

Effect of *subabul* (*Leucaena leucocephala*) canopy on yield, quality and nitrogen uptake of clusterbean (*Cyamopsis tetragonoloba*) and sesame (*Sesamum indicum*) under agro-silviculture system

O.V.S. THENUA¹, R.S. VERMA AND T.P. SINGH²

Department of Agronomy, Raja Balwant Singh College, Dr. B.R. Ambedkar University, Bichpuri, Uttar Pradesh 283 105

Received: December 1997

ABSTRACT

A field experiment was conducted during rainy season of 1991 and 1992 to study the effect of *subabul* (*Leucaena leucocephala*) canopy management practices and crop geometries on seed yield, quality and nitrogen uptake of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] and sesame (*Sesamum indicum* L.) crops. Topping at 1.50 m system of *subabul* canopy management gave significantly more yield and better quality of produce. Maximum uptake of nitrogen was also noted under the same system compared with central leader system, open centre system and no lopping conditions.

Key words: *Leucaena*, Clusterbean, Sesame, Yield, Agro-silviculture system

The cultivation of clusterbean and sesame with *Leucaena* is an introduction to the agro-climatic conditions of south-west Uttar Pradesh. The growing of these crops under various canopies of *Leucaena* is the most important aspect of agro-silviculture system. Since a meagre information is available on this aspect, an attempt was made to evaluate the response of various canopy management systems of *Leucaena* on seed, quality and nitrogen content and its uptake through cluster-bean and sesame.

MATERIALS AND METHODS

The field experiment was conducted at Bichpuri campus, under Department of Non-conventional Energy Sources Research Project during rainy season of 1991 and 1992. The mean minimum temperature varied from 8.8 to 27°C during both the crop seasons and lowest temperature was recorded at the end of crop season. The mean relative humidity generally decreased with the advance in crop season during both the seasons. Average evaporation rate during both the crop seasons was

Present address: ^{1,2} Department of Agronomy, AS(PG) College, Lakhaoti, Bulandshahr, Uttar Pradesh 245 407

Table 1. Seed yield, protein content in seed and its production and oil contents in sesame seed and its production as influenced by various treatments

Treatment	Seed yield (q/ha)		Protein content in seed (%)		Protein production through seed (kg/ha)		Oil content in seed (%)		Oil production through seed (kg/ha)	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
<i>Canopy management</i>										
M ₀ (No lopping system)	7.99	7.55	20.44	19.55	166.65	149.70	47.23	45.76	235.31	211.16
M ₁ (Central leader system)	8.55	8.21	21.65	20.00	189.04	167.51	48.35	46.91	258.98	239.84
M ₂ (Open centre system)	8.25	7.79	21.07	20.12	177.08	159.63	47.59	46.98	244.84	223.86
M ₃ (Topping at 50m or pollarding system)	9.01	8.67	22.28	22.73	205.93	203.09	49.39	48.59	286.83	266.10
CD (P = 0.05)	0.15	0.36	1.25	1.31	11.29	10.00	0.55	NS	8.94	17.55
<i>Crop</i>										
C ₁ <i>Leucaena</i> + clusterbean	11.57	11.12	22.61	21.74	262.15	242.54				
C ₂ <i>Leucaena</i> + sesame	5.32	4.99	20.11	19.46	107.20	97.42	48.14	47.06	256.49	235.24
CD (P = 0.05)	0.10	0.25	0.88	0.93	7.98	7.07				
Clusterbean (sole crop)	12.16	12.20	23.81	24.00	289.53	292.80				
	(5.10)	(9.71)	(5.31)	(10.40)	(10.44)	(20.52)				
Sesame (sole crop)	5.56	5.49	21.38	22.63	118.87	124.4	49.82	49.98	277.00	274.45
	(4.51)	(10.02)	(6.32)	(16.29)	(10.89)	(27.53)	(3.49)	(6.23)	(8.00)	(16.67)
<i>Crop geometry</i>										
D ₁ (30 cm x 15 cm)	8.42	8.01	21.14	20.28	181.92	163.42	47.97	46.67	253.20	230.17
D ₂ (45 cm x 15 cm)	8.47	8.10	21.57	20.92	187.43	176.54	48.30	47.45	259.78	240.31
CD (P = 0.05)	NS	NS	NS	NS	NS	9.50	NS	NS	7.17	11.04

Figures in parentheses are the per cent increase over agro-forestry system

Table 2. Stalk yield, N content and its uptake through clusterbean and sesame and *subabul* seed, fodder and fuel wood yield as influenced by various treatments

Treatment	Stalke yield (q/ha)		N content in seed (%)		N content in stalk (%)		N uptake through seed (kg/ha)		N uptake through stalk (kg/ha)		Subabul seed yield/tree (kg)		Fodder yield/tree (kg)		Fuel wood yield/tree (kg)	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
<i>Canopy management</i>																
M ₀ (No lopping system)	17.09	16.40	3.27	3.13	0.78	0.72	26.66	23.5	13.59	12.12	1.08	1.66	6.03	7.82	10.53	13.49
M ₁ (Central leader system)	20.72	20.07	3.46	3.20	0.86	0.83	30.25	26.85	18.58	17.05	0.72	0.96	4.20	5.10	6.57	9.36
M ₂ (Open centre system)	17.67	17.01	3.37	3.22	0.79	0.74	28.33	25.55	14.21	12.92	0.94	1.32	4.66	6.41	8.64	1.57
M ₃ (Topping at 50m or pollarding system)	22.99	22.83	3.57	3.64	0.94	0.89	32.96	32.49	22.61	20.81	0.45	0.56	3.79	3.94	5.53	5.93
CD (P = 0.05)	0.19	0.48	0.20	0.21	0.09	0.06	1.81	1.61	2.76	1.76	0.09	0.17	0.31	0.16	0.42	0.48
<i>Crop</i>																
C ₁ <i>Leucaena</i> + clusterbean	27.27	26.44	3.62	3.48	0.91	0.86	41.95	38.81	25.29	22.97	0.84	1.22	4.82	6.08	8.02	10.76
C ₂ <i>Leucaena</i> + sesame	11.97	11.46	3.22	3.11	0.77	0.74	17.15	15.61	9.20	8.48	0.75	1.03	4.36	5.56	7.61	9.42
CD (P = 0.05)	0.14	0.34	0.14	0.15	0.07	0.04	1.28	1.14	1.95	1.25	0.06	0.12	0.22	0.11	0.30	0.34
Clusterbean (sole crop)	29.85	30.53	3.81	3.84	1.02	1.00	46.33	46.85	30.45	30.53						
	(9.46)	(15.47)	(5.25)	(10.34)	(12.09)	(16.28)	(10.44)	(20.72)	(20.40)	(32.91)						
Sesame (sole crop)	12.99	13.15	3.42	3.62	0.89	0.88	19.02	19.87	11.56	11.57						
	(8.92)	(14.75)	(6.21)	(16.40)	(15.58)	(18.92)	(10.90)	(27.29)	(25.65)	(36.44)						
<i>Crop geometry</i>																
D ₁ (30 cm x 15 cm)	19.40	18.85	3.38	3.24	0.83	0.78	29.11	26.17	16.82	15.21	0.81	1.12	4.61	5.90	7.85	10.13
D ₂ (45 cm x 15 cm)	19.66	19.05	3.45	3.35	0.85	0.81	29.99	28.25	17.67	16.24	0.78	1.12	4.57	5.73	7.78	10.04
CD (P = 0.05)	NS	NS	NS	NS	NS	0.30	NS	1.52	NS	0.72	NS	NS	NS	NS	NS	NS

Figures in parentheses are the per cent increase over agro-forestry system

3.89 mm/day. Bright sunshine hours showed rising trend with advance in the season varying between 1.6 and 10 hr/day in both the years. The annual rainfall was 331.8 mm during 1991 and 487.7 mm in 1992. The soil was sandy loam and alkaline, with pH 8.25. The soil was low in organic C (90.35%) and available N (161.6 kg/ha), medium in available P (18.77 kg/ha) and rich in available K (251.74 kg/ha). The experiment was laid out in split-plot design. Four *Leucaena* canopy management systems, viz. M_0 , no lopping system; M_1 , central leader system; M_2 , open centre system; and M_3 , topping at 1.50 m height or pollarding system and 2 annual crops (clusterbean and sesame) were tried in main plots and 2 crop geometries (30 cm x 15 cm and 45 cm x 15 cm) in subplots and replicated 3 times. The tree crop 'K 8') *Leucaena* was planted at a spacing of 4 m x 2 m in the monsoon season of 1988. The trees were shaped as per treatment at the time of sowing during rainy season of 1991 and again during 1992. The seeds of 'Durgapura Safed' clusterbean and 'Type 4' sesame were sown in lines with and without *Leucaena* with recommended package of practices in the first fortnight of August in each year under rainfed condition. The crops were harvested in the second fortnight of November each year.

The seed and stalk samples taken from all the plots were oven-dried and ground into the fine powder and utilized for N and oil determination. The N content was determined by modified Kjeldahl's method and the oil content was analysed by nuclear magnetic resonance technique at Nuclear Research Laboratory, IARI, New Delhi, and represented in per cent as per Gupta *et al.*, 1985. Oil yield was calculated on the basis of oil percentage in seed and seed yield/ha. The uptake N was computed from N concentration in seed and stalk and its respective yields.

RESULTS AND DISCUSSION

Seed yield and its quality

Seed yield of clusterbean and sesame was significantly maximum in M_3 , followed by M_1 , M_2 and M_0 system. The protein content in seed, protein production through seed and oil content and its production through sesame seed was also found significantly superior under this system to that obtained under rest of the systems. In support of these results it may be inferred that topping at 1.50 m system allowed more interception of light to the crops and these crops had minimum competition for moisture and nutrients absorption in both the sphere, i.e. rhizosphere and troposphere as well. Further, there was a comparatively less changes of bio-damage and attack of insect pests and diseases on the crops, which in turn, improved the quality of produce and also increased production of protein and oil in seeds on unit area basis. The yield and its quality was found superior in sole crops than *Leucaena* association (Table 1). Our findings confirm those of Hazra (1989).

The effect of crop geometries was non-significant on seed yield, protein content and oil content in seed. However, the protein production in the second year and oil production of sesame in both the years was noted significantly more under crop geometry 45 cm x 15 cm than 30 cm x 15 cm. The significant variations are based on the hypothesis that the widely spaced plants perform better growth and development and therefore, produce bolder seeds than the narrow spaced plants.

Nitrogen content and its uptake

Nitrogen content in clusterbean and sesame seeds and stalks was maximum during the first year, because of less competition between *Leucaena* and crop plants for light,

moisture and minerals. The uptake of nitrogen through seed and stalk of both the crops was also noted significantly maximum in first year due to luxuriant vegetative growth of these crops than that in the second year. In topping at 1.50 m system, the N content in seed and stalk of the crops was significantly higher over rest of the systems of *Leucaena* canopy management in both the years. The higher N content of the produce in this system was due to more interception of light, minimum bio-damage and less attack of insects pest and diseases than rest of the systems. These factors also increase the root cation-exchange capacity, which enhances more absorption of nutrients, therefore, the uptake of N from the soil was maximum in topping at 1.50 m system. The N content and its uptake was also higher in pure stand (sole crops) than *Leucaena* association (Table 2). The results confirm the findings of Hocking and Rao (1990).

The effect of crop geometry 45 cm x 15 cm on N content and its uptake through clusterbean and sesame was significantly maximum than 30 cm x 15 cm during the second year. In the first year of experimentation the influence of crop geometries was quite nominal and could not reach the level of significance.

***Leucaena* yield**

Besides the treatments effect on production potential of clusterbean and sesame, some changes in growth behaviour and in yield of the *Leucaena* were also noticed. The yields of *Leucaena*, viz seed yield, fodder yield and fuelwood production/tree, were significantly more under M_0 , followed by M_2 , M_1 and M_3 respectively (Table 2).

The reason of higher yield of *subabul* under no lopping system, that trees of *subabul* were allowed to grow freely without any mechanical injury to any part of the tree. Therefore, *subabul* trees performed their normal physiological processes, which in turn, provided full opportunity for better growth and development. The yield of *subabul* was significantly more with clusterbean association than with sesame, because *subabul* had complimentary association with clusterbean due to its N-fixing nature and the N-collected by clusterbean might have been shared by *subabul*. The effect of crop geometries on the *subabul* yield was not significant.

REFERENCES

- Gupta S.K., Dhawan, Kamal and Yadav, T.P. 1985. Estimation of oil content by wide lines. *Nuclear Magnetic Resonance* 2 : 17-21.
- Hocking, D. and Rao, D.G. 1990. Canopy management possibilities for arboreal *Leucaena* in mixed sorghum and live stock small farm production system in semi-arid India. *Agroforestry Systems* 10 (2) : 135-152.