EFFECT OF NITROGEN AND WEED MANAGEMENTS ON GROWTH AND YIELD OF MUNGBEAN

BY

SHAMIMA SULTANA

REGISTRATION NO. 00873

A Thesis
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

AGRONOMY

SEMESTER: JANUARY-JUNE, 2008

Approved by:

(Prof. Dr. Md. Jafar Ullah)
Supervisor

(Prof. Dr. Md. Fazlul Karim)
Co-Supervisor

(Prof. Dr. Md. Jafar Ullah)
Chairman
Examination Committee

Dedicated to
My
Beloved Parents

CERTIFICATE

This is to certify that the thesis entitled, **"Effect of nitrogen and Weed managements on the growth and yield of mungbean (*Vigna radiata* L.)"** 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 AGRONOMY,** embodies the result of a piece of bonafide research work carried out by **Shamima Sultana**, Registration No.00873 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.

(Prof. Dr. Md. Jafar Ullah)

Supervisor

Dated: 11.06.08

Dhaka, Bangladesh

ACKNOWLEDGEMENT

All praises to the creator, the Almighty Allah for his blessing on ability of author to complete the research work.

The author would like to express her heartiest gratitude, sincere appreciation and immense indebtedness to her supervisor ***Professor Dr. Md. Jafar Ullah,*** *Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, for his scholastic guidance, planning, valuable suggestions, continuous encouragements and all kinds of support and help throughout the period of research work and preparation of this manuscript of thesis.*

Heartiest gratitude is due to the respectable Co-supervisor ***Professor Dr. Md. Fazlul Karim****, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, for his valuable suggestions, kind co-operation and dynamic guidance throughout the study and research works.*

The author express my profound gratitude to her most honorable teachers ***Professor Sadrul Anam Sardar*** *and* ***Professor Dr. Md. Hazrat Ali*** *for their valuable advice, encouragement, proper assistance and keen supervision during the period of research works.*

The author express my sincere respect to the ***Professor Dr. Parimal Kanti Biswas****, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh for his valuable advice and sympathetic consideration during the study.*

*The author wish to record deep appreciation to her other course teachers **Professor Dr. A.K.M.Ruhul Amin, Associate professor Dr. H M. M Tariq Hossain** and Assistant **professor** Md. **Obaidul Islam.***

The author also thankful to Deuk bhaia, Mona apu, Daigi apu, Dipon, Subaita, Aritro, Lipu, Nipa and Rubel for their constant encouragement.

At last but not the least, the author feel indebtedness to her beloved parents whose sacrifice, endless prayers, blessings and support to reach for her at this level of higher education.

EFFECT OF NITROGEN AND WEED MANAGEMENTS ON GROWTH AND YIELD OF MUNGBEAN

ABSTRACT

An experiment was conducted at the experimental field of the Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka to evaluate the effect of nitrogen and weed managements on mungbean (*Vigna radiata* L.) during the period from March 2007 to June 2007. Different managements of nitrogen (0, 20 kg N ha^{-1} at vegetative, 20 kg N ha^{-1} at vegetative and flowering) and weeding (No weeding, one weeding at vegetative, two weeding at vegetative and flowering stage) were integrated. Results showed that application of 20 kg N ha^{-1} as basal + 20 kg N ha^{-1} with one weeding at vegetative stage showed significantly higher values of all growth parameters like number of leaflets (24.27 at 20 DAS and 24.27 at 40 DAS), leaf area (23.27 cm^2 at 20 DAS and 102.17 cm^2 at 40 DAS), leaf dry weight (0.30, 6.99 and 10.61gm at 10, 17 and 24, DAS respectively) and shoot dry weight (2.76 and 4.69 gm at 17 and 24 DAS, respectively). This treatment also produced significantly more number of branches (1.67), pods $plant^{-1}$(17.83) and seed yield ha^{-1}(1982.05 kg). Mungbean yield was attributed to shoot dry weight, pods $plant^{-1}$ and 1000-seedweight and shoot dry weight.

LIST OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF PLATES

LIST OF ACRONYMS

AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
FAO	=	Food and Agricultural Organization
ppm	=	parts per million
N	=	Nitrogen
et al	=	And others
TSP	=	Triple super phosphate
MP	=	Muriate of Potash
RCBD	=	Randomized complete block design
DAS	=	Days after sowing
ha^{-1}	=	Per hectare
g	=	gram(s)
kg	=	Kilogram
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Research and Development Institute
Hi	=	Harvest Index
No.	=	Number
WUE	=	Water use efficiency
wt	=	Weight
LSD	=	Least Significant Difference
0c	=	Degree Celsius
NS	=	Not significant
mm	=	millimeter
Max	=	Maximum
Min	=	Minimum
%	=	Percent
cv.	=	Cultivar
NPK	=	Nitrogen, Phosphorus and Potassium
CV%	=	Percentage of coefficient of variance
Hr	=	Hour

CHAPTER 1

INTRODUCTION

CHAPTRE 1

INTRODUCTION

Bangladesh is a developing country. The land of our country is limited. But the population is very high. More people need more food. Due to our huse population we have to produce more food in our limited land. To meet the increased demand of food, farmers are growing more cereal crops. Moreover due to the high population pressure the total cultivable land is decreasing day by day for housing. So at present the cultivation of pulse has gone to marginal land because no one does not want to use his fertile land in pulse cultivation. Pulse cultivation is also decreasing because of its low yield and low production. Besides this long term cereal crop cultivation also effects soil fertility and productivity which could be overcome by growing pulses.

Farmers of Bangladesh grows various types of pulse crops. Among them grasspea, lentil, mungbean, blackgram, chickpea, fieldpea and cowpea are important. It is an important food crops because it provides a cheap source of easily digestible dietary protein. Pulse protein is rich in amino acids like isoleucine, leucine, lysine, valine etc. According to FAO (1999) a minimum intake of pulse by a human should be 80 g per head per day, whereas it is only 14.19 g in Bangladesh (BBS, 2005). This is because of the fact that national production of the pulses is not adequate to meet the national demand.

Among the pulse crops, mungbean (*Vigna radiata* L.) has special importance in intensive crop production of the country for its short growing period (Ahmed *et al.*, 1978). In Bangladesh mungbean ranks third in acreage and production but ranks first in market price. Mungbean grain contains 51% carbohydrates, 26%

protein, 10% moisture, 4% mineral and 3% vitamins (Khan, 1981and Kaul, 1982). The green plants can also be used as animal feed and its residues have manural value. The crop is potentially useful in improving cropping pattern as it can be grown as a catch crop due to its rapid growth and early maturing characteristics. It can also fix atmospheric nitrogen through the symbiotic relationship between the host mungbean roots and soil bacteria and thus improves soil fertility. It may play an important role to supplement protein in the cereal-based low-protein diet of the people of Bangladesh, but the acreage and production of mungbean is steadily declining (BBS, 2005).

The dry period of Kharif-I is not favorable for mungbean germination. Kharif-II period is occupied by T- aman. Cultivation of high yielding varieties of wheat and winter rice has occupied considerable land suitable for mungbean cultivation. Beside these, low yield potentiality of these crops is responsible for declining the area and production. At present the area under pulse crops is 0.406 million hectares with a production of 0.322 million tones where mungbean is cultivated in the area of 0.108 million hectares with production of 0.03 million tones (BBS, 2005).

The average yield of mungbean is 0.69 t ha^{-1} (BBS, 2005) which is very poor in comparison to mungbean growing countries in the world. There are many reasons of lower yield of mungbean. The management of fertilizer is the important one that greatly affects the growth, development and yield of this crop. Pulses although fix nitrogen from the atmosphere, there is evident that application of nitrogenous fertilizers becomes helpful in increasing the yield (Patel *et al.*, 1984 and Ardeshana *et al.*, 1993). Nitrogen is most useful for pulse crops because it is the component of protein (BARC, 1997). Bachchhav *et al.* (1994) observed that root nodule weight

per plant was highest with 30 kg N ha^{-1}. Satyanarayanamma *et al.* (1996) reported that application of urea at flowering and pod development stage produced the highest seed yield and mungbean is a legume crop, it responds well to added nitrogen to overcome it's lag phase and It influences nutrient uptake by promoting root growth and nodulation (Singh *et al.*, 1999). Nitrogen enhances the uptake of other nutrients and increasing nitrogen content in the crop which increases protein content of mungbean (Soni and Gupta, 1999).

In Bangladesh, most of the lands are deficient in organic matter and nitrogen. Farmers generally use NPK i.e. chemical fertilizers usually in the forms of urea, TSP and MP. The prices of these fertilizers are very high and often unavailable in the market at the time of urgency. For this reasons, the poor and marginal farmers can not afford to apply balanced fertilizer. As a result, their crops do not give expected yield. The imbalanced application of chemical fertilizers is also detrimental to the soil and environment.

On the other hand weed is one of the most important factors responsible for low yield of mungbean is not very competitive against weed and therefore weed control is essential for mungbean production (Moody, 1978) because yield losses due to uncontrolled weed growth in mungbean range from 27 to 100%, specifically 27% in summer and 95% in wet season (AVRDC, 1976). Dry weight of weed increased as the duration of weed competition increased in crops (Islam *et al.*, 1989). All crops have a stage during their life cycle when they are particularly sensitive to weed competition. In general, it ranges up to first 25 to 50% of the life time of crops. In Bangladesh, there is a general believed that mungbean does not require any weeding. Hence, the farmers of this country do not use any weed control measure in mungbean field so the problem of weeds and their management such as time of wedding and frequency of weeding is difficult. when the seed bed is not thoroughly prepared and the weeds removed. Weed control is essential during the early growth stage of mungbean. One hand weeding is absolutely essential 20 days after planting, and two weeding are economical for successful mungbean production (BARI, 1996). In mungbean both nitrogen and weeding play an important role. Because weed crop competition commences with germination of the crop and continues till its maturity. The yield of mungbean may be increased through appropriate combination of proper nitrogen fertilizer and weeding regimes. The experimental evidences of the effect of nitrogen and weeding on mungbean performances is limited.

Hence the present study is under taken to maximize seed yield using optimum nitrogen dose with optimum weed managements.

Objectives:

- to determine the optimum dose of nitrogen for achieving maximum yield attributes and yield of mungbean
- to determine the influence of number of weeding operation on the yield of mungbean and
- to find out the interaction, if any between nitrogen and weeding regime on the yield and yield contributing characters of mungbean.

CHAPTER 2

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

In Bangladesh, pulse crops are generally grown without fertilizer and weeding. However researches are going on in many countries to maximize the yield of mungbean. Like other crops, mungbean also needs proper fertilization for its well growth and development. Again, weeds compete with crop plants for every growth factor and ultimately reduce the crop yield. An optimum nitrogen fertilizer with minimum weeding plays an important role in improving mungbean yield. Research works related to nitrogen fertilizer and weeding are limited in Bangladesh. Some available literature related to the present study has been reviewed below

2.1 Effect of different fertilizers on plant characters of mungbean

Effects of nitrogen fertilizers on mungbean

2.1.1 Plant height

Yein *et al.* (1981) conducted a field experiment on nitrogen in combination with phosphorus fertilizer to mungbean. They revealed that application of 40 kg N ha^{-1} increased plant height.

Trung and Yoshida (1983) conducted a field trial on mungbean in nutrient-rich soil, involving 0 -100 ppm N as treatments. They observed that maximum plant height at all the stages of plant growth were obtained by the application of 25 ppm N.

Sardana and Verma (1987) carried out a study in New Delhi, India in 1983-84. They found that application of nitrogen, phosphorus and potassium fertilizers in combination resulted in significant increase in plant height of mungbean.

Hamid (1988) conducted a field experiment to investigate the effect of nitrogen and carbon on the growth and yield of mungbean (*Vigna radiate* L. wilczek). He found that the plant height of mungbean cv. Mubarik was found to be increased with nitrogen at 40 kg ha^{-1}

Suhartatik (1991) in a study observed that increased application of NPK fertilizers significantly increased the plant height of mungbean.

Quah and Jaafar (1994) found that plant height of mungbean was significantly increased by the application of nitrogen fertilizer at 50 kg ha^{-1}.

2.1.2 Number of leaves

Srivastava and Verma (1982) showed that N application at the rate of 15kg ha^{-1} increased the number of green leaves, branches and dry matter accumulation in mungbean plants.

2.1.3 Leaf area

Sardana and Verma (1987) conducted an experiment in New Delhi, India, in 1983-84 and pointed out that application of nitrogen, phosphorus and potassium fertilizers resulted in significant increases in leaf area of mungbean. Suhartatik (1991) also reported that residue of lime with NPK fertilizers significantly increased the leaf area of mungbean. In a field trial, conducted by Bali *et al.*

(1991) on mungbean in the *Kharif* seasons on silty clay loam soil and reported that LAI increased with increasing nutrient up to 40 kg N and 60 kg P_2O_5/ha.

Due to increase in N uptake there was an increase in nucleic acid, amides and amino acids. This caused cell multiplication which in turn increased LAI (Agbenin *et al.1991*) found that applied N significantly increased the LAI of mungbean over the control.

2.1.4 Total dry matter

The total dry matter production is the integration of daily dry matter production over the entire growth period. The accumulation and pattern of dry matter distribution is controlled by the rate of photosynthesis, respiration and environmental conditions with management levels.

Yein (1982) carried out a field trial on mungbean in Assam, India and reported that combined application of nitrogen and phosphorus significantly increased the dry weight of plants.

Raju and Verma (1984) carried out a field experiment during summer season of 1979 and 1980 to study the response of mungbean var. Pusa Baishaki to varying levels of nitrogen (15, 30, 45 and 60 kg N ha^{-1}) in the presence and absence of seed inoculation with *Rhizobium*. They found that maximum dry matter weight per plant was obtained by the application of 60 kg N ha^{-1} inoculated with *Rhizobium*.

Agbenin *et al.* (1992) carried out a field experiment under glass house condition and found that nitrogen application significantly increased the dry matter yield of mungbean. In another study, Leelavathi *et al.* (1991) using different levels of nitrogen found a significant increase in dry matter production of mungbean with 60 kg N ha^{-1}.

Chowdhury and Rosario (1992) studied the effect of 0, 30, 60 or 90 kg N ha^{-1} levels on the rate of growth and yield performance of mungbean at los Banos, Philippines in 1988. They observed that N above the rate of 30 kg N ha^{-1} reduced the dry matter yield.

Santos *et al.* (1993) carried out an experiment on mungbean cv. Berken which was grown in pots in podzolic soil with 7 levels of N (0, 25, 50, 100, 200, 400 or 500 kg ha^{-1}). They noted that application of N up to 500 kg ha^{-1} increased the total dry matter.

Yakadri *et al.* (2002) studied the effect of nitrogen (40 and 60 kg ha^{-1}) on crop growth and yield of greengram (cv. ML-267). Application of nitrogen at 20 kg ha^{-1} resulted in the significant increase in leaf area ratios indicating better partitioning of leaf dry matter.

2.1.5 Number of flowers

Malik *et al.* (2003) conducted an experiment to determine the effect of varying levels of nitrogen (0, 25, and 50 kg ha^{-1}) and phosphorus (0, 50, 75 and 100 kg ha^{-1}) on the yield and quality of mungbean cv. NM-98 in 2001. They observed that number of flowers per plant was found to be significantly higher by 25 kg N ha^{-1}

2.1.6 Number of Pods

In an experiment, Yien *et al.* (1981) applied nitrogen and phosphorus fertilizers to mungbean and reported that combined application of nitrogen and phosphorus fertilizers increased the number of pods per plant. The rate of nitrogen and phosphorus was 50 kg and 75 kg per hectare, respectively.

Salimullah *et al.* (1987) reported that the number of pods per plant was highest with the application of 50 kg N ha^{-1} along with 75 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} in summer mungbean.

Patel and Parmer (1986) conducted an experiment on the response of greengram to varying levels of nitrogen and phosphorus. They observed that increasing N application to rainfed mungbean (cv. Gujrat-1) from 0 to 50 kg N ha^{-1} increased the number of pods per plant.

Sarkar and Banik (1991) reported that application of 10 kg N ha^{-1} to mungbean resulted in appreciable improvement in the number of pods per plant while compared with no nitrogen.

Tank *et al.* (1992) reported that mungbean fertilized with 20 kg N ha^{-1} along with 75 kg P_2O_5 ha^{-1} significantly increased the number of pods per plant. In trials, on clay soils during the summer season Patel *et al.* (1984) observed the effect of N levels (0, 10, 20 and 30 kg N ha^{-1}) and that of the P (0, 10, 20, 40, 60 and 80 kg P_2O_5 ha^{-1}) on the growth and seed yield of mungbean. In that experiment, it was found that application of 30 kg N ha^{-1} along with 40 kg P_2O_5 ha^{-1} significantly increased the number of pods per plant.

Srinivas *et al.* (2002) examined the effect of nitrogen (0, 20, 40 and 60 kg ha^{-1}) and P (0, 25, 50 and 75 kg ha^{-1}) on the growth and seed yield of mungbean. They observed that the number of pods per plant was increased with the increasing rates of N up to 40 kg/ha followed by a decrease with further increase in N.

2.1.7 Pod length

In a field trial, carried out by Sardana and Verma (1987) in Delhi, India, during 1983-84, it was found that application of nitrogen, phosphorus and potassium fertilizers resulted in significant increases in pod length of mungbean. Suhartatik (1991) noted that residue of lime with NPK fertilizer significantly increased the pod length of mungbean.

Tank *et al.* (1992) reported that mungbean fertilized with 20 kg N/ha could be assigned to significantly increase pod length over the rest of the higher (40 kg N/ha) and lower (unfertilized control) levels of N. They also observed that pod length significantly increased up to the levels of 40 kg P_2O_5/ha. In a field trial, carried out by Sarkar and Banik (1991), it was observed that application of 10 kg N/ha to mungbean resulted in appreciable improvement in pod length over the control.

Results of a field experiment conducted by Patel and patel (1991) revealed that pod length of mungbean varieties showed superiority at 60 kg P_2O_5/ha followed by 40 kg/ha P_2O_5 application rate. Thus pod length was found to be increased with increasing levels of phosphorus from 0 to 60 kg/ha. They also noted that *Rhizobium* culture did not show any effect on pod length.

Srinivas *et al.* (2002) studied the effect of nitrogen (0, 20, 40 and 60 kg/ ha) and phosphorus (0, 25, 50 and 75 kg/ha) on the growth and yield components of mungbean. They observed that pod length was increased with the increasing rates of N up to 40 kg/ha which was then followed by a decrease with further increase of N.

Malik *et al.* (2003) studied the effect of varying levels of nitrogen and phosphorus on mungbean cv. NM-98. It was reported that pod length was significantly affected by both nitrogen and phosphorus application.

2.1.8 Number of seeds per pod

Samiullah *et al.* (1987) conducted a field experiment and observed that number of seeds/pod were the highest with 10 kg N + 75 kg P_2O_5 + 60 kg K_2O in summer mungbean.

Malik *et al.* (2003) investigated the effect of varying levels of nitrogen (0, 25 and 50 kg ha^{-1}) and P (0, 50, 75 and 100 kg ha^{-1}) on the yield and quality of mungbean cv. NM-98 during 2001. It was found that number of seeds per pod was significantly affected by varying levels of nitrogen and phosphorus.

2.1.7 1000-seed weight

Patel *et al.* (1984) studied the effect of 0, 10, 20 and 30 kg N ha^{-1} and 0, 20, 40, 60 and 80 kg P_2O_5 ha^{-1} on the growth and seed yield of mungbean during summer season. They observed that application of 40 kg P_2O_5 ha^{-1} along with 20 kg N ha^{-1} significantly increased the 1000-seed weight of mungbean.
Sardana and Verma (1987) stated that application of nitrogen, phosphorus and potassium fertilizers combinedly resulted in significant increases in 1000 seed weight of mungbean.

A field experiment was conducted by Sarkar and Banik (1991) to evaluate the effect of varying rates of N on mungbean. Results revealed that application of 10 kg N ha^{-1} resulted in the appreciable improvement in different yield attributes along with 1000 seed weight over control.

Trung and Yoshida (1983) carried out an experiment on mungbean, spraying 0-100 ppm N in the form of ammonium nitrate or 10 or 100 ppm N as urea, sodium nitrate, ammonium nitrate or ammonium sulphate. Results showed that 1000 seed weight was the highest with 100 ppm N than all the forms of N.

Bali *et al.* (1991) conducted a field trail on mungbean in kharif seasons on silty clay loam soil. They revealed that 1000- seed weight increased with 40 kg N ha^{-1} and 60 kg P_2O_5 ha^{-1}.

Quah and Jaafar (1994) noted that 1000 seed weight of mungbean increased significantly by the application of nitrogen at 40 kg ha^{-1}.

Mahboob and Asghar (2002) studied the effect of seed inoculation at different nitrogen levels on the yield and yield components of mungbean at the Agronomic Research Station, Farooqabad in Pakistan during the year of 2000 and 2001. They revealed that various yield components like 1000 grain weight were affected significantly with 50-50-0 NPK kg ha^{-1} application.

Srinivas *et al.* (2002) conducted an experiment on the performance of mungbean at different levels of nitrogen and phosphorus. Different rates of N (0, 25 and 60 kg ha^{-1}) and P (0, 25, 50 and 60 kg ha^{-1}) were tested. They observed that 1000 seed weight was increased with increasing rates of N up to 40 kg ha^{-1} along with increasing rates of P and was then followed by a decrease with further increase in N.

2.1.8 Seed Yield

Werakonphanit *et al.* (1979) stated that mungbean showed no significant differences in response to different fertilizer levels. NPK levels of 0-0-0, 3-0-0 and

3-9-0 gave seed yield of 156, 168 and 175 kg ha^{-1} respectively. From the results of that study, it was concluded that the fertilizer application in mungbean was not necessary.

Yien (1982) conducted field trials on mungbean in Assasm, India and found that 10 kg N ha^{-1} in combination with 20 kg P ha^{-1} resulted in significant increase in the seed yield.

An experiment was conducted by Trung and Yoshida (1983) using 0-100 ppm N as treatment in the form of ammonium nitrate or 10 or 100 ppm N as urea, sodium nitrate, ammonium nitrate or ammonium sulphate. They found that seed yield of mungbean increased with the increase in N up to 50 ppm.

Raju and Verma (1984) reported that application of 15 - 60 kg N ha^{1} significantly increased seed yields of mungbean.

Results an experiment, conducted by Sardana and Verma (1987) in Delhi, India, revealed that the application of nitrogen, phosphorus and potassium fertilizers in combination resulted in the significant increase in seed yield of mungbean.

Pongkao and Inthong (1988) applied N at the rate of 0 - 60 kg ha^{-1} on mungbean and reported that application of 15 kg N ha^{-1} was found to be superior giving 23% higher seed yield over the control. However 60 kg N ha^{-1} tended to produce seed yield which was at part with that of 15 kg N ha^{1}.

Arya and Kalra (1988) reported that application of N at the rate of 50 kg ha^{-1} along with 50 kg P ha^{-1} increased mungbean yield.

Results from field experiments conducted by Mahadkar and Saraf (1988) during summer season of mungbean showed that the application of N: P: K at 20:2:5 kg ha^{-1} gave higher seed yield.

A field experiment was conducted by Sarkar and Banik (1991) to study the effect of N in combination with P on yield of mungbean. Results showed that application of N along with P significantly increased the seed yield of mungbean. The maximum seed yield was obtained with the combination of 20 kg N and 60 kg P_2O_5 ha^{-1}.

Leelavathi *et al.* (1991) showed significant increase in seed yield of mungbean by N 60 kg N ha^{-1}. While in another study Sarkar and Banik (1991) also reported that seed yield of mungbean increased significantly using 60 kg N ha^{-1}.

Chowdhury and Rosario (1992) had undertaken a study to evaluate the effects of 0, 30, 60 or 90 kg N ha^{-1} on the growth and yield performance of mungbean at Los Banos, Philippines in 1988. They noted that applied N at the levels above 30 kg/ha reduced the seed yield.

Patel *et al.* (1992) conducted a field trial to evaluate the response of mungbean to sulphur fertilization under different levels of nitrogen and phosphorus. Greengram cv. Gujrarat 2 and K 851 were given 10 kg N + 20 kg P ha^{-1}, 20 kg N + 40 kg P $ha^{-1}$and 0, 10, 20 or 30 kg S ha^{-1} as gypsum. Seed yield was 1.2 and 1.24 t ha^{-1} in Gujrarat 2 and K 851, respectively in the fertilizer contribution of 20 kg N + 40 kg P ha^{-1}.

Phimsirkul (1992) conducted a field trial on mungbean variety, U- Thong I grown in different soils under varying N levels. Results revealed that there was no effect of N fertilizer when mungbean was grown in Mab Bon soil. However, seed yield of mungbean was increased when the crop received N at 30 kg ha^{-1}

Tank *et al.* (1992) found that mungbean fertilized with 20 kg N along with 40 kg P_2O_5 ha^{-1} increased seed yield significantly over the unfertilized control.

Ardeshana *et al.* (1993) conducted a field experiment on clay soil during the rainy season of 1990 to study the response of mungbean to nitrogen. They observed that seed yield increased with application of nitrogen fertilizer up to 20 kg N ha^{-1} in combination with phosphorus fertilizer up to 40 kg P_2O_5 ha^{-1}

Sing *et al.* (1993) examined the effects of varying levels of N on mungbean cv. MH-85-61. They found that nitrogen application at the rate of 30 kg N resulted in the highest seed yield in mungbean.

Bachchhav *et al.* (1994) conducted a field experiment during the summer season with greengram cv. Phule-M. They observed that among nitrogen fertilizers rates (0 - 45 kg N ha^{-1}) seed yield increased with 30 kg N ha^{-1}

Kaneria and Patel (1995) conducted a field experiment on a Vartisol in Gujarat, India with mungbean cv. K 581 using 0 or 20 kg N ha^{-1} levels. They found that application of 20 kg N ha^{-1} significantly increased the seed yield (1.14 t ha^{-1}) when compared with that of control (1.08 t ha^{-1}).

In a field experiment conducted by Satyanarayanamma *et al.* (1996), five mungbean cultivars were sprayed with 2% urea at pre-flowering, flowering, pod development or at all the combinations or at combination of two of three growth stages. They reported that spraying urea at flowering and pod development stages produced the highest seed yield.

Karle and Pawar (1998) examined the effect of varying levels of N and P fertilizers on summer mungbean. They reported that mungbean produced higher seed yield with the application of 15 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1}.

A field experiment was carried out by Sharma and Sharma (1999) during summer seasons at Golaghat, Assam, India. Mungbean was grown using farmers practices (no fertilizer) or using a combinations of fertilizer (30 kg N+35 kg P_2O_5 ha^{-1}). Seed yield was 0.40 t ha^{-1} with farmer's practices, while the highest yield was obtained by the fertilizer application (0.77 t ha^{-1}).

Mandal and Sikder (1999) conducted a greenhouse pot experiment on mungbean cv. BARI Mung-5 under different N rates (0, 20 and 30 kg ha^{-1}). They noted that the seed yield increased (700, 800 and 900 kg ha^{-1}) significantly with increased N application.

Mahboob and Asghar (2002) studied the effect of seed inoculation at different nitrogen levels on mungbean at the agronomic research station, Farooqabad in Pakistan. They revealed that seed inoculation +50-50-0 NPK kg ha^{-1} exhibited superior performance in respect of seed yield (955 kg ha^{-1}).

Malik *et al.* (2003) conducted an experiment to determine the effect of varying levels of nitrogen (0, 25 and 50 kg ha^{-1}) and phosphorus (0, 50, 75, and 100 kg ha^{-1}) on the yield and quality of mungbean cv. NM-98. Growth and yield components were significantly affected by varying levels of nitrogen and phosphorus. A fertilizer combination of 25 kg N + 75 kg P_2 O_2 ha^{-1} resulted with maximum seed yield (1112.96 kg ha^{-1}).

Mozumder *et al.* (2003) conducted an experiment to study the effect of different nitrogen levels viz. 0, 20, 40, 60 and 80 kg N ha^{-1} on Binamoog-2 and they observed that increase of nitrogen fertilizer increased seed yield up to 40 kg N ha^{-1} and that was 1607 kg ha^{-1}.

Rajender *et al.* (2003) investigated the effects of N (0, 10, 20 and 30 kg ha-1) and P (0, 20, 40 and 60 kg ha^{-1}) fertilizer rates on mungbean genotypes MH 85-111 and T44. Grain yield increased with increasing N rates up to 20 kg ha^{-1}. Further increase in N did not affect yield.

Nadeem *et al.* (2004) studied the response of mungbean cv. NM-98 to seed inoculation and different levels of fertilizer (0:0, 15:30, 30:60 and 45:90 kg N-P_2O_5 ha^{-1}) under field conditions. Application of fertilizer significantly increased the yield and the maximum seed yield was obtained when 30 kg N ha^{-1} was applied along with 60 kg P_2O_5 ha^{-1}

Asaduzzaman *et a* .(2006a) conducted a field experiment at the Sher-e-Bangla Agricultural University. They tested different levels of nitrogen (0, 20, 30 and 40) at different times (basal, split and basal+split) with one irrigation at first flowering stage and found that 30 kg nitrogen/ha as basal with one irrigation gave the highest seed yield per hectare and that was 1.6 t/ha.

2.1.9 Harvest Index

Harvest index is the ratio of economic yield to the biological yield reflected by the translocation of assimilates to the grain.

Mozumdar *et al.* (2003) conducted a field experiment at the Bangladesh Agricultural University, Mymensingh. They tested five levels of nitrogen (0, 20, 40, 60 and 80 kg ha^{-1}) and two varieties of summer mungbean viz., Binamoog-2 and Kanti. The results revealed that nitrogen application had negative affect on the harvest index in both the varieties.

Asaduzzaman *et al.* (2006) conducted a field experiment at the Sher-e-Bangla Agricultural University. They tested different levels of nitrogen (0, 20, 30 and 40) at different times (basal, split and basal+split) with one irrigation at first flowering stage and found that 30 kg nitrogen as basal with one irrigation at first flowering stage gave the highest harvest index compare to other levels of nitrogen and control treatments.

2.2 Effect of weeding on the yield and yield contributing characters on mungbean

Weed is one of the worst enemies of mungbean as it competes with the crop for space, nutrient, water and light and finally reduces its yield. Besides causing a considerable reduction in yield, weeds deplete soil fertility, particularly nitrogen and increase incidence of insect pests. Some of the work which is pertinent to the present study has been reviewed here.

Sing *et al.* (1971) stated that while early weed competition was prevented, the subsequent vigorous strands of the crop smothered out the late emerging weeds. They also stated that if weeding operation in *kharif* fodder was neglected for a fortnight or so, it was rather impossible to compensate for the losses already had taken place.

Madrid and Vega (1971) conducted an experiment on the effect of the duration of weed control and weed competition on the yield of mungbean for two successive seasons. Optimum yield was obtained when the fields were kept weed free for 5 weeks from planting during the wet season and 3 weeks weed free period in wet season. An yield of 1020.83 kg ha^{-1} was obtained from the 5 weeks weed free period in wet season. Weeds that grew after the period were not so detrimental to the crop. Allowing weeds to compete with the crop for 3 weeks from panting caused considerable yield reduction particularly in wet season. This finding emphasized the need for early weed control during the wet season. If weeds were left uncontrolled, the yield of mungbean was reduced by as much as 90%.

Retinahm *et al.* (1974) observed that grain yield attributes were inversely conrrelated with dry matter of weeds. The highest dry matter (438 g m^{-2}) of weeds resulted in the lowest grain yield (192 kg ha^{-1}) and reduced the number of seeds pod^{-1} (7) and number seeds pod^{-1} (9) number of pods plant^{-1} (11) were recorded where weed dry matter as minimum (138 m^{-2}).

Enyi (1975) Suggested that in mungbean weeding two weeks after sowing was significantly superior to that at either 4 or 8 weeks after sowing. Plants in the plots weeded 8 weeks after sowing and in the unweeded plots had few or no branches. Late weeding and no weeding reduced the proportion of dry matter diverted into the side stems. The number of pod^{-1} at harvest was highest (30) in the plots where two weeding 2 and 4 weeks after sowing respectively were done and was lowest in the nuweeded plots. Grain yield was also highest (967 kg ha^{-1}) in plots that received weeding 2 and 4 weeks after sowing and the lowest (278 kg ha^{-1}) in the unweeded plots.

Sing (1975) observed that mungbean plants grown in two weeded plots were taller and had maximum number of branches and pods plant^{-1} but the yields form the two weeded plots were identical to that from one weeded plots. They also found that plant productivity (pods plant^{-1}) improved markedly due to reduction in weed infestation in cowpea.

Vats and Sidhu (1976) reported that higher grain yield under weed free treatment could be ascribed for better crop growth since the weed population remained lower at 30 days of crop stage which was considered to be the critical for controlling weeds.

In a study on the competition of weeds in mungbean, Castin *et al.* (1976) observed that dry matter content of weeds in the unweeded, one hand weeded and two hand weeded plots were 154, 292 and 325 kg ha^{-1} respectively.

Sing and Faroda (1977) reported that weeds were serious problem in greengram (*Vigna radiata*) during *Kharif* season. Most of the weeds emerged in the early stages along with crop seedlings and competed with them for nutrients and they concluded that yield reduction as a result of crop weed competition was one of the important features in greengram production.

The yield loss of barley grain due to weed infestation ranged from 10 – 35% (Gupta and Lamb, 1987). It may even range upto 100% (Mann and Barnes, 1977).

The yield loss of mungbean was 95% during dry season in Philippines (Madrid and Vega, 1971). Yield losses due to uncontrolled weed growth in mungbean ranged from 27% to 100% (AVRDC, 1976; Vats and Sidhu, 1976; Madrid and Manimtim, 1977).

Vats and Sidhu (1977) reported that weeds reduced the yield of mungbean by 50%. One weeding at 4 weeks after sowing was quite effective in controlling weeds. Weed free condition of 2 to 4 weeks after sowing and throughout the cop season gave comparable results. They concluded that in case of mungbean critical period of crop weed competition was 4 to 6 weeks.

Panwar and Pandey (1977) conducted an experiment on weed control in Bengal gram in which seed yield of 1.63 t/ha, 2.72 t/ha and 3.25 t/ha were obtained form no weeding, two hand weeding and weed free condition, respectively.

The magnitude of yield loss due to weed was found to be depend on environmental condition and weed growth. Yield loss was 60% during spring and 27% during summer in Taiwan (AVRDC, 1976).

The knowledge of critical period of weed competition is a pre-requisite for a good harvest. Panwar and Singh (1980) reported that weeding of mungbean at 20 DAE could effectively produce yields twice than that of unweeded plots.

The harmful effect of wed infestation does not begin just after emergence of seedling; rather the competition between the weeds and crop is the most severe at a particular stage of crop growth which is known as critical period of crop-weed competition (Shahota and Govinda , 1982).

Muse *et al.* (1982) conducted an experiment on weed competition in summer mungbean and Black gram at BARI sub-station at Rajbari. In both mungbean and black gram grain yield increased considerably due to weeding. They attributed the yield to the increased number of pods/plant and number of seeds/pod. Two weeding treatments gave maximum net benefit of Tk. 8195.00/ha with the variety Mubarik of mungbean. In blackgram, maximum net benefit (Tk. 4044.00/ha) was obtained in no-weeding control.

Removal of weeks at 10, 20 or 30 days after sowing produced higher yields of mungbean than weedy check (Yadav *et al.*, 1983).

Variable number of weedings in mungbean have been suggested viz., one weeding at 2 weeks after emergence (Sarker and Mondal, 1985), two weedings during early growth stage (Madrid and Vega, 1984), and three weedings during the first 3 weeks after sowing (Enyi, 1984) for optimum yield.

Sarker and Mondal (1985) observed that weeding at different dates after sowing affected some yield contributing characters and yield of mungbean. Grain yield was by 49 to 55% when weeds were not removed at all.

Karim *et al.* (1986), found that critical period of weed competition was in between 20 and 30 days after sowing in jute. The critical period of crop/weed competition was determined in direct seeded Aus rice (Mamun *et al.* 1986), transplanted Aus rice (Ahmed *et al.* 1986).

Kumar and Kairon (1988) found that weed biomass increased mungbean yield decreased with delay in weeding. However, delay in weeding did not affect the number of seeds pod^{-1}.

Higher yield of mungbean was observed in the early-weeded plots compared to late/unweeded plots (Singh *et al.*, 1988).

Pascua (1988) determined the critical period of weed control and competition on mungbean yield. The treatments that gave lower fresh weight of weed had higher number of seeds/pod. Higher percent yield reduction was recorded when the mungbean plants were exposed to longer weed competition.

Dry matter was maximum under weed free condition followed by weed removal at 30 and 40 days after sowing (Kumar and Kairon, 1988).

Critical period of weed competition is the minimum weed free period essential during the life cycle of a crop to prevent yield loss. The critical period of weed control in interference study is the period up to which the weeds would be allowed without significant yield losses of crops (Bryson, 1990).

Maximum seed yield was obtained when weeds were removed 20 days after sowing. In competition study, 20% yield reduction in soybean occurred if weed control measure was not taken prior to 5 weeks after emergence (Crook and Renner, 1990; Marwat and Nafziger, 1990).

The critical period of crop/weed competition was determined in mungbean in cotton (Bryson, 1990); in wheat (Islam *et al.*,1989) and in mustard (Dashora *et al.*, 1990)

Bulb yield losses of about 79-89% due to weed infestation have been reported (Ahmed, 1991).

Weeds significantly reduced crop yield and quality in conventional and organic (Bulson, 1991) crops.

Ahmed *et al.* (1992) found that one hand weeding at 10 or 20 DAE produced higher yield than unweeded plots in mungbean during early Kharif.
Ahmed *et al.* (1992) also observed highest grain yield of mungbean when weeded at 10 DAE.

Weaver *et al.* (1992) found that the critical weed-free period represents the time interval between two separately measured components: the maximum weed-infested period or the length of time in which weeds have emerged with the crop and can remain before they begin to interfere with crop growth; and the minimum weed free period or the length of time a crop must be free of weeds after planting in order to prevent yield loss.

Ashik *et al.* (2007) conducted an experiment and observed that delay in weeding of munbean increased in the duration of crop/weed competition beyond 15 DAE, progressively reduced 54% seed yield than no weeding. Delay in weeding also reduced number of nodes plant^{-1}, number of seeds pod^{-1} and seed size of mungbean. The critical period of crop/weed competition appeared to be between 15 and 30 DAE. Delay in time of weeding reduced mungbean biomass and increased biomass of weed. Unrestricted (no-weeding) growth of weed through out the crop cycle reduced seed yield by 65 & 61% in 33 plant m^{-2} and 40 plants m^{-2} respectively and 43% in 66 plants m^{-2} density and mungbean biomass by 27% but increased weed biomass by about 3 times compared to weeding at emergence.

Asaduzzaman *et al.* (2008b) conducted an experiment and observed that all yield contributing parameters were highest when the field was weed free for the entire growth duration and weed free during 25-35 days after sowing and 35-45 days after sowing gave the similar results to the weed free plots for entire period. The maximum net returns and cost benefit ratio of mungbean cultivation was calculated when the crop field remained weed free during 25-35 days after sowing and 35- 45 days after sowing.

CHAPTER 3

MATERIALS AND METHODS

CHAPTER 3

MATERIALS & METHODS

The experiment was conducted at the Agronomy Field of Sher-e-Bangla Agricultural University, Dhaka during the *summer* season of March to June, 2007 to study the effects of nitrogen and weed managements on mungbean. Materials used and methodologies followed in the present investigation have been described in this chapter.

3.1 Description of the experimental site

3.1.1 Site and soil

Geographically the experimental field is located at $23^{0}\,77^{'}$ latitude and $90^{0}\,33^{'}$ E longitude at an altitude of 9 m above the mean sea level. The soil belongs to the Agro-ecological Zone – Modhupur Tract (AEZ 28). The land topography is medium high and soil texture is silt loam with pH 5.56 The morphological, physical and chemical characteristics of the experimental soil have been presented in Appendix-II.

3.1.2 Climate and weather

The climate of the locality is subtropical which is characterized by high temperature and heavy rainfall during *kharif* season (March-September) and scanty rainfall during *Rabi* season (October-March) associated with moderately low temperature. The prevailing weather conditions during the study period have been presented in Appendix-III.

3.2 Plant materials

BARI mung-6 was used as planting material which is a newly released cultivar and was introduced by Asian Vegetable Research and Development Center (AVRDC) in 2003. The cultivar is suitable for growing in the summer season. Plant height of the cultivar ranges from 60 to 70 cm. It is resistant to *cercospora* leaf spot and tolerant to yellow mosaic virus. Its life cycle is about 60 to 65 days to mature in the summer season. Two of the main characteristics of this cultivar are bold headedness and synchronization of pod ripening. Average yield of this cultivar is about 1500 kg ha^{-1} compared to 1400 kg ha^{-1} for the check cultivar BARI mung-5 (BARI, 2005). It has a 30% yield advantage over the variety of Pabna local check. The seeds of this variety were collected from the Pulse Research Centre of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. Before sowing, the seeds were tested for germination in the laboratory and the percentage of germination was found to be over 90%.

3.3 Treatments under investigation

Following treatments were tested

T_1 = No nitrogen and no weeding (Control)

T_2 = No nitrogen + one weeding at vegetative stage

T_3 = No nitrogen + two weeding (First weeding at vegetative stage and 2^{nd} weeding at flowering stage)

T_4 = 20 kg N/ha as basal with no weeding

T_5 = 20 kg N/ha as basal + one weeding at vegetative stage

T_6 = 20 kg N/ha as basal + two weeding (First at vegetative stage and 2^{nd} at flowering stage)

T_7 = 20 kg N/ha as basal + 20 kg N/ha as split at vegetative stage with no weeding

T_8 = 20 kg N/ha as basal + 20 kg N/ha as split at vegetative stage with one weeding

T_9 = 20 kg N/ha as basal + 20 kg N/ha as split at vegetative stage + two weeding (1st at vegetative stage and 2nd at flowering stage)

T_{10} = 20 kg N/ha as basal + 20 kg N/ha as split at vegetative + 20 kg N/ha as split at flowering stage with no weeding.

T_{11} = 20 kg N/ha as basal +20 kg N/ha as split at vegetative stage + 20kg N/ha as split at flowering stage + one weeding at vegetative stage.

T_{12} = 20 kg N/ha as basal + 20 kg N/ha as split at vegetative stage + 20 kg N/ha as split at flowering with two weeding (1st at vegetative stage and 2nd at flowering stage)

3.4 Land preparation

The land was irrigated before ploughing. After having field capacity, condition the land was first opened with the tractor drawn disc plough. Ploughed soil was then brought into desirable fine tilth by 4 of ploughings followed by, harrowing and laddering. The stubble and weeds were removed. The first ploughing and the final land preparation were done on 25 March and 27 March, 2007 respectively. Experimental land was divided into unit plots following the design of experiment. The plots were spaded one day before planting and the basal dose of fertilizers was incorporated thoroughly.

3.5 Experimental design and layout

The experiment was laid out in a Randomized complete block design (RCBD). Each treatment was replicated three times. The size of each plot was 3.0 m × 2.0m. The distance between two adjacent replications (block) was 1.5 meter and plot-to-plot distance was 1 meter. The intra block and plot spaces were used as irrigation and drainage channels. Laying out of the experiment was done on 27 March, 2007.

3.6 Fertilizer application

Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP) were used as a source of nitrogen, phosphorous, and potassium respectively. Nitrogen was applied in the experiment as per treatment. P_2O_5 and K_2O were applied as basal dose at the rate of 48 and 33 kg per hectare, respectively following the BARI recommendation (BARI, 2005).

3.7 Germination test

Germination test was performed before seed sowing in the field. Three layers of filter papers were placed on petridishes. Each petridish contained 100 seeds. Germination percentage was calculated by using the following formula.

$$\% \text{ Germination} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds taken for germination}} \times 100$$

3.8 Sowing of seeds in the field

The seeds of mungbean were sown on March 28, 2007 at the rate of 30 kg ha^{-1}. Seeds were treated with a fungicide named Bavistin before sowing the seeds to control the seed borne disease. The seeds were sown in solid rows in the furrows having a depth of 2-3 cm. Row to row distance was 30 cm.

3.9 Emergence of seeds from soil

Seed germination occurred from 3^{rd} day of sowing. On the 4^{th} day the percentage of germination was more than 85% and on the 5^{th} day nearly all baby plants came out of the soil.

3.10 Intercultural operations

3.10.1 Weeding and thinning

Weeding were done as per treatments and two thinning were done ; first at 8 days after sowing and second was done at 15 days after sowing (DAS) to maintain proper plant population in each plot (333333 plants ha^{-1}) maintaining plant to plant distance of 10 cm.

3.10.2 Irrigation and drainage

Two irrigations were given as there was symptoms of moisture stress during the experimentation. First at 10 days and second at 30 days after sowing. During last experimental period, there was heavy rainfall for two times. So it was essential to remove the excess water from the field.

3.10.3 Insect and pest control

At early stage of growth, few worms (*Agrotis ipsilon*) and virus vectors (jassid) attacked the young plants and at latter stage of growth pod borer (*Maruca testulalis*) attacked the plant. Dimacron 50EC was sprayed at the rate of 1litre/ha.

3.11 Determination of maturity

At the time when 80% of the pods turned brown colour, the crop was assessed to attain maturity.

3.12 Harvesting and sampling

The crop was harvested at 70 DAS from prefixed 1.0 m^2 areas. Before harvesting ten plants were selected randomly from each plot and were uprooted for data recording. The rest of the plants of prefixed $1m^2$ areas were harvested plot wise and were bundled separately, tagged and brought to the threshing floor.

3.13 Threshing

The crop was sun dried for three days by placing them on the open threshing floor. Seeds were separated from the plants by beating the bundles with bamboo sticks.

3.14 Drying, cleaning and weighing

The seeds thus collected were dried in the sun for reducing the moisture in the seeds to a constant level. The dried seeds and straw were cleaned and weighed.

3.15 Recording of characters

The following data were recorded

i. Plant height
ii. Number of branches $plant^{-1}$
iii. Number of leaf let per $plant^{-1}$
iv. Leaf area
v. Leaves dry weight
vi. Shoot dry weight
vii. Root dry weight
viii. Number of pods $plant^{-1}$
ix. Pod length
x. Number of seeds pod^{-1}
xi. 1000- seed weight
xii. Seed yield

3.16 Out line of data recording

i) Plant height (cm)

The heights of ten plants were measured with a meter scale from the ground level to the top of the plants and the mean height was expressed in cm.

ii) Number of branches plant^{-1}

Number of branches plant^{-1} was counted from each selected plant sample and than averaged at 20 and 40 days after sowing.

iii) Number of leaf let plant^{-1}

Number of leaflet plant^{-1} was counted from each selected plant sample and than averaged at 20, and 40 days after sowing.

iv) Leaf area (cm)

Leaf area was recorded from each leaf through its length and breadth and it was corrected by using a correction factor of 0.6. It was also counted at 20 and 40 days after sowing

v) Leaf dry weight

Ten plants were randomly selected from each treatment and leaves were separated from each plant. Then each leaves were dried separately in oven at 72^0 C for 72 hours and weight was taken carefully. This procedure was done at 10,17 and 24 days after sowing.

vi) Shoot dry weight

Shoot were separated from each plant. These stems were dried separately in oven for 72 hours and dry was taken carefully. This procedure was done from 10 DAS, 17 DAS and 24 DAS.

vii) Root dry weight

Root was separated from each treatments and each plant. These root were dried separately in oven for 72 hours and dry was taken carefully. This procedure was done from 10 DAS, 17 DAS and 24 DAS.

viii) Number of pods plant^{-1}

Number of total pods of ten plants from each plot was counted and the mean number was expressed on per plant basis. This procedures was done at 40 and 60 days after sowing

ix) Number of seeds pod^{-1}

Number of seeds pod^{-1} was counted from twenty selected pods and then the average seed number was calculated.

x) Pod length

Ten pods were randomly selected from each treatment and pod length was measured and then the averaged length was recorded in cm.

xi) 1000- seed weight

One thousand cleaned dried seeds were counted randomly from each harvest sample and weighed by using a digital electric balance and weight was expressed in gram (g).

xii) Seed yield

Seed yield was recorded on the basis of total harvested seeds $plot^{-1}$ and was expressed in terms of yield (kg ha^{-1}). Seed yield was adjusted to 12% moisture content.

3.17 Data analysis technique

The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of a computer package program MSTAT-C and the mean differences were adjusted by DMRT (Duncan's Multiple Range Test).

CHAPTER 4

RESULT AND DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSION

The results of the experiment were presented and discussed in this chapter. For the convenience of easy understanding results were presented and discussed under sub heading and data were presented in Table or Graph.

4.1 Effects of nitrogen and weeding on the growth characters of mungbean

4.1.1. Plant height

The results showed that the effect of integrated nitrogen and weeding on plant height was significant at 20, 40 and 65 DAS (Table 1). At 20 DAS maximum plant height (18.53 cm) was observed in treatment T_9 which is statistically similar with T_8, T_7, T_6, T_{12}, T_5, T_{11}, T_{10}, and T_2. Treatment T_8 produced second highest plant height. But at 40 DAS maximum plant height (42.19 cm) was recorded from treatment T_8 followed by T_{12} and these were statically similar with T_9, T_{11}, T_6, T_5, T_7, T_{10} and T_4. Results indicated that early weeding and basal+split nitrogen application favoured the mungbean plants to have better growth and produced the tallest plants. At 60 DAS, the highest plant height (67.00 cm) was recorded in T_8 followed by T_9, T_{12}, T_6, T_5, T_{11}, T_{10} and T_4. The lowest height was obtained from control for all the growth stages and it might be due to the no nitrogen and high weed species restricted to the plant growth and development (Table 1). Similar results were also observed in mungbean by Asaduzzaman *et al*. (2008 a) and they explained that without nitrogen plant growth is restricted and for that plant height of mungbean was low.

Table 1 Effect of nitrogen and weed managements on plant height of mungbean at different days after sowing

Treatments	Plant height (cm)		
	20 DAS	**40 DAS**	**60 DAS (At harvest)**
T_1	12.83 c	27.58 c	43.34 d
T_2	14.78 a-c	32.21 bc	50.83 cd
T_3	14.38 bc	31.67 bc	51.96 b-d
T_4	17.48 ab	35.49 ab	57.49 a-c
T_5	17.96 ab	39.55 a	64.06 a
T_6	18.14 ab	39.95 a	64.71 a
T_7	18.22 ab	37.79 ab	61.22 ab
T_8	18.40 ab	42.19 a	67.00 a
T_9	18.53 a	41.47 a	66.08 a
T_{10}	16.29 a-c	35.86 ab	58.09 a-c
T_{11}	17.24 ab	41.29 a	63.15 a
T_{12}	18.04 ab	41.73 a	65.69 a
SE	**1.208**	**2.123**	**8.75**
CV(%)	12.42	9.88	3.003

Means in a column with same letter (s) did not differ significantly at 5% level of probability

4.1.2 Number of branches plant^{-1}

Number of branches plant^{-1} was not significantly influenced by nitrogen and weed managements at 20 DAS. Numerically, the maximum numbers of branches plant-1(1.00) were produced in treatment T_8, T_9, T_{11} and T_{12} (Table 2.). T_1, T_2, T_3, T_4 and T_7 produced lowest and similar number of branches plant^{-1}(0.33). On the other hand T5, T_6 and T_{10} were produced same number of branches plant^{-1}(0.67) at 20 DAS. But at 40 DAS number of branches plant^{-1} was significantly influenced by the treatments variation and the maximum number of branches plant^{-1}(1.67) was produced by treatment T_8 followed by T_9, and T_{12}, T_{11}, T_6, T_5, T_3, T_{10} and T_3 produced intermediate number of branches palnt^{-1} and all were statistically similar to each other and also T_8(Table 2). It's might be due to the weed free as well as less competitive crop environment and proper nutrition that helped plants to under proper cell division and lateral development. Similar results were also found in mungbean by Sing *et al.* (1990). The lowest number of branches (0.99) was found in T_7 which was statistically similar with control (no nitrogen and no weeding) at 60 days. The result was in agreement with the findings of Asaduzzaman *et al.* (2008a) who reported that lack of nutrition in mungbean restricted the increased production of branches plant^{-1}.

Table 2 Effect of nitrogen and weed managements on number of branches plant^{-1} of mungbean at different days after sowing

Treatments	Number of branches plant^{-1}	
	20 DAS	**40 DAS**
T_1	0.33	1.00 d
T_2	0.33	1.18 b-d
T_3	0.33	1.27 a-d
T_4	0.33	1.07 cd
T_5	0.67	1.30 a-d
T_6	0.67	1.37 a-d
T_7	0.33	0.99 d
T_8	1.00	1.67 a
T_9	1.00	1.57 ab
T_{10}	0.67	1.21 b-d
T_{11}	1.00	1.47 a-c
T_{12}	1.00	1.57 ab
SE	**NS**	**0.120**
CV%	25.44	16.06

Means in a column with same letter (s) are not significantly different at 5% level of probability

4.1.3 Number of leaflets plant^{-1}

Number of leaflet plant^{-1} was not significantly influenced by the treatments at 20 DAS however the maximum number of leaflets plant^{-1} (11.04) was found in T_8 followed by T_6 and control plot produced lowest number of leaflets plant^{-1}.One the other hand at 40 DAS leaflet, were significantly influenced by the treatments difference and significantly the highest number of leaflet per plant^{-1}(24.27) were found in T_8 which however statically similar with T_{12}, T_9, and T_6. Probably due to the optimum dose and proper time of nitrogen application under weed free condition created a favorable condition to plants to producing maximum leaflet plant^{-1}. T_5 and T_{11} were gave intermediate number of leaflets plant^{-1} and both were statistically similar to each other. No nitrogen and no weeding (control) treatment produced the lowest number of leaflets plant^{-1}(16.47)(Table 3). Plants produced less amount of vegetative organ as well as leaflets plant^{-1} as there were low amount of nitrogen and high competition with weeds.

Table 3 Effect of nitrogen and weed managements on the number of leaflets plant^{-1} of mungbean at different days after sowing

Treatment	Number of leaflets plant^{-1}	
	20 DAS	**40 DAS**
T_1	8.70	16.75 c
T_2	8.87	18.41 c
T_3	8.63	18.27 c
T_4	9.84	19.11 c
T_5	10.78	22.38 ab
T_6	10.89	22.60 a
T_7	9.92	19.61 bc
T_8	11.04	24.27 a
T_9	10.79	23.31 a
T_{10}	9.46	19.64 c
T_{11}	10.34	22.47 ab
T_{12}	10.83	23.79 a
SE	**NS**	**0.900**
CV(%)	11.24	7.46

Means in a column with same letter (s) are not significantly different at 5% level of probability

4.1.4. Leaf area:

Mungbean was influenced by nitrogen and weeding managements at 20 DAS and 40 DAS. Observation at 20 DAS revealed that maximum leaf area was found with T_8 and numerically it was 53.27 cm^2. Treatments T_9, T_6, T_{12}, T_5 and T_{11} were gave the statistically similar leaf area plant^{-1} with T_8. Other treatments gave intermediate number of leaflets leaf let^{-1}. At 40 DAS T_8 also produced maximum leaf area value leaf area value than other treatments observation which statistically similar with T_9, T_6, T_{12}, T_5 and T_{11}. Both observations the control plots showed the lowest leaf area leaflet^{-1} (46.95 cm^2 and 99.18 cm^2, respectively)(Table 4). It was obvious that imbalanced nutrition and weed stress restricted the leaf development.

Table 4 Effect of nitrogen and weed managements on leaf area of mungbean at different day after sowing

Treatments	Leaf area (cm^2 leaflet^{-1})	
	20 DAS	**40 DAS**
T_1	16.95 d	69.18 c
T_2	17.95 cd	74.85 bc
T_3	17.14 d	74.57 bc
T_4	18.55 b-d	79.47 bc
T_5	31.41a-c	94.21 a
T_6	32.29 ab	95.16 a
T_7	19.38 b-d	80.90 b
T_8	23.27 a	102.17 a
T_9	23.10 a	99.48 a
T_{10}	18.79 b-d	82.67 b
T_{11}	21.22 a-c	93.75 a
T_{12}	22.18 ab	97.98 a
SE	**1.126**	**3.466**
CV(%)	9.66	6.90

Means in a column with same letter (s) are not significantly different at 5% level of probability

4.1.5 Leaf dry weight:

Nitrogen and weeding did not significantly increased the leaf dry weight at 10 DAS. This was a general phenomenon of mungbean being a legume crop whose initial mungbean shows lag phase. But during the later stage mungbean positively significantly responded to nitrogen and weed managements. Significant variation in leaf dry weight plant^{-1} was observed among the different treatments at 17 DAS, where the maximum value of total leaf dry matter plant^{-1} was recorded in T_9 (7.51 g). However the second highest value of total leaf dry matter obtained from T_{12}. Similarly at 24 DAS maximum leaf dry weight was obtain from T_9 (11.55 g) and second highest was obtained from T_{12}. Treatments T_2 and T_3 that were related to no nitrogen application showed lower performance to produced leaf dry weight plant^{-1}(Table 5). Unweeded and no nitrogen applied plots produced the lowest value of mungbean leaf dry weight. This result demonstrated that either delay or no weeding reduced crop biomass. Kumar and Kiron (1988) also obtained maximum biomass under weed free condition of mungbean. Yakadri *et al* (2002) observed that application of nitrogen increased the leaf area indicating better partitioning than under no nitrogen application.

Table 5 Effect of nitrogen and weed managements on leaf dry weight of mungbean at different day after sowing

Treatments	Leaf dry weight (g plant^{-1})		
	10 DAS	**17 DAS**	**24 DAS**
T_1	0.23	4.82 e	7.22 e
T_2	0.24	5.30 de	8.30 de
T_3	0.23	5.26 e	8.23 de
T_4	0.27	5.50 c-e	8.61 c-e
T_5	0.29	6.44 a-c	10.08 a-c
T_6	0.30	6.51 a-c	10.18 ab
T_7	0.27	5.65 c-e	8.84 cd
T_8	0.30	6.99 ab	10.61 ab
T_9	0.29	7.51 a	11.55 a
T_{10}	0.26	6.33 b-d	9.73 b-d
T_{11}	0.28	6.92 ab	10.64 ab
T_{12}	0.29	7.25 ab	11.14 ab
SE	**NS**	**0.330**	**0.489**
CV(%)	11.39	9.23	8.84

Means in a column with same letter (s) are not significantly different at 5% level of probability

4.1. 6 Shoot dry weight:

Accumulation of shoot dry matter was very slow at early growth stage and at this growth stage shoots dry weight of mungbean was not significantly influenced by treatments (Table 6). But at later stages, shoot dry weight plant^{-1} of mungbean was influenced by nitrogen and weeding. At 17 DAS the highest shoot dry weight plant^{-1} (2.76 g) was recorded in T_8 followed by other treatments. T_9, T_{11}, T_{12} and T_{10} produced statistically similar shoot dry weight at this stage. Where, T6, T_5, T_7 produced intermediate shoot dry weight plant^{-1}.Similar trend was found at 24 DAS where maximum shoot dry weight plant^{-1} was recorded in T_8. Control plots produced significantly lower shoot dry weight at each growth stage(Table 6).

Table 6 Effect of nitrogen and weed managements on shoot dry weight of mungbean at different days after sowing

Treatments	Shoot dry weight (g plant^{-1})		
	10 DAS	**17 DAS**	**24 DAS**
T_1	0.40	1.02 e	1.73 e
T_2	0.44	1.70 cd	2.88 cd
T_3	0.42	1.82 cd	3.09 cd
T_4	0.40	1.27 de	2.15 de
T_5	0.44	2.15 a-c	3.66 a-c
T_6	0.41	2.20 a-c	3.74 a-c
T_7	0.42	2.08 bc	3.54 bc
T_8	0.54	2.76 a	4.69 a
T_9	0.60	2.49 ab	4.56 ab
T_{10}	0.47	2.09 bc	3.54 bc
T_{11}	0.55	2.65 ab	4.59 ab
T_{12}	0.59	2.55 ab	4.66 a
SE	**NS**	**0.201**	**0.324**
CV(%)	17.77	16.88	15.73

Means in a column with same letter (s) are not significantly different at 5% level of probability

4.1. 7 Root dry weight:

Plants did not significantly responded to nitrogen and weeding managements in respect of root dry weight at different duration of plant growth (10, 17 and 24 DAS); although the maximum root dry weight plant^{-1} was recorded in control(Table 7). Nitrogen application under weedless situation induced more growth above of the ground parts which probably leaded to the lesser accumulation in roots.

Table 7 Effect of nitrogen and weed managements on root dry weight of mungbean at different days after sowing

Treatments	Root dry weight (g plant $^{-1}$)		
	10 DAS	**17 DAS**	**24 DAS**
T_1	0.207	0.976	1.176
T_2	0.203	0.928	1.149
T_3	0.197	0.898	1.111
T_4	0.183	0.837	1.036
T_5	0.163	0.746	0.923
T_6	0.17	0.788	0.975
T_7	0.173	0.791	0.979
T_8	0.15	0.719	0.923
T_9	0.16	0.794	0.961
T_{10}	0.177	0.807	0.965
T_{11}	0.163	0.778	0.995
T_{12}	0.187	0.819	0.98
SE	**0.013**	**0.005**	**0.059**
CV(%)	13.16	11.68	10.21

Means in a column with same letter (s) are not significantly different at 5% level of probability

4.2. Yield and yield attributes

4.2.1 Number of pods plant^{-1}

Number of pods plant^{-1} is one of the most important yield contributing character of mungbean that is heavily affected by environmental and management conditions of legumes. Numbers of pods plant^{-1} were significantly affected by nitrogen and weeding managements. At 40 DAS, maximum numbers of pods plant^{-1}(9.38) were recorded from T_9 followed by T_8, T_{11}, T_{12}, T_6 and T_5. T_7 and T_{10} were gave statistically similar pods plant^{-1}, the lowest number of pods plant^{-1} was obtained from T_1. At 60 DAS, T_8 produced maximum number of pods plant^{-1}(17.83) which was followed by T_{11} (17.17), T_9 (16.83) and T_{12} (16.83). At both the stages T_9 and T_8 were statistically similar. Other treatments showed intermediated results(Table 8). This result indicated that nitrogen at early stage contributed much the initial establishment of crop, where as the second dose of nitrogen helped to produce photosynthats that contribute more partitioning towards the pod development. Moreover, Number of pods plant^{-1} depended on the number of flowering nodes plant^{-1}, branches plant^{-1} and number of flowers plant^{-1} and their retention. Greater photosynthesis enhanced by more nutrient uptake helps initiating more flowering buds, which ultimately helps to develop more pods. These findings were in conformity with those of Enyi (1973), Madrid and Vega (1971) and Moody (1978).

4.2.2 Pod length

Pod length was not significantly affected by nitrogen and weeding managements although numerically higher pod length (10.40 cm) was recorded from T_6 than other treatments. Control plot showed comparatively lower pod length (9.74 cm)(Table 8).

Table 8 Yield attributes of mungbean affected by nitrogen and weed managements

Treatments	Number of pods per plant		Pod length (cm)
	40 DAS	60 DAS	
T_1	4.56 e	8.17 e	9.74
T_2	5.60 de	10.17 de	10.28
T_3	5.87 c-e	10.67 de	10.37
T_4	5.61 de	10.83 de	10.31
T_5	7.49 a-d	13.83 c	10.21
T_6	7.67 a-c	14.17 bc	10.40
T_7	6.73 b-d	13.00 cd	9.95
T_8	9.24 a	17.83 a	10.26
T_9	9.38 a	16.83 ab	10.15
T_{10}	6.85 b-d	13.83 c	10.29
T_{11}	8.54 ab	17.17 a	10.29
T_{12}	8.38 ab	16.83 ab	10.09
SE	**0.582**	**0.914**	**NS**
CV(%)	14.10	11.64	3.33

Means in a column with same letter (s) are not significantly different at 5% level of probability

4.2.3 Number of seeds pod^{-1} and 1000-seed weight

Number of seeds pod^{-1} and 1000-seed weight (g) were not significantly affected by nitrogen and weeding managements (Table 9). Numerically maximum seeds pod^{-1}(9.44) was obtained from T_9 and second highest seeds pod^{-1} were recorded from T_8. Seed size was seen to be maximum when plot was treated with 20 kg N ha^{-1} as basal with two weeding (T_6) and that was (48.47 g). The second highest 1000 seed weight was recorded from T_8 The lowest number of seeds pod^{-1}(8.13) and 1000-seeds weight(44.50 g) were recorded from the control treatment(T_1)(Table 9).

4.2.4 Seed yield/ha

Seed yield ha^{-1} was significantly affected by the treatments (Table 9). The highest yield was obtained from T_8 which was followed by T_9, T_{11} and T_{12}. T_8 was produced 57.464% more yield over the control. As seed yield plant^{-1} is the combined effect of all the yield contributing parameters of a plant. T_8 produced highest yield due to maximum production of crop characters like branches plant^{-1}, number of leaflets plant^{-1}, leaf area plant^{-1}, shoot dry weight and number of pods plant^{-1}.Seed yield (kg ha^{-1}) was found to be lower in no nitrogen and unweeded plots(T_1) which was due to lack of resources those contribute on yield parameters(Table 9). Such result corroborates with the findings of Yien (1982) who reported that nitrogen increased the seed yield of mungbean over control. Similar result was also found by Asaduzzaman *et al.* (2008a) who observed that basal and split application of nitrogen significantly increased seed yield of mungbean. Mozumder *et al.* (2003) also stated that application of 40 kg N ha^{-1} gave the highest seed yield. Similar result was also found in bushbean (Ahlawat and Sharma, 1998) and in pea (Ferdous 2001). Enyi (1975) reported that weeding at vegetative stage was superior to produce higher grain yield than the unweeded plots. Vats and Sidhu (1976) and also Enyi (1975) concluded that the vegetative stage of mungbean was critical for weed control.

Table 9 Yield of mungbean as affected by nitrogen and weed managements

Treatments	Number of seeds pod^{-1}	1000 –weight (g)	Yield (kg ha^{-1})
T_1	8.13	44.50	843.08 f
T_2	9.03	46.43	1122.29 ef
T_3	8.97	47.18	1160.32 de
T_4	9.13	47.69	1174.57 de
T_5	8.73	47.67	1468.59 cd
T_6	9.37	48.47	1619.68 bc
T_7	8.97	46.63	1262.67 de
T_8	9.40	47.80	1982.05 a
T_9	9.44	47.45	1936.67 ab
T_{10}	9.33	46.65	1476.56 cd
T_{11}	9.03	47.58	1906.61 ab
T_{12}	9.13	47.43	1875.50 ab
SE	**NS**	**NS**	**117.216**
CV (%)	6.10	3.76	13.67

Means in a column with same letter (s) are not significantly different at 5% level of probability

CHAPTER 5

SUMMARY AND CONCLUSION

CHAPTER 5

SUMMARY AND CONCLUSION

An experiment was conducted at the Agronomy research field, Sher-e-Bangla Agricultural University, Dhaka, in the summer season during the period from March to June, 2007. The experiment comprised twelve treatments viz. T_1= No nitrogen application with no weeding, T_2= No nitrogen application with one weeding at vegetative stage, T_3 = No nitrogen with application two weedings (vegetative and flowering stages), T_4= 20 kg N ha^{-1} as basal with no weeding, T_5 = 20 kg N ha^{-1} as basal + one weeding at vegetative stage, T_6 = 20 kg N ha^{-1} as basal + two weedings(vegetative and flowering stages), T_7 = 20 kg N ha^{-1} as basal + 20 kg N ha^{-1} as basal as split at vegetative stage with no weeding, T_8 = 20 kg N ha^{-1} as basal + 20 kg N ha^{-1} as split at vegetative stage with one weeding, T_9 = 20 kg N ha^{-1} as basal + 20 kg N ha^{-1} as split + two weedings(vegetative and flowering stages), T_{10} = 20 kg N ha^{-1} as basal + 20 kg N ha^{-1} as split at vegetative stage + 20 kg N ha^{-1} as split at flowering stage with no weeding, T_{11} = 20 kg N ha^{-1} as basal + 20 kg N ha^{-1} as split at vegetative stage + 20 kg N ha^{-1} as split at flowering stage + one weeding at vegetative stage and T_{12} = 20 kg N ha^{-1} as split + 20 kg N ha^{-1} as split at vegetative stage + 20 kg N ha^{-1} as split at flowering with two weedings (at vegetative and flowering stages). The experiment was laid out following randomized complet block design (RCBD) with three replications. The unit plot size was 3.0 m x 2.0 m. Chemical fertilizer except urea was applied as per the recommendation of BARI (Bangladesh Agricultural Research Institute). Urea was applied as per treatments.

Results showed that the effect of integrated nitrogen and weeding on plant height was significant at 20, 40 and 65 DAS. At 20 DAS maximum plant height (18.53 cm) was observed in treatment T_9 which was statistically similar with all treatments except T_1 and T_3. Control (T_1) produced the shortest (54.19 cm) plant at each observation.

Number of branches plant^{-1} was not significantly influenced by nitrogen and weeding managements at 20 DAS. But at 40 DAS it was significantly influenced by the treatments. The maximum number of branches plant^{-1} (1.67) was produced by the treatment T_8 followed by T_9 and T_{12}.

Nitrogen and weeding had no significant effect on number of leaflets plant^{-1} at 20 DAS but numerically maximum number of leaflet plant^{-1} (11.04) was found in T_8 followed by T_6. At 40 DAS, leaflets were significantly influenced by treatment variations and significantly the highest number of leaflets per plant^{-1} (24.27) was found in T_8. No nitrogen and no weeding (control) treatment produced the lowest number of leaflet plant^{-1}. Other treatment produced intermediate numbers of leaf lets plant^{-1}.

Irrespective of treatment difference mungbean was influenced by nitrogen and weeding managements at 20 DAS and 40 DAS in respect of leaf area plant^{-1}. At all stages the maximum leaf area was found with T_8 and T_9 which were also statistically similar. The control plot showed the lowest leaf area plant^{-1}(16.95 cm and 69.18 cm at 20 DAS and 40 DAS, respectively).

Nitrogen and weeding did not significantly increase the leaf dry weight of mungbean at 10 DAS. However the leaf dry weight of mungbean at 17 and 24 DAS were influenced and increased significantly due to the treatments. At 17 and 24 DAS, the maximum value of leaf dry weight plant^{-1} was recorded in T_9. While the second highest values of leaf dry weight was obtained from T_{12}. Unweeded and no nitrogen plots (control) produced the lowest value of mungbean leaf dry weight both the stages studied.

At early growth stage (10 DAS) shoot dry weight of mungbean was not significantly influenced by the treatment variations but in the later stages(17 and 24 DAS) it was influenced by nitrogen and weeding variations. The highest shoot dry weight plant^{-1} was recorded in T_8. Control plots produced significantly the lowest shoot dry weight at each growth stage studied.

Maximum number of pods plant^{-1} (9.38) was recorded from T_9 followed by T_8 at 40 DAS Also at 60 DAS, T_8 produced the maximum number of pods plnat^{-1} (17.83) which was the followed by T_{11}

Root dry weight, pod length, number of seeds pod^{-1} and 1000 seed weight of mungbean were not affected by the treatments

Seed yield ha^{-1} was significantly influenced by the nitrogen and weeding managements. The maximum seed yield (1982.05 kg ha^{-1}) was recorded from T_8 which was followed by T_9, T_{11} and T_{12}. The lowest seed yield was obtained from the control T_1, which was 57.46% lower than the treatment (T_8).

CONCLUSION

From the results, it may be concluded that mungbean gave maximum production of yield during summer season when treated with 20 kg N/ha as basal + 20 kg N/ha as split at vegetative stage and was provided with two weedings (at vegetative and flowering).

RECOMMENDATION

RECOMMENDATION

Determination of effectiveness of amount and time of application of nitrogen use; and management of weeds in the mungbean fields, further trails should be performed in different locations for confirmation

REFERENCES

REFERENCES

Agbenin, J. O., Lombin, G. and Owonubi, J. J. (1992). Direct and interactive effect of boron and nitrogen on selected agronomic parameters and nutrient uptake by mungbean (*Vigna radiata*) under glass house conditions. *Tropic. Agric. (Trinidad and Tobago).* **68**(4):352-362.

Ahlawat, I. P. S. and Sharma, R. P. (1998). Response of french bean (*Phaseolus vulgaris*) genotypes to soil moisture regimes and phosphorus level. *Indian J. Agron.* **34**(1): 70-77

Ahmed, Z. U., Shaikh, M. A. Q., Khan, A. I. and Kaul, A. K. (1978). Evaluation of local, exotic and mutant germplasm of mungbean for varietal characters and yield in Bangladesh. *SABRAO J.* **10**: p. 48.

Ahmed, H. (1991). Effect of weed on growth on garlic (Allium sativum L.). *Weed Sci. Abstract.* **39** (6) : 230.

Ahmed, A., Karim, M. F., Shamdane, G. and Maniruzzaman, A. F. M. (1992). Effect of time of weeding and plants density on the growth and yield of mungbean. *Bangladesh J. Agric. Res.* **16** (2) : 119-123.

Ashik, M., Amin, S and Amin, A. K. K.M (2007). Effects of plant density and weeding on the performance of mungbean (*Vigna radiata* L.). M.S. Thesis. Deapartment of Agronomy. Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207.

Ardeshna, R. B., Modhwadia, M. M., Khanparal, V. D. and Patel, J. C. (1993). Response of greengram (*Phaseoulus radiatus*) to nitrogen, phosphorus and Rhizobium inoculation. *Indian J. Agron.* **38**(3): 490-492.

Arya, M. P. S. and Kalra, G. S. (1988). Effect of phosphorus doses on growth, yield and quality of summer mungbean (*Vigna radiata*) and soil nitrogen. *Indian J. Agric. Res.* **22**(1): 23-30.

Asaduzzaman, M., Karim, M. F, Ullah, M. J. and Hasanuzzaman, M. (2008 a). Response to nitrogen and irrigarion managements of mungbean (*Vigna radiata*). *American-Eurasian J. sci. Res.* **3**(1) : 40-43.

Asaduzzaman, M., Hasanuzzaman, M., Uddin, A. A. B. M. and Islam, M. S. (2008b). Performance of summer mungbean(Vigna radiata L.) as affected by different weed free periods. *Intl. J. BioRes*. **5**(3) : 87-44.

AVRDC (Asian Vegetable Research and Development Centere). (1976). Mungbean report for 1975. Shanhua, Taiwan, p.49.

Bachchhav, S. M., Jadhav, A. S., Naidu, T. R. V. and Bachhav, M. M. (1994). Effects of nitrogen on leaf area, nodulation and dry matter production in summer greengram. *J. Maharastra Agril. Univ.* **19**(2): 211-213.

Bali, A. S., Sing, K. N., Shah, M. H. and Khandey, B.A. (1991). Effect of nitrogen and phosphorus fertilizer on yield and plant characters of mungbean (*Vigna* *radiata*) under the late sown condition of kasmir valey. *Fertilizer News.* India. **36**(7): 59-61.

BARC (Bangladesh Agricultural Research Council), (1997). Fertilizer Recommendation Guide. p.69.

BARI (Bangladesh Agricultural research Institute). (2005). Mungbean in Bangladesh. P. 33.

BBS. (Bangladesh Bureau of Statistics). (2005). Monthly Statistical Bulletin. Statistics Division. Ministry of Planning. Government of the Peoples Republic of Bangladesh. Dhaka. P. 57.

Bryson, C. T. (1990). Interference and critical Times of Removal of Himp Sesbania (*Sesbania exulenta*) in cotton (*Gossypium herbacium). Weed tech.* **4**: 833-837.

Bulson, M. H. (1991). Effect of weed species on quality and yield attributes in conventional and organic crops. *Indians J. Agron.* **35** (2): 283-290.

Castin, D. C., Renner, K. A and Hoad, A. A. (1976). Competition and time of weed removal in mungbean (*Vigna radiata*). *Weed sci.* **38**: 283-285.

Chowdhury, M. K. and Rosario, E. L. (1992). Utilization efficiency of applied nitrogen as related to yield advantages in maize/mungbean (*Vigna radiata* L., Wilczek) intercropping. *Fld. Crop Res.* **30** (1-2): 441-518.

Crook, T. M. and Remer, K. A. (1990). Common lambs quarters (*Chenopodium albun*) competition and time of weed removal in Soybeans (*Glycine max*). *Weed Sci.* **38**: 358-364.

Dashora, G. K. Maiwal, P. L. and Dashora, L. N. (1990). Weed crop competition studies in mustard (*Brassica campestries*). *Indian J Agron.* **35**: 419-422.

Enyi, B. A. C. (1975). An analysis of the effect of weed competition on growth and yield attributes in sorghum (*Sorghum vulgari*), cowpea (*Vigna unguiculata*) and green gram (*Vigna radiata*), *J. Agric. Sci.* **81**: 449-453.

FAO (Food and Agricultural Organization). (1999). FAO Production Yearbook. Basic Data Unit. Statistics Division, FAO. Rome, Italy.

Ferdous, A. K. M. (2001). Effects of nitrogen and phosphorus fertilizers on nutrients uptake and productivity of edible podded pea. M.S. Thesis. Bangabandhu Sheikh Mujibur Rahaman Agricultural University, Gazipur-1706.

Gupta, M. and Lamb, J. D. (1987). Effect of weed infection on the grain yield of barley. *Crop. Res. Hisar*. **28** (1-3): 34-38.

Hamid, A. (1988). Nitrogen and carbon effect on the growth and yield performance of mungbean (*Vigna radiata* L., Wilczek). *J. Agron. and Crop Sci.* **161**(1):11-16.

Islam, M. A. , Mamun, A . A ., Bhuyan, M . S . U. and Hossain, S. M .A .(1989a).

Weed Biomass and grain yield in wheat and Italian Ryegrasns (*Lolium multifolurum*). Ph. D thesis. Regon State University, Corvallis, OR97331, USA.

Islam, M. A., Mamun, A. A . Bhuiyan, M. S. U. and Hossain, S. M. A . (1989 b). Weed biomass and grain yield in wheat as affected by seed rate and duration of weed competition. *Bangladesh J. Agri.* **14** : 213 – 224.

Kaneria, B. B. and Patel, Z. G. (1995). Interegrated weed management and nitrogen in Indian mustard (*Brassica juncea*) and their residual effect of succeeding mungbean *Vigna radiata*). *Indian J. Agron.* **40**(3): 444- 449.

Karim, S., Saikot, M. C. and Kairon, M. S. (1986). Critical period of weed competion in Jute. *Bangladesh J. Agric. Sci.* **58**: 859-860.

Karle, A. S. and Pawar, G. G. (1998). Effect of legume residue incorporation and fertilizer in mungbean-safflower cropping system. *J. Maharastha Agril. Univ.* **23**(3): 333-334.

Kaul, A. (1982). Pulses in Bangladesh. BARC (Bangladesh Agricultural Research Council), Farmgate, Dhaka. p.27.

Khan, M. A. A. (1981). The effect of CO_2 environment on the pattern of growth and development in rice and mustard. Ph.D. Dissertation. Royal Vet. And Agril Univ. Copenhagen. p.104.

Kumar, S. and Kairon, M. S. (1988). Effect of time of weed removal on yield of gree gram(*Vigna radiata*). *Indian J. Agric. Sci.* **58**: 859-60.

Leelavathi, G. S. N. S., Subbaiah, G. V. and Pillai, R. N. (1991). Effect of different levels of nitrogen on the yield of greengram (*Vigna radiata* L., Wilezek). *Andra Agric. J. India*. **38**(1): 93-94.

Madrid, M. T. and Manimtim, M. B. (1977) weed control and weed competition and the effect on yield of mungbean(*Vigna radiata*). Philippine Agric.**55**: 216-220.

Madrid, M. T. Jr. and Vega, M. R. (1984). Duration of weed control and weed competition and the effect on yield of mungbean. *Phillippine Agric.* **55**: 216-220.

Mahadkar, U. V. and Saraf, C. S. (1988). Input response of the growth and yield performance of mungbean (*Vigna radiata* L., Wilezek) prodiction. *Minia J. Agril. Res and Dev.* **10**(1): 247-255.

Mahboob, A. and Asghar, M. (2002). Effect of seed inoculation and different nitrogen levels on the grain yield of mungbean. *Asian J. Pl. Sci.* **1**(4): 314-315.

Malik, M. A., Saleem, M. F., Asghar, A. and Ijaz, M. (2003). Effect of nitrogen and phophorus application on growth, yield and quality of mungbean (*Vigna radiata* L.). *Pakistan J. Agril. Sci.* **40**(3-4):133-136.

Mandal, R. and Sikder, B. C. (1999). Effect of nitrogen and phosphorus on the growth and yield of mungbean in saline soil of Khulna, *Bangladesh J. Dhaka Univ.* **12**(1-2): 85 - 88.

Mann, B. L. and Barnes, G. V. (1977). Influence of weed species the garin yield of barley. *Environ. Ecol.* **22** (3): 407-410.

Moody, K. (1978) Weed control in mungbean. First International Symposium on Mungbean. Los Benos, Philipines. 16-19 August, 1977.p. 132-136.

Mozumder, S. N., Salim, M., Islam, M., Nazrul M. I. and Zaman, M. M. (2003). Effect of *Bradyrhizopus* inoculums at different nitrogen levels on summer mungbean. *Asian J. Pl. Sci.* **2** (11): 817-822.

Muse, K. M., Manik, M. L. and Mian, A. L. (1982). Performance of blackgram and mungbean againset diiferent weed species. *Agron. J.* **80**: 531-534.

Nadeem, M. A., Ahmad, R. and Ahmad, M. S. (2004). Effect of seed inoculation and different fertilizer levels on the growth and yield of mungbean (*Vigna radiata* L.). *J. Agron.* **3** (1): 40-42.

Panwar, J. D. S. and Pandey, R. A. (1977). Influence of water deficits on morpho-physiological and yield behavior of mungbean (*Vigna radiata* L. Wilczek). Mungbean Proceedings of the Second Inter. Symp. Asian Vegetable Research and Development Center(AVRDC) : 252-259.

Panwar, J. D. S and Singh, G. B. (1980). Studies on weed competition of mungbean. *Indian J. Weed Sci.* **17**(1): 88-89.

Pascua, A. C. (1988). Duration of weed control and weed competition of mungbean yield. *Philippines J. Crop. Sci.* **3** : 1.

Patel, J. S and Parmar, M. T. (1986). Response of green gram to varing levels of nitrogen and phosphorus. *Madras Agril. J.* **73**(6): 355-356.

Patel, L. R., Salvi, N. M. and Patel, R. H. (1992). Response of greengram (*Phaseolus vulgaris*) varieties to sulphur fertilization under different levels of nitrogen and phosphorus. *Indian J. Agron.* **37**(4): 831-833.

Patel, R. G., Palel, M. P., Palel, H. C. and Palel, R. B. (1984). Effect of graded levels of nitrogen and phosphorus on growth, yield and economics of summer mungbean. *Indian J. Agron.* **29**(3): 42-44.

Phimsirkul, P. (1992). Nitrgen fertilizer rate optimal for *Rhizobium* on four varieties of mungbean in Mab Bon and Chan Tuk Soil series. Bangkok (Thailand) pp.76-78.

Pongkao, S. and Inthong, W. (1988). Effect of amount of nitrogen fertilizer at sowing and flowering on nitrogen fixation and yield of mungbean (*Vigna radiata* L. Wilezeck). In: Proceeding of the 3rd seminar on mungbean research. Chainat Field Crop Association Research Center, Chainat (Thailand). pp.52-67.

Quah, S. C. and Jaafar, N. (1994). Effect of nitrogen fertilizer on seed protein of mungbean. Applied biology beyond the year 2000. **In. Proc. 3rd Symp.** Malaysian Soc. Applied Biol. pp.72-74.

Rajender, K., Sing, V. P., Sing, R. C. and Kumar, R. (2003). Monetary analysis on mungbean during summer season. *Ann Biol*. **19**(2): 123-127.

Raju, M. S. and Varma, S. C. (1984). Response of greengram (*Vigna radiata*) to *Rhizobium* inoculaiton in relation nitrogen fertilizer. *Lugume Res*. **7** (2):73-76.

Retinahm, D. P. and Miller S. D. (1974). Wild oat (*Avena fatua*) Competition in Soybean (*Glycine max*). *Weed Sci*. **29**: 410-414.

Samiullah, M., Akhtar, M., Afridi, M. M. R. K. and Ansari, S. A. (1987). Effect of nitrogen and phosphorus on the yield performance of *Vigna radiata* (summer mungbean*). Comparative Physiol. and Ecol.***12**(2):85-88.

Santos, P. J. A., Edwards, D. G., Asher, C. J., Dart, P. J. and Barrow, J. J. (1993). Response of Bradyrhibium-inoculated mungbean (*Vigna radiata* L. Wilczek) to applied nitrogen. Plant nutrition from genetic engineering to field practice: Proceedings of the 12th International Plant Nutrition Colloquium, 21-26 September, Perth, Western Australia. pp. 443 - 446.

Sardana, H. R. and Verma, S. (1987). Combined effect of insecticide and fertilizers on the growth and yield of mungbean (*Vigna radiata* (L.) Wilczek). *Indian J. Entom*. **49**(1): 64-68.

Sarkar, R. K. and Mondal, G. M. (1985). Effect of weeding on different days of sowing of mungbean. *Bangladesh J. Agric. Res.* **10**: 34-40.

Sarkar, R. K. and Banik, P. (1991). Response of mungbean (*Vigna radiata*) to nitrogen, phosphorus and molybdeum. *Indian J. Agron.* **36** (1) :91-94.

Satyanarayanamma, M., Pillai, R. N. and Satyanarayana, A. (1996). Effects of foliar application of urea on yield and nutrient uptake by mungbean (*Vigna radiata*). *J. Maharastra Agril.Univ.* **21**(2) :315-316.

Sharma, C. K. and Sharma, H. K. (1999). Effect of different production factors on growth, yield and economics of mungbean (*Vigna radiata* L. Wilezeck). *Hill Farming*. **12**(1-2) : 29-31.

Sing, H. P and Sing, D. P. (1999). Recent Advances in Urdbean and Mungbean Production. *Indian Farming*. **29**(3): 18-20.

Sing, M. (1975). Response of mungbean (*Vigna radiata*) to irrigation & weeding application. *Haryana J. Agronomy*. **6**(1): 94-95.

Sing, M. and Faroda, H. K (1971). Effect of weed species on quality and yield attributes on green gram. *Indians J. Agron.* **35** (2): 283-290.

Srinivas, M., Shaik, M. and Mohammad, S. (2002). Performance of greengram (*Vigna radiata* L. Wilczek) and response functions as influienced by different levels of nitrogen and phosphorus. *Crop Res. Hisar.* **24**(3): 458-462.

Srivastava, S. N. L. and Varma, S. C. (1982). Effect of bacterial and inorganic fertilization on the growth, nodulation and quality of greengram. *Indian J. Agron.* **29**(3): 230-237.

Suhartatik, E. (1991). Residual effect of lime and organic fertilizer on mungbean (*Vigna radiata* L. Wilczek) in red yellow podzolic soil: Proceedings of the seminar of food crops Research Balittan Bogor (Indonesia). **2**: 267-275.

Tank, U. N., Damor, U. M., Patel, J. C. and Chauhan, D. S. (1992). Response of summer mungbean (*Vigna radiata*) to irrigation, nitrogen and phosphorus. *Indian J. Agron.* **37**(4): 833-835.

Trung, B. C. and Yoshida, S. (1983). Significance and nitrogen nutrition on the productivity of mungbean (*Vigna radiata* L. Wilczek). *Japanese J. Crop Sci.* **52**(4): 493-499.

Vats, O, P. and Sidhu, M. S. (1977). Critical period of crop weed competition in mungbean (*Vigna radiata* L.). *Indian J. Weed Sci.* **8** : 64-69.

Weaver, R. P. , Shibles, R. M. and Miller, S. D. (1992). Studies on critical period of weed competition and crops yield. *Indian J. Weed Sci.* **4**(1): 160-169.

Werakonphanit, P., Thawonmat, D. and Samani, C. (1979). Study of fertilizer usage for a relay cropping system: Soyabean-sweet corn-mungbean. *Annual Report.* Chainat Field Crop Experiment Station, Bankok, Thailand. pp. 59-68.

Yadav, S. K., Singh, B. R., Kumar, S. and Verma, O.P. S. (1983). Correlation and economic studies on the growth yield and yield parameters of mungbean under inter cropping system with cowpea. *Intl. J. Tropic. Agric.* **12**(1-2):33-35.

Yakadri, M., Thatikunta, R. and Rao, L. M., Thatikunta, R. (2002). Effect of nitrogen and phosphorus on growth and yield of greengram (*Vigna radiata* L. Wilczek). *Legume Res.* **25**(2): 139 - 141.

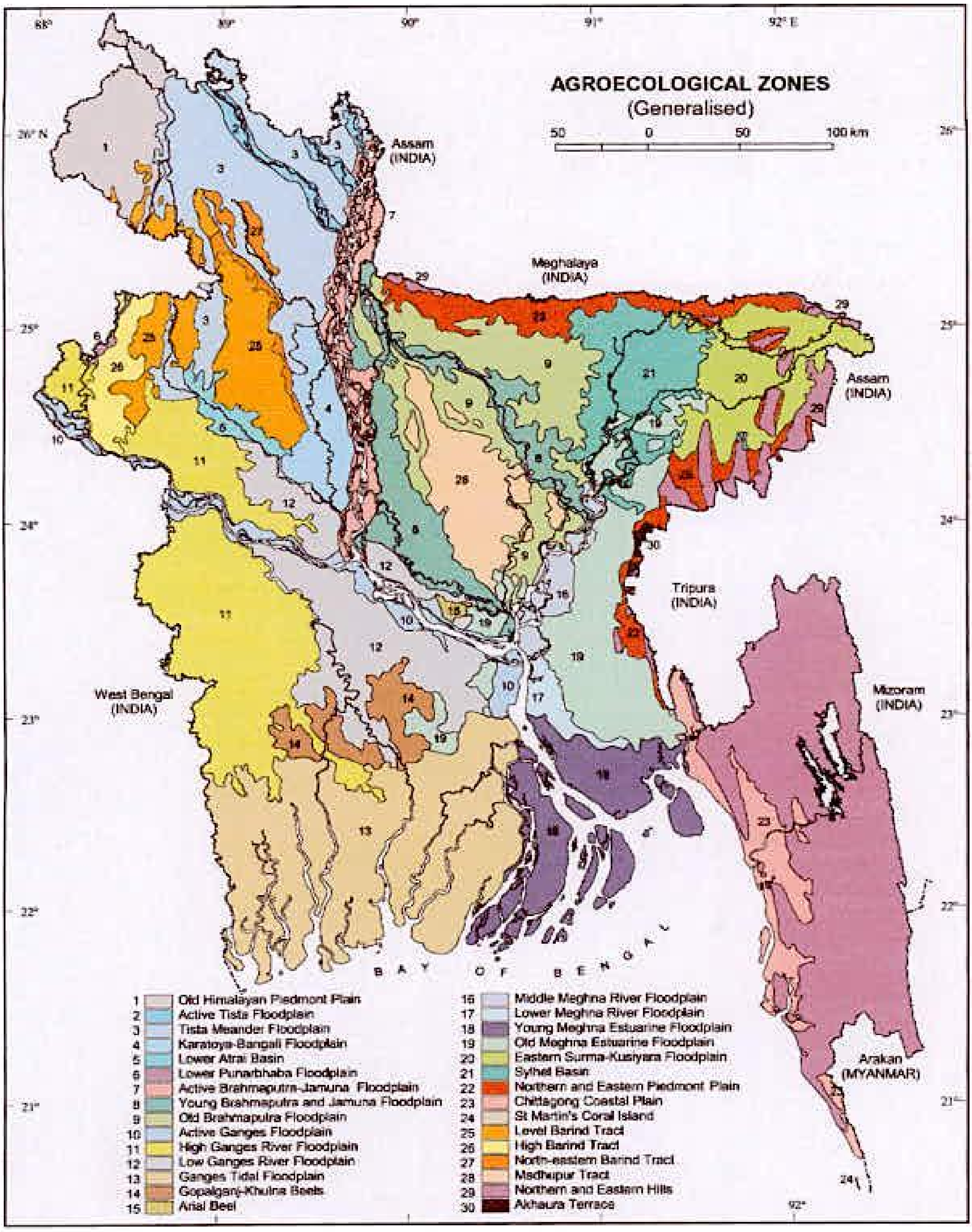
Yein, B. R. (1982). Effect of carbofuran and fertilizers on the incidence of insect pests and on the growth and yield of mungbean (*Vigna radiata* L. Wilczek). *J. Res.* **3**(2): 197-203.

Yein, B. R., Harcharan, S., Cheema, S. S. and Singh, H. (1981). Effect of combined application of pesticides and fertilizers on the growth and yield of mungbean (*Vigna radiata* L. Wilczek). *Indian J. Ecol.* **8**(2): 180-188.

APPENDICES

APPENDICES

Appendix I. Experimental location on the map of Agro-ecological Zones of Bangladesh



Appendix II. The mechanical and chemical characteristics of soil the experimental site as observed prior to experimentation (0-15 cm depth)

Mechanical composition:

Soil separates	(%)	Method employed
Sand	35.90	Hydrometer method
Silt	26.40	Hydrometer method
Clay	36.66	Hydrometer method
Texture class	Clay loam	Hydrometer method

Chemical composition:

Soil characters	Value
Organic carbon (%)	0.42
Organic matter (%)	0.75
Total nitrogen (%)	0.06
Phosphorus	22.08 μg/g soil
Sulpher	25.98 μg/g soil
Magnesium	1.00 meq/100 g soil
Boron	0.48 μg/g soil
Copper	3.54 μg/g soil
Zinc	3.22 μg/g soil
P^H	5.56
CEC	11.20

Source: Soil Resources Development Institute (SRDI), Khamarbari, Dhaka

Appendix III. Monthly records of air temperature, relative humidity, rainfall and sunshine hours during the period from February 2007 to June 2007

Year	Month	Air temperature (^{0}C)			Relative humidity (%)	Rainfal (mmh^{-1})	Sunshine (h^{-1})
		Maximum	Minimum	Mean			
2007	February	21.26	19.43	20.34	51.27	0	148
	March	36.2	22	29.1	46.13	2.0	155
	April	35.0	23.81	28.77	61.4	25	257
	May	32.0	24.95	28.72	64.27	30	96
	June	33.3	25.0	28.5	64.27	35	96

Source: Bangladesh Meteorological Department (Climate division), Dhaka-1212.

LIST OF PLATES

Plate 1. Field view of the experimental plot

Plate 2. Field view of experimental plots at vegetative stage

Plate 3. Field view of experimental plots without weed management at pod initiation stage