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Yield and economics of pigeonpea (*Cajanus cajan*)-based intercropping system on rainfed upland of Chotanagpur plateau

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ABSTRACT

An experiment was conducted during 1987 and 1988 to evaluate production potential and economic returns in pigeonpea or redgram [*Cajanus cajan* (L.) Millsp.]-based intercropping systems on rainfed upland of Chotanagpur plateau. Intercropping of rice (*Oryza sativa* L.), fingermillet (*Elusine coracana* Gaertn.) and groundnut (*Arachis hypogaea* L.) was better than sole crop of redgram both in terms of total production and net return. Intercropping of blackgram (*Phaseolus mungo* L.), greengram (*P. radiatus L.*) and soybean [*Glycine max* (L.) Merr.] with redgram proved uneconomic. Redgram + groundnut recorded highest redgram-equivalent (16.13 q/ha) and net return (Rs 3,613/ha), followed by redgram + rice (10.16 q/ha, Rs 2,917/ha) and redgram + fingermillet (10.05 q/ha, Rs, 2,797/ha). Hence intercropping with 2 rows of groundnut in between 2 rows of redgram planted at 75 cm x 30 cm spacing is economical for higher returns.

Redgram [*Cajanus cajan* (L.) Millsp.] is extensively grown throughout Chotanagpur in the uplands as rainy-season (*kharif*) crop under rainfed condition. The deep root-system of this crop has made it more suitable for its cultivation under drought conditions and poor soils. The emphasis on intercropping in redgram is justified because it can provided greater yield advantages compared with sole cropping. The intercropping increases yield and stabilizes production (Waghmare and Singh, 1982). Redgram is a long-duration, widely-spaced crop. As the growth of the crop is quite slow during initial stages, sufficient wide-space remains vacant in between 2 rows for this period. This space can be utilized for growing one or more short-duration, quick-growing, high-yielding varieties of many crops without having any competitive effect on redgram. Hence to explore the possibilities of growing suitable intercrops with redgram on uplands of Chotanagpur, the present investigation was planned.

MATERIALS AND METHODS

The field experiment was conducted during the rainy season of 1987 and 1988 at Deochanda Experiment Station, Hazaribagh, on typical upland soil (Oxisols). The soil was light-textured, highly permeable, acidic in reaction (pH

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5.6), low in N and P and medium in K status. Treatments consisted of redgram sole and redgram intercropped with ('Sattari') rice (*Oryza sativa* L.), 'A 404' fingermillet (*Eleusine coracana* Gaertn.), 'T 9' blackgram (*Phaseolus mungo* L.), 'TAP 7' greengram (*P. radiatus* L.), 'K 3' groundnut (*Arachis hypogaea* L.) and soybean 'Punjab 1' [*Glycine max* (L.) Merr.]. Three rows of rice or fingermillet or 2 rows of blackgram or greengram or groundnut or soybean as intercrops were sown in between 2 rows of redgram, spaced at 75 cm row width and 30 cm intra-plant space. The experiment was laid out in randomized block design with 3 replications. Gross plot size was 6.5 m x 6.0 m the net plot size was 5.75 m x 5.25 m. All the crops were sown on the same day in third week of June in both the years. Fertilizers (20 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha) were applied to all plots at sowing. In addition, 60 kg and 40 kg N/ha was side-dressed to rice and fingermillet respectively. Other recommended packages of practice were uniformly adopted as and when required. In general, redgram, rice, fingermillet, blackgram, greengram, groundnut and soybean were harvested respectively 179–181, 81, 125, 81, 82,96 and 126 days after sowing in both the years. Rainfall received during the crop season was 1,986.4 mm and 1,086.5 mm during 1987 and 1988 respectively. Total productivity (redgram equivalent) of intercropping systems were computed by converting yield of intercrops into yield of redgram on the basis of their existing market price. The economics of each system was also worked out as per current prices and cost of inputs prevailing during each year.

RESULTS AND DISCUSSION

The yield of redgram, pulses and oilseed crops, in general, varied highly from year to year. In 1987, the yields of legumes and soybean in particular were low because of unfavourable monsoon. In the first year there was more torrential rainfall in July during the initial stages of crop establishment, resulting in initial set-back to crops like groundnut and soybean. Probably this factor caused poor growth and significantly lower yields of groundnut and soybean in 1987 compared with that in 1988. Yield of redgram varied significantly in different cropping systems (Table 1). The highest grain yield of redgram was obtained with sole crop of redgram which was significantly superior to all other systems in both the years. The yield of redgram in intercropping system was generally reduced, depending on nature of intercrops. Intercropping cereals, pulses and oilseeds reduced the yield of redgram by 48.38 and 26% respectively. Intercropping of groundnut reduced the grain yield of main crop relatively lower than other intercropping systems, probably due to better compatibility in the system. Considerable reduction in yield of main crop was observed when cereals were grown as intercrops. It may be due to their tall-growing nature with dense canopy and standing in field for longer period. The reduction in yield of redgram in intercropping system was mainly due to competition offered by intercrop for nutrients, moisture and solar energy (Singh *et al.*, 1978). Reduction in yield of redgram due to intercropping with crops like sesame, sorghum and Italian millet was also reported by Rajput *et al.* (1989) and Reddy *et al.* (1993). In intercropping systems groundnut proved to be most compatible intercrop with redgram probably because groundnut utilizes early-season resources efficiently

Table 1. Grain yield of main crop, total production and yield of by-products in redgram-based intercropping systems

Treatment	Grain yield of redgram (q/ha)		Yield of intercrop (q/ha)		Mean total production (redgram equivalent) (q/ha)	Yield of by-products of redgram (q/ha)		Yield of by-products of intercrop (q/ha)		Gross return (Rs/ha)	
	1987	1988	1987	1988		1987	1988	1987	1988	1987	1988
Redgram (sole crop)	7.15	8.16			7.88	28.80	32.40			4,007	5,301
Redgram + rice	3.86	4.56	16.11	12.72	10.16	16.45	20.55	28.39	20.34	6,696	6,642
Redgram + fingermillet	3.40	3.99	19.56	16.20	10.50	15.86	19.10	15.65	17.35	6,122	6,176
Redgram + blackgram	4.87	6.42	2.59	3.48	8.69	22.55	24.15	17.00	15.65	4,228	6,059
Redgram + greengram	4.77	6.00	1.42	1.82	7.32	23.35	23.95	16.70	18.25	3,756	5,129
Redgram + groundnut	5.78	6.63	7.93	11.66	16.13	24.90	236.70	14.70	19.40	7,424	10,764
Redgram + soybean	5.03	5.12	1.82	7.65	8.77	23.70	25.10	18.35	20.25	3,786	6,688
CD (P = 0.05)	1.79	1.37			2.63					2.10	2.78

Prevailing market price of produce (Rs/ha): Redgram, 500 and 540; rice, 210 and 220; fingermillet, 180 and 190; blackgram, 500 and 550; greengram, 160 and 650; groundnut, 500 and 510; soybean, 400 and 415 in 1987 and 1988 respectively.

Price of by-product (Rs/ha): 15 and 20; 40 and 45; 20 and 25; 10 and 12; 10 and 12; 10 and 12; and 10 and 12 for respectively crops in respective years

Table 2. Economics of redgram-based intercropping systems

Treatment	Total cost (Rs/ha)		Net return (Rs/ha)		Benefit : cost ratio	
	1987	1988	1987	1988	1987	1988
Redgram (sole)	2,580	2,630	1,427	2,671	1.55	2.01
Redgram + rice	3,680	3,770	3,017	2,817	1.81	1.74
Redgram + fingermillet	3,310	3,395	2,813	2,781	1.84	1.81
Redgram + blackgram	3,380	3,470	8,48	2,589	1.25	1.74
Redgram + greengram	3,395	3,480	361	1,649	1.10	1.47
Redgram + groundnut	3,805	3,900	362	6,864	1.95	2.75
Redgram + soybean	3,480	3,560	306	3,128	1.08	1.87
CD (P = 0.05)	2.09	1.69	1.63	1.75	0.30	0.30

and has capability to make efficient use of low light levels (Reddy and Willey, 1980). Roysharma *et al.* (1981) also found groundnut to be a compatible intercrop with redgram.

Total productivity

All the intercropping systems except redgram + greengram gave higher total productivity (redgram equivalent) compared with sole redgram. Redgram + groundnut intercropping system gave significantly higher mean redgram equivalent (16.13 q/ha), followed by redgram + rice and redgram + fingermillet. The average increase in total productivity over sole crop was 104.69, 28.83, 27.53, 11.29 and 10.27% respectively when redgram was intercropped with groundnut, rice, fingermillet, soybean and blackgram. This was mainly due to additional advantage of intercrop yield. Redgram + greengram, however, gave lower total yield than sole crop of redgram. Redgram + groundnut system proved more advantageous compared with other intercropping treatments.

Economics

Redgram + groundnut gave the maximum mean net returns of Rs 3,613/ha with an increase of 155.78% over sole redgram, followed by redgram + rice (Rs 2,917/ha), redgram + fingermillet (Rs 2,797/ha) with 42.3 and 36.4% increase over sole crop of redgram respectively. The higher net returns in redgram + groundnut system was owing to more total yield and higher support prices of redgram and groundnut. Intercropping blackgram, greengram and soybean recorded lower mean profits of Rs 1,718.50, Rs 1,005 and Rs 1,717/ha respectively. Redgram + groundnut, redgram + rice and redgram + fingermillet system gave higher benefit : cost ratio over the other intercropping treatments (Table 2).

Thus based on 2-year study, it may be concluded that intercropping of compatible crops like groundnut, rice and fingermillet with redgram may be adopted for increased returns. The maximum net return can be obtained from intercropping of groundnut with redgram on upland conditions of Chotanagpur plateau.

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