Journal of Agricultural Technology 2010 Vol. 6(3): 573-577
Available online http://www.ijat-rmutto.com
ISSN 1686-9141

Response of wheat (*Triticum aestivum*) germination and growth of seedling to allelopathic potential of sunflower (*Helianthus annuus*) and barley (*Hordeum vulgare* L.) extracts

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Sadeghi, S., Rahnavard, A. and Ashrafi, Z.Y. (2010). Response of wheat (*Triticum aestivum*) germination and growth of seedling to allelopathic potential of sunflower (*Helianthus annuus*) and barley (*Hordeum vulgare* L.) extracts. Journal of Agricultural Technology 6(3): 573-577.

Some plants inhibit the seed germination and growth of other plants by means of producing toxic allelochemicals or allelopathins. Sunflower and Barley contains water soluble allelochemicals that inhibit the germination. Present study was conducted to evaluate the allelopathic effect of sunflower and barley on seed germination and plumule and radicle growth of wheat. The experiment was set in completely randomized design. The data indicated that aqueous extracts of sunflower and barley greatly inhibited the seed germination, plumule and radicle growth of wheat. Barley was found to be more allelopathic to wheat than sunflower. Further study are suggested to find tune our findings.

Key Words: allelopathy, wheat, seed germination, growth

Introduction

Modern agriculture is productivity oriented and thus relies heavily on the use of synthetic chemicals to control weeds and other pests. This has undoubtedly enhanced crop production but at the same time may have a negative impact on the environment quality and on human health. Further, the development of resistance among weeds to synthetic herbicides is also a cause for concern (Ashrafi *et al*., 2007). Some plants inhibit the seed germination and growth of other plants by means of producing toxic allelochemicals or allelopathins. Allelochemicals are the secondary metabolites produced by plants and are byproducts of primary metabolic processes (Levin, 1976). They have both stimulatory and inhibitory effects on the growth and development of their own kind and also on other species grown in their vicinity. All plants use

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the same primary metabolic processes for growth, development and production of seeds for the next generation. But the toxin-producing plants differ widely in their production of secondary metabolites; hence they vary in their ability to produce allelopathic effects (Ashrafi *et al*., 2008; Hamayun *et al.*, 2005; Waller and Feng, 1996). There are several ways in which these toxic chemicals are produced. Allelopathic trees release a chemical in the form of a gas through their stomata. Other plants absorb this toxic chemical and die. Some plants store protective chemicals in the leaves they drop. When the leaves fall to the ground, they decompose. The chemicals are thus released and they inhibit growth of other plants. Some plants release defensive chemicals into the soil through their roots. These chemicals are absorbed by the roots of other plants living in close proximity. As a result, other plants are damaged (Angiras *et al*., 1988; Ashrafi *et al*., 2008; Saxana, 1990). The weeds have been known as very tough competitors of crops for resources. Besides competition, weeds may also cause biochemical inhibition of the growth of crop plants (Chaghtai *et al*., 1988). Crops have also reportedly shown allelopathic effects (Ashrafi *et al*., 2007; Putnam *et al*., 1983; Yenish *et al*., 1995). The proper use of allelopathy may reduce the overuse of pesticides (herbicides, fungicides, nematocides and insecticides). Allelochemicals may also reduce pollution and decrease detrimental effects of autotoxicity and soil sickness in agriculture and forestry (Ashrafi *et al*., 2007; Waller, 1987). Recent research has revealed that there are some plants producing chemicals (Gibberellins or IAA) which are more effective in promoting growth of the other plants (Hamayun *et al.*, 2005; Hasegawa, 1993). Present study was carried out at Botany Department University of Payame Noor, Tehran city, in order to evaluate the allelopathic effects of sunflower and barley on seed germination, plumule and radicle growth of wheat.

Materials and methods

An experiment was conducted during 1998 at Botany Department, University of Peshawar in order to evaluate the allelopathic effects of shoots of sunflower and barley on seed germination and seedling growth of wheat. Seeds of a local wheat cultivar “Zarrin” were used for the purpose. The shoots of sunflower and barley were crushed to powder form. Then 0.5, 1.0, 5 and 10 g of these powders were added to 100 ml distilled water and were soaked for 6 hrs and 12 hrs at 25^{o}C. The extracts thus obtained were filtered. Petri dishes were provided with filter paper bed, litter bed, litter bed and sand bed combined. Five seeds were placed in each Petri dish and the aqueous extract was added. These Petri-dishes were then kept in an incubator for 96 hours. After 96 hours these Petri dishes were taken out and the germination rate along

with radicle and plumule length was determined for different treatments. The data were statistically analyzed by completely randomized design (Steel and Torrie, 1980).

Results and discussion

The seed germination was significantly inhibited by sunflower root and barley shoot extracts. Maximum allelopathic effect (66.0%) was recorded for ESC_1T_2 (12 hrs of *Barley* shoot with 5 g concentration) and ESC_2T_2 (12 hrs extract of barley shoot with 10 g concentration) treatments. In sunflower treatments, maximum seed inhibition was recorded for CRC1T2 (12 hrs of sunflower rhizome with 5 g concentration). In other treatments there was no significant effect on the seed germination rate. The results coincide with that of Angiras *et al.* (1988) who reported that sunflower and barley extracts had delayed the germination of wheat seeds. Plumule growth was also greatly affected. Maximum plumule length was recorded for control litter bed treatment (LB) i.e. 2.910 cm while least plumule length was observed for ESC_2T_2 (0.030 cm). In sunflower extracts, CRC_2T_2 (0.034cm) showed maximum inhibition of plumule length. In barley extracts, ESC_2T_2 (0.030 cm) showed maximum plumule inhibition. The results showed that aqueous extracts of both sunflower and barley greatly inhibited the plumule growth in wheat. Angiras *et al.* (1988) also reported that percentage germination was unaffected by the extracts of Sunflower and Barley. Radicle growth was also significantly affected by different treatments. The maximum radicle length was recorded for litter bed (check) treatment i.e. 5.86 cm. The lowest length was recorded for ESC_2T_1 (1.54 cm). In sunflower extract treatments, least inhibition in radicle length was observed in CRC_2T_1 (3.72 cm), while CSC_2T_2 (1.94 cm) resulted in maximum radicle inhibition. In barley, least inhibition in radicle length was observed for ERC_1T_2 (3.27 cm), while ESC_2T_1 (1.54 cm) showed maximum growth inhibition. However, in Sunflower extracts the radicle length inhibition was least in comparison to that of barley extracts treatments. Present results are in agreement with those of Angiras *et al.* (1988) who reported that radicle growth in wheat was inhibited by extracts of Barley.

Table 1. Allelopathic effects of sunflower and barley on seed germination, plumule length and radicle length of wheat (*Triticum aestivum* L.).

Treatments	Weed added (g)	Extract duration (hr)	Seed germination (%)	Plumule length (cm)	Radicle length (cm)
0 (Check)	-	-	96 ab	0.762 d	3.96 cdef
CSC_1T_1	5	6	94 abc	0.212 f	2.83 ghij
CSC_1T_2	5	12	96 ab	0.212 f	3.01 fghi
CSC_2T_1	10	6	100 a	0.094 f	2.43 hijk
CSC_2T_2	10	12	82 abcd	0.052 f	1.94 jk
CRC_1T_1	5	6	92 abc	0.038 f	2.45 hijk
CRC_1T_2	5	12	76 cd	0.156 f	2.19 ijk
CRC_2T_1	10	6	94 abc	0.698 de	3.72 defg
CRC_2T_2	10	12	92 abc	0.034 f	2.12 ijk
ESC_1T_1	5	6	92 abc	0.114 f	2.44 hijk
ESC_1T_2	5	12	66 d	0.114 f	2.22 ijk
ESC_2T_1	10	6	88 abc	0.158 f	1.54 k
ESC_2T_2	10	12	66 d	0.030 f	1.56 k
ERC_1T_1	5	6	100 a	0.130 f	2.98 fghi
ERC_1T_2	5	12	98 ab	0.248 ef	3.27 efgh
ERC_2T_1	10	6	90 abc	0.106 f	2.08 ijk
ERC_2T_2	10	12	88 abc	0.168 f	2.34 hijk
LB (Check)	-	-	86 abc	2.91 a	5.86 a
$LBCSC_3T_2$	0.5	12	80 bcd	1.98 b	3.96 cdef
$LBESC_3T_2$	0.5	12	92 abc	1.402 c	4.04 cde
SLB (Check)	-	-	96 ab	2.204 b	5.09 ab
$SLBCSC_4T_2$	1.0	12	92 abc	1.89 b	4.77 bc
$SLBESC_4T_2$	1.0	12	92 abc	2.098 b	4.69 bcd
$LSD_{0.05}$			19.10	0.4564	0.9994

Abbreviations used in the Table
C: Sunflower E: Barley
S: Shoots R: Rhizomes C_1: 5 grams
C_2: 10 grams C_3: 0.5 grams C_4: 1.0 grams
T_1: 6 hrs T_2: 12 hrs LB: Litter bed
SLB: Sand + Litter bed

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(Received 28 August 2009; accepted 5 May 2010)