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RESEARCH ARTICLE

Evaluation of spinetoram and sulfoxaflor against Flea beetle, *Scelodonta strigicollis* Motschulsky on Grapevine

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ABSTRACT

Grapevine flea beetle, *Scelodonta strigicollis* Motschulsky is a regular and severe pest in the grape growing area in peninsular India. The combination product spinetoram 10% w/w + sulfoxaflor 30% w/w WG was evaluated against this pest for Kharif 2015 and summer 2016 seasons at Odaipatty village of Chinnamanur block, Theni District, Tamil Nadu under field conditions. Three applications of foliar spray of spinetoram 10% w/w + sulfoxaflor 30% w/w WG @350 ml/ha and spinetoram 10% + sulfoxaflor 30% WG @300 ml/ha were superior and effective in reducing the flea beetle damage which also contributed higher fruit yield and Cost-Benefit Ratio.

Keywords: *Insecticides, grapes, Scelodonta strigicollis, spinetoram, sulfoxaflor*

INTRODUCTION

In India, the grape is commercially grown in Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. Of the total production, nearly 60 per cent goes for the production of raisins and 40 per cent is used for table purpose (Anon.,2012). Grapevine remains available for the pest development all the year round which leads to high pest infestation. Around 132 insect pests have been documented to infest grapevine (Mani *et al*., 2013). Among the various arthropod pests, flea beetle, *Scelodonta strigicollis* Motschulsky (Coleoptera: Chrysomelidae) occurs throughout the year causing considerable economic damage to grapes. The flea beetle adults scrap the sprouting buds or eat them up completely and the damaged buds fail to sprout and dry up (NRCG, 2011). In addition, the beetles cause damage to tender shoots, tendrils, leaves and rarely the bunches. They mainly feed on the new flush in October and April in Tamil Nadu after pruning. Later, they also feed on the matured leaves giving shot hole appearance or create elongated holes on the leaves. In severe cases of infestation, the entire leaf is skeletonised. The loss goes up to 50 per cent when the sprouting buds are damaged. The larvae feed on roots, devouring the cortical layer and cause yellowing of leaves lead to death of young vines (NRCG, 2008). There are not sufficient number of insecticides and the combination mixtures registered for grapes so far in India to manage this pest. The effectiveness of new molecule combination, spinetoram 10% w/w + sulfoxaflor 30% w/w against *Amrasca biguttula biguttula* was well demonstrated recently on okra (Srinivasan and Kalyanasundaram, 2019). In order to identify the efficacy of the new insecticide combination molecule, the present studies were made to evaluate spinetoram 10% w/w + sulfoxaflor 30% w/w against *S. strigicollis* on grapes during kharif 2015 and summer 2016.

MATERIAL AND METHODS

Field trials were conducted at Odaipatty village of Chinnamanur block, Theni District, Tamil Nadu which is a traditional viticulture belt during Kharif 2015 and Summer 2016 in randomized block design (RBD) with eight treatments replicated thrice with the plot size of 50 m^2. The age of the grapevine plants is three years and the number of vines maintained in each replication of 50 m^2 is six. One of the popular varieties and farmers' choice cv.Muscat (Panneer thirakshai) was zchosen for both the seasons. Routine cultural practices as per the TNAU Crop Production Guide were adopted uniformly.

The treatments included were spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 100 g a.i/ha (250 ml/ha); 120 g a.i/ha (300 ml/ha); 140 g a.i/ha (350 ml/ha); spinetoram 12% w/v SC @ 30 g a.i/ha (292 ml/ha); sulfoxaflor 24% w/v SC @ 90 g a,i/ha (375 ml/ha); emamectin benzoate 5% SG @ 11 g a.i/ha (220 g/ha); imidacloprid 17.8% SL @ 71 g a.i/ha (400 ml/ha) (standard check) and an untreated check.

Spinetoram 12% w/v SC, sulfoxaflor 24% w/v SC, emamectin benzoate 5% SG and imidacloprid 17.8% SL were included as chemicals for comparison. There was an untreated check as well. After pruning

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the vines, at the time of new flush formation, per cent flea beetle damage on leaves was observed on plant basis for pre-treatment count. First spraying was given during the first week of October 2015 in Kharif 2015 trial and last week of April, 2016 in summer 2016 trial when the flea beetle damage on the leaves is 15 – 20 per cent. The new molecules were applied as a foliar spray using high volume sprayer (500 lit/ha). Three rounds of sprays were given at 15 days interval and the observations were taken on 1, 3, 7 and 10 days after foliar spraying from 10 randomly selected plants in all the treatments. The per cent reduction over control was worked out. The fruit yield was recorded considering all the pickings. The yield obtained from each plot was recorded in kg/ plant/ plot and converted into t/ha. Data thus obtained were analysed statistically by LSD to identify the most effective treatments and doses.

RESULTS AND DISCUSSION

Efficacy of spinetoram 10% w/w + sulfoxaflor 30% w/w WG against flea beetle, S. strigicollis

Kharif 2015: The bioefficacy data of spinetoram 10% + sulfoxaflor 30% WG C against flea beetle on leaf damage is furnished in Table 1.

Table 1. Bio-efficacy of spinetoram 10% w/w + sulfoxaflor 30% w/w WG against flea beetle (*Scelodonta strigicolis*) damage on grapevine – Kharif 2015 (August 15 to December 15)

Treatments	Per cent leaf damage/vine on days after treatment													Mean	% reduction over untreated check
	Pre count	I spray				II spray				III spray					
		1	3	7	10	1	3	7	10	1	3	7	10		
T1	14.6 (22.46)	11.6 (19.91)^{abc}	9.7 (18.15)^{abc}	8.7 (17.15)^{bc}	9.4 (17.85)^{abc}	8.7 (17.15)^{bc}	7.5 (15.89)^{bc}	6.0 (14.18)^{ab}	6.8 (15.12)^{bc}	5.5 (13.56)^{ab}	4.8 (12.66)^{b}	2.9 (9.80)^{ab}	2.8 (9.63)^{ab}	7.03 (15.38)^{b}	69.94
T2	15.1 (22.87)	11.2 (19.55)^{ab}	9.3 (17.76)^{ab}	8.2 (16.64)^{ab}	8.9 (17.36)^{ab}	8.1 (16.54)^{ab}	6.9 (15.23)^{ab}	5.5 (13.56)^{ab}	6.1 (14.30)^{ab}	5.0 (12.92)^{ab}	4.0 (11.54)^{a}	2.5 (9.10)^{ab}	2.4 (8.91)^{ab}	6.51 (14.78)^{ab}	72.17
T3	14.8 (22.63)	10.8 (19.19)^{a}	9.0 (17.46)^{a}	7.8 (16.22)^{a}	8.6 (17.05)^{a}	7.9 (16.32)^{a}	6.7 (15.00)^{a}	5.3 (13.31)^{a}	5.9 (14.06)^{a}	4.8 (12.66)^{a}	3.9 (11.39)^{a}	2.3 (8.72)^{a}	2.2 (8.53)^{a}	6.27 (14.50)^{a}	73.19
T4	15.5 (23.18)	11.9 (20.18)^{bc}	10.0 (18.43)^{bc}	8.7 (17.15)^{bc}	9.7 (18.15)^{bc}	8.6 (17.05)^{abc}	7.5 (15.89)^{bc}	6.2 (14.42)^{bc}	6.9 (15.23)^{cd}	5.7 (13.81)^{b}	5.0 (12.92)^{b}	3.1 (10.14)^{b}	3.0 (9.97)^{b}	7.19 (15.56)^{bc}	69.26
T5	15.3 (23.03)	13.5 (21.56)^{d}	12.3 (20.53)^{d}	10.9 (19.28)^{d}	12.2 (20.44)^{d}	11.8 (20.09)^{d}	10.9 (19.28)^{d}	9.5 (17.95)^{d}	10.4 (18.81)^{e}	9.9 (18.34)^{d}	8.7 (17.15)^{c}	6.9 (15.23)^{d}	7.1 (15.45)^{d}	10.34 (18.76)^{d}	55.79
T6	15.2 (22.95)	12.1 (20.36)^{c}	10.2 (18.63)^{c}	9.1 (17.56)^{c}	10.0 (18.43)^{c}	9.0 (17.46)^{c}	8.2 (16.64)^{c}	7.0 (15.34)^{c}	7.6 (16.00)^{d}	6.7 (15.00)^{c}	5.6 (13.69)^{b}	4.3 (11.97)^{c}	4.2 (11.83)^{c}	7.83 (16.25)^{c}	66.52
T7	15.5 (23.18)	13.8 (21.81)^{d}	13.0 (21.13)^{d}	11.9 (20.18)^{d}	13.4 (21.47)^{d}	12.5 (20.70)^{d}	11.7 (20.00)^{d}	10.2 (18.63)^{d}	11.0 (19.37)^{e}	10.5 (18.91)^{d}	9.4 (17.85)^{c}	7.8 (16.22)^{d}	7.9 (16.32)^{d}	11.09 (19.45)^{d}	52.59
T8	14.7 (22.54)	15.1 (22.87)^{e}	15.7 (23.34)^{e}	17.6 (24.80)^{e}	19.3 (26.06)^{e}	20.5 (26.92)^{e}	22.2 (28.11)^{e}	23.9 (29.27)^{e}	26.0 (30.66)^{f}	27.4 (31.56)^{e}	29.7 (33.02)^{d}	30.8 (33.71)^{e}	32.5 (34.76)^{e}	23.39 (28.92)^{e}	–
SEd	NS	0.3743	0.3519	0.3768	0.3946	0.3660	0.3966	0.4605	0.4125	0.4408	0.5072	0.5634	0.5983	0.4051	–
CD (P=0.05)	NS	0.8029	0.7549	0.8083	0.8465	0.7851	0.8508	0.9878	0.8848	0.9455	1.0879	1.2085	1.2834	0.8689	–

*Each value is the mean of three replications; Figures in parentheses are arcsine transformed values

In a column, means followed by common letter(s) are not significantly different by LSD (P= 0.05)

Treatments:

T1 – Spinetoram 10% w/w + sulfoxaflor 30% w/w WG (250 ml/ha)

T2 - Spinetoram 10% w/w + sulfoxaflor 30% w/w WG (300 ml/ha)

T3 - Spinetoram 10% w/w + sulfoxaflor 30% w/w WG (350 ml/ha)

T4 – Spinetoram 12% SC w/v (11.7% w/w) (292 ml/ha)

T5 – Sulfoxaflor 24% SC w/v (21.8% w/w) (375 ml/ha)

T6 – Emamectin benzoate 5% SG (220 g/ha)

T7 – Imidacloprid 17.8% SL (400 ml/ha)

T8 – Untreated Control

The pre treatment observation on leaf damage due to flea beetle ranged from 14.6 to 15.5 per cent. The mean per cent leaf damage ranged between 6.27 and 23.39 per cent after imposing three rounds of foliar spray. Spinetoram 10% + sulfoxaflor 30% WG @350 ml/ha (6.27 %) and spinetoram 10% + sulfoxaflor 30% WG @ 300 ml/ha (6.51%) were effective with the least leaf damage. Spinetoram 10% + sulfoxaflor 30% WG @ 250 / ha and spinetoram 12% SC @ 292 ml/ha were next in the order of efficacy which contributed 7.03 and 7.19 per cent, respectively which were significantly superior to emamectin benzoate 5% SG @ 220 g/ha (7.83%), sulfoxaflor 24% SC @ 375 ml/ha (10.34%) and imidacloprid 17.8% SL @ 400 ml/ha (11.09%) when compared to untreated control (23.39%).

The per cent reduction over control was maximum in spinetoram 10% + sulfoxaflor 30% WG @ 350 ml/ha (73.19%) treated plots, followed by spinetoram 10% + sulfoxaflor 30% WG @ 300 ml/ha (72.17%), spinetoram 10% + sulfoxaflor 30% WG @ 250 ml/ha (69.94%), spinetoram 12% SC @ 292 ml/ha (69.26%), emamectin benzoate 5% SG @ 220 g/ha (66.52%), sulfoxaflor 24% SC @ 375 ml/ha (55.79%) and imidacloprid 17.8% SL @ 400 ml/ha (52.59%) treatments.

Summer 2016: The results on the efficacy of spinetoram 10% w/w + sulfoxaflor 30% w/w WG against leaf damage due to flea beetle varied from 16.2 to 17.1 per cent before imposing the treatments (Table 2). Mean observation based on three sprays

Table 2. Bio-efficacy of spinetoram 10% w/w + sulfoxaflor 30% w/w WG against flea beetle (*Scelodonta strigicolis*) damage on grapevine – Summer 2016 (March 16 – July 16)

Treatments	Per cent leaf damage/vine on days after treatment													Mean	% reduction over untreated check
	Pre count	I spray				II spray				III spray					
		1	3	7	10	1	3	7	10	1	3	7	10		
T1	16.2 (23.73)	13.8 (21.81)^{cd}	11.9 (20.18)^{c}	10.6 (19.00)^{b}	11.6 (19.91)^{cd}	10.5 (18.91)^{b}	9.4 (17.85)^{cd}	7.8 (16.22)^{b}	8.6 17.05)^{cd}	7.6 (16.00)^{c}	6.7 (15.00)^{cd}	5.0 (12.92)^{cd}	4.6 (12.38)^{bc}	9.01 (17.47)^{bc}	69.00
T2	16.8 (24.20)	12.6 (20.79)^{ab}	10.7 (19.09)^{ab}	9.6 (18.05)^{a}	10.3 (18.72)^{ab}	9.5 (17.95)^{a}	8.2 (16.64)^{ab}	6.7 (15.00)^{a}	7.3 (15.68)^{ab}	6.3 (14.54)^{ab}	5.4 (13.44)^{ab}	3.8 (11.24)^{ab}	3.6 (10.94)^{a}	7.83 (16.25)^{a}	73.06
T3	16.4 (23.89)	12.2 (20.44)^{a}	10.4 (18.81)^{a}	9.2 (17.66)^{a}	10.0 (18.43)^{a}	9.3 (17.76)^{a}	7.9 (16.32)^{a}	6.5 (14.77)^{a}	7.1 (15.45)^{a}	6.0 (14.18)^{a}	5.1 (13.05)^{a}	3.5 (10.78)^{a}	3.4 (10.63)^{a}	7.55 (15.95)^{a}	74.02
T4	17.1 (24.43)	13.1 (21.22)^{bc}	11.2 (19.55)^{bc}	9.9 (18.34)^{ab}	10.9 (19.28)^{b}	9.8 (18.24)^{ab}	8.7 (17.15)^{bc}	7.1 (15.45)^{ab}	7.9 (16.32)^{bc}	6.9 (15.23)^{bc}	6.0 (14.18)^{bc}	4.3 (11.97)^{bc}	3.9 (11.39)^{ab}	8.31 (16.75)^{ab}	71.40
T5	16.9 (24.27)	15.9 (23.50)^{e}	14.4 (22.30)^{e}	13.3 (21.39)^{d}	14.5 (22.38)^{e}	13.5 (21.56)^{d}	12.2 (20.44)^{e}	11.1 (19.46)^{d}	12.1 (20.36)^{e}	11.4 (19.73)^{e}	10.1 (18.53)^{e}	8.8 (17.26)^{e}	8.7 (17.15)^{d}	12.17 (20.41)^{d}	58.12
T6	16.7 (24.12)	14.4 (22.30)^{d}	12.5 (20.70)^{d}	11.4 (19.73)^{c}	12.2 (20.44)^{d}	11.3 (19.64)^{c}	10.2 (18.63)^{d}	8.7 (17.15)^{c}	9.3 (17.76)^{d}	8.4 (16.85)^{d}	7.5 (15.89)^{d}	5.6 (13.69)^{d}	5.4 (13.44)^{c}	9.74 (18.19)^{c}	66.48
T7	16.3 (23.81)	16.0 (23.58)^{e}	15.2 (22.95)^{e}	14.0 (21.97)^{d}	15.6 (23.26)^{f}	14.7 (22.54)^{e}	13.9 (21.89)^{f}	12.4 (20.62)^{e}	13.2 (21.30)^{f}	12.7 (20.88)^{f}	11.6 (19.91)^{f}	10.0 (18.43)^{f}	10.1 (18.53)^{e}	13.28 (21.37)^{e}	54.30
T8	17.1 (24.43)	18.4 (25.40)^{f}	20.5 (26.92)^{f}	22.4 (28.25)^{e}	24.1 (29.40)^{g}	26.3 (30.85)^{f}	29.0 (32.58)^{g}	30.5 (33.52)^{f}	32.6 (24.82)^{g}	34.0 (35.67)^{g}	36.3 (37.05)^{g}	37.4 (37.70)^{g}	39.1 (38.70)^{f}	29.22 (32.72)^{f}	–
SEd	NS	0.3125	0.3525	0.3767	0.3159	0.3397	0.3664	0.4216	0.3813	0.3885	0.4283	0.5164	0.5097	0.4008	–
CD (P=0.05)	NS	0.6794	0.7560	0.8080	0.6776	0.7286	0.7859	0.9043	0.8179	0.8332	0.9187	1.1077	1.0933	0.8597	–

*Each value is the mean of three replications; Figures in parentheses are arcsine transformed values

In a column, means followed by common letter(s) are not significantly different by LSD (P= 0.05)

Treatments:

T1 – Spinetoram 10% w/w + sulfoxaflor 30% w/w WG (250 ml/ha)
T2 - Spinetoram 10% w/w + sulfoxaflor 30% w/w WG (300 ml/ha)
T3 - Spinetoram 10% w/w + sulfoxaflor 30% w/w WG (350 ml/ha)
T4 – Spinetoram 12% SC w/v (11.7% w/w) (292 ml/ha)
T5 – Sulfoxaflor 24% SC w/v (21.8% w/w) (375 ml/ha)
T6 – Emamectin benzoate 5% SG (220 g/ha)
T7 – Imidacloprid 17.8% SL (400 ml/ha)
T8 – Untreated Control

indicated that leaf damage varied from 7.55 to 29.22 per cent due to all insecticidal treatments. Spinetoram 10% + sulfoxaflor 30% WG @ 350 ml/ha (7.55%) and spinetoram 10% + sulfoxaflor 30% WG @ 300 ml/ha (7.83%) were superior and effective in reducing the leaf damage by flea beetle. Spinetoram 12% SC @ 292 ml/ha (8.31%) and spinetoram 10% + sulfoxaflor 30% WG @ 250 / ha (9.01%) were the next best treatments in the order of significant superiority, followed by emamectin benzoate 5% SG @ 220 g/ha, sulfoxaflor 24% SC @ 375 ml/ha and imidacloprid 17.8% SL @ 400 ml/ha which resulted in mean per cent leaf damage of 9.74, 12.17 and 13.28, respectively. However, untreated check registered higher per cent leaf damage of 29.22 per cent.

The order of efficacy was spinetoram 10% + sulfoxaflor 30% WG @350 ml/ha > 300 ml/ha >spinetoram 12% SC @ 292 ml/ha >spinetoram 10% + sulfoxaflor 30% WG @ 250 / ha >emamectin Benzoate 5% SG @ 220 g/ha >sulfoxaflor 24% SC @ 375 ml/ha >imidacloprid17.8% SL @ 400 ml/ha with the mean per cent reduction of 74.02, 73.06, 71.40, 69.00, 66.48, 58.12 and 54.30, respectively. There was no visible phytotoxic symptoms observed on the grapevine plants in all the treatments imposed during both the seasons.

The effectiveness of insecticide molecules against *S. strigicollis* was already demonstrated by several earlier workers. Yadav *et al*. (2012) reported that cyantraniliprole 10 OD (80 g a.i/ha), thiamethoxam 25 WG (62.5 g a.i/ha) and spinosad 45 SC (112.5 g a.i/ha) resulted in highest leaf damage reduction by *S. strigicollis* on grapes. Yadav *et al*. (2016) further reported that thiamethoxam 25 WG, lamdacyhalothrin 5 CS, fipronil 80 WG, methomyl 40 SP and spinosad 45 SC recorded 89 to 93 per cent mortality of *S. strigicollis* adults in their studies. Kuhara *et al*.(2002) demonstrated the effectiveness of imidacloprid and thiamethoxam seed treatment @ 10g/kg of seed against corn flea beetle. Altof Hossain (2015) reported that thiamethoxam + chlorantraniliprole (Voliam flexi 300 SC) @ 0.5ml/l showed the best efficacy in reducing flea beetle infestation on mungbean. Kumar *et al*.(2016) evaluated different doses of spinetoram 12 SC alone and in combination with buprofezin 25 SC and reported significant effectiveness in minimizing the damage by *S.strigicollis* on grapes at 45 g a.i and 375 g a.i/ha, respectively. Patil *et al* (2018) reported that imidacloprid 17.5 SL (50 g a.i/ha), acetamiprid 20 SP (15 g a.i/ha) and dimethoate 30 EC (300 g a.i) were effective in reducing flea beetle population on cowpea.

Impact on grapevine yield and CBR

Kharif 2015:The fruit yield ranged from 14.75 to 29.50 t/ha due to various treatments (Table 3). The highest yield was recorded in spinetoram 10% + sulfoxaflor 30% WG @ 350 ml/ha (29.50 t/ha) treated plots, followed by spinetoram 10% + sulfoxaflor 30% WG @ 300 ml/ha (26.75 t/ha), spinetoram 10% + sulfoxaflor 30% WG @ 250 ml/ha (24.50 t/ha), spinetoram 12% SC @ 292 ml/ha (26.45 t/ha), emamectin benzoate 5% SG @ 220 g/ha (24.10 t/ha), sulfoxaflor 24% SC @ 375 ml/ha (23.75 t/ha) and imidacloprid 17.8% SL @ 400 ml/ha (20.50 t/ha) compared to untreated control which contributed only 14.75 t/ha fruit yield. The per cent increase of yield in the best treatment combination spinetoram 10% + sulfoxaflor 30% WG @ 350 ml/ha was 50.0 coupled with maximum cost benefit ratio (1:2.0) over untreated check. Srinivasan and Kalyanasundaram (2019) reported that three sprays of spinetoram 10 % w/w + sulfoxaflor 30 % w/w WG @ 140 g a.i/ha was effective and superior in reducing leaf hopper damage on okra and contributed higher fruit yield and cost benefit ratio which is in agreement with our present findings on grapevine against *S.strigicollis*.

Table 3. Impact of spinetoram 10% w/w + sulfoxaflor 30% w/w WG on yield of grapevine and CBR

Treatment	Dose g / ml / ha	Kharif 2015			Summer 2016		
		Yield t / ha*	% increase over untreated check	CBR	Yield t / ha*	% increase over untreated check	CBR
Spinetoram 10% w/w + sulfoxaflor 30% w/w WG	250	24.50 (4.95)^{c}	39.79	1:1.66	25.98 (5.10)^{cd}	43.76	1:1.78
Spinetoram 10% w/w + sulfoxaflor 30% w/w WG	300	26.75 (5.17)^{b}	44.85	1:1.81	27.12 (5.21)^{b}	46.12	1:1.86
Spinetoram 10% w/w + sulfoxaflor 30% w/w WG	350	29.50 (5.43)^{a}	50.00	1:2.00	28.73 (5.36)^{a}	49.14	1:1.97
Spinetoram 12% SC w/v (11.7% w/w)	292	26.45 (5.14)^{b}	44.43	1:1.79	26.64 (5.16)^{bc}	45.15	1:1.82
Sulfoxaflor 24% SC w/v (21.8% w/w)	375	23.75 (4.87)^{c}	37.89	1:1.61	24.83 (4.98)^{e}	41.16	1:1.70
Emamectin benzoate 5%	220	24.10 (4.91)^{c}	38.71	1:1.63	25.31 (5.03)^{de}	42.27	1:1.73
Imidacloprid 17.8% SL	400	20.50 (4.53)^{d}	28.04	1:1.38	21.12 (4.60)^{f}	30.82	1:1.44
Untreated check	–	14.75 (3.84)^{e}	–	–	14.61 (3.82)^{g}	–	–
SED	–	0.0412	–	–	0.0407	–	–
CD (p=0.05)	–	0.0883	–	–	0.0874	–	–

*Each value is the mean of three replications

*Figures in parentheses are square root transformed values

* In a column, means followed by common letter(s) are not significantly different by LSD (P= 0.05)

Summer 2016: Fruit yield ranged from 14.61 to 28.73 t/ha due to all treatments (Table 3). Spinetoram 10% + sulfoxaflor 30% WG @ 350 ml/ha combination resulted in the highest yield of 28.73 t/ha followed by spinetoram 10% + sulfoxaflor 30% WG @ 300 ml/ha (27.12 t/ha), spinetoram 10% + sulfoxaflor 30% WG @ 250 ml/ha (25.98 t/ha), spinetoram 12% SC @ 292 ml/ha (26.64 t/ha), emamectin benzoate 5% SG @ 220 g/ha (25.31 t/ha), sulfoxaflor 24% SC @ 375 ml/ha (24.83 t/ha) and imidacloprid 17.8% SL @ 400 ml/ha (21.12 t/ha) compared to untreated check which contributed 14.61 t/ha fruit yield. The per cent increase of yield in the best treatment combination spinetoram 10% + sulfoxaflor 30% WG @ 350 ml/ha was 49.14 coupled with maximum cost benefit ratio (1:1.97) over untreated check.

CONCLUSION

Three applications of foliar spray of spinetoram 10% w/w + sulfoxaflor 30% w/w WG @350 ml/ha and spinetoram 10% + sulfoxaflor 30% WG @300 ml/ha were superior and effective in reducing the flea beetle damage on grapevine which also contributed higher fruit yield and Cost-Benefit Ratio. The present studies confirm that newer molecules are highly effective against grapevine flea beetle, *S.strigicollis* and could provide a better alternative for the insecticides to which it has developed resistance.

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