Effect of Organic Supplements on Stem Cutting Technique of Kolanut (*Cola acuminata*) Propagation

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ABSTRACT

Kolanut is an important crop with substantial socio-economic values cultivated for their nuts. The major challenges in their propagation are due primarily to prolonged juvenile phase and erratic germination which necessitates needs for efficient and reliable propagation techniques. Improved propagation techniques will increase production, thereby ensuring stable and sufficient supply for both local and international demands. Hence, this study was conducted to evaluate potential of organic supplements to enhance propagation of kolanut through stem cuttings. Treatment consists of organic supplements (Aloe vera leaf, Banana fruit, Moringa leaf and Onion bulb) and water as control, and laid out in a completely randomized design (CRD) replicated three times. Branches 1-2years old, 1-1.5meters long and 2-3cm in diameter obtained from mature and healthy kolanut trees were treated with organic supplement extracts and untreated control. Data were collected on plant vigour, signs of rooting, survival rates and number of active buds, and subjected to analysis of variance (ANOVA). Results revealed that plant vigor was significantly higher for Aloe vera (88.9%), Moringa (88.9%), Banana (80.0%) and Onion (77.8%) compared to water (68.9%). The percentage of rooting was highest in banana (88.9%) > Aloe vera (77.8%) and Moringa (77.8%) > onion (66.7%) and water (60.7%) with lower values. Survival rates were significantly higher in cuttings treated with all extracts (100.0%) compared to water (88.9%). The study concludes that Banana and Aloe vera extracts showed higher efficiency for stem cutting of kolanut, and can therefore be used as supplements for effective vegetative propagation.

INTRODUCTION

Kolanut *(Cola* sp.*)* is a culturally and economically significant crop primarily cultivated in West Africa, particularly Nigeria, Ghana, and Côte d'Ivoire (Adebola, 2011). The kolanut tree belongs to the family Malvaceae and comprises several species, with *Cola nitida* and *Cola acuminata* being the most commonly cultivated for their nuts (Adelusi *et al*., 2020).It holds substantial economic value in traditional ceremonies, pharmaceutical products, and the beverage industry, especially as caffeine source (Unya, 2021; Ogwu *et al*., 2024). It plays a pivotal role in the socio-economic fabric of many West African societies (Ashaye *et al*., 2021). Kolanut is an important crop not only for its stimulant properties but also as a source of income and food security in many West African communities. Despite the many importance of kolanut, its cultivation faces several challenges, primarily due to inefficiencies associated with traditional propagation methods (Akerele *et al*., 2019). Seed propagation, the conventional method, is often unreliable. Kolanut seeds have a low germination rate, and seedlings exhibit high genetic variability, leading to inconsistent crop quality and

yield, making it difficult for farmers to produce uniform and high-quality kolanut crops (Oluwalana *et al*., 2016).

The cultivation of kolanut trees presents unique challenges, primarily due to the long juvenile phase, which can extend up to seven years before the trees begin to bear fruit (Udo, 2023). This prolonged period, coupled with erratic germination rates of seeds, underscores the necessity for efficient and reliable propagation techniques (Asare, 2005). Improved propagation techniques can lead to increased production, helping to ensure stable and sufficient supply of kolanut to meet both local and international market demands.

More so, the use of organic supplements, presents natural, biodegradable, and environmentally friendly alternatives to synthetic rooting hormones (Ogwu *et al*., 2024). Their application can reduce reliance on chemical inputs, thereby minimizing environmental impact and promoting healthier ecosystems (Rajendram *et al*., 2023). Hence, the need to study the efficiency of kolanut propagation technique from stem cutting using different organic supplements.

MATERIALS AND METHODS

Study Area

The study was conducted at horticultural section Institute for Agricultural Research, Samaru in Northern Guinea Savannah which lies on latitude 11˚09'52¨-11º10'22" N and longitude 07˚38'05"-07º38'22" E at 671m above sea level. The selected location though not a kolanut producing area is known for its rich biodiversity and established agricultural practices, particularly in the cultivation of tree crops. The climate is characterized by a well-defined dry and wet season, with a mean annual rainfall of 700-1400mm and an ambient temperature ranging from 26-32^{0}C. The soil is predominantly loamy, well drained and rich in organic matter.

Treatment and Experimental Design

The treatment consists of four organic supplements (Aloe vera leaf, onion bulb, banana fruit and Moringa leaf) and water as control. Treatments were laid out in a completely randomized design (CRD) replicated 3 times making a total of 15 samples.

Sourcing and preparation of stem cutting

Kolanut branches were sourced from horticultural section IAR, Ahmadu Bello University, Zaria, from healthy, matured established kolanut plants. Branches 1-2 years old, about 1-1.5 meters in length, and 2-3 cm in diameter that were stemming upwards for easy growth, germination and transportation of nutrients were selected.

Preparation of organic supplements

The organic supplements used were sourced around Zaria environment to ensure freshness and availability. Fresh Aloe vera leaves were sourced from local gardens, rinsed and sliced to extract and applied the gel on cut stem before planting. Fresh onions were purchased from local market in Samaru, peeled and chopped into small pieces, and the juice extracted and applied on the stem cut before planting. Banana fruits were cut into small pieces and macerated to form paste, and the cut stem were inserted before planting. Fresh Moringa leaves were sourced from Moringa trees in the horticultural garden, and thoroughly rinsed to remove any dirt or residues. The leaves were pounded until very smooth using a small mortar and pestle with a small amount of water to create a concentrated extract. The cuttings were dipped into extracts for 24 hours before planting.

Data collection

Plant vigor

The healthiness of the cuttings was assessed for plant vigor, and this was done using a 5-point hedonic scale; 1 = not healthy, 2 = slightly not healthy, 3 = moderately healthy, 4 = healthy, 5 = very healthy.

Survival rate

The percentage of stem cut that remain healthy and viable throughout the study was collected at the end of the study period. The percentage that survived and continued to grow after a set period was calculated using:

$$\text{Survival rate (\%)} = \frac{\text{Number of surviving cuttings}}{\text{Tota number of cuttings}} \text{ x } 100 \quad \text{eqn (1)}$$

Number of active buds

The number of active buds developed on each cuttings was counted at two weeks interval, and total number was recorded.

Sign of rooting

The proportion of cuttings that successfully develop roots were counted at two weeks intervals and expressed in percentages as:

$$\text{Sign of rooting (\%)} = \frac{\text{Number of rooted cuttings}}{\text{Total number of cuttings}} \text{ x } 100 \quad \text{eqn (2)}$$

Data Analysis

Data generated were subjected to one-way analysis of variance using statistical analysis software (SAS, version 9.0), and mean difference among treatments were separated using DMRT at 5% level of probability.

RESULTS AND DISCUSSION

Effect of organic supplements on the growth of Kolanut cutting

The effect of organic supplements on the growth of kolanut stem cuttings is shown in Table 1 and Figure I. The results showed that plant vigor was significantly higher ($P \leq 0.05$) for stem cuttings treated with Aloe vera (88.9%) and Moringa leaf extracts (88.9%) and were statistically similar compared to banana (80.0%) and onion extracts (77.8%) but significantly different from the control (68.9%) that recorded lower value.

In addition, the result revealed that higher percentage signs of rooting were observed in banana (88.9%) greater than Aloe vera (77.8%) and Moringa extracts (77.8%), while lower percentage were noticed on cuttings treated with onion extract (66.7%) and water (60.7%). For the active buds, higher number were observed in banana (4.33) > Aloe vera (3.33) and Moringa extracts (3.33) > onion extract (3.00) and the control (3.00). Furthermore, survival rate was significantly higher ($P \leq 0.05$) in cuttings treated with organic supplements (100%), compared to control which had lower survival rate (88.9%). Higher growth traits reported among organic supplements could be attributed to presence of secondary metabolites which made supplements nutritious to support the vegetative growth of the plant materials. This corroborates findings from previous studies that reported the growth stimulating role of plants secondary metabolites and allele chemicals (Bhadha *et al*., 2014; Abd El-Hack *et al*., 2018; Buthelezi *et al*., 2023).

Table 1: Effect of organic supplements on the growth of kola nut stem cutting

Treatment	Plant vigour (%)	Rooting signs (%)	Survival rate (%)	Active buds
Aloe vera	88.9a	77.8a	100.0a	3.33b
Banana	80.0ab	88.9a	100.0a	4.33a
Moringa leaf	88.9a	77.8a	100.0a	3.33b
Onion	77.8ab	66.7a	100.0a	3.00b
Water	68.9b	60.7a	88.9b	3.00b
SE±	7.420	14.910	4.970	0.460

Means followed by same letter(s) within same column are not different statistically at *P=0.05* level of probability using DMRT

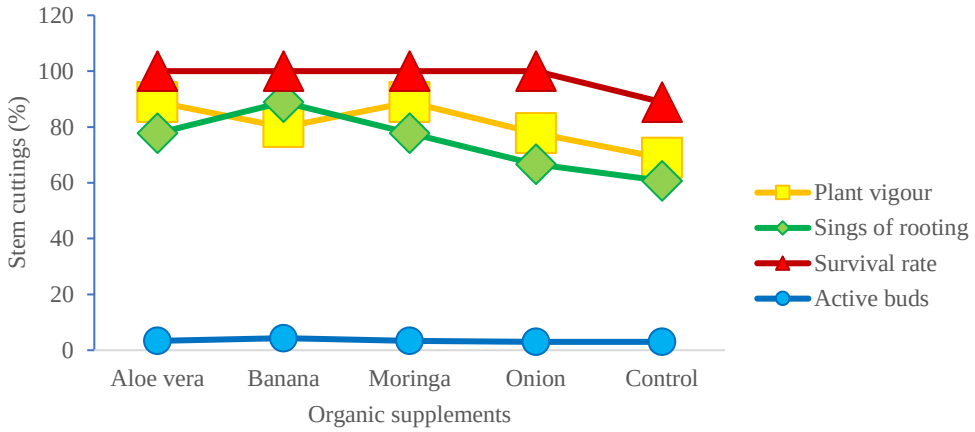


Figure I: Graphs showing effect of organic amendments on growth of stem cuttings of Kolanut

CONCLUSION

The results of this study show significant variation in growth of kolanut stem cuttings under different organic supplements. The findings revealed that plant vigor was higher in Aloe vera leaf and Moringa leaf extracts than other supplements. Similarly, rate of survival of the cuttings were higher in all the organic supplement extracts compared to control which recorded lowest survival rate. Furthermore, Banana fruit extract resulted in higher percentage of cutting showing signs of rooting compared to other extracts and the control which recorded lower percentage of cuttings with rooting signs. Similarly, Banana fruit extract produced greater number of active buds than other extracts and the control. Therefore, it can be concluded from the study that Aloe vera leaf and Banana fruit extracts showed higher efficiency for kolanut stem cuttings and can therefore be used as supplements for effective propagation. Future studies can be undertaken to determine whether synergistic effects using combination of these supplements could further improve propagation outcomes.

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