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SHORT COMMUNICATION

GERMINATION AND SEEDLING VIGOUR OF SOME MAJOR CROP PLANTS AS INFLUENCED BY ALLELOPATHY OF *SPHAERANTHUS INDICUS*

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The effect of different concentrations of capitula extract of *Sphaeranthus indicus* on seed germination and early seedling growth of *Oryza sativa*, *Triticum aestivum* and *Vigna radiata* (L.) Wilczek was examined. Germination per cent and seedling growth were decreased with increase in concentration of extract, indicating concentration dependency. The highest concentration (100 g l^{-1}) resulted in 80 per cent decrease in seed germination, 94.4 per cent decrease in root length and 83.3 per cent decrease in shoot length in *O. sativa*. In *T. aestivum*, the decrease in seed germination, root length and shoot length was 60, 93 and 84.9 per cent, respectively. These values were in order of 22.2, 71.6 and 80 per cent in *V. radiata*. The results of the study suggest that the capitula extract of *S. indicus* contains water soluble compounds which are phytotoxic in nature. Phyto-chemical analysis identified capitula extract as alkenes and aldehydes.

***Key words*: Allelopathy, germination, mungean, rice, seedling vigour, *Sphaeranthus indicus*, wheat.**

The term allelopathy refers to the detrimental effects of one species on the germination, growth and development of another speicies. The impact of allelopathy in agro-ecosystem has been recognized since ancient times. Allelopathic interactions have been of concern of many ecologists, agronomists and phytochemists in recent years (Narwal 1994). Allelochemicals are reportedly present in virtually all plant tissues and are released in a variety of ways such as volatilization, leaching, root exudation and decomposition of the pant residues. Under field conditions weed manifestations is one of the major causes of yield reduction in crops. Rice, wheat and mungbean are important crops which make the staple food of major population of India and production of these is also affected by some obnoxious weeds grown among these crops. Allelopathic effects of many problematic weeds have been studied in past (Oudhia *et al.* 1997). The stimulatory allelopathic effects of weeds on crops can be utilized to increase the rate of germination, seedling vigor, dry matter production etc. of these crops. Similarly, inhibitory allelopathic effects lead to discovery of agro-chemically active compounds from natural sources. This supports the notion that new herbicides, insecticides and antimicrobials may be developed from natural products (Cardellina 1988).

Sphaeranthus indicus is a spreading weed belongs to family compositeae and found especially in rice fields. Alleopathic effect of this weed was not studied on major crops especially on rice so far. The present study was therefore, carried out with a view 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.

Plant samples (*Sphaeranthus indicus*) were collected from salt affected areas of Gujarat. Capitula separated from plants and cut in to pieces and immersed in water and decayed for 24 hours at room temperature in the ratio of 1:10 (w/v). The extract was first centrifuged for 10 minutes and filtered through Whatman No. 1 filter paper. The extract thus obtained gave a concentration of 100 g l^{-1} on dry weight basis. Bioassay concentration of 0, 20, 40, 60, 80 and 100 g l^{-1} were prepared.

Laboratory bioassay was done in 10 cm diameter petridishes containing sterile sand. Ten uniform seeds of rice cv. CSR-10, wheat cv. KRL-191 and mungbean cv. SNL-668, were placed in each petridish and 25 ml extract of various concentrations were applied as per treatments. No external water was applied during the course of present investigation. The petridishes were kept in germinator at 26 ± 2ºC. The treatments were laid out in completely randomized design with three replications. The count of germinated seeds were made, and shoot and root lengths of seedling (both root and shoot emerged from seed coat) were recorded after 11 days.

Capitula of the plant were extracted with petroleum-ether (40-60ºC). The solvent was distilled off. The extracted residue was subjected to hydro-distillation in a Clevenger's apparatus and distillate collected over solvent ether. The aquous part was rejected and the ethereal part was dried over anhydrous sodium sulphate. The solvent was dried in a weighed conical flask on a water bath at controlled temperature and then kept in vacuum desiccator over night. The volatile extract was used for GC-MS analysis through Hewlett-Packard (HP 5996) coupled with computer library with 80,000 compounds and fitted with WACOT SET-30 (methyl silicon gum). Constituents were identified by comparing the GC-MS spectra with the library compounds and the literature.

The maximum germination in control (distilled water) was 100, 100 and 90 per cent for rice, wheat and mungbean, respectively. Application of 20 g l^{-1} aqueous extract of capitula had a significant inhibitory effect on seed germination of all test crops (Table 1). Further increase in the concentration of the extract led to the steady decline in germination to the lowest value (20 per cent) for rice. The adverse effect of capitula extract on seed germination is due to the action of various allelopathic compounds present in their diverse potencies in the extract. Among the crops under study, severe inhibitory effect was observed in rice compared to wheat and was lowest in mungbean. It was observed that the same extract has produced alleopathic effects of different intensity on different crops confirmed the hypothesis that different crops interact differently in response to same allelochemicals (Ashraf and Sen 1978).

Root and shoot lengths of the seedlings were significantly influenced by capitula extract. Maximum root and shoot length of all crops were recorded in control and declined with increase in the concentration of capitula extract (Table 2). Application of 60 g l^{-1} capitula extract concentration to rice resulted in decrease in root length by 94.4 per cent while in case of shoot length, maximum inhibition was observed at 100 g l^{-1} concentration. The maximum reduction in root and shoot length of wheat seedlings was observed at highest concentration of capitula extract (100 g l^{-1}) and resulted in 93.0 and 84.9 per cent decrease, respectively. The highest concentration (100 g l^{-1}) of capitula extract caused inhibition of 71.6 per cent of root length and 80 per cent in shoot length compared with control. However, these were non-significant compared to extract concentration of 80 g l^{-1} but significant with other treatments. The inhibitory allelopathic effects as observed during the present study might be due to the action of various

Table 1. Effect of *Sphaeranthus indicus* capitula extract on germination of rice, wheat and mungbean

Extract concentration (g l^{-1})	Germination (%)			Germination inhibition/stimulation (%)		
	Rice	Wheat	Mungbean	Rice	Wheat	Mungbean
0	100	100	90	-	-	-
20	80	90	80	-20.0	-10.0	-11.1
40	60	70	80	-40.0	-30.0	-11.1
60	40	60	70	-60.0	-40.0	-22.2
80	30	40	70	-70.0	-60.0	-22.2
100	20	40	70	-80.0	-60.0	-22.2
SE(±)	2.52	2.88	3.14	-	-	-
CD(5%)	5.50	6.27	6.85	-	-	-

Table 2. Effect of *Sphaeranthus indicus* capitula extract on root and shoot length (cm) of seeldings of rice, wheat and mungbean

Extract	Rice		Wheat		Mungbean	
concentration (g l^{-1})	Root	Shoot	Root	Shoot	Root	Shoot
0	9.0	6.0	14.0	9.3	6.0	15.0
20	2.0	4.0	4.7	7.0	4.0	9.0
	(-77.7*)	(-33.3)	(-64.6)	(-24.7)	(-33.3)	(-40.0)
40	1.0	3.4	2.5	3.5	3.0	5.0
	(-88.8)	(-43.3)	(-82.6)	(-62.3)	(-50.0)	(-66.6)
60	0.5	3.0	2.0	2.2	2.5	4.0
	(-94.4)	(-50.0)	(-83.3)	(-76.3)	(-58.3)	(-73.3)
80	0.5	2.0	1.6	1.9	2.0	3.5
	(-94.4)	(-66.6)	(-88.8)	(-79.5)	(-66.6)	(-76.6)
100	0.5	1.0	1.0	1.4	1.7	3.0
	(-94.4)	(-83.3)	(-93.0)	(-84.9)	(-71.6)	(-80.0)
SE(±)	0.16	0.15	0.25	0.21	0.14	0.32
CD(5%)	0.34	0.32	0.55	0.46	0.31	0.70

*Figures in parenthesis indicate per cent inhibition.

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).

The study revealed that capitula extract of weed *S. indicus* has potential allelopathic effects and was, therefore, further analyzed in detail to isolate, identify and characterize the allelochemicals. The compounds belong to various categories of terpenes and aromatic compounds and were mainly seed germination and growth inhibitory substances, viz. cadinene, phyllandrene, methoxy cinnamaldehyde, caryophyllene (Baruah *et al.* 1994, Lodha 2003). These are phytotoxic in nature and inhibit seed germination, reduced root and shoot length markedly.This study indicates that capitula extract of *Sphaeranthus indicus* has inhibitory allelopathic effect. Germination, root and shoot length were significantly reduced with time and increase in concentration of the extract in all the test crops, indicating the presence of plant growth inhibitors in the extract. Detailed phytochemical analysis of the plant extract identified these substances as cadinene, caryophyllene, phyllandrene, p-methoxy cinnamaldehyde.

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