

Effect of Sorghum Legume Intercropping System with Different Row Proportion on Performance of Sorghum

S. KAVYA¹, K. PUSHPA², R. KRISHNAMURTHY³ AND G. SOMU⁴

^{1,2}Department of Agronomy; ³Forestry and Environmental Science, College of Agriculture, UAS, GKVK, Bengaluru

⁴AICRP on Sorghum, Krishi Vigyan Kendra, Haradanahalli, Chamarajanagar

e-Mail : kavyasprasad318@gmail.com

AUTHORS CONTRIBUTION

S. KAVYA :

Conceptualization, investigation, original drafts preparation and data analysis

K. PUSHPA :

Conceptualization

R. KRISHNAMURTHY :

Supervision

G. SOMU :

Provided resources

Corresponding Author:

S. KAVYA

Department of Agronomy

College of Agriculture

UAS, GKVK, Bengaluru

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ABSTRACT

A field experiment was conducted at All India Co-ordinated Research Project on Sorghum, Chamarajanagar district, Karnataka during the *kharif* season of 2020 to study the performance of sorghum under different row proportion of sorghum legume intercropping system. The experiment consists of thirteen treatment combination with different legumes *viz.*, greengram, blackgram, cowpea and field bean in different row ratio of 2:1, 4:1 and 4:2. It was laid out in randomized complete block design and replicated thrice. Results of the experiment revealed that treatment combination of sorghum + blackgram (4:2) recorded taller plants (308.67 cm), increase in leaf area (4546 cm²), stem diameter (15.98 mm), leaf area index (7.58), dry matter production (138.6 g plant⁻¹), earhead length (13.95 cm), ear head width (6.01 cm), earhead weight (61.33 g), sorghum grain yield (1623 Kg ha⁻¹) and straw yield (14430 kg ha⁻¹). Sorghum+ blackgram combination at 4:2 row proportion is found better under different sorghum + legume intercropping systems.

Keywords : Sorghum, Leaf area index, Intercropping, Row proportion, Sorghum yield, Blackgram

SORGHUM [*Sorghum bicolor* (L.) Moench] is a Cereals plant having potential to be cultivated and developed in Indonesia especially in drought prone areas. Sorghum has a wide agro-ecological adaption, drought tolerance, high production, low input crop and more resistant to pest and disease than the other food crops. Due to ever increasing pressure on cultivated land for food and commercial crops, it may not be possible to increase the arable area under pulse crops. One of the potential and novel opportunities to meet this demand is by inclusion of pulses in intercropping systems.

The cereal-legume intercropping is mainly practiced for subsistence agriculture to get the full yield of cereal crop for food and legumes for protein besides some additional returns to the growers. The scientific intercropping of pulses with cereals and other

non-legume companion crops has certain in built advantage over pure cropping (Velayutham and Somasundaram, 2000). The yield advantage in cereal-legume intercropping is due to their differential rooting habit, differential growth, demand for resources, complementary interactions as brought by nitrogen fixation of legumes and legumes add enormous organic biomass (leaf, nodules, roots, etc.). Further, legume inclusion in cereal based intercropping system helps to increase productivity per unit land area by extracting moisture and nutrient from deeper layer of soil besides solving the problem of weeds, pest and disease due to differential biodiversity. Keeping the above points in view research was designed to study the effect of sorghum legume intercropping system with different row proportion on performance of sorghum.

MATERIAL AND METHODS

The field experiment was conducted at All India Coordinated Research Project (AICRP) on Sorghum, Krishi Vigyana Kendra (KVK), Hardanahalli, Chamarajanagar district, University of Agricultural Sciences, Bangalore. The experiment was laid out with randomized complete block design and replicated thrice. The experiment consists of thirteen treatment combination with different legumes *viz.*, green gram, black gram, cowpea and field bean in different row proportion of 2:1, 4:1 and 4:2. Legumes were sown as per the treatment combination. The sole



Sorghum intercropping with black gram at 4:2 proportion

sorghum sown at a spacing of 40 cm x 15 cm. The plot size was 4.8 m x 3 m. Recommended dose of fertilizer for sorghum was 65:40:40 kg nitrogen, phosphorous and potassium per hectare. Other recommended practices like thinning, weeding, application of pesticide was uniformly followed. Crop was harvested at maturity stage, seed yield per net plot of each treatment was recorded. The various biometric observations, analytical data of plant sample and the computed data were subjected to statistical scrutiny as per the procedures given by Gomez and Gomez, 1984. The treatment differences were worked out at five per cent probability level.

RESULTS AND DISCUSSION

Growth Parameters

The growth parameters like the height of the plant (cm), leaf area (cm²), stem diameter (mm) and leaf area index were presented in Table 1 and 2, which clearly

indicated that there was significant difference among the treatments in expression of said characters of sorghum. Treatment combination of sorghum + blackgram (4:2) recorded the highest plant height (308.67 cm), increased leaf area (4546 cm²), stem diameter (15.98 mm) and leaf area index (7.58). At harvest, increase in growth parameters due to better utilization of growth resources, maximum dry matter accumulation, increased availability of nitrogen to sorghum crop because of nitrogen fixation by blackgram and nitrogen saving done by black gram which diverted more soil nitrogen to increase

TABLE 1

Effect of sorghum legume intercropping system on plant height (cm), leaf area (cm²) and stem diameter (mm) of sorghum

Treatments	Plant height (cm)	Leaf area (cm ²)	Stem diameter (mm)
T ₁ : Sorghum + Green gram (2:1)	289.88	3939	13.10
T ₂ : Sorghum + Black gram (2:1)	292.07	4138	13.96
T ₃ : Sorghum + Cowpea (2:1)	282.80	3621	12.19
T ₄ : Sorghum + Field bean (2:1)	285.16	3696	12.49
T ₅ : Sorghum + Green gram (4:1)	276.69	3402	11.31
T ₆ : Sorghum + Black gram (4:1)	285.69	3757	12.50
T ₇ : Sorghum + Cowpea (4:1)	270.20	3065	11.19
T ₈ : Sorghum + Field bean (4:1)	273.27	3260	11.25
T ₉ : Sorghum + Green gram (4:2)	298.29	4277	14.97
T ₁₀ : Sorghum + Black gram (4:2)	308.67	4546	15.98
T ₁₁ : Sorghum + Cowpea (4:2)	287.37	3871	12.52
T ₁₂ : Sorghum + Field bean (4:2)	287.83	3922	12.83
T ₁₃ : Sole Sorghum	293.51	4169	14.26
S.Em ±	5.95	178.73	0.49
CD at 5 %	17.37	521.68	1.43

Note : CD at 5% - Significant at 5 % level of significance

TABLE 2

Effect of sorghum legume intercropping system on leaf area index (LAI) of sorghum

Treatments	LAI			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : Sorghum + Green gram (2:1)	4.08	6.68	7.77	6.57
T ₂ : Sorghum + Black gram (2:1)	4.36	6.96	7.93	6.90
T ₃ : Sorghum + Cowpea (2:1)	3.04	6.42	6.55	6.03
T ₄ : Sorghum + Field bean (2:1)	3.40	6.48	6.59	6.16
T ₅ : Sorghum + Green gram (4:1)	2.92	6.31	6.22	5.67
T ₆ : Sorghum + Green gram (4:1)	3.80	6.55	6.96	6.26
T ₇ : Sorghum + Cowpea (4:1)	2.32	5.86	5.90	5.11
T ₈ : Sorghum + Field bean (4:1)	2.70	6.29	6.10	5.43
T ₉ : Sorghum + Green gram (4:2)	4.87	7.25	8.38	7.13
T ₁₀ : Sorghum + Black gram (4:2)	5.05	7.83	8.56	7.58
T ₁₁ : Sorghum + Cowpea (4:2)	3.96	6.60	7.54	6.45
T ₁₂ : Sorghum + Field bean (4:2)	3.99	6.68	7.56	6.54
T ₁₃ : Sole Sorghum	4.81	6.97	8.23	6.95
F test	*	*	*	*
S.Em±	0.48	0.27	0.34	0.30
CD at 5%	1.40	0.79	1.00	0.87

Note : CD at 5% - Significant at 5 % level of significance

photosynthesis and metabolic activities of sorghum plants and ultimately vegetative growth of sorghum were enhanced. Similar finding was reported by Berhane *et al.* (2015); Sawyer *et al.* (2010); Satpal *et al.* (2015) and Kumar & Shankaralingappa (2017).

Sorghum + black gram at 4:2 row proportion recorded higher total dry matter production were presented in Table 3 might be due to higher leaf area and leaf area index leads to higher dry matter production by accumulating more photosynthates, thus higher dry

TABLE 3

Effect of sorghum legume intercropping system on total dry matter production in sorghum

Treatments	Total dry matter production (g plant ⁻¹)			
	30 DAS	60 DAS	90 DAS	At harvest
T ₁ : Sorghum + Green gram (2:1)	3.97	59.36	96.98	119.14
T ₂ : Sorghum + Black gram (2:1)	4.03	60.91	101.21	128.73
T ₃ : Sorghum + Cowpea (2:1)	3.63	46.76	76.92	94.02
T ₄ : Sorghum + Field bean (2:1)	3.73	49.15	78.53	96.39
T ₅ : Sorghum + Green gram (4:1)	3.50	45.73	73.92	84.22
T ₆ : Sorghum + Black gram (4:1)	3.72	51.06	81.72	100.33
T ₇ : Sorghum + Cowpea (4:1)	3.27	42.74	67.42	78.81
T ₈ : Sorghum + Field bean (4:1)	3.31	43.90	70.83	80.96
T ₉ : Sorghum + Green gram (4:2)	4.21	65.27	107.08	135.52
T ₁₀ : Sorghum + Black gram (4:2)	4.36	67.18	108.64	138.16
T ₁₁ : Sorghum + Cowpea (4:2)	3.78	57.18	90.54	113.39
T ₁₂ : Sorghum + Field bean (4:2)	3.86	57.84	91.51	116.45
T ₁₃ : Sole Sorghum	4.11	64.39	103.60	131.09
F-test	*	*	*	*
S.Em±	0.18	2.62	4.23	5.26
CD at 5 %	0.52	7.64	12.35	15.36

Note : CD at 5% - Significant at 5 % level of significance

matter production contributed to higher yield plant⁻¹ (Shubha, 2014).

Yield Components

Treatment combination of sorghum + blackgram at 4:2 row proportion recorded the highest earhead length (13.95 cm), ear head width (6.01 cm) and ear head weight (61.33 g) were presented in Table 4. This is due to minimum competition from blackgram for water, nutrients, light and other natural resources and also due to remobilization of photosynthates from

TABLE 4

Effect of sorghum legume intercropping system on yield attributes of sorghum

Treatments	Ear head length (cm)	Ear head length (cm)	Ear head weight (g)
T ₁ : Sorghum + Green gram (2:1)	13.03	4.93	55.47
T ₂ : Sorghum + Black gram (2:1)	13.16	5.12	57.80
T ₃ : Sorghum + Cowpea (2:1)	11.27	4.31	52.67
T ₄ : Sorghum + Field bean (2:1)	11.69	4.43	53.27
T ₅ : Sorghum + Green gram (4:1)	10.92	4.24	50.20
T ₆ : Sorghum + Black gram (4:1)	12.06	4.56	53.68
T ₇ : Sorghum + Cowpea (4:1)	10.16	4.06	48.53
T ₈ : Sorghum + Field bean (4:1)	10.52	4.16	49.33
T ₉ : Sorghum + Green gram (4:2)	13.54	5.71	60.40
T ₁₀ : Sorghum + Black gram (4:2)	13.95	6.01	61.33
T ₁₁ : Sorghum + Cowpea (4:2)	12.36	4.66	54.13
T ₁₂ : Sorghum + Field bean (4:2)	12.58	4.74	54.60
T ₁₃ : Sole Sorghum	13.25	5.26	58.40
S.Em±	0.25	0.14	1.89
CD at 5%	0.72	0.40	5.51

Note : CD at 5% - Significant at 5 % level of significance

vegetative parts to reproductive grains or higher dry matter accumulation in reproductive parts of sorghum. These results are in confirmatory with the findings of Triveni *et al.* (2017) and Poornima *et al.* (2021).

Grain Yield and Stover Yield

Sorghum + blackgram at 4:2 row proportion recorded the highest yield of 16.23 (q ha⁻¹) and straw yield of 144.30 (q ha⁻¹) (Table 5) compare to the other treatment combination. Higher yield of sorghum when grown with the blackgram due to the complementary effect between base crop and intercrop. Blackgram is a short statured crop, early maturing crop and offered lesser competition for the

TABLE 5

Effect of intercropping of legume in sorghum on the sorghum grain yield (Kg ha⁻¹) and straw yield (Kg ha⁻¹)

Treatments	Grain yield (Kg ha ⁻¹)	Straw yield (Kg ha ⁻¹)
T ₁ : Sorghum + Green gram (2:1)	1442	13137
T ₂ : Sorghum + Black gram (2:1)	1476	13530
T ₃ : Sorghum + Cowpea (2:1)	1334	9493
T ₄ : Sorghum + Field bean (2:1)	1365	9770
T ₅ : Sorghum + Green gram (4:1)	1312	8580
T ₆ : Sorghum + Black gram (4:1)	1402	10240
T ₇ : Sorghum + Cowpea (4:1)	1132	8030
T ₈ : Sorghum + Field bean (4:1)	1172	8137
T ₉ : Sorghum + Green gram (4:2)	1614	14200
T ₁₀ : Sorghum + Black gram (4:2)	1623	14430
T ₁₁ : Sorghum + Cowpea (4:2)	1411	1056
T ₁₂ : Sorghum + Field bean (4:2)	1419	1126
T ₁₃ : Sole Sorghum	1487	1417
S.Em±	18.03	0.19
CD at 5%	52.62	0.54

Note : CD at 5% - Significant at 5 % level of significance

available resource like solar radiation, water and nutrient compare to the crop like cowpea and field bean. Similar findings were reported by Amedie *et al.* 2010; Ananthi *et al.* 2017 and Mourya & Yadav 2010.

Increased straw yield of sorghum in sorghum + black gram intercropping at 4:2 row proportion is due to high nitrogen fixation by blackgram, triggered growth of ground part of the sorghum, which enable the sorghum to effectively utilize the solar radiation which resulted in the corresponding increment of photo synthetic rate. Increase in the photosynthetic rate increases the accumulation of dry matter. Similar results are observed with the finding of (Jat *et al.*, 2014 and Singh & Verma 2018).

The results showed that the growth, yield and yield components of sorghum were significantly affected by the treatments. In the present study, blackgram at 4:2 row proportion has beneficially effect on growth, yield and yield component of sorghum. Therefore, according to the results of this experiment, it was concluded that intercropping sorghum with

blackgram at 4:2 row ratio increases the growth and yield of sorghum.

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