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Bio-efficacy of novel insecticides and biorationals against invasive thrips, *Thrips parvispinus* (Karny) (Thripidae:Thysanoptera) on chilli

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ABSTRACT: Invasive thrips, *Thrips parvispinus* (Karny) is a relatively new pest on chilli crop. This species has been occurring in serous proportions and causing significant damage to chilli crop in most of the chilli growing areas of India.In this study we assessed the bio-efficacy of new generation molecules and biorationals against *T. parvispinus*. The results suggested that new molecules *viz*., broflanilide 30 SC (18.60g a.i/ha) and fluxametamide 10 EC (40 g a.i/ha) were found highly effective in reducing the thrips population on chilli crop, followed by spinetoram 11.7 SC (60 g a.i/ha) and tolfenpyrad 15 EC (150 g a.i/ha). Other insecticides *viz*., spinosad 45 SC (73 g a.i/ha), cyantraniliprole 10.26 OD (60 g a.i/ha) and thiamethoxam 25 WG (37.50 g a.i/ha) were found moderately effective on this species. Biorationals *viz*., *Lecanicillium lecanii* (2.5 kg /ha), *Beauveria bassiana* (2.5 kg /ha) and azadirachtin 1 % (2.00 ml/l) recorded comparatively higher thrips populations. The results of this investigation may be useful forthe management of invasive thrips on chilli using insecticides. Further, broflanilide and fluxametamide exhibit similar mode of action and hence must be used prudently to delay the evolution of resistance.

Keywords: Invasive thrips, *Thrips parvispinus*, chilli, bio-efficacy, broflanilide 30 SC, fluxametamide 10 EC

INTRODUCTION

Chilli is considered as one of the important commercial spice and vegetable crops in India. It is a widely used universal spice and named as “wonder spice”. India is the largest producer, consumer and exporter of dry chilli in the world. Chilli was cultivated on an area of 852,000 hectares with 1578000 MT of production and 1.90 MT productivity per hectare during 2021-22 (Anon., 2023a). On chilli crop over 35 species of insects and mites have been reported as pests. Thrips and mites are considered as major constraints for successful production of chilli. Among the thrips, *Scirtothrips dorsalis* (Hood) was reported as a major Thrips species infesting chilli. However, of late, a new invasive thrips, *Thrips parvispinus* (Karny) has been causing serious damage to leaves, flowers and fruits of chilli plants in major chilli growing regions of the country. Occurrence of this species in India was first reported on papaya from Bangalore, Karnataka State (Tyagi *et al.,* 2015). Later, an outbreak of *T. parvispinus* on chilli crop was reported from southern states *viz*., Andhra Pradesh, Karnataka and Telangana, causing 50 to 80 per cent damage (Anon., 2022). It is a polyphagous pest, infesting mainly fruits, vegetables and ornamental crops *viz.,* coffee, chilli, *Gardenia* sp., papaya, potato, sweet pepper, green bean, tobacco, *Vigna* sp., strawberry, watermelon, eggplant and cucurbits (Moritz *et al.,* 2013). The nymphs and adults predominantly colonize on underside of leaves and flowers, cause damage by sucking the plant sap (Kalshoven, 1981). Deep punctures and scratches can be seen on infested leaves. Brownish streaks appear on petals of flowers due to laceration by thrips, resulting in drying and withering of flowers. Severe infestation affects the growth of the plant, causes flower drop, reduces fruit set and development, ultimately resulting in yield loss. In severe infestation conditions, the yield loss could reach more than 85% (Prasannakumar *et al.,* 2021).

The damage caused by *T. purvispinus* to chilli crop can be minimized by adopting proper pest control tactics. Along with other integrated control options, application of insecticides plays a prominent role in reducing yield losses associated with thrips infestation. Owing to short developmental time and completion of multiple generations within single cropping season, insecticides are applied several times for the control of this pest. Further, *T. parvispinus* is a new pest on chilli in India and information regarding efficacy of insecticides against this invasive species is scanty. Therefore, the present study was carried out to assess the efficacy of insecticides and biorationals against *T. parvispinus* on chilli. The information generated in the present study may form valid basis for choosing appropriate insecticides for the control *T. parvispinus* on chilli crop.

MATERIALS AND METHODS

The bio-efficacy of insecticides and biorationals against *T.parvispinus*, *Thrips parvispinus* on chilli was assessed during *rabi* 2022 and summer 2023. The experiment was laid out in Randomized Block Design (RBD). The study

Table 1. Bio-efficacy of insecticides and biorationals against *T. parvispinus* on chilli (*rabi* 2022)

Treatments	g a.i/ha	PTC	I Spray		II Spray		Overall Mean	Reduction (%)
			7 Days	14 Days	7 Days	14 Days		
Thiamethoxam 25% WG	37.50	14.33 (3.92)	8.75 (3.12)	5.58 (2.56)	3.83 (2.17)	2.50 (1.87)	5.17 (2.48)	72.86
Cyantraniliprole 10.26% OD	60.00	13.42 (3.8)	7.33 (2.89)	4.67 (2.38)	3.42 (2.1)	2.00 (1.73)	4.35 (2.31)	75.57
Spinosad 45.0% SC	73.00	13.67 (3.83)	6.58 (2.75)	4.17 (2.27)	3.25 (2.06)	1.75 (1.65)	3.94 (2.22)	78.31
Broflanilide 30% SC	18.60	14.92 (3.99)	3.75 (2.18)	1.33 (1.53)	0.75 (1.30)	0.25 (1.11)	1.52 (1.59)	92.33
Fluxametamide 10% EC	40.00	14.67 (3.96)	4.50 (2.34)	2.25 (1.79)	1.33 (1.53)	0.75 (1.32)	2.21 (1.79)	88.67
Spinetoram 11.7 % SC	60.00	13.58 (3.82)	5.67 (2.58)	3.08 (2.02)	2.00 (1.73)	1.08 (1.44)	2.96 (1.99)	83.60
Tolfenpyrad 15EC	150.00	13.00 (3.74)	6.33 (2.7)	3.83 (2.19)	2.50 (1.87)	1.50 (1.58)	3.54 (2.13)	79.49
Azadirachtin 1%	-	12.83 (3.72)	11.75 (3.57)	10.42 (3.38)	9.58 (3.25)	8.83 (3.14)	10.15 (3.34)	40.49
Beauveria bassiana	-	12.42 (3.66)	11.50 (3.54)	10.58 (3.4)	9.42 (3.23)	8.33 (3.05)	9.96 (3.31)	39.63
Lecaniciliumlecanii	-	13.08 (3.78)	12.50 (3.67)	10.75 (3.43)	9.00 (3.16)	8.08 (3.01)	10.08 (3.33)	41.97
Control	-	12.50 (3.67)	14.50 (3.93)	16.17 (4.14)	17.25 (4.27)	18.50 (4.42)	16.60 (4.20)	-
SEm±		0.09	0.07	0.08	0.07	0.07	0.04	-
CD		NS	0.23	0.24	0.21	0.21	0.13	-

*PTC= Pre-treatment count; NS- Non-significant

consisted of eleven treatments and every treatment was replicated thrice (Table 1). The chilli crop was grown as per the recommeded package of practice (except plant protection measures). The crop was regularly monitored to assess the incidence of thrips. The treatments were imposed when adequate thrips population was noticed in the field. The insecticides were sprayed two times at 14 days interval using knapsack sprayer.

Data recording and analysis:

The observations were recorded from five randomly selected plants in each replication. Number of thrips present in five flowers were recorded on every selected plant and later average number of thrips per flower was worked out. The thrips population was recorded at one day before, seven and fourteen days after spraying of insecticides. The data were subjected to square root transformation and transformed data was analysed using ANOVA (Gomez and Gomez, 1984). Reduction in thrips population (per cent) in insecticide treated plots over untreated control was calculated using Henderson and Tilton formula (Henderson and Tilton, 1955).

RESULTS AND DISCUSSION

Efficacy of insecticides and biorationals against *Thrips parvispinus* during *rabi* 2022

At one day before spray, average number of thrips ranged from 12.42 to 14.92 thrips per flower (Table 1). Prior to the imposition of treatments, thrips population across treatment plots did not vary significantly. Application of insecticides resulted in considerable decrease in pest density in the experimental plots. After two sprays, significantly less population of thrips was observed in broflanilide 30 SC (18.60 g a.i/ha) (1.52 thrips/flower), followed by fluxametamide 10 EC (40.00 g a.i/ha) (2.21 thrips/flower) treated plots. The insecticides *viz*., spinetoram 11.7 SC (60.00 g a.i/ha),tolfenpyrad 15 EC (150 g *a.i*/ha), spinosad 45 SC (73.00 g *a.i*/ha), cyantraniliprole 10.26 OD (60.00 g *a.i*/ha)and

Table 2. Bio-efficacy of insecticides and biorationals against *T. parvispinus* on chilli (Summer 2023)

Treatments	g *a.i*/ha	PTC	I Spray		II Spray		Overall Mean	Reduction (%)
			7 Days	14 Days	7 Days	14 Days		
Thiamethoxam 25% WG	37.50	18.08 (4.37)	10.33 (3.37)	6.75 (2.78)	4.50 (2.32)	3.58 (2.14)	6.29 (2.70)	69.04
Cyantraniliprole 10.26% OD	60.00	16.17 (4.14)	8.50 (3.08)	5.00 (2.44)	3.83 (2.19)	2.50 (1.87)	4.96 (2.44)	72.71
Spinosad 45.0% SC	73.00	16.00 (4.12)	7.25 (2.87)	5.00 (2.44)	3.58 (2.14)	2.83 (1.96)	4.67 (2.38)	74.05
Broflanilide 30% SC	18.60	18.25 (4.39)	4.25 (2.29)	2.00 (1.72)	0.92 (1.38)	0.50 (1.22)	1.92 (1.71)	90.65
Fluxametamide 10% EC	40.00	18.17 (4.38)	5.00 (2.45)	2.92 (1.98)	1.75 (1.66)	0.83 (1.35)	2.63 (1.90)	87.14
Spinetoram 11.7 % SC	60.00	18.00 (4.36)	6.33 (2.70)	4.33 (2.31)	2.33 (1.82)	1.75 (1.65)	3.69 (2.16)	81.77
Tolfenpyrad 15EC	150.00	17.33 (4.28)	6.75 (2.78)	5.17 (2.48)	3.25 (2.06)	2.25 (1.8)	4.35 (2.31)	77.65
Azadirachtin 1%	-	17.83 (4.34)	15.00 (4.00)	13.00 (3.74)	11.00 (3.46)	9.42 (3.23)	12.10 (3.62)	39.60
Beauveria bassiana	-	16.92 (4.23)	15.17 (4.02)	12.50 (3.67)	9.75 (3.28)	9.42 (3.23)	11.71 (3.56)	38.41
Lecaniciliumlecanii	-	17.50 (4.30)	15.00 (4.00)	13.00 (3.73)	9.67 (3.27)	9.08 (3.17)	11.69 (3.56)	40.57
Control	-	17.00 (4.24)	17.92 (4.35)	19.08 (4.48)	19.33 (4.51)	20.08 (4.59)	19.10 (4.48)	-
SEm±		0.07	0.08	0.07	0.06	0.05	0.03	-
CD		NS	0.25	0.22	0.19	0.16	0.10	-

* PTC= Pre-treatment count; NS- Non-significant

thiamethoxam 25 WG (37.50 g a.i/ha) recorded 2.96, 3.54, 3.94, 4.35 and 5.17thrips per flower, respectively. On the other hand, biorationals *viz., Beauveria bassiana* (2.50 kg/ha), *Lecanicillium lecanii* (2.50 kg/ha) and azadirachtin 1 % (2ml/l) recorded higher populations of 9.96, 10.08 and 10.15 thrips per flower, respectively. The maximum per cent reduction in thrips population over untreated control was recorded in broflanilide 30 SC (92.33 %), followed by fluxametamide 10 EC (88.67 %), spinetoram 11.7 SC (83.60%) and tolfenpyrad 15 EC (79.49 %).

Efficacy of insecticides and biorationals against *T. parvispinus* during summer 2023

Prior to imposition of treatments, the mean number of thrips ranged from 16.00 to 18.25 thrips per flower (Table 2). Thrips populations reduced considerably in the treated plots after spraying of insecticides. Application of broflanilide 30 SC @ 18.60 g a.i/ha resulted in significant control of thrips (1.92 thrips/flower) and was followed by fluxametamide 10 EC @ 40 g *a.i*/ha (2.63), spinetoram 11.7 SC @ 60.00 g a.i/ha (3.69) and tolfenpyrad 15 EC @ 150 g a.i/ha (4.35). The insecticides *viz*., spinosad 45 SC (73.00 g a.i/ha), cyantraniliprole 10.26 OD (60.00 g *a.i*/ha) and thiamethoxam 25 WG (37.50 g a.i/ha) were found moderately effective in controlling thrips on chilli. Comparatively higher thrips population was noticed in biorationals applied plots. The plots treated with *Lecanicillium lecanii* (2.50 kg/ha), *Beauveria bassiana* (2.50 kg/ha) and azadirachtin 1 % (2ml/l) recorded 11.69, 11.71 and 12.10 thrips per flower, respectively. Maximum reduction in thrips population over the untreated control was recorded in broflanilide 30 SC (90.65%), followed byflux ametamide 10 EC (87.14%), spinetoram 11.7 SC (81.77%) and tolfenpyrad 15 EC (77.65%).

Pooled data on efficacy of insecticides against *T. parvispinus* (*Rabi* 2022 and Summer 2023)

Analysis of the data recorded during two seasons suggested significantly higher reduction in thips

Table 3. Pooled data on bio-efficacy of insecticides and biorationals against *T. parvispinus* on chilli

Treatments	g *a.i*/ha	PTC	I Spray		II Spray		Overall Mean	Reduction (%)
			7 Days	14 Days	7 Days	14 Days		
Thiamethoxam 25% WG	37.50	16.21 (4.15)	9.54 (3.25)	6.17 (2.68)	4.17 (2.25)	3.04 (2.01)	5.73 (2.59)	70.80
Cyantraniliprole 10.26% OD	60.00	14.79 (3.97)	7.92 (2.99)	4.83 (2.41)	3.63 (2.15)	2.25 (1.80)	4.66 (2.38)	73.99
Spinosad 45.0% SC	73.00	14.83 (3.98)	6.92 (2.81)	4.58 (2.36)	3.42 (2.1)	2.29 (1.81)	4.30 (2.30)	76.04
Broflanilide 30% SC	18.60	16.58 (4.19)	4.00 (2.23)	1.67 (1.63)	0.83 (1.34)	0.38 (1.17)	1.72 (1.65)	91.44
Fluxametamide 10% EC	40.00	16.42 (4.17)	4.75 (2.4)	2.58 (1.89)	1.54 (1.59)	0.79 (1.34)	2.42 (1.85)	87.84
Spinetoram 11.7 % SC	60.00	15.79 (4.10)	6.00 (2.64)	3.71 (2.17)	2.17 (1.78)	1.42 (1.55)	3.32 (2.08)	82.62
Tolfenpyrad 15EC	150.00	15.17 (4.02)	6.54 (2.74)	4.50 (2.34)	2.88 (1.97)	1.88 (1.69)	3.95 (2.22)	78.50
Azadirachtin 1%	-	15.33 (4.04)	13.38 (3.79)	11.71 (3.56)	10.29 (3.36)	9.13 (3.18)	11.13 (3.48)	40.06
Beauveria bassiana	-	14.67 (3.96)	13.33 (3.79)	11.54 (3.54)	9.58 (3.25)	8.88 (3.14)	10.83 (3.44)	38.98
Lecaniciliumlecanii	-	15.29 (4.04)	13.75 (3.84)	11.88 (3.59)	9.33 (3.21)	8.58 (3.10)	10.89 (3.45)	41.19
Control	-	14.75 (3.97)	16.21 (4.15)	17.63 (4.32)	18.29 (4.39)	19.29 (4.50)	17.85 (4.34)	-
SEm±		0.13	0.07	0.05	0.05	0.04	0.03	-
CD		NS	0.21	0.16	0.15	0.12	0.09	-

*PTC= Pre-treatment count; NS- Non-significant

population in broflanilide 30 SC @ 18.60 g a.i/ha treated plants (1.72 thrips/flower), followed by fluxametamide 10 EC @ 40 g a.i/ha (2.42), spinetoram 11.7 SC @ 60.00 g a.i/ha (3.32) and tolfenpyrad 15 EC @ 150 g a.i/ha (3.95). The treatments *viz*., spinosad 45 (73.00 g a.i/ha), cyantraniliprole 10.26 OD (60.00 g a.i/ha) and thiamethoxam 25 WG (37.50 g a.i/ha) were found moderately effective with 4.30, 4.66 and 5.73 thrips per flower, respectively. The biorationals *viz*., *Beauveria bassiana* (2.50 kg/ha), *Lecanicillium lecanii* (2.50 kg/ha) and azadirachtin 1 % (2ml/l) recorded relatively higher thrips populations compared to other treatments. Maximum per cent reduction in thrips population was recorded in broflanilide 30 SC (91.44%) sprayed plots, followed by fluxametamide 10 EC (87.84%), spinetoram 11.7 SC (82.62%) and tolfenpyrad 15 EC (78.50%).

It was noticed that among the assessed chemicals, broflanilide and fluxametamide were found highly effective. Broflanilide is a meta-diamide insecticide with a novel mode of action and exhibits insecticidal activity against various insect pests belong to order Lepidoptera, Coleopteran and Thysanoptera (Katsuta *et al*., 2019). Translaminar action of broflanilide offers ability to control targeted insect populations such as thrips that may feed on the underside of the leaf, even when the chemical is applied on the upper leaf surface. Fluxametamide is another new insecticide molecule belonging to isoxazoline group. However, both broflanilide and fluxametamide are GABA-gated chloride channel allosteric modulators and exhibit similar mode of action (Anon., 2023b). As both these chemicals are effective on invasive thrips, *T. parvispinus*, it is possible that both of these chemicals may be applied on the same crop. This situation may trigger to evolution of resistance in thrips against these molecules at an accelerated rate. Therefore, it is necessary to educate the chilli growers to use these insecticides more prudently. Chilli is a relatively long duration crop and may require application of insecticides multiple times for the effective control of thrips.

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