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Research Article

Effect of Plant Spacing on Yield and Yield Contributing Traits of Black gram (*Vigna mungo* L. Hepper) During Autumn Season at Gokuleshwor, Baitadi, Nepal

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Abstract

An experiment was carried out at the research field of Gokuleshwor Agriculture and Animal Science College Baitadi, Nepal from August 5, 2019, to November 10, 2019, to evaluate the impact of plant spacing on yield and yield contributing traits of black gram. The experiment was carried out at four levels of spacing viz. T_1 (30×5 cm), T_2 (30×10 cm), T_3 (45×10 cm) and T_4 (60×10 cm). The experiment was laid out in Randomized Complete Block Design having four replications. The differential plant spacing showed remarkable differences in yield and yield contributing traits of black gram cultivation practices at 0.05 level of significance. The highest plant spacing of 60×10 cm performed better in yield contributing traits such as; number of branches plant^{-1}, number of pods plant^{-1} and number of seeds pod^{-1}. Whereas, the maximum straw yield was found at closure spacing of 30×5 cm. Similarly, grain yield and harvest index were found superior at the spacing of 30×10 cm. Therefore, plant spacing of 30×10 cm can be recommended to the farmers of Baitadi after confirming the results for a few years.

Keywords: Branches; Black gram; Harvest Index; Spacing; Yield

Introduction

Pulses are important protein sources for predominately vegetarian populations of our country. Besides various other legume crops, black gram (*Vigna mungo* L. Hepper) is one of the most important pulse crops of Nepal. It contains about 20 - 24% protein, 1.2% fat and 56.6% carbohydrates on a dry weight basis and it is a rich source of calcium and iron. It differs from other pulses in its peculiarity of attaining a somewhat mucilaginous pasty character, giving additional body to the mass due to long polymer chain of polysaccharide chain of carbohydrate [1].

The economic product of black gram is grain, which is a good source of dietary protein. In Nepal, it is cultivated in 22,375 hectares of land and is produced 19,011 tons of grain with a productivity of 0.85 t ha^{-1} [2].

It is a prime necessity to maintain the optimum plant population by adjusting inter and intra row spacing properly. Maximum or minimum plant density may reduce the yield of black gram causing different physiological changes in the plant. 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. 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 plant canopy area and hence they produce higher seed yield and best yield quality traits [3]. Therefore, the present study was undertaken to evaluate the optimum plant population density by adjusting different inter and intra row spacing to increase the seed yield of black gram.

Material and Methods

The experiment was carried out at the experimental field of Gokuleshwor Agriculture and Animal Science College (GAASC), Baitadi, Nepal during August 5, 2019, to November 10, 2019. The experimental site was located at 780 masl. The experiment was laid out in Randomized Complete Block Design with four replications, where treatment consists of four levels of spacing viz. T_1 (30 cm x 5 cm), T_2 (30 cm x 10 cm), T_3 (45 cm x 10 cm) and T_4 (60 cm x 10 cm). Kalu cultivar was used as an experimental material sown on August 5, 2019. The seeds were planted in ridges having a depth of 3 cm from the soil surface.

The manure and fertilizer were applied and mixed thoroughly each plot through organic manures and chemical fertilizers. Farm Yard Manure (FYM) was used as organic manure and Urea, Di-ammonium Phosphate (DAP) and Muriete of Potash (MOP) were applied during the final land preparation as sources of nitrogen, phosphorus, and potassium as inorganic sources. The recommended dose of Fertilizer for Black gram in Nepal is 20:40:20 kg NPK ha^{-1}. Weeding and thinning were done manually as first weeding was carried out at 30 DAS and second at 45 DAS.

Harvesting was done when 80% of the pods turn from brown to black. Harvesting was carried out by pulling the whole plants and dried in the threshing floor for a week and threshing was done by beating by a stick. The seeds were separated and cleaned by winnowing and finally cleaned seeds are dried in sun for 3 days at 10% seed moisture. The growth parameters were collected and recorded from two selected rows of each treatment and yield and yield attributing data were collected and recorded from the middle three selected rows of each plot i.e., net plot area. The different parameters were statistically analyzed by the Gen STAT computer package program. The mean difference of yield and yield contributing traits were compared to DMRT (Duncan's Multiple Range Test) at 5% level of significance.

Result and Discussion

Number of branches $plant^{-1}$

The number of branches per plant in blackgram was significantly affected by different levels of spacing as Table 1. The number of branches was found significantly higher (4.98) at T_3 (45×10 cm) which was at par with the T_4 (60×10 cm) and T_2 (30×10 cm) and that of lowest (2.68) at closed spacing i.e., T_1 (30×5 cm). Higher the number of branches in widest spacing was might be due to the interception of more solar radiation and less interspecific competition among plants. But, in narrow spaced plant showed overcrowding and did not have enough space for branching. Our results are similar to the Raman and Sinhamahapatra [4] who stated that, wider plant spacing which intercepted more photosynthetically active radiation owing to better geometric situation resulted in vigorous plant growth and more number of branches and leaves as compared to narrow spacing.

Bahadur and Singh [5] reported that, increase the number of branches in wider spaced rows was attributed due to more horizontal growth and plant canopy area due to less plant population density and other competitions compared to those in closer spacing.

Number of pods $plant^{-1}$

The data on the number of pods per plant was highly influenced by different levels of spacing in Table 1. The result reveals that, the significantly higher number of pods per plant (20.01) was found in the plots having distant spacing i.e., T_4 (60×10 cm) followed by T_3 (45×10 cm) and T_2 (30×10 cm) and that of lowest (14.53) at T_1 (30×5 cm). Higher pod numbers in the far spaced plots might be due to higher accumulation and assimilation food reserves and better source to sink relationship in wider spaced rows which might have adversely affected the pod development, hence, pods formation were comparatively higher than that of closely spaced rows.

The number of pods $plant^{-1}$ increased and seed yield decreased with the increase in plant spacing. In contrast, optimum plant spacing of 30×10 cm showed the highest harvest index and consequently produced higher seed yield. This indicates that the optimum plant spacing containing a reasonable number of plants per unit area with the optimum of pods $plant^{-1}$ gave better seed yield [6].

Number of seeds pod^{-1}

Data presenting in Table 1 showed that, the number of seeds per pod was significantly influenced by different levels of spacing. The Significantly higher number of seeds per pod (8.27) was found in T_4 (60×10 cm) followed by T_2 (30×10 cm) and T_3 (45×10 cm) and that of lowest (5.77) at T_1 (30×5 cm). It might be due to reduced competition and higher availability of growth resources leading to more space available for plants, lesser competition for moisture and nutrients between plants, hence, better grain filling which ultimately affects the number of seeds per pod. Decreased number of seeds pod^{-1} under closer spacing was due to mortality caused by mutual shading during the pre-flowering stage of the crop. Similar findings were also reported by Siddaraju, Narayanaswamy, and Prasad [7] in cluster bean.

Treatments	Spacing (cm)	Number of branches plant^{-1}	Number of pods plant^{-1}	Number of seeds pod^{-1}
T_1	30×5	2.68^b	14.53^c	5.77^b
T_2	30×10	4.88^a	17.48^b	7.87^a
T_3	45×10	4.98^a	17.49^b	7.25^{ab}
T_4	60×10	4.93^a	20.01^a	8.27^a
SEm (±)		0.30	0.47	0.54
LSD = 0.05		0.96*	1.51**	1.72*
CV, %		13.9	5.5	14.8
Grand Mean		4.29	17.38	7.29

Table 1: Number of branches plant^{-1}, number of pods plant^{-1} and number of seeds pod^{-1} at harvest as influenced by spacing at GAASC farm, Baitadi in 2019.

Note: Means followed by common letter (s) within each column are not significantly different at 5% level of significance based on DMRT

Straw yield ha^{-1}

Data regarding mean values of straw yield as influenced by the effect of row spacing. The table 2 revealed that maximum straw yield (1.10 t ha^{-1}) was obtained by T_1 (30×5 cm) which was statistically similar with T_2 (30×10 cm) followed by T_4 (60×10 cm) and least at T_3 (45×10 cm). Higher stover yield of blackgram at closed row spacing might be due to more population per unit area which contributed to more biomass and hence higher stover yield. Sathyamoorthi, Amanullah, Vaiyapuri and Somasundaram [8] were also found more stover yield in green gram with closer spacing, which could be attributed to higher population and accumulation of nutrients per unit area compared to wider spacing. Close row spacing improved dry matter yield compared with the far row spacing.

Grain yield ha^{-1}

In respect of seed yield, the maximum seed yield (1.41 t ha^{-1}) was harvested in T_2 (30×10 cm) followed by T_1 (30×5 cm) and T_3 (45×10 cm) and least (0.64 t ha^{-1}) at T_4 (60×10 cm). Higher grain yield at closer spacing might be due to the higher plant population, there was an increase in the proportion of the number of pods produced more seed yield. Plants under optimum spacing would have effectively utilized the growth resources, particularly solar radiation as compared to plants under narrow spacing.

Treatments	Spacing (cm)	Straw yield (t ha^{-1})	Grain yield (t ha^{-1})	Harvest index (HI)
T_1	30×5	1.10^a	0.85^b	0.44^b
T_2	30×10	1.01^a	1.41^a	0.59^a
T_3	45×10	0.54^b	0.76^b	0.58^a
T_4	60×10	0.66^b	0.64^b	0.48^b
SEm (±)		0.10	0.13	0.02
LSD = 0.05		0.33*	0.42*	0.09*
CV, %		25.1	28.7	11.1
Grand Mean		0.83	0.92	0.52

Table 2: Straw yield, grain yield and harvest index as influenced by spacing at GAASC farm, Baitadi in 2019.

Note: Means followed by common letter (s) within each column are not significantly different at 5% level of significance based on DMRT

Ganiger, Kareekaatti, and Patil [9] reported that optimum plant population, spacing and proper management of weed showed higher seed yield of blackgram. This could be due to enhanced vegetative growth and lesser yield attributes owing to severe competition between plants. Kabir and Sarkar [10] also reported that spacing of 30×10 cm gave the highest number of pods per plant, the highest grain yield, and the highest stover yield.

Harvest index

Harvest index (HI) is an important physiological character of the plants that reflect dry matter partitioning to their economic parts. The harvest index of blackgram was significantly affected by different levels of spacing as Table 2. Maximum HI (0.59) was obtained by T_2 (30×10 cm) which was statistically at par with T_3 (45×10 cm) followed by T_4 (60×10 cm) and least (0.44) was found at T_1 (30×5 cm). Achakzai and Panizai [11] also found similar findings in their research and stated that maximum HI of 0.61 was got in row spacing of 40 cm, which is statistically at par with four other spacing viz; 20, 25, 30 and 35 cm.

Conclusion

The variation in yield and yield contributing traits of black gram was observed due to different levels of plant spacing. The yield contributing traits were found superior at the spacing of 60×10 cm while straw yield was increasing with decreasing the plant spacing. Maintaining the plant the spacing of 30×10 cm was found promising and gave better seed yield and harvest index of crop.

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