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# BASELINE SUSCEPTIBILITY OF RED SPIDER MITE *TETRANYCHUS URTICAE* KOCH ON TOMATO TO SELECTED ACARICIDES

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## ABSTRACT

**This study was conducted to establish the baseline susceptibility data for *Tetranychus urticae* Koch, successfully maintained under laboratory conditions without exposure to acaricides. The leaf dip method of bioassay was used to establish the baseline susceptibility. Toxicity (LC50 value) varied across the major acaricides i.e., chlorfenapyr 10SC, propargite 57EC, fenazaquin 10EC, abamectin 3EC, spiromesifen 22.9SC and dicofol 18.5EC. Maximum toxicity was recorded for fenazaquin10EC (0.08 ppm), followed by propargite 57EC, and the lowest was recorded with chlorfenapyr 10 SC (0.16 ppm). The $LC_{50}$ values for all acaricides tested were lower than concentrations used as recommended field doses. This baseline data might be useful in monitoring and in the management of acaricide resistance in *T. urticae*.**

**Key words:** Acaricides, bioassay, $LC_{50}$, baseline, susceptibility, *Tetranychus urticae*, mortality, fiducial limit, mulberry leaves, resistance, fenazaquin, propargite, chlorfenapyr

In recent years, mites have become serious pests and are gaining importance owing to their devastating nature and severe damage potential. Globally more than 1,200 species of spider mites have been identified (Bolland et al*.,* 1998; Migeon et al., 2010). Among them, the red spider mite, *T. urticae* Koch, is a predominant one and causes considerable damage to crops, particularly tomato, cowpea, french bean, okra, and brinjal (Singh and Raghuraman, 2011). These mites cause a significant yield loss of 26.94 to 64.93 per cent in solanaceous crops (Shukla et al., 2017). The control of red spider mites is usually accomplished by the application of acaricides (Roy, 2019). Although many non-chemical control tactics are available, farmers still rely on chemical pesticides to manage pests (Veres, 2020). The indiscriminate use of fertilizers, monocropping, and the application of synthetic pesticides have generated favourable conditions that allowed *T. urticae* populations to multiply and cause epidemics in agricultural systems (Ramasubramanian*,* 2005, Leeuwen et al*.,* 2010). Acaricide resistance in phytophagous mites is on the rise, particularly in *T. urticae*, which have a high potential for rapid resistance evolution (Badieinia, 2020). Furthermore, their high rate of multiplication, short life cycle, polyphagous nature, and high dispersal contribute to the quick resistance development (Kumar and Manmeet, 2018).

The widespread and indiscriminate use of acaricides to control *T. urticae* has resulted in the emergence of resistant populations in over 40 countries (Georghiou and Tejeda, 1991) and resistance to at least 95 different acaricides. More than 600 species of insects and mites have developed resistance to at least one class of insecticides /acaricides (Sparks et al., 2020). Chemical insecticides used to control red spider mites in modern agriculture are becoming ineffective and expensive due to the rapid development of resistance to most pesticides (Kumar, 2011). Moreover, baseline data on the toxicity of acaricides would greatly help in understanding the potentiality of the mite species to develop resistance to acaricides, which is the reference values for all comparisons and assessment of intensities of resistance (Sharma, 2018). Baseline data determined in the current study is the highest susceptibility level of *T. urticae* to a target acaricide when it is fully devoid selection pressure and is suggested to use it for determining the level or extent of resistance to an acaricide (Noor and Srinivasa, 2020). Because of this, the present investigation has been planned and designed to determine the susceptibility of red spider mites to selected acaricides.

## MATERIALS AND METHODS

The present investigations on the establishment of baseline susceptibility of red spider mite, *Tetranychus urticae* Koch, to selected acaricides were carried out in the Department of Entomology, College of Horticulture, University of Horticultural Sciences, GKVK campus, Bengaluru, Karnataka during 2020-21 (12°.58' N and 77°.38' E). The susceptible laboratory culture (171st generation) of two-spotted spider mite, *T. urticae* was collected from the All India Network Project (AINP) on Agriculture Acarology, Department of Entomology, UAS, GKVK, Bengaluru and maintained on mulberry leaves under laboratory condition at ambient room temperature 27± 2°C and 75± 5% relative humidity without exposure to any acaricides.The median lethal concentration ($LC_{50}$) values determined for the susceptible laboratory culture of *T. urticae* served as the baseline values. The leaf dip bioassay method was adapted to determine the baseline susceptible values as recommended by the Insecticide Resistance Action Committee (IRAC) (Roy et al., 2010). Before fixing the concentration for bioassay, preliminary bioassay (bracketing assay method) was performed to fix the concentrations of each acaricide, giving 10 to 90 per cent mite mortality.

The collected colonies were reared on detached fresh mulberry leaves, placed on wet polyethylene foam, and kept in a plastic tray in the laboratory to get a sufficient population (F1 or F2 generation) for bioassay. The leaf dip bioassay method was adapted to test the toxicity of six acaricides against red spider mites namely propargite, spiromesifen, fenazaquin, abamectin, chlorfenapyr, and dicofol. After conducting the preliminary bioassay resulting in 10 to 90% mortality, the actual dose of seven concentrations was fixed for further experimentation. For conducting the leaf dip bioassay, fresh mulberry (*Morus alba* L.) leaves of uniform size and age were cut into 4 cm diameter discs. Each leaf disc was dipped in appropriate acaricide concentration for 10-15 seconds and were placed ventral surface down, individually on a water-saturated cotton pad (9 x 9 cm) in the petri plates (10 cm diameter x 1.5 cm height). Thirty *T. urticae* adults were transferred to each treated leaf disc with a fine camel hair brush. Three replications were maintained and the leaf disc treated with water was used as control. Observations on mite mortality were recorded at 24 h, 48 h, and 72 h after treatment by using a stereo-binocular microscope and fine camel hair brush. The data recorded on mortality were subjected to probit analysis (Finney, 1971) using SPSS v.16 software after correcting the mortality in control by following the Abbott formula (Abbott, 1925). During the observation, mites that were alive but could not move when softly probed with a delicate hair brush were considered as moribund or dead.

## RESULTS AND DISCUSSION

To generate baseline susceptibility data (LC50 values), six acaricides were tested with three replications against the susceptible laboratory population of red spider mites, *T. urticae*. Based on the LC50 values obtained by the leaf dip method against red spider mites, *T. urticae* proved to be highly susceptible to fenazaquin 10 EC with an LC50 value of 0.08 ppm. Fenazaquin 10 EC showed a non-significant difference with overlapping fiducial limits (0.070-0.180 ppm). Noor and Srinivasa (2019), found an LC50 value of 0.23 ppm for Fenazaquin 10 EC during the 60th generation and the $LC_{50}$ of 0.22 ppm against susceptible laboratory population at 91st generation on tomato crop (Noor and Srinivasa, 2020; Mohin et al., 2021). The susceptibility of red spider mite population to propargite 57 EC, (0.094 ppm) was next to Fenazaquin 10 EC. There was no significant difference between six acaricides (0.080-0.180 ppm) with overlapping fiducial limits. Mohin et al. (2021) reported higher toxicity of propargite 57 EC against *T. urticae* with an $LC_{50}$ value of 0.20 ppm and Kaur and Bhullar (2019) reported the lowest $LC_{50}$ value of 0.002 ppm against the susceptible population of *T. urticae* to propargite 57 EC from Punjab. The increased susceptibility of the susceptible laboratory population might be due to increased generations in the laboratory without exposure to acaricides.

The $LC_{50}$ value for spiromesifen was 0.098 ppm, agreeing with of Mohin et al. (2021). Based on the $LC_{50}$ value, there was a significant difference between fenazaquin 10EC, propargite 57EC, and spiromesifen 22.9SC (0.070-0.100 ppm) with non-overlapping limits, and a non-significant difference was noticed for chlorfenapyr 10SC (0.130-0.180 ppm) with overlapping fiducial limits. Sridhar and Rani (2003) reported the susceptibility of *T. urticae* to dicofol in both open and greenhouse populations on roses with $LC_{50}$ values of 0.040 and 0.019%, respectively. Similarly, the $LC_{50}$ values of 0.97 ppm were reported abamectin (Patil et al., 2019). For chlorfenapyr 10SC against the red spider mite susceptible population was found to be the

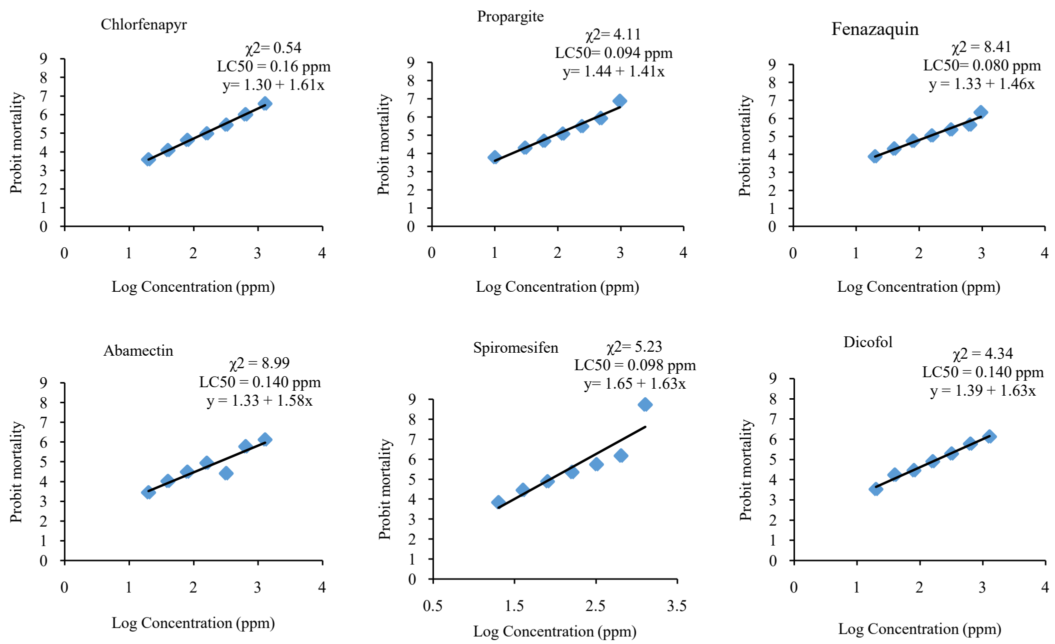


*Table $\chi^2$ (df=5) value at 5% level of significance =11.07

Fig. 1. Regression lines showing the log concentration - probit mortality response of *T. urticae* to selected acaricides

least with an $LC_{50}$ value of 0.160 ppm. A significant difference was noticed for fenazaquin 10EC, propargite 57EC, and spiromesifen 22.9SC (0.070-0.120 ppm) (Mohin et al., 2021) and 0.15 ppm was recorded against *T. urticae* (Naveena et al., 2019) reported the least susceptible value with the $LC_{50}$ value of 0.42 and 0.15 ppm against *T. urticae* in Chikkamagaluru and Coimbatore region. Beers et al. (1998) concluded that the key factor driving acaricideresistance management is the availability of effective baseline susceptibility data. The establishment of baseline values ($LC_{50}$ or $LC_{90}$) as a reference against the acaricide before its widespread use may be helpful for effective monitoring and understanding of the changes in its susceptibility over a period of time and can provide an opportunity to monitor the resistance before the instances of field failures. Baseline values estimated in the present study revealed susceptibility level of *T. urticae* when completely deprived of acaricide selection pressure.The susceptibility (LC50) varied from 0.08 to 0.16 ppm, which epitomizes two fold variation in toxicity between the six acaricides against the susceptible population.

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**AUTHOR CONTRIBUTION STATEMENT**

No authors contribution statement.

**CONFLICT OF INTEREST**

No conflict of interest.

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