Effect of Nitrogen and *Bradyrhizobium* on Growth and Yield of Mungbean

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Abstract

The objective of the present study was to investigate the comparative roles of nitrogen (50 kg ha^{-1}) and inoculums *Bradyrhizobium* (1.5 kg ha^{-1}) in improving the yield of two mungbean varieties (BARI mung-5 and BARI mung-6). The experiment was carried out during the period from April 2011 to July 2011 at the Sher-e-Bangla Agricultural University (SAU) Farm, Dhaka. The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications and plot size was 8 m^2 with 30 cm line spacing. The *Bradyrhizobium* strain BARI RVr-403 was used for the experiment. The recommended dose of TSP, MOP and Gypsum were applied in each plot. BARI Mung-6 performed higher stover and seed yield than BARI Mung-5. *Bradyrhizobium* inoculation significantly increased 1000-seed weight, pods $plant^{-1}$, seeds pod^{-1}, stover and seed yield. BARI Mung-6 with *Bradyrhizobium* inoculation recorded the highest seed and stover yield compared to other treatment combinations. Non-inoculated BARI Mung-5 gave the lowest yield.

Keywords: Mungbean, Biofertilizer, Nitrogenous fertilizer and Yield

Introduction

Mungbean (*Vigna radiata* L. Wilezek) cultivation has been declining due to low yield and less economic return whereas it is an important pulse crop in Bangladesh. It is widely grown in Bangladesh as pulse crops for human consumption, animal fodder as well as soil fertility building purpose. Costly and environmentally risky chemical fertilizers cause serious and continuous problem for increasing mungbean production in developing countries including Bangladesh. These problems are likely to become serious in future. Biological Nitrogen Fixation (BNF) resulting from symbiosis between legume crops and root nodule bacterium *Bradyrhizobium* can ameliorate these problems by reducing the chemical N-fertilizer input required to ensure productivity. As a legume, mungbean is capable of utilizing atmospheric nitrogen through symbiotic association with *Bradyrhizobium* sp. (*Vigna*) and thereby can meet the requirement of the element. Inoculation of mungbean with effective *Bradyrhizobium* inoculant is necessary for soils where the organisms are ineffective or where they are absent or scarce (Vincent, 1970).

Bradyrhizobium strains are present in all soils of Bangladesh but they may not be equally effective in nodulation and N-fixation. In this situation, inoculation can meet the challenge by providing superior strains in the soil, so that the most effective nodulation and nitrogen fixation are obtained. Thus it was thought that there is a scope for utilizing the effective bradyrhizobial strains for obtaining more yield

of mungbean under field conditions which may play vital role in improving soil environment and agricultural sustainability.

To reduce the production cost and to fulfill the demand, more pulse production could be achieved through seed inoculation with *Bradyrhizobium* strains which is known to increase biological nitrogen fixation. *Bradyrhizobium* inoculation increased mungbean seed yield from 4.3% to 16.2% (Vaishya *et al.*, 1983). In Bangladesh, inoculation with *Bradyrhizobium* increased 25% dry matter production, 28% grain yield and 21% hay yield over non-inoculated. (Bhuiyan and Mian, 2007). Maximum yields were obtained when fertilizers applied together with *Bradyrhizobium* inocula.

Materials and Method

Genetic Materials and Experimental Site

The experiment was carried out during the period from April 2011 to July 2011 to finding out the yield performance of two mungbean with nitrogenous and bio fertilizers at the Sher-e-Bangla Agricultural University (SAU) Farm, Dhaka. The experimental site was situated at 23°77' North Latitude and 90°30' East Longitude. The area belongs to the Agro-ecological Zone (AEZ- 28): Madhupur Tract. The soil was silty-loam containing 1.05% organic matters, 0.08% N and soil pH was 6.9, available P (ppm) 12.78, available K (ppm) 43.29, available S (ppm) 23.47, available B (ppm) .06 . The experiment comprised of two mungbean varieties (BARI mung-5 and BARI mung-6) fertilizers viz., control (without N and inoculum), urea (50 N kg ha^{-1}) and inoculated (*Bradyrhizobium* inoculum 1.5 kg ha^{-1}.

Experimental Design and Crop Husbandry

The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. The lands were fertilized with 22, 42, 20 and 5 kg ha^{-1} of P, K, S and Zn in the form of Triple Superphosphate, Muriate of Potash, Gypsum and Zinc Sulphate, respectively. Nitrogen was applied as urea according to the treatments.

The peat soil was collected from Gopalgonj and the pH was adjusted 4.5 to 6.8 by adding $CaCO_3$ for inoculation. Fifty grams of amended peat having 8 per cent moisture was taken in each polyethylene bag and the bags were sealed up. Then they were sterilized by autoclaving for three consecutive days for one hour each day. The sealed peat was ready for inoculation. The bradyrhizobial inoculant was prepared in the Soil Microbiology Laboratory of BARI using the broth culture. The *Bradyrhizobium* strain (BARI RVr-402) was collected from the stock culture of the laboratory. Yeast extract mannitol broth was prepared in a 250 ml Erlenmeyer flask. The liquid medium was sterilized for 30 minutes at 121°C at 15 PSI. The medium was kept for cooling. After cooling, a small portion of *Bradyrhizobium* culture was aseptically transferred from agar slant to the liquid medium in the flask with the help of a sterile inoculation needle. The flask was then placed in the shaker at 28°C under 120 rpm to enhance bradyrhizobial growth. After 6-7 days, the medium in the flask showed dense growth and then the broth culture was taken out from the shaker. From this ready broth, 20 ml were taken out by sterile syringe and injected into the polyethylene packet having the sterile peat. Finally, the moisture percent of the packet was adjusted to 50 percent. The inoculated packets were then incubated at 28°C for two weeks to make them ready for seed inoculation. Viability count of *Bradyrhizobia* in the inoculant was made one day before injecting the peat following plate count method (Vincent, 1970). The average number of *Bradyrhizobia* was approximately above 10^8 cells g^{-1} in the inoculant. Inoculation was

done just before sowing. Healthy Mungbean seeds @ 25 g for each plot were taken into polyethylene bags separately and 1 ml of the sticker solution (4% gum acacia solution) was added to each bag with sterilized pipettes. It was followed by addition of 1.25 g of the desired peat based *Bradyrhizobium* inoculant to each polyethylene bag and mixed thoroughly for uniform distribution and good adherence of inoculant on the surface of each seed. Mungbean was sown on 27 April 2011. Healthy seeds of Mungbean @ 35 kg ha^{-1} were sown by hand as uniformly as possible in furrows. Different polyethylene bags were used for different treatments and the uninoculated seeds were sown first to avoid the risk of contamination.

Seeds were sown in the afternoon and immediately covered with soil to avoid sunlight. Each plot was measured 2.4 m x 2 m. Line to line distance was 30 cm.

Data Recording, Measurements and Analysis

The observation on grain yield and stover yield was recorded. The collected data were analyzed statistically using MSTST c computer package (Freed, 1992) and mean separation was done by Duncan's Multiple Range Test (DMRT) at 5% level of significance. The correlation co-efficient and regression analysis were done for different variables wherever needed using Microsoft EXCEL programme 2007.

Results and Discussion

Effect of Variety on Yield

There was significant variation in seed yield and stover yield of the two varieties of Mungbean (Figure 1). The variety BARI Mung-6 recorded a seed yield of 836 kg ha^{-1} while it was 770 kg ha^{-1} for the variety BARI Mung-5. In modern varieties, the reasons for obtaining higher seed yield might be due to high dry matter accumulation, more pods $plant^{-1}$, seeds pod^{-1} and 1000-seed weight as compared to local variety. The present result is in agreement with Samanta *et al.* (1999), Tickoo *et al*. (2006), Navgire *et al*. (2001) and Hossain and Solaiman (2004) who reported that varieties of Mungbean differed significantly in seed yield.

The higher stover yield (1985 kg ha^{-1}) was produced by the BARI Mung-6 which was superior to BARI Mung-5 (1858 kg ha^{-1}). Obtaining higher stover yield might be due to high photosynthesis and dry matter accumulation in modern varieties compare to local varieties. Hossain and Solaiman (2004) compared six Mungbean (BARI Mung-2, BARI Mung-3, BARI Mung-4, BARI Mung-5, BINA Moog-2 and BU Mung-1) and obtained higher stover yield from BARI Mung-4 than other. Bhuiyan and Mian (2007) reported that among five Mungbean varieties BARI Mung-2 produced the highest stover yield in Mungbean. Ara (2004) gave significantly higher stover yield in BARI Mung-3 than BARI Mung-4.

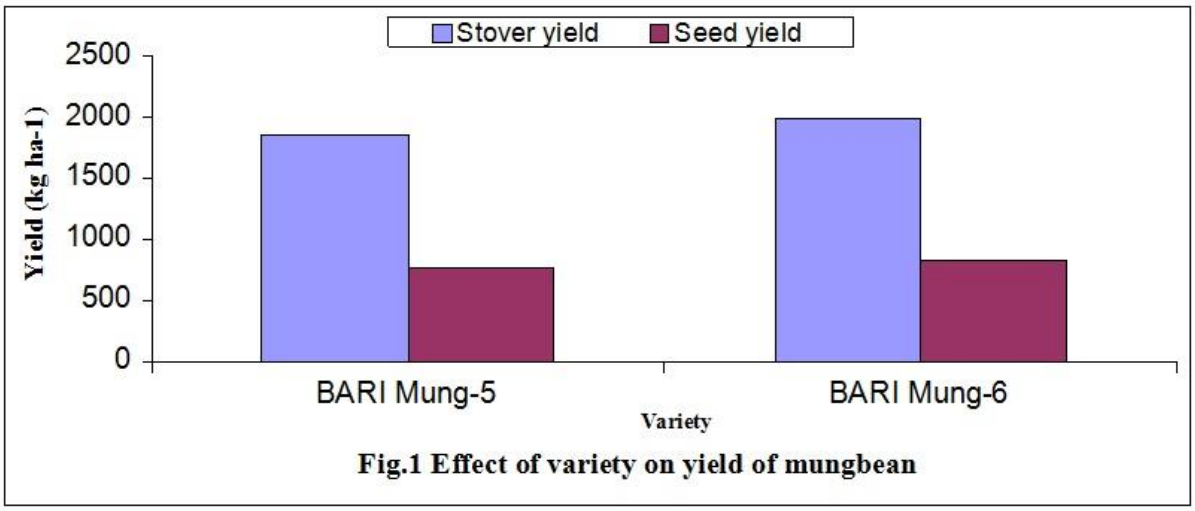

Fig.1 Effect of variety on yield of mungbean

Effect of Fertilizer on Yield

The nitrogen and *Bradyrhizobium* inoculants showed significant increase in seed yield and stover yield of Mungbean (Fig. 2). The *Bradyrhizobium* inoculated plants showed the highest seed yield (876 kg ha^{-1}) which was statistically superior to other treatments. The lowest seed yield (716 kg ha^{-1}) was showed in non-inoculated plant. *Bradyrhizobium* fix more atmospheric nitrogen (N_2) to the soil into ammonia (NH_3) or ammonium (NH_4^+) through the formation of root nodule which are readily available to the plant. Plant uptakes more available nitrogen for their growth and development. Readily available nitrogen helps to increase more photosynthesis and dry matter accumulation as well as increase the plant height, leaf area index, branches and enhance biomass of root and shoot. Ultimately it increases the pod length, seeds pod-1, 1000-grain weight of Mungbean and performed more seed yield. Sharma and Khurana (1997) stated that single strain and multi-strain *Rhizobium* inoculants increased the grain yield by 10.4% and 19.3% over uninoculated control, respectively. Bhattacharya and Pal (2001) reported that inoculation of *Rhizobium* influenced maximum seed yield comparing with control. Bhuiyan and Mian (2007) reported that application of *Bradyrhizobium* inoculant produced significant effect on seed yields and 27-29% increase over control of Mungbean. Kumari and Nair (2003) found that yields were more in blackgram and greengram inoculated with *Bradyrhizobium.*

The highest stover yield of (2290 kg ha^{-1}) was obtained due to the application of inoculum which was superior to N_{50} and non-inoculated control (1500 kg ha^{-1}). *Bradyrhizobium* take atmospheric nitrogen and fix it into ammonia (NH_3) or ammonium (NH_4^+) through the formation of nodule which uptake the plant for the growth and development. Readily available nitrogen forms helps to increase more photosynthesis and dry matter accumulation as well as the plant height, leaf area index, branches and enhance biomass of root and shoot. As a result increases the stover yield of Mungbean. Bhuiyan and Mian (2007) reported that application of *Bradyrhizobium* inoculant produced significant effect on stover yields of Mungbean. Nagarajan and Balachandar (2001) reported that seed inoculation of *Rhizobium* enhanced biomass. Srinivas and Shaik (2002) opined that seed inoculation with *Bradyrhizobium* culture enhanced haulm yield in Mungbean. Hossain and Solaiman (2004) reported that stover yields increased significantly due to inoculation of the seeds with *Rhizobium* strains.

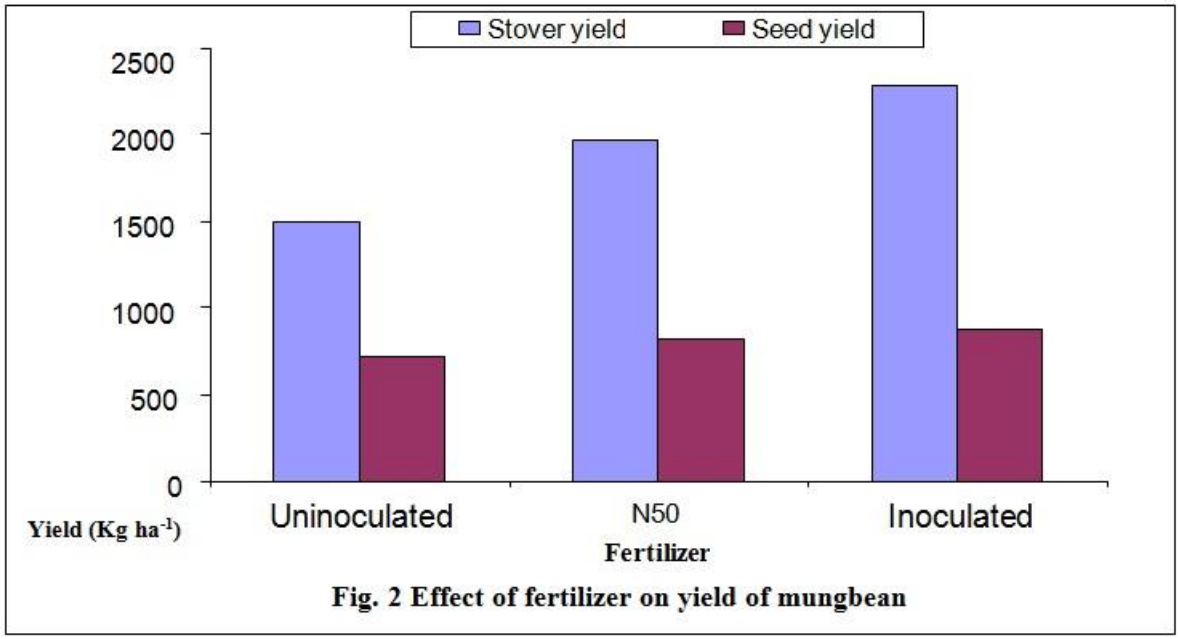

Fig. 2 Effect of fertilizer on yield of mungbean

Conclusion

The Mungbean variety namely BARI Mung-6 performed better in respect to growth and yield (seed and stover) as compared to BARI Mung-5 with the application of nitrogen (50 kg ha^{-1}) and inoculums *Bradyrhizobium* (1.5 kg ha^{-1}). The seed & stover yield of Mungbean was found increased with the innoculant of *Bradyrhizobium*. So rhizobial inoculant should be used in Mungbean for higher production of pulses and lower use of chemical fertilizer to meet up the protein requirement.

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