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Effect of Different Spacing and Pruning Intensities of *Casuarina equisetifolia* on Growth and Yield of *Trigonella foenum-graceum* Grown as Intercrop

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Abstract

The investigation comprised ten treatments involving three spacing and pruning intensities each of *Casuarina equisetifolia* and intercrop (*Trigonella foenum graceum*) under open field conditions. Under low light conditions, the number of leaves, number of branches, leaf area, relative growth rate (RGR), net assimilation rate (NAR) and yield of the intercrop (*Trigonella foenum-graceum*) were reduced. Height of intercrop increased with partial reduction in light, however, it diminished in low light conditions. Chlorophyll content showed an increasing trend up to 50% reduction in light intensity but later on it decreased. In general, all the growth parameters (except plant height) showed a declining trend with reduction in spacing and in pruning intensity of the tree. The present study indicated that wider spacing (8× 2m) with higher pruning intensity (75%) at the rotation age of tree (6 years) with *Trigonella foenum-graceum* is economically viable as intercrop.

Key words : Spacing, Pruning, *Casuarina equisetifolia, Trigonella foenum-graceum,* Intercrop.

Casuarina equisetifolia commonly known as Saru, beef-wood, she-oak is a species of Casuarinaceae with its natural distribution in Australia and parts of Asia and Oceania. It was introduced into the Indian sub-coninent in the sixties of nineteenth century to augment supply of firewood to steam locomotives of the newly formed Indian railways. Since then, it has spread along the east and west coasts of the Indian Peninsula. *Casuarina equisetifolia* is dioecious, moderately large sized tree attaining a height of 30—40 m under favorable conditions. The wood is pale brown in color, strong and heavy. The greatest use in India is for fuel. The bark of *Casuarina equisetifolia* is astringent and is used in diarrhea and dysentery. The extract of its leaves in acetic acid 1% and sodium bicarbonate 50% is anticancerous in nature. The bark is also used for tanning purposes and toughening the fisherman's net. The greatest use of *Casuarina* is for fuel with the calorific value of 4,127 calories per kg (1) and thus can be introduced in an agroforestry system. It is used extensively for afforestation of sandy beaches and is helpful in checking soil erosion. *Trigonella foenum-graceum,* an aromatic, leguminous annual commonly called as methi,methari, fenugreek. It is about 30—60 cm tall, found wild in Kashmir, Punjab and upper Gangetic plains and widely cultivated in many parts of India. The plant is a soil renovator and has been tried extensively in many parts of India. It is widely cultivated as condiment, vegetable, fodder and medicinal purposes. The yield of green leaf, on an average is 90—100 quintals per hectare. Being a short duration crop, two harvests can be easily obtained during the winter season and is cultivated under *Eucalyptus* in South Gujarat conditions, forming a good agroforestry stystem. Therefore, the present investigation was conducted to assess the effect of different spacing and pruning intensities on six year old plantation of a *Casuarina equisetifolia* for growth and yield of intercrop (*Trigonella foenum-graceum*).

Methods

The investigation was carried out at the instructional farm of ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during the winter season 2001. Six year old tree component (*Casuarina equisetifolia*) was already established in the form of block plantation on the instructional farm in the three replicates in three spacing viz., 4 × 2 m, 6 × 2 m and 8× 2 m. The whole experiment was laid in completely randomized design

Table 1. Morpho-physiological and yield influenced by different spacing and pruning of tree component.

Treatment	Light intensity (kilo lux) received by intercrop Light intensity	Percent availability of normal light	Plant height (cm)	No. of leaves	No. of branches	Leaf area (cm^2)	Plant density (sq. feet)	Internodal length (cm)	Chlorophyll content (mg/g)	RGR	NAR	Yield per ha (quintals)
T_1 (4 ×2 ; UP)	31.44	7.69	22.4	13.6	4.26	25.17	23.53	5.1	0.14	0.01	0.02	15.09
T_2 (4 × 2; 50%)	71.97	17.60	31.4	22.83	5.03	35.63	41.45	5.58	0.61	0.02	0.03	42.2
T_3 (4 ×2; 75%)	98.18	24.02	35.23	29.30	7.53	52.55	46.28	5.44	0.82	0.02	0.05	43.07
T_4 (6× 2; UP)	49.56	12.12	24.57	15.44	4.6	28.1	36.53	5.57	0.43	0.01	0.5	31.73
T_5 (6×2; 50%)	92.88	22.71	36.8	25.33	6.6	49.5	58.38	5.81	0.94	0.03	0.8	62.91
T_6 (6 × 2; 75%)	137.21	33.57	30.25	30.96	6.76	46.95	54.98	5.48	1.00	0.03	0.12	63.89
T_7 (8 ×2; UP)	83.82	20.50	24.62	16.86	5.67	39.72	46.37	5.51	0.55	0.02	0.04	44.53
T_8 (8 × 2; 50%)	180.90	44.26	38.97	23.93	7.54	50.13	54.15	6.8	1.07	0.03	0.19	69.3
T_9 (8 ×2; 75%)	250.75	61.34	38.5	29.33	7.91	62.46	59.67	5.38	1.67	0.04	0.21	82.28
T_{10} (Control)	408.73	100	29.32	36.97	12.29	91.35	63.73	3.56	1.56	0.12	0.79	144.16
CD at 5%	3.35	—	1.75	1.35	0.46	4.84	5.11	0.51	0.07	0.01	0.02	5.57
CV%	12.49	—	8.04	8.13	6.44	8.72	6.27	8.32	4.91	10.01	8.49	8.02

(CRD) with three pruning intensities viz. un-pruned (UP), 50% pruning and 75% pruning considering the average height of the tree in each of the above mentioned tree spacing. *Trigonella foenum-graceum* was intercropped in six replications between the above mentioned spacing having plot size 3m × 4m for 4m × 2m tree spacing, 5m × 4m for 6m × 2m tree spacing, 7m × 4m for 8 m ×2 m tree spacing. The farm yard manure (FYM) was applied at the rate of 10 tonnes per ha to all the plots. Nitrogen (N) and phosphorus (P) were applied to all the plots at the rate of 20 kg N and 40 kg P/ha as a basal dose.

The data were recorded on the following traits viz., plant height (cm), no. of leaves, internodal length (cm), no. of branches and plant density (per sq feet) on days 20, 30 and 42 (final harvest) from the date of sowing and for yield (quintals) attributes. The data on light intensity (kilo lux) were recorded using lux meter during the period of experiments. The data were analyzed for Chlorophyll content (mg/g) using spectronic-20 at 652 μm for total chlorophyll. The relative growth rate (RGR) was calculated as formulated by Blackman (2).

$$RGR = \frac{Log_e W_1 - Log_e W_0}{t}$$

where, W_0 = Initial weight (g) of the plant,

W_1 = Dry weight (g) on succeeding sampling dates,

t = Time between two succeeding sampling dates.

Net assimilation rate (g/cm^{-2} per day) was calculated using Gregory's formula (3)

$$NAR = \frac{W_1 — W_0 / L_1 — L_0}{Log_e L_1 – Log_e L_0}$$

where, W_0 & W_1 represent the successive dry weight (g) of the plant, L_1 & L_0 represent the successive dry weight (g) of leaves of the corresponding samples. Leaf area (cm^2) was calculated using the digital leaf area meter. The mean values of each trait were analyzed as per the following methods given by Panse and Sukhatme (4).

Results and Discussion

The light intensity ranged from 31.44 to 408.73 kilolux among the different treatments. The maximum light intensity was recorded in treatment T_{10} under open field conditions and the minimum under T_1 (4 m × 2m; UP) which was about 7.69% of the light intensity available under open field.

The plant height ranged from 22.4 cm to 38.97 cm. The treatment T_8 (8m × 2 m; 50%) gave maximum plant height which was statistically at par with treatment T_9 (8m × 2m; 75%) and minimum by treatment T_1 (4m × 2m; UP) which was at par with T_4 (6m × 2m; UP) and T_7 (8m × 2m; UP). This might be due to the difference in shade effect under different treatments. Similar results were also reported by Singh et al. (5) and Patel (6).

Among all the treatments, treatment T_{10} (open field) showed the maximum no. of branches followed by T_9 (6m × 2m; 75%) which is at par with T_8 (8m ×2 m; 50%). Range for the no. of branches varied from 12.29 to 4.26. These results are in conformity to the similar findings reported by Palani et al. (7).

Similarly, the maximum number of leaves per plant was exhibited by treatmentT_{10} (36.97) and minimum by treatment T_1 (13.6). It might be due to more light intensity under open field conditions resulting in higher photosynthetic rate. This higher photosynthetic rate activity has probably resulted in the formation of more number of leaves per plant. These results were in accordance with those of Palani et al. (7).

Among all the treatments, treatment T_8 (8 m × 2m; 50%) showed the maximum internodal length (6.8 cm) followed by T_5 (6m × 2m; 50%) in both the 2nd and 3rd internode. Range of the internodal length varied from 3.56 to 6.8. Minimum internodal length was recorded in treatment T_{10} (control). Therefore, dwarfing effects of light in open field (T_{10}) are in conformity with the findings of Tarila et al. (8).

Maximum yield (144.16 quintal per hectare) was observed in treatment T_{10}, while the lowest (15.09 q per ha) was recorded in T_1 (4m × 2m; UP). The maximum yield of the intercrop may be due to favorable light conditions coupled with lack of competition from the tree crop under open field conditions.

Treatment T_{10} (open field) exhibited maximum (63.73 per sq ft) plant density which was at par with T_9 (8m × 2m; 75%), while minimum plant density was recorded in T_1(4m × 2m; UP). Reduction in plant density may be due to allelopathic effect of the tree needles. These results are in conformity with the findings of Suresh and Rai (9).

Effect on the Physiological Parameters of the Intercrop

Higher chlorophyll content (1.67 mg/g) was recorded in T_9 (8m × 2m; 75%) followed by T_{10} (control), while the lowest (0.14 mg/g) was observed in T_1 (4m × 2m; UP) (Table 1). The chlorophyll content ranged from 0.14 mg/g to 1.67 mg/g. The maximum leaf area per plant was observed in T_{10} (control) followed by T_9(8m × 2m; 75%) . The leaf area (cm^2) per plant ranged from 25.17cm^2 to 91.35 cm^2. The treatment T_8 (8× 2; 50%), T_5 (6 × 2; 75%) and T_3 (4 × 2; 75%) were at par with each other. Similar results were also reported by Singh et al. (5).

Maximum net assimilation rate (0.79) were observed in T_{10} (control), while minimum in T_1 (4m × 2m; UP). Similarly, relative growth rate (0.12) was maximum in T_{10}(control) and minimum in T_1 (4m × 2m; UP) and T_4(6 m × 2m; UP). This was mainly due to the reduction in the chlorophyll content under lower light conditions. These results are in conformity with the findings of George and Nair (10).

Therefore, based on the present study it can be concluded that fenugreek can be raised as an intercrop under *Casuarina* plantation which has almost attained the harvestable age (six years) with wider spacing integrated with higher pruning intensities (75%) seem to be an economically feasible venture under this agroforestry system.

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