INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 11, No. 4, p. 207-218, 2017

RESEARCH PAPER OPEN ACCESS

Morpho-physiological characters, yield attributes and yield of mungbean as affected by different concentrations of Miyobi application

Khairul Kabir[1], Abdul Momin[2], Ashick Ahmed*[3], Razibur Rahman[4], Khairul Alam[5], ABM Jamiul Islam[6], Md. Jahangir Alam[7], Md. Momraz Ali[8]

[1]*Lal Teer Seed Limited, Bhaluka, Mymensingh, Bangladesh*
[2]*Bangladesh Rice Research Institute, Joydebpur, Gazipur, Bangladesh*
[3]*BRAC Agricultural Research and Development Centre, Joydebpur, Gazipur, Bangladesh*
[4]*Department of Agricultural Extension, Bagmara, Rajshahi, Bangladesh*
[5]*Land Management Group, School of Veterinary and Life Sciences, Murdoch University, Western Australia, Australia*
[6]*Rice Farming Systems Division, Bangladesh Rice Research Institute, Joydebpur, Gazipur, Bangladesh*
[7]*Department of Agricultural Extension (DAE), Ministry of Agriculture, Bangladesh*
[8]*Department of Agricultural Extension, Bagatipara, Natore, Bangladesh*

Key words: Miyobi, Morpho-physiological characters, Yield attributes, Leaf area index

http://dx.doi.org/10.12692/ijb/11.4.207-218 Article published on October 27, 2017

Abstract

A field experiment was conducted at the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, during the period from March to May, 2012 with an aim to study the morpho-physiological characters, yield and yield attributes of mungbean as affected by different concentrations of Miyobi application. The experiment comprised five levels of Miyobi *viz.* 0 (control), 3, 4, 5 and 6 mg L^{-1} sprayed on mungbean plants at 30 days after sowing. BINA moog-6 was used as planting material and the experiment was laid out in a Randomized Complete Block Design. Results revealed that application of Miyobi increased plant height, branch number, leaf area, leaf area index, total dry matter, absolute growth rate and yield contributing characters over control. The highest branch number, leaf area, leaf area index, TDM, AGR and yield contributing characters were recorded in 5 mgL^{-1} Miyobi applied plant while the highest plant was observed in 6 mg L^{-1}. Control showed the lowest of the above studied parameters. The highest seed yield was recorded in 5 mgL^{-1} Miyobi applied plant (8.22 g $plant^{-1}$ and 2.07 t ha^{-1}) due to increased number of pods $plant^{-1}$, seeds pod^{-1} and pod size. In contrast, 6.0 mgL^{-1} Miyobi applications had the adverse effect on yield attributes and yield compared to 5 mgL^{-1} Miyobi application indicating inhibitory effect of Miyobi at high concentration of 6 mg L^{-1} on mungbean. Therefore, Miyobi with 5 mg L^{-1} may be applied for increased seed yield of mungbean.

* **Corresponding Author:** Ashick Ahmed ✉ ashickahmed1981@gmail.com

Introduction

Mungbean (*Vigna radiata* L. 'wilczek'; family-Leguminosae; sub-family-Papilionaceae) is an important pulse crop at home and abroad because of its nutritive and economic value. It is an excellent supplemental protein source for rice diet. The protein content of mungbean is more than cereals. Mungbean contains 51% carbohydrate, 26% protein, 10% moisture, 4% mineral and 3% vitamins (Afzal *et al.*, 1998). Besides providing valuable protein in the diet and additional income to farmers, mungbean has the remarkable quality of helping the symbiotic root rhizobia to fix atmospheric nitrogen and hence enrich soil (Mondal, 2007). It ranks 3rd in acreage, 5th in production and 3rd in protein content among the pulses grown in Bangladesh (BBS, 2007). Pulses cover an area of about 14,530 hectares, where mungbean occupies 3,636 hectares (BBS, 2007).

Short crop duration (55-70 days), low input (fertilizer, management and pesticides) requirement and high global demand make mungbean an ideal rotation crop for smallholder farmers (Peoples and Herridge, 1990). The yield of mungbean per plant as well as per unit area is very low. Average yield of mungbean is 560 kg ha^{-1} (BBS, 2007). There are many reasons for such low yield (Ahmed *et al.*, 1978). The varieties grown are genetically low yielding, low responsive to fertilizer application and also susceptible to pests and diseases. Besides these, the principal constraint of mungbean production is about 70 to 95% of mungbean flowers do not develop into mature pods (Hamid, 1989; Mondal, 2007) indicating that potential fruit or seed number is usually much larger than the number actually produced by the plant community. The number of fruits with developing seeds increases at fruit setting stage and reaches to a maximum after maximum seed growth stages (Hamid, 1989) but during this period the plant is still growing abundantly. There fore, developing reproductive sinks are competing for assimilates with vegetative sinks. Increasing canopy photosynthesis during this period with elevated CO_2 level increased the number of fruits or seed per unit area (Egli, 1990). It is evident that seeds per unit area are related to canopy photosynthesis during flowering and pod set. Furthermore, canopy photosynthesis rate determines by leaf area index and crop growth rate.

The yield performance under developing countries condition is lower compared to other mungbean growing countries (FAO, 2005). So, it is urgent need to increase yield in mungbean by proper management practices. Plant growth regulators are important factors for increasing higher yield. Application of hormone has good management effect on growth and yield of field crops. On the other hand, flower and pod abortion are common phenomenon in mungbean (Mondal, 2007). A large proportion of mungbean reproductive structures abscise before reaching maturity, which is the primary cause of lowering yield as indicated earlier. Seed yield of mungbean can be increased through reducing reproductive abscission. Hormones regulate abscission process and synthetic hormones may reduce abscission and ultimately increase in yield of soybean (Ikeda and Sato, 1997; Nahar and Ikeda, 2002; Rahman, 2004).

The breeders are successful to develop modern varieties of almost all crops, which are being used by the farmers. It seems that the genetic potentiality of the varieties to increase their production has already been reached to saturation. There are scopes to improve yield through changes of hormonal behaviors. In this connection, use of plant growth regulators (PGRs) might be a useful alternative to increase crop production. Recently, there has been global realization of the important role of PGRs in agriculture for better growth and yield of crop. Many developed countries like Japan, China, Poland and South Korea etc. have long been using PGRs to increase crop yield.

PGRs are being used as an aid to enhance crop yield (Nickell, 1982). A large number of research works with GA_3 has been carried out on many crops all over the world and have been reported to have positive influence on growth, development and yield of field crops. However, Miyobi, a new plant growth regulator like GA_3 that may have many uses to modify the growth, yield and yield attributes of plant. Application of Miyobi and other hormones enhances growth and yield attributes in soybean (Nazneen, 2007), in sesame (Hossain, 2007), in lentil (Alam, 2007) and in wheat (Ayub, 2008).

Research works with Miyobi on growth, yield attributes and yield of mungbean are scanty. So, there is ample scope of conducting research with Miyobi for increasing yield of mungbean. Considering the above facts, the present research work was undertaken to find out the impact and optimum dose of Miyobi on morpho-physiological characters, yield and yield attributes of mungbean.

Materials and methods

Experimental site

The experiment was carried out at the Field Laboratory, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, during the period from 01 March to 10 May 2012. Geographically the experimental area is located at 24°75' N latitude and 90°50' E longitudes at the elevation of 18 m above the sea level (FAO, 1988). The experimental field was medium high land belonging to the Sonatola Soil Series of Grey Floodplain soil under the agro-ecological zone of Old Bahmaputra Flood plain (AEZ-9) (BARC, 2005). The soil was silty loam. Fertility status is sown in the Table 1.

Weather and climate

The experimental field was under subtropical climates characterized by heavy rainfall during the month of April and scanty rainfall during March and May.

The monthly means of daily maximum, minimum and average temperature, relative humidity and total rainfall received at the experimental site during the period from March to May 2012 is presented in the Table 2.

Plant material

One mungbean variety namely, BINA moog-6 was used in the present experiment. The seeds of the variety were collected from Plant Breeding Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh.

Growth regulator

The plant growth regulator *viz.*, Miyobi was collected from Dr. Yasuo Kamuro, Marketing Director, BAL Planning Co. Ltd., Ichinomiyo, Japan by Dr. M. Obaidul Islam, Professor and Head, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh. It is a mixture of more than one growth hormones and the composition of the hormone is still unknown.

Experimental treatments

Five different concentrations of Miyobi were used in the experiment. The concentrations of Miyobi were 0 (control); 3.0, 4.0, 5.0, and 6.0 mg L^{-1}. The spray was done at 30 days after sowing by a hand sprayer in the afternoon.

Experimental design and lay-out

The experiment was laid out in a Randomized Complete Block Design with 3 replications. The size of the unit plot was 2 m x 2 m. Distances between block to block and plot to plot were 1.0 and 0.5 meter, respectively. Plant to plant and row to row distance were maintained at 10 cm and 25 cm, respectively.

Land preparation

The land of the experimental site was first opened in 2nd week of February with power tiller. Later on, the land was ploughed and cross-ploughed three times followed by laddering to obtain the desire tilth. The corners of the land were spaded and larger clods were broken into smaller pieces after ploughing and laddering all the stubbles and uprooted weeds were removed and the land was made ready.

Fertilizer management

Urea, triple super phosphate (TSP), muriate of potash (MoP) and gypsum were used as source of nitrogen, phosphorus, potassium and sulphur, respectively. Total amount of urea, TSP, MoP and gypsum were applied at basal doses during final land preparation. The doses of fertilizers were: 45-100-60 kg ha^{-1} as Urea-TSP-MoP, respectively.

Sowing of seeds and thinning

The seeds of mungbean were hand sown in rows on 01 March. Seeds were placed at about 3-4 cm depth from the soil surface. Plants were thinned to 10 cm distance from one another at 20 DAS.

Irrigation and weeding

Irrigations were done at 45 DAS during flowering and fruiting stage. The crop field was weeded twice at 20 and 35 DAS.

Preparation of working solution and application of Miyobi hormone

The formulation of Miyobi was water-soluble powder. For preparation of Miyobi working solution: 3 mg, 4 mg, 5 mg and 6 mg of Miyobi powder were added to one liter of water, and spraying was done on mungbean plants in the afternoon by using a hand sprayer.

Protection against pests

At flowering, few plants were affected by hairy cater pillar. To control this pest, Acord 10 EC was sprayed two times @ 25 L ha^{-1} in the afternoon by using a sprayer with 10 days interval.

Crop sampling and data collection procedure

Growth parameters

To study ontogenetic growth characteristics, a total of four harvests were made and at final harvest, data were collected on some morpho-physiological, yield attributes and yield.

The first crop sampling was done at 40 days after sowing (DAS) and continued at an interval of 10 days up to 70 DAS. From each plot, five plants were randomly selected and uprooted for obtaining data of necessary parameters.

The plants were separated into leaves, stems and roots and the corresponding dry weights were recorded after oven-drying at 80 ± 2 °C for 72 hours.

The leaf area of each sample was measured by LICOR automatic leaf area meter. The growth analyses like absolute growth rate and leaf area index were carried out following the formulae of Hunt (1978).

i) Absolute growth rate (AGR): Rate of dry matter production per unit of time per plant.

$$\text{i.e., AGR} = \frac{W2 - W1}{T2 - T1} \text{ g plant}^{-1}\text{day}^{-1}$$

where, W2 and W1 are the dry matter at time T2 and T1, respectively.

ii) Leaf area index (LAI): It is the ratio of leaf area and land area.

$$\text{i.e., LAI} = \frac{\text{Leaf area}}{\text{Land area}} \times 100$$

Morphological parameters

Plant height (cm): Plant height was taken to be the length between the bases of the plant to the tip of the main stem.

Number of branches: Number of branch was counted from randomly 5 selected plants of each plot at each harvest and average branches $plant^{-1}$ was calculated.

Leaf area: Leaf area per plant was measured by automatic leaf area meter.

Total dry matter: The total dry matter was calculated from summation of leaves, stem, root, and pod dry weight per plant.

Yield and yield contributing characters

The following yield contributing characters and yield of mungbean were recorded.

Number of pods $plant^{-1}$: Pods of 10 randomly selected plants of each replication were counted and then the average number of pod per plant was determined. Number of seeds pod^{-1}: Number of seeds on randomly selected 10 competitive pods.

Single pod weight: Ten randomly selected pods from each of the plant were weighed and then divided by ten to get single pod weight. 100-seed weight: One hundred clean sun dried seeds were counted from the seed stock obtained from the sample plants and weighed by using electronic balance.

Seed yield/plant: The seeds were separated from pods of 10 plants manually and then sun dried and weighed at 12% moisture contain in seeds. Seed weight/plant was also calculated. Harvest index**:** Harvest index was calculated by dividing economic yield to biological yield of plant by multiplying with 100 and expressed in percentage.

$$\text{i.e., Harvest index (\%)} = \frac{\text{Economic yield (seed yield)/plot}}{\text{Biological yield/plot}} \times 100$$

Harvesting

All the plants of the given genotype under these three replications were harvested at a time, when most of the pods become mature (about 90% pods were mature). The mature pods were collected by hand.

Statistical analysis

The collected data were analyzed statistically following the analysis of variance (ANOVA) technique and the mean differences were adjusted with Duncan's Multiple Range Test (DMRT) using the statistical package program, MSTAT-C (Russell, 1986).

Results and discussion

Effect of Miyobi application on morphological and growth characters

Plant height

Plant height of mungbean varied among different doses of Miyobi at all growth stages except 40 DAS ($p \leq 0.05$; Fig. 1).

Results revealed that plant height increased with increased concentration of Miyobi.

The tallest plant was recorded in 6.0 mg L^{-1} Miyobi application at all growth stages followed by 5.0 mg L^{-1} with same statistical rank.

In contrast, control always maintained the shortest plant. Further, plant height increased rapidly until 60 DAS and thereafter increased slowly reaching a peak at physiological maturity.

Table 1. Nutrient status of soil of the experimental plots.

Properties of soil	Content
Soil P^H	7.10
Organic carbon	1.25%
Organic matter	2.06%
Total nitrogen	0.11%
Available phosphorus (ppm)	16.50
Available potassium (me in %)	0.13
Available sulphur (ppm)	12.10

Source: Soil Science Department, BAU, Mymensingh, 2012.

The Miyobi treated plants showing increased plant height than in control may be due to increased number of internodes or length of internodes because of increased cell number (Maske *et al.*, 1998).

Similar result was also reported by Sarker (2006) in soybean. He reported that plant height increased with increased concentration of Miyobi.

Number of branches plant^{-1}

Application of different doses of Miyobi changes branch production per mungbean plant ($p \leq 0.05$; Fig. 2). The dose of 5.0 mg L^{-1} produced the highest number of branches plant^{-1} over its growth period. At harvest, the second highest number of branches was recorded in 4.0 mg L^{-1} Miyobi applied plants. In contrast, control plants produced the fewest branches plant^{-1} over its growth period followed by 3.0 mg L^{-1}.

The result is supported by the report of Nazneen (2007), who reported that application of Miyobi (range 2.0-4.0 mg L^{-1}) increased branch number over control in soybean. Similar results were also reported by Alam (2007) in lentil.

Leaf area plant^{-1}

The different concentrations of Miyobi application had significant effect on leaf area plant^{-1}. Result revealed that leaf area increased till 60 DAS followed by declined because of leaf shedding (Fig. 3).

The increment of leaf area varied significantly due to application of different concentrations of Miyobi. The leaf area production by the treatment of 6.0 mg L^{-1} was higher over other doses at most of the growth stages. Control had the lowest leaf area at all growth stages.

Table 2. Average monthly rainfall, air temperature, and relative humidity during the experimental period between March to May, 2012 at the BAU area, Mymensingh.

Month	Monthly average air temperature (°C)			Average rainfall (mm)	Average relative humidity (%)
	Maximum	Minimum	Average		
March	28.5	16.4	22.45	92.2	76.75
April	30.56	22.14	26.35	266	78.57
May	32.8	23.34	28.07	96.6	82.5

Source: Weather Yard, Department of Irrigation and Water Management, BAU, Mymensingh.

The variation in leaf area might occur due to the variation in number of leaves and the expansion of leaf. The result obtained from the present study is partially consistent with result of Rahman (2006) in soybean who stated that the highest leaf area was observed in 4.0 mg L^{-1} of Miyobi. The results are also supported by the result of Samsuzzaman (2004) in groundnut.

Table 3. Effect of Miyobi application on yield attributes and yields in mungbean *cv.* BINA moog-6.

Treatments	Pods/plant (no.)	Pod length (cm)	Single pod weight (mg)	Seeds/ pod (no.)	100-seed weight (g)	Seed weight/plant (g)	Seed yield (t/ha)	Harvest index (%)
Control (T_0)	12.5 d	8.28	546	9.56 b	4.84	5.50 d	1.54 c	32.7
3 mg L (T_1)	14.1 c	8.30	557	9.60 b	4.85	6.24 c	1.57 bc	33.1
4 mg/L (T_2)	15.2 bc	8.52	560	9.66 ab	4.90	6.84 b	1.72 bc	33.3
5 mg/L (T_3)	17.5 a	8.65	573	9.97 a	4.95	8.22 a	2.07 a	34.8
6 mg/L (T_4)	16.1 ab	8.55	560	9.70 ab	4.93	6.97 b	1.76 b	32.0
Level of sig.	**	NS	NS	*	NS	**	**	NS
LSD $_{(0.05)}$	1.547	0.40	64.4	0.30	0.206	0.442	0.188	2.66
CV (%)	5.45	2.44	6.12	2.57	2.20	3.49	5.77	4.26

In a column, figures having the same letter (s) do not differ significantly at $p \leq 0.05$ by DMRT; Sig. = Significance; NS = Non-significant; *, ** = Significant at 5 % and 1 % level of probability.

Leaf area index

The development of leaf area index (LAI) in mungbean derived from different doses of Miyobi is presented in Fig. 4. The LAI continued to increase till 60 DAS followed by a decline ($p \leq 0.05$). The plants of 5.0 mg L^{-1} hormone application showed the highest LAI at fruiting stage followed by 6.0 mg L^{-1} with non-significant difference with each other. Control had the lowest LAI over their growth period. The variation in LAI might occur due to the variation in number of leaves and the expansion of leaf. The higher LAI over the growth period in 5.0 mg L^{-1} and 6.0 mg L^{-1} treatments could be attributed to higher leaf number as well as leaf area (Fig. 4).

The results obtained from the present study are consistent with the result of Prodhan (2004) who stated that the variation in LAI could be attributed to the changes in the number of leaves and rate of leaf expansion and abscission. Further, Runa (2008) found that the highest LAI was recorded at 5.0 mg L^{-1} Miyobi application on soybean compared to the other doses. These results also supported the present experimental result.

Total dry matter production plant^{-1}

Total dry matter (TDM) production varies from control to increased rate of the application of Miyobi on mungbean (Fig. 5). Result revealed that TDM production increased with time up to maturity.

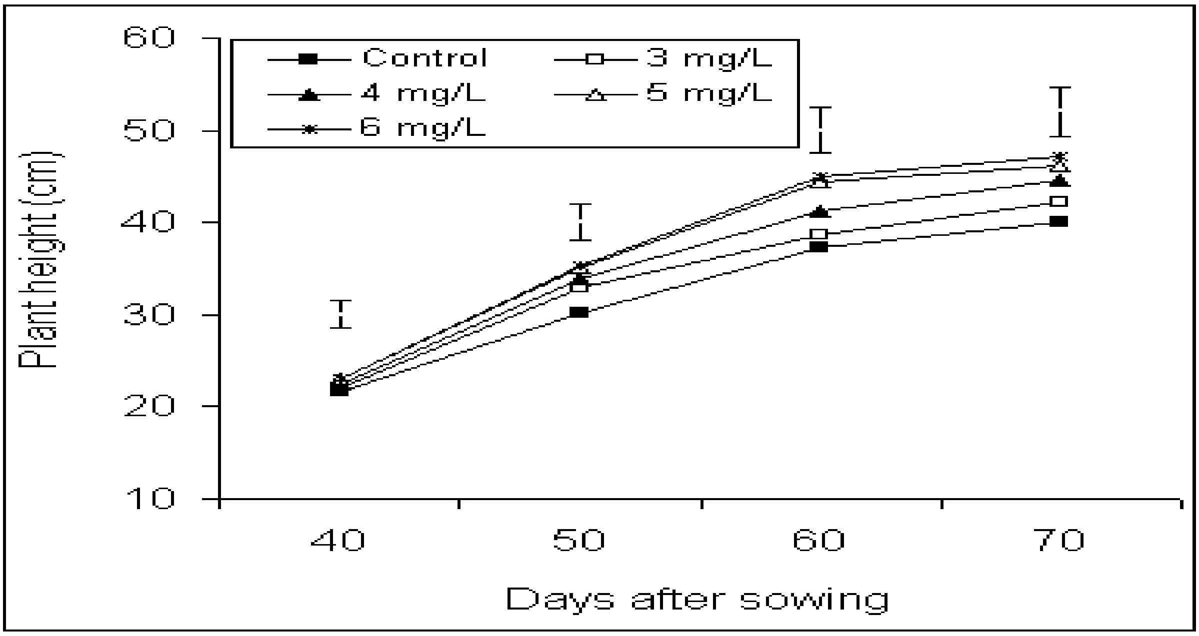

Fig. 1. Changes in plant height of mungbean *cv.* BINA moog-6 at different growth stages due to application of Miyobi. Vertical bars represent LSD $_{(0.05)}$.

The doses of 5.0 and 6.0 mg L^{-1} maintained the higher TDM over growth period than the other two doses (0, 3.0 and 4.0 mg L^{-1}) with being the highest in 5.0 mg L^{-1}. In contrast, control plants maintained lower TDM over its growth period followed by 3.0 mg L^{-1}. Increased TDM at 5.0 and 6.0 mg L^{-1} doses was possibly due to greater LAI (Fig. 4) and AGR (Fig. 6).

The result is supported by the result of Alam (2007) who reported that application of Miyobi (range 1.0-3.0 mg L^{-1}) increased TDM over control in lentil with being the highest in 3.0 mg L^{-1} hormone application at 45 DAS. Similar results were also reported by Hossain (2007) in lentil.

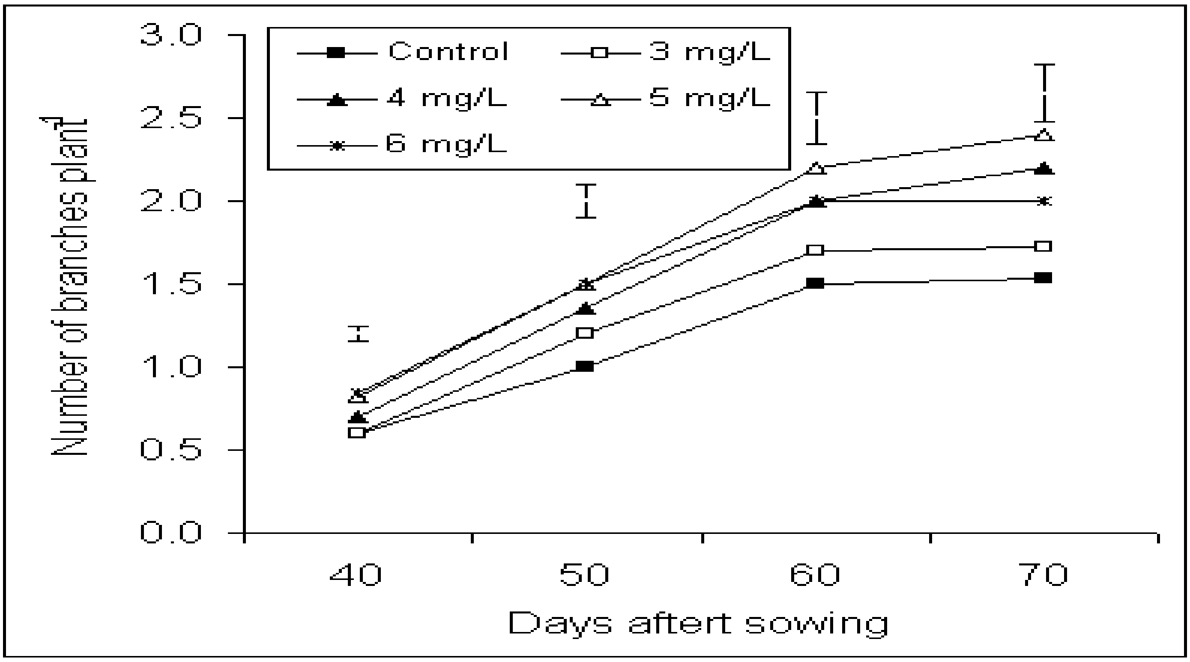

Fig. 2. Effect of Miyobi application on branch production at different plant growth stages of mungbean cv. BINA moog-6. Vertical bars represent LSD $_{(0.05)}$.

Absolute growth rate

The absolute growth rate (AGR) derived from five doses of Miyobi application was determined from flowering stage (40 DAS) to physiological maturity (70 DAS) and the results have been presented in Fig. 6. Results revealed that AGR in all treatments was significantly different at all growth stages. The increment of AGR was observed till 60 DAS and thereafter decreased with progress in maturity.

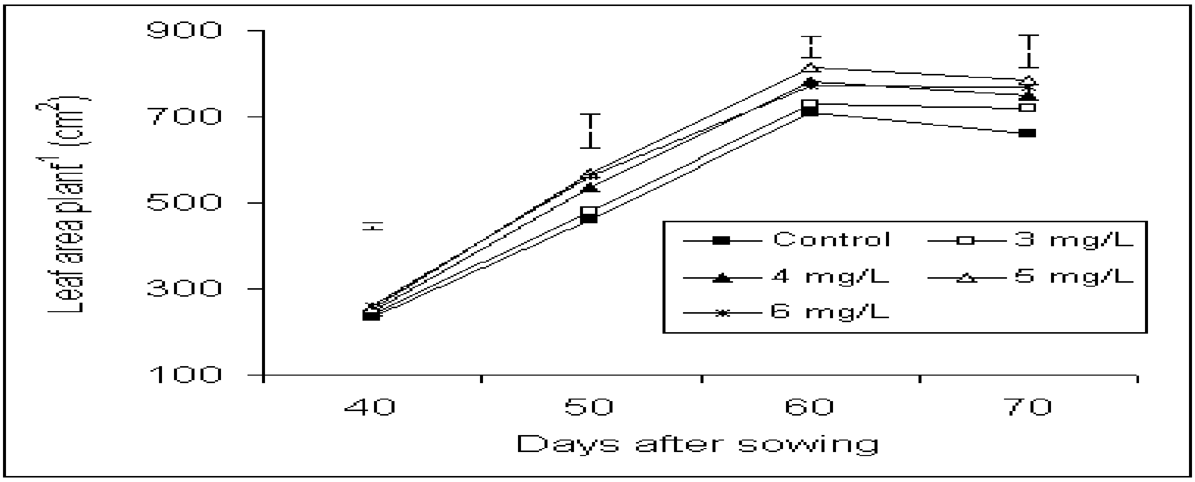

Fig. 3. Effect of Miyobi application on leaf area development at different plant growth stages of mungbean *cv.* BINA moog-6. Vertical bars represent $LSD_{(0.05)}$.

The plants of 5.0 mg L^{-1} Miyobi application maintained the highest AGR value throughout the growth period. In contrast, the control plants maintained the lowest AGR over its growth period. Further, the maximum AGR was observed during fruit development and grain filling stage (50-60 DAS) in all the treatments. AGR is positively correlated with LAI (Bhardway *et al.*, 1987).

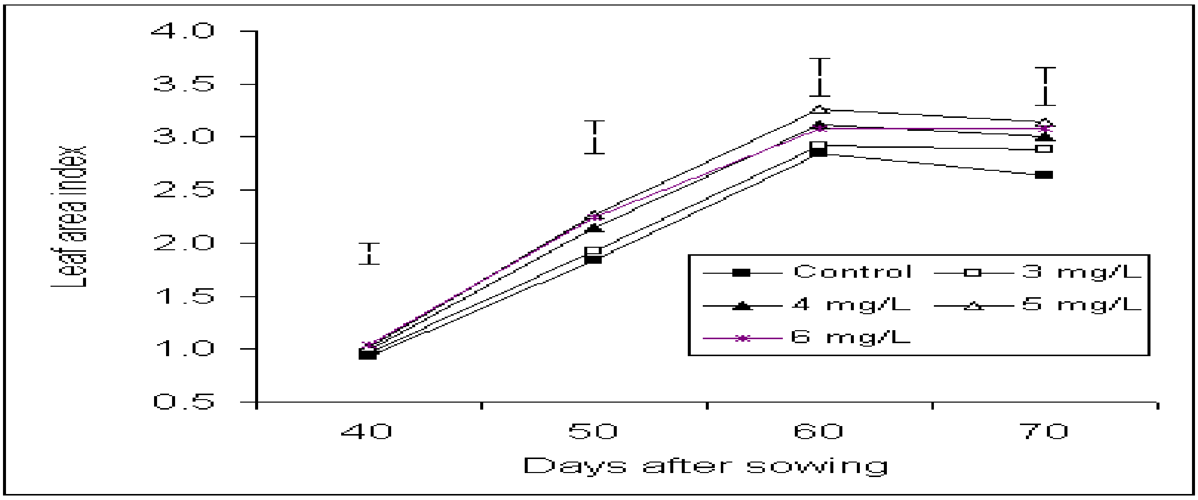

Fig. 4. Effect of Miyobi application on leaf area index at different plant growth stages of mungbean *cv.* BINA moog-6. Vertical bars represent LSD $_{(0.05}$.

The AGR increased along with increase in LAI. The lower value of AGR at initial stages of growth was the result of lower LAI. This result is in agreement with the findings of Prasad *et al.* (1978). At 50-60 DAS, the AGR value was found to be maximum which mean that plants expanded its assimilate for the growth of leaf area and feeding of fruits. The declining of AGR after reaching the maximum in all treated plants was the result of abscission of leaves. These results are consistent with the results of Dutta and Mondal (1998).

Effect of Miyobi application on yield attributes and yields of mungbean

Number of pods plant-1

The effect of Miyobi application on pod number plant^{-1} was statistically significant ($p \leq 0.05$; Table 3).

Result revealed that the number of pods plant^{-1} increased in Miyobi treated plants compared to control. The pods were greater in Miyobi applied plants than control might be due to increased number of branches which in turn increased pod bearing nodes.

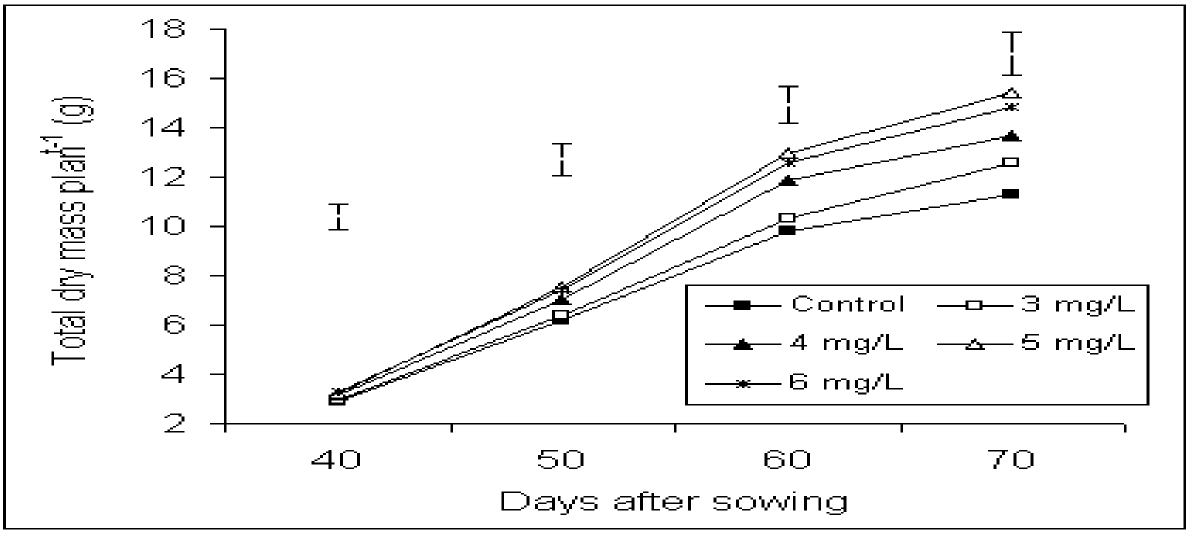

Fig. 5. Effect of Miyobi applications on total dry mass production at different plant growth stages of mungbean *cv.* BINA moog-6. Vertical bars represent LSD $_{(0.05)}$.

The highest pods plant^{-1} was observed in 5.0 mg L^{-1} Miyobi application (17.5 plant^{-1}) which was statistically similar to that of 6.0 mg L^{-1} (16.1 plant^{-1}) Miyobi application.

The lowest pods plant^{-1} was recorded in control (12.5 plant^{-1}). Similar result was also reported by Nazneen (2007) and Rahman (2006) who observed increased pod number due to Miyobi application on soybean.

Pod length

The effect of Miyobi application on pod length in mungbean was statistically non-significant at $p \leq 0.05$ (Table 3). However, apparently increased pod length was observed in Miyobi applied plants compared to control. This result disagrees with the results of Nazneen (2007) who reported that application of Miyobi had significant effect on pod length in soybean.

Single pod weight

Single pod weight differed non-significantly among the treatments of Miyobi application on mungbean (Table 3).

Result showed that single pod weight apparently increased due to Miyobi application compared to control. Rahman (2006) observed that pod size increased due to application of Miyodo and found the highest pod size in 5.0 mg L^{-1} Miyodo application.

Number of seeds pod-1

The effect of different concentrations of Miyobi on seeds pod^{-1} was significant (Table 3).

Result showed that number of seeds pod^{-1} increased due to Miyobi application compared to control. The highest number of seeds pod^{-1} (9.97) was observed in 5.0 mg L^{-1} followed by 6.0 mg L^{-1} (9.70) and 4.0 mg L^{-1} (9.66) with same statistical rank. The lowest seeds pod^{-1} was recorded in control (9.56). Sarker (2006) observed that number of seeds pod^{-1} increased due to application of Miyobi and found the highest pod size in 0.6 mg L^{-1} Miyobi application in soybean.

Hundred seed weight

The effect of Miyobi application on 100-seed weight was statistically non-significant at $p \leq 0.05$ (Table 3). However, 100-seed weight was increased apparently over control due to Miyobi application.

Seed weight plant^{-1} and seed yield

There was a remarkable difference in respect of seed yield both per plant and unit area (Table 3). Result showed that seed yield both per plant and unit area increased due to Miyobi application compared to control.

The highest seed yield (8.22 g plant^{-1} and 2.07 t ha^{-1}) was recorded in 5.0 mg L^{-1} followed by 6.0 mg L^{-1} (6.97 g plant^{-1} and 1.76 t ha^{-1}).

In contrast, the lowest seed yield was recorded in control (5.50 g plant^{-1} and 1.54 t ha^{-1}). Seed yield increased due to increase in pod number. Similar results were reported by Rahman (2006) in soybean who observed that seed yield increased due to application of Miyobi and the highest seed yield was found in 5.0 mg L^{-1} Miyobi application.

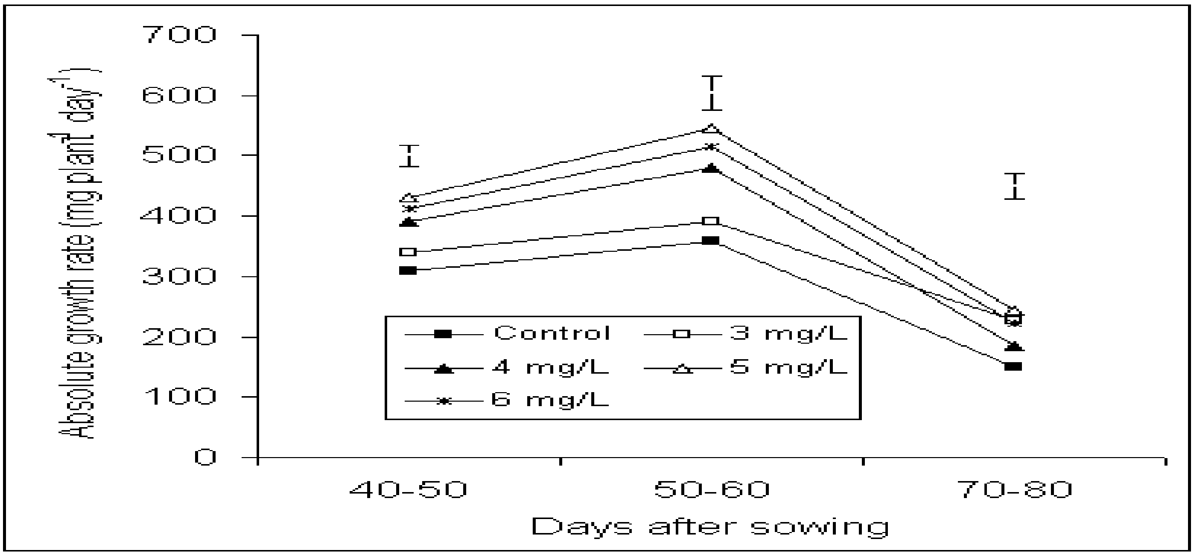

Fig. 6. Effect of Miyobi applications on absolute growth rate at different growth stages of mungbean *cv.* BINA moog-6.Vertical bars represents LSD $_{(0.05)}$.

Harvest index (%)

The effect of different levels of Miyobi application on harvest index (HI) was statistically non-significant at $p \leq 0.05$ (Table 3).

Apparently, the maximum HI (34.8%) was achieved by applying Miyobi with 5.0 mg L^{-1} concentration.

Conclusion

Foliar application of Miyobi at vegetative stage improved morpho-physiological characters, upgraded yield attributes and increased seed yield of mungbean over control. More specifically, application of Miyobi @ 5.0 mg L^{-1} had remarkable superiority for plant growth, yield components and yield over the other doses of Miyobi.

In light of present findings, it is recommended to apply Miyobi at the rate of 5.0 mg L^{-1} for increasing seed yield of mungbean.

Acknowledgement

The authors are thankful to Bangladesh Agricultural University, Mymensingh for their full cooperation in conducting research and for their funding support.

References

Afzal MA, Murshad ANMM, Baka MA, Hamid A, Salahuddin ABM. 1998. Mungbean cultivation in Bangladesh. Published by Pulse Research Station, BARI, Gazipur-1701, Bangladesh. 25 p.

Ahmed ZU, Shaikh MAQ, Khan AI, Kaul AK. 1978. Evaluation of local, exotic and mutant germplasms of mungbean for varietal characters and grain yield of Bangladesh. SABRAO Journal **10,** 48-58.

Alam MJ. 2007. Effect of Miyodo (Miyobi) on growth and yield in lentil. M. S Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Ayub BFJBK. 2008. Effect of Miyodo (Miyobi) on growth, yield attributes and yield of wheat. M. S Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

BARC. (Bangladesh Agricultural Research Counil). 2005. Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215. 32.

BBS. (Bangladesh Bureau of Statistics). 2007. Hand Book of Agricultural Statistics, December, 2007. Ministry of Planning, Government of People's Republic of Bangladesh, 14.

Bhardway SN, Singh KP, Mehra RB. 1987. Influence of PAR and transpiration during the growing season on components of biomass production in field pea. Indian Journal of Plant Physiology **30,** 272-278.

Dutta RK, Mondal MMA. 1998. Evaluation of lentil genotypes in relation to growth characteristics, assimilate distribution and yield potential. LENS Newsletter **25,** 51-55.

Egli DB. 1990. Reproductive abortion, yield components and nitrogen content in three early soybean cultivars. Journal of Agricultural Science **129,** 55-57.

FAO. 1988. Agro-ecological region of Bangladesh. Land resources appraisal of Bangladesh for agricultural development. BGD/81/035, Tech. Rep. No-2, Food and Agriculture Organization (FAO) and UNDP. 570 p.

FAO. 2005. Production Year Book of 2003. No. 65. Published by Food and Agriculture Organization (FAO), Rome, Italy. 54 p.

Hamid A. 1989. Nitrogen and carbofuran effects on the growth and yield performance of mungbean. Journal of Agronomy and Crop Science **161,** 11-16 p.

Hossain MT. 2007. Effect of Miyodo (Miyobi) on growth and yield of sesame. M. S Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Ikeda T, Sato S. 1997. The effect of Figaron on flower number, pod set and yields in soybean. Trends in Agronomy **1,** 27-31.

Maske VG, Deitale RD, Sorte NV, Gorramnagar HB, Chore CN. 1998. Influence of GA_3 and NAA on growth and yield attributing parameters of soybean. Journal of Soils and Crops **8,** 20-22.

Mondal MMA. 2007. A study of source-sink relationship in mungbean. Ph.D Dissertation, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Nahar BS, Ikeda T. 2002. Effect of different concentrations of figaron on production and abscission of reproductive organs, growth and yield in soybean. Field Crops Research **78,** 41-50.

Nazneen H. 2007. Effect of miyodo (Miyobi) and GABA on growth, yield and yield contributing characters of soybean. M. S Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Nickell LG. 1982. Plant Growth Regulators: Agricultural uses. Springer Verlag, Berlin. 122-139 p.

Peoples MB, Herridge DF. 1990. Nitrogen fixation by legumes in tropical and sub-tropical agriculture. Advances in Agronomy **44,** 155-223.

Prasad VVS, Pandey RK, Saxena MC. 1978. Physiological analysis of yield variation in gram genotypes. Indian Journal of Plant Physiology **21,** 228-234.

Prodhan MI. 2004. Studies on some mungbean genotypes in relation to growth, yield and yield components. M. S. Thesis. Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Rahman MH. 2006. Effect of Miyodo on growth and yield attributes of soybean. M. S Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Rahman MM. 2004. Effect of GABA and Cycocel on growth and yield attributes of mungbean. M. S. Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Runa MK. 2008. Effect of Miyodo (Miyobi) on growth and yield in soybean. M. S. Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Russell DF. 1986. MSTAT-C Pakage Programme. Crop and Soil Sci. Department, Michigan University, USA.

Samssuzzaman M. 2004. Effect of NAA and GABA on growth and yield contributing characters of groundnut. M. S. Thesis. M. S. Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.

Sarker MK. 2006. Effect of Miyodo (Miyobi) on growth and yield of soybean. M. S Thesis, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh.