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Allelopathic Impact of Non-Volatile Components from *Eucalyptus globulus* Labill. on *Parthenium hysterophorus* L.

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ABSTRACT

Allelopathic impact of non-volatile components extracted from *Eucalytpus globulus* was assessed on various parameters of *Parthenium hysterophorus* - a hazardous weed. Non-volatile components comprising of aqueous leachates, their aglyconic or organic component, apart from petroleum ether fraction, methanolic, chloroform or water fractions (of varying polarity) completely checked the germination of *P. hysterophorus* seeds. The respiratory ability measured in terms of cellular respiration and photosynthesis reflected through total chlorophyll contents were adversely affected. Specificity of a particular allelochemic towards a given parameter was also noticeable.

Key words : Allelopathy, non-volatile allelochemics, *E. globulus, P. hysterophorus,* bioefficacy, chlorophyll content, cellular respiration

INTRODUCTION

In the recent past, *Eucalyptus globulus* Labill. indigenous to Australia, has gained momentum outside its native place because of its wide adaptability. The usefulness of *Eucalyptus* as a source of pulpwood became an unsaid criterion for promoting it as large scale monoculture plantation on any available land with disregard to any ecological suitability particularly the edaphic or other abiotic environs. Inspite of the fact that *Eucalyptus* plantations discourage the understorey herbaceous vegetation (del Moral and Muller 1970, Kohli 1987) and fauna, this tree has been promoted under the safe and modern umbrella of "Forestry and Environment". Vegetation modification which induces hydrological instability creates threat to desertification through destruction of biological productivity of land. *Eucalyptus* also exerts negative impact on plant diversity through the phenomenon of allelopathy (del Moral and Muller 1969, Al-Mousawi and Al-Naib 1975, Kohli 1987). The extraction of non-volatile allelochemics from the leaves of *E. globulus* and their impact on various parameters of *Parthenium hysterophorus* L. formed a part of the study in the present context.

MATERIAL AND METHODS

Eucalyptus globulus leaves were collected locally from Panjab University campus for the extraction of allelochemics.

Extraction of non-volatile allelochemics

Aqueous leachates and aglyconic component of aqueous leachates were extracted from the fresh leaves. Other extract fractions (petroleum ether, methanol, chloroform or water) were extracted from dried leaf powder following Kumari et al. (1985). Selection of concentration was based on

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the results of pilot experiment of cellular respiration test involving concentration range from 0.05 to 0.5 per cent.

Bioefficacy of non-volatile chemics

a. Germination Trial : The efficacy of each non-volatile allelochemic (leachable - glyconic or aglyconic or extracted through organic solvents) was assessed through the germination of *Parthenium hysterophorus* seeds. For each treatment 400 freshly collected mature seeds of *Parthenium* were used. Each group of seeds was dipped in 30 ml of the respective solution for 18 hours. These were then arranged equidistantly over Whatman filter paper discs underlined with a thin layer of absorbent cotton in 6" Petri dishes (100 seeds in each) and moistened with requisite amount of the treating solution. Thus there were 4 Petri dishes for each treatment. The Petri dishes were housed in seed germinator maintained at 27±3°C with 75 ± 2 per cent relative humidity.

Daily germination count was observed for 7 days till no more seed germinated. Results of germination, seed vigour and seedling length were calculated. The data were analysed statistically following Duncan (1955).

b. Chlorophyll content and cellular respiration: Ninety days old healthy and uniform plants were selected from plants raised in an experimental plot. Twenty plants were maintained from each treatment and all the plants were sprayed with 50 ml of extracted solutions for three days. Twenty hours after the third spray, few leaves from each treated plants were plucked, surface cleaned and pooled with respect to their treatments. The chlorophyll content was estimated following the method of Hiscox and Israelstam (1979) and the calculations were done as suggested by Daizy (1990). Cellular respiration was calculated by the method of Steponkus and Lanphear (1967).

RESULTS AND DISCUSSION

The non-volatile allelochemics completely inhibited the germination of healthy, viable seeds, since none of the seeds treated with any of the chemics could germinate. As a matter of fact, upon prolonged exposure (30 days) the seeds even lost their viability, in contrast to healthy seedlings derived from water treated control seeds. Results being same in all cases have not been tabulated.

Plants treated with any of the test fractions under experimentation showed cellular respiration value significantly low than that of control plants. The values were nearly half in plants treated with aqueous leachates or petroleum ether or methanol or water fractions. Among the treated samples, those treated with organic component of aqueous leachates or the chloroform fraction showed cellular respiration values significantly more than that of other treatments. Nevertheless, it was significantly less than that of control (Fig 1). The decreased value of cellular respiration in response to non-volatile fractions of *E. globulus* represented by the amount of red formazan formed through tetrazolium reduction suggests that allelochemics exert their impact on the electron transport chain of the cells. The amount of red formazan represents the rate and extent at which the protons released by electron transport chain are trapped by tetrazolium salt. It, therefore, implies that non volatile allelochemics from *Eucalyptus* act through impairing the respiratory activity of the cells of the target plant.

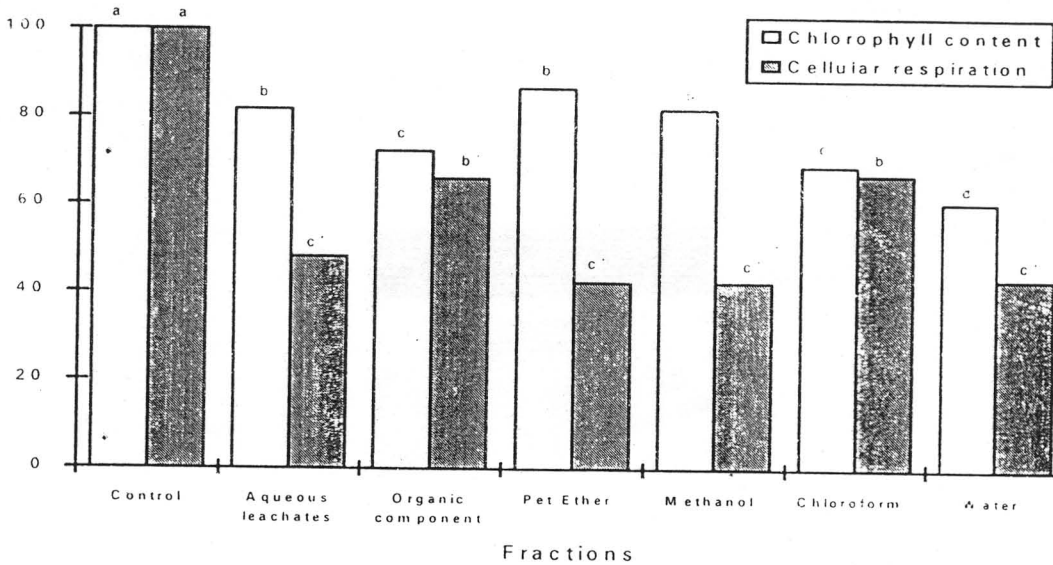

Fig 1: Effect of aqueous leachates (conc 1 g ml^{-1} fresh weight), organic or aglyconic component of aqueous leachates (0.2 mg ml^{-1} fresh weight), pet ether fraction (0.1 %), methanolic fraction (0.1 %), chloroform fraction (0.1 %) or water fraction (0.1 %) extracted from *E. globulus* on the content of total chlorophyll and cell survival of the leaves of *Parthenium hysterophorus*. [Means have been presented in the bars, similar superscribed values represent insignificant differences within themselves at 5 % level of significance applying DMRT (Duncan 1955)].

Similar to the cellular respiration values the chlorophyll content were significantly low in all of the treated samples than that of control (Fig 1).

Among the treatments, in contrast to cellular respiration value, chlorophyll content in plants treated with organic component of aqueous leachates or chloroform fraction was slightly but significantly less than those of aqueous leachates or ether fraction or methanolic fraction. Nevertheless, the impact on the chlorophyll content, when compared to that of cellular respiration values was less in any of the treatments (Fig. 1).The reduced chlorophyll content in response to non-volatile allelochemics indicate that another physiological phenomenon, i.e., photosynthesis is also adversely affected. However, it is difficult to ascertain whether the reduction in chlorophyll pigment is due to the degradation of already present pigment or as function of inhibition of its synthesis. The non-volatile allelochemics of *Eucalyptus* were at least of three kinds, extractable in water, methanol or petroleum ether representing highly polar, less polar and non-polar types, respectively. Allelochemics leachable in water (aqueous leachates) occur in glycosidic forms. According to Goss (1973), the metabolites leach out of the plant system or remain in the plant in their glycosidic forms. In their glycosidic forms, these are relatively less toxic due to the presence of glyconic shield around the active metabolite. From the results of our experiment, organic (aglyconic) component, compared to the organic component in glycosidic form i.e..aqueous leachate had more impact on chlorophyll content. However, the situation was opposite in case of

the cellular respiration value. It was reduced to the lesser extent by glyconic component compared to those by the aqueous leachates. There are reports in literature where organic compounds that have glycosidic group attached to them are easily dissolved in water (Neiman 1952, Mandava 1985, Kumari and Kohli,1987).

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