

## **EFFICACY OF SOME INSECTICIDES AGAINST INSECT PESTS OF MUNGBEAN (*Vigna radiata* L.)**

MD. ALTAF HOSSAIN<sup>1</sup>

### **Abstract**

Efficacy and profitability of insecticidal management practices using different insecticides were tested against insect pests of mungbean at Pulses Research Center, Ishurdi, Pabna, Bangladesh during two consecutive seasons of kharif-1 2013 and 2014. Insect infestations were reduced significantly by the application of synthetic insecticides. Spraying of Imidachloprid (Imitaf 20 SL) @ 0.5 ml/l of water showed the best efficacy in reducing flower infestation and thrips population followed by Fipronil (Regent 50 SC). Spraying of Thiamethoxam + Chlorantraniliprol (Voliam flexi 300 SC) @ 0.5 ml/l of water showed the best efficacy in reducing pod borer and flea beetle infestations. Spraying of Fipronil (Regent 50 SC) performed highest efficacy against stemfly infestation. The yield and the highest net return were obtained from Voliam flexi 300 SC, the highest benefit was obtained from Regent 50 SC treated plots. This might be due to the higher cost of Voliam flexi that reduced the profit margin and showed the lower marginal benefit cost ratio (MBCR) compared to Regent. Therefore, considering the efficacy and benefit, spraying of Fipronil (Regent 50 SC) @ 0.5 ml/l is the most profitable insecticidal management approach against insect pests of mungbean followed by Imidachloprid (Imitaf 20 SL) at the same dose.

Keywords: Insecticide, management, insect pests, mungbean

### **Introduction**

Mungbean (*Vigna radiata* L.) is one of the important pulse crops in Bangladesh. Due to availability of short duration varieties, farmers are becoming more interested to cultivate this valuable crop after harvesting of rabi crops in kharif-I season. However, insect pests usually cause significant yield loss. More than twelve species of insect pests were found to infest mungbean in Bangladesh (Rahman *et al.*, 2000). Among them, stemfly, flea beetles, flower thrips and pod borers are the most important.

Larvae of stemfly feed inside the main stem and finally tunnels even up to roots. The affected plants have stunted growth with poor yield. The adult flea beetles feed on the cotyledons and leaves of young plants making innumerable round holes. The damaged leaves dried up and the plant growth is rendered with few pods. Thrips (*Megalurothrips distalis* Karny, *Megalurothrips usitatus* Bagnall and *Caliothrips indicus* Bagnall) is associated mostly with the damage of tender buds and flowers of mungbean. Severe infestation of thrips resulted flower shedding causing significant yield loss (Chhabra and Kooner, 1985; Lal, 1985).

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<sup>1</sup>Principal Scientific Officer (Entomology) Pulses Research Center, Bangladesh Agricultural Research Institute (BARI), Ishurdi, Pabna, Bangladesh.

Pod borer is another insect pest causing significant yield reduction. Pod borer (*Maruca vitrata*) damages flowers, flower buds and developing or mature pods (Poehlman, 1991). In Bangladesh, pod borers (*Maruca vitrata*, *Helicoverpa armigera* Hubner and *Euchrysops* spp.) often cause serious problem resulting severe loss of the crop (Bakr, 1998). Farmers usually do not take any measure to control the insect pests due to its low profit margin. However, recent development of high yielding and short duration varieties and increased market value of mungbean, farmers become interested on the cultivation of mungbean following pest management measures. Due to easy availability of insecticides, farmers generally take action to control mungbean pests by applying synthetic chemical insecticides. Information regarding insecticidal management practices of insect pests in mungbean is not very available. Therefore, it is needed to develop insecticidal management approach to control mungbean pests and save the crop from significant yield loss. Keeping this in view, attempts have been made to evaluate the efficacy of some synthetic insecticides and economics of the management of mungbean insect pests.

#### **Materials and Method**

The experiment was conducted in the Pulses Research Center, Ishurdi, Pabna, Bangladesh during two consecutive seasons of kharif-I 2013 and 2014. Application of synthetic insecticides considered as treatments of the experiments which were: T<sub>1</sub> = Spraying Cypermethrin (Ripcord 10 EC) @ 1 ml/l of water, T<sub>2</sub> = Spraying Chlorpyrifos + Cypermethrin (Nitro 505 EC) @ 1 ml/l of water, T<sub>3</sub> = Spraying Lambda Cyhalothrin (Reeva 2.5 EC) @ 1 ml/l of water, T<sub>4</sub> = Spraying Dimethoate (Tafgor 40 EC) @ 2 ml/l of water, T<sub>5</sub> = Spraying Thiamethoxam + Chlorantraniliprol (Voliam flexi 300 SC) @ 0.5 ml/l of water, T<sub>6</sub> = Spraying Enamectin Benzoate (Wonder 5 G) @ 1 g/l, T<sub>7</sub> = Spraying Fipronil (Regent 50 SC) @ 0.5 ml/l of water T<sub>8</sub> = Spraying Imidachloprid (Imitaf 20 SL) @ 0.5 ml/l of water and T<sub>9</sub> = Untreated control (water spray)

The experiment was laid out in randomized complete block design (RCBD) with three replications. The treatments were randomly allotted in each block. The unit plot size was 3m X 4m with a distance of 1m between the plots and 1.5m between the replications. The seeds of BARI Mung 6 were sown on March 28 in rows with the spacing of 30 cm in both the seasons. The plant populations were maintained constant by keeping plant to plant distance 7 cm. Urea, triple super phosphate and muriate of potash fertilizers were applied @ 40-90-40 kg/ha in both the seasons. But in 2014, 7.5 kg/ha boric acid was applied during final land preparation for reducing flower shedding and increasing pod setting with higher number of seed setting.

Three sprays were done, first at 20 days after sowing (DAS) when plants were in active vegetative growth stage (i.e., two trifoliate leaf stage) against leaf feeding and sucking insect pests. Second spray was done at 100% flowering stage (35 DAS) and the third at 100% podding stage (42 DAS) for flower thrips and pod borers because both the pests appeared that time.

The population data for thrips in flowers were collected before spraying and one day after spraying. Thrips population was assessed from 20 opened flowers which were randomly collected from two rows of each side of the plot avoiding border and central four rows. The collected flowers were immediately opened on the white paper board and counted the adult and immature thrips present in the flowers. Central four rows were kept undisturbed for recording yield data.

Percentage of leaf area damaged by flea beetle was determined by eye estimation.

At the maturity, all pods were collected from 10 randomly selected plants from central four rows of each plot and examined. The infested (bored) and total numbers of pods were counted and the per cent pod infestation was calculated.

For recording stemfly infestation, ten mature plants were randomly selected also uprooted from two rows from each side of the plot avoiding border rows of each plot. The plants were brought to the laboratory and dissected the stem of each plant for determining the tunnel produced by stemfly larvae. Percentage of stemfly infestation was determined on the basis of stem tunneling.

The pods of central four rows of each plot comprising 4.8m<sup>2</sup> (1.2m X 4m) area were harvested. The pods were then threshed; grains were and. The grains obtained from each plot were cleaned, sun dried and converted into kg/ha.

The experimental data were analyzed by MSTAT-C software. The per cent infestation data were transformed by square root and arc sine transformation as needed for statistical analysis. Mean comparisons for treatment parameters were compared using Duncan's Multiple Range Test at 5% level of significance.

The marginal benefit cost ratio (MBCR) was calculated on the basis of prevailing market prices of mungbean and cost of insecticidal spraying. Marginal benefit cost ratio was calculated as follows:

$$\text{Marginal BCR} = \frac{\text{Benefit over control}}{\text{Cost of treatment}}$$

## Results and Discussion

### Effect of insecticides on flower infestation and thrips population

Spraying of synthetic insecticides reduced flower infestation and thrips population significantly (Table 1 & 2). During 2013, after one day of spray application, the lowest number of infested flower (1.67/20 flowers) was observed in Imitaf sprayed plots which was statistically identical to Regent, Nitro, Ripcord, Voliam flexi and Tafgor. More than 80% flower infestation reduction was observed in Imitaf and Regent sprayed plots. Accordingly the lowest number of thrips (2.00/20 flowers) was observed in Imitaf sprayed plots which was statistically similar to Regent, Nitro, Ripcord and Reeva. All insecticides reduced more than 80% thrips population but Voliam flexi reduced little beat less (Table 1).

In 2014, after one day of spray application, the lowest number of infested flower (0.83/20 flowers) was observed in Imitaf sprayed plots which was statistically identical to Nitro, Regent, Voliam flexi, Reeva and Tafgor. Like previous year Imitaf also reduced more than 80% flower infestation. Accordingly the lowest number of thrips (1.33/20 flowers) was observed in Imitaf sprayed plots which was statistically at par with Regent. Imitaf reduced more than 80% thrips population also (Table 2). These findings were agreed with the findings of Bhede *et al.* (2008) who reported the best effect of Imidachloprid for control of thrips in chilli. Hossain *et al.* (2013) cited the best efficacy of Fipronil (Regent 50 SC) in managing thrips of onion with highest benefit. Hossain *et al.* (2011) and Hossain (2014) also found the best results of Imidachloprid (Imitaf 20 SL) to reduce flower infestation and suppression of thrips population in mungbean flowers.

#### **Effects of insecticides on the incidence of stemfly, flea beetle and pod borers**

Stemfly infestation varied depending on the efficacy of the insecticides. During cropping season of 2013, stemfly infestation among different treatments was non significant but varied 40.67 to 63.33% (Table 3). The lowest infestation (40.67%) was found in Voliam flexi sprayed plots and the highest (63.33%) was observed in untreated control plots.

In 2014, stemfly infestation significantly varied among the treatments. It ranged 40.00 to 80.00% (Table 3). The lowest infestation (40.00%) was found in Regent sprayed plots which were statistically similar to Voliam flexi, Wonder and Reeva. The highest (80.00%) was observed in untreated control plots.

Leaf area damaged by flea beetle was also varied among the insecticidal sprays. During 2013, it was non significant and ranged from 5.33 to 9.67% (Table 3). The lowest percentage of leaf area damaged by flea beetle (5.33%) was observed in Voliam flexi, Regent, and Reeva treated plots and the highest was in untreated plots.

But in 2014, leaf area damaged by flea beetle was significantly varied and ranged from 3.00 to 18.00% (Table 3). The lowest percentage of leaf area damaged by flea beetle (3.00%) was observed in Voliam flexi followed by Wonder and the highest (18.00%) was in untreated plots.

Pod borer infestation was low to moderate but varied significantly among the efficacy of the treatments. During 2013, pod infestation was low and varied from 1.02 – 8.02% (Table 3). The lowest pod borer infestation (1.02%) was found in Voliam flexi sprayed plots which were statistically similar to Reeva, Nitro, Dimethoate, Wonder, Imitaf and Regent. The highest pod infestation (8.02%) was found in untreated plots.

In 2014, pod borer infestation was moderate and it varied from 3.10 – 10.64% (Table 3). The lowest pod borer infestation (3.10%) was found in Voliam flexi sprayed plots which were statistically similar to Wonder, Regent, Nitro and Tafgor. The highest pod infestation (10.642%) was found in untreated plots.

**Table 1. Efficacy of insecticides on the incidence of flower infestation and thrips population in mungbean during Kharif-1, 2013.**

Treatments (Insecticides)	Dose	Mean no. of thrips infested flowers/20 open flowers		Reduction of flower infestation after 1 day of spray (%)	Mean no. of thrips/ 20 open flowers		Reduction of thrips population after 1 day of spray (%)
		Before spray	After 1day of spray		Before spray	After 1 day of spray	
		Cypermethrin (Ripcord 10 EC)	1 ml/l	14.33 b-d	3.67 bc	74.39	27.67 c
Chlorpyrifos + Cyp. (Nitro 505 EC)	1 ml/l	14.00 cd	3.00 bc	78.57	27.67 c	3.33 cd	87.97
Lambda Cyhalothrin (Reeva 2.5 EC)	1 ml/l	16.00 a-c	4.67 b	70.81	39.67 a	5.00 b-d	87.40
Dimethoate (Tafgor 40 EC)	2 ml/l	16.00 a-c	4.33 bc	72.94	37.33 ab	5.33 bc	85.72
Thiamethoxam + Chlorantraniliprol (Voliam flexi 300 SC)	0.5 ml/l	12.67 d	3.67 bc	71.03	25.00 c	6.67 b	73.32
Emamectin Benzoate (Wonder 5 G)	1 g/l	16.33 ab	4.67 b	71.40	36.67 ab	6.00 bc	83.64
Fipronil (Regent 50 SC)	0.5 ml/l	15.00 a-c	3.00 bc	80.00	31.00 bc	3.33 cd	89.26
Imidachloprid (Imitaf 20 SL)	0.5 ml/l	14.67 a-d	1.67 c	88.62	27.67 c	2.00 d	92.77
Untreated control (water spray)	500 l/ha	16.67 a	13.00 a	22.02	41.00 a	24.67 a	39.83

Note: In a column, treatment means having the same letter(s) are not significantly different by DMRT at 5% level.

**Table 2. Efficacy of insecticides on the incidence of flower infestation and thrips population in mungbean during Kharif-1, 2014.**

Treatments (Insecticides)	Dose	Mean no. of thrips infested flowers/20 open flowers		Reduction of flower infestation after 1 day of spray (%)	Mean no. of thrips/ 20 open flowers		Reduction of thrips population after 1 day of spray (%)
		Before spray	After 1 day of spray		Before spray	After 1 day of spray	
Cypermethrin (Ripcord 10 EC)	1 ml/l	6.83	2.17 b	68.22	8.17 c	3.50 bc	57.16
Chlorpyrifos + Cyp. (Nitro 505 EC)	1 ml/l	6.17	1.33 bc	78.44	10.33 bc	3.0 bc	70.96
Lambda Cyhalothrin (Reeva 2.5 EC)	1 ml/l	7.33	1.83 bc	75.03	10.83 bc	4.17 b	61.50
Dimethoate (Tafgor 40 EC)	2 ml/l	8.50	1.83 b	78.47	14.33 ab	4.33 b	69.78
Thiamethoxam + Chlorantraniliprol (Voliam flexi 300 SC)	0.5 ml/l	6.50	1.67 bc	74.30	7.83 c	2.33 cd	70.24
Emamectin Benzoate (Wonder 5 G)	1 g/l	8.50	2.00 b	76.47	13.17 ab	3.50 bc	73.42
Fipronil (Regent 50 SC)	0.5 ml/l	6.50	1.67 bc	74.31	7.83 c	2.33 cd	70.24
Imidachloprid (Imitaf 20 SL)	0.5 ml/l	6.67	0.83 c	87.55	10.17 bc	1.33 d	86.92
Untreated control (water spray)	500 l/ha	8.67	7.00 a	19.26	16.33 a	10.67 a	34.66
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Note: In a column, treatment means having the same letter(s) are not significantly different by DMRT at 5% level.

**Table 3. Efficacy of insecticides on the incidence of stemfly, flea beetle and pod borer in mungbean during 2013 and 2014.**

Treatments (Insecticides)	Stemfly infested plant (%)		Leaf area damaged by flea beetle (%)		Pod infestation by pod borer (%)	
	2013	2014	2013	2014	2013	2014
Cypermethrin (Ripcord 10 EC)	50.00	73.33 abc (59.33)	6.33	10.00 d (3.15)	4.54 ab (2.11)	6.95 b (2.63)
Chlorpyrifos + Cyp. (Nitro 505 EC)	50.00	76.67 ab (56.56)	6.33	11.00 d (3.26)	2.07 bc (1.16)	4.50 bcd (2.11)
Lambda Cyhalothrin (Reeva 2.5 EC)	50.00	56.67 bcd (49.23)	5.33	13.00 bc (3.65)	2.06 bc (1.17)	6.58 bc (2.55)
Dimethoate (Tafgor 40 EC)	53.33	70.00 abc (57.10)	6.00	16.00 ab (4.0)	2.07 bc (1.16)	5.10 bcd (2.26)
Thiamethoxam + Chlorantraniliprol (Voliam flexi 300 SC)	40.67	53.33 cd (47.21)	5.33	3.00 f (1.73)	1.02 c (0.81)	3.10 d (1.75)
Emamectin Benzoate (Wonder 5 G)	50.00	56.67 bcd (49.14)	5.67	5.33 e (2.30)	2.39 bc (1.54)	3.56 d (1.87)
Fipronil (Regent 50 SC)	56.67	40.00 d (39.44)	5.33	16.67 a (4.07)	2.74 a-c (1.65)	4.25 cd (2.05)
Imidachloprid (Imitaf 20 SL)	40.33	70.00 abc (57.62)	6.33	12.00 cd (3.46)	2.39 bc (1.54)	6.23 bc (2.48)
Untreated control (water spray)	63.33	80.00 a (68.28)	9.67	18.00 a (4.24)	8.02 a (2.83)	10.64 a (3.25)
-	ns	-	ns	-	-	-

Means in a column having same letter(s) did not differ significantly at 5% by DMRT. Values in the parentheses are the arc sine and square root transformed mean values.

In both the years Voliam flexi performed the best in suppressing pod borer infestation. These findings agreed with the findings of Rouf and Islam (2012) and Hossain (2014) who reported that the best efficacy of Voliam flexi in controlling pod borers of mungbean.

#### **Yield, return and marginal benefit cost ratio (MBCR)**

Yield of mungbean varied significantly with the level of insect pest's infestation depending on the efficacy of different insecticides (Table 4). During 2013, the highest yield (1570 kg/ha) obtained from Regent sprayed plots which was statistically identical to Wonder, Tafgor, Voliam flexi and Imitaf followed by Ripcord, Nitro and Reeva. The lowest yield (1166 kg/ha) was recorded from untreated control plots.

But in 2014, the highest yield (2347 kg/ha) obtained from Voliam flexi sprayed plots which was statistically identical to Tafgor and Wonder followed by Regent, Ripcord and Imitaf. The lowest yield (1701 kg/ha) was recorded from untreated control plots (Table 3). Considering two years average yield Voliam flexi provided the highest. Again, it is apparent that yield of mungbean was higher in kharif-I of 2014 than that of 2013. This might be due to the less thrips infestation with relatively favourable weather condition prevailing in kharif-I of 2014 compared to 2013 and also with boric acid application during 2014 cropping season might have some effect to produce more pods and seeds which influencing higher yield in later season. Alam *et. al.* 2010, Quddus *et. al.* 2011 and Abou EL-Yazied and Mady 2012 cited the positive effect of boron application to increase yield of mungbean. They reported that application of boric acid increased number of formed flowers, setted pods per plant, seed yields, as well as reduced shedding of flowers and pods.

Return and marginal benefit cost ratio are also presented in Table 4. The net return and marginal benefit cost ratio was varied depending on cost of insecticidal application. During 2013, the highest net return (Tk 21390/ha) was recorded from Regent sprayed plots followed by Wonder (Tk 15780/ha). And accordingly the highest monetary benefit (MBCR 7.51) come from Regent sprayed plots. But the second highest benefit (MBCR 4.78) obtained from Imitaf followed by Tafgor (MBCR 4.07). Due to higher cost of Wonder and Voliam flexi profit margin goes down and showed lower MBCR.

For each taka spent, Regent gave profit of Tk 7.51 as against Tk 4.78, Tk 4.07, Tk 2.77, Tk 2.43, Tk. 2.01, Tk. 1.98 and Tk. 1.48 in Regent, Imitaf, Tafgor, Wonder, Ripcord, Voliam flexi, Reeva and Nitro, respectively.

During 2014, the highest net return (Tk 33060/ha) was recorded from Voliam flexi sprayed plots followed by Tafgor, Wonder, Regent, Ripcord and Imitaf. But the highest monetary benefit (MBCR 7.34) also comes from Regent sprayed plots followed by Tafgor, Imitaf, Ripcord, Voliam flexi and Wonder. Though the Voliam flexi offered the highest net return but its higher cost broad down the profit margin and showed lower MBCR.



**Table 4. Yield, cost and return analysis of insecticidal management on of mungbean insect pests during kharif-1, 2013 and 2014.**

Treatments (Insecticides)	Yield (kg/ha)		Addl. yield over control (kg/ha)		Addl. return over control (Tk/ha)		Cost of insecticide appl. (Tk/ha)		Net return (Tk/ha)		Marginal benefit cost ratio	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Cypermethrin (Ripcord 10 EC)	1355 bc	2077 b	189	376	11340	22560	3300	3300	8040	19260	2.43	5.84
Chlorpyrifos + Cyp. (Nitro 505 EC)	1321 c	1842 d	155	141	9300	8460	3750	3750	5550	4710	1.48	1.26
Lambda Cyhalothrin (Reeva 2.5 EC)	1300 c	1877 cd	134	176	8040	10560	2700	2700	5340	7860	1.98	2.91
Dimethoate (Tafgor 40 EC)	1483 a	2188 ab	317	487	19020	29220	3750	3750	15270	25470	4.07	6.79
Thiamethoxam + Chlorantraniliprol (Voliam flexi 300 SC)	1452 ab	2347 a	286	646	17160	38760	5700	5700	11460	33060	2.01	5.80
Emamectin Benzoate (Wonder 5 G)	1524 a	2195 ab	358	494	21480	29640	5700	5700	15780	23940	2.77	4.20
Fipronil (Regent 50 SC)	1570 a	2097 b	404	396	24240	23760	2850	2850	21390	20910	7.51	7.34
Imidachloprid (Imitaf 20 SL)	1448 ab	2047 bc	282	346	16920	20760	2925	2925	13995	17835	4.78	6.10
Untreated control (water spray)	1166 d	1701 d	-	-	-	-	-	-	-	-	-	-

Addl. = Additional, appl. = application.

For calculating income and benefit the following market prices were used: Mungbean = Tk. 60/kg.

Ripcord 10 EC = Tk. 140/100 ml, Nitro 505 EC = Tk. 170/100 ml, Reeva 2.5 EC = Tk. 100/100 ml, Tafgor 40 EC = Tk. 85/100 ml,

Voliam flexi 300 SC = Tk. 600/100 ml, Wonder 5 G = Tk. 300/100g, Regent 50 SC = Tk. 220/100 ml and Imitaf 20 SL = Tk. 230/100 ml.

Labour wage for spraying insecticides = Tk. 200/day/labourer (8 hours day).

For each taka spent, Regent gave profit of Tk 7.34 as against Tk 6.79, Tk 6.10, Tk 5.84, Tk 5.80, Tk. 4.20, Tk. 2.91 and Tk. 1.26 in Tafgor, Imitaf, Ripcord, Voliam flexi, Wonder, Reeva, and Nitro, respectively.

These profit findings showed very encouraging results of spraying in mungbean. Spraying of Imidachloprid (Imitaf 20 SL) @ 0.5 ml/l of water showed the best efficacy in reducing flower infestation and thrips population followed by Fipronil (Regent 50 SC). Spraying of Thiamethoxam + Chlorantraneliprol (Voliam flexi 300 SC) @ 0.5 ml/l of water showed the best efficacy in reducing pod borer and flea beetle infestation. Spraying of Fipronil (Regent 50 SC) performed best against stemfly infestation. Therefore, considering overall efficacy and benefit spraying of Fipronil (Regent 50 SC) at the concentration of 0.5 ml/l is the most profitable insecticidal management approach against insect pests of mungbean in Bangladesh followed by Imidachloprid (Imitaf. 20 SL) at the same dose.

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