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STUDIES ON GERMINATION AND ALLELOPATHIC POTENTIAL OF HORSE PURSLANE (*TRIANTHEMA PORTULACASTRUM* L.)

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SUMMARY

Seedling emergence of horse purslane as influenced by depth of seeding and its allelopathic effect on germination and seedling growth of wheat, chickpea and mustard was studied in pot culture and laboratory conditions. Maximum seedling emergence (26.76%) was observed at 2.0 cm seeding depth. Higher level of plant residue (4.0 t/ha) significantly reduced the germination of chickpea and mustard but not of wheat. Plant extracts or aqueous leachates did not show any toxic effect on germination of wheat, however, their effects on root and shoot growth of all the test crops was stimulatory as well as inhibitory. Among various test crops, wheat showed highest tolerance to this weed as compared to chickpea and mustard.

Key words **: Allelopathy, aqueous extracts, horse purslane, leachates, seeding depth**

INTRODUCTION

Horse purslane, known as carpet weed (*Trianthema portulacastrum* L.), is a prostrate or procumbent annual succulent herb and belongs to the family Aizoaceae. Seeds of this weed are very minute and hard. They may not germinate if placed deeply in the soil. It is the major weed during summer season in the irrigated area and rainy season in the up land crops and offers a stiff competition to the crop plants for nutrients and moisture during the early phase of crop growth. It produces more than 1000 kg/ha dry matter in 55 days after maize planting (Kumar 1983) and thus, may affect the germination and seedling growth of subsequent crops. Its dense stand and luxuriant growth indicates that the weed has some allelopathic effects on the germination and growth of associated weeds and crop (Gupta *et al.* 1992). This weed has been reported to reduce the yield of cotton by 35% and delay in maturity (Guantes and Mercado 1975). Thus, the present study was conducted to study the effect of seeding depth on germination of this weed and its allelopathic effect on the subsequent crops.

MATERIALS AND METHODS

The seeds of horse purslane were collected during May 2000. Two pot culture and one laboratory experiments were conducted at the National Research Centre for Weed Science, Jabalpur during *kharif* 2000 and *rabi* 2000-01. The materials used and methods followed in these experiments were followings.

Effect of seeding depth on seedling emergence of horse purslane

Pots (size 36 cm x 27 cm) were uniformly filled with soil, sand and farm yard manure in the ratio of 2:1:1. Ten seeds of horse purslane were sown at varying depths

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(surface 1, 2, 3, 4, 5 and 6 cm). Pots were irrigated immediately after sowing to ensure proper seed germination. Treatments were replicated 4 times in a completely randomized design (CRD). Observations on seedling emergence were recorded at 30 days after sowing (DAS).

Residual effect of horse purslane on seedling emergence of subsequent crops

To study the residual effect of horse purslane on germination of subsequent winter season crops, plants grown during the experiment no. 1 were allowed to grow up to 90 DAS and thereafter removed from the surface leaving roots as such in the pots. Plants were dried and ground in a mechanical grinder. Treatments comprised of four levels of residues (control, root residues left as such of previous season, 2.0 and 4.0 t/ha) and three winter season crops *viz.*, wheat, mustard and chickpea were replicated five times in CRD. To get the residue at 2.0 and 4.0 t/ha, dry powder of the weed was added in pots (filled with soil, sand and farm yard manure in the ratio of 2:1:1) and mixed up to 10 cm depth. Ten seeds of each crop were sown in the pots on 17th Nov., 2000. Pots were irrigated immediately after sowing to ensure proper seed germination. The seedling emergence was counted at 20 DAS.

Allelopathic effects of horse purslane on germination and seedling growth of winter crops

Preparation of fresh extract: Horse purslane plants were collected from the field at flowering stage, washed well with distilled water to remove dust and blot-dried. One hundred grams of chopped pieces were ground with 200 ml distilled water. The paste was then placed in a bag of fine cloth and the extract was squeezed out. The extract was centrifuged at 5000 rpm for 10 minutes and supernatant was considered as 50% (w/v) extract. It was further diluted with distilled water to desired concentrations of 6.25, 12.5 and 25% and used for petri dish biossay.

Preparation of aqueous leachates: The whole plant samples as collected above were sun dried and ground separately in a mechanical grinder. The powder was sieved through a 2 mm sieve. Ten grams of dry powder was soaked in 100 ml distilled water for 48 hours at room temperature (25ºC) and the leachates were squeezed out through layers of cheesecloth followed by filteration through three layers of Whatman No. 1 filter paper. The leachates were further centrifuged at 5000 rpm for 15 minutes to remove the suspended matters and the supernatant liquid was used as 10% (w/v) leachate. It was diluted with distilled water to desired concentrations of 1.25, 2.5 and 5% and stored in dark in conical flasks, until required.

Bioassay: Twenty-five seeds of test species (wheat *cv*. WH-147; Chickpea *cv*. JG-315 and mustard *cv*. Pusa bold) were placed in sterilized petri dishes lined with three layers of Whatman No. 1 filter paper. Ten-ml leachate of desired concentrations and distilled water (as control) per petri plate were added on the first day and incubated in a seed germinator at 20 ± 1ºC temperature and 90 ± 2% relative humidity. Moisture in the petri dishes was maintained by adding 2 ml of extract or distilled water as required. The seed germination, radicle and plumule growth were recorded 7 days after sowing.

RESULTS AND DISCUSSION

Effect of seeding depth on seedling emergence

In general the seedling emergence of the horse purslane was poor. This may be due to use of fresh seeds, which have hard seed coat dormancy (Tadulingam and Venkatanarayana 1932). Seedling emergence increased from surface (3.33%) to 2.0 cm seeding depth (26.67%) and thereafter it declined sharply at 3.0 cm depth (3.33%) (Fig. 1). There was no seedling emergence below 4.0 cm depth. Decreased seedling emergence at higher depths (beyond 4.0 cm) might be due to mechanical impedance, poor aeration and shorter length of coleoptile

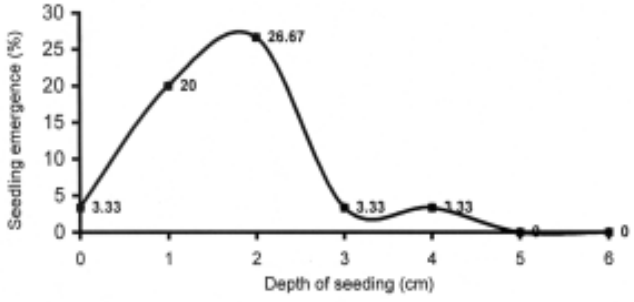

Fig. 1. Effect of seeding depth on seedling emergence of horse purslane

of the weed. Decreased emergence from the surface may be due to poor seed-soil contact. Similar findings were reported by Balyan and Bhan (1986).

Effect of horse purslane residue

The various residue levels did not influence the germination of wheat, however, showed significant effects on the germination of chickpea and mustard (Table 1). There was a slight stimulation (3.70%) of chickpea germination due to root residue but it was at par with shoot residue at 2.0 t/ha and control. Higher levels of shoot residue (4.0 t/ha) significantly decreased the germination of chickpea. Similarly in mustard, there was a slight inhibition (4.0%) in seed germination due to root residue and stimulation (20.0%) due to lower level of shoot residue, but the differences were not significant as compared to control. Higher dose of shoot residue caused 16% inhibition of germination.

Table 1. Residual effects of horse purslane on germination of wheat, chickpea and mustard. The values in parentheses indicate % inhibition (-) or stimulation (+) over control.

Residue levels	Winter crops		
	Wheat	Chickpea	Mustard
Control	100	90.0	83.3
Root residue	100	93.3	80.0
		(+3.70)	(-4.0)
Shoot residue @ 2.0 t/ha	100	90.0	100
		(0.0)	(+20.0)
Shoot residue @ 4.0 t/ha	100	60.0	70.0
		(-33.3)	(-16.0)
LSD (P=0.05)	NS	17.2	25.5

Effect of fresh plant extracts

Increasing concentration of fresh plant extract did not influence the germination of wheat significantly (Table 2) whereas the germination of chickpea and mustard was significantly reduced at concentrations more than 12.5%. There was no germination in chickpea but mustard showed 22.7% germination at 50% extract concentration. Root growth of wheat and chickpea reduced significantly with increasing concentration, but at 6.25% it was slightly stimulatory (4.5%) in wheat and was comparable to control. Root length of mustard was not affected significantly up to 25% extract concentration, however, there was complete inhibition of root growth of chickpea and mustard at 50% concentration. Shoot growth of wheat increased up to 12.5% concentration and thereafter it decreased significantly. Shoot growth of chickpea decreased with increasing levels of extract concentration, though the difference was significant only at 25% and beyond. In case of mustard, the extract was stimulatory up to 25% concentration, while, at 50% concentration, it caused 91.38% inhibition in shoot growth.

Effect of aqueous leachates

The dry plant aqueous leachate up to 5% concentration was found to be non-toxic for germination of wheat (Table 3). Further increase in concentration (10%) significantly inhibited the seed germination (19.33%). Successive increase in leachate concentration from 1.25 to 10% significantly reduced the germination of chickpea from 32.33 to 91.67%. The germination of mustard was slightly stimulated (3.67%) at 1.25% concentration but was at par with control. Further increase in concentration significantly reduced the germination. There was no seed germination at 10% concentration. The leachate had both stimulatory and inhibitory effects on the root and shoot growth. Root length of all the test crops increased up to 2.5% concentration except in chickpea where it increased up to 1.25% concentration. Increasing leachate concentration beyond 2.5% significantly inhibited the root length of all the crops and there was complete root inhibition of chickpea and mustard at 10% concentration. The shoot length of wheat and mustard increased significantly up to 2.5% concentration as compared to control. Further increase in leachate concentration significantly reduced the shoot length of both the crops. However, the shoot length of chickpea decreased significantly with successive increase in leachate concentrations and ceased completely at 10% concentration. Injurious effect of horse purslane on germination and seedling growth of radish, wheat, pigeonpea (Gupta *et al*. 1992) and sorghum (Soni 1979, Gupta, *et al*. 1992) has also been reported.

Table 2. Effect of fresh plant extracts of horse purslane on germination and seedling growth of wheat, chickpea and mustard. The values in parentheses indicate % inhibition (-) or stimulation (+) over control.

Extract concentration	Germination (%)			Root length (cm)			Shoot length (cm)		
(%)	Wheat	Chickpea	Mustard	Wheat	Chickpea	Mustard	Wheat	Chickpea	Mustard
Control	100.0	96.3	83.3	11.0	6.2	6.2	9.6	2.4	5.8
6.25	99.3	99.3	83.3	11.5	5.0	5.6	13.0	2.0	6.6
	(-0.67)	(+3.11)	(0.0)	(+4.5)	(-19.35)	(-9.68)	(+35.42)	(-16.67)	(+13.79)
12.5	98.0	93.0	70.0	8.0	4.5	5.5	12.6	2.0	6.9
	(-0.20)	(-3.46)	(-15.97)	(-27.27)	(-27.42)	(-11.29)	(+31.25)	(-16.67)	(+18.97)
25	98.0	48.7	64.7	4.1	1.10	5.2	8.7	1.7	6.6
	(-0.20)	(-49.46)	(-22.36)	(-62.7)	(-82.26)	(-16.13)	(-9.37)	(-29.17)	(+13.79)
50	98.0	0.0	22.7	1.6	0.0	0.0	4.0	0.0	0.5
	(-0.20)	(-100.0)	(-72.78)	(-85.4)	(-100.0)	(-100.0)	(-58.33)	(-100.0)	(-91.38)
LSD (P=0.05)	NS	7.4	7.0	1.4	0.66	2.8	1.0	0.60	1.4

Table 3. Effect of dry plant leachates of horse purslane on germination and seedling growth of wheat, chickpea and mustard. The values in parentheses indicate % inhibition (-) or stimulation (+) over control.

Extract concentration	Germination (%)			Root length (cm)			Shoot length (cm)		
(%)	Wheat	Chickpea	Mustard	Wheat	Chickpea	Mustard	Wheat	Chickpea	Mustard
Control	100.0	100	90.67	10.7	5.9	6.8	10.2	4.6	5.0
1.25	100	67.67	94.0	14.6	7.1	7.6	13.7	3.0	7.6
	(0.0)	(-32.33)	(+3.67)	(+36.4)	(+20.34)	(+11.76)	(+34.3)	(-34.78)	(+52.0)
2.5	100	60.00	80.0	16.3	4.7	7.8	14.5	2.4	8.3
	(0.0)	(-40.0)	(-11.77)	(+52.37)	(-20.3)	(+14.70)	(+42.16)	(-47.83)	(+66.0)
5	99.33	40.0	22.33	3.3	1.2	1.3	8.3	0.3	0.90
	(-0.67)	(-60.0)	(-75.37)	(-69.16)	(-79.66)	(-80.88)	(-18.6)	(-93.48)	(-82.0)
10	80.67	9.33	0.0	1.0	0.0	0.0	3.1	0.0	0.0
	(-19.33)	(-91.67)	(-100.0)	(-90.35)	(-100.0)	(-100.0)	(-69.6)	(-100.0)	(-100.0)
LSD (P=0.05)	2.66	3.61	7.07	1.8	3.1	2.8	2.7	1.9	1.7

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