Biological Forum – An International Journal **14(4): 977-979(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Determination of Baseline Values for Susceptibility of *Polyphagotarsonemus latus* (Tarsonemidae: Acari) to Acaricides

Neenu Augustine[1*], M. Mohan[2], N. Srinivasa[3], T. Venkatesan[4], A. Mohan Rao[5] and P.S. Benherlal[6]

[1]Ph.D. Scholar, Department of Agricultural Entomology,
College of Agriculture, University of Agricultural Sciences, Bangalore (UASB) (Karnataka), India.
[2]Principal Scientist, Division of Genomic Resources,
ICAR-National Bureau of Agricultural Sciences (NBAIR), Bangalore (Karnataka), India.
[3]Retired Professor, Department of Agricultural Entomology,
College of Agriculture, University of Agricultural Sciences, Bangalore (UASB) (Karnataka), India.
[4]Principal Scientist, Division of Genomic Resources,
ICAR-National Bureau of Agricultural Sciences (NBAIR), Bangalore (Karnataka), India.
[5]Professor and Head, Department of Genetics and Plant Breeding,
College of Agriculture, University of Agricultural Sciences, Bangalore (UASB) (Karnataka), India.
[6]Assistant Professor, Department of Plant Biotechnology,
College of Agriculture, University of Agricultural Sciences, Bangalore (UASB) (Karnataka), India.

(Corresponding author: Neenu Augustine[*])
(Received 03 September 2022, Accepted 27 October, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The broad mite/yellow mite, *Polyphagotarsonemus latus* (Banks) is an important crop pest damaging several crops including chilli, capsicum, mulberry, jute, tea, sesame, cotton, etc. In India, farmers experience frequent control failures of this mite with several recommended acaricides for which development of acaricide resistance is assumed as the major reason. In order to monitor acaricide resistance in field populations, the availability of a population that is completely susceptible is crucial. To achieve this, an iso-female colony of *P. latus* was maintained under nethouse conditions for more than 70 generations without exposure to any xenobiotics and leaf dip bioassays were conducted using diafenthiuron, dicofol, propargite and spiromesifen. The LC50 values determined were 0.40 ppm for diafenthiuron, 0.70 ppm for dicofol, 0.37 ppm for propargite and 0.58 ppm for spiromesifen. This is the first report of baseline toxicity data of commonly used acaricidal compounds to *P. latus* which can serve as reference data in monitoring acaricide resistance in field populations.

Keywords: Broad mite, *Polyphagotarsonemus latus*, acaricide, resistance, susceptibility.

INTRODUCTION

Plant-feeding mites have emerged as global pests due to several factors, including climate change, the ability to quickly expand their host base, the development of acaricide resistance, the removal of broad-spectrum pesticides from the market and/or a combination of these factors (Van Leeuwen *et al*., 2015). In particular, mite species from the family Tarsonemidae are potentially significant since they can seriously damage a variety of host plants economically. One of the most harmful of these is the broad mite/yellow mite, *Polyphagotarsonemus latus* (Banks). They are reported to damage plant species in over 57 families including potato, chilli, sweet pepper, tomato, mulberry, eggplant, beans, melons, celery, cotton, pear, guava, passion fruit, ornamentals and numerous wild plants (Gerson, 1992).

The larvae and adults suck the sap from young foliage and growing tips causing a variety of symptoms on different hosts (Gerson, 1992). In general, the newest growth is heavily damaged and plant growth is inhibited. The typical symptoms noticed on chilli and capsicum are bronzing, crinkling and downward curling of leaves giving an inverted boat-shaped appearance, elongation of the, crumpled apical shoot, development of abnormal side shoots, thickening of leaves and stunted growth (Cho *et al.,* 1996). The internodes of affected jute shoots become shortened and abnormal side branches develop (Kabir, 1979). On mulberry, the infested leaves become rough and brittle, lose their healthy green color and looks corky in appearance (Arunkumar & Srinivasa 2021).

Farmers in India use chemical control with synthetic acaricides as the most important management technique, especially in crops like chilli, capsicum, mulberry, jute, tea, sesame, cotton, etc. But frequent chemical applications throughout the growing season foster the perfect environment for the emergence of acaricide resistance. The availability of a population that is entirely susceptible to acaricides is particularly crucial as it can serve as baseline susceptibility data for bioassays and comparisons with field populations (Kwon *et al.,* 2011). In order to serve this purpose, a study was conducted to establish an acaricide-susceptible colony of *P. latus* and to determine the baseline susceptibility by dose-mortality bioassays.

MATERIAL AND METHODS

A colony of *P. latus* initially collected from capsicum from Ramnagara district in Karnataka during July 2020 was maintained on potted mulberry plants in a net house under caged conditions at ICAR-National Bureau of Agricultural Insect Resources. The iso-female colony derived from this population (NBAIR-GR-TAR-01a) was maintained for more than 70 generations without exposure to any xenobiotics. Commercial formulations of four acaricides, namely diafenthiuron, dicofol, propargite and spiromesifen were procured from local retailers (Table 1).

Leaf dip bioassays were conducted at 70^{th} generation(F_{70})using adult female mites. A minimum of five required concentrations were serially diluted from acaricide stock solutions. Fresh mulberry leaf discs were dipped for 30 seconds in each test chemical solution and left for air drying at room temperature. To keep the leaf discs turgid and prevent mite escape, the leaf discs were placed on wet cotton wads in Petri plates that were kept moist. Thirty adult female mites were carefully put onto each leaf disc and kept in a BOD incubator that was set to a temperature of 25 ± 1 and relative humidity of 65 ± 10%.

Each concentration and the respective control treatments were replicated thrice and observations on mortality were documented after 24 hours of acaricide treatment. Each concentration was given three replications and corresponding control treatments. Mites that did not move when touched with a fine brush were considered dead. The median lethal concentrations (LC_{50}) and their 95 percent fiducial limits were determined by Probit analysis (Finney, 1971) using Polo Plus 2.0 software (LeOra software, 2002).

Table 1: Details of acaricides used in bioassays with *P. latus.*

Acaricide	Trade name	Chemical group	Manufacturer
Diafenthiuron	Pegasus® 50% WP	Thiourea compound	Syngenta India Ltd.
Dicofol	Hilfol® 18.5% EC	Organochlorine	Hindustan Insecticides Ltd.
Propargite	Omite® 57% EC	Sulfite ester	DhanukaAgritech Ltd.
Spiromesifen	Oberon® 22.9% SC	Tetronic acid derivative	Bayer CropScience Ltd.

RESULTS AND DISCUSSION

Controlling broad mites in different crops has been attempted with chemicals, host resistance, biocontrol agents such as predatory mites, fungi, bacteria and botanicals. However, due to little success in the utility of host plant resistance, biopesticides and biocontrol agents, chemical control with synthetic acaricides remains as the sole management strategy followed by farmers in India. However, the failure of acaricides to suppress *P. latus* has been widely reported by crop producers and consultants for which the development of acaricide resistance is suspected as one of the reasons. This situation calls for the determination of the baseline susceptibility to major acaricides in *P. latus*by establishing a susceptible population for reference.

The acaricide susceptibility levels of the susceptible population at 70^{th} generation are depicted in Table 2. Diafenthiuron is a thiourea acaricide that is commonly used to manage *P. latus* and other sucking pests in chilli and capsicum ecosystems. At the 70^{th} generation, the population was found to be highly susceptible to diafenthiuron with an LC_{50} of 0.40 ppm.The lower and upper fiducial limits were observed to be 0.339 and 0.465 ppm, respectively. Similarly, Mohin *et al.* (2020) reported high susceptibility to diafenthiuron in the spider mite, *Tetranychus urticae* after 128 generations of laboratory rearing with an LC_{50} value of 0.30 ppm. Naveena *et al*. (2022) calculated baseline LC_{50} values of the laboratory population of *T. urticae* at the 25^{th} generation and observed a very low LC_{50} fordiafenthiuron (0.22 ppm).

Dicofol is a conventional organochlorine miticide with an unknown mode of action. At the 70^{th} generation, the LC_{50} of 0.70 ppm was recorded for dicofol with the lower and upper fiducial limits of 0.585 and 0.832 ppm, respectively. In *T. urticae,* Khadri and Srinivasa (2020) observed an LC_{50} of 0.46 ppm for dicofol after 91 generations and Mohin *et al*. (2020) reported 0.30 ppm after 128 generations of laboratory rearing which are much lower values compared to the present study.

Propargite is a sulfite ester and has been used to control phytophagous mites for a long time. The LC_{50} recorded for propargite was 0.37 ppm with the lower and upper fiducial limits of 0.233 and 0.546 ppm, respectively. An LC_{50} value of 0.29 ppm for propargite was reported by Khadri and Srinivasa (2020), 0.20 ppm by Mohin *et al*. (2020); 0.91 ppm by Naveena *et al*. (2022) in *T. urticae* after 91, 128 and 25 generations of laboratory culturing without exposure to acaricides.

Table 2: Dose-responses of *P. latus* population to acaricides at F_{70}.

Sr. No.	Acaricide	LC_{50}(ppm)	95% fiducial limits (ppm)		Slope ± SEM	χ^2 (df)
			Lower	Upper		
1.	Diafenthiuron	0.40	0.339	0.465	2.02 ± 0.18	1.17 (3)
2.	Dicofol	0.70	0.585	0.832	1.92 ± 0.16	2.42 (3)
3.	Propargite	0.37	0.233	0.546	1.20 ± 0.13	4.95 (4)
4.	Spiromesifen	0.58	0.485	0.678	1.91 ± 0.18	0.60 (3)

LC_{50}- Median lethal concentrations, SEM- standard error of mean; χ^2-chi-square value, df- degrees of freedom

Spiromesifen is an insecticide-cum-acaricide belonging to the chemical class of spirocyclic phenyl-substituted tetronic acids. In the present study, the population was found to be highly susceptible to spiromesifen at the 70^{th} generation with an LC_{50} of 0.58 ppm. The lower fiducial limit was 0.485 ppm and the upper fiducial limit was 0.678 ppm, respectively. After the 91^{st} generation of laboratory culturing, Khadri and Srinivasa (2020) observed an LC_{50} of 0.92 ppm for spiromesifenin *T. urticae*. Similarly, Mohin *et al.* (2020); Naveena *et al.* (2022) reported 0.29 ppm and 2.00 ppm as the baseline susceptibility values in *T. urticae*.

CONCLUSION

The control of *P. latus* is largely accomplished by the use of acaricides. The high reproductive potential and extremely short life cycle of this mite, combined with the frequent applications of acaricides facilitate resistance development in this species. The present study is the first report of baseline toxicity data of commonly used acaricidal compounds to *P. latus*. The baseline values determined were 0.40 ppm for diafenthiuron, 0.70 ppm for dicofol, 0.37 ppm for propargite and 0.58 ppm for spiromesifen.

FUTURE SCOPE

The outcomes of this study serve as basal data which would be helpful in future acaricide resistance-related studies of *P. latus*. The availability of baseline susceptibility data is crucial in monitoring acaricide resistance in field populations.

Acknowledgement. We extend heartfelt gratitude to the facilities, equipment and other logistics provided by ICAR-NBAIR. The award of INSPIRE fellowship to the first author by the Department of Science and Technology (DST) is gratefully acknowledged.
Conflict of Interest. None.

REFERENCES

Arunkumar, K. M. and Srinivasa, N. (2021). Spatial and temporal distribution of yellow mite (*Polyphagotarsonemus latus*) on Mulberry. *Mysore Journal of Agricultural Sciences, 55*(4), 28-38.

Cho, M., Jeon, H., Kim, D. and Yiem, M. (1996). Damage of broad mite, *Polyphagotarsonemus latus* (Banks), on pepper growth and yield and its chemical control. *Korean Journal of Applied Entomology, 35*(4), 326-331.

Finney, D. J. (1971). *Probit analysis: A statistical treatment of the sigmoid curve*, Cambridge university press, London, UK.

Gerson, U. (1992). Biology and control of the broad mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae). *Experimental and Applied Acarology*, *13*, 163-178.

Kabir, A. K. (1979). Bioecology and behaviour of yellow jute mite. *Bioecology and Behaviour of Yellow Jute Mite*, 519-523.

Khadri, S. N. E. N. and Srinivasa, N. (2020). Determining baseline susceptibility of *Tetranychus urticae* Koch (Acari: Tetranychidae) to acaricides by generation method. *Journal of Entomology and Zoology Studies,8*(3), 1416-1423.

Kwon, D. H., Kim, H., Oh, J. H., Lee, S. and Lee, S. H. (2011). Establishment of an acaricide-susceptible *Tetranychus urticae* strain and its species confirmation based on morphological and molecular characters. *Journal of Asia-Pacific Entomology*, *14*(4), 379-385.

Leora Software. (2002). *POLO-Plus; a user's guide to probit or logit analysis*.

Mohin, M., Rajashekharappa, K. and Sharanabasappa. (2021). Establishment of baseline values for susceptibility of *Tetranychus urticae* Koch to major acaricides over successive generations. *Journal of Entomology and Zoology Studies*, *9*(1), 429-432.

Naveena, K., Shanthi, M., Chinniah, C., Jayaraj, J., Ramasubramanian, T., Mini, M. L. and Renuka, R. (2022). Acaricide resistance in field-collected two-spotted spider mite *Tetranychus urticae Koch*. *Indian Journal of Entomology*, *24*, e21228.

Van Leeuwen, T., Tirry, L., Yamamoto, A., Nauen, R. and Dermauw, W. (2015). The economic importance of acaricides in the control of phytophagous mites and an update on recent acaricide mode of action research. *Pesticide Biochemistry and Physiology*, *121*, 12-21.

How to cite this article: Neenu Augustine, M. Mohan, N. Srinivasa, T. Venkatesan, A. Mohan Rao and P.S. Benherlal (2022). Determination of Baseline Values for Susceptibility of *Polyphagotarsonemus latus* (Tarsonemidae: Acari) to Acaricides. *Biological Forum – An International Journal, 14*(4): 977-979.