Bangladesh J. Sci. Ind. Res. **42**(2), 229-234, 2007

Influence of Root and Leaf Extracts of *Argemone mexicana* on Germination and Seedling Growth of Blackgram, Rapeseed and Wheat

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Abstract

Allelopathic effect of different concentrations (0, 20, 40 and 60%) of root and leaf extracts of obnoxious weed *Argemone mexicana* on germination and seedling growth of blackgram, rapeseed and wheat varieties was studied. Percentage of germination and lengths of main root and shoot and seedling dry weight were highly significantly decreased with the increase of both root and leaf extracts. In some cases, root extract was more inhibitory, but in others leaf extract was more inhibitory. Among the varieties, Dhali of rapeseed and Akbar of wheat were most sensitive to the aqueous extract of *Argemone mexicana.*

Introduction

The influences of weeds on crops and vice versa have important implications in agriculture, as these govern and direct the planning of suitable agricultural operations. An understanding of the effects of weeds on seed germination and seedling growth of crop plants is essential in exploiting the possible improvement of crop productivity by eliminating the alien weed from the field.

The soluble allelochemicals from weeds which leach out come into direct contact with crop root. There are several reports, which indicate that allelopathic potentiality of weeds plays a major role by affecting the crop growth and nutrient status of soil (Bhowmik and Doll, 1984; Pande *et.al.*, 1980; Pandya, 1975; Qudhia, *et.al.*, 1997; Qudhia, 2000; Kalita, 2001). Pande and his coworkers (Pande *et.al.*, 1980). reported that extracts of root, leaf, stem and unripe fruit of *Argemone mexicana* were growth regulatory and the root extract was more phytotoxic. Datta and Chakrabarti (Datta and Chakraborti, 1975) observed that leaf extract of *Clerodendrum* inhibited seed germination and the inhibitory effect increased with concentration. Paria and Mukharjee (Paria and Mukharjee, 1981) found that stem + leaf extracts of *Alternanthera* contain allelopathic potential which exert deleterious influences on germination and seedling growth of rapeseed and rice. It has been reported that higher inhibitory potential of the root extract of *Trianthema* on *Andropogon sorghum* could be due to the fact that inhibitory chemical was probably synthesized in the root and then translocated to the stems and leaves (Pandit *et al.*, 1980). But Kalita and Dey (Kalita and Dey, 1998) found that higher inhibitory

activity was by shoot extract than root extract of some weeds viz. *Ageratum cenyzoides, Borreria hispida, Cynodon dactylon* and *Cyperus rotandus* on growth of rice.

Argemone mexicana is a notorious weed and is found abundantly along with many crops. The present investigation was planned to study the effect of root and leaf extracts of *Argemone mexicana* on germination and seedling growth of three crops.

Materials and Methods

The materials of the experiment were 4 varieties (Barimash-1, Barimash-2, Barimash-3 and Binamash-1) of blackgram (*Vigna mungo* L.), 3 varieties (Dhali, Tori 7 and SS 75) of rapeseed (*Brassica campestris* L.) and 4 varieties (Sourav, Gourab, Akbar and Kanchan) of wheat (*Triticum aestivum* L.).

Four concentrations (0, 20, 40 and 60 %) of root and leaf extracts of *Argemone mexicana* were used. *Argemone* plants were collected from Rajshahi University campus and the root and leaf extracts were prepared separately. The extracts were prepared by cutting *Argemone* plant parts into small pieces. For preparing 20 % extract, 20 g of each of root and leaf were soaked in 100 ml distilled water separately for 24 hours at room temperature (19-24^{O} C). In the same way 40 and 60 % extracts were prepared. In case of 0 % treatment, only distilled water was used. The laboratory bioassay was done in 10 cm diameter petri dishes with one layer of filter paper. Ten seeds of each variety were placed in each petri dish. After keeping the seeds into petri dish, 10 ml of distilled water was added to the control treatment and 10 ml aqueous extract were applied at concentrations mentioned above. The petri dishes were arranged in a randomized block design with 3 replications. On alternate days, 10 ml of distilled water was added to the control and 10 ml of aqueous extract was added to the treatment petri dishes according to the gradient.

Number of seeds germinated on each day was counted. At the tenth day, the main root length and shoot length were measured. For obtaining seedling dry weight, seedlings were kept in an oven at 60^{O} C for 48 hours. Statistical analysis was performed accordingly for all the characters by a statistical package named Irristat Version 3.1 to show the significant difference.

Results and Discussion

In case of root extract of Argemone, varietal differences were significant ($p = 0.01$) for all the four characters of blackgram, rapeseed and wheat except seedling dry weight of rapeseed. Treatment differences were significant ($p = 0.01$) for all the characters of all the three crops. Variety x treatment interactions were significant ($p = 0.05$) for all the characters of blackgram and rapeseed and in wheat only shoot length and seedling dry weight.

In case of leaf extract, varietal differences were significant ($p = 0.05$) for all the characters except main root length of blackgram, all the characters except main root length of rapeseed and all the characters of wheat. Treatment effect was significant ($p = 0.01$) for all the characters of three crops. Variety and treatment interactions were significant ($p = 0.05$) for all the characters except

seedling dry weight of rapeseed, only seedling dry weight of blackgram and in case of wheat all the characters except shoot length and seedling dry weight.

Mean effects of *Argemone* on % of germination and seedling growth are presented in Tables I, II and III respectively for blackgram, rapeseed and wheat. In blackgram, both the root and leaf extracts of *Argemone*

Table I. Mean values of germination % and seedling growth characters of blackgram as affected by root and leaf extracts of *Argemone*

Treatment	0 %	20 %	40 %	60 %	Mean	0 %	20 %	40 %	60 %	Mean
Variety	% of germination (angular values)					Main root length (mm)				
Barimash 1	80**	63	63	54	66	53	51	36	33	43
	80	63	62	55	65	53	17	15	8	23
Barimash 2	90	84	84	72	83	61	53	23	19	38
	90	84	82	74	83	61	16	13	7	24
Barimash 1	90	71	61	60	71	46	25	20	17	27
	90	70	62	61	71	46	28	16	13	26
Barimash 3	72	67	60	57	64	79	58	55	51	61
	72	67	60	57	64	79	60	41	40	55
Mean	83	72	67	61		60	47	33	30	
	83	80	75	67		60	30	21	17	
LSD 5 %	(1) 6	(2) 6				(1) 6	(2) 6			
	(1) 5	(2) 5				(1) 7	(2) 7			

Treatment	0 %	20 %	40 %	60 %	Mean	0 %	20 %	40 %	60 %	Mean
Variety	Seedling length (mm)					Dry weight/ seeding (mg)				
Barimash 1	193	178	174	155	175	193	178	174	155	175
	193	192	187	165	184	193	192	187	165	184
Barimash 2	209	184	150	131	169	209	184	150	131	169
	209	189	184	177	190	209	189	184	177	190
Barimash 1	219	185	171	139	178	219	185	171	139	178
	219	202	175	174	193	219	202	175	174	193
Barimash 3	215	185	173	152	181	215	185	173	152	181
	215	196	171	163	186	215	196	171	163	186
Mean	209	184	167	144		209	184	167	144	
	209	195	179	170		209	195	179	170	
LSD 5 %	(1) 8	(2) 8				(1) 8	(2) 8			
	(1) 10	(2) 10				(1) 10	(2) 10			

*In each pair upper value and lower values indicate effect of root and leaf extract, respectively for all tables. LSD 5 % (1) for variety and (2) for treatment

inhibited % of germination, root length and seeding dry weight of all the four varieties.

However, root extracts was more effective on shoot length and seeding dry weight, but leaf extract was more effective on root length. The inhibition was increased with the increase of concentration of the extracts (Table I).

In rapeseed, both the root and leaf extracts inhibited all the characters studied and the inhibition increased with the increase of concentration. However, leaf extract was more effective than root extract for all the characters. Seed germination in Dhali was completely checked in 60 % leaf extract. Seed of Tori 7 and SS 75 germinated, but their plumule and radicle did not develop. In

Table II. Mean values of germination % and seedling growth characters of rapeseed as affected by root and leaf extracts of *Argemone*

Treatment	0 %	20 %	40 %	60 %	Mean	0 %	20 %	40 %	60 %	Mean
Variety	% of germination (angular values)					Main root length (mm)				
Dhali	80	80	64	42	66	94	32	29	23	44
	80	80	45	-	51	94	17	-	-	28
Tori 7	90	90	67	60	77	65	25	22	13	32
	90	90	60	15	64	65	25	9	-	25
SS 75	90	54	60	57	72	61	41	37	33	43
	90	80	54	18	54	61	31	11	-	26
Mean	87	83	64	53		73	33	29	23	
	87	74	63	11		73	24	7	-	
LSD 5 %	(1) 5	(2) 8				(1) 7	(2) 9			
	(1) 4.8	(2) 5.5				(1) 7	(2) 9			

Treatment	0 %	20 %	40 %	60 %	Mean	0 %	20 %	40 %	60 %	Mean
Variety	Seedling length (mm)					Dry weight/ seeding (mg)				
Dhali	46	44	44	25	40	21	20	7	6	13
	46	28	-	-	19	21	12	-	-	8
Tori 7	56	55	44	29	46	22	20	12	10	16
	56	40	35	-	33	22	15	5	-	10
SS 75	46	45	30	28	37	20	19	6	6	13
	46	17	17	-	20	20	13	4	-	9
Mean	49	48	39	27		21	19	8	7	
	49	28	17	-		21	13	2	-	
LSD 5%	(1) 4	(2) 2				(1) NS	(2) 3			
	(1) 3	(2) 4				(1) 2	(2) 2			

*In each pair upper value and lower values indicate effect of root and leaf extract, respectively for all tables. LSD 5 % (1) for variety and (2) for treatment

40 % leaf extract, seeds of Dhali germinated, but plumule and radicle were destroyed at last (Table II).

In case of wheat, all the characters of all the varieties were inhibited by root and leaf extracts. However, root extract was more effective on germination percentage and seedling dry weight and leaf extract on main root length and shoot length (Table III). It is interesting to note that Gourab maintained higher % of germination in higher concentra-

Table III. Mean values of germination % and seedling growth characters of wheat as affected by root and leaf extracts of *Argemone*

Treatment	0 %	20 %	40 %	60 %	Mean	0 %	20 %	40 %	60 %	Mean
Variety	% of germination (angular values)					Main root length (mm)				
Sourav	77 77	55 76	55 60	40 55	57 67	142 142	105 72	87 60	70 22	101 74
Gourab	90 90	90 90	90 90	76 60	87 83	186 186	135 73	130 71	105 18	139 87
Akbar	55 55	55 55	45 55	35 50	48 54	127 127	117 70	107 69	90 17	110 71
Kanchan	76 76	60 60	55 60	55 55	62 63	160 160	117 71	114 74	90 16	120 81
Mean	75 75	65 70	61 66	52 55		154 154	118 72	109 69	88 18	
LSD 5%	(1) 8 (1) 5	(2) 8 (2) 5				(1) 13 (1) 11	(2) 13 (2) 11			

Treatment	0 %	20 %	40 %	60 %	Mean	0 %	20 %	40 %	60 %	Mean
Variety	Seedling length (mm)					Dry weight/ seeding (mg)				
Sourav	159 159	153 157	138 137	146 115	149 142	98 98	53 87	23 81	21 72	49 84
Gourab	167 167	152 156	148 153	104 115	158 147	134 134	124 121	122 128	115 97	124 132
Akbar	184 184	179 182	173 178	158 148	173 173	103 103	70 100	54 96	44 63	68 90
Kanchan	139 139	136 145	123 125	121 108	130 129	124 124	100 117	74 92	73 86	93 106
Mean	162 162	155 160	146 148	147 121	152 148	115 115	87 108	68 99	63 79	83 100
LSD 5 %	(1) 6 (1) 7	(2) 6 (2) 7				(1) 14 (1) 7	(2) 14 (2) 7			

*In each pair upper value and lower values indicate effect of root and leaf extract, respectively for all tables. LSD 5 % (1) for variety and (2) for treatment.

tions of both root and leaf extracts. This indicates that Gourab is the most tolerant variety. Akbar was the most sensitive for germination among the varieties (Table III). Similar to the present results, a number of workers have reported inhibitory effects of extract of weeds on crop plants (Pande *et.al.*, 1980; Pandya, 1975; Qudhia, *et.al.*, 1997; Kalita, 2001).

The results of the present investigation indicate that some phytotoxic substances are synthesized and stored in the root and leaf of *Argemone*. No attempt was made to isolate these substances. Further, whether these phytotoxic substances are excluded into the soil in the natural conditions is still to be determined, although in the case of weeds like *Artemisia absinthium* and *Encelia farinosa*, these phytotoxic substances are effective in natural field conditions (Funke, 1943). The decay of these roots would greatly inhibit the growth of seedlings (Whittaker, 1970). It is, therefore, suggested that *Argemone mexicana* should be removed along with the roots.

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Received : August 28, 2006;
Accepted : March 01, 2007