Effects of Insecticides for Controlling Hogplum Beetle *Podontia 14-punctata* under Laboratory and Field Conditions

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Abstract
Experiments on hogplum beetle, *Podontia 14-punctata* were carried out to find out the suitable insecticide(s) with appropriate dose(s) for suppressing both larvae and adults. Results revealed that the highest mortality (100%) was found in 1st instar larvae after 24 hours at each dose of superior 505EC and the lowest mortality was in T_4 treated leaves. The highest mortality was also found in 2nd, 3rd, 4th and adult stages of hog-plum beetle by T_5 and T_6 treatments. No mortality was observed in control treatment in laboratory trial. The mean number of larvae ranged from 1.5 to 7.6 per square meter of quadrate at one week after last spray. No significant difference was observed among treatments regarding percent leaf infestation at one day before 1st spray. The percent leaf infestation ranged from 5.01 to 9.82 at one week after last spray. The lowest percent (5.87%) leaf infestation was found in T_6 treated plants while the highest percent (15.76%) leaf infestation was found in untreated control plants. The highest mortality was observed in T_5 and T_6 treated plants at all larval instars and no significant difference was found between two doses of each insecticide under field condition. The results of field trial also revealed that the minimum dose (0.75 ml L^{-1} of water) of Superior 505 EC is sufficient to suppress the field population of larvae and adults of *Podontia 14-punctata* effectively. Finally, it may be concluded that the highest mortality was found in all larval instars and adult stage of hog-plum beetle after 24 hours at each dose of superior 505 EC (T_5 and T_6 treatments) both in laboratory and field trials.

Key words: Hogplum beetle, Insecticide

Introduction

The product of hogplum (*Spondias mangifera* Wild) locally known as Amra is very much popular fruit in Bangladesh. Its fruits are edible, delicious and sources of vitamin C and carotene (Mondal and Amin, 1990). It is consumed in most cases in green stage and is also used as prickle, chattni, murabba, etc (Ahmed, 1969). It is extensively used for fodder in different parts of India like Assam, Madhya Pradesh, Maharashtra, Punjab and uttar Pradesh (Singh, 1982). The hogplum is a deciduous perennial tree with thick succulent leaves and it grows all over Bangladesh. But the quality fruits are produced only in the southern districts of Bangladesh (Sarder and Mondal, 1983), especially in Barisal and Patuakhali districts. Its quantitative and qualitative production/cultivation is seriously hampered by a Chrysomelid beetle, commonly known as hogplum beetle or fourteen spotted leaf beetle. The fourteen spotted leaf beetle, *Podontia quaturdecempunctata* or *Podontia 14-punctata* L. (Chrysomelidae: Coleoptera) is distributed throughout South East Asia and feeds on *S.mangifera* Wild (Anacardiaceae) in Bangladesh (Husain and Ahmed, 1977; Howlader, 1993), *S. dulcis* and *Ficas elestica*. It is the most destructive pest of hogplum not only in Bangladesh but also in India (Lefroy, 1971). It is reported that in Bangladesh, the beetles appear in June, abundant during July to September and disappear in October. The peak period of defoliation is August and September (Beeson, 1941; Baksha, 1997). Both adults and larvae of the beetle feed on the leaves of the hogplum (Beeson, 1941; Ahmed, 1969; Mondal, 1975; Sarder and Mondal, 1983) and heavy infestation often cause complete defoliation of the tree during peak period. Their attack resulting in stunted growth of the plant and eventually reduces the fruit size and yield (Mondal, 1975).

At present suitable control measure against this pest is not available in the country. People usually spray any insecticide to control their population. There is no recommended insecticide with optimum doses of application. The choice of effective insecticide (s) and dose (s) are important approach/component necessary for developing acceptable IPM package against this pest. Limited report reveals that in case of heavy infestation all leaves of the young trees are eaten up except midribs and subsequently cause the trees defoliated. The insect damages about 96.62 percent of the leaves of hog-plum and the average infestation of the leaves was 49.14 percent. For suppressing this pest and other beetle and weevil pests, some authors tested a few number of chemical insecticides (Hoffmann *et al*. 2000; Elzen *et al*. 2000; Singh *et al.* 1989), of them Malathion was found to be effective against these pests. As this pest is external feeder it is easier to suppress them by using Malathion or related contact insecticides with an appropriate dose (s). But the studies on the determination of suitable contact insecticides with appropriate doses were not systematically done in laboratory or in field condition so far. Therefore, two doses of Chlorpyrifos, Lambdacyhalothrin and Superior (Chlorpyriphos + Cypermethrin) were tested to find out the suitable insecticide(s) with proper dose

which can effectively suppress the larvae and adult stages of this pest in the laboratory and in field condition. Considering the above facts, the present study was undertaken to find out the most suitable insecticide(s) with appropriate dose(s) against larvae and adults of hogplum beetle.

Materials and Methods

Experiments on hog-plum beetle, *Podontia 14-punctata* were carried out in the laboratory of Entomology Department of Patuakhali Science and Technology University (PSTU), Dumki, Patuakhali as well as at the hog-plum orchard of Regional Agricultural Research Station (RARS), BARI, Rahmatpur, Barisal, Bangladesh, during August to September, 2012.

The laboratory experiment was carried out under normal room temperature (32 ± ^{0}C) and relative humidity (85 ± 5%) with a 14 ± 2:10±2 light and dark cycle (L:D) following completely randomized design (CRD). The field experiment was laid out in a randomized complete block design (RCBD) with 7 treatments and 3 replications. Treatments of different doses of chemical insecticides were T_1 = Chita (Chlorpyrifos) 48EC @ 0.75 ml L^{-1} of water, T_2 = Chita (Chlorpyrifos) 48 EC @ 1.0 ml L^{-1} of water, T_3 = Fighter (Lambdacyhalothrin) 2.5EC @ 0.75 ml L^{-1} of water, T_4 = Fighter (Lambdacyhalothrin) 25 EC @ 1.0 ml L^{-1} of water, T_5 = Superior (Chlorpyripos+ Cypermrthrin) 505 EC @ 0.75 ml L^{-1} of water, T_6 = Superior (Chlorpyripos + Cypermrthrin) 505 EC @ 1.0 ml L^{-1} of water and T_7 = Untreated control. These treatments were used both in laboratory and field condition. Each treatment was replicated 3 times.

In laboratory trial

Before applying insecticidal solution, the petiole of fresh succulent mid aged hog-plum leaflet was placed inside the plastic pot. Then 10 larvae or 10 adult beetles were released in each plastic pot. When the released larvae or adult beetles started normal movement then the insecticidal treatments were applied by a hand sprayer as cover spray. After treating the leaflet, the mouth of the plastic pot was covered with mosquito net. After application of the treatments, the covered pots were placed on the laboratory table near opened window. Mortality data of 1st, 2nd, 3rd 4th instar larvae and adult were noted at 24 hours after treatment.

In field trial

A total of 21 trees of around 6 years old were used for this study. One hogplum tree was considered as one treatment replication. Plant to plant distance was 20 ft × 20 ft. The evaluated treatments were T_1 = Chita (Chlorpyrifos) 48EC @ 0.75 ml L^{-1} of water, T_2 = Chita (Chlorpyrifos) 48EC @ 1.0 mlL^{-1} of water, T_3 = Fighter (lambdacyhalothrin) 2.5EC @ 0.75 ml L^{-1} of water, T_4 = Fighter (lambdacyhalothrin) 25 EC @ 1.0 ml L^{-1} of water, T_5 = Superior (Chlorpyripos+Cypermrthrin) 505 EC @ 0.75 ml L^{-1} of water, T_6 = Superior (Chlorpyripos+Cypermrthrin) 505 EC @ 1.0 mlL^{-1} of water and T_7 = Untreated control.

Design of the trial was laid out in RCBD with three replications. A total of three sprays were made at 10 days intervals. Each spray was done by manually driven foot pump sprayer as a full cover spray for the hog-plum tree. The leaves, branches and the main trunk of each tree were sprayed with spray mixture through the outlet of the nozzle. Application was made in such a way that the spray pressure would not knock down the pest from the tree. The pre treatment data were recorded on the number of 1st, 2nd, 3rd and 4th instars larvae and adults. Field mortality data on 1st, 2nd, 3rd 4th instar larvae and adult were recorded at 24 hours after treatment. One square meter (1 m^2) quadrat was placed in the central position of the east side canopy structure. The number of adults and larvae was also counted from inside each quadrat under different treatments at one day before the first spray and 1 week after the last spray. The number of healthy and infested leaves was counted from inside each quadrat under different treatments at one day before the first spray and one week after the last spray.

Statistical analysis

Single factor analysis of variance (ANOVA) on different parameters was done following completely randomized design (CRD) in laboratory trials and randomized complete block design (RCBD) in field trial. Data transformations were done wherever required. Multiple comparisons of parameter (where required) among different treatments were evaluated based on LSD test.

Results and Discussion

Mortality percentage of Podontia 14-punctata under laboratory condition

The mean per cent mortality of *Podontia 14-punctata* treated with two doses of three insecticides under laboratory condition after 24 hours is presented in Table 1. The highest mortality (100%) was found in 1st instar larvae after 24 hours at each dose of superior 505 EC which was statistically similar to mortality (98.62% and 98.64%, respectively) caused by each dose of Chita 48EC and the lowest mortality was in T_4 treated leaves. The highest mortality was also found in 2nd, 3rd, 4th and adult stages of hog-plum beetle by T_5 and T_6 treatments. No mortality was observed in control treatment. In case of 2nd instar larvae, the highest mortality (99.97%) was recorded in T_6 treated leaves which was statistically similar to T_5 (99.96%) followed by T_1 (98.00%) and T_2 (97.29%) treated leaves but statistically different from treatment T_3 and T_4. In case of 3rd instar larvae, the highest mortality (99.81%) was noticed

in T_6 treatment which was statistically similar to treatment T_5 (99.72%) followed by treatment T_2 (95.31%) but significantly different from treatments T_3 (73.89%) and T_4 (81.50%). However, there was no mortality observed in control treatment. In case of 4th instar larvae, the highest mortality (96.00%) was noticed in T_6 treatment which was statistically similar to treatment T_5 (94.21%) followed by treatment T_1 (87.79%) but significantly different from treatments T_3 (49.32%) and T_4 (63.32%), respectively. In adult stage, the highest mortality (98.59%) was also found in treatment T_6 which was statistically similar to treatment T_5 (97.29%) but statistically different from treatment T_1 (88.70%) followed by T_2 (83.62%), T4 (78.39%) and T_3 (76.89%). Likewise, no dead larvae or adult beetle was observed in control treatment. Mondal (1975) observed that Metation at 0.075% active ingredient killed maximum beetles and about 93.33% of them were found dead. Singh *et al*. (1989) described that 0.25% Malathion is the most effective dose against adult hog-plum beetle. Ali (2002) reported that the lower dose (0.1875%) of Malathion 57 EC may be recommended for effective suppression of *Podontia 14-punctata* instead of higher dose (0.25%).

Table 1. Mortality percentage of *Podontia 14-punctata* treated with two doses of three insecticides under laboratory condition after cover spray

Treatment	Mean per cent mortality in different stage after 24 hours				
	1st instar larvae	2nd instar larvae	3rd instar larvae	4th instar larvae	Adult
T_1	98.62a (83.20	98.00a (81.87)	92.86b (74.44)	87.79ab (69.47)	88.70b (70.36)
T_2	98.64a (83.20)	97.29a (80.37)	95.31ab (77.48)	83.67b (66.11)	83.62bc (65.63)
T_3	88.70b (70.36)	81.34b (64.38)	73.89c (59.21)	49.32c (44.60)	76.89c (62.21)
T_4	86.68b (68.53)	84.63b (66.62)	81.50c (64.52)	63.32c (52.71)	78.39c (63.31)
T_5	100.00a (89.21)	99.96a (89.00)	99.72a (89.01)	94.21a (76.06)	97.29a (80.37)
T_6	100.00a (89.21)	99.97a (89.01)	99.81a (87.44)	96.00a (78.46)	98.59a (82.96)
T_7	0.00c	0.00c	0.00d	0.00d	0.00d
LSD	0.169	0.237	0.197	0.154	0.178
CV (%)	8.45	9.20	6.80	7.81	7.54
Prob. (P)	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05

In a column, means followed by the same letter(s) did not differ significantly as per LSD Values are averages of 3 replications. Figure in parenthesis are transformed (Arcsine) value.

Treatments: T_1 = Chita 48 EC (Chlorpyriphos) @ 0.75 ml L^{-1} of water, T_2 = Chita 48 EC (Chlorpyriphos) @ 1.0 ml L^{-1} of water, T_3 = Fighter 2.5 EC (Lambdacyhalothrin) @ 0.75 ml L^{-1} of water, T_4 = Fighter 2.5 EC (Lambdacyhalothrin) @ 1.0 ml L^{-1} of water, T_5 = Superior 505 EC (Chlorpyriphos + Lambdacyhalothrin) @ 0.75 ml L^{-1} of water, T_6 = Superior 505 EC (Chlorpyriphos + Lambdacyhalothrin) @ 1.0 ml L^{-1} of water and T_7 = Untreated control. From the results of this table it is clear that two doses of Superior 50.5 EC is the best and showed most toxic effect to the larvae and adult beetles. All doses of chita 48 EC and fighter 2.5 EC showed more or less similar toxic effect to the larvae and adult beetles. Therefore, the treatment T_5 with lower dose (0.75 ml L^{-1} water) of Superior 505 EC may be recommended against this pest instead of presently studied higher dose of 1 ml l^{-1} of water.

Mortality percentage of Podontia 14-punctata under field condition

The mean number of larvae ranged from 1.5 to 7.6 per square meter of quadrate at one week after last spray (Table 2). No significant difference was observed among treatments regarding percent leaf infestation at one day before 1st spray. The percent leaf infestation ranged from 5.01 to 9.82 at one week after last spray. The lowest percent (5.87%) leaf infestation was found in T6 treated plants which was statistically similar to T_5 (5.91%) treated plants. The highest percent (15.76%) leaf infestation was found in untreated control plants (T_7) which varied significantly from other treatments. Intermediate level of leaf infestation was found in fighter 2.5 EC (Lambdacyhalothrin) treated plots with no significant difference between two treatment doses T_3 (9.45%) and T_4 (8.46%) followed by T_1 (7.36%) and T_2 (6.84%) treatments. The highest percent infestation reduction over control was obtained from T_6 (62.75%) treated plant followed by T_5 (62.50%), T_2 (56.60%) and T_1 (53.30%) treated plants. The lowest percent infestation reduction over control was obtained from T_3 (40.04%) treated plant followed by T_4 (46.32%) treated plant. The findings of the present study are similar with the reports of other authors and they stated that Malathion was effective against hog-plum beetles (Hoffmann *et al.,* 2000; Elzen *et al*., 2000; Singh *et al.,* 1989).

Table 2. Mortality percentage of *Podontia 14-punctata* treated with two doses of three insecticides under field condition after cover spray on hog-plum trees at Rahamatpur hogplum orchard during August to September 2012

Treatments	No. of larvae at 1-WALS	Leaf infestation (%) at		Infestation reduction over control (%) at 1-WALS
		1-DBFS	1-WALS	
T_1	2.6	6.12	7.36bc (2.80)	53.30
T_2	2.4	5.97	6.84bc (2.70)	56.60
T_3	3.6	5.01	9.45b (3.15)	40.04
T_4	3.5	6.82	8.46b (2.99)	46.32
T_5	1.6	5.73	5.91c (2.53)	62.50
T_6	1.5	5.64	5.87c (2.52)	62.75
T_7	7.6	5.70	15.76a (4.03)	-
LSD	-	-	0.874	-
CV (%)	-	-	14.23	-
Prob. (P)	-	NS	P<0.05	-

DBFS=Day before first spray WALS=Week after last spray
In a column, means followed by the same letter(s) did not differ significantly as per DMRT
Values are averages of 3 replications. Figure in parenthesis are square root transformed values

Table 3. Mortality percentage of *Podontia 14-punctata* treated with two doses of three insecticides under field condition after cover spray on hog-plum trees at Rahamatpur hog-plum orchard during August to September 2012

Treatment	Mean per cent mortality in different stage after 24 hours				
	1st instar larvae	2nd instar larvae	3rd instar larvae	4th instar larvae	Adult
T_1	91.85ab (73.89)	92.21b (74.18)	87.78ab (69.45)	81.50b (64.53)	85.77ab (66.51)
T_2	92.86ab (74.44)	91.30b (72.86)	87.97ab (69.62)	82.92b (65.57)	87.75ab (68.47)
T_3	85.67b (66.49)	78.41c (62.31)	77.89b (61.49)	75.89c (59.98)	82.91b (65.55)
T_4	86.64b (68.50)	82.91c (65.56)	81.68b (64.67)	78.39bc (62.08)	83.68b (66.11)
T_5	99.72a (89.01)	98.61a (82.96)	92.84a (74.42)	87.79a (69.47)	92.45a (74.00)
T_6	99.81a (89.44)	98.66a (83.20)	94.12a (75.78)	91.18a (72.74)	94.10a (75.94)
T_7	0.00c	0.00d	0.00c	0.00d	0.00c
LSD	0.142	0.108	0.124	0.149	0.129
CV (%)	5.72	8.86	7.34	8.11	6.54
Prob. (P)	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05

In a column, means followed by the same letter (s) did not differ significantly as per DMRT
Values are averages of 3 replications. Figure in parenthesis are transformed (Arcsine) values

Treatments: T_1 = Chita 48 EC (Chlorpyriphos) @ 0.75 ml L^{-1} of water, T_2 = Chita 48 EC (Chlorpyriphos) @ 1.0 ml L^{-1} of water, T_3 = Fighter 2.5 EC (Lambdacyhalothrin) () @ 0.75 ml L^{-1} of water, T_4 = Fighter 2.5 EC (Lambdacyhalothrin) @ 1.0 ml L^{-1} of water, T_5 = Superior 505 EC (Chlorpyriphos + Cypermethrin) @ 0.75 ml L^{-1} of water, T_6 = Superior 505 EC (Chlorpyriphos + Cypermethrin) @ 1.0 ml L^{-1} of water and T_7 = Untreated control.

Mortality percentage of Podontia 14-punctata under field condition within 24 hours

Mortality percentage of *Podontia 14-punctata* treated with two doses of three insecticides under field condition within 24 hours of application is presented in Table 3. The highest mortality was observed in T_5 and T_6 treated plants at all larval instars and no significant difference was found between two doses of each insecticide. In case of 1st instar larvae, the highest mortality (99.81%) was recorded in T_6 treatment which was statistically similar to treatment T_5 (99.72%) followed by T_2 (92.86%) and T_1 (91.85%) but statistically different from other treatments. In case of 2nd instar larvae, the highest mortality (98.66%) was recorded in T6 treatment which was statistically similar to treatment T_5 (98.61%) followed by T_1 (92.21%), T_2 (91.30%), T_4 (82.91%) and T_3 (78.41%). In case of 3rd instar larvae, the trend of mortality was found to be similar as in the 1st instar larvae. In case of 4th instar larvae, the highest mortality (98.18%) was recorded in T_6 treatment which was statistically similar to treatment T_5 (87.79%) but statistically different from other treatments. The next highest mortality was observed in T_2 (82.92%) followed by T_1 (81.50%) and T_4 (78.39%) but statistically different from T_3 treatments (75.89%). In adult stage, the highest mortality (94.10%) was recorded in T_6 treatment which was statistically similar to treatment T_5 (92.45%) followed by T_2 (87.75%) and T_1 (85.77%) but statistically different from other treatments. However, there were no dead larvae or adult beetles observed in untreated control at all stages of development of hog-plum beetle. No significant difference was observed between the two doses of Superior 505 EC after 24 hours of application. The results of field trial also revealed that the minimum dose (0.75 ml L^{-1} of water) of Superior 50.5 EC is sufficient to effectively suppress the field population of larvae and adults of *Podontia 14-punctata*. Hoffmann *et al.* (2000) and Lissy-o *et al.* (2000) found that ultra low volume of

Malathion has been used as an essential tool for boll weevil, *Anthonomus grandis* Boheman eradication programme in the USA. Treatments: T_1 = Chita 48 EC (Chlorpyriphos) @ 0.75 ml L^{-1} of water, T_2 = Chita 48 EC (Chlorpyriphos) @ 1.0 ml L^{-1} of water, T_3 = Fighter 2.5 EC (Lambdacyhalothrin)@ 0.75 ml L^{-1} of water, T_4 = Fighter 2.5 EC (Lambdacyhalothrin) @ 1.0 ml L^{-1} of water, T_5 = Superior 505 EC (Chlorpyriphos + Cypermethrin) @ 0.75 ml L^{-1} of water, T_6 = Superior 505 EC (Chlorpyriphos + Cypermethrin) @ 1.0 ml L^{-1} of water and T_7 = Untreated control.

Conclusions

From the results of laboratory and field trial it may be concluded that the lower dose (0.75 ml L^{-1} of water) of Superior 505 EC may be recommended for effective suppression of hogplum beetle instead of presently studied higher dose (1.0 ml L^{-1} of water) of Superior 505 EC.

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