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Impact of Different Plant Spacing Arrangements on the Profitability and Productivity of Blackgram Cultivars [*Vigna mungo* (L.) Hepper]

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Evaluation of blackgram cultivars (*Vigna mungo* (L.) Hepper) under various plant spacings was the title of a field study carried out at the Department of Agronomy, College of Agriculture, Badnapur. The experimental field had good drainage and was leveled. The soil was clay loam in texture, low in available nitrogen, medium in available phosphorus, very high in accessible potassium and alkaline in reactivity. The blackgram crop was able to develop and mature normally due to the moderate environmental conditions. Twelve treatment combinations were possible with the three different

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kinds and four different spacings used in the Factorial Split plot Design layout of the experiment. Each experimental unit included three repetitions, measuring 5.4 m × 5.0 m in the gross plot and 4.5 m x 4.6 m in the net plot. On July 14, 2015, three varieties-BDU-1, TAU-1 and AKU-15 were sown. The dibbling method was used to sow the seeds, with four distinct spacings of 30 cm x 10 cm, 30 cm x 20 cm, and 45 cm x 10 cm. The RDF was used prior to seeding. Plant preservation measures and cultural practices were implemented in accordance with recommendations. A number of pods per plant, number of seeds per pod, pod length, pod weight per plant, seed yield per plant, test weight (1000 seed weight g), harvest index, gross monetary returns (Rs ha^{-1}), net monetary returns (Rs ha^{-1}), and Benefit: Cost (B: C) ratio are among the characteristics and economics that indicate that BDU-1 (V_1) produced a significantly higher yield among the different blackgram varieties. Variety x spacing interaction effects were shown to be non-significant.

Keywords: Plant spacing; blackgram; varieties; growth; yield and economics.

1. INTRODUCTION

Pulses are important component of food grain crops because of their high nutritive value (Protein content ranging from 17 to 27%) and adaptability to wide range of agro ecological and management variable. Being a leguminous crop, they fix utilize and atmospheric nitrogen and improve the fertility of soil and therefore fit well in crop rotation and cropping systems [1-5]. The production of pulses is far below the requirement to meet even the minimum level of per capita consumption. The per capita availability of pulses is 45 g/day as against FAO/ WHO recommended level of 104 g /capita/ day. Thus, it is a big challenge for the agricultural scientists to meet the pulse requirement of teeming population of the country. Among pulses, black gram (*Vigna mungo* (L.) *Hepper*) is one of the most important crops grown in India. It is consumed in the form of ‘dal’ (whole or split or unhusked) or parched. It is chief constituent of ‘papad’. It is used as nutritive fodder specially for milch cattle and also used as green manuring crop. It adds 42 kg N/ha in soil. It posses deep root system which binds soil particles and thus, prevent erosion. Black gram contain about 24 per cent protein, 60 per cent carbohydrate, 10.9 per cent moisture, 1.4 per cent fat, 0.9 per cent fiber, 3.2 per cent minerals and vitamin viz. calcium -154 mg, phosphorus -385mg, iron-9.1mg and small amount of vitamin B complex. The delay in planting of black gram results conspious reduction in seed yield parameters that is grain yield per ha^{-1}, number of pods per plant and seed quality parameters i.e 1000 grain weight.

The productivity of black gram in Maharashtra is very low (299 kg ha^{-1}). The low productivity is due to day by day decreasing in yielding ability and non use of improved varieties and proper spacing [5-8]. To realize the maximum yield potential of black gram grown during summer and rainy season, maintenance of optimum space made available to individual plant is of prime importance. A compromising balance between the variables of row and plant spacing has to be worked out to get desired spacing. The spacing requirement depends upon the growth behaviour of genotype. So it is required to maintain spacing and variety for higher yield.

Keeping all these factors in mind, the present experiment was conducted during 2015 to study the adequate plant spacing and to find out an appropriate variety of blackgram under rainfed condition.

2. MATERIALS AND METHODS

The current experiment aimed to determine the optimum plant spacing for Blackgram varieties, investigate how different plant spacings affected the performance of various Blackgram varieties, and examine the relationship between plant spacing and blackgram variety.

The gross and net plot size of the experiment was 5.4 m x 5.0 m and 4.5 m x 4.6 m, respectively. Sowing was done by adopting dibbling method on 14th July 2015 respectively at a spacing S_1-30 cm x 10 cm, S_2-30 cm x 20 cm, S_3- 45 cm x 10 cm and S_4- 45 cm x 20 cm and the varieties used were, V_1 - BDU-1, V_2 - TAU-1 and V_3 - AKU-15. The recommended dose of fertilizer (RDF) 25:50:00 NPK kg ha^{-1} were applied at the time of sowing.

To evaluate the treatment effect, the various growth observations were recorded in the experiment from 15 DAS up to the harvest at an interval of 15 days, while the observations on yield attributing characters and post-harvest studies were recorded at respective stages. The crop was harvested at the maturity stage on 04th October 2015.

3. RESULTS AND DISCUSSION

The beneficial effect due to different plant spacing on number of pods per plant, number of seeds per pod, pod length, pod weight per plant, seed yield per plant, test weight (1000 seed weight g), harvest index and gross monetary returns (Rs ha^{-1}), net monetary returns (Rs ha^{-1}), and Benefit: Cost (B:C) ratio were evident during active growth and maturity. Compared to other spacings, the 30 cm x 10 cm spacing increased the number of pods plant^{-1} and seed output plant^{-1} better (Table 1) Due to varying spacings, a significant fluctuation in the number of pods per plant was observed. Plant^{-1} recorded a higher number of pods and seed output when the spacing was 30 cm x 10 cm. These findings are consistent with those of Singh et al. [9], Singh and Yadav [10] and Veeramani [11]. Different spacings were found to have no effect on the test weight. This may be because test weight is mostly determined by genetics and is not greatly impacted by agronomic spacing techniques. According to Table 1, pod development proceeded until maturity, with pod formation beginning at 45 DAS and continuing until 60 DAS. Compared to variety TAU-1, variety BDU-1 (V_1) generated noticeably more pods plant^{-1} (V_2). It was discovered that the varieties TAU-1 (V_2) and AKU-15 (V_3) had no significant effect on the number of pods produced by plant 1. Aher et al. [12] and Veeramani [11] reported similar results.

Spacing had a major impact on the production of seeds and straw kg ha^{-1} (Table 2). Compared to 45 cm x 10 cm, 30 cm x 20 cm, and 45 cm x 20 cm, the spacing of 30 cm x 10 cm generated a greater seed output of 688 kg ha^{-1}. Wider plant spacing and closer row spacing resulted in better grain yield plant-1 and other yield parameters. The fact that grain yield plant-1 did not rise proportionately to the available area plant-1 is likely what caused the decrease in grain yield ha-1 at wider spacing. A 30 cm × 10 cm plant spacing showed improvements in a variety of growth and yield-contributing characteristics. Higher seed yields may have resulted from using the ideal spacing 30 cm × 10 cm. This could be because of the different plant spacing. Less competition and crowding existed within the plant, or vice versa. Singh and Singh [9] and Ganvit et al. [13] all reported findings that were similar. In comparison to TAU-1 and AKU-15, variety BDU-1 performed better in terms of yield-attributing characteristics, such as number of pods per plant, number of seeds per pod, pod weight per plant, seed yield per plant, and test weight (Table 1). The genetic

Table 1. Mean number of pods per plant, number of seeds per pod, pod length, pod weight per plant, seed yield per plant and test weight (1000 seed weight g) as influenced by various treatments

Treatments	No. of pods plant^{-1}	No. of seed pod^{-1}	Pod length (cm)	Pod weight (g)	Seed yield plant^{-1} (g)	Test weight (g)
A. Main Plots (Spacings (S))						
S_1 - (30 cm x 10 cm)	19.37	7.0	5.86	6.35	5.38	41.57
S_2 - (30 cm x 20 cm)	13.69	5.85	5.03	3.69	2.73	40.28
S_3 - (45 cm x 10 cm)	17.59	6.42	5.37	5.30	4.42	41.05
S_4 - (45 cm x 20 cm)	12.33	5.34	4.31	3.03	2.66	39.34
SE ±	0.36	0.25	0.19	0.21	0.11	1.24
CD at 5%	1.10	0.76	0.57	0.64	0.33	3.71
B. Sub Plots (Varieties (V))						
V_1 - (BDU-1)	16.96	6.93	5.51	5.01	4.24	41.38
V_2- (TAU-1)	15.17	6.00	5.02	4.81	3.95	40.31
V_3 - (AKU-15)	15.11	5.53	4.89	3.96	3.20	39.98
SE ±	0.45	0.17	0.13	0.14	0.14	1.76
CD at 5%	1.37	0.52	0.39	0.42	0.42	5.29
Interaction (A x B)						
SE ±	0.91	0.35	0.26	0.28	0.28	3.53
CD at 5%	NS	NS	NS	NS	NS	NS
General Mean	**15.75**	**6.15**	**5.14**	**4.59**	**3.80**	**40.56**

Table 2. Mean yield and economics as influenced by various treatments

Treatments	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)	Gross Monetary Return (Rs ha^{-1})	Net Monetary Return (Rs ha^{-1})	B.C. Ratio
Spacings (S)							
S_1 - (30 cm x 10 cm)	688	1479	2167	31.77	57174	41966	3.75
S_2 - (30 cm x 20 cm)	447	1015	1771	30.58	37155	22322	2.50
S_3 - (45 cm x 10 cm)	550	1221	1462	31.08	45756	31173	3.13
S_4 - (45 cm x 20 cm)	411	968	1379	29.81	34209	19876	2.38
SE ±	18.51	37.96	77.61	1.92	910	1431	-
CD at 5%	55.43	113.6	232.3	NS	2725	4283	-
Varieties (V)							
V_1 - (BDU-1)	618	1344	1962	31.45	51341	36602	3.47
V_2 - (TAU-1)	536	1194	1731	30.96	44596	29856	3.01
V_3 - (AKU-15)	418	973	1391	30.01	34783	20044	2.35
SE ±	20.29	62.24	89.60	1.66	788	862	0.15
CD at 5%	60.76	186.3	268.2	NS	2361	2582	0.46
Interaction (S x V)							
SE ±	40.59	124.8	179.2	3.33	1577	1725	-
CD at 5%	NS	NS	NS	NS	NS	NS	-
General Mean	**524.3**	**1171**	**1695**	**30.81**	**43574**	**28834**	**2.94**

composition of the variety, which has contributed to enhanced photosynthetic activity through greater source capacity and effective transfer of photosynthesis to the sink (Seed), is most likely the cause of this. Ganvit et al. [13], Murade [7] and Yadahalli et al [14] all noted improvements in black gram cultivars with varying genetic compositions.

In comparison to the 45 cm x 10 cm (S_3), 30 cm x 20 cm (S_2), and 45 cm x 20 cm (S_4) spacings, the 30 cm x 10 cm spacing produced a much greater biological yield (Table 2). Saibabu and Garg [15] and observed an increased biological yield in a 30 cm × 10 cm plant. The biological yield of the black gram variety BDU-1, which was 1962 kg ha^{-1}, was greater than that of TAU-1 (1731 kg ha^{-1}) and AKU-15 (1391 kg ha^{-1}). In comparison to TAU-1 and AKU-15, BDU-1 has a larger biological yield, which could be attributed to its higher biomass potential and accumulation of more dry matter. These findings are in conformity with the finding of Ganvit et al. [13] and Pandey and Singh [16].

Spacing had an impact on the harvest index (Table 2). The harvest index value was greater for the 30 cm x 10 cm spacing than for the 45 cm x 10 cm (S_3), 30 cm x 20 cm (S_2), and 45 cm x 20 cm (S_4) spacing. The outcome is comparable to that of Chauhan et al. [3]. as well as Rasul et al. (2012). Blackgram types vary considerably in harvest index (Table 2). In comparison to the other kinds, the variety BDU-1 (V_1) recorded a higher harvest index; this could be because of its superior production efficiency. Nayak et al. [8] and Ganvit et al. [13] noted a similar tendency.

In comparison to the spacing of 45 cm x 10 cm (S_3), 30 cm x 20 cm (S_2), and 45 cm x 20 cm (S_4), the spacing of 30 x 10 cm (S_1) recorded better values of Gross Monetary Return, Net Monetary Return, and B:C ratio. When compared to the other kinds, the black gram variety BDU-1 showed greater values for the B:C ratio, net monetary returns and gross monetary returns. Ganvit et al. [17] and Pandey and Singh [10] both reported similar results [18-20].

The interaction effects were not influenced significantly in case of growth, yield and yield attributes.

4. CONCLUSIONS

Finally, it is determined that the use of a 30 cm × 10 cm treatment resulted in significantly greater seed yield (688 kg ha^{-1}), net returns (Rs. 41966 Rs ha^{-1}), gross returns (Rs. 57174 Rs ha^{-1}), and benefit cost ratio (3.75). Moreover, the Black gram variety BDU-1 was found to be more productive under 30 cm x 10 cm spacing against TAU-1 and AKU-15 as compared to other treatments. It recorded significantly higher seed yield (618 kg ha^{-1}), higher gross returns (Rs. 51341 Rs ha^{-1}), net returns (Rs. 36602 Rs ha^{-1}), and benefit cost ratio (3.47). Given that the results are derived from a single season of research.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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