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Research Article

Effects of *Parthenium hysterophorus* Aqueous Extract on Seed Germination and Seedling Growth of Maize (*Zea Mays*), Gram (*Cicer Arietinum*) and Wheat (*Triticum Aestivum*)

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Abstract

Present investigation was undertaken to study the Allelopathic effects of *Parthemium hysterophorus* extract on seed germination and seedling growth of Maize, Gram and Wheat. The applied seeds were treated with different concentration i.e. 2%, 4%, 6% of *P. hysterophorus* extract while another control set (untreated) was maintained for comparative study. Different parameters i.e. germination percentage, plumule, radicle length, fresh & dry weight and mortality percentage of germinated seeds have been observed. There was slow germination have shown in all the treated seeds after giving treatments except control and 2% level. After 2 days 4 and 6% concentration get started germination in all treated seeds. Eventually germination rate of all treated seeds recorded lowest in comparison to control. Lowest germination percentage (32%) was noticed in wheat at 6% level which is followed by 50% at 2% level. Seedling growth behavior was found better in 2% level at all concentrations in comparison to control. In most of the cases higher concentrations i.e. 4% and 6% showed negative results and inhibit the plumule and radicle length of treated seeds.

Keywords: *Allelopathy, Parthenium hysterophorus, concentration, cultivars, biochemical, weed and organisms.*

Introduction

Allelopathy is a biochemical phenomenon by which an organism produces one or more biochemical' s that influence the growth, survival and reproduction of other organisms. It is interference mechanism, in which live or dead plant materials release chemicals substances, which inhibit or stimulate the associated plant growth (Rice, E.L. *et al.*, 1983). *P. hysterophorus* is a noxious weed in America, Asia, Africa and Australia. It is known for its vigorous growth and high fecundity especially in warmer climates. (Singh, H. P. *et al.*, 2003). Now it become one of the world' s seven most devastating and hazardous weeds. Almost it grows in rain fed areas and occurs widely along the roadsides, on wastelands and sometimes invades field crops (Javaid, A. & Anjum, T., 2005). The widespread occurrence of this weed may be attributed to its aggressive behavior, very high seed production potential and suppressive effects on neighboring plants through allelopathic interactions (Evans, H.C. 1997). Inhibition and suppression, growth of neighbouring crops is the main reason of allelopathic interaction. Actually allelopathy has received high attention and become one of the central scientific problems in ecology (Fitter, A. *et al.*, 2003). However, plants communicate with organisms in the environment through volatile organic compounds, thereby achieving a wide range of ecological functions, such as affecting their growth, development, defense, reproduction, and life cycle (Bouwmeester, H . *et al.*, 2019). Allelopathy is also a phenomenon, whereby one plant influences the growth of biological systems, including microorganisms, by the release of chemical compounds into the environment (Whittaker, R. H. *et al.*, 1971). Allelopathic interaction of *P. hysterophorus* on germination rate, seedling growth and

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biochemical stimulation in applied crops is the main objective of the study. Study showed that the interaction and communication of biochemical substances of *Pathenium* is harmful to neighbouring crops. The higher doses effects of *Parthenium* on treated seeds indicated that it reduces and damage the growth of plants.

Material and Methods

The plant material of *Parthenium* was collected from Nowshera tehsil, district Rajori, J & K. The leaves were separately cut using a pair of shears and dried under shade for 25 days until all the moisture present in *Parthenium* were removed. Dried leaves were then grinded using a grinder into fine powder. Then different amount of *Parthenium* powder (2 gm., 4 gm. and 6 gm.) were separately soaked at room temperature at 25 ^{0}C in 100 ml. of distilled water dissolved for concentrations percent and left for 24 hours. Then filter through two layer of filter paper to use their aqueous extract.

The experiment was carried out with 12 petridishes that was arranged inside the laboratory and lined with three layers with filter papers.

Seeds of applied crops were thoroughly cleaned manually and ten seeds of each crop were carefully placed into each petridish using a forceps. Out of 12 petridishes three were treated with water as control and nine petridishes with different concentration of *Parthenium*. The aqueous extract obtained previously from the leaves of *Parthenium* was applied on each petridish marked as 2%, 4% and 6% and distilled water was applied for the control petridishes using dropper. All petridishes were kept at room temperature 25^{0}C±2 and continuously treated with water and respective *Parthenium* concentration. This action was continued throughout the course of the experiment. The experiment was looked after regularly for its entire duration of ten days. Those seeds inside all petridish were considered germinating whose radicle were appeared and counted visually. This activity was undertaken for two weeks' time until all the seeds were either germinated and or expired. The root and shoot length of all the seedling were measured using plastic measurements rod while there fresh weight was measured using electric balance on the eleven days of experiment.

Results And Discussion

To know the effects of allelopathy, Parthenium aqueous extract used on maize, gram and wheat seeds. The seeds treated with different concentration of *Parthenium* aqueous extract. During the experimentation, there were many ups and downs results observed in germination and seedling process of treated seeds. Doses at higher concentration expressed their negative impact in comparison of lower concentration. It is due to the higher toxicity of *Parthenium* allelochemicals. The seed germination and seedling growth rate of treated seeds were recorded (wheat, gram and maize) and compared with control set. Seed germination percentage of applied cultivers shown in Figure-1 a,b,c. The germination did not occur in gram and wheat in the primary stage, where as it was found to be higher in maize seeds as compared to control. The highest germination percentage (62%) was recorded at 2% level in maize which is followed by 4% level in gram after 10 days and it was 18% less than the control. Low germination percentage was recorded at 4% and 6% level in comparison to 2% in all the tested seeds. No seed germination occurred in both the higher doses till first 4 days in gram and wheat seed. If we look at the treated seeds of gram after 10 days, 60% germination was recorded at 2% level which is followed by 40% germination at 4% level in comparison to control. Minimum 5% germination was recorded in wheat at 6% level after 10 days. The wheat seeds also germinated less than the maize seeds and which were also significantly less than the control. The seedling growth rate of treated seeds is shown in Fig. 2a,b,c. The highest 1.3 cm (plumule length) and 0.7 cm (radicle length) were recorded at 2% level in maize after 10 days which was lower than the control (2.0 and 1.7). 4% and 6% doses was found less effective in seedling growth in gram and wheat. Similarly, it is also much lower as compared to control. Reduction and inhibition in plumule and radicle length of gram and wheat was found common in comparison to maize.

The F-test has been calculated for seedling growth of all treated seeds at 2%, 4% and 6% level. ANOVA (Table-1) shows that the calculated values of F-test are greater than the table value of F-test at 5% level of significance for V_1 4 and V_2 40. Hence, both the null-hypothesis is rejected. Therefore, it is concluded that the difference arisen due to the treatment of aqueous extract *P. hysterophorus* at 2%,4% & 6% level and the difference in seedling growth (plumule & radicle) of maize, gram and wheat seed output due to the Allelopathic effects of *P. hysterophorus*. Fresh and dry weight of plumule and radicle was also recrded (Table-2).

Actually *Parthenium* considered being a cause of allergic respiratory problems, dermatitis, and mutagenic agent in human. Productivity rate of crop is drastically reduced owing to its Allelopathy effects. Weed release allelochemical to get the nutrition from cultivated plants. The allelopathic effects are the result of plant' s secondary metabolites known as allelochemicals (Putnam, 1986), which are usually byproducts of the principal metabolic pathways in plants (Dayan. *et al*., 2009). Reduction and inhibition behaviour was seen common in all treated seeds. Subsequently, higher concentration (4%, 6%) reduced germination percentage and inhibit plumule and radicle length in comparison to lower concentration. Mostly poor seedling growth (plumule and radicle length) was notice in all treated seeds.

(Ashfaq. *et al*., 2014) reported that the interaction between *C. esculentus* and *P. hysterophorus* showed effect on germination rate, plumule length, radicle length, fresh weight, and dry weight of seeds. Suppression in the growth of seeds is depends on allelochemicals amount in the soil. Similar results pointed out by (Swain. *et al*., 2008) on rice. He suggested that rice root growth was completely inhibited at 10% leachates of 60-day-old plant. It reduced rice shoot growth by 57% and 84%, respectively; lower concentrations can stimulate plant growth, while higher concentrations cause inhibition (Hakim. *et al.* 2011). Actually over spreading rate of weed in peripheral area of crops produce toxic substances. These substances influenced to physiological process of plants. Inhibit seed germination by blocking hydrolysis of nutrients reserve and cell division (Irshad. *et al*., 2004), and cause significant reductions in the growth of plumule and radical of various crops (Ogbe. *et al*., 1994). The secretion of allechemicals in the soil is another process of allelopathy. Mixing allelochemicals in soil, directly influence the absorption rate of root hairs and it may reduce the activation of hormones. (Kohli. *et al*., 2008) also suggested that plants with allelopathic properties have been observed to significantly affect the growth and development of other neighboring plants by inhibiting seed germination, causing soil infertility and nutrient imbalance as well as limiting the microbial population in the soil. Growth hormones play a significant role in stimulation and formation of the plant organs. But maximum availability of allelochemical in soil, change the cyclic way of growth regulators. Similar results have observed by (Yang, Q.H. *et al*., 2005) and resulted that allelochemicals alter the contents of plant growth regulators or induce imbalances in various phytohormones, which inhibits the growth and development of plants, for example, with respect to seed germination and seedling growth. Most phenolic allelochemicals can stimulate IAA oxidase activity and inhibit the reaction of POD with IAA, bound GA or IAA to influence endogenous hormone levels. All vital process of plants may attribute by the action of allelochemical.

The impacts of allelochemicals on photosynthetic rate of plants, mainly involve inhibition of or damage to the synthesis process and acceleration of the decomposition of photosynthetic pigments (Meazza, G. *et al*., 2002). Eventually, photosynthetic pigment contents are decreased, which blocks energy and electron transfer, reduces ATP synthesis enzyme activity (Yu, J. *et al*., 2006), inhibits the synthesis of ATP, and affects stomatal conductance and transpiration, which inhibit the photosynthetic process (Wu, F. Z., *et al*., 2004). Some cultivated crops are provides benefits to the neighboring weeds to prevent animals, insect, pests and microbes. Lantana is common example for *Amaranthus, some legumes* and millets crops. These unexpected plants are totally depends on their nutrition to such plants. Aqueous extracts of sorghum also exhibited significant phytotoxic activity against root growth of *Parthenium*. Shoot extracts were more effective than root extracts. (Al-Saadawi, I.S. *et al*., 1986) reported that water extracts of different cultivars of sorghum significantly reduced the germination of redroot pigweed (*Amaranthus retroflexus*). Study showed that the allelopathic effects of P. ***hysterophorus*** on the applied seeds were concentration-dependent.

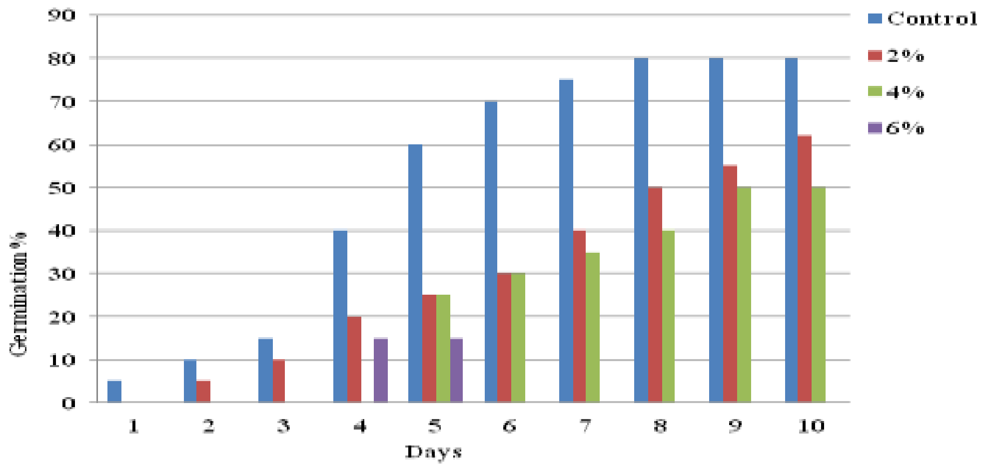

Fig. 1 (a). Effects of *P. hysterophorus* leaf extract on germination percentage of *Zea mays*.

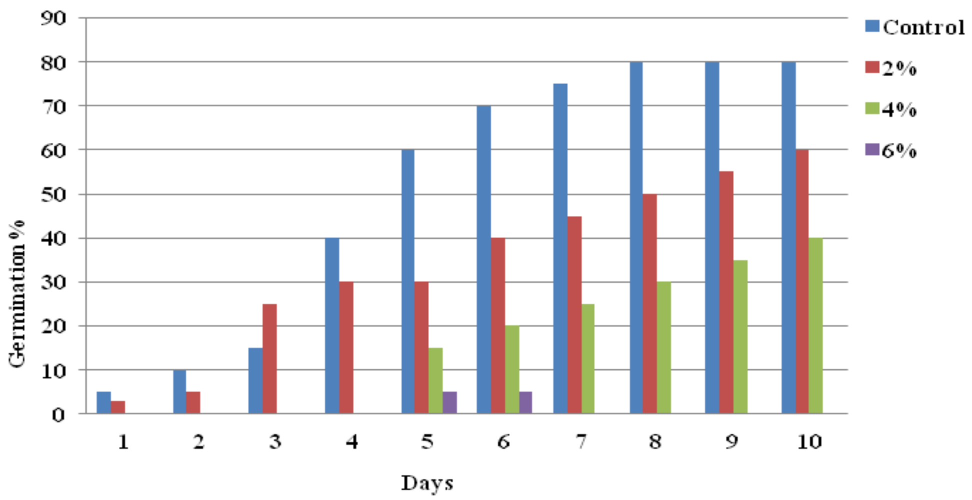

Fig. 1 (b). Effects of *P. hysterophorus* leaf extract on germination percentage of *Cicer arietinum*.

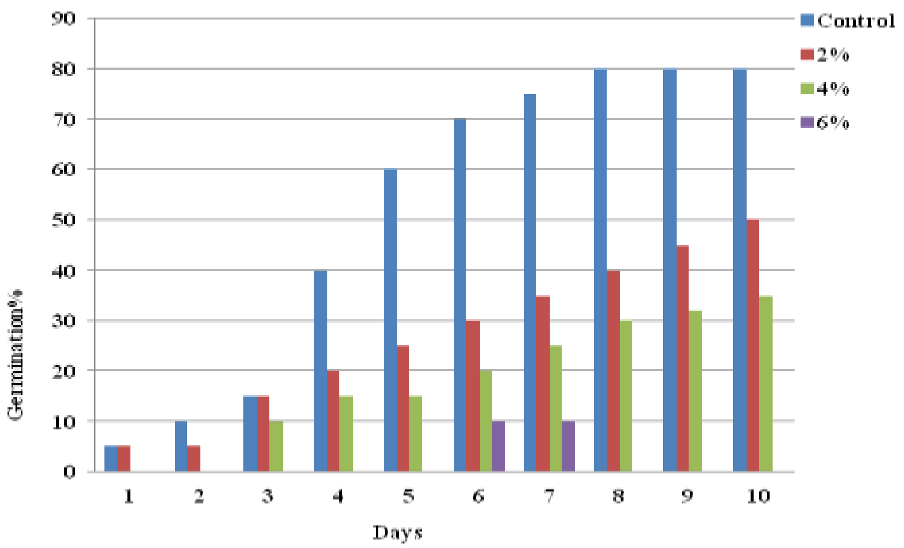

Fig. 1 (c). Effects of *P. hysterophorus* leaf extract on germination percentage of *Triticum aestivum*.

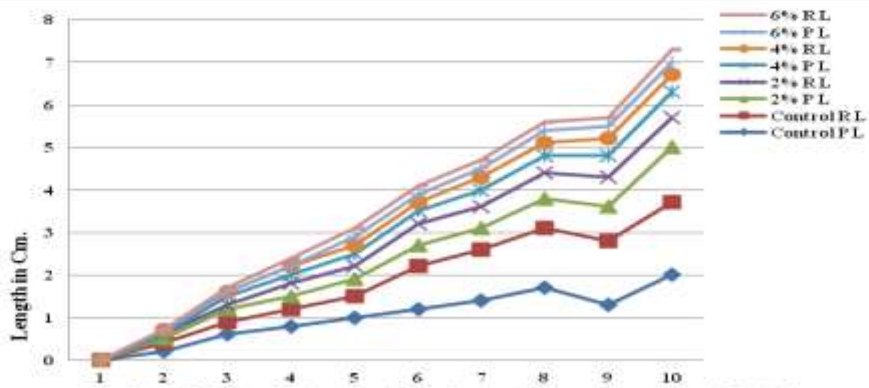

Fig. 2 (a). Effects of *P. hysterophorus* leaf extract on Plumule and Radicle length of *Zea mays* after 10 days.

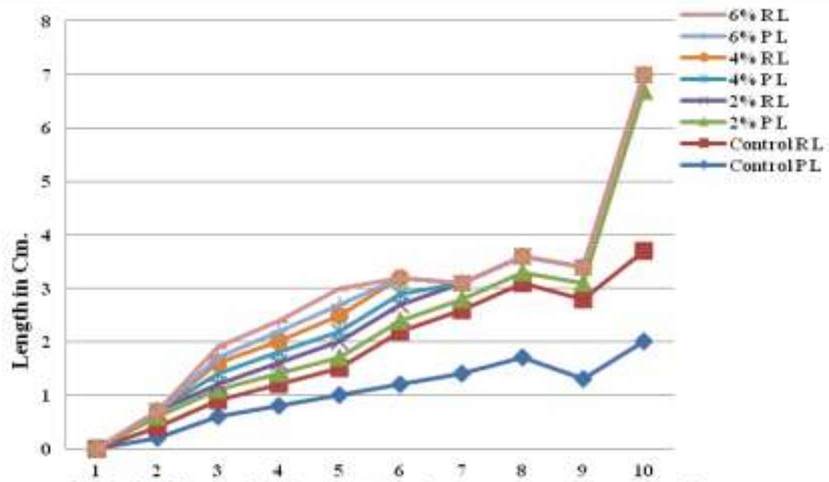

Fig. 2 (b). Effects of *P. hysterophorus* leaf extract on Plumule and Radicle length of *Cicer arietinum* after 10 days.

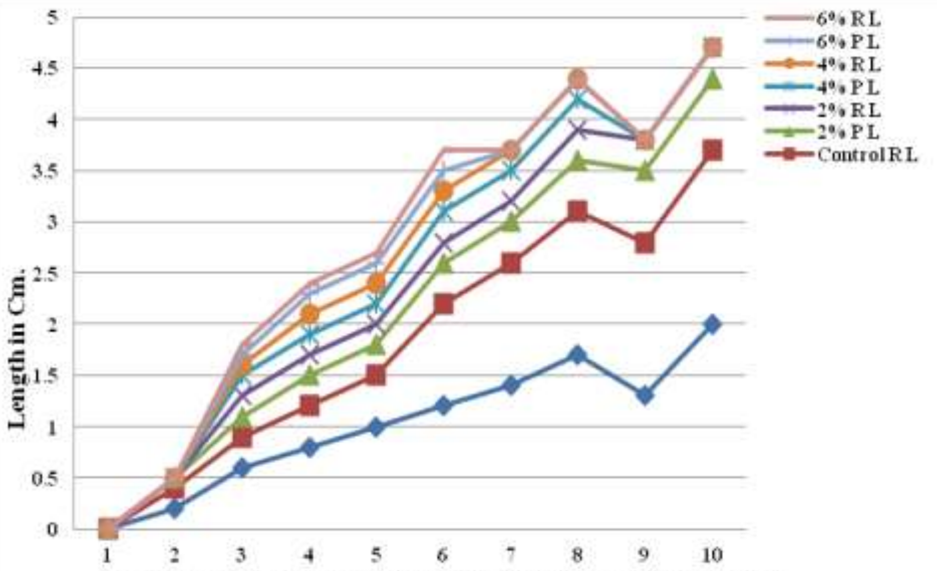

Fig. 2 (c) . Effects of *P. hysterophorus* leaf extract on Plumule and Radicle length of *Triticum aestivum after 10 days.*

Table- 1: Analysis of variance (ANOVA) for Plumule and Radicle length treated seeds.

(a). *Zey mays*.

Source of variation	S S	D F	M S S	F-Test	TVR
Dose	7.26	4	1.81	16.45	2.61
Days	5.81	10	.58	5.27	2.08
Error	4.6	40	.11	-	-

(b) *Cicer arietinum*.

Dose	10.79	4	2.69	6.40	2.61
Days	1.89	10	.18	.42	2.08
Error	17.05	40	.42	-	

(C) *Triticum aestivum*.

Dose	9.89	4	2.47	2.11	2.61
Days	9.6	10	.96	.82	2.08
Error	4.70	40	1.17	-	-

Table-2: Effects of *Parthanium* aqueous leaf extract on Fresh and Dry weight of Plumule and Radicle.

	Zea mays				***Cicer arietinum***				***Triticum aestivum***			
Doses	**Plumule**		**Radicle**		**Plumule**		**Radicle**		**Plumule**		**Radicle**	
Control	0.048 ±.012	0.016 ±.009	0.013 ±.003	0.014 ±.007	0.048 ±.012	0.016 ±.009	0.013 ±.003	0.004 ±.001	0.048 ±.012	0.016 ±.009	0.013 ±.004	0.004 ±.001
2%	0.027 ±.011	0.015 ±.009	0.005 ±.001	0.002 ±.001	0.027 ±.011	0.015 ±.009	0.005 ±.001	0.002 ±.001	0.027 ±.011	0.015 ±.009	0.005 ±.001	0.002 ±.001
4%	0.017 ±.004	0.013 ±.004	0.007 ±.001	0.003 ±.001	0.017 ±.004	0.013 ±.004	0.007 ±.001	0.003 ±.001	0.017 ±.004	0.013 ±.004	0.007 ±.002	0.003 ±.001
6%	0.012 ±.003	0.012 ±.002	0.003 ±.001	0.004 ±.001	-	-	-	-	-	-	-	-

±SE of Means

Conclusion

In present investigation maize, gram and wheat seeds treated with different concentration of *Parthenium* aqueous extract. On basis of its allelopathic effects on growth behavior of applied crops, it is concluded that *Parthenium* is harmful for the growth of all crops. Along with inhibit the growth of crops, it also reduce the fertility of the soil. It poses a potential risk to most cropping areas which will have a direct impact on the productivity of crops. From the point of view of health, it is also harmful to human being. It's over spreading in area, causes respiratory disorder and allergy in humans. Even animals do not use this plant as fodder. Therefore, strategy has been planned in response to growing community concern regarding the spread of *Parthenium* weed and its effects in crop production. Other’ s major challenges should be adopted to raise awareness about *Parthenium* weed to stop the spread and to eradication.

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