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Effect of Inter Cropping on Dry Matter Production and Nutrient Uptake in Sorghum (CSH.5) Under Rainfed Condition*

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Studies were conducted during *kharif*, 1975 to determine the most profitable system of intercropping in sorghum under rainfed conditions. The results indicated that the dry matter production of sorghum was favourably influenced by intercropping with legumes. However, uptake of N.P and K by sorghum was found to be unaffected due to intercropping

Systems involving more than one crop have been followed by the farmers traditionally, to cope up with the vagories of monsoon. With intensive cropping gaining momentum, attempts have been made to include quick growing, short statured intercrops in the widely spaced rows of crops like sorghum. Any such intercropping system should be formulated in such a way that the crops effectively utilise the resources viz., sunlight, moisture and nutrients, without causing any serious competion and thus, reducing the yield of the base crop. Andrews (1972, 1974) found that sorghum-cowpea mixtres gave better yields without any adverse effect on the base crop. Robinson(1973)observed fovourable increase in cotton height when grown in association with blackgram. Bhale Rao (1970), Ganga Prasada Rao (1975) and Tarhakar (1976) also observed similar trend in sorghum pulses mixtures. Information on the most effective intercropping system which does not very much affect the dry matter production and nutrient uptake of the base crop is rather scanty. Hence this study was undertaken to select a viable inter cropping system in sorghum and to investigate the effect of intercropping on dry matter production and nutrient uptake by sorghom.

MATERIAL AND METHODS

A field experiment was laid out during *Kharif*, 1975 in a Randomisec Block Design with three replications in the Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore. The gross and net plot sizes were 10 x 4.5m and 8 x 3.8 m respectively. The varieties chosen were CSH.5 for sorghum, CO.2 for blackgram, C.152 for cowpea and CO.8 for lab-lab. The crops were sown on July 19, 1975. The base crop was harvested on November 9. blackgram on September 25, Cowpea on October 26 and lab-lab on weekly intervels starting from October 6 to November 9, 1975. The experiment was conducted under rainfed conditions. The

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total rainfall received during crop growth period was 363 mm,distributed uniformly in 25 rainy days. The soil was well drained clay loam with low available N (148 Kg/ha), medium available P_2O_5 (46 Kg/ha) high available K_2O (480 Kg/ha), pH of 7.9 and E.C. of 0.3 m. mhos/cm. The plots were uniformly applied with 80:60:40 Kg N, P_2O_5, and K_2O/ha except in T_9 where the recommended level of fertilizers was applied to pulses. The treatment schedule is given in Table I.

TABLE I

Number	Treatment		
T_1	Solid stand of sorghum (45 x 12 cm)		
T_2	Solid stand of intercrops (with recommended spacing)		
	a) Blackgram	...	20 x 10 cm
	b) Cowpea	...	45 x 15 cm
	c) Lab-lab	...	60 x 15 cm
T_3	Sorghum paired rows (30+60 x 12 cm) with one row of intercrop		
	a) Blackgram	...	30 x 5 cm
	b) Cowpea	...	30 x 20 cm
	c) Lab-lab	...	30 x 30 cm
T_4	Sorghum paired rows (30+60 cm) with two rows of intercrop		
	a) Blackgram	...	20 x 10 cm
	b) cowpea	...	20 x 40 cm
	c) Lab-lab	...	20 x 60 cm
T_5	Sorgram uniform rows (60 x 9 cm) with one row intercrop		
a)	Blackgram	...	30 x 7 cm
b)	Cowpea	...	30 x 25 cm
c)	Lab-lab	...	30 x 42 cm
T_6	Sorghum paired rows (30+90 x 9cm) with two rows intercrop		
	a) Blackgrem	...	30 x 7 cm
	b) Cowpea	...	30 x 25 cm
	c) Lab-lab	...	30 x 42 cm

Sorghum population maintained at 1,80,000 plants/ha. Intercrop population was constant in all intercropped treatments.

Plant samples were collected on 30th and 60th days and at harvest in the case of sorghum, cowpea and lab-lab and 30th and 45th days and at harvest for blackgram in the specially reserved rows. Samples were dried in an air oven and dry matter estimated. The ground plant samples were analysed for their content of N, P and K. The nutrient uptake was calculated by multiplying the nutrient content and dry matter produced per unit area.

RESULTS AND DISCUSSION

I. Drymatter Production

a) **Sorghum :** The results (Table II) indicated that there was no significant difference in the dry matter production per plant with respect to different systems of planting under any single intercrop. However, the dry matter production was affected by intercrops under different systems of planting (Table IIa). Among intercrops, cowea and lab-lab were found to increase the dry matter production of sorghum when compared to blackgram. Pure sorghum crop produced relatively lower amount of dry matter per plant. It is evident that growing legumes as intercrops favourably influenced the drymatter production of the base crop. Of the legumes, lab-lab and cowpea, being comparitively of longer duration, probably contributed to a greater extent to the availability of N, atmospheric fixation, to the base crop. Kandasamy *et al.* (1975) observed a similar trend in sugarcane intercropping systems. Among the systems of planting, growing two rows of intercrops in the 90 cm interspace between pairs of rows of sorghum 30 cm apart seemed to be advantageous.

TABLE II. Drymatter production of sorghum at different stages of growth (g/plant)

Intercrop	Blackgram			Cowpea			Lab-lab		
Treatment	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest
T_1	13.73	65.41	189.66	14.39	65.44	217.83	14.08	64.08	216.11
T_2	—	—	—	—	—	—	—	—	—
T_3	12.71	56.88	194.33	13.13	62.17	218.33	12.62	64.09	220.02
T_4	12.39	59.82	197.33	13.48	62.11	213.71	13.50	67.02	202.21
T_5	12.99	64.79	197.22	13.09	65.25	208.88	12.70	60.27	217.82
T_6	13.30	59.82	189.77	13.73	63.85	222.22	13.51	61.07	207.77
Pure crop Vs systems									
SED	0.38	6.08	12.85	0.63	4.10	21.74	0.71	4.59	24.68
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS
Within systems									
SED	0.45	7.69	16.25	0.79	5.19	27.50	0.91	5.80	31.22
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS

TABLE II A. Interaction table for drymatter production of sorghum plant at harvest (g/plant: total of three replications)

Treatment	Blackgram	Cowpea	Lab-lab	Mean
T_1	568.88	653.49	648.43	203.86
T_2	—	—	—	—
T_3	582.99	654.98	648.06	210.89
T_4	593.32	641.12	606.06	204.56
T_5	626.65	653.46	653.46	207.96
T_6	569.32	666.70	623.33	206.59

Intercrops	:	SED	... 2.35
		CD	... 4.86
Treatment	:	SED	... 3.04
		CD	... NS
Interaction	:	SED	... 5.72
		CD	... 10.86

It is apparent that growing intercrops in wider interspaces between paired raws of sorghum did not cause much competition between the base crop and inter crops thereby resulting in increased dry matter production. It is also possible that in the wider inter row spacing, the intercrops were able to grow better fixing greater amount of atmospheric N, some part of which might have become available to the base crop. This would have caused greater dry matter production.

b) Intercrops : The drymatter produced per plant (Table III) by blackgram under different systems of planting did not vary much on 30th day after sowing. On 45th day and at harvest, pure stand of blackgram showed significant difference in drymatter production over mixed stands, which may be probably due to less competion in pure stands.

Significant differences in dry matter production was noticed between systems of planting on 45th day and at harvest. Sorghum in paired rows (30 cm) with two rows of blackgram (90 cm) in between produced the maximum drymatter which may be due to the possibility of low level competion between sorghum and blackgram. Other systems did show any variations in dry matter production.

TABLE III. Drymatter production of intercrops at different stages of growth (g/plant)

Treatment	Blackgram			Cowpea			Lab-lab		
	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest
T_1	—	—	—	—	—	—	—	—	—
T_2	1.23	4.71	5.59	2.86	7.79	21.47	6.03	27.23	41.43
T_3	1.05	2.03	2.73	2.33	5.06	8.33	4.27	10.13	17.67
T_4	1.17	1.93	2.07	2.12	3.81	7.87	3.99	5.74	15.39
T_5	1.18	2.93	2.98	2.34	3.36	6.78	4.12	7.23	16.91
T_6	1.07	3.36	4.66	2.40	5.15	9.16	5.06	13.14	22.83
Pure crop Vs systems									
SED	0.08	0.31	0.38	0.11	0.25	1.43	0.22	1.40	1.89
CD	NS	1.05	0.93	0.37	0.85	4.81	NS	4.68	6.33
Within systems									
SED	0.19	0.39	0.35	0.14	0.32	1.81	0.28	1.77	2.39
CD	NS	0.98	1.17	NS	1.07	NS	0.66	4.09	NS

In cowpea also pure stand produced maximum drymatter per plant. When different systems were considered on 60th day sorghum in paired rows (30+90 cm) with two rows of intercrop produced maximum dry matter per plant. It was closely followed by one row of intercrop in between pairs of sorghum rows (30+60 cm). However, the difference faded away at maturity. A similar trend was noticed in the case of lab-lab also. In the early period, competition might have been greater in closely planted systems which could have resulted in decreased drymatter production. As lab lab and cowpea remained in the field for over 90 days, they might have been able to over come this competitive effect and produce greater drymatter.

II. Nutrient uptake

a) **Sorghum:** Nitrogen uptake by sorghum (Table IV) at different stages of growth did not vary significantly in different systems of planting or due to intercrops. In appears that even in systems of planting where competition is likely to occur the N uptake of sorghum was not decreased, probably due to the favourable effect of legume on the base crop. Nowotnowna (1937) and Robinson (1973) also observed benificial effect of legumes on the companion crops when they were grown in association.

Phosphorus uptake of sorghum plants showed no significant difference at different stages due to systems of planting or intercrops. It is obvious that the intercrops did not cause any severe competition for P uptake by the basecrop and the soil reserves were sufficient to take care of the needs of both the base crop and intercrops.

Potassium uptake of sorghum in different stages did not vary with systems of planting or intercrops. The soil of the experimental plot analysed for high available K_2O and hence K nutrition would not have been a problem.

TABLE IV. Nutrient uptake of sorghum at different stages of growth (g/m^2)

Treatment	Blackgram									Cowpea								
	Nitrogen			Phosphorus			Potassium			Nitrogen			Phosphorus			Potassium		
	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest	90th day	60th day	Harvest
T_1	5.90	15.86	30.79	0.70	2.63	6.82	5.80	15.63	34.81	5.11	9.79	27.81	0.61	1.95	5.32	5.20	14.19	34.99
T_2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
T_3	5.29	11.30	27.06	0.56	2.13	6.34	4.70	14.60	34.82	5.03	9.52	31.67	0.59	1.90	6.83	4.65	14.12	32.00
T_4	5.42	12.52	30.83	0.56	2.31	5.58	4.61	14.66	33.60	5.84	11.34	30.79	0.66	2.36	7.48	6.12	17.00	33.71
T_5	4.66	11.02	29.18	0.55	2.19	4.99	4.24	18.14	34.02	4.72	8.30	28.13	0.51	1.83	5.40	4.40	11.24	32.21
T_6	4.89	12.36	27.29	0.56	2.02	5.66	4.39	15.12	28.95	4.42	9.40	30.46	0.59	1.79	5.85	4.89	13.78	37.87
Pure crop Vs systems																		
SED	0.40	2.61	1.91	0.66	0.35	0.93	0.22	2.69	3.02	0.82	1.51	4.12	0.05	0.61	0.68	0.47	0.22	4.41
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Within systems																		
SED	0.51	3.29	2.42	0.08	0.44	1.77	0.63	3.41	3.83	1.04	1.91	5.22	0.06	0.77	0.88	0.60	1.54	5.58
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

TABLE IV. (Continued)

Treatment	Lab-lab								
	Nitrogen			Phosphorus			Potassium		
	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest
T_1	5.35	9.96	30.07	0.54	1.96	5.98	4.83	16.97	35.48
T_2	—	—	—	—	—	—	—	—	—
T_3	4.11	8.86	28.71	0.40	1.60	5.54	3.13	13.81	36.02
T_4	4.66	9.22	26.78	0.50	1.85	6.03	3.77	16.08	34.87
T_5	4.68	8.43	27.54	0.52	1.75	5.41	4.36	15.57	33.33
T_6	4.37	9.28	28.30	0.49	1.67	4.89	3.99	13.78	34.85
Pure crop Vs systems									
SED	0.54	1.28	3.92	0.07	0.22	0.62	0.50	1.65	4.44
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS
Within systems									
SED	0.68	1.61	4.56	0.09	0.28	0.79	0.64	2.09	5.63
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS

TABLE V. Nutrient content of intercrops at different stages of growth (Percentage)

Treatment	Blackgram									Cowpea								
	Nitrogen			Phosphorus			Potassium			Nitrogen			Phosphorus			Potassium		
	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest
T_1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
T_2	3.13	1.46	1.21	0.26	0.25	0.17	1.92	1.35	1.04	3.31	1.86	1.48	0.34	0.27	0.16	2.60	1.92	2.22
T_3	3.55	1.62	1.54	0.28	0.27	0.17	1.62	1.35	1.12	3.55	2.00	1.63	0.34	0.26	0.13	2.24	2.12	2.04
T_4	3.17	1.74	1.68	0.32	0.29	0.14	1.39	1.30	0.91	3.69	2.24	1.49	0.34	0.28	0.13	2.61	2.06	2.04
T_5	3.55	1.84	1.82	0.25	0.29	0.14	0.96	1.21	1.07	3.31	2.29	1.49	0.32	0.24	0.10	2.50	1.83	2.15
T_6	3.45	1.62	1.40	0.29	0.26	0.14	1.11	1.10	1.09	3.67	2.10	1.73	0.36	0.22	0.12	2.74	2.06	1.70
Pure crop Vs systems																		
SED	0.23	0.22	0.16	0.34	0.02	0.02	0.21	0.11	0.09	0.90	0.44	0.07	0.02	0.02	0.02	0.27	0.12	0.52
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.21	NS	NS	NS	NS	NS	NS	NS	NS
Within systems																		
SED	0.29	0.28	0.20	0.45	0.09	0.02	0.26	0.14	0.12	0.11	0.55	0.09	0.01	0.03	0.03	0.34	0.50	0.32
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.26	NS	NS	NS	NS	NS	NS	NS	NS

TABLE V. (Continued)

Treatment	Lab-lab								
	Nitrogen			Phosphorus			Potassium		
	30th day	60th day	Harvest	30th day	60th day	Harvest	30th day	60th day	Harvest
T_1	—	—	—	—	—	—	—	—	—
T_2	2.47	2.19	1.26	0.19	0.22	0.15	0.92	1.35	1.24
T_3	2.43	2.10	1.63	0.22	0.17	0.12	1.25	1.44	1.46
T_4	2.57	1.96	0.98	0.22	0.22	0.09	1.16	1.70	1.37
T_5	2.24	2.12	1.40	0.19	0.21	0.10	1 00	1.60	1.17
T_6	2.85	2.47	1.17	0.17	0.22	0.12	1.14	1.75	1.21
Pure crop Vs systems									
SED	0.23	0.20	0.13	0.24	0.18	0.18	0.09	0.13	0.13
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS
Within systems									
SED	0.29	0.25	0.16	0.02	0.02	0.03	0.12	0.13	0.16
CD	NS	NS	NS	NS	NS	NS	NS	NS	NS

b) **Intercrops :** In the earlier stages the N content of blackgram did not vary much due to different systems of planting (Table V). But at later stages, blackgram in mixed stands recorded higher N content. This might be due to the absorption of some part of N applied to the base crop, sorghum since only a very low quantity of N was applied to pure stand of blackgram.

In the case of cowpea, treatments effect of N content was noticed in early stage but this difference disappeared as the crop advanced in age. As in the case of blackgram, cowpea in mixed stand contained more N than that in pure stand possibly due to the absorption of N applied to sorghum. Comparing systems of planting, N content was greater when cowpea was planted in interspace between paired rows of sorghum. When pulse crop was sown in between uniform rows of sorghum 60 cm apart N content was lower at the early stages. The difference disappeared on later dates. This may be due to the fact that cowpea would have suffered in competition in that treatment and as the stages advanced, as cowpea put forth deeper root system and foraged, the difference disappeared.

There was no significant difference in N content of lab-lab due to treatments except at maturity. One row of lab-lab planted in the interspace (60 cm) between paired rows of sorghum (30 cm) contained higher N. Lab-lab being a crop with greater spread of foliage suffered from competition with sorghum when lab-lab was planted in two rows in between pairs of rows of sorghum (30+60 cm), resulting in lower N content.

P content in all the three pulses did not vary significantly due to treatments. This is probably because the soil was adequately supplied with P and so competitive effect on P absorption did not occur.

As in the case of P, K content of the pulse crops was not affected much due to treatments. The soil K content was high and so K absorption would have taken place at optimum level.

In conclusion it can be stated that the dry matter production of sorghum was favourably influenced by intercropping with legumes particularly with cowpea and lab-lab. Different inter crops and systems of intercropping did not have any influence on the uptake of N, P and K by sorghum. Hence intercropping in sorghum with legumes is a viable system without any detrimental effect on the growth and development of the base crop.

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