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Manjunatha KL
Ph.D. Scholar, Department of Agricultural Entomology, UAS, GKVK, Bengaluru, Karnataka, India

N Srinivasa
Professor (Agril. Ent.) and Coordinator (AINP on Acarology), UAS, GKVK, Bengaluru, Karnataka, India

NR Prasannakumar
Scientist, Division of Entomology & Nematology, ICAR-IIHR, Bengaluru, Karnataka, India

Correspondence
Manjunatha KL
Ph.D. Scholar, Department of Agricultural Entomology, UAS, GKVK, Bengaluru, Karnataka, India

Holistic way of using conventional and newer insecticides for promising control of chilli thrips, *Scirtothrips dorsalis* (Hood) in southern Karnataka

Manjunatha KL, N Srinivasa and NR Prasannakumar

Abstract
Conventional and newer insecticides were evaluated against chilli thrips, *Scirtothrips dorsalis* as separate foliar spray application (two sprays at 14 days interval) during Rabi-summer season at two locations in Chikkaballapur (cropping period Dec. 2016 to May 2017 with Local variety) and Bengaluru districts (cropping period Jan. to June 2017 with *var.* Arka Meghana). The insecticides were applied on 30-60 days old crop during February-March period at the peak infestation of thrips. In Chikkaballapur district one week after application, most of the insecticides resulted in significant reduction in thrips population and were superior to water sprayed control. Of these, spinosad application resulted in maximum reduction of 91% followed by acephate (72%), dimethoate (69%), imidacloprid (61%), fipronil (61%), diafenthiuron (60%), clothianidin (55%) and thiamethoxam (55%) application. Further, spinosad treatment continued to record significant decline in thrips population up to 10 days, and thus resulted in higher green fruit yield of 9 tonnes/acre. In Bengaluru district, within one week after application spinosad resulted in >87 per cent reduction in thrips population and also its extended effectiveness was apparent up to 10 days, hence the fruit yield (13 tonnes/acre) obtained was also highest. It is opined that the conventional insecticides, like acephate or dimethoate may be used alternatively with spinosad, as the avoidable loss with their use was nearly similar (50-61%) or next (65-68%) to spinosad. This practice would also reduce the cost of plant protection as well as the insecticide selection pressure on this key pest of chilli.

Keywords: Chilli thrips, chemical control, conventional and novel insecticides, harmonious use

1. Introduction

Chilli (*Capsicum annuum* L.) is one of the important spice cum vegetable crops grown for domestic market as well as export purpose. It is a native of tropical America & West Indies and believed to have been introduced to India by the Portuguese in the 17th century [20]. India has emerged today as the foremost producer and exporter of chillies contributing to almost one fourth of the world's production followed by China, Thailand and Pakistan. As a round the year crop important chilli growing states in India are Andhra Pradesh, Orissa, Maharashtra and Karnataka. The crop is being grown in an area of 744 & 90 thousand hectares, with a production of 1453 & 112 thousand tonnes and productivity of 1.95 & 1.25 tonnes ha^{-1} of green chilli respectively in India and Karnataka [5]. However, the major constraint in chilli production and productivity is its spectrum of pests. Important pests of chilli crop are thrips *Scirtothrips dorsalis* (Hood), yellow mite *Polyphagotarsonemus latus* (Banks), aphids, *Aphis gossypii* Glover and *Myzus persicae* Sulzer as sucking pests; caterpillar pests *Spodoptera litura* (Fabricius) and fruit borer, *Helicoverpa armigera* (Hubner) [15]. Chilli thrips, is a primary serious pest in India as well as in the entire state of Karnataka and causes upward leaf curling [1]. Thrips multiplies at a faster rate during dry weather periods [3] and the yield loss caused by this pest alone ranged from 74 to 75% [4].

More often use of synthetic chemicals is one of the most common and popular methods of thrips control on chilli crop and in recent times, a large number of newer insecticides are available in the market for use. These chemicals need to be used wisely in the control or management of any key pest like chilli thrips with a due consideration of cost economics and environmental damage by new nicotinoid group of insecticides reported in the recent past [22]. It is apparent that many conventional OP insecticides still remain effective against many traditional pests like chilli thrips and find a compatible place in the plant protection schedule.

With this background, the harmonious use of conventional and newer insecticides for more promising control of chilli thrips, *Scirtothrips dorsalis* (Hood) was studied in two major chilli growing districts (Chikkaballapur and Bengaluru) of Southern Karnataka for alternative and sandwiching use of these insecticides in the spray schedule.

2. Material and methods

Field evaluation of selected insecticides against chilli thrips was carried during the *Rabi* season of 2016-17 at two locations namely, IIHR, Bangalore and Kotagal, near Chintamani with chilli cultivars Arka Meghana and Local chilli cultivars, respectively. There were eight insecticide treatments {including conventional, Acephate (Asataf® 75 SP) & Dimethoate (Rogor® 30EC)} and fairly newer generation compounds {Fipronil (Regent® 5 EC), imidacloprid (Confidor® 17.8 SL), Spinosad (Tracer® 45 SC), Diafenthiuron (Pegasus® 50 WP), Clothianidin (Dantatsu® 50WDG) & Thiamethoxam (Actara® 25 WG)}, with an untreated check in three replications laid out in Randomized complete Block Design (RBD). Each treatment plot measured 5m×3m and chilli seedlings were planted with 60cm row spacing and 30cm between plants, with protective irrigation and recommended agronomic practices except plant protection measures. First application was taken up when the thrips incidence was approximately at the Economic Threshold Level (ETL) of 1 thrips/leaf. The uniform spray was given with the desired insecticide using a high volume Gator sprayer @ 200-250 lit/acre. For recording observations on pre and post treatment thrips population in each treatment, five plants were selected randomly and thrips counts were recorded one day before (pre-treatment) and 1,3,7, 10 and 14 days after spray (DAS) application, by tapping the growing tips of the plant onto a white acrylic sheet and counting them manually. Repeat spray was given after 14 days.

Thrips population recorded was expressed as the mean number of thrips from three tappings from each plant and population data were subjected to statistical analysis (using ANOVA technique) after $\sqrt{x+0.5}$ transformation and treatment means were compared by Duncan's Multiple Range Test. Per cent reduction in the population of thrips in different insecticide treatments was computed out using the formula of Henderson and Tilton [7].

$$\text{Per cent reduction} = \left[1 - \left(\frac{Ta}{Tb} X \frac{Cb}{Ca}\right)\right] X100$$

where, T_a = Population count after treatment, T_b = Population count before treatment, C_b = Population count in control plot before treatment imposition and C_a = Population count in control plot after treatment imposition.

Treatment-wise yield of green chilli including untreated control was pooled from different pickings to record the total plot yield. The total yield of green chilli was then computed on acre basis and subjected to statistical analysis. The avoidable yield loss was also worked out as suggested by Pradhan [14]. Avoidable yield loss= (T-C/T) × 100, where, T= Yield from treated plot, & C= Yield from untreated/control plot.

3. Results and discussion

Thrips population data recorded 1,7,10 and 14 days after application and pooled over two applications at two locations are presented in Table 1 and the corresponding reduction in thrips population which was more evident 7 & 14 days after application is depicted in Fig. 1.

3.1 Bioefficacy of different insecticides - Location I

One day after the application of spinosad, thrips population was found to decrease drastically from 36.77/plant to 5.3/plant, which also retained its effectiveness at least up to 10 days. Followed by spinosad, dimethoate and acephate also reduced the thrips population significantly recording 12.23 and 16.17 thrips/plant, respectively. By 7th day after application, dimethoate (9.03 thrips), acephate (9.27 thrips), fipronil (9.97 thrips) and imidacloprid (10.97 thrips) were on par in their efficacy and however, were only next to spinosad. Spinosad accounted for maximum reduction in the thrips population; 91% in 7 days' interval followed by acephate (72% reduction) and dimethoate (69% reduction). While the untreated control plot continued to be damaged by more number of thrips, *i.e*., 26.57 thrips/plant.

Apparent decline in effectiveness of insecticides including spinosad was by the 10th day, as the number of thrips in all the insecticidal treatments increased then. Also the reduction in spinosad treatment got down to 66%, while it was less than 55% in all other insecticide treatments. Still control plot treatment had maximum damage by 23.43 thrips at this interval. By 14th day, thrips population in different insecticide treatments was more or less reached to the same level (Table 1 & Fig. 1) and this necessitated a repeat application after 10-14 days for more effective control of thrips further.

3.2 Location II

In location II also one day after spinosad application, thrips population decreased significantly (from 20.80 to 4.97/plant) and was superior up to 10 days. Fipronil, imidacloprid, dimethoate and acephate controlled thrips significantly. By 7th day next to spinosad, acephate (10.33 thrips), dimethoate (10.73 thrips) clothianidin (11.20 thrips) and diafenthiuron (11.37 thrips) treatments were statistically on par in their effectiveness. Spinosad accounted for maximum reduction of 87 per cent in 7 days' period followed by acephate (63%), diafenthiuron (60%) clothianidin, thiamethoxam and dimethoate applications with reduction up to 59% in comparison to water sprayed control, which harbored 28.10 thrips/plant then.

Gradual decline in the efficacy of insecticide treatments including spinosad was apparent up to 10 days. The number of thrips increased from 7 to 10 days in all the treatments. Apparent reduction in thrips population was 64 per cent with spinosad treatment. Conventional organophosphate acephate registered 58 per cent reduction in thrips population by 10th day against untreated control plot with more number of thrips (23.43 thrips/plant) (Table 1 & Fig. 1).

By 14th day, thrips population reached more or less at the same in all insecticide treated plots excepting spinosad treatment. This eventually suggested a repeat application after 10 to 14 days at location II also, for effective suppression of thrips. Spinosad still recorded 47 per cent reduction in the number of thrips after 14 days.

Promising features of insecticides such as fipronil, imidacloprid, thiamethoxam, acephate, dimethoate, diafenthiuron, spinosad, clothianidin used in the present study against *Scirtothrips dorsalis* have been evaluated individually or separately and reported by many earlier workers [19, 10, 16, 2, 13, 11, 9, 6, 8, 17, 18, 21, 22], particularly on chilli crop.

Application of fipronil 5%SC which recorded more significant reduction in thrips population on chilli in Andhra Pradesh [16], in West Bengal [9, 6] and in Uttar Pradesh [17] supported the apparent modest efficacy of fipronil particularly in the insecticide trial at Kotagal near Chintamani in the present study. The effectiveness of imidacloprid 17.8SL on the activity of chilli thrips in Maharashtra [2], in Karnataka [10] and in Uttar Pradesh [17, 18, 21] corroborate the efficacy of imidacloprid observed in reducing thrips population in the present study. However, the extent of reduction in thrips population noticed in the present study was in the maximum range of 31-60 per cent, when recorded one week after application. In Karnataka [10, 12], in West Bengal [16] and in Uttar Pradesh [21] also reported that application of thiamethoxam 25WG brought down thrips population on chilli crop significantly in support of the present findings. Similarly, application of diafenthiuron in Gujarat [13], in West Bengal [9] and in Andhra Pradesh [22]; application of clothianidin in West Bengal [6] have been documented in support of these compounds showing appreciable reduction in the population of thrips at different intervals after application on chilli crop as noticed in the present study.

More beneficial application of acephate 75SP and dimethoate 30EC was reported in Uttar Pradesh [18, 17]. Similarly, application of spinosad 45SC in Andhra Pradesh [22] and in Uttar Pradesh [17, 21] appreciable reduction in the population of thrips at different intervals after application on chilli crop as recorded in the present study.

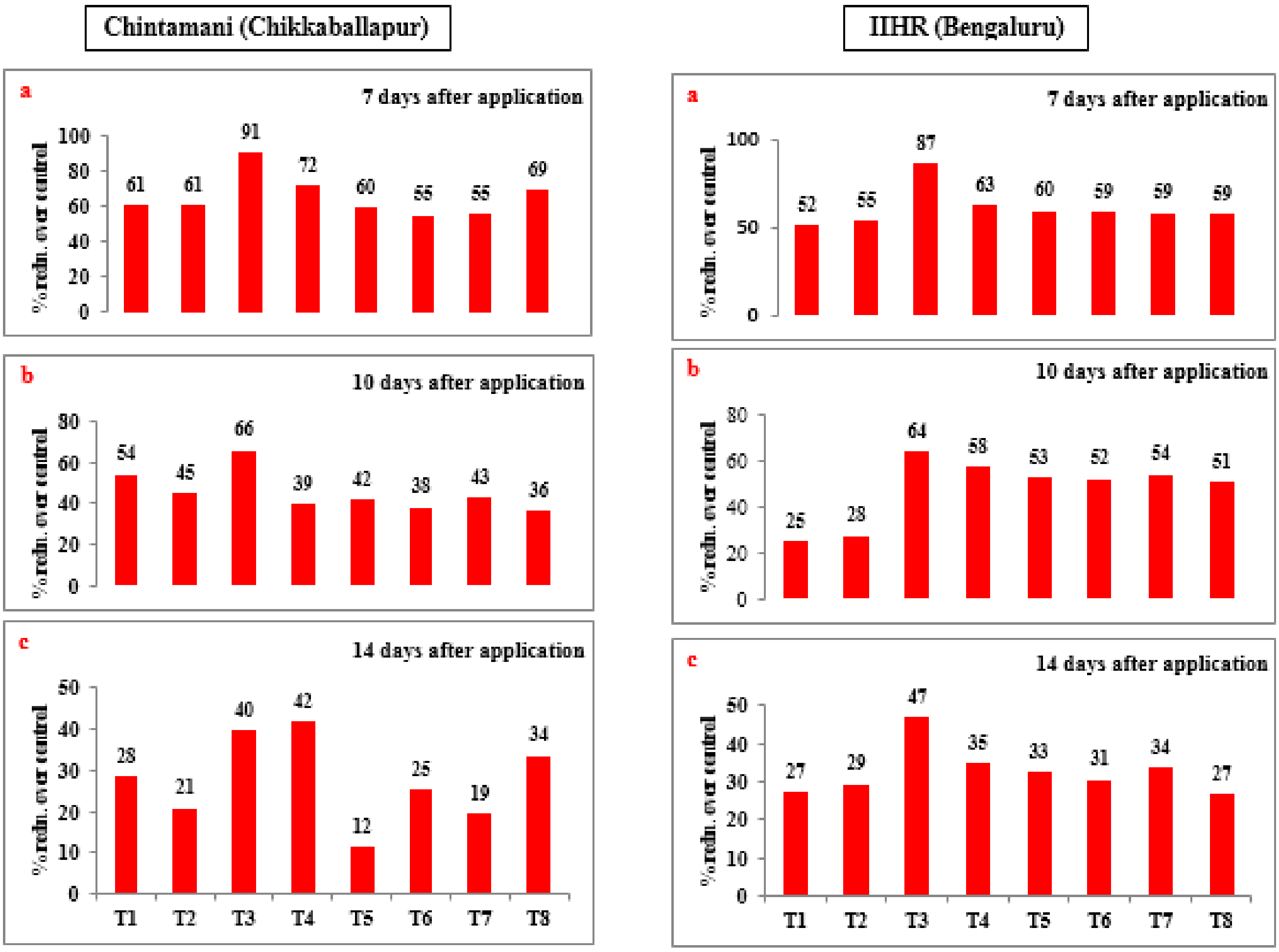
3.3 Yield of green chilli

Yield data of green chilli fruits from insecticides evaluation trial against chilli thrips, *S. dorsalis* are given in Table 2. The data revealed that, the highest yield of 9.02 - 13.21 tons/acre was recorded from spinosad treatment accounting for an avoidable loss of 65-68%. Yield from other insecticide treatments such as, imidacloprid, thiamethoxam, clothianidin, diafenthiuron, fipronil, acephate and dimethoate ranged from 5.7 - 8.76 to 7.12 - 11.70 tonnes/acre with the corresponding avoidable loss ranging from 44 - 51 per cent (imidacloprid-fipronil) to 55 - 63 per cent (dimethoate & acephate-clothianidin). Spinosad, fipronil, imidacloprid, dimethoate, thiamethoxam, diafenthiuron insecticide treated plots recorded higher chilli fruit yield as reported in Uttar Pradesh [17, 21], in Andhra Pradesh [22], in Rajasthan [8], in West Bengal [6, 9] and in Karnataka [14, 10] with improved chilli varieties like S-49, Mathanya, Suryamukhi and G-4. Better performance of corresponding chemicals against chilli thrips, which ultimately resulted in higher chilli fruit yields, they opined.

Table 1: Bioefficacy of selected insecticides against chilli thrips, *Scirtothrips dorsalis* during *Rabi* season at Kotagal (near Chintamani) and IIHR, Bengaluru (Pooled over two applications)

Insecticides	Chintamani (Chikkaballapur)					IIHR (Bengaluru)				
	Mean number of thrips@									
	Pre-treatment	1DAS	7 DAS	10 DAS	14 DAS	Pre-treatment	1DAS	7 DAS	10 DAS	14 DAS
Imidacloprid @0.05% a.i.	32.00 (5.70)	18.63 (4.35)^{cd}	10.97 (3.39)^{bcd}	11.23 (3.42)^{a}	16.90 (4.17)^{ab}	20.53 (4.58)	11.10 (3.40)^{b}	12.60 (3.62)^{c}	17.87 (4.27)^{c}	18.53 (4.36)^{b}
Fipronil @0.2% a.i.	29.07 (5.43)	16.73 (4.14)^{c}	9.97 (3.23)^{bc}	12.30 (3.58)^{ab}	16.97 (4.18)^{ab}	21.13 (4.65)	10.17 (3.27)^{b}	12.27 (3.57)^{c}	17.80 (4.28)^{c}	18.53 (4.36)^{b}
Spinosad @0.025% a.i.	36.77 (6.09)	5.30 (2.41)^{a}	2.83 (1.82)^{a}	9.60 (3.17)^{a}	16.37 (4.10)^{a}	20.80 (4.61)	4.97 (2.34)^{a}	3.37 (1.97)^{a}	8.63 (3.02)^{a}	13.70 (3.77)^{a}
Acephate @0.15% a.i.	37.63 (6.17)	16.17 (4.07)^{bc}	9.27 (3.12)^{bc}	15.37 (3.98)^{bc}	16.80 (4.15)^{ab}	22.03 (4.75)	11.60 (3.47)^{bc}	10.33 (3.29)^{b}	10.90 (3.37)^{b}	17.83 (4.28)^{b}
Diafenthiuron @0.125% a.i.	33.47 (5.82)	23.57 (4.90)^{d}	11.70 (3.49)^{cd}	14.97 (3.92)^{bc}	21.83 (4.71)^{cd}	22.23 (4.77)	14.90 (3.92)^{d}	11.37 (3.44)^{bc}	12.17 (3.56)^{b}	18.60 (4.37)^{b}
Clothianidin @0.03% a.i.	33.70 (5.84)	23.30 (4.88)^{d}	13.23 (3.70)^{d}	16.00 (4.06)^{c}	18.53 (4.36)^{abc}	21.57 (4.70)	13.30 (3.71)^{cd}	11.20 (3.42)^{bc}	11.97 (3.53)^{b}	18.60 (4.37)^{b}
Thiamethoxam @0.05% a.i.	33.10 (5.79)	21.90 (4.72)^{d}	12.87 (3.65)^{d}	14.57 (3.88)^{bc}	19.70 (4.49)^{bcd}	22.23 (4.77)	13.37 (3.72)^{cd}	11.73 (3.50)^{c}	11.83 (3.51)^{b}	18.27 (4.32)^{b}
Dimethoate @0.17% a.i.	33.84 (5.86)	12.23 (3.56)^{b}	9.03 (3.07)^{b}	15.07 (3.94)^{bc}	16.57 (4.13)^{a}	20.27 (4.56)	11.57 (3.47)^{bc}	10.73 (3.35)^{bc}	11.60 (3.48)^{b}	18.37 (4.34)^{b}
Control (Water spray)	30.47 (5.56)	34.83 (5.94)^{E}	26.57 (5.20)^{e}	23.43 (4.89)^{d}	22.47 (4.79)^{d}	21.93 (4.73)	20.87 (4.62)^{e}	28.10 (5.34)^{d}	25.53 (5.10)^{d}	27.23 (5.27)^{c}
F test	NS	*	*	*	*	NS	*	*	*	*
SEM ±	(0.18)	(0.18)	(0.12)	(0.14)	(0.12)	(0.08)	(0.09)	(0.09)	(0.09)	(0.12)
CD at P=0.05	-	(0.53)	(0.37)	(0.42)	(0.35)	-	(0.27)	(0.28)	(0.28)	(0.35)
C.V. (%)	-	22.67	25.19	13.25	7.01	-	16.76	23.75	16.55	9.18

@: Number from three young shoots; DAS: Days after spray; NS: Non-significant; *: Significant; Figures in the parentheses are $\sqrt{x+0.5}$ transformed values; Treatments with same alphabetical superscript within the column are statistically on par



T_1–*Imidacloprid;* T_2–*Fipronil;* T_3–*Spinosad;* T_4–*Acephate;* T_5–*Diafenthiuron;* T_6– *Clothianidin;* T_7–*Thiamethoxam;* T_8- *Dimethoate*

Fig 1: Per cent reduction in thrips population with different insecticidal treatments at two different locations

Table 2: Effect of insecticide application against chilli thrips on the green fruit yield during *Rabi* season under Chintamani, Chikkaballapur and IIHR, Bangalore conditions

Insecticides	Chintamani		IIHR	
	Yield of green fruits (tons/acre)	Avoidable yield loss (%)	Yield of green fruits (tons/acre)	Avoidable yield loss (%)
Imidacloprid @0.05% a.i.	5.70^{b}	44.21	9.51b^{b}	54.88
Fipronil @0.2% a.i.	6.84^{b}	53.50	8.76^{b}	51.22
Spinosad @0.025% a.i.	9.02^{a}	64.74	13.21^{a}	67.52
Acephate @0.15% a.i.	7.09^{b}	55.14	10.92^{ab}	60.71
Diafenthiuron @0.125% a.i.	6.79^{b}	53.16	9.81^{ab}	56.26
Clothianidin @0.03% a.i.	6.74^{b}	52.81	11.70^{ab}	63.33
Thiamethoxam @0.05% a.i.	6.41^{b}	50.39	11.08^{ab}	61.28
Dimethoate @0.17% a.i.	7.12^{b}	55.33	9.72^{ab}	55.86
Control (Water spray)	3.18^{c}		4.29^{c}	
F test	*		*	
SEM ±	0.40	-	1.19	-
CD at P=0.05	1.20		3.57	
C.V. (%)	10.66		20.88	

*: Significant; Treatments with same alphabetical superscript within the column are statistically on par

From the present Bioefficacy study it is proved that two applications of spinosad at two weeks interval exercised 87-91% reduction in thrips population and thus increased the green fruit yield. This accounted from the highest avoidable loss of 65-68% due to thrips infestation. Supportingly, from Andhra Pradesh [22] recorded chilli fruit yield of 9.05 tons/ha (pooled over two seasons) as consequence of 82% reduction in thrips population with spinosad application over a favorable benefit cost ratio of 1:2.22. from Uttar Pradesh [17] also emphasized on the promising effect of spinosad against chilli thrips by recording maximum control of thrips (87%) and the highest fruit yield (21.25 tons/ha.) with the maximum benefit cost ratio of 1:12.30, is in line with the previous findings [21]. This excelling performance of spinosad is attributed to its recent introduction in the chilli system and this insecticide possesses as a novel mode of action with probably a more significant trans-laminar movement. However, still conventional OP compounds such as acephate and dimethoate investigated in the present study were found next in the order of effectiveness against thrips. Perusal of earlier literature revealed that these conventional insecticides were used extensively against chilli thrips before 1999, thereafter improved insecticides such as fipronil and imidacloprid were used by the chilli growers with which both scientists and farmers appreciated more significant control of thrips. Later neonicotinoid imidacloprid became more popular and it was considered as a panacea for sucking pests in particular, which damaged most of our cultivated crops at the grand vegetative growth stage or at pre-flowering period. To this group of nerve poison insecticides, diafenthiuron, a thiourea compound with a unique mode of action as a metabolic poison inhibiting mitochondrial ATPase enzyme was later accommodated in the spray schedule of chilli crop. Diafenthiuron especially showed dual action against two major dreaded pests, thrips and yellow mite in chilli systems. Trans-laminar property associated with photo-conversion into toxic carbodiimide was its added features. Thus use of a neonicotinoid, fipronil and diafenthiuron in an alternative manner was presumed to be a good practice among chilli farmers. 2012 onwards with the introduction of new generation neonicotinoid insecticides such as, thiamethoxam and clothianidin [6, 21], diafenthiuron and fipronil were observed to be mediocre in their performance against thrips on many crops including chilli. Also at this juncture, effectiveness of imidacloprid against thrips was perceived to be inconsistent due to obvious reason of its extensive use [22]. Additionally, effective (and recommended) lower dose of application of thiamethoxam and clothianidin also compensated for their high cost.

Our past experience also highlight on more rapid development of resistance in sucking pests to nerve poison insecticides and hence inconsistent control of chilli thrips with imidacloprid application was also apparent in our present study. Even non-nerve poison insecticides like fipronil and diafenthiuron sustained their effectiveness against chilli thrips beyond 2010, as earlier reported [9, 6, 22].

4. Conclusion

It is inferred that fairly newer compounds, spinosad undoubtedly exercised more significant control of thrips, followed by conventional OP insecticides, (acephate/dimethoate), fipronil and diafenthiuron. Harmonious alternative use of these compounds more preferably at an interval of ≈10 days might control thrips more significantly to realize a better chilli fruit yield of 6.79-8.76 to 9.02-13.21 tons/ha, accounting for reasonable avoidable losses of 51-53% to 64-67%. Intelligent alternative use of such promising insecticides helps to tackle the problem of insecticide resistance and this would either delay the development of resistance or manage resistant thrips population more efficiently in addition to the reduced cost of controlling thrips on chilli crop.

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6. References

1. Ananthakrishnan TN. Bionomics of thrips. Annual Review of Entomology. 1993; 38:71-92.
2. Bhede BV, Suryawanshi DS, More DG. Population dynamics and Bioefficacy of newer insecticide against chilli thrips, *Scirtothrips dorsalis* (Hood). Indian Journal of Entomology. 1993; 70(3):223-226.
3. Borah DC. Bioecology of *Polyphagotarsonemus latus* (Acari: Tarsonemidae) and *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) infesting chilli and their natural enemies. Ph. D. Thesis, University of Agricultural Sciences, Dharwad, Karnataka, 1987.
4. Dadasaheb ST. Population dynamics, yield losses and management of thrips, *Scirtothrips dorsalis* Hood infesting chilli. M. Sc. (Agri.) thesis, Junagadh Agricultural University, 2013.
5. Geetha S, Selvarani K. A study of chilli production and export from India. International Journal of Advanced Research and Innovative Ideas in Education. 2017; 3(2):205-210.
6. Ghosh A, Chatterjee ML, Chakraborti K, Samanta., Field Evaluation of Insecticides against chilli Thrips *Scirtothrips dorsalis* Hood. Annals of Plant Protection Sciences. 2017; 17(1):69-71.
7. Henderson EF, Tilton EW. Tests with acaricides against the brown wheat mite. Journal of Economic Entomology. 1955; 48:157-161.
8. Kumar V, Swaminathan R, Singh H. Bio efficacy of newer insecticides against sucking insect pests of chilli. Annals of Plant Protection Sciences. 2017; 23(1):69-73.
9. Maity C, Santra A, Mandal L, Mondal P. Management of chilli thrips with some newer molecules of chemicals. International Journal of Bio-Technology and Research. 2015; 1(3):119-125.
10. Nagaraj T, Sreenivas AG, Patil BV, Nagangoud A. Preliminary evaluation of some new molecules against thrips, *Scirtothrips dorsalis* (Hood) and *Polyphagotarsonemus latus* (Banks) mites in chilli under Irrigated ecosystem. Pest Management in Horticultural Ecosystem. 2007; 13(2):185-188.
11. Nandihalli BS. Bio efficacy of newer insecticide molecules against chilli thrips and fruit borers. Karnataka Journal of Agricultural Sciences. 2009; 22(3):591-593.
12. Nandini. Survey and management of pests of capsicum under protected cultivation. M. Sc. Thesis, UAS, Dharwad, Karnataka, 2010, 81.
13. Patel BH, Koshiya DJ, Korat DM, Vaishnav P R. Evaluation of some insecticides against chilli thrips *Scirtothrips dorsalis* Hood. Karnataka Journal of Agricultural Sciences. 2009; 22(2):327-330.
14. Pradhan S. Insect pest of crops. National Book Trust, New Delhi, India, 1969, 80.
15. Rao D, Ahmed K. Evaluation of certain insecticides for the control of the pest complex on chilli in Andhra Pradesh. Pesticides. 1985; 19(2):41-44.
16. Reddy AV, Srihari G, Kumar AK. Evaluation of certain new insecticides against chilli thrips, *Scirtothrips dorsalis* and mites *Polyphagotarsonemus latus.* The Asian Journal of Horticulture. 2007; 2(2):8-9.
17. Sahu PS, Ashwani kumar, Khan HH. Seasonal incidence and management of chilli thrips, *Scirtothrips dorsalis*. Journal of Experimental Zoology India. 2017; 20(1):587-589.
18. Sathua SK, Reddy MS, Sulagitti A, Singh RN. Bio-

efficacy of various insecticides and botanicals against chilli thrips, *Scirtothrips dorsalis* Hood and their comparative cost: Benefit analysis in chilli crop. Journal of Entomology and Zoology Studies. 2017; 5(2):130-134.

19. Seal DR, Ciomperlik M, Richards ML, Klassen W. Comparative effectiveness of chemical insecticides against the chilli thrips, *Scirtothrips dorsalis* Hood on pepper and their compatibility with natural enemies. Crop Protection. 2005; 25:949-955.
20. Sreeramalu C. Improved variation of chillies. Arecanut and Spice Bulletin. 1976; 7:65-68.
21. Tirkey S, Kumar A. Efficacy of selected insecticides against chilli thrips, *Scirtothrips dorsalis* (Hood)} on chilli (*Capsicum annuum* L.) in Allahabad. Journal of Pharmacognosy and Phytochemistry. 2017; 6(5):322-324.
22. Vanisree A, Upendhar S, Rajashekhar P, RAO R. Effect of newer insecticides against chilli thrips, *Scirtothrips dorsalis*. Journal of Entomology and Zoology studies. 2017; 5(2):277-284.