International Journal of Current Research in Life Sciences
Vol. 4, No. 12, pp. 489-491, December 2015

www.ijcrls.com

Full Length Research Article

ALLELOPATHIC EFFECTS OF IPOMOEA CAIRICA (L) ON NOXIOUS WEED *PARTHENIUM HYSTEROPHORUS* LINN.

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Accepted 21st November 2015; Published Online December 30th 2015

ABSTRACT

Identification of species with *allelopathic* potential has been a target of researches aiming to use them to control crop weeds. Ipomoea cairica is considered a weed with *allelopathic* potential, which has already been reported. The goal of this study was to evaluate the *allelopathic* properties of leaf extracts from Ipomoea cairica on the early development of noxious weed *Parthenium hysterophorusin* Gorakhpur. We tested the effects of leaf extracts, in three concentrations, on the early development of the species. The extracts negatively affected the early development and the morphology of the target species, and the phytotoxic effect was higher as the concentration of the extracts increased.

Key words: Ipomoea cairica, leaf extract, allelopathy, *Parthenium hysterophorus*.

INTRODUCTION

Allelopathic effects are mediated through release of allelochemicals. Allelochemicals are usually called secondary plant products of the main metabolic pathway in plants (Haddadchi and Gervani, 2009). Several phytotoxic substances causing germination and growth inhibitions or stimulations have been isolated from plant tissues and soils (Turk and Tawaha, 2003). These substances, collectively known as allelochemicals, are usually secondary plant products or waste products of main metabolic pathways and most of them originate from the shikimic acid and acetate pathway (Rice, 1984; Turk and Tawaha, 2003). Allelochemicals are present in almost all plants and in many tissues, like leaves, stems, flowers, fruits, seeds and roots (Putnam, 1988). Allelochemicals that inhibit the growth of some species at certain concentrations might in fact stimulate the growth of the same or different species at different concentrations (Narwal, 1996; Ullah *et al.,* 2013). It has been documented that allelopathy play an important role in plant-plant interference by those chemical compounds (Turk and Tawaha., 2003; Turk and Tawaha., 2005; Ashrafi *et al.,* 2007). If some of those compounds are released to the environment, from leaching, litter decomposition, root exudation, or direct volatilization, they could affect (either positively or negatively) germination and growth of other species. The allelopathic effects of some plants were studied including germination inhibition (Sadeghi*et al.,* 2010), plumule and radicle length (Oudhia *et al.,* 1998), seedling growth retardation (Oudhia, 2000a; 2000b) and poor seedling survival (Vankar and Srivastava, 2008). Multiple physiological effects have also commonly been observed from treatments with many allelochemicals.

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These effects include decreases in plant growth, absorption of water and mineral nutrients, ion uptake, leaf water potential, shoot turgor pressure, and osmotic potential caused by phenolic compounds (Barkosky and Einhellig, 2003). *Parthenium* is an annual herbaceous weed belonging to Asteraceae family and has been accidentally introduced in India along with food grain PL-480 (Kanchan and Jayachandra, 1980). *Parthenium* weed not only competes with desirable crop and pasture species but also reported as a health hazard to human being and livestock throughout the world (Adkins and Navie, 2006; Pandey, 1994). The invasive nature of this weed is evident from its ability to form huge monocultural strands with no other plant in the vicinity (Riaz and Javaid, 2009). *P. hysterophorus* is perhaps the most troublesome and noxious weed of urban and rural India (Kohli *et al.,* 2006). *Ipomoea cairica* is a perennial species of the Convolvulaceae. The chemical nature of its secondary compounds was recently examined and two compounds, 3-3´-5-Trihidroxi-4´-7-dimethoxyflanove and 3-3´-5-Trihidroxi-4´-7-dimethoxyflavone-3-O-sulphate, were identified as being responsible for its allelopathic properties on radish (*Raphanus sativus* L.), cucumber (*Cucumis sativus* L.), Chinese cabbage (*Brassica pekinensis*) and a weed *Ligulariavirgaurea*, making it a possible candidate for the development of new herbicides based on natural products (Ma *et al.,* 2009). Hence this study was conducted to investigate the effect of different concentrations of aqueous leaves extract of *Ipomoea cairica*on the early germination and physiological responses of *Partheniumhysterophorus.*

MATERIALS AND METHODS

Plant sampling and preparation of leaf extracts

Fresh leaves of *Ipomoea cairica*were collected from D.D.U Gorakhpur University campus, Gorakhpur. Leaves were

washed properly with distilled water. The leaves were shade dried at room temperature. The dried leaves of *Ipomoea cairica*were uniformly grinded using mechanical grinder and stored in air tight containers for further use. Aqueous extracts of *Ipomoea cairica*were prepared as 20g of leaves were soaked in 200 mL distilled water (10%), and kept at room temperature of 28–30°C. After 24 h the aqueous extracts were filtered through four layered cheese cloth. Other concentrations of aqueous extract (15% and 20%) were also prepared and stored for planttreatment experiment.

Treatments: Four treatments C (Control), T1 (10%), T2 (15%) andT3 (20%) were used during experiment. C: *P. hysterophorus*in distilled water (control) whereas T1, T2 and T3 were receptor plant sprayed with*Ipomoea cairica* extracts at concentration of 10%, 15%, 20% concentrations, respectively.

After treatment effects records: After 15 days treatment assay, Chlorophyll 'a', Chlorophyll 'b', Carotenoid content, peroxidase (POD) and catalase (CAT) activity were estimated.

Chlorophyll extraction: Plant pigments were estimated by method given by Arnon (1949).

Enzyme extraction: Peroxidase enzyme activity was estimated by method of Shannon *et al.,* 1966 and Catalase enzyme activity was determined by method of Chance and Maehly (1955).

Statistical analysis: Data have been statistically analysed and expressed in terms of Mean±S.D.

RESULTS AND DISCUSSION

Chlorophyll extraction

The effect of *Ipomoea cairica* extracts on chlorophyll fractions like chlorophyll 'a', chlorophyll 'b' and carotenoids were estimated in leaves of *Parthenium hysterophorus* L. The results of this study showed that, in the control plants chlorophyll 'a', chl 'b' and carotenoids content was more in *Parthenium hysterophorus* L. but the *Ipomoea cairica* extract treatment caused decrease in all the pigment contents on 15th day over the control. Thus, chlorophyll 'a',chl 'b' and carotenoids content decreased significantly in the treated weed species (Tab.1). The Pigment content *i.e.* chl 'a', chl 'b' and carotenoid has been reduced with increasing concentration of extract.

Table 1. *Parthenium hysterophorus*. Effect of Allelopathy of different levels on different plant pigments

	Pigment content mg/g fr. Wt.×10^{-3}			
	C	T1	T2	T3
Chl 'a'	5.68±0.05*	2.40±0.35	1.84±0.10	0.75±0.15
Chl 'b'	0.99±0.70	0.82±0.25	0.69±0.20	0.52±0.35
Carotenoids	2.48±0.43	1.25±0.78	1.10±0.55	0.92±0.33

*Mean ± Standard deviation (n=3)

This might be either due to inhibitory impact of the extract on pigment synthesis or enhanced production of enzymesthat degrade these pigments.

Enzyme extraction

The enzymatic assaysindicate that the *Ipomoea cairica* leaf extracts at higher concentration of 15% have increased the POD and CAT activity of *Parthenium* as compared to control while above this concentration *i.e.* 20% the activity decreased (Fig 1 and Fig 2). The cause of enhanced activity of the enzymes is formation of huge amount of ROS (Reactive Oxygen Species). But in 20% extract treated plants, activity of antioxidant enzymes decreased and which shows that there was not so efficient scavenging of ROS on this concentration which in turn affects the physiology of *Parthenium*greatly.

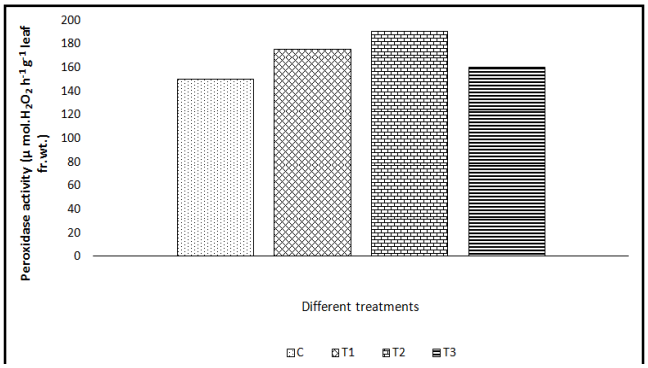

Fig. 1. *Parthenium hysterophorus*. Effect of allelopathy of different levels on Peroxidase enzyme activity

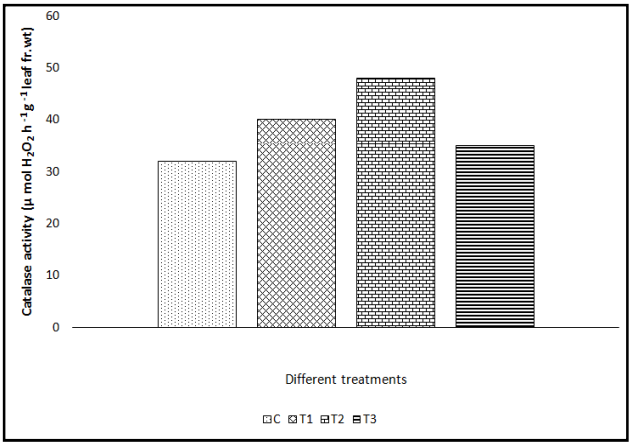

Fig. 2. *Parthenium hysterophorus*. Effect of allelopathy of different levels on Catalase enzyme activity

The present study showed that different concentrations of the water soluble leaf extracts of *Ipomoea cairica* inhibit the growth of *Parthenium hysterophorus*. These extracts also affect activity of some antioxidant enzymes. The present study shows that at higher concentration the aqueous leaf extract of *Ipomoea cairica* reduced the growth of noxious weed *Parthenium hysterophorus* due to reduction in their chlorophyll content and POD and CAT activity. The degradation of chlorophyll and carotenoid content in the present study testifies *Ipomoea cairica* extracts action on photosynthetic activity. Our results match with the previous studies on allelopathic potential of *Ipomoea cairica* on different weed species (Takao *et al.,* 2011; Wu *et al.,* 2006).

Conclusion

The higher concentration of *Ipomoea cairica* extracts had stronger inhibitory effects which can be used as herbicide to control noxious weed *Parthenium hysterophorus.* Use of synthetic herbicides are dangerous to our environment, so, allelopathic activity of plants is the need of today to be used as potentially safe weedicides. Allelopathy with vast application

in weed management, can replace hazardous chemicals and mechanical approaches being used in their elimination. Allelopathic water extracts offer better alternative for this purpose due to being cost-effective, eco-friendly, easy to use, efficient and safe. Research efforts should be focused on screening more allelopathic plants, to search potential cultivars producing more allele chemicals. In the long run it can ensure the provision of wholesome and nutritious food. It would be a luminous direction to proceed in order to achieve agricultural sustainability, environmental safety, food security, resource conservation and economic stability.

Acknowledgments

Authors are thankful to Prof. K. Shukla and Dr. Malvika Srivastava of D.D.U. Gorakhpur University, Gorakhpur for their cooperation and valuable advice in conducting this research work. Author, Dr. Deepa Srivastava is thankfulto University grant commission for the award of Post-Doctoral Fellowship and Swati Shahi acknowledges DST, New Delhi for providing funds under DST INSPIRE JRF Programme.

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