

The Phytoallelopathic Effect of *Calotropis Procera* on The Growth and Physiology of *Vigna Radiata*.

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Abstract

The effect of *Calotropis procera* on growth and germination of *Vigna radiata* was studied in the following study. To observe its effect on the germination and seedling growth of *Vigna*, experiments were conducted in laboratory (in petriplates) as well as in field conditions (in pots). Total five treatments of the aqueous extract of the leaves of *Calotropis* were given to the plant in three replicates of each. One of these was treated with water as control and other were 20%, 40%, 60% and 80% respectively. In germination assay seed germination and seedling growth was measured and the length of shoot and root and number of leaves was compared with the control. Statistical analysis revealed that the percentage of inhibition was increased with the increase in the concentration of the extract. The higher concentration (80%) adversely affected the growth and inhibited it most.

Keywords: *Calotropis procera*, Phytoallelopathy, Seed germination, *Vigna radiata*,

INTRODUCTION

Allelopathy is a biological phenomenon in which a specific organism releases certain chemicals that interferes with various life phases of other organisms [1]. It refers to both positive and negative interactions among organisms that are caused by the action of various chemical compounds generally known as allelochemicals [2].

In allelopathy, one species suppress or sometimes stimulates the growth and development of other plant species through chemicals, hence it is considered as chemical competition. These chemicals interfere in the regular physiology of the plant and make the conditions harder for their survival. There are two forms of competition first is interference and the other is

exploitation. Mainly the competition among plants is for sunlight, water availability, and uptake of nutrients and so on [3].

Weeds invite major problems in crop production. Most of weed species cause harm to crops by making them more prone to pest and disease agents [4, 5]. In major cereal crops, this loss varies in different ranges for wheat, rice, maize, gram respectively, this influences the quality and yield of the crop plants negatively and also enhances the production costs of crops that result in huge losses to economy [6]. Generally, the vigor of plants to delay or slow down or prevent the germination and growth of other plants is defined as allelopathy, and quietly used for weed control. It is completely natural and environmental friendly for weed control and also enhance the crop yield and helps to decrease the usage of chemical pesticides [2, 7].

The objective of the present work is to study the effect of *Calotropis procera* on the growth and germination of *Vigna radiata* commonly known as “Green gram” or “mung”. *Calotropis* is a common weed that is found widely in Punjab region. The work focuses on the ability of the weed to suppress the growth and other biochemical activities of *Vigna* in laboratory as well as field conditions.

MATERIALS AND METHOD

Collection of *Calotropis procera*

Fresh leaves of *Calotropis* were collected from different areas of Phagwada, Punjab such as herbal garden, lovely professional University Campus and from the agricultural fields. Mature leaves were selected for the extract preparation.

Preparation of aqueous extract from *Calotropis* leaves

30gm fresh leaves were washed under running tap water for the removal of the soil and latex particles which were present on its surface. These leaves were cut into small pieces and crushed into mortar pestle. The extract was prepared in 300ml double distilled water. The ratio of plant material and water was 1:10. It was filtered with Whatman No.1 filter paper. This extract was used to study the growth and germination of *Vigna radiata* seeds and other plant biochemical parameters.

Collection and selection of the seeds of *Vigna radiata*

Vigna radiata seeds were collected from local market of Jalandhar, Punjab. These seeds were washed and sterilised. Solution of $HgCl_2$ was used and after sterilization these were washed with double distilled water for 4-5 times. Healthy and uniform seeds were manually selected for the experiment as planting material.

Seed germination assay

Petri dish experiment was conducted to examine the growth and germination of the seeds in laboratory conditions. Seeds of green gram were washed and sterilised with $HgCl_2$. Sterilized petri dishes (6cm diameter) with clean filter paper (Whatman No. 1) and five seeds of green gram each were kept at room temperature for five days. One set of petri dishes was treated with distilled water as control and 5ml of 20%, 40%, 60% and 80% of aqueous extract of *Calotropis procera* was added to the other set. The experiment was designed in the way that each treatment had its three replicates. Five observations of growth and germination of the seeds were recorded at the interval of 24 hours. The result of the experiment was based on the total number of the germinated seeds, the growth in seedlings, length of shoot and root, fresh and dry weight of the seedlings.

RESULTS AND DISCUSSION

The results (Table 7) of the present study revealed the inhibitory effects of the leaves aqueous extract of *Calotropis procera* on growth and germination of the tested seeds in germination assay. Different concentrations of extract affected the plant growth differently. Plants treated with water (T_0) or the control treatment showed maximum growth, such as the length of shoot and root, number of germinated seeds (Table 8) and the rate of germination was higher in control treatment than that of other. It was found that the rate of growth in shoot and root lengths was decreased with the increase in concentration of the leave extract (figure 1, 2). It was more in the plants treated with 20% concentration, while significantly reduced in 40%, 60% and 80% respectively. Figure 3 revealing that the germination percentage was maximum (94.66%) in control and but it was minimum (74.66%) in the plants treated with maximum aqueous extract. Similar study was reported by Mangal *et. al.*, [6] in which they observed the inhibitory effect of *Calotropis gignentia* on *Vigna sinensis*. The results of the experiment were anti proportional with the treatments. The reduction of radicle length, seed biomass and seed

germination were increased with the increment in the concentrations (25%, 50%, 75% and 100%).

In an allelopathic study of *Celosia argentea* on the seed germination of some crop plants such as *Sorghum bicolor*, *Phaseolous aureus*, *Arachis hypogaea*, and *Vigna unguiculata*, Saritha and Sreeramulu in 2013 [8] observed the inhibitory effects of *Celosia argentea* on the seed germination and growth of the seedlings. Root and shoot lengths of plants that were treated with different concentrations (1%, 2%, 3% and 5%) were measured and compared with the control treatment. It resulted in the reduction of plumule and radicle lengths, with the increment of the concentrations. Aslam *et. al.* [9] also supported these results as they were found the similar results in the study of the allelopathic effect of *Calotropis procera*, *Peganum harmala* and *Tarmarix aphylla* on mustard and wheat. The five different concentrations (5%, 10%, 15%, 20% and 25%) of the aqueous extract of the allelopathic plants were used and it decreased the seed germination percentage and seedling lengths of wheat and mustard. The rate of reduction of growth by these phytotoxic plants was similar as it was less in 5% concentration and maximum in 25% concentration.

The results (Table 7) of the present study revealed the inhibitory effects of the leaves aqueous extract of *Calotropis procera* on growth and germination of the tested seeds in germination assay. Different concentrations of extract affected the plant growth differently. Plants treated with water (T₀) or the control treatment showed maximum growth, such as the length of shoot and root, number of germinated seeds (Table 8) and the rate of germination was higher in control treatment than that of other. It was found that the rate of growth in shoot and root lengths was decreased with the increase in concentration of the leave extract (figure 1, 2). It was more in the plants treated with 20% concentration, while significantly reduced in 40%, 60% and 80% respectively. Figure 3 revealing that the germination percentage was maximum (94.66%) in control and but it was minimum (74.66%) in the plants treated with maximum aqueous extract. Similar study was reported by Mangal *et. al.*, [6] in which they observed the inhibitory effect of *Calotropis gigentia* on *Vigna sinensis*. The results of the experiment were anti proportional with the treatments. The reduction of radicle length, seed biomass and seed germination were increased with the increment in the concentrations (25%, 50%, 75% and 100%).

In conclusion, the present study revealed the inhibitory effects of the *Calotropis procera* on the seed germination and growth of the seedlings of *Vigna radiata*, as the weed possess the phytoallelopathic compounds which suppressed the growth of the *Vigna* seeds. This reduction in the plant growth, height was due to the stress of phytotoxins present in the allelopathic plant. Moreover the phytotoxins which reduced the growth of the crop plant can also inhibit the other weeds from germination and can be isolated from the *Calotropis* plant.

Table 1: The effect of *Calotropis procera* on the shoot and root lengths of *Vigna radiata* seeds.

Concentration	Shoot length	Root length
T ₀	1.03 ± 0.886	7.13 ± 4.800
T ₁	0.88 ± 0.813	6.47 ± 4.320
T ₂	0.66 ± 0.634	5.92 ± 3.758
T ₃	0.61 ± 0.593	5.12 ± 3.731
T ₄	0.52 ± 0.521	4.16 ± 2.995

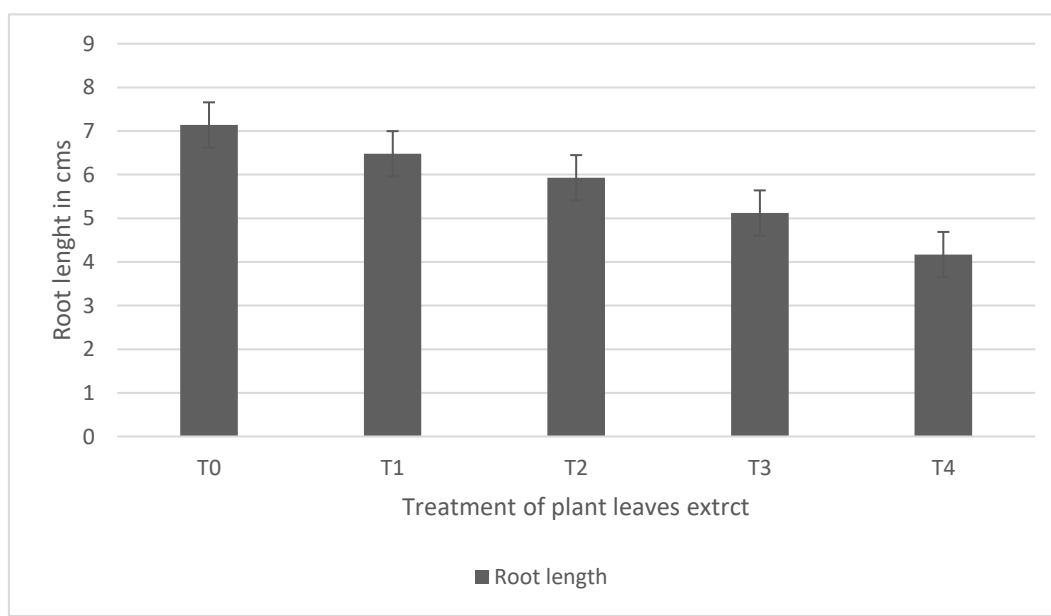
Table 2: The effect of *Calotropis procera* on the germination percentage and germination index of *Vigna radiata* seeds.

Concentration	Seed germination percentage	Seed germination index
T ₀	94.66 ± 8.692	2.14 ± 0.621
T ₁	91.99 ± 8.693	1.94 ± 0.556
T ₂	87.99 ± 8.692	1.8 ± 0.506
T ₃	81.32 ± 8.692	1.47 ± 0.572
T ₄	74.66 ± 8.692	1.22 ± 0.413



Figure 1: Effect of the aqueous leave extract of *Calotropis procera* on shoot length of *Vigna radiata*

Figure 2: Effect of the aqueous leave extract of *Calotropis procera* on root length of *Vigna radiata*.



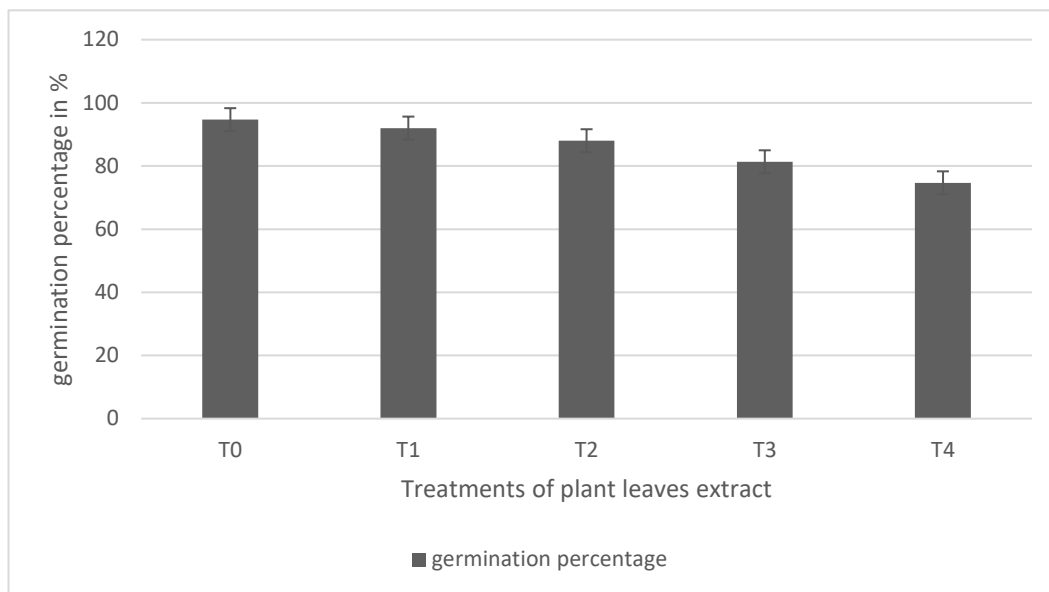


Figure 3. Effect of the aqueous leave extract of *Calotropis procera* on the germination percentage of *Vigna radiata*

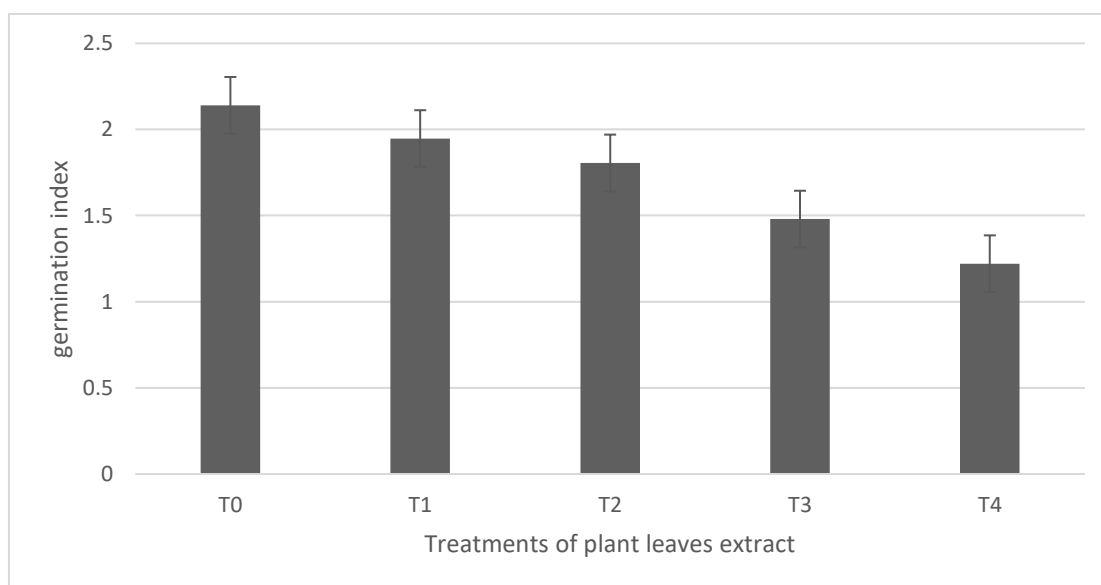


Figure 4. Effect of the aqueous leave extract of *Calotropis procera* on the germination index of *Vigna radiata*

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