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ALLELOPATHIC IMPACT OF *PENNISETUM GLAUCUM* (PEARL MILLET) ON THREE PULSES OF PAKISTAN

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ABSTRACT

Allelopathic potentialities of aqueous extract of *Pennisetum glaucum* (whole plant) was investigated on germination and seedling growth of three pulses of Pakistan (*Cicer arietinum, Phaseolus vulgaris* and *Vigna radiata).* Aqueous extracts at 5, 10 and 15% had significantly inhibited germination and growth of three test species. The inhibition was generally the function of the extract concentration.

Key-words: Allelopathy, pearl millet, pulses, *Cicer arietenum, Phaseolus vulgaris, Vigna radiata.*

INTRODUCTION

The economy of Pakistan depends on agriculture but the yield of crops is lower due to several reasons including allelopathic effects. The allelopathic potentialities present in the plants can inhibit the growth of other plants growing in the vicinity (Rice, 1984; Kim and Shim, 1998; Kadioglue *et al*., (2005). Weeds are commonly known to possess allelopathic potentialities but there are some cultivated crops also having allelopathic effect such as Sorghum has an allelopathic effect on *Amaranthus retroflexus* (Alsaadawi *et al.,* 2009). Inhibition of plant growth is due to the secretion of phytotoxin by dominant plants representing the competition for light, water and food (Inderjit *et al.,* 2003). Root and shoot of pearl millet contain water soluble compounds which are autotoxic (Sexena *et al.,* 1996). Allelopathic chemicals released from millet residues may inhibit seed germination, growth and yield of soya bean (Mallik and Tesfai, 1988). Stubble extracts of pearl millet were also found to inhibit the seed germination and shoot length of wheat and lentil (Narwal *et al.,* 1989). In this paper the effects of whole plant extract of *Pennisteum glaucum* on germination and seedling growth of three economically important pulses.

MATERIALS AND METHOD

The air-dried plants of *P. glaucum* were powdered. The whole plant powder was weighed (5, 10 and 15 g) and taken into respective conical flasks and 100 mL of distil water was added in each conical flask, the suspensions were left for 24 hours. After 24 hours these suspensions were sieved through muslin cloth, centrifuged and then filtered through Whattman No.1 filter paper. The seeds of test crops i.e. *Vigna radiata*, *Phaseolus vulgaris* and *Cicer arietinum* were surface sterilized by 0.1 % mercuric chloride. Ten seeds of a test species were placed at uniform distance in sterilized Petri plates along with 5 replicates. Three mL of each extract *i.e.* 5, 10 and 15% poured in their respective replicates while distilled water in the control. The Petri plates were placed at room temperature in laboratory. The germination of the seeds was recorded daily. The trials were terminated after fourteen days and root shoot lengths measured. .

The data were analyzed statistically. The speed of germination was calculated by following formula Khandakar and Bradbeer (1983) as Speed of germination: "S" = [N1/1 + N2/2 +N3/3 +- - - - - - - -] x 100; where "S" is the speed of germination and N1/1, N2/2…..are the ratio of number of seed germinated per day. The data were also subjected to One-way analysis of variance (ANOVA) followed by the least significant difference (LSD) test at $P<0.05$ and Duncan's multiple range test to compare treatment means (Sokal and Rohlf, 1995)

RESULTS

Cicer arietinum: Data (Table 1) indicated that the germination was significantly affected in each concentration but highly inhibited in 15 % extract (58 %) compared to control (100 %). Speed of germination showed similar trend. Root and shoot length were significantly ($P<0.05$) decreased with increase in extract concentration.

Phaseolus vulgaris: Percent germination (Table 2) was gradually decreased in each concentration of extracts but the highest reduction was observed in 15 % extract (72 %) as compared to control (98 %). The speed of germination showed similar results. Root length was significantly ($P<0.05$) reduced in 15 % extract (6.5 cm) compared with control (10.1 cm). Similarly, shoot length showed highest reduction in 15% (11.5 cm) in comparison to control (14.1 cm).

***Vigna radiata*:** The germination of this species was remarkably suppressed in the highest concentration of extract at 15 % (87 %) compared to control (100 %). Speed of germination showed similar trend. Root length in control was 5.1 cm which was significantly reduced to 2.1 cm at maximum concentration of extract (15 %). Shoot length showed maximum suppression in 15 % extract (13.2 cm) as compared to control (17.4 cm).

DISCUSSION

The whole plant extract of *P. glaucum* affected the test pulses somewhat differentially. Seed germination is considered to be most critical stage especially under stressful conditions. It is obvious from the experiment that *C. arietinum* is the most sensitive to *P. glaucum* whole plant extract. Seed germination of gram is also reported to be affected by *Euphorbia helioscopia* extract (Tanveer *et al.,* 2010). Rice (1984) reported that all the negative and positive influences of one plant on the other plants are due to the presence of allelochemicals. Alam and Islam (2002) also have similar contention. Chaturvedi and Jha (1992) also explained that inhibition in seedling growth due to the presence of allelochemicals. The findings of Chandra *et al.,* (2013) reported that *Coffea arabica* has negative allelopathic effect on the seedling growth of *C. arietinum.*

Table 1. Effect of *Pennisetum glaucum* whole plant extract on %germination, speed of germination and seedling length (cm) of *Cicer arietinum* in Petri plates.

Treatments	**% Germination Mean ± S. E.**	**germination speed**	**Shoot length (cm)**	**Root length (cm)**
Control	100 ± 0.0	85	13.4 a	10.2 a
5%	78 ± 4.0	79	11.3 b	8.2 b
10%	78 ± 4.0	68	10.2 c	6.6 c
15%	58 ± 3.7	53	8.9 d	5.6 d

Table 2. Effect of *Pennisetum glaucum* Whole plant extract on percent germination, speed of germination and seedling growth of *Phaseolus vulgaris.*

Treatments	**% Germination Mean ± S. E.**	**Speed of germination**	**Shoot length (cm)**	**Root length (cm)**
Control	98 ± 2.0	83.4	14.1 a	10.1 a
5%	94 ± 2.4	79.2	13.2 b	9.0 b
10%	78 ± 10.1	64.8	12.7 c	7.7 c
15%	72 ± 11.5	59.3	11.5 d	6.5 d

Table 3. Effect of *Pennisetum glaucum* whole plant extract on percent germination, speed of germination and seedling length (cm) on *Vigna radiata*.

Treatments	% Germination Mean ± S. E.	Speed of germination	Shoot length (cm)	Root length (cm)
Control	100 ± 0	98	17.4 a	5.1 a
5%	96 ± 0.4	94	16.4 b	4.1 b
10%	92 ± 0.97	90	15.0 c	3.1 c
15%	87 ± 0.58	88	13.2 d	2.1 d

In *Phaseolus vulgaris*, percent germination was highly influenced by *P. glaucum* in maximum concentration of the extract. This may presumably be due to allelochemicals as suggested by Herro and Callaway (2003). In *Vigna radiata* percent germination is inhibited by the increased concentration of *P. glaucum.* Germination and seedling

growth of mung bean has also been reported to be affected by the extract of *Ziziphus nummularia* (Shah *et al.,* (2013), *Anagalis arvensis* (Salam *et al.,* 2011), *Spinacea oleracea* and *Psidium guajava* (Anitha and Gandhi (2012), *Parthenium hysterophorus* (Khan *et al.,* 2011) and *Sorghum bicolor* (Moosavi *et al.,* 2011).

In *Phaseolus vulgaris* the seedling growth is significantly ($P<0.05$) decreased by the different concentrations of *P. glaucum*. Our results co-relate with the findings of Kohli *et al.* (1998) who suggested that allelochemicals were responsible for the significant decrease in seed germination and seedling growth of crop plants. *P. vulgaris* has allelopathic effect on the seedling length of Wheat and Lettuce also as described by Tarek *et al.* (2013). This shows that *P. glaucum* has stronger allelopathic effect which inhibits the seedling growth of *P. vulgaris.* Our result also co-relate with the findings of Al-Wabtan and Salama (2012) who reported that *Artemesia monosperma* has inhibitory chemicals that influence the seedlings of *P. vulgaris.* In comparative studies of three test crops the shoot length of *C. arietinum* is highly affected in comparison to *P. vulgaris* and *V. radiata.* Our result also resembles with the findings of Chandara *et al.,* (2012) who reported that *Withania somnifera* has an allelopathic effect on the seedling growth of *C. arietinum* while the root length of *V. radiata* is significantly inhibited as compare to *C. arietinum* and *P. vulgaris.*

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