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BIOEFFICACY OF NEONICOTINOID INSECTICIDES AGAINST THRIPS PEST (*Thrips palmi*) ON GRAPE VINE (*Vitis vinifera* L.)

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Author SKG carried out the experiments both in field and laboratory, recorded the data, interpreted the results and wrote the manuscript.
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ABSTRACT

The grape thrips (*Thrips palmi*), has great importance that causing huge losses to commercial production of grapes (*Vitis vinifera* L.)**.** It has become a serious pest of grape vine in West Bengal, India. The neonicotinoid insecticides viz. spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 100, 120 and 140 a.i. g /ha, spinetoram 12% SC w/v (11.7%w/w), sulfoxaflor 24% w/v (21.8% w/w) SC, emamectin benzoate 5% SG and buprofezin 25% SC @ 30, 90, 11 and 250 a.i. g /ha respectively were tested for their efficacy against thrips. Spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 140 g a.i./ha proved the most effective against thrips on grapes and it was at par with spinetoram 10% + sulfoxaflor 30% WG @ 120 g a.i./ha. Same trends have also been reflected in yield. The tested insecticides were also found safer to predators *i.e. Menochilus* sp., *Syrphus* sp. and *Chrysoperla* sp.

Keywords: Efficacy; insect growth regulator; predators; safe pesticides; thrips; yield.

1. INTRODUCTION

Presently, grapes (*Vitis vinifera* L.) are one of the most remunerative fruit India. The crop is susceptible to number of insect-pests. Among these the thrips pest (*Scirtothrips dorsalis*).causes huge losses to grape crop. Ghosh [1] reported that thrips causes huge losses of commercial production. Both nymphs and adults suck the sap from tender crop canopy, resulting in shriveling of leaves, retarded shoot development and finally the leaves fall-off, eruption of internal areas, puckering of leaves and upward curling of

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leaves [2]. Thrips population reached the peak from September-November [3,4]. Priyadarshini et al. [5] recorded that peak population of 28.55/3 leaves with an average temperature, relative humidity and weekly total rainfall were 31.04^{0}C, 74.29% and 71.1mm respectively. Laskar and Ghosh [6] showed that thrips population had significant positive correlation with temperature. Ghosh et al. [7] reported that thrips population showed significant positive correlation (p=0.05) with temperature, relative humidity, and rainfall.

Most of the synthetic insecticides viz. organochlorines and organophosphates are broad spectrum, persistent in nature and having long residual action to adverse effect i.e. residues in fruit produce, environmental contamination, resurgence, resistance and destruction of natural enemies which suggest the need to develop alternative management strategies [8]. Therefore, an effort has been made in present investigation to evaluate the efficacy green chemistry insecticides against thrips in grape vine [9,10]. No significant work has been done on thrips management with new safe insecticides, and insect growth regulator (lGR) in West Bengal, India. The Insect growth regulator, buprofezin discovered by Nihon Nohyaku Co. lkeda et al., [11], Shibuya, [12], showed activities on hoppers, green-house whitefly, thrips, scale insects. This insecticide showed excellent control effect on thrips in vinylhouse [13]. Slow-acting property of buprofezin observed on the brown plant hopper [14]. Slight ovicidal action of buprofezin was also observed for the early stage eggs of brown plant hopper [15]. Almost all larvae died in the presence of buprofezin showed abnormal rnolting on brown plant hopper [15]. Ghosh [16] reported that buprofezin, an important Insect Growth Regulator, is safer to natural enemies.

Ghosh and Chakraborty [17] reported that pest control by using bio-control agent is an important component of Integrated Pest Management (IPM) and organic farming. So, there is search for newer insecticides that can break the resistance, and non-toxic to non-target organisms. Ghosh et al. [18] reported that lady bird beetle / coccinellid beetle was an important predator of aphid and jassid, thrips and its feeding activity was found throughout the year. Coccinellid beetle has gained great interest for biological control in West Bengal, India [19,20]. Under the present investigation an attempt has been made for safe management of thrips on grape vine.

2. MATERIALS AND METHODS

2.1 Study Period and Location

The experiment was conducted in Taldanga village, Bankura near college of Agriculture, Bankura, under Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India during 2015 and 2016. The grape crop was cultivated on upland with good irrigation and drainage facility.

2.2 Treatment Details

The studies was conducted with seven insecticidal treatments and untreated control. With these treatments, three treatments contained mixed formulations of spinetoram 10% w/w + sulfoxaflor 30% w/w WG of different doses. These insecticides are also used as single formulation such as spinetoram 12%SC w/v (11.7%w/w) and sulfoxaflor 24% SC w/v (21.8% w/w). The other insecticides used are emamectin Benzoate 5% SG and buprofezin 25% SC. These insecticides are recommended for use against this thrips pest.

2.3 Lay out of the Field Experiment

Period of experiment: January to May, 2015 and 2016
Variety of grapes: Arka N
Plot size: 10 m X 5 m (50 sq.m.)
Design of experiment: Randomized Block Design (RBD) with 3 replications
Number of spraying: Two at 23rd March, 3rd April, 2015 and 16th, 26th March, 2016
Application method (type of sprayer): ASPEE Knapsack Sprayer with hollow cone nozzle
Spraying volume: 500 L/ha
Picking: Multiple

List 1. The details of the treatments are as follows

Sl. No.	Treatments	Dose (g a.i./ha)
1.	Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	100
2.	Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	120
3.	Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	140
4.	Spinetoram 12%SC w/v (11.7%w/w)	30
5.	Sulfoxaflor 24% SC w/v (21.8% w/w)	90
6.	Emamectin Benzoate 5% SG	11
7.	Buprofezin 25% SC	250
8.	Untreated	Fresh water spray

2.4 Data Recording of Bio-Efficacy against Pest

The thrips population was counted from four apical twigs from five randomly selected plants. First count was taken one day before first spray and post treatment counts were recorded at 3, 7 and 10 days after each application. Hand lens (10X) were used for recording all the observations. The yield data of each treatment was recorded separately at each plucking.The data were subjected to analysis of variance after making necessary transformation [21] and expressed on the basis of pest population/twig.

2.5 Insecticidal Effect on Natural Enemies

The data on population of natural enemies was also recorded pre and post treatment from ten leaves of ten randomly selected plants of each treatment. Three major predators were identified as *Menochilus sp. Syrphus sp.* and *Chrysoperla sp*.

3. RESULTS AND DISCUSSION

Three doses of spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 100, 120 and 140 a.i. g /ha, one dose of spinetoram 12% SC w/v (11.7%w/w), sulfoxaflor 24% w/v (21.8% w/w) SC, smamectin Benzoate 5% SG and suprofezin 25% SC @ 30, 90, 11 and 250 a.i. g /ha respectively were sprayed to work out their efficacy against leaf hopper. One untreated check (controlled treatment) was taken for observing natural infestation of target pests. Two round spraying has been done where first round was initiated during third week of March during 2015 and second week of March during 2016 and subsequent spraying has been done at 10 days interval. The data on the result of field efficacy of the treatments against leaf hopper is presented in Table 1 and Table 2 and the natural enemy population has been presented in Table 3.

In 2015, the pooled efficacy of different treatment schedules against thrips (*Scirtothrips dorsalis*) on grapes has been presented in Table 1. All the insecticidal treatments were significantly superior in their performance over the untreated control (Table 1). Spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 140 g a.i./ha provided the best control of thrips (*Scirtothrips dorsalis*) population on grape and spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 120 g a.i./ha was statistically at par with it. Same trends have also been reflected in yield of grapes. The maximum yield (7.25 kg/plant) was obtained from the application with the highest tested dose of spinetoram 10% w/w + sulfoxaflor 30% w/w WG (140 g a.i./ha) which was at par (6.74 kg/plant) with spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 120 g a.i./ha. The yield increase was also of high order, like spinetoram 12%SC w/v (11.7%w/w) @ 30 g a.i./ha (6.52 kg/plant), sulfoxaflor 24% w/v (21.8% w/w) SC @ 90 g a.i./ha (6.45 kg/plant), emamectin benzoate 5% SG @ 11 g a.i./ha (6.44 kg/plant), spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 100 g a.i./ha (5.94 kg/plant), and buprofezin 25% SC @ 250 g a.i./ha (5.73 kg/plant).

In 2016, all the insecticidal treatments were significantly superior in their performance over that of untreated plots. spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 140 g a.i./ha provided the best control of thrips (*Scirtothrips dorsalis*) of grape and spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 120 g a.i./ha. Same trends have also been reflected in yield. The maximum yield (7.64 kg/plant) was obtained from the application with the highest tested dose of spinetoram 10% w/w + sulfoxaflor 30% w/w WG (140 g a.i./ha) which was at par (7.24 kg/plant) with spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 120 g a.i./ha. The yield increase was also of high order, like sulfoxaflor 24% w/v (21.8% w/w) SC @ 90 g a.i./ha (6.95 kg/plant), spinetoram 12%SC w/v (11.7%w/w) @ 30 g a.i./ha (6.90 kg/plant), emamectin benzoate 5% SG@ 11 g a.i./ha (6.72 kg/plant), spinetoram 10% w/w + sulfoxaflor 30% w/w WG 100 g a.i./ha (6.48 kg/plant), and suprofezin 25% SC @ 250 g a.i./ha (5.85 kg/plant).

It was observed that all the treated plots had more or less higher population of all the three predators. There were no significant differences among the treated plots and untreated control.

Overall observation revealed that all the treatments provided better control of thrips pest in comparison with untreated control. Among the treatments, spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 140 g a.i./ha, and spinetoram 10% w/w + sulfoxaflor 30% w/w WG @ 120 g a.i./ha provided the best control of thrips (*Scirtothrips dorsalis*) of grape and they were statistically at par. All the treatments taken under the investigation were safer to the predators. Ghosh et al. [18] reported that lady bird beetle / coccinellid beetle was an important predator of thrips and its feeding activity was found throughout the year. The insecticides may be recommended for the farmers as they are safer to the predators.

Table 1. Efficacy of insecticidal treatments against grape vine thrips (*Scirtothrips dorsalis*) (2015)

Treatments	Dose (g a.i./ha)	Thrips population/twig before 1st spray	Thrips population at different intervals (days) after spraying/per plant						Fruit Yield (Kg/Plant)
			Different days after 1st application			Different days after 2nd application			
			3rd	7th	10th	3rd	7th	10th	
Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	100	6.7	4.3 (2.19)*	5.0 (2.35)	6.3 (2.61)	3.3 (1.95)	4.7 (2.28)	5.7 (2.49)	5.94
Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	120	6.0	0.0 (0.71)	0.0 (0.71)	0.3 (0.89)	0.0 (0.71)	0.0 (0.71)	0.3 (0.89)	6.74
Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	140	5.7	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	7.25
Spinetoram 12%SC w/v (11.7%w/w)	30	6.3	0.0 (0.71)	0.0 (0.71)	0.3 (0.89)	0.0 (0.71)	0.0 (0.71)	0.3 (0.89)	6.52
Sulfoxaflor 24% w/v (21.8% w/w) SC	90	6.3	4.0 (2.12)	4.3 (2.19)	4.7 (2.28)	2.0 (1.58)	3.3 (1.95)	4.0 (2.12)	6.45
Emamectin Benzoate 5% SG	11	7.0	2.7 (1.79)	1.7 (1.48)	1.3 (1.34)	1.3 (1.34)	1.0 (1.22)	1.3 (1.34)	6.44
Buprofezin 25% SC	250	6.7	5.7 (2.49)	5.7 (2.49)	6.3 (2.61)	5.7 (2.49)	6.3 (2.61)	7.7 (2.86)	5.73
Untreated	----	7.0	7.7 (2.86)	8.3 (2.97)	9.0 (3.08)	9.3 (3.13)	9.7 (3.19)	9.7 (3.19)	5.12
CD at 5%		**NS**	**0.74**	**1.04**	**0.56**	**0.72**	**0.83**	**0.65**	**0.64**

Value in the parenthesis are square root transformed value; N.S. = Not significant

Table 2. Efficacy of insecticidal treatments against grape vine thrips (*Scirtothrips dorsalis*) (2016)

Treatments	**Dose (g a.i./ha)**	**Thrips population/ twig before 1st spray**	**Thrips population at different intervals (days) after spraying/per plant**						**Fruit Yield (Kg/Plant)**
			Different days after 1st application			**Different days after 2nd application**			
			3rd	**7th**	**10th**	**3rd**	**7th**	**10th**	
Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	100	5.7	3.3 (1.95)*	4.7 (2.28)	5.0 (2.35)	3.3 (1.95)	3.7 (2.05)	4.7 (2.28)	6.48
Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	120	6.3	0.0 (0.71)	0.3 (0.89)	0.7 (1.10)	0.0 (0.71)	0.3 (0.89)	0.3 (0.89)	7.24
Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	140	5.7	0.0 (0.71)	0.0 (0.71)	0.3 (0.89)	0.0 (0.71)	0.0 (0.71)	0.3 (0.89)	7.64
Spinetoram 12%SC w/v (11.7%w/w)	30	5.3	0.0 (0.71)	0.3 (0.89)	0.7 (1.10)	0.0 (0.71)	0.3 (0.89)	0.3 (0.89)	6.90
Sulfoxaflor 24% w/v (21.8% w/w) SC	90	5.3	3.7 (2.05)	3.3 (1.95)	3.7 (2.05)	1.7 (1.48)	2.3 (1.67)	3.7 (2.05)	6.95
Emamectin Benzoate 5% SG	11	6.7	2.7 (1.79)	2.0 (1.58)	2.3 (1.67)	1.3 (1.34)	1.3 (1.34)	2.3 (1.67)	6.72
Buprofezin 25% SC	250	7.0	5.7 (2.49)	6.3 (2.61)	7.0 (2.74)	5.3 (2.41)	6.0 (2.55)	7.3 (2.79)	5.85
Untreated	-----	5.0	6.7 (2.68)	7.3 (2.79)	7.7 (2.86)	8.3 (2.97)	9.0 (3.08)	9.3 (3.12)	5.34
CD at 5%		**NS**	**1.04**	**0.69**	**0.23**	**0.42**	**0.65**	**0.78**	**0.92**

Value in the parenthesis are square root transformed value; N.S. = Not significant

Table 3. Insecticidal effect on some important insect predators found in grapes field during Jan-May 2015

Treatments	Dose (g a.i./ha)	No. of predators per 10 branches		
		***Menochilus* sp.**	***Syrphus* sp.**	***Chrysoperla* sp.**
Spinetoram10% w/w + Sulfoxaflor 30% w/w WG	140	3.44	3.30	2.52
Spinetoram10% w/w + Sulfoxaflor 30% w/w WG	280	3.90	3.36	2.56
Spinetoram 10% w/w + Sulfoxaflor 30% w/w WG	140	3.28	3.36	2.90
Spinetoram 12%SC w/v (11.7%w/w)	30	3.33	3.29	2.88
Sulfoxaflor 24% SC w/v (21.8% w/w)	90	3.29	3.38	2.60
Emamectin Benzoate 5% SG	11	3.27	3.27	2.44
Buprofezin 25% SC	250	3.36	3.33	2.39
Untreated	---	3.36	3.44	2.60
CD at 5%		**NS**	**NS**	**NS**

N.S = Not significant

4. CONCLUSION AND RECOMMENDATION

It is evident from the present investigation that spinetoram 10% w/w + sulfoxaflor 30% w/w WG is effective against thrips of grapes @ 120 - 140 g a.i./ha. Considering the efficacy of the product as well yield of grape, spinetoram 10% w/w + sulfoxaflor 30% w/w WG @120 g a.i./ha can be recommended as effective economical rate for controlling thrips. Similar trend followed in the experiments done during 2016. It is evident from this study that all the treatments are safer to three important predators recorded in gapes field *i.e. Menochilus* sp., *Syrphus* sp. and *Chrysoperla* sp.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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