Research Paper

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Studies on the Growth, Flowering, Fruiting and Seed output of Jatropha curcas L. in Krishna and Khammam Districts

Biology

KEYWORDS : Jatropha curcas, Bio diesel, Flowering, Fruiting, Seed output.

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ABSTRACT

In recent years thrust on increase of production of biofuels has been increasing. Out of the total of 63 species which were identified for promising biodiesel production, Jatropha curcas had been the choice of researchers as well as producers of bio diesel. However, inconsistencies in the growth and seed output were the main constraints faced by the producers of biodiesel. The plantations already existing and plantations raised for the present study under different environmental conditions have been studied in Krishna and Khammam districts and a comparison has been made in growth, flowering, fruiting and seed output. Water supply through drip irrigation and addition of NPK, Super phosphate and Gypsum have resulted in the seed output of 3-4 Kg/plant at the experimental site whereas 2 Kg/plant was reported at the other plantation where no nutrients were added. No flowering and no seed output were reported by Pallepadu and Panditapuram plantations, where there was no specific mode of watering and no nutrients were added. The results revealed that the type of soil did not show any influence on the establishment of plant and the physical growth as well as the seed output increased with inputs of the soil nutrients and adopting suitable watering schedules. The crowding effect due to minimal spacing was overcome with nutrients and water schedule at the experimental site. The details are discussed in the full paper.

INTRODUCTION:

Jatropha curcas L. is a small tree, belonging to the family Euphorbiaceae and is a native of tropical America, but now thrives in many parts of the tropics and sub-tropics in Africa and Asia (Heller, 1996 and Gubitz et al., 1999). Due to its various advantages like 30-40% oil content in seeds useful as biodiesel and also useful as illuminant, lubricant and manufacturing of soap and candle making (Wani et al., 2006). It can grow in waste lands, poor soils (Francis et al., 2005 and Jingura, 2011) and tolerate wide range of rain fall between 200 mm-1200mm (Kheira and Atta, 2009). All these special characteristics, *Jatropha* has dragged the attention of the many countries to reclaim the waste lands (Kumar et al., 2011).

The research and knowledge on *Jatropha* cultivation is in its infancy as there are limitations for its large scale cultivation. Overall difficulty in yield –prediction is the major constraint (Prasad and Wegstein, 2011) which in turn influenced by various parameters like nutrients, spacing effect, soil type, temperature etc. In India, *J. curcas* is found in almost all the states and is generally grown, as a live fence for protection of agricultural fields as cattle or goats do not eat it since it is not edible. The plant is undemanding in soil type as it grows everywhere, even on gravely, sandy, acidic and alkaline soils (Barua, 2011).

The objective of the present study was to record the growth consistency of *J. curcas* L. and the impact of various parameters over growth, flowering, fruiting and seed output and thus to find out the suitable conditions for its successful cultivation.

MATERIAL AND METHODS:

The present work has been carried out in 2 districts of Andhra Pradesh viz., Krishna and Khammam, selecting four different *Jatropha* plantations two from each district. A one acre plantation was selected as control site in Krishna district to compare the growth, fruiting and seed output under natural conditions.

All these five sites were having *Jatropha curcas* of age 2 ½ years.

Soil and other environmental conditions:

The soils at Pallepadu and Panditapuram in Khammam district were black cotton soils, having a pH of 7.5. The average temperature was 43 º C in summer 22 º C in winter and the average rain fall was 1200 mm/yr. In Pallepadu plantation *J.curcas* has been cultivated as a mixed crop with Mango and Green gram maintaining a distance of 3×3 m in 10 acres, whereas in Panditapuram, it has been cultivated as a boundary crop in 7500m with plant spacing of 1.5m.

Mylavaram and Nandigama sites were located in Krishna district, with red rocky and black gravel soils respectively. The average temperature was 45 º C in summer 21 º C in winter and the average rain fall was 1028 mm/yr. the pH of Mylavaram site was 8.01 and that of Nandigama was 8.14. the *Jatropha* planation at Mylavaram was a boundary crop in 13 acres with spacing of 3×3 m. and the plantation of Nandigama was a block plantation of 10 acres with a mixed spacing of 2×2 m, 3×3 m.

The soil of control site, which was located at Chandarlapadu, was black with fine gravel and alkaline in nature with a pH of 8.14. Minimum spacings were maintained here as 1×1 m, 1.5×1.5 m in an area of one acre, to compare the growth conditions with the natural plantations.

pH of the soil was measured by using digital pH meter. Physical growth of the plant was measured by counting the number of branches, height in feet and girth in inches. The percentage of flowering and fruiting were also estimated. The yield of the plant was measured in terms of dry seed output (Kg/ plant). The growth of the *J.curcas* in various plantations was compared by t-test.

RESULTS AND DISCUSSION:

The present study sites possessed three different soils, namely, black cotton, red soil and black gravel and all the five study sites were alkaline in nature. *Jatropha* undemands in soil type and can grow in nutrient poor soils, in waste lands except flood prone and water logged areas (Biswas et al 2006, Singh et al, 2006 and Barua, 2011). The present study confirms the same that Jatropha was successfully established in all the study sites but significant differences were found in the growth, flowering, fruiting and seed output which were influenced by various parameters like pH of the soil, watering schedule and the availability of the nutrients etc. the observations are as follows:

Growth of the plant:
Growth of the plant was influenced by various parameters like alkalinity of the soil, availability of the soil moisture and soil nutrients. pH was influencing the availability of the nutrients and in the present study an increase in the alkalinity resulted in the increase in the availability of the soil nutrients and thus resulted in the positive growth. Studies by Biswas et al 2006, Singh et al 2006, Kheira and Atta, 2009 and Barua, 2011 reported that acidic soils and the soils with high alkalinity (pH >9) were not suitable for Jatropha cultivation. However, the pH of the soils in the present study ranged between 7.5 and 8.14. The increase in the alkalinity showed a positive correlation with the growth of the plant. The two sites of Khammam viz., Pallepadu and Panditapuram were slightly alkaline in nature (pH 7.5) and the physical growth of the plant was low when compared with the plantations of Krishna district viz., Mylavaram, Nandigama and the experimental site , where the pH is above 8.

Water availability plays an important role in the overall growth of the plant. At the end of the third year of the plant, in the two drip irrigated plots viz., Chandarlapadu and Mylavaram comparatively more number of branches were recorded i.e. 14 and 13, respectively, whereas in the remaining sites the maximum average number of branches was confined to 11. Height and girth of the plant also were maximum in the three plantations of Krishna district compared to Khammam plantations. Uniform and regular availability of the water might be the reason for this growth in the Krishna district plantations.

Flowering:
Flowering of 50%, 70% and 90% at Mylavaram, Nandigama and Chandarlapadu respectively and no flowering was observed in the two sites of Khammam district even at the end of 3 rd year. The effect of root rot, poor availability of water and soil nutrients might be the reasons for the absence of flowering in the plantations of Khammam district. Addition of nutrients in the form of NPK and Super phosphate and thus the nutrients were made available for the Chandarlapadu plantation, especially Potassium, which was required by the plant during flowering. Thus, the addition of nutrients might have helped to overcome the effect of minimum spacing (1×1 m, 1.5×1.5 m). Sunlight also plays an important role in the plant growth and poor availability of the sun light might be reason for the less flowering at Mylavaram plantation.

Fruiting:
In case of fruiting also, similar results have been obtained like flowering. Maximum fruiting was observed at the Chandarlapadu site i.e., up to 80%, followed by 60% at Nandigama plot. Only 30% was reported by Mylavaram plantation and no flowering was seen at Pallepadu and Panditapuram plantations of Khammam district. Continuous availability of water through drip irrigation and availability of the soil nutrients might be the reasons for the good percentage of fruiting at the Chandarlapadu plantation, especially Potassium which helps the plant for the fruit quality.

Seed output:
Sulphur improves the seed production and this was made available in the soil at Nandigama and the Chandarlapadu sites by the addition of Gypsum. In these two plantations on an average 2-4 Kg/plant seed output was recorded. 3-4 Kg dry seed / plant was recorded at the experimental site and comparatively less output was recorded at the Nandigama plantation as 2 Kg dry seed /plant.

The studies of Heller (1996), Patolia et al.(2007), Chaudhury et al. (2007) and Jongschaap (2007) have also revealed that the application of nutrients and water in poor soils increase the production. Similar results were obtained in the present study that addition of water and nutrient has resulted in the seed production by two study sites and in the remaining three study sites no seed output was recorded where no nutrients were added.

Spacing effect:
Previous reports (Patolia et al.2007), revealed that growth and seed output were increased with the increase in the plant density and the % of nutrients was observed to be decreased in low density plots. But in contrast to it the physical growth as well as dry seed output were reported more in the low density plot at Chandarlapadu (1×1m, 1.5×1.5m) when compared to 2×2m, 3×3m plots. This was may be because of the addition the nutrients externally to overcome the competition for the nutrients.

Impact of mixed cropping:
Mixed cropping influenced the growth of *Jatropha* in a negative way at Pallepadu site. The restricted growth might be due to the competition for nutrients and water. A similar impact of mixed cropping was reported by Jongschaap (2007).

CONCLUSION:
Physical growth, flowering, fruiting and seed output could be increased at with the application of nutrients and adopting suitable watering schedule. Drip irrigation appeared to be more suitable for this crop when compared to bore well and irrigation. The present study also revealed that effect of spacing could be minimized with the administration of the nutrients and water.

Table-1: **Comparison of the Growth Conditions in Various Plots**

Parameter of the Study	KHAMMAM DISTRICT		KRISHNA DISTRICT		
	PALLEPADU PLANTATION	PANDITAPURAM PLANTATION	MYLAVARAM PLANTATION	NANDIGAMA BLOCK PLANTATION	EXPERIMENTAL PLOT AT CHANDARLAPADU
Type Of Plantation	Intercrop(with Mango& Green gram)	Boundary	Boundary	Block	Block
Total Area	10 Acre	7500 M	13 Acres	10 Acres	1 Acre
Spacing	3×3m,	1.5 M Distance	3×3m,	2×2m, 3×3m	1×1m, 1.5×1.5m
No. Of Plants /Ha	1111	5000	1500	2500, 1111	10000, 4444
Type Of Soil	Black Cotton	Black Cotton	Red soil	Black Gravel	Black Gravel
pH	7.5	7.5	8.01	8.14	8.14
VAM	Applied	Applied	Applied	Applied	Applied
Chemicals Used	Nil	Nil	Nil	Gypsum	Gypsum, NPK, Super Phosphate
Mode of Watering	Irrigation	Rain water	Bore well, Drip	Bore well	Drip
Pruning	March-2009	March-2009	Not done	November-2009	November-2009

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Avg .No. of Branches	11	10	13	11	14
Avg. Plant Height (Ft)	7	6	8	8	9
Girth of the plant (Inches)	6.5	6.5	7.5	7.5	8
Flowering	Nil	Nil	50%	70%	90%
Fruiting	Nil	Nil	30%	50-60%	70-80%
Seed Output (Kg/ Plant)	Nil	Nil	Nil	2	3-4
Remarks	Root rot, Mildew	Root rot , Mildew	Shading, rocky soil	Encouraging	Encouraging

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