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# Effect of Different Row Spacing on Growth and Yield of Black Gram (*Vigna mungo* L. Hepper) under Khumaltar Condition

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## ABSTRACT

Blackgram (*Vigna mungo* L. Hepper) is an important summer grain legume in mid hills of Nepal. An experiment was conducted at National Agronomy Research Centre, NARC Khumaltar during 2022, 2023 and 2024 to identify suitable row spacing for black gram. Five rows spacing (20 cm, 30 cm, 40 cm, 50 cm and 60 cm) and plant to plant spacing 10 cm were evaluated in randomized block design with four replications using variety Khajura Mash-1. Plot size of 12 $m^2$ (4 m × 3 m) was maintained, and fertilizer dose applied was 20:40:20 N: $P_2O_5$:$K_2O$ kg $ha^{-1}$. At physiological maturity, 10 plants per plot were sampled randomly for measurements of plant height, number of pods/plants, unfilled pods/plant and 100 seed weight. Data on days to 50% flowering, days to 90% maturity, plant height, number of pods per plant, biological yield and hundred seed weight were recorded. Combined analysis showed final stand/$m^2$, number of branches per plant, harvest index and straw dry matter were found to be affected significantly by various row spacing. There was no any significant interaction effect between rows spacing × year. Year significantly influenced all the parameters except days to 50% flowering, days to 90% maturity and final stand/$m^2$. The data of combined analysis of three years revealed that row spacing 20cm × 10 cm produced the highest grain yield (1746 kg $ha^{-1}$) followed by 30cm × 10 cm (1725 kg $ha^{-1}$). Similarly, the highest biological yield (10.5 t $ha^{-1}$) was observed at 20 and 40 cm row spacing followed by 30cm (9.6 kg $ha^{-1}$). Maximum harvest index (0.21) was provided by 60 cm row spacing followed by 30cm and 50cm (0.20). The finding concluded that maintaining 20 cm × 10 cm spacing was the better for higher grain yield and 30 cm × 10 cm was promising in better seed yield under Khumaltar, Lalitpur conditions.

**Keywords**: Black gram, planting geometry, Row spacing, Grain yield

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## INTRODUCTION

Black gram (*Vigna mungo* L. Hepper) is one of the most important short duration pulse crops which is grown in Nepal area of 26,239 hectare having the production of 24,754 Mt with productivity 940 kg $ha^{-1}$. (MOALD 2024). It is popular because of its nutritional quality having black gram contains about 24 % protein, 60 % carbohydrate, 10.9 %, 1.4% fat, 0.9 % fiber, 3.2 % minerals and vitamin viz calcium -154 mg, phosphorus -385mg, iron-9.1mg and small amount of vitamin B complex. (Bhagavat et al 2024). The crop not only fixing free atmospheric $N_2$, but also enrich the soil with N for the growth of succeeding crops (Sen 1996). Black gram is grown well in moisture retentive light soil, but loamy and clay loam are suitable for the cultivation of Black gram. Loam to clay loam with neutral PH are best suited for Black gram cultivation. It is susceptible to waterlogged conditions of the soil. Due to cheaper protein source, it is designated as poor man's meat (Aslam et al 2010).

The low productivity is due to decreasing day by day yielding ability and nonuse of improved varieties and proper spacing. 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. 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). It is prime necessity to maintain optimum plant population by maintaining inter and intra rows pacing properly.

Maximum or minimum plant density may minimize yield of black gram causing physiological change in plant. Hence appropriate fertilizer dose with adequate plant population may increase crop yield of black gram (Khan et al 2014). Maximum or minimum plant density causing different physiological changes in the plant which may reduce the yield of black gram. 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). Agroforestry is said to have among others the following advantages: protect soils from erosion and maintains soil fertility, without the use of inorganic fertilizer; provide natural pest control; diversify the risks of crop failure and also enhances resilience and to increase the agricultural output (Pinho et al 2012, Marten 2001) and hence also the ability to improve the food security, nutrition, income, health, shelter, social cohesion, energy resources and environmental sustainability.

Optimum spacing between rows is required to efficiently utilize available production factors such as moisture, nutrients, sunlight and space, which impact seed yield (Amare and Gebremedhin 2020). However, the farmers do not follow the above recommendations for crop establishment mainly due to labor shortage, as labor demand for rice cultivation is higher during the same period. Therefore, farmers usually broadcast seeds on the harrowed land at different seed rates since there is no recommended package of practices for broadcast blackgram (Ekanayake et al 2011). Optimum plant density is a primary requirement for better crop growth to minimize intra-species competition (Zhang et al 2021). So, spacing required to obtain a higher yield (Veeramani 2019). Considering the above facts, an experiment was planned and undertaken to determine the performance of varieties and effect of different plant spacings along with their combined effect towards maximum yield of blackgram.

Among many crop production constraints, appropriate varieties and crop spacing are the most important, which contribute substantially to the seed yield of black gram. Many research studies have revealed that most of the growth and yield contributing attributes were significantly and positively correlated with the seed yield of crop plants viz., black gram (Siddique et al 2006), soybean (Malik et al 2007) and sunflower (Vahedi et al 2010).
While earlier research has looked at how planting geometry affects black gram in different regions, there hasn't been much multi-year study conducted in Khumaltar, Lalitpur, which has distinct soil and climatic conditions. The results of this study may not be directly applicable to other kinds or locations because it focused on a single variety (Khajura Mash-1) at a single experimental site. Additionally, only row spacing and plant population were assessed, with other agronomic variables remaining same. Finding the ideal row spacing is crucial to maximizing grain yield and resource efficiency because it enhances plant growth, canopy development, and reproductive performance. The aim of present experiment was to find out suitable plant spacing for Khajura Mash 1 under different plant spacing.

**MATERIALS AND METHODS**

The experiment was carried out at the experimental field of National Agronomy Research Centre, Khumaltar Nepal during July 20, 2022 to June 21,2023 and July 17, 2024. In growing season period, the highest mean temperature of 29.2 $^0$C was recorded in the month of August and minimum mean temperature 17.7 $^0$C in October 2022. Highest total rainfall value of 195.4 mm in July 2022. During the year 2023, the highest mean temperature of 29.9 $^0$C and minimum mean temperature 20.6 $^0$C was recorded in the month of September. Highest total rainfall value of 281.1 mm in August 2023. In the year 2024, the highest mean temperature of 30.6 $^0$C was recorded in the month of July. Minimum mean temperature 20.3 $^0$C in and total rainfall value of 490.7 mm were recorded in the month of September 2024. The experimental site was located at 1360 meter at mean sea level. The experiment was laid out in Randomized Complete Block Design with four replications, where treatment consists of five levels of spacing: 20 cm × 10 cm, 30 cm × 10 cm, 40 cm ×10 cm, 50 cm × 10 cm and 60 cm × 10 cm. Black gram variety used was Khajura Mash-1. Seeds were treated with Bavistin @ 2 g kg$^{-1}$ seed before seeding. Chemical fertilizers of 20 N: 40 $P_2O_5$:20 $K_2O$ kg ha$^{-1}$ were applied at the time of land preparation. Thinning was done to retain single plant per hill after about a month of seeding. Cultural operation such as weeding and earthing up were done when needed. Harvesting was done when 90% 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. Ten plants were randomly selected for data collection of plant height, number of pods/plants, number of branches/plants at physiological maturity. Two hundred seeds were counted to estimate 100 seed weight. Subsample straw was oven-dried to estimate straw dry matter yield. Different parameters were statistically analyzed by the Gen STAT 12 edition.

## RESULTS AND DISCUSSION

### Plant stands and crop growth

### Final plant stand

Effect of different row spacing revealed that a highly significant variation of the final plant stand was observed in 2022, 2023 and 2024 (Table 1). The combined analysis of the three years data revealed that a highly significant variation of final stand was observed between spacing (Table 4). The highest plant stand (43/$m^2$) was obtained in 20 cm spacing, while the lowest (16/$m^2$) was observed at 60 cm spacing. The results obtained by Khalil et al 2010 and Singh et al 2013, indicated that the denser plant population increased the plant height of faba bean due to competition among plants. During the year 2022 highest plant stand (45 /$m^2$) was recorded while the lowest (15 /$m^2$) was observed in 2022 and 2023. The interaction between row spacing and year of combined analysis non-significantly influenced.

### Plant height

The plant height values were statistically non-significant with each other due to the year 2022, 2023 and 2024. The highest plant height was observed in 20 cm and 50 cm row spacing (43 cm) while the lowest height (26 cm) was observed at 50 cm respectively in 2022 and 2023 (Table1). Mehmud et al (1997) who stated that increase in row spacing decreases the plant height in black gram.

The combined analysis of the three years data revealed that among different row spacing there was no significant influence of plant height while it was highly significant influenced by year. It was observed that the highest plant height (40 cm) was recorded in 2023 while the lowest height (28 cm) was in the year 2022. Uddin et al 2017 showed significant effect on plant height due to early sowing date in bean. There was not any significant interaction effect between spacing and year on recorded parameters (Table 4).

### Phonological Parameters

All the factors did not interact significantly with physiological maturity. Sowing dates significantly influenced days to flowering, but spacing was not affected significantly. El-Masry (2010) noted that sowing in October significantly affected days to 50% flowering. There was a significant interaction effect between sowing dates and year (Table 4).

### Number of branches per plant

The number of branches per plant was significantly influenced by row spacing in 2023 while non-significant for 2022 and 2024. The result showed that the highest number of branches per plant (4) was observed, while the lowest score was recorded (3) in 2023 (Table 1). The data revealed that the three years of combined analysis, row spacing and year were significantly influenced the number of branches per plant. The highest number of branches per plant (7) was observed in 2022. This might be due to plants grown with wider spacing got better opportunity of availing maximum space, light and nutrients leading to maximum branches per plant. The above finding is in complete agreement with Kabir and Sarkar (2008). Row spacing and year did not show any significant interaction effect (Table 4). Raman and Sinhamahapatra (2014) who reported that, wider plant spacing which intercepted more photo synthetically active radiation owing to better geometric situation resulted in vigorous plant growth and a greater number of branches and leaves as compared to narrow spacing.

**Table 1. Final stand and growth parameters of black gram with respect to row spacing at Khumaltar in 2022, 2023 and 2024**

| Treatments | Final stand/$m^2$ | | | Plant height (cm) | | | Branches/plant | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2022 | 2023 | 2024 | 2022 | 2023 | 2024 |
| **Spacing** | | | | | | | | | |
| 20 cm ×10 cm | 45 | 40 | 43 | 28 | 43 | 35 | 5 | 3 | 4 |
| 30 cm × 10 cm | 30 | 29 | 33 | 29 | 40 | 35 | 6 | 4 | 5 |
| 40 cm × 10cm | 23 | 22 | 25 | 29 | 37 | 37 | 6 | 4 | 4 |
| 50 cm × 10 cm | 18 | 26 | 21 | 26 | 43 | 37 | 6 | 4 | 5 |
| 60 cm × 10 cm | 15 | 15 | 17 | 30 | 38 | 35 | 7 | 4 | 5 |
| LSD | 1.69 | 11.1 | HS | NS | NS | NS | NS | 0.64 | NS |
| CV% | 4.2 | 27.3 | 21.4 | 12.0 | 12.6 | 8.5 | 11.7 | 10.9 | 13.4 |

LSD values are shown only for traits and years with significant treatment effects at P = 0.05, NS = Not significant, HS = Highly significant at P < 0.01, CV = Coefficient of variation.

### Yield attributes and Yield

### Number of pods per plant

The number of pods per plant was non-significant influenced by different row spacing in two years (2022 and 2023). While during the year 2024, data had showed significant variation. The result showed that the highest

number of pods per plant (49) was observed in 50 cm followed by 60 cm (47) while lowest score was recorded in 20 cm (26) and 30 cm (27) during the year 2022 (Table 2). Nazir et al (1991) who stated that all the yield contributing characters were favorably affected by planting geometry.

The data revealed that three years of combined analysis, year highly influenced number of pods per plant. It was found maximum in the year 2024 (42). Row spacing influenced number of pods per plant. The highest pods per plant (41 and 40) at 50 cm and 60 cm row spacing respectively while lowest was observed at 20 cm (31) and at 30 cm (32). Row spacing and year did not have any significant interaction effect (Table 4).

**Grain yield**

Grain yield was significantly high in row spacing during the year 2022.The maximum seed yield (1416 kg $ha^{-1}$) was obtained by 20 cm and followed by 30 cm (1334 kg $ha^{-1}$). whereas the lowest value was recorded at 50cm (888 kg $ha^{-1}$). During the year 2023 and 2024, row spacing did not significantly influence. The highest yield produced by 50cm (2399 kg $ha^{-1}$) followed by 40 cm (2151 kg $ha^{-1}$) during the year 2023. In the year 2024, 30 cm showed highest grain yield (1794 kg $ha^{-1}$) than another row spacing (Table 2). Rasul at al reported that the highest seed yield (675.84 kg $ha^{-1}$) of blackgram was found with 30 cm row spacing. Result of combine analysis of three years revealed among the spacing 20 cm produced the highest yield (1746 kg $ha^{-1}$) followed by 30cm (1725 kg $ha^{-1}$). Higher grain yield at closer spacing might be due to the higher plant population, there was increase in the proportion of number of pods produced more seed yield. Similar results were also reported by Bhadrapada et al (2005). Increase in seed yield as population density is increased has been reported by many workers in black gram (Skehan et al 2002) and in soybean (Graterol and Montilla 2003).

Abuzar et al (2011) reported that the highest planting density resulted in the lowest grain yield. Row spacing significantly influenced in three years. The result showed that the highest grain yield (2110 kg $ha^{-1}$) was observed in the year 2023 while lowest grain yield (1139 kg $ha^{-1}$) was obtained during the year 2022. There was no any significant interaction effect between row spacing and year (Table 4).

**Hundred seed weight**

As presented in Table 2 row spacing was non-significant on hundred seed weight throughout the three years growing seasons except for 2024 growing season in which it was significant. In the year 2022, hundred seed weight ranged from 3.8 g to 4.0 g. Similarly, during the year 2023, hundred seed weight ranged from 4.9 g to 5.1 g and whereas in 2024, hundred seed weight ranged from 4.1 g at 50 cm to 4.4 g at 20 cm (Table 2). The test weight was found to be not influenced by different spacings. This might be due to test weight being a genetically controlled factor and it is least influenced by agronomic practices of spacing. These results fall in line with those obtained by Singh and Yadav (1994).

Result of combined analysis of three years revealed it was not significantly influenced by different row spacing. Whereas year highly significantly influenced hundred seed weight. Highest hundred seed weight 5.0 g recorded on 2023. Row spacing and year did not have any significant interaction effect (Table 4).

**Table 2. Yield and yield parameters of black gram with respect to row spacing at Khumaltar in 2022, 2023and 2024**

| Treatments | No. of pods /plant | | | Grain yield (kg $ha^{-1}$) | | | 100 seed weight (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2022 | 2023 | 2024 | 2022 | 2023 | 2024 |
| **Spacing** | | | | | | | | | |
| 20 cm × 10 cm | 26 | 36 | 31 | 1416 | 2059 | 1762 | 3.8 | 4.9 | 4.4 |
| 30 cm ×10 cm | 27 | 31 | 39 | 1334 | 2046 | 1794 | 3.9 | 5.0 | 4.3 |
| 40 cm × 10 cm | 30 | 41 | 45 | 1132 | 2151 | 1543 | 3.9 | 5.0 | 4.3 |
| 50 cm × 10 cm | 31 | 44 | 49 | 888 | 2399 | 1665 | 3.9 | 5.1 | 4.1 |
| 60 cm × 10 cm | 31 | 41 | 47 | 922 | 1897 | 1478 | 4.0 | 5.1 | 4.3 |
| LSD | NS | NS | S | 237.2 | NS | NS | NS | NS | S |
| CV% | 17.5 | 18.3 | 13.7 | 13.5 | 15.6 | 15.0 | 3.3 | 2.7 | 2.9 |

LSD values are shown only for traits and years with significant treatment effects at P = 0.05, NS = Not significant, S = Significant at P < 0.05, CV = coefficient of variation.

**Biological yield**

Biological yield was highly significant influenced by row spacing for 2022 and 2024 while non-significant for 2023. Highest biological yield was obtained in 20cm row spacing (5.2 t $ha^{-1}$) in 2022. Maximum (16.5) total biological yield was recoded in 40cm row spacing followed by 50 cm row spacing obtained 14.1 t $ha^{-1}$during the year 2023. It was observed that the highest biological yield (12.2 t $ha^{-1}$) was recorded at 20 cm row spacing while the lowest yield (9.0 t $ha^{-1}$) was observed at 60 cm respectively in 2024 (Table 2).

Result of combined analysis of three years revealed that row spacing had showed significantly influenced biological yield. Row spacing 20cm and 40 cm produced the highest biological yield (10.5 t $ha^{-1}$) followed by 30 cm (9.6 t $ha^{-1}$). Year highly significantly influenced biological yield where highest biological yield resulted in 2023 (13.6 t $ha^{-1}$). Row spacing and year did not show any significant interaction effect (Table 4).

**Harvest Index**

Data concerned about harvest index (Table 3) predicted that it was non-significantly in three years (2022, 2023 and 2024) but significantly influenced by varying level of row spacing in combined analysis (Table 4). Maximum harvest index (0.21) was provided by 60 cm row spacing and minimum (0.18) was in 20 cm and 40 cm row spacing (0.18). Shrivastav et al (1996) also concluded that increased level of row spacing generally increases the harvest index. Achakzai and Panizai (2007) reported that the maximum harvest index of blackgram (61.44%) was obtained in row spacing of 40 cm, which is statistically at par with four other spacing viz; 20, 25, 30 and 35 cm. Year highly significantly influenced and highest harvest index was observed in 2022 (0.28) (Table 4).

**Straw Dry Matter**

In the year 2022, row spacing highly significant influenced straw dry matter where as in 2023 and 2024, spacing did not significantly influenced. Row spacing 20cm showed highest straw dry matter (1.5, 2.8 and 2.3 t $ha^{-1}$) than other spacing during the year 2022, 2023 and 2024 respectively (Table 3).

The data revealed that of combined analysis revealed that straw dry matter had significantly influenced by the row spacing for three years. Straw dry matter ranged from 1.6-2.2 t $ha^{-1}$. Year significantly influenced and highest straw dry matter was observed in 2023 cm (2.6 t $ha^{-1}$) while lowest (1.1 t $ha^{-1}$) was observed in 2022 (Table 4).

**Table 3. Yield and yield parameters of black gram with respect to row spacing at Khumaltar in 2022, 2023 and 2024**

| Treatments | Biological yield (t $ha^{-1}$) | | | Harvest index | | | Straw dry matter (t $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2024 | 2022 | 2023 | 2024 | 2022 | 2023 | 2024 |
| **Spacing** | | | | | | | | | |
| 20 cm × 10 cm | 5.2 | 14.0 | 12.2 | 0.27 | 0.14 | 0.14 | 1.5 | 2.8 | 2.3 |
| 30 cm × 10 cm | 4.6 | 13.0 | 11.1 | 0.29 | 0.15 | 0.16 | 1.3 | 2.6 | 2.2 |
| 40 cm × 10 cm | 4.2 | 16.5 | 10.8 | 0.27 | 0.13 | 0.14 | 1.0 | 2.8 | 1.9 |
| 50 cm × 10 cm | 3.1 | 14.1 | 10.6 | 0.28 | 0.17 | 0.15 | 0.8 | 2.5 | 2.0 |
| 60 cm × 10 cm | 3.1 | 10.4 | 9.0 | 0.29 | 0.18 | 0.16 | 0.8 | 2.1 | 1.8 |
| LSD | HS | NS | HS | NS | NS | NS | 0.2 | NS | NS |
| CV% | 14.6 | 26.2 | 7.7 | 9.8 | 16.3 | 14.7 | 14.2 | 24.6 | 15.9 |

LSD values are shown only for traits and years with significant treatment effects at P = 0.05, NS = Not significant, HS = Highly significant at P < 0.01, CV = Coefficient of variation.

**Table 4. Combined analysis of black gram with respect to row spacing and year at Khumaltar, 2022-2023-2024**

| Treatments | Flr | Mat | Fs | Pth | Bran | Pod | Syld | Hswt | Byld | HI | Sdm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Spacing (S)** | | | | | | | | | | | |
| 20 cm × 10 cm | 37 | 82 | 43 | 35 | 4 | 31 | 1746 | 4.4 | 10.5 | 0.18 | 2.2 |
| 30 cm × 10 cm | 37 | 82 | 31 | 34 | 5 | 32 | 1725 | 4.4 | 9.6 | 0.20 | 2.0 |
| 40 cm × 10 cm | 37 | 82 | 23 | 34 | 5 | 38 | 1609 | 4.4 | 10.5 | 0.18 | 1.9 |
| 50 cm × 10 cm | 37 | 82 | 22 | 35 | 5 | 41 | 1651 | 4.3 | 9.3 | 0.20 | 1.8 |
| 60 cm × 10 cm | 37 | 82 | 16 | 34 | 5 | 40 | 1432 | 4.4 | 7.5 | 0.21 | 1.6 |
| LSD (0.05) | NS | NS | HS | NS | S | S | S | NS | S | S | S |
| | | | 4.4 | 3.3 | 0.50 | 5.8 | 221.9 | 0.1 | 1.7 | 0.02 | 0.37 |
| **Year (Y)** | | | | | | | | | | | |
| 2022 | 38 | 85 | 26 | 28 | 6 | 29 | 1139 | 3.8 | 4.0 | 0.28 | 1.1 |
| 2023 | 36 | 86 | 27 | 40 | 4 | 38 | 2110 | 5.0 | 13.6 | 0.16 | 2.6 |
| 2024 | 37 | 76 | 28 | 36 | 4 | 42 | 1649 | 4.3 | 10.7 | 0.15 | 2.0 |
| LSD (0.05) | NS | NS | NS | HS | S | HS | HS | HS | HS | HS | HS |
| | | | 3.4 | 2.5 | 0.39 | 4.5 | 171.9 | 0.08 | 1.3 | 0.017 | |
| S × Y | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| LSD (0.05) | | | 7.7 | 5.7 | 0.87 | 10.0 | 384.3 | 0.19 | 3.0 | 0.038 | 0.65 |
| CV% | | | 20.1 | | 13.2 | 19.4 | | 3.0 | 22.4 | 13.6 | 23.7 |
| **Mean** | **37** | **82** | | **35** | **5** | **36** | **1633** | **4.4** | **9.5** | **0.19** | **1.9** |

LSD values are shown only for traits and years with significant treatment effects at P = 0.05, NS = Not significant, S = Significant at P < 0.05, HS = Highly significant at P < 0.01, CV = Coefficient of variation. Flr = Days to 50% flowering, Mat=Days to 90% maturity, Fs = Final stand /$m^2$, Pth = Plant height (cm), Bran = Number of branches/plants, Pod= Number of pods/plants, Syld= Seed yield (kg $ha^{-1}$), Hswt = 100 seed weight (g), Byld = Biological yield (t $ha^{-1}$), HI = Harvest Index, Sdm=straw dry matter (t $ha^{-1}$)

## CONCLUSION

From the above research findings of three growing season field studies, it is concluded that, the variation in yield of black gram was observed due to different levels of plant spacing. Maintaining a 20 cm × 10 cm spacing was the better for higher grain yield under Khumaltar, Lalitpur conditions. Maintaining the plant spacing of 30 cm × 10 cm was found promising in better seed yield and 60 cm ×10 cm was better for harvest index of crop.


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## AUTHORS' CONTRIBUTION

The main author Reshama Neupane conducted the experiment, collected data, prepared ANOVA and manuscript, while other authors assisted in field work and write-up.

## CONFLICT OF INTEREST

The authors have no any conflict of interest to disclose.

## REFERENCES


Abuzar MR, GU Sadozai, MS Baloch, AA Baloch, IH Shah, T Javaid and N Hussain. 2011. Effect of plant population densities on yield of maize. Journal of Animal and Plant Sciences **21**(4):692–695.

Achakzai AKK and MK Panizai. 2007. Effect of row spacing on growth, yield and yield components of blackgram. Sarhad Journal of Agriculture **23**(1): 5-10.

Amare G and H Gebremedhin. 2020. Effect of plant spacing on yield and yield components of tomato (*Solanum lycopersicum* L.) in Shewarobit, central Ethiopia. Scientifica **12**: 1-6.

Aslam M, N Hussain, M Zubair, SB Hussain and MS Baloch. 2010. Integration of organic and inorganic sources of phosphorus for increased productivity of mung bean (*Vigna radiata* L.). Pakistan Journal of Agricultural Sciences **47**(2):111–114.

Bahadur A and Singh KP. 2005. Optimization of spacing and drip irrigation scheduling in indeterminate tomato (*Lycopersion esculentum*). Indian Journal of Agricultural Science **75**(9): 563-565

Bhagavat P. Taksalkar, Bhimashankar M. Satale and Avadhut D. Pawar. 2024. Effect of Different Plant Spacings on Growth and Yield of Blackgram Varieties (*Vigna mungo* (L.) Hepper). Journal of Scientific Research and Reports **30**(9): 27-31

Bhairappavar ST, HM Jaydeva, TH Gowda and S Shivanna. 2005. Effect of nutrients and spacing on the yield of urdbean under late sown condition. Legume Research **28**(1):48–50.

Ekanayake R, M Malaviarachchi, P Upashantha, R Fonseka and R Banda. 2011. Optimum seed rate and nitrogen requirement for broadcast blackgram (*Vigna mungo*.) grown on rain fed uplands. Tropical Agricultural Research, **22**(2): 165-171.

Garaterol Y and D Montilla. 2003. Effects of row spacing and plant population on performance of two indeterminate soybean cultivars. Bioagro. **15**(3):193–199.

Ihsanullah FH, H Taj, A Basir and U Noor. 2002. Effect of row spacing on the agronomic traits and yield of mung bean (*Vigna radiata* L. Wilczek). Asian Journal of Plant Sciences **1**(4):328–329.

Kabir MH and MA Sarkar. 2008. Seed yield of mungbean as affected by variety and plant spacing in kharif-I season. Journal of Bangladesh Agricultural University **6**:239–244.

Khan K and V Prakash. 2014. Effect of rhizobial inoculation on growth, yield, nutrient and economics of summer urdbean (*Vigna mungo* L. Hepper) in relation to zinc and molybdenum. International Journal of Advanced Research in Chemical and Chemical Engineering **1**(1):1–10.

Malik MF, A Ashraf, S Qureshi and A Ghafoor. 2007. Assessment of genetic variability, correlation and path analyses for yield and its components in soybean. Pakistan J Bot. **39**: 405-413.

Marten GG. 2001. Human Ecology - Basic Concepts for Sustainable Development. 1 edn. United Kingdom: Earthscan Publications Ltd.

Mazumdar SN, M Moninuzzaman, SMM Rahman and NC Basak. 2007. Influence of support system and spacing on hyacinth bean production in the eastern hilly area of Bangladesh. Legume Research **30**:1–9.

Mehmud M, UF Chiezey, MK Ahmed and I Rofia. 1997. Effect of different levels of phosphorus fertilizers and intra-row spacing on the growth and yield components of black gram (*Vigna mungo* L. Hepper). Discovery and Innovation **9**(1–2):47–51.

MoALD. 2024. Statistics and analysis of Nepalese agriculture. Ministry of Agriculture and Livestock Development, Government of Nepal, Singha Durbar, Kathmandu.

Nazir MS, MA Nadeem, MB Gill and R Ahmad. 1991. Effect of planting geometry on yield and yield components of lentil (*Lens culinaris*). Sarhad Journal of Agriculture **7**(2):7–10.

Pinho RC, RP Miller and SS Alfaia. 2012. Agroforestry and the Improvement of Soil Fertility: A View from Amazonia. Applied and Environmental Soil Science **2012**(1): 616383

Raman RB and SP Sinhamahapatra. 2014. A dwarf determinate plant type for achieving higher and stable yield in blackgram (*Vigna mungo* L. Hepper). The Bioscan **9**(2):497–500.

Rashmitha B, C Umesha and MR Meshram. 2021. Influence of spacing and phosphorus levels on growth, yield and economics of blackgram (*Vigna mungo* L.). Biological Forum – An International Journal **13**(1):82–85.
Rasul F, MA Cheema, A Sattar, MF Saleem and MA Wahid. 2012. Evaluating the performance of three mungbean varieties grown under variyng inter-row spacing. The Journal of Animal Plant Sciences **22**(4): 1030-1035.
Sekhon HS, G Singh and JS Brar. 2002. Effect of population density and planting geometry on the growth and yield of mungbean (*Vigna radiata*) genotypes. Environment and Ecology **20**(4):897–901.
Sen S. 1996. Economic botany. New Central Book Agency (Pvt.) Ltd., Calcutta, India. **pp.** 42–43.
Shrivastav DK, SK Rao and ML Tawar. 1996. Analysis of factors influencing seed yield in urid. Legume Research **19**(1):62–63.
Siddique M, MFA Malik and SI Awan. 2006. Genetic divergence, association and performance evaluation of different genotypes of mungbean (*Vigna radiata*). Int J Agric Biol. **8**: 793-795.
Singh S and DS Yadav. 1990. Response of summer blackgram to row spacing and seed rate. Indian Journal of Agronomy **39**(2):314–315.
Thongni A, L Tzudir and S Kumari. 2023. Response of summer blackgram (*Vigna mungo* L. Hepper) to planting geometry and weed management under Nagaland condition. Indian Journal of Hill Farming **36**(Special Issue):203–209.
Vahedi B, A Gholipouri and M Sedghi M. 2010. Effect of planting pattern on radiation use efficiency, yield and yield components of sunflower. Recent Research in Science and Technology **2**(2).
Veeramani P. 2019. Effect of plant spacing on the growth and yield of black gram (*Vigna mungo*). Journal of Krishi Vigyan **8**(1): 101-104.
Zhang Y, Z Xu, J Li and R Wang. 2021. Optimum planting density improves resource use efficiency and yield stability of rainfed maize in semiarid climate. Front Plant Science **12**: 1-8.