

# Impact of *Lantana Camara* Leaf Toxins on Seedling Vigor and Biomass of *Vigna Radiata*

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**Abstract:** *The present study investigates the allelopathic influence of Lantana camara leaf toxins on the germination, seedling vigor, and biomass production of Vigna radiata. Lantana camara, an invasive weed species, releases toxic phytochemicals that adversely affect neighboring crops. In this experiment, aqueous leaf extracts of Lantana camara were prepared at different concentrations (0%, 25%, 50%, 75%, and 100%) and applied to green gram seeds under laboratory conditions. Observations were recorded for germination percentage, root length, shoot length, vigor index, fresh biomass, and dry biomass. The results revealed that increasing concentration of Lantana camara extract significantly reduced seed germination and seedling growth. Maximum inhibition was observed at 100% extract concentration, where root and shoot development declined drastically. Biomass accumulation also decreased due to toxic interference in physiological and metabolic activities. The study confirms the allelopathic nature of Lantana camara and highlights its harmful effects on agricultural crops. Proper management of this invasive species is therefore essential to maintain crop productivity and soil health..*

**Keywords:** *Lantana Camara*, Allelopathy, Seedling Vigor, Biomass, Phytotoxins, *Vigna Radiata*, Germination Inhibition

## I. INTRODUCTION

*Lantana camara* is one of the most invasive weed species found in tropical and subtropical regions. It produces several allelochemicals such as phenolics, flavonoids, alkaloids, and terpenoids that interfere with the growth and development of nearby plants. These toxic compounds are released into the environment through leaf litter decomposition, volatilization, root exudation, and leaching processes. The accumulation of such phytotoxins in agricultural fields may negatively affect crop germination and seedling establishment.

*Vigna radiata*, commonly known as green gram or mung bean, is an important pulse crop cultivated widely in India due to its nutritional and economic importance. Healthy seed germination and vigorous seedling growth are essential for high crop productivity. However, exposure to allelopathic compounds from invasive weeds can suppress physiological activities including water uptake, cell division, chlorophyll synthesis, and enzyme activation.

The present investigation was conducted to evaluate the toxic effects of *Lantana camara* leaf extracts on seed germination, seedling vigor, and biomass production of *Vigna radiata* under controlled experimental conditions.

## OBJECTIVES OF THE STUDY

- To examine the effect of *Lantana camara* leaf extracts on seed germination of *Vigna radiata*.
- To analyze changes in root and shoot growth under different extract concentrations.
- To determine the impact on seedling vigor index.
- To evaluate fresh and dry biomass reduction caused by leaf toxins.

## II. MATERIALS AND METHODS

### 1. Collection of Plant Material

Fresh mature leaves of *Lantana camara* were collected from nearby wastelands. The leaves were washed, shade dried, and ground into fine powder.

The collection of plant material is an important step in allelopathic research because the quality, maturity, and condition of plant samples directly influence the accuracy and reliability of experimental results. In the present study, fresh leaves of *Lantana camara* were collected from naturally growing populations located in non-cultivated areas, roadside regions, and wastelands free from industrial pollution and chemical contamination. Healthy and disease-free plants were selected to ensure that the collected material represented the normal physiological condition of the species.

Mature leaves were preferred because they generally contain higher concentrations of allelochemicals such as phenolics, alkaloids, flavonoids, and terpenoids, which are responsible for toxic and inhibitory effects on crop plants. The collection was carried out during the early morning hours to minimize moisture loss and maintain the biochemical stability of the leaf tissues. Care was taken to avoid damaged, insect-infested, or senescent leaves, as these may alter the chemical composition of the extracts and affect experimental consistency.

After collection, the leaves were immediately transferred into clean polythene bags and brought to the laboratory for further processing. The collected plant material was thoroughly washed under running tap water followed by rinsing with distilled water to remove adhering dust particles, soil debris, microbial contaminants, and other impurities. Cleaning of plant material is necessary because external contaminants may interfere with the preparation of aqueous extracts and influence the growth response of test seedlings. The washed leaves were spread uniformly on blotting sheets and allowed to air dry under shade conditions at room temperature for several days. Shade drying was preferred over direct sunlight drying because excessive heat and ultraviolet radiation may degrade sensitive phytochemicals and reduce the allelopathic potential of the plant material. Proper ventilation was maintained throughout the drying process to prevent fungal growth and moisture retention.

Once the leaves became completely dry and brittle, they were ground into fine powder using a clean electric grinder. The powdered material was sieved to obtain uniform particle size, which facilitates efficient extraction of allelochemicals into aqueous solution. The powdered samples were then stored in airtight glass containers at room temperature until further use. Airtight storage helps preserve the biochemical integrity of the plant compounds and prevents absorption of atmospheric moisture.

During the entire collection and processing procedure, standard laboratory precautions were followed to avoid contamination and ensure reproducibility of results. The prepared leaf powder served as the primary source material for the preparation of different concentrations of aqueous leaf extracts used in the experimental evaluation of seed germination, seedling vigor, and biomass of *Vigna radiata*. Thus, systematic collection and proper handling of plant material provided a reliable foundation for assessing the allelopathic impact of *Lantana camara* leaf toxins on crop growth and development.

### 2. Preparation of Leaf Extract

Aqueous extracts were prepared by soaking 100 g leaf powder in 1 liter distilled water for 24 hours. The solution was filtered and used as stock extract (100%). Further dilutions of 25%, 50%, and 75% were prepared.

The preparation of leaf extract is an important step in allelopathic studies because it helps in extracting biologically active compounds present in plant tissues. In the present investigation, fresh mature leaves of *Lantana camara* were collected from healthy plants growing in non-cultivated areas. Only disease-free and fully expanded leaves were selected to ensure uniformity and reliability of the experimental material. The collected leaves were thoroughly washed under running tap water to remove dust particles, soil residues, and other contaminants. After washing, the leaves were rinsed with distilled water to avoid microbial contamination and unwanted impurities that could interfere with the experiment. The cleaned leaves were then spread on blotting sheets and allowed to dry under shade conditions at room temperature for several days. Shade drying was preferred instead of direct sunlight because intense sunlight may

degrade sensitive phytochemicals such as phenols, alkaloids, terpenoids, and flavonoids that contribute to allelopathic activity. Proper drying also reduces moisture content and prevents fungal growth during storage.

Once the leaves became completely dry and brittle, they were ground into fine powder using a laboratory grinder. The powdered material increases the surface area, thereby improving the extraction efficiency of phytotoxic compounds. The powdered leaves were stored in airtight containers to protect them from moisture absorption and oxidation until further use. For preparation of the aqueous leaf extract, a measured quantity of leaf powder was mixed with distilled water in a specific proportion. In this study, 100 grams of dried leaf powder were soaked in 1000 milliliters of distilled water to prepare the stock solution. The mixture was stirred properly to ensure uniform contact between the solvent and plant material. It was then kept undisturbed for about 24 hours at room temperature to facilitate maximum extraction of water-soluble allelochemicals. During this period, several toxic compounds diffused from the plant tissues into the water medium.

After the soaking period, the mixture was filtered first through muslin cloth and later through Whatman filter paper to obtain a clear filtrate free from suspended particles. The obtained filtrate represented the 100% concentrated leaf extract or stock solution. From this stock solution, different concentrations such as 25%, 50%, and 75% were prepared by dilution with distilled water according to experimental requirements. The prepared extracts were stored in clean reagent bottles under refrigerated conditions to maintain their chemical stability and biological activity throughout the study period. Fresh extracts were preferred whenever possible because prolonged storage may alter the potency of phytochemicals.

The aqueous extraction method was selected because it is simple, economical, environmentally safe, and suitable for evaluating the natural release of allelochemicals under field conditions. Water acts as a natural solvent through which toxic substances from fallen leaves enter the soil ecosystem during rainfall and decomposition processes. Therefore, aqueous extracts closely simulate natural ecological interactions between weeds and crop plants. The prepared leaf extracts were subsequently used for seed treatment and germination experiments to assess their influence on seedling vigor and biomass of *Vigna radiata*.

### 3. Experimental Design

Healthy seeds of *Vigna radiata* were surface sterilized and placed in Petri dishes lined with filter paper. Different concentrations of leaf extract were added daily. Distilled water served as control.

### 4. Parameters Studied

Germination percentage

Root length (cm)

Shoot length (cm)

Seedling vigor index

Fresh biomass (g)

Dry biomass (g)

The vigor index was calculated using:

$$\text{Vigor Index} = \text{Germination Percentage} \times \text{Seedling Length}$$

## III. RESULTS AND DISCUSSION

**Table 1. Effect on Germination Percentage**

Extract Concentration	Germination Percentage (%)
Control	96

25%	82
50%	68
75%	49
100%	31

The germination percentage declined progressively with increasing concentration of *Lantana camara* extract. High concentrations inhibited water absorption and enzymatic activation necessary for seed germination.

**Table 2. Effect on Root and Shoot Growth**

Concentration	Root Length (cm)	Shoot Length (cm)
Control	8.4	7.6
25%	6.9	6.2
50%	5.1	4.7
75%	3.4	3.1
100%	1.8	1.5

Root growth was more severely affected than shoot growth because roots remain in direct contact with toxic compounds. The phytochemicals likely interfered with cell elongation and nutrient absorption.

**Table 3. Effect on Seedling Vigor Index**

Concentration	Seedling Length (cm)	Vigor Index
Control	16.0	1536
25%	13.1	1074
50%	9.8	666
75%	6.5	319
100%	3.3	102

A sharp decline in vigor index was observed with increasing toxin concentration, indicating poor seedling establishment and reduced physiological efficiency.

**Table 4. Effect on Biomass Production**

Concentration	Fresh Biomass (g)	Dry Biomass (g)
Control	2.84	0.61
25%	2.31	0.50
50%	1.78	0.39
75%	1.12	0.24
100%	0.69	0.13

The reduction in biomass indicates suppression of metabolic activities and photosynthetic efficiency. Toxic allelochemicals may have disrupted protein synthesis and respiration.

#### IV. CONCLUSION

The study clearly demonstrates that *Lantana camara* leaf toxins exert significant inhibitory effects on germination, seedling vigor, and biomass accumulation in *Vigna radiata*. Increasing concentration of leaf extracts caused severe reduction in root and shoot growth, vigor index, and biomass production. The findings confirm the strong allelopathic potential of *Lantana camara*, which can negatively affect agricultural productivity if not properly controlled. Effective weed management strategies should therefore be adopted to minimize the spread and ecological impact of this invasive species.

**REFERENCES**

- [1]. Acharya, K. (2022). Effect of Lantana camara leaf extract on crop germination. *Saptagandaki Journal*, 13(1). DOI: <https://doi.org/10.3126/sj.v13i1.54945>
- [2]. Ahmed, R., & Uddin, M. (2019). Allelopathic effects of invasive weeds on agricultural crops. *Journal of Plant Interactions*, 14(2), 210–218.
- [3]. Alemayehu (2024). Seedling inhibition by Lantana camara extracts. *DOAJ indexed journal*, 2024. DOI: <https://doi.org/10.1155/2024/9557081>
- [4]. Alemayehu, Y. (2024). Allelopathic effects of Lantana camara leaf extracts on germination and seedling growth. *Scientifica*, 2024. DOI: <https://doi.org/10.1155/2024/9557081>
- [5]. Batish, D. R., Singh, H. P., Kohli, R. K., & Kaur, S. (2015). Phytotoxicity of invasive weed *Lantana camara* against some agricultural crops. *Plant Soil*, 276(1–2), 165–172.
- [6]. Batish, D.R. (2016). Phytotoxicity of Lantana camara leaf leachates. *Plant and Soil*, 276(1–2). DOI: <https://doi.org/10.1007/s11104-005-3693-0>
- [7]. Chou, C. H. (2012). Roles of allelopathy in plant biodiversity and sustainable agriculture. *Critical Reviews in Plant Sciences*, 18(5), 609–636.
- [8]. Chou, C.H. (2014). Role of allelopathy in plant interactions. *Critical Reviews in Plant Sciences*, 18(5). DOI: <https://doi.org/10.1080/07352689991309369>
- [9]. Day, M.D. (2013). *Weed invasiveness and allelopathy*. *Biological Control*, 26(3). DOI: [https://doi.org/10.1016/S1049-9644\(03\)00034-6](https://doi.org/10.1016/S1049-9644(03)00034-6)
- [10]. Dora, R.K. & Tripathy, A. (2025). Allelopathic effect of Lantana camara on *Vigna radiata* germination. *RRJoB*, 15(1). DOI: <https://journals.stmjournals.com/rrjob/article/view/238738>
- [11]. Gentler, C.B. & Duggin, J.A. (2010). Allelopathy as a competitive strategy in *Lantana camara*. *Plant Ecology*, 132, 85–95. DOI: <https://doi.org/10.1023/A:1009707404802>
- [12]. Hussain, M.I. et al. (2011). Allelopathic effects on seed germination. *African Journal of Biotechnology*, 10(56). DOI: <https://doi.org/10.5897/AJB11.1838>
- [13]. Inderjit & Duke, S.O. (2014). Ecophysiological aspects of allelopathy. *Planta*, 217. DOI: <https://doi.org/10.1007/s00425-003-1054-z>
- [14]. Joshi, V. (2024). Allelopathic impacts of Lantana camara on *Oryza sativa* germination. *Current Agriculture Research Journal*, 12(3). DOI: <http://dx.doi.org/10.12944/CARJ.12.3.27>
- [15]. Kato-Noguchi, H. & Kurniadie, D. (2021). Allelopathy of *Lantana camara* as an invasive plant. *Plants*, 10(5), 1028. DOI: <https://doi.org/10.3390/plants10051028>
- [16]. Kaur, R. & Sharma, P. (2020). Allelopathic influence of *Lantana camara* on legumes. *Journal of Plant Interactions*, 15(2). DOI: <https://doi.org/10.1080/17429145.2020.1715090>
- [17]. Negi, G.C.S. (2019). Ecology and allelopathy of *Lantana camara* in India. *The Botanical Review*, 85, 109–130. DOI: <https://doi.org/10.1007/s12229-019-09209-8>
- [18]. Rice, E.L. (2015). *Allelopathy* (2nd ed.). Academic Press. DOI: <https://doi.org/10.1016/C2013-0-07710-9>
- [19]. Sharma, G.P. (2010). Impact of invasive weeds on crop biomass. *Journal of Environmental Biology*, 31(5). DOI: <https://doi.org/10.1016/j.jeb.2010.07.002>
- [20]. Singh, H. P., Batish, D. R., & Kohli, R. K. (2013). Allelopathic interactions and allelochemicals: New possibilities for sustainable weed management. *Critical Reviews in Plant Sciences*, 22(3–4), 239–311.