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Effect of Spacing on Growth and Yield of *Jatropha curcas* under Rainfed Conditions of Southern Zone of Andhra Pradesh

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ABSTRACT

A field experiment was initiated during the year 2005 on sandy clay loam soils at Regional Agricultural Research station, Tirupati to study the influence of various spacings on growth and yield of *Jatropha curcas* under rainfed conditions. The results of data recorded from pooled analysis of two consecutive years revealed that the *Jatropha* plants planted at 4mx2m spacing (1250 plants ha^{-1}) recorded higher growth and yield followed by 3mx3m (1111 plants ha^{-1}) and 3mx2m (1666 plants ha^{-1}) spacings and significantly the lowest growth and yield was recorded under 2mx2m (2500 plants ha^{-1}) spacing.

Key words : Canopy spread, *Jatropha curcas*, Plant height, Pod yield, Seed yield, Spacing,.

Economic development in many developing countries has led to increased energy demand, and its security has become a key issue for many countries. India produces about 25% and imports 75% of its oil requirement. Moreover, due to uncertain supplies and spiraling prices of fossil fuel in international market, the need to explore alternate renewable, safe and non polluting sources of energy assumes top priority. Among the biodiesel crops a non-edible oil bearing tree like *Jatropha* begets practical significance *Jatropha curcas,* a promising biodiesel crop proven to convert vast wastelands into green oil fields belongs to family Euphorbiaceae and contains 25-35% oil. Claimed to produce biodiesel and enhance socioeconomic development while reclaiming marginal and degraded lands in Semi Arid and Arid regions (Francis *et al* 2005), without competing with food production.

Adapting of optimum plant spacing is intended to harness copious solar energy, avoid root competition with efficient exploitation of water and nutrients. At the same time, the concept of high plant density is gaining momentum to maximize productivity from the limited land resources. Paramathma *et al* (2009) reported that a spacing of 2mx2m for rainfed *jatropha* was found economical. Soumit K Behara *et al* (2009) observed a similar plant performance with 2mx2m and 3x3m spacings. While, Jones and Miller (1992) recommended closer spacing of 2mx1.5m to 3mx3m, while Kaushik and Kumar (2006) proposed wider spacing of 4mx2m and 4mx3m for *jatropha* plantations.

In this context, an attempt was made to standardize an optimum spacing for better growth and yield of *jatropha curcas* under rainfed conditions of Southern Agro-climatic Zone of Andhra Pradesh.

MATERIAL AND METHODS

Investigation on optimum spacing for *jatropha* under rainfed conditions was initiated during 2005 at Regional Agricultural Research Station, Tirupati which, is situated at an altitude of 182.9 m above mean sea level on 79º36´E longitude and 13º27´N latitude with an average annual rainfall of 911.84 mm. A total rainfall of 1116.4 mm and 930.6mm was received during 2007 and 2008 respectively Experimental site with sandy loam in texture was slightly acidic in reaction. The soil nitrogen, phosphorus and potassium were low, medium and high, respectively. The treatments comprising of four spacings viz., 2mx2m, 3mx2m, 3mx3m and 4mx2m with plant densities of 2500, 1666, 1111 and 1250 plants ha^{-1}, respectively, was laid out in randomized block design with replicated

Table 1 Growth attributes of *Jatropha curcas* as influenced by spacing under rainfed conditions

Spacing	Plant Height (Cm)			Stem Girth (Cm)			Number of Branches per plant			Maximum length of branch (Cm)			Canopy spread (cm) N-S Spread			Canopy spread (cm) E-W Spread		
	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean
S_1 (2 X 2m)	80.90	145.25	113.07	17.01	30.10	23.55	14.36	21.23	17.8	41.22	130.66	85.93	74.33	118.13	96.23	69.83	144.5	107.17
S_2 (4 X 2m)	114.88	187.50	151.18	19.00	34.88	26.94	18.94	30.72	24.83	62.18	155.94	113.67	108.44	166.25	137.34	105.00	149.38	127.20
S_3 (3 X 2m)	116.41	181.03	148.72	17.72	33.53	25.63	18.22	29.25	23.73	57.03	170.32	114.53	122.03	162.81	142.42	117.81	149.84	133.83
S_4 (3 X 3m)	112.50	188.13	150.31	18.81	33.41	26.11	18.75	26.65	22.70	58.91	170.15	109.00	105.15	175.63	140.40	104.41	171.09	137.75
SEM±	6.72	4.18	5.82	0.67	1.01	0.61	0.76	1.11	0.68	4.25	5.51	2.45	5.80	7.31	3.30	4.86	6.72	3.95
CD(0.05)	13.98	8.70	16.60	1.40	2.10	1.74	1.59	2.27	1.51	8.84	11.46	6.86	12.06	15.18	8.62	10.09	13.97	10.98

eight times and a common dose of 20g Urea, 120g of Single super phosphate and 16g of Muriate of potash was applied per pit at the time of planting. Data on plant growth covering plant height , maximum length of branches, stem girth ,canopy spread and yield characters like no. of pods, pod yield and seed yield per plant using standard procedures were recorded during 2007-08 and 2008-09. The pooled data was analyzed statistically and presented in Table1 and Table 2.

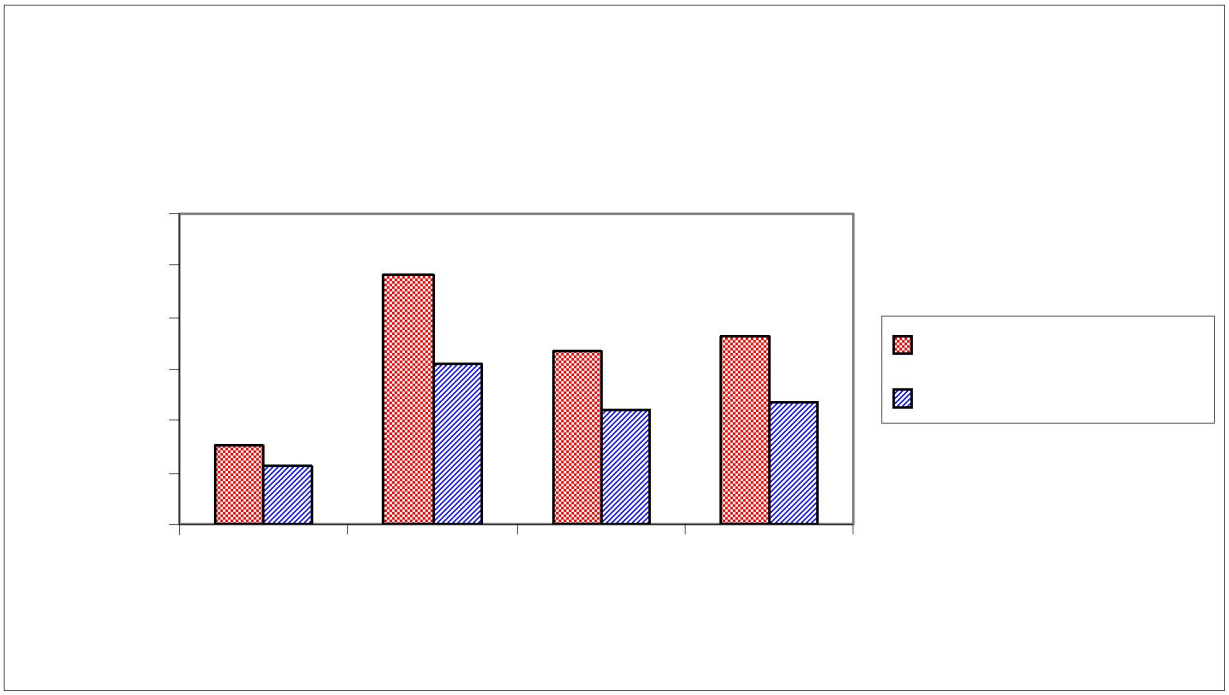
RESULTS AND DISCUSSION

The study revealed that diversification in spacings had significant effect on the plant growth factors. Plant height at 4mx2m spacing (151.18 cm) exhibited overall superiority, however, it was at par with 3mx3m (150.31 cm) and 3m x 2m (148.72m) spacing respectively but significantly taller to 2m x 2m spacing (113.07cm). Lower plant height recorded at higher density exhibited under this study was in contradiction to the reference of maximum height with closer spacing due to competition for light and reduced space for expansion and similar trend as displayed by plant height was also noted in number of branches (17.80 to 24.83 branches per plant) at various spacings.(Table 1). These findings are in concurrence with those reported by Hemalatha and Joseph (2009) length of branch and canopy spread also recorded similar results with spacing of 4mx2m, 3mx3m and 3x2m which were on a par with each other and all the three were significantly superior to a reduced spacing of 2mx2m. This trend of recording significantly greater growth factors under wider spacings might be due to increased available of space to the plants. Similar results of greater spread at low density was reported in Guava by Jaswinder singh and Bal (2002)

The reduction in vegetative growth under closer spacing (2mx2m) might be attributed to increased number of plants per unit area leading to more competition within the stands for light (Kozlowski *et al* 1991), soil water (Basset, 1964) and mineral nutrients (Cole and Newton, 1986). Availability of light, water and nutrients resulting in increased plant spread, leaf area and synthesis of carbohydrates and hormonal growth regulators might have led to better accumulation of biomass by various plant parts, which ultimately manifested their growth potentiality under wider spacing (Sharma *et al* 2008).

Table 2 Yield attributes and yield of *Jatropha curcas* as influenced by spacing under rainfed conditions.

Spacing	Number of pods per plant			Pod yield (g) plant^{-1}			Seed yield (g) plant^{-1}		
	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean
S_1 (2 X 2m)	9.78	14.00	12.25	23.88	37.50	30.68	19.23	25.10	22.16
S_2 (4 X 2m)	98.44	51.17	78.83	242.72	141.98	192.35	146.54	101.55	124.04
S_3 (3 X 2m)	54.41	22.25	38.62	141.80	59.40	100.60	91.35	40.32	65.83
S_4 (3 X 3m)	86.98	40.58	67.07	217.67	110.64	164.12	136.81	77.42	107.09
SEM±	4.46	2.24	4.10	10.65	5.94	8.62	8.61	4.30	5.35
CD(0.05)	9.26	4.87	11.70	22.14	12.95	24.61	17.90	8.95	15.28



Study of yield attributes manifested that with increasing planting distance, the number of pods, pod yield and seed yield per plant were also increased significantly. The number of pods per plant (78.83) was significantly higher in plants spaced at 4m x 2m followed by 3m x 3m (67.07) and 3m x 2m respectively (38.62). While, the lowest number of pods per plant (12.25) was recorded under 2m x 2m spacing. The highest number of pods were recorded with 4m x 2m spacing might be due to increased number of pod clusters per plant (Table 2).These results are in accordance with the findings of Hemalatha and Joseph (2009).

The highest pod yield (192.35 g) and seed yield (124.04 g) per plant were recorded under 4mx2m spacing followed by 3mx3m and 3mx2m spacings. Similar results were reported by Chikara *et a.,l* (2007) and Ghosh *et al.,*(2007) with regard to seed yield per plant while, significantly lowest pod yield (30.68 g) and seed yield (22.16 g) per plant was recorded under 2mx2m spacing. Reasons might be due to the poor vegetative growth, less no. of flowering branches per plant Similar results were reported in *Guava* by Singh *et al.,* (1980)).

The highest pod yield (240.43 kg) and seed yield (155.05 kg) per hectare was recorded under

wider spacing of 4mx2m followed by 3mx3m, which is however, comparable with 3mx2m spacing. This might due to better growth and yield attributes of *jatropha* under wider spacing. Significantly the lowest pod yield (76.71 kg/ha) and seed yield (55.40 kg/ha) were recorded under closer spacing (2mx2m) (Fig 1).

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