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CHEMICAL CONTROL OF SPIDER MITE, *TETRANYCHUS URTICAE* KOCH (ACARI : TETRANYCHIDAE) INFESTING CARNATION (*DIANTHUS CARYOPHYLLUS* L.) UNDER POLYHOUSE CONDITION

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ABSTRACT : An experiment was conducted to test the efficacy of various pesticides against spider mite, *Tetranychus urticae* Koch infesting carnation under polyhouse condition. Among all the pesticides the treatment propargite 57 EC @ 0.1% was found superiority over rest of the treatments and registered lowest spider mite population, however, the highest spider mite population was recorded in case of control. The highest marketable flower yield of carnation was obtained in case of treatment propargite 57 EC @ 0.1% (548889.27 flowers/ha) and was statistically superior over rest of the treatments. The lowest marketable flower yield was obtained in case of control (255755.42 flowers/ha). Further, the higher BCR of 1:16.89 was recorded in the treatment propargite 57 EC @ 0.1%.

Key words : Chemical control, carnation, spider mite, *T. urticae*, polyhouse.

INTRODUCTION

Colorful flowers with pleasant fragrance have been a source of attraction to mankind. Flowers provide pleasure through enlightening colors and spreading fragrance. Therefore, man has always taken support of flowers as a token of expression of kind sentiments on number of occasions and consequently, ever increasing demand of flowers has made the floriculture of paramount importance for conducting economic evaluation and marketing investigation. Floriculture is fast emerging as a major venture in the world scene. Carnation (*Dianthus caryophyllus* L.) is one of the most popular cut flowers in the world and the highest economic importance in the floriculture industry. It is also known as the divine flower. It belongs to the family of Caryophyllaceae, occupying the esteemed position among top ten flowers of the world for more than five decades. It is estimated that more than 6000 ha of land is under carnation cultivation in the world. In India, it is covering more than 600 ha of area. There are many biotic constraints in growing carnation among which attack of spider mite is very important, presently the two spotted red spider mite, *Tetranychus urticae* Koch is considered as one of the most important pest inflict the profitable cultivation of carnation under protected cultivation. The mite is known for the ability to develop resistance against acaricides. Therefore, there is an urgent need to develop the control strategies against this pest under protected conditions, so that timely management practices have been utilized for its effective and economical control.

MATERIALS AND METHODS

An experiment was carried out in polycarbonate house of AINP on Agricultural Acarology, Department of Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari during the year 2013-14 to 2016-17. The experiment was laid out in complete randomized design with seven acaricidal treatments including control and with three repetitions. The cuttings of the carnation cv Solar Cherry were grown with the distance of 20 × 20 cm. All the recommended packages and practices were followed to grow healthy carnation crop in polycarbonate house.

To ascertain the efficacy of various acaricides against *T. urticae*, observations on spider mite population were recorded by randomly selecting three plants from each bed. From each plant, three leaves one each from top, middle and bottom canopies were sampled and spider mite population which include mobile stage was recorded one day before spraying (pre-treatment) and 3, 7, 10 and 14 days after spraying. The spider mite population was recorded from 2 × 2 cm leaf bit under the stereo-binocular microscope. The acaricides were applied at the time of appearance of spider mite and three sprays were imposed at 15 days interval. The economics of different treatments were also calculated. The data thus obtained were

subjected to √X+0.5 transformation and analyzed statistically for comparing treatments following analysis of variance technique (ANOVA) and the results were interpreted at 5% level of significance.

RESULTS AND DISCUSSION

The year wise and pooled data on the efficacy of various treatments were presented and discussed as under:

During the year 2013-14, the pretreatment count of spider mite before application of first spray ranges between 38.00 to 40.25 mites per leaf (Table 1). After the application of first spray, the population of spider mite was recorded on third day and it was lowest in the treatment T_2 (Propargite 57 EC @ 0.1%) (20.50 mites per leaf) whereas maximum population was recorded in control (40.75 per leaf). Seven days after first spray, the maximum reduction in spider mite population was recorded in treatment T_2 (Propargite 57 EC @ 0.1%) (13.00 mites per leaf) while maximum population was recorded in case of control. Ten days after first spray the maximum reduction in spider mite population was noticed in case of treatment propargite 57 EC @ 0.1% (8.75 mites per leaf) and it was statistically superior over rest of the treatments, however the maximum spider mite population was recorded in case of control. Further, 14 days after the first spray, the treatment T_2 *i.e.* propargite 57 EC @ 0.1% maintains its superiority over rest of the treatment in terms of reduction of spider mite population and was statistically superior over rest of the treatments. Likewise, three days after second spray, the maximum reduction in the spider mite population was recorded in propargite 57 EC @ 0.1% (4.50 mites per leaf) and it was statistically superior over rest of other treatments. Maximum spider mite population was recorded in case of untreated control. Seven days after second spray, the same trends were noticed, where maximum reduction was observed in the treatment T_2 *i.e.* propargite 57 EC @ 0.1% and it was statistically superior over rest of the treatments. Ten days after second spray, the treatment T_2 (Propargite 57 EC @ 0.1%)

Table 1 : Efficacy of various treatments against red spider mite, *T. urticae* infesting carnation under polyhouse (I year).

Treatments	Conc. (%)	Pre-treatment count (2cm leaf bit)	Mite population I spray				Mite population II spray				Mite population III spray				Yield/ha (No. of flower)
			3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	
T_1:Wettable Sulphur 80 WG	0.25	39.25	5.66 (31.50)	5.05 (25.00)	4.61 (20.75)	4.09 (16.25)	3.77 (13.75)	3.20 (9.75)	8.50 (2.99)	5.00 (2.34)	3.50 (1.99)	1.86 (3.00)	1.86 (3.00)	1.79 (2.75)	291000.0
T_2: Propergite 57 EC	0.1	39.00	4.58 (20.50)	3.67 (13.00)	3.04 (8.75)	2.50 (5.75)	2.23 (4.50)	1.92 (3.25)	1.50 (1.40)	0.50 (0.97)	0.00 (0.71)	0.71 (0.00)	0.71 (0.00)	0.84 (0.00)	560000.0
T_3: Profenofos 50 EC	0.05	40.25	5.05 (25.00)	4.15 (16.75)	3.71 (13.25)	3.31 (10.50)	3.12 (9.25)	2.78 (7.25)	2.39 (5.00)	2.17 (4.25)	1.93 (3.25)	1.87 (3.00)	1.80 (2.75)	1.73 (2.50)	336666.66
T_4: Trizophos40 EC	0.08	40.00	5.24 (27.00)	4.39 (18.75)	3.84 (14.25)	3.46 (11.50)	3.27 (10.25)	2.99 (8.50)	2.64 (6.50)	2.49 (5.75)	2.34 (5.00)	2.29 (4.75)	2.30 (4.50)	2.17 (4.25)	350666.6
T_5: Mineral Oil 50 WP	0.1	39.25	5.59 (30.75)	4.97 (24.25)	4.64 (21.00)	4.27 (17.75)	4.06 (12.25)	3.74 (13.50)	3.53 (12.00)	3.43 (11.25)	3.32 (10.50)	3.32 (10.25)	3.28 (10.25)	3.35 (10.75)	336000.0
T_6: Neem Oil 0.03 EC	0.15	38.00	5.59 (30.75)	5.14 (26.00)	4.76 (22.25)	4.32 (18.25)	4.15 (16.75)	3.90 (14.75)	3.74 (13.50)	3.64 (12.75)	3.53 (9.50)	3.53 (12.00)	3.53 (12.00)	3.57 (12.25)	337333.3
T_7:Control (No Spray)		40.25	6.42 (40.75)	6.36 (40.00)	6.32 (39.50)	3.34 (39.75)	6.34 (39.75)	6.34 (39.75)	6.32 (39.50)	6.30 (39.25)	6.28 (39.00)	6.30 (39.25)	6.34 (39.75)	6.30 (39.25)	264000.0
SEm			0.091	0.09	0.08	0.09	0.09	0.09	0.10	0.09	0.079	0.06	0.08	0.09	20.523
CD			0.27	0.27	0.22	0.26	0.27	0.26	0.31	0.28	0.23	0.19	0.23	0.29	21209.84
CV			3.36	3.80	3.45	4.32	4.74	5.00	6.35	6.19	5.56	4.48	5.55	6.96	10.39

DAS=days after spray * Figures outside the parenthesis are √x+0.5 transformed value while figures in the parenthesis are original values or re-transformed value.

maintain its superiority over other treatment in terms of reduction in spider mite population (1.80 mites per leaf), whereas maximum spider mite population was noticed in control. Further, 14 days after the second spray the maximum reduction was observed in treatment T_2 *i.e.* propargite 57 EC @ 0.1% (0.50 mite per leaf) and was statistically superior over rest of the treatments, whereas maximum mite population was recorded in control (39.25 per leaf). Three days after third spray, the treatment T_2 was found effective in reducing the spider mite population and was statistically superior over rest of the treatments. Seven days after application of third spray the treatment T_2 (Propargite 57 EC @ 0.1%) was found free from spider mite infestation and was statistically superior over rest of the treatments, while maximum spider mite population was recorded in control. Ten and fourteen days after third spray, the similar trends were recorded where treatment T_2 *i.e.* propargite 57 EC @ 0.1% maintains its superiority over rest of the treatments and found most effective in reducing spider mite population. The flower yield of first year was maximum in the treatment T_2 (Propargite 57 EC @ 0.1%) (560000 flowers/ha) and was statistically superior over rest of the treatments. However, the lowest flower yield was recorded in the treatment control (264000 flowers/ha).

In the year 2014-15 the spider mite population before the application of various treatments was ranging between 40.05 to 41.75 mites per leaf (Table 2). Three days after application of the first spray the maximum reduction was noticed in treatment T_2 *i.e.* propargite 57 EC @ 0.1% (34.00 mites per leaf) and it was statistically at par with other treatments *i.e.* T_3 (Profenofos 50 EC @ 0.05%) (35.75 mites per leaf) and T_4 (Triazophos 40 EC @ 0.08%) (35.25 mites per leaf). The maximum spider mite population was recorded in the treatment T_7 *i.e.* control. Seven days after first spray, the treatment T_2 (Propargite 57 EC @ 0.1%) was found statistically superior over rest of the treatments in terms of reduction in spider mite population, while maximum spider mite population was noticed in case of control. Ten days after application of first spray, the spider mite population was significantly lower in treatment T_2 *i.e.* propargite 57 EC @ 0.1% (8.00 mites per leaf) as compared to other treatments. Further, 14 days after the first spray, the maximum reduction in spider mite population was recorded in T_2 (Propargite 57 EC @ 0.1%) (3.50 mites per leaf) and was statistically superior over rest of the treatments. Three days after the second spray, the maximum reduction in spider mite population was noticed in treatment comprises of propargite 57 EC @ 0.1% (2.50 mites per leaf) and was found statistically superior over rest of the treatments, whileseven days after the second spray, the similar trends were noticed where treatment T_2 (Propargite 57 EC @ 0.1%) was found statistically superior over rest of the treatment. Further, 14 days after second spray, the treatment T_2 (Propargite 57 EC @ 0.1%) was statistically superior over other treatments, where maximum spider mite population was recorded in case of control. Three days after third spray, the spider mite population was lowest in T_2 (Propargite 57 EC @ 0.1%) (2.50 mites per leaf), while it was maximum in control, while seven days after third spray, the spider mite population was not observed in T_2 (Propargite 57 EC @ 0.1%) and it was found most effective as compared to other treatments. Further, ten and fourteen days after third spray similar trends were noticed and among all the treatment, treatment T_2 (Propargite 57 EC @ 0.1%) was found statistically most superior over rest of the treatments, while maximum spider mite population was noticed in case of control.

During the year 2015-16 the pre-treatment count of spider mite population was ranging between 42.50 to 43.50 mites per leaf (Table 3). Three days after the first spray, the lower spider mite population was noticed in case of the treatment T_2 *i.e.* propargite 57 EC @ 0.1% (34.00 mites per leaf) and it was statistically at par with T_4 (Triazophos 40 EC @ 0.08%) (35.75 mites per leaf). However, the maximum population (40.75 mites per leaf) was recorded in treatment control. Seven days after the first spray, the spider mite population was recorded lowest in the treatment T_2 (Propargite 57 EC @ 0.1%) (16.00 mites per leaf) and was statistically superior over rest of the treatment, while 14days after first spray same trends were noticed. Three days after the application of second spray the maximum reduction in spider mite population was recorded in case of treatment T_2 *i.e.* propargite 57 EC @ 0.1% (8.75 mites per leaf) and it was statistically superior over rest of the treatments. Further, seven days after second spray the lowest spider mite population was noticed in T_2 (Propargite 57 EC @ 0.1%) (5.50 mites per leaf) and was superior over rest of the treatments andthen ten days after the second spray the spider mite population was lowest in treatment T_2 (Propargite 57 EC @ 0.1%) (3.50 mites per leaf) and found statistically superior over the rest of the treatments, while 14days after the second spray, the maximum reduction in spider mite population was observed in case of control. After three days of third spray, the maximum reduction in spider mite population was recorded in the treatment T_2 *i.e.* propargite 57 EC @ 0.1% (1.50 mites per leaf) and was found statistically superior over rest of the treatments, while maximum spider mite population was noticed in

Table 2 : Efficacy of various treatments against red spider mite, *T. urticae* infesting carnation under polyhouse (II year).

Treatments	Conc.	Pre-treatment count (2cm leaf bit)	Mite population (I spray)				Mite population (II spray)				Mite population (III spray)				Yield/ha (No. of flower)
			3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	
T_1:Wettable Sulphur 80 WG	0.25	41.00	6.32 (39.50)	6.04 (3.60)	5.61 (31.00)	5.36 (28.25)	5.17 (26.25)	4.55 (23.25)	4.87 (20.25)	4.12 (16.50)	3.64 (11.25)	3.35 (9.25)	3.20 (9.00)	3.08 (8.50)	285500.00
T_2:Propergite 57 EC	0.1	40.25	5.87 (34.00)	4.18 (17.00)	2.91 (8.00)	1.98 (3.50)	1.70 (2.50)	0.97 (1.00)	1.18 (0.50)	0.97 (0.50)	1.40 (2.50)	1.09 (0.00)	0.84 (0.00)	0.84 (0.00)	589849.13
T_3:Profenofos 50 EC	0.05	41.00	6.02 (35.75)	5.20 (26.50)	4.56 (20.25)	4.27 (17.75)	3.90 (14.75)	3.35 (12.75)	3.64 (10.75)	3.16 (9.50)	3.16 (7.25	2.83 (5.75)	2.69 (4.50)	2.69 (4.00)	353080.26
T_4:Trizophos40 EC	0.08	41.00	5.98 (35.25)	5.27 (27.65)	4.66 (16.25)	4.33 (18.25)	4.03 (15.75)	3.64 (14.25)	3.84 (12.75)	3.57 (12.25)	3.50 (10.50)	3.28 (8.50)	3.03 (6.50)	2.96 (6.00)	325365.70
T_5:Mineral Oil 50 WP	0.1	41.75	6.24 (38.50)	6.04 (36.00)	5.79 (33.00)	5.36 (28.25)	5.12 (25.75)	4.77 (24.00)	4.95 (22.25)	4.72 (21.7)5	3.81 (19.25)	3.53 (15.50)	3.43 (12.00)	3.39 (11.25)	336000.0
T_6: Neem Oil 0.03 EC	0.15	41.00	6.24 (38.50)	6.08 (36.50)	5.94 (34.75)	5.59 (30.75)	5.48 (29.50)	5.22 (28.25)	5.36 (26.75)	5.17 (26.25)	5.07 (24.50)	5.02 (21.25)	4.95 (20.25)	4.90 (17.75)	337333.33
T_7:Control (No Spray)		40.25	6.30 (39.25)	6.28 (39.00)	6.28 (39.00)	6.28 (39.00)	6.30 (39.25)	6.34 (39.25)	6.30 (39.75)	6.34 (39.75)	6.32 (39.50)	6.28 (39.50)	6.30 (39.25)	6.32 (39.25)	264000.00
SEm			0.07	0.04	0.05	0.08	0.08	0.07	0.08	0.08	0.08	0.05	0.06	0.06	73.25
CD			0.21	0.3	0.16	0.24	0.25	0.21	0.23	0.24	0.24	0.15	0.17	0.17	12370.40
CV			2.31	1.58	2.10	3.41	3.69	3.38	3.68	3.99	4.43	2.88	3.59	3.56	5.91

DAS=days after spray * Figures outside the parenthesis are $\sqrt{x+0.5}$ transformed value while figures in the parenthesis are original values or re-transformed value.

case of control. Seven days after the third spray the treatment T_2 maintain its superiority over rest of the treatments in terms of reduction of spider mite population whileten days after the application of third spray the lowest spider mite population was recorded in T_2 (Propargite 57 EC @ 0.1%) (0.25 mites per leaf) and maximum spider mite population was recorded in case of treatment T_7 *i.e.* control. Further, 14 days after the application of third spray, same trends were noticed and the treatment T_2 (Propargite 57 EC @ 0.1%) maintain its superiority over rest of treatments. The maximum flower yield (589849.13 flowers/ha) was recorded in the treatment T_2 (Propargite 57 EC @ 0.1%), however the lowest flower yield was recorded from the treatment T_7 (Control) (272876.70 flowers/ha).

During the year 2016-17 the pre-treatment count of spider mite population were ranging between 35.25 to 38.75 mites per leaf (Table 4). Three days after the application of the first spray, the lowest spider mite population was recorded in case of treatment T_2 (Propargite 57 EC@0.1%) (20.00 mites per leaf) and was found statistically at par with another treatment T_3 (Profenofos 50 EC @ 0.05%) (20.75 mites per leaf). The maximum spider mite population was recorded in case of treatmentcontrol (39.25 mites per leaf). Seven days after the application of first spray, the maximum reduction in spider mite population was recorded in treatment T_2 (Propargite 57 EC @ 0.1%) (3.50 mites per leaf) and it was statistically superior over rest of the treatments. Further, ten days after the first spray, similar trends were noticed while, 14days after the first spray, the treatments T_2 (Propargite 57 EC @ 0.1%) maintain its superiority over rest of the treatments (0.50 mites per leaf) whereas maximum spider mite population was recorded in T_7 (Control) (40.00 mites per leaf). After the application of second spray, the spider mite population was lowest in T_2 (Propargite 57 EC @ 0.1%) (1.50 mites per leaf) after three days and was statistically superior over rest of the treatments. Seven days after second spray, the lowest spider mite population was noticed in T_2 (Propargite 57 EC @ 0.1%) and it was found superior over rest of the treatments, while ten days after second spray treatment T_2 (Propargite 57 EC @ 0.1%) maintain its superiority over rest of the treatments (1.75 mites per leaf) and maximum in case of T_7 (Control) (38.50 mites per leaf), whereas 14 days after the second spray, same trends were noticed. Three days after the third spray the lowest spider mite population was recorded in case of treatment T_2 (Propargite 57 EC @ 0.1%) (0.75 mites per leaf) and was found statistically superior over the rest of the treatments, whereas seven days after the third spray similar trends were recorded, whereas ten days after third spray the lowest spider mite population was recorded in T_2 (Propargite 57 EC @ 0.1%) and maximum in case of T_7 (Control). Further, 14 days after the third spray, the spider mite population was lowest in treatment T_2 (Propargite 57 EC @ 0.1%) (0.25 per leaf) and was statistically superior over rest of treatments. The maximum flower yield (552419.34 flowers/ha) was recorded in the treatment T_2 (Propargite 57 EC @ 0.1%), however the lowest flower yield was recorded from the treatment T_7 (Control) (270161.33 flowers/ha).

Pooled : The pooled over data of four years are presented in Table 5 showed that the pre-treatment count before the application of all the treatments were ranging between 39.38 to 40.39 mites per leaf. Three days after the application of first spray the spider mite population was lowest in case of treatment T_2 (Propargite 57 EC @ 0.1%) (27.13 mites per leaf) and was found statistically at par with two other treatments *viz.*, T_3 (Profenofos 50 EC @ 0.05%) (29.50 mites per leaf) and T_4 (Trizophos 40 EC @ 0.08%) (30.44 mites per leaf). However, the maximum spider mite population was recorded in the treatment T_7 (Control) (40.00 mites per leaf). Seven days after the application of first spray, the maximum reduction in spider mite population was recorded in the treatment T_2 (Propargite 57 EC @ 0.1%) (12.38 mites per leaf) and was statistically superior over rest of the treatments. However, next best treatments were T_3 (Profenofos 50 EC @ 0.05%) (20.50 mites per leaf) and was at par with treatment T_4 (Trizophos 40 EC @ 0.08%) (22.00 mites per leaf). The maximum spider mite population was noticed in control (39.88 mites per leaf). Ten days after the first spray, the lowest spider mite population was recorded in treatment T_2 (Propargite 57 EC @ 0.1%) (7.38 mites per leaf) and was found statistically superior over rest of the treatments. However, it was followed by treatment T_3 (Profenofos 50 EC @ 0.05%) (15.25 mites per leaf) and it was statistically at par with treatment T_4 (Trizophos 40 EC @ 0.08%) (15.44 mites per leaf). The maximum spider mite population was recorded in case of control. Further, 14 days after the application of the first spray, the maximum reduction in spider mite population was recorded in the treatment T_2 (Propargite 57 EC @ 0.1%) (4.80 mites per leaf) and was superior over rest of the treatments.However maximum spider mite population was recorded in case of control. Three days after the second spray, the maximum reduction in spider mite population was recorded in treatment T_2 (Propargite 57 EC @ 0.1%) (4.31 mites per leaf) and was statistically superior over rest of the treatments, while maximum population was recorded in control (3.38 mites

Table 3: Efficacy of various treatments against red spider mite, *T. urticae* infesting carnation under polyhouse (III year)

Treatments	Conc.	Pre-treatment count (2cm leaf bit)	Mite population (I spray)				Mite population (II spray)				Mite population (III spray)				Yield/ha (No. of flower)
			3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	
T_1:Wettable Sulphur 80 WG	0.25	43.50	6.40 (40.50)	5.98 (35.25)	5.48 (29.50)	5.05 (25.00)	4.74 (22.00)	4.53 (20.00)	4.21 (17.25)	4.00 (15.50)	3.64 (12.75)	3.35 (10.75)	3.20 (7.25)	3.08 (9.00)	285100.00
T_2:Propergite 57 EC	0.1	43.00	5.87 (34.00)	4.06 (16.00)	3.46 (11.50)	3.20 (9.75)	3.03 (8.75)	2.45 (5.50)	2.00 (3.50)	1.65 (2.25)	1.40 (1.50)	1.10 (0.75)	0.84 (0.25)	0.84 (0.25)	552419.34
T_3:Profenofos 50 EC	0.05	42.75	6.08 (36.50)	5.38 (28.50)	4.84 (23.00)	4.47 (19.50)	4.27 (17.75)	3.97 (15.25)	3.70 (13.25)	3.43 (11.25)	3.16 (9.50)	2.83 (7.50)	2.69 (6.75)	2.69 (6.75)	355743.03
T_4:Trizophos40 EC	0.08	42.50	6.02 (35.75)	5.48 (29.50)	5.02 (24.75)	4.80 (22.50)	4.61 (20.75)	4.30 (18.00)	4.03 (15.75)	3.84 (14.25)	3.50 (11.75)	3.28 (10.25)	3.04 (8.75)	2.96 (8.25)	321743.00
T_5:Mineral Oil 50 WP	0.1	42.75	6.34 (39.75)	5.66 (31.50)	5.22 (26.75)	5.00 (24.50)	4.82 (22.75)	4.61 (20.75)	4.39 (18.75)	4.03 (15.75)	3.81 (14.00)	3.53 (12.00)	3.43 (11.25)	3.39 (11.00)	353494.63
T_6: Neem Oil 0.03 EC	0.15	43.00	6.40 (40.50)	6.22 (38.25)	5.83 (33.50)	5.63 (31.25)	5.52 (30.00)	5.41 (28.75)	5.31 (27.75)	5.12 (25.75)	5.07 (25.25)	5.02 (24.75)	4.95 (24.00)	4.90 (23.50)	338709.70
T_7:Control (No Spray)		42.50	6.42 (40.75)	6.40 (40.50)	6.32 (39.50)	3.28 (40.25)	6.30 (39.25)	6.34 (39.75)	6.32 (39.50)	6.30 (39.25)	6.32 (39.50)	6.28 (39.00)	6.30 (39.25)	6.32 (39.50)	270161.33
SEm			0.07	0.06	0.07	0.06	0.07	0.05	0.06	0.05	0.06	0.07	0.07	0.07	23.48
CD			0.19	0.16	0.21	0.19	0.20	0.16	0.17	0.15	0.17	0.19	0.22	0.22	19287.58
CV			2.14	1.99	2.72	2.57	2.93	2.39	2.75	2.44	3.08	3.66	4.26	4.26	9.44

DAS=days after spray * Figures outside the parenthesis are $\sqrt{x+0.5}$ transformed value while figures in the parenthesis are original values or re-transformed value.

Table 4 : Efficacy of various treatments against red spider mite, *T. urticae* infesting carnation under polyhouse (IV year).

Treatments	Conc.	Pre-treatment count (2cm leaf bit)	Mite population (I spray)				Mite population (II spray)				Mite population (III spray)				Yield/ha (No. of flower)
			3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	
T_1:Wettable Sulphur 80 WG	0.25	35.50	5.29 (27.50)	4.36 (18.50)	3.39 (11.00)	3.28 (10.25)	3.90 (14.75)	3.16 (9.50)	2.87 (7.75)	2.69 (6.75)	3.64 (7.75)	3.35 (6.50)	2.23 (4.50)	1.73 (9.00)	280459.96
T_2:Propergite 57 EC	0.1	35.25	4.52 (20.00)	2.00 (3.50)	1.31 (1.25)	0.97 (0.50)	1.40 (1.50)	0.97 (0.50)	1.22 (1.75)	0.97 (0.50)	1.40 (0.75)	1.10 (0.25)	0.84 (0.25)	0.84 (0.25)	493288.63
T_3:Profenofos 50 EC	0.05	36.50	4.61 (20.75)	3.28 (10.25)	2.23 (4.50)	1.84 (3.00)	2.91 (8.00)	2.34 (5.00)	1.86 (3.00)	1.73 (2.50)	3.16 (3.75)	2.83 (2.25)	1.56 (2.00)	1.49 (6.75)	328859.06
T_4:Trizophos40 EC	0.08	36.75	4.87 (23.25)	3.60 (12.50)	2.64 (6.50)	2.50 (5.75)	3.32 (10.50)	3.00 (8.50)	2.64 (6.50)	2.50 (5.75)	3.50 (8.00)	3.28 (6.50)	2.54 (6.00)	2.39 (8.25)	291946.34
T_5:Mineral Oil 50 WP	0.1	37.25	5.38 (28.50)	4.44 (19.25)	3.56 (12.25)	3.34 (10.75)	4.06 (16.00)	3.74 (13.50)	3.32 (10.50)	3.20 (9.75)	3.81 (11.50)	3.53 (10.50)	3.24 (10.00)	3.08 (11.00)	280760.63
T_6: Neem Oil 0.03 EC	0.15	37.25	5.38 (28.50)	4.11 (16.50)	3.19 (9.75)	3.11 (9.25)	4.33 (18.25)	3.99 (15.50)	3.73 (13.50)	3.63 (12.75)	5.07 (15.50)	5.02 (14.00)	3.71 (13.25)	3.64 (23.50)	291946.34
T_7:Control (No Spray)		38.75	6.30 (39.25)	6.36 (40.00)	6.42 (40.75)	6.36 (40.00)	6.30 (39.25)	6.28 (39.00)	6.24 (38.50)	6.20 (38.00)	6.32 (38.25)	6.28 (38.00)	6.20 (38.00)	6.30 (39.50)	215883.66
SEm			0.09	0.11	0.09	0.12	0.08	0.09	0.21	0.09	0.09	0.09	0.11	0.09	101.82
CD			0.28	0.31	0.27	0.37	0.24	0.29	0.61	0.28	0.26	0.28	0.32	0.25	8597.89
CV			3.66	0.11	5.67	8.13	4.36	5.79	13.35	6.27	5.54	6.38	7.41	6.21	4.77

DAS = days after spray, *Figures outside the parenthesis are $\sqrt{x+0.5}$ transformed value while figures in the parenthesis are original values or re-transformed value.

Table 5 : Efficacy of various treatments against red spider mite, *T. urticae* infesting carnation under polyhouse (Pooled).

Treatments	Conc. (%)	Pre-treatment count (2cm leaf bit)	Mite population (I spray)				Mite population (II spray)				Mite population (III spray)				Yield/ha (No. of flower)	Net profit over control (Rs.)	BCR
			3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS	3 DAS	7 DAS	10 DAS	14 DAS			
T_1:Wettable Sulphur 80 WG	0.25	39.81	5.92 (34.75)	5.36 (20.59)	4.77 (23.06)	4.44 (19.94)	4.40 (19.19)	3.86 (16.63)	3.73 (13.44)	3.29 (10.94)	2.98 (8.81)	2.74 (7.38)	2.59 (5.94)	2.40 (5.69)	285514.99	2191.96	1.07
T_2:Propergite 57 EC	0.1	39.38	5.21 (27.13)	3.48 (12.38)	2.68 (7.38)	2.16 (4.88)	2.09 (4.31)	1.58 (2.63)	1.45 (1.81)	1.14 (0.94)	1.01 (1.19)	0.84 (0.25)	0.77 (0.13)	0.80 (0.13)	548889.27	53214.29	16.89
T_3:Profenofos 50 EC	0.05	40.13	5.44 (29.50)	4.50 (20.50)	3.83 (15.25)	3.47 (12.69)	3.55 (12.44)	3.11 (10.06)	2.89 (8.00)	2.62 (6.88)	2.48 (5.94)	2.21 (3.88)	2.07 (4.00)	2.01 (3.75)	343587.25	13503.78	7.03
T_4:Trizophos40 EC	0.08	40.06	5.53 (30.44)	4.68 (22.00)	4.04 (15.44)	3.77 (14.50)	3.81 (14.31)	3.48 (12.31)	3.29 (11.45)	3.10 (9.50)	3.02 (8.81)	2.80 (7.50)	2.61 (6.31)	2.52 (5.94)	322430.42	21180.71	9.34
T_5:Mineral Oil 50 WP	0.1	40.25	5.89 (34.38)	5.28 (27.75)	4.80 (23.25)	4.49 (20.19)	4.52 (19.19)	4.21 (17.94)	4.05 (15.88)	3.84 (14.63)	3.76 (13.81)	3.54 (12.06)	3.37 (10.81)	3.31 (10.50)	333098.80	3488.44	0.81
T_6: Neem Oil 1500 ppm	0.15	39.81	5.90 (34.56)	5.39 (29.19)	4.93 (25.06)	4.66 (22.38)	4.87 (23.63)	4.63 (21.81)	4.54 (20.38)	4.39 (19.38)	4.40 (18.68)	4.26 (18.00)	4.18 (17.25)	4.09 (16.56)	329445.90	3281.53	0.88
T_7:Control (No Spray)	—-	40.39	6.36 (40.00)	6.35 (39.88)	6.34 (39.69)	6.34 (39.75)	6.31 (39.38)	6.33 (39.44)	6.30 (39.31)	6.29 (39.06)	6.29 (39.06)	6.28 (38.94)	6.29 (39.13)	6.31 (39.25)	255755.42	(-)9598.83	—
SEm ±	—	—	0.13	0.19	0.24	0.25	0.19	0.21	0.22	0.20	0.16	0.16	0.15	0.16	8028.78	—	—
CD	—	NS-	0.38	0.58	0.72	0.73	0.57	0.61	0.65	0.58	0.49	0.46	0.45	0.48	22655.60	—	—
CV	—	—	2.85	3.13	3.32	4.37	3.88	4.08	6.75	4.62	4.60	4.39	5.23	5.24	8.12	—	—

DAS = days after spray * Figures outside the parenthesis are √x+0.5 transformed value while figures in the parenthesis are original values or re-transformed value.

per leaf). Seven days after the second spray the spider mite population was lowest in treatment T_2 (Propargite 57 EC @ 0.1%) (2.63 mites per leaf) and it was statistically superior over rest of the treatments. It was followed by treatment T_3 (Profenofos 50 EC @ 0.05%) (10.06 mites per leaf) and T_4 (Trizophos 40 EC @ 0.08%) (12.31 mites per leaf). The maximum spider mite population was recorded in case of control. Ten days after the second spray, the maximum spider mite population was recorded in case of control,while it was lowest in treatment propargite 57 EC @ 0.1% (1.81 mites per leaf) and was statistically superior over rest of the treatments. The next best treatment was T_3 (Profenofos 50 EC @ 0.05%) (8.00 mites per leaf) and it was at par with T_4 (Trizophos 40 EC @ 0.08%) (11.45 mites per leaf). Fourteen days after the second spray, the maximum reduction in spider mite population was recorded in treatment T_2 (Propargite 57 EC@0.1%) (0.94 mite per leaf) and was statistically superior over rest of the treatments. However, it was followed by treatment T_3 (Profenofos 50 EC@0.05%) (6.88 mites per leaf) and T_4 (Trizophos 40 EC@0.08%) (9.50 mites per leaf) and were at par with each other. The maximum spider mite population was recorded in untreated control (39.06 mites per leaf). Three days after the application of third spray, the highest reduction in the spider mite population was noticed in treatment T_2 (Propargite 57 EC @ 0.1%) (1.19 mites per leaf) and was statistically superior over rest of the treatments. The maximum spider mite population was noticed in case of control (39.06 mites per leaf) while seven days after the third spray, the maximum reduction in spider mite population was recorded in the treatment T_2 (Propargite 57 EC @ 0.1%) (0.25 mites per leaf) and was statistically superior and followed by T_3 (Profenofos 50 EC @ 0.05%) (3.88 mites per leaf). Further, ten days after third spray, the maximum reduction in spider mite population was recorded in the treatment T_2 *i.e.* propargite 57 EC @ 0.1% (0.13 mite per leaf) and was found superior over rest of the treatments. However, it was followed by treatment T_3 *i.e.* profenofos 50 EC @ 0.05% (3.75 mites per leaf), however, maximum spider mite population was noticed in case of control (39.13 mites per leaf). Further, 14 days after the third spray, the similar trends were observed and the lowest spider mite population was recorded in treatment T_2 (Propargite 57 EC @ 0.1%) (0.13 mite per leaf), whereasspider mite population was maximum in case of control (39.25 mites per leaf). The maximum flower yield (548889.28 flowers/ha) was recorded in the treatment T_2 (Propargite 57 EC @ 0.1%), however the lowest flower yield was recorded from the untreated control (255755.42 flowers/ha). The present study was comparable with Tomar and Singh (2011) who reported that application of propargite 57% EC @ 1000 ml./ha was significantly more effective in reducing *T. urticae* population and also obtaining higher fruit yield of okra. Further, the results on the reduction in spider mite population in the present studies are also in agreement to those of Shah and Shukla (2014) and Pokle and Shukla (2015) who also found propargite 57EC (0.05%) to be effective in controlling the spider mite, *T. urticae* infesting gerbera and tomato in polyhouse at Navsari, south Gujarat.

Economics : The economics of different treatments were calculated by considering the profit increase over the control of various treatments (Table 5). The treatment T_2 *i.e.* propargite 57 EC@0.1% registered higher net income (Rs. 53214.29) and BCR (1:16.89) (Table 5) and was followed by another treatment T_4 (Trizophos 40 EC@0.08%) (Rs.21180.71 and BCR 1:9.34). It was least in case of T_6 (Neem Oil) (Rs. 3281.53 and BCR 1:0.88). In past, Shah and Shukla (2014) and Pokle and Shukla (2015) obtained higher net return and BCR when applied propargite (0.05%) to control *T. urticae* infesting gerbera and tomato in polyhouse and closely support the present findings.

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