academicJournals

Vol. 8(19), pp. 2263-2267, 23 May, 2013
DOI: 10.5897/AJAR11.793
ISSN 1991-637X ©2013 Academic Journals
http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Allelopathic effects of *Emex spinosus* L. against wheat and mustard

Muhammad Naseem[1], Farrukh Hussain[1] and Zaman Sher[2]*

[1]Centre of Plant Biodiversity, University of Peshawar, Peshawar Pakistan.
[2]Government Degree College, Lahor, District Swabi, KPK, Pakistan.

Accepted 15 May, 2013

***Emex spinosus* L. (Family Polygonaceae), a decumbent, branched annual herb, was assayed for its allelopathic potential because of it weedy habit. Aqueous extracts were obtained from powdered shoots and leaves at room temperature and by boiling. Various extracts significantly inhibited the germination and seedling growth of *Triticum aestivum* and *Brassica compestris* used as test species. The extracts reduced the development of cells and retarded cell division in root tip. Results revealed that the *E. spinosus* L. has a strong allelopathic potential at least against tested species. The phytotoxicity depended upon the test species and concentration of extract.**

Key words: Inhibition, aqueous extract, litter, mulching, *Emex* allelopathy.

INTRODUCTION

Allelopathy governs the community dynamics, pattern and productivity in natural and agroecosystem (Hussain et al., 2011, 2010a; Rua et al., 2008; Willis, 2000). Allelopathy plays important role in the weed-crop interaction by inhibiting the germination, growth or development of susceptible crops (Hisashi et al., 2009; Lodhi and Nikell, 1973; Machado, 2006; Rukhsana and Iffat, 2005), or sometime by stimulating the growth at low concentration (Oudhia and Tripathi, 1998). Studies on the allelopathy of various species of family Polygonaceae has been made (Alssadawi and Rice, 1982; Dongre and Singh, 2007; Dongre and Yadav, 2005; Iqbal et al., 2003; Monfared and Rasheed, 2006; Nazir et al., 2007; Zhang et al., 2009). Aqueous extracts from sunflower retarded the growth of *Rumex dentatus* (Anjum and Bajwa, 2007; Tehmina and Bajwa, 2007) and could be utilized as an economical and natural technique for controlling weeds. Buckwheat contains isoquercitrin, quercetin, catechin, and myricetin, which are allelopathic active substances (Kalinova and Vrchotova, 2009). Methanol extract of *R. dentatus* had alkaloids, saponins, anthraquinones, tannins and flavonoids (Fatima et al., 2009). The allelopathic effect of *Emex australis* retarded seedling growth and germination of *Triticum aestivum* (Nadeem et al., 2010). The crude methanolic extracts of *Rumex hastatus, R. dentatus, Rumex nepalensis, Rheum australe, Polygonum persicaria and Polygonum plebejum* exhibited phytotoxicity against *Lemna minor* (Hussain et al., 2010b). Allelopathy operates in agro-ecosystems through release of allelochemicals and soil sickness (Alssadawi, 2006). *Emex spinosus* L. is an annual weed of wheat, *Brassica compestris* and other crops. The present study assays the phytotoxic effects of the weed and findings will add to the existing weed-corps allelopathy.

MATERIALS AND METHODS

Mature plants of *E. spinosus* L. were collected from the wheat fields

*Corresponding author. E-mail: zamanbotany@yahoo.com. Tel: 92-0938-300187, 0938-300184, 0345-9501066. Fax: 92-0938-300187.

of Manki, District Swabi. Plants were dried at room temperature (25 to 30°C), powdered and stored in paper bags. Glassware's were thoroughly washed with water, was sterilized at 170°C for at least 4. There were always 5 replicates, each with 10 seeds of test species. The petridishes were always incubated at 25°C for 72 h. Data were analyzed using ANOVA and means were separated with LSD.

Effect of aqueous extract

5 and 10 g powder of each part were separately soaked in 100 ml distilled water at 25°C for 24 and 48 h and filtered to get aqueous extracts. These extracts were tested against *T. aestivum* and *B. compestris* on 2-folds of filter paper in petri dishes (Hussain et al., 2011, 2010a). Germination, growth of plumule and radical were noted after 72 h. 10 seedlings were randomly selected for fresh and dry weight determination. Seedlings were dried at 65°C for 72 h.

Effect of hot water extracts

Hot water extract was obtained and tested against the same test species following (Hussain et al., 2011, 2010a).

Effect of mulching

5 and 10 g crushed dried leaves and stems were placed in plastic pots containing sterilized moist sand for test. The control consist of sand and pieces of filter paper. 5 replicates, each with 10 seeds was made for each treatment. The plastic pots were incubated at 25°C and observed daily for germination. After germination the pots were transferred to light at room temperature (25 to 30°C). Shoot and root growth was measured after 15 days. 10 seedlings were randomly selected for determining fresh and dry weight and moisture contents.

Effect of litter

5 g crushed litter from leaves and shoots were placed in petridish and covered with one fold of filter paper. Filter papers were moistened with 5 ml distilled water. In the control, fine pieces of filter paper were used. For each treatment, 5 replicates, each with 10 seeds were made. The petri dishes were incubated at 25°C. After 72 h, germination, growth of plumule and radical were noted. 10 seedlings were randomly selected for fresh and dry weight determination.

RESULTS AND DISCUSSION

Effect of aqueous extracts

The germination and the radical growth of the test species was strongly inhibited at all concentrations (Table 1) especially in concentrated extracts. Similarly, the fresh and dry weights of the test species were significantly reduced under test condition. The germination of *B. compestris* was more affected than the *T. aestivum*. The results suggest that the aqueous extracts of *E.spinosus* exhibited inhibitory effect, similar to some earlier studies on allelopathy (Azirak and Karaman, 2008; Dongre and Singh, 2007; Dongre and Yadav, 2005; Rafiqul Hoque et al., 2003; Iqbal et al., 2003; Monfared and Rasheed, 2006; Nazir et al., 2007; Zhang et al., 2009) who reported that allelochemicals are released from the various parts of the plant that inhibited the germination and growth of the test species. The toxicity of the plant material depended upon the duration of plant material soaked, concentration and the test species. Similar results were reported by Alam and Shaikh (2007) and Iannuci (2007) for other allelopathic plants.

Effect of hot water

Hot water extract from shoots and leaves inhibited the germination and seedling growth of the test species. Using hot water extract seems unusual but hot water extracts have been used by many workers in allelopathic studies (Lodhi and Nikell, 1973). The germination of *B. compestris* were more affected than *T. eastivum* (Table 3). 5 g hot water extract was more inhibitory than 10 g hot water extract (Table 3). It is suggested that, the hot water extract had more inhibitory effect than the cold water extract (Table 3). Similar results were reported for *Cenchrus ciliarus* and *Bothriochloa pertusa* (Hussain et al., 2010a). Thus, our findings are in line with them. Furthermore, the extracts from leaves were more inhibitory than shoot extract. Fresh weight, dry weight and moisture content were also reduced by hot water extract especially concentrated ones.

Effect of mulching

Allelochemical compound are released directly or indirectly from dead parts of the plants with phytotoxic effects (Saffari et al., 2010). These compounds accumulate in the soil, causing soil sickness and disturb the physiological activities of the susceptible plants (Alssadawi, 2006; Jim and Hodel, 2000). Various plants released phytochemicals from dead tissue into soil this process is accelerated by leaching thus, facilitating their effect (Hussain et al., 2010a, 2010b; Inderjit and Duke, 2003). When *E. spinosus* mulch was tested against test species the germination, radical growth and plumule growth were significantly retarded (Table 2). However, the effects were specific as inhibition was more pronounced against *B. compestris* than *T. eastivum*. The fresh and dry weights were also reduced in both test species.

Effect of litter

The litter when used as growth medium significantly reduced the germination, radical and plumule growth of the test species. Fresh and dry weight were also reduced (Table 2). These results are agree with those of the earlier results regarding the litter-mediated allelopathic effects (Chenlu and Fu, 2010; Rashid et al., 2010; Hussain et al., 2011). The most common effect of

Table 1. Effect of aqueous extract on germination, plumule and radical growth, fresh and dry weight and moisture contents of test species. Each value is a mean of 5 replicates each with 10 seedlings.

Test species								
Treatment	***T. aestivum***				***B. compestris***			
Soaking duration	5 g	5 g	10 g	10 g	5 g	5 g	10 g	10 g
Concentration	24 h	48 h	24 h	48 h	24 h	48 h	24 h	48 h
Germination (%)								
Control	100	100	100	100	98	100	98	98
Leaves	10*	90	62*	98	6*	72*	0*	26
Shoots	54*	88	98	84*	44*	66*	18*	0*
Plumule growth (mm)								
Control	47.96	47.96	47.96	47.96	31.56	31.56	31.56	31.56
Leaves	1*	17.38*	5.78*	13.20*	0.14*	7.88*	0*	1.42*
Shoot s	5.34*	32.28*	25.68*	11.68*	1.44	4.02	0.50*	0*
Radical growth (mm)								
Control	37.96	37.96	37.96	37.96	18.17	18.17	18.17	18.17
Leaves	0.31*	10.17*	4.83*	8.66*	0.06*	2.45*	0*	0.66*
Shoots	3.47*	19.50*	14.53*	2.83*	0.88*	2.6*	0.28*	0*
Fresh weight (% of control)								
Leaves	62.99	84.18	79.09	87.57	0	65.59	0	61.11
Shoot s	66.66	75.70	88.13	73.44	54.83	73.11	0	68.18
Dry weight (% of control)								
Leaves	32.32	53.03	85.71	93.87	0	65.21	0	113.04
Shoot s	36.66	34.34	100	73.46	91.30	139.13	0	208.69
Moisture content (% of control)								
Leaves	95.10	70.36	89.32	90.70	0	35.06	0	61
Shoots	87.19	112.59	83.59	99.95	61.21	51.58	0	28.75

*Significantly different from control at alpha 0.050 according to LSD method in one way ANOVA.

Table 2. Effect of litter and mulching on germination, plumule and radical growth, fresh and dry weight and moisture contents of test seedlings. Each value is a mean of five replicates, each with 10 seedlings.

Treatment	**Added litter**		**Added mulch**	
	Test species			
	T. aestivum	***B. compestris***	***T. aestivum***	***B. compestris***
Germination %				
Control	100	98	100	100
Test	68*	76*	16*	18*
Plumule growth(mm)				
Control	45.40	31.78	129.6	107.80
Test	6.22*	6.94*	15.66*	10.46*
Radical growth(mm)				
Control	37.33	16.90	64.42	55.66
Test	2.36*	2.80*	5.22*	1.60*

Table 2. Contd.

Fresh weight (% of control)				
Test	35.84	28.88	83.26	60.14
Dry weight (% of control)				
Test	62.55	77.77	87.65	61.90
Moisture content (% of control)				
Test	49.80	21.42	92.52	96.64

*Significantly different from control at alpha 0.050 according to LSD method in one way ANOVA.

Table 3. Effect of hot water extract on germination, plumule and radical growth, fresh and dry weight and moisture contents of test of test species. Each value is a mean of 5 replicates each with10 seedlings.

	Test species			
Treatment	***T. aestivum***		***B. compestris***	
Concentration	5 g	10 g	5 g	10 g
Germination %				
Control	100	100	98	98
Leaves	38*	34*	4*	10*
Shoots	80*	42*	10*	14*
Plumule growth (mm)				
Control	47.96	47.96	31.56	31.56
Leaves	2.54*	1.82*	0.20*	0*
Shoots	5.34*	32.28*	4.20*	0*
Radical growth (mm)				
Control	37.96	37.96	17	17
Leaves	0.89*	1.13*	0.04*	0.46*
Shoots	3.98*	1.05*	0.28*	0.50*
Fresh weight (% of control)				
Leaves	93.11	73.11	0	35.63
Shoots	83.60	86.22	48.27	41.95
Dry weight (% of control)				
Leaves	75	67.05	0	71.42
Shoots	79.76	86.90	9.77	3.44
Moisture content (% of control)				
Leaves	133.33	110.69	0	43
Shoots	76.60	99.68	54.09	153.26

*Significantly different from control at alpha 0.050 according to LSD method in one way ANOVA.

allelochemicals is the death of cells that causes growth reduction (Wu et al., 2003). The toxins might also reduce the chlorophyll contents of the susceptible plant which leads to the reduction of plant growth (Inderjit and Duke, 2003). *E. spinosus* contain some allelochemicals which retard the growth of test species. The present study suggests that *E. spinosus* is an allelopathic plant which retards the germination and growth of various test

species. The allelopathic effect depends upon the part assayed, test species and physiological process involved. These results although obtained from laboratory assays yet suggest that *E. spinosus* exhibit allelophatic substances which released into the environment. Field experiment must be carried out to test the effectiveness of the allelopathic potential under natural condition. Further investigations are required to test its efficiency as weeds and disease control.

REFERENCES

Alam SM, Shaikh (2007). Influance of leaf extract of Nettle leaf Goosfoot (*Chenopodium murale* L.) and Nacl salinity on germination and seedling growth of rice (*Oryaza sativa* L.). Pak. J. Bot. 39(5):1695-1699.

Alssadawi IS (2006). Soil sickness in Iraq: Possible role of allelopathy and soil pathogens. Allelopathy J. 18:47-56.

Alssadawi IS, Rice EL (1982). Allelopathic effect of *Polygonum aviculare* L. isolation, characterization and biological activities of phytotoxins. J. Chem. Ecol. 8:1011-1023.

Anjum T, Bajwa R (2007). Field appraisal of herbicide potential of sunflower leaf extract against *Rumex dentatus.* Field crop Res. 100(2-3):139-142.

Azirak S, Karaman S (2008). Allelopathic effect of some essential oils and components on germination of weed species. Acta Agriculturae Scandinavica. Section B - Plant Soil Sci. 58(1):88-92.

Chenlu Z, Fu S (2010). Allelopathic effects of leaf litter and live roots exudates of *Eucalyptus* species on crops. Allelopathy J. 26(2):72-84.

Dongre PN, Singh AK (2007). Inhibitory effects of weeds on growth of wheat seedlings. Allelopathy J. 20(2):41-47.

Dongre PN, Yadav B (2005). Allelopathic effects of weed leaf leachates on seed germination of pea (*Pisum sativum* L.). Crop Res. Hisar. 29:458-461.

Fatima N, Zia M, Rehman R, Rizvi ZF, Ahmad S, Mirza B, Chaudhary MF (2009). Biological activities of *Rumex dentatus* L: Evaluation of methanol and hexane extracts. Afr. J. Biotechnol. 8(24):6945-6951.

Hisashi K-Noguchi, Salam MA, Kobayasi T (2009). A quick seedling test for allelopathic potential of Bangladesh rice cultiver. Plant Prod. Sci. 12(1):47-49.

Hoque RATM, Uddin MB, Ahmed R, Hossain MK (2003). Suppressive effect of aqueous extracts of *Azadirachta indica* leaf on some initial growth parameter of six common agricultural crops. Asian J. Pl. Sci. 2(10):738-742.

Hussain F, Ahmed B, Ilahi I (2010a). Allelopathic effect of *Cenchrus cilliarris* L. and *Bothrochloa pertusa* (L.) A. Camus. Pak. J. Bot. 42(5):3587-3604.

Hussain F, Hameed I, Dastagir G, Nisa SU, Khan I, Ahmad B (2010b). Cytotoxicity and phytotoxicity of some selected medicinal plants of the family Polygonaceae. Afr. J. Biotechnol. 9(5):770-774.

Hussain F, Ilahi I, Dasti AA, Malik SA, Ahmad B (2011). Effect of rain leachates of *Cenchrus ciliaris* and *Bothriochloa*. Pak. J. Bot. 43(1):341-350.

Iannuci A (2007). Evidences of chemical interaction on germination and seedling growth in annual forage species. J. New Seeds 8:1-13.

Inderjit, Duke SO (2003). Ecophysiological aspects of allelopathy. Planta 217(4):529-539.

Iqbal Z, Hiradate S, Noda A, Isojima S, Fujii Y (2003). Allelopathic activity of buckwheat: isolation and characterization of phenolics. Weed Sci. 51(5):657-662.

Jim D, Hodel D (2000). The effect of mulching on establishment of *Syagrus romanzoffiana* (Cham.) Becc., *Washingtonia robusta* H. Wendl and *Archontophonix cunninghamiana* (H.Wendl) H. Wendl. and Drude in the landscape. Sci. Hortic. 87(1-2):85-92.

Kalinova J, Vrchotova N (2009). Level of catechin, myricetin, quercetin and isoquercitrin in Buckwheat (*Fagopyrum esculentum* Moench): Changes of their levels during vegetation and their effect on the growth of selected weeds. J. Agric. Food Chem. 57(7):2719-2725.

Lodhi MAK, Nikell GI (1973). Effect of leaf litter of *Celtis laevigata* on growth,water content and carbon dioxide exchange rate of three grass species. Bull. Thorrey Bot. Club. 100:159-165.

Machado S (2006). Allelopathic potential of various plant species on downy brome. Agron. J. 99:127-132.

Monfared KE, Rasheed MMH (2006). Allelopathic effects of knotweed (*Polygonum avicular*) on emergence and seedling growth of tomato and corn. Iran. J. Field Crops Res. 4(1):95-104.

Nadeem AR, Asif T, Asghar A, Zaheer Z (2010). Effects of *Emex australis* Steinh on germination and early seedling growth of wheat (*Triticum aestivum* L.). Allelopathy J. 25(2):513-520.

Nazir T, Uniyal A, Todaria N (2007). Allelopathic behavior of three medicinal plant species on traditional agriculture crops of Garhwal Himalaya, India. Agroforest. Syst. 69(3):183-187.

Oudhia P, Tripathi RS (1998). Allelopathic Potential of *Datura stramunium* L. Crop Res. 16(1):37-40.

Rashid MH, Asaeda T, Uddin MN (2010). Litter-mediated allelopathic effects of kudzu (*Pueraria montana*) on *Bidens pilosa* and *Lolium perenne* and its persistence in soil. Weed Biol. Manage. 10:48-56.

Rua MA, Nijjer S, Johnson A, Rogers WE, Siemann E (2008). Experimental approaches to test allelopathy: A case study using the invader *Sapium sebiferum*. Allelopathy J. 22:1-13.

Rukhsana B, Iffat N (2005). Allelopathic effect of *Eucalyptus cirtiodora* on the growth, nodulation, and AM colonization of *Vigna radiata* (L.) Wlczk. Allelopathy J. 15(2):237-246.

Saffari M, Saffari VR, Torabi-Sirchi MH (2010). Allelopathic appraisal effects of straw extract wheat varieties on the growth of corn. Afr. J. Pl. Sci. 4(11):427-432.

Tehmina A, Bajwa R (2007). The effect of sunflower extract on *Chenopadium album* in wheat feild in Pakistan. Crop Prot. 26(13):90-94.

Willis RJ (2000). *Juglans* spp., juglone and allelopathy. Allelopathy J. 7:1-55.

Wu H, Pratley J, Lemerle D, Haig T (2003). Evaluation of seedling allelopathy in 453 wheat (*Triticum aestivum)*_accessions against annual ryegrass (*Lolium rigidum)* by the equal compartment agar method. Aust. J. Agric. Res. 51(7):937-944.

Zhang NN, Wang ZY, Li FM, Hu HY, Baoshan X (2009). Allelopathy of extracts from Hydrophytes on Coli phage. China Water Wastewater 25(13):31-34.