Khulna University Studies Volume 17(1 & 2): 1-7 : 2020

LIFE SCIENCE

EFFECT OF PRIMARY NUTRIENT (NPK) RATES ON GROWTH AND YIELD OF MUNGBEAN (*Vigna radiata*) AT BATIAGHATA UPAZILA IN KHULNA

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KUS:18/16: 191118

Manuscript submitted: November 19, 2018 Accepted: March 18, 2021

Abstract: The field experiment was conducted to investigate the effect of primary nutrients (NPK) on growth, yield and yield attributes of mungbean. The experiment was laid out in a randomized complete block design with three replications and consisted of four level of primary nutrients (N:P:K) *viz*. F_0 = no NPK added, F_1 = 8:10:12 kg ha^{-1}, F_2 = 16:20:24 kg ha^{-1} and F_3 = 24:30:36 kg ha^{-1} of N:P:K. Increasing the levels of primary nutrients significantly influence the growth, yield and yield attributes of mungbean except stover yield and harvest index. The highest plant height, number of pod plant^{-1}, weight of seed plant^{-1} and seed yield were obtained from 16:20:24 kg N:P:K ha^{-1} whereas 24:30:36 kg N:P:K ha^{-1} produced the highest number of leaf plant^{-1}, number of branch plant^{-1}, seed pod^{-1}, weight of seed pod^{-1} and 1000-seed weight. Increased rate of nutrients increased the pod plant^{-1}, seed weight pod^{-1} and seed yield up to N:P:K @ 16:20:24 kg ha^{-1} and then declined. From the results of this study it could be suggested that application of primary nutrients (N:P:K) @ 16:20:24 kg ha^{-1} optimum for BARI mung-6 at Batiaghata upazila in Khulna district of southwestern Bangladesh.

Keywords: Mungbean, Primary nutrients, Khulna, Growth and Yield

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Introduction

Mungbean (*Vigna radiata* L.) is one of the most important pulse crop grown in Bangladesh that supplies a major source of protein. Pulse crops are an important component of subsistence cropping system because of their ability to form nodules, which offer a renewable source of energy through biological nitrogen fixation (Sarker *et al.,* 2014).

In Bangladesh, on an average only 8-10 percent of protein intake originates from animal sources, the rest can be met from plant sources by increasing the consumption of pulses (Uddin et al., 2009). Hence from the point of nutritional value, mungbean is perhaps the best of all other pulses. Its seed contains about 24% protein, 58%, carbohydrate and 36% minerals (Nadeem *et al*., 2004).

In the southwestern region of Bangladesh, only *T. aman* rice is cultivated. After harvesting the crop, land usually remains fallow. The main problems of *rabi* crops cultivation in this region are i) farmers cultivate long duration local *aman* rice and harvest in last week of December to mid-January, ii) there is excess moisture in the field and iii) there is a scarcity of fresh irrigation water. Mungbean being drought tolerant and short duration can grow well under varied conditions (irrigated and

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DOI: https://doi.org/10.53808/KUS.2020.17.1and2.1816-L

rainfed). There is a great scope to fit largely in the cropping system and enhance the yield of mungbean in the southwestern region of Bangladesh.

In Bangladesh, mungbean is cultivated mainly in onset of *kharif-1* season after harvesting of rice and somewhat in *kharif-2*. During February-March, soil has optimum moisture which is suitable for sowing of mungbean. In Khulna region, yield of mungbean is not up to the mark due to lack of cultural practices resulting large yield gap. The yield gap can be minimized by adopting suitable agronomic practices. In Khulna region, fertilizers are not usually applied for pulse crop cultivation but there is an ample scope of increasing the yield of mungbean per unit area by appropriate fertilizer management.

As a legume crop, mungbean is able to fix atmospheric nitrogen which is available to plant. So, it is less dependent to nitrogenous fertilizer. But application of nitrogenous fertilizer as starter or initial dose becomes helpful in increasing the growth and yield of legume crops (Achakzai *et al.*, 2012). Nitrogen deficiency reduces the number of branches plant^{-1}, plant height, stem diameter, pod length, number of nodes (Rupa *et al.,* 2014).

Application of phosphorus and potassium along with nitrogen also increases number of pods plant^{-1}, number of seeds pod^{-1}, 1000-seed weight and seed yields (Tariq *et al.,* 2001). So, there is a need to develop appropriate levels of nitrogen, phosphorus and potassium application to harvest the maximum potential of existing mungbean yield.

The production of mungbean has been steadily decreasing due to low yield. Therefore, to face the situation, it is necessary to increase the production of mungbean through proper management practices. So, the use of optimum nutrients is one of the effective means of increasing productivity of mungbean in southwestern area of Bangladesh. Under these circumstances, the present research was conducted with a view to evaluating the performance of mungbean under different levels of primary nutrient (NPK) and find out the suitable one in Khulna region of southwestern coastal Bangladesh.

Materials and Methods

The field experiment was conducted at the experimental field of Agrotechnology Discipline, Khulna University, Khulna in 2017. The area is located in the agro-ecological zone of Ganges Tidal River Floodplain. The soil of the experimental plot was well drained, fertile clay loam type. Soil samples from experimental field was collected before sowing of seed, processed and analyzed from the laboratory of Soil Resource and Development Institute (SRDI), Daulatpur, Khulna. The physical and chemical properties of the experimental field soil (top soil; 0-15 cm depth) are presented in Table 1. BARI mung-6 was used as planting material which was collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. The fertilizers namely urea, TSP and MoP were used as the source of N, P and K, respectively. The treatments of this experiment were F_0 = no NPK added, F_1 = 8:10:12 kg N:P:K ha^{-1}, F_2 = 16:20:24 kg N:P:K ha^{-1} and F_3 = 24:30:36 kg N:P:K ha^{-1}.

Table 1. Physical and chemical properties of the experimental soil

Elements	N (%)	P (ppm)	K (meq/100 g soil)	S (ppm)	Zn (ppm)	Organic matter	pH
Soil test value	0.35	11.20	0.43	61.90	1.25	2.03	7.5
Critical value	0.12	8.0	0.10	12.0	0.6	-	-

The experiment was laid out in randomized complete block design with four replications. Before sowing, seeds were treated with Vitavax-200 @ 3.0 g/kg seed. The seeds were sown in line maintaining a spacing of 30 cm between rows. Intercultural operations such as thinning, weeding, re-sowing, drainage, irrigation and plant protection measures were taken as and when necessary and kept usual and uniform for all the experimental plots. Half urea and full dose of TSP and MoP were applied during final land preparation and rest half urea was applied at 20 days after seedling emergence.

The data on days to first flowering and duration of flowering, days to first pod initiation, duration of pod initiation, plant height, branch plant^{-1}, pod plant^{-1}, seed pod^{-1}, seed weight plant^{-1}, 1000 seed weight, seed yield, stover yield and harvest index. Finally, the collected data were analyzed following the analysis of variance using Statistical Tool for Agricultural Research (STAR) computer package program and the treatment means were compared by using the Duncan's New Multiple Range Test (DMRT) at 5% level of probability.

Results

Effect of NPK rates on days to first flowering and duration of flowering: Levels of primary nutrients (N:P:K) had no significant effect on first flowering and duration of flowering (Fig.1). Numerically the earliest flower initiation (36.67 days) was observed in control treatment (no NPK added) while the late flowering (38.00 days) was recorded from 24:30:36 kg N:P:K ha^{-1}. In case of duration of flowering, the shortest duration (19.56 days) was found in 24:30:36 kg N:P:K ha^{-1} whereas the longest duration (21.11 days) was observed in 8:10:12 kg N:P:K ha^{-1}.

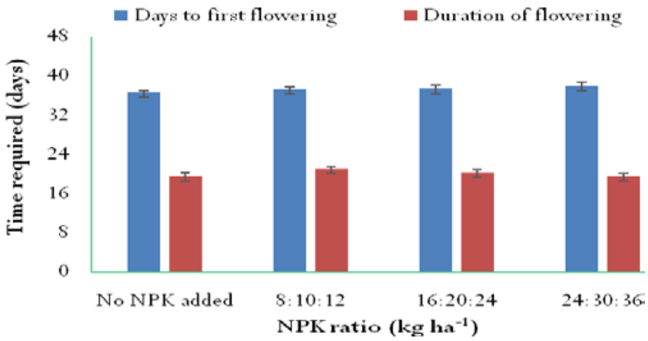

Figure 1. Effect of NPK rates on days to first flowering and duration of flowering of BARI mung-6

Effect of NPK rates on days to first pod formation and duration of pod initiation: The data in figure 2 regarding first pod initiation and duration of pod initiation had no significant differences due to NPK levels. Numerically, the earliest pod initiation (40.0 days) was found in control treatment while the last pod initiation (41.56 days) was recorded from 24:30:36 kg N:P:Kha^{-1}. In case of duration of pod initiation, the shortest duration (14.0 days) was found in control treatment whereas the longest duration (15.56 days) was recorded from 16:20:24 kg N:P:K ha^{-1}.

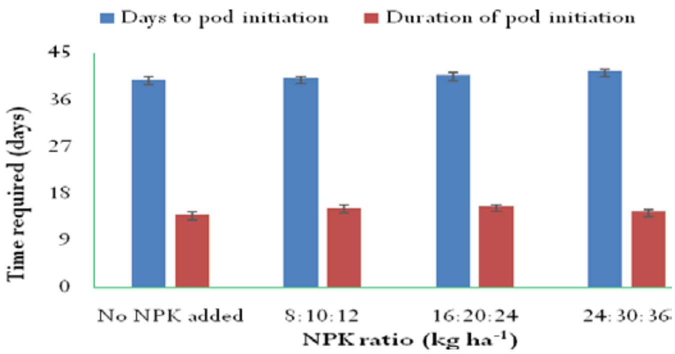

Figure 2. Effect of NPK rates on days to first pod formation and duration of pod formation of BARI mung-6

Plant height: Plant height of mungbean vari 3 ntly due to different levels of NPK (Table 2). At harvest, the tallest plant (87.44 cm) was obtained from 16:20:24 kg N:P:K ha^{-1} which was statistically similar to those in 24:30:36 kg N:P:K ha^{-1} and 8:10:12 kg N:P:K ha^{-1} while the lowest (81.00 cm) was recorded from control treatment (F_0: no NPK added).

Branch plant^{-1}: The data in table 3 indicated that there were significant differences in number of branch plant^{-1} of mungbean due to different levels of NPK combination (Table 2). The maximum branch plant^{-1} (7.67) at harvest was observed in 24:30:36 kg N:P:Kha^{-1} which was statistically similar to 16:20:24 kg N:P:K ha^{-1} and 8:10:12 kg N:P:K ha^{-1} whereas the minimum number (6.67) was found in no NPK added treatment.

Table 2. Effect of primary nutrient (NPK) rates on plant height (cm) and branch plant^{-1} of BARI mung-6

NPK ratio (kg ha^{-1})	Plant height (cm)			Number of branch plant^{-1}		
	35 DAE	45 DAE	At harvest	35 DAE	45 DAE	At harvest
No NPK added	30.34b	70.67c	81.00b	1.33	3.33b	6.67b
8:10:12	34.22a	73.22b	85.00a	1.56	4.11a	7.22ab
16:20:24	34.67a	76.56a	87.44a	1.67	4.22a	7.44a
24:30:36	35.67a	78.67a	86.89a	1.67	4.33a	7.67a
CV (%)	6.56	3.52	4.23	16.54	13.90	10.26
Significance level	*	*	*	NS	*	*

CV= Co-efficient of Variation, * indicates significant at 5% level of significance, NS= Non-significant.

Pod plant^{-1}: Data regarding number of pod plant^{-1} was affected by different levels of NPK (Table 3). The maximum number of pods plant^{-1} (34.67) was produced in 16:20:24 kg N:P:K ha^{-1} which was statistically similar to that in 24:30:36 kg N:P:K ha^{-1} while the minimum number (22.56) was found in control treatment.

Seed pod^{-1}: Data in table 3 regarding seed pod^{-1} showed significant variation among different levels of NPK (Table 3). 24:30:36 kg N:P:K ha^{-1} level produced the maximum number of seed pod^{-1} (11.33) which was statistically similar to 16:20:24 kg N:P:K ha^{-1} and 8:10:12 kg NPK ha^{-1} whereas the minimum number (10.0) was found in control treatment (no NPK added treatment).

Seed weight pod^{-1}: NPK levels had significant effect on weight of seed pod^{-1} (Table 3). The highest seed weight pod^{-1} (0.47 g) was recorded from 24:30:36 kg NPK ha^{-1} followed by 16:20:24 kg N:P:K ha^{-1} whereas the lowest (0.39 g) was recorded from no NPK added treatment.

Seed weight plant^{-1}: Data in table 3 revealed significant effect of NPK levels on weight of seed plant^{-1}. The highest seed weight plant^{-1} (13.67 g) was obtained from 16:20:24 kg N:P:K ha^{-1} which was statistically at par with 24:30:36 kg N:P:K ha^{-1} while the lowest (9.11 g) was obtained from control treatment (no NPK added).

1000 seed weight: The data regarding 1000 seed weight was influenced significantly by NPK levels (Table 3). 24:30:36 kg N:P:K ha^{-1} resulted the maximum 1000 seed weight (45.78 g) which was significantly similar to 16:20:24 kg N:P:K ha^{-1} whereas control treatment (no NPK added) resulted the minimum 1000 seed weight (38.44 g).

Seed yield: The data pertaining to seed yield was affected significantly by varying levels of NPK (Table 3). The highest seed yield (1.52 t ha^{-1}) was recorded from 16:20:24 kg N:P:K ha^{-1} which was significantly at par with 24:30:36 kg N:P:K ha^{-1} while the lowest (1.22 t ha^{-1}) was obtained from control treatment (no NPK added).

Stover yield: Varying levels of NPK had no significant effect on stover yield (Table 3). Numerically the highest stover yield (5.81 t ha^{-1}) was obtained from 16:20:24 kg N:P:K ha^{-1} while the lowest was recorded from no NPK added treatment.

Harvest index: NPK had no significant effect on harvest index (Table 3). Numerically the highest harvest index (26.83%) was obtained from 16:20:24 kg N:P:K ha^{-1} whereas the lowest was found in control treatment (no NPK added).

Table 3. Effect of NPK levels on yield attributes and yield of BARI mung-6

NPK ratio (kg ha^{-1})	Pod $plant^{-1}$	Seed pod^{-1}	Seed weight pod^{-1} (g)	Seed weight $plant^{-1}$ (g)	1000 seed weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Harvest index (%)
No NPK added	22.56c	10.00b	0.39c	9.11c	38.44b	1.22c	5.34	25.42
8:10:12	29.56b	10.67ab	0.42bc	11.22b	41.11b	1.42b	5.65	26.33
16:20:24	34.67a	10.89a	0.45ab	13.67a	44.33a	1.52a	5.81	26.83
24:30:36	32.11ab	11.33a	0.47a	13.11a	45.78a	1.48ab	5.72	26.67
CV (%)	14.27	7.70	8.66	16.34	7.21	5.46	9.92	4.76
Significance level	*	*	*	*	*	*	NS	NS

CV= Co-efficient of Variation, * indicates significant at 5% level of significance, NS= Non-significant.

Discussion

Nutrient requirement of pulse crop is comparatively lower than other field crops. Plant response was better with the addition of NPK due to the deficiency of nutrients in the soil (Table 1) especially nitrogen (N). N fertilizer enhances cell division and cell elongation of mungbean, promotes initial vegetative growth which leads to maximize plant height, increases the branch $plant^{-1}$ and supports better seed yield. P stimulates early root growth which helps in better uptake of nutrient and water from the soil. K fertilizer alleviates the soil salinity and increases drought resistance. Lower seed yield is also responsible for P deficiency but excess amount may delay and minimize seed set. Balance ratio of NPK boosts up the availability and uptake of nutrient from the soil. Previous study reported that increase of P fertilizer enhanced the vegetative growth and branch $plant^{-1}$ (Mohammad *et al.,* 2017 and Rathour *et al.,* 2015). Achakzai *et al.* (2012) suggest that nitrogen application increases the plant height significantly. P fertilizers had great influence on flowering, seed formation and seed development. Karim *et al.* (2014) found the P fertilizer substantially influences the seed pod^{-1}. The finding in this experiment revealed that with the increased rate of NPK significantly enhanced seed pod^{-1}, seed weight pod^{-1}, 1000 seed weight. Mahboob and Asghar (2002) revealed that the application of nitrogen fertilizer significantly affected the 1000 seed weight of mungbean. Similar finding was also reported by Biswas *et al.* (2014). The results are in accordance with Chattha *et al.* (2017) and Sadaf and Tahir (2017) who reported that rate of NP ratio affects the 1000 seed weight. Pod $plant^{-1}$ and seed yield of mungbean were enhanced with the increment rate of NPK ratio up to 16:20:24 kg ha^{-1} afterwards declined. This was may be due to the toxic effect of excess nitrogen. The finding is corroborated by Yin *et al.* (2018) who reported that with the increase of N, P and K rates pod $plant^{-1}$ and seed yield increased and then decreased with the further increase of N, P and K rates. Seed yield was increased by ~25% due to the application of NPK @16:20:24 kg ha^{-1} over control treatment (no nutrient added). Judicious and balanced application of N, P and K fertilizers influence fertilizer use efficiency, minimize the cost of crop cultivation, improve the yield and maintain the soil health.

Conclusion

Primary nutrient rates had substantial influence on growth and yield of mungbean. From the above results and discussion of this experiment, it is concluded that the application of primary nutrients (N:P:K) at the rates of 16:20:24 kg ha^{-1} substantiated the maximum seed yield of BARI mung-6 at Batiaghata upazila in Khulna district of southwestern Bangladesh.

References

Achakzai, A.K. K., Habibullah, S.B.H. and Wahid, M.A. 2012. Effect of Nitrogen Fertilizer on the Growth of Mungbean [*Vigna radiata* (L.) Wilczek] Grown in Quetta. *Pakistan Journal of Botany, 44*(3): 981-987.

Biswash, M.R., Rahman, M.W., Haque, M.M., Sharmin, M. and Barua. R. 2014. Effect of Potassium and Vermicompost on the Growth, Yield and Nutrient Contents of Mungbean (BARI Mung 5). *Open Science Journal of Bioscience and Bioengineering, 1*(3): 33-39.

Chattha, M.U., Hassan, M.U., Khan, I., Chattha, M.B., Ashraf, I., Ishque, W., Farooq, M.U., Usman, M. and Kharal, M. 2017. Effect of Different Nitrogen and Phosphorus Fertilizer Levels in Combination with Nitrogen and Phosphorus Solubilizing Inoculants on the Growth and Yield of Mungbean. *Pakistan Journal of Life and Social Sciences, 15:* 31-36.

Karim, A., Qasim, M., Imran, M., Gurmani, Z.A., Tajudin, D.M., and Shafiullah. 2014. Effect of Phosphorous on the Yield and Yield Components of Mungbean at Marc, Juglote, Gilgit-Baltistan. *Pakistan Life Science International Journal, 8 (*1, 2, 3, & 4): 2936-2939.

Mainul, M.I., Rupa, W.S., Nasir, A., Mehraj H., and Jamal, A. F .M. 2014. Performance of Mungbean (BARI Mung 6) to Different Nitrogen Levels. *International Journal of Business, Social and Scientific Research, 1*(3): 172-175.

Mohammad, I., Yadav, B.L., and Ahamad, A. 2017. Effect of Phosphorus and Bio-Organics on Yield and Soil Fertility Status of Mungbean [*Vigna radiata* (L.) Wilczek] under Semi- Arid Condition of Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences, 6*(3): 1545-1553.

Mahboob, A. and Asghar, M. (2002). Effect of seed inoculation and different nitrogen levels on the grain yield of mungbean. *Asian Journal of Plant Science, 1*(4): 314-315.

Nadeem, M.A., Ahmad, R., and Ahmad, M.S. 2004. Effect of Seed Inoculation and Different Fertilizer Levels on the Growth and Yield of Mungbean (*Vigna radiata* L.). *Journal of Agronomy, 3*(1): 40-42.

Rathour, D.K., Gupta, A.K., Choudhary, R.R., and Sadhu, A.C. 2015. Effect of Integrated Phosphorus Management on Growth, Yield Attributes and Yield of Summer Green Gram (*Vigna radiata* L.). *The Bioscar, 10*(1): 05-07.

Rupa, W.S., Miah, M.S., Shiam, I.H., Mehraj, H., and Uddin, A. F. M. J. 2014. Organic and Inorganic Fertilizers on Growth, Yield and Nutrient Content of Mungbean (Bari Mung 5). *International Journal of Business, Social and Scientific Research, 01*(02): 107-111.

Sadaf, A. and Tahir, M. 2017. Effect of Potassium on Growth, Yield and Quality of Mungbean under Different Irrigation Regimes. *Bulletin of Biological and Allied Sciences Research, 2*(4): 1-10.

Sarker, B.C., Roy, B., Mustary, S., Nahar, N.N., and Basak, B. 2014. Root Growth, Yield and Protein Content of Summer Mungbean in Response to Lime. *Journal of Science and Technology, 12*:1-7.

Tariq, M., Khaliq, A. and Umar, A. 2001. Effect of Phosphorus and Potassium Application on Growth and Yield of Mungbean (*Vigna radiata* L.). *Journal of Biological Sciences*, *1* (6): 427-428.

Uddin, M. S., Amin, A. K. M. R., Ullah, M. J. and Asaduzzman M. 2009. Interaction Effect of Variety and Different Fertilizers on the Growth and Yield of Summer Mungbean. *American-Eurasian Journal of Agronomy, 2*(3): 180-184.

Yin, Z., Guo, W., Xiao, H., Liang, J., Hao, X., Dong, N., Leng, T., Wang, Y., Wang, Q. and Yin F. 2018. Nitrogen, phosphorus, and potassium fertilization to achieve expected yield and improve yield components of mung bean. *PLoS ONE 13*(10):e0206285.