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EFFECT OF DIFFERENT GROWTH MEDIA ON THE SPROUTING AND GROWTH OF *Vitellaria paradoxa* C.F. Gaertn. STEM CUTTINGS

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ABSTRACT

Vitellaria paradoxa seed is recalcitrant in nature which loses germination easily and takes longer period to germinate. Meanwhile, vegetative propagation through stem cuttings enhances maturation and fructification. This study therefore investigated effect of different growth media on the sprouting and growth of *V. paradoxa* stem cuttings with a view to encouraging its development. Three different media: sandy soil, clay soil and loamy soil were used as growing media. The physical and chemical analyses were carried out on the growth media to determine their nutrient content. Twelve (12) matured cuttings were collected from young shoot of each of four randomly selected *V. paradoxa* mother trees. There were three treatments consisted of sandy soil, clay soil and loamy soil filled into forty-eight polythene pots with each treatment consisting of sixteen randomly distributed polythene pots where cuttings were planted. Leaf production, shoot height and collar girth were assessed fortnightly for eight weeks. The experimental design adopted was Completely Randomized Design (CRD) with three treatments. Each treatment comprised of 4 cuttings with four replicates. Data collected were analyzed using analysis of variance (ANOVA) at ($p < 0.05$). The results showed that the sandy soil pH was almost neutral (6.67±1.85) while both the clay soil (5.33±1.01) and loamy soil (5.82±0.68) were moderately acidic. Organic carbon was higher in loamy soil (2.59±0.27) than in sandy soil (0.58±0.08) and clay soil (1.64±0.14). The mean highest number of sprouts (10.00±1.00) and collar girth (0.28±0.01 cm) were recorded for the loamy soil. Also, the stem cuttings revealed a significantly higher plant height in loamy soil (19.70±1.74 cm), while clay and sandy soil had 15.10±0.10 cm and 10.70±1.47 cm respectively. It is concluded that loamy soil is the best growth media for the propagation of *Vitellaria paradoxa* stem cuttings.

Keywords: Vegetative propagation, Growth media, Stem cuttings, Sprouts, Soil properties

Introduction

The Shea tree (*Vitellaria paradoxa* C.F. Gaertn.) belongs to the family Sapotaceae (Lovett and Haq, 2000). It is one of the most economically and socially important tree species in the Sudano-Sahelian region (Hall *et al.,* 1996).The tree is a small to medium sized deciduous tree with a spreading round to hemispherical crown and grows about 25 m in height (Orwa *et al.,* 2009). Its bark is corky and the leaves are oblong and clustered at the ends of branches. The flowers are white and clustered at the ends of shoots. *V. paradoxa* commonly known as shea tree produces an edible fruit that is the source of one of Africa's most ancient food

oils. Shea trees are indigenous to semi-arid and sub-humid savannas of sub-Saharan Africa (SSA), occurring on nearly 1 million km^2 among 18 African countries (NRC 2006, Bonkoungou, 2004). *V. paradoxa* grows naturally in the wild in the dry savanna belt of West and South from Senegal in the west to Sudan and South Sudan in the east and onto the foothills of the Ethiopian. It is a key Non-Timber Forest Products (NTFPs) occurring largely in off-reserve forests in many parts of Africa (Jasaw *et al.,* 2015). The tree provides regulation through carbon sequestration, wind breaks, and preventing erosion in addition to serving as a habitat for other organisms and direct provision of fruits (Jasaw *et al.,* 2015). The leaves constitute good forage for animal feeding. They are also used to improve soil fertility (IPGRI and INIA, 2006).

As a result of population increase in Nigeria, *V. paradoxa* is under threat as they are often exploited for construction and production of furniture and household materials such as mortar and pestle, while those found in farmlands are often killed to make way for the farms. Another major problem in the decline of the population of *V. paradoxa* is attacked by insects (N'Djolosse *et al.,* 2012). Considering the importance of *V. paradoxa* to the locals, there is a need to ensure its continuous propagation and conservation.

Stem cutting is the most frequent method used for vegetative propagation of many plant species from rooting herbaceous to woody plants. Success of propagation via stem cuttings is usually affected by many factors including the status of mother plant or cutting source, type of culture medium, type of cutting, rooting hormones and environmental conditions, such as light, temperature, air humidity and soil moisture during propagation (Hassanein, 2013). The use of cuttings can offer a number of benefits which include reduction in juvenility phase exhibited by some grafted trees.

The importance of economic trees cannot be over emphasized due to the various benefits they provide. These economic trees have the potential of continuous source of supply of raw materials to support the food industry, Phyto medical industry, the wood industry and so on. With the prevailing demand of these species, there is a growing need for developing simple and easy methods of propagating these species to reduce maturation and fructification period. This has led to the need for information on the silvicultural techniques used in the multiplication of the fruit tree species.

In spite the economic importance of the species in West and Central Africa with huge industrial and domestic uses for the shea butter, its rapid multiplication has been hampered by its slow growth and long gestation period (Yeboah *et al*., 2011). This is a factor that affects the cultivation of most forest tree species. Most trees take a very long time to mature and fruit. This has made farmers prefer to cultivate arable crops instead of tree species. In view of this, the study therefore investigated the effects of different growth media on the growth and development of *Vitellaria paradoxa* stem cuttings.

Materials and Methods

Study Area

The study was conducted at Federal College of Wildlife Management nursery. The College is located between Kainji dam and New Bussa and about a kilometre along new

Awuru road in Borgu Local Government Area of Niger State. It is an academic environment with a very large community of trees. It lies between latitude 9°.10' N and 9°.20' N and longitude 4°.30' E and 4°.33' E (Ogunjinmi, 2007). The College has an area of 2.56km^2. The average monthly temperature is 34°C, the highest value being 41°C with a mean annual relative humidity of 60 percent (Onadeko and Meduna, 1984). The average annual precipitation amounts to about 749 mm and receives 84 rainy days on the 1 mm threshold annually. It is concentrated in the months of June, July and August. The vegetation in New Bussa is Guinea savanna which is characterized by undistributed woodland with trees 15m-18m tall. The soil is generally alluvial but it is highly variable in physical composition, low in phosphorus and nitrate but rich in potassium. The upland savanna soils are almost totally lacking in humus materials (Nnaji and Omotugba, 2014). New Bussa enjoys and average of 3852 hours of sunshine throughout the year, and daylight varies from 11 hours 32 minutes to 12 hours 40 minutes per day. The warmest months are March to May while, the coldest temperatures usually occur in July to September.

Experimental Procedure

Collections of the cuttings were made from four *Vitellaria paradoxa* mother trees located within the College premises. This was done by tagging all the shea trees in the College and a table of random numbers was used in picking the four trees used. Twelve stem cuttings from young shoots were cut to a length of 10 cm from each of the trees that were selected and a total of forty-eight cuttings were therefore collected for the study.

The sandy soil medium was obtained from the river Oli close to the College, clay soil was gotten close to river Oli, while the loamy soil was obtained from the natural forest in the College. The soil physical and chemical properties of the growth media used were evaluated. Representative soil samples were collected at 0-10cm and were air dried and analyzed using standard procedures. Soil nutrients investigated include organic matter, total nitrogen, available phosphorous, potassium, magnesium and cation exchange capacity (CEC). The acidity of the soils was determined using pH meter.

There were three treatments consisted of sandy soil, clay soil and loamy soil filled into forty-eight polythene pots (1 kg capacity) with each treatment consisting of sixteen randomly distributed polythene pots. Four (4) stem cuttings with one cutting planted in each polythene pots to a depth of 3 cm were replicated four times. The cuttings were watered twice a day in the morning and in the evening throughout the period of the experiment. The pots were weeded periodically to prevent competition between the cuttings and weeds.

The growth parameters which included number of leaves (leaf production), plant height and collar girth were measured fortnightly. Assessment of number of leaves was done by counting the number of leaves on each stem immediately after true leaves had fully grown, while the plant height was measured using a meter ruler from the base to the terminal bud while the collar girth was measured using venier calliper.

The experiment design was Completely Randomized Design (CRD) with three treatments. Each treatment comprised of 4 cuttings with four replicates.

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All data collected were analyzed using one way analysis of variance (ANOVA) in a Complete Randomized Design (CRD). Differences in mean values were tested at 0.05 level of significance with Duncan's multiple range tests (DMRTs).

Results

Physico-chemical properties of the growth media used for the experiment are shown in table 1. The soils pH values ranged from 5.33±1.01 to 6.67±1.85 reflecting slightly acidic to neutral nature of soils and they are statistically significant at 0.05%. Organic carbon of the soils was from 0.58±0.08 to 2.59±0.27 with the loamy soil been highest. The soils generally have low values for total nitrogen, available phosphorous, potassium and magnesium. The total nitrogen values for the soils differ significantly at 0.05%, so also the magnesium but both available phosphorus and potassium have statistically significant values at 0.05%.

Table 1: Physical and chemical properties of soils collected for the experiment

Physicochemical properties soil	**Treatments**		
	Sandy soil	**Clay soil**	**Loamy soil**
Soil acidity (pH)	6.67±1.85[a]	5.33±1.01[a]	5.80±0.68[a]
Organic carbon	0.58±0.08[a]	1.64±0.14[b]	2.59±0.27[c]
Total Nitrogen	0.14±0.04[a]	0.15±0.02[a]	0.23±0.08[a]
Available Phosphorus	1.70±0.30[b]	0.95±0.05[a]	1.21±0.01[a]
Potassium	0.14±0.02[a]	1.54±0.14[b]	1.88±0.64[b]
Magnesium	1.42±0.35[a]	1.40±0.20[a]	1.00±0.40[a]
Cation Capacity Exchange	5.23±0.77[a]	8.50±0.50[b]	10.17±2.48[b]

Mean values with the same letters are not significantly different at 5% probability

The mean number of sprouts of *V. paradoxa* was highest (10.00 ±1.00) at eight week for loamy soil, 7.00 ±1.00 for clay soil and 6.00 ±1.00 for sandy soil. The mean number of sprouts of *V. paradoxa* is significant difference at 5% level of significance between loamy soil and both sandy and clay at the termination of the experiment (Table 2)

Table 2: Mean Number of Sproutsof *Vitellariaparadoxa*

Weeks	Treatments		
	Sandy soil	Clay soil	Loamy soil
2	4.00 ±1.00[a]	4.00 ±1.73[a]	5.00 ±1.00[a]
4	4.00 ±1.00[a]	6.00 ± 2.65[a]	8.00 ±2.00[a]
6	5.00 ±1.00[a]	6.00 ±1.00[a]	8.00 ±1.00[b]
8	6.00 ±1.00[a]	7.00 ±1.00[a]	10.00 ±1.00[b]

Mean values with the same letters are not significantly different at 5% probability level

Results in Table 3 below present the effect of growing media on the number of *V. paradoxa* leaves. There was no significant different in the number of leaves among the growth media at the end of 8th week of experiment. The number of leaves range from 24.00 ±2.00 in the *V. paradoxa* cuttings planted with sandy soil to 25.10 ±1.90 inthe loamy soils.

Table 3: Effect of growth media on number of leaves of *V. paradoxa* cuttings

Weeks	Treatments		
	Sandy soil	**Clay soil**	**Loamy soil**
2	11.20 ±0.27^{a}	12.40 ±1.10^{ab}	13.60 ±1.04^{b}
4	16.00 ±2.00^{a}	16.80 ± 0.80^{ab}	18.70 ±0.30^{b}
6	20.00 ±1.00^{a}	21.30 ±1.30^{ab}	22.50 ±0.50^{b}
8	24.00 ±2.00^{a}	25.00 ±1.00^{a}	25.10 ±1.90^{a}

Mean values with the same letters are not significantly different at 5% probability level.

The mean plant height of *V. paradoxa* for the three growth media used is shown in the Table 4 below. There was no significant difference between plants grown in the sandy soil, clay soil and loamy soil at 0.05% except for second week of loamy soil. The mean plant height of *V. paradoxa* at 8th week were significant different from10.70 ±1.47cm for sandy soil, to 15.10 ±0.10cm for clay soil and 19.70 ±1.74cm for loamy soil.

Table 4: Effect of growth media on plant height of *V. paradoxa* cuttings

Weeks	Treatments		
	Sandy soil	**Clay soil**	**Loamy soil**
2	3.00 ±0.00^{a}	8.10 ±0.95^{b}	8.30 ±2.10^{b}
4	5.10 ±1.85^{a}	8.90 ±0.10^{b}	11.20 ±0.20^{c}
6	8.20 ±0.27^{a}	12.20 ±1.20^{b}	15.10 ±0.17^{c}
8	10.70 ±1.47^{a}	15.10 ±0.10^{b}	19.70 ±1.74^{c}

Mean values with the same letters are not significantly different at 5% probability level

Results on mean collar girth of *V. paradoxa* for the three growth media used are as shown in the Table 5. The mean collar girth of *V. paradoxa* was 0.21 ±0.03cm for sandy soil, clay soil 0.25 ±0.01cm and for loamy soil 0.28 ±0.01cm at the end of the experiment. The final values were not significantly different between clay and loamy but were significant higher than values recorded for sandy soil.

Table 5: Effect of growth media on collar girth of *V. paradoxa*

Weeks	Treatments		
	Sandy soil	**Clay soil**	**Loamy soil**
2	0.13 ±0.01^{a}	0.16 ±0.01^{b}	0.20 ±0.01^{c}

4	0.15 ±0.01[a]	0.20 ±0.02[b]	0.24 ±0.01[c]
6	0.19 ±0.01[a]	0.22 ±0.01[ab]	0.26 ±0.05[b]
8	0.21 ±0.03[a]	0.25 ±0.01[b]	0.28 ±0.01[b]

Mean values with the same letters are not significantly different at 5% probability level

Discussion

The results of the soil showed that there were differences in the physico-chemical composition in the growth media used as the media affected the stem cuttings differently. The pH of the soil is slightly acidic to neutral and they are statistically significant at 0.05%. According to Jain *et al*. (2015), the pH range of 6.8 to 8.0 had been recommended for plant growth, while Roberts (2006) opined that the availability of mineral nutrients in growing media is influenced by its pH. Organic carbon of the soils ranged from 0.58±0.08 to 2.59±0.27, with the loamy soil being highest. Soil rich in organic matter are believed to release more organic phosphate plants than soils with low organic content (Miller and Donahue, 2001).The use of quality soil media is of importance in the propagation of tropical plants. Growth and development of cuttings is known to be affected by growth media as the media serve as source of nutrient and aides root development for the cutting (Abera and Mahbuba, 2019).

According to Bhardwaj (2014), good growing media provide sufficient reservoir for plant nutrient, hold plant available water, and provide a means for gas exchange and good anchorage for the plant. In the study, loamy soil showed higher growth characteristics than the other growth media, with sandy soil showing low growth characteristics. The results show that *V. paradoxa* cuttings grow well in loamy soil. The number of sprouts from cuttings was significantly influenced by the growth media used except at the end of the experiment. This observation however, disagrees with Yeboah, *et al*. (2011) who stated that the number of sprouts from cuttings and number of roots developed per cutting were not significantly influenced by the type of growth media used.

According to Akwatulira *et al*. (2011), low levels of success for stem cuttings propagated in sandy soil may be as a result of low organic carbon in the soil. Organic carbon improves nutrient availability to the plant and allows absorption of phosphorous by the plant. This might be responsible for the good growth and development found in the cuttings that sprouted in the loamy soil (Yeboah *et al*., 2009). In an experiment carried out using different growth media, Muhammad *et al.* (2018) as cited by Abera and Mahbuba (2019) observed maximum number of leave growth in the stem cutting planted in the potting medium that was a mixture of canal silt and bagasse. While in his own work, Qadri *et al* (2018) reported a positive effect of silt on the number of leaves of stem cutting.

Conclusion

Results of this study show that the best growth media for propagating *V. paradoxa* cuttings is loamy soil. The results obtained show that the loamy soil only had the best performance on plant sprouting, number of leaves, plant height and collar girth. However, clay soil is another growth media that can be used for the growth of stem cuttings in the absence of loamy soil. It is concluded that growth media is an important

factor that influence propagation of *V. paradoxa*.

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