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ALLELOPATHIC EFFECTS OF *CHENOPODIUM MURALE* L. ON FOUR TEST SPECIES

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Abstract

The allelopathic effect of weed *Chenopodium murale* L. aqueous extract bioassay against seed germination and radicle elongation of four test crops *i.e. Triticum aestivum* L. (Wheat), *Zea mays* L. (Maiz), *Cicer arietinum* L. (Gram) and *Vigna radiata* L. (Mung) were examined. These experiments were conducted in the green house of Federal Urdu University of Arts, Science and Technology, Karachi. Plant material of the weed collected from Malir agriculture field, Karachi and dried at room temperature (25 ^{o}C-30 ^{o}C) in laboratory. The experiment was conducted in sterilized petridishes. The extract of weed at 1, 3 and 5 % concentration were used to determined their effect on seed germination and radicle elongation compared to distilled water as control. Each treatment had five replicates. The aqueous extract of weed under study effected seed germination of test species and root length and pronounced allelopathic inhibitory effects, proportional to the concentration of extracts. Data analyzed using one–way ANOVA and treatments means were compared using the least significant difference (LSD) at P=0.05.

Introduction

Different weed species have allelopathic effects on different crops. The chemical substances which are produced in weeds, are found almost in all parts of the plant *e.g.* root, stem, leaves, fruit and flowers. According to Meissner *et al* (1979) allelochemicals inhibited the growth of some species at certain concentration. It might stimulate the growth of same or different species at some other concentration. In addition, reduced photosynthetic rate which lead to reduction in root length and shoot length. In the broad spectrum the allelopathic interaction play an important role in growth of associated species. Shahrokhi *et al* (2011) reported that the weed *Amaranthus retroflexus* L., had a high allelopathic impact on germination and growth of barley crop. Jabeen and Ahmed (2009) mentioned that the weeds *Asphodelus tenufulius*, *Euphorbia hirta* and *Fumaria indica* have allelopathic effect on germination and growth of maize. There was many evidences that allelopathic effects from weeds inhibit the growth of neighboring plants. In the present studies the allelopathic effects of *Chenopodium murale* extract of different concentration on seed germination, speed of germination, radicle elongation and percent inhibition of radicle growth of four test species *i.e. Triticum aestivum* L. *Zea mays* L., *Cicer areitinum* L. and *Vigna radiate* are investigated.

Chenopodium murale Commonly known as nettle leaf goose foot. *Chenopodium spp*. fast growing and occurs throughout the world. This weed remarked among the most serious weed of several major crops throughout the world (Bassett and Crompton, 1978). The plant is broad leaved and distributed over the year. It is an annual herb, widely distributed and has a rapid growth rate (Pearcy *et al.*, 1981). *Chenopodium murale* is an annual erect plant with large dispersal rates, due to large number of seeds produced by the plant that can reach up to 24,000 seeds/plant (Holm *et al*, 1997; Guertin, 2003). The weed showed clear effects on germination, root and shoot growth, number of leaves and fresh and dry weight of test plants.

Materials and Methods

Plants of *Chenopodium murale* were collected from naturally growing population from Federal Urdu University, University of Karachi, road side and some other places. The sufficient amount of *C. murale* brought in the Laboratory and air dried. Then the whole plant was grounded by vileymill. The weed samples were kept in the paper bags until further used.

The powder of plant material was mixed with distilled water to prepare 1, 3 and 5% aqueous extract according to (Rice, 1972; Wardle *et al.*, 1992; El-Khatib and Abd-Elaah, 1998). These extracts were used in bioassay to record the different growth parameters of test species. The selected four test crops were *Triticum aestivum*, *Zea mays*, *Cicer arietinum* and *Vigna radiata.* The seeds of test species were bought from local market. Seeds of all test species were surface sterilized with 1% sodium hypochlorite solution for 1-3 minute then rinsed well with distilled water.

Germination and radicle growth record: The seed germination and radicle elongation of test species were carried in 9cm petridishes with five replicates of each concentration and five replicates of control (Distilled water). Whatman (No. 3) filter paper was placed inside the sterilized petridish. Then kept ten seeds of each test species in all replicates of control and treatments. Three mL of the bioassay extract added to petridishes at an average room temperature of laboratory 25-30^{o}C, but only the trial of gram were incubated under the growth chamber due to the required low temperature while control treated with distilled water. The trial of test crops terminated over a period of ten days. Recorded the germination per day and radicle growth recorded at alternate days. The results were expressed as germination percentage, speed of germination "S" radicle growth and percent inhibition in radicle growth. Speed of germination was calculated by the following formula describe by Khandakar & Bradbeer, (1983).

$$S = [\frac{N1}{1} + \frac{N2}{2} + \frac{N3}{3} + \frac{Nn}{n}] \times 100$$

Where N1, N2, N3… Nn = Proportion of seed which germinate on day 1,2,3…….N following the setup of the experiment. The data of all treatments of each test crop were subjected to one way ANOVA and Duncan's multiple range test (DMRT).

In wheat and maize seeds produce a number of seminal roots. Khan and Naqvi (2008) found the effect of extract of (*Guaicum officinale* L.) on seminal roots of wheat. However we ignored seminal roots individually and only recorded the total length of root in wheat and maize.

Results and Discussion

Germination: Germination (%) of four test crops is presented in Table 1. The seed germination was slightly decreasing in two test species *e.g.*, *Vigna radiata* and *Zea mays*, than the remaining two species. Overall percent germination considerably reduced in all four test species as compared to their control. Similarly, speed of germination showed same trend as percent germination. The inhibition increased in the test crops with the strength of extract concentration. Jabeen *et al.*, (2013) found that the *Euphorbia hirta* reduced the germination of wheat in the treatments may be due to the allelopathic effects. Most inhibitory effect on germination in all cases was found in highest percentage of concentration (5%). Wheat showed lowest inhibitory effect 22% on germination at 5% while the highest 56% was found in mung at same concentration of weed extract. These results also confirmed with the finding of Ejaz *et al* 2004 who studied the effect of *Eucalyptus* leaf extract on germination and growth of Cotton (*Gossypium hirustum*) and concluded that *Eucalyptus* boiled extract decreased Cotton seed germination by 57% as compared to 97% in the control. Speed of germination was maximum and minimum in lowest and highest concentration (1% & 5%) of weed extract recorded in wheat (53% and 10%) and mung (70% and 18.6%) as compared to the other two test species. It was also observed that the leaf extract of *Acacia auriculiformis* delayed and hindered the germination significantly in all test species. Rebaz (2001) reported that the aqueous extract of *Anagallis arvensis* of various concentrations inhibited the seed germination of six test species (Pearl millet, mustard, carrot, turnip, wheat and maize).

Table 1. Germination percent and speed of germination index ("S") of test crop in control and different concentration of *Chenopdium murale* extracts.

Treatment	*T. aestivum*		*V. radiata*		*Z. mays*		*C. arietinum*	
	Germination %	"S"	Germination %	"S"	Germination %	"S"	Germination %	"S"
Control	94±4	81.3	82±3.74	85	90±4.4	53	98±2	50.3
1%	82±3.7	53	60±8.36	70	82±3.74	50	74±6	23
3%	42±5.8	24	58±3.7	38	60±8.3	48	58±6.6	26
5%	22±8.6	10	56±5.09	18.6	52±3.74	52	50±7.07	31

Table 2. Radicle elongation (cm) and % reduction in radicle growth of test crop in control and different concentration of *Chenopodium murale* extracts.

Treatment	*T. aestivum*		*V. radiata*		*Z. mays*		*C. arietinum*	
	Total root length (cm)	% reduction in radicle growth	Radicle elongation (cm)	% reduction in radicle growth	Total root length (cm)	% reduction in radicle growth	Radicle elongation (cm)	% reduction in radicle growth
Control	19.42±0.54a	-	11.79±1.18a	-	21.86±1.24a	-	10.07±0.09a	-
1%	10.26±0.25b	47.16	6.3±0.39b	46.56	18.46±0.35b	15.5	1.94±0.08b	80.73
3%	6.86±0.97c	64.67	5.69±0.42b	51.73	16.47±0.91b	24.65	1.49±0.18bc	85.21
5%	3.85±0.39d	80.17	5.36±0.56b	54.53	16.53±0.54b	24.38	1.06±0.01c	89.48

The data in mean indicate radical length and % inhibition over control

Table 3. Allelopathic effect of *Chenopodium murale* on radicle elongation of different test crops.

Crops	F-value	P-value	$LSD_{0.05}$
Wheat	118.91	0.0000***	1.81
Maize	9.90	0.0006***	2.23
Gram	546.23	0.0000***	0.51
Mung	17.05	0.0000***	2.17

Radicle elongation (cm): In Table 2 Shown the mean root length and percentage of inhibition in radicle elongation of four test species. The root growth was severely reduced by the extract of *C. murale* highly significantly in all test species. But wheat and gram radical growth highly reduced than remaining two test crops. Each concentration of extract of *C. murale* highly effected the radicle growth of wheat (3.85cm) and gram (1.06 cm) as compared to control (19.42cm and 10.07cm respectively). It has been reported that *C. murale* extract inhibition in root growth was highly significant, ($P<0.001$) at all ranges of extract on barley plant (Johani, 2012). Inhibition percentages of root length in all crops were highest in 5% of extract. These studies also correlated with the findings of Siddiqui *et al.* (2009) who reported inhibition in gram (89.48%) > wheat (80.17%) > mung (54.53%) > maize (24.38%). Siddiqui *et al.*, (2009) determined the allelopathic effect of leaf extract of different concentrations of *Prosopis juliflora* on the germination and radicle length of wheat and caused pronounced inhibitory effect on the growth parameters.

Different concentration (1%, 3% & 5%) of aqueous extract of whole *Chenopodium murale* plant had clear and significant effects on the growth parameter (Table 3). In Table 3 ANOVA showed that the all test species strongly inhibited in each concentration of weed extract. But wheat and gram critically restricted the radicle growth than maize and mung. However in case of wheat and gram inhibition of growth parameters of seedling was pronounced than the other two crops (maize and mung). It was also correlated with the findings of Bora *et al* (1999) who found the allelopathic effect of leaf extracts of *Acacia auriculiformis* on seed germination of some agriculture crops. Speed of germination was not more affected than the germination percentage in all treatments. *C. murale* aqueous extract are reported to the suppress shoot length, shoot biomass, total root length, number of roots and biomass (EL-Khatib *et al.*, 2004, Shafique *et al.*, 2011). Our result showed that radicle growth was more responded and supported the phenomenon of allelopathy in extracts application to the test plants. According it is apparent that allelopathy was concentration dependent. It was confirmed by the other reports of Rai & Tripathi (1984), Rizvi & Rizvi (1987) and Daniel (1999) Khan and Shaukat, (2006a and b) and Khan and Naqvi (2008) have reported similar results.

Present study suggest that *Chenopodium murale* has allelopathic potential due to its inhibitory effects on test plants which may be due to the allelochemicals present in weed. However, there is pressing need of further field studies for the management of agriculture system in our country.

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