PLANT SCIENCE TODAY
Vol x(x): xx–xx
https://doi.org/10.14719/pst.8998

eISSN 2348-1900

RESEARCH ARTICLE

Evaluation of newer insecticides against chilli thrips *Thrips parvispinus*(Karny) infestation and its impact on yield parameters

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Received: 21 April 2025; Accepted: 09 July 2025; Available online: Version 1.0: 23 July 2025

Cite this article: Vijayashanthi VA, Yogameenakshi P, Tamilselvi C, Punitha A, Sivagamy K, Manimekalai R, Banuamthy S, Sudhasha S. Evaluation of newer insecticides on against chilli thrips *Thrips parvispinus*(Karny) infestation and its impact on yield parameters. Plant Science Today (Early Access). https:/doi.org/10.14719/pst.8998

Abstract

Chilli (*Capsicum annum* L.) is an important vegetable cum spice crop commonly used in Indian diet and grown throughout the year in Tamil Nadu. Infestation of invasive South East Asian thrips species (*Thripsparvispinus*) was reported in chilli growing areas of Andhra Pradesh, Telangana, Karnataka and Tamil Nadu and caused significant damage during Rabi season 2021-22. Survey results on damage potential and leaf curl disease incidence during rabi season in Putlur, Kilambakkam, Pondavakkam and Cherukkanur villages of Tiruvallur district revealed a maximum Percent Leaf curl index (PLI) of 22.08 with a 36.97 % reduction over potential yield at Cherukkanur village. In field trial, insecticide treatment was imposed after 45 DAP in all three locations and the results observed, indicated that Cyantraniliprole 10.26 % OD (T1) and Spinosad 45 % SC (T4) were found to be effective in reducing chilli thrips population in which significant reduction of 31.11 % and 16.11% in population count in T1 and T4 respectively over the treated check T7 (Imidacloprid 17.80 % SL). The leaf curling symptom due to the feeding of thrips was least in T1 followed by T4 and T7. Cooccinellids population was observed maximum of 1.67 per plant in T1 followed by T4 and T7. Hence, diamide insecticide Cyantraniliprole 10.26 % OD significantly reduced the thrips incidence with two sprays followed by Spinosad 45 % SC over the control check Imidacloprid 17.80 % SL.

Keywords: chilli thrips; leaf curl disease; newer molecules; pest management

Introduction

Chilli (*Capsicum annum* L.) is an important vegetable cum spice crop commonly used in Indian diet and grown throughout the year in Tamil Nadu. Chilli crop is infested by more than 21 insects and non-insect pests (1). Of the various insect pests, thrips, *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera) is considered as the most serious and important sucking pest in chilli crop. Chilli thrips *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera) is considered to be most destructive pest leading to 30 to 50 per cent yield loss under severe infestation (2). *Thrips parvispinus* has been from Thailand to Australia (3). It is reported on papaya in Hawaii, Gardenia sp. in Greece, vegetable crops like Capsicum, green beans, potato and brinjal from other countries (4). As insect vectors, thrips are the sole transmitters of Tospoviruses (genus Tospovirus, family Bunyaviridae) affecting a number of plant species belonging to unrelated plant families across the globe (5, 6). Occurrence of this species in India has been first reported by (7) on papaya from Bengaluru. Due to variation in the agro climatic conditions of different regions, insects show varying trends in their incidence on crop. Both nymphs and adults of thrips cause damage by scraping the epidermis of the leaves and suck the cell sap from the leaves resulting in the margin of the leaves rolled upwards and the leaf size reduced (8). The damage is resulted from sucking the cell sap leading to crinkling and curling of leaves and loss of plant vigour. Besides damage, these thrips are transmitting leaf curl disease. In Tiruvallur district, chilli crop is cultivated in 697 hectares with production of 577 tons during rabi season in Tiruvalangadu, Tiruthani, R.K.Pet, Ellapuram, Solavaram and Ekadu blocks. During the year 2021-2022, the severe incidence of leaf curl disease in chilli was recorded mainly due to thrips incidence in chilli. Infestation of invasive South East Asian thrips species (*Thrip sparvispinus*) was reported in chilli growing areas of Andhra Pradesh, Telangana, Tamil Nadu and Karnataka and caused significant damage during Rabi season 2021-22. Farmers are following insecticide like imidacloprid which is effective, but resulting in resurgence of sucking pests in many cases. Hence newer insecticides under anthranilic diamide class, avermectins, naturalyte class, pyrazole calss, phenyl pyrazole class were selected for evaluation of effectiveness against chilli thrips. Hence, the present field experiment was conducted to study the damage potential caused by thrips in chilli crop throughout the crop growing season and the efficacy of newer insecticides against chilli thrips which will be helpful in developing a sound pest management strategy.

Materials and Methods

Assessment of damage potential and yield loss by chilli thrips

Assessment of damage potential and yield loss caused by chilli thrips was conducted in four locations viz., Putlur (13.1202 °N, 79.9654 °E), Kilambakkam Village (13.1511°N, 79.9703 °E), Pondavakkam village (13.3152°N, 79.8885 ° E) and Cherukkanur, Tiruthani (13.1731° N, 79.6167°E) of Tiruvallur district of Tamil Nadu during rabi seasons of 2022-2023 and 2023-2024. In fixed plots, ten plants were tagged/location for different damage levels. The upward curling symptoms caused by thrips on leaves were recorded based on visual rating scale of 0-4 at 30, 50, 70 and 90 days after transplantation (9). Based on the leaf curl disease severity, the PLI was calculated for each accession as per the formula (10-12).

Damage Score	Extent of damage
0	Healthy foliage
1	<25% foliage showing thrips curling symptoms
2	26-50 % foliage showing thrips curling symptoms
3	50-75 % foliage showing thrips curling symptoms
4	>75 % foliage showing thrips curling symptoms

Formula 1:

$$PLI = \frac{\text{Sum of scores of selected plants}}{\text{Total No. of plants x Maximum score category}} \times 100$$

Filed trial for the evaluation of newer insecticide molecules against chilli thrips

To evaluate newer insecticide molecules for the management of thrips in chilli, field trial was conducted at KVK, Tirur, Kilambakkam and Pondavakkam village. Ananya hybrid seeds, selected for their high yield potential, were sown. Deep summer ploughing to destroy pupae and residual stages of thrips and other pests; seed treatment with imidacloprid 70WS at 12g/kg seed; installation of blue sticky traps of 25 numbers per acre and border cropping with 2-3 rows of tall growing crops like sorghum/maize as a barrier for thrips movement were done invariably for all treatments except untreated check. Insecticides treatments were fixed based on the “Management strategies for invasive thrips (*Thrips parvispinus*) in Chilli (ad-hoc)”, Technical Booklet- IPM-01/2022, Directorate of Plant Protection, Quarantine & Storage, NH-IV, Faridabad (Table 1).

The field experiment was conducted in randomized block design with three replications having a plot size of 3 x 2.5m per treatment. One month old seedlings of chilli were transplanted during the last week of December 2023 at a spacing of 45x 45cm. All the management practices except plant protection against thrips were adopted as per the recommended package of practices of Tamil Nadu Agricultural University (13). For counting the population of thrips, five plants were selected at random in each plot and tagged. Ten plants were selected randomly in each plot and scored for leaf curling visually using disease grade scale. The first spray of insecticides was given at 45 days after transplanting when the thrips population is sufficient enough to impose the treatments. Application of insecticides at 45 days after planting, can help to control the thrips before they establish large populations. This approach is often more effective than waiting until pest infestations become severe. The second spray was given at 15 days interval after the first spray. Observations on the number of thrips on two leaves each selected from the top, middle and bottom portions of a plant were collected at random from the top canopy of each selected plant and brought to the laboratory in zip lock bags and observed under stereo binocular microscope on six leaves from top, middle and bottom three leaves on five randomly selected plants in each plot to get a representative sample of that plot. The average population per six leaves was calculated and recorded one day prior to the implementation of treatments and at 3, 7 and 10 days after treatment and percent reduction in the thrips population was also calculated. The cost of cultivation incurred for all the agronomic practices and insecticides, yield, net return and benefit cost ratio were also recorded.

Table 1. Details of treatments for management of chilli thrips

Treatments	Concentration of chemical
T1 - Cyantraniliprole 10.26% OD	- 600 g in 500 lt of water
T2 - Acetamiprid 20 % SP	- 50 g in 500 lt of water
T3 - Emamectin benzoate 05% SG	- 200 g in 500 lt of water
T4 - Spinosad 45 % SC	- 160 g in 500 lt of water
T5 - Fipronil 05 % SC	- 800 g in 500 lt of water
T6 - Tolfenpyrad 15 % EC	- 1000 ml in 500 lt of water
T7 - Check - Imidacloprid 17.80 % SL	- 125 ml in 500 lt of water
T8 - Untreated check	-None

Statistical Analysis

The data collected from the field trials were subjected to square root transformation and Analysis of variance (ANOVA) was carried out for insecticide treatments and the critical difference test was followed to indicate the difference between the treatments at the level of $P < 0.05$ following the procedure by (14).

Results and Discussion

Fixed plot surveys in four hotspot locations for thrips incidence in Tiruvallur district during the rabi season of 2022-2023 and 2023-2024 showed that leaf curl disease incidence increased with crop age due to thrips infestation. PLI was recorded maximum of 22.08 with 36.97 % reduction over potential yield at Cherukkanur village (Table 2). Thrips incidence was negatively correlated with yield, meaning higher infestation levels corresponded to reduced yields, falling short of the expected potential. It was reported that chilli leaf curl virus disease caused by begomoviruses, has emerged as a major threat to global chilli production, causing severe yield losses and economic harm (15).

Table 2. Percent Leaf curl Index (PLI) and its impact on yield during 2023-2024

Location	Percent Disease Index (PDI)					Yield (q/ac)	Reduction over potential yield (%)
	30 DAP	50 DAP	70 DAP	90 DAP	Mean		
Putlur	3.33	17.78	17.78	26.67	16.39	36.20	24.58
Kilambakkam	2.50	16.67	16.67	20.00	13.96	38.15	20.52
Pondavakkam	3.33	20.00	20.00	30.25	18.39	32.20	32.91
Cherukkanur	5.00	26.67	26.67	30.00	22.08	30.25	36.97

Note: Potential yield of the crop (hybrid Ananya) -48q/ac

A field trial was conducted to evaluate the efficacy of insecticides in three locations of Tiruvallur district of Tamil Nadu during Rabi season of 2023-2024. Pooled mean observation on thrips incidence, PLI, yield parameters and coccinellid population in all the treatments after first and second spray were taken for analysis. The results of the one way ANOVA observed from the three locations, indicated that the thrips population was minimum in T1 (Cyantraniliprole 10.26% Oil Dispersion(OD)) and T4 (Spinosad 45 % Suspension Concentrate (SC)) which is significantly different from all other treatments except during 3rd day after the first spray in which T1 and T4 are on par with the Check T7 (Imidacloprid 17.80 % Soluble Liquid (SL)) and during 3rd day after second spray in which T4 was on par with the Check T7. In a field trial insecticide treatment was imposed after 45 DAP in all three locations and the results after the first spray indicated that a significant reduction of 31.11% in population count was recorded in T1 (Cyantraniliprole 10.26% OD) and 16.11 % reduction in T4 (Spinosad 45 % SC) over the treated check T7 (Check - Imidacloprid 17.80 % SL). The second spray was given after the first spray and the observation indicated significant reduction of 37.72 % in population count in T1 (Cyantraniliprole 10.26% OD) and a 16.16 % reduction in T4 (Spinosad 45 % SC) over the treated check T7 (Check - Imidacloprid 17.80 % SL). The findings of former studies showed that cyantraniliprole 10.26 % OD was effective against chilli thrips with 60.88 and 78.85 % reduction, respectively (16, 17). Similarly, Cyantraniliprole 10 % OD at 90 g a.i.ha-1 was significantly effective when sprayed twice at 15 days interval, minimized the sucking pests population in cotton crop (18). The insecticides Spiromesifen 45SC and Acetamiprid 20 SP to be effective against chilli thrips (19, 20). The minimum disease incidence was recorded to the extent of (27.25 %) coupled with highest fruit yield with the treatment having two spraying of Acetamiprid 20 % (Soluble Powder) SP @1.0 gm/ liter water at an interval of fifteen days during Kharif 2019 cropping season (21). In West Bengal, it was report that Cyantraniliprole 10.6 % OD @ 120 g a.i./ha as the most efficient insecticide and recorded the maximum reduction thrips incidence (78.03 %) (22). The lowest leaf curl disease incidence (14.05%) was observed in the treatment group that received seed treatment with cyantraniliprole 19.8 % + thiamethoxam 19.8 % FS, followed by a foliar spray regimen of cyantraniliprole 10.26 OD, spinetoram 11.6 SC, spiromesifen 22.9 SC, diafenthiuron 50 WP and thiamethoxam 25 WG applied at 15-day intervals starting 20 days post-transplanting (23). Phtotoxicity effects was not recorded due do the application of selected insecticides spray for the management of chilli thrips. Cooccinellids population was observed to the maximum of 1.67 per plant in T1 followed by T4, T5 and T7 (Imidacloprid 17.80 % SL). Predatory rate of adult coccinellids is 50 thrips per day. Hence, 1.67 coccinellids/plant in T1 Cyantraniliprole 10.26 % OD followed by 1.27 numbers/ plant in T3 Emamectin benzoate 05 % SG is sufficient enough for the management of thrips. Yield obtained in T1 was maximum of 41.55q/acre which is on par with T4, T5 and T7. Cyantriniliprole treatment provided the best plant protection in ornamental crops, with 70 % less damage due to *S. dorsalis* than the untreated control (24).

In corroboration with the mean population of thrips incidence in three locations, the percent leaf curl disease index PLI was recorded minimum of 1.67 in T1 which is significantly different from other treatments at CD (0.05 %) followed by T4 (1.75) and T7 (1.77) (Table 3). Imidacloprid 17.8% SL exhibited a reduction in leaf curl incidence of 0.8 to 2.2 and increased yield over farmers practice (25). The benefit cost ratio recorded was maximum in T1 (2.61) followed by T7 (2.56) and T4 (2.48).

Conclusion

Thrips incidence and leaf curl disease incidence results in crop loss up to 30-35 % in Tiruvallur district of Tamil Nadu. The results of field trial conducted with the newer insecticides indicated that the diamide insecticide Cyantraniliprole 10.26 % OD significantly reduced the thrips incidence and Percent leaf curl index with two sprays followed by the treatment Spinosad 45 % SC over the control check Imidacloprid 17.80 % SL and also the natural enemy coccinellid population was recorded high in both the above treatments over the control plots. This suggests that the appropriate and timely use of pesticide not only eliminates the target pest but also, by being safer to use, helps preserve natural predators, thus fostering ecological stability.

Acknowledgements

I gratefully acknowledge the collaborative spirit and invaluable contributions of ICAR-ATARI, Zone 10 and the Department of Entomology at Tamil Nadu Agricultural University, India, throughout this research program. Furthermore, I am deeply appreciative of the exceptional support provided by the university, which significantly contributed to its successful completion.

Table 3. Effect of insecticides on thrips population, leaf curl index and economic parameters (data– mean of three locations)

Treatments		Mean thrips population /3 leaves - after first spray*					Mean thrips population /3 leaves – after second spray*			ROC (%)	PDI (10 DAS)	Coccinellids (no. per plant)(*)	Yield (q/ac) (*)	BCR
		PT	PDI (PT)	3DAS	7DAS	10DAS	3DAS	7DAS	10DAS					
T1	Cyantraniliprole 10.26% OD	8.47 (2.98)	10.02 (3.24)	1.40 d (1.36)	1.20 e (1.28)	1.13 e (1.27)	0.87 d (1.16)	0.73 d (1.11)	0.93 e (1.19)	89.47	1.29e (1.34)	1.67 b (1.46)	41.55 a (6.48)	2.61
T2	Acetamiprid 20 % SP	8.47 (2.98)	10.09 (3.25)	2.80 b (1.80)	2.40 b (1.69)	2.67 b (1.77)	2.60 b (1.74)	2.40 b (1.70)	2.33 b (1.68)	74.46	2.80c (1.81)	0.53 de (1.01)	36.52 cd (6.08)	2.17
T3	Emamectin benzoate 05% SG	8.80 (3.04)	10.67 (3.34)	2.40 bc (1.68)	2.20 bc (1.63)	2.20 bc (1.63)	2.67 b (1.71)	2.27 b (1.66)	2.33 b (1.68)	76.37	4.17b (2.16)	1.27 bc (1.31)	35.41 d (5.95)	2.10
T4	Spinosad 45 % SC	8.13 (2.93)	10.15 (3.26)	1.60 d (1.43)	1.53 de (1.41)	1.40 de (1.37)	1.40 c (1.87)	1.20 cd (1.30)	1.27 de (1.32)	85.89	1.75d (1.50)	0.93 cd (1.19)	39.43 ab (6.31)	2.48
T5	Fipronil 05 % SC	8.20 (2.94)	10.63 (3.33)	2.40 bc (1.68)	2.27 bc (1.65)	2.33 b (1.67)	2.40 b (1.70)	2.27 b (1.66)	2.20 bc (1.64)	76.70	3.19c (1.92)	0.53 de (1.01)	38.51 bc (6.24)	2.22
T6	Tolfenpyrad 15 % EC	8.47 (2.98)	10.17 (3.26)	2.80 b (1.81)	2.47 b (1.71)	2.53 b (1.73)	2.80 b (1.81)	2.60 b (1.76)	2.60 b (1.75)	73.46	3.37c (1.96)	0.40 e (0.94)	36.15 d (6.05)	2.14
T7	Check - Imidacloprid 17.80 % SL	8.27 (2.95)	10.11 (3.24)	1.93 cd (1.54)	1.73 c (1.48)	1.73 c (1.49)	1.60 c (1.44)	1.40 c (1.37)	1.60 c (1.44)	83.20	1.77d (1.50)	0.53 de (1.01)	48.42 bc (6.23)	2.56
T8	Control-untreated	8.47 (2.93)	10.16 (3.25)	8.20 a (2.94)	9.47 a (3.15)	10.67 a (3.34)	10.20 a (3.26)	10.47 a (3.30)	10.53 a (3.31)		13.06a (3.68)	2.47 a (1.71)	33.22 e (5.80)	1.82
	SEM	NS	NS	0.063	0.055	0.058	0.061	0.077	0.079		0.044	0.072	0.057	
	CD (0.01)			0.269	0.232	0.247	0.259	0.325	0.334		0.232	0.305	0.242	
	CD (0.05)			0.193	0.167	0.178	0.187	0.234	0.241		0.167	0.220	0.174	

Values in the parenthesis are square root transformed; NS - Non-significant; DAS - Days After Spray; PDI-Percent disease index; ROC - Reduction over control; (*) - Mean value of three locations; Figures followed by the same letter in the same column did not differ significantly by DMRT

Authors' contributions

VAV conducted the field trial and drafted the manuscript. PY and CT contributed to the experimental design and data acquisition. As horticulturist and agronomist, respectively, AP and KS were actively involved in cultivation practices. RM and SB contributed to the analysis and interpretation of the data, as well as the drafting of the manuscript. SS analysed pest and disease incidence and was involved in PDI calculation.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

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Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

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