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Research Article

# Allelopathic Influence of *Celosia argentea* L. against Photosynthetic Pigments of *Lens culinaris* Medic

**Yuvraj D Kengar[1]* and Bhimarao J Patil[2]**

[1]*Department of Botany, Smt. Kusumtai Rajarambapu Patil Kanya Mahavidyalaya, Islampur, Maharashtra, India*

[2]*Department of Botany and Plant Protection, S. G. M College, Karad, Maharashtra, India*

***Corresponding Author**: Yuvraj D Kengar, Department of Botany, Smt. Kusumtai Rajarambapu Patil Kanya Mahavidyalaya, Islampur, Maharashtra, India.

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### Abstract

*Celosia argentea* L. is overwhelming weed reported in various crop fields in and around Islampur of Sangli district of Maharashtra, India. It has been scrutinized for its allelopathic potentiality against lentil (*Lens culinaris* Medic). The laboratory experiments were conducted to assess photosynthetic pigments of lentil after treating it with different concentrations (5, 20, 40, 60 and 80%) of stem, leaves and inflorescence (flower) aqueous leachates separately. It was found that 5 and 20% leaf leachates and 5 to 60% root leachates treatment responsible for enhancement of chlorophyll- a, chlorophyll- b and total chlorophyll content of lentil. There is positively correlation between the aqueous roots leachate of *C. argentea* and photosynthetic pigments of *L. culinari*s. It indicated that allelochemicals are more in roots than other plant parts of *C. argentea.* This study indicates that some allelochemicals are present in aqueous extract of *C. argentea* and regulated the photosynthetic activity of *L. culinaris.*

***Keywords:*** *Allelochemicals; Photosynthetic Pigments; Lens culinaris Medic; Celosia argentea L.*

## Introduction

Weeds are undesirable unplanted excess plant that influences the growth and development of main crop through discharging chemicals substances called as allelochemicals [1]. These allelochemicals have ability to affect metabolic and physiological functions including photosynthesis, respiration, mineral uptake and others [2] through allelopathic mechanism [3,4]. Allelopathy functions either negatively or positive interaction between the plants, results in to stimulatory or inhibitory actions on neighboring plants through releasing allelochemicals via root exudation, volatilization, leaching, and decomposition of plant residues [5].

The weed, *Celosia argentea* L. (Cocks Comb) is an extraordinary blossoming herb belonging to Amaranthaceae predominately interfere in crop field of legumes [6] and most allelopathic plant in field of *Lens culinaris* [7]. *L. culinaris* Medic. is commonly called lentil belongs to the family Fabaceae, has been part of the human diet since the ceramic times. It contains third-largest amount of protein by weight of any vegetable after soybeans and hemp. These proteins include the essential amino acids such as isoleucine and lysine. Particularly in the Indian subcontinent, it's utilization as pulse by expansive veggie lover populations [8]. 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, attempt has made to study influence of aqueous leachates of plant parts of *C. argentea* L. on photosynthetic pigments. This endeavor signified for understanding weed crops interactions and open new zone for additionally research on this background.

## Materials and Methods

### Preparation of aqueous leaf leachates

The weed, *C. argentea* L. was collected from crop 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. The dried parts were powered with the help of grinder. The stock solution prepared by taking 10g of fine powder of each part and poured in 100ml distilled water as pure extract. From this pure 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 filtrate was used as leachates, for further analysis.

### Treatment with aqueous Leachates

The lentil seed were procured from authorized shop of Shetkari Sahakari Sangh Pvt. Ltd, Kolhapur. Healthy uniform seeds were selected and surface sterilized with 1% sodium hypo-chloride for 10 minutes, then rinsed with distilled water for several times to remove excess of chemical. Then surface sterilized 25 seeds were sown in earthen pots containing soil and manure (4:1) and uniform watered regularly with 10 ml of 20 to 80% concentrations of plant parts of *C. argentea* leachates once daily. The pots were arranged in completely randomized design (CRD) and were maintained at field capacity under uniform open environment. All plants were harvested after 4 weeks of sowing and chlorophylls were estimated by following method of Arnon (1949) [9]. The carotenoids were estimated from the same acetone extract of chlorophylls as per the methods described by Kirk and Allen (1965) [10].

### Statistical analysis

The analysis was carried out in three replicates for all determinations and the mean were calculated. The data were analyzed by one-way analysis of variance (ANOVA). A multiple comparison procedure of the treatment means was performed by Duncan's new multiple range test.

## Results

The results of effect of aqueous leachates of inflorescence, leaves and root of *Celosia argentea* on photosynthetic pigments of *L. culinaris* is depicted in table 1. In *Lens culinaris*, chlorophyll-a, chlorophyll-b, total chlorophyll and carotenoids were inhibited after treatment of inflorescence leachates and stimulated after leaf and root leachates of *C. argentea*. The detailed results are elaborately discussed here with.

| | Treatment | Chlorophyll-a | Chlorophyll-b | Total Chlorophyll | Chlorophyll-a/b | Carotenoids |
|---|---|---|---|---|---|---|
| | Control | $25.20^{d} \pm 0.021$ | $24.53^{d} \pm 0.019$ | $49.73^{d} \pm 0.020$ | 1.02 | $30.83^{c} \pm 0.041$ |
| Inflorescence leachates | 5% | $24.45^{d} \pm 0.016$ | $23.88^{d} \pm 0.019$ | $48.33^{d} \pm 0.018$ | 1.02 | 25.35b ± 0.028 |
| | 20% | $21.^{87}$b ± 0.016 | $21.56^{d} \pm 0.011$ | $43.43^{c} \pm 0.014$ | 1.01 | $24.46^{b} \pm 0.032$ |
| | 40% | $19.34^{b} \pm 0.030$ | $19.70^{b} \pm 0.027$ | $39.04^{b} \pm 0.028$ | 0.98 | $20.36^{a} \pm 0.034$ |
| | 60% | $18.76^{b} \pm 0.018$ | $18.10^{b} \pm 0.013$ | $36.86^{b} \pm 0.016$ | 1.03 | $19.48^{a} \pm 0.023$ |
| | 80% | 16.88a ± 0.020 | 16.28a ± 0.015 | 33.16a ± 0.017 | 1.03 | $18.87^{a} \pm 0.017$ |
| Leaf leachates | 5% | $34.76^{d} \pm 0.032$ | $33.12^{d} \pm 0.034$ | $67.88^{d} \pm 0.033$ | 1.04 | $40.42^{c} \pm 0.038$ |
| | 20% | $28.48^{c} \pm 0.018$ | $27.76^{c} \pm 0.023$ | $56.24^{c} \pm 0.021$ | 1.02 | $37.86^{b} \pm 0.036$ |
| | 40% | $24.25^{b} \pm 0.020$ | $25.34^{b} \pm 0.022$ | $49.59^{b} \pm 0.021$ | 0.95 | $32.20^{b} \pm 0.028$ |
| | 60% | $22.46^{b} \pm 0.018$ | $23.78^{b} \pm 0.015$ | $46.24^{b} \pm 0.017$ | 0.94 | $26.10^{a} \pm 0.029$ |
| | 80% | $19.24^{a} \pm 0.013$ | $18.39^{a} \pm 0.015$ | $37.63^{a} \pm 0.014$ | 1.04 | $24.38^{a} \pm 0.020$ |
| Root leachates | 5% | $32.96^{c} \pm 0.029$ | $34.24^{c} \pm 0.032$ | $67.20^{c} \pm 0.031$ | 0.96 | $39.80^{c} \pm 0.023$ |
| | 20% | $30.80^{c} \pm 0.028$ | $29.80^{b} \pm 0.027$ | $60.60^{b} \pm 0.027$ | 1.03 | $35.26^{b} \pm 0.034$ |
| | 40% | $28.32^{b} \pm 0.018$ | $28.38^{b} \pm 0.022$ | $56.70^{b} \pm 0.020$ | 0.99 | $34.74^{b} \pm 0.029$ |
| | 60% | $25.47^{b} \pm 0.020$ | $26.19^{b} \pm 0.029$ | $51.66^{b} \pm 0.024$ | 0.97 | $25.65^{a} \pm 0.030$ |
| | 80% | $17.87^{a} \pm 0.015$ | $15.16^{a} \pm 0.021$ | $33.03^{a} \pm 0.018$ | 1.17 | $23.50^{a} \pm 0.028$ |

***Table 1:*** *Effect of aqueous leachates of C. argentea on Photosynthetic pigments of Lens culinaris Medic.*

**: Values of Chlorophyll-a, Chlorophyll-b, Total chlorophylls and Carotenoids are expressed in mg.100g$^{-1}$ fresh weight.*

**: Bottom values are Mean ± SD.*

**The effect of Inflorescence leachates:** The effect of inflorescence leachates of *Celosia argentea* on Photosynthetic pigments of *L. culinaris* is recorded in table 1 and represented with figure 1 (histogram A). The amount of chlorophyll a, b, total chlorophylls were decreased down with increasing concentrations of inflorescence leachates in *L. culinaris*. The amount of chlorophyll-a were 24.45, 21.87, 19.34, 18.76, 16.88 mg.100g$^{-1}$, chlorophyll-b were 23.88, 21.56, 19.70, 18.10, 16.28 mg.100g-1; total chlorophylls were 48.33, 43.43, 39.04, 36.86, 33.16 mg.100g$^{-1}$. The carotenoids were recorded as 25.35, 24.46, 20.36, 19.48 and 18.87 mg.100g-1 after treatment of 5 to 80% inflorescence leachates of *C. argentea.*

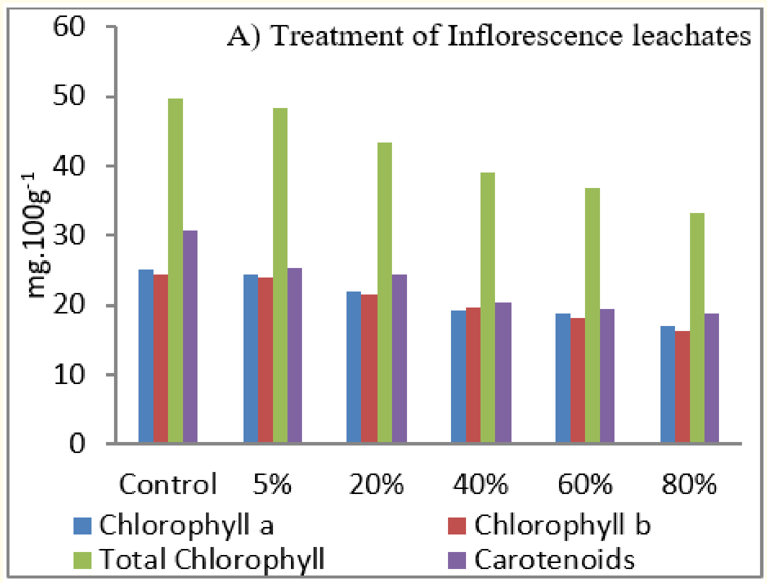


***Figure 1:*** *Effect of aqueous leachates of Inflorescence leachates of C. argentea on Photosynthetic pigments of Lens culinaris Medic.*

**The effect of Leaf leachates:** The effect of leaf leachates of *Celosia argentea* on Photosynthetic pigments of *L. culinaris* is recorded in table 1 and represented with figure 2 (histogram B). The amount of chlorophyll a, b, total chlorophylls were decreased down with increased concentrations of inflorescence in *L. culinaris*. The amount of chlorophyll-a were 34.76, 28.48, 24.25, 22.46, 19.24 mg.100g$^{-1}$; chlorophyll-b were 33.12, 27.76, 25.34, 23.78 and 18.39 mg.100g$^{-1}$; total chlorophylls were 67.88, 56.24, 49.59, 46.24, 37.63 mg.100g$^{-1}$; carotenoids were recorded as 40.42, 37.86, 32.20, 26.10 and 24.38 mg.100g$^{-1}$ after treatment of 5 to 80% inflorescence leachates. The amount of chlorophyll -a were increased after 5 and 20% leaf leachates treatment as compared to control (25.20 mg.100g-1). However, chlorophyll -b were stimulated after 5 to 40% leaf leachates compared to control. The effect of leaf leachates of *C. argentea* on carotenoids were stimulatory on lower doses i.e. 5 to 40% while inhibitory on higher doses i.e. 60 and 80% leaf leachates of *C. argentea.*

**The effect of Root leachates:** The effect of root leachates of *C. argentea* on Photosynthetic pigments of *L. culinaris* is recorded in table 1 and represented with figure 3 (histogram C). The amount of chlorophyll a, b, total chlorophylls were decreased down with increasing concentrations of inflorescence in *L. culinaris*. The amount of chlorophyll-a were 32.96, 30.80, 28.32, 25.47, 17.87 mg.100g-1; chlorophyll-b were 34.24, 29.80, 28.38, 26.19, and 15.16 mg.100g$^{-1}$; total chlorophylls were 67.20, 60.60, 56.70, 51.66, 33.03 mg.100g-1; carotenoids were recorded as 39.80, 35.26, 34.74, 25.65 and 23.50 mg.100g$^{-1}$ after treatment of 5 to 80% root leachates. It has been evidenced that amount of chlorophyll-a, chlorophyll-b and carotenoids were stimulated in 5 to 60% root leachates treatment as compared to control. The degree of allelopathic stimulatory effects were shown as inflorescence leachates < leaf leachates < root leachates.

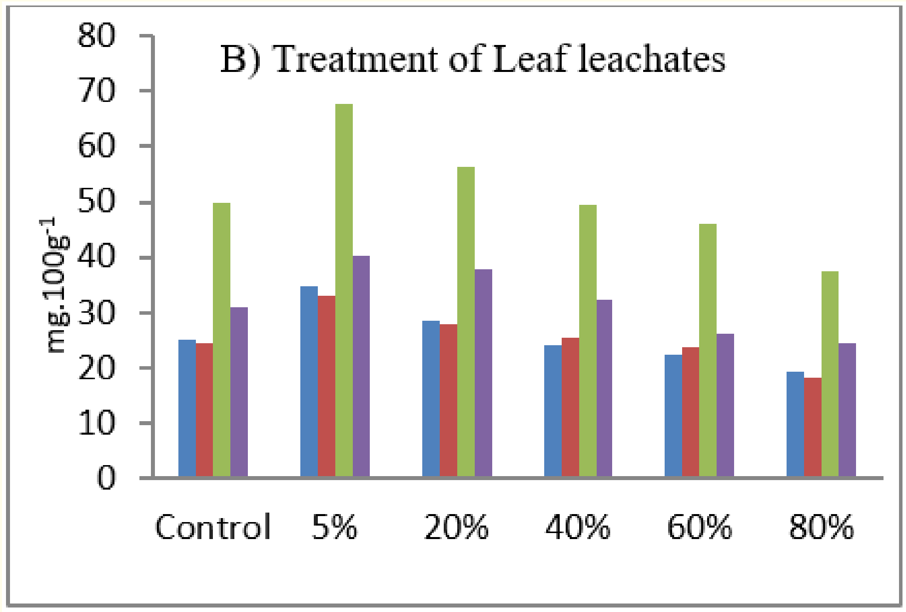


***Figure 2:*** *Effect of aqueous leachates of leaf leachates of C. argentea on Photosynthetic pigments of Lens culinaris Medic.*

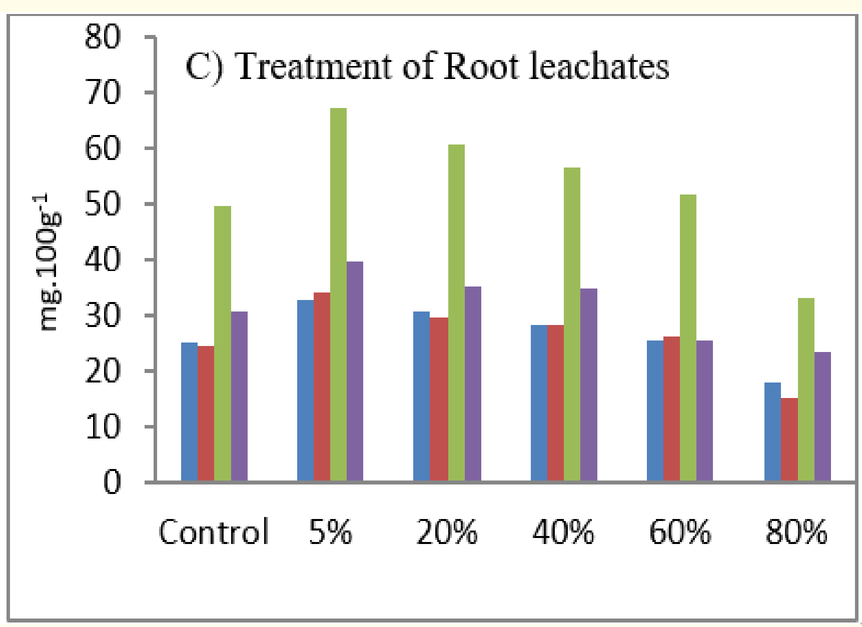


***Figure 3:*** *Effect of aqueous leachates of root leachates of C. argentea on Photosynthetic pigments of Lens culinaris Medic.*

## Discussion

Photosynthesis is significantly affected by ecological factors such light, temperature, $CO_2$ concentration, water condition and organisms. Recent studies demonstrated that allelochemicals additionally altogether affected photosynthesis. A decrease in $CO_2$ assimilation has been broadly seen in many plants after treatment with allelochemicals. It is evident that allelochemicals can conceivably debilitate the execution of the three fundamental processes of photosynthesis, the stomatal control of $CO_2$ supply, the thylakoid electron transport (light reactions), and the carbon reduction cycle (dark reaction). The detailed mechanism for the reduced assimilation induced by allelochemicals studied in most of investigations but details remains unclear.

Chlorophylls are important molecule occupied in core component of pigment complexes surrounded the membrane and play a foremost role in photosynthesis [11]. Chlorophyll a and b and carotenoids concentration correlate to the photosynthetic potentiality of a plant and gives physiological status of the plant [12].

Many researchers have experimentally proved that chlorophyll content and ion uptake was reduced significantly by allelochemicals [13]. Reduction in chlorophyll content might be because of the way that allelochemicals either inhibit the synthesis of chlorophyll or breakdown the chlorophyll molecule by acting on the pyloric ring and the phytol chain [14]. However, allelochemicals inhibit rate of photosynthesis by interfering water balance and chlorophyll content which may bring about diminishment in the measure of protein [15]. Peng., *et al.* (2004) also brought up that the allelochemical delivered by obtrusive species influences the photosynthesis and plant development by destroying the chlorophylls [16]. Photosynthetic pigments of pepper seedlings were reduced by allelochemical stress like reduction in chlorophyll a, chlorophyll b, and total chlorophyll [17,18].

Our results depicted that the chlorophyll pigments were increased after treatment of leaf and root leachates but at lower concentrations however the inflorescence leachates inhibitory in actions. This indicated that stimulatory allelochemicals are presents in leaf and root leachates whereas inhibitory allelochemicals may be present in inflorescence leachates of *C. argente*a. The allelochemicals presents in *Celosia argentea* act both stimulatory and inhibitory in action on photosynthetic activity of *L. culinaris.*

Similar to our results, Natarajan and Elavazhagan (2014) were showed no significant effect on total chlorophyll contents in *Sesamum indicum* after treatment of leaves of *T. portulacastrum* [19]. Dave and Vordzogbe, (2015) also demonstrated decline chlorophyll contain in *Phaseolus vulgaris* on allelopathic effect of the *Azadirachta indica* extract [20].

On Contrast of our results, Benyas., *et al.* (2010) studied no significant alteration chlorophyll contents in *L. culinaris* after influence of *Xanthium strumarium* aqueous extract [4].

## Conclusion

The present study indicated that, the *C. argentea* effects on *L. culinaris*, the senescent leaves and root remnant in crop field of *L. culinaris* is beneficial but immature inflorescence may act deleterious effect. So, it is suggesting that weed management of *C. argentea* should be before flowering and to burry under soil. 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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