EFFECT OF MAGIC GROWTH ON THE MORPHO-PHYSIOLOGICAL AND YIELD ATTRIBUTES OF MUNGBEAN

UMMEY TAMIMA

DEPARTMENT OF AGRICULTURAL BOTANY
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

JUNE, 2015

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BY
UMMEY TAMIMA

REGISTRATION NO. 09-03508

A Thesis

Submitted to the Faculty of Agricultural Botany
Sher-e-Bangla Agricultural University, Dhaka,
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE
IN
AGRICULTURAL BOTANY

SEMESTER: JANUARY-JUNE, 2015

Approved by:

Prof. Dr. Kamal Uddin Ahamed
Supervisor

Prof. Dr. Md. Moinul Hoque
Co-supervisor

(Dr. Md. Ashabul Hoque)
Chairman
Examination committee

CERTIFICATE

This is to certify that the thesis entitled, "**EFFECT OF MAGIC GROWTH ON THE MORPHO-PHYSIOLOGICAL AND YIELD ATTRIBUTES OF MUNGBEAN"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL BOTANY,** embodies the result of a piece of bona-fide research work carried out by **Ummey Tamima**, Registration No. 09-03508 under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated:

Dhaka, Bangladesh

Prof. Dr. Kamal Uddin Ahamed
Supervisor
Department of Agricultural Botany
Sher-e-Bangla Agricultural University
Dhaka- 1207, Bangladesh

DEDICATED TO MY ADORED PARENTS

ACKNOWLEDGEMENTS

All praises are devoted to Almighty God, Who the supreme authority of this universe, and who enable the author to complete the research work and submit the thesis for the degree of Master of Science (M.S.) in Agricultural Botany.
Guidance, help and co-operation have received from several people during the tenure of the study, for the cause of which the author grateful to all of them. Although it is not possible to mention every one by name, it will be an act of ungratefulness of some names if not mentioned here.

The author would like to acknowledge the untiring inspiration, encouragement and invaluable guidance provided by her respected teacher and supervisor Professor ***Dr. Kamal Uddin Ahamed ,*** *Department of Agricultural Botany, Sher-e-Bangla Agricultural University (SAU), Dhaka. His constructive criticisms, continuous supervision and valuable suggestions were helpful in completing the research and writing up the manuscript.*

The author would like to express her heartiest appreciation, ever indebtedness and deep sense of gratitude to her co-supervisor Professor ***Dr. Md. Moinul Hoque,*** *Department ofAgricultural Botany , Sher-e-Bangla Agricultural University (SAU), Dhaka, for his utmost cooperation, constructive suggestion to conduct the research work as well as preparation of the manuscript of the thesis.*

The author wishes to express her sincere respect and profound appreciation to the departmental Chairman ***Dr. Md. Ashabul Hoque and other teachers*** *for their valuable teaching and providing the facilities to conduct the experiment and sympathetic consideration in connection with the study.*

Heartiest thanks and gratitude are due to the officials of Farm Division, Sher-e-Bangla Agricultural University for their support to conduct the research.

*The author feels proud to express her deepest and endless gratitude to all of her course mates specially **Tahmina , Negar , Susmita, Setara and Jui** to cooperate and help her during taking data from the field . The author is very much grateful to **Arif Hossain khan ,** Joint Director of BADC, to help her to prepare the manuscript of the thesis. The Author also offers special thanks to **Rakhi Banerjee** to help her to take care of her experimental plot time to time and to prepare the thesis paper properly. The author also acknowledged the Ministry of Science and Technology for awarding a prestigious 'NST' fellowship' for conduction of the research work.*

*Diction is not enough to express her profound gratitude and deepest appreciation to her beloved father **Noor Mohammad** , mother **Farida Begum** and elder brother **Rashidul Hasan** for their sacrifice, inspiration, encouragement, endless love and continuous blessing for educating her to the postgraduate level.*

May God protect them all.

The author

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ABSTRACT

An experiment was carried out at the research field of Sher-e-Bangla Agricultural University, Dhaka during the period from September to November 2014 to study the effect of magic growth on the morpho-physiological and yield attributes of mungbean. The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. Three mungbean varieties and four different levels of magic growth as well as control treatment were used in the experiment. Three varieties of mungbean was (i) V_1 = BARI mung-4, (ii) V_2 = BARI mung-5 and (iii) V_3 = BARI mung-6 and four levels of magic growth was (i) T_0 = Control (Normal cultivation practices), (ii) T_1 = Soaking of seeds with magic growth for 3 hours (100% Urea use), (iii) T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% Urea use), (iv) T_3 = Without soaking + 3 times spraying magic growth at 35, 50 and 65 DAS respectively (50% Urea use). Data were recorded on different growth and yield parameters. All growth and yield parameters were significantly influenced by variety and magic growth and their combination. The highest plant height (18.53, 48.93, 66.29, 69.00, and 68.73 cm at 20, 30, 40, 50 and 60 DAS respectively), dry weight plant^{-1} (0.88, 3.60 and 12.34 g at 20, 40 and 60 DAS respectively), pod length (6.50 cm), number of pods plant^{-1} (34.19), number of seeds per pod^{-1} (12.73), 1000-seed weight (45.58 g), yield m^{2} (145.20), grain yield (1456.00 kg ha^{-1}), stover yield (1775.00 kg ha^{-1}) and the highest harvest index (46.72%) was recorded from V_3T_2 [BARI mung-6 and Soaking of seeds with magic growth + spraying on 35 DAS (before flowering) + spraying on 50 DAS (After 1st harvest)].

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

List of Abbreviations

Abbreviations	Full word
AEZ	Agro ecological zone
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
BINA	Bangladesh Institute of Nuclear Agriculture
BSMRAU	Bangabandhu Sheikh Mujibur Rahman Agricultural University
cm	Centimeter
cv.	Cultivar
CV	Coefficient of Variation
DAS	Days After Sowing
EC	Emulsifiable concentrate
et al.	And others (*et alibi*)
FAO	Food and Agriculture organization
g	Gram
ha	Hectare
HI	Harvest Index
kg	Kilogram
L	Liter
LAI	Leaf Area Index
LSD	Least Significance Difference
m^2	Square Meter
mL	Milliliter
MP	Muriate of potash
N	Nitrogen
No.	Number
NPK	Nitrogen phosphorus potassium
NS	Non Significant
%	Percent
pH	Hydrogen ion concentration
$plant^{-1}$	per plant
Seeds pod^{-1}	Seeds per pod
t ha^{-1}	Ton (s) per hectare
TSP	Triple super phosphate

Chapter 1

Introduction

CHAPTER I

INTRODUCTION

Pulses are vital food crops and a cheap source of protein. In Asia, mungbean (*Vigna radiata* L.) is an important pulse crop ranked as the second most drought resistant crop after soybean (Ali *et al*., 2014) and in Bangladesh it ranked as third in acreage, fifth in production and third in protein content among the pulses grown in Bangladesh (BBS, 2007). It has more protein contents and better digestibility than any other pulse crop (Tabasum *et al*., 2010).

Mungbean plays a crucial role not only in human diet but also in improving the soil fertility by fixing atmospheric nitrogen with the help of root nodules (Ashraf et al., 2003). It can be grown under drought stress conditions, where short time is available for growth. It grows well under both irrigated as well as rainfed conditions. Salt affected soils are fit for its production, while, it cannot grow well in waterlogged condition (Yadave *et al*., 1998).

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 to enrich soil (Mondal, 2007). The residues of mungbean are also used as feed for animals and enhance the soil fertility (Asaduzzaman, 2008). Mungbean, like other grain legumes is characterized by prolific flower production with an extremely low proportion of pod set. For example, the extent of flower shedding may be 60-92% in soybean (Nahar and Ikeda, 2002, Saitoh *et al.*, 2004), 59-95% in mungbean (Mondal, 2007), 60-85% in *Vicia faba*, 80-91% in *Vigna unguiculala* (Fakir and Biswas, 2001), 60-94% in lupin and 65-95% in *Cajanus cajan* (Fakir, 1997). This might be due to the determinate growth of both vegetative and reproductive and consequent competition between them (Porter, 1982), However, many pods did not fill their seeds and grain yield did not increase.

Despite the greatly increased sink potential, the plants lacked the capacity for increasing assimilates supply (Atkins and Pigcaire, 1993). Researchers have suggested the foliar fertilization minimizes nutrient depletion from the leaves. Protein concentration in mungbean seed ranges from 24 to 26% on a dry weight basis and hence the N requirement for seed development is high. It was calculated to be 26 mg N g^{-1} of photosynthate according to Mitra *et al.,* (1989). They also indicated that, at best only 20 mg N g^{-1} photosynthate can available to the developing seed from the soil. Thus, from their data it is apparent that mungbean is not able to meet the N demand of its seeds by uptake from the soil or by fixation.

The fertilizer management practices may have important role to play on the growth, yield and quality of the crop. In many cases, micronutrients may also play important role in the improvement of the growth, yield and quality of legume crops (Rahman, 2001). Foliar application of micronutrient was better than direct soil application for increasing yield. In legume crops, requires not only adequate macronutrients but also micro-nutrients for increasing the bacterial activity of nodule. So, an optimum supply of micronutrients under balanced condition is very important for achieving higher productivity (Hallock, 1988).

Foliar application is an agricultural practice of increasing growth and yield of crops (Fernandez and Eichret, 2009). The main advantage of foliar application of Fe is that the fixation reactions of Fe in alkaline or calcareous soils are avoided. In plants, micronutrients uptake and transport can be enhanced by the use of fertilizer through leaf (Mengel, 1995).

By spraying mungbean plants with 1% urea at weekly intervals the rate of photosynthesis in the urea treated plants remained constant 20 days after flowering and declined in the untreated plants. Foliar urea application during pod formation after 63 days from sowing of mungbean enhanced ammonia assimilation and the accumulation of amino acids (Ghildiyal, 1992). Foliar applied N to mungbean was found to increase seed yields (Abdo, 2001).

There is an imperative need to provide the required nutrients over and above the regular soil application through foliar application as well. Foliar application is well recognized and is being practiced in agriculturally advanced countries. In many cases aerial spray of nutrients is preferred and gives quicker and better results than the soil application (Jamal *et al*., 2006). Recently foliar application of nutrients has become an important practice in the production of crops while application of fertilizers to the soil remains the basic method of feeding the majority of the crop plants. Foliar feeding is an effective method for overcoming the flooded soil special condition. In case of foliar feeding, nutrients are absorbed directly where they are needed, the rate of the photosynthesis in the leaves is increased, nutrient absorption by plant roots is stimulated and foliar nutrition applied at critical times. Other advantages are low application rates, uniform distribution of fertilizer, reduction in plant stress, plant's natural defense mechanisms to resist plant disease and insect infestations, improvement of plant health and yield (Finck, 1982).

Foliar fertilization is the most efficient way to increase yield and plant health. Foliar fertilization can increase yield from 12% to 25% in comparison to conventional fertilization. When fertilizers like urea are foliar applied, more than 90% of the urea fertilizer is utilized by the plants. When a similar amount is applied to the soil, only 10% of it is utilized. When urea is applied in leaf it works very rapidly. This is the main base of magic solution. Magic growth solution may increase the yield of mungbean. Magic growth is a nutrient solution which helps to increase crop yield and as well helps to decrease the use of nitrogen fertilizer. As such use of magic growth would help to increase the total crop production in the country.

Considering the above facts this research program has been taken in hand to find out the effect of magic growth on the morpho-physiological and yield attributes of mungbean.

OBJECTIVES:

1. To find out the effect of magic growth on mungbean in comparison to normal cultivation system.
2. To find out the effect of different doses of magic growth on the morpho-physiological and yield attributes of mungbean.

Chapter 2

Review of literature

CHAPTER II

REVIEW OF LITERATURE

Mungbean (*Vigna radiata* L.) is a granule legume with short growing season crop and cultivated in dry land fields of central and south eastern of Asia (De Costa *et al*. 1999). Under the present study, magic growth effect was examined on the morpho-physiological and yield attributes of mungbean. Three mungbean cultivar were also used to observe the above mentioned effect. Thus this chapter includes varietal performance on morpho-physiological and yield attributes of mungbean and magic growth nutrient and/or also foliar application of plant nutrients on mungbean are reviewed.

2.1 Varietal performance of mungbean

This average yield is far below than its potential yield. The use of high yielding genotypes is one of the simplest ways to enhance the yield of Mungbean on per unit area basis. Mungbean cultivars vary in yield and yield components (Sharar, *et al*., 1999).

Ayub *et al*. (1999) reported that mungbean genotype NM- 92 produced significantly higher yield than NM-54 due to more number of pod bearing branches, number of pods and number of seeds plant^{-1}. Similarly, Ali *et al*. (1999, 2000, 2001 and 2002) reported that mungbean cultivars differ significantly from each others in plant height, number of seeds pod^{-1}, 1000 seeds weight and seed yield.

Hussain *et al*. (2011) reported that significant differences between mungbean genotypes for number of fruit bearing branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1} and 1000 seed weight.

Khan *et al*. (2001), Reddy *et al.,* also (1990) said that significant differences between mungbean genotypes for number branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, 1000grain weight and yield kg ha^{-1}.

Aslam *et al*. (2004) observed that significant differences between mungbean varieties for number of days to flowering, plant height, number of pods plant^{-1}, pod length, number of seeds plant^{-1}, 1000 seeds weight, seed yield kg ha^{-1} and biological yield.

Rahman (2000) found that plant height of different varieties varied significantly. The tallest plant 44.00 cm was recorded from BARI mung- 2 which was statistically identical with that of BINA mung-2 (43.20). BIN A mung-5 produced the shortest plants (37.10 cm) among modem varieties. The number of branches/plant varied significantly due to the varieties. Local variety had the maximum number branches plant^{-1} (4.41) while BINA mung-5 had the minimum (0.23).

In mungbean, Rahman (2001) reported that variations in morphological characters exist, and increased flower production and decreased abscission may be used as selection criteria for higher yield.

Rahman (2002) reported that plant height ranged from 19 to 23 cm. number of leaf/plant ranged from 10 to 12. Mahmud (1997) found that average plant height was about 26.30 cm and mean number of branches per plant was 2.7 in 3 mungbean varieties.

Plant height of BARI Mung-5 was the highest (31.5 cm) followed by BINA Mung-3 (29.7 cm) and BINA mung-1 (25.9 cm) (Naher, 2000).

Plant height is an important morphological character and is influenced by deflowering treatment. Several workers reported that seed yield was significantly and positively correlated with number of primary and secondary branches per plant (Oram and Belaid. 1990). I hey also reported that positive association of number of branches was observed with pods/plant.

Miller and Femandez (1988) reported that mungbean genotypes might differ in their nitrogen fixation potential. The nitrogen fixation potential is exercised through two distinct pathways: (1) nodule formation, and (2) nodule effectiveness. They added that progress in breeding for enhanced nitrogen fixation was obtained by alternating cycles followed by selection for superior N fixation potential.

Leaf is the most important trait of any crop. It is directly related with photosynthesis, which influences other morpho-physiological traits also. On the other hand, leaf area is associated with leaf number and there had a wide range of variation in leaf number as studying variability of different yield contributing traits in mungbean genotypes (Vikas *et al.,* 1999). Khan (1981) stated that leaf area index, a measure of leafiness and photosynthetic surface area of a crop, depends on the leaf growth, number of leaves, plant density, mode of branching and leaf senescence.

Hamid *et al.* (1990) reported that total dry mass production was positively correlated with the amount of foliage displayed in the upper 50% of the canopy. It seems likely that the foliage developed in the lower parts of the canopy has little or negative contribution to dry matter production.

Rahman (2002) said that dry mass partitioning into root growth was the highest in BINA mung-l (0.80g) and the lowest in BARI mung-5 (0.32g) with intermediate in BARI mung-2 (0.42g). DM growth into stem, branch and leaf was significantly greater in BARI mung-2 and BARI mung-5 (average of 2.77) than in the BINA mung-l (2.20g) with the magnitude being intermediate in the BINA mung-2 (2.47).

Craufurd and Wheeler (1999) reported that total dry mass (TDM), seed yield and other phonological traits of cowpea al two locations in Nigeria. I hey obtained 50% reduction in seed yield under drought in both locution, attended by the reduced radiation use efficiency and 1 DM. In a trial with cowpea, Medina *el al.*. (1996) observed that weight of leaf, stem, branch, flower and pod was affected by genotype and stage of growth and development.

Hamid *et al.* (1991) reported that mungbean produces a large number of flowers but the greater portion of these abscise without forming pods. An experiment with two genotypes of country bean.

The percentage of floral abscission varied between 73 and 83% according to Fakir *et al.,* (2000).

Mostafa (2001) studied four genotypes of short duration pigeonpea and reported that the total number of flowers per plant varied between 343 and 2093 while the percentage flower abscission varied between 89% and 94%.

Fourteen mungbean genotypes were evaluated for genetic variation, heritability and genetic gain in terms of biomass production, and dry weight of root, stem, peduncle, leaves and floral parts at 20. 40 and 60 days after sowing (DAS) during 2001 in west Bengal, India (Gayen *et al.*, 2004). The mean values showed that leaf biomass and floral biomass al early growth stages and floral biomass at latter stages gave the highest contribution to total biomass.

Srinivusan *et al.,* (1985) reported wide variation in leaf photosynlhetic rates among mungbean genotypes and observed that seed yield was related significantly with leaf photosynthetic rates at early pod development stage.

In a trial with 9 mungbean (*Vigna radialu)* cullivars. Mohanly *et at.,* (1998) reported that kalamung was the best performing cultivars: with a potential grain yield of 793.65 kg/ha. the highest number of pods/plant (18.67) and greater number of seeds/pod (10.43).

In experiments with mungbean (cv. J-781 and K.-851), Suryavanshi *et al.* (1995) reported that the effect of sequence of pod setting on yield component and seed quality was studied, pod length and weight, number of seeds/pod, seed weight of 10 pods, 100-seed weight and percentages hard seed were the highest in the first pod to set and lowest in the 5 pod to set.

In a field study with 11 cultivars of *Vigna mungo,* Matho (1997) reported that yield was positively correlated with 100-seed weight, days to 50% (lowering, plant height, number of branches/plant, number of seeds/pod and days to maturity. Multiple regression analysis highlighted that number of branches/plant, number of pods/plant and days to maturity were the most important yield contributing parameters. Haque (2001) found that pod number was the principal sources of variation in yield.

2.2 Performance of magic growth and/or foliar application of plant nutrient

It is reported that magic growth is a nutrient solution which helps to increase crop yield. The inventor has reported that it helps to increase yield as well as helps to decrease the use of nitrogen fertilizer. As such use of magic growth would help to increase the total crop production in the country. When a similar amount of fertilizer is applied to the soil, only 10% of it is utilized. When urea is applied in leaf it works very rapidly. This is the main base of magic solution. Magic growth solution can increase yield of mungbean.

Foliar application of magic growth as well as nitrogen influences growth and yield of field crops. In this review, an attempt has been made to present relevant literature on physio-morphological characters and yield attributes in mungbean and other field crops. Foliar fertilization is the most efficient way to increase yield and plant health. Foliar fertilization can increase yield from 12% to 25% in comparison to conventional fertilization. When fertilizers like urea are foliar applied, more than 90% of the urea fertilizer is utilized by the plants.

An experiment was conducted by Alam *et al.* (2015) at the research farm of Crop Physiology and Ecology Department, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Banglaadesh during the period of August 2013 to January 2014 to find out the efficacy of liquid fertilization

(Magic Growth) on the performance of Kataribhog rice and to calculate how much urea can be saved without the reduction of grain yield. The experiment was accommodated with the split plot design with two levels of liquid fertilization viz., no liquid fertilization (L_o), Liquid fertilization with Magic Growth applied at 30, 45 and 60 DAT (L_1), and four levels of nitrogen fertilizer viz., no nitrogen fertilizer (N_0), 50% recommended nitrogen fertilizer (N_{50}), 75% recommended nitrogen fertilizer (N_{75}) and 100% recommended fertilizer (N_{100}). The liquid fertilizer and nitrogen fertilizer doses were assigned to the main plot and sub-plot, respectively. They found that liquid fertilization (L_1) treatment provided greater grain yield compared to no liquid fertilization treatment (L_0) in all nitrogen levels. Furthermore, with the increment of nitrogen level the grain yield was increased up to N_{100} compared to no liquid fertilization treatment (L_0), but in the application of liquid fertilization treatment (L_1), grain yield was increased up to N_{75} and thereafter decreased in N_{100} dose application. They also reported that liquid fertilization with Magic Growth along with 75% of the recommended nitrogen fertilizer increased 10.5% grain yield with a saving of 25% of the recommended nitrogen fertilizer compared to recommended practice.

Rabin *et al*. (2016) conducted an experiment undertaken at the farm of Sher-e-Bangla Agricultural University, Dhaka-1207, during the Aman season from July to December, 2013 to find out the effect of foliar application of urea along with magic growth spray on the yield and nutrient content of two Aman rice cultivars. The two factorial experiments were laid out in a RCBD design with three replications. Two rice varieties *viz.*, Bina-sail (V1), BRRI dhan46 (V2) and eight different nitrogen doses and application methods *i.e.* T0=No (No nitrogen applied), T1=N0+10% (Urea was applied only 10% of the recommended dose (RD) with magic growth as foliar spray),T2=N50+5% (50% Urea was applied as top dressing and 5% Urea was applied with magic growth as foliar spray),T3=N50+10% (50% Urea was applied as top dressing and 10% Urea was applied with magic growth as foliar spray), T4=N75+5% (75% Urea was applied as top dressing and 5% Urea was applied with magic growth as foliar spray),T5=N75+10% (75% Urea was applied as top dressing and 10% Urea was applied with magic growth as foliar spray),T6=N100 (100% of RD of Urea was applied as topdressing), T7=N100+10% (100% Urea was applied as top dressing and 10% Urea was applied with magic growth as foliar spray) were used in this experiment. BRRI dhan46 and 75% Urea top dressing and 10% Urea with magic growth as foliar spray gave the highest number of effective tillers hill- ^{1}, longer panicle, number of total grains panicle^{-1}, 1000-grain weight, grain yield, straw yield and N,P, K content in rice grain. Moreover, 75% Urea top dressing and 10% Urea of the recommended dose with magicgrowth as foliar spray increased 8.27% grain yield with a saving of 15% of the recommended nitrogen fertilizer compared to recommended parctice.

Hence, the magic growth solution is the basis of foliar application of plant nutrients, here the presented review of literature is on the basis of foliar application of plant nutrients.

2.2.1 Effect of foliar application or as nitrogen and other nutrients in the field

Ali *et al.,* (2014) conducted an experiment to evaluate the effect of foliar application of iron sulfate ($FeSO_4$) on growth, yield and quality of mungbean. The experiment was consisted of foliar applications of 0.5%, 1% and 1.5% solutions of FeSO4 both at branching and flowering stages. The results revealed that various FeSO4 treatments increased growth and yield components like plant height, number of pod bearing branches per plant, number of pods per plant, number of seeds per pod, 1000-grain weight and seed yield. Moreover, application of $FeSO_4$ also improved the quality of mungbean by increasing protein and iron contents in grains. Application of

1.5% foliar $FeSO_4$ both at branching and flowering stages gave higher number of pods per plant (44.64%).

Uddin, S. *et al.* (2009) carried out an experiment including five levels of fertilizer viz. control, N + P +K, Biofertilizer, Biofertilizer + N + P + K and Bio-fertilizer + P + K. and three varieties viz. BARI mung 5, BARI mung 6 and BINA mung 5 Results showed that most of the growth and yield component of mungbean *viz*. plant height, branch plant^{-1}, number of nodules plant^{-1}, total dry matter plant^{-1}, pods plant^{-1}, seed plant^{-1}, seed pod^{-1}, weight of 1000-seeds, seed yield and straw yield were significantly influence by the bio-fertilizer (*Bradyrhyzobium* inoculums) treatment except number of leaves and dry weight of nodule. These are influenced by chemical fertilizer and biofertilizer also. All the parameters performed better in case of *Bradyrhyzobium* inoculums. BARI mung 6 obtained highest number of nodule plant^{-1} and higher dry weight of nodule. It also obtained highest number of pod plant^{-1}, seed plant^{-1}, 1000 seed weight and seed yield.

Kamel *et al.,* (2008) studied the effect of foliar application of N on growth and yield in soybean and reported that plant height, plant dry weight, leaf area, pod and seed number plant^{-1}, seed weight plant^{-1} and seed yield increased significantly with N foliar application of soybeans.

Sutoshi *et al.* (2006) reported that application of foliar urea increased 30% seed yield in soybean. Similar result was also reported by Gascho (2009) in soybean. Rchm (2003) showed no yield benefit when soybeans were sprayed with repeated of N-P-K-S at pod filling stage in soybean. Similar result was also reported by Sawyer (2008).

Takahashi *et al.* (2005) observed that during seed growth and development of soybean, the leaf N levels drastically reduced which resulted leaf senescence and foliar application of N may slow depletion of leaf N and enhanced pod set percentage thereby yield. Similar result was also reported by Maekawa and Kokubun (2005) in soybean.

Oko *et al.* (2003) carried an experiment to investigate the abscission levels of three soybean cultivars (TGX 536-02D. TGM 579 and Samsoy 11) as affected by foliar application of urea during the early reproductive stages and reported that flowering was not significantly increased by urea application, although all fertilized plants had fewer flower abortions than control. Percentage pod abortion was generally reduced (8%) when N was applied at R1-R2-R3 stages while the proportion of aborted grains was highest in the unfertilized plants. The grain yield of foliar fertilized soybean was between 6 and 68% higher than control. These increases were attributed to higher number of pods and meaningful reductions in flower and pod abortions

Alam *et al.,* (1988) said that soil application of urea normally increased plant height, leaves, branches, nodules, seeds, protein content and seed yield in soybean compare to that of control.

Anwarullah and Shivashankar (1997) worked in two separate field experiments with different doses of molybdenum on green gram and black gram and found that application of molybdenum increased the number of branches, leaves, leaf area index, total dry matter and yield. On the other hand, Srivastova and Varma (1996) observed that the application of molybdenum failed to exert significant influence on yield attributes, yield and qualitative characters of field pea.

Badaway and Tagoury (1987) studied the different concentration of N, Co, Fe and Zn in broad bean and pea in a dry loam soil and observed that the said micro-elements increased DM and fresh weight of nodules in pea .

Barik and Rout (2000) showed in their experiment that foliar spray of macronutrients enhanced the yield, yield contributing characters, nitrogen content of plants and protein content of grains of blackgram.

Boole *et al.,* (1988) reported the importance of foliar application of N, P, K to photosynthesis and suggested that foliar fertilization must enhance the C balance of the plant to result in increased yield in soybean.

Brevedan *el al.* (1988) reported that an adequate supply of N to the plant during the period of flowering and pod set increased yield in soybean. Schonbeck *et al.,* (1986) studied the effect of pod number on dry matter and nitrogen accumulation and distribution in soybean and indicated that high levels of N during flowering were necessary for maximum yields.

Bunco (1995) found that when Fe, Zn and Mn were applied with urea as foliar spray at 30 days after sowing on soybean increased DM as compared control. Hallock (1988) applied Mn both in broadcast and foliar spray and reported that foliar spray was better than broadcast in peanut.

Varshney (1995) observed that Br, Mo and Cu increased the seed yield of Vigna mungo while Zn, Fe and Mn were less effective. Singh *et al*., (1972) showed that height and TDM production were influenced by application of Fe and Mn.

Chalturvedi and Palhak (1983) reported that foliar application of Zn increased yield and protein content of soybean seeds. They also observed that combine application of micronutrients (Cu, Mn, Mo, and B) enhanced growth and yield over control but combined application of trace elements was generally inferior to individual application.

Extensive research conducted from 1980 to 1990s on foliar fertilization of soybean during reproductive stages showed inconsistent results of increased grain yield (Mallarino *et al.,* 2001). Garcia and Hanway (1986) reported yield increase of 27 to 31% when liquid N-P-K-S fertilizers were sprayed at late reproductive stage in soybean.

Gabal *et al*., (1995) conducted an experiment on effect of Cu, Mn and Zn foliar application on common bean growth, flowering and seed yield and concluded that spraying with 40 ppm Cu, 25 ppm Mn and 25 ppm Zn considerably increased the number of flowers plant'1. Fruit set percentage was considerably increased by 10-20 ppm Cu compared to other treatments. Application of 100 ppm Mn increased the weight of 100 seeds. They also concluded that application of 10 ppm Cu, 100 ppm Mn and 50 ppm Zn significantly increased the TDM and seed yield.

Gangwar and Singh (2001) observed the growth and development behaviour of lentil in relation to foliar spray of $ZnSO_4$ in the field experiment and found increased plant height and dry matter production by such in treatment. Similar result was also reported by Devarajan et al., (1990) in pulse crops. Sakai *et al*., (1993) studied the effect of Zinc sulphate solution in Kharif and Rabi maize and showed a significant increase in the dry matter production and grain yield over the control.

Garcia and Hanway (1986) reported yield increased of 27 to 31% when liquid N-P-K-S fertilizers were sprayed at late reproductive stage in soybean. Several researchers showed that foliar fertilization of soybean either did not influence or decrease yield (Parker and Boswell, 1990). But Wesley *et al.* (1998) reported that foliar fertilization had significant positive influence (yield increased > 12%) under irrigated condition of soybean.

Gupta and Potalia (1997) stated that foliar application of Zn and Mo increased TDM as well as yield in groundnut. Badaway and Tagoury (1987) studied the effect of different concentration of Co, Fe and Zn in broad bean and pea in a sandy loam soil and observed that the said elements increased DM and fresh weight of nodules in pea but showed no response in broad bean.

Haq and Mallarino (1998, 2000) reported that early foliar application of N, P, K increased plant growth and development which resulted increased TDM and yield but foliar application of N, P, K. at reproductive stage slightly increased seed yield due to increase pod number

Mitra *et al.*, (1989) study the effect of foliar application of 1.5% urea solution one week before flowering and during the period of pod development in mungbean and observed that retarded the loss of chlorophyll and leaf nitrogen which enhance total dry matter production, pod production, 100-seed weight and seed yield..

Nooden and Leopold (1998) indicated that the available literature concerning the correlative influence of seed development of legumes by foliar application of nutrients. Ezzat *et al*. (2012) reported that foliar spray of urea combined with Fe or Zn increase seed yield and quality of seeds.

Patil *et al.* (1993) worked on the effect of nitrogen and boron application n groundnut yield and observed that both soil and foliar application of N and B icreascd the pod yield significantly.

Patel and Golakiya (1996) conducted a pot experiment and observed that B at 2 ppm gave the highest pod yield in groundnut. Walker *et al.* (1986) made a comparison between soil and foliar application of Mn on peanut and reported that Mn treatments increased yield where 1.68 kg ha 1 in 6 application was the best.

Peterson *et al.*, (1990) and Atkins and Pigeaire (1993) reported that foliar application of cytokinin and nitrogen induced a longer period of flowering with the resulted the more flowers and pod developed and caused an increased seed yield in soybean and lupin. On the other hand, foliar spray of both macro (N, P, K, S) and micro (B, Mn. Mg) nutrients during llowering and podding of lupin did not increase grain yield (Seymour and Brennan, 1995).

Saxena and Mehrotra (1995) studied the effect of boron and molybdenum on growth and yield of groundnut and found that application of 11.2 kg borax ha^{-1} gave the maximum yield.

Sesay and Shibles (1990) studied the effect of N, P, K foliar application on soybean during seed filling stage and observed that foliar nutrients application gave significant yield increase over control. They also observed that foliar application of nutrients caused delay in leaf senescence.

Rupp and Derman (1988) indicated that the available literature concerning the correlative influence of seed development of soybean by foliar application of nutrients. Nooden and Leopold (1998) also gave similar opinion about the effect of foliar application of nutrients in legumes.

Michail *et al*. (2004) reported that the enhanced effect of foliar application might be attributed to the favourable of the nutrient on metabolism and biological activity and its stimulating effect on enzymatic activity which is turn enhances vegetative growth of plants.

Chapter 3

Materials and Methods

CHAPTER III

MATERIALS AND METHODS

An experiment was carried out to study the "Effect of Magic Growth on the Morpho-Physiological and Yield Attributes of Mungbean" during the period from September to November 2014.

3.1 Field location

The research work was carried out at the research field of Sher-e-Bangla Agricultural University farm, Dhaka. The experimental fields were located at 88^0 33′ E longitude and 23^0 71′ N latitude at a height of 9 m above the sea level.

3.2 Weather and climate

The climate of the experimental field was sub-tropical and was characterized by high temperature, heavy rainfall during Kharif-2 season and scanty rainfall during Rabi season associated with moderately low temperature .The monthly average temperature, humidity, rainfall and sunshine hours prevailed at the experimental area during the cropping season are presented in Appendix 1.

3.3 Soil

The land belongs to the Agro-ecological zone "Madhupur tract" (AEZ-28) having the red brown teraces soils and acid basin clay of Nodda soil series. The soil of the experimental site were well drained and medium high. The physical and chemical properties of soil of the experimental site was sandy loam in texture and having soil p^H varied from 5.45-5.61. Organic matter content was very low (0.83). The physical composition such as sand, silt, clay content were 40%, 40% and 20% respectively. The physical and chemical characteristics of the experimental field soil have been presented in Appendix 2.

3.4 Land Preparation

The land of the experimental site was first opened in 2nd week of September, 2014 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.

3.5 Planting Materials

The planting materials comprised of BARI mung-4, BARI mung-5 and BARI mung-6 which were three recommended varieties of mungbean. Seeds of the selected varieties were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

3.6 Design and layout of the experiment

The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. As the experiment was replicated thrice and four individual treatments were applied to the three varieties of mungbean, the total number of plots was 36. The size of unit plot was 3m × 2m. A spacing of 0.5 m was provided between the plots and 1 m spacing was provided between two blocks and plant spacing followed was 30cm × 8cm.

3.7 Experimental treatments

Four different levels of magic growth as well as foliar application of urea solution were used in the experiment.

Factor A: Variety

V_1 = BARI mung-4

V_2 = BARI mung-5

V_3 = BARI mung-6

Factor B: Magic growth (It is a liquid fertilizer which contains 10% total nitrogen , 5.58% phosphoras , 6.63% potassium, 0.10% sulphur, 0.16% zinc, 0.04% copper, 0.0006% iron , 0.006% manganese, 0.25% boron, 0.07% calcium and ph=1.0).

T_0 = Control (Normal cultivation practices)

T_1 = Soaking of seeds with magic growth for 3 hours (100% Urea use as soil application)

T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% urea use as soil application)

T_3 = Without soaking + 3 times spraying of magic growth at 35, 50 and 65 DAS respectively(50% urea use as soil application)

3.8 Sowing of seeds treated by magic growth

According to treatment, seeds were soaked for three hours with magic growth, without magic growth and without soaking then they were sown in the individual unit plot maintaining proper spacing

3.9 Fertilizer and foliar application of magic growth

Recommended fertilizer dose was applied during the land preparation as urea, triple superphosphate (TSP), muriate of potash (MP), gypsum and borax were used as source of nitrogen, phosphorus, potassium, sulphur and boron, respectively. Total amount of urea (as mentioned in the treatments), TSP, MP, gypsum and borax were applied at basal doses in the unit plot that was treated as control during final land preparation (Rashid, 2003). Spraying solution was made by 3 ml magic growth solution , 3gm urea and 2 gm muriate of potash in 1 L water. According to treatment, spraying solution was sprayed in 2 times as foliar application after 35 days after sowing (before flowering) and 50 days after sowing (after 1st harvest) in the unit plot where recommended. Three times foliar application also sprayed according to treatment as 35, 50 and 65 days after sowing repeatedly.

3.10 Irrigation and weeding

Irrigations were provided at 25 and 60 DAS during flower initiation and fruit development stages. The crop field was weeded once at 20 DAS.

3.11 Protection against pests

At flowering, few plants were affected by pod borer and leaf feeder. To control pod borer and leaf feeder Acord 10 EC was sprayed two times @ 25 L ha^{-1} in the afternoon by using a sprayer with 10 days interval.

3.12 Data collection

Study onto genetic growth characteristics, a total of three harvests was made and at final harvest, data were collected on some morpho-physiological, yield attributes and yield. The first crop sampling was done at 20 DAS and continued at an interval of 10 days up to 60 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 70 ± 2 °C for 72 hours.

Data was collected from the following parameters:

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

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

Dry weight plant^{-1} (g): The total dry matter was calculated from summation of leaves, stem, root and pod dry weight per plant.

Pod length (cm) plant^{-1}: Pod length was taken as the length between the bases to the tip of pod.

Number of pods plant^{-1}: Pods of 10 randomly selected plants of each replication were counted and then the average number of pod for each plant was obtained.

Number of seeds per pod^{-1}: Number of seeds from randomly selected 10 competitive pods were collected and counted then it was calculated in an average range per pod.

Thousand seeds weight (g): One thousand clean sun dried seeds were counted from the seed stock obtained from the sample plants and weighed by using electronic balance.

Yield per m^2 (g): The total seed weight of a unit plot (3m × 2m) were measure and calculate yield per m^2 in an average range of per m^2.

Grain yield (kg ha^{-1}): The seed yield per plot was recorded then converted into kg per ha.

Stover yield (kg ha^{-1}): The total sun dried matter was calculated from summation of leaves, stem and root weight per plant.

Harvest index (%): Harvest index was calculated by dividing economic yield by biological yield of plant by multiplying with 100 and expressed in percentage

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

3.13 Harvesting

All the plants of the given varieties under these three replications were harvested at 3 times, when most of the pods become mature (about 95% pods were mature). The mature pods were collected by hand.

3.14 Statistical analysis

The data obtained for yield contributing characters and yield were statistically analyzed to find out the significance differences among the treatments. The collected data from the experimental plot on morphology, yield and yield contributing characters are compiled and analyzed using the Statistical, Mathematical Calculation and Data Management (MSTATC) package program. Morphological variation and yield performance among the treatments were studied by Analysis of Variance (ANOVA) by F-test. The significance of the difference between pairs of treatment means was evaluated by least significant difference (LSD) test at 5% and 1% level of probability (Gomez and Gomez, 1984).

Chapter 4

Results and Discussion

CHAPTER IV

RESULT AND DISCUSSION

The experiment was conducted at the Agricultural Botany field of Sher-e-Bangla Agricultural University, Dhaka-1207; during late Kharif Season, 2014. Variety-BARI mung 4, BARI mung 5 and BARI mung 6 were used as test crop with varied treatments of magic growth along with control treatment to study the effect of magic growth on the morpho-physiological and yield attributes of mungbean.

The results of the study on the effect of magic growth on morpho-physiological, yield and yield related traits of mungbean have been presented and possible interpretations have been made in this chapter.

4.1 Plant height (cm)

4.1.1 Effect of variety

Different mungbean varieties had significant influence on plant height at different days after sowing (DAS) (Fig. 1 and appendix 3). Result showed that plant height was increased over control by nutrient applied in plants. Gradually increased plant height was observed till 50 DAS but after that decreased plant height was found among all the test varieties of mungbean. Findings revealed that the highest plant height (17.11, 48.03, 60.11, 62.17, and 58.96 cm at 20, 30, 40, 50 and 60 DAS respectively) was recorded from V_3 (BARI mung-6) followed by V_1 (BARI mung-4). The lowest height of plant (16.25, 45.05, 56.85, 58.19 and 58.32 cm at 20, 30, 40, 50 and 60 DAS respectively) was achieved from V_2 (BARI mung-5). Ali *et al*., (2002) reported that mungbean cultivars differ significantly from each others in plant height. Aslam *et al*., (2004) also found significant differences between mungbean genotypes for plant height.

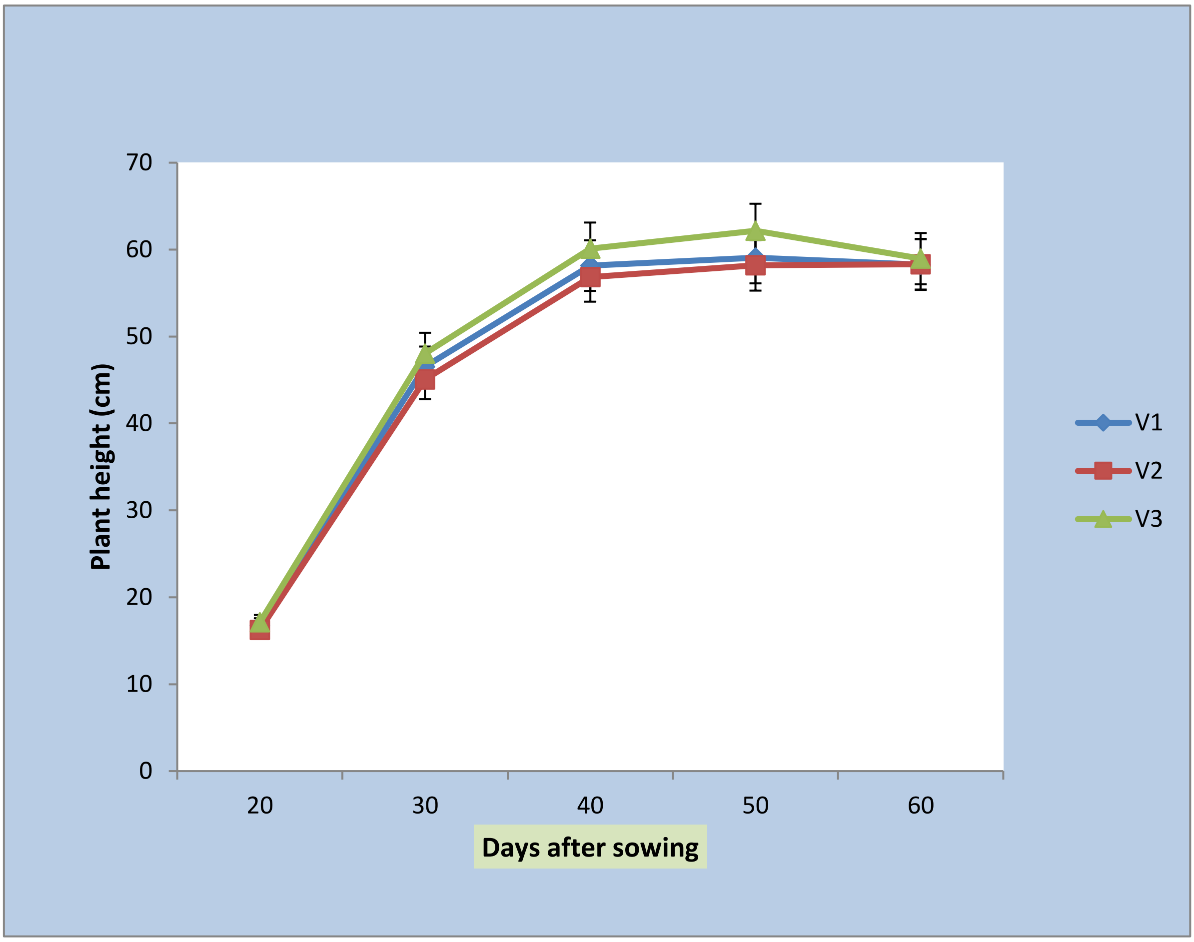

Fig. 1. Effect of variety on plant height of mungbean

V_1 = BARI mung-4
V_2 = BARI mung-5
V_3 = BARI mung-6

4.1.2 Effect of magic growth

Foliar application of magic growth effects directly growth of mungbean. It was observed that significant influence was on plant height of mungbean by the application of magic growth (Fig. 2 and Appendix 3). Results showed that the tallest mungbean (16.10, 47.56, 62.58, 61.02 and 61.80 cm at 20, 30, 40, 50 and 60 DAS respectively) was found in T_2 where the lowest plant height (15.79, 47.04, 60.89, 61.63 and 61.46 cm at 20, 30, 40, 50, 60 DAS respectively) was achieved from T_0. Kamel *et al.,* (2008) reported in terms of soybean that plant height increased significantly with N foliar application. Alam *et al.* (1988) reported for soybean and found that plant height of soybean increases significantly compared to that of control.

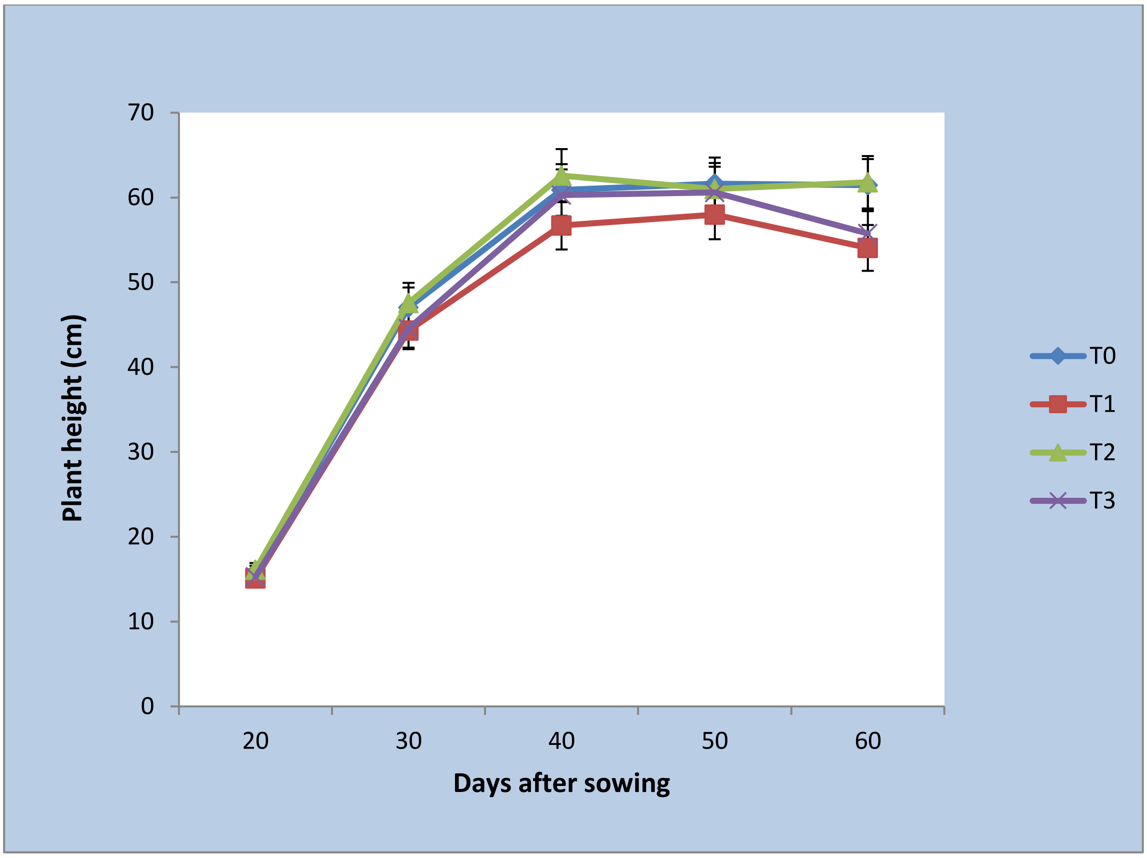

Fig. 2. Effect of magic growth on plant height of mungbean

T_0 = Control (Normal cultivation practices)
T_1 = Soaking of seeds with magic growth for 3 hours
T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% urea use)
T_3 = Without soaking + 3 times spraying of magic growth at 35, 50 and 65 DAS respectively. (50% urea use)

4.1.3 Combined effect of variety and magic growth

The combined effect of variety and magic growth application at different growth stages of plant height showed significant variation (Table 1 and appendix 3). The tallest plant (18.53, 48.93, 66.29, 69.00, and 68.73 cm at 20, 30, 40, 50 and 60 DAS respectively) was recorded from V_3T_2 followed by V_3T_1 and V_2T_0. The shortest plant (13.66, 41.33, 53.19, 54.13 and 52.39 cm) was recorded in V_1T_3 followed by V_1T_2.

Table 1. Effect of variety and magic growth on plant height of mungbean

Treatments	Plant height (cm)				
	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
V_1T_0	14.58 e	46.53 c	53.19 f	56.93 e	53.60 f
V_1T_1	14.33 ef	44.94 d	55.65 e	62.07 bc	58.35 c
V_1T_2	13.85 ef	43.33 e	57.55 d	55.53 e	52.52 f
V_1T_3	13.66 f	41.33 f	53.19 f	54.13 f	52.39 f
V_2T_0	17.11 b	48.07 ab	60.75 b	64.10 b	60.27 b
V_2T_1	16.36 bc	46.67 c	53.64 f	59.86 d	59.85 b
V_2T_2	15.93 cd	44.73 d	56.31 e	57.40 e	56.93 de
V_2T_3	16.71 b	46.73 bc	56.70 de	56.40 e	56.24 e
V_3T_0	15.67 cd	46.53 c	58.75 c	56.87 e	58.49 c
V_3T_1	17.61 b	48.07 b	61.44 b	64.13 b	66.21 b
V_3T_2	18.53 a	48.93 a	66.29 a	69.00 a	68.73 a
V_3T_3	15.47 d	45.53 cd	60.15 b	59.27 d	57.68 cd
$LSD_{0.05}$	0.7420	1.348	0.9683	1.264	1.078
CV(%)	7.442	6.336	9.112	10.364	9.327

In a column, same lettering indicate significantly same result and different indicate significantly different results among the treatments

V_1	=	BARI mung-4	T_0	=	Control (Normal cultivation practices)
V_2	=	BARI mung-5	T_1	=	Soaking of seeds with magic growth for 3 hours
V_3	=	BARI mung-6	T_2	=	Soaking of seeds with for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% urea use)
			T_3	=	Without soaking + 3 times spraying of magic growth at 35, 50 and 65 DAS respectively(50% urea use)

4.2 Number of leaves plant^{-1}

4.2.1 Effect of variety

Number of leaves plant^{-1} was statistically significant produced by different mungbean varieties (Fig. 3 and appendix 4). Result revealed that the maximum number of leaves plant^{-1} (5.12, 15.38, 20.93, 16.82 and 17.72 cm at 20, 30, 40, 50 and 60 DAS respectively) was recorded from V_2 (BARI mung-5) which was statistically identical with V_3 (BARI mung-6) at 30 DAS. The lowest number of leaves plant^{-1} (4.55, 13.35, 17.48, 12.75 and 9.83 at 20, 30, 40, 50 and 60 DAS respectively) was achieved from V_1 (BARI mung-4). Rahman (2002) observed leaf was significantly greater in BARI mung-2 and BARI mung-5 than in the BINA mung-l with the magnitude being intermediate in the BINA mung-2.

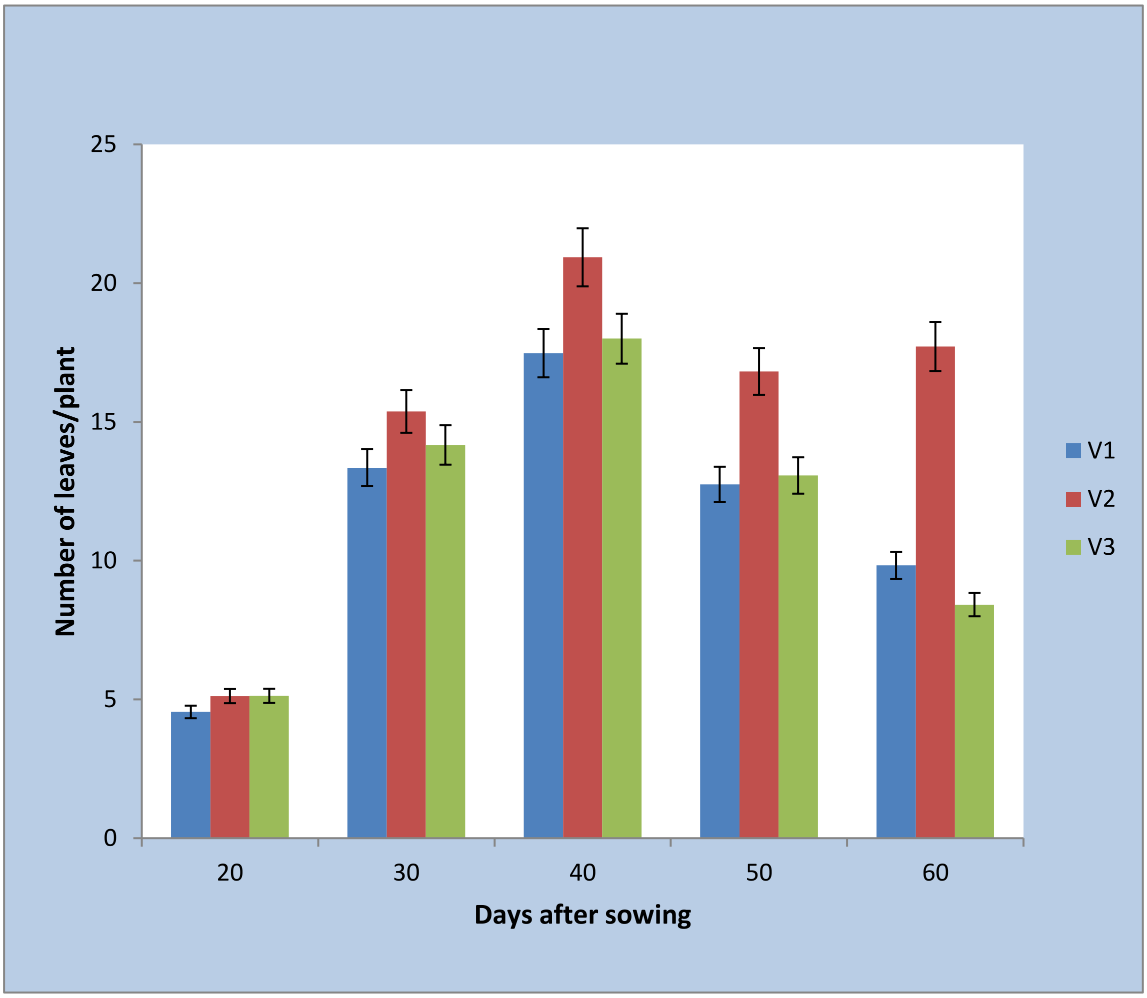

Fig. 3. Effect of variety on number of leaves plant^{-1} of mungbean

V_1 = BARI mung-4
V_2 = BARI mung-5
V_3 = BARI mung-6

4.2.2 Effect of magic growth

It was showed that magic growth directly effect on growth and yield of mungbean by foliar spraying significantly on number of leaves plant^{-1} of mungbean (Fig. 4 and Appendix 4). Results revealed that the maximum number of leaves plant^{-1} of mungbean (5.27, 15.96, 21.93, 16.73 and 13.36 cm at 20, 30, 40, 50 and 60 DAS respectively) was recorded from T_2 followed by T_3 (35, 50-55 and 65-70 DAS) where the lowest number of leaves plant^{-1} (4.02, 13.89, 18.00, 12.62 and 10.02 cm at 20, 30, 40, 50, 60 DAS respectively) was achieved from T_0. Here it was proved that cultivation practices without magic growth the number of leaves plant^{-1} was decreased. The results found from the present study was similar to the findings of Kamel *et al.* (2008), Takahashi *et al.* (2005) and Gayen *et al.* (2004) and they found foliar application of urea significantly influenced leaf number and leaf area.

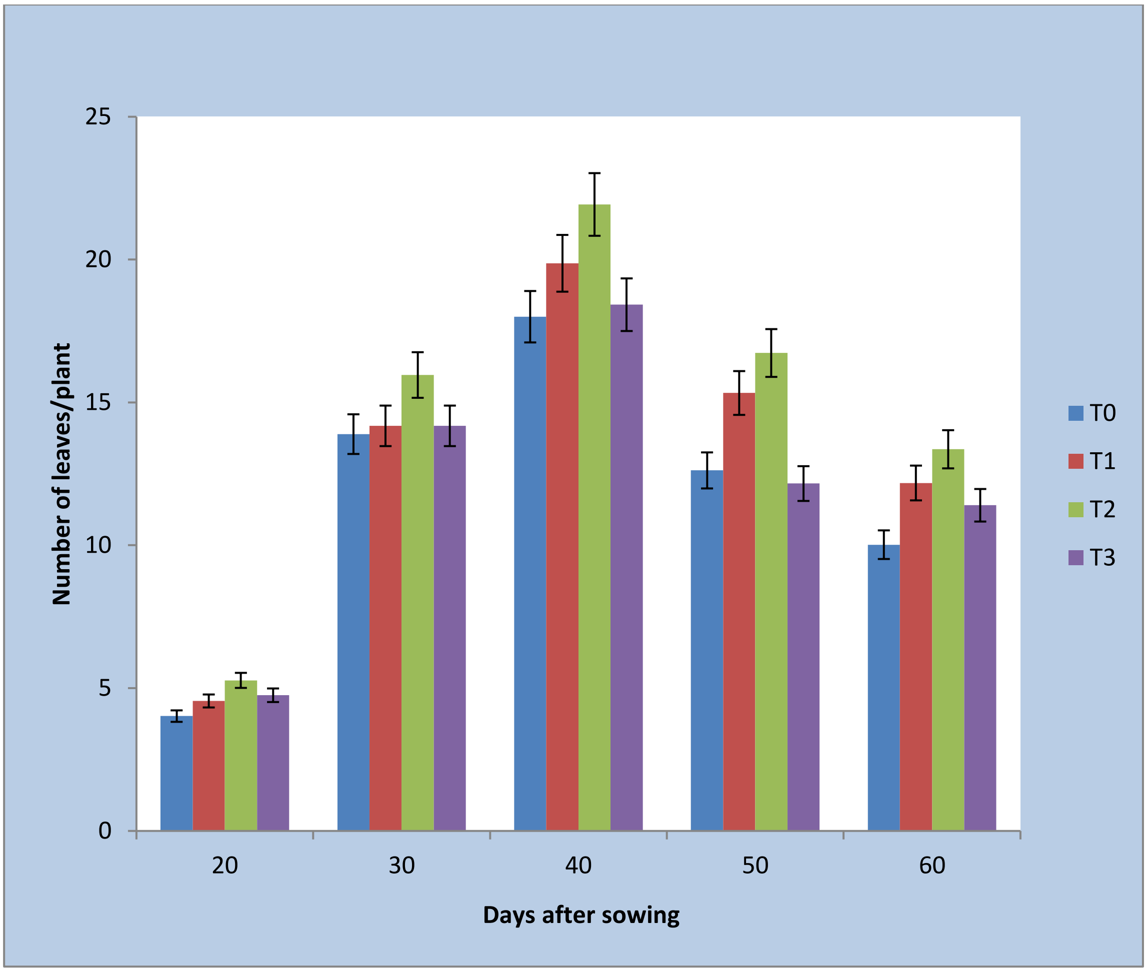

Fig. 4. Effect of magic growth on number of leaves plant^{-1} of mungbean

T_0 = Control (Normal cultivation practices)
T_1 = Soaking of seeds with magic growth for 3 hours
T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% urea use)
T_3 = Without soaking + 3 times spraying of magic growth at 35, 50 and 65 DAS respectively(50% urea use)

4.2.3 Combined effect of variety and magic growth

Significant variation was observed on number of leaves plant^{-1} with the combined effect of foliar application of magic growth and different types of varieties (Table 2 and appendix 4) at all growth stages except 20 DAS. Results revealed that the maximum number of leaves plant^{-1} (15.93, 23.60, 19.21 and 19.80 at 30, 40, 50 and 60 DAS respectively) was recorded from V_2T_2 followed by V_1T_2. Again, the minimum number of leaves plant^{-1} (13.00, 18.00, 12.07 and 7.06 at 30, 40, 50 and 60 DAS respectively) was recorded from V_3T_0 followed by V_1T_0.

Table 2. Effect of variety and magic growth on number of leaves of mungbean

Treatments	Number of leaves plant^{-1}				
	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
V_1T_0	5.13	13.73ef	17.40 f	12.27 f	7.65 e
V_1T_1	5.33	14.74 c	21.40 b	16.20 b	17.27 b
V_1T_2	5.00	15.40 b	20.67 c	16.00 bc	16.80 b
V_1T_3	5.00	14.20 d	18.07 e	16.07 bc	17.02 b
V_2T_0	5.00	13.60 f	18.00 e	14.93 d	7.67 f
V_2T_1	5.20	14.87 c	18.00 e	13.40 e	8.40 e
V_2T_2	5.88	15.93 a	23.60 a	19.21 a	19.80 a
V_2T_3	5.13	14.00 de	18.60 d	12.73 ef	8.53 e
V_3T_0	5.00	13.00 g	18.00 e	12.07 f	7.06 f
V_3T_1	5.00	13.80 ef	17.60 ef	11.26 g	10.40 d
V_3T_2	5.20	14.20 d	17.40 f	11.20 g	9.06 e
V_3T_3	5.67	13.67 ef	17.13 f	15.40 cd	11.53 c
$LSD_{0.05}$	NS	0.3511	0.4759	0.1710	0.1640
CV(%)	3.55	6.284	6.341	7.562	9..117

In a column, same lettering indicate significantly same result and different indicate significantly different results among the treatments

V_1	=	BARI mung-4	T_0	=	Control (Normal cultivation practices)
V_2	=	BARI mung-5	T_1	=	Soaking of seeds with magic growth for 3 hours
V_3	=	BARI mung-6	T_2	=	Soaking of seeds with magic growth for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% urea use)
			T_3	=	Without soaking + 3 times spraying of magic growth at 35, 50 and 65 DAS respectively(50% urea use)

4.3 Dry weight plant^{-1}

4.3.1 Effect of variety

Dry weight plant^{-1} in mungbean of different varieties was showed significant variation (Fig. 5 and appendix 5). Results revealed that the maximum dry weight plant^{-1} (0.63, 3.18 and 11.18 g at 20, 40, and 60 DAS respectively) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5) where the lowest dry weight plant^{-1} (0.49, 3.00 and 9.82 g at 20, 40 and 60 DAS respectively) was achieved from V_1 (BARI mung-4). Hamid *et a.,l* (1990) reported that total dry mass production was positively correlated with the amount of foliage displayed in the upper 50% of the canopy. It seems likely that the foliage developed in the lower parts of the canopy has little or negative contribution to dry matter production. Rahman (2002) observed dry mass growth into stem, branch and leaf was significantly greater in BARI mung-2 and BARI mung-5 than in the BINA mung-l with the magnitude being intermediate in the BINA mung-2.

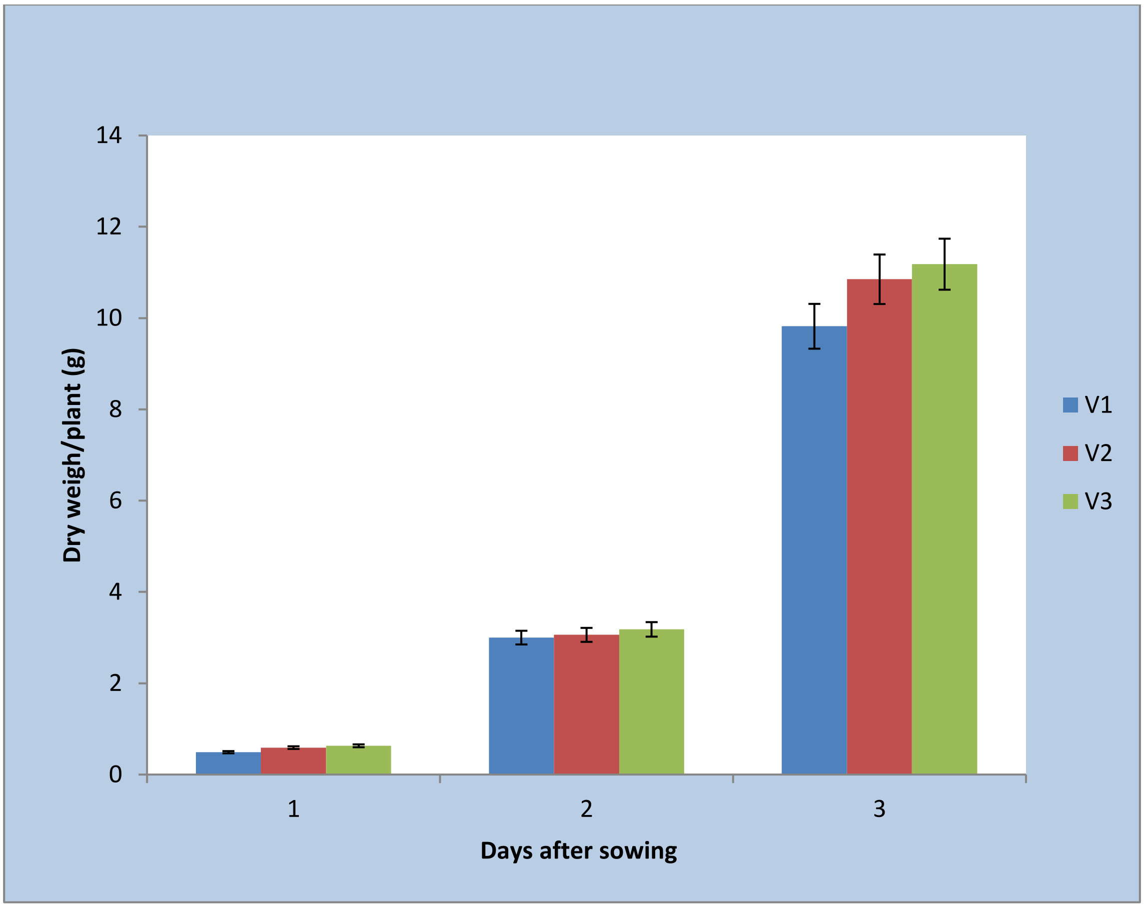

Fig. 5. Effect of variety on dry weight plant^{-1} of mungbean

V_1 = BARI mung-4
V_2 = BARI mung-5
V_3 = BARI mung-6

4.3.2 Effect of magic growth

The foliar spray was influenced significantly variation among the studied treatments for growth and yield of mungbean. It significantly influenced on dry weight plant^{-1} (g) of mungbean (Fig. 6 and Appendix 5). Results showed that the maximum dry weight plant^{-1} of mugbean (0.81, 3.44 and 12.01 g at 20, 40 and 60 DAS respectively) was recorded from T_2 followed by T_3 where the lowest dry weight plant^{-1} (0.46, 2.90 and 10.23 g at 20, 40, 60 DAS respectively) was achieved from T_0. Significant influence was found on dry matter production by Uddin, S. *et al.* (2009), Kamel *et al.* (2008) and Anwarullah and Shivashankar (1997).

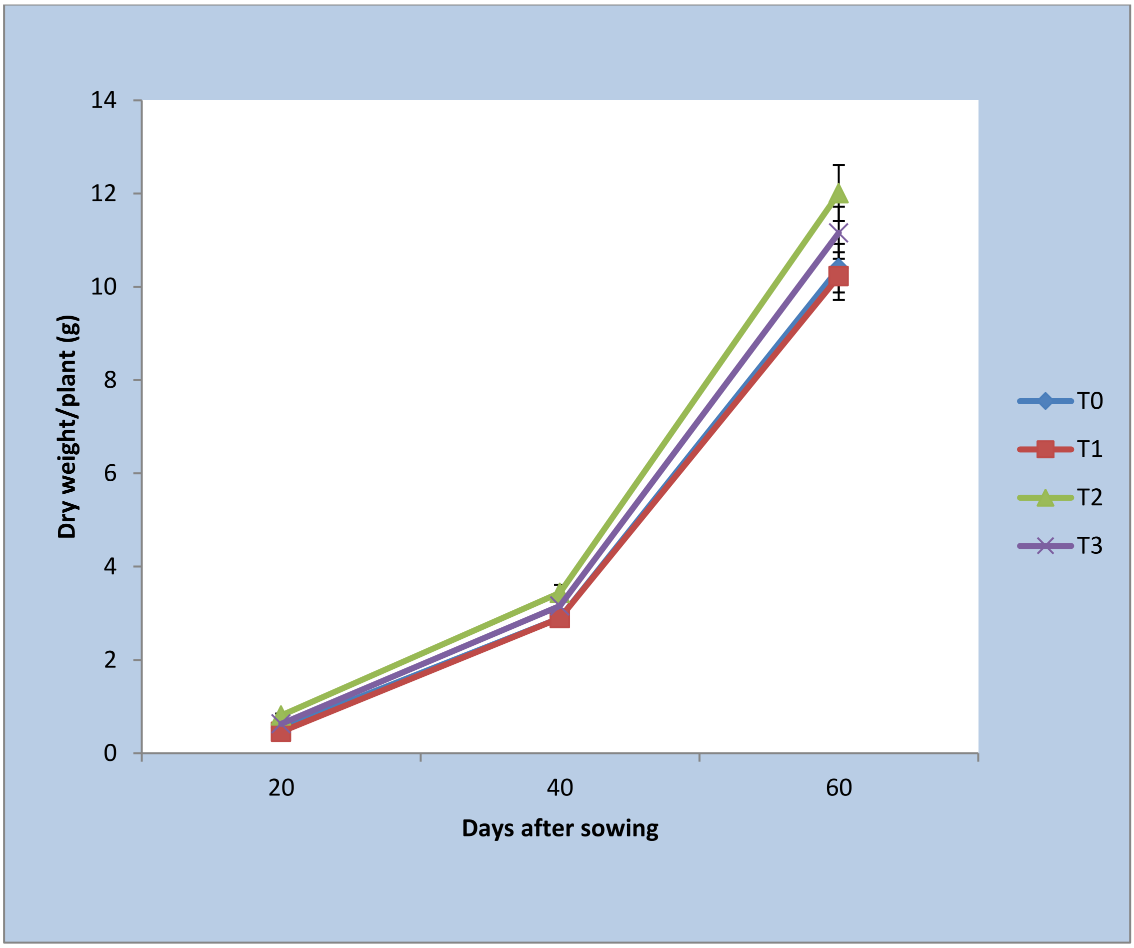

Fig. 6. Effect of magic growth on dry weight plant^{-1} of mungbean

T_0	=	Control (Normal cultivation practices)
T_1	=	Soaking of seeds with magic growth for 3 hours
T_2	=	Soaking of seeds with magic growth for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% urea use)
T_3	=	Without soaking + 3 times spraying of magic growth at 35, 50 and 65DAS respectively(50% urea use)

4.3.3 Combined effect of variety and magic growth

The combined effect of foliar application of magic growth and different types of varieties on dry weight plant^{-1} (g) was showed significant variation (Table 3 and appendix 5). Results revealed that the maximum dry weight plant^{-1} (0.88, 3.60 and 12.34 g at 20, 40 and 60 DAS respectively) was recorded from V_3T_2 followed by V_2T_2, V_1T_2 and V_1T_0 where the minimum dry weight plant^{-1} (0.40, 2.57 and 9.37 g at 20, 40 and 60 DAS respectively) was recorded from V_3T_0 followed by V_3T_1, V_2T_3, V_2T_1, V_2T_0 and V_1T_1.

Table 3. Effect of variety and magic growth on dry weight of mungbean

Treatments	Dry weight plant^{-1} (g)		
	20 DAS	40 DAS	60 DAS
V_1T_0	0.72 b	3.30 b	11.58 bc
V_1T_1	0.50 de	3.00 def	10.50 ef
V_1T_2	0.76 b	3.34 b	11.77 b
V_1T_3	0.55 cd	3.06 cde	10.85 de
V_2T_0	0.49 de	2.82 f	10.24 f
V_2T_1	0.46 ef	2.82 f	10.05 f
V_2T_2	0.78 b	3.39 b	11.93 ab
V_2T_3	0.62 c	3.17 bcd	11.19 cd
V_3T_0	0.40 f	2.57 g	9.37 g
V_3T_1	0.41 f	2.88 ef	10.13 f
V_3T_2	0.88 a	3.60 a	12.34 a
V_3T_3	0.71 b	3.24 bc	11.44 bc
$LSD_{0.05}$	0.0757	0.2004	0.4759
CV (%)	6.268	7.569	8.553

In a column, same lettering indicate significantly same result and different indicate significantly different results among the treatments

V_1 = BARI mung-4
V_2 = BARI mung-5
V_3 = BARI mung-6

T_0 = Control (Normal cultivation practices)
T_1 = Soaking of seeds with magic growth for 3 hours
T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of 50% urea at 35 DAS (before flowering) and 50 DAS (after 1st harvest)
T_3 = Without soaking + 3 times spraying of 50% urea at 35, 50 and 65 DAS respectively

4.4.1 Pod length (cm)

4.4.1.1 Effect of variety

There was significant variation for foliar application on pod length (cm) in mungbean genotypes (Table 4 and appendix 6). Results revealed that the highest pod length (6.11 cm) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5) where the lowest pod length (5.67 cm) was achieved from V_1 (BARI mung-4). Similar results was found by Aslam *et al*. (2004) and he observed significant differences between mungbean varieties for pod length.

4.4.1.2 Effect of magic growth

Magic growth was showed the directly effect on growth and yield of mungbean by foliar spraying. It influenced on pod length (cm) of mungbean (Table 4 and Appendix 6). Results showed that the maximum pod length of mugbean (6.25 cm) was recorded from T_2 followed by T_3 where the lowest pod length (5.58 cm) was achieved from T_1 followed by T_0. This findings might be due to cause of supply of proper nutrition through magic growth technique.

4.4.1.3 Combined effect of variety and magic growth

Highly significant variation was observed in the interaction effect of foliar application of magic growth and different types of varieties on pod length (cm) (Table 4 and appendix 6). Results revealed that the highest pod length (6.50 cm) was recorded from V_3T_2 which statistically similar with V_3T_3 and followed by V_2T_2 and V_1T_2.Where the minimum pod length (5.21 cm) was recorded from V_1T_1 followed by V_1T_3 and V_2T_2.

4.4.2 Number of pods plant^{-1}

4.4.2.1 Effect of variety

Foliar application was significantly influenced on number of pods plant^{-1} in mungbean varieties (Table 4 and appendix 6). Results revealed that the highest number of pods plant^{-1} (29.67) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5). Where the lowest number of pods plant^{-1} (27.60) was achieved from V_1 (BARI mung-4). Similar results was found by Aslam *et al*. (2004) and he observed significant differences between mungbean varieties for number of number of pods plant^{-1}.

4.4.2.2 Effect of magic growth

The studied findings showed significantly effect on growth and yield of mungbean by foliar spraying (Table 4 and Appendix 6). Results showed that the maximum number of pods plant^{-1} of mungbean (32.78) was recorded from T_2 followed by T_3 where the lowest number of pods plant^{-1} (26.83) was achieved from followed by T_1. From the magic growth technique, plant uptake nutrient easily and nutrient loss is less than others technique of fertilizer application such as broadcast method. This findings from the present study might be due to cause of this magic growth application technique.

4.4.2.3 Combined effect of variety and magic growth

Highly significant variation was observed in the interaction effect of foliar application of magic growth and different types of varieties on number of pods plant^{-1} (Table 4 and appendix 6). Result revealed that the highest number of pods plant^{-1} (34.19) was recorded from V_3T_2 which statistically similar with V_2T_2. Where the minimum number of pods plant^{-1} (25.33) was recorded from V_2T_1 followed by V_1T_3 and V_1T_1.

4.4.3 Number of seeds per pod^{-1}

4.4.3.1 Effect of variety

The findings were that significant variation was observed of foliar application on number of seeds per pod^{-1} in mungbean genotypes (Table 4 and appendix 6). Results revealed that the highest number of seeds per pod^{-1} (11.90) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5) where the lowest number of seeds per pod^{-1} (9.28) was achieved from V_1 = BARI mung-4. Similar results was found by Aslam *et al*. (2004) and they observed significant differences between Mungbean genotypes for number of seeds plant^{-1}. This finding was also similar with Ali *et al*. (2002), Hussain *et al*. (2011) and Khan *et al*. (2001), Reddy *et al.* also (1990).

4.4.3.2 Effect of magic growth

In the experiment magic growth had significant variation on growth and yield of mungbean by foliar spraying (Table 4 and Appendix 6). Results showed that the maximum number of seeds per pod^{-1}of mungbean (11.07) was recorded from T_2 followed by T_3 where the lowest number of seeds per pod^{-1} (11.09) was achieved from T_0 followed by T_1. From the magic growth technique, plant uptake nutrient easily and nutrient loss is less than others technique of fertilizer application such as broadcast method. This finding from the present study might be due to cause of this magic growth application technique.

4.4.3.3 Combined effect of variety and magic growth

Among all the studied treatments highly significant variation was observed in the interaction effect of foliar application of magic growth and different types of varieties on number of seeds per pod^{-1} (Table 4 and appendix 6). Results revealed that the highest number of seeds per pod^{-1} (12.73) was recorded from V_3T_2 followed by V_3T_1, V_3T_0 and V_2T_2 while the minimum number of seeds per pod^{-1} (9.93) was recorded from V_2T_1 followed by V_1T_3 and V_1T_1.

4.4.4 1000 seed weight

4.4.4.1 Effect of variety

Significant variation was observed for foliar application on 1000 seed weight in mungbean genotypes (Table 4 and appendix 6). Results revealed that the highest 1000 seed weight (45.69g) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5) where the lowest 1000 seed weight (40.77g) was achieved from V_1 (BARI mung-4). Similar results were found by Aslam *et al*. (2004) and Ali *et al*. (2002) and they observed significant differences between Mungbean genotypes for 1000 seeds weight. This findings was also similar with Hussain *et al*. (2011) and Khan *et al*. (2001).

4.4.4.2 Effect of magic growth

Magic growth showed the directly effect directly on growth and yield of mungbean by foliar spraying (Table 4 and Appendix 6). Results showed that the maximum 1000 seed weight of mungbean (45.50g) was recorded from T_2 followed by T_1 where the lowest 1000 seed weight (40.15g) was achieved T_3. Such findings might be due to cause of proper nutrition of plants or availability of plant nutrient from magic growth technique.

4.4.4.3 Combined effect of variety and magic growth

The interaction effect of foliar application of magic growth and different types of varieties showed significant variation (Table 4 and appendix III). Results revealed that the highest (45.58 g) was recorded from V_3T_2 which statistically similar to $V3T_1$ and V_2T_2.Where the 1000 seed weight (35.51g) was recorded from V_1T_3 followed by V_1T_0

4.4.5 Yield per m^2 (g)

4.4.5.1 Effect of variety

Foliar application on yield per m^2 (g) in mungbean genotypes showed significantly variation (Table 4 and appendix 6). Results revealed that the highest yield per m^2 (119.80 g) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5) where the lowest yield per m^2 (105.60 g) was achieved from V_1 (BARI mung-4).

4.4.5.2 Effect of magic growth

In the experiment magic growth was showed the directly effect on growth and yield of mungbean by foliar spraying (Table 4 and Appendix 6). Result showed that the maximum yield per m^2 of mungbean (134.30g) was recorded from T_2 followed by T_0 where the lowest yield per m^2 (100.50g) was achieved T_3.

4.4.5.3 Combined effect of variety and magic growth

Findings was that the highly significant variation among the interaction effect for foliar application of magic growth and different types of varieties on (Table 4 and appendix III). Result revealed that the highest yield per m^2 (145.20) was recorded from V_3T_2 which was statistically similar to V_3T_3, V_2T_2 and V_1T_2. Where the yield per m^2 (67.82 g) was recorded from V_1T_3 followed by V_2T_3.

Table 4. Effect of variety and magic growth on yield contributing characters of mungbean

Treatments	Pod length (cm)	Number of pods $plant^{-1}$	Number of seeds per pod^{-1}	1000 seed weight (g)	Yield per m^2 (g)
Effect of variety					
V_1	5.67 c	27.60 c	9.28 c	40.77 c	105.60 d
V_2	5.87 b	28.43 b	10.90 b	43.81 b	112.50 c
V_3	6.11 a	29.67 a	11.90 a	45.69 a	119.80 a
$LSD_{0.05}$	0.05987	0.1967	0.1136	0.2108	1.059
Effect of magic growth					
T_0	5.77 c	26.12 b	11.09 b	41.55 c	109.90 b
T_1	5.58 d	26.21 b	11.27 a	43.82 b	100.50 d
T_2	6.25 a	32.78 a	11.07 b	45.50 a	134.30 a
T_3	5.95 b	27.13 b	11.09 b	40.15 d	104.60 c
$LSD_{0.05}$	0.08179	1.004	0.1312	0.5004	1.846
Combined effect of variety and magic growth					
V_1T_0	5.80 d	31.01 bc	10.80 cde	39.53 f	127.40 b
V_1T_1	5.21 g	27.32 ef	11.05 c	42.77 d	105.00 d
V_1T_2	6.05 c	31.59 b	11.47 b	44.28 b	140.30 b
V_1T_3	5.63 ef	28.48 de	10.93 cd	35.51 g	105.70 d
V_2T_0	5.78 d	26.45 fg	11.00 c	41.51 e	104.10 de
V_2T_1	5.58 f	25.33 fg	9.93 f	43.31 cd	95.88 g
V_2T_2	6.20 b	32.55 ab	11.00 c	45.64 a	142.30 b
V_2T_3	5.92 c	29.39 cd	11.67 b	44.77 b	67.82 h
V_3T_0	5.74 de	23.02 h	11.47 b	43.63 c	98.10 fg
V_3T_1	5.93 c	25.97 fg	11.93 b	45.38 ab	100.80 ef
V_3T_2	6.50 a	34.19 a	12.73 a	45.58 a	145.20 a
V_3T_3	6.48 a	23.51 fg	10.67 e	40.17 f	140.40 b
$LSD_{0.05}$	0.1197	1.654	0.01800	0.6815	3.618
CV(%)	5.663	8.229	6.338	7.267	11.392

In a column, same lettering indicate significantly same result and different indicate significantly different results among the treatments

V_1 = BARI mung-4
V_2 = BARI mung-5
V_3 = BARI mung-6

T_0 = Control (Normal cultivation practices)
T_1 = Soaking of seeds with magic growth for 3 hours
T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of 50% urea at 35 DAS (before flowering) and 50 DAS (after 1st harvest)
T_3 = Without soaking + 3 times spraying of 50% urea at 35, 50 and 65 DAS respectively

4.5.1 Grain yield (kg ha^{-1})

4.5.1.1 Effect of variety

Variation was observed significantly in foliar application on grain yield (kg ha^{-1}) in mungbean genotypes (Table 5 and appendix 7). Results revealed that the highest grain yield (1197. 00 ton) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5). Where as the lowest grain yield (kg ha^{-1}) (1105.00 ton) was achieved from V_1 (BARI mung-4).

Aslam *et al*. (2004) observed significant differences between mungbean genotypes for seed yield kg ha^{-1}. Hussain *et al*., (2011) reported significant differences between mungbean genotypes for number of seeds pod^{-1}. Khan *et al*. (2001), Reddy *et al.*, (1990) also reported significant differences between mungbean genotypes for yield (kg ha^{-1}).

4.5.1.2 Effect of magic growth

For the studied treatment magic growth was showed the directly effect on growth and yield of mungbean by foliar spraying. It significantly influenced on grain yield (kg ha^{-1}) of mungbean (Table 5 and Appendix 7). Results showed that the maximum grain yield (kg ha^{-1}) of mungbean (1427.00 ton) was recorded from T_2 followed by T_1. Where as the lowest grain yield (kg ha^{-1}) (1005.00 ton) was achieved from T_3.

4.5.1.3 Combined effect of variety and magic growth

Highly significant variation was observed in the interaction effect of foliar application of magic growth and different types of varieties on (Table 5 and appendix 7). Result revealed that the highest grain yield (1456.00 ton) was recorded from V_3T_2 which statistically similar with V_2T_2 while the lowest grain yield (889.30 ton) was recorded from V_1T_0 followed by V_2T_3.

4.5.2 Stover yield (kg ha^{-1})

4.5.2.1 Effect of variety

Foliar application on stover yield (kg ha^{-1}) in mungbean genotypes had a significant variation (Table 5 and appendix 7). Results revealed that the highest stover yield (1637.00 kg) was recorded from V_3 (BARI mung-6) followed by V_1 (BARI mung-4). Where as the lowest stover yield (1592.00 kg) was achieved from V_1 (BARI mung-4).

4.5.2.2 Effect of magic growth

The experimental showed the directly effect on growth and yield of mungbean by foliar spraying on stover yield (kg ha^{-1}) of mungbean (Table 5 and Appendix 7). Results showed that the maximum stover yield (1724.00 kg) was recorded from T_2 followed by T_1 where as the lowest stover yield (1522.00 kg) was achieved from T_3. Similar results was found by Uddin, S. *et al.*, (2009) in mungbean which supported this findings by Kamel *et al.* (2008), HanBin *el al.* (2007), Sutoshi *et al.* (2006) and Gascho (2009).

4.5.2.3 Combined effect of variety and magic growth

Significant variation was observed in the interaction effect of foliar application of magic growth and different types of varieties on (Table 5 and appendix 7). Results revealed that the highest stover yield (1775.00 kg) was recorded from V_3T_2 which statistically similar to V_2T_2 where as the stover yield (1464.00 kg) was recorded from V_2T_3 followed by V_3T_0 and V_3T_3.

4.5.3 Harvest index (%)

4.5.3.1 Effect of variety

Significant variation showed for foliar application on harvest index (%) mungbean varieties (Table 5 and appendix 7). Results revealed that the highest harvest index (41.69%) was recorded from V_3 (BARI mung-6) followed by V_2 (BARI mung-5) where the lowest harvest index (39.22%) was achieved from V_1 (BARI mung-4).

4.5.3.2 Effect of magic growth

Magic growth showed the direct effect on growth and yield of mungbean by foliar spraying on harvest index (%) of mungbean (Table 5 and Appendix 7). Results showed that the maximum harvest index of mungbean (45.20%) was recorded from T_2 followed by T_3 (35, 50-55 and 65-70 DAS) where as the lowest harvest index (39.53%) was achieved from T_1.

4.5.3.3 Combined effect of variety and magic growth

Highly significant variation was observed in the interaction effect of foliar application of magic growth and different types of varieties on (Table 5 and appendix 7). Results revealed that the highest harvest index (46.72%) was recorded from V_3T_2 which was statistically similar to V_2T_2 and V_1T_2 where as the harvest index (36.82%) was recorded from V_3T_0 followed by V_2T_1, V_2T_0.

Table 5. Effect of variety and magic growth on yield attributes of mungbean

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
Effect of variety			
V_1	1105.00 c	1592.00 c	39.22 c
V_2	1121. 00 b	1614.00 b	40.69 b
V_3	1197. 00 a	1637.00 a	41.69 a
$LSD_{0.05}$	2.399	2.599	0.5281
Effect of magic growth			
T_0	1068. 00 c	1605.00 b	39.53 c
T_1	1005.00 d	1606. 00 b	38.18 d
T_2	1427. 00 a	1724.00 a	45.20 a
T_3	1104.00 b	1522.00 c	41.88 b
$LSD_{0.05}$	3.246	3.446	1.152
Combined effect of variety and magic growth			
V_1T_0	1274.00 d	1632.00 d	43.43 bc
V_1T_1	1053.00 g	1590.00 e	39.05 de
V_1T_2	1403.00 c	1631.00 d	43.99 b
V_1T_3	1057.00 fg	1550.00 f	40.28 d
V_2T_0	1041.00 h	1659.00 c	38.36 ef
V_2T_1	958.80 j	1594.00 e	37.55 ef
V_2T_2	1423.00 b	1738.00 b	44.89 b
V_2T_3	1061.00 f	1464.00 h	41.96 c
V_3T_0	889.30 k	1523.00 g	36.82 f
V_3T_1	1003.00 i	1636.00 d	37.96 ef
V_3T_2	1456.00 a	1775.00 a	46.72 a
V_3T_3	1193.00 e	1553.00 f	43.40 bc
$LSD_{0.05}$	5.362	5.467	1.504
CV(%)	8.994	11.367	9.442

In a column, same lettering indicate significantly same result and different indicate significantly different results among the treatments

V_1 = BARI mung-4
V_2 = BARI mung-5
V_3 = BARI mung-6

T_0 = Control (Normal cultivation practices)
T_1 = Soaking of seeds with magic growth for 3 hours
T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of 50% urea at 35 DAS (before flowering) and 50 DAS (after 1st harvest)
T_3 = Without soaking + 3 times spraying of 50% urea at 35, 50 and 65 DAS respectively

Chapter 5

Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSION

An experiment was carried out to study the effect of magic growth on the morpho-physiological and yield attributes of mungbean during the period from September to November 2014. The research work was carried out at the research field of Sher-e-Bangla Agricultural University farm, Dhaka. Three varieties of mungbean were used as the planting materials comprised of BARI mung-4, BARI mung-5 and BARI mung-6. Seeds of the selected variety were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. As the experiment was replicated thrice and four individual treatments were applied in three variety of mungbean, the total number of plots was 36. The size of unit plot was 3m × 2m and plant spacing followed was 30 cm × 8 cm. Three mungbean varieties and four different levels of magic growth as well as foliar application of urea solution including control treatment were used in the experiment. Three variety of mungbean was (i) V_1 = BARI mung-4, (ii) V_2 = BARI mung-5 and (iii) V_3 = BARI mung-6 and four levels of magic growth application was (i) T_0 = Control (Normal cultivation practices), (ii) T_1 = Soaking of seeds with magic growth for 3 hours (100% Urea use), (iii) T_2 = Soaking of seeds with magic growth for 3 hours + 2 times spraying of magic growth at 35 DAS (before flowering) and 50 DAS (after 1st harvest) (50% urea use), (iv) T_3 = Without soaking + 3 times spraying of magic growth at 35, 50 and 65 DAS respectively(50% urea use). Data were recorded on different growth and yield parameters. All the growth and yield parameters were significantly influenced by variety and magic growth and their combination.

The findings revealed that the highest plant height (17.11, 48.03, 60.11, 62.17, and 58.96 cm at 20, 30, 40, 50 and 60 DAS respectively), the maximum dry weight plant^{-1} (0.63, 3.18 and 11.18 g at 20, 40, and 60 DAS respectively), the highest pod length (6.11 cm), the highest number of pods plant^{-1} (29.67), the highest number of seeds per pod^{-1} (11.90), the highest 1000 seed weight (45.69g), the highest yield per m^2 (119.80 g), the highest grain yield (1197. 00 kg ha^{-1}), the highest stover yield (1637.00 kg ha^{-1}) and the highest harvest index (41.69%) was recorded from V_3 (BARI mung-6) where as the maximum number of leaves plant^{-1} (5.12, 15.38, 20.93, 16.82 and 17.72 cm at 20, 30, 40, 50 and 60 DAS respectively) was obtained from V_2 (BARI mung-5). On the other hand, the lowest height of plant (16.75, 46.52, 58.16, 59.07 and 58.28 cm at 20, 30, 40, 50 and 60 DAS respectively), the lowest number of leaves plant^{-1} (4.55, 13.35, 17.48, 12.75 and 9.83 at 20, 30, 40, 50 and 60 DAS respectively), the lowest dry weight plant^{-1} (0.49, 3.00 and 9.82 g at 30, 40 and 60 DAS respectively), the lowest pod length (5.67 cm), the lowest number of pods plant^{-1} (27.60), the lowest number of seeds per pod^{-1} (9.28), the lowest 1000 seed weight (40.77g), the lowest yield per m^2 (105.60 g), the lowest grain yield (1105.00 kg ha^{-1}), the lowest stover yield (1592.00 kg ha^{-1}) and the lowest harvest index (39.22%) was achieved from V_1 (BARI mung-4).

Incase of magic growth, the tallest mungbean (16.10, 47.56, 62.58, 61.02 and 61.80 cm at 20, 30, 40, 50 and 60 DAS respectively), the maximum number of leaves plant^{-1} of mungbean (5.27, 15.96, 21.93, 16.73 and 13.36 cm at 20, 30, 40, 50 and 60 DAS respectively), the maximum dry weight plant^{-1} (0.81, 3.44 and 12.01 g at 20, 40 and 60 DAS respectively), the maximum pod length of mungbean (6.25 cm), the maximum number of pods plant^{-1} of mungbean (32.78), the maximum number of seeds per pod^{-1}of mungbean (11.27), the maximum 1000 seed weight of mungbean (45.50g), the maximum yield per m^2 of mungbean (134.30g), the maximum grain yield of mungbean (1427.00 kg ha^{-1}), the maximum stover yield (1724.00 kg ha^{-1}) and the maximum harvest index of mungbean (45.20%) was recorded from T_2 = soaking of seeds with magic growth + spraying on 35 DAS (before flowering) + spraying on 50 DAS (After 1st harvest). Similarly, the lowest plant height (15.79, 47.04, 60.89, 61.63 and 61.46 cm at 20, 30, 40, 50, 60 DAS respectively), the lowest number of leaves plant^{-1} (4.02, 13.89, 18.00, 12.62 and 10.02 cm at 20, 30, 40, 50, 60

DAS respectively), the lowest dry weight plant^{-1} (0.46, 2.90 and 10.23 g at 20, 40, 60 DAS respectively), the lowest number of pods plant^{-1} (26.83) and the lowest number of seeds per pod^{-1} (11.09) was achieved from T_0 = Control (Normal cultivation practices) but the lowest pod length (5.58 cm) and the lowest harvest index (39.53%) was achieved from T_1 = Soaking of seeds with magic growth for 3 hours where the lowest yield per m^2 (100.50g), the lowest grain yield (1005.00 kg ha^{-1}), the lowest stover yield (1522.00 kg ha^{-1}) was achieved from T_3 = without soaking + 3 times spray (35, 50 and 65 DAS).

Again, in case of combined effect, the tallest plant (18.53, 48.93, 66.29, 69.00, and 68.73 cm at 20, 30, 40, 5 and 060 DAS respectively), the maximum dry weight plant^{-1} (0.88, 3.60 and 12.34 g at 20, 40 and 60 DAS respectively), the highest pod length (6.50 cm), the highest number of pods plant^{-1} (34.19), the highest number of seeds per pod^{-1} (12.73), the highest 1000 seed weight (45.58 g), the highest yield per m^2 (145.20gm), the highest grain yield (1456.00 kg ha^{-1}) and the highest stover yield (1775.00 kg ha^{-1}) and the highest harvest index (46.72%) was recorded from V_3T_2. But the maximum number of leaves plant^{-1} (15.93, 23.60, 19.21 and 19.80 at 20, 30, 40, 50 and 60 DAS respectively) was obtained from the treatment combination of V_2T_2. On the other hand the shorted plant (13.66, 41.33, 53.19, 54.13 and 52.39 cm at 20, 30, 40, 50 and 60 DAS respectively), the minimum number of leaves plant^{-1} (13.00, 18.00, 12.07 and 7.06 at 30, 40, 50 and 60 DAS respectively), the minimum dry weight plant^{-1} (0.40, 2.57 and 9.37 gm at 20, 40 and 60 DAS respectively) and the harvest index (36.82%) was recorded from V_3T_0 but the minimum number of pods plant^{-1} (23.02) and the minimum number of seeds per pod^{-1} (9.93) was recorded from V_2T_1; the minimum pod length (5.21 cm) was recorded from V_1T_1; the 1000 seed weight (35.51gm) and the yield per m^2 (67.82 gm) was recorded from V_2T_3; the lowest grain yield (889.30 kg) was recorded from V_3T_0 and the stover yield (1464.00) was recorded from V_2T_3.

From the above findings it can be concluded that most of the parameters gave the best performance which was achieved from V_3 (BARI mung-6). Again, in terms magic growth application T_2 = soaking of seeds with magic growth + spraying on 35 DAS (before flowering) + spraying on 50 DAS (After 1st harvest) showed the best performance regarding most of the growth, yield and yield contributing parameters. In case of combined effect, BARI mung-6 and soaking of seeds with magic growth + spraying on 35 DAS (before flowering) + spraying on 50 DAS (After 1st harvest) gave the best result considering yield and yield contributing parameters. The highest yield (1456 kg ha^{-1}) was obtained from BARI mung-6 and soaking of seeds with magic growth + spraying on 35 DAS (before flowering) + spraying on 50 DAS (After 1st harvest). So, this treatment combination can be treated as the best treatment combination under the present study. With the increasing demand of protein and to meet the challenge of 21st century mungbean are needed with higher yield. It may be possible to increase the production of mungbean by applying different doses of foliar spraying fertilizers for late sowing mungbean in kharif season.

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Appendices

APPENDICES

Appendix 1. Monthly records of Temperature, Rainfall, and Relative humidity of the experimental site during the period from September to November 2014

Year	Month	Air Temperature (^{0}c)			Relative humidity (%)	Rainfall (mm)	Sunshine (hr)
		Maximum	Minimum	Mean			
2014	September	28.50	26.00	27.25	61.00	2.00	221.50
2014	October	28.60	27.50	28.50	72.70	3.00	227.00
2014	November	27.50	25.90	26.70	68.50	1.00	194.10

Source: Bangladesh Meteorological Department (Climate division), Agargaon, Dhaka-1207.

Appendix 2. The mechanical and chemical characteristics of soil of the experimental site as observed prior to experimentation

Particle size constitution:

Sand	:	40 %
Silt	:	40 %
Clay	:	20 %
Texture	:	Loamy

Chemical composition:

Constituents	:	0-15 cm depth
P^H	:	6.4
Total N (%)	:	0.07
Available P (µ gm/gm)	:	18.49
Exchangeable K (meq)	:	0.07
Available S (µ gm/gm)	:	20.82
Available Fe (µ gm/gm)	:	229
Available Zn (µ gm/gm)	:	4.48
Available Mg (µ gm/gm)	:	0.825
Available Na (µ gm/gm)	:	0.32
Available B (µ gm/gm)	:	0.94
Organic matter (%)	:	1.4

Source: Soil Resources Development Institute (SRDI), Farmgate, Dhaka.

Appendix 3. Effect of variety and magic growth on plant height of mungbean

Source of variation	Degrees of freedom	Mean square of plant height (cm)				
		20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	0.753	0.486	1.499	0.192	0.315
Factor A	2	4.201*	5.098*	6.313*	5.290*	6.308**
Factor B	3	8.295*	9.613*	12.877*	8.179*	11.148*
AB	6	6.039**	7.898*	10.655*	3.488**	8.313*
Error	22	0.871	1.781	1.621	3.042	2.051

Appendix 4. Effect of variety and magic growth on number of leaves of mungbean

Source of variation	Degrees of freedom	Number of leaves plant^{-1}				
		20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	0.316	0.393	0.537	1.237	0.679
Factor A	2	4.575*	8.258*	3.033*	5.704*	6.916*
Factor B	3	8.086*	9.762*	7.709*	9.652*	5.672*
AB	6	3.641^{NS}	1.235*	2.618*	4.301**	7.611*
Error	22	0.079	2.258	2.017	2.280*	3.579

Appendix 5. Effect of variety and magic growth on dry weight of mungbean

Source of variation	Degrees of freedom	Dry weight plant^{-1} (g)		
		20 DAS	40 DAS	60 DAS
Replication	2	0.004	0.005	0.028
Factor A	2	0.017**	0.051*	0.469*
Factor B	3	1.204*	0.607**	6.000*
AB	6	0.036**	0.154*	1.319*
Error	22	0.006	0.014	0.011

Appendix 6. Effect of variety and magic growth on yield contributing characters of mungbean

Source of variation	Degrees of freedom	Mean square of				
		Pod length (cm)	Number of pods plant^{-1}	Number of seeds per pod^{-1}	1000 seed weight (g)	Yield per m^2 (g)
Replication	2	0.005	1.803	0.854	0.146	4.220
Factor A	2	0.578*	15.994*	0.488*	13.422*	30.579*
Factor B	3	0.730**	18.888*	0.078**	25.664*	205.254*
AB	6	0.097**	7.148*	1.694*	15.766*	14.222*
Error	22	0.025	4.954	1.108	1.962	12.565

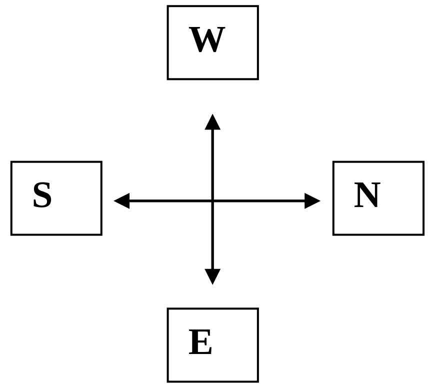
Appendix 7. Effect of variety and magic growth on yield attributes of mungbean

Source of variation	Degrees of freedom	Mean square of		
		Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
Replication	2	13.750	19.989	0.580
Factor A	2	194.937*	591.611*	3.000*
Factor B	3	320.492*	621.610*	18.968*
AB	6	39.641*	97.312*	11.943*
Error	22	24.026	26.422	3.389

V_1T_0	V_2T_1	V_3T_0
V_3T_3	V_3T_2	V_2T_2
V_1T_1	V_1T_2	V_1T_0
V_2T_2	V_3T_1	V_3T_3
V_1T_2	V_1T_3	V_2T_0
V_3T_1	V_3T_0	V_1T_0
V_1T_3	V_2T_3	V_3T_2
V_3T_0	V_1T_1	V_3T_1
V_2T_0	V_3T_3	V_2T_1
V_2T_3	V_2T_0	V_1T_2
V_3T_2	V_1T_0	V_1T_3
V_2T_1	V_2T_2	V_2T_3

Fig.1. Layout of the experimental field

Legend



Treatments:

Factor A: Variety

V1 = BARI Mung-4
V2 = BARI Mung-5
V3 = BARI Mung-6

Factor B: Magic Growth

T_0=Control
T_1= Soaking of seeds with magic growth
T_2= Soaking of seeds with magic growth+2 Times spray
T_3=Without soaking of seeds +3Times spray

Experiment layout:

Plot to plot distance = 0.5 m
Block to block distance =1.0m Plot size = 3×2 m^2
Replication = 3