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The Influence of Allelopathic Weeds Extracts on Weeds and Yield of Wheat (Triticum Aestivum L.)

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Abstract
The experiment was conducted to examine the response of weeds and wheat crop to allelopathic weeds.The treatments included T^1=weedy Check (Control), T^2=Chenopodium album concentration 30%, T^3=Chenopodium album concentration 60%, T^4=Convolvulus arvensis concentration 30%, T^5=Convolvulus arvensis concentration 60% and $T^6=T^2 + T^4$. The experiment was laid out in a three replicated Randomized Complete Block Design. The results revealed that the allelopathic effect of Convolvulus arvensis at 60% concentration resulted positive and significant impact ($P<0.05$) on various growth and yield traits of wheat with 81.66% wheat seed germination (%) 84.48 cm plant height, 16.08 cm spike length, 43.33 grains spike-1, 3.97 g grain weight spike-1, 47.82 g seed index (1000 grain weight, g) value and 4059 kg ha^{-1} grain yield; while the weed density 33.33 m-2 was recorded 20 days after sowing, 11.00 m-2 weed density at maturity , weed fresh weight 61.00 g m-2, 11.71 weed dry weight m-2 with highest weed control percentage 50.42 . On the basis of weed control percentage, the treatments Chenopodium album concentration 60% ranked 2nd, C. album + C. Arvensis conc. 30 + 30% ranked 3rd, Convolvulus arvensis concentration 30% ranked 4th and Chenopodium album concentration 30% ranked 5th. Hence, it was concluded that for achieving promising weed allelopathic effects on wheat production and weed suppression, the water extract of Convolvulus arvensis may be applied at 60% concentration.
Keywords: Wheat, Response, Weed and Allelopathic

1. Introduction

Wheat (Triticum aestivum L.) is the most important crop and among the major three cereal crops that provides 20 percent of the total energy requirement in human food (Shewry, 2009). Being a staple food in Pakistan, wheat is major source of food grain and high adaptation of this plant as well as its diverse consumptions in the human nutrition lead to present as the most important cereal in the world, especially in developing countries (Farzi and Bigloo, 2010). It is used to make flour for leavened, flat and steamed breads and most of the baked foods; for fermentation to make beer and alcohol (Tsenov et al., 2008). In Pakistan, wheat is averagely used for about 60 percent of daily diet of common man with average per capita consumption of 125 kg (Khan and Habib, 2003).

What is the essential diet of the population and occupies a central position in agricultural policies of the government. The government announced wheat support price Rs. 1200/- per 40 kg, which created interest among wheat growers. The latest Pakistan Economic Survey 2012-13 (GOP, 2013), the contribution of wheat to value addition in agriculture is 10.1; while it contributes to GDP is 2.2 percent. The area under wheat cultivation increased to 8693 thousand hectares in 2012-13 from 8650 thousand hectares showing an increase of 0.5 percent over the preceding year area under wheat. The production of wheat stood at 24.2 million tons during 2012-13 against the target of 25.5 million tons showing 5.1 percent decrease while an increase of 3.2 percent over the last year production of 23.5 million tons. The yield per hectare in 2012-13 remained 2787 kg showing a positive growth of 2.7 percent as compared to negative 4.2 percent growth last year.

Weed infestation is one of the main causes of low crop yields per unit area against the potential yields. Weeds reduce cotton yield by 16-53%. Existing weed control methods in cotton are either expensive or hazardous. Chemical herbicides may cause pollution; while hand weeding is labour intensive and costly (Hussain, 2001). In Pakistan, weeds inflict 20- 30% losses in different crops on the average (Anonymous, 2005). Existing weed control methods are either expensive or hazardous. Heavy use of chemical herbicides in most integrated weed management systems is a most concern since, it causes serious threats to the environment, public health and increase cost of crop production. Therefore, alternative strategies against weed must be developed (Rice 1983) defined allopathy as the effect of one plant on other plants through the release of chemical compounds in the environment.

Allelopathy generally refers to the inhibitory or stimulatory effects of one plant species on other plant species in terms of germination, growth and development (Patil, 2007). The donor plant release allelochemicals into the surrounding environment through leachates, root exudates and volatilization and hence accumulation of allelochemicals causes toxicity affecting crop growth and finally yield (Ahmed and Wardle, 1994). Allelopathy is a natural process of keeping a check and balance between crops and weeds (Ramzan et al., 1989). Allelopathy originally means suffering of plants each other or sensitivity of plants to each other both positive (sympathetic) and negative (pathetic) interactions (Gross, 1999). The concept of allelopathy received new attention and this concept largely accepted which included both positive (growth promoting) and negative (growth inhibiting) effects (Kim et al., 1999). Many ecologists, however, favor definitions, including only negative effects in allelopathy. Allelopathy is the growth suppression of one plant species by another due to the release of toxic compounds. Lambers et al. (1998) Kohli et al. (2001) and Singh et al. (2006) opined that allelopathy refers to any direct or indirect effect of plants on other plants through the release of chemicals and plays an important role in many agro-ecosystems (Kohli et al., 2001). A number of weed and crop species have been reported to possess allelopathic activity on the growth of other plant species (Ashrafi et al., 2007). Chemicals with allelopathic activity are present in many plants and in many organs, including leaves, flowers, fruits and buds (Inderjit, 1996). It has been reported that allelopathic interactions play a crucial role in natural as well as manmade ecosystems. Allelopathy is an important factor which contributes in determining distribution of species and their abundance within communities. Allelopathy is also helpful in the success of many invasive species; spotted knapweed, Centaurea maculosa, family Asteraceae, Nut sedge, Cyperus sp. Family Cyperaceae (Singh et al., 2006).

The allelopathic crops may affect the germination of subsequent crops, therefore, those crops should be included which are tolerant. One potential technique of exploiting allelopathy in weed management is the transfer of allelopathic characteristics from wild types or unrelated plants into the commercial crop cultivars i.e. germplasm selection. If the new allelpathic character does not have undesirable effects, this technique could increase the ability of the crop to compete naturally against the weeds. Very few attempts have been made to enhance the weed suppressing potential of crop plants through conservation or non-traditional breeding programs, even though this is a logical way to integrate the biorational approaches to pest control in the current production systems. The superior weed suppressing genotypes has been reported in cucumber, oat, rice, sunflower, soybean, sorghum, pearl millet and Brassica campestris L. (Ata and Jamil., 2001). These allelochemicals offer great potential for the pesticides because they are free from problems associated with the present pesticides (Velu et al., 1996). Therefore, allelochemicals are current areas of research for the development of new herbicides. These could be used for weed control, directly or their chemistry could be used to develop new herbicides. The water extracts of many crops, e.g. sorghum, sunflower, B. Campestris, L. E. Camaldulensis L. And tobacco etch, contain a number of allelochemicals which are more effective and economical to control the weeds of many crops. In mature sorghum plants, nine water soluble allelochemicals have been identified which are phytotoxic to the growth of certain weeds (Dhawan and Gupta, 1996).

Several reports address the importance of allelopathic effect of various trees. E. camaldulensis L., Prosopis juliflora L. and Acacia nilotica L. significantly affected seed germination and seedling growth of several crops and/or weed species (Dhawan and Gupta, 1996). Sundaramoorthy et al. (1995) concluded that P. juliflora L. Significantly inhibited the seed germination in pearl millet. Ibrahim et al. (1999) reported that E. camaldulensis L. Has an allelopathic effect on crops.

The leaves of Eucalyptus are a main releasing source of toxic compounds and its reduced normal weed population by 60 to 95%. Bisal et al. (1992) reported that Eucalyptus has harmful effects on germination and seedling growth of wheat, barley, lentil, chickpea, mustard and many weeds. Schumann et al. (1995) reported that water extracts of Eucalyptus grandis L. Significantly reduced weed establishment. It has been reported that water extracts of shoot of common lambs quarters (Chenopodium album), yellow nutsedge (Cyperus esculentus) and sunflower (Helianthus annuus) at the 1 % level significantly reduced soybean seed germination (Mishra, 2010). Kohli et al. (1998) have also described the allelopathic effect of Echinochloa sp. In maize and associated weeds in paddy. Although many botanicals are reported to have allelopathic properties, but the information on their compatibility with field crops, effective active ingredient, extraction and utilization technology is lacking.

1.1 Material and Methods

A field study was carried out in the experimental fields of the student's farm, Department of Agronomy, Sindh Agriculture University, Tandojam during Rabi, 2012-13 in a three replicated Randomized Complete Block Design with factorial arrangements having net plot size of 3 m × 3 m (9 m2). The fresh weed plants of Chenopodium album (Lambs quarter) and convolvulus arvensis (Bind weed) were collected from wheat field after 40 days of wheat sowing and soaked in distilled water for 24 hours, the concentration was prepared on a percentage basis and applied on the field. The sowing of wheat variety was done on the same date with the help of single row hand drill.

STATISTICAL ANALYSIS

The data were statistically analyzed through MSTATC computer software. The LSD value for mean comparison was calculated only if the general treatment F test was significant at a probability of ≤ 0.05 (Gomez and Gomez, 1984.

1.1.1 RESULTS AND DISCUSSION

The study was carried out at the student's farm, Department of Agronomy, Sindh Agriculture University, Tandojam during Rabi season of 2012-13 to investigate the response of weeds and wheat crop to allelopathic weeds. The effect of two weeds (Chenopodium album and Convolvulus arvensis) extracts of different concentrations on weeds and the wheat crop was examined in a three replicated Randomized Complete Block Design.

Effect of allelopathic weed, water extract on weed density (m^{-2}) 20 DAS

The results for weed density m-2 20 DAS showed non- significant response to allelopathic weeds water extract is presented in table 1. The results showed the maximum and minimum weed density m-2 20 DAS range (34.33-31.00) values were recorded in table 1 whereas the results were non- significant in all treatments, respectively.

Effect of allelopathic weeds water extract on weed density (m^{-2}) at maturity

The results for weed density (m-2) at maturity showed significant response to allelopathic weeds water extract concentrations as presented in table 2.The results showed the maximum weed density (m-2) at maturity (30.33) was observed in weedy check non allelopathic weeds extract concentration treated plots (control) whereas the lowest weed density (m-2) 12.33 and 11.00 at maturity were observed in allelopathic weeds Chenopodium album concentration 60% and Convolvulus arvensis concentration 60%, respectively.

Effect of allelopathic weed, water extract on weed fresh weight (g m^{-2})

The results for weed fresh weight (g m-2) showed a significant response to allelopathic weeds, water extract concentrations as presented in table 3.The results showed the maximum weed fresh weight (g m-2) 180.3 was observed in weedy check non allelopathic water extract concentration treated plots (control) whereas the lowest weed fresh weight (g m-2) 61.00 was observed in allelopathic weed Convolvulus arvensis concentration 60%, respectively.

The effect of allelopathic weed, water extract on weed dry weight (g m^{-2})

The results for weed dry weight (g m-2) showed a significant response to allelopathic weeds, water extract concentrations as presented in table 4. The results showed the maximum weed dry weight (g m-2) 36.34 was observed in weedy check non allelopathic water extract concentration treated plots (control) whereas the lowest weed dry weight (g m-2) 13.62, 11.71 and 12.93 were observed in allelopathic weeds Chenopodium album concentration 60%, Convolvulus arvensis concentration 60% and C. Album + C. Arvensis conc. 30 + 30%, respectively.

The effect of allelopathic weed, water extract on weed control (%)

The results for weed control (%) showed a significant response to allelopathic weeds, water extract concentrations as presented in table 5. The results showed the maximum weed control (%) 50.42% was observed @ Convolvulus arvensis concentration 60%, followed by (43.09%) Chenopodium album concentration 60% application and the minimum weed control (%) 2.153% were observed in weedy check or non allelopathic weeds water extract concentrations application, respectively.

Effect of allelopathic weed, water extract on seed germination (%) of wheat

The results for seed germination% of wheat affected by allelopathic weeds water extract concentrations presented in table 6. The results showed that seed germination % of wheat were non-significant. The maximum and minimum seed germination % (81.81 -81.33) range values were recorded from weedy check (control) to all allelopathic weeds water extract concentration treatments.

Effect of allelopathic weeds water extract on plant height (cm) of wheat

The results for plant height (cm) of wheat affected by allelopathic weeds water extract concentrations presented in table 7. The results indicated that plant height (cm) showed significant results in response to allelopathic weeds water extract concentrations. The maximum plant height cm (84.48) was observed @ application of convolvulus arvensis concentration 60%, followed by (78.40 and 76.75) was observed @ application of Chenopodium album concentration 60% and C. album + C. Arvensis conc. 30 + 30%, respectively. The minimum plant height (65.56) cm was observed in weedy check (control) treatment.

Effect of allelopathic weeds water extract on spike length (cm) of wheat

The results for spike length (cm) of wheat affected by allelopathic weeds water extract concentrations presented in table 8. The results indicated that spike length (cm) showed significant results in response to allelopathic weeds water extract concentrations. The maximum spike length cm (16.08) was observed @ application of convolvulus arvensis concentration 60%, followed by (14.56 and 13.56) was observed @ application of Chenopodium album concentration 60% and C. album + C. Arvensis conc. 30 + 30%, respectively. The minimum spike length cm (10.78) was observed in weedy check (control) treatment.

Effect of allelopathic weeds water extract on grains spike-1of wheat

The results for grains $spike^{-1}$ of wheat affected by allelopathic weeds water extract concentrations presented in table 9. The results indicated that the grains spike-1 showed significant results in response to allelopathic weeds water extract concentrations. The maximum grains spike-1 (43.33) was observed @ application of convolvulus arvensis concentration 60% followed by (39.78 and 37.28) was observed @ application of Chenopodium album concentration 60% and C. album + C. Arvensis conc. 30 + 30% , respectively. The minimum grains spike-1 (30.81) was observed in weedy check (control) treatment.

Effect of allelopathic weeds water extract on grain weight spike-1 (g) of wheat

The results for grain weight spike-1 of wheat affected by allelopathic weeds water extract concentrations presented in table 10. The results indicated that the grain weight spike-1 showed significant results in response to allelopathic weeds water extract concentrations. The maximum grain weight spike-1 (3.970) was observed @ application of convolvulus arvensis concentration 60% followed by (3.673 and 2.903) was observed @ application of chenopodium album concentration 60% and C. album + C. Arvensis conc. 30 + 30% , respectively. The minimum grain weight spike-1 (1.910) was observed in weedy check (control) treatment.

Effect of allelopathic weeds water extract on seed index (1000 grain weight, g) of wheat

The results for seed index (1000 grain weight, g) of wheat affected by allelopathic weeds water extract concentrations presented in table 11. The results indicated that the seed index showed significant results in response to allelopathic weeds water extract concentrations. The maximum seed index (47.82) was observed @ application of convolvulus arvensis concentration 60% followed by (45.40 and 36.67) was observed @ application of chenopodium album concentration 60% and C. album + C. Arvensis conc. 30 + 30% , respectively. The minimum seed index (28.41) was observed in weedy check (control) treatment.

Effect of allelopathic weeds water extract on grain yield (kg ha-1) of wheat

The results for grain yield (kg ha-1) of wheat affected by allelopathic weeds water extract concentrations presented in table 12. The results indicated that the grain yield showed significant results in response to allelopathic weeds water extract concentrations. The maximum grain yield (4059) was observed @ application of convolvulus arvensis concentration 60% followed by (3628 and 3179) was observed @ application of chenopodium album concentration 60% and C. album + C. Arvensis conc. 30 + 30% , respectively. The minimum grain yield (2278) was observed in weedy check (control) treatment.

Discussion

Allelopathy is a stimulatory effect of one plant species on other plant species to inhibit germination, growth and development (Gross, 1999). The allelopathy included both positive (growth promoting) and negative (growth inhibiting) effects (1998) Chemicals with allelopathic activity are present in many plants and in many organs, including leaves, flowers, fruits and buds (Inderjit, 1996). The allelopathic crops may affect the germination of subsequent crops (Ata and Jamil, 2001). These allelochemicals offer great potential for the pesticides because they are free from problems associated with the pesticides. The importance of allelopathic effect of various trees has been recognized world over which also include E. camaldulensis L. (Dhawan and Gupta, 1996). Ibrahim et al., (1999) reported that E. camaldulensis L. has allelopathic effect on crops. Hence, the present study was carried out to examine the allelopathic potential of Eucalyptus camaldulensis L. leaves for inhibiting growth of Convolvulus arvensis and Cyperus rotundus.The results revealed that the allelopathic effect of Convolvulus arvensis at 60% concentration resulted positive and significant impact ($P<0.05$) on various growth and yield traits of wheat with 81.66% wheat seed germination, 84.48 cm plant height, 16.08 cm spike length, 43.33 grains spike-1, 3.97 g grain weight spike-1, 47.82 g seed index value and 4059 kg ha-1 grain yield; while the weed density in this treatment was 33.33m-2, 20 days after sowing, 11.00 m-2, weed fresh weight 61.00 g m-2, 11.71 weed dry weight m-2 with highest weed control of 50.42 percent. On the basis of weed control percentage, the treatments Chenopodium album concentration 60% ranked 2nd, C. album + C. Arvensis conc. 30 + 30% ranked 3rd, Convolvulus arvensis concentration 30% ranked 4th and Chenopodium album concentration 30% ranked 5th. Hence, it was concluded that for achieving promising weed allelopathic effects on wheat production and weed suppression, the water extract of Convolvulus arvensis may be applied at 60% concentration. These results are in concurrence to those of Chandra Babu and Kandasamy (1997) who reported that aqueous leachate of fresh leaves of eucalyptus significantly suppressed the establishment of vegetative propagules and early seedling growth of the weeds. Leachate of fresh leaf cuttings had growth inhibitory effect on bermuda grass but showed growth promotion effect on purple nutsedge. Similarly the leachate of dried leaves of Eucalyptus had differential influence on the growth of the two weeds. There is a possibility to harness the allelochemicals of eucalyptus leaves as herbicides for the management of these perennial weeds. In another study, Alloli and Narayan Reddy (2000) assessed the allelopathic effects of eucalyptus leaf, bark and root extracts at different concentrations (1.0 to 10.0 per cent) on germination and seedling growth of cucumber. Germination and seedling growth were severely hampered by leaf extract than bark and root; whereas increase in concentration from 1 to 10 percent there was decrease in germination percentage and seedling growth. The experiment conducted by Sasikumar et al. (2001) found that germination was inhibited by each individual compounds tested while vigour index was significantly affected by allelopathic effects of Eucalyptus leaves; where dry matter production was affected by E. camaldulensis L. and simultaneously, reduction in vigour index and nitrogenase activity was also noted in all the cases, compared to control. Khan et al. (2003) evaluated allelopathic effects of eucalyptus and its boiled extract decreased seed germination to 66% compared to 99% germination in the control. From a series of studies,Duarte et al. (2008) reported that E. camaldulensis L. oil caused loss of leaves, inhibition of height and diameter growth and a concomitant decrease in effective quantum yield and the reduction of photosynthetic electron-transport chains of weeds. On the similar aspect, Khan et al. (2008) revealed that the data showed significantly lower fresh and dry weight of each tested weed as compared to water applied treatment (control). Germination of weeds was adversely affected and count of normal seedlings also was significantly lower than control due to suppressing effect of extract. These results suggest that aqueous extract of Eucalyptus could be used as biological suppressant for weed control. Moreover, in a recent study, Alireza and Asaadi (2010) observed that seed germination, rate of germination, root and shoot length of weeds exhibited different degree of inhibition according to the concentration of the aqueous extract. Maximum inhibitions on germination percentage, rate of germination and seedling growth were recorded when using the highest concentration of the aqueous extract (20 g L-1) of Eucalyptus. Root length was more affected than other parameters by aqueous extract of E. camaldulensis L.

Conclusion

The study concludes that on the basis of weed control percentage, the treatments Chenopodium album concentration 30% ranked 5th, Convolvulus arvensis concentration 30% ranked 4th, C. album + C. Arvensis conc. 30 + 30% ranked 3rd, and Chenopodium album concentration 60% ranked 2nd.

Hence, it was concluded that for achieving promising weed allelopathic effects on wheat production and weed suppression, the water extract of Convolvulus arvensis may be applied at 60% concentration.

Table 1. Effect of allelopathic weeds water extract on weed density (m^{-2}) 20 DAS

Allelopathic weed concentrations	Mean
Weedy check (control)	31.67
Chenopodium album concentration 30%	34.33
Chenopodium album concentration 60%	31.00
Convolvulus arvensis concentration 30%	34.00
Convolvulus arvensis concentration 60%	33.33
C. album + *C. Arvensis* conc. 30 + 30%	31.67

SE 1.070
LSD 5% -------

Table 2. Effect of allelopathic weeds water extract on weed density (m^{-2}) at maturity

Allelopathic weed concentrations	Mean
Weedy check (control)	30.33 A
Chenopodium album concentration 30%	27.33 B
Chenopodium album concentration 60%	12.33 D
Convolvulus arvensis concentration 30%	26.33 B
Convolvulus arvensis concentration 60%	11.00 D
C. album + *C. Arvensis* conc. 30 + 30%	15.67 C

SE 0.5164
LSD 5% 1.627

Table 3.Effect of allelopathic weeds water extract on weed fresh weight (g m^{-2})

Allelopathic weed concentrations	Mean
Weedy check (control)	180.3 A
Chenopodium album concentration 30%	126.3 B
Chenopodium album concentration 60%	70.67 C
Convolvulus arvensis concentration 30%	126.3 B
Convolvulus arvensis concentration 60%	61.00 E
C. album + *C. Arvensis* conc. 30 + 30%	66.67 D

SE 0.9869
LSD 5% 3.110

Table 4.Effect of allelopathic weeds water extract on weed dry weight (g m^{-2})

Allelopathic weed concentrations	**Mean**
Weedy check (control)	36.34 A
Chenopodium album concentration 30%	25.32 B
Chenopodium album concentration 60%	13.62 C
Convolvulus arvensis concentration 30%	26.06 B
Convolvulus arvensis concentration 60%	11.71 C
C. album + *C. Arvensis* conc. 30 + 30%	12.93 C

SE 0.6885
LSD 5% 2.169

Table 5.Effect of allelopathic weeds water extract on weed control (%)

Allelopathic weed concentrations	**Mean**
Weedy check (control)	2.153 E
Chenopodium album concentration 30%	11.22 D
Chenopodium album concentration 60%	43.09 B
Convolvulus arvensis concentration 30%	12.70 D
Convolvulus arvensis concentration 60%	50.42 A
C. album + *C. Arvensis* conc. 30 + 30%	33.75 C

SE 1.148
LSD 5% 3.619

Table 6.Effect of allelopathic weeds water extract on seed germination (%) of wheat

Allelopathic weed concentrations	**Mean**
Weedy check (control)	81.81
Chenopodium album concentration 30%	81.40
Chenopodium album concentration 60%	81.34
Convolvulus arvensis concentration 30%	81.33
Convolvulus arvensis concentration 60%	81.66
C. album + *C. Arvensis* conc. 30 + 30%	81.49

SE 2.258
LSD 5% -------

Table 7.Effect of allelopathic weeds water extract on plant height (cm) of wheat

Allelopathic weed concentrations	**Mean**
Weedy check (control)	65.56 D
Chenopodium album concentration 30%	69.67 C
Chenopodium album concentration 60%	78.40 B
Convolvulus arvensis concentration 30%	71.42 C
Convolvulus arvensis concentration 60%	84.48 A
C. album + *C. Arvensis* conc. 30 + 30%	76.75 B

SE 0.8373
LSD 5% 2.638

Table 8.Effect of allelopathic weeds water extract on spike length (cm) of wheat

Allelopathic weed concentrations	**Mean**
Weedy check (control)	10.78 D
Chenopodium album concentration 30%	12.77 C
Chenopodium album concentration 60%	14.56 B
Convolvulus arvensis concentration 30%	13.10 C
Convolvulus arvensis concentration 60%	16.08 A
C. album + *C. Arvensis* conc. 30 + 30%	13.56 BC

SE 0.3916
LSD 5% 1.234

Table 9. Effect of allelopathic weeds water extract on grains spike^{-1}of wheat

Allelopathic weed concentrations	Mean
Weedy check (control)	30.81 E
Chenopodium album concentration 30%	33.68 D
Chenopodium album concentration 60%	39.78 B
Convolvulus arvensis concentration 30%	35.24 D
Convolvulus arvensis concentration 60%	43.33 A
C. album + *C. Arvensis* conc. 30 + 30%	37.28 C

SE 0.5017
LSD 5% 1.581

Table 10.Effect of allelopathic weeds water extract on grain weight spike^{-1} (g) of wheat

Allelopathic weed concentrations	Mean
Weedy check (control)	1.910 F
Chenopodium album concentration 30%	2.317 E
Chenopodium album concentration 60%	3.673 B
Convolvulus arvensis concentration 30%	2.677 D
Convolvulus arvensis concentration 60%	3.970 A
C. album + *C. Arvensis* conc. 30 + 30%	2.903 C

SE 0.02582
LSD 5% 0.08136

Table 11. Effect of allelopathic weeds water extract on seed index (1000 grain weight, g) of wheat

Allelopathic weed concentrations	Mean
Weedy check (control)	28.41 D
Chenopodium album concentration 30%	36.14 C
Chenopodium album concentration 60%	45.40 B
Convolvulus arvensis concentration 30%	37.16 C
Convolvulus arvensis concentration 60%	47.82 A
C. album + *C. Arvensis* conc. 30 + 30%	36.67 C

SE 0.4070
LSD 5% 1.283

Table 12. Effect of allelopathic weeds water extract on grain yield (kg ha^{-1}) of wheat

Allelopathic weed concentrations	Mean
Weedy check (control)	2278 E
Chenopodium album concentration 30%	2880 D
Chenopodium album concentration 60%	3628 B
Convolvulus arvensis concentration 30%	2934 D
Convolvulus arvensis concentration 60%	4059 A
C. album + *C. Arvensis* conc. 30 + 30%	3179 C

SE 37.36
LSD 5% 117.7

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