

Response of *Jatropha curcas* under different spacing to Jatropha de-oiled cake

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Abstract

This work tested the response of *Jatropha curcas* plants to jatropha cake used as organic manure. Experiments, carried out with different levels of Jatropha de-oiled cake, were conducted at Mohuda located in the sub-humid part of Orissa state in India. Five levels of treatments comprising four different levels of Jatropha cake (0.75, 1.5, 2.25 and 3 tonnes ha⁻¹) and one control plot were applied to jatropha plants under two different spacings (4m x 3m and 3m x 2m). Jatropha cake significantly increased the seed yield of *Jatropha curcas* with increasing level of cake up to the maximum level of 3 t ha⁻¹ under both the spacings. The treatment receiving 3 tonnes ha⁻¹ recorded the highest per plant seed yield of 1.52 kg and 0.87 kg in 4m x 3m and 3m x 2m spacings, respectively. The increase in yield obtained with the highest level of cake was 120% over control in the treatment with 833 plants per hectare, while corresponding increase for 1667 plants per hectare treatment was 93%.

Applicable subject: Agronomy: Jatropha Soil Conditions/Fertilization

Full Title: Response of *Jatropha curcas* under different spacing to jatropha de-oiled cake

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Purpose of the work

The past work done on nutrient management by CSMCRI, Bhavnagar revealed that using only chemical fertilizers as a nutrient source has limitations in cultivation of *Jatropha* in regions of high rainfall. This is due to the fact that nitrogenous and potassic fertilizers like urea and MOP are prone to leaching losses in very short span of time, especially during rainy seasons, because of high solubility of such fertilizers in water. Organic manures have the property of reducing such losses and also can give sustained supply of nutrients over a period of time. This is of great significance given the fact fruiting of *Jatropha curcas* is staggered over a long period. Jatropha cake is one such organic manure that is rich in plant essential nutrients. Our study revealed that it contains 3-4.5% N, 0.65-1.2% P₂O₅, 0.8-1.4% K₂O, 0.2-0.35% S. Micronutrients ranged 800-1000, 300-500, 30-50 and 18-25 mg kg⁻¹ of Fe, Mn, Zn and Cu, respectively. Moreover, as the biodiesel programme reaches its maturity, a lot of jatropha cake will be produced as a by-product after oil expulsion, which can find its way back into the soil as manure, rather than transporting it for some other purpose. Till date, there has been no systematic research that looks into nutrient requirement of jatropha plants from holistic angle. Thus effort was done to evaluate the effect of Jatropha cake on seed productivity of *Jatropha curcas*.

Approach

The experiments are being conducted on cultivable wasteland at Mohuda in the Orissa state of India. The climate is sub-humid receiving high rainfall during rainy months. The soil was sandy loam and non saline with pH 7.2, 05% organic carbon and the available N, P and K were 140.2, 17.5 and 458 kg ha⁻¹, respectively. Experiments were laid out in

randomized block design with five levels (0, 0.75, 1.5, 2.25 and 3 tonnes Jatropha cake ha⁻¹) and separately applied to two differently spaced jatropha population. Each treatment was replicated four times. Jatropha cake was applied as per the treatments in the month of June during the years 2005 and 2006. The plants under 4m x 3m spacing were aged 2.5 years, while they aged 2 years under 3m x 2m spacing, when first jatropha cake treatments were applied. No other chemical fertilizer was applied to the plants except Jatropha cake during 2005 and 2006. The Jatropha cake contained 3.2% N, 1.2% P₂O₅ and 1.4% K₂O. The plants received inorganic fertilizers @ 45:30:20 N: P₂O₅:K₂O ha⁻¹ yr⁻¹ prior to the start of cake experiment. The seeds were collected during May to December and observations were treated by analysis of variance and Duncan's Multiple Range Test using MSTAT software program.

Scientific innovation and relevance: The encouraging results of this research has fostered the use of jatropha cake as a nutrient rich manure in jatropha plantation itself by ploughing it back into the soil. This will help to increase productivity of *Jatropha curcas* on wasteland, and probably should also improve the soil fertility.

Results

Seed yield

The seed yield of jatropha was significantly influenced by different levels jatropha cake. (Table 1). The seed yield increased significantly with increasing dose of cake up to the maximum level of 3 tonnes per hectare. Maximum seed yield per plant of 1.52 kg and 0.87 kg per plant were obtained by application 3 t ha⁻¹ under 4m x 3m and 3m x 2m spacing, respectively. In 4m x 3m spacing, maximum seed yield was followed by that

(1.31, 1.05 and 0.78 kg plant⁻¹) obtained under 2.25, 1.5 and 0.75 t ha⁻¹ treatments, respectively. Similarly under 3m x 2m spacing, 0.75, 0.63, 0.52 kg plant⁻¹ were obtained by application of cake @ 2.25, 1.5 and 0.75 t ha⁻¹, respectively. Minimum seed yield (0.69 kg plant⁻¹ under 4m x 3m spacing and 0.45 kg plant⁻¹ under 3m x 2m spacing) was obtained under control treatment where fertilization was not done during the two years of the present study. Although the 3m x 2m spaced plants were 6 months younger than 4m x 3m spaced ones, the magnitude of yield difference between these two spacings clearly indicate that widely spaced plants tend to give more seed yield per plant. However, when calculated on per hectare basis, the maximum seed yield (1.45 t/ha) was obtained from 3m x 2m spaced population having 1667 plants per hectare by application of 3 t ha⁻¹ cake which was 93% and 16% higher over control and next best yields obtained under the same spacing. The application of highest dose of cake brought about more than double increase (120%) in seed yield in plants spaced 4m x 2m.

Table 1 Effect of jatropha cake on *Jatropha curcas* planted under different spacing

Treatment (Jatropha cake)	Seed yield (Kg/plant)	
	4m x 3m spacing	3m x 2m spacing
Control (No cake)	0.69 d	0.45 e
0.75 t/ha	0.78 d (13)	0.52 d (16)
1.5 t/ha	1.05 c (52)	0.63 c (40)
2.25t/ha	1.31 b (90)	0.75 b (67)
3.0 t/ha	1.52 a (120)	0.87 a (93)
S.Em (±)	0.05	0.02
CV%	6.02	8.69

* S.Em- Standard error of mean; **CV- Coefficient of variation

The means of N and P levels followed by different letters differ significantly at P<0.05

Figures in parenthesis indicate per cent increase over control treatment.

Conclusions

The results of the experiment have shown that fertilization to jatropha plantation with jatropha cake was very effective in improving yield significantly and not fertilizing it at all was detrimental. Response was obtained up to the maximum level of Jatropha cake indicating that jatropha plant responds tremendously to fertilization. 3 tonnes of Jatropha cake per hectare per year proved beneficial for maximization of seed productivity under sub-humid climate in cultivable wastelands of Orissa. It is expected that as the plant grows in future, it being a perennial species, the fertilizer requirement will change necessitating long term manurial trial study.

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