

Study on the effect of aqueous leaf extract of *Anacardium occidentale* on seed germination and seedling growth of *Vigna unguiculata*.

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Abstract

Allelochemicals play a significant role in the germination and seedling growth of crop plants. Various allelochemicals are present in *Anacardium*. These chemicals enter into the crops environment and adversely affect the growth of crop and reduce their yield. It is seen that with increase in the concentration of leaf extract there is a decrease in germination value, germination percentage, cumulative germination percentage, shoot length, root length, leaf area, fresh weight, dry weight and stomatal index. For the successful cultivation of cowpea, the seeds should be grown away from this plant.

Key Words: Allelopathy, cumulative germination percentage, leaf area, *Anacardium*, stomatal index.

Introduction

Every organism has its own specific environment to which it continuously interact and adapted. The living environment includes all living things both plants and animals and their direct or indirect interactions. Various types of interactions occur among plants. These interactions may either beneficial to the participants or harmful. In some cases one population inhibit the growth and development of other population by the release of an effective phytotoxin into the environment. This is called 'Allelopathy'.

The term allelopathy derives from two separate Greek words. They are allelon which means "of each other" and pathos

which means "to suffer". Allelopathy is characteristic of certain plants, algae, bacteria, coral and fungi. Bio-chemicals that produced by them are known as 'allelochemicals' which influence the growth, survival and reproduction of other organisms.

It can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms. Allelochemicals are subsets of secondary metabolites (Stamp Nancy, 2003). It includes terpenoids, phenolic compounds, alkaloids, fatty acids, steroids and polyacetylenes (Kohli, 1998). Allelopathic substances present in any part of the plant i.e. leaves, roots, fruits, stems, rhizomes and seeds from where they are released to the soil through four biochemical process such as weathering, leaching, exudation and volatilization. The present work was conducted to study the effect of aqueous leaf extract of *Anacardium occidentale* on seed germination and seedling growth of *Vigna unguiculata*.

Material and Methods

Anacardium occidentale L.

Family : Anacardiaceae

Common name : Cashew

Anacardium is a spreading, evergreen, perennial tree; it is native to Brazil and is planted throughout the tropical regions of the world where it is a very important economic crop for some countries.

Vigna unguiculata (L.) Walp

Family : Fabaceae (Leguminosae)

Sub – family : Papilionaceae

Common name : Cowpea

Cowpeas are well adapted to the drier regions of the tropics, where other food legumes do not perform well. It is an erect, semi erect, prostrate herb.

The *Vigna unguiculata* seeds, Lola (VS 13 – 2) variety are

used for this particular study. The seeds were brought from Agricultural University Mannuthy. It is very common, high yield, extra long, light green pods with purple tip. Its average pod length is 38 –53 cm and average pod weight 22g.

The seeds were cleaned by washing in running tap water. Then surface sterilized with 0.1% HgCl₂ solution for 3 to 4 minutes and thoroughly washed in distilled water and dried on filter paper to eliminate fungal attack.

Leaves of *Anacardium occidentale* collected from the field and washed in running tap water. Then surface sterilized with 0.1% HgCl₂ solution for 3 – 4 minutes and thoroughly washed in distilled water. Then these leaves were crushed and grinded separately for extraction. These leaf extracts were filtered through a Whatman No. 1 filter paper and stored in refrigerator. The pure aqueous extract obtained was taken as a stock solution (100%) and further diluted to various concentrations, such as 25%, 50% and 75% by adding distilled water. In a control set, seeds are treated in distilled water.

The petridishes were sterilized in an autoclave at 120° C. Sterilized seeds were then arranged equidistantly over Whatman No. 1 filter paper in petridishes. Each petridish contain 25 seeds. The seeds were moistened with requisite amount of extract solution. Three replicates were always maintained. The petridishes were kept at room temperature (28 – 30°c).

After two days, the germination was observed. Radical emergence was considered as the criteria for seed germination. Germination count in each treatment was recorded. Five germinated seeds from each concentration were then transferred to separate polythene bags filled with potting mixture. Above mentioned concentration of extract were used for treatment. Control seedlings were treated with distilled water. The plants were well protected and kept for 10 days of observation. After 10 days of treatment, five plants were collected then shoot length, root length, leaf area, fresh weight and dry weight were studied and compared with control.

Then other plants were grown under above mentioned conditions and kept for 30 days of observation. After 30 days plants were collected then again shoot length, root length, leaf area, fresh weight, stomatal index is measured and compared with control. Parameters selected for this study are:-

I. GERMINATION STUDIES

- a. Germination value
- b. Germination percentage
- c. Cumulative germination percentage

II. MORPHOLOGICAL STUDIES

- a. Length of shoot

- b. Length of root
- c. Leaf area
- d. Fresh weight and dry weight

III. STOMATAL INDEX

IV. CORRELATION STUDY

I. Germination parameters

Germination value (G.V)

Germination value is the average germination of seeds.

Germination percentage (G.P)

Germination percentage (G.P) =

$$\frac{\text{No. of seeds germinated}}{\text{Total no. of seeds used}} \times 100$$

Cumulative germination percentage (C.G.P)

$$\text{C.G.P} = \frac{\text{Germination value}}{\text{Total no. of seeds used}} \times 100$$

Morphological parameters

a. Length of shoot and length of root

After 10 days of treatment in the polythene bags, the plant were picked up and length of shoot and root was taken. It was measured in centimeters using a thread and scale. Then after 30 days this was repeated again.

b. Leaf area

Leaf area is calculated by taking the mean value of length of basal, middle and tip region of leaf. It is also measured after 30 days.

c. Fresh weight and dry weight

After 10 days of observation in polythene bags, plants were collected and fresh weight was taken. The plants were then dried in hot air oven at room temperature (35 – 37°c) until a constant weight is obtained, and dry weight was taken.

III. STOMATAL INDEX

Stomatal index was calculated by the following formula

$$\text{Stomatal index} = \frac{\text{Number of stomata}}{\text{Number of stomata} + \text{epidermal cells}}$$

IV. CORRELATION ANALYSIS

Results:

The seeds of *Vigna unguiculata* were treated with different concentrations (25, 50, 75 and 100%) of *Anacardium occidentale* leaf extract.

GERMINATION STUDIES

a. Germination Value (G.V.)

In the case of seeds treated with leaf extract of *Anacardium*, the G.V. is 20.66, 17, 16 and 10.33 at 25, 50, 75 and 100% concentrations respectively.

In control, germination value is 23.66.

b. Germination Percentage (G.P.)

In the case of seeds treated with leaf extract of *Anacardium*, the G.P. is 82.67, 68, 64 and 68, 64 and 41.33.

In control G.P. is 94.66. (Table 1)

Table-1. Germination Studies

Concentration	CONTROL	25%	50%	75%
GERMINATION VALUE	23.66	20.66	17.00	33.00
GERMINATION PERCENTAGE	94.66	82.67	68.00	64.00
CGP	31.54	27.55	22.67	21.33

c. Cumulative Germination Percentage (C.G.P.)

In the case of seeds treated with leaf extract of *Anacardium*, C.G.P. is in the order 27.55, 22.67, 21.33 and 13.77 at 25, 50, 75 and 100% concentrations respectively.

In control CGP is 31.54.

MORPHOLOGICAL STUDIES

a. Shoot Length

In the case of seeds treated with leaf extract of *Anacardium* shoot length is 12.66 and 9.1 cm at 25 and 50% concentrations respectively. In the case of 75 and 100%, seedlings do not survive. In the case of control shoot length is 19.6cm. After 30 days plant showed shoot length of 22.3 cm at 25% concentration. Plants in the 50% concentration did not survive. In control, shoot length was 25cm. (Table - 2)

Table-2. Morphological Studies

	CONTROL	25%	50%	75%
Shoot length (cm)	19.6	12.66	9.1	-
Root length (cm)	6.26	3.46	1.46	-
Leaf area (cm)	5.82	4.2	3.84	-
Fresh wt (g)	0.92	0.85	0.76	-
Dry wt (g)	0.11	0.08	0.06	-
Stomatal index	0.317	0.293	-	-

b. Root Length

In the case of seeds treated with leaf extract of *Anacardium* have root length in the pattern of 3.46 and 1.46 cm at 25 and 50% respectively. In control root length is 6.26 cm. After 30 days root length was of 4 cm at 25% concentration. The plant in 50% did not survive. Control showed root length 7 cm.

c. Leaf Area

In the case of leaf area of the plants treated with *Anacardium* shows 4.2 and 3.84 cm at 25 and 50% concentrations. In control, leaf area is 5.82 cm. After 30 days leaf area is 6 cm at 25% concentration. In control, leaf area is 6.12 cm.

d. Fresh Weight and Dry Weight

In the case of plants treated with leaf extract of *Anacardium*, fresh weight was in the pattern of 0.85 and 0.76 g at 25 and 50% concentrations. The dry weight was 0.08 and 0.06 g at 25 and 50% respectively. Control plants showed the fresh weight 0.92g. The dry weight was 0.11g.

STOMATAL INDEX

In the case of seed treated with leaf extract of *Anacardium*, stomatal index was 0.293 at 25% concentration. Control plants showed the stomatal index 0.317

CORRELATION ANALYSIS

Correlation coefficient of *Anacardium occidentale* was – 0.9658 .

Discussion:

Germination value, Germination percentage and Cumulative germination percentage also decreased with increasing concentration of the *Anacardium* leaf extract. The inhibition was directly proportional to extract concentration. Muhammad Kamal Hossain and Md. Nazmul Alam (2010) observed similar results in *Lantana camara* leaf extract. Inhibitory effect was proportional to the concentration of the extract. Higher concentration had strong inhibitory effect and lower concentration showed stimulatory effect.

Reduction in germination also reported by Izzet Kadioglu and Yusuf Yanar (2004). They studied the effect of twenty two plant’s extracts on germination of seeds from nine different weeds. Result showed that some seeds are slightly affected, some stimulated the seed germination by the extract treatments. Many seeds inhibit the germination in all the plant extract. Hassan S. Al-Zahrani and samy A. Al-Robai (2007) reported that germination delayed at higher concentration and germination percentage was decreased by increasing leaf extract of *Calotropis procera* in some plants like Barley, Wheat, Cucumber, Fenugreek and Alassana.

The statistical study between concentrations of plant extract and C.G.P showed negative correlation. The correlation coefficient value was negative.

After the germination, the seedlings were transferred to separate polythene bags and the experiment continued for 10 days. After 10 days the shoot length, root length, leaf area, fresh weight, dry weight and stomatal index were studied and compared with control.

Maximum inhibition in shoot and root length occur at higher concentration. In 75% and 100% concentrations the seedling growth did not take place. Studies of allelopathic potential of fresh and dry leaves of *Eucalyptus citriodora* on amaryllis and grassy weeds by El – Rokiek and Eid (2009) showed that maximum inhibition in shoot and root length of wild oat reported at the higher concentration of the aqueous extract.

Reduction in shoot and root length reported by El – Darier (2002). He observed that Eucalyptus leaf litter water extract reduce the shoot and root length of Broad bean than in Maize. Alsaadawi and Salih (2009) reported that root exudates of *Cyperus rotundus* reduced the root and shoot growth of Tomato and Cucumber plants.

Anacardium leaf extract also reduce fresh and dry weight at higher concentration. The seedlings occurred only in the 25% concentration. Other concentration like 75% and 100% seedling did not survive. Oyun (2006) studied the allelopathic potentialities of *Gliricidia sepium* and *Acacia auriculiformis* on germination and seedling vigour of Maize. The result showed that shoot fresh weight and root dry weight decreased with increasing concentration of the extract.

In the case of *Anacardium* leaf extract, the seedlings did not survive at high concentrations (50%, 75% and 100%). Only seedlings survive at 25% concentration of leaf extract. Seedlings in 25% concentration also show lower values than control. Here thus the experimental results were also agreed with previous allelopathic works.

The present study showed that leaves of *Anacardium occidentale* exhibit a negative effect on germination and growth of crop plant *Vigna unguiculata*. The leaf extract have inhibitory effect. At higher concentrations (75% and 100%) *Anacardium occidentale* leaf extract inhibit seedling growth. Thus allelo-chemicals present inhibit the growth of neighboring crops and reduce their yield.

Conclusion:

Allelopathy is the phenomenon in which one plant releases chemicals which could either stimulate or inhibit the growth of others in the vicinity. Allelochemicals are produced by plants as end products, by-products and metabolites. These are present in the leaves, stem, roots, flowers, inflorescence, fruits and seeds of the plant. Among all these plant parts, leaves are the most consistent producer of these allelochemicals.

From the present study conducted, it is obvious that at lower concentration of leaf extract there is a high percentage of germination and growth of seedling. With increase in the concentration of leaf extract, percentage of germination

decreases and growth of seedlings did not take place.

From all the observations, it can be concluded that with increase in the concentration of leaf extract there is a decrease in germination value, germination percentage, cumulative germination percentage, shoot length, root length, leaf area, fresh weight, dry weight and stomatal index.

From the above results we can conclude that allelochemicals play a significant role in the germination and seedling growth of crop plants. Various allelochemicals are present in *Anacardium*. These chemicals enter into the crops environment and adversely affect the growth of crop and reduce their yield. For the successful cultivation of cowpea, the seeds should be grown away from this plant.

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References:

- Alsaadawi, I.S . and Salih, N.M.M. 2009. Allelopathic potential of *Cyperus rotundus* L. interference with crops. *Allelopathy Journal*. 23(2): 11-17.
- El- Darier, S.M.2002. Allelopathic effects of *Eucalyptus rostrata* on growth, nutrient uptake and metabolic accumulation of *Vicia faba* L and *Zea mays* L. *Pak. Jour. Biol. Sci.*(5):6-11.
- El- Rokiek,K.G and Eid, R.A. 2009. Allelopathic effect of *Eucalyptus citriodora* on amaryllis and associated grassy weed. *Planta daninha*. 27: 83-90.
- Hassan S. Al-Zahrani and Samy A. Al-Robai.2007. Allelopathic Effect of *Calotropis procera* Leaves Extract on Seed Germination of Some Plants. *Journal of King Abdulaziz University, Science Journal*, 19 (1):115-126.
- Izzet Kadioglu and Yusuf Yanar.2004. Allelopathic effect of plant extract against seed germination of some weeds. *Asian. J. Plant. Science*.3 (4): 472-475
- Kohli,R.K; Batish, D and Singh,H.P. 1998. Allelopathy and its implications in agroecosystems. *J.Crop.Prod*.1 : 169-202.
- Muhammad Kamal Hossain and M.D Nazmul Alam. 2010. Allelopathic effect of *Lantana camara* leaf extract on germination and growth behaviour of some agricultural and forest crops in Bangladesh. *Pak. J.weed sci. Res*. 16 (2): 217-226.
- Oyun, M.B. 2006. Potentiality of *Gliricidia sepium* and *Acacia auriculiformis* on the germination and seedling vigour of

Zea mays L. American Journal of Agricultural and Biological science. 1 (3) : 44-47.

Stamp Nancy. 2003. Out of the quagmire of plant defense hypothesis. The Quarterly Review of Biology. 78 (1): 23-55.

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