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Evaluation the effectiveness of vermicompost and vermicompost tea on the tow-spotted spider mite, *Tetranychus urticae* Koch

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Abstract
Series experiments were conducted to evaluate the impact of using vermicompost tea, vermicompost and their combination against *T. urticae* (Koch) beside investigated their effect on *T. urticae* reproduction under greenhouse conditions. Four different rates of vermicompost tea (50,100,150, and 200g) were added to soil by three different methods of application beside the combination of vermicompost and vermicompost tea. Data showed that the highest redaction percentage of *T. urticae* (96.7%) was obtained by using vermicompost rate (50g) to soil, while it was 95.83% by the using of vermicompost tea spray and its addition to soil. Whereas, the highest redaction percentage of *T. urticae* was achieved by using the combination of both vermicompost (50g) and (100g) with the using of spray vermicompost tea, where it was (96.2%) and (97.15%), respectively. In all treatments, there were significant differences in reducing *T. urticae* population on pepper between treatment and the check.

Keywords: *T. urticae*, vermicompost tea, vermicompost

Introduction
Tetranychus urticae Koch (Acari: Tetranychidae) is one of the most important mite widely spread among the different plant hosts causing serious yield damages and leads to economic losses. Despite the possibility of controlling spider mites below the economic threshold level by using chemical acaricides, its excessive use causes environmental pollution and intrinsic hazarders to human, plants and animal life's (Wilson 1993 and Wilson *et al*.,1991) [16, 15]. Therefore, the use of new eco-friendly alternative strategies and safer on non- target organisms like vermicompost and vermicompost tea (Arancon *et al*., 2003 and 2007, Edwards *et al*., 2007) [3, 1, 8] has become very necessary. Vermicomposts which are produced from organic wastes by interactions between earthworms and microorganisms in a mesophilic process are finely divided fully stabilized organic materials with large microbial population and activity. Low vermicompost application rates in the field, or substitution into plant growth media in the greenhouse have been shown to increase crop growth dramatically and significantly independent of nutrient supply (Edwards and Arancon, 2004) [7]. In our preliminary laboratory experiments, vermicomposts have shown strong affects on arthropod pests population like aphids and cabbage white caterpillars causing its suppress (Edwards and Arancon, 2004; Arancon *et al*., 2005) [7, 2]. Rao *et al*., 2001 and Rao 2002 [12, 13] reported that vermicomposts suppressed number of jassids, aphids and spider mites.
Accordingly, the present study was conducted with an aim to focus on using vermicompost and vermicompost tea by determine the effectiveness of liquid botanicals compost on the reproduction of the tow-spotted spider mite *T. urticae* on *Phaseolus valgaris* L. plants to check their efficacy in suppressing it, in addition to their enhancement to plant growth under greenhouse conditions.

Material and Methods
Rearing of *T. urticae*
P. valgaris seeds were transplanted in pots (20 cm in diameter) and all agriculture practice was followed. Three weeks after plantation, plants were infected by spider mites, *T. urticae* and were left for approximately 60 days until mites population increased.

Preparation of liquid botanical compost (vermicompost tea)
According to Brinton *et al.* (1996) [4], preparation of each liquid compost was undertaken from solid phase at three stages as follows.

1. Preparation stage: Botanical compost and water were mixed in proportion in dilution ratio 1:5 (w\v) since 1kg of each solid compost was pot in a plastic tank thereafter it stocked in 5 liters of tap water.

2. Extraction stage: The compost mixture was turned on aquarium pump, then soaked over 24 hours and stirred for about 2 hours until the water color overturned to brown and extract had no smell.

3. Filtration stage: After brewing, the compost tea mixture was strained in another bucket by the aid of cheese cloth. Plant extracts were kept in open plastic flasks.

Source of compost
Center lab of Organic Agriculture (CLOA), Agriculture Research Center.

Experimental Technique
Kidney been were infected by *T. urticae* after 25 days of planting, and then left for 15 -20 days.

The experiment consists of three parts

1. The use of vermicompost tea alone where it was used in three different ways, which were considered the three treatments used (20 mL for each replicate in the treatment) as follows:

a. Spray vermicompost tea on the plant by using hand sprayer
b. Add a vermicompost tea to the soil
c. Spraying vermicompost tea on the plant and adding vermicompost tea to the soil

2. The use of vermicompost alone where it was added to the soil during agriculture at four different rates, which are 50, 100, 150 and 200 g to represented the treatments used.

3. Use a combination of both vermicompost and vermicompost tea where vermicompost was added to the soil during agriculture at four different rates, which are 50, 100, 150 and 200 g and then, after 15-20 days of plants infection by *T. urticae*, they were sprayed with vermicompost tea at a rate of 20 ml for each replicate in the treatment.

4. Abamectin was used in the experiment as an acaricide.

In all experiments, each pot contained three plants, and each treatment was repeated four times. In all treatments numbers of dead mites were counted and recorded one, three, five and seven days after treatment and also in the check which was not treated.

Statistical analysis

Statistically analyzed of data were done by using analysis of variance program (ANOVA) (Gomez and Gomez, 1984) [9] followed by Multiple Range Test to compare means (Duncan, 1955) [6]. Percentage of reduction was estimated and corrected according to the equation of Henderson and Tilton (1955) [10].

Results

Effect of vermicopost tea on spider mites, *T. urticae*

Table (1) showed the effectiveness of Vermicompost tea against *T. urticae* by using three different methods of application under greenhouse conditions. Results indicated that number of *T. urticae* redacted from 1.75 to 0.332 after seven days of using vermicompost tea spray and addition to soil. One, three, five and seven days after treatment the mean numbers of *T. urticae* recorded by the use of abamectin were 0.25, 0.0, 0.0 and 0.0 mites, respectively where they decreased compared to numbers recorded before the treatment which was 5. It noticed that all treatments used caused significant reduction in *T. urticae* numbers compared to the check.

Table 1: Efficiency of using Vermicompost tea applied by three different methods against *T. urticae* under greenhouse conditions.

Treatment	Before spraying	After spraying			
		1 day	3days	5days	7days
Vermcompost(S)	12.65a ±1.31	8.25a ±1.43	2b ±0.70	3.75c±1.37	1.75b ±1.10
Vermcompost(S+A)	1.75d ±0.25	2.25bc±1.03	1.5b ±0.86	10.5b±2.72	0.33b ±0.23
Vermcompost(A)	9.65 ±0.62	3bc ±1.22	1.5b±0.64	3.25c±1.1	5b ±1.08
Abamectin	5c±0.40	0.25c ±0.25	0b	0b	0b
Check	1.25d ±0.25	4.5b±0.64	21.5a±2.87	34.75a±2.75	28.25a ±3.42
LSD	2.089	3.04	4.245	5.735	5.076
F	51.57	8.77	41.63	54.98	50.822
P	0.0000	0.0007	0.0000	0.0000	0.0000

Values followed by the same letter (s) in a column are not significantly different according to Duncan's test at level 0.05.
(S)= spray (S+A)= spray + added to soil (A)= added to soil

Effect of vermicopost on spider mites, *T. urticae*

Data represented in table (2) indicated that the mean number of *T. urticae* decreased from 5 mites, before spraying to 0.25, 0, 0 and 0 after one, three, five and seven days of treated by Abamectin, respectively. While, it was decreased from 16.5 mites, to 6, 3, 1.75 and 1.75 by the use of vermicompost (rate100g), and from 4.75 to 2, 2, 7.25 and 5.25 mites by the use of vermicompost (rate150g), where it was found that abamectin caused the highest rate of *T. urticae* reduction followed by vermicompost (rate100 g) then vermicompost (rate 150g) which was the least effect.

Table 2: Efficiency of using four rates of Vermicompost applied on soil against *T. urticae* under greenhouse conditions.

Treatment	Before spraying	After spraying			
		1day	3days	5days	7days
Vermicompost50g	11.25b±0.47	3.25abc±1.65	4.25 b±1.03	3bc ±1.68	2bc ±0.91
Vermicompost100g	16.5a ±3.12	6a ±1.68	3bc ±0.91	1.75c±1.43	1.75bc±0.85
Vermicompost150g	4.75c ±0.85	2bc ±1.35	2bc ±1.22	7.25b±2.42	5.25b±1.70
Vermicompost200g	0.25d ±0.25	3.25abc ±1.03	2.75bc ±0.47	2c±0.57	3.7bc±1.19
Abamectin	5c ±0.40	0.25c ±0.25	0c	0c	0c
Check	1.25cd±0.25	4.5ab±0.64	21.5a±2.87	34.75a±2.75	28.25a±3.42
LSD	4.022	3.626	4.17	5.243	5.08
F	21.218	2.641	31.71	56.514	38.73
P	0.0000	0.0583	0.0000	0.0000	0.0000

Values followed by the same letter (s) in a column are not significantly different according to Duncan's test at level 0.05

Effect of the combination of vermicompost and vermicompost on spider mites, *T. urticae*

Data in table (3) showed that the mean number of *T. urticae* individuals decreased from 4.25 mites, before treated with the combination of vermicompost (150g) and vermicompost tea (20 mL) to 1.25, 3.5, 0.5 and 1.5 at one, three, five and

seven days post treated, respectively. And, it was decreased from 15.5 mites, to 2, 3, 6.5 and 3 after treated with the combination of vermicompost (100g) and vermicompost tea (20 mL). Also, their effect on *T. urticae* reproduction was clearly noticed.

Table 3: Efficiency of using a combination of vermicompost and vermicompost tea against *T. urticae* under greenhouse conditions.

Treatment	Before spraying	After spraying			
		1day	3days	5days	7days
Vermicompost50g+S	10.75b±1.88	1c±0.40	4.25b±0.478	7b ±1.47	4.5b ±1.75
Vermicompost 100g+S	15.5a±0.5	2bc±1.08	3bc±1.47	6.5b±1.84	3b±0.57
Vermicompost 50g+S	4.25c±1.25	1.25c±0.25	3.5bc±0.64	0.5c±0.28	1.5b±0.64
Vermicompost 200g+S	0.25d±	3.33ab±0.623	4.08±0.74	10.75b±0.85	3b±0.91
Abamectin	5c ±0.40	0.25c ±0.25	0c	0c	0b
Check	1.25cd±0.25	4.5ab±0.64	21.5a±2.87	34.75a±2.75	28.25a±3.42
LSD	2.887	1.825	4.135	4.531	4.911
F	36.494	6.695	30.785	70.889	41.611
P	0.0000	0.0011	0.0000	0.0000	0.0000

Values followed by the same letter (s) in a column are not significantly different according to Duncan's test at level 0.05.
(S)= spray

Data in table (4) indicated that the highest total reduction of *T. urticae* was recorded by using the combination of vermicompost (100g) and vermicompost tea (20 mL) where it was 97.15% compared with abamectin which was 99.2%. Respecting vermicompost added to soil, the highest reduction percentage of *T. urticae* was recorded by the use of vermicompost (50g) where it was 96.7% compared with abamectin (99.2%). Vermicompost at rates (100g) and (150g) achieved equal effect on *T. urticae*, where total redaction percentages of mites were 93.01% and 93.18%, respectively. When using the combination of vermicompost tea (20 mL) with vermicompost at 50g and 100g, *T. urticae* redaction percentages were 96.2% and 97.15%, respectively.

The lowest reduction percentages of *T. urticae* were recorded by the use of vermicompost (200g) where it was 51.23% and by using the combination of vermicompost tea (20 mL) with vermicompost at 200g which recorded 59.97%. In general, all treatments achieved remarkable effects in suppressing mites compared to the check, despite the varied impact by using them which appeared through our results.

Table 4. Average percentage of mortality in spider mite population traded with Vermicompost tea and farmyard Vermicompost after different interval for application.

Treatment	1day	3days	5days	7days	Total redaction%
Vermcompost(S)	5.12	99.05	99.1	99.23	93.12
Vermcompost(S+A)	78.54	93.48	73.9	98.4	86.08
Vermcompost(A)	87.74	99.1	98.77	97.73	95.83
Vermicompost50g	91.02	97.85	99.13	98.97	96.7
Vermicompost100g	84.23	98.82	89.39	99.62	93.01
Vermicompost150g	87.67	97.5	92.11	95.46	93.18
Vermicompost200g	17	36.2	71.28	80.46	51.23
Vermicompost50g+S	94.6	97.3	96.6	96.2	96.2
Vermicompost100g+S	92.8	98.4	98.5	98.9	97.15
Vermicompost150g+S	89.8	90.9	99.4	97.2	94.32
Vermicompost200g+S	40	78	75	46.9	59.97
Abamectin	96.8	100	100	100	99.2

(S)= spray (S+A)= spray + added to soil (A)= added to soil

Discussion

There is a very sparse literature recording the suppression of pest arthropods that attack crop plants sucking plant foliage by vermicompost, and most is published in rather obscure journals. For instance, there have been reports of vermicomposts suppressing attacks of sucking insects, such as jassids, aphids, and spider mites very significantly on groundnuts in India (Rao, 2002, 2003) [13,14]. Arancon *et al.* (2007) [1], reported the effectiveness of solid vermicompost use on the arthropod pests where they found that spider mites, mealy bugs and aphids populations can suppressed by them in the field. Edwared *et al*., (2007) [8] noted decreased of spider mite numbers by the use of three soil application rates of vermicompost tea 5, 10, and 20% beside their effect in reducing the damage value caused by spider mites significantly compared with the check. Rao, 2002 and 2003 [13, 14], reported the very significantly effect of vermicomposts in suppression attacks of sucking insects like jassids, aphids and spider mites on groundnuts in India. Other workers indicated that almost all of the mixtures which containing vermicomposts had the ability to suppress the arthropod pest, population, and decreased its damage significantly, compared with the check. On the other hand, the vermicomposts did not only make plant less attractive to the pest but they also had considerable effects on pest reproduction over time. The effects of the vermicompost substitution tended to be least on spider mites, intermediate on mealy bugs and greatest on aphids; however this may related to the motility of the pests, as well as to suppression potential of vermicomposts (Arancon *et al*., 2007) [1]. Vermicompost can also suppress arthropod pests such as caterpillars: including cabbage while caterpillars, tomato hornworms, and cucumber beetle, as well as sucking arthropod: such as scale insects, mealy bugs, aphids and

spider mites (Arancon *et al*., 2005) [2]. However, Arancon *et al*., (2007) [1] found that the suppression of aphids and spider mites by vermicompost tea were very similar to those obtained from growing plants in the greenhouse. Mistry and Mukherjee (2015) [11] observed vermicompost tea suppressed population of plant roots nematode parasitic, spider mite and aphids significantly**.** Also, Doaa Abou El-Atta (2017) [5] found that the use of two compost, tea rice straw and farmyard manure against the spider mite caused the highest redaction present ages of *T. urticae* (87.46%) which obtained by spray the plant with (R.W) and added it to soil, while the effect of using (Fym) by spray and added to soil were equal, where redaction percentages by them recorded 83.7% and 82.4%, respectively.

Conclusion

The highest reduction of *T. urticae* was showed by using the combination of vermicompost (100 g) and vermicompost tea (20 mL) while the use of vermicompost (200 g) was found to be the lowest effect in reduce mites. Despite the variation in the effect of the mentioned different treatments on suppression and reproduction of *T. urticae*, there were clearly noticed compared to the check.

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