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Performance of sorghum (*Sorghum bicolor*) as influenced by intercropping and planting geometry

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ABSTRACT

A 2-year field experiment showed non-significant differences among sorghum [*Sorghum bicolor* (L.) Moench] + soybean [*Glycine max* (L.) Merr.] and sorghum + pigeonpea [*Cajanus cajan* (L.) Millsp.] intercropping systems. Higher mean values of land-equivalent ratio, grain and stover yields of the base as well as intercrop crops were obtained in sorghum + soybean combination. Paired-row planting (2 : 2) better. Mixed uniform line sowing showed better performance than mixed broadcasting.

In Vindhya region of Madhya Pradesh sorghum [*Sorghum bicolor* (L.) Moench] is generally grown mixed with pigeonpea [*Cajanus cajan* (L.) Millsp.] and soybean [*Glycine max* (L.) Merr.] under rainfed condition to cover risk against aberrant weather. This system of cultivation is inconvenient and less efficient compared with intercropping system. Therefore ample scope exists for improving the planting geometry by way of adopting intercropping system in row-arrangement pattern. The technique of paired-row planting has been developed to harness the maximum yield advantage from an intercropping system (Tarhalkar and Rao, 1980; Waghmare *et al.*, 1982).

Therefore present study was conducted at farmers' field to evaluate as well as to demonstrate sorghum-based intercropping systems in relation to crop combination and crop geometry.

MATERIALS AND METHODS

The experiment was conducted during rainy (*kharif*) season of 1988 and 1989 at Nibuha village of Sidhi district under Operational Research Project on farmers' field in sandy-loam soil. The experimental soil had pH 7.2, organic carbon 0.68% and low available N (255 kg/ha), medium available P_2O_5 (15.3 kg/ha) and high available K_2O (385.9 kg/ha).

Four planting geometries (mixed broadcasting, mixed line sowing, alternate rows in 1 : 1 and paired rows in 2 : 2 ratios) and 2 crop combinations (sorghum + soybean and sorghum + pigeonpea) were tested in randomized block design. The treatments were replicated 4 times in a plot size of 5.4 m x 5 m (gross) and 4.5 m x 4.1 m (net).

All crops were sown on 17 July 1988 and 12 July 1989 by broadcasting and line sowing as per treatment combination, with the row x plant spacing of 45 cm x 10 cm, 30 cm

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Table 1. Yield attributes of sorghum as influenced by various crop combinations and planting geometries (mean data of 2 years)

Treatment	Leaves/plant at harvest	Cob length (cm)	Cob weight/plant (g)	Grains/cob ('000)	1,000-grain weight (g)
Crop combination (CC)					
Sorghum + soybean	9.08	23.11	118.2	2.93	27.6
Sorghum + pigeonpea	8.73	21.42	111.9	2.58	24.5
CD (P = 0.05)	0.19	0.43	3.7	0.03	0.5
Planting geometry (PG)					
Mixed broadcasting	8.36	21.17	100.5	2.63	24.8
Mixed line sowing	8.47	21.92	117.7	2.82	26.0
Alternate rows (1 : 1)	9.19	22.75	119.1	2.73	26.4
Paired rows (2 : 2)	9.62	23.22	122.8	2.84	27.2
CD (P = 0.05)	0.27	0.61	5.2	0.04	0.8
Interaction CC x PG	NS	NS	NS	0.06	1.1

x 10 cm and 90 cm x 20 cm for sorghum, soybean and pigeonpea respectively. The row spacing (45 cm) of base crop was maintained under mixed line sowing. In mixed-cropping treatments seeds of both the crops were mixed before sowing in equal proportion (50 %) of the recommended seed rate. 'CSH 5' sorghum was intercropped with 'JS 72-44' soybean and 'No.148' pigeonpea. Sorghum and pulse crops were fertilized with the dose of 60 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha and 20 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha respectively. An uniform basal application of N, P_2O_5 and K_2O was done in pulses as well as in sorghum. Remaining N (40 kg/ha) in 2 equal splits was top-dressed in intercropped sorghum and side-dressed in mixed sorghum at 30 and 60 days after sowing. The total rainfall received during crop-growth period of sorghum was 1,089 and 659 mm with 15 and 19 rainy days in 1988 and 1989 respectively.

RESULTS AND DISCUSSION

Effect of crop combination

Yield attributes of sorghum were found significantly higher in sorghum + soybean combination than in sorghum + pigeonpea (Table 1). Significantly higher mean grain yield of sorghum was recorded in association with soybean than with pigeonpea (Table 2). The beneficial effect of soybean reflected on yield was probably due to availability of some extra nitrogen in soil by soybean-root nodules and also due to better yield-attributing characters. Singh (1981) also reported increase in grain yield of sorghum owing to better plant growth in intercropping with legume. The yield of soybean was significantly higher in sorghum + soybean combination than the grain yield of pigeonpea in sorghum + pigeonpea combination. This may be attributed to less competitive association effect of sorghum with soybean.

Sorghum + soybean combination had significantly higher mean value of land-equivalent ratio (Table 3) than sorghum + pigeonpea. Higher net return was observed in sorghum + soybean association. These findings are in close agreement with those of Dhope *et al.* (1992).

Effect of planting geometry

Significantly higher grain yield of sor-

Table 2. Grain and straw yields as influenced by various crop combinations and planting geometries (mean data of 2 years)

Treatment	Grain yield (q/ha)		Straw yield (q/ha)	
	Main crop	Intercrop	Main crop	Intercrop
Crop combination (CC)				
Sorghum + soybean	24.56	8.07	291.89	13.25
Sorghum + pigeonpea	23.08	6.26	266.63	12.59
CD (P = 0.05)	1.41	0.09	5.07	0.36
Planting geometry (PG)				
Mixed broadcasting	21.48	5.37	280.78	9.63
Mixed line sowing	23.59	6.75	277.29	11.80
Alternate rows (1 : 1)	24.08	7.27	275.42	14.90
Paired rows (2 : 2)	26.12	9.27	283.54	15.35
CD (P = 0.05)	1.99	0.13	NS	0.52
Interaction CC x PG	NS	0.18	10.15	0.73

Table 3. Sorghum-equivalent, land-equivalent ratio (LER) and net profit as influenced by various crop combinations and planting geometries (mean data of 2 years)

Treatment	Sorghum-equivalent (q/ha)	LER	Gross income (Rs/ha)	Net profit (Rs/ha)
Crop combination (CC)				
Sorghum + soybean	44.20	1.35	13,331	9,128
Sorghum + pigeonpea	44.74	1.19	13,047	9,071
CD (P = 0.05)	NS	0.04	NS	NS
Planting geometry (PG)				
Mixed broadcasting	36.80	1.07	11,632	7,653
Mixed line sowing	43.28	1.23	12,896	8,769
Alternate rows (1 : 1)	45.02	1.29	13,286	9,159
Paired rows (2 : 2)	52.79	1.49	14,944	10,817
CD (P = 0.05)	1.99	0.06	537	528
Interaction CC x PG	NS	NS	NS	NS

Prevailing market rates for grain and fodder (Rs/q) : Sorghum, 190, 15, 200, 15; soybean, 450, 20, 500, 30; pigeonpea, 650, 20, 700, 30 during 1988 and 1989 respectively

ghum (Table 2) was obtained in paired-row planting (2 : 2) than mixed broadcasting, probably owing to better penetration of solar radiation and lesser competition for space, moisture and nutrients. The findings confirm the results of Waghmare *et al.* (1982). Similarly, paired-row planting geometry recorded better intercrop yields because of spatial advantages available to component crops.

Significantly highest land-equivalent ratio, sorghum-equivalent and net profit were observed under paired-row planting compared with other planting geometries. Alternate-row planting (1 : 1) proved next best planting geometry and recorded better yield attributes, yield, land-equialent ratio, sorghum-equivalent and net profit than rest of the geometries. Better yield in alternate-row arrangement was also observed by Jana (1980). Mixed line sowing showed its superiority over mixed broadcasting in all respects.

Thus it was concluded that sorghum + soybean or pigeonpea intercropped in paired rows (2 : 2) fetched highest biological potential and net profit, followed by their intercropping in alternate rows (1 : 1). Mixed cropping of both the pulses in sorghum in uniform lines proved superior to their broadcast mixed cropping.

REFERENCES

Dhope, A. M., Mahakulkar, B. V., Wanjari, S. S., Shekar, V. B. and Potdukhe, N. R. 1992. Intercropping of leguminous crops in newly evolved sorghum genotype (SPV 669). *Crop Research* **5** (2) : 207–211.

Jana, R. K. 1980. Intercropping soybeans with cereals in East Africa (Tanzania). (In) *World Soybean Research Conference*, pp. 11.

Singh, S. P. 1981. Studies on spatial arrangement in sorghum-legume intercropping systems. *Journal of Agricultural Science*, Cambridge **97** : 655–661.

Tarhalkar, P. P. and Rao, N. G. P. 1981. Genotype and plant density considerations in the development of an efficient inter-cropping systems for sorghum. (In) *Proceedings of the International Workshop on Intercropping*, held during 10–13 January 1979 at International Crops Research Institute for Semi-Arid Tropics, Patancheru, Andra Pradesh, pp. 35–40.

Waghmare, A. B., Krishnan, J. K. and Singh, S.P. 1982. Crop compatibility and spatial arrangement in sorghum-based inter-cropping systems. *Journal of Agricultural Science*, Cambridge **99**: 621–629.