DOI:10.33451/florafauna.v23i2pp341-349

FLORA AND FAUNA ISSN 2456 - 9364 (Online)

2017 Vol. 23 No. 2 PP 341-349 ISSN 0971 - 6920 (Print)

ALLELOPATHIC EFFECTS OF *PARTHENIUM HYSTEROPHORUS* ON SEED GERMINATION AND SEEDLING GROWTH IN *CAJANUS CAJAN*

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Received **:** 25.06.2017; ***Accepted*** : 13.08.2017

ABSTRACT

In this study the allelopathic effects of *Parthenium hysterophorus* on seed germination and seedling growth in *Cajanus cajan* (Pigeon pea) was investigated. The dried powdered leaves of *Parthenium hysterophorus* were soaked in distilled water for 24 hours to obtain aqueous extract of leaves and sterilized seeds were treated with 2%, 4%, 6%,8%, and 10% concentration of extract in triplicate. The germinated seeds were counted every day to observe germination index (G.I.) and mean germination time (MGT). It has been found that germination index (GI) were significantly decreased and MGT were delayed to germinate with increasing concentration. It has been observed that seed germination percentage, root length, shoot length and seedling vigor index were reduced at >2% as compared to control. The 10 % aqueous extract showed completely inhibitory effect on seed germination. The present investigation showed that the leaves aqueous extract of *Parthenium hysterophorus* had inhibiting effects on seed germination and seedling growth in *Cajanus cajan* (Pigeon pea).

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KEY WORDS : Allelopathy, Aqueous extract, *Cajanus cajan*, Mean germination time, *Parthenium hysterophorus*, Seed germination, Seedling vigor index.

Introduction

A plant interacts with other plants to establish itself in new habitat and make a community, subsequently disturbs the biodirversity. Allelopathy is described as both beneficial and deleterious biochemical interaction between plants and weeds, and /or plants and microorganisms through the production of chemical compounds that escape into the environment and influence the growth and development of neighboring plants. Allelopathy is a complex phenomenon that depends on the concentration of allelochemicals. It has both inhibitory and stimulatory effects, which may be decided by concentration of allelochemicals present in extraction[5]. The term allelopathy, from the Greek-derived compounds allelo- and -pathy (meaning "mutual harm" or "suffering"), was first coined and defined the term allelopathy[17]. Weeds affect a crop's growth by releasing allelochemicals into the growing environment[12,14,22]. All plant parts of the weed including leaf, stem, root, and fruit have allelopathic potential[2,15,27]. However, various parts of weeds show different behavior in exerting their allelopathic effects on crops[28]. Weeds also exert allelopathic effects on crop seed germination and growth by releasing water-soluble compounds into the soil[6,26]. Allelopathy is known as the direct or indirect hazardous or beneficial effects of one plant to other through the production of several phytochemicals into the environment[6,8,24]. The

ACKNOWLEDGEMENTS : The author thankfully acknowledges to University Grants Commission (UGC), CRO Bhopal and New Delhi for financial support to successfully conduct this investigative work.

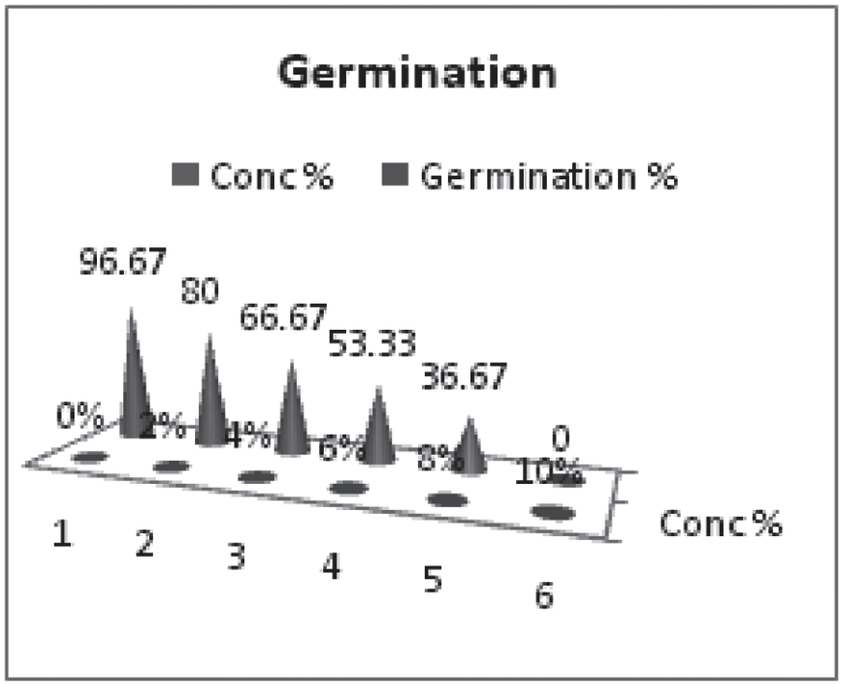

Fig. 1 : Seed germination % decreases with increasing concentration

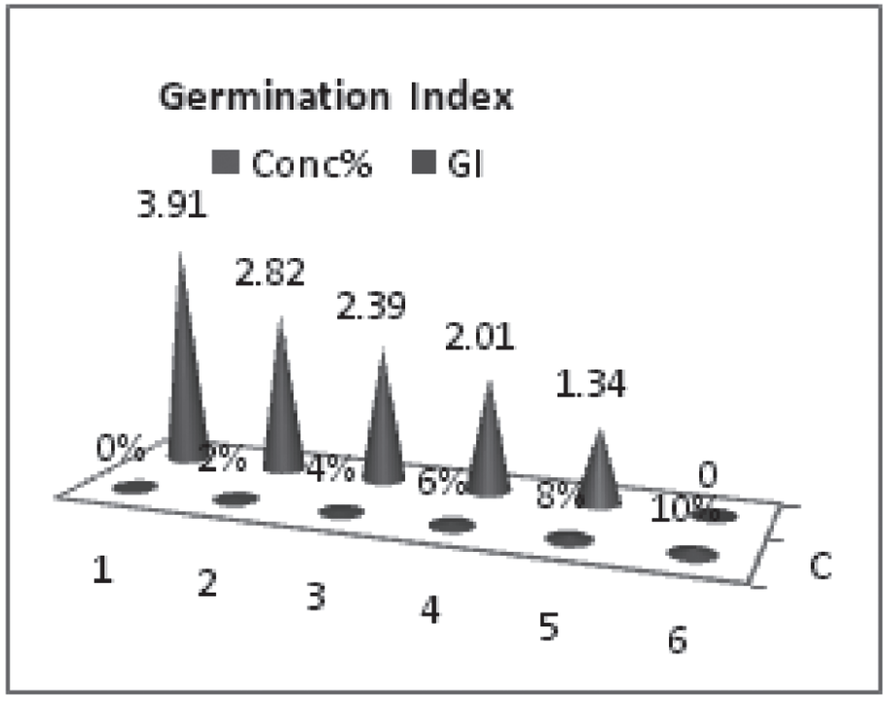

Fig.2 : Germination index decreases with increasing concentration

allelopathic effect is an important mechanism for successful establishment of spreading of weeds[23]. *Parthenium hysterophous* is native to tropical and subtropical America and it has threatened grassland ecosystem of Australia and India[9]. It has already invaded in agro field areas in Chhattisgarh. It has been shown that the *P. hysterophorus* is growing together with the *Cajanus cajan* and other crops. In the present study allelopathic effects of aqueous extract of leaves of *P. hysterophorus* on seed germination and seedling growth in *Cajanus cajan* were investigated. This crop is commonly grown as pulse in most part of Chhattisgarh.

Materials and Methods

P. hysterophorus was collected from agro crops field and Shade dried 10 gram powdered leaves were soaked in 100 ml distilled water for 24 hrs. Final volume was adjusted to 100 ml; this gave 10% aqueous extract. The extract was considered as stock solution and then a series of solutions with different dilution strengths (2, 4, 6, 8 and 10%.) were prepared. The *Cajanus cajan var.* Asha seeds were collected from government seed distribution agency Ruabandha Bhilai District Durg. Thirty healthy selected seeds were surface sterilized by 2% sodium hypochlorite for 15 min, then they were kept for germination in sterilized Petri-dishes on 2-folds of blotting paper and moister with 10 ml of different concentration of aqueous extracts (2, 4, 6, 8 and 10%) in triplicates each with 10 seeds. A separate series of control was set up using distilled water. The Petri-dishes were maintained under laboratory conditions at average 25ºC for ten days. Equal volumes of distilled water were added to dishes for maintaining moisture content of the blotting paper. Germinated seeds were counted daily according to the seedling evaluation procedure[3].The number of germinated seeds were recorded every 24 h. for ten days. After ten days germination percentage were calculated using the formula (Germinated seed\Total seed × 100) for each replication of the treatment. Mean Germination Time (MGT) was calculated according to the equation[11].

$$MGT = \frac{\sum(Dn)}{\sum n}$$

Where n is number of seeds that emerged on day, and D is the number of days counted from beginning of germination.

The Germination Index (GI) was calculated as described by the Association of Official Seed Analysts by using the following formula:

$$GI = \frac{\text{No. of germinated seeds}}{\text{Days of first count}} + \frac{}{} + \frac{\text{No. of germinated seeds}}{\text{Days of final count}}$$

Seedling growth test

All the emerged seedlings from each replication were counted and the percentage of emergence were calculated by using the following formula:

$$\text{Emergence \%} = \frac{\text{Emerged seed}}{\text{Total seed}} \times 100$$

The length of roots and shoots were measured in centimeters from the point where the root and shoot joins together at the end of the root and to the top of the shoot. Seedling Vigor Index (SVI) was calculated according to the following formula[1].

SVI = Germination/Emergence % × Radical length (cm)

Biomass

Roots and shoots of all the seedling were separated, oven dried at 70ºC for 48 h until they reached a constant weight and then they were weighed.

Statistical Analysis

The data were analyzed statistically using Fisher's analysis of variance using SPSS 16.0 Software

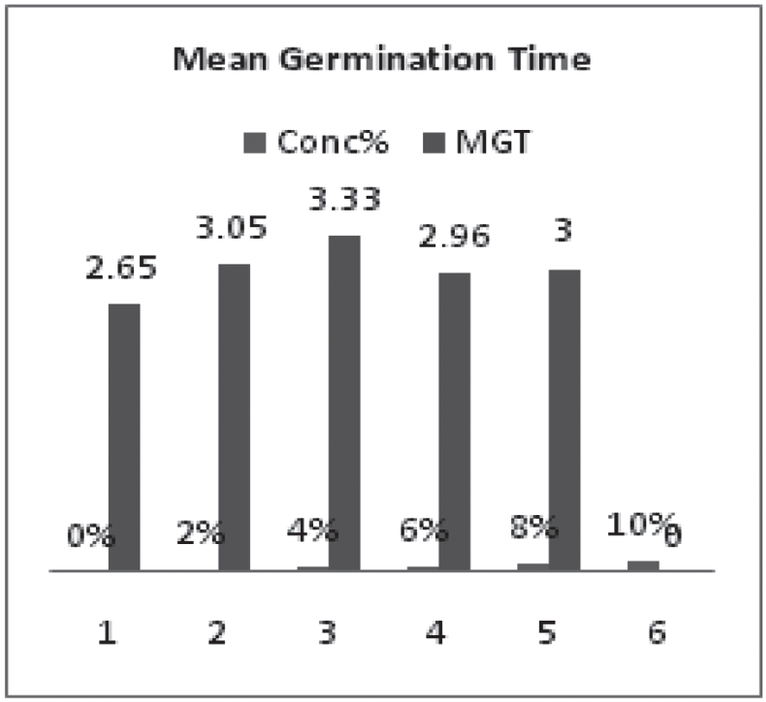

Fig.3. Mean germination time (MGT)

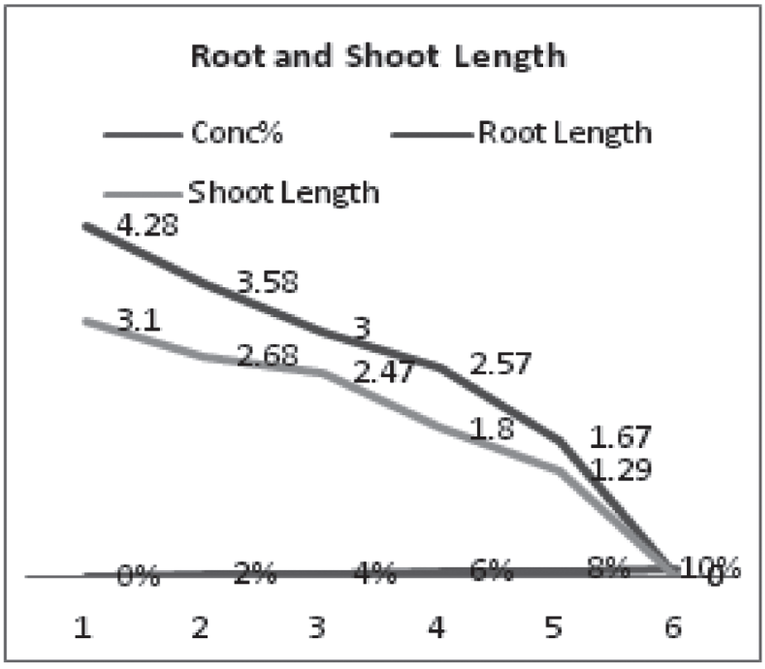

Fig.4. Root and shoot length

TABLE-1 : Effect of Leaf aqueous extract of *Parthenium hysterophorus* on seed germination & seedling growth of *Cajanus cajan* (Pigeon pea)

Conc.	Germination %	GI	MGT	Root Length (cm)	Shoot Length (cm)	SVI	Biomass (g)
Control	96.67	3.91	2.65	4.28	3.10	412.00	0.80
2%	80.00	2.82	3.05	3.58	2.68	285.00	0.61
4%	66.67	2.39	3.33	3.00	2.47	198.00	0.52
6%	53.33	2.01	2.96	2.57	1.80	136.33	0.44
8%	36.67	1.34	3.00	1.67	1.29	60.33	0.32
10%	NG	NG	NG	NG	NG	NG	NG
F Value	48.67	13.93	10.38	214.42	39.22	103.31	304.91
LSD 0.05%	10.69	0.77	0.84	0.22	0.39	32.33	0.039

GI= Germination Index, MGT = Germination Mean Time, SVI = Seedling Vigor Index.

and treatment means were compared using the Least Significance Difference (LSD) at a probability level of 0.05% .

Results and Discussions

Germination percentage

The highest seed germination percentage was recorded in control (96.67%) and the lowest was recorded at 8 % aqueous leaves extract (Fig. 1).Germination was completely inhibited at 10% extract. Seed germination was significantly reduced with increasing concentration at >2%.This showed that leaf extract of *P. hysterophorus* contained some inhibiting chemicals resulting in the reduced germination of *Cajanus cajan.* Increasing concentration of *P. hysterophorus* ash had adverse effect on germination, radicle and plumule length, biomass of *Phaseolus mungo* than the control. Plants were releasing water soluble phytotoxin from leave, stem, root, fruit and seeds. Such metabolites play an inhibitory role in delay or completely inhibition of seed germination[22].

Germination Index (GI)

Germination index was significantly influenced with different concentrations (F=13.93). Table showed significantly reduction with increasing concentration of extract. Maximum germination index was recorded at control (3.91) where as minimum (1.34) at 8% extract (Fig.2). Similar findings[10,16,19] showed that *Asphodelus tenuifolius* and *Fumaria indica* inhibited % germination and germination index of maize at higher concentration was similar to the present study.

Mean Germination Time (MGT)

Mean germination time (MGT) increased with the concentration; ANOVA showed significant deference ($p<0.05$) between treatments (F=10.38). Result was showed that mean germination time increased at > 2% extract over control. Maximum MGT was observed (3.33) at 4% extract (Fig.3). MGT was delayed at >2% concentration. The maximum MGT indicated that there might be inhibitory compound in aqueous of *P. hysterophorus* which delayed the germination process of crop seeds. Results[4] stated that chickpea seeds soaked in root extract of *Asphodilus tenuifolus* cav. took more time to germination.

Seedling Growth

Table-1 showed significant influence ($p<0.05$) between treatments in root and shoot length of *Cajanus cajan.* The control showing maximum root length (4.28 cm) and minimum (1.67 cm)was recorded at 8% extract (Fig.4). The shoot length also showed significantly deference with increasing concentration as control. *P. hysterophorus* in the form of extract or residue or growing weed effect the germination, growth and productivity of *Zea mays* workers[20] also reported that increasing concentration of *P. hysterophorus* ash has adverse effect on radicle and plumule length of *Phaseolus mungo* than the control. Foliar leachates of *P. hysterophorus* reduces root and shoot elongation of *Oryza sativa* and *Triticum aestivum*[25] *Zea mays and Glycine max*[7]. *P. hysterophorus* reduces root, shoot length of maize and soybean. Aqueous extract of *P. hysterophorus* showed inhibitory effect on different plant species[13,21]. This indicates the availability of the inhibitory chemicals in higher concentration in leaves reduced the seedling growth of *Cajanus cajan.*

Seedling Vigor Index (SVI) was decreased with increasing concentration of aqueous leaves extract of *Parthenium hysterophorus* as compared to control. The maximum SVI (412) was recorded at control and minimum (60.33) at 8% extract (Fig.5). Similar report was observed in Z*ea mays*[20].

Biomass

Biomass were significantly decreased at >2% extract between treatments (Fig.6). Biomass of wheat, maize and soybean inhibit with increasing concentration of aqueous extract of *P. hysterophorus*[9]. Other also reported that increasing concentration of *P. hysterophorus* ash has adverse effect on biomass of *Phaseolus mungo* than the control. The result showed that leaves extract has strong allelopathy property that reduces the biomass of *Cajanus cajan* with increasing concentration.

Conclusion

In the present investigation it is demonstrated that different concentration of aqueous leaves extract of *Parthenium hysterophorus* exhibited significant inhibitory effect on seed germination and seedling growth in *Cajanus cajan.* The extract induced strong inhibitory effect on the root and shoot elongation and significant reduction in germination index, seedling vigor index and biomass of seedling over control. The extract also showed adverse effect on mean germination time with increasing concentration.

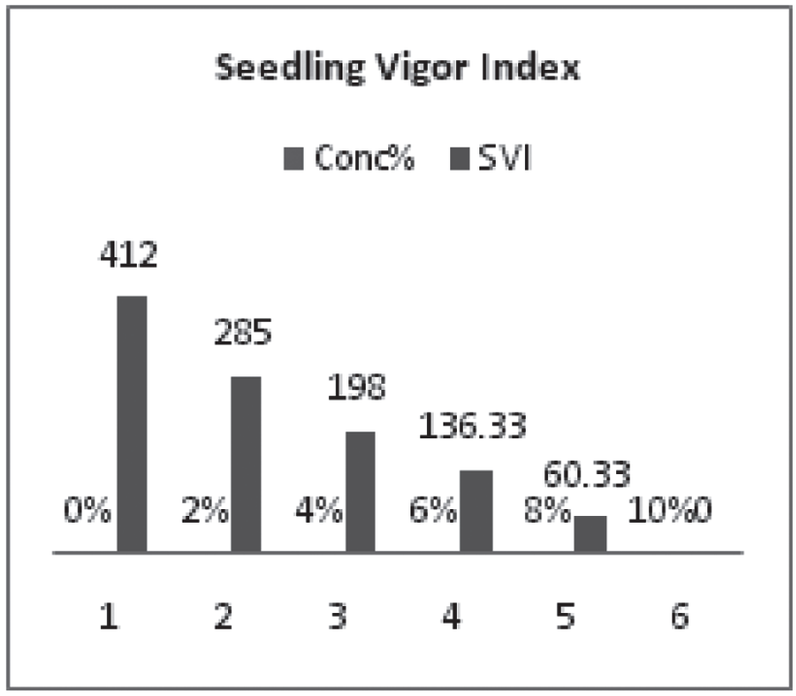

Fig. 5 : Seedling vigor index (SVI)

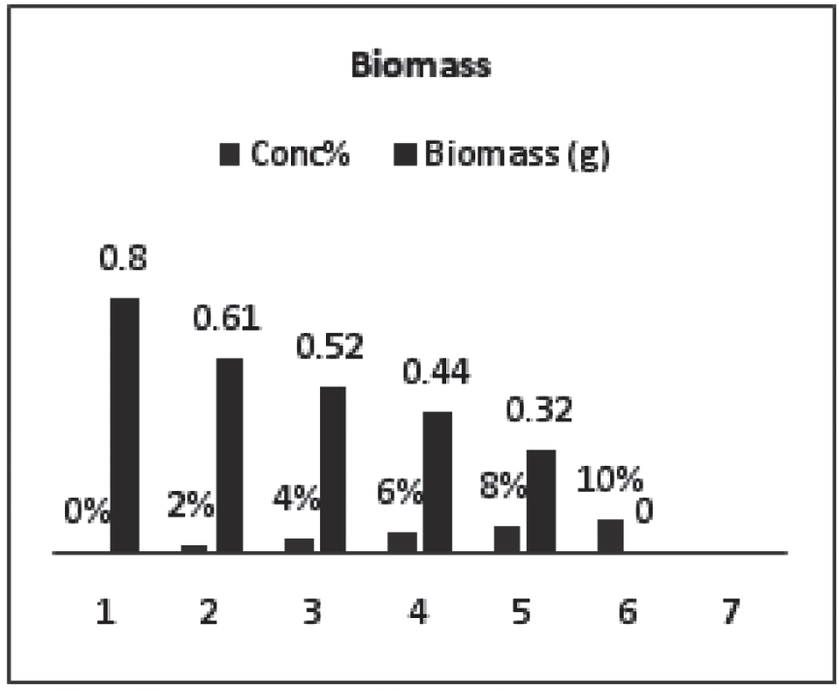

Fig. 6 : Biomass decreases with increasing concentration of extract

The data provided evidence of *Parthenium hysterophorus* has allelopathic biochemical. It is suggested that this weed should be removed at the emergence stage from the crop field, so that crop production may be enhanced.

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