Biological Forum – An International Journal **14(3): 1637-1641(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Spacing and Nutrient Management on Yield and Economics of Summer Blackgram (*Vigna mungo* L. Heeper) under Organic conditions

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(Received 25 July 2022, Accepted 04 September, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A field experiment was conducted during summer season of year 2021 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand with a view to study the effect of spacing and nutrient management on yield and economics of summer blackgram (*Vigna mungo* L. Heeper) under organic conditions. The experiment consisted of twelve treatment combinations comprised of two different spacing related to main factor and six nutrient management practices allotted to sub factor and were tested under randomized block design with factorial concept and replicated thrice. Results revealed that crop sown at spacing 30 × 10 cm (S_1) recorded significantly higher plant height, seed yield and haulm yield while, in case of number of branches/plant, dry weight of root nodules, plant dry biomass and root dry biomass were recorded significantly higher with crop sown at spacing 45 × 10 cm (S_2). Application of 100% N through castor cake + seed treatment of *Rhizobium* recorded significantly higher growth and yield attributes *viz.*, plant height, number of branches/plant, dry weight of nodules, plant and root dry biomass, pods/plant, length of pod, seeds/pod and seed index of blackgram. Further, higher net monetary returns of ₹ 35254/ha and benefit cost ratio of 2.12 were fetched under treatment combination of 100% N through castor cake + seed treatment of *Rhizobium*.

Keywords: Blackgram, FYM, vermicompost, castor cake.

INTRODUCTION

Blackgram (*Vigna mungo* L.) is third most important pulse crops of India and particularly in Gujarat state. Blackgram is grown on 4.67 mha with a production of 2.34 MT and productivity of 501 kg/ha in the country (Anonymous, 2021). In Gujarat, it is grown in about 3.74 lakh hectare with a production of 2.00 lakh tons and productivity of 845 kg/ha (Anonymous, 2021). An increase in the yield of blackgram can be brought forward either by increasing the area under cultivation or by increasing the productivity per unit area. Since the area is limited, yield level per unit area has to be increased. For the agronomist the major concern is to find the optimum crop geometry that produce maximum productivity under a given environmental conditions. To achieve higher production in a specific agro-climatic situation, Systemic development of agro-techniques particularly proper plant population through appropriate crop geometry and suitable cultivar are equally important. Maximum or minimum plant density causing different physiological changes in the plant which may reduce the yield of blackgram. Therefore, optimum row spacing plays an important role in contributing to the high yield because overcrowded plant population will not get proper light for photosynthesis and can easily be attacked by the various pests. Dry matter yield was improved in close row spacing compared with the far row spacing (Rashmitha *et al.*, 2021). A benefit of closed row spacing is extra medium plant positioning that leads to improved canopy leaf area enlargement and more light capture beginning of the season. These variations in canopy development improved crop progress level and thereby increase dry matter (Andrade *et al.*, 2002). Management of nutrient involving organic manures and biological sources has the potential to enhance the yield increment and also sustain the production level since it can supply all the essential nutrients require by the plants besides, improving soil physico-chemical properties and improving efficient use of nutrients. Through biological decomposition organic manures like FYM, vermicompost, castor cake *etc.* enhance the soil microbial activity, which supplies nitrogen, phosphorus, sulphur and other nutrients in available form to the plants (Mukherjee, 2015). Looking to this, an experiment was formed and executed to study the effect of spacing and nutrient management on yield and economics of summer blackgram under organic conditions.

MATERIALS AND METHODS

A field experiment was conducted to find out effect of spacing and nutrient management on yield and economics of summer blackgram under organic

conditions in the year 2021 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand. The experimental site was organic certified plot having loamy sand in texture, alkaline in nature (7.92 pH) with low soluble salts (0.30 dS/m) and available nitrogen (217 kg/ha), medium in organic carbon (0.53%) and available phosphorus (29.25 kg/ha) and high in available potassium (261 kg/ha). Total twelve treatment combinations comprised of two different spacing *viz.*, S_1: 30 × 10 cm and S_2: 45 × 10 cm related to main factor and nutrient management practices *viz.*, N_1: 100% N through FYM + ST (5 ml/kg seed) of *Rhizobium*, N_2: 100% N through vermicompost + ST (5 ml/kg seed) of *Rhizobium*, N_3: 100% N through castor cake + ST (5 ml/kg seed) of *Rhizobium*, N_4: 75% N through FYM + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation, N_5: 75% N through vermicompost + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation and N_6: 75% N through castor cake + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation allotted to sub factor and were tested under randomized block design with factorial concept and replicated thrice. In the experiment, blackgram variety T 9 was used as a test crop and sown as per the treatment. Entire quantity of organic manure was applied 10 days before sowing as basal as per the treatment. All the growth and yield attributes were recorded and subjected to statistically analysis for interpretation.

RESULTS AND DISCUSSION

Effect of Spacing. Significant effect of spacing was observed on plant height measured at 60 DAS and at harvest whereas, it was non-significant when plant height measured at 30 DAS (Table 1). Significantly the highest plant height was recorded under row spacing of 30 × 10 cm (S_1) at 60 DAS and at harvest. Increase in plant height under narrow row spacing could be attributed to increase the competition due to increase in number of plants per unit area certainly reduced the amount of light availability to the individual plant at closer spacing, especially to lower leaves due to greater shading effect therefore, mutual shading increases at high population densities which leads plant tends to enhanced vertical growth rather than horizontal growth under spacing of 30 × 10 cm. The findings were in close agreement with those of Tungoe *et al.* (2017); Rashmitha *et al.* (2021). Significant effect of spacing was observed on number of branches/plant, dry weight of root nodules, plant dry biomass and root dry biomass (Table 1). Crop sown at a spacing of 45 × 10 cm produced significantly the highest number of branches per plant, dry weight of root nodules, plant dry biomass and root dry biomass. This may be attributed to more horizontal growth and plant canopy area under wider spacing due to less plant population which leads to low competition among the plants for available resources as compared to those in closer spacing. Data presented in Table 2 indicated that different spacing treatment significantly influenced the seed and haulm yield of the blackgram. The crop sown at a spacing of 30 × 10 cm produced significantly higher seed yield (741 kg/ha) and haulm yield (1768 kg/ha).

Table 1: Growth attributes of blackgram as influenced by different spacing and nutrient management treatments.

Treatments	Plant height (cm)			No. of branches/plant	Dry weight of nodules (mg/plant)	Plant dry biomass (g/plant)	Root dry biomass (g/plant)
	30 DAS	60 DAS	At harvest				
S : Spacing							
S_1: 30 ×10 cm	14.32	27.81	28.91	8.68	11.61	3.13	0.31
S_2: 45 ×10 cm	14.02	26.34	27.28	9.40	12.29	3.64	0.34
SEm±	0.29	0.49	0.51	0.20	0.23	0.07	0.006
CD (P=0.05)	NS	1.44	1.48	0.60	0.68	0.20	0.017
N : Nutrient management							
N_1: 100% N through FYM + ST (5 ml/kg seed) of *Rhizobium*	13.64	26.23	29.23	8.00	11.01	2.67	0.27
N_2: 100% N through vermicompost + ST (5 ml/kg seed) of *Rhizobium*	13.71	25.70	26.31	8.67	13.05	3.54	0.33
N_3: 100% N through castor cake + ST (5 ml/kg seed) of *Rhizobium*	15.23	29.72	29.80	9.80	11.65	2.97	0.29
N_4: 75% N through FYM + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation	13.41	24.43	25.69	8.33	10.45	2.69	0.27
N_5: 75% N through vermicompost + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation	13.89	27.48	28.55	9.20	14.80	4.49	0.41
N_6: 75% N through castor cake + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation	15.17	28.92	29.00	10.23	10.73	3.95	0.37
SEm±	0.50	0.85	0.88	0.35	0.40	0.12	0.010
CD (P=0.05)	NS	2.49	2.57	1.03	1.18	0.34	0.030
Interaction (S × N)							
CD (P=0.05)	NS	NS	NS	NS	1.67	0.48	0.042
CV %	8.58	7.67	7.63	9.53	8.27	8.36	7.70

This may be due to a greater number of plants occupied per unit area, number of branches per plant and plant dry matter accumulation under narrow spacing as compare to wider spaced crop which could be led to produce higher seed yield and haulm yield. These findings are in close conformity with those of Bhatt (2020); Rashmitha *et al.* (2021).

Data on economics indicated that maximum net realization of ₹ 24987/ha with benefit cost ratio of 1.96 was registered under spacing of 30 × 10 cm (S_1). The higher net realization/ha under spacing of 30 × 10 cm (S_1) was mainly due to higher number of plants per unit area which in turn higher seed yield hence, increased the net income. This result supported the results of the studies conducted by Kumar *et al.* (2018).

Effect of Nutrient Management. Results indicated that treatment N_3 recorded significantly higher plant height of 29.72 cm as compared to rest of the treatment barring treatment N_5 and N_6 at 60 DAS. The increase in plant height may be due to diverse role of castor cake in terms of nutrients supply while Bio NP enhances the availability of phosphorus to the plant by converting inherent insoluble phosphorus into soluble form resulted in better growth of plant. Similar line of results was also reported by Tyagi and Singh (2019). Significant higher number of branches/plant (10.23) was observed under treatment N_6 as compared to rest of the treatment except treatment N_3 and N_5. The beneficial effect of organic manure on growth attributes might be due to additional supply of plant nutrients (Datt *et al.*, 2003) leads to improved vegetative growth, better availability and translocation of nutrients (Singh *et al.*, 2009) there by increased in numbers of branches/plant. Further, significantly higher dry weight of root nodules (14.80 mg/plant), higher plant dry biomass (4.49 g/plant) and higher root dry biomass (0.41 g/plant) were observed under application of treatment N_5 as compared to rest of the treatment. Moreover, application of organic manure might have favourable effect in improving the overall physical, chemical and biological properties of the soil and enhancing symbiosis with nodule bacteria thereby increasing activity of *Rhizobium* in the roots. These results are in conformity with the results obtained by Venkatarao *et al.* (2017). Higher number of pods/plant (28.58) was observed under treatment N_3 as compared to rest of the treatment except treatment N_2. The higher number of pods per plant might be due to better vegetative growth of the plant leading to higher interception of light and therefore, more assimilate production that increased number of pods per plant. Besides, increased growth in terms of plant height, number of branches per plant and dry matter accumulation might have also provided better sites for pod formation. These results are in close conformity with the findings of Singh *et al.* (2016). Length of pod and number of seeds/pod were found to be non-significant due to different nutrient management practices relegated in blackgram.

Significantly higher seed yield (800 kg/ha) and haulm yield (1793 kg/ha) were observed under treatment N_3 which remain at par with treatment N_6 in case of seed yield and haulm yield. This may be attributed due to castor cake having rich in N and P with all macronutrients with rapid mineralization coupled with increase microbial activities due to seed treatment of *Rhizobium* and soil application of Bio NP leads to provide easy availability of nutrient resulted in increased growth and yield attributes as discussed above. Further, application of bio fertilizers (*Rhizobium* and Bio NP) has resulted in improving nodulation in plant roots and supplying higher amount of N and P to the crop along with growth promoting substances like auxin, gibberellins and cytokinin which intern helped to realize higher yield.

Table 2: Effect of different spacing and nutrient management practices on yield attributes and yield of blackgram.

Treatments	Pods/ plant	Length of pod (cm)	Seeds/pod	Seed index (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)
S : Spacing						
S_1: 30 ×10 cm	25.16	3.56	4.04	3.93	741	1768
S_2: 45 ×10 cm	25.49	3.60	4.07	3.96	605	1233
SEm±	0.66	0.06	0.07	0.05	14	47
CD (P=0.05)	NS	NS	NS	NS	40	138
N : Nutrient management						
N_1: 100% N through FYM + ST (5 ml/kg seed) of *Rhizobium*	24.43	3.56	4.10	3.90	691	1348
N_2: 100% N through vermicompost + ST (5 ml/kg seed) of *Rhizobium*	27.75	3.51	3.97	3.98	700	1516
N_3: 100% N through castor cake + ST (5 ml/kg seed) of *Rhizobium*	28.58	3.69	4.17	3.99	800	1793
N_4: 75% N through FYM + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation	21.55	3.56	4.03	3.93	507	1145
N_5: 75% N through vermicompost + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation	24.11	3.54	3.93	3.92	586	1496
N_6: 75% N through castor cake + ST of *Rhizobium* + SA of Bio NP 1 L/ha at first irrigation	25.53	3.63	4.13	3.96	754	1704
SEm ±	1.14	0.10	0.12	0.09	24	82
CD (P=0.05)	3.341	NS	NS	NS	70	240
Interaction (S × N)						
CD (P=0.05)	NS	NS	NS	NS	98	NS
CV %	11.02	7.07	7.37	5.34	8.64	13.34

Table 3: Economics as influenced by different spacing and nutrient management practices in blackgram.

Treatments	Seed yield (kg/ha)	Gross realization (₹/ha)	Total cost of production (₹/ha)	Net realization (₹/ha)	BCR
S: Spacing					
S_1	741	51129	26142	24987	1.96
S_2	605	41745	24968	16777	1.67
N: Nutrient management					
N_1	691	47679	25174	22505	1.89
N_2	700	48300	30586	17714	1.58
N_3	800	55200	27983	27217	1.97
N_4	507	34983	24657	10326	1.42
N_5	585	40365	28718	11647	1.41
N_6	754	52026	26766	25260	1.94

Similarly, Brahmbhatt *et al.* (2021) observed that application of 75% N either through FYM or vermicompost or neem cake along with seed treatment of *Rhizobium* + PSB + KSB found effective as compared to application of 100% N either through FYM or vermicompost or neem cake with respect to yield attributes and yield of cluster bean.

Economics of the data indicated that higher net realization of ₹ 27217/ha with benefit cost ratio of 1.97 was registered under treatment N_3 followed by treatment N_6 with net realization ₹ 25260/ha and benefit cost ratio of 1.94. Higher net realization with benefit cost ratio with application of castor cake along with NPK consortium in summer groundnut was also observed by Bhutadiya *et al.* (2019).

Interaction effect. Interaction effect of different spacing and nutrient management practices with respect to dry weight of root nodules was found significant (Table 4). Result given in Table 4 revealed that treatment combination S_2N_5 produced significantly higher dry weight of root nodules, plant dry biomass and root dry biomass. The increase in dry weight of nodules under interaction effect was in conformity with the previous findings of Patel *et al.* (2016); Kalsaria *et al.* (2017). Among all the treatment combination, treatment combination S_1N_3 (30 × 10 cm + 100% N through castor cake + ST (5 ml/kg seed) of *Rhizobium*) produced significantly the highest seed yield of 968 kg/ha as compared to all the treatment combinations.

Table 4: Interaction effect of different spacing and nutrient management practices on dry weight of nodules, plant dry biomass, root dry biomass and seed yield.

Treatments	Dry weight of nodules (mg/plant)		Plant dry biomass (g/plant)		Root dry biomass (g/plant)		Seed yield (kg/ha)	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
N_1	9.88	12.14	2.65	2.69	0.27	0.26	761	622
N_2	12.40	13.69	3.78	3.30	0.34	0.32	771	629
N_3	12.36	10.93	2.16	3.78	0.27	0.31	968	632
N_4	10.07	10.84	3.13	2.25	0.31	0.23	535	480
N_5	14.08	15.51	3.64	5.34	0.33	0.50	572	599
N_6	10.84	10.62	3.44	4.47	0.32	0.42	839	670
SEm±	0.57		0.16		0.014		34	
CD (P=0.05)	1.67		0.48		0.042		98	
CV %	8.27		8.36		7.70		8.64	

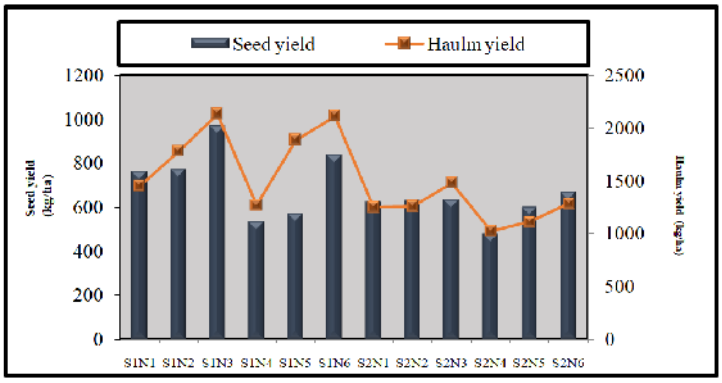

Fig. 1. Seed and haulm yield as influenced by interaction effect of spacing and nutrient management

CONCLUSION

From the results of one-year experimentation, it can be concluded that higher yield of summer blackgram could be achieved with sowing of crop at 30 × 10 cm spacing and fertilized with 100% N through castor cake and seed treatment with *Rhizobium* under organic conditions.

FUTURE SCOPE

1. Present study should be repeated for one or more season for recommendation to the farmers of this region.
2. Similar study should be carried out under different agro-climatic conditions.
3. Studies should be carried out to know the effect of different organic manures on succeeding crops.

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How to cite this article: Ganvit K.J., Patel V.J. and Desai N.B. (2022). Effect of Spacing and Nutrient Management on Yield and Economics of Summer Blackgram (*Vigna mungo* L. Heeper) under Organic conditions. *Biological Forum – An International Journal*, *14*(3): 1637-1641.