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STUDYING THE ALLELOPATHIC EFFECTS OF SHOOT AND ROOT WATER EXTRACTS OF HOARY CRESS (*Cardaria draba* L.) ON GERMINATION AND SEEDLING GROWTH OF WHEAT

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ABSTRACT

In order to evaluate the effect of water extracts of above-ground, below-ground and a mixture of above-ground and below-ground organs of hoary cress on germination and seedling growth of wheat, a factorial experiment based on completely randomized design with four replications was conducted at Faculty of Agriculture, Islamic Azad University, Birjand branch, Iran in 2008. Treatments included water extracts of different organs of hoary cress (above-ground, below-ground and an equal mixture of above-ground and below-ground) and five levels of water extract concentration including 5, 10, 20, 40 and 80% (v/v) plus a control (distilled water). Results showed that different organs of hoary cress and concentration of water extracts had a significant effect on germination and seedling growth wheat compared with control. Increasing concentration of water extract of different organs of hoary cress significantly decreased germination percentage, germination rate and also length and weight of radical and coleoptile of wheat. Estimation of three-parameter logistic model showed that concentration required for 50% reduction of maximum germination was 18.72, 43.36 and 37.02% for aboveground, belowground and mixture of organs, respectively, suggesting a stronger allelopathic impact of aboveground organs of hoary cress compared with belowground organs.

Key words: Allelopathy, aqueous extract, hoary cress, wheat, germination

INTRODUCTION

Allelopathy refers to beneficial or harmful effects of one plant on another plant, both crop and weed species, by release of chemicals from plant parts by leaching, root exudation, volatilization, residue decomposition and other processes in both natural and agricultural systems. Commonly cited effects of allelopathy include reduced seed germination and seedling growth (Ferguson and Rathinasabapathi, 2003). The phytotoxic substances are called allelochemicals (Wu *et al*., 2001). Allelochemicals disrupt plant growth and development through changes in cell wall structure and functions and by preventing cell division, some enzyme function, seed germination, nutrient uptake,

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photosynthesis, protein and pigment synthesis and denaturation of DNA and RNA (Seigler, 1996).

Different plant parts, including flowers, leaves, leaf litter and leaf mulch, stems, bark, roots, soil and soil leachates, and their derived compounds, can have allelopathic activity that varies over a growing season. In laboratory, plant extracts and leachates are commonly screened for their effects on seed germination, with further isolation and identification of allelochemicals from greenhouse tests and field soil, confirming laboratory results (Ferguson and Rathinasabapathi, 2003).

Many weeds, including hoary cress (*Cardaria draba*), interfere with plants through production of allelochemicals. Hoary cress is a member of the Brassicaceae or mustard family. It is a deep-rooted perennial plant that reproduces vegetatively and by seed production. Disturbances such as grazing, cultivation, and especially irrigation can promote the colonization and spread of plant. Hoary cress is native to the Balkan Peninsula, Armenia, Turkey, Israel, Syria, Iraq and Iran.

Qasem (1994) showed hoary cress has severe allelopathic effects on wheat and barley and both root and shoot extracts significantly reduced wheat and barley seed germination and growth. This experiment was conducted to evaluate the effects of shoot and root water extracts of local populations of hoary cress in south Khorasan, Iran on wheat germination and seedling growth.

MATERIALS AND METHODS

The experiment was conducted as a factorial based on randomized complete design with four replications during 2008 at Islamic Azad University, Birjand branch, Iran. Factors investigated were water extracts from different plant organs and in different concentrations. Water extracts of different organs included aboveground (A), belowground (B) and an equal mixture of above- and below-ground (A+B) organs of hoary cress. Water extract concentrations consisted of control (distilled water), and 5, 10, 20, 40 and 80% (v/v).

To prepare the basic solution, 20 g powder of each organ were added to 200 ml distilled water and then shaken for 24 hours. Twenty wheat seeds were placed on a whatman filter paper in a glass petri dish. Water extracts of 5 ml prepared from different treatments were added to petri dish and dishes placed in a germinator (25/15 °C for 12/12 hours). The observations recorded included germination percentage and rate, root and shoot length and their fresh weight. Analysis of variance was conducted with spss software. A three parameter logistic model was used to evaluate the allelopathic potential of different hoary cress organs.

RESULTS

Increasing the hoary cress water extract (HWE) concentration reduced seed germination percentage significantly (Table 1). Highest seed germination (100%) was found in control. Germination failed in A_{40}, A_{80}, B_{80} and $A+B_{80}$. Also germination rate decreased significantly with an increase in concentration of hoary cress water extract and the treatments A5, A10 and A20 reduced germination rate by 8, 22 and 68%, respectively. The control treatment had highest shoot and root length and fresh weight. Increased level of HWE concentration significantly reduced these traits.

DISCUSSION

The reduction in plant seed germination percent and rate, shoot and root length and fresh weight with water extract of other plants has been reported by other researchers (Uremis *et al*., 2005; Yasmin *et al*., 1999). Allelochemicals can lower the levels of hormones GA and IAA (Kamal and Bano, 2008). Shoot and root length reduction with increasing of HWE may be related to decreases in GA and IAA that reduce cell enlargement (Inderjit, 2002).

Table-1. Interaction of Hoary cress water extract concentrations and their source on some wheat germination traits.

Source of extract	Water extract concentration (%)	Germination percent	Germination rate (seed/day)	Root length (mm)	Shoot length (mm)	Root fresh weight (mg)	Shoot fresh weight (mg)
Aboveground	0	100 a	20 a	80.4 a	130 a	50.6 abc	127.33 a
	5	98.33 ab	18.32 ab	53.8 bc	121.22 a	42.7 bcd	90 cd
	10	86.66 b	15.68 cd	43.84 cd	72.29 de	38.3 cde	77.43 de
	20	45 c	6.5 e	13.44 f	39.99 f	17.4 g	39.43 f
	40	0 d	0 f	0 g	0 g	0 h	0 g
	80	0 d	0 f	0 g	0 g	0 h	0 g
Belowground	0	100 a	20 a	81.14 a	130.33 a	55.66 a	132.66 a
	5	100 a	20 a	63.9 b	102.21 b	50.73 abc	105 bc
	10	100 a	19.66 a	45.37 cd	91.43 bc	42.96 bcd	80.96 d
	20	100 a	19.41 a	41.91 d	83.22 cd	34.43 def	76.5 de
	40	95 ab	15.05 d	24.48 e	72.22 de	25.53 fg	56.36 ef
	80	0 d	0 f	0 g	0 g	0 h	0 g
Aboveground + Belowground	0	100 a	20 a	83.62 a	130.66 a	59.5 a	118.33 ab
	5	100 a	19.44 a	64.53 b	98.88 bc	52.86 ab	83.53 cd
	10	98.33 ab	18.96 ab	51.26 cd	83.52 cd	41.2 bcde	77.53 de
	20	96.66 ab	17.29 bc	29.03 e	63.34 e	35.75 def	55.76 ef
	40	38.33 c	6.15 e	11.96 f	41.82 f	29.53 efg	47.16 f
	80	0 d	0 f	0 g	0 g	0 h	0 g

- Means that have similar letters are not significantly different according to LSD (α = 0.05)

Estimation of three-parameter logistic model showed that concentration required for 50% reduction of maximum germination

was 18.72, 43.36 and 37.02% for above-ground, below-ground and mixture of organs, respectively, suggesting a stronger allelopathic impact of above-ground organs of hoary cress compared with below-ground organs. Probably water extracts from above-ground parts of hoary cress contain more of the allelochemicals than water extracts from the below-ground parts.

REFERENCES CITED

Ferguson, J. J. and B. Rathinasabapathi. 2003. Allelopathy: How Plants Suppress Other Plants. (Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida).

Inderjit, H. 2002. Allelopathic effect of *Pluchea lanceolata* on growth and yield components of mustard (*Brassica juncea*) and its influence on selected soil properties. Weed Biol. & Manag. 2: 200-204.

Kamal, J. and A. Bano. 2008. Allelopathic potential of sunflower (*Helianthus annus* L.) on soil metals and its leaves extracts on physiology of wheat (*Triticum aestivum* L.) seedlings. Afr. J. Biotech. 7(18): 3261-3265.

Qasem, J. R. 1994. Allelopatic effect of white top (*Lepidium draba*) on wheat and barley. Allelopathy J. 1: 29-40.

Seigler, D. S. 1996. Chemistry and mechanisms of allelopathic interaction. Agron. J. 88: 876- 885.

Uremis, I., M. Arsalan and A. Uludag. 2005. Allelopathic effect of some *brassica* species on germination and growth of cutleaf ground-cherry (*Physalis angulata L.*). J. Biol. Sci. 5: 661-665.

Wu, B. H., J. Pratley, D. Lemerle and T. Haig. 2001. Allelopathy in wheat (*Triticum aestivum*). Ann. Appl. Biol. 139: 1-9.

Yasmin, S., B. Saleem and A. Irshad. 1999. Allelopathic effects of aqueous extract of chickpea (*Cicer arietinum*) and wheat (*Triticum aestivum*) on each others growth and quality. Int. J. Agric. Biol. 1(3): 110-111.