Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(3): 748-752

Received: 15-03-2017
Accepted: 16-04-2017

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Insecticidal efficacy in reducing gummosis attributed to peach flat-headed borer in plum trees

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Abstract
Studies were conducted to evaluate the efficacy of seven insecticides, i.e., Fyfenon 57EC, Curacron 500EC, Thiodan 35EC, Lorsban 40EC, Regent 5%SC, Ematac 1.9EC and Confidor 20SC in plum orchard for reducing the gummosis damage induced by Peach flat-headed borer. The mean density of new gum points /m^2 on bark surface area treated with Confidor 20SC @ (30 ml/ 10 L) was significantly lower (7.55) followed by Thiodan 35EC (7.80) applied @ (50 ml/ 10 L), as compared to the untreated control (40.49).). In trees that received two applications, the mean density of new gum points/m^2 of bark surface area were significantly lower (11.24) as compared to the trees that were sprayed once (15.86). Highest percent reduction in gummosis was offered by Confidor 20SC (81.4%) followed by Thiodan 35EC (80.7%), whereas the lowest by Curacron 500EC (70.4%). It is suggested that two sprays of Confidor 20SC (imidacloprid) can successfully reduce gummosis damage caused by this pest.

Keywords: Gummosis, Imidacloprid, Peach flat-headed borer, *Sphenoptera dadkhani* (Oben.), percent reduction

1. Introduction

Fruits of Prunus species, i.e. peach, plum and apricot are the most important deciduous fruits grown in Peshawar region for domestic consumption as well as for export. These are potent in supplying nutrition to the human beings. Total area of the province under Apricot fruit is 2000 ha, with production of 14000 tons, Peach is 56000 ha, with production of 308000 tons, and Plum fruit is 3000 ha, with production of 27000 tons [1]. A number of insect pests attack these fruits but peach flatheaded borer *Sphenoptera dadkhani* (Oben.) which had previously been confused with *Sphenoptera lafertii* (Thoms.) is a serious threat for the successful development of these fruit trees and is the major insect pest of peaches and plum trees in Peshawar valley. It was reported for the first time from North-Western Pakistan infesting peach trees. One of the major bottlenecks in the successful raising of peaches is the incidence of flatheaded borer, *Sphenoptera dadkhani* [2-4].

The production of peaches and plum in Peshawar valley is severely hampered by Peach flat-headed borer, *Sphenoptera dadkhani* (Oben.) and there are increasing complaints from the orchard growers regarding the devastation of their orchards due to this pest [5]. Unfortunately, the cryptic habits of insect borers have hindered efforts to document their activity and develop appropriate management strategy. Much of the information on insect borers is widely scattered and found in older, less accessible literature. In addition, research on insect borers is commonly restricted to very few pest species. Little work is available on this pest in Peshawar region but some studies conducted in the past have clearly documented that severe infestation of this pest has been a leading cause of mortality of *Prunus* spp. trees in this region [2]. Surveys conducted by the authors [6] revealed that more than 82% of the plum and peach orchards were found infested with Peach flat-headed borer (PFB). Peach flatheaded borer, *S. dadkhani* (Oben.) is the major insect pest of stone fruit trees especially peach and plum in Peshawar Valley [2].

This pest has also been recorded from India which is now a major pest throughout the North-Western peach cultivation area of Punjab, Haryana and Himachal Pradesh, causing 10-60% fruit infestation [7-9]. The decreasing tendency in the area and production of stone fruits is mainly attributed to this notorious beetle which consequently decreased the tree life. In every orchard 20-53% trees had been found infested by this borer [2]. Gummosis damage by this borer was highest in plum (70.4%) followed by peach (53.3%) and apricot (42.5%) in Peshawar [10].

Peach flatheaded borer prefers weak or injured trees. Larvae bore into the bark and make shallow and irregular galleries. Several interconnected galleries loosen the bark and block the flow of sap, causing death of the limb. The larvae feed in the cambium and can completely girdle and kill young or newly grafted trees in a short period of time. The attacked trees exude gum (gummosis) and gradually become weak and ultimately die [9]. The signs of peach flatheaded borer infestation include flattened D-shape holes (3.7 x 1.7 mm) on bark of the trees. Substantial amounts of oozing sap mixed with frass exuding from entrance holes on the trunk and infested branches of the tree also include symptoms of attack [11].

Insecticides have played, and will continue to play, an important role in a sustainable insect management strategy. Though synthetic chemicals pose real hazards to non-targeted organisms but their importance cannot be denied in any way due to the benefits they provide to the humanity by increasing the production and decreasing the pest severity in tense situations. Oliver *et al*. (2010) reported that non-insecticide-treated red maple cultivars sustained high levels of flat-headed borer damage in 2005 (2.3-39.6%) and 2006 (32.1-41.0%) trials, indicating almost half of the crop was lost without insecticide protection [12]. These conflicting observations and the introduction of novel chemicals in the market, necessitate testing of these compounds for efficacy against the pest on regular basis. Keeping in view the importance of the fruit crops, the devastating capability of the pest and the ever dynamic pesticide market, the present research work was initiated to study the comparative efficacy of different insecticides in reducing gummosis attributed to *Sphenoptera dadkhani*.

2. Materials and methods

The present study was undertaken at Nuclear Institute for Food & Agriculture (NIFA), Peshawar, during 2012, to investigate the effect of different insecticides in reducing gummosis attributed to peach flat-headed borer.

2.1 Field testing of different insecticides against Peach flat-headed borer in Plum orchard

Seven insecticides (Table 1), applied against the first generation of PFB, were tested for their efficacy. Sixty four plum trees of uniform age (7-8 years old) were selected at the experimental farm of NIFA, Peshawar. Each tree served as an experimental unit. The experiment was laid out as Completely Randomized (CR) factorial design with eight treatments (seven insecticides and an untreated control) each at two levels (single or two sprays) and replicated four times. The first spray was applied on 3rd April, 2012. The spray was done on the whole trees using a shoulder mounted PIR spray pump. The second insecticidal spray was done in the same manner two weeks after the first application.

2.2 Data Recording

For data recording the method of Chaudhary *et al*. (1993) [12] and Sharma *et al*. (2004) [13] was employed. Before spray, the trees were checked to a height of 2 m from ground level (as maximum damage is confined to a height of 2 m from ground level) for already present gummosis. The gummosis present on the trunk was scrapped off with the help of scraper from each tree before chemical application. In order to standardize the borer damage, number of new gum points was recorded as gum points/m^2. Effect of insecticides on borer damage was evaluated by recording freshly made gum points on 13th August, 2012, two weeks after the second generation adults had completed emergence.

2.3 Data Analysis

The data obtained were entered into Microsoft excel, 2007 spreadsheet, transformed using a log transformation and subjected to ANOVA for testing the significance of insecticides, application frequency and their interaction by using the statistical package Statisitix 8.1 [14]. Mean separation was performed by using LSD test [15]. For calculating Percent gummosis reduction the following formula was used:

% Gummosis reduction= (Control – Treatment/Control)* 100

Table 1: List of the synthetic insecticides tested for the control of *S. dadkhani*

S. No	Trade Name	Common Name	Chemical Group	Dose/10 L	Active Ingredient (g/l)
1.	Fyfenon 57EC	Malathion	Organophosphate	50 ml	570
2.	Curacron 500EC	Profenofos	Organophosphate	50 ml	500
3.	Lorsban 40EC	Chlorpyrifos	Organophosphate	50 ml	400
4.	Ematac 1.9EC	emamectin benzoate	Avermectin	30 ml	19
5.	Regent 5%SC	Fipronil	Phenyl Pyrazole Family	50 ml	50
6.	Confidor 20%SL	Imidacloprid	Neonicotinoid	30 ml	200
7.	Thiodan 35EC	Endosulfan	Organochlorine	50 ml	352
8.	Control	Untreated		-------	-------

3. Results

3.1 Gum points /m^2

Data regarding the gum points/m^2 on the treated and control trees is presented in table (2). Seven insecticides, i.e., Fyfenon 57EC, Curacron 500EC, Thiodan 35EC, Lorsban 40EC, Regent 5%SC, Ematac 1.9EC, and Confidor 20SC were evaluated in plum orchard during the period of PFB adult emergence. Results indicated that the interaction of insecticide*application frequency was not significant ($F_{7,48}$=0.52, p<0.8157), therefore simple means were considered instead of interaction means.

We found a significant effect of insecticides ($F_{7, 48}$=6.22, p<0.000) in reducing the population of adult PFB indicated by the appearance of new gum points /m^2 on the bark as compared to the untreated control. The mean density of new gum points /m^2 on bark surface area treated with Confidor 20SC @ (30 ml/ 10 L) was significantly lower (7.55) followed by Thiodan 35EC (7.80) applied @ (50 ml/ 10 L), as compared to the untreated control (40.49).

Table 2: Efficacy of insecticides in reducing the damage of Peach flatheaded borer (Gum Points)

S. No.	Treatment	Mean New Gum Point/m^2
1.	Fyfenon	9.57 b
2.	Ematac	9.21 b
3.	Curacron	12.15 b
4.	Regent	10.65 b
5.	Lorsban	10.96 b
6.	Confidor	7.55 b
7.	Thiodan	7.80 b
8.	Untreated Control	40.49 a
	LSD Value	6.97

Means represented within the same letters are not significantly different at 5% level of significance.

3.2 Spray Frequency

Figure (1) demonstrated the findings of spray frequency for the insecticides tested. The results showed that all the insecticides whether sprayed once or twice, were able to exert a significant reduction in the adult population as compared with the untreated control. However, two sprays were significantly effective in reducing the borer damage when averaged across the insecticides ($F_{1, 48}$=5.25, p<0.0264). In trees that received two applications, the mean density of new gum points/m^2 of bark surface area were significantly lower (11.24) as compared to the trees that were sprayed once (15.86).

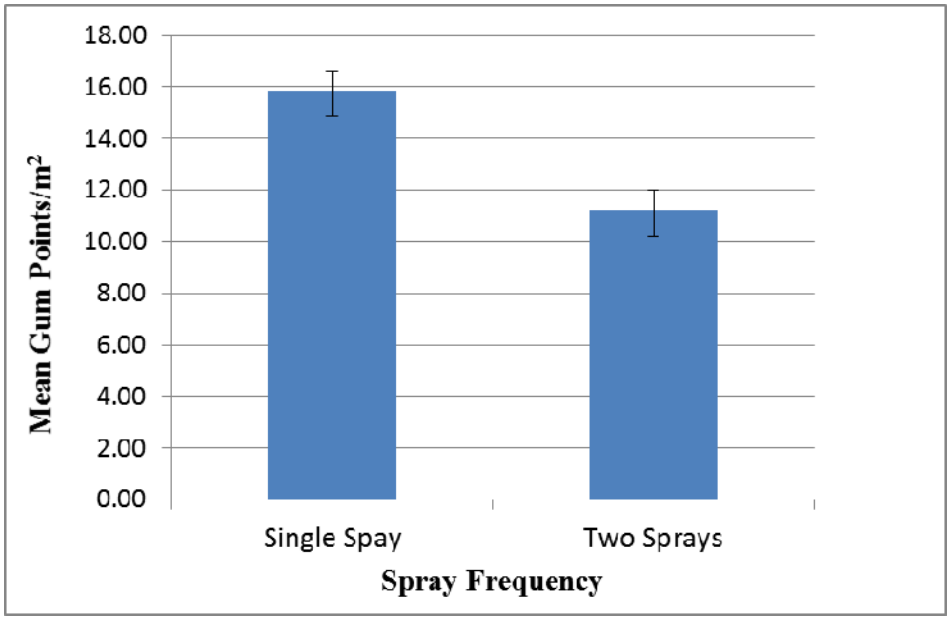

Fig 1: Comparison of Spray Frequency for different insecticides in reducing the damage of PFB.

3.3 Gummosis Reduction

Figure 2 depicted the cumulative effect of two sprays for the tested insecticides in reducing gummosis. It is obvious from the results that all the tested insecticides proved significantly better over control in reducing gummosis damage. Highest percent reduction in gummosis was offered by Confidor 20SC (84%) followed by Thiodan 35EC (81.3%), whereas the lowest by Curacron 500EC (77.4%).

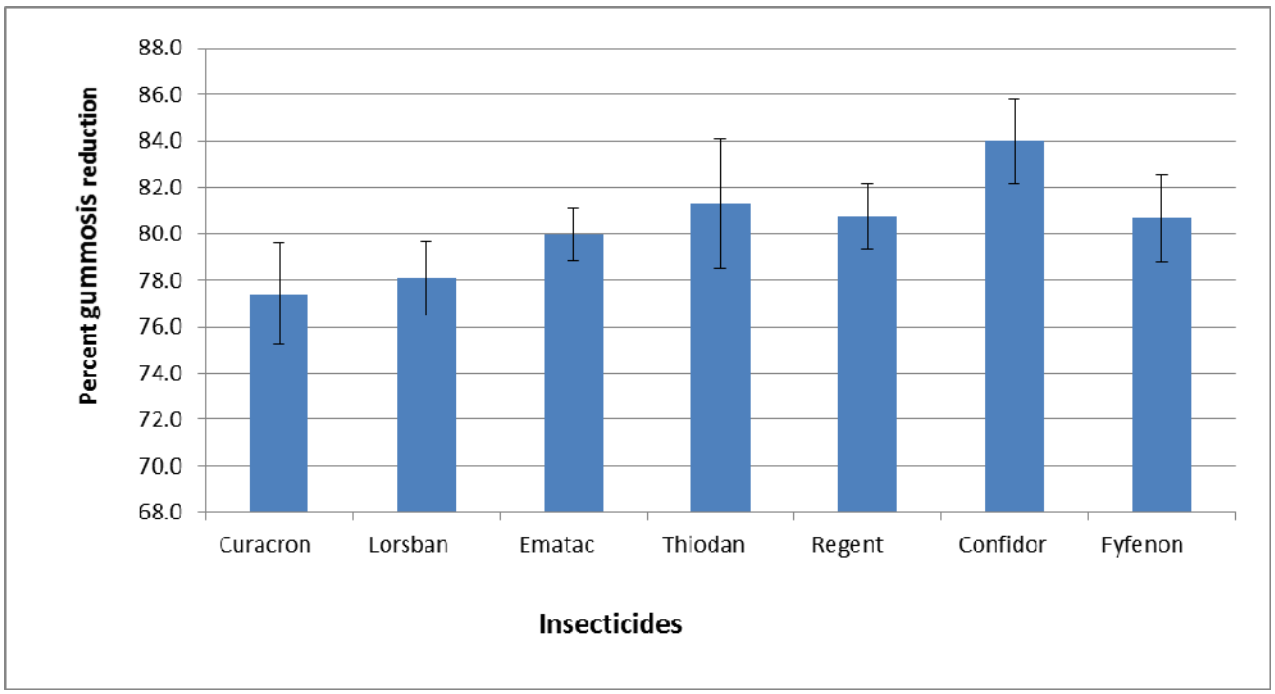

Fig 2: Percent gummosis reduction by different insecticides.

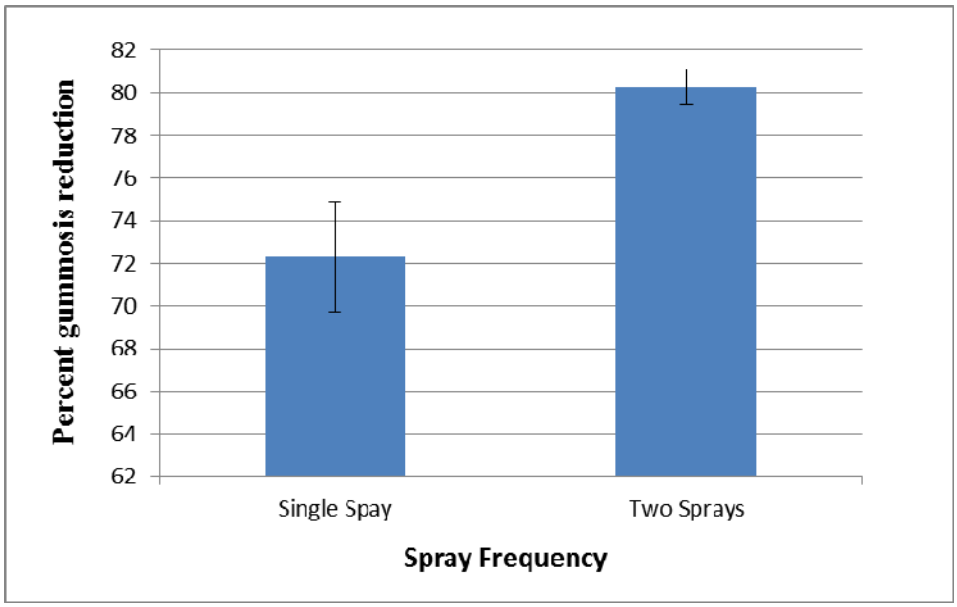

Fig 3: Percent gummosis reduction by different insecticides

4. Discussion

Results revealed that all the tested insecticides showed some promise in reducing gummosis and offered good pest control. However, fortnightly two applications of imidacloprid and endosulfan, were comparatively more effective in reducing the damage and resulted in better pest control. Since emergence period of the borer adults is expanded over a month, therefore second spray ensured a continuous insecticidal cover during that time in which borer adults were likely to be around.

The findings of our study were in accordance with results of Singh [16] and Sharma *et al*. [12] who reported that spray of endosulfan and malathion were effective against PFB and kept fruit trees in vigorous growing conditions. Likewise highly effective control was observed by Muccullough *et al*. [17] when Emarald Ash Borer, a buprestid insect having similar feeding behavior to PFB was treated with imidacloprid. Yonce [18] also reported that application of chlorpyrifos early in the growing season controlled peach tree and lesser peach tree borers in peach orchards. Emamectin benzoate has been observed to be translocated within the wood when injected into the tree and has been found to be persistent for several months [19].

The fact that trees that received two applications had significantly lower borer infestation compared with one application in some insecticides suggests that resulted increased insecticide concentration enhanced insecticidal efficacy by targeting the maximum adult emergence period. These observations corroborate the findings of Petrice and Haack [20] who advocated that imidacloprid was very effective at killing Emarald Ash Borer adults and their efficacy was increased when two applications were made. While Sharma *et al*. [13] was of the opinion that three applications registered the minimum incidence of peach flat headed borer with chlorpyrifos.

Similarly Coyle *et al*. [21] recommended that if large populations of adult beetles are observed on bark of the tree then spray the bark of trunk three times. However, Chaudhary *et al*. [10] documented that the most effective control of this pest could be achieved by integrating heavy pruning of infested peach trees followed by removal and destruction of infested branches in January, followed by the application of FYM and NPK fertilizers and three sprays of lindane (500 ga.i/ha) in April, June and September.

Endosulfan, being a chlorinated hydrocarbon insecticide, is persistent therefore provided maximum control of PFB. Imidacloprid (neonicotinoid) is a systemic insecticide which is absorbed by the plant tissues and can be effective for a longer period of time. Similarly malathion is a contact organophosphate insecticide, which can effectively kill PFB coming in contact to it.

Since, the use of organochloride has environmental concerns we do not recommend endosulfan. Hence, two sprays (fifteen days interval) of imidacloprid, can successfully reduce the gummosis damage caused by this pest.

5. Conclusion

Based on the above discussion, it is suggested that two sprays of imidacloprid (Confidor 20SC) can successfully reduce gummosis problem caused by this pest. This study provides baseline information about gummosis damage induced by peach flat-headed borer; further research needs to be done to document the complete biology, economic damages and an IPM package for efficient and safe control of this devastating insect pest.

6. Acknowledgement

The authors wish to express their profound gratitude to Pakistan Science Foundation (PSF) for financial support of this study under Project No. NSLP/ KP- NIFA (171). This study is a part of M. Sc. (Hons.) thesis of the first author.

7. Competing Interest

The authors declare that they have no competing interests.

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