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ALLELOPATHIC EFFECT OF *Parthenium hysterophorus* L. ON SEED GERMINATION AND GROWTH OF PEA PLANTS

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ABSTRACT

An experiment was carried out to assess the allelopathic effect of leaf extract of *Parthenium hysterophorus* on germination and seedling growth of *Pisum sativum* L. at various concentrations viz. 10, 20, 30 and 40% in Laboratory, the results revealed that all the germination and seedling growth attributes of both varieties of *Pisum sativum* L., were significantly inhibited by the influence of water extract at various concentrations as compared to control. Lowest germination percentage, germination index, root and shoot length, seedling dry weight and seedling vigour index of varieties of Pisum *sativum* L., was observed by the effect of water extract of *Parthenium hysterophorus* at 10% concentration. The seed germination, plumule and radicle length were reduced with increasing concentration of aqueous solution. The study concluded that increasing concentration of leaf extract of *Parthenium hysterophorus* has adverse effect on germination, shoot length, and root length and biomass production of *Pisum sativum* than the control.

KEYWORDS: *Parthenium;* Allelochemicals; Allelopathic; Leaf extract; *Pisum sativum*

The direct or indirect, stimulatory or inhibitory effects of plants on each other through the discharge of chemicals into the environment are named as allelopathy (Rice, 1984). The chemicals that are discharge throughout this method are termed as allelochemicals that are usually secondary metabolites (Asaduzzaman *et al*., 2010). A large number of allelochemicals has been found and identified. These allelochemicals are classified into various groups on the basis of their chemical properties. Phenolics, alkaloids, terpenes, fatty acids and indoles are the most ordinarily occurring allelochemicals in plants (Noguchi, 2008). The phenomenon of allelopathy refers to chemical interactions between all sorts of plants. During this process the chemical exudates or leachates released from leaves, stems or roots of a plant will inhibit the expansion of a neighboring one (Dongre *and Singh* 2011). Stimulatory and inhibitory allelopathic effect depends upon the concentration of allelochemicals (Hill *et al*., 2006). Higher concentrations of allelochemicals have been observed to have inhibitory effect (Femina *et al*., 2012,), while, lower concentrations exert stimulatory allelopathic impact on seed germination and growth of plant (Sahoo *et al*., 2010). Allelopathic effects in legumes and cereals are projected as a technique to suppress weeds (Conklin *et al.*, 2002), pests and diseases (Messiaen, 1994), pollution (Narwal *et al*., 1998) and to reduce the input of agrochemicals are artificial fertilizers were for enhances the crop productivity. The allelochemicals are commonly found in living plant exudates, volatile compounds discharged from leaves, decomposing plant residues and leaf leachates (Narwal *et al*., 2005).

Parthenium hysterophous L. is native to tropical and subtropical America. This plant species is very invasive invader in large extent and it is threatened grassland ecosystem of India. This weed possesses many hazardous substances and it is very harmful to the surrounding flora, animals and also to human health. It has been already invaded in most of the useful field areas in urban and village. It has an allergic effect which makes the weeding usually used by subsistence farmers more difficult. The successful spread of Parthenium in so many parts of the world has been attributed to its allelopathic properties, which enable it to compete effectively with otherwise strong crop or pasture species (Swaminathan *et al*. 1990).

The present study was conducted the impact of various concentrations of leaf extract of genus *Parthenium hysterophorus* on seed germination and seedling growth of a crucial legume *Pisum sativum*. Pea is cultivated in this region on large scale and *Parthenium* is invading the cropland, grassland, wasteland etc. of Muhammadadabad Gohna on large scale rapidly.

MATERIALS AND METHODS

The present study was carried out in the year 2014. The mature fresh leaves of *Parthenium hysterophorus* L. were collected from the S. G, N, Govt. P. G, College Campus, Muhammadabda, Gohna, Mau, U.P., India and brought to laboratory. The leaves were separated, cut into small pieces of approximately 1 cm^2 and soaked into sterilized water in a ratio of 1:2 (w/v) for 48 hours. The leachates were filtered through Whatmann filter paper No.1 and filtrate were considered to be 50% leachates concentration, which were stored in glass bottles in dark.

Bioassay

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The seeds were treated with different concentration of leaf leachates. Different concentrations of leaf leachates of *Parthenium hysterophorus* L. were prepared. Ten seeds of pea (Arpan and Sapana) were placed equidistantly in 10 cm dia. petriplates fitted with two layers of filter paper. 15 ml of 10, 20, 30, and 40% leachates of *Parthenium hysterophorus* L. were added into the Petri-dishes as per treatments. Sterilized water was used as control. Five replicates of each treatment and control were maintained. The Petri-dishes were maintained under laboratory condition for 5 days. Equal volume of distilled water was added in the dishes when moisture content of the blotting paper declined. Number of seeds germinated was counted on 1, 2, 3, 4, and 5 days after sowing (DAS) and seedlings growth was measures at 5 DAS. Root: shoot ratio, relation elongation ratio of root, shoot and inhibition or stimulation on seed germination percentage were calculated by Shikha and Jha (2014). Seed vigour index (SVI) was calculated by: SVI= Germination Percentage × Mean of Seedling Length. Experimental results were statistically analyzed using critical difference (CD at 5%) as a measure of significance.

RESULTS AND DISCUSSION

Effect of Leaves on Seed Germination

Parthenium hysterophorus significantly inhibited the seed germination on pea at 20% leachates concentration of both the variety of pea. There were maximum inhibitions in seed germination of 'Arpan' variety (32.6%) and 'Sapna' variety (43,1%) at 40% leacheta concentration (Table1, Figure1). The minimum inhibition of seed germination was observed in 'Arpan' variety at 10% concentration followed by 'sapna' variety of pea.

Effect of Leaves on Seedling Growth

The 20% leachates of *Parthenium hysterophorus* weed species significantly inhibited the root length in seedlings of pea (Table 1). The maximum inhibition (56,1%) of seedlings growth was observed in 'sapna' variety at 40% concentration solution and minimum inhibition (14.0%) at 10% concentration solution. The lowest inhibition of root length observes in 'Arpan' variety of pea (Fig 1). The reduction in root length was observed with increasing concentration of extracts. Similar effect of leaf aqueous extract of *Parthenium hysterophorus* was reported in cereals and pulses (Dongre and Singh 2007; Dongre *et al.*, 2004,).

Relative Elongation ratio of Root

The relative elongation ratio of root was recorded in different concentration of leaf leachates of *Parthenium*. The values were composed for 10% to 40% concentration. The relative elongation ratio of root was decreased with the higher concentration of *Ageratum* leaf leachates for both the variety of pea (Table 1, Fig 1).

The minimum value for root elongation ratio was 43.84 recorded for 40% in variety of 'Sapna' and maximum value 95.79 for 10% concentration of leaf leachates of 'Arpan' variety of pea. Increase the concentration of leachates was associated with drastic inhibition of germination and seedling growth of pea.

Verma and Rao (2006) investigated that effect of *Ageratum conzoides* L., *Cynadon dactylon* (L.) Pers., *Parthenium hysterophorous* L., and *Solanum nigrum* L. aqueous extracts increased growth and protein content of *Glycine max* (L.) Merrill

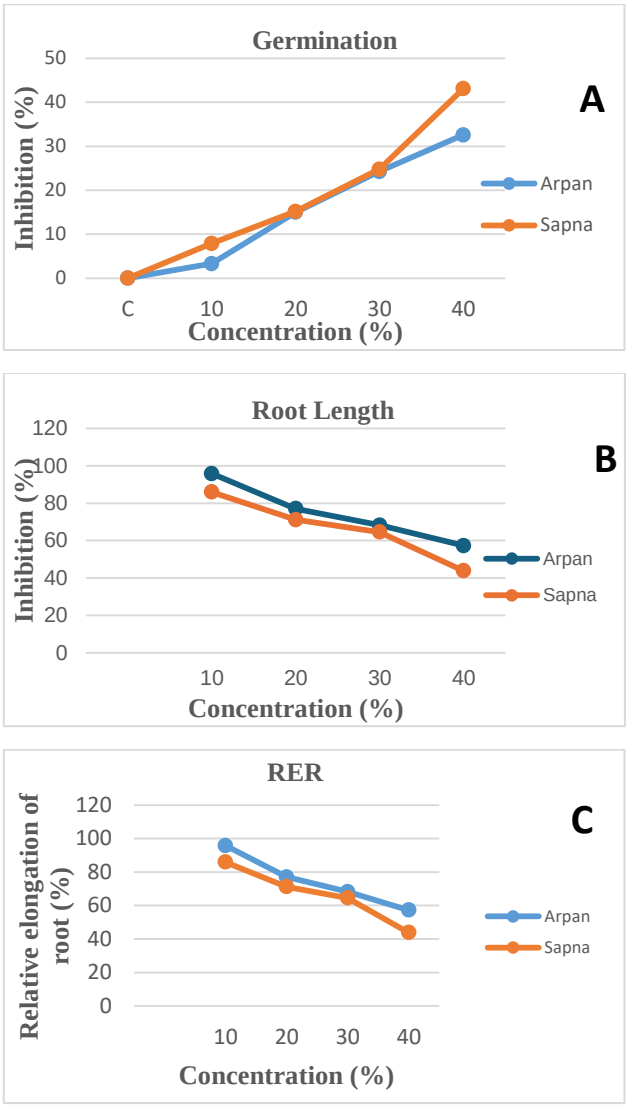

Figure1: Effect of *Parthinium* leaf leachates on inhibition of germination, root length and relative elongation of root in pea at 5DAS. (A) Germination (B) Root length and (C) Relative elongation of root

Table 1: Effect of aqueous leaf leachates of *Parthenium hysterophous* L. on germination and seedlings growth, relative elongation of root, SVI values of two variety of *Pisum sativum* L. at 5 DAS

Variety	Treatment (%)	GP (%)	RL (cm)	RER (%)	SVI
ARPAN	0 (Control)	92.0	3.48	-	284.28
	10	89.0 (-3.3)	2.96 (-4.2)	95.79	263.44
	20	78.2 (-15.0)	2.38 (-22.9)	77.02	186.11
	30	69.6 (24.3)	2.11 (-31.7)	68.28	146.85
	40	62.0 (-32.6)	1.77 (-427)	57.28	109.74
	CD at 5%	1.65	0.20	-	-
SAPNA	0 (Control)	96.0	4.06	-	389.76
	10	88.4 (-7.9)	3.49 (-14.0)	85.96	308.51
	20	81.4 (-15.2)	2.89 (-28.8)	71.18	235.24
	30	72.2 (-24.8)	2.62 (-35.4)	64.53	189.16
	40	54.6 (-43.1)	1.78 (-56.1)	43.84	97.18
	CD at 5%	2.26	0.34	-	-

Data in parenthesis indicate percent decrease from control. GP=Germination percent, RL= Root length, RER=Relative elongation of root, SVI=Seed vigour index.

The Allelopathic impact of leaf leacates of *other related weed* on seed germination and seedling growth of Green gram, Black gram, Rice, Maize and Sorghum, Chickpea etc are known (Dongre *et al.*, 2010).

Some earlier works have also reported that the *Parthenium hysterophorus* L. reduces root and shoot length of *Zea mays* L. and *Glycine max* L. (Bhatt *et al* 1994). Due to the presence of allelochemicals in aqueous extract of *Parthenium hysterophorus* L. showing inhibitory effect on different plant species (Rajan 1973). This plant releases the number of allelochemicals to surround such as phenolic acids, sesquiterpene lactones especially parthenin (Kanchan 1975, Swminathan *et al.*, 1990). Studies also shown that the phenolics compounds found in leaf of *Parthenium hysterophorus* L. have inhibitory effect on nitrogen fixing and nitrifying bacteria (Kanchan and Jayachandra 1979). The study demonstrated that leaf extract of *Parthenium hysterophorus* L. exhibited significant inhibitory effects on seed germination and seedling growth in selected plant species.

CONCLUSION

From the study it can be concluded that aqueous leaf leachates of *Parthenium hysterophorus* L. had greater inhibitory effect on germination rate, root length, relative elongation ratio of root and seed vigour index of both test variety of pea at 20% concentration. The leaf of *Parthenium hysterophorus* L. has potential to inhibit the seed germination and seedling growth of pea plants due to the presence of phenolic compound. Increase in concentration of leachates was invariably associated with further decrease in germination of test cultivars, irrespective of weed species.

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