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Efficacy of different acaricides against *Tetranychus urticae* (Koch.) infesting marigold (*Tagetes* spp.)

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ABSTRACT

A pot experiment was conducted at Department of Agricultural Entomology, N.M. Collage of Agriculture, N.A.U., Navsari during 2014 to determine the effectiveness of seven different acaricides against *Tetranychus urticae* Koch. on marigold. The bioefficacy of different acaricides *viz.* Abamectin 0.0025 per cent, Buprofezin 0.030 per cent, Chlorfenpyr 0.01 per cent, Diafenthiuron 0.055 per cent, Fenazaquin 0.01 per cent, Fenpyroximate 0.0025 per cent, Propargite 0.05 per cent tested against *T. urticae* infesting marigold revealed that the Abamectin 0.0025 per cent and Chlorfenapyr 0.01 per cent gave cent per cent mortality of mites at fourteen days after application and proved the most effective for the control of mites on marigold as compared to rest of the acaricides. The treatment of propargite was found least effective amongst the tested acaricides. The descending order of effectiveness of different acaricides was Abamectin 0.0025 per cent = Chlorfenapyr 0.01 per cent $\geq$ Difenthiuron 0.055 per cent > Fenazaquin 0.01 per cent > Fenpyroximate 0.0025 per cent > Buprofezin 0.030 per cent > Propargite 0.05 per cent at fourteen days after application.

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INTRODUCTION

Marigold (*Tagetes erecta* Linnaeus) is one of the most important hardy flower crops grown commercially throughout the world. Marigold gained popularity among gardeners and flower dealers on account of its easy cultivation, wide adaptability of diverse soil and climatic conditions, habit of profuse flowering, short duration to produce marketable flowers, wide spectrum of attractive colours, shape and good keeping quality. In India, it is one of the most commonly grown loose flowers and extensively used on religious and social functions in various forms.

Among the different states which cultivated the marigold crops in India, Karnataka has the largest area and production followed by Maharashtra, Madhya Pradesh and Gujarat. The area grown under this crop was 55.89 thousand tonnes. In Gujarat, marigold is grown

under 7.22 thousand hectors with an annual production of 68.93 thousand tones (Anonymous, 2015a).

Insect Pests and Mites reported damaging to marigold right from germination to harvesting of crops are two spotted red spider mites (*Tetranychus urticae* Koch), green peach aphids (*Myzus persicae* Sulzer), serpentine leaf miners (*Liriomyza trifolii* Burgess), green house whitefly (*Trialeurodes vaporariorum* Westwood), silver leaf whitefly or sweet potato whitefly and *Bemisia tabaci* Gennadius), beet armyworm (*Spodoptera exigua* Hubner), tobacco budworm (*Heliothis virescens* Fabricius), orange tortrix (*Argyrotaenia citrana* Walsingham), sunflower moth (*Homoesoma ectellum* Hulst), cabbage looper (*Trichoplusia ni* Hubner) (Anonymous, 2015b).

The two spotted red spider mite *Tetranychus urticae* Koch (Acarina: Tetranynchidae) is one of the most destructive pest of this crop both in open as well as protected conditions. Two spotted spider mite; *T. urticae* is being recorded worldwide infesting more than 150 different field and ornamental crops. They usually colonize under surface of leaves and when population is very high, they can found on all parts of the plant. They prefer nitrogen rich young leaves, but in well established colonies older leaves become severely infested. It cause extensive damage to the plants by continuous sap sucking from the leaves, leaving tiny pale spot where the green epidermal cells are destroyed, thus significantly reduces the photosynthetic capacity of plant. The cloudiness is caused by their webbing. The silvering of the marigold leaves is caused by the spider mites feeding on the leaf cells. Under severe infestation leaves turns to yellowish in colour resulting in to drop down. Webs of the mites in heavy infestations may cover foliage and flowers.

The management of two spotted red spider mite in marigold is essential. Several acaricides were recommended for the management of this pest. With the introduction of newer molecules, there is a need to study the comparative bioefficacy for the effective and economical control of this mite.

MATERIAL AND METHODS

Some newer acaricides along with conventional ones were evaluated with recommended concentration for their efficacy against two spotted spider mite, *T. urticae* on potted marigold under field condition. The marigold plants were grown in the pot. The pots were kept in open space. Ten gravid females of two spotted spider mite, *T. urticae* were released on each potted marigold plant and allowed for built up of mite population on each plant.

Details of the experiment:

A pot experiment was conducted at Department of Agricultural Entomology, N. M. Collage of Agriculture, N. A. U., Navsari during April 2014 to June 2014 to determine the effectiveness of different acaricides against *T. urticae* on marigold. Experiments were carried out in a Completely Randomized Design (CRD) with eight treatments and four replications. Different treatments *i.e.* Abamectin 0.0025 per cent, Buprofezin 0.030 per cent, Chlorfenpyr 0.01 per cent, Diafenthiuron 0.055 per cent, Fenazaquin 0.01 per cent, Fenpyroximate 0.0025 per cent, Propargite 0.05 per cent and control (Water spray) were tested against *T. urticae.*

Application of acaricides :

Treatments were imposed once coinciding with sufficient mite population and uniform development of mites in experimental units. Spraying of acaricides was carried out uniformly with hand atomizer till saturation of solution on plant parts on each potted plants. As tender shoots and under surface of leaves are main feeding sites of the mites, a thorough coverage of feeding sites of the mites was ensured. Before second spray again 10 healthy gravid females were released on each potted marigold plants and allowed for built up of mite population.

Method of observation :

To evaluate the effect of foliar spray of various acaricides on the population of mites, mite counts were made from three randomly selected and tagged leaves representing top, middle and lower canopy of plant. The two spotted spider mite density (all embryonic stages together) was recorded from whole leaf with the use of hand magnifying glass. A pre- treatment counts a day before and post- treatment counts at 1, 3, 7 and 14 days after application of treatment were recorded. The mites not showing any response to touch of brush were considered dead. The data so obtained on mite counts were summed up and utilized for calculation of mortality. The corrected mortality was worked out through utilizing following formula suggested by Henderson and Tilton (1955).

$$\text{Per cent mortality} = \left[1 - \frac{\text{Ta x Cb}}{\text{Tb x Ca}}\right] \text{x } 100$$

where,

Tb = Number of larvae observed before treatment

Ta = Number of larvae observed after treatment

Cb = Number of larvae observed from untreated control plot before treatment

Ca = Number of larvae observed from untreated control plot after treatment.

The data so obtained were statistically analysed using Completely Randomized Design after arcsine transformation so as to evaluate effectiveness of pesticides against two spotted spider mite, *T. urticae*.

RESULTS AND DISCUSSION

Mite population before first spraying was homogenous as indicated by non-significant differences among treatments. The results obtained are presented in Table 1.

One day after spraying :

The data presented in Table 1 indicated that all the acaricides were found significantly superior over control in reducing the population. The propargite 0.05 per cent was found more effective at one day after first spraying with maximum reduction in 96.63 per cent mite population, which was at par with Fenazaquin 0.01 per cent (95.98 %). The next best treatment was Abamectin 0.0025 per cent (84.79 %) it was at par with Chlorfenpyr 0.01 per cent (84.63 %) and Difenthiuron 0.055 per cent (84.24 %). The lowest reduction in mite population was recorded in the treatments Buprofezin 0.030 per cent (6.30 %), which was remained at par with Fenpyroximate 0.0025 per cent (4.25 %). The descending order of effectiveness of acaricides was Propargite 0.05 per cent $\geq$ Fenazaquin 0.01 per cent > Abamectin 0.0025 per cent $\geq$ Chlorfenpyr 0.01 per cent $\geq$ Diafenthiuron 0.055 per cent > Buprofezin 0.030 per cent $\geq$ Fenpyroximate 0.0025 per cent.

The data recorded one day after second spraying revealed that all the acaricides were found significantly superior over control. The highest mortality of mite was recorded in the treatment of propergite 0.05 per cent (97.71 %) was found more effective followed by the Fenazaquin 0.01 per cent (93.91 %). The treatment of Abamectin 0.025 per cent (84.77 %), Chlorfenpyr 0.01 per cent (83.00 %) and Difenthiuron 0.055 per cent (82.27 %) were statistically at par with each other. However, Buprofezin 0.030 per cent (5.04 %) and

Table: 1 Efficacy of different acaricides against T. urticae on marigold

Sr. No.	Treatments	Concentration (%)	Corrected mortality of *T. urticae* after treatment (%)							
			Days after spraying							
			First spraying				Second spraying			
			1	3	7	14	1	3	7	14
1.	Abamectin	0.0025	67.17*	75.79	87.35	88.72	67.04	74.00	84.64	88.72
			(84.79)	(93.87)	(99.65)	(100.00)	(84.77)	(92.36)	(98.97)	(100.00)
2.	Buprofezin	0.03	14.46	32.15	73.38	72.21	12.89	29.43	73.45	72.87
			(6.30)	(28.48)	(91.81)	(90.58)	(5.04)	(24.15)	(91.86)	(91.13)
3.	Chlorfenpyr	0.01	66.94	88.72	88.72	88.72	65.68	85.68	88.72	88.72
			(84.63)	(100.00)	(100.00)	(100.00)	(83.00)	(99.18)	(100.00)	(100.00)
4.	Diafenthiuron	0.055	66.66	72.77	84.68	87.45	65.11	72.12	84.41	87.54a
			(84.24)	(91.17)	(98.99)	(99.70)	(82.27)	(90.47)	(98.87)	(99.73)
5.	Fenazaquin	0.01	78.72	88.72	88.72	84.57	75.74	87.25	88.72	85.60
			(95.98)	(100.00)	(100.00)	(98.91)	(93.91)	(99.61)	(100.00)	(99.12)
6.	Fenpyroximate	0.0025	11.85	29.48	68.67	81.63	11.92	31.34	67.17	81.21
			(4.25)	(24.59)	(86.72)	(97.87)	(4.34)	(27.08)	(84.94)	(97.66)
7.	Propeargite	0.05	79.60	88.72	71.87	62.96	81.43	88.72	72.63	64.66
			(96.63)	(100.00)	(90.29)	(79.33)	(97.71)	(100.00)	(91.03)	(81.68)
S. E. ±			1.06	1.46	1.00	1.02	0.77	1.24	1.02	1.20
C.D. (P=0.05)			3.09	4.31	2.50	2.56	2.20	3.19	2.54	3.08
C.V. %			3.82	4.30	2.11	2.15	2.75	3.24	2.16	2.58

*Figures are angular transformed values Figures in parentheses are original values

Fenpyroximate 0.0025 per cent (4.34 %) recorded minimum reduction of mite. The descending order of effectiveness of acaricides was propargite 0.05 per cent > Fenazaquin 0.01 per cent > Abamectin 0.0025 per cent ≥ Chlorfenpyr 0.01 per cent ≥ Diafenthiuron 0.055 per cent > Buprofezin 0.030 per cent ≥ Fenpyroximate 0.0025 per cent.

Three days after spraying:

The data presented in Table 1 indicated that all the acaricidal treatments exhibited significantly superior over control in reducing the mite population at three days after first spraying. Chlorfenpyr 0.01 per cent (100.00%), propargite 0.05 per cent (100.00 %) and Fenazaquin 0.01 per cent (100.00 %) were found more effective with complete control of mite population. The next best treatment was Abamectin 0.0025 per cent (93.87 %), which was at par with Difenthiuron 0.055 per cent (91.17%). The lowest reduction in mite population was recorded in Buprofezin 0.030 per cent (28.48 %), which was remained at par with Fenpyroximate 0.0025 per cent (24.59 %). The descending order of effectiveness of different acaricides was Propargite 0.05 per cent = Fenazaquin 0.01 per cent = Chlorfenpyr 0.01 per cent > Abamectin 0.0025 per cent ≥ Difenthiuron 0.055 per cent > Fenpyroximate 0.0025 per cent ≥ Buprofezin 0.030 per cent.

The results obtained three days after second spraying revealed that the highest reduction in mite population was recorded in the treatment of propargite 0.05 per cent (100.00 %) was found more effective. It was at par with the treatment Fenazaquin 0.01 per cent (99.61 %) and Chlorfenpyr 0.01 per cent (99.18 %) followed by Abamectin 0.0025 per cent (92.36 %) and Difenthiuron 0.055 per cent (90.47 %). However, Fenpyroximate 0.0025 per cent (27.08 %) and Buprofezin 0.030 per cent (24.15%) recorded minimum reduction of mite population and remained statistically at par with each other. The descending order of effectiveness of different acaricides was Propargite 0.05 per cent ≥ Fenazaquin 0.01 per cent ≥ Chlorfenpyr 0.01 per cent > Abamectin 0.0025 per cent ≥ Difenthiuron 0.055 per cent > Fenpyroximate 0.0025 per cent ≥ Buprofezin 0.030 per cent.

Seven days after spraying :

The results (Table 1) revealed that all the acaricides were found significantly superior over control in reducing the mite population. Data recorded at seven days after first spraying showed cent per cent mortality in Chlorfenpyr 0.01 per cent and Fenazaquin 0.01 per cent, which was at par with Abamectin 0.0025 per cent (99.65 %). The result was followed by the treatment Difenthiuron 0.055 per cent (98.99 %). The next best treatment was Buprofezin 0.030 per cent (91.81 %), which was at par with the treatment Propargite 0.05 per cent (90.29 %). The minimum reduction in mite population was recorded in Fenpyroximate 0.0025 per cent (86.72 %). The descending order of effectiveness of different acaricides was Chlorfenpyr 0.01 per cent = Fenazaquin 0.01 per cent ≥ Abamectin 0.0025 per cent > Diafenthiuron 0.055 per cent > Buprofezin 0.030 per cent ≥ Propargite 0.05 per cent > Fenpyroximate 0.0025 per cent.

The result of second spraying was more or less on similar trends as that of first spraying. In which, cent per cent mortality was recorded in Chlorfenpyr 0.01 per cent and Fenazaquin 0.01 per cent followed by Abamectin 0.0025 per cent (98.97) and Difenthiuron 0.055 per cent. However, minimum reduction in mite population was noticed Fenpyroximate 0.0025 per cent (84.94 %) following Propargite 0.05 per cent (91.03 %) and Buprofezin 0.030 per cent (91.86 %). The descending order of effectiveness of different acaricides was Chlorfenpyr 0.01 per cent = Fenazaquin 0.01 per cent > Abamectin 0.0025 per cent ≥ Diafenthiuron 0.055 per cent > Buprofezin 0.030 per cent ≥ Propargite 0.05 per cent > Fenpyroximate 0.0025 per cent.

Fourteen days after spraying:

The results (Table 1) indicated that all the acaricides were found significantly superior over control in reducing the population at fourteen days after first spraying. Abamectin 0.0025 per cent and Chlorfenpyr 0.01 per cent were found more effective with 100 per cent reduction in mite population, which was at par with Difenthiuron 0.055 per cent (99.70 %) followed by Fenazaquin 0.01 per cent (98.91 %). The next best treatment was Fenpyroximate 0.0025 per cent (97.87 %). The lowest reduction in mite population was recorded in the treatments Buprofezin 0.030 per cent (90.58 %) and Propargite 0.05 per cent (79.33 %). The descending order of effectiveness of different acaricides at fourteen days of application was Abamectin 0.0025

per cent = Chlorfenpyr 0.01 per cent ≥ Diafenthiuron 0.055 per cent > Fenazaquin 0.01 per cent > Fenpyroximate 0.0025 per cent > Buprofezin 0.030 per cent > Propargite 0.05 per cent.

The result of second spraying was more or less on similar trends as that of first spraying, with cent per cent mortality in Chlorfenpyr 0.01 per cent and Abamectin 0.0025 per cent remained at par with Difenthiuron 0.055 per cent (99.73%). The descending order of effectiveness of different acaricides at fourteen days of application was Abamectin 0.0025 per cent = Chlorfenpyr 0.01 per cent ≥ Diafenthiuron 0.055 per cent ≥ Fenazaquin 0.01 per cent > Fenpyroximate 0.0025 per cent > Buprofezin 0.030 per cent > Propargite 0.05 per cent.

Thus, it can be seen from the results of both the spraying that the Abamectin 0.0025 per cent and Chlorfenpyr 0.01 per cent gave cent per cent mortality of mites at fourteen days after application and proved as the most effective for the control of mites on marigold as compared to rest of the acaricides. Diafenthiuron 0.055 per cent, Fenazaquin 0.01 per cent and Fenpyroximate 0.0025 per cent were the next effective treatments with reduction of more than 97 per cent of mites population. The treatment of Buprofezin 0.030 per cent was proved moderately effective for control of mites. The treatment of Propargite 0.05 per cent was found least effective amongst the tested acaricides.

According to Jayachandran (2003) the maximum mortality of *T. urticae* was observed in Abamectin 1.8 EC@ 0.25 ml/l on rose, which is more or less similar to this result. The present findings are more or less similar with the reports of Rajkumar *et al*. (2004) as they reported Abamectine, Fenazaquin, Propargite and Difenthiuron as effective miticides against *T. urticae* on jasmine. Singh and Choudhary (2008) found Abamectin 1.9 EC as effective to control mite population in okra. Similar result in respect of effectiveness of Diafenthiuron 50 SC and 50 WP both at 450 g a.i./ha recorded the highest reduction of mite population (Bhaskaran *et al*., 2007). The results of this trial is in close corroboration with (Chinniah,2013) as he reported that the treatment of Fenpyroximate 5 EC @ 0.8 ml/l, Abamectin 1.8 EC @ 0.5 ml/l recorded maximum mortality of *T. urticae* followed by Diafenthiuron 50 WP @ 0.75 ml/l were found to be very effective in controlling the mite population on brinjal. Similar reports of bio-efficacy of acaricides against *T. urticae* on chrysanthemum indicated that during first season Chlorfenapyr, Abamectin, Fenpyroximate showed cent per cent mortality of *T. urticae* on 5, 7 and 15 days after treatment (Reddy *et al.*, 2014).

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