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Weeds of Wheat Crop and Their Control Strategies in Dera Ismail Khan District, Khyber Pakhtun Khwa, Pakistan

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ABSTRACT

This study is based on research work conducted during 2008-2010 in Dera Ismail Khan, KPK, Pakistan. The research area was extensively surveyed to investigate weed species. About 32 weed species, belonging to two monocot and thirteen dicot families, were collected from the study area. Plants were identified with the help of available literature and by comparing with the already identified plant specimens of the herbarium of Quaid-i-Azam University, Islamabad, Pakistan. Data inventory constitutes botanical name, vernacular name, English name, family, and flowering and fruiting period. *Phalarus minor*, *Rumax dentatus*, *and Chenopodium album* were the dominant weeds in the study area having comparatively higher relative weed density. Weeds having tough competition with wheat crop for light, moisture, and nutrients adversely affect wheat production. Hence, a constant effort is needed to keep the weed population under control. Many methods of weed control and eradication have been devised but chemical control is the most effective one. However, it may have some environmental consequences if not handled properly.

Keywords: Weeds; Control Strategies; Wheat Crop

1. Introduction

Weeds are unwanted plant species growing in the domesticated crops [1]. They in simpler terms are plants that interfere with the healthy or normal growth and development of crops. They are now known to limit the production of crops causing serious losses in the output of grains, seeds and fruits etc. [2].

The concept of weeds as unwanted plant was born when man started to grow plants deliberately for food and other purposes [1]. Weeds belong to all plant families, but certain families particularly Asteraceae, Poaceae, Brassicaceae and Fabaceae constitute the worldwide major weed flora [3].

There are about 30,000 species of weeds in the world, of which 50 to 200 usually cause appreciable damage to the major food crops [4]. Holm, *et al*. (1979) estimated 250 weed species which are common in agricultural crops throughout the world [1].

Heavy weeds infestation may cause complete crop failure. The cost of removing weeds adds to the cost of production of crops, thus producers losses part of their investment and the country suffers a reduction in agricultural products. They harm our agricultural crops in other ways as well. They harbour insect pests and plant diseases and on account of their rapid regenerative powers they pose serious problems in our daily life in maintaining our gardens, lawns, roads and water channels [2]. Decrease in the yield of crops due to weed infestation has been well documented [5].

In Pakistan the percentage losses in yield due to unchecked weed growth in different crops are significant. In some of the crops the yield may be reduced by more than 50% [4]. It is estimated that in wheat yield losses range from 20% to 40% due to weeds [6]. Losses in wheat yield due to weeds amount to more than Rs. 28 billion at national level and Rs. 2 billion at provincial level in NWFP [7].

The critical weed competition period in wheat is 30 to 60 days after sowing. After 60 days of sowing there is no economic benefit to eradicate weeds from wheat crop [6].

Wheat (*Triticum aestivum* L.) is an important cereal crop. It is a dietary mainstay for approximately one-third

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of the total world population. Being staple food wheat plays an important role in the economy of Pakistan, hence occupies a central position in agricultural policy making. It produces several tillers plant^{-1} depending upon soil fertility crowding and environmental conditions. Wheat supplies about 73% of the calories and protein of the average diet [8].

Several studies on weeds of wheat crop have been recorded from various parts of Pakistan *i.e.*, Dir [9], Tando Jam, Sindh [6], Chitral [5], Malakandar farm, Peshawar [8], Khairpur [10], Toba Tek Singh [11], Swat [12] and Toba Tek Singh [13].

The Present paper reports the distribution of weed species within Dera Ismail Khan District and will be helpful for recognizing the severity of weed infestation in wheat crop and weed competition in the area.

2. Materials and Methods

The research work was conducted during 2008-2010 in Dera Ismail Khan District, which is located in Khyber Pakhtunkhwa (KPK), Pakistan (**Figure 1**) and has an

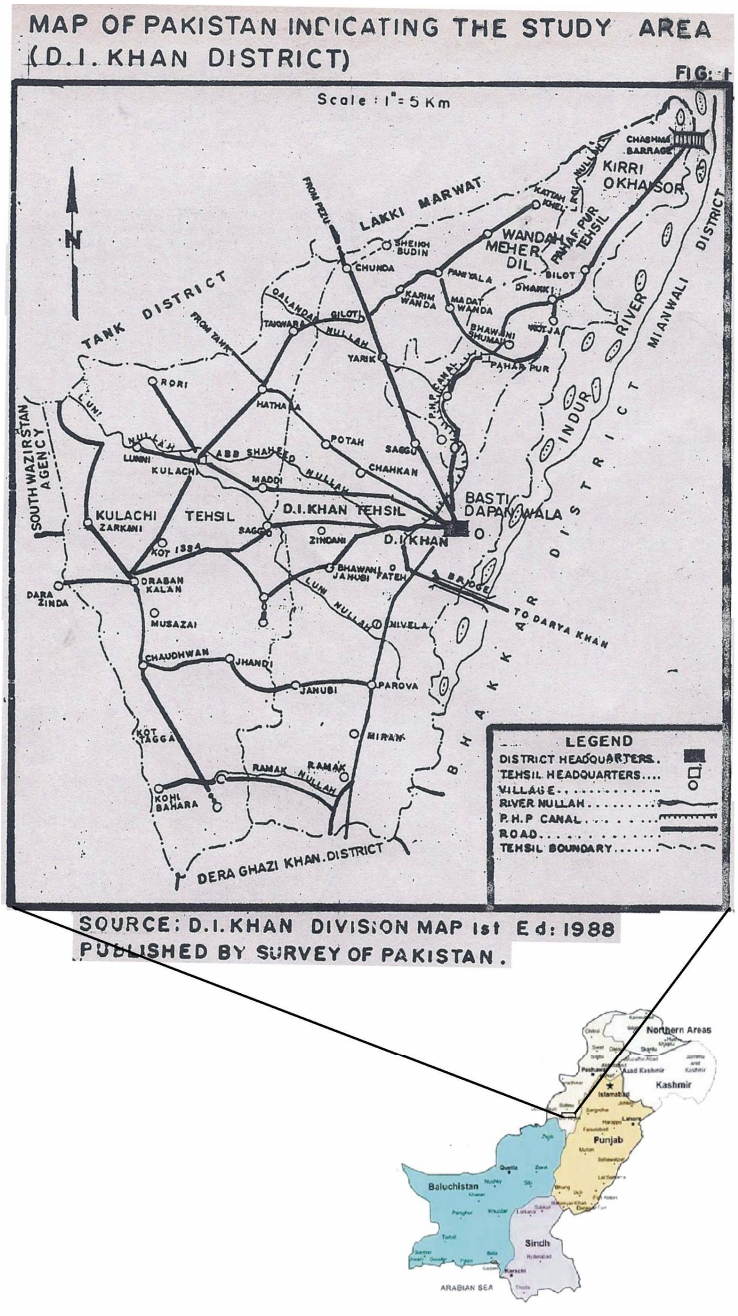

Figure 1. Map of Dera Ismail Khan, KPK, Pakistan.

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elevation of 173 meters above sea level. It has a total geographical land mass of 0.896 million hectares out of which 33% is cultivated [14]. The climate is arid to semi arid with average annual rainfall of 180 to 200 mm. The mean maximum and minimum temperatures during winter are 20.3˚C and 4.2˚C respectively, compared to 42˚C and 27˚C during summer [15]. Frequent field trips were arranged to various parts of the area to collect weed species in wheat crop. Data on weed density m^{-2} was recorded by placing square quadrate at different locations (Gomal University, Ratta Kulachi, Pahar Pur) in the farmers' fields. Relative weed density (%) or species wise weed density was then calculated by a formula [Relative weed density (%) = (Number of weeds of a species/total number of weeds) × 100]. Data was statistically analyzed using analysis of variance techniques appropriate for randomized complete block design [16]. When *F*-values were significant, means were compared using the least significant difference (LSD) test at 0.05 level of probability. The dominant weeds were particularly focused for correct identification and their control strategy. A questionnaire was also developed to interview the farmers as how they control the prevailing weeds in their area. All the traditional and improved methods of weed control were reported from the study area. Farmers and Agriculture extension workers were also interviewed for the most effective weed management strategy. Plants collected from the study areas were then identified with the help of available literature [17-19] and by comparing with the already identified plant specimens of the herbarium, Quaid-i-Azam University, Islamabad. After correct identification, the plants were deposited in the herbarium of the said university. Plants with botanical name, vernacular name, English name, family, flowering and fruiting period, major diagnostic characters and % age share of families were listed in **Tables 1-3**. Photographs of some important weeds have been presented in **Figures 2(a)-(l)**.

Table 1. Weeds of wheat crop in D. I. Khan district, KPK, Pakistan.

S.#	Scientific name	Family	English name	Vernacular name
1.	*Amaranthus viridis* L.	Amaranthaceae	Pigweed	Jangli cholai
2.	*Anagallis arvensis* L.	Primulaceae	Blue Pimpernel	Billi booti
3.	*Asphodelus tenuifolius* Cav.	Asphodeliaceae	Wild onion	Piazi, bhokat
4.	*Avena fetua* L.	Poaceae	Wild oat	Jangli jai, Javdri
5.	*Carthamus oxycantha* (L.) G. Don	Asteraceae	Wild safflower	Pohli, kandiari
6.	*Chenopodium album* L.	Chenopodiaceae	Goose foot	Bathu,bathwa
7.	*Chenopodium murale* L.	Chenopodiaceae	Fat hen	Karund
8.	*Cichorium intybus* L.	Asteraceae	Blue daisy	Kasni
9.	*Cirsium arvense* (L.) Scop	Asteraceae	Creeping thistle	Kandyari, Leh
10.	*Convolvulus arvensis* L.	Convolvulaceae	Field binweed	Lehli, Hirankhuri
11.	*Coronopus didymus* (L.)Smith.	Brassicaceae	Swine cress	Jangli halon
12.	*Cynodon dactylon* (L.)	Poaceae	Bermuda Grass	Dub, Khabbal
13.	*Euphorbia helioscopia* L.	Euphorbiaceae	Sun spurge	Dudhi
14.	*Fumaria indica* (Hausskn) Pugsley	Fumariaceae	Fumitory	Shahtra, pitpapra
15.	*Galium aparine* L.	Rubiaceae	Bedstraw	Warribooti
16.	*Lathyrus aphaca* L.	Papiolanaceae	Crow pea	Dokanni
17.	*Lathyrus sativus* L.	Papiolanaceae	Grass pea	Chraal, kasseri
18.	*Lepidium sativum* L.	Brassicaceae	Garden cress	Halon
19.	*Malva parviflora* L.	*S*Malvaceae al	Dwarf mallow	Sonchal
20.	*Medicago polymorpha* L.	Papiolanaceae	Bur clover	Maina
21.	*Melilotus alba* Desr.	Papiolanaceae	White sweet clover	Sufaid senji
22.	*Melilotus indica* (L.) All.	Papiolanaceae	Yellow sweet clover	Zard senji
23.	*Phalaris minor* Retz.	Poaceae	Bird's seed grass	Dumbi sittee
24.	*Polygonum plebejum* R. Br.	Polygonaceae	Prostrate knotweed	Dranak, hazardani
25.	*Polypogon monspeliensis* (L.) Desf.	Poaceae	Rabbit foot grass	Lomar ghas
26.	*Rumex dentatus* L.	Polygonaceae	Broadleaf dock	Jangli palak
27.	*Saponaria vaccaria* L.	Caryophyllaceae	Soapwort	Takla
28.	*Sisymbrio irio* L.	Brassicaceae	London rocket	Khoob kalan
29.	*Sonchus asper* (L.) Hill	Asteraceae	Spiny sowthisle	Kandiali, dodhak
30.	*Spergula arvensis* L.	Spergulaceae	Corn spurry	Kalri booti
31.	*Stelleria media* (L.) Vill.	Caryophyllaceae	Common chickweed	*Stel* Phullan booti,
32.	*Vicia sativa* L.	Papiolanaceae	Common vetch	Revari, Choti phali

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Table 2. Major diagnostic characters of weeds of wheat crop in D. I. Khan district.

Scientific name	Fl. & Fr.	Group	Life cycle	Major diagnostic characters
Amaranthus viridus	Aug-Nov	Dicot	Annual	An erect or more rarely ascending herb; inflorescence paniculate spikes, terminal; flowers green.
Anagallis arvensis	Mar-Apr	Dicot	Annual	Prostrate or decumbent herb, square in outline; leaves sessile, opposite and decussate; flowers solitary, axillary, red or blue; capsule with dark brown angular seeds.
Asphodelus tenuifolius	Nov-Apr	Monocot	Annual	An erect herb; leaves linear, fistular, sheathing at the base; flowers laxly racemose; perianth white to pale pink; capsule globose; seeds trigonous, black.
Avena fatua	Mar-Apr	Monocot	Annual	A tufted, erect to geniculate herb; Spikelets usually 3- rarely 2- or 4-flowered; lemma back has long, stiff hairs and a geniculate and twisted dorsal awn; fruit straw coloured; seeds hairy or tufted
Carthamus oxycantha.	Sept-Nov	Dicot	Annual	A spiny-leaved herb; infl. Terminal racemose with yellow flowers; seeds shining grey coloured or black spotted, pappus lacking.
Chenopodium album	Apr-Jun	Dicot	Annual	An erect or suberect herb, more or less mealy; leaves varing from rhombic-ovate to lanceolate; infl. panicled spikes often mealy.
Chenopodium murale	May-Oct	Dicot	Annual	An erect, angular, slightly mealy herb; leaves, rhombic-ovate, dark green, irregularly toothed; inflorescence terminal and axillary, loosely branched cymes.
Cichorium intybus	Jun-Sept	Dicot	Annual	An erect, grooved, herbaceous; infl. Terminal or axillary capitulum with blue flowers.
Cirsium arvense	Jan-Mar	Dicot	Perennial	An erect herb; stem branched, slightly hairy; leaves lance-shaped, lobed with spiny margins; infl. head rose-purple or white.
Convolvulus arvensis	Apr-Sept	Dicot	Annual or Perennial	D Diffuse or procumbent; basal and lower leaves rosulate, pinnatisect, stalked, 6-10 jugate, upper leaves similar or pinnatifid and only 3-5 jugate; racemes 30-60-flowered, flowers minute.
Coronopus didymus	Mar-Jun Dicot Annual or	Dicot Annual or	Annual or Biennial	Diffuse or procumbent; basal and lower leaves rosulate, pinnatisect, stalked, 6-10 jugate, upper leaves similar or pinnatifid and only 3-5 jugate; racemes 30-60-flowered, flowers minute.
Cynodon dactylon	Whole year	Monocot	Perennial	Widely creeping by runners and forming tufts; leaf blades linear to lanceolate; infl. racemes usually 4-6; spikelets 1-flowered.
Euphorbia helioscopia	Jan-July	Dicot	Annual	An erect sparingly pilose to glabrescent bright green fleshy herb; fruit roundly triobate with deep grooves; seeds ovoid, strongly reticulate, dark brown.
Fumaria indica	Mar-Jun	Dicot	Annual	Small, delicate, much branched, leafy, diffuse herb; leaves much dissected, 2-3-pinnatisect or decompound; racemes 6-12 (-15)-flowered.
Galium aparine.	Mar-Jul	Dicot	Annual	Climbing herb, reflexed hairs or prickles; leaves 6-8 in a whorl, linear; inflorescence axillary, 3-flowered; corolla white.
Lathyrus aphaca	Feb-Mar	Dicot	Annual	Trailing or scrambling annual; stipules foliaceous, broadly ovate, hastate, rest of the leaf reduced to a tendril. Infl. 1-2-flowered, axillary raceme;corolla fruit 4-6-seeded.
Lathyrus sativus	Mar-Aug	Dicot	Annual	herb; stem winged; leaf pinnately compound, leaflets 2, some what linear, upper leaves with mostly 3-sect tendrils; peduncle 1-flowered; corolla red, blue or white; fruit upper suture broadly winged; 3-5-seeded.

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Continued

Lepidium sativum	Apr-Jun	Dicot	Annual	erect herb; lower leaves pinnatisect or lyrate-pinnate; racemes branched, each 20-30-flowered; flowers small, white or pinkish; fruit winged; seed brown.
Malva parviflora	Mar-	Dicot	Annual	prostrate herb; leaves orbicular, cordate at base; flowers axillary usually fascicled, rarely solitary; petals white, pinkish at the tips; fruit discoid, mericarps (8-)10.
Medicago polymorpha	Aug-Oct	Dicot	Annual	somewhat spreading; leaves trifoliate; infl. 2-8-flowered raceme with yellow flowers; fruit with spines hooked in 2 rows lying almost parallel to the surface of the disc.
Melilotus alba	Mar-Sept	Dicot	Annual	An erect herb; leaves, trifoliate; infl.raceme with white flowers; fruit single seeded pod; seeds orange brown.
Melilotus indica	Mar-Apr	Dicot	Annual	Erect annual herb; leaves compound, trifoliate; infl. a 10-16-flowered raceme with yellow flowers; fruit single seeded pod; seeds orange brown.
Phalaris minor	Mar-May	Monocot	Annual	Culms 20 - 100 cm high, profusely branched tillers at the base; leaves linear, sheathing; inflorescence terminal spike, ovate-oblong.
Polypogon monspeliensis l	Mar-Jul	Monocot	Annual	Cculms 6 - 80 cm high, erect or geniculately ascending. Panicle narrowly ovate to narrowly oblong, cylindrical or lobed, very dense and bristly, pale green.
Polygonum plebejum	whole year	Dicot	Annual	Prostrate, densely branched herb. Stem l lineolate, branched from bases.Leaves linear, Inflorescence axillary, 3-4-flowered. Flowers sunken between ochrea or hardly exserted, pink in colour.
Rumex dentatus	Feb-Sept	Dicot	Annual	An erect annual herb with large lower leaves a and oblong to linear upper leaves; flowers in I distinct whorls which are usually leafy, green; achenes acutely trigonous, almost winged.
Saponaria vaccaria	Feb-Apr	Dicot	Annual	An erect herb; leaves opposite, sessile; inflorescence dichasial panicle; corolla pink; capsule sub globose.
Sisymbrio irio	Mar-May	Dicot	Annual	An erect herb; basal and lower leaves, pinnately lobed with a hastate terminal lobe; racemes 50-80(-100)-flowered; yellow; siliqua with ute brown seeds.
Sonchus asper	Jun-Oct	Dicot	Annual	erect herb; leaves lobed, margin spiny, basal lobes of the cauline leaves rounded; infl. head yellow; achene having papus.
Spergula arvensis	Mar-Apr	Dicot	Annual	Stems ascending, leaves in false whorls, linear-subulate; flowers solitary or in few-flowered cymes; petals white, as long as or slightly exceeding the sepals.
Stelleria media	Feb-Apr	Dicot	Annual	With prostrate to ascending stems; flowers in lax panicles; petals white, deeply bilobed; capsule splitting by valves nearly to the base; seeds small, brown.
Vicia sativa	Mar-Apr	Dicot	Annual	Climbing or decumbent herb;leaves pinnately compound with 4-18 linear leaflets per leaf; flower reddish blue; legume with grayish black seeds.

3. Result and Discussion

Weed flora of the study area is comprised of 32 species including 5 monocots distributed across 29 genera and 15 families (2 monocot and 13 dicot). The dominant weeds prevailing in wheat crops were *Avena fatua*, *Chenopodium album*, *Chenopodium murale*, *Convolvulus arvensis*, *Cynodon dactylon*, *Malva parviflora*, *Melilotus indica*, *Medicago denticulata*, *Phalaris minor and Rumex dentatus*. The other reported weeds were of rare occurrence. The detail list of weeds identified in wheat crop in the study area along with their scientific names, families, English names, vernacular names and major diagnostic characters are given in **Tables 1** and **2**.

The predominance was shown by Fabaceae, Asteraceae and Poaceae represented by 6, 4 and 4 weed species respectively. Bracicaceae, Caryophyllaceae included three weed species each. Chenopodiaceae and Polygonaceae were represented by two species each.

The remaining families were represented by one weed species each. The relative % age of family Fabaceae is

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(a)

(b)

(c)

(d)

(e)

(f)

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(g)

(h)

(i)

(j)

(k)

(l)

Figure 2. (a) *Amaranthus viriuis* L.; (b) *Anagalis arvensis* L.; (c) *Carthamus oxycantha* (L.) G. Don; (d) *Chenopodium album* L.; (e) *Convolvulus arvensis* L.; (f) *Coronopus didymus* (L) Smith; (g) *Euphorbia helioscopia* L.; (h) *Gallium aparina* L.; (i) *Malva parviflora* L.; (j) *Medicago polymorpha* L.; (k) *Polypogon monspoliensis* (L.) Desf.; (l) *Stelleria media* (L.) Vill.

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Table 3. Percentage of families of weed plant species in wheat crop in D. I. Khan district.

S. #	Family	No. of species	% age
1.	Fabaceae	6	18.75
2.	Asteraceae	4	12.50
3.	Poaceae	4	12.50
4.	Brassicaceae	3	08.375
5.	Caryophyllaceae	3	08.375
6.	Chenopodiaceae	2	06.25
7.	Polygonaceae	2	06.25
8.	Amaranthaceae	1	03.12
9.	Asphodeliaceae	1	03.125
10.	Convolvulaceae	1	03.125
11.	Euphorbiaceae	1	03.125
12.	Fumariaceae	1	03.125
13.	Malvaceae	1	03.125
14.	Primulaceae	1	03.125
15.	Rubiaceae	1	03.125

18.8%, Asteraceae and Poaceae 12.5%, Brassicaceae and Caryophyllaceae 8.4%, Chenopodiaceae and Polygonaceae 6.3% and of other families is 3.1% each (**Table 3**, **Figure 3**).

The data on relative weed density at different locations in D. I. Khan District revealed that *P. minor* Retz. had the maximum infestation of 37.8% and 46.4% during 2008-2009 and 2009-2010, respectively (**Table 4**). *R. dentatus* was the next major weed with 26.8% and 33.4% during 2008-2009 and 2009-2010, respectively. There was significant effect of locations in each year as well as mean over years on *R. dentatus*. There was more infestation of *R. dantatus* at Gomal University particularly in 2009-2010 growing season compared to other locations. However, relative weed densities for all other weed species were statistically identical in individual years as well as mean over years.

The weeds control is the basic requirement and the major component of crop management in the production system [8].

The cultivated crops are infested with different weed species in various countries of the world. Moreover, ecotypes occurring in different regions may differ in response to control method. Thus each weed-crop-environmental complex requires special technology. The problem of weed control, especially in the canal irrigated area, is very intricate. In fact, canal water is the principle source of dissemination of weed seeds. A constant effort is needed to keep the weed population under control. Many methods of weed control and weed eradication have been devised. However, the method to be employed varies with the weed [20]. The following methods are generally used in Dera Ismail Khan District.

1) Dab: It is a local term which means that after pre-sowing irrigation (rauni) when the soil comes into workable condition, it is ploughed and planked by a heavy sohaga. For a period of 7 to 10 days, the soil is left as it is so that weed seeds may germinate, which are destroyed while preparing the soil for wheat sowing.

2) Hoeing and Weeding: Mechanical hoeing and weeding is a good measure for eradication of weeds during early growth period or during seedling. However, these methods are time consuming and laborious. On large scale these cannot be practiced. Moreover, hoeing and weeding becomes difficult in standing crop particularly in heavy textured soil whereby weeds cannot be uprooted but they are rather cut at the ground surface. Weeds regenerate their growth more vigorously if injured at seedling stage. While doing hoeing and weeding in the standing crops roots of the wheat crop are also damaged. It is difficult to differentiate between some of the weeds such as *Phalaris minor* and *Avena fatua* and wheat crop at early vegetative stage while doing weeding [6].

3) Tillage: Tillage is also an effective way to control annual as well as perennial weeds [20]. During primary tillage, the weeds present in the field are uprooted and buried deep in the soil before sowing crop and the weeds germinated after sowing are controlled by inter tillage

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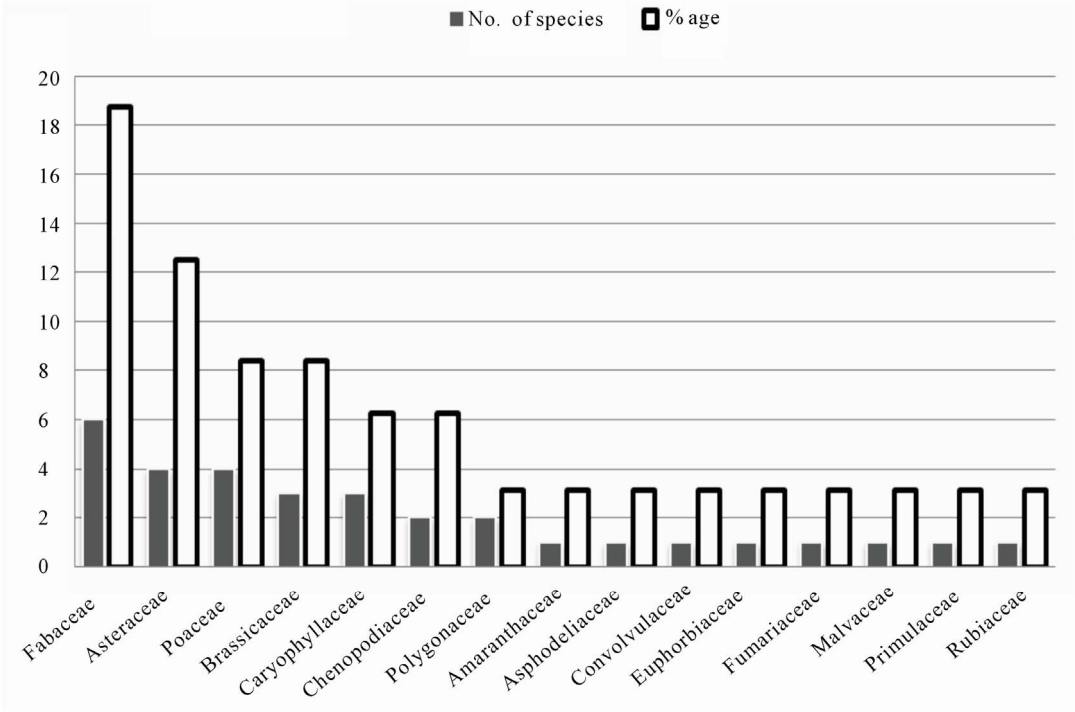

Figure 3. Graph showing % age of plant families in the weed flora of wheat crop in D. I. Khan district.

Table 4. Relative weed density (%) at different locations in D. I. Khan district.

Weed species	Location	2008-2009	2009-2010	Mean
P. minor	Gomal University	34.4	42.8	38.6
	Ratta Kulachi	44.2	45.2	44.7
	Paharpur	34.8	51.2	43.0
	Mean	37.8	46.4	
R.. dentatus	Gomal University	25.8[b]	43.5[a]	34.7[a]
	Ratta Kulachi	24.6[b]	25.9[b]	25.3[b]
	Paharpur	30.0[b]	30.8[b]	30.4[ab]
	Mean	26.8	33.4	
M. denticulata	Gomal University	25.8	10.8	18.3
	Ratta Kulachi	19.0	20.1	19.5
	Paharpur	23.4	11.8	17.6
	Mean	22.8	14.2	
M. indica	Gomal University	10.8	3.9	7.4
	Ratta Kulachi	11.7	5.1	8.4
	Paharpur	8.9	5.8	7.3
	Mean	10.4[a]	4.9[b]	
C. album	Gomal University	6.5	3.3	4.9
	Ratta Kulachi	3.5	3.5	3.5
	Paharpur	5.7	4.8	5.2
	Mean	5.3	3.8	

Data in each category followed by same letter (or no letter) do not differ significantly at 5% level of probability.

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operations in wider row crops [6]. However, this method is not economical due to recent rise in fuel prices. Excessive tillage practices also affect aggregate stability ad degrade soil structure. Zero tillage and reduced tillage technology are the best alternative to conventional tillage. Zero tillage in combination with broad spectrum herbicide is resource conserving and the most effective and economical weed management strategy in Dera Ismail Khan District [21].

4) Bar Harrowing: This is another method of weed eradication. It is used after the application of first or second irrigation and many growing weeds are eradicated. The operation becomes easier when the crop is cultivated in rows.

5) Crop Rotation: Crop rotation is one of the best and effective method for controlling weeds in crops and inclusion of legumes and a fallow in the rotation may enhance soil fertility and allow the natural suppression of weeds. Some weeds are associated with certain crops and changing the crop sequence, disturb the normal life cycle of these weeds. In wheat crop, the problem of weeds especially *Phalaris minor* and wild oats is increasing rapidly. The well planned crop rotation can effectively help in the control of these weeds. If in a field wheat is grown continuously for 3 years, weed population is increased tremendously. Therefore, in such fields after every three years of wheat cultivation, berseem crop should be cultivated. The cultivation of berseem will add nutrients to the soil in addition to controlling weeds via berseem cuttings [6].

6) Chemical Control: It is the most effective, time saving and economical way of weed control. The weeds especially *Avena fatua* and *phalaris minor* are very difficult for the farmers to identify due to their resemblance with the wheat plants in early stages. Keeping the importance of these circumstances in view, it is necessary to select the suitable chemical capable of controlling weeds effectively and economically in wheat crop. There are many kinds of chemicals which are used for controlling the weeds. These chemicals are called as herbicides. The herbicides are most effective in controlling annual as well as perennial weeds. However, it is essential to select an appropriate kind of chemical and to use it at a specified rate, otherwise they may damage the crop [6]. For example, Affinity 50 WDG (carfentrazone ethyle ester + isoproturon) at the rate of 2 $kg \cdot ha^{-1}$ is the most effective broad spectrum herbicide controlling almost all species of weeds in wheat, however application of higher dose than the recommended one may cause crop injury [21]. While spraying chemicals, it should be kept in mind that the chemicals not only destroy the weeds but also mix with air, water, and land causing environmental hazards [6]. The fate of these chemicals may appear in residual toxicity to soil microbes and crops when they take up these chemicals in excess. However, if herbicides are sprayed as per recommendations of the manufacturer their residual effects can be kept to the minimum [20]. Eradication of weeds through chemicals is considered suitable for more area during short period of time [6].

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