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Yield Performance of Mungbean (*Vigna radiata* L. Wilczek) cv. Barimung-4 as Influenced by *Rhizobium* Inoculation and NPK Fertilizers

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Abstract: A field experiment was conducted at the Regional Agricultural Research Station of Barisal, Bangladesh during the Kharif season of the year 2000 to find the optimum fertilizer rate for summer mungbean cv. Barimung-4 in an attempt to maximize the yield potential. In this regard, various combinations of NPK fertilizers and *Rhizobium* inoculation ($N_{20}P_{40}K_{20}$ kg ha^{-1}, $P_{40}K_{20}$ kg ha^{-1}, $N_{20}K_{20}$ kg ha^{-1}, $N_{20}P_{40}$ kg ha^{-1}, N_{20} kg ha^{-1}, *Rhizobium* + $P_{40}K_{20}$ kg ha^{-1}, *Rhizobium*, and control) were imposed to the experimental plots. Results revealed that Barimung-4 produced the maximum seed (1270.21 kg ha^{-1}) and straw yields (2434.36 kg ha^{-1}) when the crop was fertilized with $N_{20}P_{40}K_{20}$ kg ha^{-1} followed by *Rhizobium* + $P_{40}K_{20}$ kg ha^{-1} (1220.30 and 2406.14 kg ha^{-1}, respectively. The lowest seed and straw yields were obtained from the control (887.01 and 1864.68 kg ha^{-1}, respectively). Different plant characteristics such as plant height, branches/plant, pods/plant, pod length, seeds/pod, 1000-seed weight and harvest index increased significantly due to the application of various combinations of NPK fertilizers and *Rhizobium* inoculation over the control.

Key words: Yield performance, mungbean, fertilizer and *Rhizobium*

Introduction

Mungbean (*Vigna radiata* L. Wilczek) is an important grain legume. Among the pulses in Bangladesh, mungbean ranks fifth in acreage and production, and first in market price (BBS, 1999). It is an excellent source of vegetable protein which contains about 21-25% protein (Afzal *et al*., 1998).

In Bangladesh, it is traditionally used as whole or split seeds as *Dhal* (soup) but in some other countries of the world sprouted seeds are used as vegetables. In addition, it also improves the fertility status of the soil through nodulation.

Mungbean is generally grown on marginal lands of poor fertility and low moisture status and under poor management conditions. In other words, due to the competition with high yielding variety (HYV) of cereals such as rice, wheat etc. in terms of production and economic returns, and are thus being pushed to the marginal lands where nutrient limitations are severe. That is why, the acreage and production of mungbean are decreasing day by day (BBS, 1999). Under this situation, proper nutrient management and use of modern variety may be practiced. Application of fertilizers improves the plant productivity and enhanced the seed yield compared with the farmers' practices (Sarma and Sarma, 1999). Adreshna *et al*. (1993) also reported that *Rhizobium* inoculation significantly increased the seed yield, and the increase was 9.6% more compared with no inoculation. Therefore, an experiment was undertaken to determine the fertilizer requirements for mungbean in increasing the seed yield to a considerable extent.

Materials and Methods

The experiment was carried out at the Regional Agricultural Research Station of Barisal, Bangladesh in the Kharif season of the year 2000. The experimental site belongs to the Non-Calcareous Grey Floodplain soils under Agroecological Zone-13 (Anonymous, 1988). The experimental field was medium high land with clay loam textured soil having a pH value of 6.8. Characteristically, the soil contains 2.15% organic matter, 1.47% organic carbon, 0.23% total nitrogen, 23.87 μg/g soil available phosphorus, 41.84 μg/g soil available sulphur and 0.55% meq/100 g soil exchangeable potassium.

Following experimental treatments were applied:

A. Mungbean variety: Barimung-4
B. Fertilizer combinations (kg ha^{-1})
   I) $N_{20}P_{40}K_{20}$
   ii) $P_{40}K_{20}$
   iii) $N_{20}K_{20}$
   iv)$N_{20}P_{40}$
   v) N_{20}
   vi)*Rhizobium* + $P_{40}K_{20}$
   vii) *Rhizobium* alone, and
   viii) Control

The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 x 3m^2. Plot to plot distance was 1m, and each plot was separated from another by 25 cm wide ridges and 50 cm wide furrows. Previously, the experimental land was opened with a tractor drawn disc plough. Later on, the land was ploughed and cross-ploughed three times by country plough followed by laddering to obtain a desirable tilth. All the weeds and stubbles were removed and the land was made ready.

After layout preparation, the unit plots were fertilized as per the experimental specifications. Nitrogen, phosphorus and potassium were applied in the form of urea, triple super phosphate and muriate of potash, respectively. On the other hand, seeds were inoculated with *Rhizobium* just before sowing. All the fertilizers were incorporated into the soil before seed sowing.

The seeds of Barimung-4 were sown following line sowing method. The line to line and plant to plant distances were 30 and 10 cm, respectively. The sowing depth was maintained at about

3 cm from the soil surface. The intercultural operations were done as and when required.

The crop was first harvested when about 80% pods of the plants became mature and the pods were collected by hand plucking from the plants of the individual plots and kept separately with proper tagging. After proper sun drying, the seeds were separated from the pods and further the seeds were dried maintaining about 8-10% moisture level. The rest of the pods were harvested after maturity, and drying and threshing were done following the procedure described above.

Data on different plant characters such as plant height, branches/plant, pods/plant, pod length, seeds/pod, were recorded carefully from the randomly selected 10 plants of each plot. Thousand seeds were also randomly selected from each plot and weighed. The seed and straw yields were taken plot wise and converted into kg ha^{-1}. All the collected data were analyzed statistically and the means were separated by Duncan's Multiple Range Test using the computer package MSTAT.

Results and Discussion

All the plant characters studied in present study viz., branches/plant, plant height, pods/plant, pod length, seeds/pod, 1000-seed weight, seed and straw yields, and harvest index significantly influenced due to the application of various combinations of NPK fertilizers and *Rhizobium* inoculation (Table 1). The results of the present experiment are presented and interpreted under following headings:

Seed yield: The munghean variety produced the maximum seed yield (1270.21 kg ha^{-1}) when the crop was fertilized with $N_{20}P_{40}K_{20}$ kg ha^{-1} (Table 1). This result was similar to the findings reported by Dhingra *et al.* (1998), they noted that the highest productivity of mungbean was obtained with 30 kg N, 40 kg P and 20 kg K ha^{-1} under the normal plant density. Khanam *et al.* (1996) also found that the NPK plus compost treatment increased the seed yield of mungbean by 83-87%. On the other hand, Sardana and Verma (1987) carried out a field trial and followed that application of N, P and K fertilizers resulted in significant increases in seed yield of mungbean.

Among the fertilizer combinations, the second highest seed yield (1220.30 kg ha^{-1}) was obtained from the plants treated with *Rhizobium* inoculation + $P_{40}K_{20}$ kg ha^{-1}. The application of $N_{20}P_{40}$ kg ha^{-1} to mungbean gave the moderate seed yield (1131.68 kg ha^{-1}) which was statistically similar with *Rhizobium* inoculation alone (1123.32 kg ha^{-1}) and $N_{20}K_{20}$ kg ha^{-1} (1106.67 kg ha^{-1}). The lowest seed yield (887.01 kg ha^{-1}) was produced from the control condition where no fertilizer or *Rhizobium* inoculation was applied (Table 1).

Straw yield: The maximum straw yield (2434.36 kg ha^{-1}) was received from the plants fertilized with $N_{20}P_{40}K_{20}$ kg ha^{-1} showing statistically identical variation with the application of *Rhizobium* inoculation + $P_{40}K_{20}$ kg ha^{-1} (2406.14 kg ha^{-1}). Partially similar trends were also observed by Sarkar and Banik (1991) that the interaction effects between N and P on straw yield of mungbean was significant with higher rates of both N and P, these were corresponding higher straw yield. The lowest straw yield (1864.68 kg ha^{-1}) was obtained from the control (Table 1).

The yield components such as pods/plant, pod/length, seeds/pod and 1000-seeds weight were found to be the highest (43.00, 6.84 cm, 12.11 and 32.08 g respectively) from the crops fertilized with $N_{20}P_{40}K_{20}$ kg ha^{-1}. The longest plant (48.63 cm), maximum number of branches/plant (6.28) and maximum harvest index (34.29%) were obtained by the application of $N_{20}P_{40}K_{20}$ kg ha^{-1}, and the parameters namely plant height and number of branches/plant were statistically at par with the fertilizer combination, *Rhizobium* + $P_{40}K_{20}$ kg ha^{-1}.

Table 1: Effects of NPK fertilizers and *Rhizobium* inoculation on the plant characteristics and yields of mungbean

Treatments (kg ha^{-1})	Plant height (cm)	Branches/ plant	Pods/plant	Pod length (cm)	Seeds/pod
$N_{20}P_{40}K_{20}$	48.63a	6.28a	43.00a	6.84a	12.11a
$P_{40}K_{20}$	51.57c	4.20c	26.30b	6.41b	10.73d
$N_{20}K_{20}$	41.77c	3.90c	24.72d	6.48cd	10.62d
$N_{20}P_{40}$	45.95b	4.88b	32.03c	6.54bc	11.42bc
N_{20}	44.87b	3.58d	23.17d	6.46cd	11.07cd
Rhizobium + $P_{40}K_{20}$	47.65a	5.89a	36.27b	6.65b	11.63ab
Rhizobium	44.47b	4.86b	31.18c	6.52cd	11.20cd
Control	36.47d	2.33e	19.43e	6.03e	9.80e
LSD (0.01)	1.85	0.49	2.89	0.13	0.47
CV (%)	6.10	8.13	6.52	3.21	5.41

Treatments (kg ha^{-1})	000-seed weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
$N_{20}P_{40}K_{20}$	32.08a	1270.21a	2434.36a	34.29a
$P_{40}K_{20}$	30.98bcd	996.20d	1994.67d	33.31c
$N_{20}K_{20}$	30.73cd	1106.67c	2343.37c	32.07e
$N_{20}P_{40}$	31.38ab	1131.68c	2295.24bc	33.02c
N_{20}	31.03bcd	1010.65d	2081.13d	32.68cd
Rhizobium + $P_{40}K_{20}$	31.78a	1220.30b	2406.14ab	33.65b
Rhizobium	31.17bcd	1123.32c	2230.12c	33.49bc
Control	30.20d	887.01e	1864.68e	32.23d
LSD (0.01)	0.46	52.71	132.53	0.69
CV (%)	2.03	8.34	9.13	5.18

In a column, the figures having common letter(s) do not differ at 1% level

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