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Assessment of the Growth Responses of some Vegetative Cuttings of *Jatropha curcas*

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KEYWORDS

Assessment, Growth responses, Vegetative cuttings, *Jatropha curcas*, Apical, Basal

A B S T R A C T

A study was conducted to assess the sprouting and growth performance of different cuttings (Root, Basal, Middle and Apical) of *Jatropha curcas* at the Nursery of Faculty of Agriculture, University of Abuja, Nigeria. A completely Randomized Design (CRD) with 3 replications was used. Each plot contained 10 stands of *Jatropha curcas*. Data collected were number of sprouts per plant, plant height (cm), number of leaves per plant, effect of different sections of the plant on the dry matter yield, number of stems developed as influenced by different sections of plant and survival percentage. At 12 weeks after planting (WAP), there were significant ($P > 0.05$) changes in the growth of the plants. Stands grown through apical section (cuttings) grew relatively taller than others (16 cm). At 12 WAP, the stands grown through the apical stem cuttings had higher number of leaves (26). Those grown through the Middle cutting had the largest leaf area per plant (41.4 cm^2). Dry matter yields of all the stands irrespective of the planting stock were fairly similar ($P > 0.05$). The cuttings with the best growth response were apical stem, therefore the most suitable for establishing plantation of *Jatropha curcas*.

Introduction

Jatropha curcas (Physic or Barbados nut) a flowering plant in the *spurge* family Euphobiaceae, is native to the tropical America, mostly Mexico and Central America (Jules and Paul, 2008). It is almost pan tropic, now widely planted as a medicinal plant in Brazil, Fiji, Honduras, India etc (Holm *et al.*, 1979). As a result of the popularity of this plant, it is grown all over Nigeria, where it is referred to as Binidazugu or Cinidazugu (Hausa), kwalkwalja (Fulani), Kasha (Nupe), Lapalapa (Yoruba) and Okwu-enwu (Ibo) (Atabo, 2009). The plant has thick glabrous branchlets, straight trunk and grey or reddish bark, masked by large white patches. It has green leaves with short shallow lobs, which are alternately arranged (Samba *et al.*,

2006). *Jatropha curcas* is usually propagated by seed. Naturally, its seed yield per plant is relatively low and this has affected the establishment of the crop which is currently in high demands.

Jatropha curcas has been known to be of great importance. Its seed contains 40% viscous oil, highly suitable for cooking and for the production of Bio-diesel wish is a substitute for fossil fuel. Analysis showed that the oil contains in minute quantity other components such as unsaturated fatty acids, sulphur content, unsaturated oleic and lenoleic acid (Achten, 2010) and has a very good quality for burning (Vaitilingom and Liennard, 1997).

The absence of sulphur oxide in exhaust from diesel engine that run on *Jatropha curcas* oil shows that the oil may have a less adverse impact on the environment (Kandpal and Madam, 1995). The seed has a high content of oil and the oil of *Jatropha curcas* has a strong purgative action which is also widely used for skin diseases and to soothe pain such as those caused by rheumatism (Heller, 1996).

It has been reported that propagation through seed leads to a lot of genetic variability in terms of growth, biomass, seed yield and oil content (Heller, 1996). Its propagation vegetatively has been achieved by stem cuttings, grafting, budding as well as air layering techniques. Finding from earlier trials have recommended the use of cuttings rather than the seeds in the propagation of *Jatropha* plant especially when treated with 200 micro grams per liter of Indole-butiric acid (IBA) which ensures highest level of rooting in stem cuttings (Heller, 1996).

Materials and methods

Location of the study: The experiment was conducted at the Experimental field of Faculty of Agriculture, University of Abuja mini–campus Gwagwalada Area council, Federal Capital Territory Abuja, Nigeria. Abuja is located in the Guinea savannah. Rainy season begins from April and ends in October in Abuja and the average day time temperatures reach 28 ^{0}C to 30 ^{0}C. In the dry season, average daily temperature can soar as high as 40^{o}C. Annual rainfall ranges from 1100 mm to 1600 mm. Gwagwalada is geographically located on latitude 8^{0}56’59’’ North of the Equator and longitude 7^{0}5’59’’ East. Gwagwalada has an average temperature of 33 ^{o}C, Humidity of 14% at planting time and wind of 10km/h North-East. The soil is Alfisol with Aquick moisture regime which are well drained, classified as clay loam. Ground water fluctuation does not affect plant growth.

Experimental material: The experimental material is the stem of *Jatropha curcas*.

Experimental treatment: The experimental treatments of which effect were estimated included the various sections of the *Jatropha* plant; Apical cutting, Middle cutting, Basal cutting and Root cutting.

Experimental design: Completely Randomized Design (CRD) with 3 replications was used. Each replication consisted of plots; each plot contained 10 pots of *Jatropha* cuttings. A pot contained 2 kg of top soil and total of 120 pots were used in the trial. The experimental layout covered an area of 76 m^2. Each replication (9.5 m) was separated from the others by 1m pathway. Each plot measures 2 m^2, separated from each other by 0.5m alley. Planting of the cutting was done on the same day (21/07/ 2010).

Each cutting (20cm long) was planted with its part 6cm deep into the poly pot. Watering was done occasionally when there was no

rain; weeds were removed by hand picking, 2 times before the end of the experiment

Data collection: Data collected were plant height of different section, number of leaf per plant, and effect of different section of the plant on the dry matter yield. Number of Sprout of cuttings and Percentage Survival were collected at 2, 4, 6, 8, 10 and 12 weeks after planting.

Data analysis: **A**ll data collected were subjected to Analysis of Variance (ANOVA). Means were separated using Duncan Multiple Range Test (DMRT). As a qualitative trial, treatment means were also used to construct Tables and Bar charts on some parameters determined to express how they were influenced by the various sections of the plant.

Results and Discussion

The number of sprouts per cutting of *Jatropha* as influenced by various sections of the plant is presented in Table 1. At two weeks after planting (2WAP), number of sprouts per cutting was significantly ($P > 0.05$) affected by the different sections of the plant. The trend of the result was the same at 4 WAP, even up to 12 WAP. These significant differences ($P > 0.05$) in sprouting production are an indication that the different parts of the plant (*Jatropha*) had different sprouting ability. Highest number of sprouts was recorded from the Apical Cuttings. As a meristematic section of the plant, vegetative growth is relatively higher in its section. The result on this parameter corresponded with Samba *et al.* (2006). The least number of sprouts per cutting was recorded from stands grown through the root cuttings. Perhaps meristematic activity is low in the roots of the plant.

The Plant Height of *Jatropha* over time as influenced by the various sections of the plant is presented in Fig. 1. The height of the plant at 2 WAP, was not affected significantly ($P > 0.05$) by the different sections (3-4 cm). The trend was the same at 4 WAP. Perhaps growth was not vigorous at 2 and 4 week of growth in *Jatropha*. However, at 6 WAP, there was a significant change in growth of the plant. Stands grown through Apical (Cutting) grew relatively taller than others. The results were similar the same at 10 and 12 WAP.

Generally, the highest plant height was recorded from stands grown through the Apical section of the plant, followed by those grown through Middle cuttings though not significantly different from those grown through the Basal cutting. However the least plant height was recorded from stand grown, through the root cuttings. These results are in agreement with the results reported by Samba *et al.* (2006).

Leaf production of *Jatropha* as presented in Table 2, was not significantly affected by the various sections of the plant from the 2^{nd} week of planting up to the 10^{th} week. However, at the 12 WAP, stands grown through the apical cuttings produced more leaves ($P > 0.05$) than others, followed by those grown through the middle stem cuttings. Conversely, there was a significant development on the leaf production of the plant. The leaf number of all the stands irrespective of the planting stock was fairly the same ($P > 0.05$). The result on the parameter was the same from 2 WAP (4.0-4.9) to 10 WAP (20.0-22.5). 12 WAP, as the stands grown through the apical stem cuttings had the largest number of leaves (26), those grown through the Middle cutting had the largest leaf area per plant.

Dry matter yield of *Jatropha* as presented in Table 3, was not significantly affected by the various sections of the plant at 6WAP

(3.9-4.8). However, at the 8th WAP, stand grown through the apical cuttings produced more Dry Matter than others (10.4). The result was similar at the 10th (13.2) and 12th WAP (15.1). This was followed by those grown through the Middle stem cuttings. The least Dry Matter yield was recorded from stands grown through the Root cutting (12.1). Dry matter yield of all the stands irrespective of the planting stock was fairly the same (P > 0.05). The results agree with the report of *Critical Review in Plant* (1989).

Leaf Area of *Jatropha* as influenced by the various sections of the plant is presented in Table 4. The Leaf Area per plant at 2 WAP, 4 WAP and 6 WAP was not affected significantly (P > 0.05) by the different sections of it. The trend could be as a result of non vigorous growth of *Jatropha.* However, at 8WAP there was significant (P > 0.05) change in area of the leaf of the plant. Stand grown through apical section (Cutting) were relatively wider (8.7-31.4 cm) than others. The result was the similar at the 10th (9.7-34.0 cm). At 12 WAP, the largest leaf area was recorded (11.1-38.4 cm) from stands grown through the Apical section of the plant, followed by those grown through Middle cuttings. This agrees with Jongchaap *et al*. (2007).

Number of stems of *Jatropha* as influenced by various sections of the plant is presented in Table 5. Number of stem 2 WAP was significantly (P > 0.05) affected by different sections of the plant (2.4-4.7). The result was similar at 4 WAP even up to the 12 WAP (64.0-6.9). The significant difference in the number of stem is also an indication that there were different sprouting abilities of the different sections. Apical cuttings recorded the highest number of leaves. The least number of stems was recorded from stands grown through the Root cuttings.

The percentage survival of *Jatropha* as influenced by the various sections of the plants is presented in Fig. 2. At 12 WAP the survival percentage of the plant was significantly (P > 0.05) affected by the different sections of the plant. Stand grown through the Apical section (cutting) survived relatively more than the others (60%) and recorded the highest survival percentage while those grown through the middle (58%) and the basal (58%) was next and they had equal survival rate. The least survival rate was recorded from the stands grown through the root. Results of this parameter also correspond with the results reported by Samba *et al.* (2006).

The results of the study revealed that stands grown through the apical cuttings grew taller (16.2 cm), closely followed by Basal cuttings (15.6cm) and the Root cuttings had the least height (12.8cm). At 12 WAP apical cuttings had the highest number of leaves (26.0) while the Basal had the least number of leaves (21.0). The Dry mater yield 12 WAP shows that Apical has 15.1g as the highest, the Middle and Basal yield 13.2g and Root yield as the least 12.1g. Highest Leaf Area per plant (41.4cm^2/plant) was recorded from stands grown through the Middle cuttings while the least 11.1cm^2/plant was from stands grown through the Root cuttings. Highest Number of Stems per cuttings (6.9) at 12WAP was recorded from stands grown through the apical cuttings though not significantly different from those of the Middle and Basal, cuttings (5.8). Therefore, for growth of *Jatropha curcas* through cuttings or asexual means, the apical cuttings are recommended.

Table.1 Number of sprout per cutting of *Jatropha curcas* as influenced by different sections of the plant

Treatment	Time (Weeks after planting)					
	2	4	6	8	10	12
Apical	4.7b	5.3a	6.8a	7.3a	7.3a	7.3a
Middle	2.7d	3.7c	5.7b	5.9b	3.4d	6.1b
Basal	5.3a	5.3a	5.7b	5.9b	6.0b	6.0c
Root	3.2c	3.2d	3.7c	3.9c	4.1c	4.4d
DMRT (>0.05)	*	*	*	*	*	*

a-d are levels of significance in each column, DMRT (> 0.05)
n.s. = non-significant difference P > 0.05
* = significant difference P > 0.05

Table.2 Number of leaf per plant of Jatropha as influenced by different sections of the plant

Treatment	Time (Weeks after planting)					
	2	4	6	8	10	12
Apical	4.0	10	17.7	21	20	26a
Middle	4.9	8.7	17.0	18.9	20.8	23.4b
Basal	4.3	8	16.7	18.7	20	21.3c
Root	4.0	9.7	14	20.3	22.5	22.8c
DMRT (>0.05)	n.s	n.s	n.s	n.s	n.s	*

a-d are levels of significance in each column, DMRT (> 0.05)
n.s. = non-significant difference P > 0.05
* = significant difference P > 0.05

Table.3 Effect of different sections of Jatropha plant on its dry matter yield (g)

Treatment	Time (Weeks after planting)			
	6	8	10	12
Apical	4.50	10.4a	13.2a	15.1a
Middle	4.80	10.3a	12.4b	13.2b
Basal	4.70	8.6b	10.3c	13.2b
Root	3.90	6.0c	10.2c	12.1c
DMRT (>0.05)	n.s	*	*	*

a-d are levels of significance in each column, DMRT (> 0.05)
n.s. = non-significant difference P > 0.05
* = significant difference P > 0.05

Table.4 Effect of different sections of Jatropha plant on its leaf development (cm2)

Treatment	Time (Weeks after planting)					
	2	4	6	8	10	12
Apical	3.2	12.7	18.3	31.4a	34a	38.4b
Middle	3.7	10.8	11.7	28.1b	32b	41.4a
Basal	2.6	8.8	14.1	18.4c	25c	30.2c
Root	2.1	6.9	10.9	8.7d	9.7d	11.1d
DMRT (>0.05)	n.s	n.s	n.s	*	*	*

a-d are levels of significance in each column, DMRT (> 0.05)
n.s. = non-significant difference P > 0.05
* = significant difference P > 0.05

Table.5 Number of *Jatropha curcas* stems developed as influenced by different sections of plant

Treatment	Time (Weeks after planting)					
	2	4	6	8	10	12
Apical	4.7a	4.3a	5.3a	6.3a	6.7a	6.9a
Middle	1.7c	3.2b	4.0b	4.7b	4.8c	5.9b
Basal	4.7a	4.3a	3.8c	4.3c	5.0b	5.8b
Root	2.4b	2.0c	2d	2.9d	3.0d	4.0c
DMRT (>0.05)	*	*	*	*	*	*

a-d are levels of significance in each column, DMRT (> 0.05)
n.s. = non-significant difference P > 0.05
* = significant difference P > 0.05

Fig.1 Plant height of Jatropha as influenced by different sections of the plant

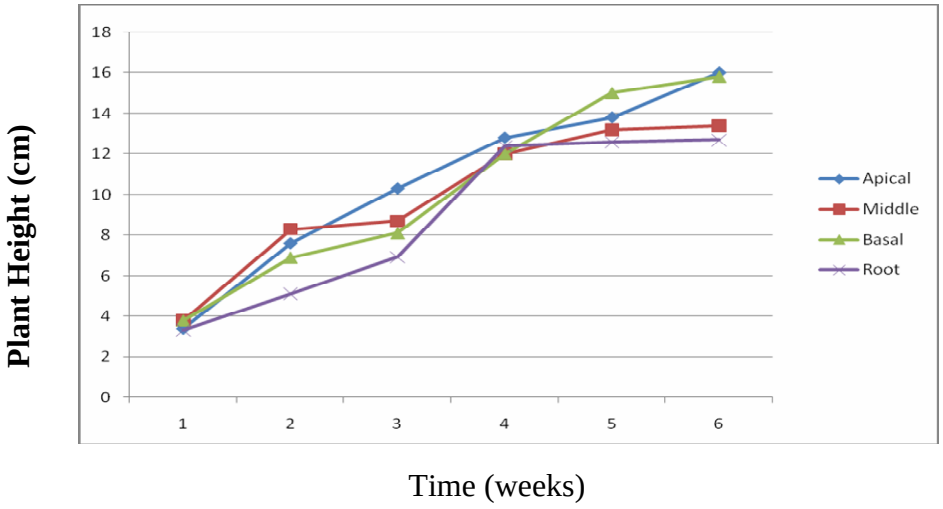
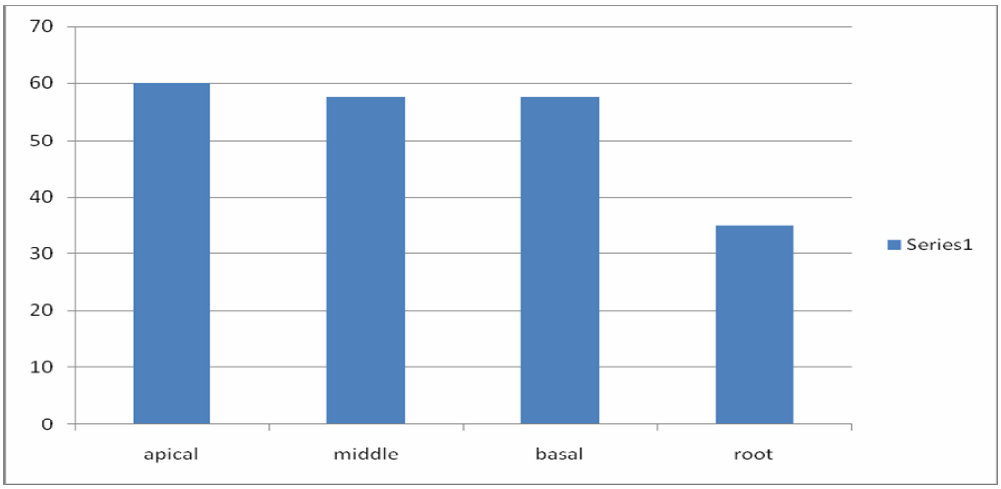


Fig.2 Survival percentage of Jatropha as influenced by different sections



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