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Management of two-spotted spider mite, *Tetranychus Urticae* koch infesting gerbera with biopesticides and predatory mite

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ABSTRACT

Among various flowers, gerbera holds a prominent place and a good market in India, but it can be attacked by the two-spotted spider mite, Tetranychus urticae Koch. Indiscriminate use of pesticides has led to the development of resistance in this spider mite species, affected human health and also caused environmental pollution. For safer and more cost-effective and environmentally friendly alternative approaches for the management of this pest is desirable. Different combinations of chemical pesticides, plant products, entomopathogenic fungi, and predatory mite, Neoseiulus longispinosus were tested for four years (2017-2020). The results showed that the ctreatment combination of propargite (0.05%) + propargite (0.05%) + propargite (0.05%) was found most effective against spider mite, T. urticae and were followed by the treatment combination of neem oil (0.5%) + neem oil (0.5%) + release of 20 gravid females of predatory mite, N. longispinosus.

Keywords: *Gerbera, spider mite, plant products, entomopathogenic fungi, predatory mite, Neoseiulus longispinosus (Evans)*

INTRODUCTION

Gerbera (*Gerbera jamesonii*) ranks fifth in the world trade among the top ten cut flowers suitable for both export and domestic purposes. More than 20 species of arthropods are known to cause economic injury to gerbera and the two-spotted mite, *Tetranychus urticae* Koch is considered a key pest. The spider mite generally feeds 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 mite spread to all parts of the plants as the population increases especially during the day period and produces webbing over the entire plants. Moderate population may greatly affect crop production and heavy infestation results in death of the plants [1]. The spider mite remains active throughout the year in protected cultivation and causes damage to the high-value crops including gerbera. Indiscriminate use of pesticides has led to the development of resistance in spider mites to pesticides, affects human health, and caused environmental pollution. To avoid long-term adverse effects of these chemicals, the determination of safer and more cost-effective, and eco-friendly alternative approaches for the management of this pest is desirable. One of the best available options to be exploited is the use of botanicals or entomopathogenic fungi as such or in combination with natural enemies. These are pathogenic or repellent or lethal to the spider mite. The present investigation was carried out to know the possibilities to use of combinations of entomopathogenic fungi, botanicals, and predatory mite in the management of two-spotted spider mites, *T. urticae* infesting gerbera in protected cultivation.

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MATERIALS AND METHODS

The experiment was conducted during the year 2017-18 to 2020-21 under protected cultivation (polyhouse) on Gerbera cv Stenza. Different treatment combinations were imposed after the sufficient build-up of the spider mite population on gerbera. Each treatment combination was applied 15 days after the application of the first one. Immediately before the application of each treatment, the density of mobile stages (nymphs and adults) of spider mites was recorded on five randomly selected leaves from five plants of each treatment combination. The gerbera leaves were taken to the laboratory, where the mobile stages of spider mites were counted under the stereo-binocular microscope. Post-treatment count of mobile stages of spider mites and predatory mite was recorded at 1, 3, 7, and 14 days after application of each treatment component. The stock culture of the predatory mite, *N. longispinosus*, was maintained on potted Frenchbean plants under polyhouse conditions. The observations on marketable flower yield were also recorded.

RESULTS AND DISCUSSION

The pooled over data of four years were presented in Table 2. Before the application of the first combination, the population of spider mites was non-significant. After the application of the treatment combinations, spider mite population was lowest in treatment comprising spraying of propargite (0.5%). 3 days after application the spider mite population was lower *i.e.* 35.27 mites/leaf in spraying propargite (0.5%) and it was followed by the treatment which comprises of the first spray of neem oil (0.5%). 7 days after application, the treatment comprises of first spray of propargite (0.5%) and was found effective with lower spider mite population, however, it was closely followed by the treatment having the first spray of neem oil (05%) (113.14 mites/leaf). After 14 days of imposing the treatments, the spider mite population was lowest in the treatment having propargite

(0.5%) (93.75 mites/leaf) and was followed by the first spray of neem oil (0.5%) (96.72 mites/leaf). In application of second round of treatment combinations, the spider mite population was lowest (89.59 mites/leaf) in the treatment of propargite (0.5%) and it was followed by the treatment having second spray of neem oil (0.5%) (94.30 mites/leaf) after one day of spray. After three days, the spider mite population was lowest in the treatment comprises of propargite (0.5%) (75.77 mites/leaf) and was followed by the treatment of neem oil (0.5%) (80.14 mites/leaf). Likewise, seven days after imposing the second round of treatments, the spider mite population was lowest in the treatment of propargite (0.05%) (51.89 mites/leaf) and was followed by another treatment of neem oil (0.5%) (57.33 mites/leaf), however the spider mite population was maximum in case of control (157.19 mites/leaf). Similar trends were noticed 14 days after the application of second round of all the treatments. In third round of application of various treatments, the spider mite population was highest (152.58 mites/leaf) in control, whereas lowest population were noticed in the treatment of propargite (0.05%) (19.25 mites/leaf) and was followed by the treatment having release of 20 gravid females of predatory mite, *N. longispinosus* (22.83 mites/leaf) after first day. Similar trends were noticed after third and seventh days after application of various treatment combinations. Fourteen days after the third application, the spider mite population was lowest (3.52 mites/leaf) in the treatment comprises of propargite (0.05%) and it was followed by the treatment combination having the release of gravid female of predatory mite, *N. longispinosus* (4.48 mites/leaf). The pooled over data of four years were presented in the Table 2 showed that the treatment combination propargite (0.05%) + propargite (0.05%) + propargite (0.05%) was found most effective with maximum (69.77 flowers) number of flowers and was followed by the treatment combination comprises of neem oil (0.5%) + neem oil (0.5%) + release of 20 gravid females of predatory mite, *N. longispinosus* (66.00 flowers). The lowest number of flowers were obtained in the untreated control (29.65 flowers). On the basis of the present study, it can be concluded that significantly lower incidence of mite, *T. urticae* with higher flower yield was recorded in treatment combination of propargite 57% EC (0.5%) + propargite 57% EC (0.5%) + propargite 57% EC (0.5%) which were at par with treatment combination of neem oil (0.5%) + neem oil (0.5%) + release of predatory mite, *N. longispinosus* @ 20 gravid female/plant. The best results were obtained by three subsequent weekly releases of *N. longispinosus* and three subsequent applications of chemical pesticide profenofos. These results show the potential of this predatory mite as a control agent of two spotted spider mite on carnation under protected conditions [2]. Neem-based various products like econeem has been reported to reduce the fecundity and hatchability of eggs of *T. urticae* on capsicum crop [3]. Natural infection of that mite by *L. lecanii* complex has been mentioned in the literature [4]. Experimental reduction of the population of that pest mite was observed under glasshouse conditions. Thus, the results obtained in this study with these organisms warrant further investigations on their possible use as new alternatives for the control of *T. urticae* [5]. The predatory mite, *N longispinosus* was found as effective as the pesticide profenofos for the control of *T. urticae*. This predator was described from Indonesia and was first reported in India and other Asian countries quite a long time ago, although more recently it has been reported from other tropical and subtropical countries [6]. In India, it has been observed to Tetranychus species on apple and fig trees [7]. The predatory mite, *N longispinosus* reported to prey on *T. urticae* on 33 plant species, including ornamentals, in Thailand [8] and the comparative biology, reproductive compatability and geographial distribution of predatory mite, *N longispinosus* was studied [9]. The results of the present research showed that if *N. longispinosus* is released alone or in combinations of entomopathogenic fungi or neem oil at a density of 20 predatory mites per plant at the initial stages of pest buildup, it can effectively control two-spotted spider mite, *T. urticae* and reduce the pesticide pressure in the crop ecosystem.

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CONFLICT OF INTEREST
The authors declare that there are no conflicts of interest.

Table 1. Detail of the treatments

Treatment	I Application	II Application	III Application
T_1	Neem oil (0.5%)	Neem oil (0.5%)	Predatory mite (release 20 gravid female)
T_2	*L. lecanii* (1x10^{9}cfu/ml)	Neem oil (0.5%)	Predatory mite (release 20 gravid females)
T_3	Predatory mite (release 20 gravid female)	Predatory mite (release 20 gravid females)	Predatory mite (release 20 gravid females)
T_4	*L. lecanii*(1x10^{9}cfu/ml)	*L. lecanii*(1x10^{9}cfu/ml)	Predatory mite (release 20 gravid females)
T_5	Propargite 57EC (0.5%)	Propargite 57EC (0.5%)	Propargite 57EC (0.5%)
T_6	*L. lecanii*(1x10^{9}cfu/ml)	Neem oil (0.5%)	*L. lecanii*(1x10^{9}cfu/ml
T_7	Control	Control	Control

Table 2. Effect of different treatment combinations on two spotted spider mite, T. urticae on gerbera (Pooled over of four years)

Treatment	I Application					II Application				III Application				Overall pooled	Flower yield (Nos.)
	BS	1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS		
T_1	12.72 (162.09)	11.93 (142.38)	11.69 (136.47)	10.62 (113.14)	9.82 (96.72)	9.68 (94.30)	8.88 (80.14)	7.48 (57.33)	5.89 (35.20)	4.75 (22.83)	3.94 (15.77)	3.43 (12.75)	2.12 (4.48)	8.22 (67.67)	66.00
T_2	12.75 (163.02)	12.66 (160.66)	12.25 (150.13)	11.51 (132.97)	10.80 (116.89)	10.60 (112.94)	10.03 (101.50)	8.89 (80.14)	7.63 (59.38)	6.86 (47.73)	5.91 (35.70)	4.85 (24.52)	3.62 (14.33)	9.27 (86.36)	56.93
T_3	12.73 (162.42)	12.47 (155.70)	12.24 (149.83)	11.26 (127.00)	10.59 (112.39)	10.24 (105.42)	9.67 (94.13)	8.48 (73.05)	6.82 (46.91)	5.79 (33.91)	4.84 (24.09)	4.07 (17.78)	2.74 (7.75)	8.88 (79.00)	59.12
T_4	12.79 (163.94)	12.82 (164.31)	12.56 (157.83)	12.00 (144.47)	11.51 (133.13)	11.38 (130.25)	10.92 (120.63)	9.38 (89.75)	8.33 (70.70)	7.59 (58.75)	6.74 (46.56)	5.61 (32.95)	4.45 (21.33)	9.85 (97.55)	48.03
T_5	12.54 (157.42)	11.81 (139.64)	11.63 (135.27)	10.48 (110.14)	9.65 (93.75)	9.42 (89.59)	8.59 (75.77)	7.08 (51.89)	5.43 (30.28)	4.37 (19.25)	3.64 (13.38)	3.16 (10.75)	1.92 (3.52)	7.94 (63.15)	69.77
T_6	12.77 (163.56)	12.77 (163.30)	12.39 (153.64)	11.62 (135.66)	10.96 (120.58)	10.77 (116.73)	10.20 (104.81)	9.15 (85.08)	7.98 (64.77)	7.19 (52.31)	6.15 (38.56)	5.10 (26.75)	3.92 (16.81)	9.46 (89.92)	50.67
T_7	12.82 (164.75)	12.98 (168.56)	13.08 (171.00)	13.01 (169.69)	12.93 (167.81)	12.98 (168.70)	12.71 (161.80)	12.54 (157.19)	12.44 (154.63)	12.35 (152.58)	12.32 (151.69)	11.97 (143.19)	11.79 (138.72)	12.61 (158.80)	29.65
SEm ± (T)	0.120	0.082	0.083	0.102	0.129	0.094	0.165	0.262	0.248	0.257	0.221	0.209	0.291	0.096	1.068
YXT	0.241	0.164	0.167	0.205	0.258	0.187	0.201	0.229	0.224	0.220	0.181	0.179	0.159	0.098	2.136
CD @ 5% (T)	NS	0.232	0.235	0.288	0.364	0.264	0.490	0.777	0.736	0.765	0.658	0.621	0.866	0.294	3.788
YXT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	3.78	2.63	2.72	3.56	4.74	3.49	3.96	5.09	5.75	6.29	5.81	6.55	7.30	2.08	7.86

**Figures in the parentheses are original value, whereas those out side are $\sqrt{x+0.5}$ transformed values, DAS: Days after Spray*

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