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# ALLELOPATHIC ASSESSMENT OF FRESH AQUEOUS EXTRACTS OF *CHENOPODIUM ALBUM* L. FOR GROWTH AND YIELD OF WHEAT (*TRITICUM AESTIVUM* L.)

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**Abstract**

*Chenopodium album* L. is an annual weed of cultivated fields. In order to determine its allelopathic potentials, water soluble leaf extracts at different concentrations (25, 50 and 75 %) were tested on growth and yield related attributes of wheat (*Triticum aestivum* L.) in a pot culture experiment. Results showed that application of concentrated extracts had detrimental effects on plant height, number of tillers and spike length which corresponded to significantly lower grain yield. However, lower concentration (25 %) of the extract promoted these parameters. Results of this study reported significantly suppressive effects of higher concentrations (50 and 75 %) on plant height of *T. aestivum* L. corresponding to lower grain yield.

## Introduction

Plants posses various naturally occurring chemicals in the form of secondary metabolites which may leach out from their various parts to the surrounding rhizosphere either as exudates or rain-residues that may directly or indirectly influence germination, growth and other developmental processes of nearby plants (Sajjad *et al*., 2007; Iqbal *et al*., 2010). Major allelochemicals found in plants with documented allelopathic activity are phenolic compounds (Chon *et al*., 2005). This is generally accepted in the literature that phenolic compounds at low concentrations are stimulatory to germination and plant growth (Hegab *et al*., 2008; Gharieb *et al*., 2010). However, there are several reports indicating that most of the allelochemicals at high concentrations are phytotoxic and show detrimental effects on plant growth and seed germination although some allelochemicals are also identified as insecticidal and pesticidal in nature (Turk *et al*., 2005; Iqbal & Cheema, 2008; Terzi, 2008; Khan *et al*., 2009). In this connection, allelopathic plants may widely be used in sustainable agriculture for their potential role in herb/weed and insect/pest management.

*Chenopodium album* L., is a common weed of wheat which may release allelochemicals into the soil which may exhibit inhibitory or stimulatory effects on germination and growth of other neighboring plants. Allelopathic effects of *C. album* on wheat (*T. aestivum*) with reduced germination (%), decreased shoot and root length (Daizy *et al*., 2006); on germination and growth of radish (Malik *et al*., 1994), wheat and jute (Roy *et al*., 2006) and safflower (Rezaie & Yarnia, 2009) have been documented. Previously allelopathic activities of *Chenopodium album* L. against *Triticum aestivum* L., has been investigated in laboratory conditions only. This study was undertaken with the objective of evaluating different concentrations of fresh aqueous leaf extracts of *C. album* L., for their efficacy on growth and yield of *T. aestivum* L., in pot-culture.

## Materials and Methods

Fresh leaves of *Chenopodium album* were collected from the vicinity of Botany Department, Hazara University in April 2007 and were crushed in distilled water @ 20g/100 ml for 48 hours at room temperature (30 ± 2ºC). Crushed material was filtered through Whatman filter paper No. 1. This was served as original stock solution and stored at 4ºC for further use.

Seeds of *Triticum aestivum* L. cv Inqilab-91 were obtained from Herbarium of Botany Department, University of Peshawar. They were sown in four earthen pots of equal size (height 16 inches, diameter 12 inches) in November 2007. Each pot had 4 kg of loamy soil. Each treatment was replicated four times with 10 seeds per pot. Pots were arranged in Completely Randomized Design (CRD) and were maintained at field capacity under uniform open environment. Irrigation was done with tap water. After germination had completed, thinning was done and five healthy seedlings were left in each pot. Thereafter, pots were irrigated with different concentrations (25, 50 and 75%) of aqueous leaf extract (original stock solution) by diluting it with appropriate amount of distilled water. Control pots were irrigated with tap water. On maturity, data on different growth parameters, such as plant height, grain yield per plant and 1000-grain weight were recorded and statistically analyzed using ANOVA and difference between means under different treatments were calculated by Least Significant Differences (LSD) test at 5% probability.

## Results

Different concentrations of extracts of *C. album* reduced plant height, number of tillers/plant, spike length, number of grains/spike, grain yield/plant and 1000-grain weight especially at higher concentrations. However, lower concentration (25%) had stimulatory effects on all these parameters (Table 1). ANOVA revealed significant ($p \leq 0.05$) differences among mean squares of these growth parameters under various concentrations (Table 2).

**Table 1. Effect of different concentrations of leaf extracts of *C. album* on *T. aestivum*.**

| Extract concentration (%) | Plant height (cm) | No. of tillers/plant | Spike length (cm) | No. of grains/spike | Grain yield/plant(g) | 1000-grain weight (g) |
|---|---|---|---|---|---|---|
| 00 | 53.72$^{ab}$ | 6.450$^{ab}$ | 8.400$^{ab}$ | 45.85$^{ab}$ | 13.30$^{ab}$ | 40.29$^{ab}$ |
| 25 | 57.73$^{a}$ (+7.46) | 6.955$^{a}$ (+7.83) | 8.550$^{a}$ (+1.78) | 47.06$^{a}$ (+2.64) | 13.56$^{a}$ (+1.95) | 41.53$^{a}$ (+3.07) |
| 50 | 51.01$^{bc}$ (-5.04) | 6.202$^{b}$ (-3.84) | 7.975$^{b}$ (-5.06) | 42.81$^{b}$ (-6.63) | 12.29$^{b}$ (-7.59) | 38.42$^{b}$ (-4.87) |
| 75 | 48.60$^{c}$ (-9.53) | 6.125$^{b}$ (-5.03) | 7.250$^{c}$ (-13.69) | 42.34$^{b}$ (-7.65) | 12.37$^{b}$ (-6.99) | 37.87$^{b}$ (-6.00) |
| LSD values at 0.05 probability | 4.038 | 0.7060 | 0.4330 | 3.953 | 1.243 | 1.853 |

Means followed by similar letters in each column do not differ significantly at p≤0.05. Values in parenthesis represent percent increase (+) or decrease (-) of control.

**Table 2. Mean squares of plant height, no. of tillers/plant, spike length, no. of grains/spike, and grain yield/plant and 1000-grain weight of wheat.**

| Source of variation | Degrees of freedom | Plant height (cm) | No. of tillers/plant | Spike length (cm) | No. of grains/spike | Grain yield/plant | 1000-grain weight (g) |
|---|---|---|---|---|---|---|---|
| Treatment | 3 | 61.354$^{*}$ | 0.561$^{*}$ | 1.357$^{*}$ | 21.224$^{*}$ | 1.661$^{*}$ | 13.107$^{*}$ |
| Error | 12 | 6.869 | 0.210 | 0.079 | 6.582 | 0.651 | 1.441 |
| F-value | | 8.932 | 2.674 | 17.190 | 3.624 | 2.550 | 9.064 |
| Coefficient of variation | | 4.97 | 7.12 | 3.49 | 5.76 | 6.27 | 3.03 |

*Significant at p≤0.05

Maximum plant height (57.73 cm) and spike length (8.55 cm) were recorded in pots treated with 25% concentration and thereafter plant height and spike length decreased with increasing concentrations. Strong inhibitory effects on these parameters were observed at 75% concentration treatment where plants attained a height of 48.60 cm with spikes 7.25 cm in lengths. Compared with control, 25% concentrated extract stimulated plant height by 7.46%, and spike length by 1.78%. Concentrated extract (75%) decreased plant height by 9.53% and spike length by 13.69% respectively. Number of tillers/plant and number of grains/spike were stimulated by lower concentration by 7.83% and 2.64% respectively. However, 75% concentrated extract reduced the number of tillers/plant by 5.03% and number of grains/spike by 7.65% compared to control.

Data shows that significantly lower grain yield/plant (12.37 g) and 1000-grain weight (37.87 g) were recorded in pots treated with 75% concentration showing 6.99% and 6.00% reduction of untreated control pots respectively. At 50% concentrated extract grain yield/plant was 12.29 g and 1000-grain weight was 38.42 g which did not differ significantly from grain yield recorded at 75% extract concentration but significantly different from untreated control (13.30 g and 40.29 g) and 25% concentration (13.56 g and 41.53 g). Like other parameters, grain yield was positively influenced by lower (25%) concentration. It increased grain yield/plant by 1.95% and 1000-grain weight by 3.07% over control (Table 1).

## Discussion

The present study shows that both stimulatory (at lower concentration) and inhibitory (at higher concentrations) effects of fresh aqueous leaf extracts of *Chenopodium album* on growth and yield of wheat were recorded. Allelopathic activity of *C. album* could be related to the presence of phenolics and alkaloid compounds present in its leaves. Malik *et al*., (1994) have reported inhibited germination and growth of radish and wheat under aqueous air-dried extract of *Chenopodium album*. They isolated seven phenolics from shoots of test plant and identified chlorogenic acid as the principal phytotoxin. Similarly, Cutillo *et al*., (2003) isolated seven cinnamic acid amides from *Chenopodium album* and tested them for their effect on germination and growth of *Lactuca sativa*, *Lycopersicon esculentum* and *Allium cepa*. They observed reduced germination and growth of all these plants.

It has been assumed that allelopathic compounds in soil come in contact with roots of test plant and may alter its absorption capacity for water and minerals, cell division and other physiological functions. Increase in plant height with increased number of tillers/plant and maximum spike length at lower concentration of *C. album* extract in our study could possibly be due to cell elongation of root and shoot of wheat and better absorption of water and essential minerals from the soil as a result of allelochemicals supplied to pots in the form of water soluble leaf extracts. Similarly higher concentration of extract containing phenolics and alkaloids might have lowered absorption of minerals and water and their translocation from roots to other plant parts (El-Khatib *et al*., 2004) with reduced photosynthesis and consequently shorter plants with reduced spike lengths and lesser number of tillers/plant.

Like other parameters, grain yield in the present study was found to be concentration dependent. Lower extract concentration had positive effects on grain yield while higher concentrations corresponded to lower grain yield. Lower grain yield (number of grains/spike, grain

yield/plant and 1000-grain weight) under higher extract concentration might possibly be related to shorter plants, reduced spikes' lengths, hormonal imbalances due to alleochemical interactions and reduced photosynthetic activities as a result of lower mineral and water uptake.

The study concludes that aqueous leaf extracts of *Chenopodium album* exhibits strong detrimental effects on plant growth and grain yield of wheat hence the presence of this weed in wheat-grown fields may adversely affect growth of wheat corresponding to lower yield.

**References**


Chon, S.U., H.G. Jang, D.K. Kim, Y.M. Kim, H.O. Boo and Y.J. Kim. 2005. Allelopathic potential in lettuce (*Lactuca sativa* L.) plants. *Sci. Hort*., 106: 309-317.

Cutillo, F., B.D. Abrosca, M.D. Greca, C.D. Marino, A. Golino, L. Previtera and A. Zarrelli. 2003. Cinnamic acid amides from *Chenopodium album*: effects on seeds germination and plant growth. *Phytochemistry*, 64 (8): 1381-1387.

Daizy, R., P.S. Harminder, R. Nipunika and K.K. Ravinder. 2006. Assessment of allelopathic interference of *Chenopodium album* through its leachates, debris extracts rhizophere and amended soil. *Arch. Agron. Soil Sci*., 52: 705-715.

El-Khatib, A.A., A.K. Hegazy and H.K. Galal. 2004. Does allelopathy have a role in the ecology of *Chenopodium murale*? *Annals of Botany Fennici*., 41: 37-45.

Ghareib, H.R., M.S. Abdelhamed and O.H. Ibrahim. 2010. Antioxidative effects of the acetone fraction and vanillic acid from *Chenopodium murale* on tomato plants. *Weed Biol. Manag*., 10: 64-72.

Hegab, M.M., S.E.A. Khodary, O. Hammouda and H.R. Ghareib. 2008. Autotoxicity of chard and its allelopathic potentiality on germination and some metabolic activities associated with growth of wheat seedlings. *Afr. J. Biotech*., 7: 884-892.

Iqbal, J. and Z.A. Cheema. 2008. Purple nutsedge (*Cyperus rotundus* L.) management in cotton with combined application of surgaab and S-metolachlor. *Pak. J. Bot*., 40(6): 2383-2391.

Iqbal, J., F. Karim and S. Hussain. 2010. Response of the wheat crop (*Triticum aestivum* L.) and its weeds to allelopathic crop water extracts in combination with reduced herbicides rates. *Pak. J. Agri. Sci*., 47: 309-316.

Khan, A.L., J. Hussain, M. Hamayun, Z.K. Shinwari, H. Khan, Y. Kang, S. Kang and I. Lee. 2009. Inorganic profile and allelopathic effect of endemic *Inula Koeilzii* from Hamalaya Pakistan. *Pak. J. Bot*., 41(5): 2517-2527.

Mallik, M.A.B., R. Puchala and F.A. Grosz. 1994. A growth inhibitory factor from lambsquarters (*Chenopodium album*). *J. Chem. Ecol.,* 20(4): 957-967.

Rezaie, F. and M. Yarnia. 2009. Allelopathic effects of *Chenopodium album*, *Amaranthus retroflexus* and *Cynodon dactylon* on germination and growth of safflower. *J. Food Agric. Env.,* 7(2): 516-521.

Roy, B., M.R. Alam, B.C. Sarker, M.S. Rahman, M.J. Islam, M.A. Hakim and R.I. Mahmood. 2006. Effect of aqueous extracts of some weeds on germination and growth of wheat and jute seeds with emphasis on chemical investigation. *J. Biol. Sci*., 6(2): 412-416.

Sajjad, H., S. Sadar, S. Khalid, A. Jamal, A. Qayyum and Z. Ahmad. 2007. Allelopathic potential of Senna (*Cassia angustifolia* Vahl.) on germination and seedling characters of some major cereal crops and their associated grassy weeds. *Pak. J. Bot*., 39(4): 1145-1153.

Terzi, I. 2008. Allelopathic effects of Juglone and decomposed walnut leaf juice on muskmelon and cucumber seed germination and seedling growth. *Afric. J.Biotech*., 7(12): 1870-1874.

Turk, M.A., K.D. Lee and A.M. Tawaha. 2005. Inhibitory effects of aqueous extracts of black mustard on germination and growth of Radish. *Res. J. Agric. Biol. Sci*., 1(3): 227-231.


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