Research Paper :

Allelepathic Effects of Dried Plant Parts of *Parthenium hysterophorus* L. on Seed Germination and Post Emergence Growth of *Phaseolus mungo* Roxb var. T-9

AJAY KUMAR SINGH, ARVIND KUMAR SINGH, RAMESH SINGH AND TOSHI SINGH

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See end of the article for authors' affiliations

Correspondence to :
AJAY KUMAR SINGH
Department of Botany, T.D.P.G. College, JAUNPUR (U.P.) INDIA

SUMMARY

***Parthenium hyterophorus* L., a native of tropical America and invasive to several countries including India was evaluated for its allelopathic potential of dried plant parts *i.e.* root, stem, leaf and reproductive organs on seed germination and post emergence growth of Black gram *Phaseolus mungo* var.T-9. The experiment was conducted in pot conditions. It was observed that reproductive part of *Parthenium* exerted strong allelopathic effects followed by stem, leaf and root on reductions in seed germination at 11 days after sowing were 9.24%, 8.10%, 6.86% and 4.30%, respectively. Post emergence growth was observed at 35 days after sowing. Significant reduction was found in shoot dry weight, root dry weight, nodule dry weight and root nodule number.**

Key words : *Parthenium*, Allelopathy, *Phaseolus mungo*, Seed germination and post emergence growth

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Allelopathy refers to the beneficial or harmful effect of one plant to another plant by the release of chemicals from different plant parts by leaching, root exudation, volatilization, residue decomposition and other processes. Common effects of allelopathy include reduced seed germination and seedling growth. However, known sites of action for some allelochemicals include cell division, pollen germination, nutrient uptake, photosynthesis and specific enzyme function.

Parthenium hysterophorus L. also known as 'carrot weed' , 'congress grass',' white head', 'gajarghas' is a herbaceous, erect and annual plant belonging to the family Asteraceae. *P. hysterophorus* L. has been reported to contain several allelochemicals, like parthenim, kermpferol, p-cumaric acid, caffeic acid etc. (Pickman and Towers, 1982). Organic compounds like phenolic acids and flavonoids have been found to retard the growth of several plants (Mall and Dagar, 1979). *Parthenium* is not only harmful to crops but also causes several diseases to man e.g Asthma, contact dermatitis and loss of weight, eye irritation in dogs and horses (Towers *et al.*, 1977).*Phaseolus mungo* var.T-9 (black gram or urd) a leguminous crop, is highly priced pulse. It is early maturing (80 days), erect, medium, black seeded, recommended as a early crop in *kharif*.

MATERIALS AND METHODS

Fresh samples of root, stem, leaf and reproductive parts of *Parthenium* were collected at random. Samples were dried at 80^0C for 48 hours in oven. Twenty grams of each plant material was mixed separately in one kilogram of sterilized garden soil (neutral clay loam) in earthen pots of 25 cm diameter and 20 cm in depth. Soil was sterilized in autoclave at the pressure of 1.1 kg/cm^2 for 5 minutes. Soil was uniformly fertilized with 16,18 and 12 ppm of urea, diammonium phosphate and muriate of potash. Seeds of *Phaseolus mungo* were thoroughly washed with water to remove dust and dirt and then with mild detergent solution for 5 minutes. The seeds were surface sterilized with 0.1% $HgCl_2$ for 10 minutes and washed with sterilized distilled water, 4 to 7 times. Twenty seeds were sown in each pot and evenly irrigated daily with double distilled water. The experiment was laid out in a randomized complete block design with five replicates and was repeated twice. Germination was recorded at 3, 5, 7, 9 and 11 days after sowing (DAS). Post emergence growth was observed at 35 DAS. For control, seeds were sown in pots with sterilized soil only.

Statistical analysis:

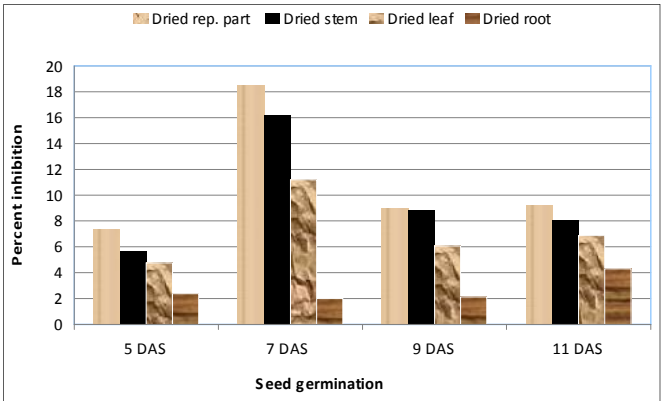
Statistical analysis of data was done wherever necessary. Mean, standard error (SE)

and analysis of variance (ANOVA) were calculated according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

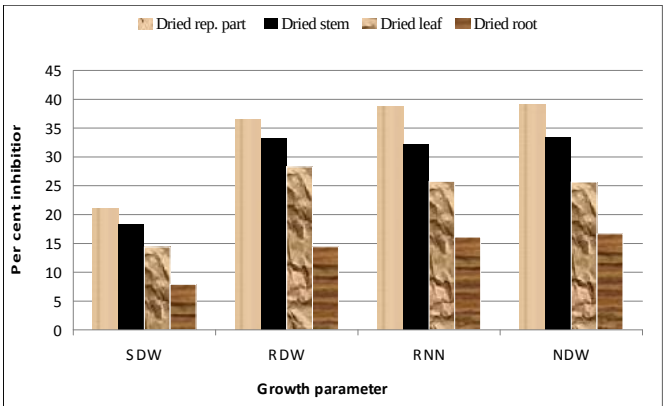
Per cent inhibition of seed germination at 3,5,7,9 and 11 days after sowing (DAS) are given in Table 1. Seeds treated with dried reproductive part of *Parthenium* showed maximum variation over the control followed by stem, leaf and root. At 11 DAS, per cent inhibition of seed germination due to reproductive part, stem and leaves were 9.2%, 7.8%, 6.9% and 4.3%, respectively (Fig. 1).

For post emergence growth shoot dry weight (SDW), root dry weight (RDW), root nodule number (RNN) and nodule dry weight (NDW) were considered. Data were recorded at 35 DAS (Table 2). Again reproductive parts of *Parthenium* exhibited maximum allelopathic inhibition in the above parameters. Per cent reduction in the above parameters due to reproductive parts were 21.02%, 36.53%, 38.7% and 39.02%, respectively (Fig. 2).



DAS=Days after sowing, rep. part=reproductive part

Fig. 1 : Effect of different dried parts of *P. hysterophorus* on germination of black gram var. T-9



SDW=Shoot dry weight, RDW=root dry weight, RNN=Root nodule number and NDW=Nodule dry weight

Fig. 2 : Effect of different dried parts of *P. histerophorus* on post emergence growth of blackgram var. T-9.

Table 1 : Allelopathic effect of dried plant parts of *Parthenium hysterophorus* L. on seed germination of *Phaseolus mungo* Roxb. Var. T-9

Treatments	% seed germination (mean ± t (0.05) × SEM)				
	3DAS	5DAS	7DAS	9DAS	11DAS
Dried rep. parts	0.00±0.00	38.9±2.39 (7.3%)	40.75±2.15 (18.5%)	71.9±1.03 (8.98%)	78.05±0.25 (9.24%)
Dried stem	0.00±0.00	39.6±3.38 (5.7%)	41.9±2.02 (16.2%)	72.0±1.02 (8.86%)	79.03±0.39 (8.1%)
Dried leaf	0.00±0.00	40.0±1.99 (4.76%)	44.4±1.982 (11.2%)	74.2±1.32 (6.07%)	80.1±0.72 (6.86%)
Dried root	0.00±0.00	41.0±2.4 (2.38%)	49.0±1.33 (2.0%)	77.3±2.01 (2.12%)	82.3±1.02 (4.30%)
Control	0.00±0.00	42.0±3.21	50.0 ±0.92	79.0±1.32	86.0±1.23

Value in parentheses are per cent inhibition over control. DAS=Days after sowing, rep. part=reproductive part. Significant to 't' test, DF=4.0.

Table 2 : Allelopathic effect of dried plant parts of *Parthenium hysterophorus* L. on post emergence growth of *Phaseolus mungo* var. T-9

Treatments	SDW (g)	RDW (g)	RNN	NDW (g)
Dried rep. parts	10.981±2.21 (21.02%)	0.330±0.04 (36.53%)	19.0±3.2 (38.70%)	15.75±1.3 (39.02%)
Dried stem	11.351±0.231 (18.36%)	0.347±0.03 (33.26%)	21.0±2.3 (32.25%)	17.22±1.4 (33.33%)
Dried leaf	11.901±0.310 (14.41%)	0.373±0.04 (28.26%)	23.0±1.3 (25.80%)	19.20±0.52 (25.66%)
Dried root	12.802±0.321 (7.93%)	0.445±0.04 (14.42%)	26.0±1.9 (16.12%)	21.52±0.7 (16.68%)
Control	13.905±0.84	0.520±0.29	31.0±2.3	25.83±2.4

SDW=Shoot dry weight, RDW=root dry weight, RNN=Root nodule number, NDW=Nodule dry weight. Values in parentheses are per cent inhibition over control .Data recorded at 35 days after sowing, mean ± t (0.05)×SEM and DF=4.0

Phaseolus seeds treated with dried plant parts of *Parthenium* showed inhibition of seed germination and post emergence growth . It is evident from the data that allelochemicals present in *Parthenium* inhibited the process of seed germination and post emergence growth. The process of seed germination included radicle emergence and seedling growth. The absorption of water increases the turgor pressure which results in expansion of cell. The embryo is activated due to imbibitions of water. Embryo produces gibberellin which induces synthesis of digestive enzymes like hydrolases, proteases and α-amylases. These enzymes convert starch into sugars and proteins into amino acids including tryptophan, which is a precursor of IAA (Van Overbeek, 1966). Haggar *et al*. (1971) suggested that IAA activates plasma membrane ATPase, thereby stimulating active efflux of H^+ from the cell. H^+ once pumped into the cell wall, would break acid liable bonds leading wall extension and growth. IAA induced growth affect cell wall extensibility. Anderson *et al*. (1981) observed an increase in respiration in maize coleoptile on treatment with IAA. Thus, IAA and ATPase are responsible for elongation of cells of embryo *i.e*. radicle emergence. Mobilization of reserve food materials occurs after elongation and expantion of cells resulting into synthesis of biomolecules for cell division.But there are reports that allelochemicals inhibit respiration (Rice, 1984) and energy transfer (Moreland and Noritzy, 1985) responsible for ATP synthesis. Inhibition in seed germination might be due to allelochemicals inhibiting Gibberellin and IAA induced growth.

Thapar and Singh (2003) reported depletion of chlorophyll and protein content in *Parthenium* due to allelochemicals derived from *Amaranthus viridis*. Polyphenolic compounds and other allelochemical compounds are known to change the permeability of plasma membrane. Rapid loss of integrity of plasma membrane under the influence of allelochemicals cause the cellular leakage (Abbas *et al.*,1992). Allelochemicals might inhibit the photosynthetic process resulting into depletion of food reserve *i.e*. carbohydrate and protein. As a result, net assimilation was reduced. This might caused reduction in shoot and root dry weight during post emergence growth.

The process of nodule formation includes infection of host legume by the appropriate *Rhizobium* species. Root hairs are the site of infection. The first microscopically visible indication of bacteria plant interaction is deformation and curling of normally straight root hairs. A characteristic deformation is curling at the root hair tip to produce a "shepherd's crook". The bacteria enter the root hairs by the process of invagination and are enclosed in a tubular structure, the infection thread. There is no direct penetration through the root hair cell wall and bacteria remain extracellular.Bacteroid produce nitrogenase, which converts atmospheric nitrogen into ammonia. Nitrogenase are highly sensitive to oxygen. To solve the oxygen- toxicity problem, the bacteria in root nodule are bathed in a solution of a oxygen- binding protein called leghemoglobin. This protein is provided by the plant. Plant utilizes ammonia produced during the nitrogen fixation for synthesis of proteins resulting into growth. Allelochemicals from *Parthenium* might be interfering in bacteria plant interaction for poor nodulation and reduction in nodule dry weight.

Authors' affiliations:
ARVIND KUMAR SINGH AND TOSHI SINGH, Department of Botany, T.D.P.G. College, JAUNPUR (U.P.) INDIA
RAMESH SINGH, Department of Plant Pathology, T.D.P.G. College, JAUNPUR (U.P.) INDIA

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