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INFLUENCE OF COMMON PURSLANE AQUEOUS EXTRACTS ON GERMINATION AND SEEDLING GROWTH OF RICE

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Aqueous extracts of various parts of leaf, stem and root of common purslane were evaluated alone or in combination with NaC1 to see their effects on germination and seedlings growth of rice. Leaf and stem extracts have no effects on germination, while the root extract alongwith 0.4% NaC1 decreased the rice seed germination. However, length of both shoot and root were significantly decreased under extracts alone or in combination with NaC1 levels. Root growth was affected more than the shoot irrespective of the treatments.

Key words: Common purslane, Aqueous extracts, Rice.

Introduction

Common purslane (*Portulaca oleracea* L.) is an annual and very common weed in warm areas (Horowitz 1971). The common purslane, locally known as kulfa or lunak is commonly found in maize and berseem fields as well as along the sides of canals. The allelopathic effects of this weed on crop growth have been reported in a number of studies (Alam *et al* 1990,1997,1998,2001a; Anaya *et al* 1987).

The aqueous extract of common purslane inhibited the seed germination, coleoptile and root growth of Mida wheat (*Triticum aestivum*) in an earlier investigation (Le Tourneau *et al* 1956). They reported that pH and osmotic potential of the extract was not responsible for reduction. Gressel and Holm (1969) found that weed seeds of purslane reduce the seed germination and growth of alfalfa and radish due to release of allelochemicals. Pope *et al* (1984) found that root exudate of common purslane significantly reduced the seedling growth of soybean, root growth of radish and tomato. Using different weed's parts on the growth of wheat, it was found that germination, shoot and root lengths significantly reduced with aqueous leaf, stem and root extracts of scarlet pimpernal and bermuda grass (Alam *et al* 2001b, 2001c).

Using several weed parts, in a short term experiment, Alam (1996) has reported that parts of weed are; common lambsquarter, bermuda grass, purple nutsedge, common purslane, field bindweed etc have reduced the germination and seedling growth of wheat and rice. Anaya *et al* (1987) reported that leachate of fresh common purslane produced high inhibition of radicle growth of corn, bean and squash. It was observed that shoot and root leachates of common purslane caused the greatest reduction in seed germination. Shoot leachate caused greater reduction in seedling growth as compared with root leachates. Phenolics such as coumorin benzoic and ferulic acid were found in the extract (Dharmaraj *et al* 1988). In a bioassay test common purslane showed an allelopathic potential against clover (*Trifolium repens*) and lettuce (Souto *et al* 1990). This study was therefore, carried out to evaluate the effects of different parts of common purslane on the seed germination and seedling growth of rice.

Materials and Methods

The common purslane plants were collected, washed with distilled water and dried in an oven at 70°C for 24 h. Each plant was separated into leaf, stem and root . They were dried in the oven at 70°C for 48 h. The dried samples were ground in a Wiley mill to pass through a 20 mesh screen. The aqueous extracts of leaf, stem, root were prepared by soaking 5 g of powdered materials of each part separately in 100 ml of distilled water for 24 h. The extracts were filtered using whatman filter paper no. 42 and kept in reagent bottles. Five ml of the filtered aqueous extracts each of leaf, stem and root from the filtered solution were added separately to 0.08% agar gel supplemented with the levels of 0.0, 0.2 and 0.4% NaCl. Fifty ml of the agar media of each treatment was poured into a series of glass bowls. A similar set, but without leaf, stem and root extracts were prepared to determine the NaC1 affect alone, while the bowls with only 0.8% agar were considered as control. Rice seeds of Shua-92 were surface

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sterilized with 1% sodium hypochlorite for 3min and then rinsed with water. Ten healthy seeds of rice were planted in each bowl on the surface of the solidified agar contained in each bowl in a circle with the embryo side up and pointing inwards. The bowls were then covered with petri-dishes and kept in a completely randomized design with 4 replicates. The experiment was terminated after 5 days of growth. The germinated seeds were counted. Shoot and root lengths were measured and their dry weights were recorded. The data were analyzed statistically to see the treatment effects using standard deviation test.

Results and Discussion

The leaf extract had no effect on seed germination Table 1. The leaf extract alone had no effect on shoot length, but leaf extract in combination with NaC1 reduced the shoot length by 45.3 and 55.7% as compared to control Table 1. The root growth was affected in a similar way and extract with NaC1 levels reduced the root length by 67.0 and 90.8% over the control. The NaC1 level (0.4%) alone reduced the root length by 40.1%.

The stem extract alongwith NaC1 had no effect on seed germination. However, the stem extract alone significantly reduced the shoot length by 75.0%. Similarly, the extract in combination with NaC1 level (0.2 and 0.4%), reduced the shoot length by 81.7 and 85.2%, respectively compared to control. NaC1 levels alone reduced the shoot length by 15.9 and 43.3%. Root length followed the similar pattern and with similar treatments markedly reduced the root lengths by 89.9, 98.6 and 97.8%, respectively compared to control. NaC1 treatments alone reduced the root length by 13.9 and 23.4% Table 1.

The root extract in combination with 0.4% NaC1 significantly reduced the seed germination of rice, while, other treatments had no effect on rice seed germination. The root extract alone reduced the shoot length by 17.9% and in combination with 0.2 and 0.4% NaCl levels by 41.2 and 39.6% campared to control. NaCl levels reduced the shoot length by 8.3 and 33.1%. Similarly, root extract alone reduced the root length by 71.2% and alongwith NaC1 levels by 71.4 and 69.3%, respectively, compared to control. NaC1 level had milder effect on root length of rice plant Table 1.

In the present experiment, leaf and stem extracts have no effect on seed germination, while root extract alongwith NaC1 treatment significantly reduced the rice seed germination. Seed germination of a crop is considered to be the most critical stage especially understress conditions. From the interference viewpoint, allelopathy is an important phenomenon in seed germination and seedling emergence through weed-crop interaction. Plants are known to exhibit allelophathy by releasing water-soluble phytotoxins from leaves, stems, roots, fruits and seeds. Such metabolites play inhibitory role in delay or complete inhibition of seed germination, stunted growth and injury to root systems (Rice 1984). Seed germination as a bioassay for allelopathic effect does not seem to provide a conclusive evidence. There are so many factors involved in the germination process itself that uniformity and reproducibility of results should be exception rather than a rule. The difficulties with seed germination test have been encountered by scientists working in the field of salinity, drought, and radiation sensitivities.

In the field of allelopathy, the difficulty in using seed germination as a bioassay has been appreciated. Leather and Einhelling (1985) reviewed various techniques used for seed germination tests and concluded that many factors like temperature, light/dark cycle, oxygen availability, toxic products, value of the solution, osmotic potential and other interferences of the growth media may modify the results. The main and only reason seems to be the ease with which it can be performed. In the present study, every effort was made to perform the experiment under controlled conditions, but the results suggest that neither the salinity nor the combination of leaf and stem aqueous extracts had any inhibitory effect on the seed germination. However, the reports on the inhibition of germination by plant extracts are not lacking.

One interesting phenomenon, which has the effect on the final result is the sterilization of seeds and growth media. This has clearly been demonstrated by the study of Martin *et al* (1990), who found no effect of crop residues on corn seed germination understerile conditions, but under non-sterile conditions a significant inhibition in germination was recorded. Another factor, which has been shown to affect the results, is the osmotic potential of the medium. Buchanan *et al* (1980) found that osmotic potentials of -1.8 atm. (approx. 148 millimoles for mannitol solution), had no influence on germination of the two terrestrial grasses and three cereals they examined. Cheng and Riemer (1980) found that osmotic potential of less than 70 millimoles does not seem to affect lettuce seed germination. Most extracts had osmotic potentials higher than -2 bars, which was not an osmotically inhibitory concentration. They concluded that growth inhibitions caused by the extracts were possible due to organic materials present in the extracts. Leather and Einhellig (1985) considered 150 millimoles to be germination inhibitory and extract of 4 g of dried sunflower tissue in 100 ml of water was found to have the osmotic potential of 150 millimoles. It seems that in their studies either the os-

Table 1
Effect of aqueous leaf, stem and root extracts of common purslane and NaC1 on germination and seedlings growth of rice

Growth parameters	Control (no extract, no. NaC1)	Extract alone	0.2% NaC1	0.2% NaC1 + extract	0.4% NaC1	0.4% NaC1 + extract
			Leaf extract			
Germination (%)	85.00±12.91	83.00±05.00	90.00±14.14	87.00±05.77	92.00±09.57	87.00±09.57
Shoot length (cm)	03.09±00.40	03.25±00.41	02.94±00.17	01.69±00.20	02.59±00.47	01.37±00.10
	(-)	(+5.2)	(-4.9)	(-45.3)	(-16.2)	(-55.7)
Root length (cm)	04.79±00.35	04.87±01.08	05.16±00.56	01.58±00.48	02.87±00.30	00.44±00.07
	(-)	(+1.7)	(+7.7)	(-67.0)	(-40.1)	(-90.8)
			Stem extract			
Germination (%)	78.00±17.07	85.00±10.00	95.00±10.00	82.00 ±12.58	85.00±10.00	82.00±18.90
Shoot length (cm)	03.72±00.13	00.93±00.17	03.13±00.16	00.68±00.17	02.10±00.40	00.55±00.10
	(-)	(-75.00)	(-15.9)	(-81.7)	(-43.3)	(-85.2)
Root length (cm)	07.26±00.57	00.73±00.14	06.25±00.17	00.10±00.02	05.56±01.06	00.16±00.03
	(-)	(-89.9)	(-13.9)	(-98.6)	(-23.4)	(-97.8)
			Root extract			
Germination (%)	90.00±08.20	85.00±5.77	87.00±09.57	70.00±08.06	75.00±09.57	52.00±09.57
	(-)	(-6)	(-3)	(-22)	(-17)	(-42)
Shoot length (cm)	05.20±00.39	04.27±00.62	04.77±00.37	03.06±00.52	03.48±00.18	03.14±00.06
	(-)	(-17.9)	(-8.3)	(-41.2)	(-33.07)	(-39.6)
Root length (cm)	10.06±00.67	02.90±00.67	09.90±00.82	02.88±00.09	09.64±00.59	03.03±00.28
	(-)	(-71.2)	(-1.6)	(-71.4)	(-4.1)	(-69.8)

Figures in parenthese indicate % increase (+) or decrease (-) over control

motic value did not reach the expected high value or the test plants used were tolerant to high osmotic potential.

The literatures cited above, give information about the osmotic potential of the extract and the effect it may have had on germination. If liberty is taken to extrapolate their results to the plant materials used by the authors quoted above, it would be safe to assume that the order of magnitude of osmotic potential would be around 150 millimoles in all cases, where 5g of plant material was used. In case of concentration higher than 5g, higher osmotic potential may be expected. In all such cases, the effect reported was perhaps not allelopathic, but osmotic.

In the present experiment, both shoot and root lengths of rice seedlings were significantly decreased in all treatments compared to control. The leaf extract of common purslane alone had no effect on shoot length compared to control. However, the shoot length in combination with 0.2 and 0.4% NaC1 levels reduced the shoot length compared to control. The NaC1 salinity levels (0.2 and 0.4%) alone slightly reduced the shoot length by compared to control Table 1. The aqueous leaf extract of common purslane had severe inhibitory effects on root length and reduced the root length by 73.5%. In a similar manner, the aqueous leaf extract in combination with salinity levels reduced the root lengths compared to control. Salinity levels (0.2 and 0.4% NaC1) alone reduced the root lengths and their effects were lower than the effects of leaf extract alone or in combination Table 1. This indicated that the inhibitory effect was due to some water-soluble phytotoxins released from the leaf residue. Theoretically, it was thought that the presence of weed would intensify the effect of salinity as both have deleterious effect. Under the two saline levels, common purslane both generally intensified the effect of salinity. Unfortunately, no one seems to have studied the effect of salinity in combination with common purslane, which is so important in areas, where salinity is a persistent problem. Overall, the root length was affected more than the shoot, irrespective of treatments. This may be due to the fact, that they were indirect contact with the allelochemicals, which may not have been translocated rapidly to the shoot. Some workers have reported that leaf aqueous extract caused injury, if the extract was indirect contact with or present in the immediate vicinity

of the plant roots. Leather and Einhellig (1985) found seedling growth bioassay often to be more sensitive than germination bioassay. A concentration of as low as 1/25th required for seed germination inhibition was reported to be sufficient to inhibit radicle elongation.

Mckee *et al* (1971) studying the effect of leachate of 'Penngift' Crownvetch (*Coronilla varia* L.) on 48 plant species tested found the root length to be affected more than shoot length. They also found seedling growth to be more sensitive to osmotic potential than germination. In some cases, osmotic potential of as low as -1 bar was sufficient to retard the seedling growth, whereas, an osmotic potential of -8 bar did not inhibit the germination significantly. Bieber and Hoveland (1968) also found seed germination of crownvetch to be less affected than radicle elongation. In the present study, the root growth was found to be more sensitive compared to shoot growth and germination at the dilution used. Interestingly, root growth showed greater sensitivity than shoot growth. The allelopathic effects of most of the weeds studied on the growth and development of crop plants have been reported. Le Tourneau *et al* (1956) reported reduction in both shoot and root lengths of wheat when grown in 2% (w/v) extract of a common purslane. Bhowmik and Doll (1984) found that water extract of residues of common purslane inhibited the root and shoot growth of corn and hypocotyl growth of soybean.

Anaya *et al* (1987) studied corn, bean and squash and found high inhibitory effects of common purslane on their radicle growth. Satoh *et al* (1989) found that stem length of cucumber was reduced by the addition of leaf powder of purslane in the medium. Reduction in the growth of cucumber plants grown in a medium containing common lambsquarters was assumed to be caused by the increase of osmotic pressure and by growth inhibiting substances released from the leaves. Bukolova (1971) studied wheat, rye and garden cress (*Lepidium sativum* L.) and found a reduction in mitotic activity in roots. It is therefore, concluded that leaf and stem extracts have no effect on germination, while root extract in combination with highest NaC1 level reduced the germination. However, leafstem and root extracts are in combination, significantly with the growth of rice seedlings under present experimental conditions. Root growth was affected more than the shoot. It is therefore, concluded that aqueous extracts of leaf, stem and root of common purslane alone or in combination with NaC1 significantly reduced the shoot and root length of rice. Root growth was affected more than the shoot. It is, therefore, very important to uproot this weed by hand from the experimental field at the early stage of its appearance.

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