Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 108 (2017) 47673-47675

ISSN: 2229-712X

Allopathic effects of Hoary Cress tissues aqueous extract on growth of barley seedlings

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ARTICLE INFO

Article history:
Received: 2 June 2017;
Received in revised form:
4 July 2017;
Accepted: 17 July 2017;

Keywords
Allelopathic activity,
Aqueous extract,
Hoary Cress.

ABSTRACT

This study was conducted to evaluation of allopathic effects of Hoary Cress tissues aqueous extract on growth of barley seedlings in split plot experiment in CRD design with 3 replications. Main plot included root, stem, leaf and flower extract and sub plot included extract concentration (0, 2, 4 and 8%) of Hoary Cress. After one week, some properties evaluated such as radicle and plumule length, radicle and plumule fresh weight, radicle and plumule dry weight.Data analysis was done using SAS software and mean comparison was done by Duncan test at the 5% level. Studied traits reduced by the increase of extract concentration, flower extract specially. So, application of 8% aqueous extract had highest significant effects on growth traits of barley seedling.

Introduction

Hoary cress is a member of the Brassicaceae family, some members of which contain glucosinolates. Hydrolytic breakdown products of glucosinolates have shown bioactivity inhibiting germination and growth (Brown and Morra 1997). One breakdown product, thiocyanate, has reduced the growth of 22 species (Stiehl and Bible 1989). Aboveground tissue of hoary cress contains glucosinolates (McInnis et al. 1993), and one study has shown the allelopathic potential of hoary cress shoot extracts (Qasem 1994) on wheat and barley (Hordeum vulgare L.). In this study root extracts from fresh tissue inhibited germination and root growth, but not extracts from dried tissue. One glucosinolate, glucobrassicin, and several isothiocyanates have reduced germination and seedling root growth of wheat (Baily et al. 1990). An invasive Brassicaceae, hill mustard (Bunias orientalis L.) apparently does not exhibit allelopathy during its establishment in native environments (Dietz et al. 1996). Root extracts reduced seedling growth of three native species in artificial growth media, but not when soil was used as the growth media. Monocultures of hoary cress may result from highly competitive growth characteristics, allelopathic influences, or both. The extensive root system of hoary cress would indicate strong competition for water and nutrients, but could also be effective in the release of one or more allelochemicals. At one study by Gary et al., (2002), the allelopathic potential of hoary cress was evaluated by exposing the seeds and the germinated seeds of winter wheat, alfalfa, crested wheatgrass, bluebunch wheatgrass, and hoary cress to a water extract of dried, hoary cress roots under controlled conditions in an environmental chamber. Germination for all species was reduced in the hoary cress root extract when compared with distilled water, with winter wheat and hoary cress being more tolerant than the other species. Root length of all species was reduced by the extract when compared with distilled water. These data show the presence of phytotoxic chemical(s) that may inhibit germination and initial seedling growth in natural environments.

Three glucosinolate compounds were identified in hoary cress root extracts. The aim of our study was evaluation of allopathic effects of Hoary Cress tissues aqueous extract on growth of barley seedlings.

Material and methods

Experimental design performed as split plot in CRD design with 3 replications. Main plot included root, stem, leaf and flower extract and sub plot included extract concentration (0, 2, 4 and 8%) of Hoary Cress. After one week, some properties evaluated such as radicle and plumule length, radicle and plumule fresh weight, radicle and plumule dry weight. For extraction in 4 different concentrations, powder of different tissue weighed as 0, 2, 4 and 8g, separately. 100 mg distilled water was added to each and were placed in a shaker for 24 hours at 130 rpm, and it was used to test after passing through Whatman No 1 filter paper. The 1% sodium hypochlorite was used for 2 minutes for disinfection of seeds and immediately washed with distilled water. For each treatment, 20 disinfected seeds were counted in petri dish, 5 mL of aqueous extracts from different parts were added to each of petri dish and petri dishes were placed in an incubator at 20 ° C. Traits were evaluated after 8days. Data analysis was done using SAS software and mean comparison was done by Duncan test at the 5% level.

Results and discussion

According to analysis of variance, it was founded that tissue treatment show no significant effects on studied traits but extract concentration and them interaction showed significant effect on all studied traits at 1% statistically level. According to table 2, it was founded that means of traits reduced by increasing of extract concentration. Application of 2, 4 and 8% extract led to 2, 66 and 97% reduction in fresh radicle weight in compared to control (water). Highest mean of fresh radicle weight obtained 376.67mg by leaf extraction at 2% level. The phytotoxic compound(s) in the hoary cress extract negatively affected both stem and root growth of barely, indicating the potential of hoary cress to interfere at both texture growth (Kiemnec and McInnis, 2002).

Table 1. Mean of squares for studied traits in responses to experiment treatments.

S.O.V	D.F	Fresh radicle weight	Fresh plumule weight	Dry radicle weight	Dry plumule weight	Radicle length	Plumule length
extraction		7982.9ns	63441.5ns	86.0ns	138.8ns	2.02ns	0.75ns
Rep(extraction)		6046.8	36984.3	246.8	206.2	5.35	2.96
concentration		158902.0**	1930147.2**	4583.3**	13872.2**	390.3**	174.09**
Extraction* concentration		23250.2**	173134.2**	225.9**	805.5**	13.33**	8.31**
Error		4407.0	44495.0	67.11	61.01	1.60	0.62
CV%		8.63	9.18	7.18	6.97	10.96	8.86

ns,* and ** show no significant and significant effect at 5 and 1 % statistically levels, respectively

Table 2. Means comparison between treatments effects on studied traits.

	Concentration%	Fresh radicle weight		Fresh plumule weight		Dry radicle weight		Dry plumule weight		Radicle length		Plumule length	
Root	0	153.33	cd	936.67	ab	46.67	ab	70.00	ab	11.78	ab	8.58	ab
	2	270.00	abc	586.67	bc	33.33	abc	56.67	b	9.41	b	6.48	c
	4	216.67	bc	460.00	cd	16.67	cde	30.00	c	5.12	c	3.77	d
	8	20.00	e	40.00	e	0.00	e	3.33	d	0.39	d	0.40	e
Stem	0	250.00	abc	856.67	ab	43.33	ab	83.33	a	13.08	a	8.88	a
	2	250.00	abc	1193.33	a	30.00	a-d	66.67	ab	9.75	b	6.55	bc
	4	46.67	de	116.67	de	10.00	de	16.67	cd	2.29	d	1.22	e
	8	3.33	e	0.00	e	16.67	cde	0.00	d	0.30	d	0.00	e
Flower	0	240.00	bc	860.00	ab	46.67	ab	70.00	ab	13.19	a	8.90	a
	2	33.33	de	93.33	de	0.00	e	3.33	d	1.69	d	0.73	e
	4	0.00	e	0.00	e	0.00	e	0.00	d	0.00	d	0.00	e
	8	0.00	e	0.00	e	0.00	e	0.00	d	0.00	d	0.00	e
Leaf	0	310.00	ab	820.00	abc	50.00	a	73.33	ab	13.31	a	7.47	abc
	2	376.67	a	610.00	bc	26.67	bcd	73.33	ab	9.03	b	7.09	abc
	4	60.00	de	20.00	e	0.00	e	0.00	d	1.00	d	0.30	e
	8	0.00	e	0.00	e	0.00	e	0.00	d	0.00	d	0.00	e

Means with similar alphabet show no significant effect at 5% statistically level (Duncan 5%)

Application of 2, 4 and 8% extract led to 28, 82 and 98% reduction in fresh plumule weight in compared to control (water). In relation to factor interaction, it was founded that highest (1193.33 mg) and lowest (0 mg) means obtained by stem extraction with 2% concentration and 8%concentration of stem, flower and leaf textures, respectively. Agarwal et al. (2002), Stavrianakou et al. (2004), and Dongre and Yadav (2005) also reported inhibition in the length of plumule and radicle, a reduction in their dry weights and total seedling weight in wheat, pea and lentil with water extracts of various weeds. Also, dry radicle weight was reduced by increasing of concentration, so application of 2, 4 and 8% extract led to 51, 85 and 91% reduction in dry radicle weight in compared to control (water). According to results, root, flower and leaf extraction at 8% concentration showed lowest means (0mg) and highest means (50 mg) was obtained by no extract. Other authors have also reported changes in mitotic indices in the presence of allelopathic substances (Pires et al. 2001; Iganci et al. 2006). Application of 2, 4 and 8% extract led to 32, 84 and 98% reduction in dry plumule weight in compared to control (water). Stem, flower and leaf extraction at 8% concentration showed lowest means (0mg) and highest means (83.3 mg) was obtained by no extract. Similar results were observed by Rehman et al. (1991) when wheat was grown with water extracts of roots, shoots, and leaves of Sisymbrium irio. These results are also similar to the findings of Channappagoudar et al. (2005). They reported that extracts of Cyperus rotundus and Commelina benghalensis had an inhibitory effect on the germination, seedling length, and seedling vigor index of wheat, sorghum, green gram, and soybean. Application of 2, 4 and 8% extract led to 41, 83 and 98% reduction in radicle length in compared to control (water). Flower and leaf extraction at 8% concentration showed lowest means (0mg) and highest means (13.31 mg) was obtained by no extract.

Aliotta et al. (2004) demonstrated that the expansion of root cells was reduced in the presence of different concentrations of parts of Olea europea and this reduction resulted in thickening of the root tip in comparison to the control. According to Al-Wakeel et al. (2007), inhibition of cell elongation can be related to the direct action of allelochemicals, by interfering in the process of cell division and thus altering the balance of the different hormones. Application of 2, 4 and 8% extract led to 39, 85 and 99% reduction in plumule length in compared to control (water). Stem, flower and leaf extraction at 8% concentration showed lowest means (0mg) and highest means (8.9 mg) was obtained by no extract. Authors demonstrated that this happened because of changes in the mitochondrial metabolism, thus altering various other physiological and metabolic processes associated with growth and development of the plants (Abrahim et al. 2000). Other studies have also identified stimulated plant growth in the presence of extracts. Extracts of Euphorbia serpens stimulated growth of the aerial parts and roots of Lactuca sativa (Dana & Domingo 2006), and leaf extracts of Phytolacca americana stimulated growth of the aerial parts and roots of Cassia mimosoides (Kim et al. 2005). Totally, according to result, studied traits reduced by the increase of extract concentration, flower extract specially. So, application of 8% aqueous extract had highest significant effects on growth traits of barley seedling.

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