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# Research Article
# Coconut Milk and Moringa Leaf Extracts Effect on Seedling Production of Ceiba (*Ceiba Pentandra* L.) in the Nursery

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## Abstract

**Background and Objective:** *Ceiba pentandra* is a tropical tree that belongs to the order *Malvales*, the family of *Malvaceae* native to Mexico, Central America, the Caribbean, Northern South America and tropical West African. An experiment was conducted to investigate the effect of aqueous Moringa *(Moringa oleifera* L.*)* leaf and Coconut *(Cocos nucifera* L.*)* milk extracts on the performance of *Ceiba pentandra* seedlings by determining the effect of the substances on the early growth characteristics of the seedling and determining the best concentration of the extracts for optimum growth of the seedling of Ceiba. **Materials and Methods:** The treatment combination consists of different levels of Moringa Leaf Extract (MLE) and Coconut Milk (CM). Treatments were tested on *Ceiba pentandra* seedlings raised in polythene pots arranged in a randomized complete block design and replicated three times. Foliar spray of the treatments started at 2 Weeks After Sowing (WAS) and subsequent application continued at 4 weeks intervals until 14 WAS. Data were collected on plant height, number of leaves, number of branches and stem girth per seedling. Data obtained were subjected to analysis of variance (ANOVA) using GenStat 17th edition and significant mean differences were separated using Fischer's Protected Least Significant Difference (FPLSD). **Result:** Results obtained revealed significant effects of the treatments on early growth characteristics of the *Ceiba pentandra* seedlings. Where the combination of 5% CM/5% MLE had the highest significant effects followed by 5% of MLE only. **Conclusion:** The finding of the trial depicts an application of organic plant growth enhancers that can reduce time, energy and expenses in raising seedlings of *Ceiba pentandra*.

Key words: *Ceiba pentandra*, moringa leaf, coconut milk, extracts, seedling, production, nursery

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

*Ceiba pentandra* is a tropical tree that belongs to the order *Malvales*, the family of *Malvaceae,* believed to have originated from Mexico, Northern South America and tropical West African[1]. The common name for the tree is Kapola which refers to the cotton-like soft material in its pods[2]. The tree is cultivated particularly in South East Asia for its seed that is used in oil production, other common names of the tree are java cotton, java kapok, silk cotton[2]. The tree grows up to 70 m (230 ft) and up to 3 m (9.8 ft) in diameter with buttresses[3]. The trees produce several hundred 15 cm (5.4 inches) pods containing seeds surrounded by a fluffy yellowish fibre that is a mix of lignin and cellulose[4]. The silk cotton in the pod is difficult to spin, but is used as an alternative filling material in mattresses, pillows, upholstery and stuffed toys such as teddy bears and for insulation. It was used those days in the production of life jackets and other related devices until replaced nowadays by synthetic materials[5]. Oil extracted from the seeds of the tree is locally used in soap making, cosmetics and organic manure. The oil has a yellow colour and a pleasant, mild odour and taste, resembling cottonseed oil, it becomes rancid quickly when exposed to air. Kapok oil is produced in India, Indonesia and Malaysia. It has an iodine feature that makes it not dry quickly when exposed to air. The oil obtained from the seed can be used as a biofuel and in paint production[2]. The commercial tree is most heavily cultivated in the rainforests of Asia notably in java (hence its nicknames) Philippines, Malaysia, Hainan island in china as well as in South America. It is reported that leaves, buds and fruit are edible when cooked[5]. The flowers of the tree are an important source of nectar and pollen for honey bees, also the tree bark is used in the preparation of decoction for the treatment of headaches as well as type II diabetes[2]. The tree is good for shelterbelt establishment and also a source of raw material for timber and textile industries. Thus, its production needs to be encouraged by the establishment of more of its plantations to keep in phase with the growing demand for the tree.

However, plant growth regulators (e.g., Moringa leaf extract and Coconut milk) were reported to enhance and fasten the growth of some plants[6]. Therefore, the current research was aimed at testing the efficacy of Moringa leaf extract and Coconut milk on the growth of *Ceiba pentandra* at an early stage.

The objectives of the research were to determine the combined and individual effect of Coconut milk and Moringa leaf extract concentration for the fast production of *Ceiba pentandra* seedlings in the nursery.

## MATERIALS AND METHODS

**Location:** The experiment was conducted during the 2016-2017 dry season for 4-month at the plant's nursery of Forestry Research Institute of Nigeria (FRIN) Shelterbelt Research Station, Kano located in the Sudan Savannah zone of Nigeria. The station lies between latitude 12°1. 42.20 N and longitudes 8°30. 19.06 E. The potting mixture consisted of 4 different components (cow dung, river sand, topsoil and sawdust) mixed in the ratio of 1:1:1:1 and 840 polythene bags were filled.

**Treatments and experimental design:** The treatment combination consists of different levels of Moringa leaf extract and Coconut milk (0 % (control), 3% MLE/4% CM, 4% MLE/5% CM, 3% CM/4% MLE, 5% CM/5% MLE and 5% MLE only. The experiment was laid in a Randomised Complete Block Design (RCBD), with each block (i.e., replicate) containing seven plots of 40 polythene pots each and replicated three times at an interval of 0.30×0.50 m inter and intra-row. Good and viable seeds were sourced from Jargaba, Bakori LGA of Katsina state and two seeds were sown per pot at the depth of 2 cm and seedling were thinned to 1-seedling per pot at 2 weeks after sowing and watering and weeding were done at regular interval using a watering can and hand pulling, respectively.

Moringa leaf extract was prepared by collecting 1 kg of fresh Moringa leaf, pound using pestle and mortar until it turns into a paste, 500 mL of water was added into the pound Moringa leaf paste, squeeze and filtered into a container using a local sieve to obtain the concentrate of the aqueous Moringa leaf extract[2]. The 3% MLE was prepared by adding 32 mL of water into 1 mL of MLE, 4% by adding 25 mL of water into 1 mL of MLE and 5% was prepared by adding 20 mL of water into 1 mL of MLE[2], while the Coconut Milk (CM) was prepared, where 1 kg of the fresh coconut was crushed and blends using an electric blender in about 1000 mL of water to obtain the concentrate of the Coconut Milk extract (CM)[3]. 3% was obtained by adding 1 mL of CM into 42 mL of water, 4% by adding 1 mL of the CM into 36 mL of water and 5% was prepared by adding 1ml of the CM into 30 mL of water[4].

**Data collection:** The applications of the treatments started 2 weeks after sowing and it was applied 3 times at 4 weeks intervals using a hand sprayer. Data were collected on growth parameters such as plant height, stem collar girth, number of branches, fresh weight and dry weight per sample. The experiment lasts for 14 weeks.

**Statistical analysis:** Data collected were subjected to analysis of variance (ANOVA) using GenStat, 17th edition and significant means differences were separated using Fisher's protected LSD.

## RESULTS

**Plant height:** The result shows that there was no significant difference among the treatments at 4, 6 and 8 WAS while at 10 WAS, 5% MLE/5% CM and 5% MLE were at par but significantly higher in plant height than 4% CM/5% MLE which was also higher than plant height of 5% CM while the least plant height was obtained with the control, also at 14 WAS a combination of 5% MLE and 5% CM produced significantly taller plant than an individual spray of 5% MLE and 5% CM which were statistically the same in plant height but higher than 4% CM/5% MLE followed by 5% MLE/4% CM, respectively while the least height was obtained with 3% MLE/4% CM and the control as shown in Table 1.

**Stem collar girth:** Table 2 shows the combined effect of Coconut milk and Moringa leaf extract on the stem collar girth of *Ceiba pentandra* seedlings. At 4 WAS, 5% MLE/5% CM and 3% MLE/4% CM produced significantly thicker stem collar girth than the remaining treatments which were at par with each other but at 6 WAS 5% CM, 5% MLE/5% CM and 3/4% were statistically similar but produced significantly thicker stem collar girth than 4% CM/5% MLE, 5% CM/4% MLE and 5% MLE which were statistically the same while the least stem collar girth was obtained with the control. The result obtained at 8, 10 and 12 WAS portrayed that there was no significant difference among the treatments in stem collar girth across the weeks. While at 14 WAS, 5% MLE/5% CM produced significantly thicker stem collar girth than 5% MLE, 5% CM , 3% MLE/4% CM, 4% CM/5% MLE and 5% CM/4% MLE which were all statistically similar in stem collar girth while the control produced the thinner stem collar girth.

**Number of leaves**: Table 3 shows the combined effect of Coconut milk and Moringa leaf extract on the number of leaves of *Ceiba pentandra* seedlings. The result obtained indicated that there was no significant difference between the treatments at 4, 6 and 8 WAS. But at 10 WAS, 5% MLE/5% CM had a significantly higher number of leaves

Table 1: The combined effect of Coconut milk *(Cocos nucifera* Linn*)* and Moringa leaf extract *(Moringa oleifera* Lam*)* on the plant height of *Ceiba pentandra* seedlings

| | Plant height (cm) | | | | | |
|---|---|---|---|---|---|---|
| Treatments | 4 WAS | 6 WAS | 8 WAS | 10 WAS | 12 WAS | 14 WAS |
| **MLE/CM (%)** | | | | | | |
| 0 | 9.20 | 10.87 | 11.87 | 13.97$^{c}$ | 20.07$^{de}$ | 26.66$^{d}$ |
| 5 MLE/5 CM | 9.53 | 12.20 | 14.97 | 27.67$^{a}$ | 33.00$^{a}$ | 48.67$^{a}$ |
| 3 MLE/4 CM | 9.87 | 11.77 | 11.97 | 13.40$^{c}$ | 18.73$^{e}$ | 26.55$^{d}$ |
| 4 CM/5 MLE | 9.70 | 11.77 | 14.00 | 19.00$^{b}$ | 24.00$^{bc}$ | 30.44$^{c}$ |
| 5 MLE/4 CM | 9.53 | 10.67 | 11.53 | 14.63$^{c}$ | 23.07$^{bcd}$ | 28.11$^{cd}$ |
| 5 MLE | 9.43 | 11.07 | 12.27 | 25.33$^{a}$ | 25.53$^{b}$ | 35.33$^{b}$ |
| 5 CM | 10.20 | 10.87 | 11.63 | 17.60$^{b}$ | 22.20$^{cd}$ | 36.00$^{b}$ |
| SE± | 0.45 | 0.50 | 1.18 | 0.86 | 1.05 | 1.21 |

Means followed by the same letter(s) are not significantly different at a 5% level of significance using FPLSD, WAS: Weeks after sowing, MLE: Moringa leaf extract and CM: Coconut milk

Table 2: The combined effect of Coconut milk *(Cocos nucifera* Linn) and Moringa leaf extract *(Moringa oleifera* Lam*)* on the stem collar girth of *Ceiba pentandra* seedlings

| | Stem girth (cm) | | | | | |
|---|---|---|---|---|---|---|
| Treatments | 4 WAS | 6 WAS | 8 WAS | 10 WAS | 12 WAS | 14 WAS |
| **MLE/CM (%)** | | | | | | |
| 0 | 0.62$^{b}$ | 1.05$^{c}$ | 1.50 | 1.93 | 2.25 | 2.56$^{c}$ |
| 5 MLE/5 CM | 0.92$^{a}$ | 1.43$^{ab}$ | 1.87 | 2.48 | 2.82 | 4.90$^{a}$ |
| 3 MLE/4 CM | 0.82$^{a}$ | 1.30$^{abc}$ | 1.72 | 2.15 | 2.42 | 2.84$^{bc}$ |
| 4 CM/5 MLE | 0.72$^{b}$ | 1.22$^{b}$ | 1.82 | 2.26 | 2.53 | 3.13$^{bc}$ |
| 5 CM/4 MLE | 0.73$^{b}$ | 1.21$^{b}$ | 1.66 | 2.16 | 2.45 | 3.06$^{bc}$ |
| 5 MLE | 0.75$^{b}$ | 1.24$^{b}$ | 1.73 | 2.20 | 2.46 | 3.27$^{b}$ |
| 5 CM | 0.55$^{b}$ | 1.90$^{a}$ | 1.70 | 2.17 | 2.69 | 3.39$^{b}$ |
| SE± | 0.09 | 0.07 | 0.13 | 0.13 | 0.16 | 0.23 |

Means followed by the same letter(s) are not significantly different at a 5% level of significance using FPLSD, WAS: Weeks after sowing, MLE: Moringa leaf extract and CM: Coconut milk

Table 3: The combined effect of Coconut milk *(Cocos nucifera* Linn) and Moringa leaf extract *(Moringa oleifera* Lam) on the number of leaves of *Ceiba pentandra* seedlings

| | Number of leaves | | | | | |
|---|---|---|---|---|---|---|
| Treatments | 4 WAS | 6 WAS | 8 WAS | 10 WAS | 12 WAS | 14 WAS |
| **MLE/CM (%)** | | | | | | |
| 0 | 8.00 | 12.33 | 17.67 | 25.33$^{de}$ | 34.33$^{e}$ | 48.67$^{b}$ |
| 5 MLE/5 CM | 9.00 | 12.67 | 17.33 | 38.67$^{a}$ | 59.33$^{a}$ | 78.67$^{a}$ |
| 3 MLE/4 CM | 8.67 | 11.00 | 15.00 | 22.00$^{e}$ | 37.33$^{e}$ | 51.33$^{b}$ |
| 4 CM/5 MLE | 8.33 | 12.67 | 20.67 | 31.67$^{b}$ | 46.33$^{b}$ | 56.33$^{b}$ |
| 5 CM/4 MLE | 8.00 | 12.00 | 16.67 | 26.33$^{cde}$ | 40.67$^{cd}$ | 52.33$^{b}$ |
| 5 MLE | 8.00 | 11.67 | 16.33 | 30.67$^{bc}$ | 45.00$^{bc}$ | 53.67$^{b}$ |
| 5 CM | 8.00 | 11.67 | 16.33 | 30.00$^{bcd}$ | 43.67$^{bc}$ | 50.33$^{b}$ |
| SE± | 0.35 | 0.87 | 1.88 | 1.58 | 1.81 | 4.10 |

Means followed by the same letter(s) are not significantly different at a 5% level of significance using FPLSD, WAS: Weeks after sowing, MLE: Moringa leaf extract and CM: Coconut milk

Table 4: The combined effect of Coconut milk *(Cocos nucifera* Linn) and Moringa leaf extract *(Moringa oleifera* Lam*)* on the number of branches of *Ceiba pentandra* seedling

| | Number of branches | | | | | |
|---|---|---|---|---|---|---|
| Treatments | 4 WAS | 6 WAS | 8 WAS | 10 WAS | 12 WAS | 14 WAS |
| **MLE/CM (%)** | | | | | | |
| 0 | 2.00 | 3.30 | 4.67$^{d}$ | 7.67$^{b}$ | 9.33$^{c}$ | 12.00$^{c}$ |
| 5 MLE/5 CM | 2.00 | 3.93 | 13.33$^{a}$ | 17.00$^{a}$ | 17.67$^{a}$ | 28.00$^{a}$ |
| 3 MLE/4 CM | 2.00 | 3.03 | 5.00$^{cd}$ | 7.66$^{b}$ | 8.67$^{c}$ | 11.67$^{c}$ |
| 4 CM/5 MLE | 2.00 | 3.33 | 6.33$^{b}$ | 9.33$^{b}$ | 13.00$^{b}$ | 14.67$^{c}$ |
| 5 CM/4 MLE | 2.00 | 3.37 | 6.00$^{bc}$ | 8.67$^{b}$ | 9.33$^{c}$ | 11.67$^{c}$ |
| 5 MLE | 2.00 | 3.33 | 5.00$^{cd}$ | 8.00$^{b}$ | 11.67$^{b}$ | 17.67$^{b}$ |
| 5 CM | 2.00 | 3.00 | 5.00$^{cd}$ | 7.33$^{b}$ | 9.33$^{c}$ | 11.00$^{c}$ |
| SE± | 0.00 | 0.18 | 0.33 | 0.78 | 0.62 | 1.605 |

Means followed by the same letter(s) are not significantly different at a 5% level of significance using FPLSD, WAS: Weeks after sowing, MLE: Moringa leaf extract and CM: Coconut milk

then 4% CM/5% MLE which was higher also than 5% MLE that was also higher than 5% CM. Also, at 12 WAS 5% MLE/5% CM was significantly higher in number of leaves than 4% CM/5% MLE, 5% MLE and 5% CM, 5% CM/ 4% MLE, respectively and the least number of leaves was obtained with 3% MLE/4% CM and the control. While at 14 WAS, the highest number of leaves was also recorded with 5% MLE/5% CM than the remaining treatments which were statistically the same.

**Number of branches:** Table 4 shows the combined effect of Coconut milk and Moringa leaf extract on the number of branches of *Ceiba pentandra* seedling. The result shows that there was no a significant difference in the number of branches among the treatments at 4 and 6 WAS but at 8 WAS 5% MLE/5% CM gives the higher number of branches than 4% CM/5% MLE which was also higher than 5% CM/4% MLE that is also higher in number of branches than the remaining treatment s which were statistically the same. At 10 WAS, 5% MLE/5% CM was significantly higher in number of branches than the remaining treatments which were at par with each other in the number of branches per plant. 5% MLE/5% CM recorded the highest number of branches at 12 WAS followed by 4% CM/5% MLE, 5% MLE and the control, while the least number of branches was obtained with 3% MLE/4% CM and 5% CM but at 14 WAS 5% MLE/5% CM produced significantly higher number of branches followed by 5% MLE and all the remaining treatments which were obtained to be statistically the same.

## DISCUSSION

The result shows that there was no significant effect of the treatments on the plant height at 4, 6 and 8 WAS this might be due to low physiological responses of PGH on the tissues responsible for primary growth (elongation) at the early stage while at 10 WAS the highest plant height of 27.67 and 25.33 cm were obtained. This result is in agreement with the previous finding of[5] who stated that plant height of pawpaw increased at 6, 9 and 12 WAS as affected by MLE and CM. The significant effect of the treatments on the plant height might be due to the role of PGH in promoting cell division and elongation of plants.

At 4 WAS, 5% MLE/5% CM and 3% MLE/4% CM produces the highest Ceiba seedling collar girth of 0.92 and 0.82 cm respectively than all the remaining treatments statistically at par. At 6 and 14 WAS the best result of 1.43 and 4.90 cm collar girth were also recorded with 5% MLE/5% CM and the least collar girth of 1.05 and 2.56 cm were obtained with the control respectively. This result is in line with the result obtained by the previous studies[6] and contradicts the findings of Ebofin[5]. The significant effect of the treatments on the stem diameter might be due to the role of PGH in promoting cell division on secondary growth in plants. The result obtained at 8, 10 and 12 WAS indicated that there was no significant difference between the treatments across the weeks and this might be a result of translocation of the Treatments to the elongation point at the expense of the diameter[5]. With regards to the number of leaves, there was no significant difference between the treatments at 4, 6 and 8 WAS. The non-significant effect of the treatment on the number of leaves might be due to the low physiological response of the leaf tissues to the PGH at an early stage. A significant effect was observed at 10 and 12 WAS where 5% MLE/5% CM manifested the highest effect of 38.67 and 59.33 and the least number of leaves of 22.00, 25.33 and 37.33, 34.33 were obtained with 3% MLE/4% CM and the control respectively while at 14 WAS 5% MLE/5 CM had the highest number of leaves of 78.67 then all the remaining treatments statistically at par. This result validates the findings of[7,8-11] that application of MLE and CM greatly influences the number of plant leaves as tested on Kalmegh and *Amaranthus hybridis*. The significant effects of the treatments on the number of leaves might be in response to the role of the PGH in promoting cell division and leaf production[5-13].

There was no significant difference between the treatments at 4 and 6 WAS, on the number of branches per seedling of Ceiba, the non-significant effect of the treatment on the number of branches might be due to the low physiological response of the branch tissues to the PGH at an early stage but at 8, 12 and 14 WAS 5% MLE/5% CM gives the best result of 13.33, 17.67 and 28.00 number of branches respectively where the least number of branches was obtained with the control, while at 10 WAS 5% MLE/5% CM gave the highest number of 17.00 followed by the remaining treatments statistically at par. This result agrees with the previous findings of the researchers[9]. The significant effects of the treatments on the number of branches might be in response to the role of the PGH in promoting cell division and branch production[2-10]. Therefore, foliar spray of the combination of 5% MLE and 5% CM is recommended among plant growers to fast track the growth and development of plants as they contain some growth-promoting substances[11,12]. It is also recommended that more researches should be carried out to ascertain the effects of the extracts on plantation establishment of Ceiba tree.

## CONCLUSION

In conclusion, aqueous extract of Moringa leaf *(Moringa oleifera* Lam*)* and Coconut milk (i.e. the liquid endosperm of *Cocos nucifera* Linn) enhances the growth of *Ceiba pentandra* seedling in the nursery with the combination of 5% MLE/5% CM manifesting the highest effect followed by 5% MLE only and the least effect was obtained with the control (0%). Thus, the finding of the trial indicated that the application of plant growth hormones can reduce the time, energy and expenses of raising seedlings of *Ceiba pentandra* in the nursery.

## SIGNIFICANCE STATEMENT

This study discovers the efficacy of local organic plant extract that can be beneficial for tree seedlings production. This study will help the researcher to uncover the critical areas of obtaining plant growth-promoting substances that many researchers were not able to explore. Thus a new theory on locally source plants growth regulators may be arrived at.

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