INFLUENCE OF PLANTING DEPTH ON SEEDLING VIGOR OF *JATROPHA CURCAS.* L.

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Abstract
One major factor of importance in the cultivation of Jatropha curcas L. is the planting depth at which seeds or vegetative materials (cuttings) are established in the soil. This is because there must be easy access of these planting materials to soil nutrients for optimum performance. Hence, this study was carried out to evaluate the effect of planting depth on seedling vigor and growth of J.curcas. To this effect, an experiment was carried out using randomised complete block design (RCBD) with three replicates. Two propagating materials- seeds and stem cuttings were used. Dry seeds of J. curcas were planted at different depths of 3, 6 and 9cm respectively, while the stem cuttings were planted at depths of 10, 15 and 20 cm respectively. Results showed that sowing depth had significant effect on rate of seedling emergence, plant height, root length and root weight at p<0.05. For the stem cuttings, planting depth had no significant effect on sprouting parameters while root length and biomass were significantly affected (p<0.05). Conclusively, the 3cm depth was found to be most suitable for planting the seeds to achieve high seedling vigor while Jatropha stem cuttings could be planted at 10cm depth for good root development. Hence, when considering selection of seedlings for field establishment, rate of seedling emergence, plant height and root biomass could serve as good indicators for seedling vigor.

Keywords: Jatropha, planting depth, vigor, cuttings, seedlings.

Introduction
Jatropha curcas L. (family Euphorbiaceae) is a plant which grows well under tropical and sub-tropical conditions. It is also known to withstand conditions of severe drought and low soil fertility due to its ability to grow well in marginal soils. It could be used to reclaim problematic lands and restore eroded areas (Heller, 1996; Joker and Jepsen, 2003). *Jatropha* plant is usually described as a tall shrub which grows to a height of about 6 metres and has a life span of about 50 years. *Jatropha* curcas is a promising crop with many applications which include the production of bio-fertilizer from the pressed residue of the seeds and production of bio-diesel from the seeds for direct combustion in Ignition engines (Berchmans *and Hirata*, 2008; Anonymous, 2006) among others. Sowing depth is a factor of importance when considering seedling vigor and growth. This is because rapid seedling establishment is an important attribute for successful crop production particularly in short season areas (McGinnies, 1974). Previous studies have shown a wide range of planting depth for both seed and stem cuttings cultivated in different areas. In countries like India and Mali where *J. curcas* has been cultivated on commercial scale, sowing depth for seed propagated plants was 6 cm while for stem cuttings, a deeper depth was used (Prakash, 2006; Oliveira *et al*., 2009). Heller (1996) and Grimm *et al*.,(2008) suggested that *Jatropha* seeds could be sown at a depth of 2cm with the whitish part of the seed pointing slightly downward. Kaushik *et al*., (2007) stated that for *Jatropha* seeds sown in poly bags, a depth of 1.5 - 2.0 cm was appropriate while planting depth should be a little deeper down for stem cuttings. On the other hand, Henning (2000) recommended a sowing depth of 3cm for seed propagated *J. curcas* on the field. For optimal establishments of *J. curcas* on the field, seeds as well as stem cuttings should have easy access to soil organic matter and soil nutrients. This study therefore aims at evaluating the effect of planting depth on the seedling vigor of the *J. curcas* in the Southern Guinea savanna ecological zone of Nigeria.

Materials and Methods

This study was carried out during the late rainy season of 2011, at the nursery pavilion of the Faculty of Agriculture, University of Ilorin, Ilorin, in the Southern Guinea savanna ecological zone of Nigeria. It is located on latitude 8' 30N and longitude 4' 32E characterized by a bimodal rainfall pattern with slightly acidic sandy loam soil. The experiment was laid out as a randomised complete block design with three replicates. The treatments comprised of *Jatropha* seeds and stem cuttings planted at different planting depths: 3cm, 6cm and 9cm for the seeds and 10cm, 15cm and 20cm for the stem cuttings. The seeds were sun dried for 24hours before planting to hasten up germination while the stem cuttings which were obtained from lateral branches of matured plants were pretreated with a solution of Indole Butyric Acid (IBA) and air dried for 24hours prior to planting. For the seed propagated plants, data collected included survival percentage, percentage seedling emergence, plant height, leaf number, leaf length and number of branches at 2 weeks interval from 2 to 10 weeks after planting. Rooting parameters assessed included the root length, root fresh weight and root dry weight. For the stem cuttings, data collected included number of buds that sprouted, bud length, number of leaves/cutting and leaf area at intervals of 2 weeks from 6 to 10 weeks after planting. Rooting parameters assessed included root length, root fresh and dry weight at 10weeks after planting.

Statistical Analysis: The data obtained were subjected to analysis of variance using Genstat 5 (Release 3.2), and significant means were separated using the Least Significant Difference (LSD) test at $p<0.05$.

Results and Discussion

Results obtained on the effect of sowing depth on the seedling vigor of *J. curcas* propagated generatively using seed were as presented below. Table 1 showed the effect of sowing depth on the percentage seedling emergence and survival of seed propagated *J. curcas*. Significant treatment differences were observed at 7^{th} and 14^{th} days after planting ($p<0.05$). At 7 days after planting, seeds sown at a depth of 3cm had the highest percentage seedling emergence (46.7%) while no emergence was found in seeds sown at 9cm depth. Seeds sown at 3cm depth attained the maximum seedling emergence (97.3%) by 14 days after planting while the least was recorded for 9cm depth (30.0%). However, no significant treatment difference was found in percentage seedling emergence by 21 days after planting. This observation may be supported by the findings of McGinnies (1974) who reported that as plants grow older, the effect of planting depth on the individual plant gradually reduces. It could be said that an increase in the sowing depth of seeds probably resulted in reduction of percentage seedling emergence at 7^{th} and 14^{th} days after planting due to delayed emergence. These observations conformed with the report of Beveridge and Wilsie (1959) which stated that when seeds are sown too deeply, emergence might be delayed. Time of emergence has been recommended as a good indicator of a cotton plant vigor and potential yielding ability (Wanjura *et al.*, 1969). Survival percentage of seedlings was not significantly affected by the planting depth at $p<0.05$ throughout the period of emergence. This may be due to the fact that survival of plant is conditioned by other factors aside planting depth. Table 2 showed the effect of planting depth on the sprouting behavior of *J. curcas* at 8 weeks after planting. Significant treatment differences were observed for mean plant height and leaf number at 8 weeks after planting ($p<0.05$) while mean number of branches and mean leaf length were not significantly affected. Mean plant height ranged from 18.8 to 28.2cm. *J. curcas* seeds sown at 3cm depth had seedlings with the highest plant height (28.2cm) while the least height (18.8cm) was observed for seeds sown at 9cm depth. Mean leaf number ranged from 15.0 to 18.0. The highest value was observed among seedlings planted at 3cm depth while the least was found at 9cm depth. The height differences between plants sown at different depths apparently resulted from the fact that rate of emergence was faster at 3cm depth. This may be responsible for faster growth which resulted in higher plant

height and similarly, higher number of leaf produced per plant. Mean number of branches/plant was between 13.3 and 15.0. Seeds sown at depth of 3cm had seedlings with the highest number of branches/ plant (15.0) while the least number of branches (13.3) was observed for seeds sown at depth of 9cm. However, no significant difference was observed among the treatments at $p<0.05$. This observation corroborated the findings of Henning (2000) who suggested that, when planting *J.curcas* seeds on the field, a depth of 3cm should be adopted for optimal growth. Table 3 shows the effect of planting depth on the rooting behaviors of *J. curcas* propagated through seed. Significant treatment differences were observed for root fresh weight and root biomass and not for root length at $p\leq0.05$. Mean root fresh weight ranged from 13.6 to 15.3g. The highest value (15.3g) was observed among seedlings from seeds sown at 9cm depth while the least (13.6g) was found at 3cm planting depth. Root biomass was between 5.5 g as found in 3cm planting depth and 7.7g found in 9cm planting depth. Also, mean root length was between 34.0 and 42.0cm. This probably indicates that sowing deeper than 3cm actually enhanced development of root mass in seed propagated plants, though root length was not significantly affected. This is related to the findings of Sandhi (2008) in his report on the effect of sowing depth on wheat.

Table 4 shows the effect of planting depth on sprouting behavior of *J. curcas* raised from stem cuttings at 10 weeks after planting. Results showed that there were no significant treatment differences for all the sprouting parameters evaluated. Mean number of buds that sprouted was between 4 and 5 buds/plant while mean bud length was between 11.8 and 12.7 cm/plant. Mean leaf number ranged from 24 to 30 while mean leaf area ranged from 0.17 to 0.19 cm^2. Table 5 shows the effect of planting depth on the rooting behavior of *J. curcas* raised from stem cuttings. Significant difference was observed among the treatments for each of the rooting parameters assessed. Mean root length ranged from 29.7 to 44.3 cm as observed with cuttings planted at 20cm and 10cm depth respectively. Mean root fresh weight ranged from 11.9 to 31.2g. The highest root fresh weight was observed with cuttings planted at 10cm depth while the least was observed at 20cm depth. Mean root dry weight ranged from 4.3 to 11.3g found with cuttings planted at 20cm and 10cm depth respectively.

Conclusion

For the seed propagated *Jatropha curcas*, rate of seedling emergence, plant height and leaf number were significantly affected by planting depth which probably affects seedling vigor. Early emergence favoured optimal plant growth in terms of the plant height and leaf number which will probably lead to good field establishment and fruit yield. Planting depth had significant effect on the mean root fresh weight and biomass. Higher planting depth appeared to have positive effect on root development. This attribute may be important in areas prone to strong wind and low soil moisture. However, plant survival was not significantly affected by planting depth. Planting depth significantly affected the rooting behaviors of vegetatively propagated *J. curcas*. Increase in planting depth resulted in corresponding reduction in the rooting parameters of the plant. For optimal field establishment seeds may be sown at a depth of 3cm while stem cuttings may be planted at a depth of 10cm. It should also be noted that planting at different depths could significantly affect seedling vigor and consequently may affect crop yield.

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Table 1: Effect of planting depth of seeds on rate of seedling emergence and survival

Planting Depth	% seedling emergence			Survival (%)
	7 DAP	14 DAP	21 DAP	
3cm	46.7[a]*	97.3[a]	98.0	88
6cm	20.0[b]	56.7[b]	96.7	87
9cm	0.0[c]	30.0[c]	96.5	93
LSD (0.05)	19.8	24.8	Ns	Ns

* Means having different letters are significantly different at 0.05 level of probability.
ns = no significant difference at p< 0.05

Table 2: Effect of planting depth of seeds on vegetative growth of J. curcas

Planting Depth	Mean plant height (cm)	Mean no. of branches	Mean Leaf number	Mean Leaf length (cm)
3cm	28.2[a]	15.0	18.0[a]	11.0
6cm	20.5[b]	14.3	17.0[a]	10.7
9cm	18.8[c]	13.3	15.0[b]	10.8
LSD (0.05)	1.33	n.s	3.06	n.s

*Means followed by different letters are significantly different at 0.05 level of probability.
ns = no significant difference at p< 0.05

Table 3: Effect of planting depth of seed on rooting behavior of J.curcas (10 WAP)

Planting Depth	Root Length (cm)	Root Fresh Weight. (g)	Root Dry Weight (g)
3cm	34.0	13.6[c] *	5.5[c]
6cm	38.3	14.1[b]	6.0[b]
9cm	42.0	15.3[a]	7.7[a]
LSD (0.05)	n.s	5.5	6.0

*Means followed by different letters are significantly different at 0.05 level of probability.
ns = no significant difference at p< 0.05

Table 4: Effect of planting depth of stem cuttings on sprouting behavior of *J. curcas*

Planting Depth	Mean no of buds/cutting	Mean bud length/cutting (cm)	Mean leaf number/cutting	Mean leaf area/ cutting (cm^2)
10cm	5.0	11.8	30.0	0.19
15cm	4.0	12.6	25.0	0.18
20cm	4.0	12.7	24.0	0.17
LSD (0.05)	n.s	n.s	n.s	n.s

n.s means no significant difference

Table 5: Effect of Planting Depth on the Rooting Behaviours of *J. curcas* stem cuttings

Planting Depth (cm)	Root length (cm)	Root fresh wt (g)	Root dry wt (g)
10cm	44.3[a] *	31.2[a]	11.3[a]
15cm	35.7[b]	21.1[b]	6.2[b]
20cm	29.7[c]	11.9[c]	4.3[c]
LSD (0.05)	4.9	6.9	1.9

* Means having different letters are significantly different at 0.05 level of probability