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Impact of Imidacloprid 17.8 SL on Coccinellids in Cotton

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ABSTRACT

Field trials were conducted to study the toxicity of chloronicotinyl compound, imidacloprid against the predator, coccinellids in cotton cultivars, Ranjit and MCU 12. All the imidacloprid treatments, irrespective of doses recorded a sudden decrease in the coccinellids population after application, in cotton ecosystem, but found to increase in numbers subsequently. The neonicotinoid check, thiamethoxam was also found to be similar to imidacloprid in its toxicity to coccinellids. Thus, the results revealed that neonicotinoids were relatively safer to coccinellids when compared to conventional insecticide methyl demonstration.

Key Words: Coccinellids, Cotton, Imidacloprid, Toxicity.

INTRODUCTION

Leafhoppers, *Amrasca biguttula biguttula* (Ishida), thrips, *Thrips tabaci* Lindeman, whiteflies, *Bemisia tabaci* (Gennadius), and aphids, *Aphis gossypii* Glover, are the major sucking pests that attack cotton ecosystem. The problem of these pests has been observed from the seedling stage, resulting in a significant decrease in the yield of up to 22.85 per cent in cotton seeds (Satpute *et al*, 1990). Coccinellids are found to be the most well-known group of beneficial insects and they usually consume aphids, other soft-bodied insects, also feed on mites, and small nematocerous Dipteran flies (Hodek, 1970). Over the past 20 years, predators have declined around 68.4 per cent and the eradication of numerous parasitoids was observed in the cotton ecosystem (Dhawan and Simwat, 1996). As the farmers spray broad range of spectrum insecticides that have a relatively long-term residual effect. According to Acharya *et al* (2002), in India at least two to three sprays are used to combat sucking pests in cotton.

This practice may cause reduction in the count of natural enemies from the field and lead to complex insect pest damage and they tend to flare up of one or more pest species in the cotton ecosystem. In such scenario, there is an immediate need for newer systemic and selective insecticide, which has the least effect on the beneficial insects. Imidacloprid is to be very effective in testing the insect pests of cotton, especially sucking pests, but its effect on the beneficial need to be studied. So the impact of imidacloprid on the coccinellid population was studied in the major cotton growing regions of Coimbatore district of Tamil Nadu.

MATERIALS AND METHODS

Field trials were conducted for two seasons to study the impact of imidacloprid 17.8 SL on coccinellids in cotton. The trial for first season was conducted in cotton cultivar (Ranjit) at Kanjapalli, Annur, and the second season trial in MCU 12 cotton at Kavilipalayam, Puliampatti. The crop was sown in three replications for each trial in a randomized block design (RBD) with plot size of 6 x 5 m and 7 x 5 m for I and II trial. All agronomic practices were followed properly as recommended by Tamil Nadu Agricultural University. To evaluate the impact of imidacloprid 17.8 SL on coccinellids, the number of coccinellids (grubs, pupae, and adults) were recorded before insecticide treatment, and after application of insecticide treatment on 1, 3, 7, 10, and 14 DAT (Day After Treatment) from ten randomly selected plants for each trail.

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Table 1. Effect of imidacloprid 17.8 SL on coccinellids in cotton ecosystem.
(Mean of three replications)

Treatment	Number/ 3 leaves/ plant													
	Days after first application							Days after second application						
	PTC	1	3	7	10	14	Mean	PTC	1	3	7	10	14	Mean
Imidacloprid 15 g a.i. ha^{-1}	6.33	5.67^{ab} (2.47)	6.00^{b} (2.53)	7.00^{ab} (2.73)	7.67^{b} (2.85)	8.67^{ab} (3.02)	7.00	9.33	8.33^{b} (2.96)	9.00^{b} (3.07)	9.67^{b} (3.18)	10.33^{b} (3.29)	11.00^{ab} (3.38)	9.67
Imidacloprid 25 g a.i. ha^{-1}	6.67	5.00^{b} (2.28)	5.67^{b} (2.43)	6.33^{b} (2.57)	7.00^{b} (2.70)	8.00^{bc} (2.88)	6.40	9.00	6.67^{bcd} (2.63)	7.00^{bc} (2.70)	7.67^{bc} (2.82)	8.33^{bc} (2.94)	9.00^{bcd} (3.05)	7.73
Imidacloprid 50 g a.i. ha^{-1}	7.00	4.67^{b} (2.25)	5.00^{b} (2.32)	5.67^{b} (2.47)	6.33^{b} (2.60)	7.67^{bc} (2.85)	5.87	8.67	5.33^{cd} (2.40)	5.67^{c} (2.47)	6.67^{c} (2.66)	7.33^{c} (2.79)	8.33^{cd} (2.96)	6.67
Imidacloprid 25 g a.i. ha^{-1} (Tatamida®)	7.00	5.00^{b} (2.34)	5.33^{b} (2.41)	6.00^{b} (2.55)	7.33^{b} (2.80)	8.00^{bc} (2.91)	6.40	9.00	7.00^{bc} (2.74)	7.33^{bc} (2.80)	8.00^{bc} (2.91)	8.33^{bc} (2.97)	9.33^{bcd} (3.13)	8.00
Thiamethoxam 25 g a.i. ha^{-1}	7.33	5.67^{ab} (2.47)	6.33^{ab} (2.60)	7.00^{ab} (2.73)	7.33^{b} (2.79)	8.33^{b} (2.96)	6.93	9.33	8.00^{b} (2.91)	8.67^{b} (3.02)	9.33^{b} (3.13)	10.00^{b} (3.23)	10.67^{bc} (3.34)	9.33
Methyl demeton 125 g a.i. ha^{-1}	7.67	4.00^{b} (2.10)	4.67^{b} (2.26)	5.00^{b} (2.33)	5.67^{b} (2.47)	6.00^{c} (2.54)	5.07	8.00	4.67^{d} (2.26)	5.33^{c} (2.40)	6.00^{c} (2.54)	7.00^{c} (2.73)	7.67^{b} (2.85)	6.13
Untreated check	7.33	8.00^{a} (2.91)	8.67^{a} (3.02)	9.33^{ab} (3.13)	10.67^{a} (3.34)	11.00^{a} (3.39)	9.53	12.33	12.67^{a} (3.62)	12.67^{a} (3.62)	13.00^{a} (3.67)	13.67^{a} (3.76)	13.33^{a} (3.77)	13.07

PTC - Pre treatment count
Figures in parentheses are $\sqrt{x+0.5}$ transformed values
In a column, means followed by a common letter(s) are not significantly different by DMRT (p=0.05)

RESULTS AND DISCUSSION

In the first field trial, the population of coccinellids in cotton was found uniformly distributed (6.33 to 7.67/ ten plants) before spraying insecticides. As compared with all the insecticide treatments, the mean population of coccinellid predators was significantly higher in the lowest dose (15 g a.i. ha^{-1}) of imidacloprid (7.00/ ten plants) followed by thiamethoxam at 25 g a.i. ha^{-1} (6.93 coccinellids/ ten plants), imidacloprid (Tatamida®) at 25 g a.i. ha^{-1} (6.40/ ten plants) and imidacloprid at 25 g a.i. ha^{-1} (6.40/ ten plants), respectively (Table 1). The least population of coccinellid was recorded in the standard check, methyl demeton at 125 g a.i. ha^{-1} (5.07/ ten plants) followed by the high dose of imidacloprid at 50 g a.i. ha^{-1} (5.87/ ten plants). The treatment with imidacloprid at 50 g a.i. ha^{-1} has recorded a reduction of 2.33 coccinellids/ ten plants on the first day after spray, when compared to PTC. Thus it is evident from the table that all the insecticidal treatments applied for the control of sucking pests had significantly reduced the coccinellids grub as well as the adult population of coccinellid predators over control.

The coccinellid population before second round of spray varied from 8.00 to 12.33/ ten plants (Table 1). Imidacloprid at 15 g a.i. ha^{-1} has recorded a mean coccinellid population of 9.67/ ten plants followed by thiamethoxam at 25 g a.i. ha^{-1} (9.33/ ten plants), imidacloprid (Tatamida®) at 25 g a.i. ha^{-1} (8.00/ ten plants) and imidacloprid at 25 g a.i. ha^{-1} (7.73/ ten plants). As compared with untreated check, all the insecticidal treatments showed a decrease in the population of coccinellids but it was known that after initial decline there is a slow progressive increase in the number of coccinellids.

In the second field trial, the population of coccinellids ranged from 7.67 to 8.33/ ten plants before imposing the treatments (Table 2). Imidacloprid at 15 g a.i. ha^{-1} recorded the higher mean coccinellid population of 8.07/ ten plants next to untreated check (9.80/ ten plants). The standard check, methyl demeton 25 EC at 125 g

Table 2. Effect of imidacloprid 17.8 SL on coccinellids in cotton ecosystem.
(Mean of three replications)

Treatment	Number/ 3 leaves/ plant													
	Days after first application							Days after second application						
	PTC	1	3	7	10	14	Mean	PTC	1	3	7	10	14	Mean
Imidacloprid 15 g a.i. ha^{-1}	7.67	6.67^{b} (2.67)	7.33^{b} (2.79)	8.00^{b} (2.91)	8.67^{b} (3.03)	9.67^{b} (3.19)	8.07	10.33	9.00^{b} (3.08)	9.33^{b} (3.13)	10.00^{b} (3.24)	10.67^{b} (3.34)	11.67^{b} (3.49)	10.13
Imidacloprid 25 g a.i. ha^{-1}	7.67	5.67^{bc} (2.48)	6.00^{cd} (2.54)	6.67^{c} (2.68)	7.67^{cd} (2.86)	8.33^{cd} (2.97)	6.87	9.00	7.00^{c} (2.73)	7.33^{c} (2.79)	8.33^{c} (2.97)	9.00^{cd} (3.08)	10.00^{c} (3.24)	8.33
Imidacloprid 50 g a.i. ha^{-1}	8.33	5.00^{cd} (2.34)	5.33^{de} (2.41)	5.67^{d} (2.48)	6.67^{ef} (2.67)	8.00^{d} (2.91)	6.13	9.00	6.67^{c} (2.67)	7.00^{c} (2.74)	8.00^{c} (2.91)	8.67^{d} (3.03)	9.33^{c} (3.13)	7.93
Imidacloprid 25 g a.i. ha^{-1} (Tatamida®)	8.00	5.67^{bc} (2.48)	6.00^{cd} (2.55)	7.00^{bc} (2.74)	7.33^{de} (2.80)	8.33^{cd} (2.97)	6.87	9.33	7.33^{c} (2.80)	7.67^{c} (2.86)	8.33^{c} (2.97)	9.33^{cd} (3.13)	10.00^{c} (3.24)	8.53
Thiamethoxam 25 g a.i. ha^{-1}	8.33	6.33^{b} (2.61)	7.00^{bc} (2.74)	7.67^{bc} (2.85)	3.33^{bc} (2.97)	9.00^{bc} (3.08)	6.67	10.00	7.67^{c} (2.85)	8.00^{c} (2.91)	8.67^{c} (3.03)	9.67^{c} (3.19)	11.00^{b} (3.39)	9.00
Methyl demeton 125 g a.i. ha^{-1}	7.67	4.33^{d} (2.19)	4.67^{e} (2.27)	5.33^{d} (2.41)	6.00^{f} (2.55)	7.00^{e} (2.74)	5.47	8.00	5.33^{d} (2.41)	5.67^{d} (2.48)	6.67^{d} (2.68)	7.33^{e} (2.80)	8.33^{d} (2.97)	6.67
Untreated check	8.00	8.33^{a} (2.97)	9.00^{a} (3.08)	9.33^{a} (3.13)	10.33^{a} (3.29)	12.00^{a} (3.53)	9.80	13.00	14.00^{a} (3.81)	14.67^{a} (3.89)	15.00^{a} (3.94)	16.00^{a} (4.06)	16.33^{a} (4.10)	15.20

PTC - Pre treatment count
Figures in parentheses are $\sqrt{x+0.5}$ transformed values
In a column, means followed by a common letter(s) are not significantly different by DMRT (p=0.05)

a.i. ha^{-1} recorded a relatively less population of coccinellids (5.47/ ten plants). After second round of pesticide application, imidacloprid at 15 g a.i. ha^{-1} has recorded 10.13 per ten plants, while imidacloprid at 50 g a.i. ha^{-1} has recorded 7.93 coccinellids/ ten plants. The least population of coccinellids was reported by the standard check, methyl demeton at 125 g a.i. ha^{-1} (6.67/ ten plants). All the insecticidal treatments were found to have adverse effect on coccinellids population when compared with the untreated check throughout the observation period. But it was quite worth to note that after a sudden decline in the population immediately after spraying there was a gradual increase in the population of coccinellids.

Beneficial predators and parasites are typically abundant in cotton ecosystems and often offer partial to adequate pest control. Choosing insecticides for pest control should be done carefully to conserve the natural enemies and reduce the negative impacts they cause. The suggested dosage of imidacloprid 17.8 SL (25 g a.i. ha-1) significantly reduced the harmful effect on natural enemies, particularly coccinellids.

Srinivasababu and Sharma (2003) found that imidacloprid at 12.5 g a.i. ha^{-1} was the safest chemical against coccinellids compared to conventional insecticides like dimethoate and chlorpyriphos. Whereas, Skouras et al (2017) reported that the mortality rates of coccinellid predator, *C. septempunctata* can be increased through residual toxicity and by feeding on imidacloprid treated aphids which deviated from the present findings. The toxicity of standard check, methyl demeton was already reported by Manisekaran *et al* (1991) that the application of methyl demeton considerably reduced the population of coccinellids.

CONCLUSION

In the present study, imidacloprid was found to be safer to natural enemies when compared with conventional insecticides.

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