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STUDIES ON THE INTERCROPPING OF SORGHUM (*Sorghum bicolor*) REDGRAM (*Cajanus cajan*), GREENGRAM (*Vigna radiata*) AND SOYBEAN (*Glycine max*) WITH REFERENCE TO PLANT POPULATION

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Intercropping of greengram (S-9), sorghum (CSH 6), redgram (UPAS 120) and soybean (Bragg) with two plant populations for each component crop (50 and 100% of their normal population) in a paried row system was studied at Dryland Research area of Haryana Agricultural University, Hissar, during *kharif* 1979 and 1980. Intercropping, especially with sorghum reduced the grain yield of greegram. During normal year of rainfall (1979) there was no yield difference between 50 and 100 per cent plant population; In compartively dry year (1980), 100 per cent plant in intercropping gave higher yield. Sorghum as an intercrop reduced total dry matter production in greengram.

Hariyana usually receives less than 400 mm of annual rainfall, of wihch 80 per cent of rainfall is received in two and a half months ie from July to mid September. Besides scanty ranifall, there are long dry spells and sometimes heavy intensity rainfall of more than 55 mm occurs in a day. Thus, distribution of rainfall is uncertain and uneven with frequent aberrant weather.

The soils of Hariyana are light, sandy loam and loams with calcium concretion layers at varying depths with problem of surface crusting with poor water holding capacity. Under uncertain weather conditions intercropping of cereals and pulses could cover the risk of total crop failure which is one of the main constraints.

Rao (1977) reported that while maintaining the yield levels of sole crop of sorghum, additional yields with intercropping have been realised in various systems. Reports from IARI (Anonymous, 1971) indicated that intercropping of greengram gave an additional yield of 7-8 q/ha withou adversely affecting the yield of redgram Willey *et al.* (1980) indicated that as a sole crop, late maturing redgram is relatively inefficient because of it slow initial growth rate and low harvest index Intercropping redgram with more rapid growing crops such as cereals or legumes can give substantial yield advantages. In such case, growing of short duration greengram variety would be most profitable.

MATERIAL AND METHODS

The experiment was conducted at the Dryland Research Area of Haryana Agricultural University, Hissar, during *kharif* 1979 and 1980. The ranifall during the experimental period of 1979 and 1980 were 341 and 198 mm respectivaly. The soil of the experimental field was sandy loam, poor in nitrogen, medium in phosphorus and rich in potassium. Calcium concretion layers were prasent in the field at varying depths of 60 to 90 cm.

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The experiment was laid out (in both the years) in a randomized block design with three replications. The gross plot size was 30 m² (6 m x 5 m) and net plot size was 13.5 m² (3m x 4.5 m). Tha treatments consisted of sole crops of sorghum, redgram, greengram and soybean each at 100 per cant population (normal population). Intercrop combinations were

Sorghum (PR) + Redgram (PR) Sorghum (PR) + Greengram (PR) Sorghum (PR) + Soybean (PR) Redgram (PR) + Greengram (PR) Redgram (PR) + Soybean (PR)	100% + 100% 50% + 50% x 100% + 50% 50% + 100%	of normal plant population

(PR) = Paired row (30/90 cm)

The total number of treatments were twenty four

Crop	*Variety/Hybrid*	*Plant population at 100 %*
Sorghum	CSH + 6	.8 lakh/ha
Redgram	UPAS + 120	.0 lakh/ha
Greengram	S + 9	.0 lakh/ha
Soybean	Bragg	.0 lakh/ha

The seeds of pulse crops were inoculated with respective cultures. The experiment was sown on 17th July during 1979 and 1980. The sole crops had twelve rows spaced at 50 cm where as in the intercropping treatments, there were five pairs of each component crop alternated with each other, The plant population was adjusted within the rows. Plant protection measures were taken up as and when needed. The years 1979 and 1980 being drought years, two life saving irrigations were applied in both the years around 45 and 85 days after sowing.

Observations like drymatter production per plant at harvest, and number of pods per plant, 1000-grain wieght, and grain yield were recorded.

RESULTS AND DISCUSSION

Intercropping reducee the grain yield of greengram. Grain yield of sole crop of greengram and intercropped greengram were 14.41 and 7.40 q/ha during 1979 and 10.56 and 7.91 q/ha during 1980, respectively. (Table 1). This indicates that there was greater competition for various resources in intercropping due to which the grain yield of intercropped greengram was reduced On the other hand sole crop did not face as much competition as in intercropping and thus gave higher grain yields. In comparison with redgram, sorghum as intercrop resulted in greater reduction of grain yield of greengram, indicating that sorghum has greater smothering effect than redgram. Sorghum is more competitive than redgram because of its faster rate of growth during early stages unlike the redgram. During 1980, increase in plant population of greengram from 50 to 100 per cent of its normal population increased significantly its grain yield from 6.99 to 8.83 q/ha; but no such

Table 1 Grain yield of greengram as influenced by intercrops and plant population

		Grain yield (q/ha)			
		1979		1980	
Sole crop		14.41		10.56	
Mean of intercropped treat		7.40		7.91	
		Intercrops			
		1 SOR	1 RG	1 SOR	1 RG
Pl. Popl. (%)	100 : 100	3.88	9 88	6.60	10.01
	50 : 50	4.20	10.31	5.46	9.40
	100 : 50	5.91	11.74	7.46	11.25
	50 : 100	4.01	9.25	4.64	8.46
	Mean	4.50	10.29	6.04	9.78
					Mean
				Pl. Popl. 100	8.83
				GG (%) 50	6.99
		S.Ed. ±	C.D at 5%	S.Ed. ±	C.D. at 5 ±
Sole crop Vs. Inter-cropped treat		0.96	2.03	1.17	2.49
		S.Em ±		S.Em. ±	
Intercrops		0.45	1.35	0.55	1.66
Pl. Popl. GG		0.45	N.S.	0.55	1.56
Pl. Popl. Intercrops		0.45	N.S.	0.55	N.S.
Pl. Popl. GG x Pl. Popll ntercrops		0.64	N.S.	0.78	N S.

Table 2. Test weight (1000 grain weight) of greengram as influenced by intercrops and plant population

	1000-Grain weight (g)			
	1979		1980	
Sole Crop	24.71		32.46	
	Intercrops			
	1 SOR	1 RG	1 SOR	1 RG
	36.70	35.05	29.10	28.80
	36.98	34.93	32.70	33.03
	38.44	34.54	30.56	31.43
	35.26	34.23	29.90	25.50
	37.00	34.94	30.56	29 66
	S.Em.±	C.D. at 5%	S.Em.±	C.D. at 5%
	0.44	1.32	1.30	N.S.
	0.44	N.S.	1.30	N.S.
	0.44	N.S.	1.30	N.S.

Table 3. Total dry matter production (g/plant) and number of pods per plant of greengram as influenced by intercrops and plant population

	Podnumber			
	1979		1980	
	32.66		38.00	
	26 50		39.29	
	Intercrops			
	ISOR	IRG	ISOR	IRG
	12.00	30.00	37.33	47.33
	21.00	38.33	37.00	48.33
	20.33	32.33	19.33	38.66
	18 00	40.00	23.66	52.69
	17.83	35.16	31.83	46.75
	S.Ed.±	C.D at 5%	S.Ed.+	C.D. at 5%
	4.21	N.S.	8.78	N S.
	S.Em.+		S.Em.+	
	1.98	5 96	4.13	12.40
	1.98	N.S.	4 13	N.S.
	1.98	N.S.	4.13	N.S.

OSR = Sorghum
RG = Redgram
GG = Greengram
SOY = Soybean
100 : 100
50 : 50
100 : 50
50 : 100

IRG = Redgram as an intercrop
IGG = Greengram as an intercrop
ISOY = Soybean as an intecrop
ISOR = Sorghum as an intercrop
The first number refers to badse crop and second to the intercrop. These figures are the per cent population of their normal plant population.

increase was noticed during 1979. Probably higher grain yield was obtained at higher population due to more plant stand during 1980 when the rainfall received was nearly 50 per cent of the rainfall received in 1979.

The differences in grain yield of greengram might have been the result of differences in its yield components. Thus it is noticed that all the yield components of greengram were adversely affected by sorghum intercrop resulting in reduced grain yield of greengram. Table 2 and 3 redgram was more compatible with greengram it indicates that redgram+greengram combination makes better use of resources by complementing each other and giving rise to temporal effect Shelke (1977) reported that the system in which greengram was intercropped with sorghum (both the component crops at optimum population density) gave 63 per cent yield recovery of the intercropped greengram over its sole crop. Although grain weight per plant of greengram decreased when its plant population was increased from 50 to 100 per cent of its normal population overall grain yield increased with a yield recovery of 84 per cent of its sole crop.

Intercropping reduced the dry matter production per plant of greengram during 1979 (Table 3) probably due to greater competition offered by intercrops. But during 1980, intercropping had no adverse effect. This may be due to the poor growth of sorghum and slow growth of redgram in early stages which might have offered less competition. Sorghum as intercrop reduced significantly the dry matter per plant in greengram as compared to redgram. It indicates the dominance and aggressiveness of sorghum crop. The reduction in the dry matter per plant resulted in reduced grain yields. Similarly, decreasing the plant population of either greengram or intercrops increased the dry matter in greengram which may be due to the reduction of intra and inter-crop competition.

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PHYSIOLOGICAL ASPECTS OF DROUGHT TOLERANCE IN GROUNDNUT (*Arachis hypogala* L.)

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The groundnut cultivars *viz.*, VG 77, JL 24 and CO 2 possess greater drought tolerance characters like higher root-shoot ratios, accumulations of cations, K^+ in particular. These characters have contributed for the higher pod yields in groundnut under moisture stress conditions. Thus K^+ content in the leaf can also be considered as one of the criteria for the drought tolerance in groundnut.

India ranks first both in area (7.4 m ha) and production (6.0 m.t) of world groundnut but productivity wise it is lowest (850 kg/ha). The reason for the low productivity is that groundnut crop is predominantly cultivated as rainfed crop and exposed to the vagories of monsoon. Inadequacy and uneven distribution of rain bring about low yield and in extreme

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