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Efficacy of Spinetoram 12% SC against thrips on grape

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Abstract
A study was carried out during 2012-13 and 2013-14 at Mataladinni village of Yalaburga taluk, (Koppal Dist.), Karnataka, India, which is 80 km away from Agricultural Research Station Gangavathi on efficacy of a novel insecticide spinetoram 12% SC at different doses against thrips and its impact on natural enemies in Grapes along with recommended insecticides. Among the different insecticides tested, spinetoram 12% SC @ 300 and 375 g.a.i/ ha found to be effective in reducing the thrips population and also for realising the higher fruit yield with a least adverse effect on natural enemies build up like Coccinellids.

Keywords: Grapes, thrips, spinetoram

Introduction
Grape (*Solanum melongena* L.) also known as Aubergine or eggplant, is an important solanaceous vegetable crop, which is grown all over the world. It is grown throughout the year in one or other parts of the country as a continuous source of income to vegetable farmers. It is grown extensively in India, Bangladesh, Pakistan, China and other parts of the world. India ranks second in the world and its contribution is 27.1 per cent. In India, it is mainly grown in Bihar, Orissa, West Bengal, U.P. and other parts. Grape is being cultivated round the year during *kharif, rabi* and summer season. The area under Grape cultivation is estimated as 0.68 million ha with the total production of 12706 thousand MT [1]. The productivity of Grape is still below the expected due to various constraints of which insect and non-insect pests that attack the crop at various physiological growth stages from the nursery stage to harvest considered to be major one. Grape fruit and shoot borer, *Leucinodes orbonalis* (Guenee) (Lepidoptera: Pyralidae) is reported most destructive [2] as the pest species may cause fruit damage as high as 95% and losses up to 70% in commercial plantings [3]. Only the larva of this pest causes 12-16% damage to shoots and 20-60% to fruits [4]. The study of biology of an insect provides the growth rate statistics, which can be used as a predictive basis for pest control. Hence, the present investigation on the study of biology of *Leucinodes orbonalis* on Grape crop was undertaken in the Varanasi condition Spinetoram is a semi-synthetic active ingredient representing the spinosyn chemical class of insecticides. This molecule has got more efficacy compared to that of spinosad. Spinetoram is a reduced-risk pesticide that has minimal impacts on beneficial arthropods and maintains the exceptional environmental and toxicological profile established for the spinosyn chemistry [6, 7, 13]. Considering the above points in view this experiment was formulated to evaluate the efficacy of spinetoram 12.5SC against thrips in grapes.

Materials and Methods
Experiment was carried out during 2013-14 *Rabi* season in a Randomized block design with seven treatments and three replications. Observations were made on number of thrips on 5 leaves per vine and from five vines per replication before imposition of the treatment and 3, 5 and 7 days after imposition of treatments. Similarly, observations were also made on lepidopteran insect Pests *viz.*, *Spodoptera* (no of egg mass/branch, number of larvae/branch and number of larvae per bunch) and *Helicoverpa* (number of larvae per bunch) randomly on five planting before imposition of treatment and 5 and 10 days after imposition of treatments. Observations were also recorded on number of natural enemies (*viz.*, *coccinellids* on vine

planting before imposition of treatment and 5 and 10 days after imposition of treatments. Observations were also recorded on number of natural enemies (*viz.*, *coccinellids* on vine). Data was subjected to square root transformation and applied to statistical analysis. The analysed data was sorted out based on critical difference or least significant difference (LSD). Fruit yield from each individual plot summarized from each harvest and was converted into hectare basis and computed statistically.

Results

Before imposition of any treatment the population of thrips was uniform throughout the experiment which ranged from 20.15 to 25.10 thrips/ shoots/ vine during 2012-13 (Table 1). However, variation was observed after the treatment imposition. After the 3 days of first spray treatment, spinetoram 12% SC @ 300 and 375 g.a.i/ ha were found to be equally superior among other treatments by significantly reducing thrips population (17.42 and 15.40 thrips/ shoot/ vine, respectively) over thiametoxam 25% WG (19.20 thrips/ shoot/ vine) and spinosad 45% SC (19.00 thrips/ shoot/ vine). Highest number of thrips population (29.65 thrips/ shoot/ vine) was recorded in untreated check which is significant over other treatments. The similar trend was followed at 5 and 7 days after spray (Table 1). The same situation was prevailed even at 3, 5 and 7 days after the second spray.

During 2013-14, similar trend was observed (Table 3). Pooled data analysis for both the seasons also revealed the same trend (Table 5). Significantly less number of thrips/ shoot/ vine in the spinetoram 12% SC @ 300 and 375 g.a.i/ ha (18.92 and 17.35 spinetoram 12% SC @ 300 and 375 g.a.i/ ha at 3 days after sprying, respectively) compared to thiametoxam 25% WG and spinosad 45% SC (21.95 and 21.61 thrips/ shoot/ vine, respectively). However, untreated control check recorded significantly highest number of 34.38 thrips/ shoots/ vine at 3 days after spray. The similar trend was noticed at 5 and 7 days after first spray and 3, 5 and 7 days after second spray (Table 5).

The results of the study showed that before the first foliar application, the population of the predatory coccinellid was uniform throughout the experiment (Table 4, 6) and there was no significant difference in the population of predatory coccinellid among the treatments (Table 2). However, after the first foliar application, there was a decline in the populations of predatory coccinellid was noticed. It was found that the highest population of predatory coccinellid was recorded in the untreated check (9.30 coccinellids/ vine). In all the chemical treatment natural enemies like *coccinellid* population per vine was also recorded and it was found that there was no adverse effect on *coccinellid* population after application of Spinetoram 12 SC at various dosages as predatory population after application maintained at a satisfactory level and were comparable with other insecticides (Table 2). The same situation was prevailed in the next year also (2013-14). The pooled data of the two years also depict the same trend.

Table 1: Bio-efficacy of Spinetoram 12% SC against thrips during 2012-13

Sl. No	Treatment detail	Dosage (gm or ml /ha)	No. of Thrips / Shoot per vine												Yield (Q/ha)
			First Application				Second Application				Average of two applications				
			DBS	3 DAS	5 DAS	7 DAS	D BSS	3 DAS	5 DAS	7 DAS	DBS	3 DAS	5 DAS	7 DAS	
1	Spinetoram 12% SC	250	20.60 (4.65)	18.28 (4.39)	9.39 (3.22)	4.88 (2.42)	27.16 (5.31)	16.15 (4.14)	7.15 (2.85)	2.84 (1.96)	23.88 (4.99)	17.22 (4.27)	8.27 (3.04)	3.86 (2.20)	253.80
2	Spinetoram 12% SC	300	21.35 (4.73)	17.42 (4.29)	8.84 (3.14)	4.26 (2.29)	25.37 (5.14)	15.26 (4.03)	5.51 (2.55)	2.02 (1.74)	23.36 (4.94)	16.34 (4.16)	7.18 (2.86)	3.14 (2.03)	254.60
3	Spinetoram 12% SC	375	25.10 (5.11)	15.40 (4.05)	8.16 (3.03)	3.10 (2.02)	24.22 (5.02)	11.17 (3.49)	5.05 (2.46)	1.33 (1.53)	24.66 (5.07)	13.29 (3.78)	6.61 (2.76)	2.22 (1.79)	255.00
4	Fipronil 80% WG	50	23.45 (4.94)	18.70 (4.44)	9.88 (3.30)	6.45 (2.73)	29.14 (5.49)	19.12 (4.49)	9.73 (3.28)	4.96 (2.44)	26.29 (5.22)	18.91 (4.46)	9.81 (3.29)	5.71 (2.59)	248.07
5	Spinosad 45% SC	250	21.74 (4.77)	19.00 (4.47)	16.30 (4.16)	9.33 (3.21)	26.11 (5.21)	22.18 (4.81)	14.17 (3.89)	8.92 (3.15)	23.92 (4.99)	20.59 (4.65)	15.24 (4.03)	9.13 (3.18)	207.43
6	Thiamethoxam 25% WG	250	20.15 (4.60)	19.20 (4.49)	15.17 (4.02)	8.16 (3.03)	27.15 (5.31)	20.36 (4.62)	12.18 (3.63)	7.19 (2.86)	23.65 (4.96)	19.78 (4.56)	13.68 (3.83)	7.68 (2.95)	209.60
7	Untreated check		22.60 (4.86)	29.65 (5.54)	33.25 (5.85)	34.12 (5.93)	32.18 (5.76)	35.49 (6.04)	38.1 (6.25)	39.25 (6.34)	27.39 (5.33)	32.57 (5.79)	35.68 (6.06)	36.69 (6.14)	161.90
	CD		0.86	0.88	0.96	0.73	1.65	0.89	0.68	0.64	1.07	0.91	0.80	0.62	43.44
	S.Em ±		0.29	0.30	0.33	13.98	0.56	0.30	0.23	0.22	0.36	0.31	0.27	0.21	14.77
	CV(%)		10.55	11.40	14.86	13.98	18.25	11.66	11.29	13.22	12.46	11.90	12.71	12.30	11.26

Figures in the parenthesis are √ x+1 transferred value

Table 2: Impact of Spinetoram 12% SC on natural enemy.

Sl. No	Treatment detail	Dosage (g or ml /ha)	*Coccinellids*/vine			
			DBS	10 DAS	10 DASS	Mean
1	Spinetoram 12 SC	250	8.30 (3.05)	5.20 (2.48)	4.90 (2.41)	6.13 (2.67)
2	Spinetoram 12 SC	300	7.20 (2.86)	4.80 (2.40)	4.00 (2.23)	5.33 (2.52)
3	Spinetoram 12 SC	375	6.50 (2.74)	4.40 (2.31)	3.60 (2.13)	4.83 (2.42)
4	Fipronil 80WG	50	8.40 (3.07)	6.50 (2.73)	5.80 (2.59)	6.90 (2.81)
5	Spinosad 45 SC	250	7.8 0 (2.97)	6.30 (2.70)	5.50 (2.54)	6.53 (2.74)
6	Thiamethoxam 25WG	250	8.50 (3.08)	4.70 (2.38)	3.90 (2.20)	5.70 (2.59)
7	Untreated check		7.40 (2.90)	9.30 (3.20)	14.70 (3.96)	10.47 (3.39)
CD			0.79	0.47	0.50	0.53
S.Em ±			0.27	0.16	0.17	0.18
CV			15.74	10.69	11.43	11.50

Figures in the parenthesis are √ x+1 transferred value

Table 3: Bio-efficacy of Spinetoram 12% SC against thrips during 2013-14

Sl. No	Treatment detail	Dosage (gm or ml /ha)	No. of Thrips / Shoot per vine												Yield (Q/ha)
			First Application				Second Application				Average of two applications				
			DBS	3 DAS	5 DAS	7 DAS	D BSS	3 DAS	5 DAS	7 DAS	DBS	3 DAS	5 DAS	7 DAS	
1	Spinetoram 12% SC	250	24.30 (5.03)	20.55 (4.64)	9.83 (3.29)	5.03 (2.46)	31.88 (5.73)	17.36 (4.28)	7.73 (2.95)	3.15 (2.04)	28.09 (5.39)	18.96 (4.47)	8.78 (3.13)	4.09 (2.26)	256.43
2	Spinetoram 12% SC	300	26.80 (5.27)	20.41 (4.63)	9.47 (3.24)	4.51 (2.35)	30.15 (5.58)	16.71 (4.21)	7.27 (2.88)	2.30 (1.82)	28.48 (5.43)	18.56 (4.42)	8.37 (3.06)	3.41 (2.10)	257.83
3	Spinetoram 12% SC	375	27.40 (5.33)	19.30 (4.51)	9.11 (3.28)	4.02 (2.24)	28.33 (5.42)	13.28 (3.78)	6.88 (2.81)	1.89 (1.70)	27.87 (5.37)	16.29 (4.16)	7.995 (3.00)	2.96 (1.99)	261.33
4	Fipronil 80%WG	50	30.50 (5.61)	23.15 (4.91)	11.93 (3.60)	7.22 (2.87)	32.13 (5.76)	18.92 (4.46)	10.16 (3.34)	5.85 (2.62)	31.32 (5.68)	21.04 (4.69)	11.04 (3.47)	6.54 (2.74)	249.73
5	Spinosad 45% SC	250	27.90 (5.38)	24.22 (5.02)	17.82 (4.34)	9.41 (3.23)	33.44 (5.87)	23.46 (4.95)	15.08 (4.01)	9.05 (3.17)	30.67 (5.63)	23.84 (4.98)	16.45 (4.18)	9.23 (3.20)	209.20
6	Thiamethoxam 25%WG	250	30.70 (5.63)	24.70 (5.07)	17.61 (4.31)	9.10 (3.18)	32.17 (5.76)	22.06 (4.80)	14.57 (3.95)	7.95 (2.99)	31.44 (5.70)	23.38 (4.94)	16.09 (4.13)	8.53 (3.09)	210.80
7	Untreated check		28.10 (5.39)	39.11 (6.33)	42.55 (6.60)	45.70 (6.83)	40.12 (6.41)	42.49 (6.59)	45.13 (6.79)	47.21 (6.94)	34.11 (5.93)	40.80 (6.47)	43.84 (6.70)	46.46 (6.89)	163.80
	CD		1.23	1.02	0.88	0.72	1.35	1.05	0.89	0.73	1.18	1.04	0.86	0.61	45.01
	S.Em ±		0.42	0.35	0.30	0.24	0.46	0.36	0.30	0.25	0.40	0.35	0.29	0.21	15.30
	CV (%)		13.48	11.94	12.69	12.83	13.72	13.13	13.80	14.08	12.42	12.54	12.87	11.28	11.53

Figures in the parenthesis are √ x+1 transferred value

Table 4: Impact of Spinetoram 12% SC on natural enemy.

Sl.No	Treatment detail	Dosage (g or ml /ha)	*Coccinellids*/vine			
			DBS	10 DAS	10 DAS	Mean
1	Spinetoram 12% SC	250	9.30 (3.12)	6.30 (2.68)	5.70 (2.58)	7.10 (2.85)
2	Spinetoram 12% SC	300	8.80 (3.13)	5.80 (2.59)	4.30 (2.30)	6.30 (2.70)
3	Spinetoram 12% SC	375	9.50 (3.24)	5.50 (2.54)	4.80 (2.40)	6.60 (2.76)
4	Fipronil 80%WG	50	9.10 (3.18)	6.80 (2.78)	6.20 (2.68)	7.37 (2.89)
5	Spinosad 45% SC	250	8.30 (3.05)	6.30 (2.70)	6.00 (2.64)	6.87 (2.80)
6	Thiamethoxam 25%WG	250	9.60 (3.26)	5.90 (2.62)	5.20 (2.48)	6.90 (2.81)
7	Untreated check		9.50 (3.24)	11.60 (3.54)	18.60 (4.40)	13.23 (3.77)
CD			0.63	0.54	0.52	0.72
S.Em ±			0.21	0.18	0.18	0.244
CV			11.56	11.42	11.01	14.40

Table 5: Bio-efficacy of Spinetoram 12% SC against thrips (pooled)

Sl. No	Treatment detail	Dosage (gm or ml /ha)	No. of Thrips / Shoot per vine												Yield (Q/ha)
			First Application				Second Application				Average of two applications				
			DBS	3 DAS	5 DAS	7 DAS	DBSS	3 DAS	5 DAS	7 DAS	DBS	3 DAS	5 DAS	7 DAS	
1	Spinetoram 12% SC	250	22.45 (4.84)	19.42 (4.52)	9.61 (3.26)	4.96 (2.44)	29.52 (5.52)	16.76 (4.21)	7.44 (2.91)	3.00 (2.00)	25.99 (5.19)	18.09 (4.37)	8.53 (3.09)	3.98 (2.23)	255.12
2	Spinetoram 12% SC	300	24.08 (5.00)	18.92 (4.46)	9.16 (3.19)	4.39 (2.32)	27.76 (5.36)	15.99 (4.12)	6.39 (2.71)	2.16 (1.78)	25.92 (5.18)	17.45 (4.29)	7.77 (2.96)	3.27 (2.07)	256.22
3	Spinetoram 12% SC	375	26.25 (5.22)	17.35 (4.28)	8.64 (3.10)	3.56 (2.13)	26.28 (5.22)	12.23 (3.63)	5.97 (2.63)	1.61 (1.61)	26.26 (5.22)	14.79 (3.97)	7.30 (2.88)	2.59 (1.89)	258.17
4	Fipronil 80%WG	50	26.98 (5.28)	20.93 (4.68)	10.91 (3.45)	6.84 (2.80)	30.64 (5.62)	19.02 (4.47)	9.95 (3.31)	5.41 (2.53)	28.81 (5.46)	19.97 (4.58)	10.43 (3.38)	6.12 (2.67)	248.90
5	Spinosad 45% SC	250	24.82 (5.07)	21.61 (4.75)	17.06 (4.25)	9.37 (3.22)	29.78 (5.54)	22.82 (4.88)	14.63 (3.95)	8.99 (3.16)	27.30 (5.31)	22.22 (4.82)	15.84 (4.10)	9.18 (3.19)	208.32
6	Thiamethoxam 25%WG	250	25.43 (5.12)	21.95 (4.78)	16.39 (4.17)	8.63 (3.10)	29.66 (5.53)	21.21 (4.71)	13.38 (3.79)	7.57 (2.93)	27.54 (5.33)	21.58 (4.75)	14.88 (3.98)	8.10 (3.02)	210.20
7	Untreated check	--	25.35 (5.13)	34.38 (5.94)	37.90 (6.23)	39.91 (6.38)	36.15 (6.09)	38.99 (6.32)	41.62 (6.52)	43.23 (6.64)	30.75 (5.63)	21.58 (6.13)	39.76 (6.38)	41.57 (6.51)	162.85
	CD		1.04	0.82	0.73	0.65	0.84	0.85	0.66	0.65	1.00	0.88	0.77	0.50	45.09
	S.Em ±		0.34	0.27	0.24	0.22	0.27	0.28	0.22	0.22	0.32	0.29	0.26	0.17	15.03
	CV(%)		11.51	9.64	10.41	11.42	8.51	10.33	10.04	12.40	10.50	10.58	11.27	9.18	11.09

Figures in the parenthesis are √ x+1 transferred value

Table 6: Impact of Spinetoram 12% SC on natural enemy (pooled)

Sl. No	Treatment detail	Dosage (g or ml /ha)	*Coccinellids*/vine		
			DBS	10 DAS	10 DAS
1	Spinetoram 12% SC	250	8.80 (3.13)	5.75 (2.58)	5.30 (2.50)
2	Spinetoram 12% SC	300	8.00 (3.00)	5.30 (2.50)	4.15 (2.26)
3	Spinetoram 12% SC	375	8.00 (2.99)	4.95 (2.43)	4.20 (2.27)
4	Fipronil 80%WG	50	8.75 (3.12)	6.65 (2.76)	6.00 (2.63)
5	Spinosad 45% SC	250	8.05 (3.01)	6.30 (2.70)	5.75 (2.59)
6	Thiamethoxam 25%WG	250	9.0 5 (3.17)	5.30 (2.50)	4.55 (2.34)

7	Untreated check	--	8.45 (3.07)	10.45 (3.37)	16.65 (4.18)
CD			0.64	0.47	0.43
S.Em ±			0.21	0.16	0.14
CV			11.79	9.76	9.06

Figures in the parenthesis are √ x+1 transferred v

Yield

Spinetoram 12% SC at its higher dosage 375 ml/ha was to be significantly superior by registering highest yield of 255 q/ha compared to standard checks thiamethoxam 25% WG (209.60 q/ha), Spinosad 45% SC (207.43) during 2012-13. The same situation was prevailed in 2013-14 also (Table 2). The average of these two years depicts the same trend (Table 3). However, it was statistically comparable with its lower dosages i.e., 300 and 250 ml/ha and also with Fipronil 80%WG (Table 1). Significantly lowest yield of 161.90 q/ha was obtained in untreated checks.

Discussion

The current study revealed the efficacy of spinoteram 12% SC against thrips in grapes. The pre-treatment observation on thrips population indicated an uniform spread of thrips in the field. However after the three days of first spray treatment with spinetoram 12% SC @ 300 the variation in the population was reduced. Further the same trend was noticed in 5 and 7 days after treatments and where as in untreated check the highest population was observed. The present findings are in agreement with the previous reports of Mahmoud *et al.* [9] for thrips control with a novel chemical spinetoram 12% EC, at 400 µg/ ml with a 79.00% efficacy which was found to be best for managmnet of thrips under field conditions. The present study has revealed the superiority of the new molecule in reducing the thrips population over the existing molecule such as thiamethoxam 25% WG and spinosad 45% SC and this result also supported by the previous report of thrips control with new molecules of insecticide spinetoram @ 50 g.a.i/ ha over spinosad at various doses Siebert *et al.* [10].

The predatory coccinellids were found abundantly in the field before the treatment and in the untreated check plots. But after the imposition of the treatment the gradual decrease in the coccinellids was noticed. This is due to the toxic effect of the insecticides applied. The above findings are in accordance with the reports of Galvan *et al.* [8]. who reported that coleopteran predators seem to be unaffected by the spinosad treatments. Furthermore, a similar selectivity was also performed on the two aphidophagous coccinellids *Stethorus punctillum* (Weise) and *Scymus subvillosus* (Goeze). One field risk assessment was conducted with the semi-synthetic spinosyn analogue spinetoram by Srivastava *et al.* [14]. to evaluate its effects on *O. insidiosus* in a field trial on pepper. When spinetoram was applied at 61 g a.i. ha−1, the predator was still sufficiently abundant to suppress thrips population growth.

The highest fruit yield was recorded in the plots which were treated with spinoteram 12% SC @ 375ml/L. in both the seasons. Comparatively less yield in the standard check thiamethoxam 25% WG treated and untreated check plots.

Conclusion

From the present study it is concluded that spinetoram 12% SC @ 300- 375 ml/ha (36 to 45 g a.i/ha) was found to be optimum dosage in suppressing the thrips infestation in grape and maintained its efficacy even at seven days after spray resulting in higher fruit yield. Moreover, all the dosage of Spinetoram 12% SC tested did not adversely affect population of natural enemies compared to other insecticides and maintained the population at satisfactory level.

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