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Field evaluation of insecticides against chilli thrips (*Scirtothrips dorsalis* Hood)

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Abstract
The present investigation was carried out to field evaluation of insecticides against chilli thrips (*Scirtothrips dorsalis* Hood) during *rabi* season of 2016-17 at Central Experimental Station, Wakawali, Dist- Ratnagiri. During this experiment total seven insecticides tested *viz*., acetamiprid 20 SP @ 0.004, dimethoate 30 EC @ 0.6, emamectin benzoate 5 SG @ 0.002, imidacloprid 17.8 SL @ 0.004, lambda cyhalothrin 5 EC @ 0.018, spinosad 45 SC @ 0.014 and thiamethoxam 25 WG @ 0.01 percent, respectively. The overall efficacy of all three sprays revealed that spinosad 45 SC @ 0.014 percent was the best treatment which recorded minimum (1.41) mean thrips population per three leaves per plant and was significantly superior over all other treatments followed by emamectin benzoate 5 SG @ 0.002 percent recorded (1.92) and was at par with thiamethoxam 25 WG @ 0.01 percent recorded (2.09).

Keywords: Efficacy, chilli thrips, *Scirtothrips dorsalis*, insecticides

Introduction
Chilli (*Capsicum annum* L.) is one of the important vegetable and condiments crop having immense commercial dietary and therapeutic values and grown throughout the year. At present, India is the second largest producer of chillies in the world, which contributes about one fourth of the world's production. Chilli has been reported as a commercial spice crop in tropical and sub-tropical parts of the India with an annual production of 3.40 million tonnes from an area of 287 thousand hectares and productivity is 12 MT per hectare (Anon., 2017) [1]. Besides several factors responsible for low productivity and quality deterioration of chilli the damage caused by insect pests is the most important. So far, 293 insect and mite species were reported on chilli (Butani, 1976) [2]. The pest infesting vegetables cause crop loss to the tune of 30-40 percent. Particularly in chilli yield losses due to thrips was upto 12-90 percent and mites upto 34 percent (Rai *et al*., 2014) [5]. The yield losses due to thrips and mite pests are estimated to be 50 percent (Hosmani, 2007) [3].
Due to mono culture of chilli over a period of time, the pest buildup of *S. dorsalis* has increased enormously and the farmers are resorting to a minimum of 5 - 6 chemical sprays. In addition to this the increased pesticide sprays become a threat to chilli ecosystem causing resurgence of pests and menace to natural enemies. Pesticide residues in chilli are also of great concern for domestic consumption and exports as well. Keeping in view the present investigation has been carried out suitable, effective, feasible and economical plant protection measures against chilli thrips was undertaken.

Materials and methods
A field experiment was conducted during *rabi* season of 2016-17 to study the effectiveness of some insecticides against *S. dorsalis* infesting chilli (cv. Konkan kirti). The details of experiment are given in below.

Cultural operations
The land was prepared as per the requirements of cucumber crop and cleared by removing the residues of the previous crop. The experiment was laid out in Randomized Block Design (RBD). The recommended dose of fertilizers for cucumber is 100:50:50 N:P:K kg ha^{-1}. Nitrogen @ 100 kg $ha^{-1}$was applied in three splits doses *viz*., first dose of 50 percent N at the time of transplanting, second dose of 50 percent N during flowering and fruiting stage.

Phosphorus was applied @ 50 kg $ha^{-1}$and potassium was applied @ 50 kg ha^{-1}, these fertilizers were applied in a single dose at the time of transplanting.

The experimental area was sown with good seed of chilli (cv. Konkan kirti) in each plot. The transplanting of seedlings was done forty days after sowing. The other agronomic operations *viz.,* intercultural operations and weeding were done as per recommendation.

Details of the field experiment

1	**Location**	**:**	**Central Experimental Station, Wakawali, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist- Ratnagiri**
2	Variety	:	Konkan kirti
3	Spacing	:	60 cm × 60 cm
4	Total plot size	:	190.08 m^2
5	Size of treatment plot	:	6.6 m × 1.2 m
6	Date of transplanting	:	26th December, 2016
7	Method of planting	:	On raised bed
8	Design	:	Randomized Block Design (RBD)
9	Number of treatment	:	Eight
10	Number of replication	:	Three
Treatment Details:			
No.	**Insecticides**		**Concentration (%)**
T_1	Acetamiprid 20 SP		0.004
T_2	Dimethoate 30 EC		0.6
T_3	Emamectin benzoate 5 SG		0.002
T_4	Imidacloprid 17.8 SL		0.004
T_5	Lambda cyhalothrin 5 EC		0.018
T_6	Emamectin benzoate 5 SG		0.002
T_7	Thiamethoxam 25 WG		0.01
T_8	Untreated Control		-

Spraying

The quantity of spray suspension required for each treatment was calibrated by spraying water over three plots in the experiment prior to the application of insecticide. Spray suspension of desired strength of each insecticide was prepared against thrips in the field.

The insecticides were sprayed thrice. First spray of each insecticide was applied when incidence was noticed, while remaining two sprays were given at an interval of 15 days with manually operated knapsack sprayer. The observations were recorded in each treatment on randomly selected five plants.

Method of recording observations

An observation on the number of thrips was recorded on five randomly selected plants per plot. Numbers of thrips were recorded from three leaves top, middle and bottom of the plant. The populations of aphids before spraying as precount and on third, seventh, tenth and fourteenth days after each spray were recorded in the early morning hours. The data thus obtained were converted into square root transformation and then statistically analysed.

Results and Discussion

Efficacy of insecticides against thrips (*S. dorsalis*) infesting chilli

1. Efficacy of some insecticides against thrips (*S. dorsalis*) infesting chilli recorded at different intervals after first spray

The data pertaining to the efficacy of different insecticides against thrips infesting chilli at 3, 7, 10 and 14 days after spray are presented in Table 1.

The data on mean population of thrips prior to insecticide application ranged from 3.40 to 3.53. There is no significant difference among the different treatments since uniform distribution of thrips in different treatments.

The observations recorded on third day after spraying of insecticide ranges from 2.73 to 3.76. The treatment spinosad 45 SC @ 0.014 percent was found to be most effective treatment which recorded 2.73 mean populations of thrips and was at par with the treatment emamectin benzoate 5 SG @ 0.002 percent (2.84).The treatment thiamethoxam 25 WG @ 0.01 percent recorded (3.09) and was at par with lambda cyhalothrin 5 EC @ 0.018 (3.20) and acetamiprid 20 SP @ 0.004 (3.33). The remaining treatments were dimethoate 30 EC @ 0.6 percent (3.40) and imidacloprid 17.8 SL @ 0.004 percent (3.42).The maximum (3.76) pest population was found in untreated control.

At the seventh day after first spray the minimum (1.07) thrips population recorded in the treatment spinosad 45 SC @ 0.014 percent which was significantly superior over rest of the treatments. The nest best treatment emamectin benzoate 5 SG @ 0.002 percent (1.78) was at par with treatment thiamethoxam 25 WG @ 0.01 percent (1.89). The treatment dimethoate 30 EC @ 0.6 percent (2.39) and lambda cyhalothrin 5 EC @ 0.018 percent (2.50) was at par with each other. The remaining treatment was acetamiprid 20 SP @ 0.004 percent and imidacloprid 17.8 SL @ 0.004 percent which recorded 2.98 and 3.05 thrips population, respectively. The maximum (3.44) thrips population was noticed in untreated control.

The observations recorded at 10th day after first spray revealed that the thrips population in the treatment spinosad 45 SC @ 0.014 percent was minimum (1.33) and found significantly superior over rest of the treatments. The next best treatments thiamethoxam 25 SG @ 0.01 percent (2.10) which was at par with the treatments dimethoate 30 EC @ 0.6 percent (2.13), emamectin benzoate 5 SG @ 0.002 (2.33), acetamiprid 20 SP @ 0.004 (2.53), lambda cyhalothrin 5 EC @ 0.018 percent (2.60) and imidacloprid 17.8 SL @ 0.004 percent (2.92). The maximum (3.21) thrips population was recorded in untreated plot.

At 14th day of observation, the minimum (2.55) pest population was recorded in spinosad 45 SC @ 0.014 percent and which was significantly superior to rest of the treatments. The next best treatments was emamectin benzoate 5 SG @

0.002 percent (2.82) and thiamethoxam 25 WG @ 0.01 percent (2.90) thrips population and both these treatments at par with each other. The remaining treatments were dimethoate 30 SC @ 0.6 percent (3.12), lambda cyhalothrin 5 EC @ 0.018 percent (3.25), acetamiprid 20 SP @ 0.004 percent (3.47) and imidacloprid 17.8 SL @ 0.004 percent (3.70). The maximum population (4.20) was found in untreated plot.

2. Efficacy of some insecticides against thrips (*S. dorsalis*) recorded at different intervals after second spray

The results on effect of second spray are presented in Table 1. The observations recorded at third day after second spray indicated that the treatment with spinosad 45 SC @ 0.014 percent was found to be most effective treatment which recorded 1.83 mean thrips population per three leaves per plant. The treatment emamectin benzoate 5 SG @ 0.002 percent (2.15), thiamethoxam 25 WG @ 0.01 percent (2.50), lambda cyhalothrin 5 EC @ 0.018 percent (3.00), dimethoate 30 EC @ 0.6 percent (3.06), acetamiprid 20 SP @ 0.004 percent (3.33) and imidacloprid 17.8 SL @ 0.004 percent (3.63). The maximum (4.35) mean thrips population per three leaves per plant was noticed in untreated control.

At 7th day after second spray, the minimum population was recorded in the treatment spinosad 45 SC @ 0.014 percent (1.50) and which was significantly superior over rest of the treatments. The treatment emamectin benzoate 5 SG @ 0.002 percent (1.85) and thiamethoxam 25 WG @ 0.01 percent (1.86) were at par with each other. The remaining treatments *viz*., lambda cyhalothrin 5 EC @ 0.018 percent, dimethoate 30 EC @ 0.6 percent, acetamiprid 20 SP @ 0.004 percent and imidacloprid 17.8 SL @ 0.004 percent with mean pest population 2.07, 2.64, 3.04 and 3.30 per three leaves per plant, respectively. While, maximum (4.24) pest population was observed in untreated control.

The observations recorded at 10th day after second spray revealed that the treatment spinosad 45 SC @ 0.014 percent recorded 1.65 thrips population and was significantly superior over rest of the treatments. The treatment thiamethoxam 25 WG @ 0.01 percent (2.20) which was at par with emamectin benzoate 5 SG @ 0.002 percent recorded (2.34). The remaining treatments were lambda cyhalothrin 5 EC @ 0.018 percent (3.03), dimethoate 30 EC @ 0.6 percent (3.04), acetamiprid 20 SP @ 0.004 percent (3.36) and imidacloprid 17.8 SL @ 0.004 percent (3.65). The maximum pest population 4.58 recorded in untreated control.

At 14th day of observation, the minimum (1.57) pest population was recorded in spinosad 45 SC @ 0.014 percent which was significantly superior over rest of the treatments. The next best treatment was emamectin benzoate 5 SG @ 0.002 percent (2.54) and thiamethoxam 25 WG @ 0.01 percent (2.61) was at par with each other. The treatments dimethoate 30 EC @ 0.6 percent, lambda cyhalothrin 5 EC @ 0.018 percent, acetamiprid 20 SP @ 0.004 percent and imidacloprid 17.8 SL @ 0.004 percent recorded pest population 3.21, 3.24, 3.38 and 3.53 respectively. The maximum population observed 4.62 in untreated control.

3. Efficacy of some insecticides against thrips (*S. dorsalis*) infesting chilli recorded at different intervals after third spray

The results on effect of third spray are presented in Table 1. After 3 days of third spray, the treatment spinosad 45 SC @ 0.014 percent was found significantly superior over rest of treatments which recorded 1.35 mean thrips population per three leaves per plant- followed by emamectin benzoate 5 SG @ 0.002 percent (2.01). The remaining treatments *viz*., thiamethoxam 25 WG @ 0.01 percent (2.38), lambda cyhalothrin 5 EC @ 0.018 percent (2.77), dimethoate30 EC @ 0.6 percent (3.00), acetamiprid 20 SP @ 0.004 percent (3.19) and imidacloprid 17.8 SL @ 0.004 percent (3.35), respectively. The highest thrips population was noticed in untreated control (4.60).

The data at 7th day of third spray indicated that recorded spinosad 45 SC @ 0.014 percent recorded 1.09 thrips population and was significantly superior over rest of the treatments which was followed by emamectin benzoate 5 SG @ 0.002 percent recorded mean thrips population 1.40. The treatments were in descending order of effectiveness thiamethoxam 25 WG @ 0.01 percent (1.72), lambda cyhalothrin 5 EC @ 0.018 percent (2.44), dimethoate 30 EC @ 0.6 percent (2.60), acetamiprid 20 SP @ 0.004 percent (2.93) and imidacloprid 17.8 SL @ 0.004 percent (3.21). The maximum 4.62 thrips population was recorded in untreated control.

The observations recorded at 10th day after third spray revealed that spinosad 45 SC @ 0.014 percent recorded showed better result amongst the treatments with 0.23 mean thrips population and was significantly superior over rest of the treatments. The treatment emamectin benzoate 5 SG @ 0.002 (0.90) was at par with treatment thiamethoxam 25 WG @ 0.01 percent (1.08). The remaining treatments were lambda cyhalothrin 5 EC @ 0.018 percent (1.45), acetamiprid 20 SP @ 0.004 percent (1.58), dimethoate 30 EC @ 0.6 percent (1.67) and imidacloprid 17.8 SL @ 0.004 percent (2.02). Untreated plot recorded highest (4.49) mean thrips population per three leaves per plant.

At 14th day of observation, the no thrips population was recorded in spinosad 45 SC @ 0.014 percent followed by emamectin benzoate 5 SG @ 0.002 percent (0.13) was at par with each other. The treatment thiamethoxam 25 WG @ 0.01 percent (0.78) and lambda cyhalothrin 5 EC @ 0.018 percent (0.93) both were at par with each other. The remaining treatments were dimethoate 30 EC @ 0.6 percent (1.16), acetamiprid 20 SP @ 0.004 percent (1.60) and imidacloprid 17.8 SL @ 0.004 percent (1.78) while untreated control recorded maximum pest population (4.17).

4. Overall mean of different insecticides against thrips (*S. dorsalis*) infesting chilli

The data pertaining to the overall efficacy of different insecticides against Thrips (*S. dorsalis*) infesting chilli are presented in Table 1.

The results regarding overall mean of all three sprays revealed that spinosad 45 SC @ 0.014 percent was the best treatment which was recorded minimum (1.41) mean pest population per three leaves per plant and was significantly superior over all other treatments. The treatment emamectin benzoate 5 SG @ 0.002 percent recorded (1.92) and thiamethoxam 25 WG @ 0.01 percent recorded (2.09) was at par with each other. The next treatments in descending order of effectiveness were lambda cyhalothrin 5 EC @ 0.018 percent, dimethoate 30 EC @ 0.6 percent, acetamiprid 20 SP @ 0.004 percent and imidacloprid 17.8 SL @ 0.004 percent which recorded 2.54, 2.62, 2.89 and 3.13 mean thrips population, respectively. All the above treatments were found to be superior over untreated control which recorded highest pest population (4.23).

Present findings are in agreement with Seal *et al*. (2006) [7] they evaluated the efficacy of the insecticides irrespective of the number of applications and use of surfactant, chlorfenapyr

was the most effective in reducing the densities of *S. dorsalis* adults and larvae followed by spinosad and imidacloprid.

Reddy *et al*. (2007) [6] observed that among all the treatments, fipronil 5 SC at 2 ml/litre was found the best treatment followed by spinosad 45 SC at 0.3 and 0.2 ml/litre against thrips.

Vanisree *et al.* (2013) [8] evaluated certain new insecticides results revealed that spinosad @ 0.015 percent was found most effective in reducing the population of *S. dorsalis* as well as in increasing yields.

Khaire (2017) [4] reported that thrips population/3 leaves/plant was minimum (1.59) in the treatment spinosad 45 SC @ 0.016 percent which was at par with treatment acetamiprid 20 SP @ 0.004 percent (1.77). The next effective treatments were emamectin benzoate 5 SG @ 0.0016 percent (1.87) and diafenthiuron 50 WP @ 0.06 percent (1.99).

Table 1: Efficacy of different insecticides against thrips (*S. dorsalis*) infesting chilli

Treatment	Pre count	Mean population of thrips per 3 leaves per plant												Overall mean
		Ist spray				IInd spray				IIIrd spray				
		3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	
T_1	3.45 (2.11)*	3.33 (2.08)	2.98 (1.99)	2.53 (1.88)	3.47 (2.11)	3.33 (2.08)	3.04 (2.01)	3.36 (2.09)	3.38 (2.09)	3.19 (2.05)	2.93 (1.98)	1.58 (1.61)	1.60 (1.61)	2.89 (1.97)
T_2	3.40 (2.10)	3.40 (2.10)	2.39 (1.84)	2.13 (1.77)	3.12 (2.03)	3.06 (2.01)	2.64 (1.91)	3.04 (2.01)	3.21 (2.05)	3.00 (2.00)	2.60 (1.90)	1.67 (1.63)	1.16 (1.47)	2.62 (1.90)
T_3	3.53 (2.13)	2.84 (1.96)	1.78 (1.67)	2.33 (1.81)	2.82 (1.95)	2.15 (1.77)	1.85 (1.69)	2.34 (1.83)	2.54 (1.88)	2.01 (1.73)	1.40 (1.55)	0.90 (1.38)	0.13 (1.06)	1.92 (1.71)
T_4	3.45 (2.11)	3.42 (2.10)	3.05 (2.01)	2.92 (1.98)	3.70 (2.17)	3.63 (2.15)	3.30 (2.07)	3.65 (2.16)	3.53 (2.13)	3.35 (2.09)	3.21 (2.05)	2.02 (1.74)	1.78 (1.67)	3.13 (2.03)
T_5	3.53 (2.13)	3.20 (2.05)	2.50 (1.87)	2.60 (1.89)	3.25 (2.06)	3.00 (2.00)	2.07 (1.75)	3.03 (2.01)	3.24 (2.06)	2.77 (1.94)	2.44 (1.85)	1.45 (1.56)	0.93 (1.39)	2.54 (1.88)
T_6	3.42 (2.10)	2.73 (1.93)	1.07 (1.44)	1.33 (1.52)	2.55 (1.88)	1.83 (1.68)	1.50 (1.58)	1.65 (1.63)	1.57 (1.60)	1.35 (1.53)	1.09 (1.44)	0.23 (1.10)	0.00 (1.00)	1.41 (1.55)
T_7	3.47 (2.11)	3.09 (2.02)	1.89 (1.70)	2.10 (1.76)	2.90 (1.97)	2.50 (1.87)	1.86 (1.69)	2.20 (1.87)	2.61 (1.90)	2.38 (1.84)	1.72 (1.65)	1.08 (1.44)	0.78 (1.33)	2.09 (1.76)
T_8	3.50 (2.12)	3.76 (2.18)	3.44 (2.11)	3.68 (2.16)	4.20 (2.28)	4.35 (2.31)	4.24 (2.29)	4.58 (2.36)	4.62 (2.37)	4.60 (2.37)	4.62 (2.37)	4.49 (2.24)	4.17 (2.27)	4.23 (2.29)
SE (m±)	0.04	0.02	0.03	0.05	0.02	0.02	0.02	0.04	0.03	0.02	0.03	0.04	0.03	0.03
CD at 0.05%	NS	0.07	0.08	0.14	0.06	0.06	0.05	0.11	0.08	0.07	0.08	0.11	0.08	0.08

*Figures in parenthesis are $\sqrt{X+1}$ values (DAS- Days after Spraying)

Conclusion

From the present study, it can be concluded that the overall efficacy of all three sprays revealed that spinosad 45 SC @ 0.014 percent was the best treatment which recorded minimum (1.41) mean thrips population per three leaves per plant and was significantly superior over all other treatments followed by emamectin benzoate 5 SG @ 0.002 percent recorded (1.92) and was at par with thiamethoxam 25 WG @ 0.01 percent recorded (2.09).

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