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Identification of most important weed species in wheat crop under high altitude in northern Pakistan

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Abstract
A field survey was carried out to highlight the most important and problematic weeds of wheat crop at District Dir (Lower), Pakistan during, 2016. The weeds were randomly sampled from the fields of wheat crop using a quadrate of size 1 m x 1 m randomly thrown at 5 different sites. The data were recorded on weed density, relative weed density weed frequency, relative weed frequency, importance value index, fresh biomass and dry biomass of weeds. The survey data showed that total 14 plant weed species, belonging to 10 families were collected and identified from the study area. The data further showed that the surveyed fields were mostly infested with *Phalaris minor*, *Cannabis sativa*, *Stellaria media*, *Poa annua*, *Coronopus didymus*, *Medicago minima*, *Fumaria indica*, *Euphorbia helioscopia*, *Medicago denticulata*, *Malcolmia africana*, *Vicia sativa*, *Ranunculus muricatus*, *Avena fatua* and *Chenopodium album.* While the dominant weed species of the wheat field were *Phalaris minor*, *Cannabis sativa* and *Stellaria media.* The results further revealed that the highest density (30.4 m^{-2}), relative weed density (16.8%) and important valve index (25.1%) were recorded for *Phalaris minor*, while the lowest valves for these parameters were noted from *Chenopodium album* (4.3 m^{-2}), (2.4%) (8.4%) respectively. *Cannabis sativa* showed the maximum valves for weed frequency (88%) and relative weed frequency (8.7%), while the lowest were recorded for *Chenopodium album* (60%) and (5.9%) respectively. The maximum fresh and dry biomass of 142.6 g $plant^{-1}$ and 59.1 g $plant^{-1}$ respectively were noticed from *Cannabis sativa.* While, minimum fresh and dry biomass were obtained from *Medicago denticulata* (17.2 g $plant^{-1}$) and (8.8 g $plant^{-1}$) respectively. Among the different identified weeds *Phalaris minor (G.sokay)*, *Cannabis sativa* and *Stellaria media* are the most problematic weed of wheat crop and should be managed through integrated weed management approach in wheat crop in the target area.

Keywords: Weed Species, Wheat, Dir (Lower), Pakistan

Introduction
Weeds are unwanted plants which provide hard time to any particular crop in which it occurs. Its svariety and distribution differs from crop to crop. Such vegetation is found abundant in cultivated fields of great financial and biological significance (Jabeen & Ahmed, 2009). These unwanted plants grow along with agricultural plants and cause gradual and important loss in crop yield because they can compete with crop plants for want of available nutrients, space, water contents, sunlight etc (Dangwal *et al.*, 2010). Weed occurrence is the major problem in wheat crop which can reduce wheat production by 25-30% in Pakistan (Nayyar *et al.*, 1994).Weed utilizes soil nutrients and competes for space and sunlight with crop, thus reduce crop yield and subsequently market value (Pervaiz and Quazi, 1992). Besides measureable effects on yield, weeds also affect the quality of crop due to presence of their seeds and fragments. The magnitude of crop yield loss is determined by the persistence of weeds, their density, type and also by the practices used for crop management.

The chief weeds of wheat in Pakistan are Wild oat, *Avenafatua, Lamb's quarters, Chenopodium album, Canary grass, Phalaris minor*, Wild medic, (*Medicago polymorpha), Blue pimpernel, Anagallisarvensisc*, Field bind weed, *Convolvulus arvensis, Rumex dentatus, Seniberadidym*, Broad leaf dock, (Swine cress) and *Fumariaindica* (fumatory), *Melilotus* alba L. (sweet clover), (Shamsi and Ahmad, 1984). There are nearly 30,000 weeds species in the world, out of these 50 to 200 mostly cause considerable damage to the major food crops (Mahmood and Niaz, 1992). In Pakistan mostly loss in crop production takes place because of unchecked weed growing in different crops. It is expected that is loss in wheat production is about from 20% to 40% is due to weeds (Ahmad and Sheikh, 2003). The wheat grower enhanced wheat crop qualities by using new variety, increase biodiversity and keep away wheat crop from adverse effects of pest and climatic condition.(Walburger *et al.*, 1999).

Wheat is cultivated in Pakistan on an area of 9.25 million ha with total production of 25.5 million tons in Khyber Pakhtunkhwa it is cultivated on 0.75 million ha producing 1.4 million tons (MNFSR, 2015). It is not only the most important cereal crop in the world but also the major source of staple food for the inhabitants of Pakistan (Malik, 2006). It contributes 3% to GDP and 13.7% to the value added in agriculture. Though it is grown on larger area, despite of this its average yield at farmers' fields is still far below than the potential (Mann *et al.,* 2004). The demand of wheat in Pakistan is increasing day by day due to the population pressure. So to fulfill the requirement will have to be met by increasing the yield per unit area for which there is an ample scope. To overcome this short fall in wheat productivity, the latest production technologies that emphasize on the use of adequate inputs and other techniques for weed management should be used. Therefore the following survey was conducted to identify different weed species and the most dominant weed speices in wheat crop in the Northren Pakistan Dir (lower).

Materials and methods

The field survey was carried out at Khall District Dir (Lower). The weeds were randomly sampled from the fields of wheat crop using a quadrate of size 1 m x 1 m randomly thrown at 5 different sites.

The data were recorded on the following parameters:

Weed density m^{-2}

A quadrate of size 1m x 1 m was thrown five times in wheat field and then averages were computed to record the weed density or number of weeds m^{-2}.

$$\text{Density} = \frac{\text{Total number of individual species in all quadrates}}{\text{Total number of quadrates thrown}} \text{ x } 100$$

Relative weed density m^{-2}

Similarly, for good understanding of weeds in wheat field the value for relative weed density were also generated by using the following formula.

$$\text{RWD} = \frac{\text{Number of weeds of a particular species in a single quadrate}}{\text{Total number of weeds species in that quadrate}} \text{ x } 100$$

Weed Frequency

Weed frequency for each individual weed was computed by recording the occurrence of every weed in each quadrate and then multiplying with 100 for percentage as given in the formula.

$$\text{Frequency} = \frac{\text{Number of quadrates in which a species occurred}}{\text{Total number of quadrates}} \text{ x } 100$$

Relative weed frequency

Relative weed frequency for each individual weed was computed by dividing the frequency of each individual weed by total weed frequency and multiplying the obtained valve with 100 for percentage as given in the following formula.

$$\text{RWF} = \frac{\text{Number of quadrates where a weed species occurred}}{\text{Total number of thrown quadrates}} \text{ x } 100$$

Importance value indices (IVI)

The importance valve index for each individual weed was computed by adding the obtained valves of relative weed density and relative weed frequency, as given in the following formula.

IVI = Relative weed density + Relative weed frequency x 100

Fresh Biomass (g)

The fresh biomass was recorded by uprooting each individual weed plants from the quadrates and their fresh biomass was taken with the help of electric balance and then average was calculated.

Dry Biomass (g)

After recording the fresh biomass the samples were then sundried for one week, after complete drying their dry weight was taken with help of electronic balance and their average was calculated. During the survey, the data were noted on the mentioned parameters as adopted from the procedure of Hussain *et al.* (2004).

Materials

The following materials were used in the field study

Graduated scale, digital balance and 1 meter square quadrate.

Results and Discussion

Weed density (m^{-2})

The survey data showed that total 14 plant weed species, belonging to 10 families were collected and identified from the study area. (Table 1).

Table 1: List of weed flora found during visits to wheat fields.

Botanical Name	Common name	Family Name	Annual/ Perennial
Phalaris minor	Gwansokay	Myrsinaceae	Annual
Cannabis sativa	Bang	Cannabaceae	Annual
Stellaria media	Spenstargay	Caryophyllaceae	Annual
Poa annua	Wakha	Poaceae	Annual
Coronopus didymus	Skhabotay	Brassicaceae	Biennial
Medicago minima	Shpeshtary	Fabaceae	Annual
Fumaria indica	Krachay	Fumariaceae	Annual
Euphorbia helioscopia	Mandaroo	Euphorbiaceae	Annual
Medicago truncatula	L. peshtary	Fabaceae	Annual
Malcolmia africana	Bashka	Brassicaceae	Annual
Vicia sativa	Margaykhpa	Fabaceae	Annual
Ranunculus muricatus	Sarbawale	Ranunculaceae	Annual/Biennial
Avena fatua	Jawdar	Poaceae	Annual
Chenopodium album	Sarmay	Chenopodaceae	Annual

The results on weed density of a particular species are shown in Table 2. The data showed that the surveyed fields were mostly infested with *Phalaris minor (G.sokay), Cannabis sativa, Stellaria media, Poa annua, Coronopus didymus, Medicago minima, Fumaria indica, Euphorbia helioscopia, Lwny peshtray, Malcolmia africana, Vicia sativa, Ranunculus muricatus, Avena fatua* and *Chenopodium album.* While, the dominant weed species of the wheat field were *Phalaris minor (G. sokay), Cannabis sativa* and *Stellaria media.* The study also expressed that maximum species of the field were broad leaf weeds with least number of grassy.

Table 2: Weed density (m^{-2}), relative weed density (%), weed frequency (%) and relative weed frequency (%) for the individual weed species of wheat crop at khall, Dir (lower).

Weed Species	Density (m^{-2})	Relative weed density (%)	Weed frequency (%)	Relative weed frequency (%)
Phalaris minor	30.4	16.8	88	8.7
Cannabis sativa	28.4	15.6	84	8.3
Stellaria media	24.2	13.3	84	8.3
Poa annua	23.9	13.2	76	7.5
Coronopus didymus	21	11.6	76	7.1
Medicago minima	13	7.2	72	7.1
Fumaria indica	5.7	3.2	72	7.1
Euphorbia helioscopia	5.5	3.1	72	7.1
Medicago truncatula	5.2	2.9	68	6.7
Malcolmia africana	5	2.8	64	6.3
Vicia sativa	4.9	2.8	64	6.3
Ranunculus muricatus	4.9	2.8	64	6.3
Avena fatua	4.7	2.7	64	6.3
Chenopodium album	4.3	2.4	60	5.9

The weed density of dominated species (30.4 m^{-2}) was recorded for *Phalaris minor (G.sokay)* followed by *Cannabis sativa* (28.4 m^{-2}). While, the lowest weed density was calculated for *Chenopodium album* (4.3 m^{-2}) in the wheat fields. The infestation of weeds depends on the frequent rainfall i.e. when rainfall is higher the infestation of the species will be more. The farmers did not used the proper weed management practices to control weeds in their fields. In earlier studies Muhammad *et al.* (2009) also found 34 broad leaf, sedges and grassy weed species in maize crop that resulted in maize yield reduction.

Relative weed density (%)

The results on relative weed density of a particular species are shown in Table 2. The relative weed density of dominated species (16.8%) was recorded for *Phalaris minor (G.sokay)* followed by *Cannabis sativa* (15.6%). While, the lowest relative weed density was calculated for *Chenopodium album* (2.4%) in the wheat fields. The infestation of weeds depends on the frequent rainfall i.e. when rainfall is higher the infestation of the species will be more. The peoples are not aware about integrated management practices that's why weed infestation in wheat crop is more critic and needs proper management techniques. In earlier studies Muhammad *et al.* (2009) also found 34 broad leaf, sedges and grassy weed species in maize crop that resulted in maize yield reduction.

Weed frequency (%)

The weed frequency of weeds is the best way of indication for the prevalence of weed species in the studied area. The results on weed frequency (%) of a particular species are shown in Table 2. On the basis of the data provided the highest frequency was computed for *Cannabis sativa* (88%) followed by *Stellaria media* and *Phalaris minor (G.sokay)* (84% respectively); while, the lowest (60%) fequency was recorded for *Chenopodium album.* The remaining weeds included in the Table-2 were of minor phytosociological status and relatively unimportant as far as wheat production in the target area is concerned. The highest weed frequency in wheat fields might be due to lack of weed management in the target area that's why, weeds reproduce more and are frequently occurring in wheat crop. Saeed *et al.* (2010) also reported the frequent occurrence of different weeds in their experiments. In a similar study, Khan *et al.* (2012) also narrated the highest weed frequency for broad leaved weeds as compared to grassy weeds. The major weed were reported to infest wheat crop in the northern Pakistan were *Cannabis sativa* Hussain *et al.* (2007).

Relative weed frequency (%)

The relative weed frequency of weeds is the best way of indication for the prevalence of weed species in the studied area. The results on relative weed frequency (%) of a particular species are shown in Table 2. On the basis of the data provided the highest relative frequency was computed for *Cannabis sativa* (8.7%) followed by *Stellaria media* and *Phalaris minor (G.sokay)* (8.3% respectively); while, the lowest (5.9%) relative fequency was recorded for *Chenopodium album.* The remaining weeds included in the Table-2 were of minor phytosociological status and relatively unimportant as far as wheat production in the target area is concerned. The highest weed frequency in wheat fields might be due to lack of weed management in the target area that's why, weeds reproduce more and are frequently occurring in wheat crop. Saeed *et al.* (2010) also reported the frequent occurrence of different weed species in their experiments. In a similar study, Khan *et al.* (2012) also narrated the highest weed frequency for broad leaved weeds as compared to grassy weeds. Hussain *et al.* (2007) reported that the major weed in the northern Pakistan were *Cannabis sativa*. Kazi *et al.* (2007) reported that the relative density and frequency of *Chenopodium album* were 13.53% and 30% respectively. While *Heliotropium europacum* showed less frequency (3.33%) and density (0.52). Qureshi *et al.* (2009) determined that *Cannabis sativa* and *Ranunculus muricatus* were the most common and dominant weed species with an average rate of 72% and 84% respectively in wheat crop in District Toba Tak Singh. Muhammad *et al.* (2009) recorded that the *Cynodon dactylon* and *Convolvulus arvensis* were most common weed species in wheat, maize and potato crops. Subedi (2013) studied tha the major weed species on the basis of frequency and density were *Vicia hirsutum, Chenopodium album, Oxalis*

corniculata, Anagalis arvensis and Poa annua while Chenopodium album, Polypogon fudax, Solanum nigrum, Gnaphalium affine Anagalis arvensis and Polygonum plebijum in wheat population. Whereas, Khobragade and Sathawane (2014) studied that *Chenopodium album, Parthenium heterosphorus, Melilotus indica, Phaselous aconitifolius, Tridax procumbence, Alternanthera spinosus, Anagalis arvensi, Rumex dentatus, Cyprus rotunds, Portulaca oleracea* and *Euphorbia thymifolia* were reported to be the common weed species in wheat crop. Khan *et al.* (2012) found seven weeds in wheat crop which were *Cirsium arvense, Convolvulus arvensis, Conyza bonariensis, Cynodon dactylon, Cyperus rotundus, Parthenium hysterophorus,* and *Sonchus aspera.*

Importance value index

The importance value index is important for understanding the status of a given weed specie in a weeds community. The data in Table-3 exhibits the highest importance value index (25.1%) was recorded for *Phalaris minor (G.sokay)* followed by *Cannabis sativa* (24.3%), while the lowest importance value index (8.4%) for *Chenopodium album* and the second lowest by *Avena fatua* (9.0%). The highest importance value index of the above weed species is due to their high valve of relative weed density and relative weed frequency and are ought most important to be managed properly on time. The weeds should be control before threshold level, so that could not decrease wheat productivity. These results are supported by those of Saeed *et al.* (2010) who observed the highest importance value index for kharif weeds in their investigations. Waheed *et al.* (2009) concluded that weed species such as *Cannabis sativa, Polypogon fugax, Melilotus indica, Cirsium arvense, Chenopodium album* and *Cynodon dactylon* were also uniformly observed with IVI ranging from 6.70-44.45%.

Fresh biomass (g plant^{-1})

Data regarding fresh weed biomass of of different weeds during the survey indicated that fresh biomass varied among different weeds speices (Table 3). The data further revealed that maximum fresh biomass was recorded from *Cannabis sativa* (142.6 g plant^{-1}) followed *Vicia sativa* and *Medicago minima* (128.3 and 128.2 g plant^{-1}) respectively. While, the lowest fresh biomass was noted from *Euphorbia helioscopia* and *Medicago truncatula* (20.3 and 17.2 g plant^{-1}) respectively. The more fresh biomass of the weeds might be due to the avialibility of sufficient water, nutrients and no weed management techniques. That's why weeds grow vigoursley and produce more biomass. The used of proper weed management technique caused maximum reduction in the germination and biomass of horse purslane (Khan *et al.*, 2012). The lowest weed biomass in treated fields negatively affected the weed growth and biomass (Patel *et al.*, 2006).

Dry biomass (g plant^{-1})

Data regarding dry weed biomass of of different weeds during the survey indicated that dry biomass varied among different weeds speices (Table 3). The data further revealed that maximum dry biomass was recorded from *Cannabis sativa* (59.1 g plant^{-1}) followed *Vicia sativa* and *Medicago minima* (44.1 and 37.9 g plant^{-1}) respectively. While, the lowest dry biomass was noted from *Euphorbia helioscopia* and *Medicago truncatula* (20.3 and 17.2 g plant^{-1}) respectively. The more dry biomass of the weeds might be due to the availability of sufficient water, nutrients and no weed management techniques. That's why weeds grow vigourasliy and produce more biomass. The used of proper weed management technique caused maximum reduction in the germination and biomass of horse purslane (Khan *et al.*, 2012). The lowest weed biomass in treated fields negatively affected the weed growth and biomass (Patel *et al.*, 2006).

Table 3: Important valve index, fresh biomass (g plant^{-1}) and dry biomass (g plant^{-1}) for the individual weed species of wheat crop at khall, Dir (lower).

Weed Species	Importance value index	Fresh biomass (g plant^{-1})	Dry biomass (g plant^{-1})
Phalaris minor	25.1	142.6	59.1
Cannabis sativa	24.3	128.3	44.1
Stellaria media	21.6	128.2	37.9
Poa annua	20.7	71.3	26.1
Coronopus didymus	18.7	60.1	22.3
Medicago minima	14.3	50	21.8
Fumaria indica	10.3	47.6	19.2
Euphorbia helioscopia	9.9	44.9	18.8
Medicago truncatula	9.5	42.7	17.9
Malcolmia africana	9.4	34.8	16.9
Vicia sativa	9.2	30.1	13.5
Ranunculus muricatus	9.1	22.3	11.5
Avena fatua	9	20.3	10.5
Chenopodium album	8.4	17.2	8.8

Conclusion

There was a diverse weed flora present in wheat fields indicating that wheat is vulnerable to weed infestation and competition, as indicated by the important valve indices of the weeds. Among the different identified weeds *Phalaris minor (G. sokay), Cannabis sativa* and *Stellaria media* are the most problematic weed of wheat crop in khall District Dir (lower) Khyber Pakhtunkhwa. This study provided very helpful knowledge to the scientific community about weed flora to design a solid integrated weed management plane in wheat crop in the target area. Similar survey studies should be carried out for timely information and resolution of issues related to farming system.

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