



Potential of *Senna septemtrionalis* and *Pluchea dioscoridis* extracts as alternative acaricidal against *Tetranychus urticae* Koch (Acari: Tetranychidae)

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Abstract

Senna septemtrionalis (Arsenic bush) Fabaceae and *pluchea dioscoridis* (pluchea) Asteraceae were collected from farm of faculty of Agriculture, Al-Azhar University, Assiut, Egypt during flowering stages. The extracts obtained from *S. septemtrionalis* and *P. dioscoridis* were tested against two-spotted spider mite *Tetranychus urticae* Koch as acaricidal. Bioassay experiments were carried out under laboratory and field conditions using two different solvents (Acetone and Methanol) by direct leaf spraying. The amount of plant extracts applied at laboratory condition were 1, 2, 3, 4 and 5% concentrations at $27\pm 2^\circ\text{C}$ temperatures and $65\pm 5\%$ relative humidity (RH.) on adult females and eggs of *T. urticae*. The concentration applied at the field was 4% concentration and dimethyl sulphocied (damson) was used by rate 0.1% as a solvent. The results revealed that, the concentration 4 and 5% gave high mortality than the low concentrations for all solvents. The extracts obtained from *P. dioscoridis* plant were the highest effective on eggs (67.72% at concentration 5%), adult females (86.51% for acetone and 82.02% for methanol after three days and at concentration 5% under laboratory conditions) and population of *T. urticae* (71.81% for acetone and 76.82% for methanol after one week at concentration 4% under field conditions). When, *S. septemtrionalis* extracted by acetone as solvent gave high results at concentrations 2, 3, 4 and 5% after three days from spraying, while when extracted by methanol was effective only at 4 and 5% concentrations, both plants recorded highly reduction percentages after one week when applied on *Cucumis sativus* (Cucurbitaceae) cucumber under field condition at concentration 4%. Whereas, the *P. dioscoridis* extracts were the best. The acetone was the best solvent for both plants.

Keywords: plant extracts, acaricidal, *Tetranychus urticae*, *Senna septemtrionalis*, *Pulchea dioscoridis*.

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1. Introduction

The two-spotted spider mite *Tetranychus urticae* Koch is considered the most important mite among the different species of family Tetranychidae. This mite is a ubiquitous species present worldwide and attacks more than 150 economically important plant species, causes significant damage to vegetable, field crops, fruit trees and ornamental plants. A number of some common field crops and vegetable plants attacked by *T. urticae* including corn, cotton, cucumber, beans, tomato, eggplant, peppers and rose (Aucejo et al., 2003; Navaias 1998). The main form of control for *T. urticae* is the use synthetic chemical acaricides with a level of residually and permanence that constitutes a barrier to the commercialization of agriculture products and causes detrimental effects to environment and human health. Pesticides formulated with herbal extracts are thus in practice as a safer alternative and have become part of leading research all over the world. Using natural plant extracts, might be suitable for controlling spider mite on the vegetables because of it is safety. Many workers have identified the acaricidal properties of plant products against *T. urticae*, (Numa et al., 2015; Premalatha et al., 2018). Also, Azadirachtin was efficient against *T. urticae*, with a mortality rate similar to that of abamectin (Daniel et al., 2013). The extract obtained from *Leptospermum petersonii* when used by leaf dipping method at 0.5% concentration caused the highest mortality (100%) in the nymph and adult stages of *T. urticae*, (Erdogan, 2019). Demsis, duranta and cumin

extracts when applied at concentration 1x10⁵ ppm resulted high mortality percentages 93.33%, 69.00% and 64.67% for demsis, duranta and cumin extracts, respectively, (Badr El-Sabah and Kholoud, 2011). Also, plant oils were studied by many searchers and they found that, plant oils were more effective against *T. urticae*. The plant oils obtained from karanja (*Millettia pinnata* L.) and mahogany (*Swietenia mahogoni* L.) were more effective against *T. urticae* (Tarikul et al., 2017). When plant oils of physic nut (*Jatropha curcas*), castor, (*Ricinus communis*), radish (*Raphanus sativus*) and lupine (*Lupinus termis*) applied at concentration 8ml/L. under laboratory condition reached 97.81, 81.76, 89.78 and 85.41% reduction percentages in adult females of *T. urticae* after 72 hours from spraying for physic nut, castor, radish and lupine, respectively, (Abou-Shosha, 2015). Therefore, the present work aimed to evaluate the efficacy of some plant extracts extracted from two plants, arsenic (*Seena septemtrionalis*) and pluchea (*Pulchea dioscoridis*) against *T. urticae* mite, the plants extracted by two solvents (acetone and methanol 80%). Bioassays were tested by five different concentrations (1, 2, 3, 4 and 5%) to determine the effects of varying concentrations under laboratory condition and with concentration 4% under field condition.

2. Materials and methods

2.1 Rearing technique of *Tetranychus urticae*

Tetranychus urticae mite was collected

from cucumber *Cucumis sativus* at farm of Faculty of Agriculture Al-Azhar University, Assiut, Egypt. A pure culture of *T. urticae* was maintained on kidney beans leaf placed in petri-dishes on moisturized cotton under conditions of $25\pm 1^{\circ}\text{C}$ and 70 ± 5 Relative humidity. Green bean plants (*Phaseolus vulgaris*) planted in pots (25 cm. diameter) in sunny place. When the kidney bean ants 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

Two plant species were covered in this study of these *Seena septemtrionalis* (Arsenic) Fabaceae leaves and *Pluchea dioscoridis* (Pulchea) Asteraceae leaves. The leaf of plants were collected from the forests, Faculty of Agriculture Al-Azhar University, Assiut, Egypt, Fifty hindered grams of leaf 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 methanol successively. Each time before employing the solvent of higher polarity sample was dried.

2.3 Effect of extracts on adult females of *T. urticae* and treatment design

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 1%, 2%, 3%, 4% and 5% 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 $27\pm 2^{\circ}\text{C}$ and $65\pm 5\%$ RH . The untreated control was sprayed by water and additive solvent dimethyl sulphocied (damson) by rate (0.1 %) the results were assayed after 1, 2 and 3 days by counting the number of living females.

2.4 Effect on eggs and treatments design

Ten newly adult females were transferred to the upper surface of green bean leaf discs (3cm diameter) kept on moist cotton pad in each petri-dish (10 cm diameter), each dish was replicated five time and left 24 hour to deposited eggs to evaluate the effect of the plant extracts on the eggs of *T. urticae* . After 24 hours the females were removed and the eggs counted, and the dishes continuously moistened during the experiment. The disk surface which carrying the eggs was sprayed separately with plant extract using a manual atomizer and the dishes were kept in incubator at temperatures $25\pm 1^{\circ}\text{C}$ and $70\pm 5\%$ RH. The untreated control was sprayed with water and

additive solvent (damson) by rat (0.1%). Hatching percent was calculated after 6 days after treatments, according to Abbot's formula (1925).

2.5 Field efficacy

To evaluate the effect of the plant extracts on *T. urticae* population in the field, trials were conducted at research farm, Faculty of Agriculture, Al-Azhar University, Assiut branch. For the present experiment, natural *T. urticae* infestation was used to evaluate the efficacy of the above mentioned extracts against *T. urticae* population at concentration 4% for each extract on cucumber (*Cucumis sativus*). The experimental units comprised three plots each measuring 11m x 25m four treatments at concentration 4% and another one as a control. A randomised block design with three replicates was used for experimentation. During application of extracts the whole plant was thoroughly covered by spray fluid and care was taken to maintain the distance around 25cm 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).

2.6 Statistical analysis

Obtained data was subjected to one-way analysis of variance (ANOVA) followed by f-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 plant extracts on adult females of *T. urticae* under laboratory condition

The plant extracts were applied on *T. urticae* females at laboratory and the reduction percentages were determined after 24, 48 and 72h. The results were shown in Table (1) indicated that the concentration of 5% shown higher rates of reduction with plant extracts of *S. septentrionalis*. The mortality rates of adult females at concentration 5% were 60.00, 68.36 and 77.52 % with average reduction 68.62 % for *S. septentrionalis* when extracted by acetone. While, it gave 50.00, 61.22 and 71.91 % with average reduction 61.04% when extracted by methanol after 1, 2 and 3 days, respectively. Whereas, concentration 1% was the lowest.

Table (1): Effect of *Senna septemtrionalis* extracts on adult females of *urticae* under laboratory condition.

Concentrations	Solvents	Effects	<i>S. septemtrionalis</i> reduction %			Average
			1 day	2 days	3 days	
1%	Acetone	Reduction	06.00 %	20.40 %	32.58 %	19.66 %
		Effect	9.40 ±0.52c	7.80 ±0.63ab	6.60 ± 1.26 c	7.93 ± 0.80d
	Methanol	Reduction.	08.00 %	14.00 %	21.34 %	14.44 %
		Effect	9.20±0.92c	8.40 ± 1.17 c	7.00 ±1.25d	8.20 ± 1.11d
2%	Acetone	Reduction.	47.00 %	57.14 %	67.41 %	57.18 %
		Effect	5.2± 0.92 a	4.20 ± 0.92 a	2.90 ±1.20ab	4.10 ± 1.01b
	Methanol	Reduction.	20.00 %	25.51 %	40.44 %	28.65 %
		Effect	8.00 ± 1.15 b	7.30 ±1.64bc	5.30 ± 1.89 c	6.86 ±1.56c
3%	Acetone	Reduction	48.00 % a	60.20 %	74.15 %	60.78 %
		Effect	5.30 ± 2.00 a	3.90 ± 2.23 a	2.60 ±1.64ab	3.93 ± 1.95ab
	Methanol	Reduction	24.00 %	33.67 %	40.44 %	32.70 %
		Effect	7.60 ± 0.97 b	6.50 ± 1.51 b	5.30 ± 1.42 c	6.46 ± 1.30c
4%	Acetone	Reduction	59.00 %	63.26 %	75.28 %	65.84 %
		Effect	4.10 ± 1.73 a	3.60 ± 1.60 a	2.30 ± 1.42 a	3.33 ± 1.58ab
	Methanol	Reduction	48.00 %	58.16 %	66.29 %	57.48 %
		Effect	5.20 ± 1.76 a	4.10 ± 1.91 a	3.00 ± 2.20 b	4.10 ±1.95b
5%	Acetone	Reduction	60.00 % a	68.36 %	77.52 %	68.62 %
		Effect	4.00 ± 1.15 a	3.10 ± 1.6 a	2.00 ±1.25ab	3.03 ± .33a
	Methanol	Reduction	50.00 %	61.22 %	71.91 %	61.04 %
		Effect	5.00 ± 1.76 a	3.80 ± 1.55 a	2.50 ± 1.18 a	3.76 ± 1.49ab
F value			36.51	27.55	25.78	34.02
M. S			45.53	49.25	50.37	47.32

Reduction percentages were 6.00, 20.40 and 32.58 % with average reduction 19.66 % for acetone extract and 8.00, 14.00 and 21.34 % with average reduction 14.44 % for methanolic extracts after 1, 2 and 3 days respectively. The concentration 2, 3 and 4 % gave significant mortality rates for *T. urticae* with average reduction 57.18, 60.78 and 65.84% respectively when *S. septentrionalis* plant extracted by acetone. While the methanol extract was effective at concentration 4% and 5% only with average of reduction 57.48 and 61.04 respectively. From Table (1) evidenced that, the high concentration and the long period led to increase mortality, and the Acetone solvent was the best solvent for *S. septemtrionalis* plant. Statistical analysis showed significant difference between solvents and among the

concentrations. The results in Table (2) demonstrated that both organic solvents (acetone and methanol) were the favourable solvents for *P. dioscoridis* plant. The concentration 1% was slightly effective on *T. urticae* females it gave 25.00, 44.49 and 57.30% reduction percentages with average 42.26 % for acetone solvent and 39.00, 47.95 and 62.92 % reduction percentages with average 49.95 % for methanol solvent after 1, 2 and 3 days respectively. While the *P. dioscoridis* extracts when applied at concentration 4 and 5 % gave reduction percentages above 50 % from first day. The mortality rates at concentration 4 % were 52.00, 66.32 and 76.40 % with average 64.90 % for acetone solvent and 53.00, 68.36 and 74.15 % with average 65.17 % for methanol extract after 24, 48 and 72h

respectively. Concentration of 5% was the highest effective one on spider mite females it recorded 55.00, 69.38 and 86.51 % reduction percentages with average 70.29 % for acetone solvent and 56.00, 72.44 and 82.02% reduction percentages with average 70.15% for methanol solvent after 24, 48 and 72h, respectively. On the other hand the concentrations of 2 and 3% gave moderate effectively with average

reduction 50.39 and 68.06 % for acetone solvent respectively and 56.76 and 58.15 % reduction percentages for methanol solvent respectively. From the result in Tables (1 and 2) evidenced the plant extracts of *P. dioscoridis* were more effective than those extracted from *S. septemtrionalis* plant. Statistical differences were found for concentration and extracts and solvents in *P. dioscoridis* treatments.

Table (2): Effect of *pulchea dioscoridis* extracts on adult females of *Tetranychus urticae* under laboratory condition.

Concentrations	Solvents	Effects	<i>P. dioscoridis</i> reduction %			Average
			1 day	2 days	3 days	
1%	Acetone	Reduction	25.00 %	44.49 %	57.30 %	42.26 %
		Effect	7.50 ± 1.18 c	5.40 ± 1.26 b	3.80 ± 1.32 c	5.56 ± 1.25d
	Methanol	Reduction.	39.00 %	47.95 %	62.92 %	49.95 %
		Effect	6.10 ± 1.73 b	5.10 ± 1.91 b	3.304 ± 1.72 c	4.83±1.78c d
2%	Acetone	Reduction.	42.00 %	51.02 %	58.16 %	50.39 %
		Effect	5.80 ± 0.79 b	4.20 ± 0.92 a b	2.50 ± 1.42 a b	4.16 ±1.04Bc
	Methanol	Reduction.	48.00 %	57.14 %	65.16 %	56.76 %
		Effect	5.20 ± 1.40 a b	4.20 ± 1.87 a b	3.10 ± 1.91 c	4.16 ±1.72b c
3%	Acetone	Reduction	43.00 %	58.16 %	73.03 %	68.06 %
		Effect	5.70 ± 1.55 a b	4.10 ± 2.02 a b	2.40 ± 1.36 a b	4.06 ± 1.64b
	Methanol	Reduction	49.00 %	59.18 %	66.29 %	58.15 %
		Effect	5.10 ± 2.55 a b	4.00 ± 2.62 a b	3.00 ± 2.44 b c	4.03 ± 2.53b
4%	Acetone	Reduction	52.00 %	66.32 %	76.40 %	64.90 %
		Effect	4.80 ± 1.03 a b	3.30 ± 1.25 a b	2.10 ± 0.99 a b	3.40 ±1.09a b
	Methanol	Reduction	53.00 %	68.36 %	74.15 %	65.17 %
		Effect	4.70 ± 1.83 a b	3.10 ± 1.37 a	2.30 ± 1.16 a b	4.36 ± 1.45c
5%	Acetone	Reduction	55.00 %	69.38 %	86.51 %	70.29 %
		Effect	4.50 ± 0.90 a	3.00 ± 0.94 a	1.20 ± 0.63 a	2.90 ± 0.82a
	Methanol	Reduction	56.00 %	72.44 %	82.02 %	70.15 %
		Effect	4.40 ± 1.58 a	2.70 ± 1.58 a	1.60 ± 1.26 a	2.90 ± 1.47a
F value			4.93	5.50	8.84	6.88
M. S			10.09	12.04	16.52	11.87

3.2 3.2. Effect of extracts on *T. urticae* eggs

The results in Table (3) showed that the ovicidal action of experimented natural extracts extracted from *S. septemtrionalis* and *P. dioscoridis* by methanol solvent against eggs of *T. urticae* were effective

on eggs and reduced the hatching of eggs. But the *P. dioscoridis* extract was the highest effect than the other one and the highly concentrations were more effective than the lowest concentrations. The concentrations of 4 and 5% recorded 64.55 and 67.72 % reduction percentages respectively for *P. dioscoridis* extract and

46.56 and 54.49 % reduction *septomtrionalis* extract after 6 days from percentages, respectively for *S.* egg laying and sparing.

Table (3): Effect of *Senna. septentrionalis* and *P. dioscoridis* extracts on eggs of *Tetranychus urticae*.

Concentrations	<i>S. septentrionalis</i>		<i>P. dioscoridis</i>	
	Reduction (%)	Hatching (%)	Reduction (%)	Hatching (%)
1%	34.39 f g	65.61	28.04 g	71.96
2%	35.44 f	64.56	41.79 d	58.21
3%	44.44 cd	55.56	45.50 c	54.50
4%	46.56 bc	53.44	64.55 a	35.45
5%	54.49 b	45.51	67.72 a	32.28

In columns, values followed by the same later are not significantly differences at 5% level of probability.

Whereas, the low concentrations of 1, 2 and 3% didn't reach to 50% reduction, and they recorded 28.04, 41.79 and 45.50 % reduction percentages for *P. dioscoridis* extract respectively and 34.39, 35.44 and 44.44% reduction percentages for *S. septentrionalis* extract at 1, 2 and 3% concentrations, respectively.

3.3 3.3. Effect of plant extracts on *T. urticae* population infesting cucumber plants under field conditions

The acaricidal effects of the four plant extracts obtained from *S. septentrionalis* and *P. dioscoridis* against *T. urticae* population on cucumber crop (*Cucumis sativus*) in the field are summarized in Table (4). The results congruous with those obtained from the laboratory experimental. When the plant extracts applied at 4% concentration at the field on cucumber crop, the *P. dioscoridis* recorded higher reduction percentages with both solvents within 63.23, 64.33,

76.82, 51.47 and 37.80% reduction and average reduction was 58.73% for methanol and 45.81, 54.82, 71.81, 63.88 and 25.61% reduction percentage with mean 52.38% for acetone after one day, three days, one week, two weeks and three weeks, respectively. While, the *S. septentrionalis* extracts recorded 31.97, 41.07, 54.53, 53.45 and 62.43% reduction percentages for methanol solvent after one day, three days, one week, two weeks and three weeks with average 48.69%. While when extracted by acetone solvent gave 31.31, 58.40, 45.10, 44.61 and 41.95% reduction percentage after one day, three days, one week, two weeks and three weeks, respectively with average 44.37%. Whole plant extracts reach above 50% mortality after 7 days. The reduction percentages starting in decrease after two weeks from applied, expect methanol extract of *S. septentrionalis* it still rise until the third week. Statistical analysis showed significant difference among the treatments and solvents.

Table (4): Effect of *Senna septentrionalis* and *P. dioscoridis* extracts on *Tetranychus urticae* at the field.

Extracts	Days		One day	Three days	One week	Two weeks	Three weeks	Average
	Solvents							
<i>S. septentrionalis</i>	Acetone	Reduction	31.31 %	58.40 %	45.10 %	44.61 %	41.95 %	44.37 %
		Effect	23.70 ± 12.05 a	18.30 ± 10.12 a	17.20 ± 10.85 a	22.70 ± 25.43 a	14.20 ± 8.51 a b	19.22 ± 13.48
	Methanol	Reduction	31.97 %	41.07 %	54.53 %	53.45 %	62.43 %	48.69 %
		Effect	16.20 ± 6.96 a	19.00 ± 8.89 a	12.50 ± 6.31 a	19.40 ± 12.19 a	9.20 ± 2.35 a	15.26 ± 7.34
<i>P. dioscoridis</i>	Acetone	Reduction	45.81 %	54.82 %	71.81 %	63.88 %	25.61 %	52.38 %
		Effect	20.10 ± 10.53 a	23.00 ± 14.37 a	9.40 ± 7.09 a	10.90 ± 7.78 a	22.10 ± 15.58 b c	17.08 ± 11.07
	Methanol	Reduction	63.23 %	64.33 %	76.82 %	51.47 %	37.80 %	58.73 %
		Effect	21.90 ± 10.12 a	23.70 ± 11.01 a	12.30 ± 10.04 a	23.30 ± 12.46 a	29.40 ± 6.65 c	20.32 ± 10.05

F value = 14.77, M.S. = 813.59.

4. Discussion

Tetranychus urticae is a global pest in greenhouse production and field crops, infesting many vegetables crops such as tomatoes, peppers, cucumbers and strawberries. Control *T. urticae* with chemical acaricides due to their ability to develop resistance to chemical groups after a few years of use (Inac et al., 2019). While, no resistance was noted to essential oils in mites (Abd El-Moneim et al., 2012). Based on present study, the plant extracts which extracted from *P. dioscoridis* are promising for the control of *T. urticae* and both of acetone and methanol were favourable to plant extraction. The present results of *P. dioscoridis* are in agreement with those documented by Ebadollahi et al. (2016), Ebadollahi et al. (2017), Fatemikia et al. (2017) and Nicolle et al. (2016). Example, Pervin and Ayşegül (2016), they evaluated the efficacy of insecticides extracted from three different

plants such as *Xanthium strumarium* L., *Tanacetum parthenium* L. and *Hypericum calycinum* L. against green peach aphid (*Myzus persicae* Sulzer) and found the extracts showed nymphal mortality of 89%, 88% and 57%, respectively at the highest concentration (12%). The *S. septentrionalis* extracts were less toxic effect on *T. urticae* and the methanol solvent was unfavourable for extraction it. The results also agreement with Premalatha et al. (2018); they demonstrated that, Among 20 plant species, the aqueous extract of *Sesbania grandiflora* when applied on *T. urticae* females at concentration 10 % under laboratory condition caused highest mortality percent of 94.43% after 72 hours from treatment, and the reduction percentages of 7 plant extracts ranged from 85.57% to 74.43% after 72 h. from treatment. Further, the aqueous extract of *Jatropha curcas*, *Leucaena leucocephala*, *Senna auriculata*, *Cassia fistula* and *Anacardium occidentale*

caused more than 50 percent mortality of *T. urticae* females. The results of this study explained that the plant extracts when applied in the open field against *T. urticae* on the vegetable plants loses their effect after one week form applied. So, the extracts could be useful against *T. urticae* on vegetable crops.

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