



## A study to Establish a Protocol for Cultivation of *Jatropha curcas* Linn

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### Abstract

Survival rate of stem cutting, vegetative and reproductive growth studies were performed with *Jatropha curcas*. Plant species were collected from different topographical regions of Bangladesh viz. Chittagong, Sylhet, Jessore and Thakurgaon. No organic, inorganic fertilizer or plant hormone were used in this experiment. Results of the study revealed that best performance in respect of vegetative growth and reproductive growth was found in field condition. The study also showed that survival rate of stem cutting is highest in pot. The maximum survival rate (42.7%) for stem cutting was found during the month of March. Stem cutting collected from Chittagong showed best performance. The results suggested that genome collection and cultivation of *Jatropha curcas* performed best in summer season, specifically from March to early April, which is unusual to other plants in our country. It also suggested that to cultivate *J. curcas* in level land like Dhaka, stem cutting should be collected from hilly areas of Bangladesh like Chittagong district for more survival rate of plants.

**Key words:** *Jatropha curcas*, growing season, fertilizer, soil pH, survival percentage.

### Introduction

*Jatropha curcas* L. belongs to the family, Euphorbiaceae, one of the important multiusefull fast growing large shrub species for oil extraction, especially since it is drought resistant and can be cultivated on marginal land, without competing with food production (Heller, 1996; Grimm, 1996; RF, 1998). Locally, it is grown as a boundary fence or live hedge and can be used to reclaim eroded areas (Heller, 1996; Joker and Jepsen, 2003). Its leaves and stems are toxic to animals, but after treatment, the seeds or seed cake is also an excellent source of plant manure (FR 1998, Makkar *et al.*, 2001). *J. curcas* is fast growing and produce seeds after approximately 1-3 years, depending on rainfall conditions and how the plant is propagated (from stem cuttings or seeds, respectively). *Jatropha* the wonder plant produces seeds with an oil content of 37%. The oil can be combusted as fuel without being refined. It burns with clear smoke-free flame, tested successfully as fuel for simple diesel engine. The by-products are press cake a good organic fertilizer, oil also contains insecticide. Among the many species, which yield oil as a source of energy in the form of biodiesel, *J. curcas* L. has been identified as most suitable oil seed bearing plant due to its various favourable attributes like hardy nature, short gestation period, and adaptability in a wide range of agro-climatic conditions, high oil recovery and quality of oil etc.

For a country reeling under the burden of a large oil import bill and spiraling oil prices biodiesel is a promising indigenous and renewable source of energy. Production of bio-fuel from plant materials is a major step toward harnessing renewable energy resources. It may also transform the poorest people and the most marginalized land into the source for this energy (Kochar *et al.*, 2005). *J. curcas* is available in Bangladesh. So far no study was done to establish a standard method or protocol to cultivate the plant species. Accordingly, the present investigation was undertaken to find out the rooting percentage and survival rate of stem cuttings in field, pot and propagation room respectively and was cultivated both in dry and rainy season to show the survival performance of the plant species.

### Materials and Methods

*Jatropha curcas* stem cuttings were collected from different regions of Bangladesh such as Chittagong, Jessore, Sylhet and Thakurgaon. The stem cuttings were cut into 8-12 inch long with a diameter of 20.50-13.00 mm. The field methodology involved three stages- i) research field plantation at IFRD, BCSIR, Dhaka ii) earthen pot plantation and iii) study of root cuttings in the propagator. The collection period of stem cuttings used in all experiments were performed from April to June, 2007 and March, 2008.

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### Preparation of research field and sowing of stem cuttings

The investigation was made in the research field at IFRD, BCSIR, Dhaka. The time period was from March, 2007 to August, 2008. The soil of the experimental field was a clay loam with pH 6.58. Range of annual humidity and temperature were 53-92% and 14.5-35.0 °C, respectively. The line to line distance was 1.5 meters. Stem cuttings were sown in the soil at a depth of 4-6 cm and plant to plant spacing of plantation was 2 meters. Watering was done four times per week in November to February and two times per week in March and April and no watering was done in May to October. Weeding and other cultural practices were done as and when necessary. Cuttings were observed regularly to find its bud initiation, growth rate and survival rate. The observation showed first bud initiation after 15 days, flowering showed after 9 month and fruit formation after 11 month. The inflorescence was formed in leaf axil. Flowers are formed terminally where each inflorescence contains a bunch of approximately six or more ovoid fruits. The seeds become mature when the capsule changes from green to yellow, two to four months after flowerings. After collection the fruits were transported in open bag until all the fruits have opened. When the seeds were dry they were separated from the fruits and cleaned. The seeds were dried to low moisture content and stored in air-tight containers.

### Preparation of earthen pots and sowing of stem cuttings

The investigation was made in the earthen pot at IFRD, BCSIR, Dhaka. The time period was from March, 2007 to August, 2008. Air-dried soil with pH 6.40 was used in the earthen pot. Stem cuttings were sown in the soil at a depth of 6 cm in each earthen pot. Watering and weeding was done similarly to the field experiment as mentioned earlier. Afterwards, the cuttings were inspected every day for its bud initiation, growth rate and survival rate.

### Preparation of propagation room and sowing of stem cuttings

The investigation was made in the propagator at IFRD, BCSIR, Dhaka. The time period was from March, 2007 to August, 2008. The soil of the experimental earthen pot was air dried sandy soil with pH 6.85. Range of annual humidity and temperature were 85-96% and 14.5-35.0 °C respectively. The size of the propagator is 6ft x 3ft x 4ft where eight (12cm,x 40cm) perforated plastic baskets were placed. All the baskets were prepared by filling with air dried sandy soil.

Stem cuttings were sown in the sandy soil at a depth of 6-8 cm. Water sprayed every day. Afterwards cuttings were inspected every day for its bud initiation, growth rate and survival rate. The observation showed after 7 days 36 out of 73 cuttings showed bud initiation, then after 15 days of planting the number of cuttings showing bud reduced 36 to 20. In the 3rd week number was 10. Finally none of the cutting survived. All of the cuttings which showed bud initiation did not show root initiation. The negative result may be due to fungus infection. The propagation provides lot of moisture for better root and bud initiation. But in this case it was rather an adverse situation for *Jatropha curcas* as it can not tolerate high moisture or wet weather. No organic and inorganic fertilizer and hormone has been used for trails in the all experiment. The collected data were analyzed statistically and the mean, standard deviation and other calculations are evaluated considering 5% level of significance by a computer package programme called SPSS (Statistical Package for Social Science) of version 14, now frequently being used to analyze all sort of data and this version was developed by SPSS Inc. in 2006.

### Results and Discussion

*Jatropha curcas* stem cutting cultivations in different seasons were studied here. Stem cuttings were collected from four different districts namely, Chittagong, Jessore, Sylhet and Thakurgaon and cultivated in five different months in two years; 2007 and 2008. In April 2007 survival percentage of stem cuttings in field was 24.47. And in May 2007 this percentage became 13.10. Similarly, survival percentage of stem cuttings dropped to 11.39 in the month of June 2007. However, in March 2008 survival rate climbed to 42.73 percent and this was the highest performance of survive. Finally, 34.60 percent stem cuttings were survived when they were cultivated in April 2008.

**Table I. Survival percentage of *Jatropha curcas* cultivation in different months of the year**

Month	Sample size (n)	Mean	Standard Deviation (SD)
April/07	3	24.47	23.20
May/07	6	13.10	15.23
June/07	3	11.39	16.25
March/08	9	42.73	23.13
April/08	3	34.60	23.64

Above table depicts survival percentage of stem cutting collected from four areas shows height percentage in March *i.e*

in dry season and lowest in June *i.e* in rainy season. Survival percentage varies noticeably in different cultivation periods, so comparatively high standard deviations are found.

Results from ANOVA test showed that average survival percentages in different periods are significantly different ( $p=0.078$ ) at 5% level of significance.

**Multiple Comparisons**

**Table II. Comparison of means of survival percentage of *Jatropha curcas* by Least Significant Difference (LSD)**

Month(I)	Month(J)	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
April/07	May/07	11.37	14.65	0.447	-19.30	42.04
	June/07	13.08	16.92	0.449	-22.33	48.50
	March/08	-18.25	13.82	0.202	-47.17	10.66
	April/08	-10.13	16.92	0.556	-45.55	25.29
May/07	April/07	-11.37	14.65	0.447	-42.04	19.30
	June/07	1.71	14.65	0.908	-28.96	32.39
	March/08	-29.63(*)	10.92	0.014	-52.49	-6.76
	April/08	-21.50	14.65	0.159	-52.17	9.17
June/07	April/07	-13.08	16.92	0.449	-48.50	22.33
	May/07	-1.71	14.65	0.908	-32.39	28.96
	March/08	-31.34(*)	13.82	0.035	-60.26	-2.42
	April/08	-23.21	16.92	0.186	-58.63	12.20
March/08	April/07	18.25	13.82	0.202	-10.66	47.17
	May/07	29.63(*)	10.92	0.014	6.76	52.49
	June/07	31.34(*)	13.82	0.035	2.42	60.26
	April/08	8.12	13.82	0.563	-20.79	37.04
April/08	April/07	10.13	16.92	0.556	-25.29	45.54
	May/07	21.50	14.65	0.159	-9.17	52.17
	June/07	23.21	16.92	0.186	-12.20	58.63
	March/08	-8.13	13.82	0.563	-37.04	20.79

\* The mean difference is significant at the .05 level

Least Significant Difference (LSD) test showed that survival percentage of stem cutting cultivation in May and June varies significantly with that in March.

**Table III. Comparison of survival percentage by duncan multiple rank test (DMRT)**

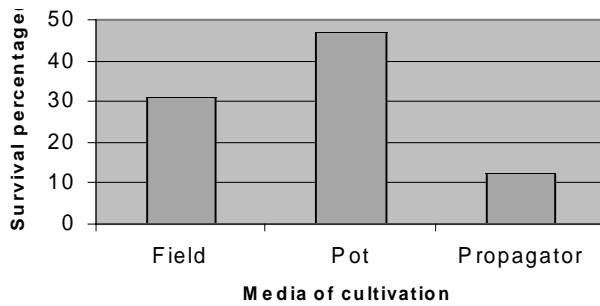
Month	N	Subset for alpha = .05
June/07	3	11.3900
May/07	6	13.1033
April/07	3	24.4733
April/08	3	34.6033
March/08	9	42.7289
Sig.		0.07100

Means for groups in homogeneous subsets are displayed

This finding confirms that *J. curcas* shows best performance in condition which is free from water stagnation and upland situation. It can grow in poor soils, in wastelands except flood prone and waterlogged areas. It can grow in acidic soils. *Jatropha* grows on well drained soils with good aeration and is well adapted to marginal soil with low nutrient content (ICRAF, 2003).

Furthermore, Duncan Test ranked averages of survival percentage of stem cutting cultivation in ascending order as June/07, May/07, April/07, April/08 and March/08 with 0.071 significance values.

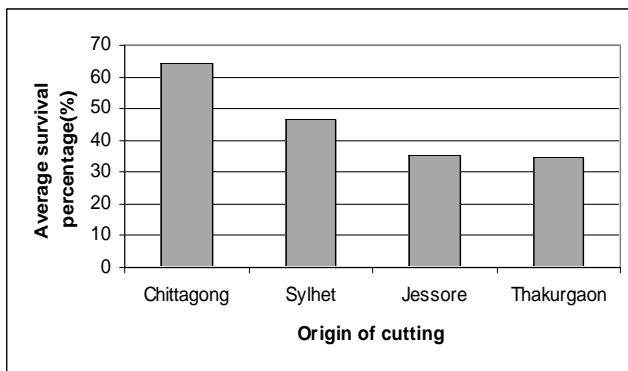
Under this study *J. curcas* stem cuttings were cultivated in three different growth conditions namely field, pot and propagators. The average survival percentages were different for these media where the highest number of cuttings were survived in pot and that is 47.07%. In fields, 31.05% cuttings survived but in propagators survival rate was lowest which is only 12.40%.



**Fig. 1. Survival percentage of *Jatropha curcas* in different media of cultivation**

*J. curcas* stem cuttings were collected from four districts of Bangladesh to cultivate in Dhaka, the central part of the country. These four districts namely, Chittagong, Sylhet, Jessore and Thakurgaon stand for four corners of the country which represents maximum heterogeneity of soil, weather and other environmental factors.

Average percentage of survival is highest for the cuttings which were collected from Chittagong which is about 65%. Sylhet stood second position that is about 47 percentages. About 35% of cuttings which were collected from Jessore and Thakurgaon were survived in Dhaka (Fig. 2).



**Fig. 2. Survival percentage of *Jatropha curcas* in different source of cutting**

After performing Analysis of Variance (ANOVA) for comparing the survival percentages of cutting over their source or collecting area. Results showed that survival percentages of cutting were significantly different for four different districts at 5% level of significance.

## Conclusion

From the present study it can be concluded that best season for *J. curcas* plantation is summer i.e March to April. Growth performance in respect of vegetative and reproductive cultivation in field condition performed better growth under field condition. Stem cutting collected from Chittagong showed best adaptability and survival rate at pot condition.

## Acknowledgement

The authors are grateful to Mr. Jasim Uddin Chowdhury, Director, Institute of Fuel Research and Development (IFRD), BCSIR, Dhaka for his kind cooperation and guidance during the experimental period.

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Received : November 10, 2008;

Accepted : June 01, 2009