Field evaluation of biorationals and chemical insecticides against *Thrips parvispinus* (Karny) (Thysanoptera: Thripidae), in chrysanthemum

ABSTRACT

Field study was conducted to evaluate the efficacy of biorationals and chemical insecticides against black thrips, *Thrips parvispinus* (Karny) on chrysanthemum. Thrips population ranged from 15.33 to 13.89/flower before spraying. The efficacy of seven biorationals and seven chemical insecticides were evaluated against black thrips under field conditions. The application of pongamia soap @7g/lit and Spinosad 45% SC @ 0.2 ml/lit reduced the thrips incidence significantly among the biorational and chemical insecticides respectively. The mean per reduction of thrips incidence in pongamia soap @ 7 gm/lit application was 74.90%. This was followed by neem soap @ 7g/lit (72.25%), azadirachtin @10000ppm (71.10%), *Beauveria bassiana* (66.76%), *Isaria fumosorosea* (64.93%), *Lecanicillium lecanii* (63.72%), and *Metarhizium anisopilae (*62.46%). Among the chemical insecticides Spinosad 45%SC @ 0.2 ml/lt. stood first in the order of efficacy with 80.2% reduction in thrips population. The order of efficacy of chemical insecticides against black thrips in chrysanthemum are spinetoram 11.7%SC (76.245%) > cyantraniliprole 10%OD (73.92%) > fipronil 5% SC (72.24%) > thiamethoxam 25% WG (70.79%) > dinotefuran 20% WG (69.80%) > tolfenpyrad 15% EC (68.02%). The effective biorational and chemical insecticide can be included as a component in the Integrated pest management of thrips complex in chrysanthemum. The rotation of effective compounds will reduce the resistance development against insecticides in thrips associated with chrysanthemum and also reduces the thrips infestation.

Keywords: [Thrips parvispinus, chrysanthemum, bio-rational, chemical insecticides)

1. INTRODUCTION

Chrysanthemum (*Chrysanthemum indicum* L.) is a member of the Asteraceae family and also known as the “Queen of the East” due to its broad diversity of flower forms and sizes, brilliant colours, and prolonged blooming period. It has a wide range of types such as pompon, anemone, spider, incurving, reflexing, spoon type, quilled, incurved, and ball type. Chrysanthemum is one of the top ten cut flowers in the global trade and one of the top five cut flowers in India (Brahma, 2002; Janakiram *et al.,*2006). Currently, over 2000 kinds of chrysanthemums are grown throughout the world, with 1000 of those cultivars being grown in India (Datta *et al.,* 2001). The aphids, thrips, caterpillars, mites, and leaf miners are important biotic constraints in chrysanthemum cultivation

Thrips parvispinus (Karny) (Thysanoptera: Terebrantia: Thripidae) is a polyphagous invasive pest causes damage beans, eggplant, papaya, chilli pepper, potato, shallot, and strawberry (Moritz *et al.,* 2013; Sartami and Mound, 2013). This invasive pest expanded its geographic range for the past 20 years. Its incidence noticed in French, Greek, Hawaii, Tanzania, Netherlands, India, Thailand, Austraila and India (Mound and Collins, 2000). *Thrips parvispinus* have been found in Hawaii, Greece, and other locations on brinjal, green beans, potatoes, and capsicum (Murai *et al.,* 2009). *T. parvispinus* incidence in papaya was first recorded in Bengaluru, India (Tyagi *et al.,* 2015). The spread and host expansion of *T. parvispinus* in India has been documented by Roselin *et al.,* (2021), Basavaraj *et al.,* (2022) and Rachana *et al.,* (2022).

T.parvispinus damage in chrysanthemum causes qualitative and quantitative losses. The farmers apply combination of insecticides for the management of black thrips in chrysanthemum. The increase in number of broad-spectrum insecticide application increases the chances of control failures. Effective management should consist of molecules with novel model of action and chances of rotation of management options. Many newer insecticide molecules and biorationals options are available against thrips species in other crops. The present field investigation was carried out to identify effective biorational and chemical insecticide against black thrips in chrysanthemum.

2. MATERIAL AND METHODS

2.1. Experimental details

Experiments were conducted in the farmer's field in K.N.Pudur, Tamil Nadu (11°57'17.3"N 78°14'13.0"E), Dharmapuri district to evaluate the efficacy of bio-rational and chemical insecticides against *T.parvispinus* on chrysanthemum. The chrysanthemum variety "Sent yellow” cultivated in a drip cum fertigation system was used in the present investigation. All the agronomic practices were followed as per Tamil Nadu Agricultural University, Coimbatore recommendation. The experiment was laid out in randomized block design (RBD) with 8 treatments and 3 replications of a 40x10 m^2 plot for both biorationals and chemical insecticides in a single field separately. To avoid spray drift and cross-contamination, a 1.5 m isolation was maintained between experimental plots.

2.2. Treatment Details

The biorational and chemical insecticides were evaluated against black thrips under field conditions. The details of the treatments are given in Tables 1 & 2.

Table 1. Biorational insecticides used in the experiment

Treatment No.	Treatment	Dosage	Product details
1	Azadirachtin 10000 ppm	1% (2ml/lit)	Neemazal 1% EC (coromandel, India)

2	Pongamia soap	7 g/lit	Soap formulation (ICAR-IIHR, Bengaluru)
3	Neem soap	7g/lit	Soap formulation (ICAR-IIHR, Bengaluru)
4	*Beauveria bassiana* $1x10^8$ CFU	10 g/lit	*Beauveria bassiana* 1% WP powder ($1x10^8$ CFU) (Organic Dews, Gurgaon, India)
5	*Lecanicillium lecani* $1x10^8$ CFU	10 g/lit	*Verticillum lecanii* 1.0 % W.P powder ($1x10^8$ CFU) (Organic Dews, Gurgaon, India
6	*Metarhizium anisopliae* $1x10^8$ CFU	10 g/lit	*Metarhizium anisopliae* 1.0 % W.P powder (($1x10^8$ CFU) (Organic Dews, Gurgaon, India)
7	*Isaria fumosorosea* $1x10^8$ CFU	5g/lit	*Isaria fumosorosea* ICAR-NBAIR Pfu-5 Talc formulation
8	Untreated control		

Table 2. Chemical insecticides used in the experiment

Treatment No.	Treatment	Dosage	Product details
1	Tolfenpyrad 15% EC	1ml/lit	Tychi 15%EC (Nichno India)
2	Fipronil 5% SC	1ml/lit	Reagent 5 SC (5% w/w) (Bayer, India)
3	Cyantraniliprole 10.26% OD	1ml/lit	FMC BENEVIA 10.26% OD (Dupont company, India)
4	Thiamethoxam 25% WG	0.5 gm/lit	Actara,25% WG, sygenta company, India.
5	Dinotefuran 20% SG	0.5 gm/lit	Indofil token 20% SG, India.
6	Spinosad 45% SC	0.2 ml/lit	Tracer 45% SC, Dow Agro sciences, India.
7	Spinetoram 11.7% SC	0.25 ml/lit	SUMMIT – 11.7% SC, Tata Rallis, India.
8	Untreated Control		

2.3. Application of Treatments

To achieve the desired concentration of spray fluid, a measured amount of the biorational or chemical insecticide was mixed with 10 ml of water and stirred thoroughly. Subsequently, the desired quantity of water was added to the mixture. Spraying was administered using a battery-operated sprayer (20litres/each treatment plot) during morning hours. After imposing each treatment, the sprayer was rinsed thoroughly with water to avoid any residue from previous molecules. While spraying care was taken to avoid any spillover on the adjacent treatments

2.4 observations and data collection:

Precount of thrips population was recorded before treatment application and at 3,5,7 and 14 days after imposing treatments (biorationals or insecticides). Relative sampling methods, such as visual counts of thrips by tapping flower parts on plastic paper, were used. Five flowers were randomly selected in each plot and tapped on white paper to count the number of thrips. The population of nymphs and adults of *T. parvispinus* was estimated by visual examination using a hand lens. The Field data were analysed statistically by using Statistical Package for the Social Sciences (SPSS) software.

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The percent reduction over untreated control was worked using modified Abbot's formula given below.

$$P = \frac{(100 \times 1 - T_a \times C_b)}{(T_b \times c_a)}$$

Where, P = Percent population reduction over control

Ta = Population in treatment after spray

Ca = Population in control after spray

Tb = Population in treatment before spray

Cb = Population in control before spray (Fleming and Ratnakaran, 1985)

3. RESULTS AND DISCUSSION

The efficacy of biorational and chemical insecticides against *T. parvispinus* in chrysanthemum were evaluated under field conditions. The average number of black thrips/flower before the application of biorationals ranged from 12.56 to 13.78 thrips/flower. Among the seven biorationals evaluated against *T. parvispinus* the pongamia soap@7g/lit recorded highest percent reduction of black thrips (74.90%). The neem-based formulation neem Soap @7g/lit and Azadirachtin 1% @1.5ml/lit recorded 72.24 and 71.10 percent reduction control respectively. The order of other biorationals were *B. bassina* (66.76), *I. fumosorosea* (64.93), *L. lecanii* (63.72), *M.anisopilae* (62.46) (Table 1).

After 5th day, the increase in thrips population was observed in the treatment plots and reached14.79 to 15.78 thrips/flower. Immediately after observing the upsurgence in thrips population the biorational second spraying was done. The application of pongamia soap @ 7g/lit recorded 5.00 thrips/flower followed by neem soap @ 7g/lit (5.45 thrips/flower), azadirachtin 1%@ 2ml/lit (5.59 thrips/flower), *B. bassina* (6.38 thrips/flower), *I. fumosorosea* (6.54 thrips/flower), *I. lecanii* (6.86 thrips/flower) and *M. anisopilae* (7.42 thrips/flower).

The precount before application of chemical insecticides were from 14.3 to 14.7 / flower in the experimental plots. Among seven chemical insecticides, Spinosad 45%SC recorded highest percent reduction of thrips (80.2%) followed by spinetoram 11.7%SC (76.24%), cyantraniliprole 10%OD (73.92%), fipronil 5% SC (72.24%) and thiamethoxam 25% WG (70.79%), dinotefuran

20% WG (69.80%) and tolfenpyrad 15% EC (68.02) (Table 2). The thrips population was increased after 7 days of application and the second spraying of chemical insecticides was done. After second spraying, lowest thrips density was found in the Spinosad 45% SC treatment, with a mean of 4.16 thrips / flower, followed by spinetoram 11.7% (5.03 thrips/ flower), cyantraniliprole 10%OD (5.41 thrips/ flower), fipronil 5% SC (5.73 thrips/ flower), thiamethoxam 25% WG (6.09 thrips/ flower), dinotefuran 20% WG (6.33 thrips/ flower), and tolfenpyrad 15% EC (6.56 thrips/ flower).

To minimize the thrips infestation, a second spray was administered, and the results were better than the first spray.

List 1 : **Biorationals in different two sprays.**

Biorationals		**1st spray**			**2nd spray**		
Sl. NO	Treatment	Precount	Mean*	PRC	Precount	Mean*	PRC
1	Azadirachtin 1% 2ml/lit	13.33	8.68 (2.94) ab	40.47	15.33	5.59 (2.36) a	71.10
2	Pongamia soap @7g/lit	13.78	7.30 (2.74) a	51.58	15.78	5.00 (2.21) a	74.90
3	Neem soap @ 7g/lit	13.56	8.38 (2.89) b	43.50	15.56	5.45 (2.32) a	72.24
4	*Beauveria bassiana @10 g/lit*	13.22	9.57 (3.09) c	33.18	15.22	6.38 (2.52) bc	66.76
5	*Metarhizium anisopilae @10g/lit*	13.67	10.05 (3.17) c	32.78	15.67	7.42 (2.72) c	62.46
6	*Lecanicillium lecanii @ 10g/lit*	12.89	10.39 (3.22)	26.32	14.98	6.86 (2.61) c	63.72
7	*Isaria fumosorosea@ 5g/lit*	12.56	9.82 (3.13) c	28.57	14.79	6.54 (2.55) b	64.93
8	Untreated control	13.11	14.35	-	15.11	19.075	-
	S. Em (±)	0.0758	0.0672		0.0815	0.0575	
	CD @5%	0.1626	0.1442		0.1379	0.1233	
	Significant	NS	**		NS	**	

*Mean of 3,5,7,14DAS (days after spraying) replications.
Means followed by the same letter in each column with treatments did not differ significantly at the 5% level by LSD test. Figures in parentheses are √n+1 transformed values, PRC is percent reduction over control, NS = non-significant, **=significant value.

List 2 : **Chemical insecticides in different two sprays.**

Chemical insecticides	**1st spray**	**2nd spray**

Sl.no	Treatment	Precount	Mean*	PRC	Precount	Mean*	PRC
1	Tolfenpyrad 15% EC @ 1ml/lit	14.33	7.17 (2.67) [c]	58.54	12.95	6.56 (2.56)	68.02
2	Fipronil 5% SC @ 1ml/lit	14.397	6.18 (2.48) [bc]	64.44	13.017	5.73 (2.39) [c]	72.24
3	Cyantraniliprole 10% OD @1ml/lit	14.464	5.78 (2.40) [ab]	66.88	13.084	5.41 (2.32) [bc]	73.92
4	Thiamethoxam25 % WG @ 0.5gm/lit	14.531	5.96 (2.44) [c]	66.04	13.151	6.09 (2.46)	70.79
5	Dinotefuran 20% WG @ 0.5gm/lit	14.598	6.56 (2.56) [bc]	62.75	13.218	6.33 (2.51)	69.80
6	Spinosad 45% SC @ 0.2ml/lit	14.665	5.24 (2.20) [a]	70.37	13.285	4.16 (2.04) [a]	80.24
7	Spinetoram 11.7 % SC @ 0.25ml/lit	14.732	5.5 (2.36) [a]	68.95	13.352	5.03 (2.24) [ab]	76.24
8	Untreated control	14.799	17.85 (4.22)	--	13.49	21.285 (4.61)	--
	S.Em (±)	0.0762	0.0561		0.0761	0.0554	
	CD@5%	0.1635	0.1204		0.1632	0.1189	
	Significant	NS	**		NS	**	

Mean of 3,5,7,14das(days after spraying) replications. Means followed by the same letter in each column with treatments did not differ significantly at the 5% level by LSD test. Figures in parentheses are $\sqrt{n+1}$ transformed values, PRC is percent reduction over control, NS = non-significant, **=significant value

Venkateswarlu *et al.,* 2021 revealed that pongamia oil in combination with neem oil, cotton seed oil, and citronella oil was the most effective in managing sucking pests in chilli plants. The application of pongamia cake, vermicompost, neem cake, combined with azadirachtin 10000 ppm foliar spray effectively controlled sucking pests and increased tomato yield (Reddy, S. G. and Kumar, N. K. 2006). Saroja *et al.,* 2013 found that neem soap, neem seed powder extract, and essential oils can be used as alternatives to synthetic insecticides for the management of chilli thrips in capsicum. The effectiveness of pongamia oil against aphids was documented by Sajay *et al.,* 2020. Anu Thomas and in the present investigation also, the application of pongamia soap @ 7g/lt. effectively reduced the incidence of thrips in chrysanthemum.

In pomegranate, spinosad was most effective, followed by fipronil and lamda cyhalothrin, and dinotefuran being the least effective against *Scirtothrips dorsalis* (Jadhao *et al*., 2019). Laboratory studies indicated that *Scirtothrips dorsalis* was susceptible to spinosad but not to acetamiprid (Murai et al., 2010). Spinosad 45% SC was found to be the most effective and cost-effective treatment among the chemical and biorational compunds (Neelofor and Kumar, 2022). The application of spinosad reduced the thrips incidence up to 80.2% in the present study. Wale *et al.,* 2011 found that Spinetoram 12% SC @ 56 g.a.i./ha was found most effective for the control of thrips as well as spotted bollworms on cotton with higher seed cotton yield. Guruprasad *et al.,* 2019 revealed that Spinetoram 12% SC was effective in reducing the thrips population and also higher fruit yield with a least adverse effect on natural enemies build up like Coccinellids. Though the spinetoram 11.7% application stood second in the order in the present investigation it reduced the thrips incidence up to 76.24%.

Biorational insecticides have less environmental impact than the broad-spectrum chemical insecticides. In the present investigation, the application of botanicals and chemical insecticides became less effective by 7 days after treatment Hence it is necessary to repeat the application after 7 days to effectively manage the pest population. Further studies are required on rotation of insecticides to avoid resistance development in the target insect.

4. CONCLUSION

The study revealed that among different biorationals and chemical insecticides evaluated against thrips infesting chrysanthemum the pongamia soap @7g/litre and Spinosad 45% SC @ 0.2ml/lit were highly effective in reducing the thrips incidence in chrysanthemum.

COMPETING INTERESTS

AUTHOURS HAVE DECALRED THAT NO COMPETITING INTERESTS EXIST.

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