

Phytotoxic Effect Of Aqueous Extracts of Different Plant Parts Of Sphaeranthus Indicus On Germination And Seedling Growth Of Eleusine Coracana

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Abstract

Background

The phytotoxic influences of water extract of different plant parts of *Sphaeranthus indicus* (Burandu) were tested by growing test crop of *Eleusine coracana* (Nagli) for seedling growth. Significant differences in the growth of the test crop were observed.

Result

The hypocotyl growth of test crop depressed significantly at high concentration (6%) aqueous extract of different plant parts of *S. indicus* was found after 10 days. Redicle length of Nagli crop was stimulated in 2% shoot aqueous extract of *Sphaeranthus indicus* whereas other concentrations of all aqueous extracts of Burandu weed show phytotoxic effects as compared to control after ten days. Shoot and Root dry weights of food crop were reduced by Burandu residue.

Conclusion

Test crop Nagli was more sensitive to root aqueous extract while less sensitive to shoot aqueous extract of *Sphaeranthus indicus*.

Background

The term allelopathy was introduced by Molisch in 1937 and is derived from Greek words allelon of each other and pathos to suffer and mean the injurious effects of one upon the other. Allelochemicals are present in virtually all plant tissue, including leaves, flowers, fruit, roots rhizome, seed and pollen. In the current work, the effects of leaf aqueous extract of certain weeds are studied on seed germination of a common wheat crop.

“Allelopathy has been defined as the inhibitory or stimulatory effects of a plant or microorganism on other plants through the release of chemical compounds into the environment.” Allelopathic interactions between plants have been studied in both managed and natural ecosystems.

Weeds are one of the most serious problems in agriculture production. The identification of harmful and beneficial weeds can be done by studying their allelopathic effects on crops. Several workers have shown that allelopathy plays an important part in weed and weed interaction (Rejila and Vijayakumar, 2011; Eyini M, Jayakumar M, Pannirselvam S, 1989; Oudhia P, SS Kolhe and RS Tripathi, 1998 and Oudhia P. 1999) and weed/ crop interaction (Akmal M, Vimala and Aslam,) Survey conducted on a diversity of ruderal vegetation of several plants showed that in the vicinity of several plants no plants were present or very few plant species were able to survive. Some plants are *Lantana camara*, *Eupatorium odoratum*, *Alternanthera sessilis*, etc .

The allelochemicals in a weed may occur in all plant parts or may remain concentrated in roots, rhizomes, stems, leaves, flowers, inflorescence, pollen, fruits or seeds. They may be released in the environment through volatilization, leaching, root exudates or decomposition of residues. The amount of allelochemicals in a plant or a plant part has been reported to depend upon radiation, the mineral status of soil, temperature, presence of other allelopathic agents in the environment, age of plant parts, presence of pathogens and predators and also on the genetic characteristics of the plants (Rice 1984).

Sphaeranthus indicus is a spreading weed that belongs to the family Compositae and is found especially in the Nagli crop fields. The allelopathic effect of this weed was not studied on major crops especially on Nagli crop so far. The present study was, therefore carried out to intending to know the effects of this weed on germination and seedling growth and in turn to identify some of the allelopathic substances that are present in *S. indicus* and to assess the level of phytotoxicity. The present investigation was carried out to further test the allelopathic nature of Burandu against Nagli crop to determine the phytotoxic effect of aqueous extracts of *Sphaeranthus indicus* (Burandu) weed species on seed germination and seedling growth of *Eleusine coracana* (Nagli).

Methods

Materials

Aqueous extract of different parts of Burandu was prepared by digesting 10 gm of air-dried plant material in 100 ml of distilled water for 24 h at $25^{\circ}\text{C}\pm 3^{\circ}\text{C}$. It was filtered through Whatmann filter paper no. 1 of the volume of the filtrate made to 100ml (Dhavan and Narwal, 1994). Different dilutions such as 2%, 4% & 6% of the extract were prepared from this stock solution.

The seeds of Nagli crop were soaked for 24h in different concentrations of the extracts for seedling growth. For control seeds were soaked in distilled water only. The seeds of crop sterilized by dipping in the solution of 0.1% HgCl_2 (Mercury chloride) for 1 min followed by 3-4 washing under running tap water to remove residues of HgCl_2 and dried in folds of ordinary filter papers. In each Petri dish containing Whatmann no. 1 filter paper was kept at the bottom and thereafter 10 seeds arranged at equal distance on the top of the filter paper. The Petri dishes were covered with glass covering. The whole set of experiments was kept undisturbed at room temperature of $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$. Treatments were arranged in a completely randomized design with four replications. Grown shoot and root branches of Nagli were oven-dried for 72 hours and then their dry weight was measured.

Results And Discussions

The phytotoxic effects of water extract of different plant parts of *Sphaeranthus indicus* (Burandu) on test crop *Eleusine coracana* (Nagli). The observations have been presented in tables and graphs.

Hypocotyl Growth: For hypocotyl length of test crop (Nagli) was tested under 2%, 4% & 6% of the aqueous extract of Burandu and control. In Nagli it was only the various concentrations (2%, 4% & 6%) of root extract of Burandu which decreased shoot lengths i.e. 0.99 cm, 0.58cm and 0.29cm respectively indicating the reduction of hypocotyl growth 55.62%, 73.99% and 86.99% respectively as compared to the control (2.23cm) after ten days. High concentration (6%) in not only the root extract but also in the leaf and inflorescence aqueous extracts which decreased shoot lengths i.e. 0.39cm and 0.48cm respectively indicating the reduced hypocotyl growth 82.51% and 78.48% respectively as compared to the control (2.23cm) after ten days.

It concludes that when the increasing concentration of weed extracts the shoot lengths were decreased. Shoot aqueous extract of *Sphaeranthus indicus* (Burandu) does not show any effects on the hypocotyl growth of *Eleusine coracana* (Nagli). The most toxic effect in hypocotyl growth of Nagli was found is that root aqueous extract followed by another aqueous extract (Table-1). These findings are supported by Chung and Miller (1995).

Radicle Growth: For radicle length, *Eleusine coracana* (Nagli) crop was tested under 2%, 4%, and 6% concentrations of aqueous extract made from different plant parts of *Sphaeranthus indicus* and control. Radicle length of Nagli crop in 2% shoot aqueous extract of *Sphaeranthus indicus* was stimulated 6.17%. Radicle growth of Nagli was reduced significantly i.e. 0.54cm, 0.43cm and 0.53cm at high concentration (6%) of aqueous extract made from different plant parts (Leaf, Root and Inflorescence respectively) except shoot of *Sphaeranthus indicus* indicating the reduction of radicle growth 83.33%, 86.73% and 83.64% respectively as compared with control (3.24cm) after ten days. Similarly, other values of radicle length decreased with increasing aqueous concentration (Table 2).

Table 1
Effects of various concentrations of aqueous extract of different plant parts made from *Sphaeranthus indicus* weed on the shoot length of 10 days old test crop seedlings.

Plant Parts	Leaf	Root	Shoot	Inflorescence
Concentration	CM (Mean ± SD)			
Control (DDW)	2.23 ± 0.77	2.23 ± 0.77	2.23 ± 0.77	2.23 ± 0.77
2%	1.67 ± 0.95	0.99 ± 0.33	2.21 ± 0.61	1.89 ± 0.38
4%	0.87 ± 0.48	0.58 ± 0.39	2.09 ± 0.57	0.97 ± 0.65
6%	0.39 ± 0.29	0.29 ± 0.30	1.86 ± 0.46	0.48 ± 0.32
SD = Standard Deviation DDW = Double distilled Water				

Table 2

Effects of various concentrations of aqueous extract of different plant parts made from *Sphaeranthus indicus* weed on the root length of 10 days old test crop seedlings.

Plant Parts	Leaf	Root	Shoot	Inflorescence
Concentration	CM (Mean \pm SD)			
Control (DDW)	3.24 \pm 0.773	3.24 \pm 0.773	3.24 \pm 0.773	3.24 \pm 0.773
2%	2.22 \pm 0.588	1.91 \pm 0.448	3.44 \pm 0.640	1.82 \pm 0.399
4%	1.31 \pm 0.595	1.73 \pm 0.566	2.27 \pm 0.497	0.94 \pm 0.386
6%	0.54 \pm 0.401	0.43 \pm 0.330	1.71 \pm 0.681	0.53 \pm 0.298
SD = Standard Deviation DDW = Double distilled Water				

Root length was relatively more sensitive to autotoxic allelochemicals than was shoot length. These results are in agreement with earlier studies reporting that water extracts of allelopathic plants were more pronounced effects on radicle growth than on hypocotyl growth or shoot growth interaction. Such an outcome might be expected, because it is likely that roots are the first to absorb the allelochemicals or autotoxic probability compounds from the environment (Turk, M.A., M.K. Shantnawi and A.M. Tawaha, 2003; Turk, M.A., and A.M. Tawaha, 2002).

Seedling weight: Radicle dry weight tended to decrease as the extract concentration increased (Table 4). Compared with the control, radicle dry weight (Table 4) was significantly inhibited by all concentrations of aqueous extract made from different plant parts of *Sphaeranthus indicus*.

Table 4

Effects of various concentrations of aqueous extract of different plant parts made from *Sphaeranthus indicus* weed on the dry weight of root of 10 days old test crop seedlings.

Test crops	LEAF	ROOT	SHOOT	INFLORESCENCE
Concentration	mg	mg	mg	mg
Control (DDW)	0.126	0.126	0.126	0.126
2%	0.095	0.087	0.098	0.091
4%	0.061	0.074	0.089	0.057
6%	0.019	0.012	0.075	0.015

The phytotoxic effects were usually subject to concentration. Among the test crop species, reduced root and shoot dry weights significantly more as compared to control at all concentrations of water extract of different plant parts made from *Sphaeranthus indicus* (Table 3, 4). These results are similar to those Turk and Tawaha (2002). The inhibitory allelopathic effects as observed during the present study might be due to the action of various allelopathic compounds present in their diverse potencies in the extract (Singh et al. 1989, Baruah et al. 1994, Parsad and Subashni 1994, Bansal et al. 1992, Ignacimuthu 1997).

Table 3

Influence of various concentrations of aqueous extract made from different plant parts of *Sphaeranthus indicus* on the dry weight of the shoot of 10 days old test crop seedlings.

Test crops	LEAF	ROOT	SHOOT	INFLORESCENCE
Concentration	mg	mg	mg	mg
Control (DDW)	0.096	0.096	0.096	0.096
2%	0.081	0.053	0.095	0.087
4%	0.041	0.029	0.089	0.054
6%	0.021	0.016	0.077	0.023

Conclusion

At the highest extract concentration, all aqueous extracts significantly reduced seed germination compared with distilled water. Allelochemicals inhibited the growth of some species at certain concentrations, might stimulate the growth of the same or different species at lower concentrations. It is difficult to apply our results to a production situation directly because the concentration of inhibitory substances in aqueous extracts is probably greater than what would be observed under natural conditions.

Declarations

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Contributions

B. A. Kumbhar participated the discussion and concepts of experimental designs, manuscript writing and revision; P. J. Dabgar performed the experiments. Both authors read and approved the final manuscript

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Ethics declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

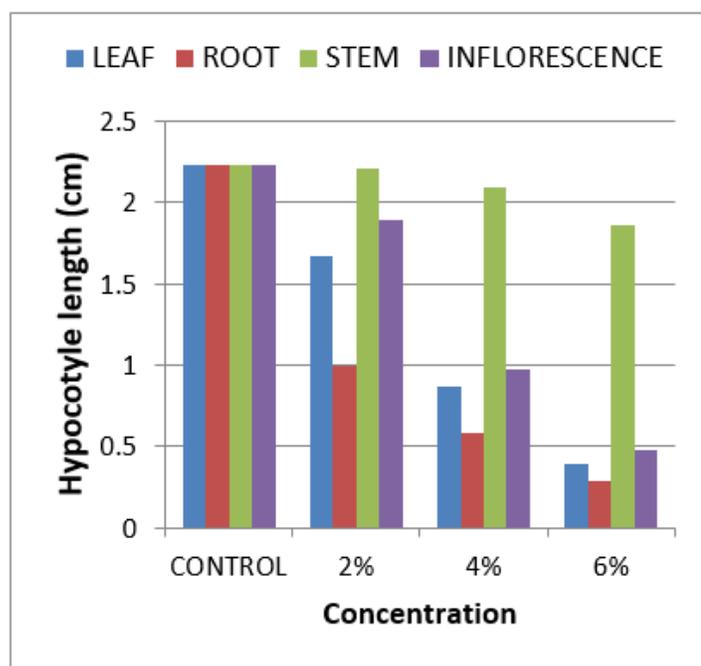
All data generated during the study are interpreted in the manuscript

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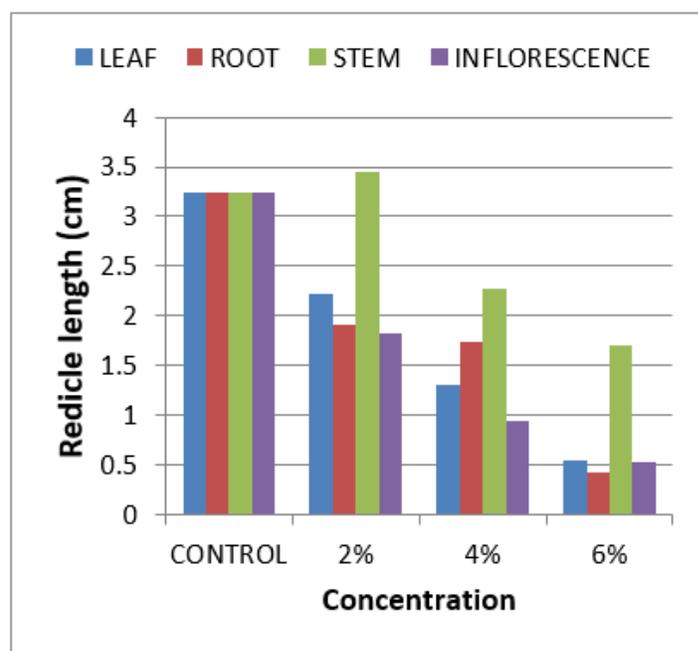
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Figures



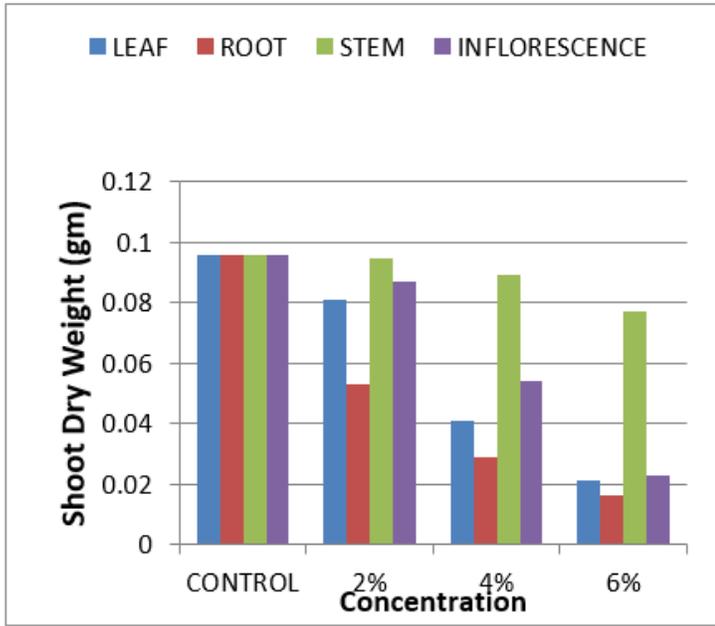
(a)



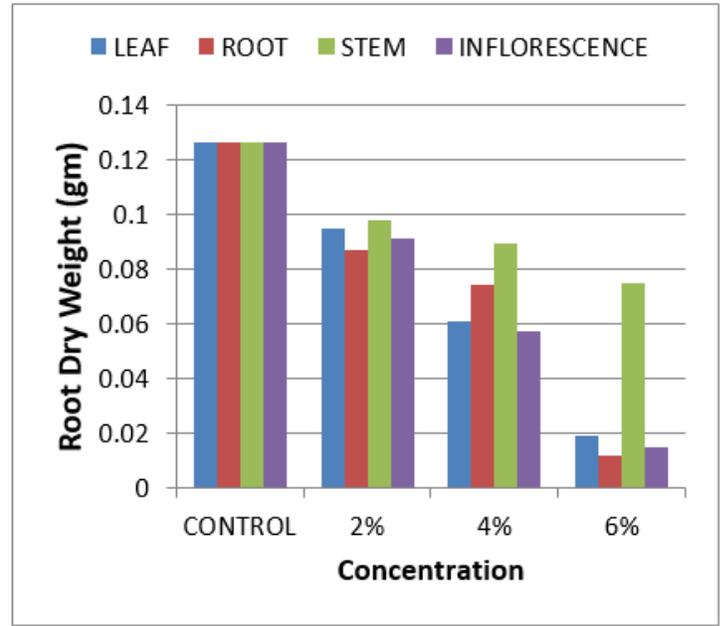
(b)

Figure 1

(a, b) Influence of various concentrations of aqueous extract made from different plant parts of *Sphaeranthus indicus*. on the hypocotyl and radicle growth of 10 days old test crop (Nagli) seedlings.



(c)



(d)

Figure 2

(c, d) Influence of various concentrations of aqueous extract made *Sphaeranthus indicus* plant on the dry weight of the root and shoot of 10 days old test crop seedlings.