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ENTOMOLOGY

Study of population dynamics and impact of abiotic factors on thrips, *Scirtothrips dorsalis* of chilli, *Capsicum annuum* and comparative bio-efficacy of few novel pesticides against it

Shafia Zainab, Sandeep Kumar Sathua* and R.N. Singh

Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, India

*Corresponding authors: sandeepkumar.sathua@gmail.com

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Abstract

Field experiment to study the population dynamics and bio-efficacy of some newer pesticides at various test concentrations against chilli thrips, *Scirtothrips dorsalis* Hood, on chilli crop was tested in field conditions. The highest incidence of thrips was observed during first week of October. The population of thrips showed significant positive correlation with maximum temperature and negatively correlated with rainfall, relative humidity. The bio-efficacy results revealed that the mean per cent reduction in thrips population over the untreated-control in Pyridaben 20% WP 125g a.i/ha was significantly superior over other treatments; with highest per cent reduction of 74.47%; closely followed by Fenpyroximate 5% EC 20g a.i/ha (70.58%). Pyridaben 20% WP 100g a.i/ha and Propargite 57% EC both were less effective than previous two treatments and were at par with a reduction of 68.08% and 65.45% respectively. However, the lower doses of Pyridaben 20% WP 50g a.i/ha and 75g a.i/ha gave the lowest performance with a mean percent reduction of 56.66% and 59.85% respectively against control. Such studies are helpful in developing prediction models against thrips for its efficient management with combining both conventional and newer pesticides.

Highlights

- The pesticides used have rarely been tested for control of *Scirtothrips dorsalis* Hood.
- The result obtained was highly significant in the pest management and also enhance the yield.

Keywords: Population dynamics, bio-efficacy, thrips, pyridaben, propargite, fenpyroximate

Chilli is an important spice cum commercial vegetable crop of India, introduced to India, Indonesia and other parts of the Asia around 450-500 years ago by Portuguese traders (Berke and Scieh 2000). The pest spectrum of chilli is complex with more than 293 insects and a mite species debilitating the crop in the field as well as storage (Anonymous 1987). The chilli thrips was proved as a major pest in the chilli crop because of its presence during most of the crop life. Since there is great variation in different agro climatic conditions of various regions; the pests show varying trends in their distribution, incidence, nature and extent of damage to the crop.

Moreover, there may also be some unknown factors contributing major role in incidence and dominance of a particular pest or pest complex. Both the nymphs and adults of thrips feed by rasping and sucking the oozing cell sap due to which leaves exhibit characteristic upward curling symptoms. The attacked plants are stunted and may finally dry up. A yield loss due to mite and thrips were estimated to the tune of 50 per cent (Ahmed *et al*. 1987 and Kandasamy *et al*. 1990).

The present research therefore, was carried out with an objective to study the population dynamics of chilli thrips in relation with different weather parameters and to evaluate the bio efficacy of some commercially available newer pesticides (pyridaben 20% WP, propargite 57% EC and fenpyroximate 5% EC) at various test concentrations in the field to screen out the most effective one that can be used efficiently by the farming community.

Materials and methods

Experimental details

The experiment was conducted during the *kharif* season of 2014, at the Agricultural Research Farm, Banaras Hindu University (B.H.U), Varanasi (24° 56′ N to 25° 35′ N Latitude and 82° 14′ E to 83° 24′ E Longitude). The population dynamics and bio-efficacy of pesticides against chilli thrips (*Scirthothrips dorsalis* Hood) was studied in the field condition by taking two separate plots for both experiment. The trial field for bio-efficacy was laid out in Randomized Block Design (RBD) with 3 replications and 7 treatments including an untreated control with plot size of 3m × 2m each. Seedlings of the chilli variety G-4 were raised in nursery and 30 days old seedlings were transplanted in main field during last week of July 2014 with a pre-treatment in carbendazim (0.1 %) solution.

Treatments and method of application

The plots were sprayed with seven treatments *viz.*, Pyridaben 20% WP at 4 doses *i.e.* 50g a.i/ha, 75g a.i/ha, 100g a.i/ha and 125g a.i/ha; Propargite 57% EC 570g a.i/ha; Fenpyroximate 5% EC 20g a.i/ha and an untreated check (sprayed only with water) using a knapsack sprayer, when the thrips population reached Economic Threshold Level.

Data collection and Statistical analysis

For Seasonal incidence

To study the seasonal occurrence of thrips (both nymphs and adults) population on chilli crop three plots of 3 m × 2 m were kept free from every plant protection measures and the sampling was done from five randomly selected plants. Three leaves were plucked from each plant from varying heights of same plant *i.e.* upper, middle and lower position (Satpathy 1973). The count of thrips population was preferably done during early morning hours *i.e.* between 6.30 AM to 8 AM at weekly intervals. The meteorological data on temperature, relative humidity and rain fall were recorded weekly during the experimental period and correlation was worked out between insect pest population and abiotic factors.

For bio-efficacy

The observations were recorded from five randomly selected and tagged plants from each plot with sampling of 3 leaves per plant from upper, middle and lower portion of the tagged plant. They were brought to laboratory in zip-lock poly-bags separately and counted with the help of stereoscopic binocular microscope. The data of percentage reduction in thrips population after 1, 3, 5, 10 days of spraying of chemical was calculated by using Abbot's formula (1925).

$$\% \text{ reduction} = \frac{\text{Average reduction in population}}{\text{Average pre treatment population}} \times 100$$

The significant difference between the mortality caused by the treatments in respect to untreated check was judged by C.D values at 5% level of significance. Harvesting of red ripe fruits was done in three pickings, weighed, converted to kilograms per hectare and mean yield of different treatments were recorded. The data were statistically analyzed using OPSTAT computer software (CCS Haryana Agricultural University, Hisar, India)

Results and Discussion

For Seasonal incidence

In the present study we found that there was gradual rise in the thrips incidence after transplanting. The first appearance of thrips was observed when crop was two-weeks old *i.e.*, during the 31st standard week (Table1, Figure1).The population increased steadily and touched its peak during first week of October with a mean of 14.1 thrips per leaf *i.e.*, during the 40th standard week. After which the pest density remained more or less around the same figure. From the 47th standard week onwards *i.e.*, during third week of November; the population started declining gradually.

Correlation coefficient values (Table 2) worked out for the incidence of *S. dorsalis* and weather parameters revealed that, the population of thrips had significant positive correlation with maximum temperature (r = 0.6331), whereas it was negatively correlated with rainfall, relative humidity (morning), relative humidity(evening), relative humidity (average), temperature(minimum) and temperature(average) with correlation coefficient (r) value of -0.4842, -0.1331, -0.5708, -0.5631, -0.5773 and -0.2872 respectively. Similar results have been observed by Meena *et al.* (2013).

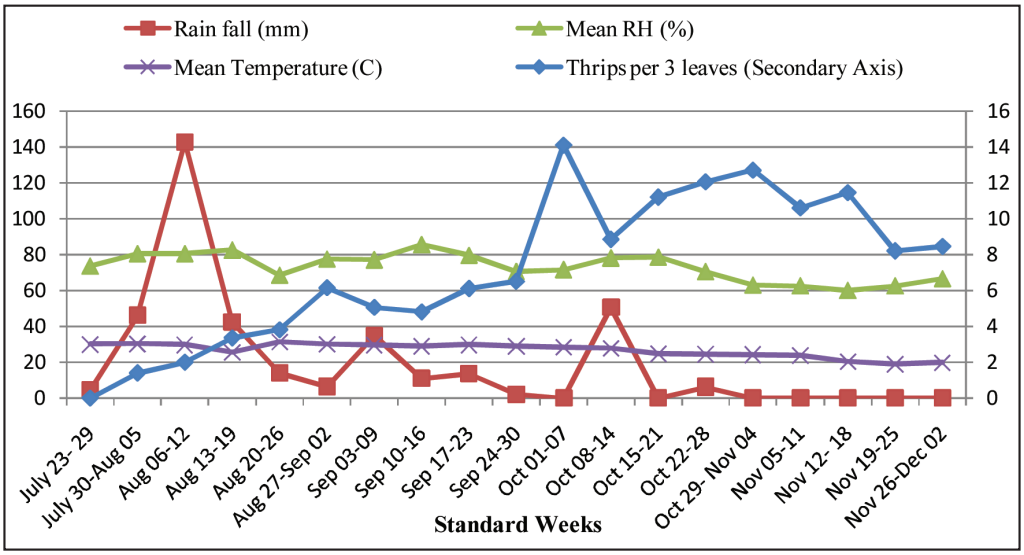

Fig. 1: Seasonal incidence of trips population in relation to different weather parameters in2014

Table 1: Incidence of thrips population during *kharif* 2014

Sl. No.	Standard Week	Thrips per 3 leaves
1	30	0
2	31	1.40
3	32	2.00
4	33	3.35
5	34	3.80
6	35	6.15
7	36	5.05
8	37	4.80
9	38	6.10
10	39	6.50
11	40	14.10
12	41	8.85
13	42	11.20
14	43	12.05
15	44	12.70
16	45	10.60
17	46	11.45
18	47	8.20
19	48	8.45

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For bio-efficacy

In the experiment, we evaluated seven treatments and an untreated check (sprayed only with water) to observe the efficacy of the chemicals against chilli thrips, one day before spraying and after 1, 3, 5, 10 days of spraying respectively.

Result of first spray

One day after the first spray, all the treatments showed significant reduction of over 60% in thrips' population compared to control which was expressed in Table 3. The mean percent reduction in thrips population was highest in case of Pyridaben 20% WP 125g a.i/ha (75.03%) after the 1st spray. Kodandaram *et al*., (2010) have also reported that Pyridaben shows excellent activity against all developing stages of phytophagous mites and also effective against thrips of vegetable crops. Fenpyroximate 5% EC 20g a.i/ha (71.49%) was next best treatment found. Pyridaben 20% WP 100g a.i/ha and Propargite 57% EC both remained at par with a reduction of 67.67% and 64.20% thrips respectively. The lower doses of Pyridaben 20% WP at the rate of 50g a.i/ha and 75g a.i/ha showed comparatively less effectiveness with a mean percentage reduction of 57.36% and 61.01% respectively when compared to other treatments.

Result of second spray

The second spray was done 22 days after the first spray. The result of 2nd spray also came out in similar fashion as the first spray. This time again mean percent reduction in thrips population was again highest in case of Pyridaben 20% WP 125g a.i/ha with 73.91% over control which was closely followed by Fenpyroximate 5% EC 20g a.i/ ha with a mean reduction 69.66% of thrips. The results obtained by Biswas *et al.,* (2009) also indicates that Fenpyroximate 5% SC (SEDNA) @ 500 ml formulation per hectare was found to be the best acaricide among Fenazaquin 10 EC, Propargite 57 EC, Fenpropathrin 10 EC, Dicofol 18.5 EC and Bifenthrin 10 EC in controlling chilli yellow mite. Pyridaben 20% WP 100g a.i/ha and Propargite 57% EC remained at par with per cent reduction of 68.48% and 66.70% over control respectively. Similarly, the lower doses of Pyridaben 20% WP at the rate 50g a.i/ha and 75g a.i/ha proved moderately effective against thrips.

Table 2: Correlation (r) between population of *S. dorsalis* and weather parameters during *kharif* 2014

Thrips	Correlation coefficient (r)					
Rainfall	Relative Humidity (RH)			Temperature		
	Morning	Evening	Average	Maximum	Minimum	Average
-0.4842	-0.1331	-0.5708	-0.5631	0.6331	-0.5773	-0.2872

Yield

The yield data confirmed the superiority of Pyridaben 20% WP 125g a.i/ha providing highest yield (2442.2kg/ha) with 56.24% increase in yield over control, followed by Fenpyroximate 5% EC 20g a.i/ha (2385.3 kg/ha)with 52.60% increase, Pyridaben 20% WP 100 g.a.i/ha (2334.3 kg/ha) with 49.34% increase and Propargite 57% EC 570g a.i/ ha(2185.4 kg/ha) with 39.81% increase in yield. Results are shown in the figure 2 and table 3. All other treatments show moderate to lower percentage increase in yield over the untreated check.

In our extensive study we found that Pyridaben20% WP at 125g and 100g a.i/ha along with Fenpyroximate 5% EC and Propargite 57% EC remained significantly effective in checking the population of chilli thrips throughout the season. The mortality percentage of thrips reduced sharply after seven to ten days of spraying; that showed the reduction in the efficiency of pesticides, when compared to the mortality one day after spray with that of ten day after spray showed in Table 3. The research material available in this area is scanty. Though Thania and Thomas (2013) have found that the leaf curling symptom due to feeding of mites and thrips was lowest in spiromesifen followed by propargite and acetamiprid treated chilli plants at 1 and 2 week after insecticidal spray. Similar to our findings, Singh and Singh (2014) have also reported that Fenpyroximate 5% EC showed superior results than propargite 57% EC against *Tetranychus neocaledonicus* in brinjal.

Table 3: Per cent reduction in thrips populationover control and yieldin chilli crop

Treatment	Concentration (g a.i./ha)	First spray						Second spray						Overall Mean % reduction	Yield of red ripe fruits (kg/ha)
		1 DBS	1 DAS	3DAS	5 DAS	10 DAS	Mean	1 DBS	1 DAS	3DAS	5 DAS	10 DAS	Mean		
Pyridaben 20% WP	50	10.33	64.5* (55.11)**	58.08 (51.25)	54.88 (47.53)	51.99 (45.85)	57.36	11.00	66.72 (56.77)	60.13 (51.37)	54.54 (46.73)	42.45 (36.57)	55.96	**56.66**	1699.5
Pyridaben 20% WP	75	8.33	68.06 (59.90)	63.98 (55.67)	60.02 (51.42)	51.98 (45.82)	61.01	8.66	69.28 (61.41)	61.54 (52.67)	57.73 (50.57)	46.18 (40.89)	58.68	**59.85**	1894.7
Pyridaben 20% WP	100	5.66	76.50 (69.70)	70.67 (60.37)	64.66 (55.78)	58.83 (51.47)	67.67	6.18	78.98 (69.04)	73.77 (63.12)	63.19 (53.24)	57.97 (49.85)	68.48	**68.08**	2334.3
Pyridaben 20% WP	125	7.33	81.85 (73.65)	77.35 (69.15)	72.71 (64.51)	68.21 (58.75)	75.03	7.66	81.85 (71.90)	77.35 (68.04)	72.71 (63.75)	63.71 (53.60)	73.91	**74.47**	2442.2
Propargite 57% EC	570	7.00	72.33 (64.25)	66.66 (57.26)	61.16 (52.56)	56.66 (42.26)	64.20	6.33	77.83 (68.14)	72.33 (62.45)	66.66 (56.76)	50.00 (42.93)	66.70	**65.45**	2185.4
Fenpyroximate 5% EC	20	6.00	81.00 (73.05)	76.28 (68.19)	66.71 (57.11)	62.00 (56.11)	71.49	7.33	82.63 (72.02)	73.89 (63.57)	69.58 (61.78)	52.52 (45.12)	69.66	**70.58**	2385.3
Untreated Control	**-**	6.33	00.00	00.00	00.00	00.00	-	9.00	00.00	00.00	00.00	00.00	-	-	1563.08
C.D(0.05)	-	-	**2.03**	**2.42**	**2.71**	**2.00**	-	-	**2.63**	**2.47**	**2.87**	**2.36**	-	-	**202. 57**
SE(m)	-	-	**0.65**	**0.78**	**0.87**	**0.64**	-	-	**0.84**	**0.79**	**0.92**	**0.75**	-	-	-

Legend:*Mean of 3 replications, **Figures in parenthesis are arc-sin percentage transformed values, DBS- Day before spraying, DAS- Day after spraying

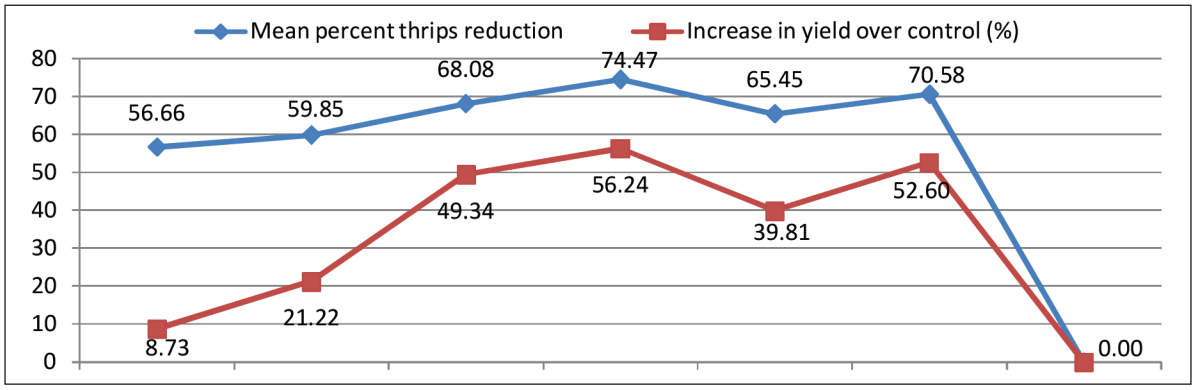

Fig. 2: Comparative studies between the percent mite reduction and increase in yield over control

Conclusion

The study on seasonal incidence helps us in deciphering the proper time for management of the thrips by targeting the vulnerable stage of insect. The newer molecules were found to be effective against chilli thrips and consequently it was reflected in yield as well. In view of the efficacy of these pesticides against sucking pest of chilli, they can be incorporated as the chemical component in the integrated pest management programme.

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