COMPARATIVE EFFICACY OF SYNTHETIC INSECTICIDES ON MANGO HOPPER COMPLEX

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ABSTRACT

Mango production in Bangladesh is enormously affected due to the infestation of mango hopper *Amritodus atkinsoni*, a sucking insect belong to the family Cicadellidae under the order Hemiptera. Management of hopper in Bangladesh is purely based on different classes of synthetic insecticides. In the present study, four insecticides, namely Desis 2.5 EC (Deltamethrin), Ripcord 10 EC (Cypermethrin), Relothrin 10 EC (Cypermethrin), and Sumithion 50 EC (Fenitrothion) were evaluated against mango hopper infestation, fruit setting performance and assessed the effect of the insecticides on the abundances of natural enemies in mango orchard. The insecticides were applied four times maintaining recommended doses and 7-day intervals during the flowering period. A significant reduction of hopper population was observed in the treated mango plants compared to untreated control plants. Desis 2.5 EC and Sumithion 50 EC performed better than that of control and other tested insecticides considering the abundances of hopper populations as well as fruit settings. The applied insecticides had negative impact on the abundances of natural enemies. Decis 2.5 EC and Sumithion 50 EC were found comparatively safe than that of Relotrhin 10 EC and Ripcord 10 EC regarding the abundances of ladybird beetle, spider and wasp populations.

Keywords: *Amritodus atkinsoni, Idioscopus,* Insecticide, *Mangifera indica.*

INTRODUCTION

Mango plants are affected by different insect pests from seedling stage to maturity stage. More than 50 insect pests have been recorded causing damage to mango. Hopper is one of the most widespread and serious pests throughout the Bangladesh causing heavy damage to mango plants by sucking phloem sap from twigs, inflorescences, tender leaves and fruits (Adnan *et al*. 2014). The most important species of mango hopper found in Bangladesh are *Amritodus atkinsoni* (Lethierry),

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Idioscopus niveosparsus (Lethierry) and *I. clypealis* (Lethierry). Among them *A. atkinsoni* causes the serious damage (Rahman *et al.* 2007).

Nymphs and adults of the hoppers puncture and suck sap from tender shoots, inflorescences, and leaves of mango tree, which can cause non-setting of fruits and dropping of immature fruits, at the end it can reduce the yield significantly (Shawan *et al.* 2018). On heavily infested trees, it can cause crop losses up to 50% or more (Adnan *et al*. 2014). Physical injury by hopper can also be seen on leaves, panicles and shoots while laying eggs there.

Insecticidal control has remained the only viable strategy that controls the pest efficiently and prevents crops from the deleterious effects of hoppers. Insecticides such as, imidacloprid, lambdacyhalothrin and azadiractin are recommended to save the crop from loses due to Mango hopper damage (Haider and Bakhsh 2018). Buprofezin, spinosad, acetamiprid, thiamethoxam, deltamethrin and cypermethrin can also be useful to effectively control mango hopper.

Many synthetic insecticides having different mode of actions have been recommended so far by different scientists for the management of mango hopper. Under this circumstance, to test the efficacy of insecticides marketed by different companies to manage the hopper incidence, the present study was conducted with four highly used insecticides, namely Desis 2.5 EC (Deltamethrin), Ripcord 10 EC (Cypermethrin), Sumithion 50 EC (Fenitrothion) and Relothrin 10 EC (Cypermethrin). Therefore, the present study was undertaken to know the effects of the insecticides on the abundance and mortality effects of the insecticides on the nymph and adult hoppers, the natural enemies of the hopper.

MATERIALS AND METHODS

Study site and condition: The study was conducted from January to March 2022 in the mango orchard, Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh.

Experimental design and surrounding condition of the orchard: The experiment was conducted in a 8 years old mango orchard. The orchard consisted of 3 rows, each row containing 9 plants which made a total of 27 plants. Planting distance between trees were 3.0 m and distance between rows were 4.0 m. The average height of the plant was around 2.5 meters and the canopy cover of the plants was almost similar.

The treatments were allotted following randomized complete block design (RCBD) with three replications.

Insecticide treatments: Four insecticides, namely Decis 2.5 EC, Ripcord 10 EC, Relothrin 10EC and Sumithion 50 EC were selected to assess their comparative effectiveness in controlling hopper infestation on mango as well as fruit setting in treated mango trees. Details of the insecticides are listed in Table 1.

Application of insecticides: The chemical insecticides, namely Decis 2.5 EC (Deltamethrin) @ 1.0 ml/L water, Ripcord 10 EC (Cypermethrin) @ 1.0 ml/L water, Relothrin 10 EC (Cypermethrin) @ 1.0 ml/L water and Sumithion 50 EC (Fenitrothion) @ 2.2 ml/L water were applied to mango plants at flowering stage to manage the hopper attack. The insecticides were applied following randomized complete block design with three replications. The insecticides were sprayed four times maintaining 7 days interval. Spray mixture was poured into the knapsack sprayer and sprayed covering the whole plants. The spraying was done in the morning to avoid bright sunlight and drift caused by strong wind. Untreated control plants were kept free from insect pest management.

Monitoring of insect and their natural enemies: Mango hoppers and their natural enemies were monitored during the period from March to April 2022 by using yellow sticky trap (Ishpahani Agro Ltd.). Three plants were randomly selected for three replications of each treatment and were tagged individually. Yellow sticky traps were set under the canopy of individual plant. Data were collected after 2 and 7 days of spraying by counting total number of insects on both sides of each trap. Selected plants were sprayed after 7 days interval and new yellow sticky traps were

Table 1. Details of the insecticide treatments applied to mango plants for controlling mango hoppers

Trade name	Active ingredient	Recommended dose	Mode of action
Desis 2.5 EC	Deltamethrin	1000 ppm	Direct contact or ingestion
Ripcord 10 EC	Cypermethrin	1000 ppm	Non-systemic insecticide with contact and stomach action
Relothrin 10 EC	Cypermethrin	1000 ppm	Non-systemic insecticide with contact and stomach action
Sumithion 50 EC	Fenitrothion	2200 ppm	Non-systemic insecticide with contact and stomach action, Cholinesterase inhibitor

installed after each spray. The number of natural enemies (ladybird beetle, wasp, ant and spider) was counted along with the number of mango hoppers.

Statistical analysis: One-way analysis of variance was done to determine the efficacy of the insecticides on the abundance of mango hopper and their natural enemies (ladybird beetle, wasp, ant and spider) followed by Tukey's HSD posthoc test (at 5% level of significance). The percent efficacy of different insecticides on the abundance of mango hoppers was also calculated based on the percent reduction of abundance over control by the following formula:

$$\% \text{ Reduction} = \frac{\text{Abundance in control plant- Abundancein treated plant}}{\text{Abundance in control plant}} \times 100$$

RESULTS AND DISCUSSION

The effects of selected insecticides on the abundances of mango hopper are presented in Table 2. All the selected insecticides had significant effect on the reduction of hopper abundance in comparison to untreated control. Hopper abundances at 3 and 7 days after given spray ranged from 47.0±0.6 to 55.3±1.2 and 43.3±0.9 to 51.7±1.4, respectively, after second spray ranged from 41.3±0.9 to 53.3±0.9 and 36.7±0.3 to 53.0±0.6, respectively, and after third spray ranged from 28.0±0.6 to 47.0±0.6 and 21.3±0.7 to 42.3±1.8, respectively, and after fourth spray ranged from 15.3±0.9 to 37.3±1.8 to 11.0±0.6 to 35.3±2.4, respectively. Among four insecticides, Decis 2.5 EC and Sumithion 50 EC were found superior in controlling hopper and the result significantly differed than that of Relothrin 10 EC and Ripcord 10 EC. Relothrin 10

Table 2. Effect of the studied insecticides on the abundance of mango hopper

Insecticide treatments	Abundance of mango hopper (Number of insect/trap)							
	First spray		Second spray		Third spray		Fourth spray	
	3DAS	7DAS	3DAS	7DAS	3DAS	7DAS	3DAS	7DAS
Desis 2.5 EC	47.0±0.6b	43.3±0.9b	41.3±0.9b	36.7±0.3c	28.0±0.6d	21.3±0.7c	15.3±0.9c	11.0±0.6b
Ripcord 10 EC	49.0±0.6b	46.7±0.9ab	45.3±0.9b	42.7±0.7b	34.3±0.9b	26.7±0.3b	21.7±0.3b	14.7±0.7b
Relothrin 10 EC	49.7±1.8b	46.3±1.2b	44.3±1.2b	41.0±1.5bc	33.0±1.5bc	26.7±0.9b	22.0±0.6b	14.7±0.3b
Sumithion 50 EC	48.3±0.9b	45.0±1.0b	41.7±0.9b	38.0±1.1c	29.3±1.2cd	22.7±0.9bc	17.0±0.6c	11.0±0.6b
Control	55.3±1.2a	51.7±1.4a	53.3±0.9a	53.0±0.6a	47.0±0.6a	42.3±1.8a	37.3±1.8a	35.3±2.4a

Means within a column followed by the same letter(s) are not significantly different by Tukey's HSD posthoc test at $p \leq 0.05$.

EC and Ripcord 10 EC had similar efficacies with insignificant difference in respect of hopper abundance.

Fig. 1 showed the percent reduction of hopper populations over untreated control. The highest reduction (37.8%) was observed in case of Decis 2.5 EC that was followed by Sumithion 50 EC (35.4%) and Relothrin 10 EC (28.3%) respectively. Ripcord 10 EC showed the lowest efficacy with 27.4% reduction of mango hopper population.

The current findings showed conformity with the results of Singh *et al*. (2019) who suggested that Decis 2.5 EC is highly effective in controlling mango hopper. The current findings also showed conformity with those of Singh *et al*. (2019) who found that the application of Decis 2.5 EC resulted in a 98% reduction of hopper populations. Chaudhary *et al*. (2015) found that the application of Ripcord 10 EC and Sumithion 50 EC @ 0.1% resulted in a 99.6% and 97% reduction of hopper populations respectively. Tariq *et al*. (2017) observed that the application of Relothrin 10 EC resulted in a 96% reduction in the population of mango hoppers on treated trees.

Effect of selected insecticides on number of flowers per inflorescence has been presented in Table 3. In case of pre-treated condition, the mean number of flowers per inflorescence ranged from 34.0±1.0 to 46.7±0.9 on different mango plants.

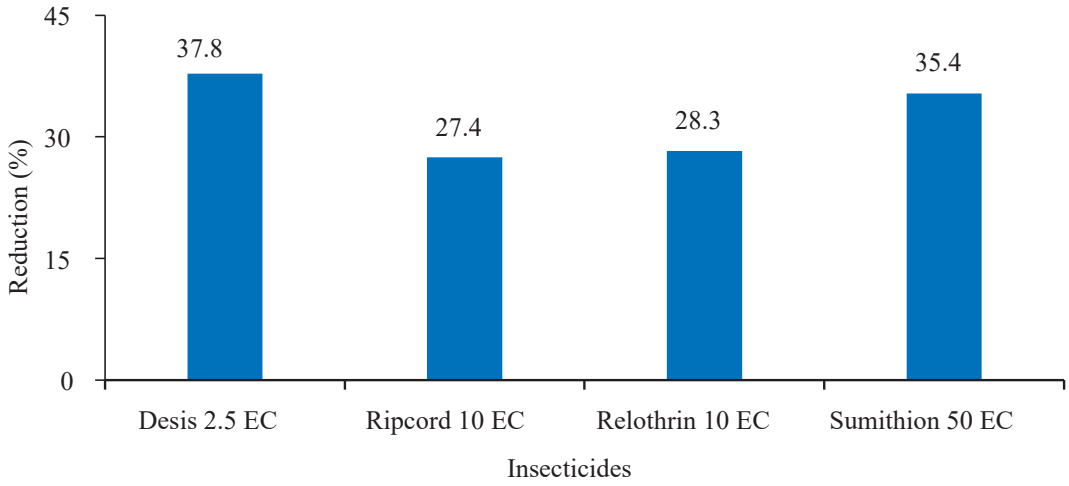


Fig. 1. Mean reduction (%) of mango hopper on mango over control after multiple applications of insecticides.

Table 3. Efficacy of the tested insecticides on fruit setting of mango

Insecticide treatments	Mean number of flowers per inflorescence in case of pre-treated condition	Mean number of fruits per inflorescence in case of treated condition (15 DAP)	Fruit set (%) per inflorescence in case of treated condition (15 DAP)
Decis 2.5 EC	40.7±2.3ab	11.7±1.8a	28.7
Ripcord 10 EC	34.0±1.0b	4.3±1.4ab	12.7
Relothrin 10 EC	46.7± 0.9a	5.7±1.8ab	12.1
Sumithion 50 EC	38.3± 3.0ab	11.3±1.8a	29.5
Control	34.3± 2.3b	2.7±1.2b	7.8

Footnote: Means within a column followed by the same letter(s) are not significantly different by Tukey HSD posthoc test at $p \leq 0.05$. DAP= Days after Pea Shaped

After insecticides application, pea-shaped mango fruits were counted in control and insecticides treated condition. The lowest, 2.7±1.2 fruit per inflorescence was counted in case of untreated control. On the other hand, the highest mean, 11.7±1.8 fruits per inflorescence was found when mango plants were treated with Decis 2.5 EC which was insignificantly followed by Sumithion 50 EC (11.3±1.8). Poor efficacies were found when mango trees were treated with Relothrin 10 EC and Ripcord 10 EC. The mean number of fruits per inflorescence was 5.7±1.8 when mango trees were treated with Relothrin 10 EC while it was 4.3±1.4 in case of Ripcord treated trees although numbers were significantly higher in comparison with that in the control. Percent fruit setting was also counted after insecticides application and the result has been presented in Table 3. The highest 29.5% fruit setting was found in the Sumithion 50 EC treated trees that were insignificantly followed by Decis 2.5 EC (28.7%) treated mango trees. Comparatively lower fruit setting was found when trees were treated with Ripcord 10 EC (12.7%) and Relothrin 10 EC (12.1%) although the result was higher than that of untreated control trees.

The effects of the selected insecticides on the abundance of natural enemies of mango hopper are presented in Table 4. All the selected insecticides significantly reduced natural enemies, viz., ladybird beetle, spiders and wasp on treated mango trees compared to untreated control. The highest was counted in case of control condition. Since after insecticides application, numbers of natural enemies were gradually reduced from the 1st to last spray. However, Decis 2.5 EC and Sumithion 50 EC were found more toxic than that of Relothrin 10 EC and Ripcord 10 EC.

Table 4. Effects of the studied insecticides on the abundance of the natural enemies of mango hopper

Insecticide treatments	Abundance of natural enemy (Number of insect/trap)							
	First spray		Second spray		Third spray		Fourth spray	
	3DAS	7DAS	3DAS	7DAS	3DAS	7DAS	3DAS	7DAS
Desis 2.5 EC	13.3±0.9b	11.3±0.9b	9.7±1.2b	8.3±0.9b	6.7±0.3c	5.7±0.3c	4.0±0.6c	3.0±0.6c
Ripcord 10 EC	16.0±0.6b	14.7±0.9ab	12.7±1.4b	11.0±1.0b	10.0±1.5bc	8.3±0.9bc	7.0±0.6bc	6.3±0.9bc
Relothrin 10 EC	16.7±1.8b	15.0±2.1ab	14.0±1.5b	12.7±1.8b	11.3±1.2b	10.3±1.2b	9.3±0.9b	8.0±0.6b
Sumithion 50 EC	15.3±0.9b	13.3±0.9b	10.7±0.7b	9.0±1.0b	7.3±0.9bc	5.7±0.9c	4.7±0.9c	4.0±1.0c
Control	18.0±1.2a	20.7±1.4a	23.3±1.5a	25.0±0.6a	26.0±0.6a	21.0±1.0a	21.0±0.6a	21.0±0.6a

Means within a column followed by the same letter(s) are not significantly different by Tukey HSD posthoc test at $p \leq 0.05$.

Fig. 2 represents the mean percent reduction of natural enemies of mango hopper over control after multiple applications of the selected insecticides. Decis 2.5 EC showed the highest reduction (63.8%) of the population of natural enemies of mango hopper followed by Sumithion 50 EC (59.0%) and Ripcord 10 EC (50.0%). Relothrin 10 EC showed the lowest negative impact on the population of

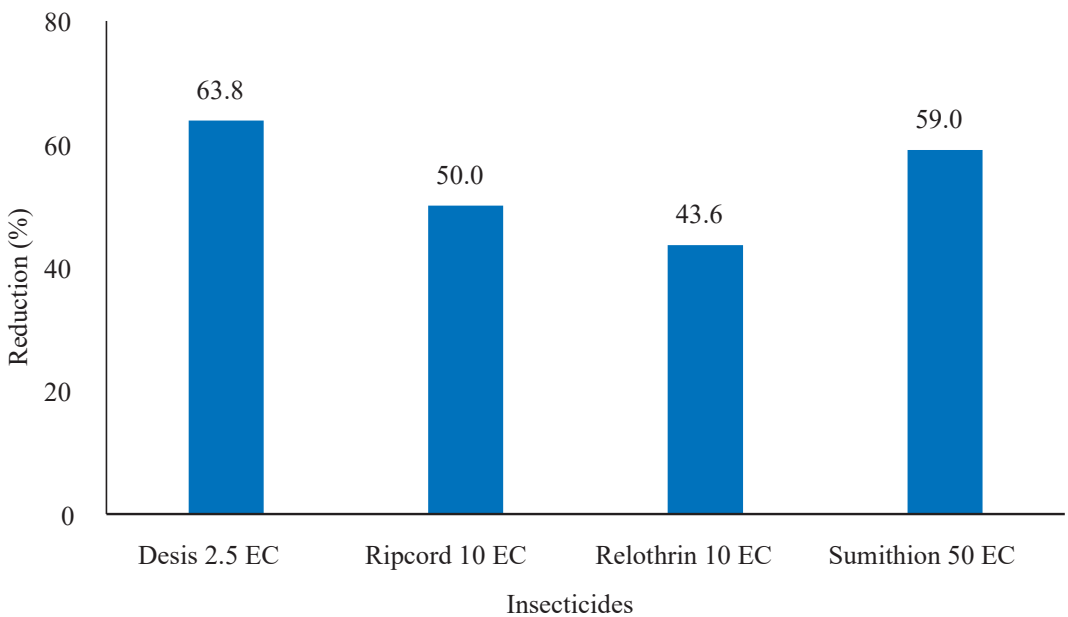


Fig. 2. Mean reduction (%) of natural enemies of hopper on mango over control after multiple applications of insecticides.

natural enemies of mango hopper with 43.6% reduction. The findings supported the results of Tariq *et al*. (2017) who observed that applying Decis 2.5 EC resulted in a significant reduction in the population of ladybird beetles, a major predator of the mango hopper. Chaudhary *et al*. (2015) also found that using Ripcord 10 EC limited the population of parasitic wasps, which are another important natural enemy of the mango hopper. Singh *et al*. (2019) found that applying Relothrin 10 EC at a rate of 0.1% resulted in a significant reduction in the population of ladybird beetles. Chaudhary *et al*. (2015) found that the application of Sumithion 50 EC @ 0.1% significantly decreased the number of parasitic wasps. Pawar *et al*. (2020) also reported that Decis 2.5 EC resulted in a 57% reduction in ladybird beetles, while Sarwar *et al*. (2017) noticed an 84.2% reduction in predatory bug, *Orius sauteri* with Decis 2.5 EC. Kumar *et al*. (2019) observed a significant reduction in green lace wing population using Ripcord 10 EC. Pawar *et al*. (2020) stated a 50% reduction in ladybird beetles with Relothrin 10 EC and Raza *et al*. (2015) found 93% reduction in green lacewing *Chrysoperla carnea* using Relothrin 10 EC. Khan *et al*. (2016) found a 90% reduction in predator *Cryptolaemus montrouzieri* population using Ripcord 10 EC. Khan *et al*. (2017) found 85% reduction in parasitic wasp *Aphytis melinus* with Sumithion 50 EC. Overall, these findings suggested that Desis 2.5 EC may be the most suitable insecticide for controlling mango hopper infestations. However, it is important to note that insecticide resistance can develop over time, and regular monitoring of pest populations is necessary to ensure continued effectiveness of any insecticide treatment. Additionally, integrated pest management strategies, including the use of cultural control methods, can also be effective in reducing mango hopper populations and reducing the reliance on insecticides.

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