Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(6): 1975-1977

Received: 18-09-2017
Accepted: 21-10-2017

Indhumathi VS
Ph.D scholar, Department of Entomology, Tamil Nadu Agricultural University, Coimbatore, TN, India

Durairaj C
Professor, Department of Entomology, Tamil Nadu Agricultural University, Coimbatore, TN, India

Nakkeeran S
Professor, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore, TN, India

Shanmugaprema M
Ph.D scholar, Department of Entomology, Tamil Nadu Agricultural University, Coimbatore, TN, India

Correspondence
Indhumathi VS
Ph.D scholar, Department of Entomology, Tamil Nadu Agricultural University, Coimbatore, TN, India

Safety of newer insecticide fipronil 200 SC to natural enemies in the chilli ecosystem of Tamil Nadu

Indhumathi VS, Durairaj C, Nakkeeran S and Shanmugaprema M

Abstract
A field experiment on chilli were conducted to study the effect of newer insecticide Fipronil 200 SC to natural enemies of chilli pests at Narasipuram and Mathampati villages of Coimbatore district, Tamil Nadu, India during 2013-2014. Three foliar applications were carried out at an interval of seven days after the pest population reached the economic threshold levels. The result revealed that the mean population of coccinellids was found to be more in the untreated checks followed by fipronil 200 SC at 30 and 40 g *a.i.* ha^{-1} in the first, second and third spray of foliar application. The lower dose of fipronil 200 SC at 30 g *a.i.* ha^{-1} recorded the mean population of coccinellids as 8.91/ten plants, which was next to the untreated check (11.90/ten plants) in both field trials. Taking into consideration the bioefficacy and safety aspects of chemical insecticides tested here, the present investigation has arrived at a result that fipronil 200 SC can be considered as a good option for including as a component in the management of chilli sucking pests. Even though immediate killing was not noticed in the case of fipronil, the insecticide was proved to be potent on subsequent days of insecticidal treatment and also found safe to the natural enemies.

Keywords: Fipronil 200 SC, Safety studies, Coccinellids, Chilli

Introduction
Chilli (*Capsicum annum Linnaeus*) is one of the important and commercial spice-cum vegetable crops of India and belongs to the family Solanaceae [1]. There is no spice probably as popular as chilli and no other spice has become such an indispensable ingredient of the daily food of majority people of the world [1]. It is grown for its pungent fruits, which are used both green and ripe (dried form) to impart pungency to the food. India is the largest producer of chilli in the world and contributes one fourth of world production with an area of 7.94 lakh ha^{-1}. The total production is around 1304.38 million tonnes with productivity of 1591 kg ha^{-1} [2]. India's share to world spice trade is around 45 to 50 per cent by volume and 25 to 30 per cent by value. India exported 1.69 lakh tonnes of dry chilli in 2011-2012 and the value of the export was 906.44 crore rupees [3].
Although, chilli has greater export potentialities besides huge domestic requirement, a number of limiting factors has been attributed for its low productivity. One among them, the pest complex that attack chilli at different crop stages. It includes aphids (*Myzus persicae* Sulzer), thrips, *Scirtothrips dorsalis* (Hood), mites, *Polyphagotarsonemus latus* (Banks) and fruit borers *viz.*, *Spodoptera litura* (Fabricus) and *Helicoverpa armigera* (Huber) [4] in Tamil Nadu responsible for considerable yield loss. The natural enemies, predators and parasitoids will impart the effect over the population of chilli pests under favourable conditions. The new formulation insecticide fipronil 200 SC was not evaluated against the major pests of chilli and their performance was not studied on the natural enemies of the chilli sucking pests and borers. Therefore, the present study was undertaken with the objective to investigate field toxicity of fipronil 200 SC and other insecticides against coccinellids on chilli ecosystem.

Materials and Methods
Field trials were conducted in farmers' holdings at two locations *viz.*, Narasipuram and Mathampati of Coimbatore district, Tamil Nadu, India during December 2013 to March 2014. It includes eight treatments with three concentrations of fipronil 200 SC, four standard checks and an untreated control. The trials were laid out in Randomized Block Design and replicated thrice in a plot size of 5m x 5m with two chilli varieties (Polystar in Narasipuram and Bullet

variety in Mathampati). The crop was maintained well by adopting standard agronomic practices as per the recommendations of Tamil Nadu Agricultural University, Coimbatore. Three rounds of spraying were given, starting from 50th day after planting and repeated at 7 days interval, using a hand operated high volume knapsack sprayer. Observations on the grubs and adults of coccinellids on number basis per plot from ten randomly selected plants were recorded at one day before and on 1, 3, 5 and 7 DAT after each spray.

Statistical Analysis

Data obtained from field experiment were subjected to ANOVA. Before analysis, data on population were subject to square root transformation. In order to assess the Interaction between treatments, the data were subjected to factorial RBD analysis and the treatment means obtained were separated by LSD (Least Significant Difference).

Results and Discussion

Population of coccinellids on insecticide treated and control plots for both the fields are given in Table 1 and 2. Before spray, observation on the coccinellid species in different treatments showed that the population ranged from 7.67 to 8.33 per ten plants and found that there was no significant variation.

Field experiment – I

The mean coccinellid population after first spray ranged from 4.04 to 7.36/ten plants in fipronil 80 WG at 50 g *a.i.* ha^{-1} and fipronil 200 SC at 30 g *a.i.* ha^{-1}, respectively. After second round of application at 3DAT, the highest mean coccinellid population per ten plants was observed in untreated control (8.20) followed by fipronil 200 SC at 30 and 40 g *a.i.* ha^{-1} (6.93 and 5.58 respectively). After third spray, the maximum mean population was noted in fipronil 200 SC at 30 g *a.i.* ha^{-1} (6.69/ten plants) and the minimum mean population was recorded in fipronil 200 SC at 50 g *a.i.* ha^{-1}(4.40/ten plants).

Field experiment – II

The mean coccinellid population prior to first spray ranged from 14.13 to 15.40/ten plants. After first round of spraying at 7 DAT, the untreated check recorded the maximum mean coccinellid population of 15.62/ ten plants followed by fipronil 200 SC at 30g *a.i.* ha^{-1} (11.29) and the minimum mean population/ten plants was recorded in imidacloprid 200 SL at 50 g *a.i.* ha^{-1} (7.60/ten plants). After second spray, fipronil 200 SC at 30 and 40 g *a.i.* ha^{-1} recorded mean population of 10.07 and 9.07 coccinellids per ten plants, respectively. After third round of spray, the highest mean population of coccinellids/ten plants was recorded in untreated plots (15.09) and the lowest mean population was documented in fipronil 200 SC at 50 g *a.i.* ha^{-1} (6.89).

The present findings are in agreement with Hamon *et al.* [5] who observed that fipronil at 64 g *a.i.* ha^{-1} and 75 g *a.i.* ha^{-1} showed selectivity towards *C. sanguinea*, *Scymnus* sp., *Geocoris*sp., *Nabis sp*., *Dorulineare* and spiders with moderate knockdown and low residual action for 3 days. Kaakeh and Bennett [6] observed that fipronil showed low toxicity to the convergent lady bird beetle but showed good selectivity towards the coccinellids *Cyclonedas anguinea* and *Scymnus sp* with no observable effect on 5 days after spraying. In peru, fipronil @ 50 g *a.i.* ha^{-1} was not toxic to *Scymnus sp.* but did cause knock- down of *Ceratocapsus disperses* and *Orius sp*. however, populations recovered 7 days after treatment Hamon *et al.* [5]. Patel and Das [7] reported that the coccinellid population was the highest in fipronil at 2ml l^{-1} and imidacloprid 17.8 SL at 0.4ml per 1 litre *i.e.*0.20 and 0.13 per plant, which was on par with untreated control with 0.33 per plant respectively in cotton. Similar kind of observation was made by Panda *et al.* [8] who concluded that fipronil 5 EC @ 0.075 and 0.05 kg *a.i* ha^{-1} caused a significant reduction in controlling rice pests and safety to spiders. Acharya *et al.* [9] suggested that imidacloprid (25 g a.i ha^{-1}) was relatively safer to predatory ladybird beetles. Rathod and Bapodra [10] also reported the moderate toxicity of imidacloprid to coccinellid predators.

Table 1: Safety of fipronil 200 SC to coccinellids in chilli at Narasipuram village, Coimbatore.

Treatments	No. of coccinellids/ten plants*										Pooled Mean	Reduction over Control (%)
	PTC	Post treatment count on										
		First spray			Second spray			Third spray				
		3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT		
Fipronil 200 SC @ 30 g *a.i.* ha^{-1}	8.07	6.93 (2.73)^{b}	7.40 (2.81)^{ab}	7.73 (2.87)^{a}	6.00 (2.55)^{b}	7.13 (2.76)^{b}	7.67 (2.86)^{ab}	6.07 (2.56)^{b}	6.80 (2.70)^{b}	7.20 (2.77)^{b}	6.99	14.61
Fipronil 200 SC @ 40 g *a.i.* ha^{-1}	7.93	5.60 (2.47)^{c}	6.00 (2.55)^{c}	6.67 (2.68)^{b}	5.33 (2.42)^{c}	5.47 (2.44)^{c}	5.93 (2.54)^{c}	5.20 (2.39)^{c}	5.33 (2.42)^{d}	5.80 (2.51)^{cd}	5.70	30.33
Fipronil 200 SC @ 50 g *a.i.* ha^{-1}	8.00	4.80 (2.30)^{d}	4.93 (2.33)^{d}	5.20 (2.39)^{d}	4.27 (2.18)^{e}	4.27 (2.18)^{e}	4.73 (2.29)^{d}	4.20 (2.17)^{e}	4.33 (2.20)^{e}	4.67 (2.27)^{e}	4.60	43.80
Fipronil 5 SC @ 50 g *a.i.* ha^{-1} (Standard check)	8.33	6.40 (2.63)^{b}	6.80 (2.70)^{b}	7.13 (2.76)^{ab}	6.00 (2.55)^{b}	7.07 (2.75)^{b}	7.20 (2.77)^{b}	5.93 (2.54)^{b}	6.07 (2.56)^{c}	6.20 (2.59)^{c}	6.54	20.20
Fipronil 80 WG @ 50 g *a.i.* ha^{-1} (Standard check)	7.87	3.33 (1.96)^{e}	3.93 (2.11)^{e}	4.87 (2.32)^{d}	4.33 (2.20)^{e}	4.33 (2.20)^{e}	4.73 (2.29)^{d}	4.13 (2.15)^{e}	4.40 (2.21)^{e}	4.73 (2.29)^{e}	4.31	47.51
Lambda Cyhalothrin 5 EC @ 15 g *a.i.* ha^{-1} (Standard check)	7.67	5.33 (2.42)^{cd}	5.93 (2.54)^{c}	6.20 (2.59)^{bc}	4.93 (2.33)^{cd}	5.13 (2.37)^{d}	6.13 (2.58)^{c}	4.80 (2.30)^{cd}	5.20 (2.39)^{d}	5.67 (2.48)^{cd}	5.48	35.89
Imidacloprid 200 SL @ 50 g *a.i.* ha^{-1} (Standard check)	8.13	5.00 (2.35)^{d}	5.13 (2.37)^{d}	5.33 (2.42)^{cd}	4.67 (2.27)^{de}	5.00 (2.35)^{d}	5.20 (2.39)^{d}	4.47 (2.23)^{de}	5.13 (2.37)^{d}	5.20 (2.39)^{de}	5.02	35.97
Untreated Control	7.53	7.60 (2.85)^{a}	7.87 (2.89)^{a}	8.00 (2.92)^{a}	8.07 (2.93)^{a}	8.20 (2.95)^{a}	8.33 (2.97)^{a}	8.20 (2.95)^{a}	8.67 (3.03)^{a}	9.00 (3.08)^{a}	8.21	-
S Ed	-	0.0538	0.0712	0.0915	0.0583	0.0445	0.0657	0.0451	0.0617	0.0800	-	
CD (p = 0.05)	NS	0.1154	0.1527	0.1964	0.1250	0.0955	0.1410	0.0968	0.1324	0.1715	-	

* Mean of three replications, PTC- Pretreatment count, DAT- Day(s) after treatment

Figures in parentheses are square root transformed values

In a column, means followed by a common letter (s) are not significantly different by LSD (p = 0.05)

Table 2: Safety of fipronil 200 SC to coccinellids in chilli at Mathampati village, Coimbatore

Treatments	No. of coccinellids/ten plants*									Pooled mean	Reduction over Control (%)
	PTC	Post treatment count on									
		First spray			Second spray			Third spray			
		3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT	
Fipronil 200 SC @ 30 g *a.i.* ha^{-1}	14.93	10.67 (3.34)^{b}	11.13 (3.41)^{b}	12.07 (3.54)^{b}	9.33 (3.14)^{b}	10.13 (3.26)^{b}	10.73 (3.35)^{b}	8.67 (3.03)^{b}	9.47 (3.16)^{b}	9.87 (3.22)^{b}	10.23	34.44
Fipronil 200 SC @ 40 g *a.i.* ha^{-1}	14.13	9.13 (3.10)^{c}	9.47 (3.16)^{c}	9.80 (3.21)^{c}	8.13 (2.94)^{cd}	9.33 (3.14)^{bc}	9.73 (3.20)^{c}	7.47 (2.82)^{c}	8.00 (2.92)^{c}	9.07 (3.09)^{c}	8.91	42.95
Fipronil 200 SC @ 50 g *a.i.* ha^{-1}	14.53	8.33 (2.97)^{d}	9.27 (3.13)^{c}	9.60 (3.18)^{c}	7.67 (2.86)^{de}	8.00 (2.92)^{d}	8.33 (2.97)^{de}	6.33 (2.61)^{d}	7.00 (2.74)^{e}	7.33 (2.80)^{de}	7.99	48.86
Fipronil 5 SC @ 50 g *a.i.* ha^{-1} (Standard check)	15.27	8.80 (3.05)^{cd}	9.40 (3.15)^{c}	9.73 (3.20)^{c}	8.47 (2.99)^{c}	8.93 (3.07)^{c}	9.07 (3.09)^{cd}	7.47 (2.82)^{c}	7.73 (2.87)^{cd}	8.07 (2.93)^{d}	8.63	44.72
Fipronil 80 WG @ 50 g *a.i.* ha^{-1} (Standard check)	15.00	7.27 (2.79)^{e}	7.73 (2.87)^{e}	7.80 (2.88)^{e}	7.13 (2.76)^{e}	7.73 (2.87)^{d}	8.13 (2.94)^{e}	6.47 (2.64)^{d}	6.87 (2.71)^{e}	7.20 (2.77)^{e}	7.37	52.78
Lambda Cyhalothrin 5 EC @ 15 g *a.i.* ha^{-1} (Standard check)	14.73	8.53 (3.01)^{cd}	8.87 (3.06)^{cd}	9.20 (3.11)^{cd}	8.00 (2.92)^{cd}	8.53 (3.01)^{cd}	8.47 (2.99)^{de}	7.00 (2.74)^{cd}	7.20 (2.77)^{de}	7.73 (2.87)^{de}	8.17	47.66
Imidacloprid 200 SL @ 50 g *a.i.* ha^{-1} (Standard check)	15.40	8.27 (2.96)^{d}	8.33 (2.97)^{d}	8.33 (2.97)^{de}	7.60 (2.85)^{de}	7.93 (2.90)^{d}	8.00 (2.92)^{e}	6.93 (2.73)^{cd}	6.93 (2.73)^{e}	7.13 (2.76)^{e}	7.72	50.55
Untreated Control	14.33	15.07 (3.95)^{a}	15.73 (4.03)^{a}	16.07 (4.07)^{a}	15.73 (4.03)^{a}	16.07 (4.07)^{a}	16.47 (4.12)^{a}	14.40 (3.86)^{a}	15.07 (3.95)^{a}	15.80 (4.04)^{a}	15.60	-
S Ed	-	0.0449	0.0499	0.0674	0.0492	0.0617	0.0609	0.0768	0.0601	0.0628		-
CD (p = 0.05)	-	0.0964	0.1070	0.1447	0.1055	0.1323	0.1307	0.1647	0.1290	0.1348		-

* Mean of three replications, PTC- Pretreatment count, DAT- Day(s) after treatment
Figures in parentheses are square root transformed value s.
In a column, means followed by a common letter(s) are not significantly different by LSD (p = 0.05)

Conclusion

Indiscriminate use of insecticides, resistance development by insects and ill effects posed on environment, have opened the new era of chemicals safer to environment and having novel mode of action with higher bioefficacy against target insects. One of these new molecules of insecticides is fipronil belongs to the group, phenylpyrazole, which is very effective at very low doses. This novel group showed increased efficacy against sucking pests and lepidopteran caterpillars and relatively safe to non-target organisms. In the present investigation, fipronil 200 SC was found to be the most effective chemical than the other standard checks against sucking pests without significantly affecting the natural enemies in the chilli ecosystem. Hence, it is imperative therefore, to develop appropriate insecticide management strategies to contain the pest with protection of predators as well as the environment.

Acknowledgement

The authors express sincere thanks to Department of Entomology, Tamil Nadu Agricultural University and Bayer Crop Science Pvt Ltd., for providing financial assist during the course of investigations.

References

1. Parvathi S, Yurnus AHJ. Chilli an economically profitable crop of Malaysia, Spice India. 2000; 13(7):18-19.
2. Anonymous. Available technologies to raise yield of spices. Survey Indian Agriculture, The Hindu Yearbook, 2006, 82-86.
3. Anonymous. 2012-2013. www.indiastat.com
4. Berke T, Shieh SC. Chilli peppers in Asia, Capsicum and Egg plant Newsletter. 2000; 19:38- 41.
5. Hamon NM, Gamboa H, Garcia JEM. Fipronil: a major advance for the control of boll weevil in Columbia. In: Herzog, G.A., Ireland, C.S and Nelms, J.V (eds.) Proceeding Beltwide Cotton Conferences USA. 1996, Nasville, TN. 1996; 2:990-994.
6. Kaakeh NW, Bennett GW. Topical toxicity of imidacloprid, fipronil and seven conventional lady beetle (Coleoptera: Coccinellidae). Journal of Entomological Science. 1996; 31(3):315-322.
7. Patel Y, Das SB. Effect of insecticides on population of *Cocceinella Septumpuctata* and *Chrysoperla zastrowi* in cotton field. Annals of plant protection sciences. 2010; 18:362-365.
8. Panda Sk, Nayak S, Behera VK. Bio-efficacy of fipronil 0.4G against insect pests of rice. Oryza. 2004; 41(1,2):32-34.
9. Acharya S, Mishra HP, Dash D. Efficacy of insecticides against okra jassid, *Amrasca biguttula biguttula* (Ishida). Annals of plant protection sciences. 2002; 10(2):230-232.
10. Rathod RR, Bapodra JG. Relative toxicity of various insecticides to coccinellid predators in cotton. Indian Journal of Plant Protection. 2002; 30(1):29-31.