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Non-target Effect of Ethiprole 10 SC to Predators of Rice Planthoppers

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Studies were conducted to evaluate the safety of ethiprole 10 SC to predators of rice planthoppers in Tamil Nadu Agricultural University, Coimbatore. Ethiprole 10 SC at three doses along with imidacloprid 200 SL, thiamethoxam 25 WG and acephate 76 SP were tested in field condition for its effect on non-target organisms *viz.,* insect predators, *Cyrtorrhinus lividipennis* and *Paederus fuscipes* found in rice ecosystem. Ethiprole 10 SC at 25 g a.i. ha^{-1} was found to be the least toxic to *C. lividipennis* and recorded relatively more predators in treated plots. Acephate 76 SP at 468.75 g a.i. ha^{-1} and ethiprole 10 SC at higher dose of 50 g a.i. ha^{-1} were more toxic to *C. lividipennis* and *P. fuscipes*. Thiamethoxam 25 WG at 25 g a.i. ha^{-1} and ethiprole 10 SC at 37.5 g a.i. ha^{-1} were at par with regard to toxicity. Among the treatments tried, imidacloprid 200 SL at 25 g a.i. ha^{-1} was relatively least toxic to *C. lividipennis* and *P. fuscipes.* All the treatments registered their effect on predators up to 10th day of insecticide application.

Key words: Ethiprole, *Cyrtorrhinus lividipennis, Paederus fuscipes*

Insecticides are an integral part of agriculture and the first line security option when the insect population crosses economic threshold level. These insecticides protect the crop from pests with resultant increased productivity of various crops. Intensive and excessive use of insecticides, however, has caused several problems *viz.,* development of insecticide resistance in insect pests, environmental pollution and side effects on non-organisms including the natural enemies of target pests (Kiritiani, 1979). As the earlier used organo phosphorous, carbamate and synthetic pyrethroids were highly risk associated and caused resistance and resurgence problems, many of the pesticide industries develop insecticides that are effective even at low doses, besides effective to pests. Because of much reduced dosage and increased dissipation, these insecticides leave minimum residues and render lesser environmental problems. Furthermore, use of selective insecticides that are less toxic to natural enemies than pests will conserve natural enemy population and the surviving natural enemies might suppress the pest populations, which in turn will reduce the rate of insecticide application.

The recent novel insecticides are highly efficacious and remain in plant to defy the pests, thereby delaying the pest buildup. Ethiprole is one such insecticide being used to protect the rice crop from brown planthoppers, green leaf hoppers and white backed planthoppers. This insecticidal pyrazole compound acts on the GABA (gamma-amino-butyric acid) receptors of insects by blocking the passage of chloride ions, thereby causing disruption of the central nervous system (Cole *et al*. 1993). The mode of action of pyrazoles is similar to cyclodienes, and in general pyrazoles are highly specific to insects and are considered to have low toxicity against mammals (Arthur, 2002). Though there is more research on efficacy of this new insecticide on various pests, information on its effect on natural enemies found in crop ecosystem is scanty. In rice ecosystem, *Lycosa pseudoannulata, Cyrtorrhinus lividipennis* and *Paederus fuscipes*

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are the major predators of plant hoppers and are effective and found to control rice leaf hoppers, planthoppers and leaf folders. Among the predators, spiders are more predominant and are effective in reducing rice pests (Teramoto and Nagasuka, 1994). There are more reports regarding toxicity of various insecticides to spiders, hence the present investigation was confined to other two predators. These predators are effective and can spare the insecticides in management of insect pests, so the use of selective insecticides that will not harm them is essential. Hence, the present research was carried out to elucidate information on selectivity of ethiprole to insect predators of rice ecosystem.

Materials and Methods

Two season field experiments were conducted at Coimbatore district of Tamil Nadu to evaluate the effect of ethiprole 10 SC to *C. lividipennis* and *P. fuscipes* of rice. The experiments were carried out with the var. ADT 43 in plots of 5 ´ 4 m size in a randomized block design (RBD).

In this experiment six treatments were tested *viz.,* ethiprole 10 SC at 25, 37.5 and 50 g a.i. ha^{-1}, imidacloprid 200 SL at 25 g a.i. ha^{-1}, thiamethoxam 25 WG at 25 g a.i. ha^{-1} and acephate 76 SP at 468.75 g a.i. ha^{-1}, they were replicated four times. The insecticides selected for test have been applied to control rice planthoppers and leaf hoppers. Three standard insecticides apart from ethiprole were tested to compare the detrimental effect of ethiprole on predators. All the treatments were imposed two times at active tillering stage in both the seasons at 14 days interval with pneumatic knapsack sprayer. Applications were made during morning hours to avoid photooxidation of the insecticides. Observation on the populations of *C. lividipennis* and *P. fuscipes* was recorded in ten randomly selected hills per plot before and 7 and 14 days after application. Analysis of variance was carried out by randomized block design using IRRISTAT. The data obtained were transformed to corresponding values by using square root transformation. The mean values of treatments were then separated using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Data collected regarding impact of insecticides on *C. lividipennis* and *P. fuscipes* are presented in Table 1 and 2. Irrespective of the test doses, ethiprole 10 SC reduced the natural enemies in both the seasons. Imidacloprid 200 SL, thiamethoxam 25 WG and acephate 76 SP also recorded lesser *C. lividipennis* and *P. fuscipes*, when compared to populations recorded in plots which received no insecticide spray.

C. lividipennis

Of the predatory arthropods tested, *C. lividipennis* were abundant in field. There was no significant difference in number of *C. lividipennis* in experimental plots. Among the ethiprole treatments, ethiprole 10 SC at 25 g a.i. ha^{-1} recorded the highest (Table.1)

C. lividipennis population of 2.30 and 1.53 per ten hills after 14 days of first and second round of application respectively. Ethiprole 10 SC at 37.5 and 50 g a.i. ha^{-1} recorded 2.00 and 1.33; 2.03 and 0.67 per ten hills respectively after first and second round of application. Among the standards tested, acephate 76 SP at 468.75 g a.i. ha^{-1} was found highly toxic to *C. lividipennis*, which recorded significantly lesser number of *C. lividipennis*. This result is in line with the result of Somchoudhury *et al*., (2007), who reported 51 per cent reduction of *C. lividipennis* due to acephate application and 15 per cent due to ethiprole application, but it is obvious that the agrochemicals will reduce

C. lividipennis in rice field (Chen *et al*., 2008). Imidacloprid 200 SL at 25 g a.i. ha^{-1} and thiamethoxam 25 WG at 25 g a.i. ha^{-1} also reduced the *C. lividipennis* population and were at par with ethiprole at 37.5 g a.i. ha^{-1}. This finding corroborated with the result of Tanaka *et al*., (2000) and Widiarta *et al*., (2001), who reported that imidacloprid was toxic to *C. lividipennis.* The trend was similar in second experiment also, where ethiprole 10 SC at 25 g a.i. ha^{-1} registered significantly higher *C. lividipennis* and acephate 76 SP at 468.75 g a.i. ha^{-1} was highly toxic to *C. lividipennis*. Order of treatments regarding their toxicity was; acephate 468.75 g a.i. ha^{-1} > thiamethoxam 25 g a.i. ha^{-1} > ethiprole 50 g a.i. ha^{-1} > imidacloprid 25 g a.i. ha^{-1} = ethiprole 37.5 g a.i. ha^{-1} > ethiprole 25 g a.i. ha^{-1}.

In the treatments tried, population of *C. lividipennis* was lower than the pretreatment population. Population was gradually reduced up to 10 days of observation with highest reduction at 10th day after insecticide application. There was a modest increase in population at 14 days after insecticide application, which reveals that the insecticides showed its toxicity up to 10 days of application. Irrespective of the doses tested, the treatments showed reduction in *C. lividipennis* population, which indicated that all the insecticides were detrimental to *C. lividipennis*.

P. fuscipes

Population of *P. fuscipes* was low in all the plots, but was uniform before commencement of insecticide application. Pretreatment population of *P. fuscipes* ranged from 1.00 to 2.33 per ten hills in both the seasons. After first round of application all the treatments recorded reduction of *P. fuscipes*, and were on par with each other. After second round of application, ethiprole 10 SC at 50 g a.i. ha^{-1} and imidacloprid 200 SL at 25 g a.i. ha^{-1} wiped out *P. fuscipes*, the other two concentration of ethiprole 10 SC, thiamethoxam 25 WG at 25 g a.i. ha^{-1} and acephate 76 SP at 468.75 g a.i. ha^{-1} were on par with each other (Table. 2).

In the second experiment, ethiprole 10 SC at 50 and 37.5 g a.i. ha^{-1} recorded 0.50 and 0.33 *P. fuscipes* after 14 days of first and second round of application respectively. Imidacloprid 200 SL at 25 g a.i. ha^{-1}, thiamethoxam 25 WG at 25 g a.i. ha^{-1} and acephate 76 SP at 468.75 g

Table 1. Effect of ethiprole 10 SC on mirid bug, *Cyrtorrhinus lividipennis* in rice ecosystem

Treatment	Mirid bug (No./ 10 Hills)									
	Experiment I					Experiment II				
	PTC	First spray		Second spray		PTC	First spray		Second spray	
		7 DAS	14 DAS	7 DAS	14 DAS		7 DAS	14 DAS	7 DAS	14 DAS
Untreated check	4.00	3.63 (2.02)a	6.93 (2.71)a	8.17 (2.94)a	7.53 (2.83)a	4.07	4.17 (2.16)a	3.83 (2.08)a	5.20 (2.38)a	5.63 (2.47)a
Ethiprole 10 SC @ 25 g a.i. ha^{-1}	4.33	2.20 (1.64)b	2.30 (1.67)b	1.17 (1.29)bc	1.53 (1.42)b	4.90	2.93 (1.85)b	3.70 (2.05)a	3.63 (2.03)b	3.80 (2.07)b
Ethiprole 10 SC @ 3 7.5 g a.i. ha^{-1}	4.23	1.80 (1.51)bc	2.00 (1.57)bc	1.67 (1.47)b	1.33 (1.35)b	4.83	2.13 (1.62)bc	3.57 (2.01)a	3.57 (2.01)bc	3.63 (2.02)b
Ethiprole 10 SC @ 50 g a.i. ha^{-1}	4.00	1.76 (1.50)bc	2.03 (1.58)bc	1.47 (1.40)b	0.67 (1.08)c	4.07	2.20 (1.64)bc	3.80 (2.07)a	2.50 (1.73)cd	3.57 (2.01)b
Imidacloprid 200 SL @ 25 g a.i. ha^{-1}	4.00	1.90 (1.54)bc	2.00 (1.57)bc	1.37 (1.37)b	1.43 (1.39)b	4.37	1.97 (1.57)c	3.73 (2.05)a	2.47 (1.72)d	3.63 (2.03)b
Thiamethoxam 25 WG @ 25 g a.i. ha^{-1}	3.67	1.63 (1.46)c	2.16 (1.62)bc	1.67 (1.47)b	1.33 (1.35)b	4.47	2.00 (1.58)c	3.57 (2.02)a	2.53 (1.74)cd	3.00 1.87)b
Acephate 76 SP @ 468.75 g a.i. ha^{-1}	3.67	1.60 (1.44)c	1.70 (1.48)c	0.67 (1.08)c	1.13 (1.27)bc	4.63	1.83 (1.52)c	3.57 (2.01)a	2.20 (1.64)d	2.63 (1.76)b

* Mean of ten observations, DAS-Days after spray, Values in parentheses are $\sqrt{x+0.5}$ transformed values, In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

Table 2. Effect of ethiprole 10 SC on rove beetle, *Paederus fuscipes* in rice ecosystem

Treatment	Rove beetle (No./10 Hills)									
	Experiment I					Experiment II				
	PTC	First spray		Second spray		PTC	First spray		Second spray	
		7 DAS	14 DAS	7 DAS	14 DAS		7 DAS	14 DAS	7 DAS	14 DAS
Untreated check	1.66	1.10 (1.26)ᵃ	1.03 (1.23)ᵃ	1.47 (1.40)ᵃ	1.13 (1.27)ᵃ	2.03	2.00 (1.57)ᵃ	1.60 (1.45)ᵃ	0.53 (1.01)ᵃ	0.47 (0.98)ᵃ
Ethiprole 10 SC @ 25 g a.i. ha^{-1}	1.00	0.40 (0.94)ᵇ	0.26 (0.87)ᵇ	0.23 (0.85)ᵇᶜ	0.23 (0.85)ᵇ	2.17	0.37 (0.93)ᵇ	0.63 (1.06)ᵇ	0.47 (0.98)ᵃ	0.33 (0.91)ᵇ
Ethiprole 10 SC @ 37.5 g a.i. ha^{-1}	1.33	0.36 (0.93)ᵇ	0.36 (0.92)ᵇ	0.27 (0.88)ᵇ	0.20 (0.84)ᵇ	2.33	0.37 (0.93)ᵇ	0.50 (1.00)ᵇ	0.47 (0.98)ᵃ	0.33 (0.91)ᵇ
Ethiprole 10 SC @ 50 g a.i. ha^{-1}	1.66	0.23 (0.85)ᵇ	0.33 (0.91)ᵇ	0.17 (0.82)ᵇᶜ	0.00 (0.71)ᶜ	2.23	0.23 (0.86)ᵇ	0.50 (1.00)ᵇ	0.33 (0.91)ᵇ	0.33 (0.91)ᵇ
Imidacloprid 200 SL @ 25 g a.i. ha^{-1}	1.33	0.26 (0.87)ᵇ	0.33 (0.91)ᵇ	0.20 (0.84)ᵇᶜ	0.00 (0.71)ᶜ	2.07	0.23 (0.85)ᵇ	0.63 (1.06)ᵇ	0.33 (0.91)ᵇ	0.40 (0.95)ᵃᵇ
Thiamethoxam 25 WG @ 25 g a.i. ha^{-1}	1.33	0.23 (0.85)ᵇ	0.33 (0.91)ᵇ	0.13 (0.79)ᶜ	0.13 (0.79)ᵇ	1.97	0.23 (0.85)ᵇ	0.63 (1.06)ᵇ	0.33 (0.91)ᵇ	0.37 (0.93)ᵃᵇ
Acephate 76 SP @ 468.75 g a.i. ha^{-1}	1.33	0.26 (0.87)ᵇ	0.26 (0.87)ᵇ	0.17 (0.82)ᵇᶜ	0.23 (0.85)ᵇ	2.03	0.23 (0.85)ᵇ	0.47 (0.98)ᵇ	0.27 (0.88)ᵇ	0.33 (0.91)ᵇ

* Mean of ten observations, DAS-Days after spray, Values in parentheses are $\sqrt{x+0.5}$ transformed values, In a column means followed by a common letter are not significantly different by DMRT (P=0.05)

a.i. ha^{-1} recorded 0.63 and 0.40; 0.63 and 0.37 and 0.47 and 0.33 *P. fuscipes* per ten hills after first and second round of application respectively. After second round of application all the treatments including untreated check were at par with each other. Since, the population was low even before the application of insecticides, all the treatments were not significantly different with one another. Like *C. lividipennis*, in this case also, gradual population reduction was noticed up to ten days of insecticide application, slow but increase of population was also noticed at 14th day after treatment. Record on effect of insecticides on *P. fuscipes* is scarce all over the world, but there is a report from China, where effect of four insecticides was tested. Report indicated that, *P. fuscipes* was the most sensitive to chlorpyriphos, deltamethrin followed by imidacloprid (Yu and Fake, 2006).

In present experiment, all the insecticide treatments exhibited their influence on *C. lividipennis* and *P. fuscipes*. These predators might be exposed to insecticides by several routes *viz*., direct uptake after exposure, uptake of residues by contact with contaminated surface of vegetation and oral uptake by feeding on contaminated prey. Since, the insecticides may express the same effect on predators, which they exert on pests; mortality of predators due to insecticides is unavoidable in modern agriculture. But, in this experiment relatively more number of predators were recorded, when they were treated with lower doses of insecticides. So, the selection of insecticides which is highly selective to pests and judicious dose that will exert little impact on predators is vital, thus the predators would also help in checking the pest populations in integrated pest management programme.

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