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BIOEFFICACY OF NEWER INSECTICIDE MOLECULES AGAINST PEST COMPLEX OF CHILLI

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Abstract: A field experiment was conducted at Vegetable Research Centre, GPBU&T, Pantnagar during 2015 in a randomized block design with nine insecticidal treatments which were replicated three times and tested against thrips, aphids, whiteflys, cut worms and fruit borers. Among all the treatments, Fipronil 200 SC 250 mL/ha, was found to be the best treatment followed by Fipronil 200 SC 200 mL/ha, Fipronil 200 SC 150 mL/ha, Lamda cyhalothrin 5EC 300 mL/ha, Fipronil 5 SC 1000mL/ha, Imidacloprid 200SL 250 mL/ha, Lamda cyhalothrin 4.9% CS 15 g a.i./ha and Indoxacarb 14.5% SC60 g a.i/ha were found most effective against different pest compelex of chilli.
Keywords: Bioefficacy, Chilli, Thrips.
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INTRODUCTION

Chilli is one of the most important commercial crops grown in India and it is produce almost throughout the country. The worldwide area and production of chilli is around 15 Lakh ha and 70 Lakh tonne respectively. Important chilli producing nations are China, India, Pakistan, Indonesia, Turkey, and Sri Lanka in Asia. Nigeria, Tunisia, Ghana, and Egypt in Africa, Mexico, United States of America in North and Central America, Spain, Yugoslavia, Romania, Italy, Bulgaria, and Hungary in Europe and Peru, Argentina and Brazil in South America. India is a major producer, consumer, and exporter of the chilli. The total aggregate area and production of chilli in the nation is 775 thousand hectares and 1492 million tonnes production during 2014 (Anonymous, 2014a). The important states producing chilli in the country are Gujarat, Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Rajasthan, Tamilnadu, Uttar Pradesh and West Bengal. The area and production of chilli in Uttarakhand, is the tune of 7626 MT from the area of 2092 hectors. In terms of area and production in Uttarakhand may not be in the highest point of the chilli producing states in the country, but chilli of Uttarakhand has an special place owing to their colour, pungency and sharpness. The local district wise area and production under the chilli is 129 ha area produced 690 ton of chilli in Nainital district, 367 ha area produced 821 ton of chilli in Almora district and 215 ha, produced 1207 ton in Udham Singh Nagar_district. These are the major chilli growing regions of the state (Anonymous, 2014b).Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae is an important spice cum vegetable crop generally used as a part of human dietary. The plant is an herbaceous, annual have a basal or terminal gathering of leaves. The different factors are responsible for the low productivity and production of chilli includes unfavourable climate, low quality seeds, insect, mite pests and diseases. The insects and mites which are of prime importance which altogether significantly affects both the quality and

production of chilli. About 51 insect and 2 mite species, belonging to 27 families and 9 orders were infesting to chilli. Among these whitefly, *Bemisia tabaci Genn., thrips, Scirtothrips dorsalis Hood, jassid, Amrasca biguttula biguttula* (Ishida), aphid *Aphis gossypii* Glover, fruit borer *Helicoverpa armigra* (Hubner) and mites, *Polyphagotarsonemus latus* Banks are important pests contributing 60 to 75 % yield loss in chilli crop. In order to preventing the infestation of the insect pests and to produce a quality crop production, it is essential to manage the pest population at proper time with suitable and appropriate measures.

EXPERIMENTAL

First spraying of insecticides was done at 40 Days after transplanting if seedling (DAT) when uniform insect population was seen in all the treatments and the population came to ETL. In every plot, five plants were chosen at random leaving the outer border row and labelled before recording the field data. Three leaves, one each from top, central and bottom from each labelled plant were minutely watched for aphid, thrips, tobacco caterpillar and fruit borer population with the assistance of a magnifying glass (10x) at PTC (Pre-treatment count) and also 3,5, and 7 DAS (days after spraying).

Plot size : 5x5 m^2 (25sq.m)
Design :Randomized Block Design (RBD)
Replication : Three
Season : 2015
Variety : Pant C 1
Date : 6.10.2015
Spacing : 60x45cm
Date of Spray: 1ndspraying: 16. 11. 2015,
2nd spraying 01.12.2015
Date of Harvest: 10. 03. 2016

Table 1. Chemical treatments used against various insect pests of chilli

#	Treatment	Dose
1.	Control	---
2.	Fipronil 200 SC	150 mL/ha
3.	Fipronil 200 SC	200mL/ha
4.	Fipronil 200 SC	250 mL/ha
5.	Fipronil 5 SC	1000 mL/ha
6.	Lamda cyhalothrin 5EC	300 mL/ha
7.	Lamda cyhalothrin 4.9% CS	15 g a.i./ha
8.	Imidacloprid 200SL	250 mL/ha
9.	Indoxacarb 14.5% SC	60 g a.i/ha

RESULTS AND DISCUSSION

The different treatments used against chilli pests in open field condition *viz.,* Chemical intensive Fipronil 200 SC, Fipronil 5 SC, Lamda cyhalothrin 5EC, Lamda cyhalothrin 4.9% CS , Imidacloprid 200SL, Indoxacarb 14.5% SC were imposed sequentially at 15 days interval during 2015 . The results obtained are presented here.

Efficacy of New Molecules against chilli pest (2015) during First spraying observation

Thrips: Before 1st spraying pre observation of thrips maximum mean population was 6.80 of thrips /3 leaves in T8 (Imidacloprid 200SL 250 mL/ha), and mimimum was recorded 4.27 of thrips /3 leaves in T6 (Lamda cyhalothrin 5EC 300 mL/ha) And Three days after spraying maximum mean population of thrips was recorded 7.11 thrips/3 leaves in T1 (control), and minimum was 4.08 thrips/3 leaves in T4 (Fipronil 200 SC250 mL/ha) and T3 (Fipronil 200 SC200 mL/ha) 4.33 thrips/3 leaves, Than five days after spraying the maximum mean population of thrips was 8.82 thrips/plant observed in T1 (control), and minimum was recorded 3.07 thrips / 3 leaves in T4 (Fipronil 200 SC250 mL/ha) (Table 1) and After seven days of first spray among the different insecticide treatments, T4 (Fipronil 200 SC250 mL/ha) gave the best result in managing thrips populations 2.19 thrips/ 3 leaves followed by T3 (Fipronil 200 SC 200mL/ha) is 3.05thrips/3 leaves and T2 (Fipronil 200 SC 150mL/ha) 2.15 thrips/3 leaves. These findings are in agreement with the report of Nagaraj *et al.* and Sable *et al*. (2007). The results are conformity with that of Pandey 2013 who found the lowest mean thrips population in the plots treated with fipronil. Patil *et al., (*2002) reported imidacloprid 17.8 SL effective in suppressing the population of thrips confirm the present findings.

Aphids: There was no significant difference among the treatments on a day before first spray during kharif 2015.On the basis of mean population of aphid all the treatments including were found to be significantly superior over the untreated control in reducing the aphid population, however, considerable difference

was noticed between the different treatments (Table 1).

After 3 days of first spray significantly minimum population of aphid was noticed on the crop treated with Fipronil 200 SC 250mL/ha and Fipronil 200 SC 200mL/ha (5.08 and 5.32 aphid/3 leaves respectively) followed by Fipronil 200 SC 150mL/ha (5.54 aphid/3 leaves),Fipronil 5 SC 1000mL/ha (7.53 aphid/3 leaves), Lamda cyhalothrin 5EC 300 mL/ha (7.43 aphid/3 leaves) and Lamda cyhalothrin 4.9% CS 15 g a.i./ha (7.45 aphid/3 leaves). Application with Imidacloprid 200SL250 mL/ha (7.48 aphid/3 leaves) and Indoxacarb 14.5% SC60 g a.i/ha (8.04 aphid/3 leaves) was at par with each other for reduction of aphid population, as compare to control plot (9.48 aphid/ 3 leaves). After five days, the treatments population records of aphid demonstrate that the most effective treatment was Fipronil 200 SC 250 mL/ha and Fipronil 200 SC 200mL/ha with lowest aphid population of (3.80 and 4.12 aphid/ 3 leaves respectively). It was followed by Fipronil 200 SC 150mL/ha (4.17 aphid/ 3 leaves), Lamda cyhalothrin 5EC 300 mL/ha (5.12 aphid/3 leaves) and Fipronil 5 SC 1000mL/ha (5.90 aphid/3 leaves) compare to control (10.12 aphid/3 leaves). The post treatment data at seven days after spraying showed that Fipronil 200 SC 250mL/ha (2.11 aphid/ 3 leaves), Fipronil 200 SC 200mL/ha (2.75 aphid/ 3 leaves) and Fipronil 200 SC 150mL/ha (3.06 aphid/ 3 leaves) were the most effective treatments in reducing the aphid populations.The next best treatments were Fipronil 5 SC 1000mL/ha and Lamda cyhalothrin 4.9% CS 15 g a.i./ha (4.66 and 4.69 aphid/3 leaves respectively). Lamda cyhalothrin 5EC 300 mL/ha and Imidacloprid 200SL250 mL/ha are equally effective to reduce the aphid population (5.09 aphid/ 3 leaves). Indoxacarb 14.5% SC60 g a.i/ha treated plots had the highest aphid populations of 5.80 aphid/ 3 leaf. However, all the treatments were significantly superior than the control and statically at par with each other.

Whitefly: There was no significant difference among the treatments on a day before first spray during. Record of population data three days after the imposition of all the treatments on chilli crop demonstrated that the lowest population of whitefly was present in plots treated with Fipronil 200 SC 250mL/ha (7.52 whitefl/ 3 leaves), Fipronil 200 SC 200mL/ha(7.80 whitefly/ 3 leaves) and Fipronil 200 SC 150mL/ha (7.86 whitefly/ 3 leaves). These were followed by Lamda cyhalothrin 5EC 300 mL/ha. (8.01whitefly/3 leaves), Fipronil 5 SC 1000mL/ha (8.05 whitefly/3 leaves) and Lamda cyhalothrin 4.9% CS 15 g a.i./ha (8.06 whitefly/3 leaves) and these all treatments were at par with each other and also with the most effective dosages. Highest population was recorded with Indoxacarb 14.5% SC60 g a.i/ha (8.15 whitefly/3 leaves) and Imidacloprid 200SL250 mL/ha (8.21 whitefly/3 leaves). Five days after the insecticides application the results showed that all the treatments were significantly better than the control. The average lowest pest populations were recorded with Fipronil 200 SC 250mL/ha (5.53 whitefly/3 leaves) and Fipronil 200 SC 200mL/ha (5.85 whitefly/3 leaves) followed by Fipronil 200 SC 150mL/ha (6.23 whitefly/3 leaves). Imidacloprid 200SL250 mL/ha and Lamda cyhalothrin 5EC 300 mL/ha (8.01whitefly/3 leaves) are equally effective for reducing the whitefly population (6.53 whitefly/plant). Fipronil 5 SC 1000mL/ha (8.05 whitefly/3 leaves) and Lamda cyhalothrin 4.9% CS 15 g a.i./ha were statistically at par with each other, Untreated control had a population of (15.79 whitefly/3 leaves). The present result is conformity with that of (Singh *et al*., 2004) that found that imidacloprid 17.8 SL @ 250 mL/ha was most effective insecticide against whitefly. (Kumar *et al*., 2015) observed maximum reduction in sucking pest in the treatment of imidacloprid.

Fruit borers: Mean population of larvae of *H. armigera* (pre-spray, 3, 5 and 7 days after spray) and the results are represented in table 1. There was no significant difference between the larval populations before spray however; the difference was significant after the application of different treatments. Three days after the application of treatments lowest population (0.77 larvae/3 leaves) of helicoverpa was present in plots treated with Fipronil 200 SC 250mL/ha and it was significantly superior

to all the other treatments. Fipronil 200 SC 200mL/ha and Fipronil 200 SC 150mL/ha represented another lower population record (1.12 and 1.18 larvae/3 leaves respectively) followed by Lamda cyhalothrin 5EC 300 mL/ha (1.37 larvae/ 3 leaves) and Fipronil 5 SC 1000mL/ha and Lamda cyhalothrin 4.9% CS 15 g a.i./ha are equally effective (1.39 larvae/3 leaves). Plot treated with Imidacloprid 200SL250 mL/ha and Indoxacarb 14.5% SC60 g a.i/ha recorded (1.41 and 1.54 larvae/3 leaves).

Five days after the treatments population records of fruit borer demonstrate that the most effective treatment was equally effective Fipronil 200 SC 250mL/ha, Fipronil 200 SC 150mL/ha and Lamda cyhalothrin 5EC 300 mL/ha with lowest fruit borer population of (0.33 larvae/ 3 leaves). It was followed by Fipronil 200 SC 200mL/ha (0.37 larvae/ 3 leaves), Fipronil 5 SC 1000mL/ha (0.67 larvae/ 3 leaves) and Imidacloprid 200SL 250 mL/ha (0.77 larvae/3 leaves). Lamda cyhalothrin 4.9% CS 15 g a.i./ha and Indoxacarb 14.5% SC60 g a.i/ha are equally effective (1.00 larvae/ 3 leaves). Seven days past the imposition of insecticide treatments larval population was nil in plots treated with Fipronil 200 SC 250mL/ha and Fipronil 5 SC 1000mL/ha followed by Fipronil 200 SC 150mL/ha, Fipronil 200 SC 200mL/ha and Lamda cyhalothrin 4.9% CS 15 g a.i./ha are equally effective (0.33 larvae/ 3 leaves). Second lowest larval population was recorded in plot treatment with Imidacloprid 200SL250 mL/ha (0.34 larvae/ 3 leaves), Lamda cyhalothrin 5EC 300 mL/ha (0.74 larvae/ 3 leaves) and and Indoxacarb 14.5% SC60 g a.i/ha (1.00 larvae/ 3 leaves).

Cut worms: There was a significant difference in all the treatments of insecticides applied after three, five and seven days of spray. After three days of treatment application, again cut worm the Fipronil 200 SC 250mL/ha and Fipronil 5 SC 150 mL/ha represented the lowest population of *S. litura*. larvae (2.91 and 2.97 larvae/5 leaf/3 leaves). Second best treatment for reducing the larval populations was observed in crop treated with Fipronil 200 SC 200mL/ha (3.13 larvae/3 leaves) and Fipronil 5 SC 1000mL/ha (3.99 larvae/3 leaves) and it was also significantly superior as compared to other treatments. Lamda cyhalothrin 5EC 300 mL/ha (4.02 larvae/3 leaves), Imidacloprid 200SL 250 mL/ha (4.15 larvae/3 leaves), Indoxacarb 14.5% SC60 g a.i/ha (4.73 larvae/3 leaves) and Lamda cyhalothrin 4.9% CS 15g a.i./ha (4.95 larvae/ 3 leaves) were at par with each other. Higher number larval population (5.01 larvae/ 3 leaves) was noticed in the control plot. Five days after the treatment the most effective insecticides were observed to be Fipronil 200 SC 250mL/ha (1.00 larvae/3 leaves). These were followed by Fipronil 200 SC 200mL/ha (1.18 larvae/3 leaves) and Fipronil 200 SC 150mL/ha (1.68 larvae/3 leaf). Crop treated with Lamda cyhalothrin 5EC 300 mL/ha (1.88 larvae/ 3 leaves), Fipronil 5 SC 1000mL/ha (2.00 larvae/ 3 leaves), and Imidacloprid 200SL250 mL/ha (3.04 larvae/ 3 leaves) also reduces the second highest population of larvae. Indoxacarb 14.5% SC60 g a.i/ha (3.05 larvae/3 leaves) and Lamda cyhalothrin 4.9% CS (3.14 larvae/3 leaves) were at par with each other and reduce next higher larval population. However, all the treatments were significantly better in efficacy as compared to the untreated control and were statically at par with each other. Seven days after the application of Fipronil 200 SC 250mL/ha observed the most effective treatment (0.33 larvae/3 leaves) and it was significantly superior to all the other treatments. Plots treated with Fipronil 200 SC 200mL/ha, and Fipronil 200 SC 150mL/h are equally effective (0.67 larvae/ 3 leaf). Fipronil 5 SC 1000mL/ha and Lamda cyhalothrin 5EC 300 mL/ha are also equally reduced the larval population (0.68 larvae/3 leaves). Indoxacarb 14.5% SC60 g a.i/ha Imidacloprid 200SL250 mL/ha and cyhalothrin 4.9% CS 15 g a.i/ha represented another lower population record (0.69.1.00 and 2.50 larvae/3leaves respectively).

Second spraying Observation

Thrips: There was no significant difference among the treatments on a day before first spray during. Record of population data three days after the imposition of all the treatments on chilli crop demonstrated that the lowest

population of thrips was present in plots treated with Fipronil 200 SC 200mL/ha (3.17 thrips/ 3 leaves), Fipronil 200 SC 250mL/ha (3.32 thrips/3 leaves) and Fipronil 200 SC 150mL/ha (3.31 thrips/ 3 leaves). These were followed by *Lamda cyhalothrin* 5EC 300 mL/ha (4.09 thrips/ 3 leaves), Fipronil 5 SC 1000mL/ha (5.09 thrips/ 3 leaves) and Indoxacarb 14.5% SC60 g a.i/ha (5.14 thrips/ 3 leaves) and these all treatments were at par with each other and also with the most effective dosages. Highest population was recorded with Imidacloprid 200SL250 mL/ha (5.27 thrips/ 3 leaves) and Lamda cyhalothrin 4.9% CS (5.33 thrips/ 3 leaves) (Table 2). Five days after the insecticides application the results showed that all the treatments were significantly better than the control. The average lowest pest populations were recorded with Fipronil 200 SC 250mL/ha (2.90 thrips/ 3 leaves) and Fipronil 200 SC 200mL/ha (2.95 thrips/ 3 leaves) followed by Fipronil 200 SC 150mL/ha (3.10 thrips/3 leaves); Lamda cyhalothrin 5EC 300 mL/ha (3.44 thrips/3 leaves). Imidacloprid 200SL250 mL/ha (4.35 thrips/ 3 leaves) and Lamda cyhalothrin 4.9% CS (4.44 thrips/3 leaves) are the second highest reduction of thrips population. Fipronil 5 SC 1000mL/ha (4.58 thrips/ 3 leaves) and Indoxacarb 14.5% SC60 g a.i/ha (4.92 thrips/ 3 leaves) were statistically at par with each other, untreated control had a population of (9.33 thrips/ 3 leaves). Seven days after the treatment the most effective insecticides were observed to be Fipronil 200 SC 250mL/ha (2.06 thiprs/ 3 leaves). These were followed by Fipronil 200 SC 200mL/ha (2.28 thrips/ 3 leaves) and Fipronil 200 SC 150mL/ha (3.02 thrips/ 3 leaves). Crop treated with Lamda cyhalothrin 5EC 300 mL/ha (3.28 thrips/ 3 leaves), Fipronil 5 SC 1000mL/ha (5.28 thrip/ 3 leaves), and Imidacloprid 200SL250 mL/ha (3.89 thrips/ 3 leaves) also reduces the second highest population of thrips. Indoxacarb 14.5% SC60 g a.i/ha (4.21 thrips/ 3 leaves) and Lamda cyhalothrin 4.9% CS (4.22 thrips/ 3 leaves) were at par with each other and reduce next higher thrips population. However, all the treatments were significantly better in efficacy as compared to the untreated control and were statically at par with each other.

Aphids: Considerably lowest aphid population was noticed in the crop applied with Fipronil 200 SC 250mL/ha (3.40 aphid/ 3 leaves), Fipronil 200 SC 200mL/ha (3.45 aphid/ 3 leaves) and Fipronil 200 SC 150mL/ha (4.17 aphid/3 leaves) on the third day after spraying followed by the crop treated with Imidacloprid 200SL250 mL/ha (4.37 aphid/3 leaves), Lamda cyhalothrin 4.9% CS (4.57 aphid/3 leaves) and Fipronil 5 SC 1000mL/ha (5.07 aphid/3 leaves). Spraying with Indoxacarb 14.5% SC60 g a.i/ha (5.11 aphid/ 3 leaves) and Lamda cyhalothrin 5EC 300 mL/ha (5.26 aphid/ 3 leaves) reduced next higher number of aphid. Highest aphid population (9.07 aphid/3 leaves) was noticed in the control plot. Five days after the insecticides application the results showed that all the treatments were significantly better than the control. The average lowest pest populations were recorded with Fipronil 200 SC 250mL/ha (3.07 aphid/3 leaves) Fipronil 200 SC 200mL/ha (3.24 aphid/3 leaves) and Fipronil 200 SC 150mL/ha (4.07 aphid/3 leaves) followed by Lamda cyhalothrin 5EC 300 mL/ha (4.40 aphid/3 leaves), Lamda cyhalothrin 4.9% CS (4.47 aphid/3 leaves) and Imidacloprid 200SL250 mL/ha (4.50 aphid/3 leaves) nest higher number of aphid population was reduced in creop treated with Fipronil 5 SC 1000mL/ha (4.98 aphid/3 leaves) and Indoxacarb 14.5% SC60 g a.i/ha (5.01 aphid/3 leaves).While significantly higher population of aphid was observed in the control (9.13 aphid/ 3 leaves) plot. Fipronil 200 SC 250mL/ha (3.07 aphid/ 3 leaves) Fipronil 200 SC 200mL/ha (3.24 aphid/3 leaves) and Fipronil 200 SC 150mL/ha (4.07 aphid/3 leaves) reduced significantly more aphid population and were superior over all other treatments when mean of all the seven days of observation was considered. Lamda cyhalothrin 5EC 300 mL/ha (4.07 aphid/ 3 leaves) Fipronil 5 SC 1000mL/ha (4.17 aphid/ 3 leaves) Lamda cyhalothrin 4.9% CS (4.24 aphid/3 leaves) Imidacloprid 200SL250 mL/ha (4.31 aphid/ 3 leaves) and Indoxacarb 14.5% SC60 g a.i/ha (4.61 aphid/ 3 leaves) were at par with each other, while control recorded

highest aphid population number (10.02 aphid/ 3 leaves) (Table 2).

Whitefly: Treatment with Fipronil 200 SC 200mL/ha was superior in reducing higher whitefly population on third day after spraying (5.87whitefly/3 leaves). Next lowest whitefly population was recorded in the treatment with Fipronil 200 SC 250mL/ha (6.11 whitefly/3 leaves) and Fipronil 200 SC 150mL/ha (6.15 whitefly/3 leaves). Spraying with Lamda cyhalothrin 5EC 300 mL/ha (6.21 whitefly/3 leaves), Fipronil 5 SC 1000mL/ha (6.39 whitefly/ 3 leaves), Imidacloprid 200SL250 mL/ha (6.40 whitefly/ 3 leaves) and Indoxacarb 14.5% SC60 g a.i/ha (6.57 whitefly/3 leaves nt) were at par with each other followed by Lamda cyhalothrin 4.9% CS (6.69 whitefly/3 leaves). Significantly higher population was recorded in the control (13.33 whitefly/3 leaves). On five day after spraying Fipronil 200 SC 200mL/ha (5.50 whitefly/3 leaves) continued to be superior in reducing more whitefly population; followed by Fipronil 200 SC 250mL/ha (5.61 whitefly/ 3 leaves) and Fipronil 200 SC 150mL/ha (5.87 whitefly/ 3 leaves). Treatment with Lamda cyhalothrin 5EC 300 mL/ha (6.07 whitefly/ 3 leaves) Fipronil 5 SC 1000mL/ha (6.21 whitefly/ 3 leaves) and Imidacloprid 200SL250 mL/ha (6.30 whitefly/ 3 leaves) are next higher reducing of whitefly population. Followed by Indoxacarb 14.5% SC60 g a.i/ha (6.38 whitefly/3 leaves) and Lamda cyhalothrin 4.9% CS (6.58 whitefly/ 3 leaves). After seven days, the treatment the most effective insecticides were observed to be Fipronil 200 SC 250mL/ha and Fipronil 200 SC 200mL/ha were nil whitefly population was recorded. These were followed by Fipronil 200 SC 150mL/ha (0.75 whitefly/ 3 leaves) and Lamda cyhalothrin 5EC 300 mL/ha (0.87 whitefly/3 leaves).Crop treated with Fipronil 5 SC 1000mL/ha (1.26 whitefly/ 3 leaves), Lamda cyhalothrin 4.9% CS (1.45 whitefly/ 3 leaves). Imidacloprid 200SL 250 mL/ha (2.27 whitefly/ 3 leaves) and Indoxacarb 14.5% SC60 g a.i/ha (3.04 whitefly/ 3 leaves) also reduces the second highest population of whitefly. However, all the treatments were significantly better in efficacy as compared to the untreated control and were statically at par with each other.

Fruit borers: There was no significant difference between the larval populations before spray however; the difference was significant after the application of different treatments. Three days after the application of Fipronil 200 SC 200mL/ha observed the nil population of fruit borer and it was significantly superior to all the other treatments. The plots treated with Fipronil 200 SC 200mL/ha, and Lamda cyhalothrin 4.9% CS represented another lower population record (0.33 and 0.62 larvae/3 leaves respectively). Fipronil 200 SC 200mL/ha, and Fipronil 5 SC 1000mL/ha are equally effective to reduce larval population (0.63 larvae/3 leaves) Followed by Lamda cyhalothrin 5EC 300 mL/ha (0.83 larvae/ 3 leaves), Indoxacarb 14.5% SC60 g a.i/ha (0.93 and 1.54 larvae/ 3 leaves) and Imidacloprid 200SL250 mL/ha (1.00 and 1.54 larvae/ 3 leaves). Five days past the imposition of insecticide treatments larval population was also nil in plots treated with Fipronil 200 SC 250mL/ha. Followed by Fipronil 200 SC 150mL/ha, Fipronil 200 SC 200mL/ha are equally effective to reduce larval population (0.33 larvae/3 leaves). Second lowest larval population was recorded in plot treatment with Fipronil 5 SC 1000mL/ha (0.43 larvae/ 3 leaves), Lamda cyhalothrin 5EC 300 mL/ha (0.67 larvae/3 leaves), Lamda cyhalothrin 4.9% CS (0.70 larvae/3 leaves), Indoxacarb 14.5% SC60 g a.i/ha (0.72 larvae/ 3 leaves) and Imidacloprid 200SL250 mL/ha (0.78 larvae/3 leaves). While significantly higher population of whitefly was observed in the control (2.13 larvae/3 leaves) plot. Seven days after the treatments population records of fruit borer demonstrate that the most effective treatment was equally effective Fipronil 200 SC 250mL/ha, Fipronil 200 SC 150mL/ha and Fipronil 200 SC 200mL/ha with nil fruit borer population. It was followed by Fipronil 5 SC 1000mL/ha and Indoxacarb 14.5% SC60 g a.i/ha are also equally effective (0.33 larvae/ 3 leaves). Second lowest larval population was recorded in plot treatment with Lamda cyhalothrin 5EC 300 mL/ha (0.35 larvae/3 leaves), Lamda cyhalothrin 4.9% CS (0.40

larvae/ 3 leaves), Imidacloprid 200SL 250 mL/ha (0.67 larvae/ 3 leaves) (Table 2).

Cut worms: After three days of treatment application, again cut worm the Fipronil 200 SC 250mL/ha represented the lowest population of *S. litura*. larvae (0.34 larvae/ 3 leaves). Fallowed by Fipronil 200 SC 200mL/ha (0.68 larvae/5 leaf/3 leaves) and Fipronil 5 SC 150 mL/ha (082 larvae/3 leaves). Second best treatment for reducing the larval populations was observed in crop treated with Lamda cyhalothrin 5EC 300 mL/ha (0.87 larvae/ 3 leaves). Fipronil 5 SC 1000mL/ha and Indoxacarb 14.5% SC60 g a.i/ha are equally effective to reduce the larval population (1.00 larvae/3 leaves). Lamda cyhalothrin 4.9% CS 15 g a.i./ha (1.33 larvae/3 leaves) and Imidacloprid 200SL250 mL/ha (1.53 larvae/3 leaves) were at par with each other. Higher number larval population (4.21 larvae/3 leaves) was noticed in the control plot. Five days after the treatment the nil population of fruit borer was observed in crop treated with Fipronil 200 SC 250mL/ha and Fipronil 200 SC 200mL/ha. These were followed by Fipronil 200 SC 150mL/ha (0.34 larvae/3 leaves). Crop treated with Lamda cyhalothrin 5EC 300 mL/ha (0.40 larvae/3 leaves), Fipronil 5 SC 1000mL/ha (0.67 larvae/3 leaves), and Indoxacarb 14.5% SC60 g a.i/ha (0.73 larvae/ 3 leaves) also reduces the second highest population of larvae. Lamda cyhalothrin 4.9% CS 15 g a.i./ha (0.78 larvae/ 3 leaves) Imidacloprid 200SL250 mL/ha (1.00 larvae/ 3 leaves) were at par with each other and reduce next higher laral population. However, all the treatments were significantly better in efficacy as compared to the untreated control and were statically at par with each other. Same trend was observed on seven day after spraying were nil population of fruit borer was observed in crop treated with Fipronil 200 SC 250mL/ha, Fipronil 200 SC 200mL/ha, Fipronil 200 SC 150mL/ha and by Indoxacarb 14.5% SC60 g a.i/ha. followed by Fipronil 5 SC 1000mL/ha and Imidacloprid 200SL 250 mL/ha are equally effective to reduce the larval population (0.33 larvae/ 3 leaves). next higher reducing of larval population in crop treated with Lamda cyhalothrin 4.9% CS 15 g a.i./ha (0.35 larvae/ 3 leaves) and Imidacloprid 200SL250 mL/ha (0.43 larvae/ 3 leaves). Reddey et *al*., (2007) reported that fipronil 5 % SC was found to be best treatment followed by spinosad 45%SC against sucking pests of chilli also corroborate the present findings.

Table 2. Efficacy of newer molecules against chilli pest during kharif 2015

Figures in the parenthesis are √x+0.5 transformed values.

1st spraying		Pre observation					3 days after spraying observation					5days after spraying observation					7 days after spraying observation				
Treatment	Dosage (mL/g/ ha)	Thrips/ 3 leaves	Aphid/3 leaves	Whitefly/ 3 leaves	Fruit Borer/ 3 leaves	Cut Worm/3 leaves	Thrips/3 leaves	Aphid/3 leaves	Whitefly /3 leaves	Fruit Borer/3 leaves	Cut Worm/3 leaves	Thrips/3 leaves	Aphid/3 leaves	Whitefly/3 leaves	Fruit Borer/ 3 leaves	Cut Worm/3 leaves	Thrips/3 leaves	Aphid/3 leaves	Whitefly/ 3 leaves	Fruit Borer/ 3 leaves	Cut Worm/3 leaves
Control (T1)	---	6.20 (2.58)	8.16 (2.9)	12.37 (3.59)	2.21 (1.64)	4.04 (2.12)	7.11 (2.76)	9.49 (3.16)	14.16 (3.83)	3.08 (1.89)	5.01 (2.35)	8.82 (3.05)	10.12 (3.26)	15.79 (4.04)	1.77 (1.50)	5.34 (2.42)	9.61 (3.18)	8.35 (2.97)	12.96 (3.67)	1.4 (1.36)	4.22 (2.17)
Fipronil 200 SC(T2)	150 mL/ha	5.81 (2.50)	8.24 (2.9)	11.23 (3.42)	2.28 (1.66)	3.20 (1.92)	5.04 (2.35)	5.54 (2.46)	7.86 (2.89)	1.18 (1.29)	2.97 (1.86)	4.09 (2.14)	4.17 (2.16)	6.23 (2.59)	0.33 (0.88)	1.68 (1.47)	3.15 (1.91)	3.06 (1.89)	3.83 (2.08)	0.3 (0.88)	0.67 (1.05)
Fipronil 200 SC(T3)	200mL/ha	6.71 (2.69)	8.11 (2.9)	11.42 (3.45)	2.73 (1.79)	4.50 (2.23)	4.33 (2.20)	5.32 (2.41)	7.80 (2.88)	1.12 (1.27)	3.13 (1.90)	3.72 (2.05)	4.12 (2.15)	5.85 (2.52)	0.37 (0.89)	1.18 (1.29)	3.05 (1.88)	2.75 (1.80)	4.15 (2.15)	0.3 (0.88)	0.67 (1.05)
Fipronil 200 SC(T4)	250 mL/ha	5.94 (2.54)	8.27 (2.96)	11.63 (3.48)	2.40 (1.70)	4.57 (2.25)	4.08 (2.14)	5.08 (2.36)	7.52 (2.83)	0.77 (1.09)	2.91 (1.85)	3.07 (1.89)	3.80 (2.07)	5.53 (2.45)	0.33 (0.88)	1.00 (1.22)	2.19 (1.64)	2.11 (1.62)	2.76 (1.80)	0.0 (0.71)	0.33 (0.88)
Fipronil 5 SC (T5)	1000 mL/ha	6.30 (2.57)	8.11 (2.9)	10.97 (3.39)	1.74 (1.50)	4.89 (2.32)	6.01 (2.55)	7.53 (2.83)	8.05 (2.92)	1.39 (1.37)	3.99 (2.12)	5.93 (2.53)	5.90 (2.53)	7.12 (2.76)	0.67 (1.05)	2.00 (1.58)	5.04 (2.35)	4.66 (2.27)	4.26 (2.18)	0.0 (0.71)	0.68 (1.06)
Lamda cyhalothrin 5EC (T6)	300 mL/ha	4.27 (2.18)	8.61 (3.0)	11.37 (3.44)	2.95 (1.85)	4.84 (2.31)	5.48 2.44)	7.43 (2.81)	8.01 (2.91)	1.37 (1.37)	4.02 (2.13)	4.45 (2.22)	5.12 (2.37)	6.53 (2.65)	0.33 (0.88)	1.88 (1.54)	3.91 (2.10)	5.09 (2.36)	4.21 (2.17)	0.7 (1.08)	0.68 (1.06)
Lamda cyhalothrin 4.9% CS (T7)	15 g a.i./ha	6.68 (2.68)	8.53 (3.0)	10.43 (3.31)	2.83 (1.82)	5.30 (2.41)	6.08 (2.56)	7.45 (2.82)	8.06 (2.93)	1.39 (1.37)	4.95 (2.33)	5.93 (2.53)	7.12 (2.76)	7.40(2.81)	1.00 (1.17)	3.14 (1.90)	5.22 (2.39)	4.69 (2.26)	5.09 (2.36)	0.3 (0.88)	2.50 (1.73)
Imidacloprid 200SL (T8)	250 mL/ha	6.80 (2.70)	8.89 (3.0)	10.30 (3.29)	1.78 (1.51)	4.92 (2.33)	6.06 (2.56)	7.48 (2.82)	8.21 (2.95)	1.41 (1.38)	4.15 (2.15)	5.79(2.50)	6.19 (2.58)	6.53 (2.65)	0.77 (1.09)	3.04 (1.88)	5.60 (2.47)	5.09 (2.36)	4.35 (2.19)	0.3 (0.88)	1.00 (1.22)
Indoxacarb 14.5% SC	60 g a.i/ha	6.26 (2.60)	8.80 (3.0)	9.84 (3.21)	2.61 (1.76)	4.26 (2.16)	6.10 (2.57)	8.04 (2.92)	8.15 (2.94)	1.54 (1.43)	4.73 (2.29)	6.01 (2.55)	7.16 (2.77)	6.69 (2.68)	1.00 (1.22)	3.05 (1.88)	5.78 (2.50)	5.80 (2.51)	5.39 (2.43)	1.0 (1.22)	0.69 (1.06)
S.Em (±)		NS	NS	NS	NS	NS	0.06	0.07	0.04	0.07	0.06	0.08	0.06	0.06	0.15	0.05	0.05	0.09	0.07	0.14	0.15
CD (0.05)		0.36	0.12	0.22	0.26	0.30	0.18	0.21	0.12	0.23	0.18	0.24	0.18	0.19	0.45	0.17	0.15	0.27	0.23	0.41	0.45

Means followed by the same letter in a column do not differ significantly by DMRT (P= 0.05)

Table 3. Efficacy of Newer Molecules against Chilli pest during Kharif 2015

2nd spraying		Pre observation					3 days after spraying observation					5days after spraying observation					7 days after spraying observation				
Treatment	Dosage (mL/g/ ha)	Thrips/ 3 leaves	Aphid/ 3 leaves	Whitefly/ 3 leaves	Fruit Borer/ 3 leaves	Cut Worm/ 3 leaves	Thrips/ 3 leaves	Aphid/3 leaves	Whitefly/3 leaves	Fruit Borer/ 3 leaves	Cut Worm/ 3 leaves	Thrips/ 3 leaves	Aphid/ 3 leaves	Whitefly/ 3 leaves	Fruit Borer/3 leaves	Cut Worm/ 3 leaves	Thrips/ 3 leaves	Aphid/3 leaves	Whitefly/3 leaves	Fruit Borer/3 leaves	Cut Worm/3 leaves

Control(T1)	---	8.50 (3.00)	8.93 (3.07)	12.30 (3.55)	1.80 (1.51)	4.04 (2.13)	8.80 (3.05)	9.07 (3.09)	13.33 (3.72)	1.67 (1.47)	4.21 (2.17)	9.33 (3.13)	9.13 (3.10)	14.21 (3.84)	2.13 (1.62)	4.20 (2.17)	10.03 (3.25)	10.02 (3.24)	14.38 (3.86)	2.25 (1.66)	5.11 (2.37)
Fipronil 200 SC (T2)	150 mL/ha	5.82 (2.51)	4.72 (2.27)	6.72 (2.69)	1.07 (1.25)	1.31 (1.32)	3.31 (1.95)	4.17 (2.16)	6.15 (2.58)	0.63 (1.06)	0.82 (1.11)	3.10 (1.90)	4.07 (2.14)	5.87 (2.52)	0.33 (0.88)	0.34(0.88)	3.02 (1.88)	3.73 (2.06)	0.75 (1.09)	0.00 (0.71)	0.00 (0.71)
Fipronil 200 SC (T3)	200mL/ha	5.78 (2.49)	3.74 (2.05)	7.51 (2.83)	1.69 (1.48)	1.80 (1.48)	3.17 (1.91)	3.45 (1.99)	5.88 (2.52)	0.33 (0.91)	0.68 (1.06)	2.95 (1.86)	3.24 (1.93)	5.50 (2.45)	0.33 (0.88)	0.00(0.71)	2.28 (1.67)	3.06 (1.89)	0.00(0.71)	0.00 (0.71)	0.00 (0.71)
Fipronil 200 SC (T4)	250 mL/ha	5.55 (2.46)	3.55 (1.99)	6.48 (2.62)	0.74 (1.08)	1.00 (1.22)	3.22 (1.93)	3.40 (1.97)	6.11 (2.57)	0.00 (0.71)	0.34 (0.88)	2.90 (1.84)	3.07 (1.89)	5.61 (2.47)	0.00 (0.71)	0.00(0.71)	2.06 (1.60)	2.25 (1.66)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Fipronil 5 SC (T5)	1000 mL/ha	6.64 (2.67)	5.92 (2.51)	6.50 (2.64)	1.78 (1.50)	2.15 (1.63)	5.09 (2.36)	5.07 (2.36)	6.40 (2.62)	0.63 (1.06)	1.00 (1.22)	4.58 (2.25)	4.98 (2.34)	6.21 (2.59)	0.43 (0.92)	0.67(1.05)	3.28 (1.94)	4.17 (2.16)	1.26 (1.33)	0.33 (0.88)	0.33 (0.88)
Lamda cyhalothrin 5EC (T6)	300 mL/ha	6.22 (2.59)	5.63 (2.48)	6.26 (2.60)	1.23 (1.25)	2.55 (1.71)	4.09 (2.14)	5.26 (2.40)	6.22 (2.59)	0.83 (1.14)	0.87 (1.13)	3.44 (1.98)	4.40 (2.21)	6.07 (2.56)	0.67 (1.05)	0.40 (0.91)	3.10 (1.90)	4.07 (2.14)	0.87 (1.13)	0.35 (0.89)	0.33 (0.88)
Lamdacyhalothrin 4.9% CS (T7)	15 g a.i./ha	5.59 (2.46)	5.22 (2.36)	6.45 (2.59)	1.89 (1.54)	3.23 (1.89)	5.33 (2.41)	4.57 (2.25)	6.69 (2.68)	0.62 (0.98)	1.33 (1.35)	4.44 (2.22)	4.47 (2.23)	6.58 (2.66)	0.70 (1.09)	0.78 (1.09)	4.22 (2.17)	4.24 (2.18)	1.45 (1.39)	0.40 (0.91)	0.35 (0.89)
Imidacloprid 200SL (T8)	250 mL/ha	6.11 (2.57)	4.45 (2.15)	6.65 (2.67)	2.26 (1.66)	1.34 (1.35)	5.27 (2.40)	4.37 (2.20)	6.40 (2.63)	1.00 (1.22)	1.53 (1.42)	4.35 (2.20)	4.50 (2.23)	6.30 (2.61)	0.78 (1.10)	1.00 (1.22)	3.89 (2.09)	4.31 (2.19)	2.27 (1.66)	0.67 (1.05)	0.43 (0.92)
Indoxacarb 14.5% SC	60 g a.i/ha	5.31 (2.40)	5.78 (2.49)	7.66 (2.86)	2.04 (1.59)	2.14 (1.60)	5.14 (2.37)	5.11 (2.37)	6.58 (2.66)	0.93 (1.19)	1.00 (1.22)	4.92 (2.33)	5.01 (2.35)	6.38 (2.62)	0.72 (1.10)	0.73 (1.08)	4.21 (2.17)	4.61 (2.26)	3.04 (1.88)	0.33 (0.88)	0.00 (0.71)
S.Em (±)		NS	NS	NS	NS	NS	0.04	0.05	0.03	0.10	0.12	0.04	0.03	0.03	0.14	0.14	0.03	0.02	0.09	0.12	0.12
CD (0.05)		0.34	0.70	0.57	0.39	0.54	0.13	0.16	0.11	0.32	0.37	0.13	0.10	0.09	0.43	0.43	0.09	0.08	0.29	0.36	0.38

Means followed by the same letter in a column do not differ significantly by DMRT (P= 0.05)
Figures in the parenthesis are √x+0.5 transformed values.

Table 4. Effect of Newer Molecules on the Natural enemy, Fruit borer damage and yield of Chilli in 2015

Treatments	Dosage ML/g/ha ---	No. of coccinellids/plant				No. Pentatomid predator/plant				Fruit damage (%)	Green fruit yield (q/ha)	% yield increased over control
		1st spray		2nd spray		1st spray		2nd spray				
		3rd DAS	7DAS	3rd DAS	7th DAS	3rd DAS	7thDAS	3rd DAS	7th DAS			
Control(T1)	----	0.67 (1.05)	0.81 (1.11)	0.76 (1.09)	0.68 (1.06)	0.54 (1.00)	0.44 (0.94)	0.33 (0.88)	0.00 (0.71)	5.11	4.77	-----
Fipronil 200 SC (T2)	150 mL/ha	0.77 (1.09)	0.87 (1.13)	0.68 (1.06)	0.50 (0.98)	0.33 (0.88)	0.00 (0.71)	0.53 (0.99)	0.00 (0.71)	2.58	6.32	32.49
Fipronil 200 SC (T3)	200mL/ha	0.80 (1.10)	0.82 (1.11)	0.42 (0.93)	0.39 (0.91)	0.00 (0.71)	0.34 (0.88)	0.00 (0.71)	0.51 (0.98)	2.47	7.15	49.89
Fipronil 200 SC (T4)	250 mL/ha	0.71 (1.06)	0.83 (1.11)	0.52 (0.99)	0.69 (1.06)	0.33 (0.88)	0.00 (0.71)	0.67 (1.05)	0.00 (0.71)	2.33	7.95	66.66
Fipronil 5 SC (T5)	1000 mL/ha	0.87 (1.13)	0.75 (1.08)	0.50 (0.94)	0.34 (0.88)	0.00 (0.71)	0.20 (0.83)	0.00 (0.71)	0.33 (0.88)	2.83	5.86	22.85

Lamda cyhalothrin 5EC (T6)	300 mL/ha	0.64 (1.00)	0.43 (0.92)	0.68 (1.06)	0.68 (1.07)	0.35 (0.91)	0.00 (0.71)	0.47 (0.97)	0.17 (0.80)	3.04	6.15	28.93
Lamdacyhalothrin 4.9% CS (T7)	15 g a.i./ha	0.85 (1.12)	0.77 (1.09)	0.37 (0.90)	0.49 (0.97)	0.33 (0.88)	0.34 (0.88)	0.20 (0.82)	0.33 (0.88)	3.10	5.34	11.94
Imidacloprid 200SL (T8)	250 mL/ha	0.71 (1.06)	0.66 (1.05)	0.51 (0.98)	0.65 (1.07)	0.34 (0.88)	0.17 (0.80)	0.33 (0.88)	0.13 (0.79)	4.02	5.76	20.75
Indoxacarb 14.5% SC	60 g a.i/ha	0.73 (1.08)	0.61 (1.03)	0.51 (0.97)	0.56 (1.01)	0.17 (0.81)	0.20 (0.82)	0.00 (0.71)	0.00 (0.71)	4.03	5.72	19.91
S.Em (±)		NS	NS	NS	NS	NS	NS	NS	NS	0.22	49.38	--------
CD (0.05)		0.61	0.62	0.53	0.47	0.39	0.32	0.29	0.30	0.65	148.06	--------

Means followed by the same letter in a column do not differ significantly by DMRT (P= 0.05)

Figures in the parenthesis are √x+0.5 transformed values.

Effect of newer molecules on the natural enemy, fruit borer damage and yield of chilli in 2015

Total 5.11% fruit damage was significantly reduced in all treated plots as compared to untreated control plot. Among treated plots, it was markedly low in plot treated with Fipronil 200 SC 250 mL/ha (2.33%), followed by Fipronil 200 SC 200 mL/ha (2.47%), Fipronil 200 SC 150 mL/ha (2.58 %) and Fipronil 5 SC 1000mL/ha (2.83%). Second lowest fruit damage was recorded in plot treated with Lamda cyhalothrin 5EC 300 mL/ha (3.04%), Lamda cyhalothrin 4.9% CS 15 g a.i./ha (3.10 %), Imidacloprid 200SL250 mL/ha (4.02 %) and Indoxacarb 14.5% SC60 g a.i/ha (4.03%) (Table 3). The data presented in table and figures revealed that in all the plots treated with insecticides significantly higher fruit yield of chilli was obtained over untreated control. The maximum yield of chilli 7.95 q/ha was obtained in the plots treated with Fipronil 200 SC 250 mL/ha followed by Fipronil 200 SC 200 mL/ha (7.15 q/ha), Fipronil 200 SC 150 mL/ha (6.32 q/ha) and Lamda cyhalothrin 5EC 300 (6.15 q/ ha) and these were statistically at par. The minimum yield (5.34 q/ha) was obtained in the plots treated with Lamda cyhalothrin 4.9% CS 15 g a.i./ha followed by Indoxacarb 14.5% SC60 g a.i/ha (5.72q/ha), Imidacloprid 200SL250 mL/ha (5.76 q/ ha) and Fipronil 5 SC 1000mL/ha (5.86 q/ ha)

CONCLUSION

The bioefficacy of nine insecticides were evaluated against different pest in chilli crop in 2015 revealed that the treatment of Fipronil 200 SC250 ml/ha, followed by Fipronil 200 SC 200 ml/ha, Fipronil 200 SC 150 ml/ha, Lamda cyhalothrin 5EC 300 ml/ha, Fipronil 5 SC 1000ml/ha, Imidacloprid 200SL 250 ml/ha, Lamda cyhalothrin 4.9% CS 15 g a.i./ha and Indoxacarb 14.5% SC60 g a.i/ha were found most effective against different pest complex of chili.

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