Evaluation of newer insecticides against leaf eating caterpillar, Spodoptera litura (fab.) infesting capsicum under Polyyhouse condition

AA Tompe, UB Hole, SA More, SR Kulkarni and MS Walase

Abstract

The present investigation was conducted to evaluate bioefficacy of newer insecticides against leaf eating caterpillar, Spodoptera litura (Fab.) infesting capsicum under Polyyhouse condition at Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune during Kharif 2018-19. Studies indicated that all the insecticidal treatments were significantly superior over untreated control. The treatment with cyantraniliprole was observed to be the most promising for suppression of larval population by recording lowest number of 0.63 larvae per plant. This was followed by chlorantraniliprole and lufenuron; in which 0.80 and 1.09 larvae per plant were observed. The remaining treatments in order of efficacy were flubendiamide, lambda cyhalothrin, spinosad and indoxacarb; which recorded 1.34, 1.62, 1.97 and 3.22 larvae per plant, respectively, as compared to untreated control plot in which 6.69 larvae per plant were observed.

The efficacy of newer insecticides against S. litura in terms of per cent fruit damage revealed that cyantraniliprole was found to be effective treatment among all treatments which had recorded 11.35 per cent fruit damage per plant which was at par with chlorantraniliprole; which recorded 12.31 per cent fruit damage per plant. The next best treatments in order of efficacy were lufenuron, flubendiamide, labdaclyathorin, spinosad and indoxacarb in which 14.15, 16.05, 18.00, 20.94 and 26.71 per cent fruit damage per plant, respectively, were reported. The untreated plot was recorded highest 35.01 per cent fruit damage per plant.

Keywords: Capsicum, bioefficacy, insecticides, leaf eating caterpillar, S. litura Fab

1. Introduction

Capsicum (Capsicum annuum L.) is an important spice and vegetable crop from family Solanaceae and native of the Central America and is now cultivated worldwide (Baikar and Naik, 2016) [1]. Worldwide it is cultivated in an area of 15 lakh ha with 70 lakh tonnes of productivity (Vijayalakshmi et al., 2016) [2]. India is the world leader in capsicum production followed by China and Pakistan. The area under capsicum cultivation is about 0.96 million hectares with annual production of 1.05 million tonnes in India (Sreenivas et al., 2008) [3]. Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Maharashtra are the major capsicum producing states in the country. In Maharashtra, the crop is mainly grown in Nagpur, Chandrapur, Dhule, Nanded, Pune, Kolhapur and Amaravati districts (Guru and Patil., 2018) [4]. Capsicum crop is grown in an area of 99,300 hectares with a production of 51,214 metric tons in Maharashtra (Patil et al., 2013) [5].

It is reported that nearly twenty insect pests attack capsicum crop viz., whiteflies (Trialeurodes vaporariorum Westwood.), aphids (Aphis gossypii Glov.), thrips (Scirtothrips dorsalis Hood.), fruit borer (Helicoverpa armigera) and leaf eating caterpillar, (Spodoptera litura Fab.). Amongst these pests, S. litura are very important causing maximum damage to capsicum crop (Shreenivas et al., 2008) [3].

Leaf eating caterpillar, S. litura (Fab) (Lepidoptera: Noctuidae) is a polyphagous insect pest of national importance causing economic damage to about 120 host plants such as cotton, groundnut, tobacco, rice, sunflower, tomato, brassicas and many other crops are attacked by this pest. 40-50% of yield loss were observed due to infestation of S. litura (Vijayalakshmi et al., 2016) [2]. Recently farmer depends upon the use of chemical pesticides for the control of S. litura, but it had reported resistance to a wide range of conventional insecticides, which has result into sporadic out breaks of the pest led to failure of crops (Shad et al., 2012) [6]. Because of these reasons, the control of S. litura is becoming increasingly difficult.
Hence, hazardous effects of conventional insecticides in chemical control needs to use of newer insecticides which is effective and safer for human being as well as less toxic to ecosystem (Sharma and Sharma, 2018). Keeping in view the above facts, an experiment was carried out to evaluate the efficacy of some newer insecticides viz., cyantraniliprole, chlorantraniliprole, lufenuron, flubendamide, lambda cyhalothrin, spinosad and indoxacarb against *S. litura* infesting capsicum crop under Polyhouse condition.

### 2. Materials and Methods

The 45 days old seedling of capsicum variety Indra were purchased from local nursery and transplanted in experimental field on 25th June 2018 at High Tech Floriculture and Vegetable Project, College of Agriculture, Pune. All recommended practices with the object of cultivation of good capsicum crop was followed. The other facilities such as knapsack sprayer, bucket, chemicals required were provided by Department of Entomology, Pune. An experiment to evaluate the insecticides was laid out in randomized block design with three replications and eight treatments with plot size of 6x1 m². To compare the efficacy of insecticides and untreated control was maintained. Spraying of respective insecticidal treatments, were done in morning hours due to calm climate in morning to avoid drift due to heavy wind. Five plants were selected randomly from each plot which were tagged with wax coated label for subsequent replication trial then observations were recorded on basis of number of larvae per plant and per cent fruit damage per plant per treatment.

Precount of *S. litura* was recorded at one day before first spray and subsequent observations on post count were recorded at 3, 7, 10 and 14 days after each spray application in morning hours at 7.30 to 9.30 AM.

### 2.1 Statistical analysis of the data

Data of average population of *S. litura* larvae were transformed into square root for numbers by Poisson’s formula $\sqrt{x + 0.5}$ and arc sin transformation for values of fruit damage (Panse and Sukhatme, 1985). The standard error (S. E) and critical difference (C.D.) at 5% level of significance were calculated, in order to ascertain the bioefficacy of each pesticide against *S. litura*. Per cent efficacy of different treatments was worked out using formula:

$$\text{Per cent efficacy} = \left[1 - \frac{Ta}{Ca} \times \frac{Cb}{Tb}\right] \times 100$$

Where,  
Ta - Infestation in treated plot after application  
Th - Infestation in treated plot before application  
Ca - Infestation in control plot after application  
Cb - Infestation in control plot before application

The data on per cent infestation of leaf eating caterpillar was calculated at each picking by counting damage and healthy fruits in each spray application. The mean per cent fruit damage was calculated by using formula:

$$\text{Mean fruit damaged} = \frac{\text{No. of damaged fruits}}{\text{Total no. of fruits}} \times 100$$

### 3. Results

#### 3.1 Bioefficacy of newer insecticides against larval population of *S. litura*

Overall result of three cumulative spray against larval population of *S. litura* revealed that each treatments differed significantly and presented in table 1. All the insecticidal treatments were found to be effective against *S. litura* over untreated control. The treatment with cyantraniliprole was observed to be the most promising by recording 0.63 larvae per plant. The next best treatment was chlorantraniliprole and lufenuron; in which 0.80 and 1.09 larvae per plant were observed. These were followed by flubendamide, lambda cyhalothrin, spinosad and indoxacarb which recorded 1.34, 1.62, 1.97 and 3.22 larvae per plant, respectively. In untreated control, 6.69 larval population of *S. litura* per plant was observed.

### 3.2 Bioefficacy of insecticides against per cent fruit damage by the *S. litura*

Overall result of all three sprayings against fruit damage due to *S. litura* revealed that all the treatments were best for *S. litura* control and displayed in table 2. The chlorantraniliprole was found to be superior treatment among all treatments which was recorded 11.35 per cent fruit damage per plant which was at par with the treatment chlorantraniliprole which recorded 12.31 per cent fruit damage per plant. This was followed by the next best treatments were lufenuron, flubendamide, lambda cyhalothrin, spinosad and indoxacarb in which 14.15, 16.05, 18.00, 20.94 and 26.71 per cent fruit damage per plant, respectively were reported. The untreated plot was recorded highest 35.01 per cent fruit damage per plant.

### 4. Discussion

An experiment carried out on evaluation of bioefficacy of newer chemicals against *S. litura* reported that treated plot with cyantraniliprole 10.26 OD was superior among all treatments. Remaining treatments in order of efficacy were chlorantraniliprole 18.5 SC, lufenuron 50 EC, flubendamide 39.35 SC, lambda cyhalothrin 5 EC, spinosad 45 SC and indoxacarb 14.5 SC.

The present finding are in accordance with Bhatnagar et al., (2013) observed that toxicity of insecticides against *S. litura* (Fab.). Indoxacarb was more toxic than cartap hydrochloride at LC50 value. The relative toxicity ratio of novel 50 molecules at LC50 value in comparison to cartap hydrochloride were flubendamide (118.33) > indoxacarb (71). Karuppaiha and Srivastava (2013) stated that the order of toxicity was chlorantraniliprole > emamectin benzoate > indoxacarb > spinosad > pyridial > fluendamide with the relative toxicity of 37.75, 37.75, 3.28, 1.91, 1.61 and 1.24 revealed that chlorantraniliprole (0.0001) was most effective followed by emamectin benzoate (0.0002) and indoxacarb (0.0012). The order of relative toxicity was for chlorantraniliprole, emamectin benzoate, indoxacarb, spinosad, pyridial and flubendamide, respectively. Patil et al., (2013) reported the efficacy of flubendamide 39.35 SC at two concentrations (48 and 60 g a.i./ha) against indoxacarb 14.5 SC (50 g a.i./ha) and spinosad 45 SC, (73 g a.i./ha) on *S. litura* in capsule. The results on efficacy of insecticides used in experiment showed that maximum reduction in mean larvae per plant as well as lowest fruit damage was recorded in flubendamide 39.35 SC @ 60 g a.i. per ha. Duraimurugan and Laxminarayana (2014) observed that flubendiamide @ 48 g a.i. per ha and chlorantraniliprole @ 30 g a.i. per ha were very effective in suppressing the larval population of tobacco caterpillar. Significantly superior to emamectin benzoate and lufenuron (0.1 to 0.7 and 0.7 to
3.3 larvae per plant, respectively and untreated control 1.9 to 2.4 and 4.3 to 5.3 larvae/plant, respectively. Patra et al., (2015) [12] stated that Lambda cyhalothrin 4.9 CS was more effective than spinosad 48 SC @ 80 g a.i per ha along with an untreated check to control population of S. litura. Maruthi et al., (2017) [13] reported that the treatment with chlorantraniliprole 18.5 SC was effective by recording minimum larval population with lowest fruit damage over all other treatments. The next effective treatment was cyantraniliprole 10.26 OD. The order of moderate effective treatments were flubendiamide 480 SC, spinosad 45 SC, and indoxacarb 15.8 EC. Nayaka et al., (2018) [14] stated that flubendiamide 480 SC recorded the least larval population and it was significantly superior over other treatments. Indoxacarb 14.5 SC and spinosad 45 SC were found to be the next best treatments, which recorded 0.64 and 0.68 larvae per meter row length, respectively and were on par with each other. Flubendiamide 480 SC provided consistent protection from defoliation to a soybean crop from S. litura.

Table 1: Bioefficacy of different treatments against larval population of S. litura

<table>
<thead>
<tr>
<th>Tr. No.</th>
<th>Treatment</th>
<th>Pre count</th>
<th>1st spray</th>
<th>2nd spray</th>
<th>3rd spray</th>
<th>Pooled mean</th>
<th>Per cent efficacy over control</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Cyantraniliprole 10.26 OD</td>
<td>2.78 (1.81)*</td>
<td>1.19 (1.30)</td>
<td>0.46 (0.97)</td>
<td>0.25 (0.86)</td>
<td>0.63 (1.06)</td>
<td>91%</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Chlorantraniliprole 18.5 SC</td>
<td>2.50 (1.73)</td>
<td>1.27 (1.33)</td>
<td>0.68 (1.08)</td>
<td>0.46 (0.97)</td>
<td>0.80 (1.14)</td>
<td>87%</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>Lufenuron 50 EC</td>
<td>2.67 (1.78)</td>
<td>1.55 (1.43)</td>
<td>1.00 (1.22)</td>
<td>0.72 (1.10)</td>
<td>1.09 (1.26)</td>
<td>84%</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>Flubendiamide 39.35 SC</td>
<td>2.67 (1.78)</td>
<td>1.73 (1.49)</td>
<td>1.29 (1.34)</td>
<td>1.00 (1.23)</td>
<td>1.34 (1.35)</td>
<td>80%</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>Lambda cyhalothrin 5 EC</td>
<td>2.72 (1.80)</td>
<td>1.94 (1.56)</td>
<td>1.60 (1.45)</td>
<td>1.32 (1.34)</td>
<td>1.62 (1.45)</td>
<td>76%</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>Cyantraniliprole 45 SC</td>
<td>2.89 (1.84)</td>
<td>2.22 (1.64)</td>
<td>1.97 (1.57)</td>
<td>1.74 (1.49)</td>
<td>1.97 (1.57)</td>
<td>73%</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;</td>
<td>Indoxacarb 14.5 SC</td>
<td>2.83 (1.83)</td>
<td>2.93 (1.85)</td>
<td>3.28 (1.94)</td>
<td>3.45 (1.98)</td>
<td>3.22 (1.92)</td>
<td>54%</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt;</td>
<td>Untreated control</td>
<td>2.72 (1.80)</td>
<td>4.81 (2.32)</td>
<td>6.80 (2.70)</td>
<td>8.46 (2.99)</td>
<td>6.69 (2.68)</td>
<td>0%</td>
</tr>
</tbody>
</table>

*Figures in parenthesis are arc sin transformed values
NS- Non significant

Table 2: Bioefficacy of different treatments against per cent fruit damage due to S. litura

<table>
<thead>
<tr>
<th>Tr. No.</th>
<th>Treatment</th>
<th>Precinct (%)</th>
<th>1st spray</th>
<th>2nd spray</th>
<th>3rd spray</th>
<th>Mean</th>
<th>Per cent efficiency over control</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>Cyantraniliprole 10.26 OD</td>
<td>19.20 (20.59)*</td>
<td>10.72 (19.11)</td>
<td>11.78 (20.08)</td>
<td>11.55 (19.86)</td>
<td>11.35 (19.69)</td>
<td>47%</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Chlorantraniliprole 18.5 SC</td>
<td>18.68 (21.65)</td>
<td>11.63 (19.94)</td>
<td>12.77 (20.94)</td>
<td>12.52 (20.72)</td>
<td>12.31 (20.54)</td>
<td>40%</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>Lufenuron 50 EC</td>
<td>17.90 (22.94)</td>
<td>13.39 (21.46)</td>
<td>14.67 (22.52)</td>
<td>14.39 (22.29)</td>
<td>14.15 (22.10)</td>
<td>31%</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>Flubendiamide 39.35 SC</td>
<td>19.46 (24.63)</td>
<td>15.20 (22.95)</td>
<td>16.63 (24.06)</td>
<td>16.31 (23.82)</td>
<td>16.05 (23.62)</td>
<td>26%</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>Lambda cyhalothrin 5 EC</td>
<td>20.14 (26.21)</td>
<td>17.08 (24.41)</td>
<td>18.64 (25.58)</td>
<td>18.29 (25.32)</td>
<td>18.00 (25.11)</td>
<td>22%</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>Spinosad 45SC</td>
<td>23.10 (27.68)</td>
<td>19.85 (26.46)</td>
<td>21.61 (27.70)</td>
<td>21.37 (27.54)</td>
<td>20.94 (27.23)</td>
<td>19%</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;</td>
<td>Indoxacarb 14.5 SC</td>
<td>26.10 (31.59)</td>
<td>25.31 (30.21)</td>
<td>27.29 (31.49)</td>
<td>27.54 (31.65)</td>
<td>26.71 (31.12)</td>
<td>10%</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt;</td>
<td>Untreated control</td>
<td>31.48 (34.13)</td>
<td>33.41 (35.31)</td>
<td>35.29 (36.44)</td>
<td>36.34 (37.07)</td>
<td>35.01 (36.28)</td>
<td>0%</td>
</tr>
</tbody>
</table>

SE(m)± C.D at 5% NS 1.08 1.11 1.26 1.15 4.53

CV 16.41 15.27 10.49 13.67 13.14

*Figures in parenthesis are arc sin /percentage value
NS- Non significant

4. Conclusion
Studies on efficacy of insecticides against larval population of S. litura indicated that all the treatments were significantly superior over control. The treatment with cyantraniliprole was observed to be most promising over all treatments. The remaining treatments in order of efficacy were chlorantraniliprole > lufenuron > flubendiamide > lambda cyhalothrin > spinosad > indoxacarb. However, efficacy of insecticides against per cent fruit damage due to S. litura recorded that cyantraniliprole was most effective treatment among all treatment which was at par with chlorantraniliprole. Remaining treatments in order of efficacy were lufenuron > flubendiamide > lambda cyhalothrin > spinosad > indoxacarb.

5. Acknowledgement
Authors are thankful to the High Tech Floriculture & Vegetables Project and department of Entomology, College of Agriculture, Pune for providing the funds and facilities for conducting the present research work.

6. References


