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Evaluate the plant extracts of *Syzygium aromaticum*, *Citrulus colocynthis* and *Jatropha curcas* against *Tetranychus urticae* Koch (Acari: Tetranychidae) on *Cucumis satives*

Abou-Shosha M. A. A.*

Department of Agricultural Zoology and Nematology, Faculty of Agriculture, Al-Azhar University (Assiut Branch), Assiut, Egypt

Abstract

A comparative efficiency of three plant extracts of clove *Syzygium aromaticum* Mytaceae flowers, colocynthor or bitter melon *Citrulus colocynthis* Cucurbitaceae fruits and physic nut *Jatropha curcas* Euphorbiaceae seeds extracted by the organic solvent acetone; were assessed against adult females of *Tetranychus urticae* under laboratory condition at concentrations 0.5, 1, 2 and 4% at 27±2 °C and 65±5% relative humidity (Rh) The results were recorded after 24, 48 and 72h from spraying. Also, field trial efforts was conducted to evaluation the best extract of *J. curcas* at 4% concentration to submission the population of *T. urticae* compared with the acaricidal vertemic and the results were recorded after 1, 3, 7, 14 and 21 days intervals after treatment. The results explained that, 0.5% concentration was non effective when applied with the three plant extracts. Also, *C. colocynthis* was the lowest potently one it recorded 33.33% reduction percentages after 72h from applied at concentration 4 %. While the *J. curcas* extract was the best one it gave reduction percentages 85.41, 89.58 and 94.79% after 72h. from applied at concentration 1, 2 and 4%, respectively. The same results were observed when *J. curcas* applied on cucumber (*Cucumis satives*) plants at field condition at concentration 4%, it gave 79.37, 89.50 and 88.91% reduction percentages after 1, 3 and 7 days from spraying, respectively. *S. aromaticum* extract when evaluated under laboratory condition against *T. urticae* females gave 64.89, 73.40 and 85.10% reduction percentages, after 3 days from applied at concentration 1, 2 and 4%, respectively. The results suggested that, extracts of *J. curcas* seeds and *S. aromaticum* flowers have a great potential for future development as natural acaricides for controlling *T. urticae* mite.

Keywords: plant extracts, *Tetranychus urticae*, *Jatropha curcas*, *Syzygium aromaticum*, *Citrulus colocynthis*, acaricides.

*Corresponding author: Abou-Shosha M. A. A.,
E-mail address: abuealhamd43@gmail.com

1. Introduction

Tetranychus urticae koch (Tetranychidae) is the most serious mite pest of vegetables belonging to Cucurbitaceae, which includes *Cucumis vulgaris*, *C. melo*, *Cucurbita pepo* and *Citrullus lanatus* as a major cucurbitaceaid crops in Egypt. Cucumber plant (*C. sativus*) is one of the preferred hosts of *T. urticae*. Immature and adult stages of *T. urticae* lacerate leaf cells and produce some characteristic light green and reddish brown marks on the upper surface of leaves. Therefore increased their web strings which produced by the mite due to reduce photo-synthesis. The main of control for *T. urticae* is the use of synthetic pesticides and the continually of use acaricides has caused serious damage due to environmental contamination, (Motazedian *et al*., 2012). Also, continuance use of synthetic pesticides has caused resistance for some pests. The first detection of etoxazole resistance (>12 500 fold) in Australian two-spotted mite *T. urticae* from pome fruit via both bioassay and DNA methods, (Grant *et al*. 2018). Many researchers have tasted plant oils, essential oils and plant extracts as alternative methods for the control of *T. urticae* and plant bests to reduce the negative effects of pesticides. The plant extracts of *Marticaria chamomilla* L. [hydroethanolic extract (HE)] and *Pimpinella anisum* L. [aqueous extract (AE)] have acaricidal effect for females of *Tetranychus urticae*, providing above 83% of mortality after 120h. from spraying (Vinicius *et al.*, 2018). Beside, many of natural plant-based pesticides have fewer side effects compared with synthetic chemicals (Nicolle *et al.* 2016). In general, essential oils can be used as fumigants, as contact and systemic insecticides, and as repellents in stored-grain pest control, (Bakkali *et al.*, 2008). The essential oils of *Syzygium aromaticum, Cinnamomum zeylanicum*, and the eugenol compound are the most promising to control *Callosobruchus maculatus*, via fumigation, (Jose, *et al.*, 2017). Also, *Myrtus communis* oil was proven to be a stronger repellent compared to *Laurus nobilis* oil at concentration 2 ml/l for *T. urtichae*, (Yeilayer, 2018). *T. urticae* has shown resistance to many synthetic acaricides applied in the field and greenhouse, (Ashrafiju *et al*., 2013). They also, investigated six Plant extracts against *T. urticae* under laboratory condition with 5ml/L. concentration and they found the greatest total mortality was recorded in *Melia azedarach* (87.5%) and *Peganum harmala* (81.25%). When neem cedar and clove oils sprayed at dose 100 µL under laboratory condition, clove oil showed greater potential for adult *Tenuipalpus heveae* mortality, (Thalia *et al*., 2019). In citrus orchard, neem oil, citrus peel oil and citronella oil were proved 76.60, 74.00 and 72.90% reduction percentages in *Panonychus citri population* respectively and to be superior with higher fruit yield, (Chinniah *et al*., 2020). The *Solanum nigrum* extract showed marked efficacy in controlling the carmine spider mite *Tetranychus cinnabarinus* in vitro, (Chen and Dai, 2017). Ditto, *Atropa belladonna* herbal extract could be incorporated in integrated pest management (IPM) programs of *T. urticae*, (Ayad *et al.*, 2018). Moreover the

objective of the study was to evaluation the effect of clove *Syzygium domatium*, colocynthor *Citrulus colocynthis* and physic nut *Jatropha curcas* on *T. urticae* females under laboratory condition and bioassay of *J. curcas* extract compared with acaricide vertemic to submission the population of this mite (*T. urticae*).

2. Materials and methods

2.1 Rearing technique of Tetranychus urticae

Tetranychus urticae mite was collected from cucumber (*C. sativus*) at farm of Faculty of Agriculture Al-Azhar University, Assiut, Egypt. A pure culture of *T. urticae* was maintained on kidney bean leaves placed in petri-dishes on moisturized cotton under conditions of 25±1°C and 70 ± 5, relative humidity (RH). Green kidney bean plants (*Phaseolus vulgaris*) planted in pots 25 cm. diameter in sunny place. When the kidney bean plants reached about six to eight leaf contaminated with two–spotted spider mites from the pure culture as a source.

2.2 Plants and preparation of extracts

Three plant species were covered in this study of these clove *Syzygium aromaticum* Mytaceae flowers, colocynthor or bitter apple *Citrulus colocynthis* Cucurbitaceae fruits and physic nut *Jatropha curcas* Euphorbiaceae seeds. The flower buds of *S. aromaticum* plant and *C. colocynthis* fruits collected from the market, while seeds of *J. curcas* plant were collected from the farm of Faculty of Agriculture Al-Azhar University, Assiut, Egypt, fruits, flower buds and seeds of plants were dried in shade at room temperature for two weeks and grinded using an electric blender homogenized to fine powder and stored in opaque screw tight jar until use. 200 g. powdered sample from each plant was charged into Soxhlet apparatus and acetone successively. Each time before employing the solvent of higher polarity sample was dried.

2.3 Effect of the extracts on adult females of T. urticae and treatment design under laboratory condition

To evaluate the effect of the plant extracts on the adult females of *T. urticae* mite, ten newly emerged adult females were transferred to the upper surface of kidney beans leaf discs (3 cm diameter). Leaf disc was kept on moist cotton pad in petri-dish 10cm. diameter; each dish was replicated ten times. Each ten dishes carrying the adult females were sprayed with one of following concentrations 0.5%, 1%, 2% and 4% plus untreated control. The disk surface which carrying the adult females was sprayed separately with plant extract using a manual atomizer and the dishes were left at room temperature at 27 ± 2°C and 65 ± 5 % RH. The untreated control was sprayed by water and additive solvent Dimethil salphoccied (damson) by rate (0.1 %).

The results were assayed after 1, 2 and 3 days by counting the number of living females.

2.4 Field efficacy

To evaluate the effect of the plant extracts on *T. urticae* in the field, trials were conducted at research farm, Faculty of Agriculture, Al-Azhar University, Assiut, Egypt. For the present experiment, natural *T .urticae* infestation was used to evaluate the efficacy of the *Jatropha curcas* extract against population of mite at concentration 4% in cucumber field. The experimental units comprised three plots each measuring 12m x 30m one treatment of *J. curcas* at concentration 4% and one treatment for vertemic at concentration 40ml/100L. Water another one as a control. A randomised block design with three replicates was used for experimentation. During application of extract the whole plant was thoroughly covered by spray fluid and care was taken to maintain the distance around 25 cm. between the nozzle and plant parts, treatments were applied by knapsack sprayer furnished with one nozzle boom. The number of *T. urticae* population (mobile stages) were counted before spraying and after using binocular from upper and lower surface of 10 leaves from each plot in three replicates. The samples were collected after spraying with intervals 1, 3, 7, 14 and 21 days, the reduction percentages were calculated according to Abbot's formula (1925).

2.5 Statistical analysis

Obtained data was subjected to one-way analysis of variance (ANOVA) followed by t-test according to procedures by IBM SPSS Statistics for Windows, version 20 (2011) and M.S. Mean Square. The mean values were compared at 5% level tests and reduction percentages were calculated according to Abbot's formula (Abbot, 1925).

3. Results

3.1 Effect of different plant extracts on adult females of Tetranychus urticae under laboratory condition

The bioassay of different extracts of *S. aromaticum, C. colocynthis* and *J. curcas* after 24, 48 and 72 hours were summarised in Table (1) the results showed that, both extracts of *S. aromaticum* and *J. curcas* gave slightly effective on *T. urticae* females at concentration 0.5%, the reduction percentage reached 24.46% for *S. aromaticum* with average 15.60 % and 39.58% for *J. curcas* with average 34.78 % after 72h. from applied. But *C. colocynthis* extract was non effective at the same concentration (0.5%). Also, among the plant extracts *C. colocynthis* extract was the lowest effective one on adult females of *T. urticae* at the other concentration it recorded intermediately 12.35, 19.54 and 23.25% reduction percentages after three days of treatment at concentration 1, 2 and 4%,

respectively. Whereas, the greatest effect on the females of *T. urticae* demonstrated in treatment of *J. curcas* extract particularly at high concentration.

Table (1): Effect of plant extracts on adult females of *Tetranychus urticae* under laboratory condition

Plant extracts	Concentrations \ Days		1 day	2 days	3 days	Average
S. aromaticum	0.5 %	Reduction	09.09 %	13.26 %	24.46 %	15.60 %
		Effect	9.00 ± 0.94 ^{d}	8.50 ± 1.08 ^{f}	7.10 ± 1.66 ^{f}	8.20 ± 1.22 ^{g}
	1 %	Reduction	47.47 %	63,26 %	64.89 %	58.54 %
		Effect	5.20 ± 2.27 ^{b}	3.60 ± 2.84 ^{c}	3.4 ± 2.84 ^{c}	4.06 ± 2.65 ^{d}
	2 %	Reduction	51.51 %	66.32 %	73.40 %	63.74 %
		Effect	4,80 ± 2.62 ^{b}	3.30 ± 2.41 b ^{c}	2.50 ± 1.84 b ^{c}	3.53 ± 3.25 c ^{d}
	4 %	Reduction	59.5 %9	80.61 %	85.10 %	75.07
		Effect	4.80 ± 2.62 ^{b}	3.30 ± 2.41 b ^{c}	2.50 ± 1.84 a ^{b}	2.53 ± 2.29 b ^{c}
C. colocynthis	0.5 %	Reduction	00.00 %	00.00 %	00.00 %	0.00 %
		Effect	10.00 ± 0.00 ^{d}	10.00 ± 0.00 ^{f}	10.00 ± 0.00 ^{g}	10.00 ± 0.00 ^{g}
	1 %	Reduction	05.00 %	11.22 %	20.83 %	12.35 %
		Effect	9.50 ± 0.53 ^{d}	8.70 ± 0.82 $^{e f}$	7.60 ± 1.26 e ^{f}	8.26 ± 0.87 ^{g}
	2 %	Reduction	08.00 %	19.38 %	31.25 %	19.54 %
		Effect	9.20 ± 0.63 ^{d}	7.90 ± 0.88 ^{e}	6.60 ± 1.07 d ^{e}	7.90 ± 0.86 f ^{g}
	4 %	Reduction	14.00 %	22.44 %	33.33 %	23.25 %
		Effect	8.60 ± 0.70 c ^{d}	7.60 ±0.70 ^{e}	6.40 ± 0.84 d ^{e}	7.53 ± 0.7 f ^{g}
J. curcas	0.5 %	Reduction	26.00 %	38.77 %	39.58 %	34.78 %
		Effect	7.40 ± 2.80 ^{c}	6.00 ± 2.75 ^{d}	5.80 ± 2.62 ^{d}	6.40 ± 2.72 ^{f}
	1 %	Reduction	48.12 %	81.63 %	85.41 %	71.72 %
		Effect	5.20 ± 1.40 ^{b}	1.80 ± 1.23 ^{a}	1.40 ± 1.07 $^{a b}$	2.80 ± 1.23b ^{c}
	2 %	Reduction	76.41 %	83.67 %	89.58 %	83.22 %
		Effect	2.40 ± 1.26 ^{a}	1.60 ± 1.26 ^{a}	1.00 ± 1.15 ^{a}	1.66 ± 1.22a ^{b}
	4 %	Reduction	88.32 %	91.01 %	94.79 %	91.37 %
		Effect	4.00 ± 1.15 ^{a}	3.10 ± 1.6 ^{a}	2.00 ± 1.25 a ^{b}	3.03 ± 1.33^{a}
F value			33.63	40.69	42.55	43.24
M. S.			83.96	103.68	99.62	93.52

The mortality rates of *T. urticae* females for *J. curcas* were 76.41, 83.67 and 89.58% at concentration 2% after 24, 48, and 72h, respectively, with mean of reduction 83.24%. While, at 4% concentration recorded 88.32, 91.01 and 94.79% reduction percentages after 24, 48, and 72h, respectively with mean of reduction 91.37%**.** Effects of clove (*S. aromaticum*) extract on adult females of *T. urticae* were observed with treatments (1 and 2%) they gave reduction percentages 58.54 and 63.74% at concentrations 1 and 2%, respectively. Whereas, the clove extract gave 59.50, 80.61 and 85.10% reduction percentages for *T. urticae* females at concentration 4% after 24, 48, and 72h respectively with average 75.07%. Statistically there were significance differences among the extracts and among the concentrations.

3.2 Effect of Jatropha curcas extract on population of T. urticae infested Cucumis sativus compared with acaricide vertemic under field condition

Among the plant extracts *J. curcas* was appear highly effective on *T. urticae* females during laboratory experiences.

So, it was selected to apply against *T. urticae* as a comparative with acaricide vertemic. As shown in Table (2), *J. curcas* when applied at concentration 4% against population of *T. u*rticae witch infested *C. sativus* was reduced the population of *T. urticae* from first day until 7th day with reduction percentages 79.37 , 89.50 and 88.91% after 1, 3 and 7 days respectively. While the effective was decreased after 2 weeks with 59.14 and 36.31% reduction percentages after two and three weeks, respectively, with mean of reduction 70.64% when spraying at concentration 4% in field of *C. sativus* infested *T. urticae*. The vertemic was effective too from first day until the tertiary weeks and decreased after third week. The reduction percentages of vertemic were 93.97, 95.06, 96.60, 98.87 and 66.12 after 1, 3, 7, 14 and 21 days, respectively with average reduction 90.12%. The vertemic was more effective on population of *T. urticae* in cucumber field, but the extract of *J. curcas* was cognately in effective on *T. urticae* population in cucumber field from vertemic. Whilst the *J. curcas* more safety than vertemic because the *J. curcas* extract starting in degradable after one week but the vertemic start the degradable after two weeks.

Table (2): Effect of plant extract of *J. curcas* on *Tetranychus urticae* population under field condition at concentration 4 % on *Cucumis sativus* as a compared with vertemic.

Days / Treatments	Reduction & Effect	One day	Three days	One week	Two weeks	Three weeks	Mean
J. curcas	Reduction	79.37 %	89.50 %	88.91 %	59.14 %	36.31 %	70.64 %
	Effect	7.40±5.13	5.20±3.12	4.60±2.80	13.70±7.09	17.50±11.53	9.68±3.44
Vertemic	Reduction	93.97 %	95.06 %	96.60 %	98.87 %	66.12 %	90.12 %
	Effect	2.30±3.33	2.60±3.24	1.50±1.65	0.40±0.70	9.90±7.05	3.34±1.23
T value		6.64	1.83	3.02	5,91	1.78	5.49
F value		1.29	0.36	4.93	13.61	3.45	7.34

4. Discussion

Several plant extracts have been found to contain bioactive compounds against insects and mites. Pesticides based on plant oils, essential oils and plant extracts could be used in a variety of ways to control a large number of pests. The essential oil of *Cinnamomm zeylanicum* and its main components are effective in controlling Paenibacillus larvae, (Brenda *et al*., 2008; Yeole *et al.*, 2014). Also, essential oil vapours from *Saturja hortensis, Ocimum basilicum* and *Thymus vulgaris* had a potential against *T. urticae* in greenhouse, (Aslan *et al*., 2004). Plant oils too were tested by Tarikul, *et al*. (2017), they evaluated three essential plant oils namely, neem *Azadirachta indica,* mahogany *Swietenia mahogoni* and karanja *Millettia pinnata*. They explain that, among the plant oils tested, karanja and mahogany oils were found most effective against *T. urticae* and both the oils showed significantly better performance compared to all other treatments. Although, Traka, *et al*. (2018) investigated the effects of hydrosols

derived from *Ocimum basilicum* (sweet basil) and *Ruta chalepensis* (rue) on the serious crop pests *Aphis gossypii* and *Tetranychus urticae*. They found both hydrosols caused significant mortality rates, which fluctuated between 46.0% and 64.0%. According to this studies it can be concluded that, the extract of *J. curcas* showed highly mortality in adult females of *T. urticae* when applied at concentration 1, 2 and 4% under laboratory condition, as well as when applied at concentration 4% on cucumber plants infested *T. urticae* under field condition notched highly reduction percentage in population of *T. urticae* compared with acaricide vertemic. Also, clove (*S. aromaticum*) extract has acaricide effect, it caused high mortality rate especially with increasing concentrations. But, bitter melon *C. colocynthis* extract has slightly toxic on *T. urticae* females whereas its effective enhanced with increasing concentration. The present results are agreement with Badgujar *et al*. (2017). They evaluated the effect of *Cinnamomum zeylanicum* bark and *S. aromaticum* bud extracts and their major secondary metabolites (cinnamaldehyde and eugenol) against *Plutella xylostella* and they found that, *S. aromaticum* when extracted with hexane and methanol and applied by direct contact method exhibited 97.50% and 67.50% mortality at 1% (v⁄v) concentration after 48h., respectively. Also, in another study, Lakhdari, (2015) demonstrated that, the aqueous plant extracts of *Cotula cinerae* and *Limoniatrum guyonianum* do not show an effect on *Oligonychus afrasiaticus* pest of date palm. Unlike, *Zygophyllum album* showed a very significant effect on the mite by a mortality rate of 76%. Maria *et al*. (2018) evaluate the efficiency, phytotoxicity and residual effect of the aqueous extract of *Prosopis juliflora* leaves on *Tetranychus bastos* and they found the efficiency was verified throughout the evaluated period, with an average of 81.67% for LC50 and 73.05% for LC90. Also, the present results within agreement with those optioned by Roy *et al.* (2014), Jumbo *et al*. (2014), Kanika and Rachna (2014), Ferreia (2018), Hong *et al*. (2018) and Pervin *et al.* (2018). Finally, the plant extracts of *S. aromaticum* and *J. curcas* can be introduced as alternative to conventional synthetic acaricides against *T. urticae* mite.

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