Research Article

Management Studies of Noxious Weed (*Asphodelus tenuifolius* Cav.) In Chickpea Growing Areas of District Karak, Khyber Pakhtunkhwa, Pakistan

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Abstract | A survey was carried out to determine the major factors influencing chickpea productivity. Weeds may be one of the main causes of low productivity in Pakistan. In order to highlight the most significant and challenging weeds of the chickpea crop in the southern regions of Khyber Pakhtunkhwa, Pakistan, during the Rabi season 2022. Five chickpea growing regions were selected in chickpea growing area of district Karak. The quadrate method was used to determine the relative weed density. The data were recorded on density (%), relative density (%), frequency (%), relative frequency (%) and importance value of weed species. The present findings revealed that *Asphodelus tenuifolius* Cav., *Carthamus oxycantha* M. Bieb., *Medicago denticulata* Willd., *Anagallis arvensis, Lathyrus aphaca* L. *Euphorbia helioscopia* L., *Convolvulus arvensis* L., *Cyprus rotundus, Vicia sativa* L. Ehrh., *Cynodon dactylon* L. Pers. and *Fumaria indica* Hausskn were all found in five locations around the district. The main species in the district emerged as *A. tenuifolius* Cav. The highest relative weed density (64.2%) and relative weed frequency (45.2%), respectively was noted for *A. tenuifolius* Cav. While, the lowest value of relative weed density (3.5%) and relative weed frequency (1.2%), respectively was documented for *E. helioscopia* L. A good judgement for determining the status of a particular weed in a community is the assessment of importance value of the weed species. The data showed that the highest importance value (55.7%) was considered for *A. tenuifolius* Cav. While, the minimum importance value (3.2%) was noted for *E. helioscopia* L. Thus, farmers and the scientific community found the information from this study to be extremely helpful in developing a strong integrated weed management plan for the chickpea crop in District Karak.

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Introduction

Chickpea (*Cicer arietinum* L.), also known as Gram or Bengal gram is a member of the Fabaceae family (Anonymous, 2020). It is a substantial cool winter legume crop grown in many countries and geographic regions around the globe (Kanatas and Gazoulis, 2022). Due to its ability of fixing nitrogen,

the chickpea crop provides a substantial source of nutritional protein for humans and is crucial for managing soil fertility. It is well known that chickpea is a rich source of protein, dietary fibers, carbohydrates, minerals and vitamins. Chickpea contains 15 to 22% proteins (USDA, 2021). Chickpeas are grown in over forty countries around the world (Soomro *et al.*, 2021). In Pakistan, the total area under cultivation of chickpeas for the 2020 crop year was 0.940 million hectares and production was approximately 0.54 million tonnes. The province of Khyber Pakhtunkhwa produced 18.6 thousand tonnes of chickpeas on 29 thousand hectares of land, with an average grain yield of 643 kg ha^{-1} (Pakistan Bureau of Statistics, 2020).

Khyber Pakhtunkhwa is the region of Pakistan where chickpeas are the most significant pulse crop. In contrast to other countries that produce chickpeas, Pakistan average yield of such legumes is incredibly low. The main reasons for low chickpea production in Pakistan are lack of organic matter in the soil, lack of nutrients, soil erosion, improper tillage practices and weed management (Khan and Khan, 2013). Among all the yield limiting factors weeds are the significant biotic constraints which reduce the productivity of chickpea (Kaushik *et al.*, 2014). Major weeds include *Asphodelus tenuifolius* CAV., *Carthamus oxycantha* M. Bieb., *Medicago denticulata* Willd., *Anagallis arvensis, Lathyrus aphaca* L. *Euphorbia helioscopia* L., *Convolvulus arvensis* L., *Cyprus rotundus, Vicia sativa* L. Ehrh., *Cynodon dactylon* L. Pers. and *Fumaria indica* Hausskn (Hassan *et al.*, 2018.).

Asphodelus tenuifolius Cav. is a highly invasive weed species that predominates in Pakistan sandy areas and strives with the chickpea crop during its growing season. This weed species causes a 45% average annual loss in chickpea production (Khan *et al.*, 2011). There are fifteen different crops where *A. tenuifolius* Cav. is a serious weed (Khan *et al.*, 2008). In District Karak and Lakki Marwat, *A. tenuifolius* Cav. was the most common weed of chickpea (Hassan and Khan, 2005). *A. tenuifolius* Cav. was found to cause a decline in chickpea yield of about 80% (Tewari *et al.*, 2001). *A. tenuifolius* Cav. pointed out that the competition for rain-fed chickpea is worse in the first 60 days after sowing (Yaduraju *et al.*, 2000). Due to the dry and worm climatic conditions, the southern area of Pakistan is ideal for chickpea cultivation. Chickpea is primarily grown in the arid regions of Lakki Marwat, Bannu, Karak, Malakand, Kulachi and D.I. Khan in Khyber Pakhtunkhwa (Ali *et al.*, 2018; Shengu *et al.*, 2018).

The study goal was to identify the most competitive weeds in district Karak, Khyber Pakhtunkhwa, that were causing yield losses in the chickpea crop. This was done in light of the losses caused by weeds in the chickpea crop. To determine the ideal time when the most weed germination occurs and causes severe infestation, and to implement the right management measures for controlling the concern weeds problem in chickpea.

Materials and Methods

In Pakistan, one of the key regions for the production of chickpeas is District Karak, Khyber Pakhtunkhwa Province. Winter crops includes, chickpea and wheat, while summer crops includes, sorghum and pearl. The district southern half is sandy with little rainfall, while the northern half is hilly and receives more of it. The primary crop in the district sandy belt is chickpea. Five chickpea growing areas were randomly selected from the chickpea growing area of district Karak. All the designated areas were rain-fed and mostly sandy in nature. At these locations, no chemical has ever been applied during the crop growing season. Weed density was measured seven to eight weeks after chickpea seeding and from the same information, relative weed density (%), weed frequency (%), relative weed frequency (%) and importance value (IV) of weed species were calculated.

Three fields of chickpeas were randomly chosen from each of the designated sites and surveyed using, with minor modifications, the techniques described by (McCully *et al.*, 1991; Thomas, 1985, 1991). In each field, five quadrates measuring (33 x 33 cm^2) was randomly arranged in an inverted horizontal pattern. According to the size, shape, as well as any potential obstacles in the fields, the distance between each quadrate fluctuated. The space between quadrates was increase as the size of the field increases.

Data on the following weed parameters was collected during the course of the studies.

Weeds parameter

1. Weed density (m^{-2})
2. Relative density (%)
3. Frequency (%)

4. Relative frequency (%)
5. Importance value (IV)

Weed density m^{-2}

The data for weed density was recorded. Each subplot was containing a quadrate of size 33 x 33 cm^2 thrown at 3 randomly designated locations, and the means was calculated from three observations.

$$\text{Weed density} = \frac{\text{Total number of individual species in all qadrates}}{\text{Total number of qudrates}}$$

Relative density % (RD)

The quadrate was randomly placed three to four times in each experiment plot to measure the relative weed density. Within the quadrate, weeds were recorded, recognized, and later converted to a percent relative weed density.

$$\text{Relative density (\%)} = \frac{\text{Mean of individual species}}{\text{Mean of total species}} \times 100$$

Weed frequency % (WF)

The total number of samples containing a plant expressed as a percentage of all samples observed. Data on weed frequency was collected using quadrates.

$$\text{Weed frequency (\%)} = \frac{\text{No. of qudartes in which a species occuared}}{\text{Total number of qudrates}} \times 100$$

Relative frequency % (RF)

The relative frequency of a particular species is expressed as a percentage of the overall frequency of all species, and this is known as relative frequency.

$$\text{Relative frequency (\%)} = \frac{\text{Frequency value of a single species}}{\text{Total frequency of all species}} \times 100$$

Importance value (IV)

The following formula was used to calculate the importance value of the weed species.

$$\text{Importance value (IV)} = \frac{\text{Relative density (\%)} + \text{Relative Frequency (\%)}}{2}$$

Results and Discussion

Weed density (m^{-2})

In Figure 1 data showed that there are diverse levels of weed density in the various study locations. Data regarding various location show that the highest weed density (18.05 m^{-2}) was recorded at Takht-e-Nasrati succeeded by Hada (17.37 m^{-2}), while, the lowest weed density (16.13 m^{-2}) was recorded at Titer Khel. Among the weed species the highest weed density (55.2 m^{-2}) was recorded for *Asphodelus tenuifolius* Cav., followed by *Medicago denticulata* Willd. (24.4 m^{-2}) plants. The variation in the relative number of species encountered in the study area was also noted. According to the mean, *Asphodelus tenuifolius* Cav. and *Medicago denticulata* Willd. have the highest density among the weed species. The least significant weeds in the areas under study were *Cynodon dactylon* L., *Vicia sativa* L. Ehrh., *Fumaria indica*, Hausskn and *Euphorbia helioscopia* L. as shown in (Table 1). Similarly, increasing the density of *A. tenuifolius* Cav. will reduce chickpea yield (Sibtain *et al.*, 2015). The findings are consistent with those of Punia *et al.* (2009), who discovered the highest weed density (m^{-2}) of *A. tenuifolius* Cav. in a chickpea crop. The reduction in yield caused by weed-crop competition is mostly determined by weed species and densities, as well as crop species (Tauseef *et al.*, 2012).

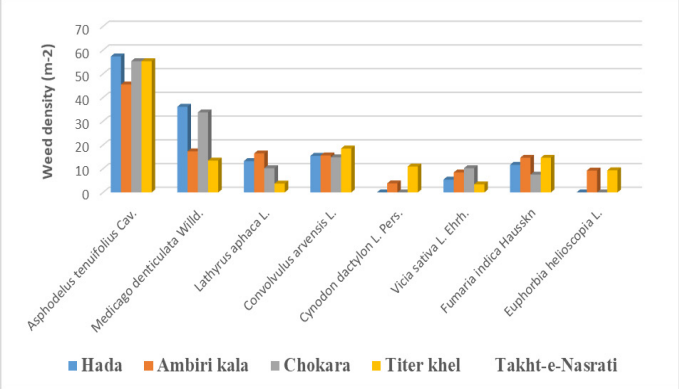

Figure 1: *Density (m^{-2}) of the weed species across 5 locations in district Karak.*

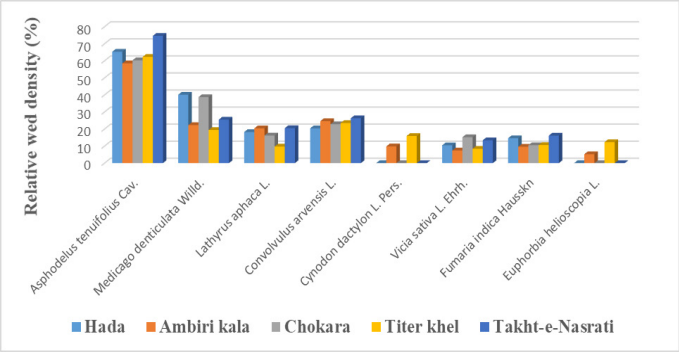

Figure 2: *Relative weed density (%) of the weed species across 5 locations in district Karak.*

Relative weed density (%)

According to the data, all five of the district Karak localities that were looked at during the survey were more diverse than the other localities. In Figure 2 relative weed density (%) of weed species was

presented. According to the results of the current study, *A. tenuifolius* Cav., *M. denticulata* Willd., L. *aphaca* L., *E. helioscopia* L., *C. arvensis* L., *V. sativa* L. Ehrh., *C. dactylon* L. Pers. and *F. indica* Hausskn were all present at five places throughout district Karak. Among the weed species the highest relative weed density (64.2 %) was noted for *A. tenuifolius* Cav., followed by *M. denticulata* Willd. (29.2 %). Whereas, *E. helioscopia* L. was found to have the lowest relative weed density (3.5 %). These are the weeds that are prevalent in district Karak as displayed in (Table 2). Furthermore, data from various sites show that Takht-e-Nasrati has the highest relative weed density (22.05 %), followed by Hada (21.12 %). While Ambiri Kala has the lowest relative weed density (19.72 %). Likewise, the worst weed mostly in Karak is *A. tenuifolius* Cav. and Masha Mansoor reported the highest relative weed density (Hassan *et al.*, 2010). The distinctive weed spectrum, composition, and number of each region are determined by the various environmental constraints (Memon *et al.*, 2007).

Weed frequency % (WF)

In our study site, as shown in Figure 3, a variety of weed species were present. In the current study, it was reported that *A. tenuifolius* Cav., *M. denticulata* Willd. and *C. arvensis* L. had the maximum numbers of weeds. Among the weed species the worst weed of chickpea in district Karak was *A. tenuifolius* Cav., which had an 86% frequency, trailed by *M. denticulata* Willd (64 %). While for *E. helioscopia* L., the lowest weed frequency (6 %) was observed. According to data from various localities, Takht-e-Nasrati recorded the maximum weed frequency (43.75%), followed by

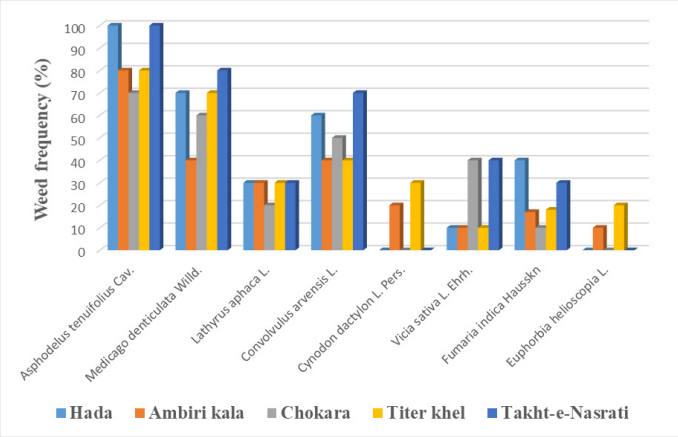

Figure 3: *Weed frequency (%) of the weed species across 5 locations in district Karak.*

Table 1: *Weed density (m^{-2}) of weed species in chickpea in 5 different locations in the district of Karak.*

Weed species	Hada	Ambiri kala	Chokara	Titer Khel	Takht-e Nasrati	Mean
Asphodelus tenuifolius Cav.	57.3	45.5	55.3	55.3	62.6	55.2
Medicago denticulata Willd.	36.1	17.3	33.7	13.4	21.5	24.4
Lathyrus aphaca L.	13.2	16.4	10.2	3.7	15.5	11.8
Convolvulus arvensis L.	15.4	15.6	14.8	18.5	21.3	17.12
Cynodon dactylon L. Pers.	0	3.8	0	10.9	0	2.94
Vicia sativa L. Ehrh.	5.4	8.4	10.2	3.4	8.4	7.16
Fumaria indica Hausskn	11.6	14.6	7.5	14.6	15.1	12.68
Euphorbia helioscopia L.	0	9.2	0	9.3	0	3.7
Mean	17.37	16.35	16.46	16.13	18.05	

Table 2: *Relative weed density (%) of weed species in chickpea in 5 different locations in the district of Karak.*

Weed species	Hada	Ambiri Kala	Chokara	Titer Khel	Takht-e-Nasrati	Mean
Asphodelus tenuifolius Cav.	65.3	58.5	60.3	62.3	74.6	64.2
Medicago denticulata Willd.	40.1	22.3	38.7	19.4	25.5	29.2
Lathyrus aphaca L.	18.2	20.4	16.2	9.7	20.5	17
Convolvulus arvensis L.	20.4	24.6	22.8	23.5	26.3	23.52
Cynodon dactylon L. Pers.	0	9.8	0	15.9	0	5.14
Vicia sativa L. Ehrh.	10.4	7.4	15.2	8.4	13.4	10.96
Fumaria indica Hausskn	14.6	9.6	10.5	10.6	16.1	12.28
Euphorbia helioscopia L.	0	5.2	0	12.3	0	3.5
Mean	21.12	19.72	20.46	20.26	22.05	

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Hada (38.75%). On the other hand, Ambiri Kala had the lowest relative weed frequency (30.87%). In light of the findings, it may be concluded that weeds of all species are found throughout as shown in (Table 3). Similarly, according to Hassan *et al.* (2006), *A. tenuifolius* Cav. was the most common weed in Karak district and had a 100% frequency. *A. tenuifolius* Cav. infestations were particularly severe at Bhaun, Kot Sarang, and Dudyal, according to Sultan and Nasir (2007).

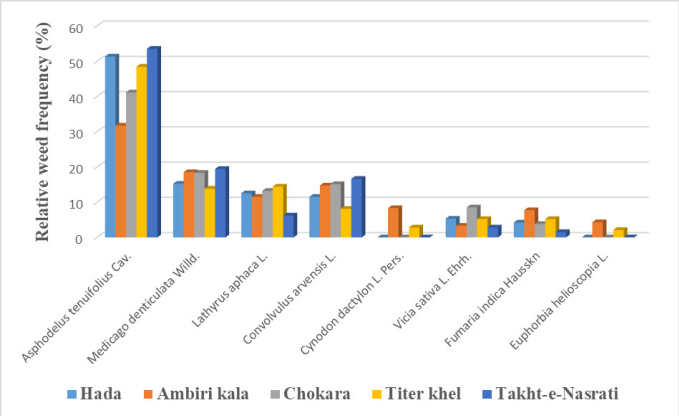

Figure 4: *Relative weed frequency (%) of the weed species across 5 locations in district Karak.*

Relative weed frequency (%)

In Figure 4 relative weed frequency (%) is the best way of indication for the occurrence of weed species in study region. In terms of the weed species, *A. tenuifolius* Cav. had the highest relative weed frequency (45.2%), followed by *M. denticulata* Willd. (17.0%) and *C. arvensis* L. (13.2%). Whereas, *E. helioscopia* L. and *C. dactylon* L. Pers. had the lowest relative weed frequency 1.2% and 2.2%, respectively. According to data based on localities, Takht-e-Nasrati had the highest relative weed frequency (53.5%), followed by Hada (51.3%). While Ambiri kala registered the lowest relative weed frequency (31.7%). In perspective of the district Karak yield of chickpeas, the remaining weeds listed in (Table 4) had a minor phytosociological status and were comparatively insignificant. Likewise, Hassan *et al.* (2006) discovered a rich weed flora in district Karak as well as the greatest relative weed frequency (%) of *A. tenuifolius* Cav.

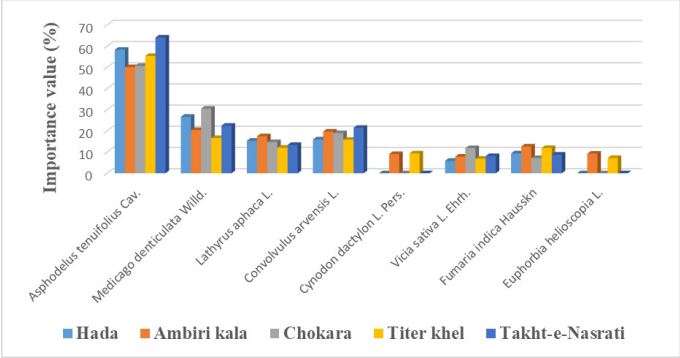

Figure 5: *Importance value (%) of the weed species across 5 locations in district Karak.*

Table 3: *Weed frequency (%) of weed species in chickpea in 5 different locations in the district of Karak.*

Weed species	Hada	Ambiri Kala	Chokara	Titer Khel	Takht-e-Nasrati	Mean
Asphodelus tenuifolius Cav.	100	80	70	80	100	86
Medicago denticulata Willd.	70	40	60	70	80	64
Lathyrus aphaca L.	30	30	20	30	30	28
Convolvulus arvensis L.	60	40	50	40	70	52
Cynodon dactylon L. Pers.	0	20	0	30	0	10
Vicia sativa L. Ehrh.	10	10	40	10	40	22
Fumaria indica Hausskn	40	17	10	18	30	23
Euphorbia helioscopia L.	0	10	0	20	0	6
Mean	38.75	30.87	31.25	37.25	43.75	

Table 4: *Relative weed frequency (%) of weed species in chickpea in 5 different locations in the district of Karak.*

Weed species	Hada	Ambiri Kala	Chokara	Titer Khel	Takht-e-Nasrati	Mean
Asphodelus tenuifolius Cav.	51.3	31.7	41.1	48.4	53.5	45.2
Medicago denticulata Willd.	15.2	18.5	18.3	13.8	19.4	17.0
Lathyrus aphaca L.	12.5	11.5	13.2	14.4	6.2	11.5
Convolvulus arvensis L.	11.5	14.7	15.1	8.1	16.6	13.2
Cynodon dactylon L. Pers.	0	8.3	0	2.8	0	2.2
Vicia sativa L. Ehrh.	5.3	3.3	8.5	5.2	2.8	5.0
Fumaria indica Hausskn	4.2	7.7	3.8	5.2	1.5	4.4
Euphorbia helioscopia L.	0	4.3	0	2.1	0	1.2

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Table 5: *Importance values wise ranking of weed species in chickpea in 5 different locations in the district of Karak.*

Weed species	Hada	Ambiri Kala	Chokara	Titer Khel	Takht-e-Nasrati	Mean	Ranking
Asphodelus tenuifolius Cav.	58.3	50.1	50.7	55.3	64.0	55.7	1
Medicago denticulata Willd.	26.6	20.4	30.5	16.6	22.4	23.3	2
Lathyrus aphaca L.	15.3	17.4	14.7	12.0	13.3	14.5	4
Convolvulus arvensis L.	15.9	19.6	18.9	15.8	21.4	18.3	3
Cynodon dactylon L. Pers.	0	9.0	0	9.3	0	3.6	7
Vicia sativa L. Ehrh.	5.8	7.8	11.8	6.8	8.1	8.0	6
Fumaria indica Hausskn	9.4	12.6	7.1	11.9	8.8	9.9	5
Euphorbia helioscopia L.	0	9.2	0	7.2	0	3.2	8

Importance value of weeds

An effective way to determine the status of a certain weed species in a community is to look at its importance value. The importance value is an effective way to draw attention to the significance of the weedy vegetation that hinders the growth and development of the chickpea crop. In Figure 5 data indicated that *A. tenuifolius* Cav. had the highest important value, with a value of (55.7 %), preceded by *M. denticulata* Willd. (23.3 %), while *E. helioscopia* L. (3.2 %) and *C. dactylon* L. Pers. (3.6%) had the lowest importance values, respectively. However, the slightly higher values obtained by *C. arvensis* L. (18.3 %), *L. aphaca* L. (14.5 %) and *F. indica* Hausskn (9.9 %) displayed in (Table 5). These findings are consistent with those of Khan *et al*. (2011) and Sultan and Nasir (2003), who separately detected several weed communities in chickpea fields in the districts of Peshawar and Chakwal. High density of weeds in the fields could pose serious problems for chickpea production in the future. In order to slow down the growth and yield of the associated crop, the weed species with high importance values may compete more effectively (Kumara, 2016).

Conclusions and Recommendations

The survey was conducted in district Karak, Khyber Pakhtunkhwa province during winter season, 2022. *A. tenuifolius* Cav., *M. denticulata* Willd., *L. aphaca* L., *E. helioscopia* L., *C. arvensis* L., *V. sativa* L. Ehrh, *C. dactylon* L. Pers. and *F. indica* Hasskn are the major weeds infesting the chickpea fields in district Karak. Therefore, the precise control of this weed needed to achieve potential chickpea yield.

Acknowledgement

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Novelty Statement

The current findings revealed that the Asphodelus tenuifolius has been identified as a one of the most troublesome weed in southern districts of Khyber Pakhtunkhwa. This weed substantially reduces chickpea productivity in District Karak. Therefore, the precise control of this weed needed to achieve potential chickpea yield.

Author's Contribution

Abdullah: Performed data analysis, writing, figure and table development, and interpretation.
Imtiaz Khan: Developed the research concept, set the study's goals, and supervised all aspects of its completion.
Muhammad Ishfaq Khan: The manuscript was critically evaluated and modified.
Muhammad Ibrahim: Participated in collecting data, conducted experiments, and collected results from experiments.
Muhammad Fawad: Conducted an extensive review of relevant literature and contributed to the revision of the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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