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Influence of Spacing and Phosphorus Levels on Growth and Yield of Blackgram (*Vigna mungo* L.)

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ABSTRACT: The present study aimed to evaluate the effect of spacing and phosphorus levels on blackgram (var. "*TYPE-9*") during *Kharif* 2020 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) spacing and phosphorus levels seems necessary factors for achieving the higher yield of blackgram. The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.7), low high carbon (0.44%), medium available N (171.48 kg/ha), low available P (27.0kg/ha) and high available K (291.2 kg/ha). The treatment consisted of spacing *viz.*, 20 × 10 cm^2, 30 × 10 cm^2, 40 × 10 cm^2 and nutrient phosphorus application 20 kg/ha, 30 kg/ha and 40 kg/ha. The experiment was laid out in Randomized Block Design (RBD) with nine treatments which are replicated thrice. The results showed that higher plant height (45.93 cm) was recorded significantly higher with spacing 20 × 10 cm^2 + 40 kg/ha P_2O_5 of phosphorus. Whereas, number of branches per plant (6.67), number of nodules per plant (26.20), dry weight (6.70 g), crop growth rate (4.67g/m^2/day), relative growth rate (0.04 g/g/day) was found to be maximum in treatment combination with the spacing 40 × 10cm^2 + 40 kg/ha of phosphorus as compared to all other treatments. While, number of pods per plant (66.30), number seeds per pod (7.80), 1000 seed weight (37.33 g), grain yield (854 kg/ha), Stover yield (2072 kg/ha), biological yield (2926 kg/ha) and harvest index (29.17%) was found to be maximum in treatment combination with 30 × 10 cm^2 + 40 kg/ha of phosphorus as compared to rest of the treatments which is beneficial for blackgram production.

Keywords: Black gram, spacing, phosphorus, yield.

INTRODUCTION

The black gram (*Vigna mungo* L.) is very important pulse crop of India. Which belongs to family "Leguminosae" and genus '*Vigna*'. Pulses occupy a unique position in cropping system as a main, catch, cover, green manure and as intercrop. The average productivity of Blackgram / Urdbean continues to be low mainly due to its cultivation under poor management and without proper and adequate inputs. Inherent yield potential of Blackgram can be realized by adopting input intensive management practices. Suitable sowing time, variety, and plant population are important non-cash inputs to achieve synchronous maturity and higher productivity of urdbean. It is mostly cultivated on marginal lands in mono/mixed cropping system without any fertilizers under rainfed conditions with results in generally low yield gap can be maintained through adequate and balance supply of plant nutrients (Rathore *et al.*, 2010).

Important reasons for low average yield of blackgram at farmer's field were the continuous cultivation of traditional low potential cultivars, use of low seed rate and improper agronomic practices. Among many crop production constraints, appropriate crop spacing and phosphorus levels are the most important, which contribute substantially to the seed yield of blackgram. Maintaining 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 various pest. Maintaining optimum plant population per unit area provides conditions such as, maximum light interception, photosynthetic activity, assimilation and accumulation of more photosynthates, which facilitates luxuriant crop growth and better crop canopy area and hence they produce higher seed yield and best yield quality traits (Mazumdar *et al.*, 2007). Advantage of optimum spacing under irrigated conditions is due to reduced competition for light because when the moisture is lacking, light is no longer limiting factor and the advantage of uniform spacing is lost (Ihsanullah *et al*., 2002).

Phosphorus is second most critical plant nutrient, but for pulses, it assumes primary importance, owing to its important role in root proliferation and there by atmospheric nitrogen fixation, also Phosphorous play a vital role in production of pulses (Nair, 1985). Phosphorous stimulates the symbiotic nitrogen fixation of bacterial cell to root hair for nodulation (Charel, 2006). Phosphorous helps in proper root development which increases root nodules and consequently increases nitrogen fixation. It also plays an important role in the process of photosynthesis energy conservation and transportation, cell division and meristematic growth in living tissues, grain quality and most of physic-bio-chemical activities. Keeping in view the above facts the present investigation was conducted to study the response of black gram under different spacing and levels of phosphorus treatments under eastern Uttar Pradesh condition.

MATERIALS AND METHODS

The experiment was conducted during the Kharif season 2020, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25° 30′42″N latitude, 81° 60′ 56″ E longitude and 98 m altitude above the mean sea level (MSL). The experiment consisting of nine treatments, comprising of three spacing *viz.*, 20 × 10 cm^2, 30 × 10 cm^2 and 40 × 10 cm^2 and three phosphorus levels *viz.*, 20 kg/ha, 30 kg/ha and 40 kg/ha. The treatment combinations which are T_1: 20 × 10 cm^2 + 40kg/ha P_2O_5, T_2: 20 × 10 cm^2+ 30 kg/ha P_2O_5, T_3: 20 × 10 cm^2 + 20 kg/ha P_2O_5, T_4: 30 × 10 cm^2 + 40 kg/ha P_2O_5, T_5:30× 10 cm^2 + 30 kg/ha P_2O_5, T_6: 30 × 10 cm^2 + 20 kg/ha P_2O_5, T_7: 40 × 10 cm^2 + 40 kg/ha P_2O_5, T_8: 40 × 10 cm^2 + 30 kg/ha P_2O_5, T_9: 40 × 10 cm^2 + 20 kg/ha P_2O_5. Which were tried in Randomized Block Design replicated thrice. The soil of experimental plot was sandy loam in texture, neatly neutral in soil reaction (pH 7.7), low organic carbon (0.44%), medium available N (171.48 kg/ha), low available P (27.0 kg/ha) and high available K (291.2 kg/ha). Fertilizer were applied as band placement, for which 4-5 cm deep furrows were made along the seed rows with a hand hoe. The nutrient sources were Urea, SSP and MOP to fulfill the requirement of nitrogen, phosphorous and potassium. The recommended dose of 20 kg/ha nitrogen and 20 kg/ha potassium was applied as basal, and also phosphorus was applied according to the treatment details. Irrigation was based on the necessity and as per the time of sowing. The growth parameters viz., plant height, number of branches per plant, number of nodules per plant, dry weight per plant, crop growth rate, relative growth rate was recorded at harvest. The yield parameters *viz.*, number of pods per plant, number of seeds per plant, 100 seed weight, grain yield, Stover yield, biological yield, harvest index, gross returns, net returns and benefit cost ratio were recorded with standard process of observation. The data was statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design. (Gomez and Gomez 1984).

RESULT AND DISCUSSION

A. Growth parameters

Data presented in Table 1 indicated that the significantly maximum plant height (45.93 cm) was recorded at harvest in those plots which are treated with spacing 20 × 10 cm^2 + 40 kg/ha phosphorus. Whereas, with spacing 30 × 10 cm^2 + 40 kg/ha phosphorus in growth parameter plant height (43.07 cm) was found statistically at par with spacing 20 × 10 cm^2 + 40 kg/ha phosphorus. This may be due to increase in plant height (cm) was due to increasing trend with closer geometry level could be noticed. This may due to the competition between the inter and intra plants for sun light, water, nutrients and space at closer spacing which encouraged self-thinning of branches and enhanced vertical growth rather than horizontal growth (Thavaprakaash, 2017). Similar findings were also reported by Siddaraju *et al.*, (2010). And significantly maximum number of branches per plant (6.67), number of nodules per plant (26.20), dry weight per plant (6.70 g), crop growth rate (4.67 g/m^2/day) and relative growth rate (0.04 g/g/day) was recorded at harvest in those plots which are treated with spacing 40 × 10 cm^2 kg/ha phosphorus. With spacing 40 × 10 cm^2 + 30 kg/ha phosphorus in growth parameters like number of branches (6.40), number of nodules (23.93) was found statistically at par with spacing 40 × 10 cm^2 + 40 kg/ha phosphorus. The dry weight and relative growth rate were significantly superior over all other treatments, with spacing 20 × 10 cm^2 + 40kg/ha phosphorus in crop growth rate per plant (4.33 g) which is statistically at par with spacing 40 × 10 cm^2 + 40 kg/ha phosphorus.

Table 1: Effect of spacing and phosphorus levels on growth of blackgram at harvest.

S. No.	Treatments	Plant height (cm)	No. of branches/plant	No. of nodules/plant	Dry weight (g/plant)	CGR (g/m^2/day)	RGR (g/g/day)
1.	20 × 10 cm^2 + 40 kg/ha P_2O_5	45.93	5.53	20.00	3.80	4.33	0.03
2.	20 × 10 cm^2 + 30 kg/ha P_2O_5	44.36	5.47	19.33	3.47	3.89	0.03
3.	20 × 10 cm^2 + 20 kg/ha P_2O_5	43.67	5.20	19.33	3.27	3.67	0.03
4.	30 × 10 cm^2 + 40 kg/ha P_2O_5	44.63	6.00	21.40	5.37	4.30	0.03
5.	30 × 10 cm^2 + 30 kg/ha P_2O_5	43.07	5.87	21.00	4.77	3.70	0.03
6.	30 × 10 cm^2 + 20 kg/ha P_2O_5	42.42	5.60	20.73	4.13	3.19	0.03
7.	40 × 10 cm^2 + 40 kg/ha P_2O_5	41.20	6.67	26.20	6.70	4.67	0.04
8.	40 × 10 cm^2 + 30 kg/ha P_2O_5	39.87	6.40	23.93	5.23	3.50	0.03
9.	40 × 10 cm^2 + 20 kg/ha P_2O_5	39.23	6.07	23.47	4.83	3.11	0.03
	SEm (±)	1.08	0.23	1.17	0.07	0.11	0.00
	CD (5%)	3.23	0.68	3.50	0.21	0.67	0.01

This may be attributed to more horizontal growth and plant canopy area under wider spacing due to less plant density and competition compared to those in closer spacing (Bahadur and Singh, 2005). And increase in growth parameters might be due to phosphorus which is an indispensable, constituent of nucleic acid, ADP and ATP. It has beneficial effects on nodulation, root development, growth and also hastens maturity as well as improves quality of crop produce (Choudhary *et al*., 2015). When P supply is limited, the availability of P and N to chloroplast became limited ultimately affect the photosynthetic processes as well as photosynthates supply to nodules. The effect of P could be related to the finding by that it stimulates root growth and activity and nodule formation (Apáez Barrios *et al.,* 2014).

B. Yield and yield attributes

Data presented in Table 2 indicated that the significantly maximum number of pods per plant (66.30), 1000 seed weight (37.33g), higher grain yield (854 kg/ha), higher Stover yield (2072 kg/ha), higher biological yield (2926 kg/ha) and harvest index (29.17 %) was recorded at harvest in those plots which are treated with the spacing 30 × 10 cm^2 + 40 kg/ha phosphorus. With spacing 30 × 10 cm^2 + 30 kg/ha phosphorus in yield parameters like number of pods per plant (62.00), Stover yield (1735 kg/ha) biological yield (2400 kg/ha) and harvest index (27.52 %) was found statistically at par with spacing 30 × 10 cm^2 + 40 kg/ha phosphorus. In 1000 seed weight, however with spacing 30 × 10 cm^2 + 30 kg/ha phosphorus, spacing 40 × 10 cm^2 + 40 kg/ha phosphorus which is statically at par with spacing 30 × 10 cm^2 + 40 kg/ha phosphorus. The grain yield was significantly superior with spacing 30 × 10 cm^2 + 40 kg/ha phosphorus over all other treatments. The data presented in Table 2, indicated that the number of seeds per pod shows non – significant results.

However, under 40 × 10 cm^2 and 20 × 10 cm^2 the more or less intra row spacing increases competition in solar radiation that stunt growth of some intra row plant in vegetative phase and they were unable to reach reproductive phase even though the yield contributing variables were high, and the productivity was low due to lesser plant population reached to reproductive phase (Sarkar *et al.*, 2004). Which ultimately increases yield attributing characters like number of pods per plant, 1000 seed weight, grain yield, Stover yield and harvest index under recommended spacing i.e., 30 × 10 cm^2. The increase in seed yield due to phosphorus application is attributed to source and sink relationship. It appears that greater translocation of photosynthates from source and sink might have increased seed yield (Balai *et al.,* 2017). Phosphorus increases yield due to its well-developed root system, increased N fixation and its availability to the plants and favorable environments in the rhizosphere (Lokhande *et al*., 2018).

Table 2: Effect of spacing and phosphorus levels on yield of blackgram at harvest.

S. No.	Treatments	Pods/ Plants (no.)	Seed/ Pod (no.)	Test weight (g)	Grain yield (kg/ha)	Stover yield (/ha)	Biological yield (kg/ha)	Harvest index (%)
1.	20 × 10 cm^2 + 40 kg/ha P_2O_5	60.77	7.57	36.33	600.0	1684.0	2284.0	26.29
2.	20 × 10 cm^2 + 30 kg/ha P_2O_5	57.23	7.33	34.67	462.0	1358.0	1820.0	25.66
3.	20 × 10 cm^2 + 20 kg/ha P_2O_5	56.60	7.27	32.67	440.0	1318.0	1758.0	25.02
4.	30 × 10 cm^2 + 40 kg/ha P_2O_5	66.30	7.80	37.33	854.0	2072.0	2926.0	29.17
5.	30 × 10 cm^2 + 30 kg/ha P_2O_5	62.00	7.60	36.67	665.0	1735.0	2400.0	27.52
6.	30 × 10 cm^2 + 20 kg/ha P_2O_5	57.53	7.20	35.00	560.0	1606.0	2166.0	25.81
7.	40 × 10 cm^2 + 40 kg/ha P_2O_5	55.23	7.33	35.33	500.0	1544.0	2044.0	24.98
8.	40 × 10 cm^2 + 30 kg/ha P_2O_5	51.07	7.13	34.33	480.0	1494.0	1974.0	24.17
9.	40 × 10 cm^2 + 20 kg/ha P_2O_5	52.60	7.27	33.33	406.0	1269.0	1675.0	22.83
	SEm (±)	1.44	0.17	0.73	11.44	124.81	87.19	0.78
	CD (5%)	4.32	-	2.20	34.30	374.18	251.39	2.34

CONCLUSION

Based on the findings of the investigation it may be concluded that for obtaining optimum seed yield performance of blackgram under rainfed conditions, maintaining a wider spacing of 30 × 10 cm^2 along with 40 kg/ha phosphorus is the best management practice to increase the availability and utilization of nutrients by the crop. Whereas, optimum growth was observed with a wider spacing of 40 × 10 cm^2 along with 40 kg/ha phosphorus.

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