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Inhibition of Germination and Seedling Growth of Crops by Aqueous Extracts of Shrubs

V.S. Rathore, J.P. Singh and R.K. Beniwal

Central Arid Zone Research Institute, Regional Research Station, Bikaner 334 004, India

Abstract: The effect of aqueous extracts of arid shrubs viz., C*alligonum polygonoides*, *Haloxylon salicorni*cum and seedling growth of *Pennisetum americanum*, *Vigna aconitifolia* and *Cyamopsis tetragonoloba* were investigated. *Aqueous extracts* of shrubs inhibited germination and seedling growth of all the crops especially at higher concentrations. Inhibitory effect of shrubs on germination and seedling growth was concentration and species specific. Maximum reduction in germination and seedling growth of test crops was caused by *H. recurvum* followed by *H. salicornicum* and *C. polygonoides*.

Key words: Allelopathy, shrubs, crops, seedling, vigor, vigor index.

Allelospoly, allelopathy and allelomediation are three possible mechanisms for plant interference (Szczepanski, 1977). The role of allelopathy has been well established in natural, as well as agro-ecosystem (Rice, 1984). Recently interest in allelopathy has increased with strategies to capitalize on allelopathy for avoidance of negative impact, exploitation of stimulatory effect, management and development of allelopathic crops to suppress weeds, development of allelochemicals as herbicide or growth regulators and combination of these approaches (Einhellig, 1985).

Shrubs are integral part of arid ecosystem and important both from ecological and economic point of view. Realizing the economic and environmental benefits provided by these shrubs along with their decreasing population, now emphasis is to introduce them in various Alternate Land Use System (ALUS) in farming system perspective. Hence, this investigation was undertaken to assess the influence of aqueous extract of arid shrubs on germination and growth of arid crops.

Materials and Methods

Allelopathic effects of aqueous extracts of lana (*Haloxylon salicornicum* (Moq.) Bunge ex Boiss.), Saji (*Haloxylon recurvum* (Moq.) Bunge ex Boiss.) and phog (*Calligonum polygonoides* L.) on germination and seedling growth of three common arid crops viz., pearl millet (*Pennisetum americanum* L.K. Schum. var. HHB-67), moth bean (*Vigna aconitifolia* (Jacq.) Marechal var. RMO-40) and clusterbean (*Cyamopsis tetragonoloba* L. (Taub.) var. RGC-936) were studied. 10 g air-dried foliage of each of these shrubs was grounded separately in 100 ml of distilled water and kept at 5°C for 24 hours and then filtered. From the filtrate (10% stock solution), 7.5, 5.0, 2.5, 1.0, 0.5 and 0.1% dilutions were prepared.

Ten viable seeds of crops were kept in sterilized Petri dishes, lined with

Table 1. Effect of aqueous extracts concentration of shrubs on germination (%) of crops (after 96 hours)

Extract (%)	*Haloxylon salicornicum*			*Haloxylon recurvum*			*Calligonum polygonoides*		
	PM	MB	CB	PM	MB	CB	PM	MB	CB
Control	100	96.3	85.0	96.6	98.0	86.0	98.0	97.0	85.7
0.1	96.0	90.7	82.7	92.7	86.3	77.0	92.7	94.3	88.0
0.5	89.3	82.1	71.0	79.3	79.3	62.3	84.3	94.3	75.7
1.0	82.3	77.7	62.7	70.7	72.7	53.0	84.3	93.7	69.4
2.5	71.0	76.0	51.3	61.0	64.3	40.3	72.0	92.0	57.3
5.0	62.0	61.0	42.0	51.0	57.7	33.7	68.7	89.7	50.3
7.5	44.7	51.2	39.0	39.5	46.7	25.7	59.5	92.0	46.3
10.0	43.7	48.7	19.3	37.0	37.0	11.7	52.0	81.7	26.0
CD (P=0.05)	15.0	13.5	15.1	15.0	17.0	10.4	16.4	11.2	14.9

* PM refers pearl millet, MB refers moth bean and CB refers clusterbean.

Whatman No.1 filter paper moistened with 10.0 ml of respective concentration of the aqueous extracts prepared, and with distilled water for the control. Ten milliliter of aqueous extract and distilled water was added to each Petri dish and kept at room temperature. Control seeds were kept on distilled water. The treatments were tested in RBD with three replications. Germination was recorded after 96 hours and radicle and plumule/hypocotyl growth was recorded after 120 hours. Seedling vigor and vigor index was calculated by multiplying radicle and plumule/hypocotyl length with germination per cent, respectively.

Results and Discussion

Haloxylon salicornicum

Aqueous extract of *H. salicornicum* significantly inhibited the germination, growth and vigor of seedlings of all test crops.

Significant inhibition of germination was observed at 0.5% in moth bean and 1.0% concentration in pearl millet and clusterbean as compared to control (Table 1). At lower concentration (up to 1.0%), maximum reduction in germination was registered in clusterbean followed by moth bean and pearl millet. At higher concentrations (1.0%) magnitude of reduction in germination was clusterbean>pearl millet>moth bean. Inhibition of germination up to 77.3, 56.3 and 49.4% with 10% extract as compared to control was registered in clusterbean, pearl millet and moth bean, respectively. Seedling growth of test species was significantly inhibited by 0.1% extract of *H. salicornicum*. Inhibition of seedling growth was positively correlated with concentration. In clusterbean inhibition of hypocotyl growth was more than radicle growth. In moth bean and pearl millet, inhibition of radicle was more pronounced on radicle than plumule, particularly at higher aqueous concentration. (Table 2). Highest reduction in seedling growth was recorded in clusterbean followed by moth bean and pearl millet. Reduction in growth of plumule/hypocotyl up to 100, 97.2, 97.7% and in radicle up to 95.7, 97.3 and 93.1% at 10.0% concentration as compared to control was registered in clusterbean, moth bean and pearl millet, respectively. Reduction in vigor of seedlings increased

Table 2. Seedling growth (mm) of crops as influenced by the aqueous extracts of shrubs (after 120 hours)

Extract (%)	Pearl millet		Moth bean		Clusterbean	
	Plumule	Radicle	Hypocotyl	Radicle	Hypocotyl	Radicle
			Haloxylon salicornicum			
Control	56.7	68.7	35.7	47.3	20.3	30.3
0.1	57.7	67.7	34.2	47.9	20.5	29.7
0.5	37.3	46.9	22.3	35.7	8.7	16.0
1.0	34.4	44.7	16.2	21.0	4.7	9.0
2.5	15.3	15.0	10.0	13.3	2.0	6.0
5.0	4.7	9.5	5.7	5.3	1.3	4.0
7.5	2.3	7.1	1.7	4.0	0.3	2.0
10.0	1.3	4.7	1.0	1.3	0.0	1.3
CD (P=0.05)	8.30	8.74	4.30	5.34	1.88	4.01
			Haloxylon recurvum			
Control	58.8	45	40.3	49.0	23.5	34.3
0.1	49.7	44.7	32.2	44.7	22	29.0
0.5	31.6	15.0	17.2	28.4	11.7	18.7
1.0	28.2	16.7	9.3	28.0	5.0	7.3
2.5	7.2	8.0	5.0	17.1	2.3	5.3
5.0	4.4	3.7	3.0	6.7	2.3	4.7
7.5	1.0	2.0	0.7	3.0	0.3	1.3
10.0	0.7	1.3	0.3	2.0	0.0	1.0
CD (P=0.05)	6.49	5.64	3.25	7.36	2.06	3.55
			Calligonum polygonoides			
Control	47.7	58.0	39.6	50.0	34.7	40.0
0.1	50.0	60.0	39.6	51.7	26.4	36.3
0.5	42.7	57.3	27.5	38.0	18.7	26.7
1.0	42.1	51.7	25.9	37.3	19.7	29.3
2.5	39.6	50.1	25.3	35.7	19.5	25.7
5.0	33.3	41.7	17.5	22.3	3.7	7.7
7.5	20.3	27.7	9.4	22.3	2.3	6.3
10.0	13.1	11.0	7.4	15.0	1.3	5.7
CD (P=0.05)	11.16	13.89	7.08	10.73	5.73	5.19

with concentration of extracts and minimum vigor of seedling and vigor index was registered at 10.0% concentration in all crops (Table 3). At higher concentration (5.0% or more), maximum reduction in seedling vigor was observed in clusterbean followed by moth bean and pearl millet. The magnitude of reduction in vigor index at same concentration followed the order clusterbean>pearl millet>moth bean. More than 90% reduction in seedling vigor and seedling index of test crops was registered

Table 3. Seedling vigor and vigor index of arable crop as influenced by extracts of shrubs

AEC (%)	Pearl millet		Moth bean		Clusterbean	
	Seeding vigor	Vigor index	Seeding vigor	Vigor index	Seeding vigor	Vigor index
			Haloxylon salicornicum			
Control	686.0	567.0	455.5	343.8	257.6	172.6
0.1	653.9	557.4	434.5	310.2	245.7	169.5
0.5	418.8	333.1	293.1	183.1	113.6	61.8
1.0	367.8	283.1	163.2	125.9	56.4	29.5
2.5	106.5	108.6	101.1	76.0	30.8	10.3
5.0	58.9	29.1	32.3	34.8	16.8	5.5
7.5	31.7	10.3	20.5	8.7	7.8	1.2
10.0	20.5	5.7	6.3	4.9	2.5	0.0
			Haloxylon recurvum			
Control	434.7	568.0	480.2	394.9	249.9	202.1
0.1	414.4	460.7	385.8	277.9	223.3	169.4
0.5	118.9	250.6	225.2	136.4	116.5	72.9
1.0	118.1	199.3	203.6	67.6	38.7	26.5
2.5	48.8	43.9	109.9	32.2	21.4	9.3
5.0	18.9	22.4	38.7	17.3	15.8	7.8
7.5	7.9	3.9	14.0	3.3	3.3	0.8
10.0	4.8	2.6	7.4	1.1	1.2	0.0
			Calligonum polygonoides			
Control	568.4	467.5	485.0	384.1	342.8	297.4
0.1	556.2	463.5	487.5	373.2	319.4	232.2
0.5	483.1	359.9	358.3	259.3	202.1	141.6
1.0	435.8	354.9	349.5	242.7	203.3	136.8
2.5	360.7	285.1	328.4	232.8	147.3	111.7
5.0	286.5	228.8	200.0	156.9	38.7	18.6
7.5	164.8	120.8	205.2	86.5	29.2	10.7
10.0	57.2	68.1	122.6	60.5	14.8	3.4

at higher concentration (5.0%). Maximum inhibition of seedling vigor and vigor index was observed in clusterbean with 10.0% extract.

Haloxylon recurvum

Germination, growth and vigor of seedlings of test crops were significantly inhibited by extract of *H. recurvum*. Germination was significantly inhibited up to 5.0, 7.5 and 10.0% aqueous extract of saji in pearl millet, moth bean and clusterbean, respectively. Inhibition in germination up to 86.4, 62.2 and 61.7% as compared to control, was observed in clusterbean, moth bean and pearl millet, respectively with 10.0% extract (Table 1). *H. recurvum* strongly inhibited seedling growth of all three crops and inhibition was more pronounced at higher concentrations. However difference in inhibition of seedling growth between 2.5% and 5.0% extracts was not significant, except radicle growth of moth bean. Inhibition of seedling growth was maximum with 10.0% extract in all crops, which remained at par with 5.0% extract except radicle growth of clusterbean (Table 2). Extracts having 5.0% concentration caused 85-100% reduction in seedling growth of test crops as compared to control. Sharp reduction in vigor of seedling of crops was observed with increasing extract concentration from 0.1 to 0.5% of *H. recurvum*. At lower concentration (1.0%), maximum reduction in seedling vigor was observed in clusterbean followed by pearl millet and moth bean, however the magnitude of reduction in vigor index was clusterbean> moth bean>pearl millet (Table 3). At higher concentration (5.0%) more than 90% reduction in vigor of seedling was recorded in all crops.

Calligonum polygonoides

Aqueous extract of phog having 1.0%, 2.5% and 10.0% caused significant inhibition of germination in clusterbean, pearl millet and moth bean, respectively. Further, difference in inhibition of germination between 2.5% and 7.5% extract was non-significant (Table 1). At 10.0% concentration. Maximum inhibition of germination was recorded in clusterbean (69.7%) followed by pearl millet (46.9%) and moth bean (15.8%). Extracts of *C. polygonoides* inhibited seedling growth of all the test species and inhibition was significant at 0.5% extract in legumes and 5.0% in pearl millet. Difference in seedling growth between 0.5 and 2.5% was non-significant in all test species. Inhibition of seedling growth was maximum with 10.0% extract (Table 2). Maximum inhibition was recorded in clusterbean followed by moth bean and pearl millet. In legumes, the inhibition of hypocotyl was more than radicle.

More than 5.0% extracts showed 52-96% reduction in seedling growth of test crops. Increasing concentration from 0.1 to 0.5% resulted in sharp reduction in seedling vigor and vigor index of test crops (Table 3) and the reduction was maximum in clusterbean.

Results indicate that aqueous extracts of arid shrubs have inhibitory influence on arable crops, which is concentration and species specific. Extent of inhibition of germination, growth and vigor of seedlings of test crops by aqueous extracts of *H. recurvum* and *H. salicornicum* was more than *C. polygonoides* and it was more pronounced on legumes as compared to pearl millet. The effect on germination and seedling growth may be due to presence of allelochemicals in arid shrubs. Hence, there is need to fine tune management practices for introduction of shrubs in ALUS to minimize negative impacts.

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