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Management of Red Spider Mite (*Tetranychus urticae* Koch.) Infesting Marigold (*Tagetes erecta* L.) in Jammu Region

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A B S T R A C T

A field experiment was conducted on marigold (*Tagetes erecta* L.) to evaluate few insecticidal molecules, viz., novaluron, carbosulfan, imidachloprid, bifentrhin, methyl-o-demeton, chlorpyriphos dust, neem oil, propargite and thiamethoxam alone against the field populations of *Tetranychus urticae* Koch during 2014 and 2015 at the Research Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, India. The results indicated that propargite showed higher efficacy against *T. urticae* in reducing pest population. Mean population of *T. urticae* after two sprays revealed that propargite 0.800% was effective and superior. The next best were imidacloprid 0.008% and thiamethoxam 0.100% which were at par. Bifenthrin 0.050% and novaluron 0.100% were found to be least effective against *T. urticae*.

Introduction

At present, the world trade of floriculture is worth more than US $ 60 billion. In India, flowers occupied an area of 249 thousand hectares with a production of 2157 thousand metric tonnes during 2015-16 (Anonymous, 2016). Jammu and Kashmir is the most colorful State of the country and is blessed with climatic and geographic conditions that are conducive for producing world class flowers and it's in this regard that this state is attempting to increase its export base to cater to new markets that would help in creating employment opportunities for the unemployed youth of the state (Khan and Fazili, 2015). Floriculture scenario in Jammu province has changed very rapidly since 2000. The area under commercial floriculture is 233.88 hectors area in Jammu Division with a production of 51453.62 q. More than 1094 registered progressive growers covered under Commercial Floriculture (Anonymous, 2016). Mites' are among the destructive pests of agri-horticultural crops in many parts of the world. The spider mites' generally feed on the lower surface of the leaves as a result the infested leaves initially show speckling and later turn yellowish, finally leading to defoliation. The mites' spread to all parts of

the plants as the population increases especially during day periods and produce webbing over the entire plants. Moderate population may greatly affect crop production and heavy infestation results in death of the plants (Jeppson *et al.,* 1975). Since, very little information is available on the damage caused by *T. urticae* to marigold particularly from this region; the present study is proposed to investigate the infestation of this in marigold and to evaluate the available insecticides against this pest.

Materials and Methods

The replicated field trials of marigold variety "Pusa Narangi Gainda" were conducted at University Research Farm, Chatha, SKUAST, Jammu. Replicated trials were laid out in Randomized Block Design (RBD). All recommended agronomic practices for marigold plants were followed. In order to find out efficiency of some insecticides, the crop thus raised was sprayed with ten treatments including control replicated thrice. The crop was sprayed twice. Five plants were randomly selected from each plot. Observations were recorded on insect count before the spray and also after 1, 7 and 14 days of spray using a knapsack sprayer. In control plots only water was sprayed. The sprayer was rinsed carefully after each spray. Data thus obtained was statistically analyzed and the efficacy of the insecticides was evaluated.

Results and Discussion

Efficacy of the insecticides for the management of the pest revealed that all the insecticidal treatments at 1, 7 and 14 days after spray were superior to control in reducing the pest population (Tables 1 and 2) during 2014 and 2015. The observations recorded on 14th day after spray revealed that all the treatments proved significantly superior over control. Propargite (0.62 and 1.16 mites' plant^{-1}) and imidacloprid (1.00 and 2.53 mites' plant^{-1}) were found best treatment in reducing the mite population which was statistically at par with each other. The treatments viz. thiamethoxam (1.68 and 3.16 mites' plant^{-1}) and carbosulfan (2.67 and 4.17 mites' plant^{-1}) were statistically at par with each other. Methyl-o-demton (3.61 and 5.15 mites' plant^{-1}), neem oil (4.00 and 6.20 mites' plant^{-1}), chlorpyriphos dust (5.06 and 6.56 mites' plant^{-1}), bifenthrin (6.55 and 7.66 mites' plant^{-1}) and novaluron (7.05 and 8.31 mites' plant^{-1}) were found to be least effective against the red spider mite.

The pooled data during 2014 and 2015 (Table 3, First spray) revealed that there was no significant difference between the treatments one day before spray. The observations recorded on 1st day after spray revealed that all the treatments proved significantly superior over control. Propargite (2.47 mites' plant^{-1}) was found to be most effective treatment in reducing the mites' population which was statistically at par with imidacloprid (3.58 mites' plant^{-1}). The treatments viz. thiamethoxam (4.24 mites' plant^{-1}), carbosulfan (5.50 mites' plant^{-1}), methyl-o-demeton (6.03 mites' plant^{-1}), neem oil (6.81 mites' plant^{-1}) and chlorpyriphos dust (7.70 mites' plant^{-1}) were statistically at par with each other. Bifenthrin (8.32 mites' plant^{-1}) and novaluron (8.97 mites' plant^{-1}) were found to be least effective against the mites'. The observations recorded on 7th day after spray revealed that all the treatments proved significantly superior over control. Propargite (1.16 mites' plant^{-1}) was found to be most effective treatment in reducing the mites' population which was statistically at par with imidacloprid (2.53 mites' plant^{-1}). The treatments viz. thiamethoxam (3.16 mites' plant^{-1}), carbosulfan (4.17 mites' plant^{-1}), methyl-o-demeton (5.15 mites' plant^{-1}), neem oil (6.20 mites' plant^{-1}) and chlorpyriphos dust (6.56 mites' plant^{-1}) were statistically at par with each other.

Table.1 Efficacy of different insecticides against red spider mite on marigold (2014)

Treatments	Concentration / Dose	Mean mite population/plant							
		1st spray				2nd spray			
		1DBS*	1DAS**	7DAS	14DAS	1DBS	1DAS	7DAS	14DAS
Novaluron 10 EC	**0.100**	11.00 (3.46)	9.30 (3.21)	8.30 (3.05)	7.05 (2.83)	10.00 (3.32)	8.65 (3.11)	7.33 (2.89)	6.02 (2.65)
Carbosulfan 250 EC	**0.003**	10.67 (3.39)	5.63 (2.58)	4.34 (2.28)	2.67 (1.91)	10.67 (3.40)	4.60 (2.37)	3.39 (2.07)	1.69 (1.55)
Imidacloprid 200 SL	**0.008**	12.30 (3.65)	3.56 (2.16)	2.68 (1.88)	1.00 (1.38)	12.00 (3.55)	2.58 (1.91)	1.61 (1.63)	0.65 (1.28)
Bifenthrin 10 EC	**0.002**	10.05 (3.32)	8.63 (3.11)	7.65 (2.94)	6.55 (2.76)	11.82 (3.55)	8.04 (2.99)	6.67 (2.75)	5.81 (2.58)
Methyl-o-Demeton 25 EC	**0.030**	11.62 (3.44)	6.07 (2.71)	5.30 (2.51)	3.61 (2.15)	11.33 (3.49)	5.43 (2.58)	4.08 (2.27)	2.76 (1.90)
Chlorpyriphos dust 1.5%	**25kg/ha**	10.56 (3.41)	7.78 (2.93)	6.07 (2.72)	5.06 (2.45)	12.00 (3.58)	6.71 (2.74)	5.54 (2.58)	4.00 (2.24)
Neem oil	**0.050**	10.00 (3.32)	6.60 (2.76)	6.01 (2.65)	4.00 (2.24)	11.60 (3.52)	6.19 (2.76)	5.00 (2.45)	3.33 (2.08)
Propargite 57 EC	**0.800**	10.67 (3.40)	2.61 (1.91)	1.33 (1.52)	0.62 (1.28)	12.00 (3.54)	1.63 (1.63)	0.64 (1.28)	0.25 (1.14)
Thiamethoxam 25 EC	**0.100**	10.33 (3.36)	4.09 (2.36)	3.00 (2.00)	1.68 (1.61)	11.78 (3.50)	2.67 (1.90)	2.00 (1.73)	1.07 (1.38)
Control	**-**	11.00 (3.46)	10.01 (3.32)	9.33 (3.21)	8.02 (3.00)	10.67 (3.41)	9.00 (3.16)	8.67 (3.11)	7.00 (2.83)
CD ($p \leq 0.05$)	**-**	**NS**	**0.310**	**0.558**	**0.380**	**NS**	**0.407**	**0.430**	**0.485**
SE(m)		**0.166**	**0.104**	**0.186**	**0.127**	**0.236**	**0.136**	**0.144**	**0.162**

*DBS – Days Before Spray, **DAS – Days After Spray

Figures in parenthesis are square √x+1 transformed values

Table.2 Efficacy of different insecticides against red spider mite on marigold (2015)

Treatments	Concentration / Dose	Mean mite population/plant							
		1st spray				2nd spray			
		1DBS*	1DAS**	7DAS	14DAS	1DBS	1DAS	7DAS	14DAS
Novaluron 10 EC	**0.100**	9.67 (3.26)	8.65 (3.11)	8.33 (3.05)	7.04 (2.83)	8.30 (3.05)	7.61 (2.92)	7.24 (2.89)	6.38 (2.71)
Carbosulfan 250 EC	**0.003**	9.85 (3.09)	5.38 (3.51)	4.00 (2.24)	2.68 (1.91)	8.09 (3.00)	4.33 (2.27)	2.67 (1.91)	2.00 (1.73)
Imidacloprid 200 SL	**0.008**	8.31 (3.05)	3.60 (2.16)	2.38 (1.82)	1.00 (1.41)	8.63 (3.02)	3.05 (2.00)	1.30 (1.52)	1.04 (1.41)
Bifenthrin 10 EC	**0.002**	9.00 (3.16)	8.01 (3.00)	7.67 (2.94)	6.46 (2.75)	9.35 (3.20)	7.10 (2.83)	6.33 (2.71)	6.08 (2.65)
Methyl-o-Demeton 25 EC	**0.030**	9.43 (3.24)	6.00 (3.65)	5.00 (2.45)	3.63 (2.15)	9.61 (3.22)	5.09 (2.45)	4.06 (2.34)	3.61 (2.00)
Chlorpyriphos dust 1.5%	**25kg/ha**	8.09 (3.00)	7.62 (2.94)	7.05 (2.83)	6.39 (2.68)	7.33 (2.89)	6.66 (2.77)	5.61 (2.58)	5.33 (2.46)
Neem oil	**0.050**	9.60 (3.26)	7.03 (2.83)	6.39 (2.71)	5.30 (2.49)	8.62 (3.07)	6.00 (2.65)	5.39 (2.51)	4.02 (2.24)
Propargite 57 EC	**0.800**	8.67 (3.05)	2.33 (1.82)	1.00 (1.41)	0.33 (1.14)	9.00 (3.09)	1.88 (1.63)	0.67 (1.28)	0.33 (1.14)
Thiamethoxam 25 EC	**0.100**	8.33 (3.05)	4.39 (2.31)	3.32 (2.08)	2.07 (1.73)	6.30 (2.71)	6.33 (2.71)	2.35 (1.82)	1.24 (1.52)
Control	**-**	10.00 (3.32)	9.67 (3.26)	8.30 (3.05)	8.00 (3.00)	9.25 (3.21)	8.62 (3.11)	7.67 (2.92)	7.00 (2.83)
CD ($p \leq 0.05$)	**-**	**NS**	**0.258**	**0.208**	**0.442**	**NS**	**0.381**	**0.344**	**0.371**
SE(m)		**0.210**	**0.086**	**0.069**	**0.148**	**0.247**	**0.127**	**0.115**	**0.124**

*DBS – Days Before Spray, **DAS – Days After Spray

Figures in parenthesis are square √x+1 transformed values

Table.3 Efficacy of different insecticides against red spider mite on marigold (pooled)

Treatments	Concentration / Dose	Mean mite population/plant							
		1st spray				2nd spray			
		1DBS*	1DAS**	7DAS	14DAS	1DBS	1DAS	7DAS	14DAS
Novaluron 10 EC	**0.100**	10.33 (3.36)	8.97 (3.16)	8.31 (3.05)	7.04 (2.83)	9.15 (3.18)	8.13 (3.01)	7.28 (2.89)	6.20 (2.68)
Carbosulfan 250 EC	**0.003**	10.26 (3.24)	5.50 (3.04)	4.17 (2.26)	2.67 (1.91)	9.38 (3.2)	4.46 (2.32)	3.03 (1.99)	1.84 (1.64)
Imidacloprid 200 SL	**0.008**	10.30 (3.35)	3.58 (2.16)	2.53 (1.85)	1.00 (1.39)	10.31 (3.28)	2.81 (1.95)	1.45 (1.57)	0.84 (1.34)
Bifenthrin 10 EC	**0.002**	9.52 (3.24)	8.32 (3.05)	7.66 (2.94)	6.50 (2.75)	10.58 (3.37)	7.57 (2.91)	6.5 (2.73)	5.94 (2.61)
Methyl-o-Demeton 25 EC	**0.030**	10.52 (3.34)	6.03 (3.18)	5.15 (2.48)	3.62 (2.15)	10.47 (3.35)	5.26 (2.51)	4.07 (2.30)	3.18 (1.95)
Chlorpyriphos dust 1.5%	**25kg/ha**	9.32 (3.20)	7.70 (2.93)	6.56 (2.77)	5.72 (2.56)	9.66 (3.23)	6.68 (2.75)	5.46 (2.54)	4.66 (2.35)
Neem oil	**0.050**	9.80 (3.29)	6.81 (2.79)	6.20 (2.68)	4.65 (2.36)	10.11 (3.29)	6.09 (2.70)	5.19 (2.48)	3.67 (2.16)
Propargite 57 EC	**0.800**	9.67 (3.22)	2.47 (1.86)	1.16 (1.46)	0.47 (1.21)	10.5 (3.31)	1.75 (1.63)	0.65 (1.28)	0.29 (1.14)
Thiamethoxam 25 EC	**0.100**	9.33 (3.20)	4.24 (2.33)	3.16 (2.04)	1.87 (1.67)	9.04 (3.10)	4.50 (2.30)	2.17 (1.77)	1.15 (1.45)
Control	**-**	10.52 (3.39)	9.84 (3.29)	8.81 (3.13)	8.01 (3.00)	9.96 (3.31)	8.81 (3.13)	8.17 (3.01)	7.00 (2.83)
CD ($p \leq 0.05$)	**-**	**NS**	**0.284**	**0.383**	**0.411**	**NS**	**0.394**	**0.387**	**0.428**
SE(m)		**0.188**	**0.095**	**0.127**	**0.137**	**0.241**	**0.131**	**0.129**	**0.143**

*DBS – Days Before Spray, **DAS – Days After Spray

Figures in parenthesis are square √x+1 transformed values

Bifenthrin (7.66 mites' plant^{-1}) and novaluron (8.31 mites' plant^{-1}) were found to be least effective against the mites'. On 14th day after spray revealed that all the treatments proved significantly superior over control. Propargite (0.47 mites' plant^{-1}) and imidacloprid (1.00 mites' plant^{-1}) were found best treatment in reducing the mites' population which were statistically at par with each other. The treatments viz. thiamethoxam (1.87 mites' plant^{-1}), carbosulfan (2.67 mites' plant^{-1}), methyl-o-demeton (3.62 mites' plant^{-1}), neem oil (4.65 mites' plant^{-1}) and chlorpyriphos dust (5.72 mites' plant^{-1}) were statistically at par with each other. Bifenthrin (6.50 mites' plant^{-1}) and novaluron (7.04 mites' plant^{-1}) were found to be least effective against the mites'. The pooled data during 2014 and 2015 (Table 3, Second spray) revealed that there was no significant difference between the treatments one day before spray.

The observations recorded on 1st day after spray revealed that all the treatments proved significantly superior over control. Propargite (1.75 mites' plant^{-1}) was found to be most effective treatment in reducing the mites' population which was statistically at par with imidacloprid (2.81 mites' plant^{-1}). The treatments viz. thiamethoxam (4.50 mites' plant^{-1}), carbosulfan (4.46 mites' plant^{-1}), methyl-o-demeton (5.26 mites' plant^{-1}), neem oil (6.09 mites' plant^{-1}) and chlorpyriphos dust (6.68 mites' plant^{-1}) were statistically at par with each other. Bifenthrin (7.57 mites' plant^{-1}) and novaluron (8.13 mites' plant^{-1}) were found to be least effective against the mites'. The observations recorded on 7th day after spray revealed that all the treatments proved significantly superior over control. Propargite (0.65 mites' plant^{-1}) was found to be most effective treatment in reducing the mites' population which was statistically at par with imidacloprid (1.45 mites' plant^{-1}). The treatments viz. thiamethoxam (2.17 mites' plant^{-1}), carbosulfan (3.03 mites' plant^{-1}), methyl-o-demeton (4.07 mites' plant^{-1}), neem oil (5.19 mites' plant^{-1}) and chlorpyriphos dust (5.46 mites' plant^{-1}) were statistically at par with each other. Bifenthrin (6.50 mites' plant^{-1}) and novaluron (7.28 mites' plant^{-1}) were found to be least effective against the mites'. On 14th day after spray revealed that all the treatments proved significantly superior over control. Propargite (0.29 mites' plant^{-1}) and imidacloprid (0.84 mites' plant^{-1}) were found best treatment in reducing the mites' population which were statistically at par with each other. The treatments viz. thiamethoxam (1.15 mites' plant^{-1}), carbosulfan (1.84 mites' plant^{-1}), methyl-o-demeton (3.18 mites' plant^{-1}), neem oil (3.67 mites' plant^{-1}) and chlorpyriphos dust (4.66 mites' plant^{-1}) were statistically at par with each other. Bifenthrin (5.94 mites' plant^{-1}) and novaluron (6.20 mites' plant^{-1}) were found to be least effective against the mites'.

Our results are in agreement with Dhooria (1999) who reported that oxydemeton methyl against was highly effective against *T. urticae* infesting roses under polyhouse condition and had quick knock-down effect on mites' and effective up to 3 weeks after spray. The results are in line with Ahn *et al.,* (2004) who reported that among the insecticides, acetamiprid, imidacloprid, spinosad, thiamethoxam and acetamiprid + etofenprox showed less toxicity to *P. persimilis* and *T. urticae*.

The results of the present studies are in consonance with Varghese and Mathew (2013) who evaluated the bioefficacy of newer insecticides against the sucking pests and reported that Spiromesifen 45 SC at 100 g a.i. ha^{-1} and propargite 57 EC at 570 g a.i. ha^{-1} were found to be effective in reducing mite population whereas acetamiprid 20 SP at 20 g a.i. ha^{-1} along with spiromesifen were found to be effective against thrips.

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