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DARDIZING CUTTING SIZE FOR CLONAL MULTIPLICATION OF JATROPHA CURCAS

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ABSTRACT

An attempt was made to standardize the cutting size for clonal multiplication of Jatropha. Four different sizes of stem cuttings *viz.*, 5 mm-10 mm, 10 mm-15 mm, 15 mm-20 mm and 20 mm-25 mm were taken based on mid diameter of the cuttings and raised in mistless polytunnel system. The growth parameters *viz.*, survival percentage, average root length, number of roots and sprouts per plant were taken. Among the sizes, the cutting size of 20 mm-25 mm expressed maximum survival percentage (94.34 %) and was followed by 15 mm-20 mm (87.18 %). All the clonal cuttings were planted in the field adopting Randomized Block Design in four replications at an espacement of 2m x 2m. These clonal plants evaluated at three months interval up to one year. The cuttings expressed significant variability in terms of growth. Among different cutting sizes, the cutting size of 20 mm-25 mm expressed early superiority in terms of plant height (184.58 cm), diameter (80.63 cm), and number of branches (6.33) under field conditions.

Key words: Biofuel, Clonal propagation, Cutting size, Growth, Jatropha.

Jatropha curcas is a tree native to Central America. It is commonly known as physic nut or purging nut, belongs to the family Euphorbiaceae. It is a small tree or shrub with smooth gray bark, which exudes whitish colored, watery, latex when cut. Normally, it grows between three and five meters in height with spreading branches, but can attain a height of up to eight or ten meters under favourable conditions. It flowers in hot and rainy season and set fruits in winter. In field condition this may produce the seed after five year of plantation (Jones and Miller, 1992). The oil content of seeds represents a reasonable opportunity for renewable fuel (Shultz. and Morgan, 1985; Harrington, 1986). The seed of Jatropha contains about 34 to 37 % non-edible oil. However, they also contain a high percentage of clean oil used for candles, soap and biofuel production (Pant *et al.*,2006). Physic nut has insecticidal and fungicidal properties; it has latex that contains an alkaloid (Jatrophine) which shows anti-cancerous properties.

There has been growing interest in using the techniques of clonal forestry and there by, exploring the genetic variability of selected superior genotype for the production of quality planting stock and to achieve yield improvement (Leaky, 1987). However these clonal technologies are currently available only for few species and the cuttings collected from the same plant expressed variability interms of survival and growth pattern which might be due to epigenetic variation (Surendran *et al.* 2000; Parthiban *et al.*, 2010). Age and size of planting material is important for initial survival and establishment of seedlings (Haq, 1992). Hence it is necessary to standardise the optimal cutting size for adoption of clonal technology. Against this backdrop the current study was conducted to screen the cutting size in Jatropha clonal propagation.

The experiment was conducted in department of Tree Breeding, Forest College and Research Institute (11°19'N; 76°56'E; 300 MSL), Mettupalayam, Tamil Nadu, India. Four different

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sizes of stem cuttings *viz.*, 5 mm-10 mm, 10 mm-15 mm, 15 mm-20 mm and 20 mm-25 mm were taken based on mid diameter of the cuttings. The cuttings were trimmed to a length of approximately 15cm and planted in polybags filled with sand, soil and farm yard manure and kept under shade. The treatments were replicated four times and for each replication twenty five cuttings were used. Observations on percentage of cuttings rooted, number of roots per cuttings, number of sprouts per cuttings and average root length (cm) were recorded after 60 days of planting. Ninety days old clonal cuttings were planted in the field adopting randomized block design in four replications. In each replication, nine ramets were planted in 2m x 2m spacing. Observation on plant height, collar diameter and number of branches was made at three months interval. Plant height was measured using one meter scale and collar diameter was measured using digital vernier caliper. All clonal cuttings were started to flower after two months of planting.

The observation on percentage of cuttings rooted, number of roots per cuttings, number of sprouts per cuttings and average root length (cm) were recorded after sixty days of planting (Table 1.).

The survival percentage differed significantly due to size of the cuttings. Among different diameter of cuttings, the cutting size of 20 mm-25 mm expressed maximum survival percentage (94.34 %) followed by 15 mm-20 mm size (87.18 %) as in *Ficus roxburghii* (Rana, and Sood, 2012). However, all the cutting types showed good survival percentage ranging from 77 % to 94 %. It is presumed that the large and medium sized cuttings might have got sufficient food material and hormones for induction of early root and shoot growth. Hormones have been shown to regulate different aspects of plant growth and development including cell division, cell elongation and differentiation (Davis, 1996). It is also been presumed that the sprouting behavior of stem cuttings varied with age, genotypes and physiological status of mother plant (Pal, 1980). The factors like age of the mother tree, size of cuttings and the changes in nutrients reserves as well as carbohydrate reserves might be greatly influenced the rooting of branch cuttings (Rieckermann *et al.*, 1999).

The vigor of the sprouted cuttings in all grades of cuttings was rated interms of number of sprouts/cutting, root length (cm) and number of roots. Number of roots was higher in the cutting sizes of 20 mm-25 mm and 15 mm-20 mm; however the average root length was higher in 20 mm-25 mm cuttings only. The cutting thickness of 20 mm-25 mm produced more number of sprouts per plant. The small sized cuttings registered low growth. The differences in rooting indicated that growth regulators alone were not responsible for rooting in cuttings, but variety of factors including the size of the cutting, age of cutting, season and position of the cuttings in the mother tree (Nanda *et al.*, 1969). A reduction in root length was observed with reduction in size of cuttings, due to inadequate supply of nutrients in smaller cuttings resulted in poor performance in rooting. This might be due to higher adventitious ability of juvenile characters of larger cutting compared to smaller cutting which are having tender tissues, with unsaturated latex and the higher content of metabolites like tannin, lignin, etc. which adversely interfere with sprouting and root development (Hegde, 1988). The initial levels of endogenous auxin and its oxidation enzymes IAA-oxidase and peroxidase play a significant part in the rooting process. IAA-oxidase activity is involved in triggering and initiating the roots/root primordial, whereas peroxidase is involved in both root initiation an elongation.

To find out the suitable cutting diameter for propagating of *Jatropha curcas* for commercial

TABLE 1: Performance of Jatropha clones in the nursery

Cutting size	No of Roots/Plant	Average root length (cm)	No of sprouts/Plant	Survival %
5mm -10mm	7.83	7.28	4.00	77.28
10mm-15mm	13.33	11.23	3.78	83.68
15mm-20mm	15.45	11.35	5.10	87.18
20mm-25mm	15.45	12.05	6.20	94.35
Mean	13.01	10.48	4.77	85.62
SEd	0.36	0.70	0.06	0.21
CD(0.05)	0.81	1.95	0.15	0.47

propagation, the four different sizes of stem cuttings were forwarded to the field produced much longer and healthier plants which produced flowers, fruits and seeds during the ûrst year of growth itself, which is of great importance for commercial cultivation of this biofuel plant. It was found that vegetatively propagated planting stock had higher field growth performance than seedlings in *Ecucalyptus* spp (Rockwood, 1994). A similar result was also reported by Bergmann (2003) in *Paulownia* spp.

Different size of cuttings were not significantly influenced the plant height of Jatropha at different intervals of observations (Table 2.). The cutting size of 15mm-20mm recorded the maximum height(101.46 cm, 145.58 cm and 170.25 cm) at three, six and nine months after planting. But at twelve month, plant height was higher in 20mm-25mm cutting size (184.58 cm). Similar findings were reported in *Populus deltoids*. The results revealed that the cutting length and thickness of the clones had no effect on plant height which is of great importance for commercial cultivation of this biofuel plant (Sanjeev e*t al.*, 2003).

The effect of different size of cuttings on diameter of Jatropha was not significant at different intervals after planting (Table 3.). The results were supported by the findings of Sanjeev *et al.* (2003) in *Populus deltoids*. However the maximum diameter was recorded with 20 mm - 25 mm cuttings and the minimum with 5 mm-10 mm at all the four observations. It was observed that growth of cuttings after outplanting was positively related to size (David *et al.*, 2005). The author suggested the stem diameter ranged from 8 mm to 10 mm and height ranged from 25 cm to 40 cm for good performance of rooted cuttings of *Pinus radiata*.

The present study revealed that the macro propagation of *Jatropha curcas* stem cuttings with 15 mm-20 mm and 20 mm-25 mm diameter is successful in generating higher survival and growth at nursery level. But no significant differences were observed for further growth characters in the field condition. Equal performance was shown by all size of cuttings at field level. In the present situation, availability of quality seeds for large scale planting/afforestaton is scanty. Hence, this study implies that the stem cuttings of any size between 5 mm-10 mm and 20 mm-25 mm diameter helps to develop uniform planting stock for successful afforestation of wastelands through Bio-fuel plantations.

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TABLE 2: Effect of different size of cuttings on plant height (cm) of Jatropha at three months interval

Diameter of cuttings	3 MAP*	6 MAP	9 MAP	12 MAP
5mm -10mm	97.25	142.42	165.17	181.42
10mm-15mm	100.04	141.95	167.33	180.33
15mm-20mm	101.46	145.58	170.25	184.00
20mm-25mm	94.45	141.58	165.25	184.58
Mean	98.30	142.88	167.00	182.58
SEd	10.53	15.39	8.31	10.34
CD	NS	NS	NS	NS

*MAP-Months After Planting

TABLE 3: Effect of different size of cuttings on diameter (mm) of Jatropha at three months interval

Diameter of cuttings	3 MAP	6 MAP	9 MAP	12 MAP
5-10mm	36.32	44.04	61.73	74.73
10-15mm	37.23	47.31	63.63	77.15
15-20mm	39.11	49.05	63.04	80.14
20-25mm	40.83	49.86	69.83	80.63
Mean	38.37	47.57	64.56	78.16
SEd	3.24	3.27	5.24	6.47
CD	NS	NS	NS	NS

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