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Field efficacy of newer insecticides and neem products against *Scirtothrips dorsalis* on grapes, *Vitis vinifera* L. (cv. Thompson Seedless)

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Abstract
Field experiments on the efficacy of novel insecticide molecules and neem products to grape thrips, *Scirtothrips dorsalis* Hood were conducted in Vijayapur and Bagalkot district for two seasons during 2013-14. Among twelve treatments, Fipronil 5% SC @ 1.0 ml/l, Imidacloprid 17.8% SL @ 0.3 ml/l were significantly superior to other treatments with more than 87 per cent reduction of thrips damage over untreated control. The next best treatments were Emamectin benzoate 5% SG @ 0.2 g/l, Spinosad 45% SC @ 0.25 ml/l, Thiamethoxam 25% WG @ 0.25 g/l recorded more than 73 per cent reduction of thrips damage over untreated control. Clothianidin 50% WDG @ 0.2 g/l, Dimethoate 30% EC @ 1.0 ml/l, Lambda cyhalothrin 5% EC @ 0.5 ml/l and Acephate 75% SP @ 0.5 g/l recorded more than 48 per cent reduction of thrips damage over untreated control. Botanicals such as azadirachtin 1500 ppm @ 3.0 ml/l and Neem Seed Kernel Extract @ 5 per cent @ 5.0 ml/l were less effective than insecticides. The results of the two season trials revealed that all the insecticides were harmful to the population of thrips than botanicals. In addition to reduction in thrips population, Imidacloprid 17.8% SL @ 0.3 ml/l recorded highest marketable fruit yield (41.63 t/ha) and maximum net return of Rs. 5,06,982 per hectare.

Keywords: Grapes, *Scirtothrips dorsalis*, Imidacloprid, Fipronil and botanicals

1. Introduction
Grape (*Vitis vinifera* L.) is one of the most important fruit crops of temperate zone, which has acclimatized to sub-tropical and tropical agro climatic conditions prevailing in the Indian sub-continent [1]. In India, grape is commercially grown in an area of about 1,16,000 hectares with annual production of 24,83,000 tonnes with a productivity of 21.1 metric tonnes per hectare [2]. In India, grapes growing states are Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. Maharashtra stands first with 29,800 hectares followed by Karnataka having 8,200 hectares with an annual production of 7.79 and 2.28 lakh tonnes, respectively [2]. Vijayapur is one of the major districts of Karnataka in grape cultivation (6137 ha) with an annual production of 1.22 lakh tones [3]. Of the total production, nearly 60 per cent goes for the production of raisins and 40 per cent is used for table purpose [3].
Insect pests are the important production constraints in grape cultivation next to diseases. There are about 132 insect pests attacking grapes in the world [4]. In grape, 85 species of insect pests have been reported in India [5], but only a few of them are of potential threat and have gained the major importance as far as loss in yields caused by them are concerned. Among them, grape thrips (*Scirtothrips dorsalis* Hood) is of much importance and the most damaging pest species, infestation in grape (leaves) take whitish hue, acquire a withered appearance and then turn brown. Leaves ultimately curl up and drop off. In recent past, the damage by thrips is increasing year by year particularly on cv Thompson Seedless. Keeping in view the economic importance of this insect pest, the present study was undertaken to control through chemical and botanical means. Generally, conventional insecticides belonging to organophosphates and synthetic pyrethroides are used to control the thrips in grapes [6].

2. Material and Methods
Field experiment was conducted at progressive farmer field, Khedagi, Vijayapur district after April and October pruning (2013 and 2014) in randomized block design with twelve treatments and three replications to determine the efficacy of new molecules of insecticide at various doses against thrips infesting grape *Vitis vinifera* L. (cv. Thompson Seedless). The treatments were imposed as and when thrips population reached peak in vegetative stage two

(fifteen days after pruning) using knapsack sprayer with high volume sprayer. Observations on the number of thrips were recorded one day prior to the spray, three and ten days after the spray. Pre-treatment and post treatment counts on 10 randomly selected shoots were taken by gently beating the shoots on a black cardboard sheet. The number of thrips present on the black cardboard sheet were counted. The per cent berry damage was also recorded. The yield was recorded on the net plot area basis which was converted to kg/ha for statistical interpretations. The data obtained from field experiments were analysed using the analysis of variance for randomized block design [7].

3. Result and discussion

3.1 Thrips on shoots after April and October pruning

The grape thrips, *Scirtothrips dorsalis* population was uniform in all the treatments before spray as treatment difference was non-significant ranging from 9.00 to 10.60 thrips per shoot during after April pruning 2013 (Table 1). There was a significant reduction in thrips population after spraying of the insecticides over untreated control. Fipronil (T_3) and Imidacloprid (T_6) recorded significantly lower infestation of thrips (1.56 and 1.66 thrips/shoot respectively). The results are in accordance with earlier efindings who found efficacy of Fipronil (T_3) and Imidacloprid (T_6) against mulberry thrips [8]. The next best treatment Emamectin benzoate (T_4) (3.00 thrips/shoot), Spinosad (T_5) (3.46 thrips/shoot) and Thiamethoxam (T_7) (3.70 thrips/shoot) and were on par with each other followed by Clothianidin (T_8) (4.83 thrips/shoot). These results are in conformity with the earlier reports [9], who reported the effective of Emamectin benzoate and Spinosad in reducing thrips population in rose. The other treatments, Dimethoate (T_9) (5.56 thrips/shoot), Lambda Cyhalothrin (T_{10}) (5.90 thrips/shoot) and Acephate (T_{11}) (6.80 thrips/shoot) which were statistically on par with each other. The botanical produces Azadirachtin (T_1) (8.20 thrips/shoot) and Neem seed kernel extract (NSKE) 5% (T2) (8.43 thrips/shoot) were found to be statistically superior over untreated control (11.43 thrips/shoot). These results are close to the findings of earlier workers who reported that, NSKE and nimbicidine were found effective in controlling the thrips population but at lower rate as compared to chemical insecticides[10 and 11].

A similar trend was noticed in the treatments at 10 DAS of first spray and 3, 10 DAS of second spray. Fipronil (T_3) and Imidacloprid (T_6) were recorded significantly lower infestation in all the observations and was found superior to the untreated control, Emamectin benzoate (T_4), Spinosad (T_5) and Thiamethoxam (T_7) in reducing the thrips damage. The results of the second field experiment conducted during after October pruning 2013-14 (Table 2) also provided a comparable trend of reduction in the thrips damage with respect to different treatments. Fipronil (T_3) and Imidacloprid (T_6) also provided a significant decrease in the level of thrips infestation in both after April and October pruning trials, compared to the untreated control.

3.2 Effect on berry damage

The plots with newer insecticides registered significantly low incidence of neem product in comparison to farmers practices (Table 3). Minimum fruit damage of 21.89 % and 24.60 % (on number basis) was recorded in the treatment Fipronil (T_3) and Imidacloprid (T_6). The results are in line with findings [6], who reported significantly less bunch infestation in neonicotinoid treated plots. These three treatments i.e. Emamectin benzoate (T_4), Spinosad (T_5) and Thiamethoxam (T_7) were at par with each other in minimizing the thrips incidence (30.81, 31.34 and 33.70 percent berry damage respectively) followed by Clothianidin (T_8) with 38.34 % fruit damage. The treatments Dimethoate (T_9), Lambda Cyhalothrin (T_{10}) and Acephate (T_{11}) were also found to be moderately effective with 48.94, 49.49 and 47.92 percent fruit damage respectively. Among the botanical products evaluated, Azadirachtin (T_1) (56.43 % berry damage) and Neem seed kernel extract (NSKE) (T2) (60.15 % berry damage) proved relatively inferior in managing the thrips infestation. Highest thrips damage on berries was noticed on untreated control (T_{12}).

3.3 Effect on the yield

Yield losses due to *S. dorsalis* was significantly low in all insecticides treatment over farmers practice. The data pertaining to fruit yield (Table 3) revealed that, significantly highest yield was obtained in T_3 (42.08 t/ha) and T_6 (41.63 t/ha). Similar results with respect to higher yield of grapes was recorded by earlier worker [12]. The next best treatments were T_4 (38.37 t/ha), T_5 (37.57 t/ha) and T_7 (37.22 t/ha), followed by T_8 (32.12 t/ha). Among botanical products T_1 (23.69 t/ha) and T_2 (23.45 t/ha) were significantly superior over untreated control (20.22 t/ha). In effectiveness of NSKE and azadirachtin in decreasing the fruit yield in garlic ecosystem which agrees with the present findings [12].

4. Conclusion

Among the different insecticides evaluated for the effective management of thrips in grapes, two sprays of Fipronil 5 %SC @ 1 ml/l after October pruning was found most effective. Significantly less damage by thrips and higher yield of grapes was recorded in Fipronil 5 % SC @ 1 ml/l treatment compared to others. Hence, Fipronil 5 %SC @ 1 ml/l can be recommended for management of thrips in grapes.

Table 1: Efficacy of new molecules of insecticides on grape thrips cv. Thompson Seedless (*Vitis vinifera* L.) after April pruning (on shoots)

Tr. No.	Treatments	No. of *S. dorsalis* per shoot*						Per cent reduction over UTC
			First Spray		Second Spray			
		PTC	3 DAS	10 DAS	3 DAS	10 DAS	Mean	
T_1	Azadirachtin 1500ppm @ 3.0 ml/l	9.82	8.20 (2.95)e	9.00 (3.08)e	8.50 (3.00)e	7.60 (2.85)e	8.32	29.49
T_2	NSKE 5% @ 5.0 ml/l	9.62	8.43 (2.99)e	9.16 (3.11)e	8.76 (3.04)e	8.16 (2.94)e	8.62	26.94
T_3	Fipronil 5%SC @ 1.0 ml/l	10.03	1.56 (1.42)a	1.90 (1.55)a	1.20 (1.30)a	0.70 (1.09)a	1.43	87.88
T_4	Emamectin benzoate 5%SG @ 0.2 g/l	9.00	3.00 (1.87)b	3.30 (1.95)b	2.83 (1.81)b	2.53 (1.73)b	2.91	77.33
T_5	Spinosad 45%SC @ 0.25 ml/l	9.50	3.46 (1.99)b	3.40 (1.97)b	3.00 (1.87)b	2.66 (1.78)b	3.13	73.47
T_6	Imidacloprid 17.8%SL @ 0.3 ml/l	9.60	1.66 (1.46)a	1.90 (1.55)a	1.50 (1.41)a	1.20 (1.30)a	1.56	86.77
T_7	Thiamethoxam 25%WG @ 0.25 g/l	10.00	3.70 (2.05)b	4.13 (2.15)b	3.53 (2.00)b	3.13 (1.90)b	3.62	69.32
T_8	Clothianidin 50%WDG @ 0.2 g/l	10.30	4.83 (2.30)c	5.81 (2.51)c	5.11 (2.37)c	4.91 (2.32)c	5.16	56.27
T_9	Dimethoate 30%EC @ 1 ml/l	9.52	5.56 (2.46)d	7.13 (2.76)d	6.53 (2.65)d	5.93 (2.59)d	6.55	44.49

T10	Lambda cyhalothrin 5%EC @ 0.5 ml/l	9.60	5.90 (2.53)d	7.10 (2.76)d	6.60 (2.66)d	6.90 (2.66)d	6.62	43.89
T11	Acephate 75% SP @ 0.5 g/l	10.60	6.80 (2.70)d	7.20 (2.77)d	6.40 (2.63)d	6.80 (2.60)d	6.75	42.79
T12	Untreated control	10.30	11.43 (3.46)f	12.00 (3.54)f	12.50 (3.61)f	11.30 (3.44)f	11.80	-
	SE m±	NS	0.08	0.08	0.09	0.09		
	CD at 5%	NS	0.24	0.24	0.25	0.26		
	CV(%)	NS	5.93	5.70	6.30	6.90		

Figures in the parantheses are √x+0.5 transformed values
Means followed by same letter do not differ significantly by DMRT (P=0.05)
PTC-Pre treatment count per shoot
DAS-Day After Spraying
UTC-Untreated control
*Mean of thirty shoots

Table 2: Efficacy of new molecules of insecticides on grape thrips cv. Thompson Seedless (*Vitis vinifera* L.) after October pruning (on shoots)

Tr. No.	Treatments	No. of *S. dorsalis* per shoot on different days*					Mean	Per cent reduction over UTC	No. of thrips/inflorescence after 10 DAS of second spray
		PTC	First Spray		Second Spray				
			3 DAS	10 DAS	3 DAS	10 DAS			
T1	Azadirachtin 1500ppm @ 3.0 ml/l	10.22	7.67 (2.85)e	8.50 (3.00)e	8.50 (3.00)e	9.10 (3.09)e	8.44	33.80	8.10 (2.93)e
T2	NSKE 5% @ 5.0 ml/l	10.78	7.47 (2.82)e	8.66 (3.02)e	8.45 (2.99)e	9.66 (3.18)e	8.56	32.86	8.43 (2.99)e
T3	Fipronil 5%SC @ 1.0 ml/l	9.62	2.04 (1.58)a	1.40 (1.38)a	1.30 (1.34)a	1.20 (1.30)a	1.48	88.39	1.56 (1.42)a
T4	Emamectin benzoate 5%SG @ 0.2 g/l	10.40	3.83 (2.08)b	2.83 (1.81)b	3.33 (1.95)b	3.03 (1.87)b	3.25	74.50	3.00 (1.87)b
T5	Spinosad 45%SC @ 0.25 ml/l	10.00	3.87 (2.09)b	2.90 (1.84)b	3.66 (2.04)b	3.16 (1.91)b	3.29	74.19	3.46 (1.99)b
T6	Imidacloprid 17.8% SL @ 0.3 ml/l	9.40	2.45 (1.72)a	1.40 (1.38)a	1.70 (1.48)a	1.80 (1.52)a	1.83	85.64	1.66 (1.46)a
T7	Thiamethoxam 25%WG @ 0.25 g/l	9.62	4.10 (2.14)b	3.63 (2.03)b	4.03 (2.12)b	3.60 (2.02)b	3.84	69.88	3.70 (2.05)b
T8	Clothianidin 50%WDG @ 0.2 g/l	10.60	5.13 (2.37)c	5.31 (2.41)c	5.21 (2.39)c	5.41 (2.43)c	5.26	58.74	4.63 (2.26)c
T9	Dimethoate 30%EC @ 1 ml/l	10.78	6.30 (2.60)d	6.63 (2.67)d	6.83 (2.71)d	6.93 (2.73)d	6.67	47.68	5.56 (2.46)d
T10	Lambda cyhalothrin 5%EC @ 0.5 ml/l	10.50	6.33 (2.61)d	6.60 (2.67)d	7.06 (2.73)d	6.99 (2.73)d	6.75	47.05	5.90 (2.53)d
T11	Acephate 75% SP @ 0.5 g/l	9.52	6.30 (2.61)d	6.70 (2.68)d	6.70 (2.68)d	7.20 (2.81)d	6.72	47.29	6.80 (2.70)d
T12	Untreated control	9.56	11.53 (3.47)f	14.50 (3.87)f	13.20 (3.70)f	11.80 (3.51)f	12.75	-	11.43 (3.45)f
	SE m±	NS	0.07	0.09	0.08	0.08			0.08
	CD at 5%	NS	0.20	0.25	0.24	0.25			0.24
	CV(%)	NS	5.21	6.20	5.93	6.18			5.93

Figures in the parantheses are√x+0.5 transformed values
Means followed by same letter do not differ significantly by DMRT (P=0.05)
PTC-Pre treatment count per shoot
DAS-Day After Spraying
UTC-Untreated control
*Mean of thirty shoots

Table 3: Efficacy of various insecticides on berry damage and grape fruit yield

Tr. No.	Treatments	Per cent berry damage*	Per cent reduction over control	Fruit yield		
				Kg/ plant	t/ha	Per cent increase over UTC
T1	Azadirachtin 1500ppm @ 3.0 ml/l	56.43 e	18.15	6.83 e	23.69 e	17.18
T2	NSKE 5% @ 5.0 ml/l	60.15 e	12.75	6.76 e	23.45 e	15.98
T3	Fipronil 5%SC @ 1.0 ml/l	21.89 a	68.25	12.13 a	42.08 a	108.11
T4	Emamectin benzoate 5%SG @ 0.2 g/l	30.81 b	55.31	11.06 b	38.37 b	89.75
T5	Spinosad 45%SC @ 0.25 ml/l	31.34 b	54.54	10.83 b	37.57 b	85.81
T6	Imidacloprid 17.8%SL @ 0.3 ml/l	24.60 a	64.32	12.00 a	41.63 a	105.88
T7	Thiamethoxam 25%WG @ 0.25 g/l	33.70 b	51.12	10.73 b	37.22 b	84.09
T8	Clothianidin 50%WDG @ 0.2g/l	38.34 c	44.39	9.26 c	32.12 c	58.87
T9	Dimethoate 30%EC @ 1 ml/l	48.94 d	29.01	8.33 d	28.90 d	42.92
T10	Lambda cyhalothrin 5%EC @ 0.5 ml/l	49.49 d	28.21	8.30 d	28.79 d	42.40
T11	Acephate 75% SP @ 0.5 g/l	47.92 d	30.49	7.70 d	26.71 d	32.11
T12	Untreated control	68.94 f	-	5.83 f	20.22 f	-
	SE m±	1.48		0.28	0.291	
	CD at 5%	4.42		0.86	0.87	
	CV(%)	6.12		5.58	5.60	

PTC-Pre treatment count per shoot
DAS-Day After Spraying
UTC-Untreated control
*Mean of thirty bunches

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