PSM Biological Research
2017 | Volume 2 | Issue 3 | 124-127
ISSN: 2517-9586 (Online)

www.psmpublishers.org

Short Communication **Open Access**

Allelopathic Effects of Some Common Weeds Prevailing in Wheat Fields on Growth Characteristics of Wheat (*Triticum aestivum* L.)

Saira Siyar[1], Zubeda Chaudhry[2], Fida Hussain[1], Zahid Hussain[3], Abdul Majeed[4*]

[1]Department of Botany, Qurtuba University of Science and Technology, Peshawar, Pakistan.
[2]Department of Botany, Hazara University Mansehra, Mansehra, Pakistan.
[3]Department of Weed Science, University of Agriculture, Peshawar, Pakistan.
[4]Department of Botany, Government Degree College Naguman Peshawar, Peshawar, Pakistan.

Received: 28.Jun.2017; Accepted: 18.Jul.2017; Published Online: 10.Aug.2017
***Corresponding author: Abdul Majeed; Email: majeedpsh@gmail.com**

Abstract
In this study, aqueous extracts of aerial parts of four common weeds (*Avena fatua, Phalaris minor*, *Melilotus alba* and *Chenopodium album*) found in cultivated fields of district Peshawar were tested for their allelopathic effects on wheat in seed bioassay. Extracts of each weed were applied at concentration 6, 8, 10 and 12 g/100 ml. Seeds germination and growth attributes of wheat such as radicle and plumule heights were significantly retarded under respective allelopathic aqueous extracts of all the tested weeds except *M. alba* which showed slight phyto-inhibition at the highest dose (12 g/100 ml) only; however, significant variation were observed among the weeds for their phyto-toxic behavior. In general, deleterious effects on germination and growth were found to be linearly correlated with concentration of extracts. Moreover, *C. album* was found more phyto-toxic followed by *A. fatua* and *P. minor* respectively. Least phytotoxicity was shown by the aqueous extracts of *M. alba* which had negative effects only at higher concentration.
Keywords: Allelopathy, chemical ecology, allelochemicals, growth inhibition, weed control, soil fertility.

Cite this article: Siyar, S., Chaudhry, Z., Hussain, F., Hussain, Z., Majeed, A., 2017. Allelopathic Effects of Some Common Weeds Prevailing in Wheat Fields on Growth Characteristics of Wheat (*Triticum aestivum* L.) PSM Biol. Res., 2(3): 124-127.

INTRODUCTION

Allelopathy is a scientific discipline which mainly deals with interactions of plants within and with other organisms (microorganisms, insects, pest, herbivores) mediated by the release of chemicals known as allelochemicals - secondary metabolic substances produced in plants during different stages of their growth (Rizvi *et al.,* 1992; Weir *et al.,* 2004). These interaction are initiated by donor plants which release allechemicals from their aerial parts, roots, and fallen plant parts targeting the receiving species with apparent negative consequences on the responding organism (Weir *et al.,* 2004); however, the interaction could also lead to positive consequences and may not always be negative in nature (Hierro and Callaway, 2003; Majeed *et al.,* 2017a). The interactions, whether between plants or with other organisms is sought to be an evolutionary mechanism of donor plants to make the environment suitable for their growth and utilization of maximum resources available by repelling insects, pest, herbivores and suppressing other plants which could be potential competitors or stimulating supporting plant and microorganisms (Majeed *et al.,* 2017b). Nearly all plants produce biological molecules during secondary metabolism which are considered as stress compounds because production of these compounds are generally signaled or elevated when environmental and biological stresses are imposed on plants (Pichersky and Gang, 2000; Zhao *et al.,* 2005). In allelopathy, such compounds – referred to as allelochemicals - are released from one plant and affect the growth, physiology and metabolic activities of other plants and play a very prominent role in either growth inhibition or stimulation of the receiving plants (Inderjit *et al.,* 2011; Majeed *et al.,* 2012). Thus, allelopathy – governed by allelochemical interactions – has significant role in agriculture.

Wheat has been remained an important agriculture and staple food crop in Pakistan and throughout the world. It has a prominent role in fulfilling food and energy needs, and livelihood of farmers. Kaghan-93 (7.77g plant^{-1}) was seen to be the highest production of yield and was considered best among 26 varieties (Kamran *et al.,* 2016). One of the major limiting factors in wheat production is the occurrence of diverse range of weeds in fields where wheat is cultivated (Asad *et al.,* 2016). Weeds are considered as noxious biotic

constraints of agricultural crops which are responsible for yield losses (Bàrberi, 2002; Abbas *et al.,* 2009). Effects of weeds on yield of wheat depend on types of weeds and their density. They compete with wheat for nutrients, water, light and space and consequently result in low yield of the crop if kept unchecked (Oerke and Dehne, 2004; Petit *et al.,* 2010). One of the potential reasons for negative effects of weeds on wheat might be due to their alleloptahic activities. Thus, it is necessary to understand the allelopathic effects of weeds on the growth of wheat and other agricultural crops. The aim of this work is to report the allelopathic effects of four commonly occurring weeds (*Avena fatua, Phalaris minor*, *Melilotus alba* and *Chenopodium album*) in wheat fields on germination and growth of wheat.

MATERIALS AND METHODS

Wheat seeds (cultivar Pirsabaq-2005) collected from certified seed center in Peshawar were grown on folded filter paper in petridishes arranged in completely randomized design replicated four times at the Department of Botany, Qurtuba University of Science and Technology, Peshawar during February 2017. Previously collected aerial parts of four weeds viz *Avena fatua, Phalaris minor*, *Melilotus alba* and *Chenopodium album* found in cultivated fields of district Peshawar were used as aqueous extracts prepared from dried powder soaked for 48 hours in distilled water at room temperature. Different concentrations for the extracts of each weed species were 6, 8, 10 and 12 g/100 ml. 5 ml of each extract concentration of each weed was supplied to each petridish. Controlled petridishes received distilled water. The petridishes were maintained at room temperature. Final germination percentage, radicle and plumule length, and dry weight of seedling were recorded in each treatment.

Statistical analysis

Analysis of variance (ANOVA) was applied to data collected using computer software SPSS (IBM Inc.) and comparison between treatments were made by applying LSD test.

RESULTS AND DISCUSSION

Germination in water treated petridishes was found as 81.8% which was significantly reduced by different concentration of extracts of different weeds except *M. alba* where it was slightly increased at 6 g/100 but not affected by concentration up to 10 g/100 ml (Table 1). Only highest dose (12 g/100 ml) of *M. alba* showed negative effects on germination. Among tested weeds, *C. album* caused drastic effects on germination and effects were more pronounced at at 12g/100 ml where only 50.3% seeds germinated. Germination for the same dose of aqueous extracts of *A. fatua* was 63.4% followed by *P. minor* which resulted in 64.9% while comparatively closer to control percent germination was obtained in *M. alba* treatment.

Table 1. Effect of different concentration of aqueous extracts of different weeds on final germination parentage of wheat

Extract conc. (g/100 ml)	*C. album*	*M. alba*	*A. fatua*	*P. minor*
0	81.8	81.8a	81.8a	81.8a
6	76.3b	82.0a	78.7b	74.6b
8	77.0b	81.4a	76.5c	75.0b
10	58.1c	80.9a	70.9d	68.2c
12	50.3d	72.9b	63.4e	64.9d

Radicle and plumule length showed declining tendency with increasing doses of aqueous extracts of the weeds except *M. alba* (Figure 1 and 2). Maximum lengths 6.4 and 2.3 cm for radicle and plumule respectively were recorded in control followed by gradual decrease with increasing concentration of extract treatments of different weeds. Extract concentration of *M. alba* had no effect on radicle and plumule length except 12 g.100 ml which resulted in lower lengths. Other weeds C. album, *A. fatua* and *P. minor* had inhibitory effects on these attributes.

Dry weight was lowest (158 mg) in *C. album* at concentration 12 g/100 ml when compared to control (180 mg) while it was not affected by *M. alba* at lower extract concentrations (Figure 3). 6g/100 ml extract concentration of *A. fatua* and *P. minor* did not alter dry weight and almost consistent readings were observed to control; however, increase in concentration gradually decreased dry weight. Like other attributes, dry weight was drastically influenced by *C. album* followed by *A. fatua* and *P. minor.*

The aim of this work was to study the allelopathic effects of four common weeds on germination and growth of wheat in lab experiment. Results indicated that all the four weeds inhibited germination and growth of wheat which suggests that studied weeds possess allelopathic properties. The most noxious weeds was recorded as *C. album* followed by *A. fatua* and *P. minor* while lower effects were exhibited by *M. alba*. Moreover, higher concentration of the extract had more detrimental effects. These results are in contradiction with previous work of Majeed *et al*. (2012) who reported that lower extract concentration of *C. album* promoted germination and growth of wheat. On the other hand, similar results were obtained by Perez (1990) who attributed the

inhibitory effects of *A. fatua* to hydroxamic acids. Siddiqui *et al*. (2010) have also documented that *P. minor* along with other problematic weeds of wheat had negative effect on growth of different cultivars of wheat.

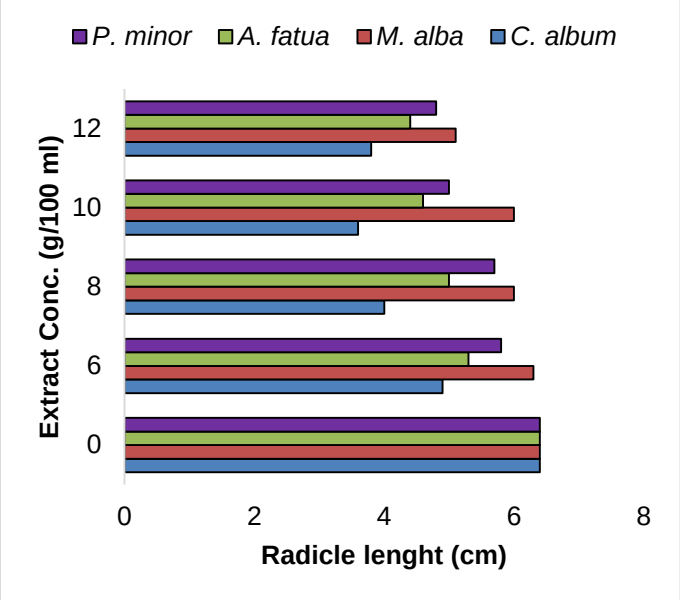

Fig. 1. Radicle length in cm as influenced by different extract concentration of four weeds

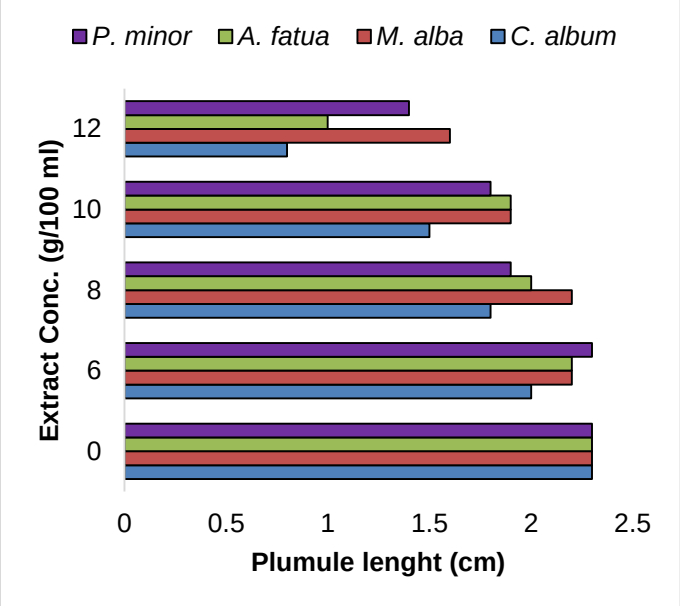

Fig. 2. Effect of aqueous extracts of four weeds on plumule length of wheat

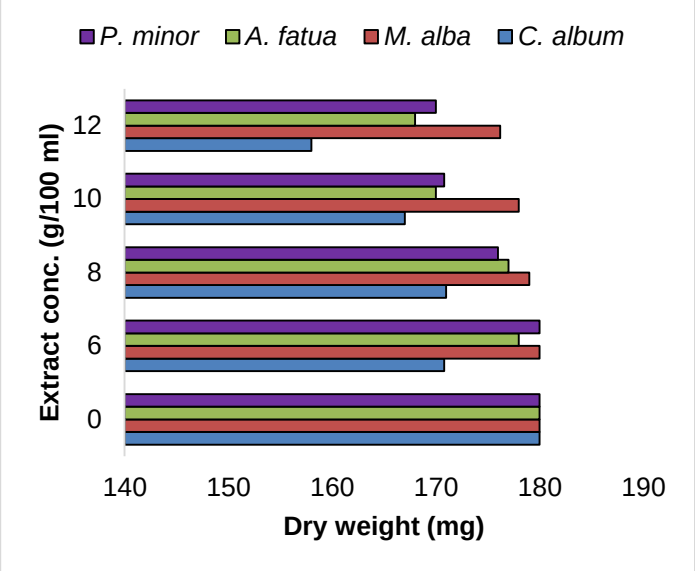

Fig. 3. Effect of different extracts of four weeds on dry weight of wheat seedling

Arrested germination and growth traits of wheat in response to aqueous extracts of four weeds in this study might be due to different allelopathic compounds which exhibited greater toxicity at higher concentration. Under normal growth conditions, seeds germinate to full extents unless they are challenged by some stressful environment. Allelopathic stress caused allelochemicals can influence imbibition process which could lead to reduced germination. Moreover, growth regulatory substances such as gibberellin and abscisic acid are actively involved in seed germination (Koornneef *et al.,* 2002) and disturbance in these substances caused by allelopathic chemical can influence this trait. Similarly, seedling growth (radicle and plumule) and dry weight are determined by proper uptake of water and nutrients from the given environment and rate of photosynthesis which is further facilitated by a set of enzymes, chemical signals and permeability of cell membrane (Majeed *et al.,* 2012). Any changes in enzymes and these processes may result in abnormal seedling growth and accumulation of photosynthate with consequent low dry matter.

CONCLUSION

Based on the results of this study, it is concluded that common weeds (*Avena fatua, Phalaris minor*, *Melilotus alba* and *Chenopodium album*) of wheat fields possess allelopathic properties. *C. album* was found more phyto toxic than other weeds. Least inhibitory effects were exhibited by *M. alba*. The allelopathic potential of tested weeds may be tested against other weeds for possible weed control measures.

ACKNOWLEDGEMENT

Financial support provided to Mr. Abdul Majeed by Higher Education Commission (HEC), Govt. of Pakistan through Indigenous PhD Fellowship Program (Batch-IV) is thankfully acknowledged.

CONFLICT OF INTEREST

There is no conflict of interest.

REFERENCES

Abbas, S. H., Saleem, M., Maqsood, M., Mujahid, M. Y., Saleem, R., 2009. Weed density and grain yield of wheat as affected by spatial arrangements and weeding techniques under rainfed conditions of Pothowar. Pak. J. Agri. Sci., 46(4): 242-247.

Asad, M., Iqbal, M.N., Ashraf, A., Mahmood, Z., Arshad, A., Raza, U., Kashif, M., 2016. Effect of Post-emergence Herbicides to Control Broad-leaved Weeds in Wheat Under Rainfed Conditions. PSM Biol. Res., 01(1): 16-21.

Bàrberi, P., 2002. Weed management in organic agriculture: are we addressing the right issues?. Weed Res., 42(3): 177-193.

Hierro, J. L., Callaway, R. M., 2003. Allelopathy and exotic plant invasion. Plant Soil, 256(1): 29-39.

Inderjit, Wardle, D. A., Karban, R., Callaway, R. M., 2011. The ecosystem and evolutionary contexts of allelopathy. Trends Ecol., Evol., 26(12): 655-662.

Kamran, M., Inamullah, Iqbal, M.S., 2016. Yield Performance and Factor Analysis for Superior Cultivars Identification in Wheat (Triticum aestivum L.). PSM Biol. Res., 01(1): 11-15.

Koornneef, M., Bentsink, L., Hilhorst, H., 2002. Seed dormancy and germination. Curr. Opin. Plant Biol., 5(1): 33-36.

Majeed, A., Chaudhry, Z., Muhammad, Z., 2012. Allelopathic assessment of fresh aqueous extracts of Chenopodium album L. for growth and yield of wheat (*Triticum aestivum* L.). Pak. J. Bot., 44(1): 165-167.

Majeed, A., Muhammad, Z., Ahmad, H., 2017a. Allelopathic effects of leaf extracts of three agroforestry trees on germination and early seedling growth of wheat (*Triticum aestivum* L.). Azarian J. Agric., 4(3): 69-73.

Majeed, A., Muhammad, Z., Hussain, M., Ahmad, H., 2017b. In vitro allelopathic effect of aqueous extracts of sugarcane on germination parameters of wheat. Acta Agric. Slov., 109(2): (accepted)

Oerke, E. C., Dehne, H. W., 2004. Safeguarding production—losses in major crops and the role of crop protection. Crop Prot., 23(4): 275-285.

Perez, F. J., 1990. Allelopathic effect of hydroxamic acids from cereals on *Avena sativa* and *A. fatua*. Phytochem., 29(3): 773-776.

Petit, S., Boursault, A., Le Guilloux, M., Munier-Jolain, N., Reboud, X., 2010. Weeds in agricultural landscapes. A review. Agron. Sust. Develop., 31(2): 309-317.

Pichersky, E., Gang, D. R., 2000. Genetics and biochemistry of secondary metabolites in plants: an evolutionary perspective. Trends Plant Sci., 5(10): 439-445.

Rizvi, S. J. H., Haque, H., Singh, V. K., Rizvi, V., 1992. A discipline called allelopathy. In Allelopathy. Springer Netherlands, 1-10.

Siddiqui, I., Bajwa, R., Zil-e-Huma, Javaid, A., 2010. Effect of six problematic weeds on growth and yield of wheat. Pak. J. Bot., 42(4): 2461-2471.

Weir, T. L., Park, S. W., Vivanco, J. M., 2004. Biochemical and physiological mechanisms mediated by allelochemicals. Curr. Opin. Plant Biol., 7(4): 472-479.

Zhao, J., Davis, L. C., Verpoorte, R., 2005. Elicitor signal transduction leading to production of plant secondary metabolites. Biotechnol. Advanc., 23(4): 283-333.