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RG Samota
Department of Entomology, SKNCOA, Jobner, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

BL Jat
Department of Entomology, SKNCOA, Jobner, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Mamta Devi Choudhary
Department of Entomology, SKNCOA, Jobner, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Correspondence
RG Samota
Department of Entomology, SKNCOA, Jobner, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Efficacy of newer insecticides and biopesticides against thrips, *Scirtothrips dorsalis* Hood in chilli

RG Samota, BL Jat and Mamta Devi Choudhary

Abstract

Investigations on "Efficacy of newer insecticides and biopesticides against thrips, *Scirtothrips dorsalis* Hood on chilli." were conducted at Horticulture farm, S.K.N. College of Agriculture, Jobner during *Zaid*, 2014 and 2015. Total ten treatments including untreated control were taken for test their efficacy. On the basis of mean per cent reduction in thrips population in all the three sprays the treatment of acetamiprid (82.62%) was found to be the most effective, followed by thiamethoxam (80.79%), imidacloprid (77.90%), fipronil (76.38%) and standard check (71.92%), former three treatments were statistically at par with each other in their efficacy. The treatments of spinosad and NSKE with 61.65 and 48.95 per cent reduction, formed a moderately effective group of insecticides, however, both were differed significantly to each other. The minimum reduction was noticed in *M. anisopliae* (33.60%) and B. *bassiana* (34.86%) and both were comparable to each other. The highest fruit yield of 105.11 q ha^{-1} was recorded in the plots treated with imidacloprid, followed by thiamethoxam (103.18 q ha^{-1}), acetamiprid (99.99 q ha^{-1}), dimethoate/ oxydemeton methyl (99.69 q ha^{-1}) and fipronil (97.65 q ha^{-1}). The highest B: C ratio was recorded in imidacloprid (37.37), followed by acetamiprid (35.18) and dimethoate/ oxydemeton methyl (30.03). The order of effectiveness of these treatments in descending order was acetamiprid > thiamethoxam > imidacloprid > fipronil > standard check > spinosad > NSKE > *B. bassiana* > *M. anisopliae*.

Keywords: Chilli (*Capsicum annum* L.), thrips, newer insecticides, biopesticides

Introduction

Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae is an important spice cum vegetable crop commonly used in Indian dietary. It is grown throughout the year as a cash crop and used in green and red ripe dried stage for their pungency, colour and other ingredients in all culinary preparations of rich and poor alike to impart taste, flavour and colour. Nutritionally, it is a rich source of vitamin A, B and C. Capsaicin an alkaloid responsible for pungency in chillies has medicinal properties and it prevents heart attack by dilating the blood vessels (Gill, 1989) [7]. India is the largest consumer and exporter of chilli in the world with a production of 1492 million tones from an area of 775 thousand hectares during 2014 (Anonymous, 2014) [4]. In India, it is intensively cultivated in Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Rajasthan and in hilly areas of Uttar Pradesh (Ratnakumari *et al*., 2001) [21]. In Rajasthan, it is cultivated in an area of 12.21 thousand hectares with an annual production of 17.71 million tones (Anonymous, 2013) [3]. The major chilli growing districts of Rajasthan include Jodhpur, Swai Madhopur, Pali, Jalore, Bhilwara, Jaipur, Ajmer, Tonk, Udaipur and Bharatpur.

The chilli crop is attacked by a number of insect-pests right from germination to harvest of the crop, out of them thrips is a major sucking insect pests, responsible for low productivity, reduce up to 50 per cent yield (Ahmed *et al*., 1987) [2]. Under severe infestation thrips alone cause 50 per cent yield loss (Kandasamy *et al*., 1990) [10]. The yield losses range from 50-90 per cent due to insect pests of chilli (Nelson and Natrajan, 1994 and Kumar, 1995) [15, 11]. These sucking pests causes serious damage to chilli crop by direct feeding and transmit deadly chilli leaf curl disease. Both adults and nymphs of thrips feed by rasping and sucking the oozing cell sap from the ventral side of the leaves, growing shoots, developing flowers and fruits. The affected leaves curl and exhibit characteristic leaf curl symptoms.

Over use of pesticides has often led to the development of undesirable problems like destruction of natural enemies, pest resurgence and failure of control strategies leading to outbreak of leaf curling in chilli. In addition the presence of pesticide residues in chillies (Joia *et al*., 2001) [9] has been of more concern for export of chillies to developed countries. In this context, it is therefore necessary to develop effective non-chemical pest management strategies against sucking pests for sustained crop management and production of healthy food.

In view of this indiscriminate use of chemical pesticides and public concerns, the rise of new generation insecticides provides an alternative to reduce the ill effects of conventional insecticides. The new insecticides are more tissue-specific, activated in unique ways inside the target cells of insects resulting in reduced threat to other organism. Selective toxicity to insects and safety to natural enemies have made the new class of insecticides more user and eco-friendly. Keeping these points in view in the present field experiments, some organic manures, newer insecticide molecules with novel mode of action and biopesticides were included to find out a viable option for sustainable management against the sucking insect pests of chilli.

Material and methods

The materials used and methodology adopted during the course of investigation on “Efficacy of newer insecticides and biopesticides against thrips, *Scirtothrips dorsalis* Hood on chilli” as envisaged in the plan of work has been described in this chapter. the experiment was laid out in a Randomized Block Design (RBD) with ten treatments (insecticides) including untreated control, each replicated thrice. The plot size was 2.25 x 1.50 m^2 keeping row to row and plant to plant distance of 45 and 30 cm, respectively. The chilli variety ‘RCH-1’ recommended for this region was used for the experiment. The recommended packages of practices were followed to raise the crop except insecticidal application, which was followed as per schedule.

Table 1: Details of insecticides and biopesticides used

S. No.	Common name	Trade name	Concentration (%) or dose
1.	Imidacloprid 17.8 SL	Confidor	0.005
2.	Acetamiprid 20 SP	Pride	0.004
3.	Thiamethoxam 25 WG	Actara	0.025
4.	Fipronil 5 SC	Regent	0.01
5.	Spinosad 45 SC	Tracer	0.01
6.	*Beauveria bassiana* 1.15 WP	Racer-BB	1g/l
7.	*Metarhizium anisopliae* 1.15 WP	Pacer-MA	1g/l
8	NSKE*	-	5.0
9.	Dimethoate 30 EC/ Oxydemeton-methyl 25EC	Rogor/ Metasystox	0.03/0.025
10.	Untreated check	-	-

*NSKE- Neem seed kernel extract

Preparation of Neem seed kernel extract

Neem seed kernel extract was prepared by grinding 5 kg weight of kernels into a fine powder. The resulting powder was then soaked overnight in to 10 liters of water. The desired concentration of NSKE on kernel weight to volume (of water) basis was obtained by filtering the extract in a fine muslin cloth with repeated washing in the next morning. The volume was made up 100 liters by adding the required quantity of water to get 5 per cent solution. Add 1 per cent detergent (make a paste of the detergent and then mix it in the spray solution well and use).

Application of insecticides

Three foliar sprays of all the insecticides were given at three weeks interval during both the years of experimentation. The spray was done by using knap sack sprayer. Utmost care was taken to check the drift of insecticides by putting polythene check screen around each plot at the time of spraying. The quantity of water used for plot was increased depending on the growth of the crop. The quantity of spray solutions required for full coverage in first, second and third insecticidal application were 500, 550 and 600 litres per hectare, respectively.

Observations

The observations on population of thrips were recorded visually using a magnifying lens early in the morning on three leaves at top, middle and bottom canopy from five randomly selected and tagged plants in each plot. The populations were recorded at one day before spray and 1, 3, 7 and 15 days after the spray. The yield of green chilli per plot was recorded and converted into q/ha.

The percentage reduction in population was calculated using formula given by Henderson and Tilton (1955) [8] which is modification of Abbott’s formula (1925).

$$\text{Per cent reduction in population} = \left(1 - \frac{TaxCb}{TbxCa}\right) \times 100$$

Where,

Ta= Number of insect after treatment in treated plot

Tb= Number of insect before treatment in treated plot

Ca= Number of insect in untreated check after treatment

Cb= Number of insect in untreated check before treatment

The analysis of variance was computed after subjecting the data in to angular transformation.

Result and discussion

During the study period thrips, *S. dorsalis* was observed as major sucking insect of chilli. The bioefficacy of various newer insecticides and biopesticides was evaluated against this pest. Three foliar sprays were applied for the control of this pest under field conditions. The obtained results described only on the basis of mean data of both the seasons

Zaid, 2014

The thrips infestation during first year *i.e. Zaid*, 2014 commenced from 22^{th} April. The first spray was applied on 28^{th} May and remaining two sprays were applied at three weeks interval when the population built up again. Result revealed that all the insecticidal treatments were reduced the population of thrips significantly over untreated control at one, three, seven and fifteen days after application of insecticides in all the sprays, however, significant difference existed among the treatments.

The data presented in table-2 revealed that on the basis of mean per cent reduction in thrips population in all the three sprays, acetamiprid (82.69%) proved to be most effective, followed by thiamethoxam (80.59%), imidacloprid (77.70%), fipronil (76.51%) and standard check (71.33%). The former three treatments were statistically at par with each other in their efficacy. The moderately effective treatments were spinosad and NSKE which resulted in 62.09 and 49.29 per cent reduction, respectively and both differed significantly with each other. The treatments of *M. anisopliae* (33.78%) proved least effective, followed by *B. bassiana* (35.36%) and both were comparable with each other.

Zaid, 2015

The incidence of thrips during *Zaid*, 2015 commenced from 18^{th} April. The first spray was applied on 24^{th} May and remaining two sprays were applied at three weeks interval when the population rebuilt up again. All the insecticidal treatments were found significantly superior over untreated control at different intervals in all the three sprays, however, significant difference existed among them.

The data presented in table-2 indicated that on the basis of mean per cent reduction in thrips population in all the three sprays, acetamiprid (82.54%) was found to be the most effective, followed by thiamethoxam (80.99%), imidacloprid (78.10%), fipronil (76.25%) and standard check (72.50%). However, former three treatments were statistically at par with each other in their efficacy. The treatments of fipronil and standard check differed significantly with acetamiprid and thiamethoxam though fipronil and imidacloprid differed non significantly. The treatments of spinosad and NSKE with 61.21 and 48.61 per cent reduction, formed a moderately effective group of insecticides, however, both were differed significantly to each other. The minimum reduction was noticed in *M. anisopliae* (33.43%) and B. *bassiana* (34.36%) and both were comparable to each other.

Pooled (*Zaid*, 2014 and 2015)

On the basis of mean per cent reduction in thrips population in all the three sprays the treatment of acetamiprid (82.62%) was found to be the most effective, followed by thiamethoxam (80.79%), imidacloprid (77.90%), fipronil (76.38%) and standard check (71.92%). Former three treatments were statistically at par with each other in their efficacy. The treatments of spinosad and NSKE with 61.65 and 48.95 per cent reduction, formed a moderately effective group of insecticides, however, both were differed significantly to each other. The minimum reduction was noticed in *M. anisopliae* (33.60%) and B. *bassiana* (34.86%) and both were comparable to each other. The order of effectiveness of these treatments in descending order was acetamiprid > thiamethoxam > imidacloprid > fipronil > standard check > spinosad > NSKE > *B. bassiana* > *M. anisopliae*.

The maximum reduction in thrips population was recorded in the treatment of acetamiprid (82.62%), followed by thiamethoxam (80.79%), imidacloprid (77.90%), fipronil (76.38%) and standard check *i.e.* dimethoate/ oxydemeton methyl (71.92%). The results are conformity with that of Sunitha and Jagginavar (2010) [28], Mandal (2012) [14] and Varghese and Mathew (2013) [29] who found acetamiprid most effective insecticide against thrips. Ghosh *et al.* (2009) [6] reported that thiamethoxam, followed by acetamiprid, fipronil, clothianidin and oxydemeton methyl were effective insecticides against thrips support the present findings. Patil *et al.* (2002) [19] reported imidacloprid 17.8 SL effective in suppressing the population of thrips confirm the present findings. Seal *et al*. (2006) [23] also reported that imidacloprid as best insecticide against thrips. Reddy *et al*. (2014) [24] reported the lowest thrips population in methyl demeton as most effective insecticide supports the present result. Pandey *et al*. (2013) [16] recorded the lowest mean thrips population in the plots treated with fipronil.

The treatments of spinosad and NSKE with 61.65 and 48.95 per cent reduction formed a moderately effective group of insecticides. The present findings corroborate with the findings of Seal *et al*. (2006) [23], Srinivas *et al*. (2007) [27] and Prasad and Ahmed (2009) [20] who reported spinosad as effective insecticide against thrips. Patel *et al*. (2009) [18] and Pandey *et al*. (2010) [17] recorded lower thrips population in the plots treated with NSKE support the present findings.

The minimum reduction in thrips population was noticed in *M. anisopliae* (33.60%) and B. *bassiana* (34.86%), though both were significantly superior over untreated control. Singh *et al*. (2011) [24] observed entomopathogenic fungus was less effective compared to chemical insecticides, though Beauveria *bassiana* performed better in respect of reducing onion thrips population support the present result. Ghatak *et al*. (2009) [5] reported that *Verticillium lecanii* caused high per cent reduction of thrips population. Mallinath and Biradar (2015) [13] also found *V. lecanii* as moderately effective in reducing the onion thrips.

Effect of newer insecticides and biopesticides on yield of chilli

The data presented in table 4.2 revealed that in all the plots treated with insecticides significantly higher fruit yield of chilli was obtained over untreated control during both the years *i.e. Zaid* 2014 and 2015. During first year *i.e.* 2014 the maximum yield of chilli 104.36 q ha^{-1} was obtained in the plots treated with imidacloprid, followed by thiamethoxam (102.62 q ha^{-1}), acetamiprid (99.75 q ha^{-1}), dimethoate/ oxydemeton methyl (99.25 q ha^{-1}) and fipronil (97.00 q ha^{-1}) and these were statistically at par. The minimum yield (68.50 q ha^{-1}) was obtained in the plots treated with *M. anisopliae* followed by *B. bassiana* (70.23 q ha^{-1}) and NSKE (71.30 q ha^{-1}) which were comparable to each other. The higher yield was also obtained in the plots treated with spinosad (84.30 q ha^{-1}).

Similarly during *Zaid* 2015 the maximium yield of 105.86 q ha^{-1} was obtained in the plots treated with imidacloprid followed by thiamethoxam (103.75 q ha^{-1}), acetamiprid (100.23 q ha^{-1}), dimethoate/ oxydemeton methyl (100.14 q ha^{-1}) and fipronil (98.30 q ha^{-1}) and these were statistically at par to each other and significantly superior to the untreated control. The higher yield of chilli was also obtained in the plots treated with spinosad gave fruit yield of 85.18 q ha^{-1}. The minimum yield of 69.15 q ha^{-1} was obtained in the plots treated with *M. anisopliae*, followed by *B. bassiana* (71.00 q ha^{-1}) and NSKE (71.45 q ha^{-1}), which were comparable to each other.

Pooled data of both the years also revealed that the maximum fruit yield of chilli (105.11 q ha^{-1}) was obtained in the plot treated with imidacloprid followed by thiamethoxam (103.18 q ha^{-1}), acetamiprid (99.99 q ha^{-1}), dimethoate/ oxydemeton methyl (99.69 q ha^{-1}) and fipronil (97.65 q ha^{-1}), respectively and these were comparable to each other. The minimum fruit yield of 68.82 q ha^{-1} was obtained in the plots treated with *M. anisopliae* (68.82 q ha^{-1}), followed by *B. bassiana* (70.61 q ha^{-1}) and NSKE (71.37 q ha^{-1}), which were at par to each other. The higher yield of chilli was also obtained in the plots treated wih spinosad gave fruit yield of 84.74 q ha^{-1}. The present results are in agreement with those of Patil *et al*. (2002) [19] and Singh *et al*. (2004) [26] who reported highest yield of chilli in the treatment of imidacloprid. Srinivas *et al*. (2007) [27] and Prasad and Ahmed (2009) [20] reported higher yield of chilli in the treatment of spinosad also support the present findings. Mandal (2012) [14] reported highest yield of chilli in the plots treated with acetamiprid. Singh (2011) [25] recorded higher yield of chilli in the plots treated with fipronil and spinosad corroborate the present findings. Kumar *et al*. (2015) [12] recorded highest marketable yield of chilli in the plots treated with imidacloprid support the present results.

The maximum benefit cost ratio of 37.37 was recorded in the treatment of imidacloprid, followed by acetamiprid (35.18) and dimethoate/ oxydemeton methyl (30.03). The benefit cost ratio of 10.90, 10.39, 9.98, 8.85, 8.81 and 5.48 were recorded in the treatments of fipronil, thiamethoxam, *B. bassiana*, NSKE, *M. anisopliae*, and spinosad, respectively. Patel *et al*. (2009) [18] recorded higher cost: benefit ratio in imidacloprid and Mandal (2012) [14] recorded higher cost: benefit ratio in acetamiprid corroborate with the present findings.

Table 2: Bioefficacy of newer insecticides and biopesticides against thrips, *Scirtothrips dorsalis* Hood in chilli crop during *Zaid*, 2014 and 2015 (pooled)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent reduction of thirps population			Yield (q/ha)			B:C ratio
			2014	2015	Pooled	2014	2015	Pooled	Pooled
1.	Imidacloprid 17.8 SL	0.005	77.70*	78.10	77.90	104.36	105.86	105.11	37.37
			(61.82)**	(62.10)	(61.96)				
2.	Acetamiprid 20 SP	0.004	82.69	82.54	82.62	99.75	100.23	99.99	35.18
			(65.41)	(65.30)	(65.36)				
3.	Thiamethoxam 25 WG	0.025	80.59	80.99	80.79	102.62	103.75	103.18	10.39
			(63.86)	(64.15)	(64.00)				
4.	Fipronil 5 SC	0.01	76.51	76.25	76.38	97.00	98.30	97.65	10.90
			(61.01)	(60.84)	(60.92)				
5.	Spinosad 45 SC	0.01	62.09	61.21	61.65	84.30	85.18	84.74	5.48
			(52.00)	(51.48)	(51.74)				
6.	*Beauveria bassiana* 1.15 WP	1 g/l	35.36	34.36	34.86	70.23	71.00	70.61	9.98
			(36.49)	(35.88)	(36.19)				
7.	*Metarhizium anisopliae* 1.15 WP	1 g/l	33.78	33.43	33.60	68.50	69.15	68.82	8.81
			(35.53)	(35.32)	(35.43)				
8.	NSKE	5.0%	49.29	48.61	48.95	71.30	71.45	71.37	8.85
			(44.59)	(44.20)	(44.40)				
9.	Dimethoate 30 EC/ Oxydemetonmethyl 25 EC	0.03/ 0.025	71.33	72.50	71.92	99.25	100.14	99.69	30.03
			(57.63)	(58.37)	(58.00)				
10.	Control	-	0.00	0.00	0.00	56.00	55.70	55.85	-
			(0.00)	(0.00)	(0.00)				
	SEm ±		1.23	1.09	1.15	3.44	3.76	3.84	-
	CD (p= 0.05)		3.64	3.24	3.43	10.21	11.18	11.41	

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References

1. Abbott WS. A method of computing the effectiveness of an insecticide. Journal of Economic Entomology, 1925; 18:265-267.
2. Ahmed K, Mohamed MG, Murthy NSR. Yield losses due to various pests in hot pepper. Capsicum Newsletter, 1987; 6:83-84.
3. Anonymous. Spices Board of India. Ministry of Commerce and Industry, Govt. of India. 2001, 2013, 1.
4. Anonymous, Indian Horticulture Database, 2011. National Horticulture Board, Ministry of Agriculture, Govt. of India, Gurgaon, 2014, 19.
5. Ghatak SS, Mondal S, Vishwakarma R. Bioefficacy of some biopesticides against *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera) infesting chilli. Indian Journal of Entomology, 2009; 71(4):355-357.
6. Ghosh Amalendu, Chatterjee ML, Chakraborti K, Samanta A. Field evaluation of insecticides against chilli thrips (*Scirtothrips dorsalis* Hood). Annals of Plant Protection Science, 2009; 17(1):69-71.
7. Gill HS. Improved technologies for chilli production. Indian Cocoa Arecanut and spices Journal. 1989; 12:118-119.
8. Henderson CF, Tilton EW. Tests with acaricides against brown wheat mite. Journal of Economic Entomology, 1955; 48(2):157-161.
9. Joia BS, Jaswinder K, Udean AS. Persistence of ethion residue on/in green chilli. Proceeding of National Symposium on Integrated Pest Management in Agriculture Crops, Bagalore, 2001, 174-175.
10. Kandasamy C, Mohanasundaram M, Karuppachamy P. Evaluation of insecticides for the control of thrips, *Scirtothrips dorsalis* Hood, in chillis (*Capsicum annum* L.). Madras Agriculture Journal, 1990; 77(3-4):169-172.
11. Kumar NKK. Yield loss in chilli and sweet pepper due to *Scirtothrips dorsalis* Hood. (Thysanoptera: Thripidae). Pest Management in Horticultural Ecosystems, 1995; 1(2):61-69.
12. Kumar V, Swaminathan R, Singh H. Bio-efficacy of newer insecticides against sucking insect pests of chilli. Annals of Plant Protection Sciences, 2015; 23(1):69-73.
13. Mallinath N, Biradar AP. Bio-efficacy of organic and inorganic chemical molecules against onion thrips, *Thrips tabaci* Lindeman. Karnataka Journal of Agricultural Sciences, 2015; 28(1):49-52.
14. Mandal SK. Field evaluation of alternate use of insecticides against chilli thrips, *Scirtothrips dorsalis* (Hood). Annals of Plant Protection Science, 2012; 20(1):59-62.
15. Nelson SJ, Natarajan S. Economic threshold level of thrips in semi-dry chilli. South Indian Horticulture, 1994; 42(5):336-338.
16. Pandey S, Singh BK, Gupta RP. Effect of neem based botanicals, chemicals and bio-Insecticides for the management of thrips in onion. Indian Journal of Agricultural Research, 2013; 47(6):545-548.
17. Pandey SK, Mathur AC, Srivastava M. Management of leaf curl disease of chilli (*Capsicum annuum* L.). International Journal of Virology, 2010; 6:246-250.
18. Patel BH, Koshiya DJ, Korat DM, Vaishnav PR. Evaluation of some insecticides against chilli thrips, *Scirtothrips dorsalis* Hood. Karnataka Journal of Agricultural Sciences, 2009; 22(2):327-330.
19. Patil AS, Patil PD, Patil RS. Efficacy of different schedule doses of imidacloprid against sucking pests of chilli. Pestology, 2002; 26(12):31.
20. Prasad NVVSD, Ahmed K. Efficacy of spinosad 45 SC against thrips, *Scirtothrips dorsalis* Hood and Pod borer, *Spodoptera exigua* (Hubner) on chillies. Pesticide Research Journal, 2009; 21(1):49-51.
21. Ratnakumari PVL, Prabhu Prasadini P, Venkat Reddy P. Active root distribution zone of bell paper (*Capsicum*

annum L.) under drip irrigation with and without mulches. Vegetable Science, 2001; 28(1):82-83.
22. Reddy AV, Srihari G, Kumar AK. Newer insecticides against pod borer, *Spodoptera litura* and thrips, *Scirtothrips dorsalis* Hood in chilli (*Capsicum annuum* Linn.). Pesticide Research Journal, 2014; 26(1):74-77.
23. Seal DR, Ciomperlikb M, Richardsc ML, Klassena W. Comparative effectiveness of chemical insecticides against the chilli thrips, *Scirtothrips dorsalis* Hood on pepper and their compatibility with natural enemies. Crop Protection, 2006; 25:949-955.
24. Singh BK, Pandey JG, Gupta RP, Abraham Verghese. Efficacy of entomopathogenic fungi for the management of onion thrips, *Thrips tabaci* Lind. Pest Management in Horticultural Ecosystems, 2011; 17(2):92-98.
25. Singh S. Bio- efficacy of pyridalyl 10 EC against thrips, *Scirtothrips dorsalis* Hood on chilli (*Capsicum annum* L.). Indian Journal of Entomology, 2011; 25(1):43-45.
26. Singh S, Choudhary DP, Mathur YS. Efficacy of insecticides against whitefly, *Bemisia tabaci* Genn. on chilly, *Capsicum annum* L. Indian Journal of Entomology, 2004; 66(4):316-318.
27. Srinivas AG, Nargund VB, Sushila Nadagouda AM, Amaresh YS. Efficacy of spinosad (Tracer 45 SC) against the thrips and fruit borers in chilli (*Capsicum annum* L.) under irrigated conditions. Pest-Management and Economic Zoology, 2007; 15(1):41-44.
28. Sunitha ND, Jagginavar SB. Management of *Scirtothrips dorsalis* Hood in grape. Indian Journal of Plant Protection, 2010; 38(2):131-133.
29. Varghese TS, Mathew TB. Bioefficacy and safety evaluation of newer insecticides and acaricides against chilli thrips and mites. Journal of Tropical Agriculture, 2013; 51(1-2):111-115.