MANAGEMENT OF MUNGBEAN POD BORER, *MARUCA VITRATA* [L.]

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MANAGEMENT OF MUNGBEAN POD BORER,
MARUCA VITRATA [L.]

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CERTIFICATE

This is to certify that the thesis entitled, **"MANAGEMENT OF MUNGBEAN POD BORER, *MARUCA VITRATA* [L.]** Submitted to the Department of Entomology,Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN ENTOMOLOGY**, embodies the result of a piece of bona fide research work carried out by **PROKASH KUMAR DASH** Registration No. 05-01791 under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated: June, 2011
Place: Dhaka, Bangladesh

Prof. Dr. Md. Serajul Islam Bhuiyan
Supervisor

Dedicated

to

My Beloved Parents

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MANAGEMENT OF MUNGBEAN POD BORER, *MARUCA VITRATA* [L.]

ABSTRACT

The present research was conducted at the experimental field of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from April to November, 2011 to study management of mungbean pod borer. The experiment compared with seven different chemicals and botanical pesticide including control treatment viz. Dursban 20EC @ 2 ml L^{-1} of water, Ripcord 10 EC @ 3.0 ml L^{-1} of water, Diazinon 60EC @ 3.5 ml L^{-1} of water, Marshal 20EC @ 3 ml L^{-1} of water, Suntap 50SP @ 3 ml L^{-1} of water, Neem oil @ 2 ml L^{-1} of water, Control were used in this study. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications.. The lowest flower and pod infestation was recorded in Marshal 20EC treated plots. The same treatment also produced the tallest plant, maximum number of leaves $plant^{-1}$ and number of branch per plant. These results indicate that the Marshal 20EC @ 3 ml L^{-1} of water showed the better performance in managing the pod borer of mungbean as well as on growth and yield of mungbean.

CHAPTER I

INTRODUCTION

Mungbean [V*igna radiata* (L.) Wilczek] is one of the most important pulse crops of global economic importance. The mungbean belongs to the family Leguminosae and sub-family Papilionaceae. It is originated in the South and Southeast Asia (India, Mayanmar, Thailand) (Poehlman, 1991a). It is widely grown in India, Pakistan, Bangladesh, Mayanmar, Thailand, Philippinnes, China and Indonesia (FAO, 2005). It ranks 3rd in acreage, 5th in production and 3rd in protein content among the pulses grown in Bangladesh (BBS, 2008). Mungbean covers an area of 23077 hectare and production was about 20000 metric tons. The average production of mungbean in the country is about 867 kg ha^{-1}(BBS, 2010). About 3 ton ha^{-1} of seed yield have been reported in a trial in Taiwan but in Bangladesh the average yield is very low. The yield difference indicates the wide scope for increasing yield of mungbean.

Mungbean has raceme type of inflorescence, with asynchronous flowering and poding. This leads to double harvest of the crop lengthening its harvest at least up to two weeks. Mungbean requires about 70-85 to mature. It is mostly grown in dry season following T. aman and winter crops (Dutta, 2001) but it can be grown almost throughout the year (Afzal *et al*., 2008).

Bangladesh is a developing country and there is a serious nutritional crisis of cereal-based diet. Mungbean is an excellent supplemental protein source for rice diet. The protein content of mungbean is more than cereals. Mungbean contains 51% carbohydrate, 26% protein, 10% moisture, 4% mineral and 3% vitamins (Afzal *et al.*, 2008). Besides providing valuable protein in the diet, mungbean has the remarkable quality of helping the symbiotic root rhizobia to fix atmospheric nitrogen and hence to enrich the soil (Anonymous, 2005).

Bangladesh is a developing country. The land of our country is limited. But the population is very high. More people need more food. We have to produce more food in our limited land. To meet up the increased demand of food, farmers are growing more cereal crops. Due to the high population pressure, the total cultivable land is decreasing day by day along with the pulse cultivable land. So, at present the cultivation of pulse has gone to marginal land because farmers do not want to use their fertile land in pulse cultivation. Pulse cultivation is also decreasing because of its low yield and production. The long term cereal crop cultivation also effects soil fertility and productivity.

Mungbean is attacked by different species of insect pests. Insect pests that attack mungbean can be classified based on their appearance in the field as it related to the phonology of mungbean plant. They are stem feeders, foliage feeders, pod borers and storage pests. This classification is convenient in judging the economic importance of the pest, especially their influence on seed yield, and in devising control measures. Mungbean is attacked by different species of insect pests but pod borer are of the major importance (Islam *et al*., 2008). Pest appearance, population fluctuation, infestation rate and crop yield are very much dependent on sowing time. Most of the farmer's usually sow mungbean just after harvesting their rabi crops without considering optimum sowing dates (Hossain *et al*., 2000).

Though many options are available for the management of these insect pests, farmers in Bangladesh mostly use synthetic chemicals because of their quick knock down effect with or without knowing the harmful effects of these chemicals. However, farmer education for the safe and in time use of the insecticides is very important. Previously many research workers have also used and evaluated different synthetic chemicals against different insect pests, especially against pod borer of Mungbean. Ahmad *et al*. (1998) found that 0.03% dimethoate or 0.04% monocrotophos effectively reduced the insect pest complex of Mungbean when applied 45 and 60 days after sowing. Ahmad and Khan (1995), Tufail *et al*. (1996), Mustafa (1996) and Latif *et al*. (2001) have also evaluated different insecticides against insect pests of cotton.

Despite its importance, mungbean yields are greatly depressed by a complex of biotic and abiotic factors of which insect pests are the most important. Mungbean is attacked by a number of insect pests which cause a heavy loss to crop. Major insect pests are stemfly, thrips, whitefly, jassid and pod borer. In Bangladesh, insecticides are frequently being used in controlling insect pests of field and horticultural crops (Kabir *et al*., 1996). Pod borer damages flower, flower bud and tender or mature pods (Poehlman, 1991b). This pest could cause up to 14.33% pod damage (Anon., 1998). In Bangladesh, the pod borer is a chronic and often causes serious problem resulting severe loss of the crop (Bakr, 1998). Pod borer alone has been reported to cause grain losses of 136 kg/ha (Anon., 1986). The average yield loss of mungbean due to different insect pests has been estimated to be 22 percent (Key, 1979). Insecticide resistance in *Helicoverpa armigera* (Hubner) has led to the reduced efficacy of some older insecticide groups (Pyrethroids and carbamates) and serious crop losses. For the management of insect pest many options such as chemical, cultural and mechanical and biological etc. are available. Chemical control is generally being advocated for the management of insect pest of mungbean. Cypermethin of Cymbush at 0.008% applied at flowering and podding were effective against pod borer (Rahman, 1989). Plant products were found to be effective against various pests (Rajasekaran and Kumaraswami, 1985).

Under the above context the present study has been undertaken with the following objectives:

i. To assess the abundance and damage severity of mungbean pod borer.

ii. To explore the efficiency of different insecticides for the management of mungbean pod borer.

CHAPTER II

REVIEW OF LITERATURE

2.1 Effect of pod borer infestation on mungbean

Pod borer is one of the serious preharvest pests of mungbean in Bangladesh, in India (Sehgal and Ujagir, 1988) and other tropical and subtropical countries. The adult moth of pod borer is dark in color. There is a white half circle spot on the front pair of wings. Hind pair of wings is grayish white in color and moth having light brown spots on the wing. The larvae are yellowish in color. They enter into the inflorescence and start feeding the flowers. The flowers, later they cripple leaves together making nets and nets with leaves, flowers and young pods. They remain inside the nets hiding themselves and eat the young seeds boring the pods. Bakr (1998) reported that the span of larval period may be 10-24 days.

Altaf *et al*. (2009) conducted an experiment was at Pulses Research Center, Ishurdi, Pabna, Bangladesh during kharif-I to find out the insect pests attacking mungbean crop sowing at different dates to determine the optimum date(s) of sowing. It is seen that the incidence and population fluctuation of various insect pests was very much dependent on the prevailed climatic conditions of the cropping season. The early (February 14 to March 06) and late sown (mid April to onward) crops received higher pest infestation than the mid sown (March 13 to April 10) crops.

Lal (2008) reviews the studies of various insect pests infesting mungbean or green gram, *Vigna radiata* (L) Wilczeck, in India. A total of 64 species of insects reported to attack mungbean in the field have been tabulated. Information on distribution, biology, ecology, natural enemies, cultural, varietal and chemical methods of control etc. of whitefly, *Bemisia tabaci* Genn, leaf hopper, *Empoasca kerri* Pruthi, black aphid, *Aphis craccivora* Koch, Bihar hairy caterpillar, *Diacrisia obliqua* (Wik), galerucid beetle, *Madurasia obscurella* Jacoby, stem fly, *Ophiomyia (Melanagromyza) phaseoli* (Tryon), lycaenid borer, *Euchrysops cnezus* Fabr., and spotted caterpillar, *Maruca testulalis* Geyer, is included.

Sreekant *et al*. (2004) conducted field experiments in kharif seasons on mungbean cv. K-851 to determine the effect of intercropping on the incidence of thrips. The treatments comprised intercropping mungbean with pigeon pea, maize, sorghum, pearl millet, castor bean and cotton, sole cropping of mungbean. The reduction in thrips was observed with pearl millet intercrop during both the seasons.

Mungbean (*Vigna radiata* L) is one of the important pulse crops in Bangladesh. Due to its short lifespan gradually farmers are becoming more interested to cultivate this valuable crop after harvesting of rabi crops (kharif-I season). Several insect pests have been reported to infest mungbean damaging the crops during seedlings, leaves, stems, flowers, buds and pods causing considerable losses. More than twelve species of insect pests were found to infest mungbean in Bangladesh of which aphid, whitefly, thrips and pod borers are important (Hossain *et al.*, 2004).

Chi Yuchenque *et al*. (2003) conducted an experiment in Kagoshima, Japan to study the seasonal variation in legume pod borer abundance in four legumes species by cowpea, odzuki, soybean and kidney bean. The infestation peaked in mid July, when more than 90% of cowpea and adzuki flowers were infested.

2.2 Effect of chemicals and botanical control on pod borer growth and yield of mungbean

Regression analysis was used to quantify yield variations in cowpea due to major insect pests, i.e., aphids, thrips, Maruca pod borer, *Maruca vitrata* Fabricius and a complex of pod sucking bugs. Variability in pest infestation was created by growing Ebelat (an erect cowpea cultivar) in two locations over three seasons and under different insecticide spray schedules. Stepwise regression for individual locations and seasons data indicated that most of the variation in cowpea grain yields was caused by thrips. It was estimated that the total variation in cowpea grain yields, on average, the major pests contributed 51-69% in Pallisa nd 24-48% in Kumi. Thrips alone contribute 35-41% and 13-19% at these two sites, respectively (Kyamanywa, 2009).

Singh *et al*. (2009) evaluated of certain management schedules against major insect pests of *Vigna radiata* (L.) Wilczek, was carried out for two crop seasons (July to October 2001 and 2002) at the Agronomy Farm and the Department of Agricultural Zoology and Entomology of Rajasthan College of Agriculture, Maharana Pratap University of Agriculture & Technology, Udaipur, India. The efficacy of *Azadirachta indica* A. Juss oil and malathion, as first application against aphids, jassids and whiteflies was significantly lower under sole crop of *V. radiata* than when it was inter-cropped with maize during both years (2001 and 2002). Among the different treatment schedules as third application, endosulfan was most effective against the pod borers (*Maruca testulalis* Geyer and *Lampides boeticus* L.) in both sole crop and the intercrop. During the two-year study (2001 and 2002), the maximum yield of maize and green gram in the inter-cropped pattern and that as sole crop of green gram, as well as the maximum rupee equivalent yield value was recorded for the management schedule comprising release of *Chrysoperla carnea* 25 DAS, spray of *A. indica* oil 40 DAS and endosulfan 55 DAS. The lowest yield of *V. radiata* was recorded under the management schedule comprising three release of *Chrysoperla carnea* Stephen at 25, 40 and 55 DAS irrespective of the cropping pattern.

Gupta and Pathak (2009) reported that the efficacy of some indigenous neem products, insecticides and their admistures were tested at Research Farm of College of Agriculture, Tikamgarh during *kharif* 2003-2005. The results indicated that admixture treatments, neem seed kernel extract (NSKE) (in cow urine), 3% + dimethoate, 0.03% and neem oil, 0.5% + dimethoate, 0.03% not only reduced the incidence of whitefly and yellow mosaic but also of pod borer. These treatments gave maximum grain yield of 935 and 902 kg ha^{-1}, net profit of Rs 3934 and Rs 3320 ha^{-1} with incremental cost benefit ratio of 11.2 and 10.9, respectively.

Field study was carried out at Bangladesh Agricultural Research Institute (BARI) farm during March to August, 2005 to find out the most appropriate management practices against thrips of mungbean. The experiment consisted of seven treatments of various management practices. The incidence of this pest was first noticed during vegetative and flowering stage. The infestation rate was highest in reproductive stage. Application of Furadan 5 G as a seed treatment gave the maximum yield (950.05 kg ha^{-1}). On the other hand, minimum yield was found in control treatment. Two times application of Shobicron 425 EC also gave the satisfactory result but it was not economically viable. Neem oil with Trix gave the significant result in comparison with other treatments and it may be environmentally friendly (Kyamanywa, 2009).

Shah *et al*. (2007) conducted a field study was undertaken at Arid Zone Research Institute (AZRI), Bahawalpur, during Kharif, 2005 to investigate the efficiency of different insecticides, namely imidacloprid (Confidor 200SL), acetameprid (Mospilan 20SP), buprofezin (Polo), thiomethoxam (Actara 25WG) along with control on the growth and yield of mungbean. The results revealed that pods/plant and seed yield kg ha-1 varied significantly among different insecticides. Out of all the insecticides used in this study, imidacloprid treated plots had significantly the highest yield of (1563 kg ha-1) while the lowest seed yield of (1056 kg/ha) was obtained from the control plots where no insecticide was applied.

Rajnish *et al*. (2006) investigated different insecticides *viz.*, dimethoate (0.03%), monocrotophos (0.04%) and carbofuran (0.5 kg a.i./ha) gave better response and were found most effective followed by neem based formulations as moderately effective. The neem based insecticides *viz.*, NSKE (3%), neem gold (0.3%) and nimbecidin (0.3%) were found comparable to monocrotophos and dimethoate in all respects. All the insecticides were found economical but two sprays of dimethoate were found most effective and economical.

Oparaeke *et al*. (2005) reported that the mixtures of Neem and Eucalyptus leaf extracts with extracts of other plant species was investigated for efficacy in the management of two major post flowering insect pests (*Maruca* pod borers and *Clavigralla tomentosicollis* Stal.) of cowpea in the Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria. The results revealed that in 2000 and 2001 seasons the mean number of Maruca vitrata (F.) was reduced (< 1.0 / flower and /or pod) on plots sprayed with leaf extracts of Neem + Lemongrass, Neem + African curry, Neem + Tomato, Neem + Bitter leaf, and Eucalyptus + African Bush tea. Pod sucking bugs (dominated by C. tomentosicollis) numbers were suppressed (< 1.5 / plant) on plots treated with leaf extracts of Neem + African curry, Neem + Lemongrass, Neem + Tomato, Neem + Bitter leaf, and Eucalyptus + African Bush tea. These extracts mixtures caused great reductions in pod damage per plant and ensured higher grain yield compared with the unsprayed plots during the two years of investigation. The complementary roles played by individual plant species used for the extracts mixtures in reducing pests numbers and increasing grain yields on sprayed plots suggest the future direction of new formulations of Biopesticides in the management of field pests of crops on farms owned by resource limited farmers in low input agriculture characterizing the developing countries.

Different indices for developing an insecticide application schedule against euchrysops cnejus were evaluated in mungbean and fenitrothion @ 0.1% when egg number reached about 5.2 per meter was found as the best schedule for it (Rahman 1989). Rahman (1987) also reported thar Fenitrothion or Sumithion 50 EC @ 2ml/L of water was recommended for the control of pod borer. In another trial on need based application of insecticides against the pod borer in mungbean at Joydebpur, it was found that the spraying of Fenitrothion 0.1% at flowering and the second spary either at an interval of 15 days or at podding offered the highest cost bendfit ration (Rahman, 1989). The pod borer can also be controlled by cymbush 10 EC @ 1.0 m/l of water (Bakr, 1998).

Lal (1987) reported that foliar application at flower initiation with Endosulfon 0.07%, Dimethoate 0.03%, Phosphamidon 0.03% gave significant control of pod damage against pod borer, Srivastava *et al.* (1987) reported that the synthetic pyrethroids were effective in reducing pod borer damage and did not leave a toxic residre. Application of 0.3% Dimethoate or 0.4% Monocrotophos at 45 and 60 DAS were found effective in protectin kharif mungbean against lepidopteran pod borers and other pests attacking the crop at the flowering and fruiting stage (Ahmad *et al.,* 1998).

The aqueous extract from kernels was effective on pod borer as antifeedant (Kareem, 1978). Oils of plant origin such as neem seed oil (Puri *et al*., 1991; Butler *et al.,* 1991), cotton seed oil (Butler and Rao, 1990), Soybean oil (Butler *et al.,* 1991) have been tested against whitefly and the results were encouraging. In a laboratory study, Butler and Rao (1990) reported that 0.5%

sprays of 3 commercial neem oil formulation namely Neemguard, Newark, Neempon to single eggplant leaves against whitefly resulted 97% fewer eggs and 87% fewer immature compared to those on untreated leaves. The ether estract of *Tribulus terrestris* L. had juvenilising effects on cutworm (*Spodoptera litura*) and pod borer (*Heliothis armigera*), respectively (Gunasekaran and Chelliah, 1985).

CHAPTER III

MATERIALS AND METHODS

The details of the materials and methods of this research work as well as on experimental materials, site, climate and weather, land preparation, experimental design, lay out, data collection on pod borer incidence, grain yield etc. from April to November, 2011were described in this chapter. Overall discussion about experiment was carried out to study on the management of mungbean pod borer under the following headings and sub-headings:

3.1 Description of the experimental site

3.1.1 Location and time

The present research was conducted at the research field of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from March to November, 2011. The experimental area is located at 23.74^0 N latitude and 90.35^0 E longitudes with an elevation of 8.2 m from the sea level (Khan, 1997).

3.1.2 Soil of the experimental site

The soil of the experimental area was to the general soil type series of shallow red brown terrace soils under Tejgaon series. Upper level soils were clay loam in texture, olive-gray through common fine to medium distinct dark yellowish brown mottles under the Agro-ecological Zone (AEZ- 28) and belonged to the Madhupur Tract (UNDP, 1988; FAO, 1988). The selected plot was above flood level and sufficient sunshine was available having available irrigation and drainage system during the experimental period. Soil samples from 0-15 cm depths were collected from experimental field. The analyses were done from Soil Resources Development Institute (SRDI), Dhaka. The experimental plot was also high land, fertile, well drained and having pH 5.8. The physicochemical property and nutrient status of soil of the experimental plots are given in Appendix 1.

3.1.3 Climate and weather

The experimental area is situated in the sub-tropical climatic zone and characterized by heavy rainfall during the months of April to September (Kharif Season) and scanty rainfall during the rest period of the year (Biswas, 1987). The Rabi season (October to March) is characterized by comparatively low temperature and plenty of sunshine from November to February. The detailed meteorological data in respect of temperature, relative humidity and total rainfall recorded by the Weather Station of Bangladesh, Sher-e-Bangla Nagar, Dhaka during the period of study have been presented in Appendix II.

3.2 Plant materials

BARI mung 6:

BARI mung-6 was used as planting material. BARI mung-6 was released and developed by BARI in 2003. Plant height of the cultivar ranges from 40 to 45 cm. Its life cycle is about 55 to 58 days after emergence. One of the main characteristics of this cultivar is synchronization of pod ripening. Average yield of this cultivar is about 1800 kg ha^{-1}. The seeds of BARI mung-6 for the experiment were collected from BARI, Joydepur, Gazipur. The seeds were large shaped, deep green and free from mixture of other seeds, weed seeds and inert materials.

3.3 Treatments under investigation

There were five synthetic insecticides from different groups, one botanicals and one untreated control were evaluated against mungbean pod borer. The experiment comprised the following seven treatments including control

T_1 = Dursban 20EC @ 2 ml L^{-1} of water

T_2 = Ripcord 10EC @ 3.0 ml L^{-1} of water

T_3 = Diazinon 60EC @ 3.5 ml L^{-1} of water

T_4 = Marshal 20EC @ 3 ml L^{-1} of water

T_5 = Suntap 50SP @ 3 ml L^{-1} of water

T_6 = Neem oil @ 2 ml L^{-1} of water

T_7 = Untreated control

3.4 Experimental design and layout

The experiment consisted of BARI mung 6 and was laid out in Randomized Complete Block Design (RCBD) with three replications which were divided into seven equal plots. Thus there were 21 (3 × 7) unit plots in the experiment. The size of each unit plot was 2.5 m × 2 m. Block to block and plot to plot distances were 0.40 m and 0.50 m, respectively. The treatments of the experiment were randomly distributed into the experimental plot.

3.5 Land preparation

Power tiller was used for the preparation of the experimental field. Then it was exposed to the sunshine for 7 days prior to the next ploughing. Thereafter, the land was ploughed and cross-ploughed to obtain good tilth. Deep ploughing was done to produce a good tilth, which was necessary to get better yield of this crop. Laddering was done in order to break the soil clods into small pieces followed by each ploughing. All the weeds and stubbles were removed from the experimental field. The plots were spaded one day before planting and the whole amount of fertilizers were incorporated thoroughly before planting according to fertilizer recommendation guide (BARI, 2006).

3.6 Manures and fertilizers

The calculated entire amount of all manures and fertilizers were applied during final field preparation. The applied manures were mixed properly with the soil in the plot using a spade. The dose and method of application of organic and inorganic fertilizers are shown below:

Manure and fertilizers	Dose (kg ha^{-1})
Urea	30
TSP	70
MP	35
Cow dung	10 ton

Source: BARI, 2006 (Fertilizer Recommended Guide)

3.7 Seed treatments

Before planting seeds were treated with Vitavex-200 @ 0.25% to prevent seeds from the attack of soil borne disease. Furadan @1.2 kg ha^{-1} was also used against wireworm and mole cricket.

3.8 Sowing of seeds

Treated mature 4-5 seeds of mungbean were sown in each hole by hand. Seeds were sown on 8th April, 2011. The row to row and plant to plant distances were 40 cm and 10 cm, respectively. Seeds were placed at about 6-7 cm depth from the soil surface. Few seedlings were grown in the border of the plots as stock seedling for gap filling subsequently.

3.9 Intercultural operations

3.9.1 Thinning out

As the seeds were sown continuously, so there were so many seedlings which need thinning. Emergence of seedling was completed within 10 days after sowing. Over crowded seedlings were thinned out two times. First thinning was done after 15 days of sowing which is done to remove unhealthy and lineless seedlings. The second thinning was done 10 days after first thinning.

3.9.2 Gap filling

Seedlings were transferred to fill in the gaps where seeds failed to germinate. The gaps were filled in within two weeks after germination of seeds.

3.9.3 Weeding

There were some common weeds found in the mungbean field. First weeding was done at 30 days after sowing and then once a week to keep the plots free from weeds and to keep the soil loose and aerated.

3.9.4 Irrigation and drainage

The first irrigation was applied after first weeding. Subsequent irrigation was given and when irrigation needed. Proper drainage system was also developed for draining out excess water.

3.9.5 Insect and pest control

The experimental crop was infested with pod borer and no fungicide was used. They attacked at the flowering and reproductive stage. Various chemicals and botanical extract spray as water solution at 7 days interval as a treatment from germination to harvest period to control this pod borer.

3.9.6 Procedure of spray application

Diazinon 60 EC @ 3.5 ml L^{-1}, Ripcord 10 EC @ 3.0 ml L^{-1}, Dursban 20 EC @ 2 ml L^{-1}, Marshal 20EC @ 3 ml L^{-1}, Suntap 50 SP @ 3 ml L^{-1}, Neem oil @ 2 ml L^{-1} were sprayed in assigned plots and doses by using Knapsack sprayer at 7 days interval to control the pod borer.

3.10 Data collection

3.10.1 Number of leaves plant^{-1}

Number of leaves per plant^{-1} data was also recorded at different days after sowing from the randomly selected ten plants of inner rows of each plot.

3.10.2 Number of branch plant^{-1}

Number of branch per plant^{-1} data was also recorded at different days after sowing from the randomly selected ten plants of inner rows of each plot.

3.10.3 Plant height

Plant height was measured in centimeter by a meter scale at different days after transplanting and their average data was recorded per replication. Data were also recorded as the average of randomly selected 10 plants from the inner rows of each plot. Plant height the ground surface to the top of the main shoot and the mean height were expressed in cm.

3.10.4 Percent flower infestation

The number of infested flower was counted for each sample plant. The infested flowers were identified by recognizing the bored flower caused by the pod borer after emerging adult from the flowers. The percent flower infestation was then calculated from the data on number of infested and total flowers observed by using the following formula:

$$\% \text{ infestation of flowers} = \frac{\text{Number of infested flowers}}{\text{Total number of flowers}} \times 100$$

3.10.5 Percent pod infestation

The number of infested pod was counted for each sample plant. The infested pods were identified by recognizing the bored pod caused by the pod borer after emerging adult from the pods. Magnifying lens and simple microscope were also used in that purpose whenever needed. The percent grain infestation was then calculated from the data on number of infested and total pods

observed by using the following formula:

$$\% \text{ infestation of pods} = \frac{\text{Number of infested pods}}{\text{Total number of pods}} \times 100$$

3.10.6 Number of bore per plant

Numbers of borers were recorded at different days transplants. Ten randomly plants were selected for the collection of data. Data on number of insects were recorded at an interval of 7 days commencing from first incidence and continued up to the 5 weeks. Reduction percentage was also recorded on the basis of control treated plant where the maximum number of pod borer was attack. The following formula were used for taking the reduction percentage

$$\% \text{ reduction of borer} = \frac{\text{Mean infestation of untreated plot} - \text{Mean infestation of treated plot}}{\text{Mean infestation value of untreated plot}} \text{ X } 100$$

3.11 Statistical analysis

The data obtained from experiment on various parameters were statistically analyzed in MSTAT-C computer program. The mean values for all the parameters were calculated and the analysis of variance for the characters was accomplished by Duncan's Multiple Range Test (DMRT) at 5 % level of probability.

CHAPTER IV

RESULTS AND DISCUSSION

The experimental results were studied on management of mungbean pod borer and their control under different chemical and botanicals solution spray. Beside different crop characters, yields and yield contributing characters have also been presented and discussed in this chapter.

4.1 Effect of chemicals and botanical control on growth of mungbean

4.1.1 Number of leaves plant^{-1}

Effect of chemicals and botanical extract showed significant variation in respect of number of leaves plant^{-1} at different day after sowing. Among the treatments, the maximum number of leaves (28.17 and 28.83, at 42 and 49 DAS, respectively) was found from the treatment Marshal 20EC @ 3 ml L^{-1} of water and the maximum percent increase by number over control (20.00%). the lowest results was obtained by

Table1. Effect of different management practices on the number of leaf per plant in the field of mungbean during second and third week of May 2011

Treatments	Number of leaves per plant			% leaf increase by number over control
	42 DAS	49 DAS	Mean	
T_1	25.33 ab	25.50 b	25.42 bc	7.01
T_2	26.00 ab	26.17 ab	26.09 ab	9.83
T_3	22.67 b	25.67 b	24.17 b	1.77
T_4	28.17 a	28.83 a	28.50 a	20.00
T_5	25.33 ab	23.83 b	24.58 bc	3.49
T_6	23.50 b	25.17 b	24.34 bc	2.46
T_7	24.00 b	23.50 b	23.75 bc	-
$LSD_{(0.05)}$	3.11	2.86	2.99	-
CV (%)	6.99	6.31	6.65	-

DAS= Days after sowing, In column, the treatment means having similar letter(s) are not statistically significant at 5% level of probability.

[T_1= Dursban 20EC @ 2 ml L^{-1} of water, T_2= Ripcord 10 EC @ 3.0 ml L^{-1} of water, T_3= Diazinon 60EC @ 3.5 ml L^{-1} of water, T_4= Marshal 20EC @ 3 ml L^{-1} of water, T_5= Suntap 50 SP @ 3 ml L^{-1} of water, T_6= Neem oil @ 2 ml L^{-1} of water, T_7= Untreated Control]

control treatment (Table 1). The minimum percent increase of leaf over control in Diazinon 60EC @ 3.5 ml L^{-1} of water (1.77%). After the all DAS, the trend of efficiency among different insecticides and botanical including untreated control in terms of number of leaves per plant was $T_4>T_2>T_1>T_5>T_6>T_3$.

4.1.2 Number of branch per plant (cm)

An insignificant variation was also observed due to the effect of different chemicals and botanical management of pod borer on mungbean plant in respect of number of branch per plant at different days after sowing. The maximum number of branches (5.23 and 5.33 at 42 and 49 DAS, respectively) was found at Marshal 20EC @ 3 ml L^{-1} of water where the pod borer was not more effective incase of highest control was

Table 2. Effect of different management practices on the number of branch per plant in the field of mungbean during second and third week of May 2011

Treatments	No. of branch per plant			% branch increase by number over control
	42 DAS	49 DAS	Mean	
T_1	4.67 a	4.90 a	4.78 a	5.25
T_2	4.67 a	4.63 a	4.65 a	2.31
T_3	4.67 a	4.77 a	4.72 a	3.78
T_4	5.23 a	5.33 a	5.28 a	16.24
T_5	5.07 a	5.00 a	5.03 a	10.75
T_6	5.00 a	5.07 a	5.03 a	10.75
T_7	4.50 a	4.59 a	4.55 a	-
LSD $_{(0.05)}$	0.75	0.86	0.81	-
CV(%)	8.78	9.85	9.32	-

DAS= Days after sowing, In column, the treatment means having similar letter(s) are not statistically significant at 5% level of probability.

[T_1= Dursban 20EC @ 2 ml L^{-1} of water, T_2= Ripcord 10 EC @ 3.0 ml L^{-1} of water, T_3= Diazinon 60EC @ 3.5 ml L^{-1} of water, T_4= Marshal 20EC @ 3 ml L^{-1} of water, T_5= Suntap 50 SP @ 3 ml L^{-1} of water, T_6= Neem oil @ 2 ml L^{-1} of water, T_7= Untreated control]

obtained by Marshal 20EC @ 3 ml L^{-1} of water. However, Diazinon 60EC @ 3.5 ml L^{-1} of water showed the minimum control on pod borer as well as the minimum number of branch (4.67 and 4.77, at 42 and 49, 56 DAS, respectively) was recorded (Table 2). The percent increase number of branch over untreated control was the highest (16.24%) under Marshal 20EC @ 3 ml L^{-1} of water and the lowest (2.31%) was in Ripcord 10 EC @ 3.0 ml L^{-1} of water (Table 6).

The result showed that the highest pod borer attack reduced the plant growth but pesticide using reduced the pod borer and maximum the plant growth as well as plant height, number of leaves, number of primary branch etc.

4.1.3 Plant height

Plant height was significantly affected by the application of chemicals and botanical extract uses as treatment at different days after sowing. Among the treatments, the highest plant height (44.63 and 45.4 cm at 42 and 49 DAS, respectively) was observed at chemicals pesticide Marshal 20 EC @ 3 ml L^{-1} of water where minimum number and more reduction of pod borer was recorded which was closely followed by Neem oil @ 2 ml L^{-1} of water (39.93 and 40.17 cm at 42 and 49 DAS, respectively). On the other hand, the shortest plant (34.97 and 35.03 cm at 42 and 49 DAS, respectively) was recorded from control treatment (Table 3).

Table 3. Effect of different management practices on the plant in the field of mungbean during second and third week of May 2011

Treatments	Plant height (cm)			% increase of Plant height over control
	42 DAS	49 DAS	Mean	
T_1	39.58 b	40.13 b	39.86 bc	14.36
T_2	37.33 bc	37.77 b	37.55 bc	7.75
T_3	38.87 b	39.77 b	39.32 bc	12.83
T_4	44.63 a	45.4 a	45.02 a	29.17
T_5	38.33 b	39.03 b	38.68 bc	10.99
T_6	39.93 b	40.17 b	40.05 b	14.92
T_7	34.67 b	35.03 c	34.85 c	-
LSD $_{(0.05)}$	2.78	2.53	2.66	-
CV(%)	4.01	3.60	3.81	-

DAS= Days after sowing, In column, the treatment means having similar letter(s) are not statistically significant at 5% level of probability.

[T_1= Dursban 20EC @ 2 ml L^{-1} of water, T_2= Ripcord 10 EC @ 3.0 ml L^{-1} of water, T_3= Diazinon 60EC @ 3.5 ml L^{-1} of water, T_4= Marshal 20EC @ 3 ml L^{-1} of water, T_5= Suntap 50 SP @ 3 ml L^{-1} of water, T_6= Neem oil @ 2 ml L^{-1} of water, T_7= Untreated control]

The plant height percent increase over untreated control was the highest (29.17%) under T_4 (Marshal 20EC @ 3 ml L^{-1} of water) and the lowest (7.75%) was in Ripcord 10 EC @ 3.0 ml L^{-1} of water (table 3). In the rest of the treatment the plant height increased over control was 14.36% Dursban 20EC @ 2 ml L^{-1} of water, 10.99 % in Suntap 50 SP @ 3 ml L-1 of water, 12.83% Diazinon 60EC @ 3.5 ml L of water, 14.92% in Neem oil @ 2 ml L-1 of water. Marshal 20EC @ 3 ml L^{-1} of water the most effective insecticide against pod borer on mungbean. After the all DAS, the trend of efficiency among different insecticides and botanical including untreated control in terms of plant height was T_4>T_6>T_1>T_3>T_5>T_2.

4.2 Effect of different insecticides and botanical on number of flower infestation

Significant differences were observed among different management practices in terms of flower infestation during the management of mungbean pod borer (Table 4). The highest flower infestation (4.67 and 4.33, at 30 and 32 DAS, respectively) was recorded in T_7 (untreated control) which was statistically different from all other treatments (Table 1) and was followed (2.67 and 2.67 at 30 and 32 DAS, respectively) by T_1 (Dursban 20EC @ 2 ml L^{-1}). On the other hand, the lowest flower infestation (1.67, 1.33 at 30 and 32 DAS, respectively) was recorded in T_4 (Marshal 20EC @ 3 ml L^{-1} of water).

Table 4. Effect of different management practices on the number of flower infestation in the field of mungbean during first week of May 2011

Treatments	Number of Flower infestation			% flower infestation reduction over control
	30 DAS	32 DAS	Mean	
T_1	2.67 bc	2.67 b	2.67 b	40.70
T_2	2.33bc	2.33 bc	2.33 bc	48.19
T_3	2.33 bc	2.33 bc	2.33 bc	48.16
T_4	1.67 c	1.33 d	1.50 c	66.67
T_5	2.67 bc	2.00 bcd	2.33 bc	48.14
T_6	3.00 b	1.67 cd	2.33 bc	48.14
T_7	4.67 a	4.33 a	4.50 a	-
LSD $_{(0.05)}$	1.19	0.98	1.08	-
CV (%)	14.14	23.07	18.61	-

DAS= Days after sowing, In column, the treatment means having similar letter(s) are not statistically significant at 5% level of probability.

[T_1= Dursban 20EC @ 2 ml L^{-1} of water, T_2= Ripcord 10 EC @ 3.0 ml L^{-1} of water, T_3= Diazinon 60EC @ 3.5 ml L^{-1} of water, T_4= Marshal 20EC @ 3 ml L^{-1} of water, T_5= Suntap 50 SP @ 3 ml L^{-1} of water, T_6= Neem oil @ 2 ml L^{-1} of water, T_7=Untreated control]

The number of flower infestation reduction over untreated control was the highest (66.67%) under Marshal 20EC @ 3 ml L^{-1} of water and the lowest (40.70%) was in Dursban 20EC @ 2 ml L^{-1} (Table 1). In the rest of the treatment the pod infestation reduction over control was 48.19 % in Ripcord 10 EC @ 3.0 ml L^{-1} of water, 48.16%

in Suntap 50 SP @ 3 ml L-1 of water, 48.14% in Neem oil @ 2 ml L-1 of water and 48.16 Diazinon 60EC @ 3.5 ml L of water. Marshal 20EC @ 3 ml L^{-1} of water the most effective insecticide against pod borer on mungbean. After the all DAS, the trend of efficiency among different insecticides and botanical including untreated control in terms of number of flower infestation was $T_4 > T_2 > T_3 > T_6 > T_5 > T_1$.

4.3 Effect of different insecticides and botanical on pod infestation

Significant differences were observed among different management practices in terms of pod infestation during the management of mungbean pod borer (Table 5).

The highest pod infestation (5.67 and 6.33 at 42 and 49 DAS, respectively) was recorded in T_7 (untreated control) which was statistically different from all other treatments (Table 2) and was followed (3.67 and 2.67 at 42 and 49 DAS, respectively) by T_1 (Dursban 20EC @ 2 ml L^{-1}). On the other hand, the lowest pod infestation (2.67 and 1.33 at 42, 49 DAS, respectively) was recorded in T_4 (Marshal 20EC @ 3 ml L^{-1} of water) and was followed (3.00 and 1.33 at 42 and 49 DAS, respectively) by Spraying of T_3 (Dursban 20EC @ 2 ml L^{-1} of water).

Table 5. Effect of different management practices on the pod infestation in the field of mungbean during second and third week of May 2011

Treatments	Pod infestation			% Pod infestation reduction over control
	42 DAS	49 DAS	Mean	
T_1	3.67 b	2.67 b	3.17 b	47.17
T_2	3.33 b	2.00 b	2.67 bc	55.58
T_3	3.00 b	1.33 c	2.17 bc	63.92
T_4	2.67 b	1.33 c	2.00 c	66.67
T_5	2.67 b	1.67 c	2.17 bc	63.83
T_6	3.33 b	2.00 bc	2.67 bc	55.58
T_7	5.67 a	6.33 a	6.00 a	-
$LSD_{(0.05)}$	1.28	0.92	1.1	-
CV(%)	20.66	20.98	20.82	-

DAS= Days after sowing, In column, the treatment means having similar letter(s) are not statistically significant at 5% level of probability.

[T_1= Dursban 20EC @ 2 ml L^{-1} of water, T_2= Ripcord 10 EC @ 3.0 ml L^{-1} of water, T_3= Diazinon 60EC @ 3.5 ml L^{-1} of water, T_4= Marshal 20EC @ 3 ml L^{-1} of water, T_5= Suntap 50 SP @ 3 ml L^{-1} of water, T_6= Neem oil @ 2 ml L^{-1} of water, T_7= Untreated control]

The pod infestation reduction over untreated control was the highest (66.67%) under Marshal 20EC @ 3 ml L^{-1} of water and the lowest (47.17%) was in Dursban 20EC @ 2 ml L^{-1} (table 5). In the rest of the treatment the pod infestation reduction over control was 63.92 % in Diazinon 60EC @ 3.5 ml L of water, 63.83% in Suntap 50 SP @ 3 ml L-1 of water, 55.58% in Neem oil @ 2 ml L-1 of water and 55.58% Ripcord 10 EC @ 3.0 ml L^{-1} of water. Marshal 20EC @ 3 mlL^{-1} of water the most effective insecticide against pod borer on mungbean. Nath and Yein reported that Dursban could also be used for the control of pod borer in this crop. Ahmed *et al.* (1998) recommended that Dimethoate, Monochrotophos were most effective in protecting kharif mungbean against pod borer. After the all DAS, the trend of efficiency among different insecticides and botanical including untreated control in terms of pod infestation was $T_4>T_3>T_5>T_6>T_2>T_1$.

4.4 Number bore infestation per plant

Number of pod borer and their reduction percentage of mungbean showed significant difference (Table 6). Those significant variation results were presented in Table 6. Different chemicals and botanical extract were used to suppress the number of pod bore and to test the effectiveness their controlled whereas the maximum incidence of pod borer was found under the untreated treatment (control treatment) on mungbean at vegetative stage. Among the chemicals and botanical extract, using Marshal 20 EC @ 3 ml L^{-1} of water gave the maximum effectiveness of pod borer (1.33 and 0.67 at 42 and 49 DAS, respectively) and it was maximum percent reduction over control (75.00%)

Table 6. Effect of different management practices on the number of bore pre pod in the field of mungbean during second and third week of May 2011

Treatments	Number of bore per pod			% reduction of bore infestation over control
	42 DAS	49 DAS	Mean	
T_1	2.67 b	2.00 b	2.33 b	41.66
T_2	1.6 bc	1.67 b	1.67 bc	58.33
T_3	2.33 bc	2.00 b	2.17 bc	45.88
T_4	1.33 c	0.67 c	1.00 c	75.00
T_5	1.67 bc	1.67 b	1.67 bc	58.33
T_6	2.00 bc	1.33 bc	1.67 bc	58.34
T_7	4.00 a	4.00 a	4.00 a	
$LSD_{(0.05)}$	1.04	0.99	1.01	
CV(%)	26.10	29.21	27.66	

DAS= Days after sowing, In column, the treatment means having similar letter(s) are not statistically significant at 5% level of probability.

[T_1= Dursban 20EC @ 2 ml L^{-1} of water, T_2= Ripcord 10 EC @ 3.0 ml L^{-1} of water, T_3= Diazinon 60EC @ 3.5 ml L^{-1} of water, T_4= Marshal 20EC @ 3 ml L^{-1} of water, T_5= Suntap 50 SP @ 3 ml L^{-1} of water, T_6= Neem oil @ 2 ml L^{-1} of water, T_7= Untreated control]

To compare another using insecticides and botanical extract. But compare with other treatments, uses of Dursban 20EC @ 2 ml L^{-1} of water showed less effectiveness to incidence the pod borer (2.67, 2.00, at 42, 49, DAS, respectively) which was minimum reduction (41.66%). After the all DAS, the trend of efficiency among different insecticides and botanical including untreated control in terms of number of pod bore was $T_4>T_6>T_2>T_5>T_3>T_1$.

CHAPTER V

SUMMARY AND CONCLUSION

The present research was conducted at the experimental field of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from April to November, 2011 to study management of mungbean pod borer. The experiment compared with five different chemicals and botanical pesticide including untreated control treatment viz. T_1= Dursban 20EC @ 2 ml L^{-1} of water, T_2= Ripcord 10 EC @ 3 ml L^{-1} of water, T_3= Diazinon 60EC @ 3.5 ml L^{-1} of water, T_4= Marshal 20EC @ 3 ml L^{-1} of water, T_5= Suntap 50 SP @ 3 ml L^{-1} of water, T_6= Neem oil @ 2 ml L^{-1} of water, T_7= Control treatment were used as treatments. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications.

Significant differences were observed among different management practices in terms of flower infestation during the management of mungbean pod borer. The lowest flower infestation (1.67, 1.33 at 30 and 32 DAS, respectively) was recorded in T_4 (Marshal 20EC @ 3 ml L^{-1} of water). The flower infestation reduction over untreated control was the highest (66.67%) under Marshal 20EC @ 3 ml L^{-1} of water and the lowest (40.70%) was in Dursban 20EC @ 2 ml L^{-1}.

Significant differences were observed among different management practices in terms of pod infestation during the management of mungbean pod borer. Among the treatments, Marshal 20EC @ 3 ml L^{-1} was more effective on pod borer as well as the lowest pod infestation (2.67 and 1.33 and at 42 and 49 DAS, respectively) was recorded. The pod infestation reduction over untreated control was the highest (66.67%) under Marshal 20EC @ 3 ml L^{-1} of water and the lowest (47.17%) was in Dursban 20EC @ 2 ml L^{-1} of water.

Incidence of pod borer and their reduction percentage on mungbean showed significant difference. The marshal 20EC@3 ml L^{-1} of water gave the maximum effectiveness of pod borer (1.33 and 0.67 at 42 and 49 DAS, respectively) and it was maximum percent reduction over control (75.00%) to compare another using chemicals and botanical extract.

Chemicals and botanicals treatments on pod borer significantly influenced on growth characteristics of mungbean whereas the tallest plant (44.63 and 45.4 cm at 42 and 49 DAS, respectively), maximum number of leaves $plant^{-1}$ (28.17 and 28.83 and 29.33 at 42 and 49 DAS, respectively) and number of branch per plant (5.23 and 5.33, at 42 and 49 DAS, respectively) were found from marshal 20EC @ 3 ml L^{-1} of water where the minimum number of pod borer.

From the above results investigate, it could be concluded that among the all applied chemical chemicals and botanical extract treatments in this study, marshal 20EC @ 3 ml L^{-1} of water showed the greater perform on manage the pod borer of mungbean as well as on growth and yield characteristics.

The following recommendation may be suggested for this present study-

1. More chemicals and botanical extract treatments may be needed to include for future study as sole or different combination to make sure the better performance of Marshal 20EC @ 3 ml L^{-1}.

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APPENDICES

Appendix I. Physiological properties of the initial soil

Characteristics	Value	Critical value
Partical size analysis		
% sand	26	-
% silt	45	-
% clay	29	-
Textural class	Silty clay	-
pH	5.6	Acidic
Organic carbon (%)	0.45	-
Organic matter (%)	0.78	-
Total N (%)	0.03	0.12
Available P (ppm)	20.00	27.12
Exchangeable K (me 100^{-1} g soil)	0.10	0.12
Available S (ppm)	45	-

Appendix II: Monthly record of air temperature, rainfall and relative humidity of the experimental site during the period from March 2011 to November 2011

Date/Week	Temperature		Relative humidity (%)	Rainfall (mm) (Total)
	Maximum	Minimum		
March	32.1	21.5	57	20
April	33.5	23.2	64	123
May	33.4	24.6	76	235
June	32.6	26.3	80	314
July	32.3	26.7	79	356
August	31.1	26.5	82	409
September	32.4	26.4	77	207
October	32.7	24.7	73	112
November	29.7	19.2	67	0

Source: Bangladesh Meteorological Department (Climate and Weather Division), Agargaon, Dhaka- 1207