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Evaluation of Jatropha Cutting Lengths on the Growth and Yield of Physic Nut (*Jatropha curcas* L.) in the Rainforest Agro-ecological Zone

Uwuigbe, Edith U.

Department of Agronomy
Delta State University, Asaba Campus, Nigeria

ABSTRACT
The study investigated the effect of varied lengths of stem cuttings on the growth and yield of the physic nut plant (*Jatropha curcas* L.). The study was conducted at Delta State University's Asaba Teaching and Research Farm. The stem cuttings used were 40cm, 50cm, and 60cm in length. The cumulative seed weight/yield for 60cm, 50cm, and 40cm stem cuttings was 2,313kg/ha, 1,649kg/ha, and 910kg/ha, respectively. The oil extraction findings also revealed that 12.2kg of seeds processed from 60cm stem cuttings produced the most oil quantity of 350ml, followed by 8.4kg of seeds processed from 50cm stem cuttings providing 240ml and 3.8kg of seeds processed from 40cm cuttings producing 120ml.The results showed that the 60cm stem cutting length outperformed the 50cm and 40cm stem cutting lengths in terms of growth characteristics and yield-related components. There were There are substantial yield changes between stem cutting lengths.
Keywords: length, stem cuttings, growth, yield, oil, quantity.

INTRODUCTION

Physic nut (*Jatropha curcas* L)I is a drought resistant large shrub or small tree, belonging to the genus Euphorbiaceae. Compared to other woody species, jatropha can be domesticated quickly and effectively (Achtenet al., 2010). Depending on the country or area, the plant goes by many names. In Nigeria it is known as binidazugu/cinidazugu in Hausa, lapalapa in Yoruba and Wuluidu in Igbo (Blench, 2003, 2007). Producing oil containing seeds (Jongschaapet al., 2008), although several species exist in different regions of the world, Jatropha curcas L is the most frequent species found in Nigeria.

Jatropha grows best on well-drained, well-aerated soils, is well adapted to marginal soils with low nutrient content, and is not affected by day length changes. Jatropha is also a fast-growing plant that can be replicated from cuttings or seeds, depending on several circumstances such as rainfall conditions. Cuttings are a quick and inexpensive approach to propagate Jatropha. Traditionally, however, cuttings of fifty to sixty centimeters long, or slightly more, are generally used by farmers to fences (Henning, 2009). Establish their live one advantage of cuttings is that they are clones with the same genetic characteristics as the mother plant, and in case a high yielding mother plant is selected, the cuttings will have the same properties. Usually, the length and thickness of the cutting typically affect the plant's chance of survival. Size suggested for stem cutting length varies from 25 to 120 cm. Cuttings taken from the middle or lower parts of year-old branches show greater survival rates (Kaushik and Kumar, 2006, cited in Achten, 2008).

There are several restrictions to *Jatropha curcas* cultivation in Nigeria (Yammama, 2011), including a lack of understanding about appropriate stem cutting length for propagation (Henning, 2000). Cuttings of Jatropha usually root more quickly and grow faster into productive trees than seeds do. Opinions are divided on the cutting lengths that are ideal for use by farmers for best growth and productivity of Jatropha. This study was therefore designed to determine the most suitable stem cutting length for the growth and yield of Jatropha in rainforest agro-ecological zone of Delta State, Nigeria.

MATERIALS AND METHODS

Field Establishment and Experimental Design

A tubular sampling auger was used to sample surface soils (0-15cm). Three alternative stem cutting lengths of 40cm, 50cm and 60cm were used in the field experiment. The stem cuttings were planted immediately in the field. The field was cleared, the trash was packed and the field was ploughed to provide for soil aeration and simple root penetration. The stem cuttings were planted directly on the field, each on the 6th of June, 2013. The experiment was a one way factorial on a Randomized Complete Block Design (RCBD) and experimental site measured 48m x 18m covering an area of 864m^2. Each plot measured 12m x 6m with 1m between plots and 1m between blocks. The plot was divided into three blocks, having 4 plots per block. Healthy stem cuttings were planted at 2m x 2m spacing (Achten, 2008), with each plot having 12 stands of 4 rows. The stem cuttings were planted at a depth of 5cm in the soil. Weeding was done manually at three weeks interval.

Data Analysis: Data collected were subjected to analysis of variance (ANOVA), and means were separated using LSD at 5% level of probability (SAS, 2015).

RESULTS

The stem cutting length of 60cm was also the first to sprout (Table 1). At eight weeks after planting, the percentage of stem cuttings with open buds increased to 60% for 60cm stem cutting length, 30% for 50cm stem cutting length, and at 16 and 23 days for 40cm stem cuttings, respectively. By the twelfth week, the percentage of cuttings with open buds had increased to 80% for 60cm stems. The stem cutting length of 60cm sprouted first (Table 1). The percentage of stem cuttings with open buds grew to 60% for 60cm stem cutting length, 30% for 50cm stem cutting length, and 16 and 23 days for 40cm stem cuttings, respectively, eight weeks after planting. The percentage of cuttings with open buds had climbed to 80% for 60cm stems by the twelfth week. The 60cm stem cuttings were first to flower and attain maturity.

Table 1: Cumulative number of stem cuttings (40cm, 50cm, 60cm long) with open buds and number of dead stem cuttings at different sampling periods

Parameters	Weeks After Planting											
	4			8			12			16		
	Stem Cutting Lengths											
	40	50	60	40	50	60	40	50	60	40	50	60
	Cm											
Stem cutting witl open buds	10	14	17	26	33	43	45	69	86	58	101	130
Dead stem cuttings	15	10	9	24	13	7	26	14	8	26	18	14
Total	25	24	26	50	46	50	71	83	94	84	119	144

cutting, 60% for 50cm stem cutting and 20% for 40cm stem cutting. By the sixteenth week, the 60cm stem cutting length had a 90% sprouting rate, compared to the 50cm, which had a 70% sprouting rate, and the 40cm stem cuts, which had a 40% sprouting rate.

Assessment of Plant height (cm), Number of branches, Number of leaves and Leaf area (cm^2) using different stem cutting lengths

The 60cm stem cutting length performed significantly higher in plant height, number of leaves and leaf area, followed by the 50cm stem cuttings while the least was observed in the 40cm stem cuttings. The highest plant height mean values of 51.6, 103.3, and 108.6 were recorded for 60cm stem cutting lengths at 12, 16 and 24WAP while the least mean values of 31.6, 63.6, and 140.7 for plant height were recorded for 40cm stem cutting lengths at 12, 16 and 24WAP. The highest mean values of 230.3cm for plant height and 248.6 for number of leaves were recorded for 60cm stem cutting length at 28 weeks after planting. The highest mean values of 11.00 and 24879cm^2 for number of branches and leaf area respectively were also recorded for 60cm stem cutting length at 28WAP (Table 2).

Table 2: Evaluation of different cutting length of *Jatropha* on Number of Leaves, Plant height (cm), Number of branches, Leaf area (cm^2) on different stem cutting lengths

	Weeks After Planting						
Stem cuttings	**4**	**8**	**12**	**16**	**20**	**24**	**28**
Number of Leaves							
forty	8.66b	22.33b	64.66b	82.6c	161.3a	182.0b	197.5b
fifty	8.66b	28.33b	58.00b	108.0b	110.0b	170.3b	189.0b
Sixty	10.66a	38.00a	89.33a	136.0a	160.3a	236.3a	248.6a
Plant Height(cm)							
forty	3.10a	8.00a	31.6b	63.6b	123.6a	140.6b	172.6b
fifty	2.82a	8.90a	41.3b	68.33b	118.6a	141.3b	180.5b
sixty	3.33a	9.36a	51.6a	103.3a	117.6a	180.6a	230.3a
Number of branches							
forty	7.00b	3.00c	9.30a	4.33b	9.00b	9.00a	10.00a
Fifty	7.66b	6.33b	9.00a	3.66b	7.66b	9.00a	11.00a
Sixty	10.66a	12.66a	8.30a	7.00a	12.66a	10.66a	11.00a
Leaf area (cm^2)							
Forty	2508b	7176a	1245a	1694b	1862a	2115a	22391 a
Fifty	2672b	8152a	1359a	1617b	1909a	2137a	23692 a
Sixty	4731a	8286a	1579a	1933a	2086a	2405a	24879 a

Evaluation of different stem cuttings on yield

Jatropha stem cutting length (60cm) outperformed 50cm stem cutting length and 40cm stem cutting length (Table 3). Significant differences were also observed in total fruit yield/plant for the different lengths. The highest yield values for 60cm stem cuttings were 558.2kg/hectare, 4,66.7kg/hectare, 605kg/hectare, and 682.5kg/hectare at 16, 20, 24, and 28 weeks after planting (WAP), respectively, while the lowest yield values for 40cm cutting lengths were 58.25kg/hectare, 625kg/hectare, 70kg/hectare, and 157.5kg/hectare at 16, 20, 24, and 28 WAP. The 60cm stem cuttings performed highest in fruit yield and were first to fruit and mature. The highest total cumulative yield values of 2,313kg/hectare were recorded for 60cm stem cuttings, while 40cm stem cutting lengths were the least to fruit and mature and it also had the least total cumulative yield value of 910kg/hectare.

Table 3: Evaluation of different stem cutting lengths on Number of pods and seed weight at different sampling periods.

	WAP				
Stem cuttings	16	20	24	28	Total Cumulative Yield (kg/ha)
Number of Pods					
40cm	10.33b	288.3a	188.0b	174.5c	661.13c
50cm	104.61a	236.3a	241.8b	275.8b	858.51ab
60cm	111.00a	191.0a	289.3a	365.2a	956.5a
Seed Weight (kg/ha)					
40cm	58.25c	625.0a	70.0c	175.5c	910c
50cm	125.8b	508.2b	465.0b	555.0b	1946b
60cm	558.3a	466.8c	605.0a	682.5a	2318a

Table 4: Quantity of oil Extracted and Weight of Physic Nut

	40	50	60
Cm			
Quantity of Seeds (kg)	12.2	8.4	3.6
Quantity of Oil (ml)	120	240	350
Physic Nut Cake (kg)	1.7	2.2	3.8

DISCUSSION

Field establishment using different stem cutting lengths

From the results shown in Table 1, the different stem cutting length of Jatropha planted directly on the field, shows that 60cm stem cutting length and 50cm stem. The 40cm stem cutting length performed better in terms of growth characteristics. The 60cm stem cutting lengths were likewise more likely to survive than the 50cm and 40cm stem cutting lengths. From the results, it was also observed that the 60cm stem cutting length performed better in yield than the 50cm and 40cm stem cutting length. DaeyOuwens*et al.,* (2007) in his research work stated that traditionally, cuttings of fifty to sixty centimeters long, or slightly more, are generally used by a farmer to establish their live fences and his finding also agrees with the result of this research work.

Studies have also shown on the other hand that cuttings shorter than 10 cm have a very low survival rate and are not suitable for *J. curcas* propagation (Heller, 1996). Many other variables can influence the establishment of *J. curcas* such as direct planting of cuttings/cutting materials (length, diameter of branch, age, location of the cutting in the tree), cutting time, storage of cuttings, fungicide treatment, planting time, depth of planting, soil moisture content and weed clearance (Heller, 1996).

Seed yields

Significant changes in seed weight/yield values were discovered among the various stem cutting lengths planted in the field. The 60cm stem cutting length produced the largest yield, followed by the 50cm stem cutting length, while the 40cm stem cutting length produced the lowest yield. The mean values of number of seed pods and seed weight were highest in 60cm stem cutting lengths, followed by 50cm stem cutting lengths, and lowest in 40cm stem cutting lengths. These differences in yield values could be attributed to the size of planting materials employed, which had a direct impact on plant establishment. (DaeyOuwens *et al*., 2007). Research works on yields of Jatropha have also shown that seed weight per 1000 seeds was 556.9 g (FACT, 2007), and the result of the seed weight obtained in this work agrees with the research findings of FACT Foundation (2007).

Oil Extraction

The quantity of oil extracted from seeds of 60cm stem cutting length was higher followed by 50cm stem cutting length and the least oil quantity was obtained from 40cm stem cutting lengths. The difference in the quantity of oil derived from the quantity of seeds obtained from the different stem cutting length is as a result of the seed yield derived from each of the plots of the stem cuttings planted. The 60cm stem cutting lengths had highest mean values of number of pods, seeds and total seed weight, followed by 50cm stem cutting length and the least were in 40cm stem cutting lengths. Therefore the differentials in the quantity of oil produced could be affected by the amount of seeds processed which was harvested from each plot.

The quantity of oil obtained in this work was very small compared with the research work of Achtens *et al.* (2008), who reported the Bielenberg ram press method which is a simple traditional method for Jatropha oil extraction and in his findings he stated that 4 kg of seeds will produce 1 liter of oil. The difference in the quantity of oil obtained in this work could be as a result of the difference in the traditional method used in extracting oil from the seeds.

CONCLUSION

The study investigated the influence of three different stem cutting lengths on the growth and yield of J. curcas propagation in Delta State's Oshimili South local government area. The study found that 60cm stem cuttings as the best length than the other two lengths of stem cuttings. 60cm stem cutting lengths having the highest cumulative seed weight/yield value of 2,313kg/hectare is therefore recommended to farmers who are interested in *Jatropha curcas* cultivation.

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