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EVALUATION OF BIO-EFFICACY OF SYNTHETIC, BOTANICAL AND BIO-PESTICIDES AGAINST ROSE MITE, *TETRANYCHUS URTICAE* KOCH

V. Sridhar, N.S. Nagegowda*, S. Onkaranaik and C. Manasa
Division of Crop Protection, ICAR-Indian Institute of Horticultural Research,
Hessaraghatta Lake P.O, Bengaluru-560 089.Karnataka India
*Corresponding author E-mail: nsngowda2192@gmail.com
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ABSTRACT

A trial was conducted at the ICAR-Indian institute of Horticultural Research (IIHR), Hessaraghatta, Bengaluru for the evaluation of bio-efficacy of synthetic pesticides. The treatment, abamectin 1.9 EC and propargite 57EC @ 0.0019 and 0.057 %, respectively at 14 days intervals were found to be most promising by recording the minimum survival population of mites for three subsequent years (2.71, 2.76, 3.07 and 3.13, 2.89, 3.10 mites/3 leaves, respectively), whereas, diafenthiuron 50WP and fenazaquin 10 EC had 3.20 to 4.67 mites/3 leaves on rose under polyhouse. M. anisopliae @ 3 g/(1 x 10 9 spores) also equally good with the fenazaquin 10 EC in reducing the mite. A minimum incidence of the damage on the flowers was also noticed in the plots treated with the synthetic insecticides, abamectin 1.9 EC and propargite 57 EC.
Keywords**:** Bio-efficacy, synthetic, botanical bio-pesticides, rose mite, *Tetranychus urticae*.

Introduction

Rose flowers are popular landscape plants grown for their beauty. Rose plants/creepers are vulnerable to the attack of many insects and pathogens that reduce flower growth and quality as well as frustrate rose gardeners. Rose is used for worshiping, making garlands, flower arrangements, and bouquets. Rose oil is incorporated in ayurvedic medicines, perfumes, soaps and cosmetics, flavoring soft drinks, and alcoholic beverages. Rose-water is extensively used for cooking and confectionery, especially in the oriental region. It is also used in flavoring wines, jams, jellies, cakes, and syrups (Bose and Yadav, 1989).

The mite species, *Tetranychus urticae* occurs to be a severe non-insect pest that damages the floral and other tender parts of plants resulting in the reduction of the flower quality. Both nymphs and adults suck the sap from the lower sides of the leaves. Besides, heavy infestations could lead to the death of the plants. Feeding activity of the mites results in light colored 'stipplings' which is due to localized cell death (Hegde *et al*., 2020). Severely injured leaves may curl and drop from the plant. Initially, mite infestations are normally confined to the undersides of leaves, but under heavy infestations, the mites produce webbing. Because of this, the name spider mite has been accorded. Spider mites usually occur and colonize on the tops of leaves and on other plant parts. Feeding by low numbers of mites is inconsequential, but these pests have a high reproductive potential and can complete a generation in as little as seven days. Hence the present work was aimed to evaluate synthetics, botanicals and biopesticides for the effective management under polyhouse condition.

Material and Methods

A trial was conducted at the ICAR-Indian institute of Horticultural Research (IIHR), Hessaraghatta, Bengaluru for the evaluation of bio-efficacy of synthetic pesticides *viz*., fenazaquin 10 EC, propargite 57 EC, diafenthiuron 50 WP, abamectin 1.9 EC, a botanical (neem oil) along with three biopesticides, *Paecilomyces fumosoroseus*, *Metarhizium anisopliae*, *Beauveria bassiana* along with control. The field was laid in Randomized Block Design (RBD) with three replications. Each of the synthetic insecticide was scheduled for two sprays at 14 days intervals, while 10 days for botanical and biopesticides (Table 1). First spray was given at flower initiation stage and second spray was given 14 and 10 days after spray. A control was maintained without any chemical spray. The experiment was conducted for three different years and the observations recorded included number of mites per three leaves. The data obtained was subjected to simple RCBD analysis followed by Duncan Multiple Range Test (DMRT) using Wasp 2.0 software.

Table 1 : List of synthetics, botanicals and biopesticides evaluated against rose mites, *T. urticae* Koch

Sl. No.	Treatment	Dose	Spray intervals
1	Fenazaquin 10 EC	1 ml/l (0.01%)	14 days
2	Diafenthiuron 50 WP	1 g/l (0.05%)	14 days
3	Propargite 57 EC	1 ml/l (0.057%)	14 days
4	Abamectin 1.9 EC	1 ml/l (0.0019%)	14 days
5	Neem oil	10.0 ml/l (1.00%)	10 days
6	*Paecilomyces fumosoroseus*	5 g/l (1 x 10^9 spores)	10 days
7	*Metarhizium anisopliae*	3 g/l (1 x 10^9 spores)	10 days
8	*Beauveria bassiana*	3 g/l (1 x 10^9 spores)	10 days
9	Control	-	-

Results and Discussion

The efficacies of the insecticides were assessed based upon its population / 3 leaves and per cent reduction over control. The results pertaining to the three years are presented here.

The population of mites per 3 leaves registered a significant variation across the treatments. The population ranged from 2.71 to 16.47 mites/3 leaves across 3 years. The synthetic insecticide, abamectin 1.9 EC @ 1 ml/l recorded minimum mite population (2.71 mites/3 leaves) with a per cent reduction of 83.50 mites over the control and was significant over all other treatments (Table 2). This was followed by propargite 57 EC @ 1 ml/l and was found to be on par with the abamectin 1.9 EC by registering a population of 3.13 mites/3 leaves with a reduction of 80.89 % over control. The insecticides, diafenthiuron 50WP @ 1g/l and fenazaquin 10EC @ 1ml/l recorded a significant maximum mite population (3.60 mites/3 leaves and 4.40 mites/3 leaves, respectively) when compared to abamectin 1.9 EC and propargite 57 EC. However, the efficacies of these insecticides were higher in comparison to botanicals and biopesticides and had 78.08 and 73.24 per cent reduction of mites over control. Within the biopesticides, *Metarhizium anisopliae* @ 3 g/l (1 x 10^9 spores) recorded lesser population (4.64 mites/3 leaves) with 71.72 % reduction of population over control and was on par with fenazaquin 10 EC. The next best treatments were *B. bassiana* and *P. fumosoroseus* with a population of 8.13 and 8.49 mites/3 leaves. The botanical, neem oil recorded a population of 9.33 mites/3 leaves with per cent reduction of 43.09 which was significantly higher than synthetic and biopesticides. Besides, exhibiting lesser population than the control (16.47 mites/3 leaves).

The trend of the efficacies of insecticides in the year 2019-20 was in similar with the results of first year. The population ranged from 2.76 to 15.07 mites/3 leaves across the treatments. Insecticide, abamectin 1.9 EC registered the minimum incidence of the mites by recording a population of 2.76 mites/3 leaves with 81.52 per cent reduction over control (15.07 mites/3leaves) (Table 3). The next best insecticide, propargite 57 EC reduced the population by 80.58 per cent by recording 2.89 mites /3 leaves and was on par with abamectin 1.9 EC. This was followed by diafenthiuron 50WP (3.24 mites/3 leaves and fenazaquin 10 EC (4.09 mites/3 leaves with significant difference with each other. The next best treatment was found to be *M. anisopliae* (4.84 mites /3 leaves) with a per cent reduction of 67.66 over control and was significantly effective over other biopesticides. Neem Oil exhibited lesser efficacy among the evaluated insecticides by registering higher no of mites *i.e.* 9.58 per 3 leaves (36.43 per cent reduction over control).

Table 2: Bioefficacy of synthetics, botanicals and biopesticides against two spotted Spider mites on rose under poly house condition in the year 2018-19

Sl. No	Treatment	Dose	No. mites / 3 leaves /plant	% mite Reduction over control
1	Fenazaquin 10 EC	1 ml/l (0.01%)	4.40c	73.24c
2	Diafenthiuron 50 WP	1 g/l (0.05%)	3.60b	78.08b
3	Propargite 57 EC	1 ml/l (0.057%)	3.13ab	80.89ab
4	Abamectin 1.9 EC	1 ml/l (0.0019%)	2.71a	83.50a
5	Neem oil	10.0 ml/l (1.00%)	9.33f	43.09f

6	*P. fumosoroseus*	5 g/l (1 x 10^9 spores)	8.49ef	49.70ef
7	*M. anisopliae*	3 g/l (1 x 10^9 spores)	4.64cd	71.72cd
8	*B. bassiana*	3 g/l (1 x 10^9 spores)	8.13e	50.39e
9	Control	-	16.47g	0.00g
	C V (%)	**-**	**4.09**	**1.97**
	C D (0.05)	**-**	**0.48**	**1.67**

Table 3 : Bioefficacy of synthetics, botanicals and biopesticides against two spotted spider mites on rose under poly house condition in the year 2019-20

Sl. No	Treatment	Dose	No. mites / 3 leaves /plant	% mite Reduction over control
1	Fenazaquin 10 EC	1 ml/l (0.01%)	4.09d	72.58c
2	Diafenthiuron 50 WP	1 g/l (0.05%)	3.24c	78.19b
3	Propargite 57 EC	1 ml/l (0.057%)	2.89ab	80.58ab
4	Abamectin 1.9 EC	1 ml/l (0.0019%)	2.76a	81.52a
5	Neem oil	10.0 ml/l (1.00%)	9.58gh	36.43f
6	*P. fumosoroseus*	5 g/l (1 x 10^9 spores)	9.07g	39.81g
7	*M. anisopliae*	3 g/l (1 x 10^9 spores)	4.84e	67.66d
8	*B. bassiana*	3 g/l (1 x 10^9 spores)	8.40f	43.60e
9	Control	-	15.07h	0.00h
	C V (%)	**-**	**4.61**	**3.27**
	C D (0.05)	**-**	**0.53**	**2.62**

Table 4: Bioefficacy of synthetics, botanicals and biopesticides against two spotted spider mites on rose under poly house condition in the year 2020-21

Sl. No.	Treatment	Dose	No. mites/3 leaves	% mite Reduction over control
1	Fenazaquin 10 EC	1 ml/l (0.01%)	4.67c	77.98c
2	Diafenthiuron 50 WP	1 g/l (0.05%)	4.07b	79.94b
3	Propargite 57 EC	1 ml/l (0.057%)	3.10a	84.71a
4	Abamectin 1.9 EC	1 ml/l (0.0019%)	3.07a	84.93a
5	Neem oil	10.0 ml/l (1.00%)	9.77d	51.65d
6	*P. fumosoroseus*	5 g/l (1 x 10^9 spores)	12.53e	38.12e
7	*M. anisopliae*	3 g/l (1 x 10^9 spores)	9.47d	53.19c
8	*B. bassiana*	3 g/l (1 x 10^9 spores)	13.37f	33.96f
9	Control	-	20.27g	0.00g
	C V (%)	**-**	**3.37**	**2.01**
	C D (0.05)	**-**	**0.53**	**1.84**

Table 5: Mean number of flowers damaged across various insecticides and benefit cost ratio

Sl. No.	Treatment	No. of Damaged Flowers /pl	No. of Healthy Flowers /pl	BCR
1	Fenazaquin 10 EC	4.53	19.20	2.75
2	Diafenthiuron 50 WP	4.07	19.40	2.71
3	Propargite 57 EC	3.07	20.20	2.79
4	Abamectin 1.9 EC	3.10	20.20	2.87
5	Neem oil	9.77	13.80	1.92
6	*P. fumosoroseus*	12.53	11.80	1.67
7	*M. anisopliae*	9.47	14.20	1.98
8	*B. bassiana*	13.37	10.60	1.39
9	Control	20.27	4.80	1.75

The mite population across the treatments ranged from 3.07 to 3.10. The synthetic insecticide, abamectin 1.9 EC and propargite 57 EC recorded minimum population *viz*, 3.07 mites/3 leaves and 3.10 mites/3 leaves, respectively with a reduction of 84.93 and 84.71per cent over control (20.27 mites/3 leaves),respectively and were significantly superior over other treatments. The next best treatments were Diafenthiuron 50 WP and fenazaquin 10 EC by reducing mite population by 79.94 and 77.98 per cent over the control, respectively. The entomopathogenic fungi, *M. anisopliae* was found to be best among the biopesticides and recorded 9.47 mites/3 leaves with 53.19 per cent reduction of population. Neem oil displayed a slighter deviation in the efficacy towards mites from the previous year and its activity was found to be on par with *M. anisopliae* by recording 9.77 mites/3 leaves and 51.65 percent reduction of mite population. *B. bassiana* displayed a lesser efficacy among the insecticides with 33.96 per cent reduction.

The no. of flowers damaged across insecticides are represented in Table 5. The data pertaining to the damage in the flowers indicated that minimum damaged flowers was noticed in the plants treated with the propargite 57 EC and abamectin 1.9 EC *viz*., 3.07 and 3.10 flowers/pl, respectively. This was followed by diafenthiuron 50 WP and fenazaquin 10 EC with 4.07 and 4.53 flowers/pl, respectively. The trend of damaged flowers across the biopesticides was *M. anisopliae* < *P. fumosoroseus* < *B. bassiana*. Neem oil application resulted in the damage of 9.77 flowers/plant and was found to be on par with *M. anisopliae.*

With reference to the Benefit: Cost Ratio, abamectin 1.9 EC recorded the highest B:C ratio (2.87) followed by propargite (2.79), fenazaquin (2.75) and Diafenthuron (2.71).This was followed by *M. anisopliae* (1.98) was higher among the biopesticides. Further Neem oil registered 1.92.

The data on evaluation of bioefficacy of the insecticides (synthetic,botanicals and biopesticides) against rose mites, *T. urticae* for three subsequent years reveals that, Synthetic pesticides are more effective in reducing the mite population (Fig. 1). In the current study, abamectin 1.9 EC and propargite 57 EC were found to be more effective against mites and was followed by diafentiuron and fenazaquin. The results of the present findings are in conformity with Sheeba *et al*. (2008) who reported that abamectin 1.9 EC had an excellent acaricidal activity against mites on rose. Akashe *et al*. (2006) also reported that, abamectin 1.9 EC at 0.0025 percent was highly active in checking *T. urticae* population on rose. Jayachandran (2003) have reported that Vertimec 1.8 EC (abamectin) at 0.25 ml/l as a very effective chemical in controlling the mite population upto three weeks on rose. Similarly, Tulail and Mohammadali reported 100 % mortality of *T. urticae* in cucumber with the application of Transact 1.8 EC (abamectin). The findings were also in accordance with the studies of Saleh et *al*., 2019, Fatemi *et al*., 2021, Uddin *et al.,* 2015, Masoud *et al*., 2018 and Patel and Ghetiya, 2018. The efficacy of propargite 57 EC against rose mites were in agreement with Patke *et al*., 2015 who reported that propargite 0.1 per cent gave best control for management of mite by recording /2.37 per cent reduction of nymphal population. Singh *et al.*, 2017 reported that propargite at 0.0057 % was more effective in reducing the population of two spider mite in rose. Tilekar *et al.* (2023) have also reported the effectiveness of the propargite 57 EC against mites infesting rose by reducing 35.71 per cent reduction of population over control. The efficacy of propargite 57 EC was also in accordance with the findings of Nag *et al*., 2020, Kavya *et al.*, 2015. Rai *et al.*, 2010 has reported maximum mortality of *T. urticae* with the application of abamectin and propargite and hence effective molecules against mites.The observations on the effectiveness of abamectin 1.9 EC and propargite 57 EC in reducing the mite's population during the present finding are in accordance with those workers. The efficacies of fenzaquin in the present study is in agreement with the findings of Srinivasa and Pushpa, 2013, Shukla and Radadia, 2018, Meetkumar and Shukla, 2023 while efficacy of diafenthiuron 50WP is in accordance with Rajashekarappa *et al*., 2023, Pokle and Shukla,2015, Shah and Shukla, 2014. The study also revealed that *M. anisoplae* was effective against mites among the biopesticides, The results were in confirmation with the study Cobanaglu *et al.* (2003) who studied the potentiality of entomopathogenic fungi against *T. urticae* and reported that *M. anisopliae* caused a significant mortality of 40.1 per cent at $4x10^8$ conidia/ml suspension. These findings are nearly identical to the current findings.

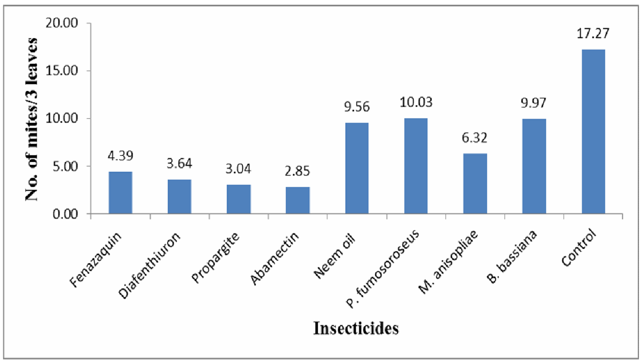

Fig. 1: Pooled mean of insecticide efficacies against rose mite

Conclusion

The treatment abamectin 1.9 EC and propargite 57EC @ 0.0019 and 0.057 %, respectively at 14 days intervals were found to be most promising insecticides for the management of mites as these recorded the minimum average survival population of mites for three subsequent years (2.71, 2.76, 3.07 and 3.13, 2.89, 3.10 mites/3 leaves, respectively) in the rose under polyhouse conditions. This was followed by other synthetic insecticides, diafenthiuron 50WP and fenazaquin 10 EC with a population ranging from 3.20 to 4.67 mites/3 leaves. However, *M. anisopliae* @ 3 g/(1 x 10^9 spores)at was also found to be equally good with the fenazaquin 10 EC in reducing the mite population in rose and hence could be considered as an effective biopesticide. A minimum incidence of the damage on the flowers was also noticed in the plots treated with the synthetic insecticides, abamectin 1.9 EC and propargite 57 EC. Hence these molecules serve to be effective molecules in reducing mite population.

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