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Residual Toxicity of Acaricides Against Two Spotted Spider Mite (*Tetranychus urticae* Koch) Infesting Okra

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ABSTRACT

The residual toxicity of various acaricides against T. urticae under the field conditions at recommended doses on okra crop ranges from 6.99 days (fenpropathrin 10 EC @30 g a.i./ha) to 19.65 days (spiromesifen 240 SC @100 g a.i./ha). The descending order of relative residual toxicity (RRT) was spiromesifen (19.65 days) > propargite (18.03 days) > fenpyroximate (17.57 days) > fenazaquin (17.12 days) > chlorfenapyr (16.02 days) > hexythiazox (14.11 days) > buprofezin (13.50 days) > diafenthiuron (12.56 days) > fenpropathrin (6.99 days).

Keywords: *Residual toxicity, acaricides, spider mite, Lt50*

INTRODUCTION

Okra, Abelmoschus esculentus L. is a member of the Malvaceae family. It is an important vegetable crop cultivated in most parts of the world. Okra is one of the world's oldest cultivated crops. The first reference to okra as a vegetable was recorded by the Egyptians in 1216 A.D. [1]. It originated in tropical Africa and was also grown in the Mediterranean region and its wild forms are found in India. It is now grown in all parts of the tropics and during the summer in the warmer parts of the temperate region [2]. Its tender green fruits are used as a vegetable and are generally marketed in the fresh state, but one times in the canned or dehydrated form [3]. Okra crop is infested by numerous insect pests and mites [4]. Sucking pests in the early stage and the fruit borers in the later stage causes extensive damage to fruits and results in 69 per-cent yield loss [5 and 6]. Mites belong to the subclass Acari and are among the most diverse and successful of all the invertebrate groups. They have exploited an incredible array of habitats. Some of the plant pests include the spider mites (family Tetranychidae), thread-footed mites (family Tarsonemidae), and the gall mites of the family Eriophyidae [7]. Plants can be infested with the mite pest with no visible symptoms. Once the damage is evident, it is too late because the mites are already established within the plant tissue. However, insecticides and acaricides are effective in reducing crop damage during periods of pest outbreaks. Considering the importance of plant mites, especially the two-spotted spider mite, Tetranychus urticae Koch, which is polyphagous and causes serious damage to okra, the present study was carried out to know the residual toxicity of various acaricides used against the spider mite.

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MATERIALS AND METHODS

The present studies carried out to know the residual toxicity of some acaricides against two-spotted spider mite, *T. urticae* infesting okra was carried out under the laboratory of the Department of Entomology, as well as at College farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during summer 2022. The methods followed are presented hereunder.

Maintenance of mite culture: Spider mite-infested leaves from the field were brought to the Acarology laboratory. They would be identified by using the keys [8]. Thirty mating pairs of mites were released separately on okra leaf bits measuring 2cm x 2cm kept on moist cotton wads in Petri plates and were allowed to lay eggs and colonize for 10 to 15 days. The leaf bits were maintained in turgid condition and changed periodically. It was considered starter culture and individuals obtained were released on potted okra plants in a polyhouse. Thus, the culture of *T. urticae* maintained would be used for further experiments. The spider mite culture maintained on a potted okra plant (variety-Gujarat Anand Okra-5) in the polyhouse was used for bioassay studies to determine the relative toxicity of acaricides to eggs and adult females.

Experimental details: The okra (variety-Gujarat anand okra-5) was raised in the plots of 2.25m x 1.35m with a spacing of 45cm x 30cm. There were a total of ten treatments- including control (water spray). The experiment was laid out in a randomized block design with three replications. To assess the residual toxicity of acaricides against spider mite, *T. urticae*, 3-4 weeks old okra plants were given a uniform spray with acaricide treatments separately with the recommended dose using a knapsack sprayer. After spraying, every alternate day starting from zero-day (four to six hours after application), leaf bits measuring 4cm x 4cm were prepared from treated okra leaves and kept on a moist cotton wad in a Petri plate. Thirty adult female mites released on each leaf bit served as one repetition. Mites released similarly on untreated leaf bits were considered as control. The mortality of the mites would be recorded at 24

hour intervals and up to 72 hours in all the treatments including control. The leaf samples were drawn from treated plants on 0 (4-6 hrs.), 2, 4, 6, 8, 10, 12, 14,16 and 20 days, till the mortality records reached below 10 per-cent. The mortality observed in control was used to correct the mortality records in different treatments using Abbott's formula [9]. The corrected mortalities were subjected to Probit analysis [10] to calculate the median lethal time (LT50) values. Based on LT50 values, the residual toxicity of different acaricides was determined. The acaricides used and their concentrations/dosages are as: Buprofezin 25 EC 150 ml a.i./ha, Chlorfenapyr 10 EC 75 a.i./ha, Diafenthiuron 50 WP 300g a.i./ha, Fenazaquin 10 EC 125 ml a.i./ha, Fenpropathrin 10 EC 30 ml a.i./ha, Fenpyroximate 5 EC 30 ml a.i./ha, Hexythiazox 5.45 EC 25 ml a.i./ha, Spiromesifen 240 SC 100 ml a.i./ha, Propargite 57 EC 570 ml a.i./ha, and control (water spray).

RESULTS AND DISCUSSION

The residual toxicity of various acaricides was assessed against two-spotted spider mite at the corresponding field-recommended doses. Adult females were released on field-treated okra leaves at an interval of 2 days and per-cent mortality observed up to 72h was recorded. The mortality data for different intervals (*i.e.,* 2 days, 4 days, 6…) are shown in Table 1. The mortality data were subjected to probit analysis to determine LT50 values, presented in Table 2. The residual toxicity of different acaricides ranged from 6.99 days (fenpropathrin) to 19.65 days (spiromesifen). On the same day of application *i.e.,* zero days, all the compounds caused a cent per-cent mortality of adults within 4-6 h after application (on 0 day). The residual toxicity of different acaricides ascertained by median lethal time (LT50) is shown in Table 1. Reduction in toxicity over time (days) was gradual with almost all the acaricides. The residual toxicity of different acaricides as evidenced by their LT50 values is in the order of spiromesifen (19.65 days) > propargite (18.03 days) > fenpyroximate(17.57 days) > fenazaquin (17.12 days) > chlorfenapyr (16.02 days) > hexythiazox (14.11 days) > buprofezin (13.50 days) > diafenthiuron (12.56 days) > fenpropathrin (6.99 days). Spiromesifen treated okra leaves remained toxic to *T. urticae* adults for a longer period of time *i.e.,* for 20 days followed by propargite, fenpyroximate fenazaquin, and chlorfenapyr which were found toxic for 16 to 18 days. Hexythiazox, buprofezin and diafenthiuron were toxic for 12 to 14 days, while fenpropathrin application remained toxic for less than 7 days. The overall residual toxicity data revealed that most of the acaricides *viz.,* spiromesifen, propargite, fenazaquin, chlorfenapyr, hexythiazox, buprofezin and diafenthiuron offered good protection against *T. urticae* adults for at least 12 days and up to 20 days compared to fenpropathrin, less than 7 days. In an investigation, spiromesifen was found significantly more effective against both the nymphs (89 to 99.2%) and adult (37.3 to 87.9%) stages of spider mite than other acaricides [11]. In the present study more or less similar results were obtained and spiromesifen showed its superiority over other available acaricides. Further, propargite @0.17 and 0.11 per cent was found effective against *T. cinnabarinus* under field conditions on okra [12]. Fenazaquin was found effective in reducing spider mite population on okra [13] as well as in cucumber [14]. The chlorfenapyr was found very effective against coconut mite [15]. A low level of mortality of *T. urticae* infesting marigold was recorded in the treatment comprises of buprofezin (0.03%) and diafenthiuron (0.055%) [16]. All these earlier findings on residual or persistent toxicity of different acaricides against various mite species are closely in accordance with the present investigation.

Table 1. Mortality response of T. urticae adult females to acaricides at different intervals after treatment on okra crop

Acaricides	Per cent mortality after									
	4-6 hour	2 days	4 days	6 days	8 days	10 days	12 days	14 days	16 days	20 days
Buprofezin 25 EC	100	95	85	82	80	72	60	46	30	29
Chlorfenapyr 10 EC	100	93	84	80	74	69	60	57	47	35
Diafenthiuron 50 WP	100	99	94	85	66	63	60	47	32	0
Fenazaquin 10 EC	100	97	90	82	74	71	69	64	49	36
Fenpropathrin 10 EC	100	98	70	58	48	35	28	22	0	0
Fenpyroximate 5 EC	100	98	97	96	88	75	70	65	58	37
Hexythiazox 5.45 EC	100	99	88	86	83	69	57	52	33	0
Spiromesifen 240 SC	100	98	97	94	91	83	80	76	59	33
Propargite 57 EC	100	100	91	84	80	79	75	65	55	30

Table 2: Residual toxicity of acaricides to T. urticae adult females on okra

Acaricides	LT_{50} (DAYS)	Fiducial limit	Regression equation	Order of RRT basedon LT50	P	T	PT	Order of RRT based on PT Values
Buprofezin 25EC	13.50	10.01-18.18	y = -2.2172x +7.5035	7	20	67.90	1358	6
Chlorfenapyr10 EC	16.02	11.08-23.15	y = -1.7526x +7.1103	5	20	69.90	1398	5
Diafenthiuron50 WP	12.56	9.92-15.91	y = -3.097x + 8.405	8	16	71.77	1148.32	8
Fenazaquin 10EC	17.12	12.38-23.68	y = -2.0584x + 7.54	4	20	73.20	1464	4
Fenpropathrin10 EC	6.99	5.17-9.44	y = -2.4212x +7.0455	9	14	57.37	803.18	9

Fenpyroximate 5 EC	17.57	14.00-22.06	y = -3.2436x +9.0317	3	20	78.40	1568	2
Hexythiazox 5.45 EC	14.11	10.72-18.58	y = -2.6412x +8.0316	6	16	74.11	1185.76	7
Spiromesifen240 SC	19.65	15.37-25.12	y = -3.0558x +8.9443	1	20	81.10	1622	1
Propargite 57EC	18.03	13.34-24.37	y = -2.2986x +7.8831	2	20	75.90	1518	3

LT_{50}= Median Lethal Time; P= Period of persistent toxicity; T= Average residual toxicity; RRT= Relative residual toxicity

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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