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Allelopathic effect of *Calotropis procera* (L) leaves extract on seed germination and early growth of *Arachis hypogeae* (L) and *Pennisetum glaucum* (L)

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Abstract
The effect of aqueous leaves extract of *Clotropis procera* at 20%, 40% and 80% on seeds germination and early growth of Groundnut (*Arachis hypogeae*) and Millet (*Pennisetum glaucum*) was investigated. The results showed that the extract both at lower and higher concentration did not affect the seeds germination of the two plants species. Final germination percentage after ten days was increased by increasing the extract concentration especially on Millet where 100% and 95% germination was observed at 20% and 80% concentration of the extract respectively. Generally, the radicle and plumule growth was sensitive to different levels of the extract where the plumule length was decreased by increasing the extract concentration and some leaves began to die at higher concentration (80%) in Groundnut (*Arachis hypogeae*). However, plumule emergence and growth was stimulated in both lower (20%) and higher (80%) concentration in Millet (*Pennisetum glaucum*) seedlings more than control treatment. Therefore the seedlings of Groundnut were more affected by the aqueous extract of *Clotropis procera* than that of Millet. The implications of these findings are hereby discussed.

Keywords: *Clotropis procera*, *Arachis hypogeae*, *Pennisetum glaucum*, growth, germination, seedling

Introduction

Allelopathy is a phenomenon where by the plant (donor) has a detrimental effect on another plant (receptor) [1]. Allelopathy was first coined by Molish (1937) to include both inhibitory (harmful) and beneficial (stimulatory) effects of plants on each other. Association and disassociation patterns between certain plant species are widely known. Such phenomena may be governed by direct competition for necessary growth factors or through addition of allelopathic chemicals into the soil environment [1, 2]. Other researchers described allelopathy as any direct or indirect effect of plant chemical compounds on another plant or even microbes.

Calotropis procera (Milk weed) is an evergreen poisonous shrubs plant from the family Aselepidiaceae. Its height is about 2-4 meters but it may sometimes reach 6 meters depending on the climatic condition of the environment where it is grown [3]. The plant grows naturally and the hairy seeds are spread by wind of different areas. *Calotropis procera* grows widely throughout the tropical and subtropical regions of Asia and Africa. In Nigeria, *Clotropis procera* is abundant in Bauchi, Borno, Kano, Kaduna and other part of northern Nigeria [4]. The plant is popularly known due to the abundance of latex and such a fact reinforces the idea that this milky latex is accumulated as a defense strategy against insect, nematode, virus and fungi. It has been reported that all parts of the plant are poisonous and the plant grows commonly around farms, agricultural areas and in the sandy warm part of the world. *Calotropis procera* (Milkweed) is adapted to hot and dry climates and it can tolerate drought but prefers locations that have 150-1000mm autumn rainfall [4, 5]. *Calotropis procera* is able to grow in a wide range of soil such as alkaline and saline soils, but it prefers sandy soils. The latex is a good source of various biologically active compounds including glycosides, tannins and many proteins. In this present work, the allelopathic effect of the plant was investigated on the germination and early growth of *Arachis hypogeae* (L) and *Pennisetum glaucum* (L) so as to determine the degree it can act as a weed and also to be advise Farmers subsequently on how best to mitigate its growth.

Materials and Methods

Study area

The research was conducted at the experimental garden of the Department of Botany, Ahmadu Bello University Zaria, Kaduna State-Nigeria.

Viability Test

The viability of the seeds were determined using water floating method. Seeds that settled beneath the water are considered as viable and those that float on the water are termed not viable [6, 7].

Samples collection

Groundnut and Millet seeds were collected from Samaru Market in Zaria local government, while *Calotropis procera* leaves was collected within the school campus (main campus) around the Department of Mass Communication annex Building using the method of [8, 9].

Extraction

The collected *Calotropis procera* leaves were washed with water to remove dust and other residue and then spread under the sun to dry. The dried leaves was crushed to powder using mortar and pestle, milling machine was also used to grind it to fine powder [10].

Aqueous extract of the powder was then prepared by soaking the powder sample in water (1:10W/V) for 48hours at room temperature [11, 12]. The extract was filtered using what man No 1 filter paper. The filterate was taken as 100% concentration of the extract. Finally, the filtered solution was diluted with water to obtained concentrations of 20%, 40% and 80% and tap water at 0% concentration of the treatment.

Soil preparation

Loamy soil was obtained from the experimental garden, crushed to fine soil particles for easy penetration and emergence of Radicule and Plumule respectively. One hundred and twenty (120) poly bags was used for the experiment each filled up with the soil [13].

Seed germination and test

Ten seeds of Millet and five of Groundnut were placed on filter paper inside a petri dish 9 cm in diameter for germination and 10ml of the aqueous extract were added to each while distilled was used as the control. The experiment was conducted in three replicates. The seed was watered each day with 10ml of the extract in the morning and germinated seeds were recorded for ten days. The germination tests were carried out in the dark room [14, 15].

Seedling growth

One hundred and twenty poly bags was filled with soil (sixty for Millet and sixty for Groundnut). The seeds were planted in the soil in poly bags and watered with the different concentrations of the extract and control with tap watered each in three replications. The plants were thinned to two plants per poly bag of groundnut and three plants in Millet for five days after germination by selecting the most healthy and vigorously growing seedlings. Plant height, number of leaves and root length were recorded weekly for five weeks [16]. The entire experiment last for six weeks. The work was conducted in the screen house, Department of Botany, Ahmadu Bello University Zaria.

Data analysis

The data obtained was subjected to one way analysis of variance (ANOVA) for each plant species. Duncan's multiple range test (DMRT) was also used to separate the means where significant was recorded at 5%

Results

Table 1: shows the percentage germination of millet and groundnut seeds. The germination percentage increases from 60% at control to 80% concentration and 50% germination was observed at the other concentration (40% and 80% concentration) in millet seeds. Similar results was observed in groundnut seeds with 100% germination at 20% of the extract and 80% germination at control and 40% of the extract while 95% germination was observed at 80% of the extract.

Table 2: shows the effect of the plant extract on the seedlings growth of groundnut from week 2-6. At week 2, highest shoot length was observed to be 21.97cm at control and least at 80% of the extract (11.23cm). This was observed throughout the experiment; high shoot length and number of leaves at control and low numbers of leaves and shoot length at 80% of the extracts. While for root length, it was observed to be 6.87cm at control and least was 4.03cm at 40% of the extract and in week six, highest growth was observed to be 14.33cm at 20% extracts and least 4.47cm at 80% of the extract.

Table 3: shows the combined effect of the extract from week 2-6 on seedlings growth of groundnut for the three parameter (shoot length and number of the leaves) and both the three parameters increased from week 2-6 with deviation only at week 6 where numbers of leaves was found to be 35 instead of more than 38 leaves, since 38 leaves were observed at week 5 and 6 respectively with regards to root length.

Table 4: shows the effect of the extract on the seedlings growth of millet from week 2-6. In week 2 highest root length was observed to be 7.83 cm at 20% of the extract and least at control at 4.23 cm and also 19.07 cm and 3.23 cm at 40% respectively for shoot length and four leaves was observed both at control and treated seedlings. While for week 3,4,5and 6, highest shoot length was observed to be 25.37 cm at control, 36.97cm at 40% , 45.97 cm at 60% and 56.60 at 80% and least as 20.93 cm at 40%, 35.20 cm at control, 52.53 cm at 60% and 52.13 cm at 80% respectively. Highest root length was always observed at control week 3-5 with deviation only at week 6 were highest root length was observed to be 20.60 cm at 40% of the extract and least at 15.73cm at control.

Table 5: Shows the combined effect of the extracts of the extract from week 2-6 on seedlings growth of millet for the parameters under studies and it shows significant increases between the weeks throughout the experiment in terms of number of leaves, root length and shoot length. In the case of root length significant increases was not observed between week 2 and 3 likewise between week 5 and 6 with regards to shoot length.

Table 1: Effect of the Different Extract of *Calotropis procera* on germination percentage on Millet (*Pennisetum glaucum*) and Groundnut (*Arachis hypogeae*)

Plant species	Concentration (%)			
	0% (control)	20%	40%	80%
Millet	60	80	50	50
Groundnut	80	100	80	95

Table 2: Effect of different concentration of *Calotropis procera* extract on Groundnut (*Arachis hypogeae*) from week 2-6 after sowing (WAS)

Weeks	Concentration (36)	Number of leaves	Root length (cm)	Shoot L (cm)
2	0	27.33±3.71a	6.87±0.54a	21.97±0.58a
	20	21.33±3.53ab	6.83±0.88a	17.37±2.60ab
	40	22.00±1.1ab	4.03±1.56a	17.27±2.29ab
	80	16.67±0.67b	5.83±1.30a	11.23±1.38b
	P-value	0.114	0.322	0.025
3	0	40.67±0.67a	14.87±0.92a	27.27±1.50a
	20	30.00±5.03a	7.57±2.23b	25.70±1.45ab
	40	28.67±1.33a	5.30±0.76b	20.03±2.25b
	80	32.00±6.00a	13.37±1.70a	23.50±1.68ab
	P-value	0.219	0.006	0.083
4	0	41.33±7.06a	10.90±2.33a	30.33±0.98a
	20	41.33±1.33a	10.50±0.36a	29.93±0.66a
	40	34.67±1.33a	10.63±3.28a	24.93±1.95b
	80	29.33±5.33a	10.07±2.47a	21.77±1.36b
	P-value	0.253	0.995	0.005
5	0	49.33±1.33a	19.77±1.91a	35.10±0.50a
	20	34.67±7.06ab	10.93±2.14b	29.67±4.02ab
	40	41.33±2.67ab	9.30±0.20b	23.67±0.74b
	80	28.67±4.67b	10.87±0.38b	21.60±2.52b
	P-value	0.054	0.003	0.016
6	0	46.67±3.53a	13.33±1.05a	38.93±1.37a
	20	44.00±6.11a	14.33±4.36a	31.63±2.05b
	40	34.67±2.67a	10.37±0.87a	30.06±2.10b
	80	14.67±1.33b	7.47±0.49a	18.20±2.00c
	P-value	0.001	0.220	0.001

Table 3: Combined effect of *Calotropis procera* leaves extract on seedling growth of Groundnut (*Arachis hypogeae*) from 2-6 weeks after sowing (WAS)

Weeks	NL	RL (cm)	SL (cm)
2	21.83±1.60b	5.89±0.60b	16.96±1.40c
3	32.83±2.21a	10.28±1.36a	24.13±1.11b
4	36.67±2.45a	10.53±1.01a	26.74±1.22ab
5	38.50±3.01a	12.72±1.39a	27.48±1.90ab
6	35.00±4.12a	11.38±1.27a	30.09±2.28a
P-value	0.001	0.002	0.000

Table 4: Showed the effect of different concentration of *Calotropis procera* leaves extract on seedlings growth of Millet (*Pennisetum glaucum*) from 2-6 weeks after sowing (WAS)

Weeks	Concentration (36)	Number of leaves	Root length (cm)	Shoot L (cm)
2	0	3.00±0.00a	4.23±3.60b	18.67±0.85a
	20	3.00±0.00a	783±1.67a	13.63±2.09b
	40	3.00±0.00a	4.43±3.64b	13.23±0.54b
	80	3.33±0.33a	4.23±3.27b	19.07±0.62a
	P-value	0.441	0.071	0.013
	0	4.33±0.67a	5.90±0.17a	25 37±4.04a
	20	4.33±0.33a	4.00±0.15a	21.53±2.17a
	40	4.33±0.33a	4.46±0.96a	20.93±1.22a
	80	4.33±0.33a	5.57±1.67a	22.13±3.20a
	P-value	1.000	0.503	0.707
	0	5.33±0.33a	9.87±3.79	35.20±1.93
	20	5.33±0.33a	5.73±0.58	36.53±4.54
	40	6.00±0.58a	6.47±0.81	36.97±2.47
	80	6.00±1.00a	7.50±1.64	31.87±6.59
	P-value			
	0	6.67±0.67a	12.17±0.48a	43.10±4.71a
	20	7.33±0.67a	9.83±2.26a	45.97±2.98a

	40	8.33±0.33a	10.37±1.59a	42.53±5.29a
	80	6.67±0.88a	9.60±2.20a	43.10±7.07a
	P-value	0.313	0.740	0.964
	0	8.33±0.33a	15.79±1.22ab	5147±7.71a
	20	8.67±0.33a	14.80±3.79ab	56.10±2.25a
	40	8.67±0.33a	20.60±1.23a	59.60±2.06a
	80	7.33±1.20a	9.37±0.71b	52.13±5.57a
	P-value	0.484	0.035	0.773

Table 5: Showed the combined effect of *Calotropis procera* leaves extract on seedlings growth of Millet (*Pennisetum glaucum*) from 2-6 weeks after sowing (WAS)

Weeks	Number of leaves (cm)	Root length (cm)	Shoot length (cm)
2	3.08±0.08d	5.18±0.61c	16.15±0.97d
3	4.33±0.19c	4.98±0.48c	22.49±1.33c
4	5.67±0.28b	7.39±0.65b	36.14±1.84b
5	7.25±0.35a	10.49±0.81a	43.68±2.26a
6	7.25±0.35a	10.49±0.82a	43.68±2.26a
P-value	0.000	0.000	0.000

Discussion

The 100% germination at 80% concentration and 80% germination at control and 40% concentration of the extract on Groundnut seeds and 60% germination at control and 80% germination at 20% concentration of the extract on Millet seeds indicated that the plant extract both at higher and lower concentration has no allelopathic effect on seeds germination of Groundnut and Millet and this may be due to the antagonistic interaction between the hormones in the seeds such as cytokinins and Gibberellins etc. [17, 18, 19]. This breaks the seeds dormancy with the phytochemicals thereby suppressing the allelopathic effect of the extract.

The significant decrease in shoot length, number of leaves and root length of Groundnut from control at higher concentration (80%) of the extract indicated that the extract has allopathic effect on the seedlings growth and this agrees with the work of [20, 21] who worked on the allopathic effect of *Calotropis procera* leaves extract on seed germination and seedlings growth of Soya beans (Glycine max).

The high shoot length , root length and number of leaves at high concentration (80%) of the extracts and the significant difference between the treated seedlings and the control indicated that the extract has no allelopathic effect on the seedlings growth of Millet and this may be due to the action of the plant exudates in the soil which suppressed the inhibitory effect of the allelochemicals present in the soil and this agrees with the findings of [22, 23, 24, 25] that noticed that certain species of plants will not grow well close to *Helianthus annuus* and Sunflower but *Croton glanduloulus* grows better near Sunflower. However, the work disagreed with the findings of [26, 27], who found that decrease in seedling growth and seeds germination in some crops including Barley may have some genes that can enable the plant to tolerate some chemical stress similar to those found in *Calotropis procera* [28].

Plate 1: Millet and Groundnut seedlings three WAS

Plate 2: Millet and groundnut six WAS

Conclusion

From the result obtained it can be concluded that *Calotropis procera* aqueous extract has no allelopathic effect on seeds germination and seedlings growth of Millet (*Pennisetum glaucum*). It can also be concluded that the plant extract has no allelopathic effect on seed germination of Groundnut (*Arachis hypogeae*) but has inhibitory effect on the seedling growth of the plants. The inhibitory effect caused by the aqueous extract of *Calotropis procera* might be as a result of allelochemicals such as calotropin present in the leaves of the plant [27, 28]. Crops plants especially Groundnut and other cultivated crops should not be planted in areas where *Calotropis procera* grows as this will severely suppress their growth.

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