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INHIBITORY EFFECTS OF GOAT WEED ON GROWTH AND DEVELPOPMENT OF CHICK PEA (*Cicer arietinum* L.) AND BLACK GRAM (*Phaseolus mungo* L.)

AWANISH KUMAR SINGH[1]

Department of Botany, S.G.N. Govt. P.G. College, Muhammadabad, Gohna, Mau, U.P., India

ABSTRACT

In present study an attempt has been made to investigate the allelopathic effects of Goat weed (*Ageratum conyzoides* L.) on the germination and seedling growth of chickpea and black gram. Seeds were placed in petridishes containing 10, 20, 30 and 40% leaf leachates of goat weed extracts. The germination percentage was evaluated at the end of 10th day after sowing (DAS) whereas seedling growth was evaluated at 28th day (28 DAS). The increase in leachate concentrate was associated with the increased reduction of seed germination and seedling growth. The weed leaf leachates at different concentrations reduced the seed germination, plant height, leaf numbers, leaf area and seedling dry weight of the test crop species. The inhibitory effects of the test crop were positively related to the concentration of *Ageratum conyzoides* weed leaf leachates. The leaf leachates of *Ageratum conyzoides* at 10% concentration, significantly reduced seed germination, plant height, leaf numbers, leaf area and seedling dry weight.

KEYWORDS: *Ageratum conyzoides*, Allelpathy, *Cicer arietinum,* Leaf Leachates, *Phaseolus mungo*

The allelopathy described as biochemical interactions that inhibit the growth of nearby plants by another plant due to the release of chemical compounds (Molisch, 1937). The weeds are undesirable plants competing for moisture, light, water, nutrients and space with crop plants (Anonymous, 1994). It affects a crop growth dynamics by releasing chemical compounds called allelochemicals (Kadioglue *et al*., 2005). The root, rhizome, stolon, stem, leaves, branches, flower, fruit and seeds of weeds have allelopathic potentiality. These parts possess allelochemicals like phenolic compounds, flavonoids, terpenoids, alkaloids, amino acids and have an inhibitory or stimulatory effect on the seed germination of crop plants (Ghodake *et al*., 2012; Dongre and Singh, 2011). The leaf extract have much allelochemicals property studied by (kumbhar and Patel, 2012).

A number of plants, including crops, weeds and trees, have been reported to have allelopathic properties. It has been reported that some of the weed exerts chemical stress on some crops by their phytotoxic root exudates and other foliage leachates which are accumulated into the soil (Nakano *et al*., 2003). As a result the growth of other plants in the proximity is adversely affected. Most allelochemicals are released during germination and early growth stages. Considerable research work has been done on the allelopathic effect of weeds on natural plant communities viz, abandoned field or old fields (Dongre and Rajeev Mishra, 2007; Shetty *et al*., 2007; Singh, 2019).

Although information on the allelopathic effects of this weed on some temperate crop plants is available, such information is lacking for some tropical crop plants. Moreover, the work has not yet been done on the effect of plant debris of Siam weed on the growth of rice, mustard and groundnut. Therefore, the present study was undertaken to evaluate the allelopathic effect of Siam weed debris on the seed germination and growth of rice, mustard and groundnut and to identify the appropriate concentration of Siam weed debris at which considerable growth inhibition occurs for seed germination and seedling growth of rice, mustard and groundnut.

MATERIALS AND METHODS

Bioassays

The present study was conducted at the laboratory of Department of Btany, S. G, N, Govt. P. G, College, Muhammadabda, Gohna, Mau, U.P., India in the month of January 2021. The mature fresh leaves of *Ageratum conyzoides* L. (goat weed) were collected from the area of the Muhammadabad, Gohna Mau (UP) 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 was considered to be 50% leachates concentration, which were stored in glass bottles in dark.

Two test crop species viz., *Sheenghar-2000* (*Cicer arietinum* L.) and P-19 (*Phaseolus mungo* L.) were

[1]**Corresponding author**

used in the study. Healthy uniform seeds were selected manually as test planting material. The seeds were sterilized with 0.1 % $HgCl_2$ solution for 2 minutes and washed in double distilled water for 2-3 times. Ten seeds of each test crop were placed on sterilized filter paper inside sterilized Petri dishes (90 mm diameter) and covered with filter paper (Whatman No. 2). In each Petri dish 15 ml of 10, 20, 30 & 40 % *Ageratum* leaves extract was added and distilled water was also used as control. The treatments were arranged in a completely randomized design with three replicates. Seed germination and seedling growth were recorded at an interval of 24 hrs for 10 days. The results of experimental seedling were recorded by counting the number of germinated seeds, measuring the radical length and weighing of fresh seedling weight. The radicle length less than 0.2 cm was ignored. (Siddiqui *et al.*, 2009).

Pot Culture

Aqueous leaf leachates (`10, 20, 30 and 40%) of *Ageratum* were prepared. Plastic pots of 25 cm diameter were filled with garden soil at 2 kg soil/pot. Pots were sown with 20 seeds of test crops and then irrigated with aqueous leaf leachates of the *Ageratum* weed. The control pots were irrigated with distilled water. The experimental design was, Completely Randomized Design (C.R.D.) with three replications.

Data were collected on seed germination, plant height, leaf number, leaf area and leaf dry weight. Plant height of the test crops was measured after 30 days of seed placement. Leaf numbers of randomly selected ten plants of two crop species were counted. Leaf area was measured at 30 days after seed placement. Dry weight of randomly selected 10 seedlings was recorded after being placed in an electric oven for seven days at 70^0c temperature. Percent reduction of plant height, leaf number, leaf area and leaf dry weight due to different concentrations of Siam weed debris was also estimated according to the equation described by Islam and Kato-Noguchi (2012) with slight modification as follow:

Reduction (%) = [1- (treatment / control)] × 100. The data were analyzed statistically using critical difference at 5% level of significance.

RESULTS AND DISCUSSION

Petri Dish Germination Bioassay

In both the test crop, chick pea and black gram seed germination and root length were significantly affected by different concentrations of *Ageratum conyzoides* (Table 1). The highest seed germination (93.0%), (83.0%) and highest seedling growth (4.6cm), (5.9cm) in chick pea and black gram respectively were observed in control treatment whereas the lowest performance of this parameter was in 40% concentration of leaf leachates of goat weed. Three other concentrations of goat weed showed intermediate results of these studied parameters (Table 1). At 40% concentration of leaf leachates of goat weed, the percent reduction of seed germination and seedling growth over control was 24.6 and 49.7% respectively in chick pea. The maximum inhibition in seed germination and seedling growth was 27.2 and 40.7% respectively in black gram. (Table 1 and Figure 1).

Degree of inhibition increased with increasing the concentrations of the extracts. This tends to suggest that the effect of the extract is concentration dependent. Seed germination percentage was decreased with increasing the aqueous leaves extract concentration. Similar finding was also observed by many researchers (Dongre and Singh, 2007; Dongre *et al* 2004; Siddiqui, *et al*., 2009; Singh 2019; Begum *et al* 2021; Singh 2021a; Singh 2021b), that germination percentage, radicle and plumule length were reduced by the leaf leachate of *Ageratum conyzoides* and other noxious weeds. The seed germination and seedling growth inhibition of the test plants by the leaf leachates of goat weed may be due to the inhibitory substances.

Greenhouse Additive Studies

Weed leaf leachates significantly decreased the plant height, number of leaf per plant, leaf area per plant and dry weight (Table 2) in chick pea and black gram. In chick pea tallest plant (18.1cm), highest number of leaves (8.4), highest leaf area (10.0cm2) and highest seedling dry weight (3.0g/10 plants) were recorded in control. The tallest plant (21.0cm), highest number of leaves (5.3), highest leaf area (98.5cm2) and highest seedling dry weight (12.8g/10 plants) of black gram were observed in control whereas the lowest performance of these parameter was observed in 40% concentration of goat weed in both chick pea and black gram. At 10% leachates, maximum inhibition was observed in chick pea leaf area/plant of ($26.1cm^2$) followed by leaf number (14.3), seedling dry weight (13.3g/10 plants) and then plant height (11.6 cm) whereas the maximum inhibition at 10% in black gram leaf area/plant of ($20.9cm^2$) followed by plant height (14.3 cm), leaf number (5.7) and seedling dry weight (5.5g/10 plants).The maximum inhibition in all the test parameter recorded in both the test crop was observed in 40% concentration of leaf leachates of *Ageratum conyzoides* (Table 2). `

The leaf extracts of some weed species *Ageratum conyzoides*, *Anagallis arvensis, Chenopodium*

album, Parthenium hysterophorus and *Rumex dentatus* reduced all growth parameters viz., root-shoot length, leaf area, root biomass,shoot biomass, total biomass, pod number and seed weight of wheat (Dongre and Singh, 2007) and green gram (Dongre *et al*.,2010). A number of plants have inhibitory effect on the growth of neighboring plants by releasing phytotoxic chemical into the soil due to decomposition of plant residues (Li and Wang, 1998; Chaves *et al*., 2001).

The allelopathic effects of these weeds, their related species and their possible allelochemicals have already been reported. Kalita *et al* (1998) found a reduction in leaf number, leaf area, chlorophyll content and nitrate reductase activity of rice grown in soils mixed with sun dried biomass of *Ageratum conyzoides*. Gogoi *et al* (2002) found that the spraying of aqueous extracts (1:4, w/v) of *A. conyzoides* reduced the plant height, leaf number, leaf area, tiller number and root dry weight of rice. Singh (2021b) found severe inhibition of seed germination from *Ageratum conyzoides*. Saxena *et al* (2003) isolated gallic, vanillic and p-hydroxybenzoic acids from *A. conyzoides* extracts and also found the inhibition of germination, seedling length, seedling dry weight and uptake of labelled phosphorus and zinc (32P and 65Zn) in seedlings of three varieties of wheat with increasing concentration (5 and 10%) of its extracts.

Table 1: Effect of aqueous leaf leachates of *Ageratum conyzoides* on germination and seedlings growth of Chick pea and Black gram in bioassay at 7 DAS

Test Crop Species	Treatment (%)	Germination (%)	Root length (cm)
Chick pea	0 (Control)	93.0	4.6
	10	83.2 (-10.5)	3.1 (-32.7)
	20	80.6 (-13.3)	2.9 (-36.4)
	30	75.0 (-19.3)	2.6 (-43.4)
	40	70.1 (-24.6)	2.3 (-49.7)
	CD at 5%	6.3	0.19
Black gram	0 (Control)	83.0	5.9
	10	75.2 (-9.3)	4.6 (-21.0)
	20	70.2 (-15.5)	3.9 (-33.0)
	30	62.3 (-24.9)	3.7 (-37.8)
	40	60.4 (-27.2)	3.5 (-40.7)
	CD at 5%	0.11	0.51

Data in parenthesis indicate percent decrease from control.

Table 2: Effect of aqueous leaf leachates of *Ageratum conyzoides* on morphological characteristics of Chick pea and Black gram in pot culture at 30 DAS

Test Crop Species	Treatment (%)	Plant height (cm)	Leaf number/plant	Leaf area/plant (cm^2)	Dry weight (g/10 plants)
Chick pea	0 (Control)	18.1	8.4	10.0	3.0
	10	16.0 (-11.6)	7.2 (-14.3)	7.4 (-26.1)	2.6 (-13.3)
	20	14.3 (-20.9)	6.8 (-19.0)	5.1 (-39.1)	1.8 (-40.0)
	30	13.9 (-23.2)	5.8 (-30.9)	4.8 (-52.0)	1.5 (-50.0)
	40	12.8 (-29.3)	4.9 (-41.7)	4.1 (-59.0)	1.5 (-50.0)
	CD at 5%	0.46	3.6	0.20	0.10
Black gram	0 (Control)	21.0	5.3	98.5	12.8
	10	18.1 (-14.3)	5.0 (-5.7)	77.9 (-20.9)	12.1 (-5.5)
	20	16.9 (-10.0)	4.8 (-8.9)	60.3 (-38.8)	10.4 (-18.7)
	30	16.1(-23.3)	4.5 (-14.5)	52.8 (-46.4)	9.5 (-25.9)
	40	13.6 (-35.2)	3.6 (-31.7)	48.2 (-49.0)	8.6 (-32.8)
	CD at 5%	0.19	0.74	9.5	0.17

Data in parenthesis indicate percent decrease from control.

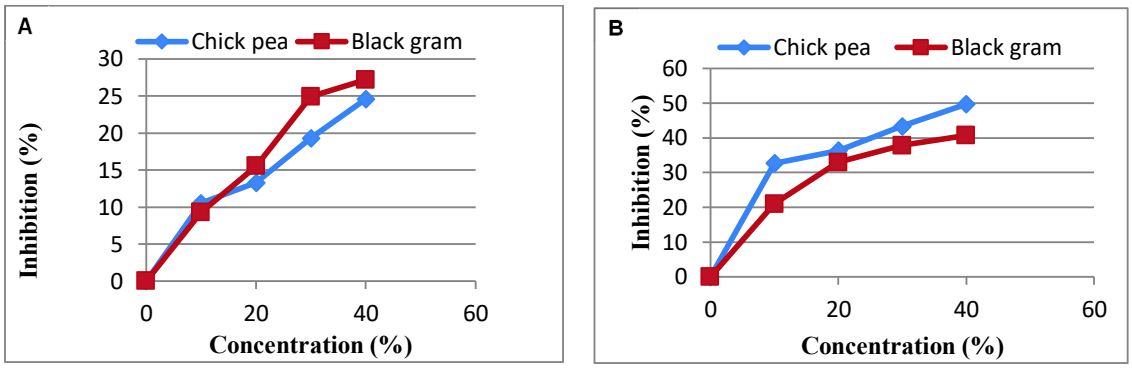

Figure 1: Effect of leaf leachates of *Ageratum* on germination (A) and root length (B) of chick pea and black gram at 7 DAS

CONCLUSION

The leaf leachates of *Ageratum conyzoides* weed exhibited inhibitory effects on the seed germination and seedling growth of both test crop species (chick pea and blackgram). The effect of the leaf leachates is concentration dependent. These weed leachates inhibited the different growth parameters: plant height, leaf number per plant, leaf area and seedling biomass. This inhibition may be attributed to presence of strong allelopathic potential and contain allelochemicals in them. However, further isolation and identification is necessary to confirm which allelopathic substances are responsible for the inhibitory activity of goat weed against test crop species.

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