Bioefficacy and residues of imidacloprid in chillies used against chilli thrips

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Abstract: Imidacloprid an insecticide belonging to chloronicotinyl group was applied as seed treatment, root dip and foliar spray for the management of thrips on chillies. Seed treatment of imidacloprid 70 WS at 10, 20 and 30g kg^{-1} protected the seedlings in the nursery upto 45 days. The root dip of the seedlings before transplanting had no effect on the thrips population. Foliar treatment of imidacloprid 200 SL at 250, 375 and 500 ml ha^{-1} reduced the thrips population significantly and also recorded higher yield of chilli fruits. There was no phytotoxicity in the chilli plants due to the treatment of imidacloprid either as seed treatment, root dip or foliar application. Residue analysis in the chilli fruits collected in the first harvest (7 weeks after last foliar application) revealed that the residue was at below detectable limit.

Key words : Chilli, Capsicum annum, Thrips, Scirtothrips dorsalis, imidacloprid, bioefficacy, residue.

Introduction

Chillies or red pepper, *Capsicum annum* L. is an important spice crop grown under large acreage in Tamil Nadu, Andhra Pradesh and Karnataka and is having export potential. The crop is ravaged by many insect pests right from nursery till harvest. Among them thrips, *Scirtothrips dorsalis* Hood (Thripidae : Thysanoptera) is important which occurs in all chilli growing tracts throughout the year. Thrips cause severe damage to the plants in the nursery and in transplanted crop and is the main constraint in the cultivation. Chemical insecticides are used to control the pest (Chandele and Deshpande, 1984; Khaire and Naik, 1985). Present studies were undertaken to evaluate the efficacy of imidacloprid belonging to chloronicotinyl group in the control of the pest and to determine the residue in the fruits.

Materials and Methods

Two field experiments were conducted during kharif 1997-98 and 1998-99 with cultivar PKM-1 and K-1 respectively at Agricultural Research Station, Bhavanisagar, Tamil Nadu. Two formulations of imidacloprid, imidacloprid 70 WS (Gaucho 70 WS) containing 700 g a.i./kg and imidacloprid 200 SL (Confidor 200 SL) containing 200 g a.i./litre supplied by M/s. Bayer (India) Ltd were used in the experiments. Seed treatment with imidacloprid 70 WS done at 10, 20 and 30 g/kg and observations were made on the population of thrips, both nymphs and adults in three leaves per plant on five seedlings selected at random in the nursery at fortnightly intervals starting from two weeks after sowing. There were five replications. Observations on germination and phytotoxicity were also recorded in the nursery. For root dip treatment the seedlings from untreated plots were pulled out and roots were dipped in the respective treatments for 2 h and planted. Normal seedlings were used for planting in foliar and check treatments. Fortyfive day old seedlings were planted in respective treatments. There were four replications and the experiments were laid out in a randomized blocks design. Foliar applications were given when the incidence of thrips was noticed in the planted crop 5, 7, and 10 weeks after planting in the first experiment and 4 and 6 week after planting in the second experiment. Observation on the incidence of thrips was recorded in three leaves per plant one each from top, middle and bottom region in five plants per plot selected at random on 7 and 14 days after each round of treatments. Observations on phytotoxicity symptoms like injury to leaf tip and leaf surface, wilting,

Table 1. Effect of imidacloprid seed treatment on chilli thrips in nursery. No. of thrips/3 leaves

(Mean of 5 observations)

Treatments	Experiment I		Experiment II	
	30 DAS**	45 DAS**	30 DAS**	45 DAS**
1. Imidacloprid 70 WS 10 g/kg	0.0 (0.71)a	0.00 (0.71)a	0.00a (0.71)	0.00a (0.71)
2. Imidacloprid 70 WS 20 g/kg	0.0 (0.71)a	0.0 (0.71)a	0.00a (0.71)	0.00a (0.71)
3. Imidacloprid 70 WS 30 g/kg	0.0 (0.71)a	0.0 (0.71)a	0.00a (0.71)	0.00a (0.71)
4. Untreated check	6.8 (2.69)b	6.4 (2.61)b	2.20b (1.62)	6.00b (2.54)

**- Significant at P=0.01
DAS - Days after sowing
In a column means followed by a common letter are not significantly different by DMRT (P=0.05)
Values in parentheses are transformed values, x + 0.5

vein clearing, necrosis and epinasty and hyponasty were recorded on 7, 14 and 21 day after foliar treatment. Cumulative yield of four harvests of ripe chillies in each plot was recorded.

Residue Analysis

Samples of green chillies were taken from the first harvest, 7 weeks after last foliar application and ripe fruits 9 weeks after last foliar application. Samples from seed and root dip treatment were also taken simultaneously.

Extraction and clean up : Fifty gram of the sample (green and ripe) and 20 g of dried fruits were soaked in acetonitrile, blended, filtered, evaporated to near dryness in roto-vacuum evaporator and partitioned with dicloromethane and evaporated to near dryness. The remainder was then dissolved in 10 ml ethyl acetate and cleaned up with Florisil(R) column and eluted with acetonitrile. The elute was evaporated to near dryness and made upto 5 ml with acetonitrile and fed into High Performance Liquid Chromatography (HPLC).

Final quantification : HPLC, Hitachi, model L6200 was used for the estimation of residue with following parameters.

Column : ODS2
Mobile phase : Acetonitrile: water (35:65 v/v)
Flow rate : 1 ml/min
Detection (wave length) : 270 nm
Injection volume : 20 µl
Retention time : 3.18 min
Sensitivity : 0.50 µg
Determinability level : 0.50 µg for green and ripe fruits
0.125 µg for dried fruits

Recovery studies were conducted with chilli fruit samples, green and ripe fruit with working standards of 1 ppm and 2 ppm level.

Results and Discussion

Nursery

There was no incidence of thrips in any of the treatments at 15 days after sowing (DAS) in both the experiments. Even at 30 and 45 DAS, untreated plants only recorded 6.8 and 6.4 thrips/3 leaves (Experiment 1) and 2.2 and 6.0 thrips/3 leaves (Experiment II). The results have indicated the complete protection of chilli seedlings in the nursery from thrips at all the dosages tried viz. 10, 20 and 30 g/kg (Table 1). The seed treatments with imidacloprid 70 WS at 10, 20 or 30 g/kg did not

Table 2. Bioefficacy of imidacloprid in the control of chilli thrips. Experiment-I (No. of thrips/3 leaves)

(Mean of 4 observations)

	Treatment	4 weeks* after planting	7 DAT** I Round	14 DAT** I Round	7 DAT** II Round	14 DAT** II Round	7 DAT* III Round	14 DAT# III Round	Yield of ripe** fruits kg ha^{-1}
1.	Imidacloprid 70 WS 10 g/kg^{-1} seed treatment	3.20 (1.91)c	1.75 (1.49)d	2.30 (1.66)c	2.00 (1.56)c	1.55 (1.43)bcd	0.50 (0.99)abc	0.25 (0.86)	634cd
2.	Imidacloprid 70 WS 20 g/kg^{-1} seed treatment	3.20 (1.87)c	2.15 (1.62)d	3.50 (1.99)d	2.70 (1.77)c	1.50 (1.45)bcd	0.50 (0.98)abc	0.30 (0.88)	616d
3.	Imidacloprid 70 WS 30 g/kg^{-1} seed treatment	3.00 (1.86)bc	1.90 (1.54)d	3.10 (1.89)d	2.20 (1.63)c	1.90 (1.53)cd	0.70 (1.09)c	0.25 (0.86)	654cd
4.	Imidacloprid 70 WS 10 g/kg^{-1} seed treatment + imidacloprid 200 SL0.35% root dip 2 h	1.85 (1.52)abc	2.10 (1.60)d	3.25 (1.93)d	2.30 (1.66)c	2.20 (1.63)d	0.55 (1.02)abc	0.30 (0.88)	686cd
5.	Imidacloprid 200 SL 0.7% root dip 2h	2.00	3.10	3.90	2.60	2.00	0.60	0.30	698c
6.	Imidacloprid 200 SL 250 ml ha^{-1} foliar spray	2.35 (1.68)abc	0.75 (1.11)bc	1.80 (1.51)bc	0.35 (0.90)ab	1.00 (1.22)ab	0.20 (0.79)ab	0.05 (0.73)	981ab
7.	Imidacloprid 200 SL 375 ml ha^{-1} foliar spray	1.75 (1.48)ab	0.20 (0.82)a	0.65 (1.06)a	0.20 (0.83)a	0.70 (1.08)a	0.10 (0.77)a	0.10 (0.76)	1044a
8.	Acephate 75 SP 500 g ha^{-1} foliar spray	1.70 (1.55)abc	0.50 (0.98)ab	0.80 (1.13)a	0.35 (0.91)ab	1.10 (1.25)abc	0.15 (0.79)ab	0.15 (0.79)	1027a
9.	Methyl-o-demeton 25 EC 500 ml ha^{-1} foliar spray	1.80 (1.50)abc	1.00 (1.22)c	1.65 (1.46)b	0.80 (1.13)b	1.75 (1.49)bcd	0.30 (0.88)abc	0.25 (0.86)	951b
10.	Untreated check	1.55 (1.42)a	1.70 (1.47)d	3.90 (2.09)d	2.70 (1.77)c	2.15 (1.61)a	0.65 (1.01)abc	0.30 (0.87)	624d

Table 3. Bioefficacy of imidacloprid in the control of chilli thrips. Experiment-II (No. of thrips/3 leaves)

(Mean of 4 observations)

	Treatment	4 weeks after planting #	7 DAT** I Round	14 DAT** I Round	7 DAT** II Round	14 DAT** II Round	21 DAT # II Round	Yield of ripe** fruits kg/ha
1.	Imidacloprid 200 SL 1.0% root dip for 2h	0.65 (1.60)	0.40 (0.94)b	1.90 (1.54)c	1.75 (1.48)b	1.65 (1.46)c	0.55 (0.99)	735d
2.	Imidacloprid 200 SL 250 ml/ha foliar spray	(1.30) (1.33)	0.00 (0.71)a	1.05 (1.24)ab	0.30 (0.89)a	0.30 (0.89)b	0.10 (0.76)	8.99bc
3.	Imidacloprid 200 SL 375 ml/ha foliar spray	1.20 (1.30)	0.10 (0.77)ab	1.00 (1.20)ab	0.10 (0.77)a	0.05 (0.73)a	0.20 (0.83)	934ab
4.	Imidacloprid 200 SL 500 ml/ha foliar spray	1.40 (1.37)	0.05 (0.73)ab	0.75 (1.11)a	0.10 (0.77)a	0.10 (0.77)ab	0.15 (0.79)	969a
5.	Methyl-o-demeton 25 EC 500 ml/ha foliar spray	1.05 (1.23)	0.20 (0.82)ab	1.20 (1.28)abc	0.20 (0.83)a	0.10 (0.77)ab	0.05 (0.73)	864c
6.	Dimethoate 30 EC 750 ml/ha foliar spray	1.05 (1.24)	0.35 (0.91)ab	1.65 (1.45)bc	0.10 (0.77)a	0.10 (0.77)ab	0.30 (0.88)	776d
7.	Untreated check	1.35 (1.35)	2.30 (1.66)c	2.95 (1.85)d	1.45 (1.39)b	1.75 (1.49)c	0.55 (1.02)	649e

- Not significant
* - Significant at P = 0.05
** - Significant at P = 0.01

In a column means followed by a common letter are not significantly different by DMRT (P=0.05)
Values in parenthesis are transformed values x + 0.5
DAT - Days after treatment

affect the germination and there was no phytotoxicity symptom observed on the plants. Jarande and Dethe (1994) reported the effectiveness of seed treatment with imidacloprid 70 WS in chillies at 15 g/kg. The present findings also confirm the effectiveness of imidacloprid 70 WS seed treatment against chilli thrips in the nursery.

Transplanted crop

Results of the experiments are furnished in Table 2 and 3. In the first experiment the incidence of thrips was observed 4 weeks after planting and ranged from 1.55 to 3.20 per three leaves. The incidence was significanty high in the seed treated plants than other treatments at this stage. The plants from the seed treatments were healthy when compared to other treatments and this might be the reason for harbouring of more number of thrips in the seed treatment. Plants in other treatments were not healthy and harboured less population. Seed treatment was not effective in the planted crop against thrips and the population was on par with untreated check at all the dosages tested. Root dip of imidacloprid 200 SL at 0.7 per cent was also not effective in protecting the plants from thrips as also the seed treatment of imidacloprid 70 WS @ 10g/kg + root dip of

imidacloprid 200 SL at 0.35 per cent. Based on the results of the first experiment, concentration of root dip treatment of imidacloprid 200 Sl was increased to 1.0 per cent in the second experiment. Still the root dip treatment was not effective. However Jarande and Dethe (1994) reported that root dip with imidacloprid at 0.04 per cent was effective in reducing the thrips on chillies. Similar results were reported by Mote *et al.* (1994). But in the present studies it was found that the root dip treatment of imidacloprid was not effective against thrips in the transplanted crop.

In the foliar treatments of imidacloprid 200 SL, all the three dosages viz. 250, 375 and 500 ml/ha reduced the thrips population significantly. In the first experiment three rounds were given while in the second two rounds were given based on the build-up of thrips population. These treatments were on par with the standard, acephate 75 SP at 500 g/ha in the first experiment. In the second experiment also they were equal to methyl-o-demeton ad dimethoate and significantly superior to untreated check. Kumar (1998) reported that foliar treatment of imidacloprid 200 SL at 100ml/ha was effective against thrips, aphids and leafhopper on cotton. Rameshbabu and Santharam (2000) reported the efficacy of imidacloprid 200 SL at 100 ml/ha against thrips on groundnut. Similar results were reported by Sivaveerapandian (2000) against thrips on okra. Present findings confirm the efficacy of foliar treatment of imidacloprid against thrips. In the yield of ripe fruits, imidacloprid 200 SL foliar treatments were significantly superior to seed and root dip treatments and on par with standard, acephate in the first experiment. In the second experiment, imidacloprid 200 SL at 375 and 500 ml/ha was superior to standards, methyl-o-demeton and dimethoate. Such increase in yield due to imidacloprid 200 SL foliar treatments was reported by Sivaveerapandian (2000) in okra. These treatments have not caused any phytotoxicity symptoms in the transplanted crop.

Residue analysis

The mean recovery was 92.04 per cent from fortified samples at 1 and 2 ppm level. The residue of imidacloprid was at below detectable limit in green, ripe and dry chilli samples collected at first harvest in both the experiments in seed and root dip treatments and 7 and 9 weeks after last foliar application in the first and second experiments respectively.

Results of the two experiments indicate the efficacy of seed treatment of imidacloprid 70 WS at 10 g/kg against thrips in the chilli nursery upto 45 days. Foliar treatment of imidacloprid 200 SL at 375 ml/ha is sufficient to reduce the thrips population significantly and to record higher fruit yield. These treatments were not phytotoxic to chilli plants and the residue was at below detectable limit in the fruits harvested 7 weeks after last foliar application.

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References

Chandele, A.G. and Deshpande, A.D. (1984). Chemical control of chilli pests. *Indian J. Ent.* **46**: 257-260.

Jarande, N.T. and Dethe, M.D. (1994). Imidacloprid for effective control of sucking pests of chilli. *Pestology*, **18**: 15-17.

Khaire, V.A. and Naik, R.L. (1985). Comparative efficacy of certain newer insecticides against sucking pest complex on chilli. *South Indian Hort.* **33**: 402-403.

Kumar, K. (1998). Studies on bioefficacy and determination of residue of imidacloprid applied against sucking pests on cotton. *Ph.D. Thesis*, Tamil Nadu Agric. Univ., Coimbatore, India, p.115.

Mote, U.N., Datkhile, R.V. and Pawar, S.A. (1994). Efficacy of imidacloprid as seed treatment and root dip against sucking pests of chillies. *Pestology*, **18**: 5-9.

Rameshbabu, K. and Santharam, G. (2000). Bioefficacy against thrips and aphids on groundnut, *Arachis hypogaea* L. *Madras Agric. J.* **87**: 605-608.

Sivaveerapandian, D. (2000). Bioefficacy of imidacloprid against sucking pests on bhendi and determination of half life. *M.Sc.(Ag.) Thesis*, Tamil Nadu Agric. Univ., Coimbatore, India. p.100.

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