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Growth and Yield Performance of Different Cultivars of Mungbean (*Vigna radiata* L.) for Summer Cultivation in Terai, Nepal

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Abstract

Mungbean (*Vigna radiata* L. Wilczek) is a significant legume crop with commercial potential, particularly in Terai region of Nepal. An experiment was conducted in the research field of the Regional Agricultural Business Promotion Support and Training Centre, Khajura, Banke to determine the best mungbean cultivar for higher production. The experiment consists of five mungbean cultivars, *viz.* Pratikshya, Pratigya, SML-668, Kalyan, and Pant-5 replicated thrice in Randomized Complete Block Design (RCBD). The data revealed that the plant height was recorded highest in Pant-5 at 45 (59.37 cm) and 60 (31.91 cm) days after sowing. The highest number of seed germination pod-1 (9.5) was observed in Pant-5, which was statistically similar to Pratigya (9.25). 1000-seed weight was recorded as highest for cultivar Pratigya (50.35g). Pratigya has the highest yield (2135.40 kgha-1), while SML-668 showed the lowest yield (1634.67 kgha-1). Therefore, farmers primarily aiming for maximum yield can opt for the Pratigya variety, as it demonstrates superior yield-related traits compared to other varieties.

Keywords: Growth, variety, yield

Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) is a significant legume crop with commercial potential, particularly in regions such as the Terai of Nepal. Mungbean, commonly known as green gram, is widely grown in temperate, subtropical, and tropical regions across the globe. In Nepal and its neighboring countries, it serves as an essential pulse crop, offering substantial nutritional benefits and adaptability to diverse land types, including fallow land. It contains high-quality lysine (460 mgg^{-1} N^{-1}) and tryptophan (60 mgg^{-1} N^{-1}) (Islam et al., 2020), along with substantial ascorbic acid and riboflavin (0.21mg per 100g) (Azadi et al., 2013). Dried grains are used in food products like "Papad," "Dalmoth," "Daal," a soup made from mungbean, which is popular in the Indian subcontinent. Additionally, the plants are an excellent source of fodder and serve as green manure.

Mungbean can be integrated into existing cropping systems (Rice-wheat), thereby increasing the farmer's income, and can also restore soil fertility (Zahir et al. 2018). The climatic conditions of Nepal support the mungbean cultivation in the rainy and spring seasons across different geographic belts. However, spring mungbean in rice-wheat-mungbean is more widely adopted these days. Mungbean is also drought-tolerant and can grow with a minimum supply of nutrients (Islam et al., 2020). Therefore, it can be suitable for the dry Terai climate during summer in Nepal. Over 75% of the mungbean cultivation area is observed in Eastern and Central Terai, while 25% is located in the Western Terai and foothills (Darai et al. 2010).

The yield of mungbean was low (approximately 500 $kgha^{-1}$) before the 2000s (Joshi et al. 1997), while in recent days the productivity in Nepal has reached 833 $kgha^{-1}$ (MoALD, 2023). The main reasons for the low yield of mungbean include varietal and management factors (Islam et al., 2020). Nevertheless, current productivity levels of mungbean have increased substantially (NGLRP, 2020), with research demonstrating that mungbean production can be enhanced through summer cultivation, varietal advancement, and proper management practices, which encompass irrigation, fertilization, spacing, tillage, and pest control (Uddin et al., 2009).

In Nepal, rising food expenditures are influenced by dietary patterns that increasingly include meat, fruits, and nuts, which are generally expensive foodstuffs (Nepal Statistics Office, 2023). In this context, mungbean offers a cost-effective source of protein alternative. Therefore, promoting the cultivation and enhancing the yield of mungbean can significantly contribute to food sustainability and economic support to the region. It was estimated that about 400,000 hectares of land remain fallow after wheat harvest and before transplanting of monsoon rice in Nepal (Gharti et al. 2014). Hence, mungbean can be successfully integrated as a catch or filler crop and provides additional income and food security to the farmers. More efforts should be made to enhance the yield of mungbean, considering the food sustainability perspective. For this, choosing the appropriate variety, looking at the crucial yield attributing characters *viz*. plant height, pods plant^{-1}, seeds pod^{-1}, 1000-seed weight, seed germination pod^{-1} and number of picking days is necessary for maximizing the yield. The selection of superior mungbean cultivars helps in improving yield and meeting the nutritional needs of the country. Therefore, the research emphasizes the need for ongoing evaluation of different varieties to identify those that perform best under specific conditions.

National Agriculture Research Council (NARC) has initiated observation nurseries, advanced varietal trials, initial evaluation trials, coordinated varietal trials, and participatory trials to assess different genotypes across various locations in Nepal. Mungbean cultivars developed by NARC were evaluated for their adaptability concerning growth and yield. However, there are only a few varieties of mungbean that have been released to date viz. Pusha Baisakhi, Kalyan, Pratigya and Pratikshya (Gharti et al. 2014; Neupane et al. 2023). This limited release suggests a need for more focused research suggests a need for more focused research and effort on the varietal development of mungbean in Nepal. Therefore, it is necessary to collect promising and improved cultivars to evaluate their broad adaptability in various locations in Nepal to recommend the most suitable cultivar for farmers' fields.

Despite its nutritional and economic importance, mungbean is often cultivated on fallow lands in the Terai, resulting in low productivity. Further extensive research is necessary to identify effective methods and provide accurate data to enhance mungbean productivity in Nepal.

The experiment aims to determine the yield-attributing traits and yield of mungbean to recommend a suitable mungbean variety for the Banke district of Nepal. However, it is important to note that this study does not fully assess the economic viability of mungbean cultivation, and comprehensive data remains insufficient.

Research Methodology

Description of the Study Area

The experiment was carried out in the research field of Regional Agricultural Bussiness Promotion Support and Training Centre, Khajura, Banke (GPS coordinates: 28.1.89, 81.594) from January 25 to May 29, 2023. The experimental site was situated between mango and litchi orchards. The experimental site experiences a hot and humid climate, with light rainfall recorded during the cultivation period. Composite soil samples were collected using a soil auger from a depth of 0-30cm. Analysis of 10 samples revealed low nitrogen levels, while phosphorus, potassium, and organic matter were moderately available. The soil had a clayey loam texture with a slightly acidic pH.

Research Material

A set of five promising cultivars, *viz.* T_1: Kalyan, T_2: Pant-5, T_3: SML-668, T_4: Pratigya, T_5: Pratikshya, which were obtained from the National Grain Legume Research Program (NGLRP), Khajura, Banke.

Table 1

Information about the varieties used in this study

Varieties	Plant height (cm)	Seed per pod	Pods per plant	Days to first picking	Yield (kg/ha)	Recommended domain
Kalyan	45	10	17	60	2125	T, IT and FH
Pant-5	45	9	21	63	1972	T, IT and FH
SML-668	49	8.5	19	63	1803	T, IT and FH
Pratigya	40	10	17	65	2224	T, IT and FH
Pratikshya	43	10	15	63	1642	T, IT and FH

(Grain Legumes Research Program (NGLRP), 2021; Neupane et al., 2023)

Note. T= Terai region, IT= Inner terai region and FH= Foothills region of Nepal

Experimental Design

The mungbean cultivars were evaluated in Randomised Complete Block Design with three replications in the same year in an area of 60 m^2. The seed was inoculated with *Rhizobium* a day earlier than sowing. The field was prepared on 25 January 2023 by tractor, followed by manual harrowing and labeling. After the first plowing, well-rotted farmyard manure was applied at the rate of 10 tons ha^{-1}.

The fertilizer dose was applied as recommended, 20:40:20 kg NPKha^{-1}. A basal dose of fertilizer was applied 54 g of Urea (46% N), 522 g of DAP (18% N_2 and 16% P_2O), and 200 g of Murate of Potash (60% K_2O) for each plot. The chemical fertilizers were broadcast and incorporated as basal doses at the time of sowing. Respective varieties were sown on 26 January 2023 at a seed rate of 2 kgha^{-1}, maintaining the spacing of 30×10 cm in the plots. The manual harvesting was done by picking the pods when they reached physiological maturity (pods color changes to brown from green). Second and subsequent picking and harvesting were done at a one-week interval. Pods were sundried on a tray for a week before threshing to reduce the seed moisture content by up to 10-12%.

Statistical Analysis

The mean collected data were spread in the MS Excel and R Studio packages, version R-4.2.2 was used for data analysis. The Duncan Multiple Range Test (DMRT) was used at the 5% significance level to separate the treatment means for significant differences.

Results and Discussion

Plant Height

Cultivars showed a significant influence on plant height (Table 1). At 45 days after sowing (DAS), the highest plant height (59.37 cm) was recorded in Pant-5, closely followed by Kalyan (58.18 cm). At 60 DAS, Pant-5 (61.98 cm) and Pratigya (61.13 cm) were statistically similar and significantly taller than other cultivars. The cultivar Pratikshya consistently showed the shortest plants at both intervals, which aligns with the findings from the Annual Report of Grain Legume Research Program (GLRP) (2021/22).

Table 1

Effect of plant height at different dates on the yield of different mungbean cultivars

Variety	Plant height in cm (45 DAS)	Plant height in cm (60 DAS)
Kalyan	58.18^{ab}	59.49^{b}
Pant-5	59.37^{a}	61.98^{a}
SML-668	55.94^{cd}	57.84^{c}
Pratigya	57.13^{bc}	61.13^{a}
Pratikshya	55.25^{d}	58.55^{bc}
SEM (±)	0.09	0.08
LSD (=0.05)	1.38	1.32
CV, %	1.57	1.43
Grand mean	57.17	59.80

Note. SEM= Standard Error of Mean, CV= Coefficient of variation, LSD= Least Significant Difference, DAS= Days after sowing

Number of Pods Plant^{-1}

According to Table 2, the highest number of pods per plant (22.23) was observed in Pratigya, significantly outperforming all other cultivars, which was followed by Pratikshya (19.68) and Kalyan (18.64) cultivars. In contrast, SML-668 exhibited the lowest number of pods per plant (17.28). A greater number of pods plant^{-1} along with seed weight directly contributes to yield and is often prioritized in varietal selection due to its strong positive correlation with seed yields (Kate et al., 2017). The high-yielding cultivars typically have higher pod numbers plant^{-1} (Mondal et al., 2011).

Pod Length

The pod length differed significantly among the cultivars (Table 2). The highest pod length (9.22 cm) was found in Pratigya cultivar, which was statistically similar to Kalyan (8.62 cm), Pant-5 (8.60 cm), and Pratikshya (8.57 cm). The cultivar SML-668 exhibited the shortest pod length (7.80 cm). These findings are consistent with those of

Basnet et al. (2024), who also reported longer pods in Pratigya.

Seeds Pod^{-1}

The number of seeds pod^{-1} varied significantly among the tested cultivars (Table 2). The mean number of seeds pod^{-1} was found to be 8.57, and it ranged from 8.80 to 10.00. Pratigya showed the highest seed count (10.00), statistically similar to Pratikshya (9.96) and Pant-5 (9.93). SML-668 had the fewest seeds per pod (8.80). The results were in close agreement with Madhav et al. (2023).

Number of Seed Germination Pod^{-1}

The number of fertile seeds was observed to be significantly different among the varieties. A germination test was performed to measure the number of seed germination pod^{-1}. The number ranged from 10 to 7 germinations from each pod (Table 2). The highest number of seed germination pod^{-1} was observed in Pant-5 (9.50 fertile seeds pod^{-1}), while the cultivars Kalyan (7.25) and SML-668 (7.50) were observed to have the lowest.

1000-seed Weight

The effect of cultivars on 1000-seed weight was significant, with a mean weight of 47.35 g (Table 2). The highest weight was recorded in Pratigya variety (50.35g), while the lowest was recorded in SML-668 (44.67g). The 1000-seed weight was recorded for the cultivars Kalyan (46.60g) and Pant-5 (46.46g) was statistically similar. There is a significant positive correlation between yield and seed weight (Gowsalya et al., 2016).

Table 2

Effect of number of pods per plant, pod length, seeds pod^{-1}, fertile seeds per pod, and 1000-seed weight of different mungbean cultivars

Variety	Number of pods plant^{-1}	Pod length (cm)	Seed pod^{-1}	Seed germination pod^{-1}	1000-seed weight (g)
Kalyan	18.64^{c}	8.62^{a}	9.32^{b}	7.25^{b}	46.60^{c}
Pant-5	18.61^{c}	8.60^{a}	9.93^{a}	9.50^{a}	46.46^{c}
SML-668	17.28^{d}	7.80^{b}	8.80^{b}	7.50^{b}	44.67^{d}
Pratigya	22.23^{a}	9.22^{a}	10.00^{a}	9.25^{a}	50.35^{a}
Pratikshya	19.68^{b}	8.57^{a}	9.96^{a}	8.25^{ab}	49.88^{b}
SEM (±)	0.06	0.04	0.03	0.09	0.03
LSD (=0.05)	0.96	0.67	0.67	1.49	0.29
CV, %	3.23	5.10	4.03	11.62	0.39
Grand mean	19.28	8.57	8.57	8.35	47.35

Note: SEM= Standard Error of Mean, CV= Coefficient of variation, LSD= Least Significant Difference

Yield

The total yield was calculated from the four harvests. The total yield (FY) varied significantly across cultivars, as illustrated in Table 3. The highest yield was observed in Pratigya (2135.33 $kgha^{-1}$), followed by Pratikshya (1992.83 $kgha^{-1}$) and Kalyan (1864.67 $kgha^{-1}$). SML-668 had the lowest yield (1634.67 $kgha^{-1}$). Pratigya cultivar showed the superior agronomic traits, which were attributed to the yield, including pod number, number of seeds pod^{-1}, number of seed germination pod^{-1}, and seed weight. The yield was reduced subsequently from the first harvesting to the fourth harvesting, with Pratigya consistently recording the highest total yield (2135.00 $kgha^{-1}$). These findings were in close conformity with Neupane et al. (2023), who also reported high yield potential for Pratigya under comparable agro-climatic conditions.

Table 3

Yield of different mungbean cultivars at different harvests

Variety	YH1 ($kgha^{-1}$)	YH2 ($kgha^{-1}$)	YH3 ($kgha^{-1}$)	YH4 ($kgha^{-1}$)	FY ($kgha^{-1}$)
Kalyan	834.66^{b}	628.00^{a}	276.67^{b}	125.33^{b}	1864.67^{c}
Pant-5	915.33^{a}	465.33^{c}	371.33^{a}	112.00^{b}	1864.00^{c}
SML-668	699.67^{c}	596.67^{ab}	269.33^{b}	69.00^{c}	1634.67^{d}
Pratigya	925.67^{a}	640.67^{a}	367.67^{a}	201.33^{a}	2135.33^{a}
Pratikshya	860.50^{b}	569.33^{b}	379.67^{a}	183.33^{a}	1992.83^{b}
SEM (±)	1.80	2.95	1.51	1.36	4.23
LSD (=0.05)	29.06	45.60	23.4	21.01	65.30
CV, %	2.22	5.10	4.56	9.87	2.23
Grand mean	847.16	580.00	332.93	138.20	1898.30

Note. YH1= Seed yield of mungbean at first harvest, YH2= Seed yield of mungbean at second harvest, YH3= Seed yield of mungbean at third harvest, YH4= Seed yield of mungbean at fourth harvest, and FY= Total yield of mungbean summing all the harvests

Conclusion

The study revealed significant variations in yield and yield-attributing traits among the five mungbean varieties evaluated. Pratigya demonstrated superior performance, exhibiting higher productivity compared to other tested varieties. Given its enhanced yield potential, Pratigya is recommended for summer cultivation in Nepal's dry, hot Terai region. Its adoption could contribute to improved agricultural productivity and food security in the area.

Data Availability

The data supporting this study are available for the corresponding author upon request.

Conflict of Interest

The author declares that there are no conflicts of interest.

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