

Allelopathic activity of aqueous decomposed leaf litter extracts on the germination and early seedling growth of cowpea (*Vigna unguiculata*) in Aden, Yemen

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Abstract

Allelopathic effect of Aqueous decomposed leaf litter from four common trees and shrubs in Aden governorate, Yemen was investigated on the germination and early seedling growth of Cowpea, the test crop was subjected to four concentrations of 25, 50, 75 and 100% of the aqueous extract, while a control was maintained at 0% extract level. The study carried out in the laboratory of Botany at Faculty of Education, University of Aden.

The Percentage of germination, Germination rate per plate, radicle length, plumule, (hypo and epicotyl lengths) observed. Data was recorded at 24 hours interval after germination for 15 days, the research revealed delayed germination rate per plate and a significant reduction in the radicle length and germination percentage (data was collected on percentage germination; plant height. Results obtained showed that significant reduction in the growth parameters considered at 100% and 75%, while at 50% and 25% the difference was not significant.

From the result obtained, it can concluded that *Conocarpus lancefolius* and *Thevetia peruviana* possess allelopathic effect that inhibit the germination and early seedling growth of Cowpea, hence at 100% concentration.

Keywords: Allelopathy; *Azadirachta indica*; *Pitheculubium dulce*; *Conocarpus lancefolius*; *Thevetia peruviana*

1. Introduction

Allelopathy is a biological phenomenon in which one or more biochemical produced influences the growth, survival, and reproduction of other organism. Plants species considered as rich source of secondary metabolites (allelochemicals), these chemicals modify the environmental system on other plants growing in their vicinity, and the phenomenon known as allelopathy [8]. The term allelochemicals derived from “Allelochmics” it was coined by [12]. Since then, the term used in literature dealing with interspecific chemical interaction between plants. In order, a compound to be designated as allelochemical its release into or its origin in the environment must be demonstrated [4]. These biochemicals known as allelochemicals and can have beneficial (Positive allelopathy) or detrimental (negative allelopathy) effect on the target organisms. [12, 14] explained that allelochemicals are a subset of secondary metabolites, which are not required for metabolism (i.e. growth, development and reproduction) of the allelopathic organism and the allelochemicals with negative allelopathic effect are an important part of the plant [2, 3].

Plants can favorably affect other plants through release into the environment of substances named allelochemicals [1]. A lot of study carried out on the effects of chemicals released by roots, leaves, fruits, and other parts of growing plants on the growth of another species [12]. Plants may influence the growth of each other by means of exudates, leachates from decomposing residues, and residues incorporated into growing medium. [10, 9]

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Allelopathic studies in Yemen are rather very limited.

The goal of this study was to determine the possible allelopathic effects of commonly distributed plant in Aden and most of coastal part of the country (*Conocarpus lancefolius*, *Pithecellobium dulce*, *Azadirachta indica* and *Thevetia peruviana*.) " Figure (1): A, B, C, D" on germination and seedlings growth of *Vigna unguiculata* (L.)Walp. *Fabaceae*.

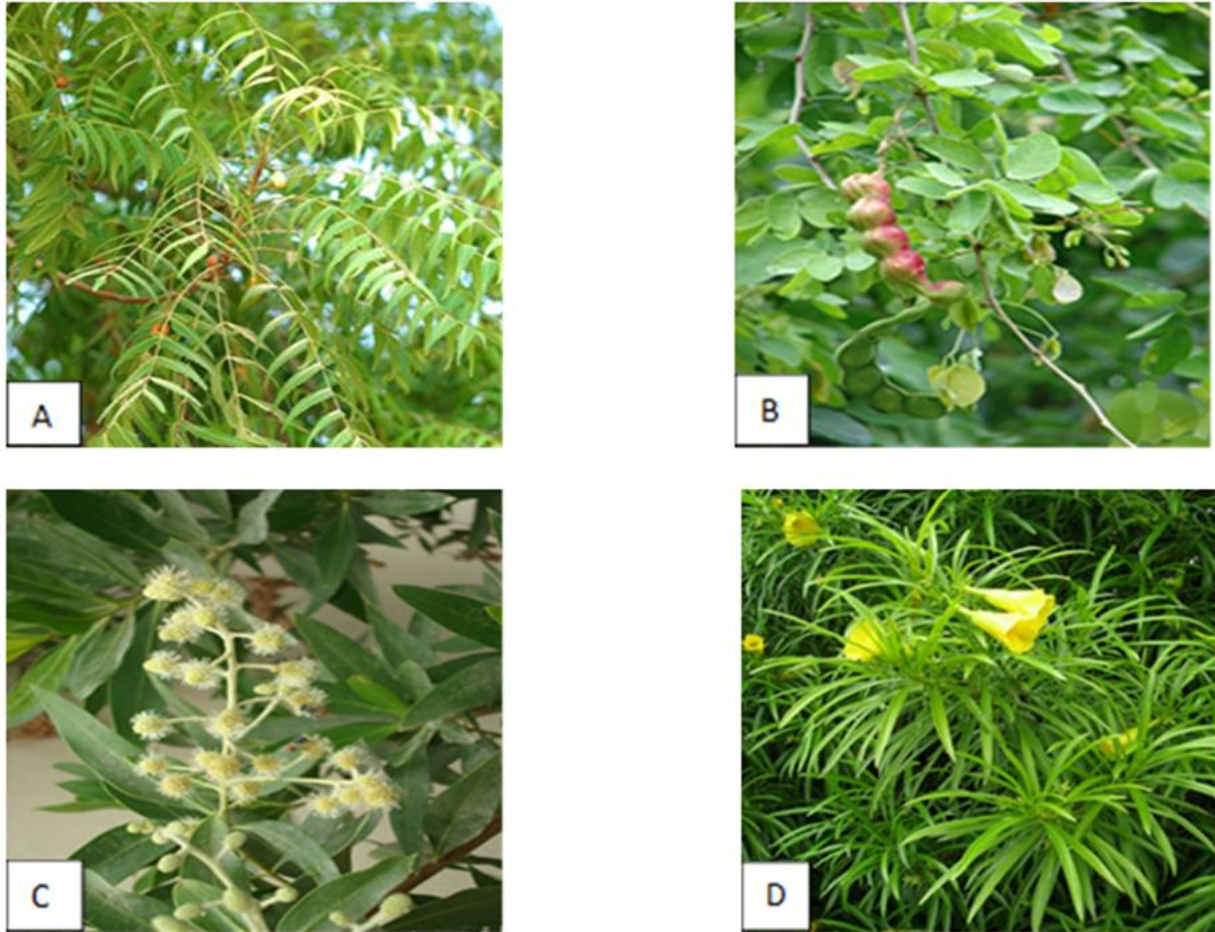


Figure 1 Common plants in Aden governorate, Yemen. A- *Azadirachta indica*, B- *Pithecellobium dulce*, C- *Conocarpus lancefolius*, D- *Thevetia peruviana*

2. Material and methods

This research carried out in the laboratory of Biology Department, Faculty of Education, Aden University of Yemen. All the plant species used in this experiment grown in the Faculty campus. The Cowpea seeds purchased from the local market.

2.1. Preparation of aqueous extract of the litter and soil

The soil medium was mixed with distilled water at a ratio of 9:25 (w/v, which is equal to the ratio of 1 g of litter to 25 ml of water) and extracted by water for 24 h. The soil and water mixtures then filtered. Five treatments viz, Control 1 treatment (0% extract), (25% extract), (50 % extract), (75 % extract) and (100% extract) were prepared to start the experiment. On 16 February 2020, at 10:30 am Aden time, start the *Vigna unguiculata* germination and seedling growth experiment to investigate the effects of the litter extracts on seed germination and seedling growth, on medical cotton-dish cultivation method used. 10 seeds in each plate with three replicates. The observation was at first 24 h, for 14 days, the growth of radicals and plumules recorded daily. The average of three different growths Tallest (T), Medium (M) and Shortest (S), observed and recorded, for all the treatments and the replicates.

3. Results and discussion

The results summarized in the tables (1-6)

While analysis the result the following findings observed:

- The percentage of the germination at 25% extract was higher with *Pithiceliubum dulce* (78%) and *Azadrichta indica* (71.6%). (Table 1).
- At 50% extract, the *Conocarpus lancefolius* with (79.6%) and *Thevetia peruviana* with (46%). (Table 1)
- The Vigna radical and plumule growth comparing to control
- At 25% of *Thevetia peruviana*, *Pithiceliubum dulce* and *Conocarpus lancefolius* were taller than the control. (Table 2,4,5,6).
- *Azadrichta indica* was shorter than the control except the epicotyl growth was higher. (Table 2,4,5,6).
- At 100% was the fatal for all except *Pithiceliubum dulce* with (11%) and *Azadrichta indica* with (6.6%). (Table 2, 3, 4).

Table 1 Effect of Plant Extracts on the Germination Percentage of Cowpea

Treatment	Con %	Control	Azad.	Pith	Cono	Thev.
Vigna unguiculata with Soil and decomposed leaf extract	0	100	0	0	0	0
	25	0	71.6	78	55.3	41.3
	50	0	47.6	58.6	79.6	46
	75	0	37.6	16.6	39.6	29.3
	100	0	6.6	11	0	0

Table 2 The effect of control on radical/plumule growth in cm

Treatment	Con.%	Radical			hypocotyl			epicotyl		
		T	M	S	T	M	S	T	M	S
Vigna unguiculata seeds with water only	0	7	5	4	10	8.5	6	5.5	2.7	1.7

Table 3 The effect of Azadaricta indica extract on radical/ plumule growth in cm

Treatment	Con.%	Radical			Hypocotyl			Epicotyl		
		T	M	S	T	M	S	T	M	S
Vigna unguiculata seeds with Soil and Decomposed leaf extract	25	4.5	3.6	3.3	8.5	6.7	5	9	6	4
	50	2.5	3	3	6	5.7	4	1.5	1.2	1
	75	2.5	1.5	1	5	4.5	1.7	5	3	1.3
	100	1	0.5	0.5	3	2.7	1	0.8	0.6	1

Table 4 The effect of *Pithiceliubum dulce* extract on radical/ plumule growth in cm

Treatment	Con.%	Radical			Hypocotyl			Epicotyl		
		T	M	S	T	M	S	T	M	S
<i>Vigna unguiculata</i> seeds with Soil and Decomposed leaf extract	25	8.2	5	3.5	11.3	8	7	8.4	6	3
	50	4.5	3.8	3	7	7.3	3	5.5	3	1
	75	5	3	2.5	6.5	6	5.3	4.5	3.5	1.2
	100	1.2	0.9	0.3	2.8	1.8	2	1.2	1.2	0.5

Table 5 The effect of *Conocarpus lancefolius* extract on radical/plumule growth in cm

Treatment	Con.%	Radical			Hypocotyl			Epicotyl		
		T	M	S	T	M	S	T	M	S
<i>Vigna unguiculata</i> seeds with Soil and Decomposed leaf extract	25	7	6.5	4	10.5	9	7	9.5	5	1
	50	4	3.8	3.5	8.5	6.7	5	8.2	5.7	4.3
	75	5	3	2.5	6.5	6	5.3	5.5	3.5	1.2
	100	0	0	0	0	0	0	0	0	0

Table 6 The effect of *Thevetia peruviana* extract on radical/ plumule growth in cm

Treatment	Con.%	Radical			Hypocotyl			Epicotyl		
		T	M	S	T	M	S	T	M	S
<i>Vigna unguiculata</i> seeds with Soil and Decomposed leaf extract	25	9.5	7.2	3.5	12	6	5.5	8	4	3
	50	4	3	4.2	7	3.5	2	3.5	1.5	0.8
	75	3	2	2.5	5.5	3	1.5	4.5	2	1
	100	0	0	0	0	0	0	0	0	0

The results obtained in the present study corroborates with the results obtained from similarly several studies have proved the allelopathic efficacy of several species have on seed germination and seedling growth [1, 5, 6, 8, 10] Indeed, the radicle growth was more sensitive to allelochemicals than the plumule growth. The results obtained in the present study are in agreement with many previous research studies on allelopathy. [7, 9, 11, 13].

4. Conclusion

It can be concluded that aqueous leaf extract of common trees and shrubs in Aden, inhibit delays or suppress the germination and early seedling growth of cowpea, even though at lower concentrations it tends to stimulate the germination and growth of the test plant, hence, have the potential to be used as an alternative to synthetic herbicide.

Recommendations

It recommended that further research should carried out to investigate the effect of those plants, on the germination of different crop in the study area. It further recommended that farmers should take appropriate care on some of the plant that may cause damage to their crops on the farms during land preparation.

Compliance with ethical standards

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Disclosure of conflict of interest

Hana A. Al-Quhbi, Amna A.I. Saeed and Abdul Nasser Al-Gifri, declare that there was no conflict of interest.

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