Allelopathic effects of *Celosia argentea* L. on enzyme activity of peroxidase and catalase in germinating seeds of *Lens culinaris* Medic

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ABSTRACT

Celosia argentea L. is dominant alien weed reported from crop field of Islampur in Walwa taluka of Sangli district of Maharashtra, India. It has been scrutinized for its allelopathic potentiality of *C. argentea* L. against enzyme activity of peroxidase and catalase in germinating seeds of Lentil (*Lens culinaris* Medic). The laboratory experiments were conducted to assess enzymatic activity of catalase and peroxidase during seed germination of lentil after treating with different concentrations (5, 20, 40, 60 and 80%) of aqueous leachates of inflorescence (flower), leaves androot of *C. argentea* separately. It was recorded that the activity of peroxidase was decreased after treatment of leachate of inflorescence, leaf and root. The higher concentrations of inflorescence and root leachates (60 and 80%) were act detrimentally on peroxidase activity. The activity of catalase was enhanced by two to three folds after leachates treatment as compared to control in lentil. The pronounced increased in catalase activity in germinating seeds of lentil was seen after inflorescence leachates of *C. argentea*. It has been also recorded that the higher concentrations treatment of leachates of all parts of *C. argentea* was responsible for enhanced activity of catalase. The activity of catalase elevated while peroxidase declined after inflorescence, leaf and root leachates treatment in lentil. The present study indicated that the allelochemicals are present in weed, *C. argentea*. It needs further screening of allelochemicals and their characterization for detailed study.

KEY WORDS: Allelochemicals, *Celosia argentea* L., Lentil (*Lens culinaris*), Peroxidase and Catalase etc.

INTRODUCTION:

Weeds are a mostly belligerent redundant plant that hampers the growth of main crop through releasing chemical substances, called as allelochemicals (Batish *et al.*, 2007). They often affect growth dynamics crop (Kadiolgue *et al.*, 2005). The allelochemicals have ability to affect on metabolic functions including photosynthesis, respiration, mineral nutrition and such others (Saxena *et al.*, 2004) through allelopathic mechanism (Benyas *et al.*, 2010). Allelopathy signifies either negatively or positive interaction between the plants, results in to inhibitory or stimulatory effect on adjacent plants (Einhellig, 2001).

The weed, *Celosia argentea* L. is an exotic flowering herb belonging to Amaranthaceae predominately interfere in crop field of legumes (Inamdar and Kamble, 2009).

Lentil (*Lens culinaris* Medic.) belongs to the family Fabaceae, has been part of the human diet since the ceramic times. Lentils have the third-highest level of protein, by weight, of any legume, after soybeans and hemp. These proteins include the essential amino acids such as isoleucine and lysine. Especially in the Indian subcontinent, it's consumption by large vegetarian populations. It has been cultivating all over world including Maharashtra but its field is affecting by weed like *C. argentea* L. in western part of Maharashtra, India.

In this connection the attempt has made to study the influence of aqueous leachates plant parts of *Celosia argentea L.* on activity of enzyme peroxidase and catalase in lentil during seed germination. This attempt signified for understanding weed crops interactions and open new area for further research on this background.

MATERIALS AND METHODS:

Preparation of aqueous leachates

The weed, *C. argentea* was collected from lentil fields of Islampur, Sangli district of Maharashtra, India[17° 15' - 18° 01' N latitude and 74° 12' - 74° 74' E longitude] and washed with tap water to remove soil particles. The plant parts such as leaves, roots and inflorescence were separated and shade dried for 10 days. Dried parts were powered with the help of grinder and stored in polythene bag. The extract were prepared by taking 10gm of fine powder of each part and poured in 100ml distilled water as pure extract, stock solution. From this extract, the different (5, 20, 40, 80%) concentrations were prepared for treatments while distilled water used as control (0%). The extract was filtered after 24h through a double layered muslin cloth; the filtrates were used as leachates, for further analysis.

Seed treatment with aqueous leachates:

Healthy uniform seeds of lentil were selected and procured from authorized shop of Shetkari Sahakari Sangh Pvt. Ltd, Kolhapur. The seeds were surface sterilized with 1% sodium hypo-chloride for 10 min, then rinsed with distilled water for several times to remove excess of chemical. Then surface sterilized seeds were soaked for treatments in 20 to 80% concentrations of plant leachates for 6h. The seeds were soaked in distilled water were used as a control. These treated seeds were placed in petriplate ((9.0 cm diameter) containing wet blotting paper and covered with a lid. At each concentration and incubation period, triplicate sets were arranged and placed in the laboratory under normal temperature for germination, for 72h.

For this study, enzyme peroxidase (E.C. 1.11.1.7) was estimated after the method by Maehly and Chance (1954) and activity of enzyme catalase (E.C. 1.11.1.6) was studied after a modified method of Herbert (1955).

Statistical analysis

The analysis was carried out in three replicates for all determinations and the mean were calculated.

RESULTS

Activity of Peroxidase (E.C. 1.11.1.7)**:**

The activity of peroxidase in germinating seeds of lentil after treatment of aqueous leachates of *C. argentea* is depicted in table 1. It was recorded that activity of peroxidase were decreased after treatment of inflorescence, leaf and root leachates in lentil. The activity of peroxidase were recorded as 28.05, 26.43, 24.41, 20.22, 17.48 ΔOD $min^{-1}g^{-1}$ fresh weight after 5 to 80 % inflorescence leachates; 27.42,25.11, 22.98, 20.61, 18.41 ΔOD $min^{-1}g^{-1}$ fresh weight after 5 to 80 % leaf leachates and 23.64, 21.60, 19.70, 17.81, 14.80 ΔOD $min^{-1}g^{-1}$ fresh weight after 5 to 80 % root leachates treatment in germinating seeds of lentil. The activity of peroxidase was reduced nearly half after higher concentrations treatment of leachates of all parts of *C. argentea* in lentil.From above result; it is observed that the activity of peroxidase was decreased after inflorescence, leaf and root leachates treatment in lentil.

Activity of Catalase (E.C. 1.11.1.6)**:**

The activity of catalase in germinating seeds of lentil after treatment of aqueous leachates of *C. argentea* is depicted in table 1. It was recorded that activity of catalase was increased after treatment of inflorescence, leaf and root leachates in lentil. The activity of catalase were recorded as 0.581, 0.670, 0.790, 0.803, 0.812 mg.H2O2 broken $min^{-1}g^{-1}$ after 5 to 80 % inflorescence leachates; 0.310, 0.554, 0.680, 0.703, 0.743 mg.H2O2 broken $min^{-1}g^{-1}$ after 5 to 80 % leaf leachates and 0.632, 0.765, 0.887, 1.003, 1.026 mg.H2O2 broken $min^{-1}g^{-1}$ after 5 to 80 % root leachates treatment in germinating seeds of lentilThe activity of catalase was enhanced by two to three fold after leachates treatment as compared to control in lentil. The pronounced increase in catalase activity was seen after influence of leachates of *C. argentea*. It has been also recorded that the higher concentrations treatment of leachates of all parts of *C. argentea* in lentil responsible for more activity of catalase.From above result, it is observed that the activity of catalase enhanced after inflorescence, leaf and root leachates treatment in lentil.

DISCUSSION:

Qualitative and quantitative changes were involved in several metabolic pathways during seed germination and seedling growth (Chauhan *et al.*, 2013). Seed germination is linked with degradation and mobilization of food accumulated during seed maturation (Borisjuk *et al.*, 2004 & Penfield *et al.*, 2005). These carbohydrates are utilizes by developing seedling for the synthesis of various metabolic products. The entry of allelochemicals in plants may result in changes in growth with fluctuation in metabolites (Roushan Islam, 2016) and affect the various metabolic activities and growth components in plants (Mali and Kanade, 2004). The seed germination is complex process accelerated through antioxidative enzymes (Ghayal *et al.*, 2013) and greatly influenced by some putative allelochemicals present in the plants. The oxidative metabolism is very significant in defense mechanism and further allied metabolism of plants (Kengar and Patil, 2018). Therefore, the activity of catalase and perioxidase were studied and analysed in germinating seeds of lentil under influence of aqueous leachates of *C. argentea*.

The enzyme peroxidases are belonging to a group of oxido-reductases which are almost present in most of the plant tissues. Ascorbate peroxidase is involved in scavenging of H_2O_2 and forms an important part of the antioxidant system (Dabrowska *et al.*, 2007). Peroxidase is very sensitive to stress condition, it alter its

activity immediately after stress (Srivalli *et al.,* 2003).

Catalase is also powerful and potentially harmful oxidizing enzyme involved in the

decomposition of hydrogen peroxide in to less reactive gaseousoxygen and water molecules (Scandalios, 1997) like peroxidase. Hydrogen peroxide (H_2O_2) is a harmful byproduct formed in metabolic reaction, to avoid oxidative damage it need in to be immediately detoxify. However, catalase utilizes hydrogen peroxide to oxidize toxins like phenols, formic acid, formaldehyde and alcohols (Ozturk *et al.*, 2007). It is also reported that Catalase plays key role in plant defense, aging and senescence mechanism (Mura *et al.*, 2007) and actively involved in photorespiration and nitrogen fixation. Peroxidase and catalase produced in the plants exposed to different environmental stresses (Bartosoz, 1997). The allelochemicals stress causes oxidative damage to cell and trigger the synthesis of reactive oxygen species (ROS) to disrupt the sub cellular structures (Qian *et al.*, 2009).

Our results depicted straight forward declining activity of peroxidase in concentration dependent. The activity of peroxidase was inhibited in treatment of leachates of *C. argentea* L. The sequence of allelopathic toxicity was more in root leachates followed by leaf leachates by inflorescence leachates of *C. argentea* in lentil. The activity of catalase was enhanced after leachates treatments. The higher concentrations of leachates responded in more activity of catalase. The maximum enhancement in catlatase activity was noticed after treatment of root leachates followed by leaf leachates followed by inflorescence leachates. This clearly indicated the interaction of allelochemicals present in leachates interfere the enzymatic activities might have regulated and impaired the germination performance and metabolism of the test crops (Maiti *et al.*, 2013).

In support of our results, Manimegalai and Manikandam (2010) had recorded intensity of the inhibition of catalase, peroxidase in black gram and green gram with increased concentration of leaf extract of weeds. The result of the work conducted by Gulzar and Siddiqui (2017) indicated that catalase, Peroxidase and superoxide dismutase activity was decreased in brassica after treating with leaf, fruit and flower extracts of *Calatropusprocera.* They found maximum significant decrease in activity of catalase, peroxidase and superoxide dismutase at 20 and 40% aqueous extract of leaf. Mujawar *et al.* (2019) also recorded reduced activity of peroxidase in wheat and groundnut seedlings after treatment of extract of *Pascalia glauca* but at higher concentrations. They elaborately discussed some inhibiting allelochemicals released by plant into soil that affect on wheat and groundnut seedlings.

In the overall experiment, decrease in peroxidase and increase in catalase activity in lentil by leachates treatment is quite confusing but definitely pose limitation on scavenging of ROS (Qian *et al.*, 2009) as well as cell wall biogenesis in the germinating seeds of lentil and this in turn canlead to affect seedling growth and its growth adversely.

CONCLUSION:

The present results of study showed enhanced activity of catalase and declined activity of peroxidase. This indicated many allelochemicals presents in *C. argentea* L. and showed diverse action of mechanism or single allelochemicals might have diversified action mechanisms on activity of enzymes. It needs further screening of allelochemicals and their characterization for detailed study. Therefore, present investigation recommended that, some eco-friendly preventing measures should be taken to minimize the deleterious effects of *C. argentea* at the time of growing crops.

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Table 1: Effect of aqueous leachates of *C. argentea* on activity of peroxidase and catalase in germinating seeds of Lens *culinaris* Medic

The values of activity of peroxidase are expressed in *ΔOD* $min^{-1}g^{-1}$ fresh weight.
The values of activity of catalase are expressed in mg.H_2O_2 broken $min^{-1}g^{-1}$ fresh tissue.

Source of Plant parts	Treatment	**Peroxidase**	**Catalase**
	Control	28.11 ± 0.02^a	0.280 ± 0.06^c
Inflorescence leachates	5%	28.05 ± 0.05^a	0.581 ± 0.07^b
	20%	26.43 ± 0.04^b	0.670 ± 0.041^{ab}
	40%	24.41 ± 0.03^b	0.790 ± 0.061^a
	60%	20.22 ± 0.05^c	0.803 ± 0.07^a
	80%	17.48 ± 0.012^d	0.812 ± 0.05^a
Leaf leachates	5%	27.42 ± 0.048^a	0.310 ± 0.043^c
	20%	25.11 ± 0.035^b	0.554 ± 0.51^b
	40%	22.98 ± 0.24^b	0.680 ± 0.015^{ab}
	60%	20.61 ± 0.04^b	0.703 ± 0.013^a
	80%	18.41 ± 0.06^c	0.743 ± 0.020^a
Root leachates	5%	23.64 ± 0.03^b	0.632 ± 0.034^{ab}
	20%	21.60 ± 0.045^b	0.765 ± 0.048^a
	40%	19.70 ± 0.086^c	0.887 ± 0.04^a
	60%	17.81 ± 0.047^d	1.003 ± 0.034^d
	80%	14.80 ± 0.02^e	1.026 ± 0.25^d

The values are mean of three replications and according to Duncan's multiple range test.
The letter on values are not significantly different ($P<0.05$).
Above values are obtained after 72h of germination.