea nudicaulis N.K.F.		41.03	29.01	5.54	11.7	23.59	27.01		11.21		
Malva parviflora L.						13.68					
Medicago denticulata Willd.	24.65		23.16	41.71	19.8	29.9	16.81	21.2	31.98	57.80	26.17
Orobanche aegyptiaca Pers.	1.91			15.6	9.7						
Oxalis pes-carpae L.							11.9				
Pentanema vestitum (Wall. ex.DC) Ling.							38.4				
Silene arenosa C.Koch.					11.2						
Sisymbrium irio L.						13.93					
Sonchus asper (L.) Pers.					13.2						
Sorghum halepense (L.) Pers.				15.53		17.27		27	54.74		
Stellaria media (L.) Cyr.						16.35	22				
Trichodesma indicum (L.) Cyr.	1.45										
Trifolium polycerata L.	12.61				20.6		30.95			15.09	
Veronica agrestis Auct. non.L.									2.69		
Vicia monantha L.	10.04	57.28	23.53	10.75	22.9		11.73	12.7			

Key: Bh (Bhaun), Ka (Kalar Khar), Bo (Bochal), Dud (Dudyal), Pi (Pindi Gugran), Ba (Balkasar), Ra (Ratuch), Dul (Dulmyal), Ja (Jahtla), Ko (Kot Sarang), Ta (Taman)

the area. The unused resources are a "niche vacuum" within which weeds have adapted over short and long time periods. The numbers of species at different sites were 7-16. At Kot Sarang, Kalar Kahar and Bochal only 7,8 and 9 species were recorded, respectively. The low number of species might be due to shade casting effect of mustard crop, as once the mustard plants are established they grow rapidly and seized the weed growth below leaf canopy. A parasitic weed, spreading at an alarming rate in mustard field, was *Orobanche aegyptiaca*, collected from Bhaun, Dudyal and Pindi Gugran (Table 1). Marwat *et al.*[33] and Siddiqui *et al.*[34] also reported its parasitism with roots of mustard crop. Various species establishing themselves below the canopy of mustard crop might be shade loving. Malik and Hussain[35] reported that *Anagallis* and *Medicago* generally prefer shady and moist habitats. Climbing weeds like *C. arvensis*, *Lathyrus aphaca*, *Vicia monantha* and *Galium aparine* climb over the mustard plant and deform it during the initial stages. Prickly weeds like *C. oxycantha, Cirsium arvense* and *Emex australis* cause difficulty in cultural operations. The present study has demonstrated that *Asphodelus* and *Convolvulus* were most persistent and well adjusted weeds in the "niche vacuum" of mustard fields. They spread rapidly even in heterogeneous habitats. The prevalence of these weeds might be due to their prolific seed output, which ensure their large seed accounts in the fields. Ashiq *et al.*[36] reported that seeds produced by *Asphodelus* and *Convolvulus* were 391 and 52, respectively. Moreover, *Convolvulus arvensis* is a perennial herb that reproduces not only by seeds but also by creeping roots[37]. Seed bank is key element in persistence of most annual weeds[38]. The most persistent and abundant weeds are easily dispersed, colonize highly disturbed sites, persist for a long time in the soil as seeds, respond quickly to disturbed sites and are tough and resilient[16]. A dreaded weed *Partheium hysterophorus* was observed through out the district in the form of thick stands particularly along the roadsides and field margins. The need to control these weeds also increased as the area under investigation is rainfed and scarcity of water creates competition for soil moisture between weeds and crop.

There are several avenues through which weeds can enter into agro-ecosystems. We cannot totally wipe out the weeds as the harder we try, the better they get, the winner and still champion. But the level of weeds should be kept under check to such an extent as to not affect the production of crop drastically. An integrated approach might be required to arrest the prevalence of these weeds.

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