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ACARICIDAL ACTIVITY OF BOTANICAL EXTRACTS AGAINST *TETRANYCHUS TRUNCATUS* EHARA

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ABSTRACT

The potential of aqueous and methanol extracts of ten botanicals were evaluated against the egg and adult of the spider mite *Tetranychus truncatus* Ehara, under laboratory conditions. The extracts showed no or negligible ovicidal action, but significant adulticidal action; among the aqueous extracts, *A. squamosa* (5, 7.5 and 10%), *C. papaya* (10%) and *B. monnieri* (10%) caused significantly maximum mortality, while it was methanolic extracts of *A. calamus, C. papaya* (1 and 2%) and *A. marmelos* (2%) which revealed maximum mortality with adults.

Key words: *Tetranychus truncatus*, *Annona squamosa*, *Acorus calamus*, *Carica papaya*, *Bacopa monnieri*, aqueous extracts, methanol extracts, mortality, eggs, adults

In India, spider mites of the genus *Tetranychus* are serious pests of vegetables and are reported to cause yield loss of 7-48% (Srinivasa and Sugeetha, 1999). Amongst these, *Tetranychus truncatus* Ehara is the predominant one infesting many economically important crops in Kerala. Synthetic acaricides, though effective in mite management, pose several adverse effects to human and environment. Their continuous use leads to development of resistance. Recently, field populations of *T. truncatus* in Thrissur district, Kerala were observed to have developed resistance to the commonly used acaricides (Bachhar et al., 2019). Hence, there is a need to shift to safer and easily biodegradable products for mite management. Studies have been undertaken for the evaluation of potential candidates viz*.,* the predatory mite *Neoseiulus longispinosus* Evans, the acaropathogenic fungi *Acremonium zeylanicum* (Petch) Gams and Evans and horticultural mineral oil against *T. truncatus* recently (Lenin and Bhaskar, 2019; Sherief and Bhaskar, 2018; Yadav, et al., 2019). Though botanicals have been recognized as an alternative to synthetic pesticides, with least risk to human and environment these have not been effectively utilized. This study was conducted to evaluate the extracts of ten botanicals against *T. truncatus* under laboratory conditions.

MATERIALS AND METHODS

Acaricidal activity of ten botanical extracts viz*.,* leaves of *Quassia indica*, *Eucalyptus* sp., *Aegle marmelos*, *Vitex negundo*, *Carica papaya* and *Ocimum sanctum;* whole plant of *Bacopa monnieri* and *Lantana camara;* seeds of *Annona squamosa;* and rhizome of *Acorus calamus* were evaluated in the laboratory against *T. truncatus*. The botanicals collected were shade dried, finely powdered, sieved and stored separately in air tight containers at 4ºC until further used. The culture of *T. truncates* being maintained in the Acarology laboratory, All India Network Project on Agricultural Acarology, KAU Centre for seven years (approximately 210 generations) was used. The aqueous (5, 7.5 and 10%) and methanol (1 and 2%) extracts of the botanicals were prepared (Salma et al., 2017) and evaluated separately against egg and adult of *T. truncatus* following topical application and leaf dip bioassay method, respectively (Yadav and Bhaskar, 2020). For ovicidal bioassay, ten females were released/ mulberry leaf bit (5x 5 cm) placed in petri plate lined with moistened cotton. The mites were removed after 24 hr to obtain one day old eggs and 25 eggs were retained/ leaf bit by carefully removing excess eggs. The eggs were sprayed with appropriate treatments using a hand atomizer (2ml/ bit). Eggs sprayed with water alone served as untreated control. The hatchability of eggs after 24, 48, 72, 96 and 120 hr of spraying was recorded and % mortality was calculated. For adulticidal bioassay, mulberry leaf bit (7x 7 cm) dipped in botanical extract for 60 sec and then air dried for 20 min were placed in a petri plate lined with moistened cotton. Twenty five females were released to each leaf bit and then padded with wet cotton along the margin, to prevent the mites leaving the treated bit. Leaf bit dipped in distilled water served as control. Mortality of mite was recorded 24, 48, 72, 96 and 120 hr after treatment and % mortality was calculated. The experiments were laid out in completely randomised design with three replications/ treatment and the data subjected to ANOVA using the software, Web Agri Stat Package 2.0 (WASP 2.0).

RESULTS AND DISCUSSION

The aqueous extract of none of the botanicals evaluated showed ovicidal action against *T. truncatus* and by fifth day, 100% hatchability was observed. Similar observations were made by Radhakrishnan and Prabhakaran (2014) with aqueous extracts of some botanicals with *Oligonychus coffeae.* In the present study aqueous extracts varied significantly in their efficacy against adult mites. After five days of treatment, the seed extract of *A. squamosa* and leaf extract of *C. papaya* at 10% concentration revealed maximum mortality of adults (98.67%) followed by 10% *B. monnieri*, 7.5% and 5% *A. squamosa* extracts which were all statistically at par (Table 1). The seed oil and leaf extract of *A. squamosa* have been reported to have acaricidal property- seed oil (0.5% and 0.25%) caused > 80% mortality of the kanzawa spider mite *T. kazawai* after 3 days of application, while complete mortality was observed by 10^{th} day (Lin et al., 2009). The aqueous leaf extract of *A. squamosa* (10%) caused 40% mortality of *T. urticae* adults after 72 hr of treatment under laboratory condition (Premalatha et al., 2018). Field evaluation of aqueous seed extract of *A. squamosa* (10%) resulted in significant reduction in incidence of flea beetles viz., *Podagrica uniforma* and *P. sjostedti* infesting okra (Onunkun, 2012). The extracts of bark, branches, leaves, fruits, and seeds of *Annona* sp. contain alkaloids, acetogenins, diterpenes and flavonoids, which may be responsible for the insecticidal effect (Gajalakshmi et al., 2011). The active substances of *Annona* sp. were reported to affect the neuroendocrine system and thereby interfere the process of metamorphosis (Freitas et al., 2014). Sunarti (2019) reported that *C. papaya* leaf extract caused 90-100% mortality of tomato aphid. Though the acaricidal property of *C. papaya* has not been reported earlier, while in the present study significant mortality of adults of *T. truncates* has been observed.

Among the methanol extracts evaluated, mortality of eggs was observed only with 2% of *A. squamosa***,** *A.calamus* and *A.marmelos* and it was all negligible. But the extracts caused significant mortality of adults; *A. calamus* (2%) extract gave maximum and significantly high mortality of 90.67% within single day of treatment; and by fifth day 100% mortality was observed with 1 and 2%. Similar was the result with extract of *C. papaya* (1 and 2%), while *A. marmelos* (2%*)* led to 98.67% mortality (Table 1). The reason for low egg mortality of methanol extract of the botanicals also may be due to the inability to penetrate the chorion of egg (Radhakrishnan and Prabhakaran, 2014). These observations corroborate with those of Erdogan et al. (2012) with some botanicals on the eggs of *T.urticae.* The insecticidal property of solvent extracts of *A. calamus* has been well documented. It also possesses acaricidal property against phytophagous mites as well as ticks. In laboratory studies, methanol fraction of *A. calamus* at 5% concentration caused 94.6% mortality of adult red spider mite *Oligonychus coffea*e (Sarmah et al., 2007). The ethanol extract of *A. calamus* at 10% concentration could significantly reduce the field population of *T. urticae* (78.23 %) on tomato (Premalatha and Chinniah, 2017).

The activity of *Acorus* sp. could be because of individual or combined effect of bioactive compounds (Balakumbahan et al., 2010). The insecticidal property of *C. papayae* is known- ethanolic leaf extract is effective against field population of German cockroach, *Blattella germanica*. Very high level of repellency was also recorded (Rahayu et al., 2020). The methanolic leaf extract of *A. marmelos* at 10% has acaricidal effect against all stages of *O. coffeae* (Hazarika et al., 2019). Liu et al. (2020) studied the composition of essential oil of another species of *Bacopa* namely, *B. caroliniana* and its insecticidal activity against the rice weevil *Sitophilus oryzae* was observed. After fifth day of treatment, methanol extract of *A. squamosa* seeds at 2% showed significant mortality (70.67%) followed by *B. monnieri*. Maciel et al. (2015) with solvent extracts of *Annona muricata* seeds in ethanol observed significant mortality of *T. urticae.* Ethanolic seed extract of *A. mucosa*, *A. sylvatica* and *A. muricata* caused significant mortality of adult females of *T. urticae* (Miotto et al., 2020). The insecticidal activity of *A. squamosa* seed extract is attributed to adjacent bis-tetrahydrofuran ring acetogenins and that of *A. muricata* to mono-tetrahydrofuran ring acetogenins (Leatemia and Isman, 2004).

Table 1. Efficacy of aqueous and methanol extracts of botanicals on females of *T. truncatus*

Treatment	Aqueous extract						Methanol extract					
	5%		7.5%		10%		1%			2%		
	3DAT	5DAT	3DAT	5DAT	3DAT	5DAT	1DAT	3DAT	5DAT	1 DAT	3DAT	5DAT
Lantana camara	32.00^{cd}	41.33^{cd}	44.00^{bc}	50.67^{c}	50.67^{b}	72.00^{b}	0.00^{f}	5.33^{hi}	9.33^{ij}	0.00^{f}	10.67^{ghi}	20.00^{ghi}
	(33.96)	(39.78)	(41.42)	(45.36)	(45.45)	(59.26)	(0.57)	(13.17)	(17.18)	(0.57)	(18.18)	(26.09)
Aegle marmelos	6.67^{d}	9.33^{f}	9.33^{d}	21.33^{e}	17.33^{d}	25.33^{de}	4.00^{ef}	28.00^{de}	61.33^{bcd}	16.00^{d}	86.67^{b}	98.67^{a}
	(14.79)	(17.71)	(17.71)	(27.36)	(24.16)	(30.12)	(9.51)	(31.59)	(51.68)	(23.47)	(73.67)	(85.77)
Eucalyptus sp.	12.00^{d}	22.67^{e}	26.67^{cd}	41.33^{cd}	28.00^{cd}	52.00^{c}	0.00^{f}	9.33^{ghi}	18.67^{h}	0.00^{f}	14.67^{fgh}	30.67^{fg}
	(20.09)	(28.19)	(30.92)	(39.96)	(31.59)	(46.16)	(0.57)	(17.18)	(25.38)	(0.57)	(22.47)	(33.59)
Vitex negundo	6.67^{d}	18.67^{ef}	17.33^{d}	37.33^{d}	18.67^{cd}	45.33^{cd}	0.00^{f}	8.00^{hi}	30.67^{fg}	0.00^{f}	9.33^{ghi}	38.67^{f}
	(14.79)	(24.98)	(24.57)	(37.66)	(25.26)	(42.29)	(0.57)	(16.08)	(33.50)	(0.57)	(17.18)	(38.34)
Ocimum sanctum	9.33^{d}	14.67^{e}	16.00^{d}	28.00^{de}	33.33^{c}	41.33^{cd}	0.00^{f}	6.67^{hi}	21.33^{gh}	0.00^{f}	26.67^{de}	50.67^{de}
	(17.71)	(22.48)	(23.47)	(31.91)	(35.21)	(39.96)	(0.57)	(14.79)	(27.36)	(0.57)	(31.04)	(45.37)
Quassia indica	8.00^{d}	12.00^{ef}	10.67^{d}	17.33^{ef}	12.00^{d}	24.00^{e}	0.00^{f}	5.33^{hi}	13.33^{hij}	0.00^{f}	20.00^{efg}	40.00^{ef}
	(16.08)	(20.09)	(18.46)	(24.57)	(19.46)	(29.28)	(0.57)	(13.17)	(39.18)	(0.57)	(26.09)	(39.18)
Bacopa monnieri	41.33^{bc}	69.33^{b}	53.33^{b}	78.67^{b}	68.00^{ab}	93.33^{a}	0.00^{f}	25.33^{def}	54.67^{cd}	2.67^{f}	30.67^{cde}	62.67^{bc}
	(39.95)	(56.49)	(46.88)	(62.51)	(55.78)	(77.58)	(0.57)	(30.12)	(47.71)	(5.86)	(33.55)	(52.44)
Carica papaya	12.00^{d}	25.33^{de}	24.00^{cd}	74.67^{b}	66.67^{ab}	98.67^{a}	9.33^{e}	82.67^{b}	100.00^{a}	36.00^{c}	100.00^{a}	100.00^{a}
	(20.09)	(30.12)	(28.79)	(59.79)	(54.89)	(85.77)	(14.81)	(65.89)	(89.43)	(36.85)	(89.43)	(89.43)
Annona squamosa	62.67^{ab}	88.00^{ab}	69.33^{a}	92.00^{a}	76.00^{a}	98.67^{a}	0.00^{f}	34.67^{cd}	56.00^{cd}	0.00^{f}	41.33^{c}	70.67^{b}
	(52.38)	(70.19)	(56.41)	(73.92)	(60.72)	(85.77)	(0.57)	(36.04)	(48.45)	(0.57)	(39.98)	(57.28)
Acoruscalamus	6.67^{d}	20.00^{ef}	9.33^{d}	20.00^{ef}	25.33^{cd}	77.33^{b}	72.00^{b}	100.00^{a}	100.00^{a}	90.67^{a}	100.00^{a}	100.00^{a}
	(14.79)	(26.49)	(17.71)	(26.49)	(30.21)	(61.64)	(58.29)	(89.43)	(89.43)	(72.82)	(89.43)	(89.43)
Control	2.67^{d}	6.67^{f}	2.67^{d}	6.67^{f}	2.67^{d}	6.67^{f}	0.00^{f}	0.00^{i}	4.00^{j}	0.00^{f}	0.00^{i}	4.00^{j}
	(7.88)	(14.79)	(7.88)	(14.79)	(7.88)	(14.79)	(0.57)	(0.57)	(9.51)	(0.57)	(0.57)	(9.51)
CD (p=0.05)	14.72	12.15	14.72	12.15	14.72	12.15	6.10	11.65	11.45	6.10	11.65	11.45

DAT=Days after treatment; Each value mean of three replications; Figures in parentheses arc sine transformed values; Means followed by common letter(s) do not significantly (p=0.05)

REFERENCES

Bachhar A, Bhaskar H, Pathrose B, Shylaja M R. 2019. Resistance to acaricides in *Tetranychus truncatus* Ehara on vegetables. Indian Journal of Entomology 81(1): 131-133.

Balakumbahan R, Rajamani K, Kumanan K. 2010. *Acorus calamus*: An overview. Journal of Medicinal Plants Research 4(25): 2740-2745.

Erdogan P, Yildirim A, Sever B. 2012. Investigations on the effects of five different plant extracts on the two-spotted mite *Tetranychus urticae* Koch (Arachnida: Tetranychidae). Psyche 1-5.

Freitas A F, Pereira F F, Formagio A S N, Lucchetta J T, Vieira M C, Mussury R M. 2014. Effects of methanolic extracts of *Annona* species on the development and reproduction of *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae). Neotropical Entomology 43(5): 446-452.

Gajalakshmi S, Divya R, Deepika V D, Mythili S, Sathiavelu A. 2011. Pharmacological activities of *Annona squamosa*: A review. International Journal of Pharmaceutical Sciences Review and Research 10(2): 24-29.

Hazarika L K, Kalita S, Das P, Roy S. 2019. Leaves of *Aegle marmelos* Correa (Rutaceae): a potential source of acaricide for the management of *Oligonychus coffeae* (Nietner) (Acari: Tetranychidae). International Journal of Tropical Insect Science, pp.1-5.

Leatemia J A, Isman M B. 2004. Insecticidal activity of crude seed extracts of *Annona* spp., *Lansium domesticum* and *Sandoricum koetjape* against lepidopteran larvae. Phytoparasitica 32(1): 30-37.

Lenin N, Bhaskar H. 2019. Efficacy of *Neoseiulus longispinosus* (Evans) (Mesostigmata: Phytoseiidae) for the management of *Tetranychus urticae* Koch (Prostigmata: Tetranychidae) on cucumber under protected cultivation. Journal of Biological Control 33(1): 48-52.

Lin C, Wu D, Yu J, Chen B, Wang C, Ko W. 2009. Control of silverleaf whitefly, cotton aphid and kanzawa spider mite with oil and extracts from seeds of sugar apple. Neotropical Entomology 38(4): 531-536.

Liu T T, Chao L K P, Hong K S, Huang Y J, and Yang T S. 2020. Composition and insecticidal activity of essential oil of *Bacopa caroliniana* and interactive effects of individual compounds on the activity. Insects 11(1): 23.

Maciel A G S, Rodrigues J S, Trindade R C P, Silva E S, Sant'Ana A E G, Lemos E E P. 2015. Effect of *Annona muricata* L. (1753) (Annonaceae) seeds extracts on *Tetranychus urticae* (Koch, 1836) (Acari: Tetranychidae). African Journal of Agricultural Research 10(48): 4370-4375.

Miotto J, Duarte A F, Bernardi D, Ribeiro L P, Andreazza F, Cunha U S, 2020. Toxicities of acetogenin based bioacaricides against two−spotted spider mite and selectivity to its phytoseiid predators. Experimental and Applied Acarology 81: 173-187.

Onunkun O. 2012. Evaluation of aqueous extracts of five plants in the control of flea beetles on okra (*Abelmoschus esculentus* (L.) Moench. Journal of Biopesticides 5: 62-67.

Premalatha K, Chinniah C. 2017. Evolving an integrated management strategy for effective suppression of mite pests infesting tomato. Journal of Entomology and Zoology Studies 5(6): 38-42.

Premalatha K, Nelson S J, Vishnupriya R, Balakrishnan S, Krishnan V P S. 2018. Acaricidal activity of plant extracts on two spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae). Journal of Entomology and Zoology Studies 6(1): 1622-1625.

Radhakrishnan B, Prabhakaran P. 2014. Biocidal activity of certain indigenous plant extracts against red spider mite, *Oligonychus coffeae* (Nietner) infesting tea. Journal of Biopesticides 7(1): 29-34.

Rahayu R, Darmis A, Jannatan R. 2020. Potency of papaya leaf (*Carica papaya* L.) as toxicant and repellent against German cockroach (*Blattella germanica* L.). Pakistan Journal of Biological Sciences 23: 126-131.

Salma U, Kundu S, Gupta S K. 2017. New record of mites occurring on medicinal plants and bio-efficacy of green pesticides for management of *Tetranychus ludeni* Zacher on *Rauwolfia serpentina* (L.) Benth. ex Kurz. Pesticide Research Journal 29(1): 60-67.

Sarmah M, Basit A, Bhattacharyya B, Rahman A, Gurusubramanian G. 2007. Ovicidal, acaricidal and growth inhibitory activity of *Xanthium strumarium* L., *Acorus calamus* L., and *Pongamia pinnata* L. (Pierre) against a major pest of tea, *Oligonychus coffeae* Nietner (Tetranychidae: Acarina). International Journal of Tea Science 6: 1-14.

Sherief, A. and Bhaskar, H. 2018. Evaluation of the acaropathogen, *Acremonium zeylanicum* (Petch) Gams and Evans against *Tetranychus truncatus* Ehara (Prostigmata: Tetranychidae) on cucumber under protected cultivation. Entomon 43(4): 271-276.

Srinivasa N, Sugeetha, G. 1999. Bioeffectiveness of certain botanicals and synthetic pesticide against okra spider mite, *Tetranychus macfarlanei*. Journal of Acarology 15(122): 1-5.

Sunarti R N. 2019. The effectiveness of papaya leaf extract (*Carica papaya* L.) against *Aphis* sp. in tomato (*Solanum lycopersicum*) plantation in the natural fence area of South Sumatra. Journal Biota 5(2): 111-117.

Yadav K, Bhaskar H, 2020. Efficacy of horticultural mineral oil against *Tetranychus truncatus* Ehara. Indian Journal of Entomology 82(1): 123-127.

Yadav K, Bhaskar H, Subramanian M. 2019. Bioefficacy of horticultural mineral oil against spider mite, *Tetranychus truncatus* Ehara (Prostigmata: Tetranychidae) on okra. Entomon 44(4): 301-306.

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