Indian Journal of Agronomy **47** (3) : 355–360 (September 2002)

Effect of planting pattern and fertilizer management on castor (*Ricinus communis*)-based intercropping system

SUBHASH KUMAR[1]

Agricultural Research Station, Rajasthan Agriculture University, Keshwana, Jalore, Rajasthan 343 001

Received : November 2001

ABSTRACT

A 2-year field experiment on castor (*Ricinus communis* L.)-based intercropping system comprising main plot treatments of castor sole crop, combinations of castor + greengram (*Phaseolus radiatus* L.), castor + clusterbean [*Cyamopsis tetragonoloba* (L.) Taubert], castor + sesame (*Sesamum indicum* L.) with 2 planting patterns (1:2 paired row) and subplot treatments of control, FYM @ 10 tonnes/ha, 80 kg N/ha and 40 kg N/ha + 5 tonnes FYM/ha was conducted at the Agricultural Research Station, Keshwana, Jalore, during 1996–97 and 1997–98. Castor + clusterbean intercropping yielded 10% higher average castor-equivalent yield than castor sole cropping. Sesame intercropping in castor found superior to castor sole cropping only for early sowing. Paired row geometry (60–120 × 60 cm) had no advantage over normal geometry (90 cm × 60 cm) in castor sole cropping as well as intercropping with other crops. Half of dose N (40 kg N/ha) with half dose of FYM (5 tonnes/ha) was found at par with the full dose of N (80 kg/ha). Sole cropping of castor as well as intercropping system based on castor when fertilized with 80 kg N/ha through chemical fertilizer or half through chemical fertilizer and half through FYM resulted in higher return.

Key words : Intercropping, Castor, Clusterbean, Sesame, Greengram, Planting pattern, Fertilizer management

Castor is a widely spaced, long-duration crop and covers the ground 80–90 days after sowing. In the castor-growing areas of Rajasthan, other popular crops of the same season are greengram, clusterbean and sesame which matures between 70 and 90 days. Therefore, an attempt was made to identify the intercrop (s) to utilize the space, light, water and nutrients in the early months of the cropping for fetching more benefit per unit area by the farmers as reported by Chetty and Rao (1979) and

Present address : [1]Bioassay Division, Central Insecticides Laboratory, Directorate of PPQ & S, NH-IV, Faridabad, Haryana 121 001, India

Willey (1979). These crops were tested as intercrop between the castor lines with the normal and paired row pattern of planting.

MATERIALS AND METHODS

A field experiment was planted during rainy seasons of 1996–97 and 1997–98 at the Agricultural Research Station, Keshwana, Jalore, Rajasthan Agriculture University, Bikaner. The soil was silty loam, with pH 8.2, organic carbon 0.25%, available phosphorus 20 kg P_2O_5/ha and available potassium 578 kg K_2O/ha. During the crop seasons there was 13.9 and 22.6 cm rainfall in 1996–97 and 1997–98 respectively.

The experiment was laid out in split-plot design comprising 7 main plot treatments of castor sole crop, combinations of castor + greengram, castor + clusterbean and castor + sesame with 2 planting patterns of 90 cm × 60 cm (1:2) and 60 cm – 120 cm × 60 cm (paired row). In 1:2 planting pattern, 2 rows of intercrop were sown after 1 row of castor, whereas in the paired row (PR) pattern each wider row of 120 cm distance accommodated 3 rows of intercrop (s). The plant-to-plant distance was kept 60 cm in both kinds of planting pattern. In the subplots there were 4 treatments, viz. control, FYM @ 10 tonnes/ha, nitrogen @ 80 kg/ha and half dose of nitrogen. (40 kg N/ha) + half dose of FYM, (5 tonnes FYM/ ha). The experiment was replicated 3 times using castor 'GCH 4', greengram 'K 851', clusterbean cv. 'RGC 936' and sesame cv. 'RT 46'. All the crops were sown on 26 July 1996 and 6 August 1997 with the castor seed rate of 8 kg/ha, greengram 10 kg/ha, clusterbean 12 kg/ha and sesame 2 kg/ha in plot size of 4.8 m × 4.5 m. At the distance of 60 cm, 2 seeds of castor were dibbled at 1 place in the rows of above prescribed fashion, whereas greengram, clusterbean and sesame crops were sown continuously in the rows. In all the intercrops plant-to-plant distance of 15 cm was maintained by thinning at 20 days after sowing. Likewise, 1 plant of castor was maintained at 60 cm distance in all the rows by pulling out the additional plant, if both seeds germinated at one spot. Recommended fertilizer doses of 80 and 40 kg/ha of N and P was applied in total to the crop. For it even dose of phosphorus @ 40 kg/ha was applied basal using the source single superphosphate. As per treatment, 50% of the total N applied as basal, 25% applied locally after harvesting of intercrops and 25% nitrogen applied after second picking of castor, through urea. Hand-weeding in the field was done 2 times at 30 and 60 days after sowing. Total 7 irrigations were given to the crop at 40, 75, 105, 150, 180, 210 and 240 days after sowing. Picking of castor was being made 6 times in total at 90, 130, 160, 200, 242 and 270 days after sowing respectively. One picking of greengram pods 55 days after sowing was being made before its harvesting during both the years.

RESULTS AND DISCUSSION

Cropping system

In castor + clusterbean intercropping, castor-equivalent yield was 8.0 and 12.9% higher than castor sole cropping during both the years respectively (Table 1). In this intercropping system, as castor seed yield and yield attributes, viz. plant height,

Table 1. Castor yield, component crop yield, castor-equivalent yield and economics (average of 2 years) as influenced by intercropping system, planting pattern and fertilizer management

Treatment	Castor yield (kg/ha)		Intercrop yield (kg/ha)		Castor-equivalent yield (kg/ha)			Gross income (Rs)	Net income (Rs)	Benefit : cost ratio
	1996–97*	1997–98^	1996–97*	1997–98^	1996–97*	1997–98^	Mean			
Castor sole crop	3,946.9	3,971.7			3,946.9	3,971.7	3,959.3	43,160	28,367	1.92
Castor + greengram (1:2)	3,231.4	4,066.6	210.3	54.0	3,648.2	4,178.1	3,913.5	42,720	27,527	1.81
Castor + clusterbean (1:2)	3,952.8	4,053.7	215.2	218.3	4,286.6	4,465.1	4,375.9	47,719	32,687	2.18
Castor + sesame (1:2)	4,003.3	4,121.1	213.8	0.0	4,384.1	4,121.1	4,252.6	46,321	31,348	2.09
Castor + greengram (PR)	3,351.5	4,170.8	182.4	35.0	3,729.8	4,243.1	3,986.5	43,517	28,324	1.86
Castor + clusterbean (PR)	3,940.8	4,205.7	190.0	156.0	4,235.3	4,499.6	4,367.5	47,639	32,606	2.17
Castor + sesame (PR)	3,954.6	4,201.8	191.4	0.0	4,276.8	4,201.8	4,238.5	46,199	31,227	2.09
CD (P=0.05)	173.4	281.5			173.8	281.4	201.6			
Control	2,385.7	2809.6	96.6	79.9	2,543.7	2,886.6	2,715.2	29,638	15,801	1.14
FYM 10 tonnes/ha	3,569.6	3696.1	190.2	155.6	3,823.3	3,845.0	3,834.2	41,795	25,958	1.64
FYM 5 tonnes + 40 kg N/ha	4,604.2	4862.5	266.4	134.1	4,996.6	4,991.5	4,994.1	54,435	39,016	2.53
80 kg N/ha	4,561.2	5,078.8	248.9	93.8	4,926.5	5,147.5	5,037.0	56,108	41,610	2.87
CD (P=0.05)	115.0	234.6	14.5	25.6	109.3	234.9	131.4			

*1996–97 : Sale price of castor Rs 10.35, greengram Rs 20.25, clusterbean Rs 16.0 and sesame Rs 17.0/kg each
^1997–98 : Sale price of castor Rs 11.15, greengram Rs 23.0, clusterbean Rs 21.0/kg each

spikes/plant, length of primary spike and 100-seed weight (Table 2), were at par with sole cropping of castor, indicating higher castor-equivalent yield owing to additional yield of clusterbean.

In castor + sesame intercropping, castor-equivalent yield was recorded significantly higher than castor sole cropping during 1996–97 only, whereas it was par during 1997–98 due to not bearing of fruits and seed by sesame crop (Tables 1, 3). It might be due to late sowing, i.e. 6 August 1997, of the crops because the right time of sesame sowing in the region is first week of July. Castor seed yield and yield attributes, viz. plant height, spikes/plant, length of primary spike and 100-seed weight, were at par with those of the castor sole cropping in this system during both the years.

Castor + greengram intercropping yielded significantly less castor yield as well as castor-equivalent yield during 1996–97, however, it was at par during 1997–98 with castor sole cropping.

The reduction in castor yield was accompanied with significantly less spikes/plant and length of primary spikes (Table 2). It might be due to the more severe competition for resources between castor and greengram.

Planting pattern

As evident from the data on castor yield, castor-equivalent yield and the yield attributes, paired row (PR) had no advantage over 1:2 planting pattern in all 3 castor intercropping systems as well as in castor sole cropping (Tables 1, 2). It might be due to the longer duration (270 days) and well-developed root-system of the castor. Singh (1988) also described the well-developed root-system of castor.

Table 2. Yield attributes of castor as influenced by intercropping system, planting pattern and fertilizer management

Treatment	Plant height (cm)		Spikes/ plant		Length (cm) of primary spike		100-seed weight (g)	
	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98
Castor sole crop	190	185	10.8	11.6	40.3	41.5	24.3	23.7
Castor + greengram (1:2)	184	188	9.3	10.1	35.6	38.7	25.1	24.2
Castor + clusterbean (1:2)	192	175	11.3	10.5	42.3	40.7	24.6	23.8
Castor + sesame (1:2)	178	188	10.5	11.1	39.8	42.5	24.9	25.1
Castor + greengram (PR)	183	191	9.2	10.8	36.0	41.3	23.9	24.9
Castor + clusterbean (PR)	189	177	10.6	11.4	41.6	42.6	25.0	23.9
Castor + sesame (PR)	175	186	11.3	10.2	42.1	41.7	24.5	25.1
CD (P = 0.05)	NS	NS	0.81	NS	3.96	NS	NS	NS
Control	156	161	6.2	5.4	30.6	29.5	18.1	17.4
FYM 10 tonnes/ha	182	179	8.5	8.1	35.8	35.1	21.8	20.7
FYM 5 tonnes + 40 kg N/ha	190	186	11.8	12.3	43.4	45.3	25.3	25.1
80 kg N/ha	194	193	12.2	13.0	44.1	44.8	24.7	25.6
CD (P = 0.05)	18.5	16.2	2.11	2.72	4.14	4.42	2.32	2.41

Fertilizer management

Minimum yield and yield attributes of castor as well as castor-equivalent yield were recorded in the control plots (Table 1, 2). The 100-seed weight of component crops clusterbean and sesame and seeds/pod of greengram were found unaffected by fertilizer treatments. The FYM @ 10 tonnes/ha treatment resulted in significantly higher castor yield, castor-equivalent yield and intercrop yield than the control treatment, but provided significantly less castor yield, castor-equivalent yield, intercrop yield and yield attributes in castor than half dose of N + half FYM and full dose of N (80 kg/ha). It indicated that alone FYM @ 10 tonnes was not sufficient to realize the full potential of the castor crop. Half dose of N (40 kg/ha) + half dose of FYM (5 tonnes/ha) treatment yielded at par with the full dose of N (80 kg/ha) treatment for castor yield, component crop yield, yield attributes and castor-equivalent yield (Tables 1, 2, 3). Thus in the castor intercropping systems, half dose of N (40 kg/ha) may be replaced by the FYM 5 tonnes/ha from the recommended dose (80 kg/ha) to obtain the same yield levels of the crop.

Table 3. Yield attributes of component crops as influenced by fertilizer management

Treatment	Plant height (cm)		Branches/ plant		Pods/ plant		Seeds/ pod		100-seed weight (g)	
	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98
Clusterbean										
Control	102	100	5.2	5.3	36.1	34.2	4.2	4.1	3.3	3.4
FYM 10 tonnes/ha	119	116	6.3	6.8	44.1	45.2	5.6	5.2	3.5	3.5
FYM 5 tonnes/ha + 40 kg N/ha	128	130	8.5	7.8	45.9	46.1	5.9	5.4	3.4	3.5
80 kg N/ha	131	132	8.5	8.0	47.1	46.8	5.1	5.4	3.6	3.4
CD (P=0.05)	14.5	16.2	1.0	1.2	5.4	5.7	0.9	0.9	NS	NS
Greengram										
Control	26	25	2.4	2.3	41.7	45.1	3.2	3.2	2.0	2.1
FYM 10 tonnes/ha	29	31	3.1	3.0	63.6	61.7	3.7	3.9	2.8	2.6
FYM 5 tonnes/ha + 40 kg/ha	33	35	3.2	3.1	65.1	64.7	3.6	3.7	2.7	2.9
80 kg N/ha	35	34	2.9	2.9	56.3	58.4	3.8	3.8	2.5	2.7
CD (P=0.05)	3.8	4.3	0.42	0.44	10.7	9.8	NS	NS	0.4	0.4
Sesame										
Control	56	59	2.2	1.1	8.7	4.1	32.5	0	0.20	NA
FYM 10 tonnes/ha	79	78	2.9	1.5	11.6	4.9	39.2	0	0.21	NA
FYM 5 tonnes/ha + 40 kg N/ha	86	80	3.0	1.6	16.6	7.1	44.6	0	0.22	NA
80 kg N/ha	91	85	3.2	1.4	17.2	6.8	45.5	0	0.21	NA
CD (P=0.05)	17.1	17.4	0.5	NS	3.0	2.2	4.5		NS	

Hegde (1998) also observed results in similar results in the pearl millet–wheat sequence.

Economics

All the intercropping systems, except castor + greengram (1:2) provided substantially higher gross income, net income and benefit : cost ratio than castor sole cropping. Net income and benefit : cost ratio of castor + greengram (PR) was though lower than sole crop, but gross income from this cropping system was slightly higher than sole cropping of castor. Highest average net income (Rs 32,647) was recorded under castor + clusterbean intercropping system which was 15.1 % higher than the average net income of castor sole cropping (Table 1). On an average, benefit : cost ratio was also recorded highest (2.18) under the same intercropping system. Castor+sesame intercropping also provided 10.3% higher average net income than the castor sole cropping, with average benefit : cost ratio of 2.09.

An intercropping of the clusterbean in the castor may be followed for fetching higher yield advantages and better utilization of resources in the castor-growing areas of Rajasthan. Sesame intercropping with castor may be advised but only when it is sown early. Application of 40 kg N/ha with 5 tonnes FYM/ha may be recommended for castor intercropping as well as castor sole cropping, as an alternate of 80 kg N/ha dose to reduce the chemical fertilizer dose without any significant reduction in the yield and profit.

REFERENCES

Chetty, C. K. R. and Rao, U. M. B. 1979. Experimental design for intercropping systems and analysis of data. (In) *Proceedings of International Intercropping Workshop, International Crop Research Institute of Semi-Arid Tropics, Hyderabad, India,* held during 10–13 January 1979, pp. 277–281.

Hegde, D. M. 1998. Effect of integrated nutrient management on productivity and soil fertility in pearl millet *(Pennisetum glaucum)*–wheat *(Triticum aestivam)* cropping system. *Indian Journal of Agronomy* **43** (4) : 580–587.

Singh, C. 1988. *Modern Techniques of Raising Field Crops,* 291 pp. Oxford & IBH Publishing Co. Private Ltd, New Delhi.

Willey, R. W. 1979. Intercropping–its importance and research needs. Competition and yield advantage. *Field Crops Abstracts* **32** (1) : 1–10.