

## Effect of miyobi on morpho-physiological characters, yield attributes and yield of mungbean

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**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 2008 to investigate the effect of Miyobi on morpho-physiological characters, yield attributes and yield of mungbean cv. BINA moog-6. The experiment comprised five levels of Miyobi viz. 0, 3, 4, 5 and 6 mgL<sup>-1</sup> sprayed on mungbean plants at 30 days after sowing. The experiment was laid out in a Randomized Complete Block Design with three replications. Results revealed that application of Miyobi increased plant height, branch number, leaf area, LAI, TDM, AGR 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<sup>-1</sup> Miyobi applied plant while the highest plant was observed in 6mgL<sup>-1</sup>. Control showed the lowest of the above studied parameters. The highest seed yield was recorded in 5 mgL<sup>-1</sup> Miyobi applied plant (8.22 g plant<sup>-1</sup> and 2.07 t ha<sup>-1</sup>) due to increased number of pods plant<sup>-1</sup>, seeds pod<sup>-1</sup> and pod size. In contrast, 6.0 mgL<sup>-1</sup> Miyobi applications had the adverse effect on yield attributes and yield compared to 5 mgL<sup>-1</sup> Miyobi application indicating inhibitory effect of Miyobi at high concentration of 6 mgL<sup>-1</sup> on mungbean. Therefore, Miyobi with 5 mgL<sup>-1</sup> may be applied for increased seed yield of mungbean.

**Key words:** Miyobi, Mungbean, yield.

### Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) is an important pulse crop at home and abroad because of its nutritive and economic value. The cultivated mungbean belongs to the family Leguminosae, sub-family Papilionaceae. Mungbean 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, mungbean has the remarkable quality of helping the symbiotic root rhizobia to fix atmospheric nitrogen and hence enrich soil (Mondal, 2007). It ranks 3<sup>rd</sup> in acreage, 5<sup>th</sup> in production and 3<sup>rd</sup> 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). The yield of mungbean per plant as well as per unit area is very low. Average yield of mungbean is 560 kg ha<sup>-1</sup> (BBS, 2007). The yield performance under Bangladesh 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 one of the most 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 (Nahar and Ikeda, 2002; Ikeda and Sato, 1997; 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 for making breakthrough for improving yield through changes of hormonal behaviours. 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<sub>3</sub> has been carried out on many crops all over the world and have been reported positive influence on growth, development and yield of field crops. However, Miyobi, a new plant growth regulator like GA<sub>3</sub> 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 study the effect of Miyobi on growth, canopy structure, yield attributes and yield in mungbean; and to find out the optimum dose of Miyobi for getting higher yield.

### Materials and Methods

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 2008. 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. 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, 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 till unknown. 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<sup>-1</sup>. The spray was done at 30 days after sowing by a hand sprayer at afternoon. 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. The land of the experimental site was first opened in 3<sup>rd</sup> 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. Urea, triple super phosphate (TSP), muriate of potash (MP) and gypsum were used as source of nitrogen, phosphorus, potassium and sulphur, respectively. Total amount of urea, TSP, MP and gypsum were applied at basal doses during final land preparation. The doses of fertilizers were: urea 400, TSP 80, MP 60 and gypsum 50 kg ha<sup>-1</sup>. The seeds of mungbean were hand sown in rows on 01 March, 2008. 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. 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 at afternoon by using a hand sprayer. At flowering, few plants were affected by leaf cutter piller. Acord 10 EC was sprayed two times @ 25 Lha<sup>-1</sup> in the afternoon by using a sprayer with 10 days interval to control leaf cutter piller.

#### Crop sampling and data collection

**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 dry 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. i.e.,  $AGR = \{(W_2 - W_1) \div (T_2 - T_1)\}$  g plant<sup>-1</sup>day<sup>-1</sup>, where W<sub>2</sub> and W<sub>1</sub> are the DM at time T<sub>2</sub> and T<sub>1</sub>, respectively.
- (ii) Leaf area index (LAI): It is the ratio of leaf area and land area. i.e.,  $LAI = (\text{Leaf area}) \div (\text{Land area})$ .

#### Morphological parameters

- (i) Plant height (cm): Plant height was taken to be the length between the base of the plant to the tip of the main stem.
- (ii) Number of branches: Number of branch was counted

from randomly 5 selected plants of each plot at each harvest and average branches plant<sup>-1</sup> was calculated.

- (iii) Leaf area: Leaf area per plant was measured by automatic leaf area meter.
- (iv) 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:

- (i) Number of pods plant<sup>-1</sup>: Pods of 10 randomly selected plants of each Replication were counted and then the average number of pod for each plant was determined.
- (ii) Number of seeds pod<sup>-1</sup>: Number of seeds on randomly selected 10 competitive pods.
- (iii) Single pod weight: Ten randomly pods from each of the plant were weighed and then divided by ten to get single pod weight.
- (iv) 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.
- (v) 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 and seed weight/plant was calculated.

(vi) Harvest index: Harvest index was calculated by dividing economic yield to biological yield of plant by multiplying with 100 and expressed in percentage. Harvest index (%) =  $[\{\text{Economic yield (seed yield)/plot}\} \div (\text{Biological yield/plot})] \times 100$ .

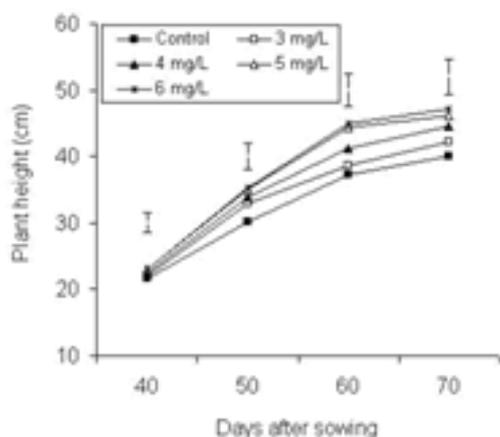
**Harvesting:** All the plants of the given genotype under these three replications were harvested at a time, when most of the pods become mature (about 90% pods were mature). The mature pods were collected by hand.

**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 computer package program, MSTAT-C (Russell, 1986).

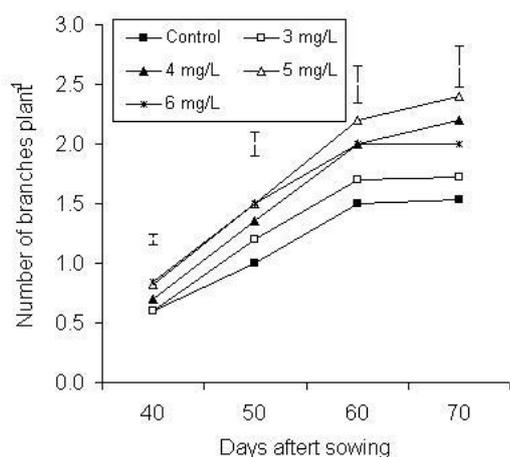
## Results and Discussion

### Effect of Miyobil application on morphological and growth characters

**Plant height:** The effect of Miyobi application at different concentrations on plant height of mungbean is presented in Fig. 1. Plant height was influenced significantly ( $p \leq 0.05$ ) at all growth stages except 40 DAS (Fig. 1). Results revealed that plant height increased with increased concentration of Miyobi. The tallest plant was recorded in 6.0 mgL<sup>-1</sup> Miyobi application at all growth stages followed by 5.0 mgL<sup>-1</sup> 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. 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.



**Figure 1.** Changes in plant height of mungbean, Vertical bars represent LSD (0.05).



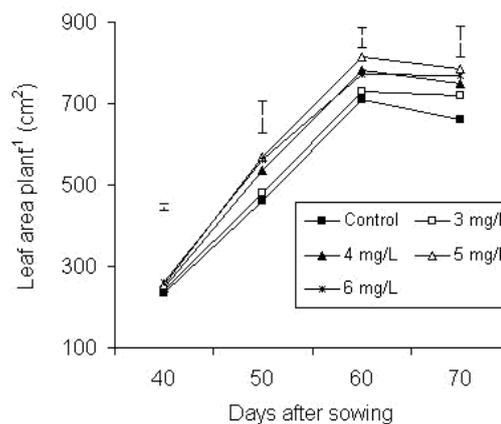
**Figure 2.** Effect of Miyobi application on branch production, Vertical bars represent LSD (0.05).

**Number of branches plant<sup>-1</sup>:** Branch production was significantly influenced by the application of different doses of Miyobi on mungbean (Fig. 2). The dose of 5.0 mg L<sup>-1</sup> produced the highest number of branches plant<sup>-1</sup> over its growth period. At harvest, the second highest number of branches was recorded in 4.0 mg L<sup>-1</sup> Miyobi applied plants. In contrast, control plants produced the fewest branches plant<sup>-1</sup> over its growth period followed by 3.0 mg L<sup>-1</sup>. The result is supported by the report of Nazneen (2007), who reported that application of Miyobi (range 2.0-4.0 mgL<sup>-1</sup>) increased branch number over control in soybean. Similar results were also reported by Alam (2007) in lentil.

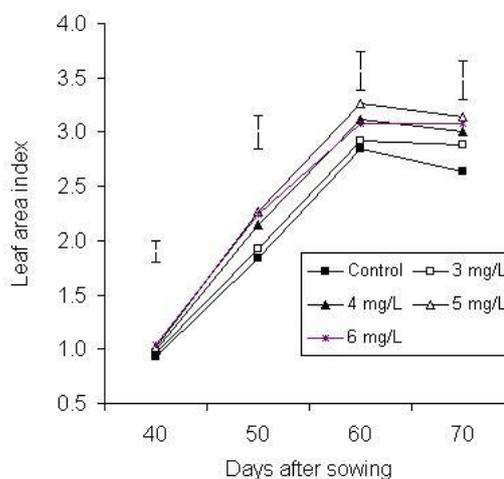
**Leaf area plant<sup>-1</sup>:** The different concentrations of Miyobi application had significant effect on leaf area plant<sup>-1</sup>. Result revealed that leaf area increased till 60 DAS followed by declined because of leaf shedding (Fig. 3). The increment of leaf area varied significantly due to application of different concentrations of Miyobi. The leaf area production by the treatment of 6.0 mgL<sup>-1</sup> was higher over other doses at most of the growth stages. Control had the lowest leaf area at all growth stages. 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 mgL<sup>-1</sup> of Miyobi. The results are also supported by the result of Samsuzzaman (2004) in groundnut.

**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. The LAI varied significantly due to different doses of Miyobi application at all growth stages. The plants of 5.0 mgL<sup>-1</sup> hormone application showed the highest LAI at fruiting stage followed by 6.0 mgL<sup>-1</sup> 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 mgL<sup>-1</sup> and 6.0 mgL<sup>-1</sup> treatments could be attributed to higher leaf number as well as leaf area (Fig. 3).



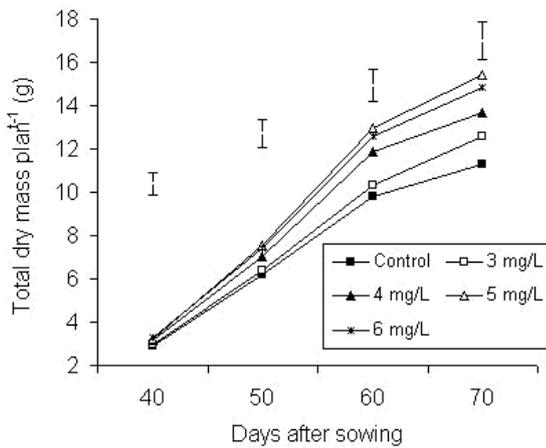
**Figure 3.** Effect of Miyobi application on leaf area development, Vertical bars represent LSD (0.05).



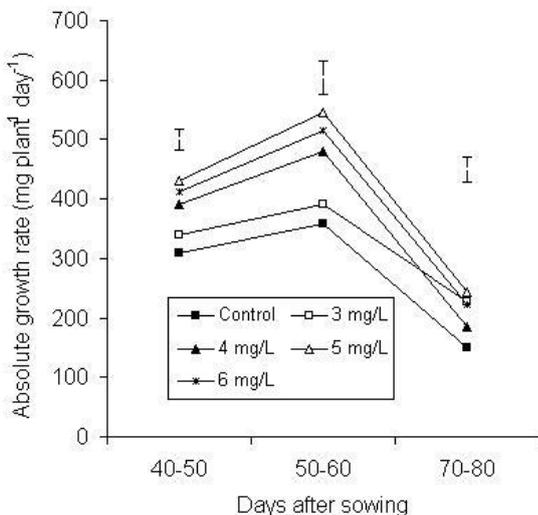
**Figure 4.** Effect of Miyobi application on leaf area index, Vertical bars represent LSD (0.05).

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 mgL<sup>-1</sup> Miyobi application on soybean compared to the other doses also supported the present experimental result.



**Figure 5.** Effect of Miyobi application on total dry mass production, Vertical bars represent LSD (0.05).



**Figure 6.** Effect of Miyobi application on absolute growth rate, Vertical bars represent LSD (0.05).

**Total dry matter production plant<sup>-1</sup>:** Total dry matter (TDM) production was significantly influenced by the application of different doses of Miyobi on mungbean (Fig. 5). Result revealed that TDM production increased with time up to maturity. The doses of 5.0 and 6.0 mgL<sup>-1</sup> maintained the higher TDM over growth period than the other two doses (0, 3.0 and 4.0 mgL<sup>-1</sup>) with being the highest in 5.0 mgL<sup>-1</sup>. In contrast, control plants maintained lower TDM over its growth period followed by 3.0 mgL<sup>-1</sup>. Increased TDM at 5.0 and 6.0 mgL<sup>-1</sup> 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 mgL<sup>-1</sup>) increased TDM over control in lentil with being the highest in 3.0 mgL<sup>-1</sup> hormone application at 45 DAS. Similar results were also reported by Hossain (2007) in lentil.

**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. The plants of 5.0 mgL<sup>-1</sup> 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). 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 it's 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 yield in mungbean:** The effect of Miyobi application on pod number plant<sup>-1</sup> was statistically significant at  $p \leq 0.05$  (Table 1). Result revealed that the number of pods plant<sup>-1</sup> 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 level of probability which in turn increased pod bearing nodes. The highest pods plant<sup>-1</sup> was observed in 5.0 mg L<sup>-1</sup> Miyobi application (17.5 plant<sup>-1</sup>) which was statistically similar to that of 6.0 mg L<sup>-1</sup> (16.1 plant<sup>-1</sup>) Miyobi application. The lowest pods plant<sup>-1</sup> was recorded in control (12.5 plant<sup>-1</sup>). Similar result was also reported by Nazneen (2007) and Rahman (2006) who observed increased pod number due to Miyobi application on soybean. The effect of Miyobi application on pod length in mungbean was statistically non-significant at  $p \leq 0.05$  (Table 1). 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 differed non-significantly among the treatments of Miyobi application on mungbean (Table 1). 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 5mgL<sup>-1</sup> Miyodo application. The effect of different concentrations of Miyobi on seeds pod<sup>-1</sup> was significant (Table 1). Result showed that number of seeds pod<sup>-1</sup> increased due to Miyobi application compared to control. The highest number of seeds pod<sup>-1</sup> (9.97) was observed in 5.0 mgL<sup>-1</sup> followed by 6.0 mgL<sup>-1</sup> (9.70) and 4.0 mgL<sup>-1</sup> (9.66) with same statistical rank. The lowest seeds pod<sup>-1</sup> was recorded in control (9.56). Sarker (2006) observed that number of seeds pod<sup>-1</sup> increased due to application of Miyobi and found the highest pod size in 0.6 mgL<sup>-1</sup> Miyobi application

in soybean. The effect of Miyobi application on 100-seed weight was statistically non-significant at  $p \leq 0.05$  (Table 1). However, 100-seed weight was increased apparently over control due to Miyobi application. There was a remarkable difference in respect of seed yield both per plant and unit area (Table 1). Result showed that seed yield both per plant and unit area increased due to Miyobi application compared to control. The highest seed yield ( $8.22 \text{ g plant}^{-1}$  and  $2.07 \text{ t ha}^{-1}$ ) was recorded in  $5.0 \text{ mgL}^{-1}$  followed by  $6.0 \text{ mgL}^{-1}$  ( $6.97 \text{ g plant}^{-1}$  and  $1.76 \text{ t ha}^{-1}$ ). In contrast, the lowest seed yield was recorded in control

( $5.50 \text{ g plant}^{-1}$  and  $1.54 \text{ t ha}^{-1}$ ). 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  $5.0 \text{ mgL}^{-1}$  Miyobi application. The effect of different levels of Miyobi application on harvest index (HI) was statistically non-significant at  $p \leq 0.05$  (Table 1). From the results, it may be concluded that application of Miyobi has profound effects on seed yield in mungbean and application of  $5.0 \text{ mgL}^{-1}$  is the best dose for increased yield.

**Table 1.** Effect of Miyodo application on yield attributes and yield in mungbean cv. BINAmoog-5

Treatments	Pods/ plant	Pod length (cm)	Single pod wt. (mg)	Seeds/pod	100- seed weight (g)	Seed weight/ plant (g)	Seed yield (t/ha)	Harvest index (%)
Control (T0)	12.5 d	8.28	546	9.56 b	4.84	5.50 d	1.54 c	32.7
3 mg/L (T1)	14.1 c	8.30	557	9.60 b	4.85	6.24 c	1.57 bc	33.1
4 mg/L (T2)	15.2 bc	8.52	560	9.66 ab	4.90	6.84 b	1.72 bc	33.3
5 mg/L (T3)	17.5 a	8.65	573	9.97 a	4.95	8.22 a	2.07 a	34.8
6 mg/L (T <sup>4</sup> )	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

Results revealed that application of Miyobi had a profound influence upon morphological and growth characters in mungbean. In general, plant height and total dry mass increased gradually with increasing concentration of Miyobi. The tallest plant was observed in  $6.0 \text{ mgL}^{-1}$  Miyobi applications on mungbean and the shortest plant was recorded in the control. On the other hand, the highest branch number was recorded in  $5.0 \text{ mgL}^{-1}$  Miyobi treatment followed by  $4.0 \text{ mgL}^{-1}$  and the lowest was recorded in control plants. Leaf area, leaf area index and total dry mass increased with increasing concentration of Miyobi till  $5.0 \text{ mg L}^{-1}$  followed by a decline indicating  $> 5.0 \text{ mgL}^{-1}$  concentration may be toxic for plant growth and development. Results further revealed that leaf area and leaf area index increased with age till 60 DAS followed by a decline due to leaf shedding. The lowest leaf area, leaf area index and total dry mass were recorded in control plants. The AGR was the highest in  $5.0 \text{ mgL}^{-1}$  Miyobi application at all growth stages followed by  $6.0 \text{ mgL}^{-1}$  with same statistical rank. In contrast, control maintained the lowest AGR over its growth period. Furthermore, the maximum AGR was observed during pod development and grain filling stages (50-60 DAS) in all doses of Miyobi. The effect of foliar application of Miyobi on yield contributing characters and yield such as number of pods  $\text{plant}^{-1}$  and seeds  $\text{pod}^{-1}$  was statistically significant and pod length, single pod weight and 100-seed weight was non-significant. Results revealed that all the yield attributes were greater in Miyobi applied plants than the control. Results further revealed that yield contributing characters and yield increased with increasing concentration of Miyobi up to  $5.0 \text{ mgL}^{-1}$  followed by a decline. The higher yield contributing characters and yield were observed in  $5.0 \text{ mgL}^{-1}$  and  $6.0 \text{ mgL}^{-1}$  with being the highest in  $5.0 \text{ mgL}^{-1}$  Miyobi application. In contrast, the lowest yield contributing characters and yield were recorded in control

plants.

Based on the experimental results, it may be concluded that (i) Foliar application of Miyobi at vegetative stage had significant positive influence on morpho-physiological characters, yield attributes and seed yield of mungbean over control; and (ii) Application of Miyobi @  $5.0 \text{ mgL}^{-1}$  had remarkable superiority for plant growth, yield components and yield over the other doses of Miyobi. So, Miyobi with  $5.0 \text{ mgL}^{-1}$  may be applied for increased seed yield of mungbean.

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