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Research Article

ALLELOPATHIC EFFECT OF *AGERATUM CONYZOIDES* ON CHLOROPHYLL CONTENT IN THE LEAVES OF MUNGBEAN

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ABSTRACT

An experiment was designed to study the allelopathic effect of *Ageratum conyzoides* L. on chlorophyll content of the leaves of mungbean (*Vigna radiata* L.) plants. The mungbean plants were raised by seeds in polythene bags and kept in an open field. These were treated with aqueous extracts of various parts viz. leaves, stem and roots of *Ageratum conyzoides*. The plants were analyzed for chlorophyll 'a', chlorophyll 'b' and total chlorophyll content at different stages of its growth. For estimation of chlorophyll healthy and treated plants of 15, 30, 45 and 60 days were taken. A decrease in the contents of chlorophyll a, b and total chlorophyll was observed in all the treated plants as compared to control during all the stages of the growth. The maximum reduction in chlorophyll content was observed in the plants treated with leaf extract followed by those treated with stem extract while the plants treated with root extract did not show much change in chlorophyll content. It was concluded that *Ageratum conyzoides* cause a reduction in chlorophyll content in mungbean plants by inhibiting its biosynthesis or enhancing its degradation. However these phytotoxic compounds are present in varying concentrations in different parts of the weed.

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INTRODUCTION

Allelopathy as an important form of plant interference (Rice, 1984, Putnam and Tang, 1986), as indicated by several studies conducted on allelopathy. Besides competing for moisture, nutrients, and light, weeds can also affect crop growth by releasing allelochemicals into the growing environment (Rice 1984, Kadioglu *et al.* 2005).

Allelochemicals may interfere with various physiobiochemical processes of seed germination, root elongation, plant growth as well as various biochemical contents and metabolic activities of crop plants (Maiti *et al.* 2008). Most of the reports are based on the preliminary investigations on some putative allelochemical-induced changes in germination behaviour and growth parameters of target species. However, least attention has been given to correlate the changes of growth behaviour with the metabolic status of the test plants. The present research work is devoted mainly to the biochemical aspect aimed to evaluate the effect of a very common allelopathic species against an important pulse crop. Thus, in this investigation, experiments were designed to determine the phytotoxic potential of extracts of different parts of *Ageratum conyzoides* on chlorophyll content of the crop plant, which is an important biochemical aspect.

Such studies may determine the extent of allelopathic effects that a weed may have on the target plant. Chlorophyll estimation is one of the important biochemical parameters that are used as the index of production capacity.

Mungbean, *Vigna radiata* is one of the most important pulse crops. It is grown in almost all parts of our country. It has been grown in India since ancient times. It is also referred to as green gram, golden gram, and chop suey bean. Mungbean is grown widely for use as a human food (as dry beans or fresh sprouts), but can be used as a green manure crop and as forage for livestock.

Ageratum conyzoides (Billygoat Weed) is a common weed found in agriculture fields. It is a short-lived annual weed, exhibiting extreme plasticity and quick flowering. It is very adaptable, and it rapidly colonizes disturbed and cultivated areas. Thus the present work was undertaken to study the allelopathic effect of *A. conyzoides* on chlorophyll content of mungbean (*V. radiata*), which is an important crop grown in many parts of Madhya Pradesh.

MATERIALS AND METHODS

The experiment was carried out during 2010 at Regional Institute of Education, Bhopal, Madhya Pradesh, which is a constituent unit of NCERT, New Delhi. The extremities of

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Bhopal district lie between parallels of latitude 22° 33' and 23° 53' North and the meridians of longitude 76° 26' and 77° 91' East. It lies 509 M above mean sea level. The mungbean plants were raised by seeds (PDM-11 variety, obtained from M. P. State Seed Corporation, Bhopal) in polythene bags and kept in an open field. These were treated with aqueous extracts (1/10 w/v) of leaf, stem, and roots of *Ageratum conyzoides* on alternate days. The extract was obtained by submerging 1 gram of the leaves, stems, and roots of the weed separately per 10 ml of water for 24 hours. A control was also maintained, which was irrigated with water only. For estimation of chlorophyll, healthy and treated plants of 15, 30, 45 and 60 days were taken. The leaves were washed with distilled water and the water was soaked by butter paper. Then, the leaves were cut into small pieces with scissors and 100 mg were taken for grinding into mortar and pestle with 80% acetone. The ground solutions were taken into test tubes and the final volume made to 10 mL by adding 80% acetone. The solutions were centrifuged at 5000 rpm for 10 min. The supernatant was taken in clean test tubes separately. The absorbance was recorded at 663 and 645 nm in a double beam spectrophotometer (Bruinsona, 1963). Chlorophyll a, b and total chlorophyll were calculated by using following formula:

$$\text{Chlorophyll a (mg/g-1 tissue)} = [12.7 (D663) - 2.69 (D645)] \times V / 1000 \times W$$

$$\text{Chlorophyll b (mg/g-1 tissue)} = [22.9 (D645) - 4.68 (D663)] \times V / 1000 \times W$$

$$\text{Total Chlorophyll (mg/g-1 tissue)} = [20.2 (D645) + 8.02 (D663)] \times V / 1000 \times W$$

Where,

D=Optical density at respective nm

V=Final volume of chlorophyll extract in 80% acetone

W=Fresh weight of the tissue extracted

The values presented in the experiment are means of three independent experiments. In figures, SEM (standard error of means) values were used.

RESULTS AND DISCUSSION

A reduction in the contents of chlorophyll a, b and total chlorophyll in mungbean plants when treated with aqueous extracts of leaves, stem and roots of *A. conyzoides* were observed as compared to control during all the stages of the experiment. The leaf extract caused a maximum reduction followed by stem and root extracts (Fig. 1, 2, 3).

Fifteen days after sowing, maximum chlorophyll a, b and total chlorophyll was observed in the control plants (chl. a = 0.624 mg/g, chl. b = 0.528 mg/g, total chlorophyll = 1.152 mg/g fresh weight), while it significantly decreased in all the other treatment plants with a minimum of (chl. a = 0.409 mg/g, chl. b = 0.306 mg/g, total chlorophyll = 0.715 mg/g fresh weight) in plants treated with leaf extract followed by those treated with stem extract (chl. a = 0.531 mg/g, chl. b = 0.402 mg/g, total chlorophyll = 0.993 mg/g fresh weight) and then root extract with chlorophyll content (chl. a = 0.618 mg/g, chl. b = 0.508 mg/g, total chlorophyll = 1.126 mg/g fresh weight). Figure 1.1: Allelopathic effects of different parts of *A. conyzoides* on chl. a content of *V. radiata*.

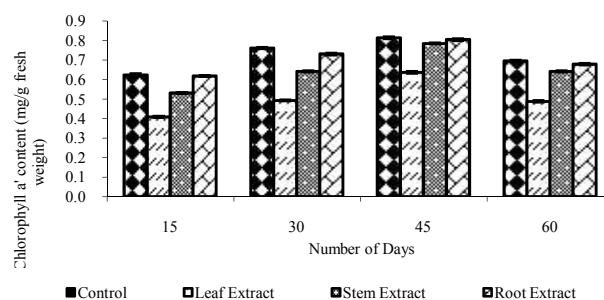


Figure 1 Allelopathic effects of different parts of *A. conyzoides* on chl. a content of *V. radiata*.

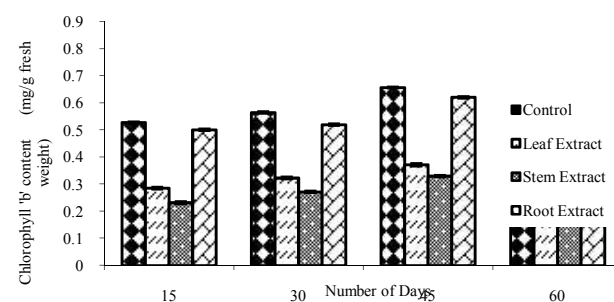


Figure 2 Allelopathic effects of different parts of *A. conyzoides* on chl. b content of *V. radiata*.

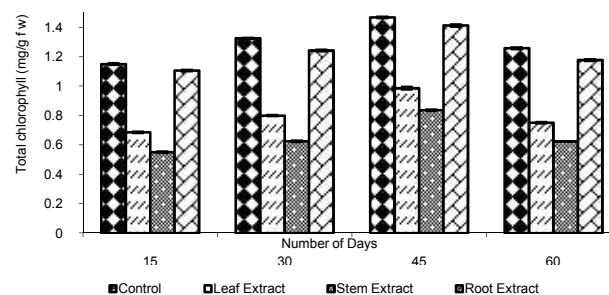


Fig.3 Allelopathic effects of different parts of *A. conyzoides* on total chlorophyll content of *V. radiata*.

The decline continued till the end of the experiment (60DAS) with control exhibiting maximum chlorophyll a, b and total chlorophyll content (chl. a = 0.695 mg/g, chl. b = 0.565 mg/g, total chlorophyll = 1.260 mg/g f.w.), followed by plants treated with leaf extract (chl. a = 0.488 mg/g, chl. b = 0.330 mg/g, total chlorophyll = 0.818 mg/g f.w.), and then stem extract (chl. a = 0.642, chl. b = 0.449 and total chlorophyll = 1.091 mg/g f.w.). Root extract was observed to cause minimum inhibitory effect with chlorophyll content (chl. a = 0.679 mg/g, chl. b = 0.542 mg/g, total chlorophyll = 1.221 mg/g f.w.) next to control.

There is much evidence to show that *A. conyzoides* inhibit germination and growth of other plants through chemicals produced by its root and shoot systems. Seedling growth of various plants including peanut, redroot amaranth, cucumber, and ryegrass is inhibited by fresh leaves and volatile oils of *A. conyzoides* (Kong Hu & Xu 2002). The phenolics present in leaf extracts and residues of *A. conyzoides* negatively interfere with the growth and development of wheat. There is a significant reduction in root and shoot length and biomass

accumulation of rice, when grown in the rhizosphere soil of *A. conyzoides* (Batish et al. 2009a).

Reduction in chlorophyll a, chlorophyll b and total chlorophyll contents in many plants have been reported when treated with different weed extracts (Venkateshwarlu et al., 2001). Bagavathy and Xavier [2007] also reported the reduction in chlorophyll a, chlorophyll b and total chlorophyll in sorghum plants when treated with *Eucalyptus* leaf extract. This is also supported by the reduction in total chlorophyll content under allelopathins as recorded by Abu-Romman et al., [2010] while studying allelopathic effects of spurge (*Euphorbia hierosolymitana*) on Wheat (*Triticum durum*).

The quantitative analyses of phytotoxins in the rhizosphere soil showed it contained nearly six times more phenolics than the control soil. The main allelochemicals in the rhizosphere soil of *Ageratum conyzoides* were isolated and identified to be *p-coumaric acid*, *gallic acid*, *ferulic acid*, *p-hydroxybenzoic acid*, and *anisic acid* (Batish et al. 2008).

Rice (1984) has suggested that allelopathic compounds impede the synthesis of porphyrin precursors of chlorophyll biosynthesis. The reduction of chlorophyll contents in treated plants could be attributed to the inhibition of chlorophyll biosynthesis and/or the stimulation of chlorophyll degradation as suggested by Yang (2004).

Allelochemicals present in aqueous extracts of weed might have reduced chlorophyll content in the tested crop species by interfering with the biosynthesis of photosynthetic pigments or enhancing their degradation or through the integration of both (Huang et al., 2010). Changes in chlorophyll contents in the present study are also supported by the findings of Inderjit & Dakshini (1992) who cited allelochemical-mediated reduction in seedling photosynthetic pigments primarily due to phenolic acids.

Differential inhibitory effects of various parts of the same plants are likely due to variability in the number of phytotoxic compounds in different plant tissues.

The study suggests that the weed *A. conyzoides* contain compounds that are phytotoxic in nature and cause a reduction in chlorophyll content in mungbean plants by inhibiting its biosynthesis or enhancing its degradation. However these phytotoxic compounds are present in varying concentrations in different parts of the weed.

The data so generated can be used for the development of bioherbicide from these weeds. This study indicates the potential to use allelopathic species to suppress the growth of other weeds. It can further be used as a tool to formulate new eco-friendly bioherbicides to control weeds in agricultural lands and natural ecosystems.

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