INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Effects of Different Botanicals and Chemicals on the Incidence of Sucking Insect Pests and their Impact on Mosaic Disease of Mungbean

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Abstract:
A field experiment was conducted at the research field of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from April to November, 2011 to manage the sucking insects of mungbean and its impact on incidence of mosaic disease. The mungbean variety, BARI mung 4 was grown in the field and seven treatments viz., Ripcord 10EC, Actara 25WG, Marshal 20EC, Malathion 57EC, Neem oil, Tamarind extract and an untreated control were tested against the sucking pests. Whitefly, jassid, aphid and leaf hooper were found as sucking insects and whitefly was the most abundant in mungbean field. The lowest population of aphid, jassid, whitefly and leafhopper (3.85, 1.80, 4.90, 1.35 plant^{-1} respectively at vegetative stage & 2.80, 1.25, 3.80, 0.55 plant^{-1} respectively at reproductive stage) was found in marshal 20EC treated plots which showed maximum percent reduction of aphid, jassid, whitefly and leafhoppers over control (63.17%, 55.70%, 57.33% & 64.76% respectively at vegetative stage & 66.65%, 65.01%, 58.89% & 75.79% respectively at reproductive stage). The number of mosaic infected plant was found lowest (6.75/plot at before flowering and 4.75/plot at after flowering stage) in the same treatment. Marshal also produced the maximum plant height (90.25 cm), dry weight of plant (62.85 g), number of pods plant^{-1} (26.25), length of pod (7.19cm), number of seeds pod^{-1} (8.25), 1000-seed weight (35.50 g) and gave highest yield (566.50 g plot^{-1}) of mungbean followed by ripcord 10 EC . Neem oil showed the intermediate results considering all the parameters. The results of present study indicate that the marshal 20EC was the most effective treatment against sucking insects and mosaic infection.

Keywords: *Sucking pests, Chemicals, Botanicals and Mungbean*

1. Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) is a good source of protein, carbohydrates, vitamin for mankind all over the world. Being an important short-duration Kharif grain legume, mungbean is grown extensively in major tropical and subtropical countries of the world. It is a drought tolerant, grown twice a year and fits well in crop rotation programme in Bangladesh. The reasons of this low yield are numerous but yield losses due to insect pest complex are distinct one. 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 feeders 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 sucking insect pests (aphid, jassids, leaf hopper and whitefly) are of the major importance (Islam *et al*., 2008). These insect pests not only reduce the vigor of the plant by sucking the sap but also transmit diseases and affect photosynthesis as well (Sachan *et al*., 1994) and ultimately yield losses. Pest appearance, population fluctuation, infestation rate and crop yield are very much dependent on sowing time. Most of the farmer's usually sown mungbean just after harvesting the 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 used synthetic chemicals because of their quick knock down effect with or without knowing the ill 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 sucking insects of Mungbean. Sachan *et al.* (1994) found a drastic reduction in the infection of YMV when whitefly attack was reasonably controlled. The yellow mosaic virus caused 30-70% yield loss (Marimuthu *et al.* 1981). Chamder *et al.* (1991) noticed a significant reduction in the attack of whitefly and infection of YMV in Mungbean when 0.04% monocrotophos, 0.03% dimethoate, and 0.05% chlorvinphos 55 days after sowing were applied. In similar studies, 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.* (1995), Mustafa (1996) and Latif *et al.* (2001) have also evaluated different insecticides against sucking insect pests of cotton common to Mungbean.

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). These conventional chemical control measures failed to adequately control this pest that resulting in severe yield losses. Under these circumstances it becomes necessary to find out some eco-friendly alternative methods for insect pests management in formulating the Integrated Pest Management approach.

Yellow mosaic is reported to be the most destructive viral disease not only in Pakistan, but also in India, Bangladesh, Srilanka and contiguous areas of South East Asia (Biswass *et. al.*, 2008. John *et al.*, 2008). MYMV resembling other whitefly-transmitted Geminiviruses has appeared as the most important, serious and often overwhelming disease throughout Pakistan. The virus causes uneven yellow and green specks or patches on the leaves which finally turn entire yellow. Affected plants generate fewer flowers and pods, which also develop mottling and remain small and contain fewer, smaller and shrunken seeds.

Moreover, majority of these sucking pests to mungbean yellow mosaic virus (MYMV) disease which is the major cause of unsuccessful cultivation of mungbean. Because of these limitations, the production of mungbean is very low. Keeping all these constraints in view, the present study was undertaken to study on the infestation status of sucking pests such as aphid, jassid, whitefly, leaf hopper on mungbean and to know the effect of some chemical insecticides and botanicals on sucking pests and its impact on mosaic disease infestation which affet the growth and yield of mungbean.

2. Materials and Methods

The present research was conducted at the research field of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from April to November, 2011. The field trial was carried out in a randomized complete block design (RCBD) with four replications. Seeds of Mungbean variety BARI mung 4 were collected from the Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh. Before planting, seeds were treated with Vitavex-200 @0.25% to prevent seeds from the attack of soil borne disease. Furadan 5G @1.2 kg ha^{-1} was also used as per treatment against wireworm and mole cricket. Seeds were sown on 20^{th} April, 2011 in 28 plots. The whole field was divided into four blocks of equal size having 1.0 m space between the blocks and 0.5m between the plots. The unit plot size was 3.0 m× 2.0 m accommodating row to row and plant to plant distances 35cm and 15cm, respectively. Seeds were placed at about 5 cm depth from the soil surface. Three seeds were sown in each hole. Supplementary irrigation was applied when needed. Proper drainage system was also developed for draining out excess water. Weeding was done as and when necessary. Excess seedlings of mungbean were thinned out two times. First thinning was done after 15 days of sowing which was done to remove unhealthy seedlings. The second thinning was done 10 days after first thinning. Manures and fertilizers were applied as per fertilizers recommendation guide, BARI (Annon. 2006).

The treatments were as follows:

- T_1 = Application of Ripcord 10 EC @ 1.0 ml L^{-1} of water at 7 days interval.
- T_2 = Application of Actara 25 WG @ 0.25 g L^{-1} of water at 7 days interval.
- T_3 = Application of Marshal 20EC @ 3 ml L^{-1} of water at 7 days interval.
- T_4 = Malathion 57EC@ 2 ml L^{-1} of water at 7 days interval
- T_5 = Application of Neem oil @ 3 ml L^{-1} of water + 3 g detergent at 7 days interval.
- T_6 = Application of Tamarind extract @ 100 g L^{-1} of water at 7 days interval.
- T_7 = Untreated control

2.1. Procedure of Spray Application

The actual amount of each chemical insecticide was taken in a knapsack sprayer having pressure of 4-5 kg cm^{-2} and thoroughly mixed with water and sprayed in the respective plot. The required amount of neem oil was taken by measuring cylinder in the sprayer then 3.0 g detergent were added with it and mixed properly before spraying. 100 g ripe fruits of tamarind was soaked in 1.0 liter water for 24 hours then thoroughly mixed with hand and filtrated through fine mesh. Then it was sprayed in assigned plots by using Knapsack sprayer. Each treatment was repeated at 7 days interval and 14 sprays were applied in the field.

2.2. Data Collection

Number of sucking pests (aphid, jassid, whitefly and leaf hopper) were recorded at vegetative and reproductive stage. Five randomly plants of each plot were selected for the collection of data. After application of the treatments percent reduction of pests were estimated on the basis of control treated plant where the maximum number of sucking pests attacked. Incidence of mosaic diseases were recorded at before and after flowering stage of the crop. Data on number of insects and mosaic disease were recorded at an interval of 7 days commencing from first incidence and continued up to the 14 weeks (14 times). Plant height from the ground surface to the top of the main shoot was measured in centimeter by a meter scale at vegetative and reproductive stage and their average data was recorded per replication. Number of leaves per plant^{-1} was also recorded at before and after flowering stage. All pods were separated from five sample plants and the total number of pods were counted and recorded. Average number of pods per plant was calculated. Pod length was measured in centimeter (cm) scale from randomly selected five pods. The plant dry matter weight was taken by oven dry method. Five plant samples were randomly collected from unit plot at the harvest period were gently washed to remove sand and dust particles adhere to the plants. Then the water adhere to the plants were soaked with paper towel. After then the samples were kept in an oven at 70^{o}C for 72 hours to attain constant weight. When the plant samples were attained at constant weight, the dry weights were recorded at harvest. Number of seeds pod^{-1} was recorded after harvesting of the crop from the five randomly selected pods from five pre-selected plants was counted. The data were pooled over and then averaged to obtain the mean value of each parameter. One thousand grains were randomly counted and selected from the stock seed and weighed in gram by digital electric balance. After harvesting the plant was sun-dried and threshed by pedal thresher. Seeds were properly sun-dried and their weights recorded. Seed yield was then converted to g plot^{-1}.

2.3. Statistical Analysis

Data were analyzed by using MSTAT software for analysis of variance. Mean values were ranked by Duncan's Multiple Range Test (DMRT) at 5% level of significance which was used to compare the mean differences among the treatments (Gomez and Gomez, 1984).

4. Results and Discussion

4.1. Incidence of Sucking Insects on Mungbean

The comparative population dynamics of sucking insects from untreated control plot in relation to plant age is shown in Fig1. The graph expresses that the population of all sucking insects was increased with plant age and it was reached maximum at 8th week after germination and then declined with plant age. The whitefly (B*emisia tabaci*) was the most abundant insect and aphid (*Aphis craccivora*) was the second highest insect attacking mungbean. Jassid (*Amrasca biguttula biguttula*) population occupied the 3rd position and leafhopper *(Empoasca fabae)* population was found lowest on mungbean during the cropping season. These results support the findings of Ganapathy and Karuppiah (2004) who reported that aphid, whitefly and jassid were the major sucking insects of mungbean.

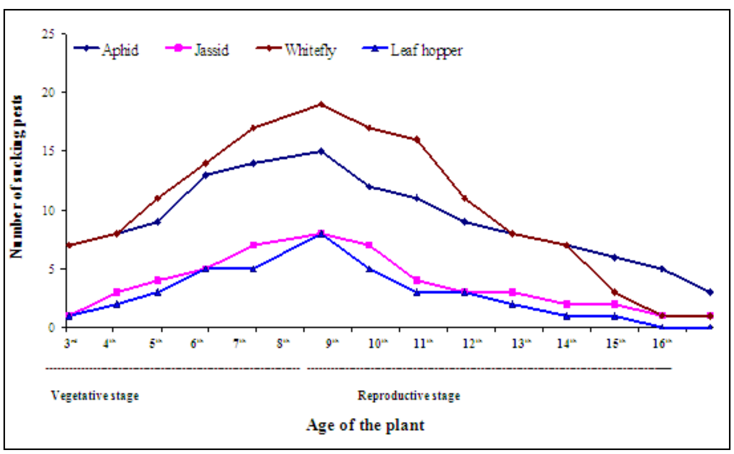

Figure 1: Population Dynamics of Sucking Insects on Mungbean throughout the Cropping Season

5. Effect of Treatments in Reducing Sucking Pests (aphid, jassid, whitefly, white leaf hopper) on Mungbean

The average population of aphid, jassid, whitefly and leaf hopper at vegetative and reproductive stage of mungbean under different treatments has been shown in Table 1. The data indicated that the lowest number of aphid (3.85/plant at vegetative and 2.80/plant at reproductive stage) was observed in marshal 20EC treatment followed by ripcord 10EC (4.40/plant at vegetative and 4.05/plant at reproductive stage) having significant difference between them. Plots treated by other insecticides have intermediate number of aphid. However, the highest number of aphid (10.40/plant at vegetative stage and 8.30/plant at reproductive stage) was found in control plots which were significantly higher than all other treated plots. Similarly the average population of jassid was lowest (1.80/plant at vegetative stage and 1.25/plant at reproductive stage) in marshal 20EC treatment followed by ripcord 10EC treatment (2.35/plant at vegetative stage and 1.95/plant at reproductive stage) having significant difference between them. The highest number of jassid (4.00/plant at vegetative stage and 3.50 at reproductive stage) was found in control treatment which was significantly higher than all other treatments. The whitefly and white leaf hopper population also showed almost similar trends as aphid and jassid. The lowest number of whitefly (4.90/plant at vegetative stage and 3.80/plant at reproductive stage) was observed in marshal 20EC treatment followed by ripcord 10EC treatment

(7.35/plant at vegetative stage and 6.00/plant at reproductive stage) having significant difference between them. The highest number of whitefly (11.50/plant at vegetative stage and 9.20/plant at reproductive stage) was found in control treatment which was significantly higher than all other treatments. The data also indicate that the lowest number of leaf hopper (1.35 /plant at vegetative stage and 0.55 /plant at reproductive stage) was observed in marshal 20EC treatment followed by ripcord 10EC treatment (1.70 /plant at vegetative stage and 1.00 /plant at reproductive stage) having significant difference between them. The highest number of leaf hopper (3.750 /plant at vegetative stage and 2.150 at reproductive stage) was found in control treatment which was significantly higher than all other treatments. Other insecticides have intermediate number of these sucking pests. In contrast, Neem oil and tamarind extract was poorly effective against these sucking pests infesting mungbean in field condition.

Treatments	No. of insects plant^{-1}at Vegetative stage				No. of insects plant^{-1}at Reproductive stage			
	Aphid	Jassid	Whitefly	Leaf hopper	Aphid	Jassid	Whitefly	Leaf hopper
Ripcord 10EC	4.40 f	2.35 e	7.35 f	1.70 e	4.05 e	1.95 e	6.00 e	1.00 e
Aktara 25WG	7.00 d	3.15 d	9.10 d	2.25 c	4.95 d	2.65 d	6.70 d	1.55 c
Marshal 20EC	3.85 g	1.80 f	4.90 g	1.35 f	2.80 f	1.25 f	3.80 f	0.55 f
Malathion 57EC	5.45 e	3.10 d	7.95 e	2.05 d	4.85 d	2.65 d	6.65 d	1.40 d
Neem oil	7.40 c	3.35 c	9.80 c	2.40 c	5.45 c	2.95 c	8.30 c	1.55 c
Tamarind extract	8.25 b	3.55 b	10.40 b	2.60 b	6.95 b	3.20 b	8.90 b	1.80 b
Control	10.40 a	4.00 a	11.50 a	3.750 a	8.30 a	3.50 a	9.20 a	2.150 a
CV (%)	1.22	2.41	1.24	4.96	2.51	3.54	1.32	3.74

Table 1: Population incidence of aphid, jassid, whitefly and leaf hopper
On mungbean under different treatments at vegetative and reproductive stage

In a column, means having same letter(s) are statistically similar at 5% level of significance by Duncan's Multiple Range Test (DMRT).

In terms of percent reduction of sucking pest populations over control marshal 20EC showed the best performance which reduced the aphid, jassid, whitefly and leaf hopper population over control (63.17%, 55.70%, 57.33% & 64.76% respectively at vegetative stage and 66.65%, 65.01%, 58.89% & 75.79% respectively at reproductive stage) followed by ripcord 10EC and malathion 57EC (Table 2). Neem oil and tamarind extract showed poor results in reducing aphid, jassid, whitefly and leaf hopper populations over control. However, none of the insecticides gave standard level of reduction (80%) of these sucking pest populations. The findings of the present study is partly comparable with the findings of Singh *et al.* (2009) who reported that malathion was the most effective insecticide against aphid population on mungbean. Thiamethoxam was reported to be the best insecticide for controlling sucking pests such as jassid and aphid in okra (Mishra 2002) and whitefly in mungbean (Ganapathy and Karuppiah 2004). However, Khattak *et al.* (2004) reported that insecticides application reduced population of jassid and whitefly on mungbean as well as increased yield. The results of the present study also agree with the findings of Lal (2008) who reported that application of insecticides reduced sucking insects of mungbean.

Treatments	Percent pest population reduction over untreated control							
	Vegetative stage				Reproductive stage			
	Aphid	Jassid	Whitefly	Leaf hopper	Aphid	Jassid	Whitefly	Leaf hopper
Ripcord 10EC	57.87 b	41.83 b	35.88 b	55.37 b	51.67 b	43.51 b	34.87 b	54.57 b
Aktara 25WG	32.80 d	22.07 c	20.56 d	40.56 cd	40.96 c	24.77 c	27.28 c	28.42 d
Marshal 20EC	63.17 a	55.70 a	57.33 a	64.76 a	66.65 a	65.01 a	58.89 a	75.79 a
Malathion 57EC	47.76 c	22.76 c	30.68 c	46.20 c	42.04 c	24.85 c	28.35 c	35.62 c
Neem oil	29.16 e	16.51 d	14.48 e	36.55 de	34.87 d	16.08 d	9.75 d	28.42 d

Tamarind extract	20.70 f	11.32 e	9.22 f	30.80 e	19.42 e	8.91 e	3.31 e	16.67 e
Control	-	-	-	-	-	-	-	-
CV (%)	5.01	13.21	5.61	10.67	7.33	13.61	8.07	13.29

Table 2: Percent reduction of aphid, jassid, whitefly and leaf hopper population over control on mungbean under different treatments at vegetative and reproductive stage

In a column, means having same letter(s) are statistically similar at 5% level of significance by Duncan's Multiple Range Test (DMRT).

6. Effect of Treatments on Incidence of Mosaic Disease on Mungbean

The effect of chemical insecticides and plant products on incidence of mosaic disease infested at before flowering and at after flowering is shown in Table 3. The number of mosaic infected plant (13.25/plot at before flowering and 11.25/plot at after flowering stage) was significantly highest in control treatment. However, the lowest number of mosaic infected plant (6.75/plot at before flowering and 4.75/plot at after flowering stage) was recorded from marshal 20EC treatment followed by ripcord 10EC treatment having no significant difference between them. Almost same level of mosaic infected plant was found in neem oil and tamarind extract treatment at before flowering and at after flowering stage of mungbean. The result indicates that application of chemical insecticides and plant products reduced the mosaic infection in mungbean although their performance was different. These results agree with the reports of several researchers (Gupta and Pathak 2009; Yaquoob *et al.* 2007) who reported that schedule spraying of insecticides and neem products reduced the population of whitefly and jassid, and also reduced the infection of mosaic virus.

Treatments	**Mosaic infested plant plot^{-1}**	
	Before flowering	**After flowering**
Ripcord 10EC	7.75 de	6.00 cd
Aktara 25WG	10.00 bc	8.25 b
Marshal 20EC	6.75 e	4.75 d
Malathion 57EC	8.75 cd	6.50 c
Neem oil	11.00 b	9.00 b
Tamarind extract	11.25 b	9.50 b
Control	13.25 a	11.25 a
CV (%)	9.40	14.23

Table 3: Number of mosaic infected mungbean plant plot^{-1} under different treatments at before and after flowering stage

In a column, means having same letter(s) are statistically similar at 5% level of significance by Duncan's Multiple Range Test (DMRT).

7. Effects of Chemical Insecticides and Plant Extracts on Growth and Yield of Mungbean

Number of leaves plant^{-1} was significantly affected by the application of chemical insecticides and botanical extracts. Among the treatments, the maximum number of leaves (31.00 at before flowering and 27.50 at after flowering) was found from the treatment marshal 20EC because minimum number of sucking pests was recorded when this treatment was applied followed by ripcord 10EC (29.50 and 29.00 respectively). On the other hand, the minimum number of leaves (20.50 at before flowering and19.00 at after flowering) was recorded from control treatment where maximum number of sucking pests was found (Fig. 2). Almost same level of leaves number was found in neem oil and tamarind extract plots at before and after flowering of mungbean.

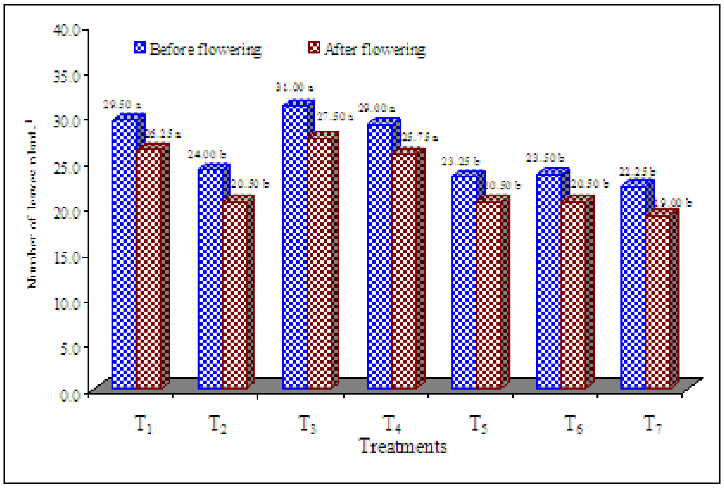

Figure 2: Effect of chemical insecticides and botanicals to manage the sucking pests and its impact on number of leaves plant^{-1} of mungbean
T_1= Ripcord 10EC, T_2= Aktara 25WG, T_3= Marshal 20EC,
T_4= Malathion 57EC, T_5= Neem oil, T_6= Tamarind extract, T_7= Control

Table 4 expressed that the tallest plant (90.25 cm) was observed at marshal 20EC, which was closely followed by ripcord 10EC (85.50 cm). On the other hand, the shortest plant (69.50 cm) was recorded from control treatment where maximum number of sucking pests was found. Plant dry weight did not vary significantly due to the effect of different chemical insecticides and botanicals. However, the maximum plant dry weight (62.85 g) was recorded at the application of marshal 20EC and the minimum plant dry weight (51.45 g) was obtained in untreated control treatment. Another treatment also showed the statistically similar results with each others in respect of plant dry weight shown in Table 4.

Treatments	Plant Height (Cm)	Plant Dry Weight (G)
Ripcord 10EC	80.50 B	60.83
Aktara 25WG	78.00 D	52.50
Marshal 20EC	90.25 A	62.85
Malathion 57EC	82.00 C	56.35
Neem Oil	72.50 E	53.30
Tamarind Extract	74.00 E	57.63
Control	69.50 F	51.45
CV (%)	2.37	16.19

Table 4: Effect of Chemical Insecticides and Botanicals to Manage the Sucking Pests and Its Impact on Growth of Mungbean
In A Column, Means Having Different Letter(S) Are Significantly Different At 5% Level Of Significance

The data (Table 5) revealed that marshal 20EC treated plants produced the maximum number of pods plant^{-1} (26.25) and the longest pod ((7.19 cm) which was statistically similar to ripcord 10EC (25.75) and (6.79 cm) respectively in terms of number of pods plant^{-1} and length of pod. Among the other treatments, the minimum number of pods plant^{-1} (12.75) and also the shortest pod (5.37 cm) was recorded in untreated or control treatment followed by neem oil. A significant variation was found due to the effect of different chemical insecticides and botanical control agents against sucking insects on mungbean in respect of number of seeds pod^{-1}.

Among the treatments, marshal 20EC produced the maximum number of seeds pod^{-1} (8.25) as well as the highest weight of 1000 seeds (35.50 g) and also the highest yield plot^{-1} (566.5 g) which was closely followed by ripcord 10EC in terms of number of seeds pod^{-1}(6.75) , weight of 1000 (30.50 g) and yield plot^{-1} (558.80 g) respectively. On the other hand, the minimum number of seeds pod^{-1} (4.00), the lowest 1000-seeds weight (23.25 g) and also the lowest yield plot^{-1} (463.50 g) was recorded in control treatment where the minimum reduction of sucking pests was obtained (Table 5). These results agree with the reports of several researchers Jahangir Shah *et al*. (2007) who reported 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^{-1}) was obtained from the control plots where no insecticide was applied.

Treatments	No. Of Pods Plant^{-1}	Pod Length (Cm)	No. Of Seeds Pod^{-1}	1000-Seed Weight (G)	Yield Plot^{-1} (G)
Ripcord 10EC	25.75 A	6.49 Ab	6.75 B	30.50 B	558.80 Ab
Aktara 25WG	20.00 C	6.08 Bc	4.75 D	26.25 D	527.50 Cd
Marshal 20EC	26.25 A	7.19 A	8.25 A	35.50 A	566.50 A
Malathion 57EC	21.00 B	6.17 Bc	6.00 C	27.50 C	543.30 Bc
Neem Oil	14.50 E	5.60 C	4.25 E	24.50 E	490.00 E
Tamarind Extract	17.00 D	5.91 Bc	4.00 E	25.50 D	511.30 D
Control	12.75 F	5.37 C	4.00 E	23.25 F	463.50 F
CV (%)	2.65	8.08	5.92	2.13	2.38

Table 5: Effect of Chemical Insecticides and Botanicals to Manage the Sucking Pests and Its Impact on Yield Contributing Characteristics of Mungbean
In a column, means having different letter(s) are significantly different at 5% level of significance

8. Conclusion

From the above results, it might be concluded that among all the applied chemical insecticides and botanicals, marshal 20EC showed the superior performance on control the sucking pests as well as on growth and yield of the crop. However, further studies may be needed for ensuring the sucking pests incidence on mungbean and its impact on mosaic diseases as well as the growth and yield performance and to make sure the better performance of marshal 20 EC.

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