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PARALLEL AND RELAY INTERCROPPING IN RAINFED REDGRAM ON GROWTH AND YIELD

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A field experiment was conducted to study the feasibility of introducing two sets of intercrops in redgram and to find out the most economical intercrop and relay intercrop in vertisol under rainfed conditions at the Tamil Nadu Agricultural University Farm, Coimbatore. Sorghum followed by ratoon sorghum were found to be the most profitable intercrop and relay intercrop respectively in redgram, fetching the highest net return (Rs. 2628/ha) followed by greengram and wheat as intercrop and relay intercrop respectively (Rs. 2354/ha). Raising pure redgram was the least remunerative.

In Tamil Nadu, redgram is grown mainly under rainfed conditions. Generally one crop is taken under rainfed conditions (Verma *et al*, 1978). This leads to under utilization of land, labour and other resources (Singh *et al*, 1980). Increasing in cropping intensity will lead to better resource utilisation and employment opportunities in rainfed agriculture. The emphasis on intercropping is justified because of the valid reason that intercropping can provide yield advantage compared to sole cropping. The practice of intercropping is important especially in redgram because the initial growth of redgram is rather very slow The space between widely spaced redgram could efficiently be utilised by growing some quick growing short duration crops like cereals, millets and pulses Since redgram is of long duration, there is possibility of introducing two sets of intercrops especially in moisture retentive vertisol. The space left over after the harvest of first set of intercrops could profitably be utilised by raising relay intercrops.

MATERIALS AND METHODS

An experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *kharif*, 1979 in vertisols under rainfed conditions, with a view to find out the feasibility of introducing two sets of intercrops and the most economical intercrop in redgram. The experiment was laid out in a split plot design and replicated thrice. The intercropping systems were allotted to main plots in which redgram (Co. 3) (base crop) was raised under paired row 30/90 cm with setaria (Co. 1), sorghum (Co. 21), blackgram (Co. 4), green gram (Co. 3) and cowpea (Co. 3) as first set of intercrops and *panivaragu* (Co. 1) ratoon sorghum, setaria, wheat (HD 2189) and coriander (local) as relay intercrops in treatment I_1, I_2, I_3, I_4 and I_5 In addition to pure cropping of redgram in paired row (I_6). The relay intercrops *viz.*, *panivaragu* (*Panicum miliaceum*), setaria (*Setaria italica*), wheat and coriander were chosen in such a way that these crops will utilise the stored soil moisture during *kharif* and growth

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with the help of dewfall apart from monsoon rains. Three levels of P_2O_5 *viz.*, 0, 25 and 50 kg/ha were assigned to sub-plots Urea to supply a uniform dose of 20 kg N/ha was applied in a single bund along with phosphorus The soil was low in available N, medium in available P_2O_5 and high in available K_2O status with an organic content of 0.74 per cent. The intra-row spacing for redgram was 30 cm, and 15 cm for sorghum and cowpea. 10 cm for blackgram and greengram while *panivaragu*, setaria and wheat were sown in solid rows. Sowing of both main crop and first set of intercrops was taken with a previous day rainfall of 7.2 mm and the relay intercrops were sown with 7.0 mm.

RESULTS AND DISCUSSION

The total rainfall received during the crop growth period was 1044 mm in 46 rainy days. The rainfall was low in the early stages of crop growth upto 105 days after sowing of redgram. There was good receipt of north-east monsoon showers after 105th day. Though redgram should have matured in 135 days, being an intedeterminate type, it put fourth profusely the second flush of growth and the additional yield was obtained after 135 days (crop was retained upto 156 days in the field). 47.2 mm of raifall was received during seedling stage. *33 8* mm during vegetative phase, 62.3 mm during flowering and pod formation phase, 648.3 mm during pod development and maturity stage of redgram and 20.0 mm during the growth and development stage of relay intercrops.

Yield attributes :

The pure crop of redgram and redgram intercropped with blackgram registered more number of pods (Table 1). There was no significant difference among the intercropping systems in pod weight, number of seeds per pod, pod length and seed weight in redgram. The least number of pods was recorded with sorghum as intercrop. This is the result of severe competition from sorghum which hampered the growth and development of redgram. Tnis falls in line with the findings of Raghavalu (1967).

Phosphorus application significantly increased the number of pods, pod weight per plant and number of seeds per pod, however there was no difference between 25 and 50 kg P_2O_5/ha. There was no increase in pod length due to application of P while P application increased the 100 seed weight of redgram and there was no significant difference among 25 and 50 kg P_2O_5/ha.

Dry matter production :

Intercropping systems exerted significant influence on the dry matter production of redgram at all stages of crop growth. Sorghum as intercrop reduced the dry matter production to a greater extent (12.5 per cent) than pure crop of redgram at all stages (Table 2) Since sorghum is an aggressive crop, putforth more canopy and has ability to compete effectively with sorghum. Such a reduction in dry matter production due to intercropping of sorghum was also reported from ICRISAT (1976) and Soundararajan (1978). Cowpea increased the dry matter production of redgram significantly (4.7 per cent) over pure red-

Table 1. Effect of intercropping systems and P levels on yield attributes of redgram

Treatment	No of pods per plant	Pod weight per plant (g)	No. of seeds per pod	Pod length (cm)	100 seed weight (g)
Main Plot					
I_0 — Redgram in paired row 30/90 cm	63.27	20.57	3.62	4.48	7.39
I_1 — Redgram (paired row) Setaria - I st intercrop + panivaragu relay intercrop	54.84	19.62	3.53	4.46	7.37
I_2 — Redgram (paired row)+ Sorghum Ist intercrop+ratoon sorghum — relay intercrop	49.43	14.90	3.58	4 52	7.38
I_3 — Redgram (paired row)+ Blackgram — I st intercrop+ Setaria — relay intercrop	61.60	21.37	3.56	4.51	7.38
I_4 — Redgram (paired row)+ Greengram — I st intercrop+ wheat – relay intercrop	54 29	17.53	3.84	4.52	7.52
I_5 — Redgram (paired row)+ Cowpea – Ist intercrop+ coriander - relay intercrop	52.62	17 50	3.49	4 50	7.43
S.E.	2.78	1 03	0.16	0.12	0.42
CD%	6.19	2.29	N S.	N S.	N.S.
Sub Plot (P_2O_5)					
P_0 0 kg/ha	48.40	15.79	3.42	4.40	7.17
P_1 25 kg/ha	58.52	19.99	3.60	4.40	7.51
P_2 50 kg/ha	61.11	19.97	3 79	4.59	7.55
S.E.	1.08	0.42	0 11	0.11	0.05
CD (5%)	2.24	0.87	0 23	N.S.	0.10

Table 2. Effect of intercropping systems and P levels on dry matter production and grain yields of redgram and yield of intercrops in the system.

Treatments	Dry matter production (kg/ha)		Grain yield (kg/ha)		
	Redgram	Intercrop	Redgram	First Intercrops	Relay intercrops
I_0	4090	—	834	--	—
I_1	3689	1255	712	558	**
I_2	3579	4206	596	437	7093 b
I_3	3964	960	774	163	**
I_4	3769	849and 1103 a	775	122	147
I_5	4284	1173	768	271	**
S.E.	27.99	—	9.65	—	—
CD (5%)	62.36	—	21 50	—	—
P_0	3403	—	692	—	—
P_1	4111	—	762	—	—
P_2	4173	—	778	—	—
S.E.	51.70	—	8.69	—	—
CD (5 %)	106.71	—	17.94	—	—

a = Dry matter production of wheat (relay intercrop)
b = Fodder yield of ratoon sorghum (relay intercrop)
** Crops failed

Phosphorus application had a significant influence in increasing the dry matter production of redgram. but the difference between P_1 and P_2 levels was found to be on par. This might be due the medium status of available P in soil.

Seed yield of redgram :

The pure crop of redgram established its supremacy by producing the highest seed yield (838 kg/ha presented in Table 2). The increased leaf area with high photosynthetic efficiency, greater dry matter production, higher N and P uptake, higher values of yield attributes and better utilisation of available soil moisture end nutrients under paired row planting system (30/90 cm) contributed to the higher seed yield of pure redgram.

All the intercropping systems significantly affected the yield of base crop of redgram. Significant reduction in seed yield due to intercropping of cowpea, greengram and blackgram was observed. Eventhough these short-term pulse intercrops were not competitive for nutrients, there existed a definite competition for available soil moisture especially under rainfed condition and space with redgram and thus reduced the seed yield. The possible reason is that the initial growth loss in redgram was not compensated. However, the yield reduction by these pulses was not marked to that extent, when sorghum and setaria were intercropped with redgram. The lowest seed yield was recorded due to intercropping of sorghum (596 kg/ha), the reduction being 28.8 per cent over pure redgram. The competition by sorghum with redgram remained upto 105th day. Thus competition existed for moisture, nutrients and light availabliity till the early pod filling stage of redgram. Even after the harvest of first intercrop sorghum, ratoon sorghum as relay intercrop also competed with redgram by putting better forth canopy. This would have ultimately led to reduction in seed yield Similar reduction in yield of redgram due to intercropping of sorghum was reported by saraf *et al* (1972).

Significant influence on seed yield of redgram was noticed due to P application. Seed yield was higher at 50 kg P_2O_5/ha (778 kg/ha) and at 25 kg P_2O_5/ha (762 kg/ha) as compared to no P application (691 kg/ha). The percentage of increase in yield due to application of P was 10.2 and 12.5 at 25 and 50 kg P_2O_5/ha reapectively. However, the difference between 25 and 50 kg P_2O_5/ha was not significant. Increased dry matter production higher values of yield attributes were tne probable reasons for increased yield due to P application. This is in confirmity with the findings of Ramiah (1978).

Economics of intercropping systems :

Among different intercropping systems, redgram+plant sorghum+ratoon

Table 3. Economics of Redgram-Based Intercropping Systems

Intercropping systems	Gross returns (Rs /ha)	Cost of cultivation Rs./ha	Net returns Rs./ha	Return per Rupee invested
I_0	2978	1090	1888	2.73
I_1	3070	1146	1925	2.68
I_2	3913	1285	2628	3.05
I_3	3423	1227	2199	2.79
I_4	3630	1276	2354	2.85
I_5	3322	1216	2106	2.73
S.E.	—	—	46.03	0.03
CD (5%)	—	—	102.56	0 06
P_0	—	—	1930	2.74
P_1	—	—	2315	3.00
P_2	—	—	2305	2.70
S.E.	—	—	19.49	0.03
CD (5%)	—	—	40.22	0.06

sorghum was found to be best both in net returns (Rs. 2628/ha) and return per rupee invested (Rs. 3 05 presented in Table 3). This is because higher income from grain yield of plant sorghum and fodder yield of ratoon sorghum Eventhough sorghum being an efficient competitor with redgram which reduced the growth and yield of redgram to a greater extent, additional in come from sorghum combination compensated more than the loss incurred to the redgram. Raising of setaria as intercrop and pure redgram were the least remunerative. Since the monetary value of setaria is lower, it could not fetch greater returns and so raising setaria as intercrop was uneconomical.

It was also noted that failure of *panivaragu*, setaria and coriander as relay intercrops after setaria, blackgram and cowpea respectively was one of the reasons for lesster net returns in these combinations

The greater net return was obtained due to application of 25 kg P_2O_5/ha (Rs 2315/ha) and 50 kg P_2O_5 (Rs. 2305/ha) oner no P fertilization (Rs. 1930/ha). In case of return per rupee invested application of 25 kg P_2O_5/ha was superior to 50 kg P_2O_5/ha and no P application.

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