

Effect of Decayed Leaf Litters of *Moringa Olifera*, *Terminalia catappa* and *Terminalia mentally* on Growth and Yield Parameters of Three Cowpea Varieties

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Abstract

A research was carried out to evaluate the effect of dissolved leaf litters of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* on germination, seedling vigour and growth parameters of three cowpea varieties (IT07K-243-1-2, IT06K-111 and IT06K-134). Cowpea varieties were obtained from the cowpea collection of the Molecular Biology Laboratory, Joseph Sarwuan Tarka University Makurdi. Fresh leaves of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* were collected from uncultivated fields within the University campus. This experiment was carried out in a Completely Randomized Design where the seeds were planted in polythene bags in duplicates. The decomposed leaf litters of the test plants were administered to the growing medium at 150g and 300g respectively while NPK (at 1.4 and 2.5g respectively) fertilizer was also used as treatment medium and a control experiment was also set up. The single and combined effect of the leaf litters on the germination and growth performance of the cowpea seeds were measured and recoded appropriately. The data collected were subjected to one way analysis of variance (ANOVA) using Genstat software. The results obtained indicated that the single and combined leaf litters of the test plants had significant influence on the germination and growth of the cowpea plant. Highest germination count and percentage germination (3.00 ± 0.00 and 100% respectively) were recorded in IT07K-243-1-2 variety planted on soils with Tc+Tm+Mo (300g) leaf compost, Seedling vigour was highest (27.73 ± 0.15) in IT07K-243-1-2 with Tc+Tm+Mo (300g) leaf compost. The plant height was highest (11.0 ± 0.23) in IT06K-111 treated with Tc+Tm+Mo (150g) compost, while number of leaf was highest (9.17 ± 0.19) in IT06K-111 treated with NPK (2.5g) at 5WAP. Plant spread was highest in the control (5.33 ± 0.15). IT06K-111 variety had the overall best performance across all the treatments and the *Moringa olifera* had the best single effect on the germination and growth of the cowpea plants compared to *Terminalia catappa* and *Terminalia mentally*. However the combination of the decomposed leaf litters of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* had significant effect on germination and growth characters of cowpea and can be considered as viable organic manure sources for growing of cowpea.

Keywords

Decayed Leaf Litters, Moringa Olifera, Terminalia Catappa, Terminalia Mentally, Cowpea Varieties

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1. Introduction

Cowpea (*Vigna unguiculata* (L.) Walp), as a grain legume is an important source of food, income and livestock feed and forms a major component of tropical farming systems because of its ability to improve marginal lands through nitrogen fixation and as cover crop [1]. Cowpea is widely cultivated in Nigeria under rain fed conditions mainly in the savanna and transitional agro ecological zones, but yields are among the lowest in the world, averaging 310 kg ha⁻¹ [2]. Consequently, efforts have been made to improve cowpea production in Nigeria through various means including the introduction of new varieties [3]. None of these improved varieties could achieve the optimum yield without appropriate and site specific fertilizer recommendations. On the other hand, there is limited use of fertilizer for agriculture in Nigeria (less than 8 kg ha⁻¹) while N, P and K depletion rates in the country range from about 40 to 60 kg ha⁻¹ yr⁻¹ [4], which is among the highest in Africa. The addition of organic amendments by smallholder farmers corresponds in most cases to a recycling process, which cannot compensate for nutrients exported through crop harvest [1] as a result, the use of inorganic fertilizer remains a key input for increased productivity for smallholder farmers. In recent times, intercropping trees with crop plants has become a promising agroforestry practice for its economic and ecological benefits. Common trees intercropped with crops include *Moringa* species and *Terminalia* species. Ecology and nature of growth of the *Moringa peregrina* were studied by [3]. It is an economic threat to agriculture in cropping areas for its probable allelopathic potentiality of their falling leaves. *Moringa* species are one of the most useful trees in the tropics and subtropics of Asia and Africa, with multiple uses. Genus *Moringa* is the only genus in family *Moringaceae* and comprises 13 species from Africa, Madagascar, western Asia and the Indian subcontinent [5]. It is drought resistant, preferring regions with a wet/dry climate, but can grow in a wide range of habitats on a variety of soils, and is widely known for nutritional and medicinal values in many countries in Middle East. *Terminalia* (Combretaceae, Myrtales) is a pantropical genus accommodating about 200 species [6]. About fifty of these are native to Africa and distributed throughout the sub-saharan region [7]. Based on both their functional uses and distribution in Africa, the most important are *Terminalia ivorensis* A. Chev. and *T. superba* Engl. and Diels. in West and Central Africa and *T. prunioides* M. A. Lawson and *T. sericea* Burch D. C. in Southern Africa [8]. Tropical almond (*Terminalia catappa*) is a large, spreading tree now distributed throughout the tropics in coastal environments. It has a spreading, fibrous root system and plays a vital role in coastline stabilization. It is widely

planted throughout the tropics, especially along sandy seashores, for shade, ornamental purposes, and edible nuts. The tree has a demonstrated potential to naturalize in coastal plant communities, but not to adversely dominate such communities [9]. In order to select appropriate trees for intercropping, attention should be paid not only to the competition between the crops and interplanted trees for sunlight, water, and nutrients, but also to the harmful allelopathic effects of trees on crops. Previous research studies regarding allelopathic effects have been carried out by simply extracting the living or dead plant organs of the donor plants using water or an organic solvent and then treating the receptor plants. However, under natural conditions, only very small amounts of allelochemicals are leached or volatilized directly and subsequently come into contact with receptor plants [10]. Furthermore, after they are released into the soil, allelochemicals would be affected by the soil, such as by absorption, migration, or decomposition by microorganisms and enzymes. This allelochemical initially aggregates into a dimer and then decomposes into small molecules, which can be inactivated by high levels of soil nutrients. On the basis of the above, the practical allelopathy of the decomposed leaf litter of three commonly found Savannah tree species; *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* on cowpea plants was investigated in this study. This study may provide scientific insight into the allelopathic effects of litter decomposition, and provide a basis for the selection of interplanting trees that can be used in conjunction with cowpea and other plants.

2. Materials and Methods

2.1. Study Area and Experimental Material

The study was conducted at the Botanical Garden of the Department of Botany, College of Science, Joseph Sarwuan Tarka Makurdi. Three cowpea varieties IT07K-243-1-2, IT06K-111 and IT06K-134, were obtained from the Gene Bank of the Molecular Biology Laboratory, Joseph Sarwuan Tarka University Makurdi for the study. Fresh leaves of *Moringa olifera*, *Terminalia catepa* and *Terminalia mentally* were collected from uncultivated fields within the campus of the University.

2.2. Leaf Sample Identification and Preparation

Terminalia catepa and *Terminalia mentally* were identified following the description of [11], while *Moringa olifera* was identified following the description of [12]. The leaves of *Moringa olifera*, *Terminalia catepa* and *Terminalia mentally* were rinsed with distilled water to remove any external

contaminants. Leaves were soaked in clean water for two weeks until decomposition set in and were suitable for the experiment.

2.3. Experimental Design and Treatments

This experiment was carried out in a Completely Randomized Design (CRD) with three (3) varieties of cowpea. The cowpea varieties were sown in polythene bags. The three varieties were code named A, B, and C. Variety A was planted in thirty six bags which was labelled Ax₁, Ax₂, Ax₃,.....Ax₃₆ respectively. The same arrangement was done for sample B and C which was labelled Bx₁, Bx₂, Bx₃,.....Bx₃₆, and Cx₁, Cx₂, Cx₃,.....Cx₃₆ respectively. The treatment was done singly and in combined form. Leaf litter of *Moringa olifera*, *Terminalia catepa* and *Terminalia mentally* were applied singly and in

combination as follows; *Moringa olifera* and *Terminalia catepa*, *Moringa olifera* and *Terminalia mentally*, *Terminalia catepa* and *Terminalia mentally* as treatments. A mixture of the leaf litre of *Moringa olifera*, *Terminalia catepa* and *Terminalia mentally* was also applied as treatment in the experiment. NPK fertilizer was used as a positive control in the experiment, where it was applied at two (2) rates. A neutral control in which no treatment was applied was also among the experimental set. The total number of experimental set up (bag) for this experiment was 108 bags comprising of all treatments and their respective replicates for the three varieties of cowpea. All treatments were applied 21 days after planting (WAP). A summary description of experimental treatments is given in Table 1 below:

Table 1. Treatment Combination and Interpretation.

Treatment combination	Interpretation
Mo (150g)	Moringa olifera leaf litter at quantity 150g
Mo (300g)	Moringa olifera leaf litter at quantity 300g
Tc (150g)	Taminalia catappa leaf litter at quantity 150g
Tc (300g)	Taminalia catappa leaf litter at quantity 300g
Tm (150g)	Terminalia mentaly leaf litter at quantity 150g
Tm (300g)	Terminalia mentaly leaf litter at quantity 300g
Tc+Tm+Mo (150g)	Taminalia catappa + Terminalia mentaly + Moringa olifera at quantity 150g
Tc+Tm+Mo (300g)	Taminalia catappa + Terminalia mentaly + Moringa olifera at quantity 300g
NPK(1.4g)	NPK at quantity 1.3g
NPK (2.5g)	NPK at quantity 2.4g
CLT	0
CTL	0
CTL	0

2.4. Experimental Procedure

The soil was dried, pulverised and properly sorted to remove dead plants and other materials that may alter the result of the experiment. Seeds were sown in 5kg of soil in polythene bags at the rate of three (3) seeds per bag, and thinned to two (2) seeds per bag at 2 WAP

The soil containing the seeds was watered twice daily, morning and evening throughout the period of the experiment. Data was collected and recorded weekly throughout the period of the experiment.

2.5. Parameters Measured

Data were taken on a treatment basis per cowpea variety per replicate. Data were collected on the following parameters of Cowpea; Germination Count, Percentage (%) germination, Seedling vigour, Plant Height, Area covered by leaves (Plant spread) (m²) at 3 and 5 WAP, Plant Height (cm) at 2, 3 and 5 weeks after planting (WAP), Number of leaves at 3 and 5 WAP, Leaf length, Leaf width, Number of branches and stem circumference.

2.6. Data Analysis

The data collected from this experiment were subjected to

analysis of variance (ANOVA) using Genstat release version 17. Significant means were separated using least significant difference (LSD) at P≤ 0.05.

3. Results and Discussion

Cowpea varieties performed differently in response to decomposing leaf litter of *Moringa olifera* (Table 2). Significant differences (P≤ 0.05) were obtained in all the parameters under study. Germination parameters measured in this research were germination count, percentage germination and seedling vigour. The effect of the decomposition of the leaf litter of *Moringa olifera* had a significant effect (P≤ 0.05) on the germination of the cowpea seeds compared to seeds planted in soils with NPK fertilization and soils without any form of treatment (control). Highest germination count and percentage germination (3.00±0.00; 100.0±0.00% respectively) was recorded for seed planted on soils with 300 g of *Moringa olifera* leaf compost and NPK fertilizer application at 1.4 g. Lowest germination count (1.50±0.00) and percentage (50.00±0.02) was recorded across different treatments and varieties, this was however most recorded in the IT06K-111 and IT06K-134 varieties and in the non-organic fertilizer treatments. Seedling vigour was highest

(28.09±0.04) in the IT07K-243-1-2 under the Mo (150g) treatment while it was lowest (11.10±0.02) in the IT06K-111 under the control experiment.

Table 2. Effect of the decomposition of leaf litter of *Moringa olifera* on germination of Cowpea plant.

Varieties	Treatments	Germination count	% germination	Seedling vigour
IT07K-243-1-2	Mo (150g)	2.50±0.02	83.35±0.03	28.09±0.04
	Mo (300g)	3.00±0.00	100.0±0.00	22.50±0.33
	NPK(1.4g)	3.00±0.04	100.0±0.00	23.85±0.00
	NPK (2.5g)	2.00±0.00	66.55±0.02	27.73±0.34
	CLT	2.50±0.00	83.35±0.11	17.15±0.22
IT06K-111	Mo (150g)	1.50±0.05	50.00±0.02	16.05±0.24
	Mo (300g)	2.50±0.23	83.35±0.30	20.70±0.22
	NPK(1.4g)	2.50±0.00	83.35±0.00	22.20±0.11
	NPK (2.5g)	1.50±0.00	50.00±0.02	24.40±0.10
	CLT	1.50±0.00	50.00±0.00	11.10±0.02
IT06K-134	Mo (150g)	1.50±0.11	50.00±0.00	16.66±0.22
	Mo (300g)	1.50±0.00	50.00±0.00	12.95±0.14
	NPK(1.4g)	2.00±0.00	66.70±0.02	21.68±0.11
	NPK (2.5g)	2.00±0.00	66.70±0.12	18.50±0.01
	CLT	1.50±0.00	50.00±0.04	13.89±0.00
LSD(≤0.05)		0.2117	0.3951	0.2455

LSD = least significant difference. Mo = *Moringa olifera*. CLT = Control

3.1. Effect of the Decomposition of Leaf Litter of *Moringa olifera* on Growth Performance of Cowpea Plant

The result for the effect of litter of *Moringa olifera* on growth performance of Cowpea plant is as presented in table 3 below. Parameters considered were plant height, number of leaf, plant spread, leaf length, stem circumference, leaf width, number of branches and trace of disease. The growth performance of cowpea seed as affected by *Moringa olifera* was compared with seeds planted with the application of NPK at 1.40 and 2.5g respectively. Significant differences ($p \leq 0.05$) were observed across most of the parameters measured due to the effect of the different treatment and treatment levels. The interaction of the different cowpea varieties with the treatments also resulted in significance changes on the growth parameters. On plant height, the overall best height (11.0±0.11) was recorded for IT06K-134 treated with NPK (2.5g) followed IT07K-243-1-2 seeds grown with Mo (300g) (7.85±0.11). It was however lowest (4.10±0.42) in the IT06K-134 under the Mo (300g). All measurement were taken 5 weeks after planting Number of leaves was highest in IT06K-111 treated with NPK (2.5g) with a mean value of 9.17±0.02 at 5WAP followed by the IT06K-134 seed variety treated with Mo (150g) at 5WAP (8.92±0.02). The list number of leave (7.83±0.02) 5WAP was recorded in IT07K-243-1-2 planted with Mo (150g). Plant

spread was significantly affect the different treatment at 3WAP but was not significant at 5WAP. The widest plant spread (14.80±0.55) was recorded for IT06K-134 in the control experiments 5WAP; Seeds without any treatment followed by IT06K-134 (14.50±0.00) in the control experiment. This however had no significant difference ($p \leq 0.05$). The least value for plant spread (10.85±0.34) was recorded in IT07K-243-1-2 treated with Mo (300g). Leaf length showed significant differences across the different treatment and varieties of cowpea in this experiment. The longest leaf length (6.90±0.12) was recorded in IT06K-111 followed by 6.88±0.22 obtained for IT06K-134 variety treated with Mo (150g). The shortest leaf length was recorded at IT06K-134 variety (5.40±0.33) treated with Mo (300g). Stem circumference was highest (1.60±0.04) at IT06K-111 treated with NPK (2.5g) followed by 1.43±0.02 obtained at IT07K-243-1-2 treated with NPK (2.5g). The lowest value (1.00±0.00) for stem circumference was recorded for IT07K-243-1-2 treated with Mo (150g). These values showed significances across the parameters and varieties under investigation ($P \leq 0.05$). Leaf width showed significant differences ($P \leq 0.05$). Highest number of branches (7.0±0.02) was recorded in the IT06K-134 variety under the control treatment followed by 6.5±0.16 obtained in IT06K-111 in Mo (300g). The least number of branches (4.5±0.12) was obtained at T07K-243-1-2 varieties treated with NPK (1.4g).

Table 3. Effect of the decomposition of leaf litter of *Moringa olifera* on growth performance of Cowpea plant compared with NPK (15:15:15).

Varieties	Treatments	Plant height			Number of leaves		Plant spread		Leaf length	Stem circum.	Leaf width	No. of branch
		2WAP	3WAP	5WAP	3WAP	5WAP	3WAP	5WAP				
IT07K-243-1-2	Mo (150g)	2.95±0.11	3.50±0.23	7.10±0.05	4.25±0.45	7.83±0.02	3.50±0.13	13.65±0.71	6.50±0.39	1.00±0.00	4.18±0.11	5.0±0.21
	Mo (300g)	4.50±0.23	6.25±0.04	7.85±0.11	4.25±0.05	7.85±0.02	3.50±0.06	10.85±0.34	5.90±0.06	1.20±0.09	3.83±0.12	5.0±0.53
	NPK(1.4g)	5.20±0.04	6.75±0.66	7.67±0.23	4.65±0.75	8.50±0.02	5.25±0.10	13.00±0.06	6.05±0.22	1.05±0.01	3.78±0.08	4.5±0.12
	NPK (2.5g)	2.50±0.02	4.50±0.24	6.10±0.33	3.50±0.77	8.30±0.02	4.35±0.85	12.45±0.00	5.75±0.27	1.43±0.02	3.67±0.04	5.0±0.33
	CLT	5.00±0.11	6.25±0.56	7.50±0.32	3.67±0.54	8.67±0.02	4.95±0.50	11.00±0.05	6.40±0.34	1.10±0.02	3.75±0.20	6.5±0.16
IT06K-111	Mo (150g)	3.05±0.34	4.83±0.66	6.05±0.43	3.83±0.35	9.0±0.02	5.50±0.34	10.40±0.02	5.97±0.64	1.06±0.02	3.60±0.11	5.5±0.22
	Mo (300g)	4.10±0.09	5.40±0.34	6.75±0.33	3.50±0.34	8.39±0.02	5.25±0.45	13.65±0.44	6.90±0.12	1.23±0.40	4.50±0.21	6.5±0.04
	NPK(1.4g)	3.75±0.44	5.00±0.73	6.20±0.04	4.15±0.45	8.69±0.02	4.83±0.65	14.80±0.55	5.90±0.34	1.30±0.02	3.50±0.32	5.0±0.02
	NPK (2.5g)	2.85±0.3	4.67±0.23	5.80±0.00	3.65±0.75	9.17±0.02	4.23±0.33	13.25±0.74	6.42±0.22	1.60±0.04	3.90±0.15	6.0±0.05
IT06K-134	CLT	5.00±0.05	6.15±0.11	7.00±0.04	3.33±0.46	8.00±0.02	5.33±0.75	12.90±0.07	6.03±0.15	1.15±0.11	3.67±0.90	6.0±0.06
	Mo (150g)	3.00±0.03	5.05±0.34	6.50±0.64	3.00±0.45	8.40±0.02	3.00±0.53	14.15±0.00	6.88±0.22	1.20±0.12	4.60±0.03	5.5±0.01
	Mo (300g)	3.75±0.05	5.25±0.57	4.10±0.42	4.10±0.34	8.92±0.02	3.75±0.53	14.15±0.11	5.40±0.33	1.30±0.10	3.48±0.00	6.2±0.06
	NPK(1.4g)	3.25±0.22	5.65±0.33	11.0±0.11	4.10±0.65	8.42±0.02	3.50±0.02	13.20±0.21	6.30±0.12	1.20±0.13	4.56±0.34	5.0±0.02
	NPK (2.5g)	4.25±0.12	5.75±0.05	7.15±0.21	4.10±0.45	8.15±0.02	3.00±0.22	14.30±0.04	6.82±0.23	1.05±0.02	5.00±0.01	6.0±0.11
CLT	2.75±0.16	5.00±0.34	6.80±0.22	3.50±0.33	8.45±0.02	4.00±0.00	14.50±0.00	5.44±0.11	1.25±0.01	4.80±0.02	7.0±0.02	
LSD(≤0.05)		0.2117	0.3951	0.2455	0.2117	14.71	74.29	NS	14.71	1.2117	0.3951	0.2455

LSD = least significant difference. Mo = *Moringa olifera*. CLT = Control

3.2. Effect of the Decomposition of Leaf Litter of *Terminalia catappa* on Germination of Cowpea Plant

Significant differences ($p \leq 0.05$) were observed in all parameters as affected by the leaf litter of *Terminalia catappa*. Germination count was higher at IT07K-243-1-2 treated with Tc (300g) and NPK (1.4g) respectively and

consequently these two treatments had 100% germination. The least germination count (1.00±0.01) was obtained at IT06K-111 treated with Tc (300g) and also with the least percentage germination (33.00±0.21). Seedling vigour was highest (30.85±0.03) at IT07K-243-1-2 treated with Tc (300g), it was however lowest (11.10±0.21) in the IT06K-111 variety under the control experiment.

Table 4. Effect of the decomposition of leaf litter of *Terminalia catappa* on germination of Cowpea plant.

Varieties	Treatments	Germination count	%germination	Seedling vigour
IT07K-243-1-2	Tc (150g)	2.50±0.05	83.35±0.11	21.20±0.02
	Tc (300g)	3.00±0.01	100.0±0.00	30.85±0.03
	NPK(1.4g)	3.00±0.02	100.0±0.00	23.85±0.31
	NPK (2.5g)	2.00±0.01	66.55±0.75	27.73±0.12
	CLT	2.50±0.02	83.35±0.02	17.15±0.23
IT06K-111	Tc (150g)	1.50±0.01	50.00±0.11	14.94±0.11
	Tc (300g)	1.00±0.01	33.00±0.21	9.65±0.02
	NPK(1.4g)	2.50±0.02	83.35±0.05	22.20±0.02
	NPK (2.5g)	1.50±0.01	50.00±0.10	24.40±0.08
IT06K-134	CLT	1.50±0.08	50.00±0.02	11.10±0.21
	Tc (150g)	1.50±0.01	66.70±0.22	13.65±0.14
	Tc (300g)	1.50±0.02	50.00±0.33	13.88±0.11
	NPK(1.4g)	2.00±0.01	66.70±0.11	21.68±0.40
	NPK (2.5g)	2.00±0.01	66.70±0.02	18.50±0.03
CLT	1.50±0.02	50.00±0.00	13.89±0.11	
LSD(≤0.05)		0.2117	0.3951	0.2455

LSD = least significant difference. Tc = *Terminalia catappa*. CLT = Control

Effect of the decomposition of leaf litter of *Terminalia catappa* on growth performance of Cowpea plant

Table 5 below shows the effect of *Terminalia catappa* on the growth performance of cowpea seeds. All parameters measured in these experiments showed significant different ($p \leq 0.05$) except for plant spread (5WAP), leaf length, stem circumference, and trace of disease.

The highest plant height (11.0±0.22) was recorded for IT06K-134 treated with NPK (1.4g) Followed by 8.75±0.34 in IT07K-243-1-2 treated with Tc (150g). The least plant

height (6.10±0.27) (5WAP) was recorded at IT07K-243-1-2 treated with NPK (2.5g). Number of leaf was highest (9.17±0.05) at IT06K-111 under NPK (2.5g) treatment. It was however (7.67±0.14) lowest at IT07K-243-1-2 under treatment with Tc (300g) all at 5WAP.

A wider plant spread (16.00±0.12) was recorded for IT06K-134 varieties treated with Tc (150g). The least value (10.00±0.12) for plant spread as however recoded for IT07K-243-1-2 varieties treated with Tc (300g) all at 5WAP.

Leaf length was not significant across the different treatment and

varieties observed in this experiment. However, numerical differences were observed in the measurement. A higher leaf length (6.62 ± 0.23) was recorded for IT06K-134 varieties treated with Tc (300g) while the shortest leaf length (5.44 ± 0.32) was recorded at the control experiment in the IT06K-134 variety.

Stem circumference showed no significant difference across the different treatments and varieties of cowpea in this

experiment, highest leaf circumference (2.60 ± 0.09) was obtained in the IT06K-111 in the Tc (300g) treatment. Leaf width was highest (5.00 ± 0.12) in the IT06K-134 variety under the control experiment while it was lowest (3.50 ± 0.12) in IT06K-111 variety under the Tc (300g) treatment. The number of branches was higher (7.00 ± 0.11) at the IT06K-134 in the control experiment.

Table 5. Effect of the decomposition of leaf litter of *Terminalia catappa* on growth performance of Cowpea plant.

Varieties	Treatments	Plant height			Number of leaves		Plant spread		Leaf length	Stem circumference	Leaf width	No. of branch
		2WAP	3WAP	5WAP	3WAP	5WAP	3WAP	5WAP				
IT07K-243-1-2	Tc (150g)	5.15±0.31	7.75±0.34	8.75±0.34	4.65±0.09	7.97±0.00	2.75±0.11	10.50±0.09	6.25±0.18	1.25±0.03	4.50±0.21	6.00±0.10
	Tc (300g)	4.00±0.21	6.42±0.12	7.80±0.08	4.15±0.02	7.67±0.14	2.95±0.13	10.00±0.12	6.25±0.14	1.22±0.18	3.62±0.01	4.50±0.05
	NPK(1.4g)	5.20±0.41	6.75±0.08	7.67±0.09	4.65±0.07	8.50±0.19	5.25±0.08	13.00±0.10	6.05±0.21	1.05±0.14	3.78±0.07	4.50±0.11
	NPK (2.5g)	2.50±0.41	4.50±0.15	6.10±0.27	3.50±0.22	8.30±0.06	4.35±0.22	12.45±0.16	5.75±0.17	1.43±0.12	3.67±0.15	5.00±0.04
	CLT	5.00±0.81	6.25±0.13	7.50±0.01	3.67±0.08	8.67±0.09	4.95±0.08	11.00±0.41	6.40±0.15	1.10±0.12	3.75±0.18	6.50±0.12
IT06K-111	Tc (150g)	3.25±0.21	4.25±0.10	5.25±0.06	3.50±0.12	8.44±0.23	5.17±0.43	13.00±0.08	6.30±0.08	1.43±0.15	4.25±0.13	5.00±0.09
	Tc (300g)	3.50±0.86	5.45±0.00	6.20±0.25	3.77±0.13	8.25±0.00	5.33±0.09	11.70±0.25	6.85±0.42	7.60±0.09	4.00±0.02	6.00±0.33
	NPK(1.4g)	3.75±0.31	5.00±0.32	6.20±0.12	4.15±0.65	8.69±0.13	4.83±0.18	14.80±0.22	5.90±0.21	1.30±0.12	3.50±0.12	5.00±0.21
	NPK (2.5g)	2.85±0.17	4.67±0.53	5.80±0.44	3.65±0.32	9.17±0.05	4.23±0.13	13.25±0.14	6.42±0.16	1.60±0.08	3.90±0.03	6.00±0.16
	CLT	5.00±0.09	6.15±0.66	7.00±0.21	3.33±0.08	8.00±0.04	5.33±0.11	12.90±0.22	6.03±0.12	1.15±0.42	3.67±0.02	6.00±0.14
IT06K-134	Tc (150g)	4.90±0.08	6.55±0.13	8.20±0.13	3.17±0.24	8.25±0.22	4.25±0.22	16.00±0.12	5.99±0.43	1.27±0.21	4.15±0.08	5.50±0.10
	Tc (300g)	3.00±0.70	4.65±0.24	6.65±0.12	3.17±0.09	8.53±0.33	3.00±0.03	15.25±0.10	6.62±0.23	1.25±0.13	4.43±0.06	4.50±0.12
	NPK(1.4g)	3.25±0.33	5.65±0.09	11.0±0.22	4.10±0.08	8.42±0.04	3.50±0.08	13.20±0.23	6.30±0.51	1.20±0.10	4.56±0.04	5.00±0.13
	NPK (2.5g)	4.25±0.21	5.75±0.40	7.15±0.12	4.10±0.09	8.15±0.32	3.00±0.08	14.30±0.43	6.82±0.14	1.05±0.23	5.00±0.12	6.00±0.10
	CLT	2.75±0.31	5.00±0.13	6.80±0.31	3.50±0.15	8.45±0.11	4.00±0.30	14.50±0.87	5.44±0.32	1.25±0.32	4.80±0.12	7.00±0.11
LSD(≤0.05)		0.3211	0.2145	0.243	0.2116	2.5571	0.3229	NS	NS	NS	0.2251	0.1255

LSD = least significant difference. Tc = *Terminalia catappa*. CLT= Control

Effect of the decomposition of leaf litter of *Terminalia mentally* on germination of Cowpea plant

Significant differences was observed in the measured parameters as affected by the application of *Terminalia mentally* litter in comparison with the conventional NPK fertilizer and a control experiment. The results presented in table 6 below shows that the highest (3.00 ± 0.00) germination count was obtained at IT07K-243-1-2 treated with Tm (150g), NPK(1.4g) and IT06K-111 varieties treated with Tm

(150g) respectively and consequently the highest percentage germination (100.00 ± 0.0). The germination count and percentage germination was lowest (1.50 ± 0.02) at IT06K-111 in the NPK (2.5g), Seedling vigour showed significant difference ($p\leq 0.05$) across the varieties and treatment. Highest (36.40 ± 0.16) vigour was obtained at IT06K-111 varieties treated with Tm (150g) and lowest (11.10 ± 0.22) at IT06K-111 under the control experiment.

Table 6. Effect of the decomposition of leaf litter of *Terminalia mentally* on germination of Cowpea plant.

Varieties	Treatments	Germination count	%germination	Seedling vigour
IT07K-243-1-2	Tm (150g)	3.00±0.00	100.00±0.0	18.75±0.11
	Tm300g)	2.50±0.02	83.35±0.03	20.25±0.17
	NPK(1.4g)	3.00±0.00	100.00±0.0	23.85±0.14
	NPK (2.5g)	2.00±0.00	66.55±0.11	27.73±0.13
	CLT	2.50±0.05	83.35±0.12	17.15±0.22
IT06K_111	Tm (150g)	3.00±0.00	100.00±0.00	36.40±0.16
	Tm300g)	2.00±0.02	66.70±0.23	21.62±0.05
	NPK(1.4g)	2.50±0.03	83.35±0.08	22.20±0.12
	NPK (2.5g)	1.50±0.02	50.00±0.07	24.40±0.16
	CLT	1.50±0.11	50.00±0.11	11.10±0.22
IT06K-134	Tm (150g)	2.00±0.03	66.70±0.15	19.44±0.13
	Tm300g)	1.50±0.03	50.00±0.16	15.40±0.13
	NPK(1.4g)	2.00±0.00	66.70±0.15	21.68±0.09
	NPK (2.5g)	2.00±0.03	66.70±0.13	18.50±0.30
	CLT	1.50±0.12	50.00±0.15	13.89±0.18
LSD(≤0.05)		0.3017	0.2091	0.1261

LSD = least significant difference. Tc = *Terminalia catappa*. CLT= Control

Effect of the decomposition of leaf litter of Terminalia mentally on growth performance of Cowpea plant

The result for the effect of litter of *Terminalia mentally* on growth performance of Cowpea plant is as presented in table 7 below. Parameters considered were plant height, number of leaf, plant spread, leaf length, stem circumference leaf width, number of benches and trace of disease. The growth performance of cowpea seed as affected by *Terminalia mentally* was compared with seeds planted with the application of NPK at 1.40 and 2.5g and a control experiment respectively. Significant differences ($p \leq 0.05$) were observed across most of the parameters measured due to the effect of the different treatment and treatment levels.

The interaction of the different cowpea varieties with the treatments also resulted in significance changes on the growth parameters. On plant height, the overall best height (11.0±0.13) was recorded for IT06K-134 treated with NPK (2.5g) followed IT07K-243-1-2 seeds grown with NPK

(1.4g) (7.67±0.07). The shortest plant height (6.10±0.10) was recorded at IT07K-243-1-2 treated with NPK (2.5g).

Number of leafs was highest (9.17±0.23) in IT06K-111 treated with Tm (150g) followed by the IT07K-243-1-2 seed variety treated with Mo (150g) at 5WAP (9.10±0.30). The least number of leave (7.45±0.16) 5WAP was recorded in IT06K-134 planted with Tm300g).

The widest plant spread (14.80±0.03) was recorded for IT06K-111 varieties treated with NPK (1.4g) 5WAP; followed by 14.30±0.19 obtained in the control experiment with IT06K-134 variety. The least value for plant spread 5WAP (7.75±0.05) was recorded in IT07K-243-1-2 treated with Tm (150g).

The longest leaf length (6.82±0.04) was recorded in IT06K-134 under NPK (2.5g) treatment. The shortest leaf length was recorded at IT07K-243-1-2 variety (5.25±0.04) treated with Tm (150g).

Table 7. Effect of the decomposition of leaf litter of *Terminalia mentally* on growth performance of Cowpea plant.

Varieties	Treatments	Plant height			Number of leaves		Plant spread		Leaf length	Stem circum	Leaf width	No. of branch
		2WAP	3WAP	5WAP	3WAP	5WAP	3WAP	5WAP				
IT07K-243-1-2	Tm (150g)	4.40±0.01	6.13±0.10	7.35±0.23	3.65±0.08	9.10±0.30	3.90±0.11	7.75±0.05	5.25±0.04	1.15±0.08	3.25±0.11	5.50±0.01
	Tm300g)	4.10±0.02	5.50±0.14	7.20±0.14	4.0±0.010	8.55±0.17	4.15±0.02	10.10±0.10	5.95±0.02	1.35±0.15	2.87±0.13	6.00±0.03
	NPK(1.4g)	5.20±0.02	6.75±0.16	7.67±0.07	4.65±0.07	8.50±0.22	5.25±0.23	13.00±0.07	6.05±0.33	1.05±0.22	3.78±0.11	4.5±0.10
	NPK (2.5g)	2.50±0.03	4.50±0.19	6.10±0.10	3.50±0.18	8.30±0.02	4.35±0.18	12.45±0.04	5.75±0.12	1.43±0.13	3.67±0.02	5.0±0.03
	CLT	5.00±0.05	6.25±0.13	7.5±0.17	3.67±0.06	8.67±0.16	4.95±0.21	11.00±0.03	6.40±0.11	1.10±0.21	3.75±0.02	6.50±0.10
IT06K_111	Tm (150g)	2.80±0.02	4.67±0.08	5.75±0.20	8.33±0.11	8.33±0.21	5.17±0.36	12.75±0.11	6.56±0.20	1.10±0.15	4.45±0.14	5.00±0.03
	Tm300g)	3.25±0.00	5.10±0.12	6.17±0.17	8.00±0.07	8.00±0.19	5.25±0.15	13.00±0.17	5.75±0.16	1.30±0.31	3.57±0.11	4.50±0.04
	NPK(1.4g)	3.75±0.20	5.00±0.13	6.20±0.22	4.15±0.01	8.69±0.22	4.83±0.25	14.80±0.03	5.90±0.02	1.30±0.44	3.50±0.09	5.00±0.03
	NPK (2.5g)	2.85±0.01	4.67±0.10	5.80±0.16	3.65±0.22	9.17±0.23	4.23±0.31	13.25±0.12	6.42±0.07	1.60±0.13	3.90±0.11	6.00±0.11
	CLT	5.00±0.20	6.15±0.22	7.00±0.13	3.33±0.16	8.00±0.16	5.33±0.15	12.90±0.14	6.03±0.13	1.15±0.11	3.67±0.22	6.00±0.13
IT06K-134	Tm (150g)	3.25±0.03	4.55±0.19	7.35±0.08	7.70±0.04	7.70±0.22	2.50±0.22	13.18±0.11	6.82±0.04	1.20±0.06	4.60±0.10	7.00±0.04
	Tm300g)	3.45±0.02	4.75±0.12	6.60±0.19	7.45±0.30	7.45±0.16	3.00±0.13	13.21±0.14	6.67±0.21	1.25±0.04	4.60±0.07	6.50±0.11
	NPK(1.4g)	3.25±0.01	5.65±0.13	11.0±0.13	4.10±0.07	8.42±0.17	3.50±0.14	13.20±0.22	6.30±0.11	1.20±0.33	4.56±0.16	5.00±0.05
	NPK (2.5g)	4.25±0.09	5.75±0.22	7.15±0.04	4.10±0.17	8.15±0.28	3.00±0.22	14.30±0.19	6.82±0.03	1.05±0.12	5.00±0.12	6.00±0.08
	CLT	2.75±0.03	5.00±0.10	6.80±0.13	3.50±0.16	8.45±0.23	4.00±0.04	14.50±0.13	5.44±0.03	1.25±0.22	4.80±0.15	7.00±0.11
LSD(≤0.05)		0.3211	0.2145	0.243	0.2116	2.5571	0.3229	NS	NS	NS	0.2251	0.1255

LSD = least significant difference. Tm = *Terminalia mentally*

Table 8. The combined effect of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* leaf litters on germination of Cowpea plant.

Varieties	Treatments	Germination count	%germination	Seedling vigour
IT07K-243-1-2	Tc+Tm+Mo (150g)	2.50±0.03	83.35±0.13	20.61±0.04
	Tc+Tm+Mo (300g)	3.00±0.00	100.00±0.00	24.70±0.09
	NPK(1.4g)	3.00±0.00	100.00±0.00	23.85±0.10
	NPK (2.5g)	2.00±0.10	66.55±0.02	27.73±0.15
	CLT	2.50±0.01	83.35±0.15	17.15±0.10
IT06K-111	Tc+Tm+Mo (150g)	2.50±0.02	83.35±0.17	21.65±0.11
	Tc+Tm+Mo (300g)	2.00±0.02	66.35±0.14	17.45±0.12
	NPK(1.4g)	2.50±0.01	83.35±0.10	22.20±0.17
	NPK (2.5g)	1.50±0.12	50.00±0.11	24.40±0.13
	CLT	1.50±0.04	50.00±0.14	11.10±0.19
IT06K-134	Tc+Tm+Mo (150g)	2.00±0.06	66.56±0.10	17.45±0.17
	Tc+Tm+Mo (300g)	2.00±0.22	66.56±0.13	20.47±0.35
	NPK(1.4g)	2.00±0.06	66.70±0.22	21.68±0.52
	NPK (2.5g)	2.00±0.08	66.70±0.14	18.50±0.31
	CLT	1.50±0.28	50.00±0.11	13.89±0.20
LSD(≤0.05)		0.3017	0.2091	0.1261

LSD = least significant difference. Tc+Tm+Mo = *Terminalia catappa* plus *Terminalia mentally* plus *Moringa olifera*. CLT= Control

The result for the combined effect of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* leaf litters on growth performance of Cowpea plant is as presented in table 9 below. Significant differences ($p \leq 0.05$) were observed across most of the parameters measured due to the effect of the different treatment and treatment levels. The interaction of the different cowpea varieties with the leaf litters compost also resulted in significance changes on the growth parameters. On plant height, the overall best height (11.0±0.23) was recorded for IT06K-111 treated with Tc+Tm+Mo (150g) compost followed by IT06K-134 varieties grown with NPK (1.4g) (8.00±0.12) all at 5WAP. The shortest plant height (5.80±0.11) was recorded at IT06K-111 treated with NPK (2.5g).

Number of leafs was highest (9.17±0.19) in IT06K-111 treated with NPK (2.5g) at 5WAP. The least number of leave (6.92±0.02) 5WAP was recorded in IT07K-243-1-2 varieties treated with Tc+Tm+Mo (150g). The widest plant spread (14.80±0.28) was recorded for IT06K-111 varieties treated with NPK (1.4g) 5WAP; followed by 14.50±0.11 obtained in the control experiment with IT06K-134 variety. The least value for plant spread 5WAP (11.15±0.03) was recorded in IT07K-243-1-2 in the Tc+Tm+Mo (150g) experiment. Leaf length, stem circumference, leaf width, number of branches and trace of disease showed no significant difference in this experiment.

Table 9. The combined effect of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* leaf litters on growth performance of Cowpea plant.

Varieties	Treatments	Plant height			Number of leaves		Plant spread		Leaf length	Stem circumference	Leaf width	No. of branch
		2WAP	3WAP	5WAP	3WAP	5WAP	3WAP	5WAP				
IT07K-243-1-2	Tc+Tm+Mo (150g)	4.00±0.10	5.85±0.22	7.65±0.22	3.00±0.32	6.92±0.02	4.85±0.41	11.15±0.03	5.75±0.15	1.28±0.22	3.65±0.23	7.00±0.00
	Tc+Tm+Mo (300g)	4.60±0.11	6.78±0.15	8.00±0.12	3.50±0.11	8.27±0.05	4.43±0.21	13.75±0.04	6.15±0.22	1.20±0.23	4.35±0.34	5.00±0.06
	NPK(1.4g)	5.20±0.02	6.75±0.13	7.67±0.27	4.65±0.13	8.50±0.22	5.25±0.09	13.00±0.13	6.05±0.05	1.05±0.23	3.78±0.11	4.5±0.00
	NPK (2.5g)	2.50±0.03	4.50±0.12	6.10±0.23	3.50±0.21	8.30±0.15	4.35±0.25	12.45±0.02	5.75±0.41	1.43±0.03	3.67±0.34	5.0±0.01
	CLT	5.00±0.04	6.25±0.22	7.5±0.15	3.67±0.11	8.67±0.23	4.95±0.16	11.00±0.11	6.40±0.06	1.10±0.27	3.75±0.42	6.50±0.02
IT06K_111	Tc+Tm+Mo (150g)	4.00±0.11	5.50±0.15	11.72±0.63	3.65±0.05	7.00±0.10	4.83±0.43	13.25±0.06	6.40±0.11	1.10±0.23	4.17±0.11	6.50±0.11
	Tc+Tm+Mo (300g)	4.35±0.20	5.65±0.64	6.70±0.32	3.00±0.04	8.58±0.29	4.67±0.23	13.00±0.05	6.05±0.34	1.20±0.34	3.80±0.34	6.50±0.52
	NPK(1.4g)	3.75±0.12	5.00±0.22	6.20±0.44	4.15±0.23	8.69±0.05	4.83±0.13	14.80±0.28	5.90±0.21	1.30±0.09	3.50±0.22	5.00±0.32
	NPK (2.5g)	2.85±0.19	4.67±0.14	5.80±0.11	3.65±0.11	9.17±0.19	4.23±0.43	13.25±0.05	6.42±0.23	1.60±0.43	3.90±0.53	6.00±0.22
	CLT	5.00±0.11	6.15±0.35	7.00±0.50	3.33±0.15	8.00±0.33	5.33±0.23	12.90±0.17	6.03±0.32	1.15±0.24	3.67±0.54	6.00±0.17
IT06K-134	Tc+Tm+Mo (150g)	3.85±0.15	6.15±0.13	7.90±0.22	4.75±0.21	8.79±0.28	3.50±0.61	13.40±0.22	6.32±0.23	1.15±0.16	10.00±0.17	5.50±0.21
	Tc+Tm+Mo (300g)	3.35±0.00	4.25±0.21	6.75±0.12	3.15±0.14	8.72±0.19	4.00±0.31	13.05±0.04	6.03±0.32	1.25±0.11	7.65±0.034	6.00±0.25
	NPK(1.4g)	3.25±0.11	5.65±0.22	11.0±0.23	4.10±0.14	8.42±0.12	3.50±0.22	13.20±0.31	6.30±0.14	1.20±0.03	4.56±0.06	5.00±0.29
	NPK (2.5g)	4.25±0.08	5.75±0.12	7.15±0.11	4.10±0.10	8.15±0.10	3.00±0.04	14.30±0.14	6.82±0.22	1.05±0.15	5.00±0.33	6.00±0.11
	CLT	2.75±0.01	5.00±0.09	6.80±0.24	3.50±0.08	8.45±0.04	4.00±0.08	14.50±0.11	5.44±0.11	1.25±0.23	4.80±0.30	7.00±0.29
LSD(≤0.05)		0.2117	0.3951	0.2455	0.2117	14.71	4.298	0.4267	NS	NS	NS	NS

LSD =least significant difference. Tc+Tm+Mo = *Terminalia catappa* plus *Terminalia mentally* plus *Moringa olifera*. CLT= Control

The present research was carried out to determine the effect of the single and combined effect of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* leaf litters on germination and Growth Performance of Cowpea plant. This experimental plant however have described to exhibit allelopathic characteristics. This research is therefore carried out the possible inhibitive effect of the leaf litters of these plants on the germination and growth of cowpea seeds in comparison with the conventional NPK fertilizer. Some researchers reported that allelochemicals exhibited inhibitory effects on physiological processes during germination and growth of plants that may occur through a variety of

mechanisms including reduced mitotic activity in roots and hypocotyls, suppressed hormone activity, reduced rate of on uptake, inhibited photosynthesis and respiration, inhibited protein formation, decreased permeability of cell membranes and/or inhibition of enzyme action [13]. The inhibitory effect of the donor plant is directly proportional to the increasing extract concentrations. The differences in the germination count and germination percentage between the different concentrations could be attributed to differences in the selective permeability of broad cowpea seeds to inhibitory substances [14]. Therefore, effects of allelochemicals on seeds germination appear to be mediated through a disruption

of normal cellular metabolism rather than through damage of organelles [15]. Moreover, these allelochemicals may either have inhibitory or stimulatory effects on germination and growth of an adjacent or subsequent crop to varied extents depending upon their concentration and plant part and varieties [16] and [17] as shown in this experiment. In the present study, it has been shown by the results that allelopathic compounds from *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* leaf litters reduced germination as compared to NPK fertilizer and control treatments cowpea seeds. On the contrary, Phiri [18] reported that *M. Oleifera* leaf extracts enhanced germination of sorghum, length of maize radicle and hypocotyl of wheat. The overall growth of the seeds was also affected by the leaf litter's interaction with varieties of the cowpea seeds. The result obtained in this presents research however portray some deviation from the report of Hall *et al.* [19] that, allelochemicals released by allelopathic plants do have negative effects large number of biochemical reactions on neighboring plant species resulting in growth and yield. In this present research some of the parameters measured showed no significant different and some varieties of cowpea performed slightly better in with the leaf litters than the NPK fertilizer and control experiment. This could be because of the different sources of this allelochemical in their experiment and that of the present research. Unlike allelochemicals obtained directly by extraction from living organs or tree litter, allelochemicals released from decomposed leaf litter are influenced by soil; thus their concentration, composition, structure, and activity might be extremely different. The important circumstances in which allelopathic effects appear occur when allelochemicals reach the recipient plant in their active structure and at their effective concentration, thus extracts of litter and decomposed litter (or the decomposed medium) often show different allelopathic effects. This explains the differences in the growth performance of the cowpea plant at different concentration and treatment. On the single effect of the leaf composts of these plants, *Moringa olifera*, leaf litters had a better germination and growth performance compared to the *Terminalia catappa* and *Terminalia mentally* leaf litter compost. This can be explained by the fact that *Terminalia catappa* and *Terminalia mentally* contains a higher level of inhibitive allelochemicals. This results agree with the findings of Chi *et al.* [20] that the effect of allelopathic substance from plants on farmed crops is dependent on the species of the plants and the concentration of this substance on the soil and also the species of crops grown.

4. Conclusion

Following the result of this experiment, it is concluded that

the leaf litter compost of *Moringa olifera*, *Terminalia catappa* and *Terminalia mentally* leaf litters have significant effect on the germination and growth performance of cowpea plant. Highest germination count and percentage germination (3.00 ± 0.00 and 100% respectively) were recorded in IT07K-243-1-2 varieties planted on soils with Tc+Tm+Mo (300g) leaf compost, Seedling vigour was highest (27.73 ± 0.15) at IT07K-243-1-2 with Tc+Tm+Mo (300g) leaf compost. The plant height was highest (11.0 ± 0.23) in IT06K-111 treated with Tc+Tm+Mo (150g) compost, while number of leaf was highest (9.17 ± 0.19) in IT06K-111 treated with NPK (2.5g) at 5WAP. Plant spread was highest in (14.80 ± 0.28). The effects of this leaf litters differed among the different plants and varieties of cowpea used in the experiment. The IT06K-111 varieties had the overall best performance across all the treatments. The *Moringa olifera* had the best single effect on the germination and growth of the cowpea plants compared to *Terminalia catappa* and *Terminalia mentally*.

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