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# Allelopathic effect of weed extracts on seed germination of finger millet

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**ABSTRACT**

Finger millet is a nutritious food grain crop with a fair amount of minerals like calcium and iron. Present investigation deals with the allelopathic effect of *Parthenium hysterophorus* and *Lantana camara* on germination and seedling vigour in finger millet. Seeds of the finger millet were subjected to different concentrations of leaf aqueous extracts of *Parthenium hysterophorus* and *Lantana camara* (4%, 6%, 8%, 10%, 25%, 50% and 75%) to find out allelopathic effects on Total germination percentage (GT), Plant height stress tolerance index (PHSI), Root length stress tolerance index (RLSI), Peak value (PV), Germination value (GV). Experimental results revealed that leaf extract of *Parthenium* showed profound allelopathic effect on seeds of the finger millet over to *Lantana camera*. The present study helps farmers to be aware with the lethal allelopathic effect of obnoxious weeds like *Parthenium* and *Lantana*.

***Key words :*** *Parthenium hysterophorus, Lantana camara, Allelochemicals, Allelopathic, Finger millet, Leaf extract.*

## Introduction

Allelopathy refers to any process involving secondary metabolites produced by plants, micro-organisms, fungi etc. that positively or negatively influence the growth and development of agricultural and biological systems. These allelochemicals are released into the environment (atmosphere or rhizosphere) in ample quantities by means of volatilization, leaching, decomposition of residues, root exudation etc. and if persistent long enough could either stimulate or inhibit the growth and physiological processes of the neighbouring or successional plant (Putnam, 1988; Inderjit and Keating, 1998). The higher concentrations of allelochemicals usually inhibit the growth of recipient plants and soil microorganisms or both. In nature, many plants growing together interact with each other by inhibiting or stimulating growth and development of each other through allelopathic interactions (Macias *et al*., 1998). The different types of allelochemicals present in weeds, reduces the crop yield and quality (Zohaib *et al*., 2016; Latif *et al*., 2017). Weeding in crops increases the cost of cultivation and is great problem for the farmers (Cheng and Cheng, 2015). Hence, biological control of weeds through understanding the weed-weed and crop-weed interactions is important research area (Mervat, 2009). Currently, crop performance, which is suppressed by allelopathic weeds, has received more attention in order to control weeds in farming systems.*Lantana camara* and *Parthenium hysterophorus* are the America originated weeds belonging to family Verbenaceae and Asteraceae. It has spread to the other regions of world including India. *Lantana camera* was introduced in India from National Botanical Gardens, Calcutta in 1807 as an ornamental plant and parthenium in 1952 in Pune. The *Parthenium*

(*Parthenium hysterophorus* L.) and *Lantana* (*Lantana camera*) is a common weed on roadsides, wastelands and crop fields. It interferes with the growth of crops, not only due to its fast growth and high seed production but also due to release of allelochemicals in the environment. The most common effects of the allelochemicals on the plant are reduction in percent germination and rate of germination, reduction in root or/ and stem length injuring of the root tips, lack of chlorophyll, boost seminal root, decline dry matter accumulation, increased sterility in crop (Bhadoria, 2011). *P. hysterophorus* can also affect crop production, animal husbandry as well as human health and ecosystems in its area of infestation (Nadeem *et al*., 2005; Shabbir and Bajwa, 2006). Effect of *Parthenium* and *Lantana* extracts on seed germination and seedling growth inhibition of many crops have been reported in Wheat (*Triticum aestivum*) (Naeem *et al*., 2012; Anwar *et al*., 2018; Muhammad Imad *et al*., 2021), *Cicer arietinum*, *Glycine max* (Rana *et al*., 2021), *Abelmoschus esculentus* (Akbar *et al*., 2021), *Brassica campestris* (Hassan *et al*., 2018) and maize (Desalegn, 2014).

Finger millet (*Eleusine coracana*) is an annual herbaceous cereal crop belonging to family poaceae. It is commonly known as ragi and one of the important millet crops grown for grain and fodder purpose under varied agro-climatic conditions in India. Finger millet is rich in calcium, dietary fibre, protein, iron, zinc, essential amino acids than other major food crops (Gupta *et al.,* 2017; Sood *et al.,* 2016). The grain is used as flour in the preparation of cakes, bread and other pastry products and serves as a beneficial food for infants (Ceasar and Ignacimuthu, 2011). Finger millet has nutritional properties superior to that of rice and wheat, so it has been proposed to help in strengthening the nutritional security in the developing countries of Asia and Africa (Puranik *et al.,* 2017). Aim of the present investigation was to study the allelopathic potential of aqueous leaf extracts of *Lantana camara* and *Parthenium hysterophorus* on seed germination and early growth of the economically important food crop finger millet.

## Materials and Methods

### Collection and Extraction of Plant Material

Fresh plant material was collected from the H. P. T. College campus and nearby areas of Nasik. Plant was correctly identified with the flora of Maharashtra (Singh *et al*., 2000) and flora of Nashik district (Lakshminarasimhan and Sharma, 1991). Plant material was washed under running tap water and dried under shade. It was than homogenized into powder with electric blender and different stock solutions were prepared for further studies.

### Preparation of Aqueous Extract

The aqueous extracts were prepared from dry leaves of weeds (*Lantana camara, Parthenium hysterophorus*). 300 gm of dry leaves powder were soaked in 300 ml of distilled water and kept at room temperature. After 24 hours, the aqueous extract was filtered with the help of muslin cloth. The filtrate was designated as 100 % stock solution. From this stock solution other concentration were prepared such as 4%, 6%, 8%, 10%, 25%, 50% and 75% by diluting it with distilled water.

### Germination Test

Seeds of finger millet (Red and white) were first washed with distilled water and after that sterilized with 15% sodium hypochlorite for 20 min. The seeds were soaked for 24 hours in distilled water before treatment. Three replicates in a completely randomized design, each containing 25 seeds of finger millet was prepared for each extract concentration using sterile petri dishes (9 cm diameter) lined with sterile Whatman No. 1 filter paper. Seeds were evenly distributed on the filter paper and aqueous extract solution was added to each petri dish. The seeds used as controls were treated with only distilled water. After two weeks different parameters were recorded daily such as, Total germination percentage (GP), Plant height stress tolerance index (PHSI), and Root length stress tolerance index (RLSI). The samples were calculated using the formula below.

**Germination percentage**

$$GP = \frac{\text{Seed germinated}}{\text{Total seeds}} \times 100$$

**Plant Height Stress Tolerance Index (PHSI)**

$$PHSI = \frac{\text{Plant height of stressed plants}}{\text{Plant height of control plants}} \times 100$$

**Root Length Stress Tolerance Index (RLSI)**

$$RLSI = \frac{\text{Root length of stressed plants}}{\text{Root length of control plant}} \times 100$$

## Results and Discussion

### Effect of *Parthenium hysterophorus* and *Lantana camera* aqueous leaf extract on finger millet (Red and white)

The aqueous extracts of leaves of *Lantana camara* and *Parthenium hysterophorus* have been evaluated at 4% to 75% for their allelopathic potential on germination (Table 1) and seedling growth parameters (Table 2) of two varities (red and white) of finger millet. The allelopathic effect of *Parthenium* and *Lantana* on total germination percentage, root and shoot length is shown in Table 1 and 2.

The result show that seed germination of Finger millet (red and white) was found to be decreased with the increasing concentration of *P. hysterophorus* extract. Seed germination was observed more at control as compare to treated seed.

The results reveal that *Parthenium* extract significantly decreased growth parameters of root and shoot length of red and white finger millet. Shoot length was gradually decreased by increasing concentrations of *Parthenium* extract. Slightly increased concentration (4%) of *Parthenium* extract stimulates the growth of shoot. 4% extract shows maximum shoot growth (166 % and 168 %) in red and white finger millet as compare to control (100 %).

In case of *Lantana camera*, seed germination was gradually decreased by increasing concentration of aqueous extract of *Lantana camera* at all concentrations as compared to control in both white and red finger millet variety. After control treatment, maximum shoot (250 %) and root (257 %) length was found in red finger millet variety at 25 and 50 % respectively. While higher (75 %) concentration was totally inhibiting the growth of root and shoot as compared to non-treated seeds. On other hand, slightly increased (8 %) concentration showed maximum (263 %) root growth and higher concentration shows maximum (166 %) shoot growth of white finger millet.

## Discussion

*Lantana camara* and *Parthenium hysterophorus* are the America originated weeds and have spread to the other regions of world including India, threaten ecological biodiversity in forest ecosystems by their huge proliferation in any place at any time thus it exerts negative effects on agriculture, animal husbandry, ecology and environment in natural and managed ecosystems (Ahmed *et al*., 2007). *P. hysterophorus* is widely regarded as the most vicious weed due to its toxic effects both to humans and to biodiversity (Kaur *et al*., 2014). Due to presence of toxic chemicals, there are strong allelopathic effects on various crops and its allelopathic conditions hampered the germination and growth of agricultural crops such as wheat, rice, maize, pigeon pea, sorghum and black gram (Meena *et al*., 2017). In most dicot and monocot plants, the parthenin inhibits its germination and radicle growth. Later, it enters the soil through the decaying leaf debris (Saini *et al*., 2014).

In the present study, *Parthenium hysterophorus* and *Lantana camera* extract was found to inhibit significantly seed germination of tested white and red finger millet variety. Similar observations were recorded in *P. hysterophorus* extract concentration on *Cicer arietinum* (Fozia *et al.,* 2020), *Vigna radiata* (Lalita *et al.,* 2020), wheat, rice, maize, pigeon pea, sorghum, and black gram (Meena *et al.,* 2017), Hassan *et al.* (2018) reported a significant effect of *Parthenium* extract on seed germination of some crops. A slightly increased (4 %) concentration of

**Table 1.** Effect of *Parthenium* and *Lantana* on total seed germination

| Parameter | | No of Days | 4% | 6% | 8% | 10% | 25% | 50% | 75% | Control |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 | Effect of *Parthenium* extract on finger millet (white variety) | | | | | | | |
| | | | 84% | 76% | 72% | 84% | 24% | - | - | 85% |
| GP | Total germination percentage | | Effect of *Lantana* extract on finger millet (white) variety | | | | | | | |
| | | | 72% | 92% | 80% | 96% | 64% | 68% | 48% | 96% |
| | | | Effect of *Parthenium* extract on finger millet (red variety) | | | | | | | |
| | | | 94% | 94% | 90% | 60% | 20% | - | - | 95% |
| | | | Effect of *Lantana* extract on finger millet (red variety) | | | | | | | |
| | | | 100% | 100% | 95% | 90% | 60% | 55% | 20% | 100% |

**Table 2.** Effect of *Parthenium* and *Lantana* on Seedling Growth

| Crop | Type of weed | Extract concentration | Germination percentage | Root length | Shoot length |
|---|---|---|---|---|---|
| Finger millet (red) | *Parthenium hysterophorus* | 4 % | 94 % | 125 | 166 |
| | | 6% | 94% | 50 | 33.36 |
| | | 8% | 90% | 116.66 | 133 |
| | | 10% | 60% | 58.33 | 100 |
| | | 25% | 20% | - | - |
| | | 50 % | - | - | - |
| | | 75 % | - | - | - |
| | | Control | 95% | 100 | 100 |
| Finger millet (white) | | 4 % | 84% | - | 168 |
| | | 6% | 76% | - | 160 |
| | | 8% | 72% | - | 91 |
| | | 10% | 84% | - | 120 |
| | | 25% | 24% | - | 40 |
| | | 50 % | - | - | - |
| | | 75 % | - | - | - |
| | | Control | 85% | 100 | 100 |
| Finger millet (red) | *Lantana camera* | 4 % | 100% | 185 | 75 |
| | | 6% | 100% | 214 | 75 |
| | | 8% | 95% | 200 | 100 |
| | | 10% | 90% | 242 | 125 |
| | | 25% | 60% | 257 | 100 |
| | | 50 % | 55% | 142 | 250 |
| | | 75 % | 20% | - | - |
| | | Control | 100% | 100 | 100 |
| Finger millet (white) | | 4 % | 72% | 227.27 | 100 |
| | | 6% | 92% | 204.54 | 164 |
| | | 8% | 80% | 263.63 | 140 |
| | | 10% | 96% | 231.81 | 100 |
| | | 25% | 64% | 172.72 | 106 |
| | | 50 % | 68% | 145.45 | 116 |
| | | 75 % | 48% | 113.63 | 166 |
| | | Control | 96% | 100 | 100 |

*Parthenium* extract was stimulatory effect of shoot and root growth. Maximum shoot and root growth was observed as compared to control. Rashid *et al.* (2008) also reported the stimulation of shoot length with a slight dose treatment. The present findings suggest that the release of allelochemicals in low amounts stimulates growth, while greater amounts result in inhibition of other plants. Gindri *et al.* (2020) reported that all tested aqueous concentrations of *Lantana camara* affected seed germination of *Avena sativa*.

## Conclusion

The present experimental study results show that *Parthenium* and *Lantana* had strong allelopathic effects on seed germination and seedling growth of white and red finger millet variety. Its aqueous extract phytotoxicity increased with concentration. Higher concentration of both aqueous extract shows inhibitory effect in both varieties. Further study will be identifying the exact allelochemicals in the weeds which promote the growth of the test crop.

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