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EVALUATION OF SPINETORAM 10% W/W + SULFOXAFLOR 30% W/W WG AGAINST *MACONELLICOCCUS HIRSUTUS* ON GRAPEVINE

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ABSTRACT

Pink mealybug *Maconellicoccus hirturus* Green is a major devastating insect pest of grapevine. The combination product spinetoram 10% w/w + sulfoxaflor 30% w/w WG was evaluated against this pest for two seasons i.e., kharif 2015 and summer 2016 at Odaipatty village of Chinnamanur block, Theni District, Tamil Nadu. Three rounds 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 found superior along with higher fruit yields and cost-benefit ratio.

Key words: Grapevine, *Maconellicoccus hirsutus,* Tamil Nadu, spinetoram, sulfoxaflor, combination sprays, yield, cost benefit ratio,

Grapevine (*Vitis vinifera* L.) is one of the most important fruit crops of temperate zone, which has acclimatized to subtropical and tropical agroclimatic conditions (Bose et al.,1999). The crop is ravaged by number of insect pests and around 132 insect pests are known (Mani et al., 2013). Among its sucking pests, mealybugs occur throughout the year causing considerable economic damage. Pink mealybug *Maconellicoccus hirsutus* Green has become an increasing threat to grapevine in peninsular India causing heavy yield loss. Nymphs and adult mealybug suck the sap from the trunk, cordons, buds, spurs, aerial roots, leaves, shoots, nodes, flower panicles and bunches. Further, honew dew secreted by mealybug nymphs and adults, support the growth of sooty mould on leaves, shoots and bunches. Sooty and sticky bunches harbouring mealybugs and their white cottony wax masses are unfit for marketing as table grapes (Amala et al., 2014). Keeping in view the economic impotance of this insect pest, the present study was carried out to evaluate the efficacy of spinetoram 10% w/w + sulfoxaflor 30% w/w against *M. hirsutus* on grapevine during kharif 2015 and summer 2016.

MATERIALS 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. One of the popular varieties and farmers' choice muscot (*Panneer thirakshai*) was chosen 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 the vines, at the time of new flush formation, population of mealybug on the bunch was observed on plant basis for pre-treatment count. Based on the ETL the new molecules were applied as 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 percent reduction over control was worked out. The total yield of marketable fruits 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

Kharif 2015: In *kharif* 2015, the incidence of mealybug is as given in Table 1 reveal that the nymph and adult population ranged from 17.9 to 18.8 / bunch or shoot tip before imposing treatments. This was observed to range between 8.57 and 26.54 / bunch after three rounds of foliar application. Spinetoram 10% + sulfoxaflor 30% WG @350 ml/ha (8.57 / bunch) and spinetoram 10% + sulfoxaflor 30% WG @300 ml/ha (9.07 / bunch) were superior and effective followed by imidacloprid 17.8% SL @ 400 ml/ha (9.54 / bunch) and spinetoram 10% + sulfoxaflor 30% WG @ 250 ml/ha (9.94 / bunch). Sulfoxaflor 24% SC @ 375 ml/ha, spinetoram 12% SC @ 292 ml/ha and emamectin benzoate 5% SG @ 220 g/ha were the next in the order of efficacy. The % reduction over control was maximum in case of spinetoram 10% + sulfoxaflor 30% WG @ 350 ml/ha (67.71) combination.

The fruit yield ranged from 14.75 to 29.50 t/ha due to various treatments (Table 3). The highest yield was recorded with reference to 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 (26.50 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 recorded only 14.75 t/ha fruit yield. The percent increase of yield in the best treatment combination was 50.0 coupled with maximum cost benefit ratio (1:1.98) over untreated control.

Summer 2016: The results of the efficacy of spinetoram 10% + sulfoxaflor 30% WG on the population of mealy bug during summer is given in Table 1. The initial population ranged from 22.4 to 23.3 before imposing treatments without any significant difference. Mean population data revealed that the nymphs and adults ranged from 9.55 to 30.90 / bunch after the application of three sprays with spinetoram 10% + sulfoxaflor 30% WG, significant reduction being noticed with spinetoram 10% + sulfoxaflor 30% WG @ 350 and 300 ml /ha combinations. Next treatments in descending order of effectiveness were imidacloprid 17.8% SL @ 400 ml/ha and spinetoram 10% + sulfoxaflor 30% WG @ 250 ml /ha. The data on % reduction in the mealy bug population over untreated control was in the order - spinetoram 10% + sulfoxaflor 30% WG @350 ml/ha (69.09 %), spinetoram 10% + sulfoxaflor 30% WG @300 ml/ha (67.06), imidacloprid 17.8% SL @ 400 ml/ha (65.89), spinetoram 10% + sulfoxaflor 30% WG @ 250 ml/ha (64.40), sulfoxaflor 24% SC @ 375 ml/ha (60.71), spinetoram 12% SC @ 292 ml/ha (49.74) and emamectin benzoate 5% SG @ 220 g/ha (48.48).

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 recorded 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 control which recorded 14.61 t/ha fruit yield.

The efficacy of insecticides against mealybugs had been reported by earlier workers: Daane et al. (2006) reported that imidacloprid provided the greatest reduction in cluster damage caused by vine mealy bug, *Planococcus ficus*. Four sprays of acetamiprid 40 SP resulted in 97.37 per cent reduction of mealy bug infestation in grapes with a significant higher yield of 266.80 Q/ha (Sunitha et al. 2009). Castle and Prabhaker (2011) reported that thiamethoxam 25 WG resulted in cent per cent reduction of pink mealybug, *Maconellicoccus hirsutus* and Kulkarni et al (2012) reported the effectiveness of methomyl 40 SP @800g a.i /ha against mealybug colonies in grapes.The present studies confirm that newer molecules are highly effective against *M.hirsutus* and could provide a better alternative for the insectides to which it has developed resistance.

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Table 1. Efficacy of spinetoram 10% w/w + sulfoxaflor 30% w/w WG against *M. hirsutus* on grapevine (2015, 2016) *kharif* 2015

Treatments	Pre count	Number of nymphs and adults / bunch (days after treatment)* I spray 1	I spray 3	I spray 7	I spray 10	II spray 1	II spray 3	II spray 7	II spray 10	III spray 1	III spray 3	III spray 7	III spray 10	Mean	% reduction over control
T1	18.4 (4.39)	15.6 (3.95)^{b}	13.6 (3.69)^{b}	11.0 (3.32)^{c}	12.5 (3.54)^{c}	10.4 (3.22)^{ab}	9.3 (3.05)^{b}	8.6 (2.93)^{cd}	10.3 (3.21)^{c}	8.8 (2.97)^{a}	7.6 (2.76)^{bc}	6.5 (2.55)^{c}	5.1 (2.26)^{b}	9.94 (3.15)^{cd}	62.55
T2	18.1 (4.25)	14.7 (3.83)^{a}	13.1 (3.62)^{b}	9.9 (3.15)^{ab}	11.6 (3.41)^{b}	10.3 (3.21)^{ab}	8.5 (2.92)^{a}	7.6 (2.76)^{ab}	9.2 (3.03)^{ab}	8.4 (2.90)^{a}	6.9 (2.63)^{ab}	4.6 (2.14)^{a}	4.0 (2.00)^{a}	9.07 (3.01)^{ab}	65.83
T3	17.9 (4.23)	14.3 (3.78)^{a}	11.5 (3.39)^{a}	9.4 (3.07)^{a}	10.3 (3.21)^{a}	9.8 (3.13)^{a}	8.0 (2.83)^{a}	7.2 (2.68)^{a}	9.0 (3.00)^{a}	8.4 (2.90)^{a}	6.7 (2.59)^{a}	4.3 (2.07)^{a}	3.9 (1.97)^{a}	8.57 (2.93)^{a}	67.71
T4	18.6 (4.31)	18.2 (4.27)^{c}	16.5 (4.06)^{c}	12.7 (3.56)^{d}	14.8 (3.85)^{d}	12.9 (3.59c	12.3 (3.51)^{d}	11.7 (3.42)^{e}	12.7 (3.56)^{d}	10.9 (3.30)^{b}	10.4 (3.22)^{d}	8.6 (2.93)^{d}	7.0 (2.65)^{d}	12.39 (3.52)^{e}	53.32
T5	18.2 (4.27)	15.1 (3.89)^{ab}	13.5 (3.67)^{b}	12.2 (3.49)^{d}	12.4 (3.52)^{c}	12.3 (3.51)^{c}	10.8 (3.29)^{c}	9.2 (3.03)^{d}	10.5 (3.24)^{c}	8.9 (2.98)^{a}	8.3 (2.88)^{c}	6.7 (2.59)^{c}	6.1 (2.47)^{c}	10.50 (3.24)^{d}	60.44
T6	18.2 (4.27)	17.6 (4.20)^{c}	16.0 (4.00)^{c}	14.7 (3.83)^{e}	15.1 (3.89)^{d}	14.8 (3.85)^{d}	13.3 (3.65)^{e}	12.2 (3.49)^{e}	12.8 (3.58)^{d}	11.4 (3.38)^{b}	10.8 (3.29)^{d}	9.2 (3.03)^{d}	8.6 (2.93)^{e}	13.40 (3.66)^{e}	50.87
T7	18.8 (4.34)	14.9 (3.86)^{ab}	13.6 (3.69)^{b}	10.5 (3.24)^{bc}	12.6 (3.55)^{c}	10.7 (3.27)^{b}	8.5 (2.92)^{a}	8.2 (2.86)^{bc}	9.8 (3.13)^{bc}	8.7 (2.95)^{a}	7.3 (2.70)^{ab}	5.5 (2.35)^{b}	4.2 (2.05)^{a}	9.54 (3.09)^{bc}	64.05
T8	18.7 (4.32)	19.3 (4.39)^{d}	20.9 (4.57)^{d}	22.6 (4.75)^{f}	24.0 (4.90)^{e}	24.8 (4.98)^{e}	26.2 (5.12)^{e}	29.6 (5.44)^{f}	30.1 (5.49)^{e}	29.8 (5.46)^{c}	30.0 (5.48)^{e}	30.3 (5.50)^{e}	30.9 (5.56)^{f}	26.54 (5.15)^{f}	--
SEd	NS	0.0494	0.0559	0.0565	0.0525	0.0560	0.0588	0.0669	0.0582	0.0630	0.0702	0.0772	0.0806	0.0602	--
CD (P=0.05)	NS	0.1060	0.1200	0.1211	0.1127	0.1201	0.1262	0.1434	0.1249	0.1351	0.1505	0.1656	0.1730	0.1291	--
Summer 2016															
T1	22.8 (4.77)	16.4 (4.05)^{bc}	14.6 (3.82)^{c}	11.0 (3.32)^{b}	13.8 (3.71)^{cd}	12.0 (3.46)^{c}	10.2 (3.19)^{b}	9.1 (3.02)^{b}	12.0 (3.46)^{cd}	11.5 (3.39)^{cd}	9.0 (3.00)^{b}	6.9 (2.63)^{b}	5.5 (2.35)^{b}	11.00 (3.32)^{c}	64.40
T2	22.5 (4.74)	15.7 (3.96)^{b}	13.5 (3.67)^{b}	10.7 (3.27)^{b}	12.5 (3.54)^{b}	11.3 (3.36)^{ab}	9.3 (3.05)^{a}	8.7 (2.95)^{ab}	11.0 (3.32)^{ab}	10.4 (3.22)^{ab}	8.3 (2.88)^{ab}	6.2 (2.49)^{ab}	4.6 (2.14)^{ab}	10.18 (3.19)^{ab}	67.06
T3	22.4 (4.73)	14.8 (3.85)^{a}	12.7 (3.56)^{a}	9.8 (3.13)^{a}	11.2 (3.35)^{a}	10.9 (3.30)^{a}	8.9 (2.98)^{a}	8.0 (2.83)^{a}	10.5 (3.24)^{a}	9.8 (3.13)^{a}	7.9 (2.81)^{a}	5.8 (2.41)^{a}	4.3 (2.07)^{a}	9.55 (3.09)^{a}	69.09
T4	22.6 (4.75)	19.9 (4.46)^{d}	19.0 (4.36)^{d}	16.4 (4.05)^{d}	17.7 (4.21)^{e}	16.3 (4.04)^{d}	15.4 (3.92)^{d}	14.7 (3.83)^{d}	15.3 (3.91)^{e}	14.2 (3.77)^{e}	12.8 (3.58)^{d}	11.8 (3.44)^{d}	12.8 (3.58)^{d}	15.53 (3.94)^{e}	49.74
T5	22.4 (4.73)	17.3 (4.16)^{c}	14.5 (3.81)^{c}	12.6 (3.55)^{c}	13.9 (3.73)^{d}	12.2 (3.49)^{c}	11.9 (3.45)^{c}	10.7 (3.27)^{c}	12.8 (3.58)^{d}	11.8 (3.44)^{d}	11.3 (3.36)^{c}	8.8 (2.97)^{c}	7.9 (2.81)^{c}	12.14 (3.48)^{d}	60.71
T6	23.3 (4.83)	20.4 (4.52)^{d}	19.4 (4.40)^{d}	16.6 (4.07)^{d}	18.0 (4.24)^{e}	17.1 (4.14)^{e}	15.9 (3.99)^{d}	15.3 (3.91)^{d}	15.6 (3.95)^{e}	14.4 (3.79)^{e}	13.3 (3.65)^{d}	12.1 (3.48)^{d}	12.9 (3.59)^{d}	15.92 (3.99)^{e}	48.48
T7	22.8 (4.77)	16.1 (4.01)^{b}	14.0 (3.74)^{bc}	11.1 (3.33)^{b}	13.0 (3.61)^{bc}	11.6 (3.41)^{c}	9.6 (3.10)^{ab}	9.1 (3.02)^{b}	11.4 (3.38)^{bc}	10.8 (3.29)^{bc}	8.3 (2.88)^{ab}	6.5 (2.55)^{ab}	4.9 (2.21)^{ab}	10.54 (3.25)^{bc}	65.89
T8	23.6 (4.86)	24.2 (4.92)^{e}	25.1 (5.01)^{e}	26.4 (5.14)^{e}	28.2 (5.31)^{f}	27.7 (5.26)^{f}	30.5 (5.52)^{e}	33.2 (5.76)^{e}	35.9 (5.99)^{f}	34.0 (5.83)^{f}	35.1 (5.92)^{e}	34.7 (5.89)^{e}	35.8 (5.98)^{e}	30.90 (5.56)^{f}	--
SEd	NS	0.0515	0.0505	0.0555	0.0546	0.0447	0.0549	0.0626	0.0596	0.0523	0.0620	0.0683	0.0724	0.0548	--
CD (P=0.05)	NS	0.1104	0.1084	0.1191	0.1170	0.0959	0.1179	0.1344	0.1278	0.1122	0.1330	0.1466	0.1554	0.1176	--

*Mean of three replications; Figures in parentheses square root transformed values; In a column, means followed by common letter(s) not significantly different by LSD (p= 0.05; T1 – Spinetoram 10% w/w + sulfoxaflor 30% w/w WG (250 ml/ha) T5 – Sulfoxaflor 24% SC w/v (21.8% w/w) (375 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

Table 2. Impact of spinetoram 10% w/w + sulfoxaflor 30% w/w WG on yield

Treatment	Dose g / ml / ha	Yield t / ha*		% increase over control		CBR
		kharif 2015	Summer 2016	kharif 2015	Summer 2016	
T1- Spinetoram 10% w/w + sulfoxaflor 30% w/w WG	250	24.50 (4.95)[c]	25.98 (5.10)[cd]	39.79	43.76	1:1.72
T2- Spinetoram 10% w/w + sulfoxaflor 30% w/w WG	300	26.75 (5.17)[b]	27.12 (5.21)[b]	44.85	46.12	1:1.83
T3- Spinetoram 10% w/w + sulfoxaflor 30% w/w WG	350	29.50 (5.43)[a]	28.73 (5.36)[a]	50.00	49.14	1:1.98
T4- Spinetoram 12% SC w/v (11.7% w/w)	292	26.45 (5.14)[b]	26.64 (5.16)[bc]	44.43	45.15	1:1.80
T5- Sulfoxaflor 24% SC w/v (21.8% w/w)	375	23.75 (4.87)[c]	24.83 (4.98)[e]	37.89	41.16	1:1.65
T6- Emamectin e bnzoate 5%	220	24.10 (4.91)[c]	25.31 (5.03)[de]	38.71	42.27	1:1.68
T7- Imidacloprid 17.8% SL	400	20.50 (4.53)[d]	21.12 (4.60)[f]	28.04	30.82	1:1.41
T8-Untreated Control	--	14.75 (3.84)[e]	14.61 (3.82)[g]	--	--	--
SED ±	--	0.0412	0.0407	--	--	--
CD (p=0.05)	--	0.0883	0.0874	--	--	--

*Mean of three replications; Figures in parentheses square root transformed values;
In a column, means followed by common letter(s) not significantly different- LSD at p= 0.05

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