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Evaluation of certain insect pests response to the application of several types of organic fertilizers on eggplant under rooftop cultivation conditions

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Abstract

Compost and compost tea can be used to combat soil fertility problems by improving its physical, biological and chemical properties, in addition to their indirect effect in controlling pests. The present study showed that compost and compost tea showed significant effects on the tested insects [the green peach aphid, *Myzus persicae* Sulzer (Hemiptera: Aphididae), the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae), and the potato tuber moth, *Phthorimaea operculella* (Zeller) (Lepidoptera, Gelechiidae)] infesting eggplant plants under rooftop conditions; where the inhibitory effects of compost and compost tea on the tested insects were highly significant effect, and significantly increased by the elapsed time after treatments application, unlike the pesticides, which demonstrated a direct effect after its application on the aforementioned pests. This makes both compost and compost tea promising methods that can be combined into an integrated framework with other control methods through integrated pest management (IPM) programs.

Keywords: *Myzus persicae*, *Phthorimaea operculella* certain insect pests

Introduction

Environment-friendly agriculture substitutes (like compost and compost tea) promote increases of soil organic matter, microbial activities, gradual releases of plant nutrients, and reduce the amounts of toxic compounds (such as nitrate) produced by chemical fertilizers; so, improve physical, biological and chemical properties of the soil; which derive plants to more balanced nutrition (Albiach *et al.*, 2000; Andrews *et al.*, 2001; Baziramakenga & Simard, 2001; Arancon *et al.*, 2005; Salman *et al.*, 2007 and Mahmoud *et al.*, 2009) [4, 10, 16, 12, 71, 48]. Some of organic fertilizers contained toxic agents such as boron, cadmium, cobalt and inorganic salts (Gleason *et al.*, 1969; Mousa & El-Sisi, 2001; Abdel-Wahab & El-Sisi, 2001 and Ebaid & Mansour, 2006) [39, 54, 1, 29]; which proved pesticidal activity against some insect pests; so, composts can be used to combat the problems of soil fertility in addition to pest management thereby decrease herbivorous insect populations (Akanbi *et al.*, 2009; Mehta *et al.*, 2014 and Pane *et al.*, 2015) [29, 51, 61]. However, available information on the relative toxicity of some organic additives to insect pests is limited.

The green peach aphid, *Myzus persicae* Sulzer (Hemiptera: Aphididae) is a worldwide polyphagous pest; it has a wide host range and can harm more than 400 plant species from 50 families, mainly Solanaceae, Cruciferae, Compositae, Leguminosae, and Malvaceae (Rajendra *et al.*, 2015; Zienab *et al.*, 2021 and Ata, 2024) [70, 75, 13] resulting in serious economic losses (Davis *et al.*, 2007 and Bai *et al.*, 2015) [27, 15]. This aphid feeding on the sap leads to chlorosis and necrosis spots, honeydew production, transmission of plant viral diseases, and a dramatic reduction in the marketability of crops (Satar *et al.*, 2008; He *et al.*, 2017; Mulot *et al.*, 2018 and Nampeera *et al.*, 2020) [72, 41, 55, 57].

The pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae) is native to Southern Asia and has established in many countries in tropical and subtropical regions throughout the world. This insect pest is a highly polyphagous insect, feeding on 229 genera of plants belonging to over 78 families, including some vegetables from the Solanaceae family, such as eggplant, *Solanum melongena* (EPPO, 2025) [32] and tomato, *Solanum lycopersicum* L. (Marsaro Jr. *et al.*, 2013) [52], and also some economically important crops from the Malvaceae family, like cotton (*Gossypium* spp.), which may be significantly affected by *M. hirsutus* (EPPO, 2025) [32], as well as some other hosts in the legume and berry families (CABI, 2015 and Garcia Morales *et al.*, 2016) [21, 37].

The potato tuber moth, *Phthorimaea operculella* (Zeller) (Lepidoptera, Gelechiidae) is a

serious pest that has been found feeding on more than 60 plants in different parts of the world with the majority of the hosts belonging to the Solanaceae family (Das and Raman, 1994) ^[25]. This pest causes significant economic losses in potato production (under both field and storage conditions) in subtropical and tropical areas; where more than 50% of plant infestations and 100% damage on tubers were recorded under storage conditions (Das *et al.*, 1992 and Ali & Naziri, 2019) ^[26, 6]. After potato harvest, the pest remains in the field and feeds on other solanaceous plants such as tomato and eggplant (Gilboa and Podoler, 1995 and Primiya *et al.* 2022) ^[38, 67].

The previously mentioned insect pests (*M. persicae*, *M. hirsutus* and *P. operculella*) are of the serious insect pests infesting eggplant (*Solanum melongena* L.) plants (Rahouma, 2018; Ata, 2024 and EPPO, 2025) ^[69, 13, 32], which is considered as the fifth most economically important solanaceous crop after potato, tomato, pepper, and tobacco (FAO, 2014) ^[34]. Insect pests play a vital role in lowering eggplant yield, by attacking the plants from the nursery till harvesting stage (Borkakati *et al.*, 2019) ^[19]. About 53 species of pests attack eggplant plants worldwide (CAB International, 2017) ^[21] including lepidopterans, leafminers, leafhoppers, whiteflies, aphids, thrips, mealybugs, and spider mites; which are considered as important pests affecting eggplant yield (Rahouma, 2018; Kumar *et al.*, 2019; Nayak *et al.*, 2021; Ata, 2024 and EPPO, 2025) ^[69, 45, 58, 13, 32].

According to Patriquin *et al.* (1995) ^[62], Arancon & Edwards (2004) ^[11] and Arancon *et al.* (2005) ^[12], the application of organic matters to soils may decrease the populations of insect pests. Therefore, this study aimed to test this approach against the populations of green peach aphid (*M. persicae*), the pink hibiscus mealybug (*M. hirsutus*), and potato tuber moth (*P. operculella*) infesting eggplant through treating the soil by adding compost and compost tea at different rates (as organic fertilizations) to verify their effects on the aforementioned insect pests, under rooftop conditions, compared to the recommended insecticide for each pest.

Materials and Methods

Preparations of rooftop cultivation experiments

As a first step for preparation to carry out these experiments, about of 500 newly seedlings of eggplant were purchased from a nursery at Mansoura district, Dakahlia governorate. After approximately a month, plants of eggplant were divided into three groups. The first and second groups were infested artificially by placing leaves infested with the green peach aphid, *Myzus persicae* Sulzer and the pink mealybug, *Maconellicoccus hirsutus* (Green), respectively, which were collected from eggplant farm at Faculty of Agriculture, Mansoura University. As for the third group, it was naturally infested with the potato tuber moth, *Phthorimaea operculella* (Zeller); therefore, we decided to subject it to test using the same experimental treatments. Furthermore, plastic agricultural basins were prepared (each one measuring as 40 cm length, 40 cm width and 25 cm height), which were designated for rooftop cultivation, where the soil was treated with compost, and the eggplant plants transferred and cultivated in it subsequently to start implementing experiments, with five plants per pot as replication, and all cultivation operations in all groups were carried out according to traditional agricultural management practices for eggplant varieties.

Treatments used in the experiments

Compost and compost tea were obtained from Al Shafei Agricultural Investment Company. According to this company, compost and compost tea (Table, 1) were prepared as recycling farm waste, whether plant or animal, in addition to organic environmental waste, after composting it for a period ranging between 55 and 70 days, in order to activate the work of aerobic bacteria necessary for the decomposition of organic materials and the release of elements present in the components, which ultimately leads to raising the temperature of the product to degrees reaching 70 degrees Celsius; which is capable of eliminating all pathogens and parasites that are harmful to plants and soil alike. The final product is also rich in minerals and all the elements necessary for plants, especially organic farming. Compost tea is a dark brown viscous liquid; it is a natural preparation containing a group of beneficial bacteria, organic compounds, and natural nutritional elements.

Table 1: Main components and some characteristics of compost and compost tea.

Compost		Compost tea	
Cubic meter weight	780 kg	Density	1.24 gm/cm ³
pH (1:10)	6.56	pH (1:10)	6.90
Electrical conductivity (EC) (1:10)	4.39 ds/m	Electrical conductivity (EC) (1:10)	2.8 ds/m
Total nitrogen	0.56%	Total Nitrogen	4.52% (w/v)
Ammonium nitrogen	81 ppm	Potassium	13.10% (w/v)
Nitrate nitrogen	553 ppm	Phosphorus	393.10 mg/L
Organic matter	24.23%	Boron	2.10 mg/L
Organic carbon	14.05%	Manganese	19.10 mg/L
Ash	75.77%		
C:N ratio	1:25	Zinc	0.70 mg/L
Total phosphorus	0.57%		
Total potassium	0.755	Copper	mg/L
Moisture	20%		

For using treatments from different types of organic fertilizers, three rates of compost (50, 60 and 70 gm) and also, three concentrations of compost tea (40, 45 and 50%) were prepared for experimental application by adding to soil. For insecticides, tow types were used as supplementary

treatments (Medamec 1.8% EC and Spanfek 10% SC). Medamec 1.8% EC was used against *M. persicae* and *M. hirsutus*, where abamectin belonging to avermectin group of insecticides, whereas, Spanfek 10% SC was utilized against *P. operculella* and belonging to spinosad group of

insecticides. Both insecticides were obtained from Plant Protection Research Institute, Agricultural Research Center, Dokki, Egypt, and applied by spraying using hand sprayer at the recommended rates.

Rooftop cultivation experiments applications

For each insect species (*M. persicae*, *M. hirsutus*, and *P. operculella*), eight treatments were applied, including three rates of compost (50, 60, and 70 g per replicate as a soil addition), three concentrations of compost tea (40, 45, and 50% as a soil addition, at 40 ml per replicate), and insecticide treatment by spraying with the recommended rate of use, beside the control where the soil was irrigated only with water without any other additions. Each treatment was repeated four times. According to the recommended estimation protocol of the used insecticides. The number of individual alive insect pests for each of the above-mentioned tested species was counted and recorded immediately before treatment applications and then 3, 5, 7, and 10 days after treatment, and a similar process was also performed in the control.

Statistical analysis

Agricultural basins of all treatments were arranged in a completely randomized design. Numbers of each insect species were analyzed according to analysis of variance (ANOVA) and the standard error (SE) were used for the presents results of the bioassay test by using CoHort software (CoHort, 2004) [24] followed by Duncan multiple range tests to compare means (Duncan, 1955) [28]. Reduction percentages for each insect pest were calculated by the formula of Henderson and Tilton (1955) [42]. Also, regression analysis was performed by using CoHort software.

Results

The current experiments were conducted under rooftop cultivation conditions to assess the effectiveness of soil application of compost and compost tea as organic fertilizers, and verify their role in suppressing the tested pests, green peach aphid (*M. persicae*), the pink hibiscus mealybug (*M. hirsutus*), and the potato tuber moth (*P. operculella*) infesting eggplant plants.

1. The green peach aphid, *M. persicae*

The obtained data (Table, 2) showed that there were no significant differences between *M. persicae* populations before treatment applications in most of the prepared plants for the present experiment; where the highest population was recorded in the control; while the lowest was recorded in compost tea 40%. After three days of treatment applications (initial effect), the highest population of *M. persicae* was in the control where it was highly significant, followed by compost tea 50 and 45%, whereas, the lowest population was recorded with abamectin insecticide. So, the highest reduction percentage after three days of treatment was recorded with abamectin treatment; while, the reduction percentages caused by application of compost or compost tea were obviously low.

With respect to the residual effects of the tested treatments, the effect of abamectin was relatively stable (after 5, 7 and 10 days); while, the effects of compost and compost tea treatments were obviously increased gradually (Table, 2). After ten days of treatments' application, the population of *M. persicae* was significantly low at all treatments of compost and compost tea as well as abamectin treatment in comparison with the control, where reduction percentages reached 94.7 to 97.1% for compost and compost tea treatments, and 99.2% for abamectin, respectively.

The general mean effect revealed that abamectin was obviously the highest effective treatment which showed the lowest mean population of *M. persicae* and highest mean reduction percentage. For compost and compost tea treatments, the mean populations of *M. persicae* was significantly less than control (6.4 to 20.7% of the population in the control) with mean reduction percentages ranged between 62.3 and 70.4% (Table, 2).

Mathematically as shown in Figure (1), reduction percentages caused by the tested treatments on *M. persicae* population increased by the elapsed time. The highest increases were recorded with compost tea 50% and 45% treatments; where each elapsed one day after treatment increased the reduction percentage by 12.0% and 11.9%, respectively ($R^2 = 0.8271$ and 0.8473). While, the lowest increase of the reduction percentages was recorded with the tested insecticide (abamectin); where each elapsed one day after treatment increased reduction percentage by 7.3% ($R^2 = 0.6417$).

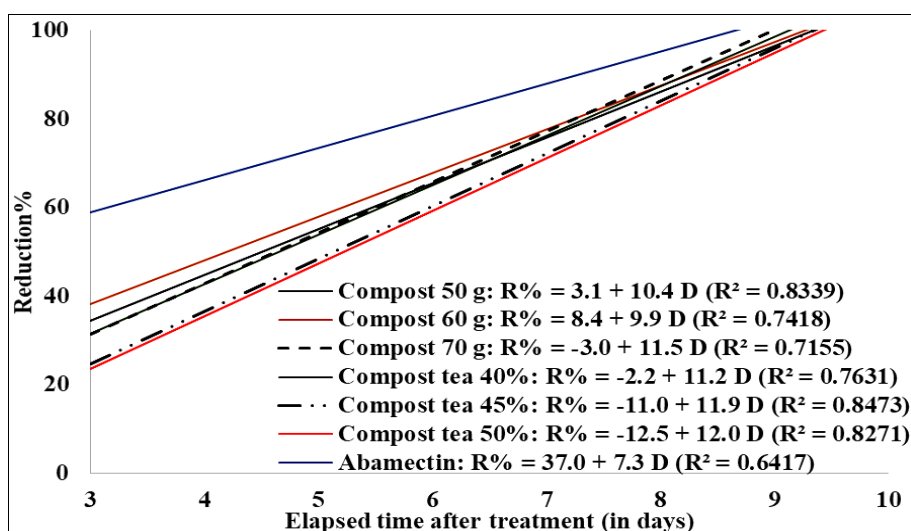


Fig 1: Effect of elapsed time on reduction percentages of *M. persicae* population caused by different rates of compost and compost tea in comparison with abamectin on eggplant plants under rooftop cultivation conditions.

2. The pink hibiscus mealybug, *M. hirsutus*

Data illustrated in Table (3) showed that there were no significant differences between *M. hirsutus* populations before treatment applications in most of the prepared eggplant plants for the present experiment; where the highest population was recorded only in compost tea 40% treatment; while the populations in the rest treatments were statistically equals. After three days of treatment applications (initial effect), the highest population of *M. hirsutus* was significantly higher in the compost tea treatments and the control (with no significant difference between them), while the pest population in the other treatments ranked the second (with no significant difference between them). So, the reduction percentages after three days of treatments' applications were pretty close together; where the reduction percentages ranged between 34.7% (with compost tea 40% treatment) and 53.6% (with compost 60 g treatment).

Table (3) also showed the residual effects of the tested treatments; where the effects of all treatments (rates of compost, compost tea and abamectin) on *M. hirsutus* population were obviously increased gradually. After ten days of treatments' application, the populations of *M. hirsutus* were significantly low at all treatments of compost and compost tea as well as abamectin treatment (with no significant differences between them) in comparison with the control (which had the highest population). Also, reduction percentages were pretty closed together; where it

ranged between 88.5% (with compost tea 45% treatment) and 97.8% (with compost tea 40% and 50% treatments).

As indicated in Table (3), the general mean effect revealed that population of *M. hirsutus* was obviously the highest in the control, and the population in compost tea 40% ranked the second (51.8% of the population in the control); while the populations of *M. hirsutus* in the rest treatments were pretty closed together with obvious low values in comparison with treatment of compost tea at 40% or the control. On the another hand, abamectin showed the highest mean reduction percentage of *M. hirsutus* population (75.7%); while the mean reduction percentages caused by compost and compost tea treatments ranged between 67.5% (with compost 50 g treatment) and 74.6% (with compost 60 g treatment).

As shown in Figure (2), reduction percentages caused by the tested treatments on *M. hirsutus* population increased by the elapsed time. The highest increase was recorded with compost 50 g treatments; where each elapsed one day after treatment increased the reduction percentage by 12.2 ($R^2 = 0.7858$). On contrary, the lowest increase of the reduction percentages was recorded with compost 60 g treatment; where each elapsed one day after treatment increased reduction percentage by 5.0% ($R^2 = 0.9017$). Regression coefficient values (b) for the other treatments ranged between 7.0 (for compost tea 45% treatment; where $R^2 = 0.8989$) and 8.7 (for compost tea 40% treatment; where $R^2 = 0.9365$).

Table 2: Effect of using different rates of compost and compost tea on *M. persicae* population infesting eggplant in comparison with abamectin under rooftop cultivation conditions.

Treatment	Rate	Pre-treatment	Effect of treatments on <i>M. persicae</i> population											
			Initial effect (After 3 days)		Residual effect								General mean	
					After 5 days		After 7 days		After 10 days		Mean			
			No.	R%	No.	R%	No.	R%	No.	R%	No.	R%	No.	R%
Compost	50 g	198±27.9	164.2±28.4	21.1	142.2±20.7	65.6	59.2±9.7	89.3	23.0±12.3	96.5	74.8	83.8	97.1	68.1
	60 g	113.2±5.2	95.0±8.1	20.4	59.2±6.9	75.4	32.2±2.4	90.1	18.2±4.1	95.5	36.5	87.0	51.2	70.4
	70 g	178.0±48.1	169.2±46.6	9.4	82.2±17.6	76.2	42.2±9.9	92.0	21.2±4.9	96.9	48.5	88.4	78.7	68.6
Compost tea	40%	102.0±22.7	95.0±23.6	12.5	53.2±10.4	72.4	23.0±3.2	89.7	5.7±2.1	97.1	27.3	86.4	44.3	67.9
	45%	248.0±5.7	231.2±9.0	11.1	221.5±9.0	57.5	80.7±10.8	88.6	38.2±7.5	95.8	113.5	80.6	143.0	63.2
	50%	241.5±25.7	233.5±24.6	7.7	197.2±15.7	60.1	96.2±13.3	86.6	54.5±20.4	94.7	116.0	80.5	145.4	62.3
Abamectin		110.7±94.9	62.7±31.6	42.2	27.7±21.5	90.7	9.7±9.7	98.3	5.7±5.7	99.2	14.4	96.1	26.5	82.6
Control		282.5±25.5	295.2±23.7	----	587.7±29.6	----	847.7±22.2	----	1079.0±8.9	----	838.1	----	702.5	----
LSD		89.2	78.9	---	52.3	---	34.1	---	28.8	---	---	---	---	---
F-value		5.3	9.0	---	103.5	---	591.1	---	1430.6	---	---	---	---	---
P-value		0.001	0.000	---	0.000	---	0.000	---	0.000	---	---	---	---	---

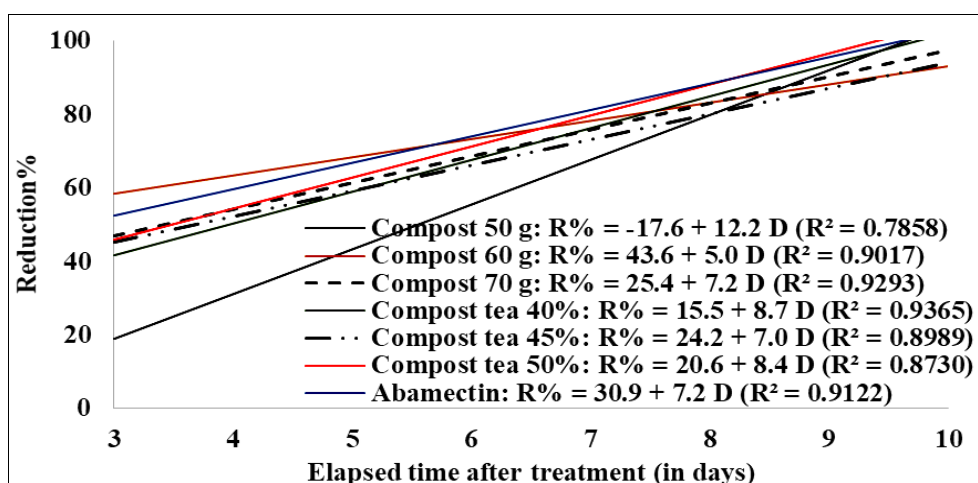


Fig 2: Effect of elapsed time on reduction percentages of *M. hirsutus* population caused by different rates of compost and compost tea in comparison with abamectin on eggplant plants under rooftop cultivation conditions.

Table 3: Effect of using different rates of compost and compost tea on *M. hirsutus* population infesting eggplant in comparison with spinosad under rooftop cultivation conditions.

Treatment	Rate	Pre-treatment	Effect of treatments on <i>M. hirsutus</i> population												General mean	
			Initial effect (After 3 days)		Residual effect											
					After 5 days		After 7 days		After 10 days		Mean					
			No.	R%	No.	R%	No.	R%	No.	R%	No.	R%	No.	R%		
Compost	50 g	14.0±2.2	10.5±1.8	35.6	6.7±1.5	60.8	3.5±1.3	82.9	2.0±0.4	90.6	4.1	78.1	5.7	67.5		
	60 g	10.7±4.7	7.2±4.1	53.6	4.2±2.4	73.0	3.0±1.5	82.1	2.0±1.1	89.7	3.1	81.6	4.1	74.6		
	70 g	13.5±1.0	9.2±0.8	41.3	5.7±0.8	66.3	3.7±0.5	81.5	1.5±0.3	93.2	3.6	80.3	5.1	70.6		
Compost tea	40%	34.7±20.6	28.0±16.7	34.7	15.0±8.8	65.9	13.2±8.7	80.8	2.5±1.6	97.8	10.2	81.5	14.7	69.8		
	45%	6.0±0.8	4.2±0.6	39.0	2.7±0.5	63.1	1.7±0.2	81.0	1.0±0.0	88.5	1.8	77.5	2.4	67.9		
	50%	23.2±11.5	16.7±7.9	36.7	8.7±4.4	70.5	4.5±2.4	88.7	1.2±0.9	97.8	4.8	85.7	7.8	73.4		
Abamectin		15.2±5.9	9.5±4.0	46.9	6.5±3.2	69.7	3.2±1.9	89.2	1.2±0.9	97.3	3.6	85.4	5.1	75.7		
Control		20.0±1.8	23.5±2.1	---	25.0±2.3	---	31.0±3.9	---	34.2±5.3	---	30.1	----	28.4	---		
LSD		25.8	20.2	---	11.4	---	10.6	---	6.0	---	---	---	---	---		
F-value		1.0	1.4	---	3.5	---	7.5	---	31.0	---	---	---	---	---		
P-value		Ns	Ns	---	0.010	---	0.000	---	0.000	---	---	---	---	---		

3. The potato tuber moth, *P. operculella*

Before treatment applications, there were no significant differences between *P. operculella* populations in all of the prepared plants for the present experiment (Table, 4). After three days of treatment applications (initial effect), the highest population of *P. operculella* significantly higher in the control, while the lowest population was recorded with spinosad insecticide (with no significant differences between it and the other tested treatments of compost and compost tea), where the highest reduction percentage after three days of treatment was recorded with spinosad treatment (76.9%); while, the reduction percentages caused by application of compost or compost tea ranged between 60.4% (in compost tea 40% treatment) and 72.9% (in compost tea 45% treatment).

As shown in Table (4), the residual effect of spinosad on *P. operculella* decreased after five days of treatment, and then increased gradually till the tenth day after treatment. With respect to the residual effects of compost and compost tea treatments, these effects were increased gradually from the first till the end of this experiment (ten days). After ten days of treatments' application, the population of *P. operculella* was significantly low at all treatments of compost and compost tea as well as spinosad treatment in comparison with the control (harbored the highest population). The reduction percentages for compost and compost tea

treatments ranged between 92.1% (in compost tea 45% treatment) and 97.5% (in compost 70 g treatment), with the highest reduction rates among the other tested treatments.

The general mean effect revealed that compost and compost tea treatments were obviously higher effective treatments on *P. operculella* population which showed the lowest mean population of the pest and highest mean reduction percentages (ranged between 81.5 and 86.9%). For spinosad treatment, the mean populations of *P. operculella* was significantly less than control (26.5% of the population in the control) with mean reduction percentage of 77.0% (Table, 4).

Mathematically as shown in Figure (3), reduction percentages caused by the tested treatments on *P. operculella* population increased by the elapsed time. The highest increases were recorded with compost 70 g treatment; where each elapsed one day after treatment increased the reduction percentage by 5.1% ($R^2 = 0.9312$), followed by treatments of compost tea 50 and 40%; where each elapsed one day after treatment increased the reduction percentage by 4.5 and 4.3%, respectively ($R^2 = 0.7978$ and 0.7701), whereas the lowest increase of the reduction percentages by elapsed time was recorded with the tested insecticide (spinosad); where each elapsed one day after treatment increased reduction percentage by 1.3% ($R^2 = 0.4800$).

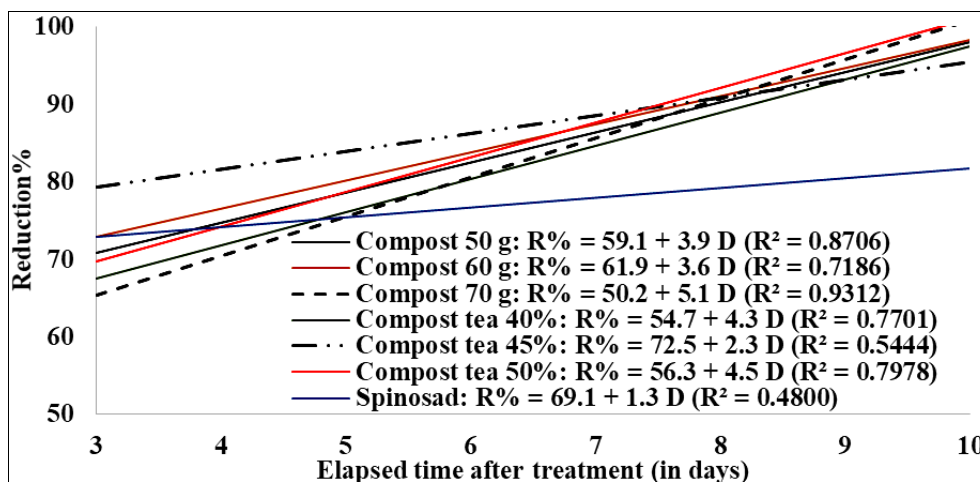
**Fig 3:** Effect of elapsed time on reduction percentages of *P. operculella* population caused by different rates of compost and compost tea in comparison with spinosad on eggplant plants under rooftop cultivation conditions.

Table 4: Effect of using different rates of compost and compost tea on *P. operculella* population infesting eggplant in comparison with spinosad under rooftop cultivation conditions.

Treatment	Rate	Pre-treatment	Effect of treatments on <i>P. operculella</i> population											
			Initial effect (After 3 days)		Residual effect								General mean	
			No.	R%	No.	R%	No.	R%	No.	R%	No.	R%	No.	R%
Compost	50 g	8.5±0.6	3.5±0.5	66.2	2.0±0.0	83.5	1.5±0.3	89.0	0.7±0.2	95.2	1.4	89.2	1.9	83.5
	60 g	10.0±0.9	4.0±0.4	66.0	2.0±0.4	86.7	1.2±0.7	92.6	1.2±0.5	93.6	1.5	91.0	2.1	84.7
	70 g	8.7±0.8	4.0±0.7	62.5	3.2±0.8	76.2	1.5±0.6	91.2	0.5±0.5	97.5	1.7	88.3	2.3	81.9
Compost tea	40%	8.0±1.3	3.7±0.4	60.4	2.2±1.1	83.3	1.5±0.6	89.3	1.0±0.4	92.8	1.6	88.5	2.1	81.5
	45%	8.2±0.9	2.7±0.5	72.9	1.0±0.4	91.8	1.2±0.2	90.8	1.2±0.6	92.1	1.1	91.6	1.5	86.9
	50%	9.7±1.1	4.7±0.7	63.7	2.5±0.5	82.9	1.0±0.6	95.0	0.7±0.5	95.8	1.4	91.2	2.2	84.4
Spinosad		8.7±0.6	2.2±0.7	76.9	4.0±1.1	70.5	3.2±0.8	76.7	2.5±0.9	83.8	3.2	77.0	3.0	77.0
Control		8.0±1.7	9.2±1.2	---	11.5±2.1	---	12.7±1.9	---	14.7±2.6	---	13.0	---	11.3	---
LSD		3.1	2.0	---	3.0	---	2.6	---	3.1	---	---	---	---	---
F-value		0.8	9.4	---	10.7	---	20.2	---	20.6	---	---	---	---	---
P-value		Ns	0.000	---	0.000	---	0.000	---	0.000	---	---	---	---	---

Discussion

Practices of soil fertility can impact the susceptibility of crop plants to insect pests by affecting the resistance of plants to attack or by altering plant acceptability to herbivores (Chau and Heong, 2005) [23]. Compost and compost tea improve physical, biological and chemical properties of the soil by increasing the soil organic matter, microbial activities, gradual releases of plant nutrients, and reduce the amounts of toxic compounds (which produced by chemical fertilizers) (Albiach *et al.*, 2000; Andrews *et al.*, 2001; Baziramakenga & Simard, 2001; Arancon *et al.*, 2005; Salman *et al.*, 2007 and Mahmoud *et al.*, 2009) [4, 10, 16, 12, 71, 48]. On the another hand, effects of fertilization on the performance of herbivores are well known (Patriquin *et al.*, 1995; Herms, 2002; Arancon & Edwards, 2004 and Arancon *et al.*, 2005) [62, 43, 11, 12]; so, Pane *et al.* (2015) [61] and Mehta *et al.* (2014) [51] reported that compost can create soil conditions which suppress pest effects, and this was clearly confirmed by the results of the current study, where compost and compost tea showed significant effects on the tested insects (*M. persicae*, *M. hirsutus* and *P. operculella*) infesting eggplant plants under rooftop conditions, where the efficacy of using compost and compost tea was very satisfactory in suppressing the populations of the tested insect pests. These findings are supported by Phelan (1997) [64], Altieri *et al.* (2012) [7], Mehta *et al.* (2014) [51] and Pane *et al.* (2015) [61]; they suggested that that application of compost has negative effects to pest pressures. Also, El-Mogy *et al.* (2021) [31] found that compost showed suppressive effects on the populations of certain insect pests (*Empoasca* spp., *Aphis gossypii*, *Bemisia tabaci*, *Thrips tabaci* and *Nezara viridula*) infesting Roseline plants. According to Arancon & Edwards (2004) [11] and Arancon *et al.* (2005) [12], composts have been shown to suppress populations of insect pests, such as aphids and caterpillars. Also, Najafabadi (2014) [56] and Ibrahim *et al.* (2016) [44] revealed that compost tea had significant effects on the population growth of *Macrosiphum rosae* and *Spodoptera littoralis*. Ibrahim *et al.* (2016) [44] added that compost tea represents insecticidal activity against *S. littoralis* and associated with the death of it. Phelan (2004) [63] reported that plants grown with organic fertilizers are usually attacked by fewer insect pests, and can tolerate pest attacks more than plants that receive conventional fertilizers. The suppressive effects of compost and compost tea on *M. persicae*, *M. hirsutus* and *P. operculella* populations may be

attributed to their contain of many components such as nitrogen, potassium, phosphorus, boron, manganese, copper and zinc which resulted a balanced nutrient for plants; then, plants achieve better growth and lower pest pressures (act as anti-insect infestations). Also, Beanland *et al.* (2003) [17] and Alyokhin *et al.* (2005) [8] reported that fertilizers containing boron, iron and zinc proportions produce largest and healthy plants; accordingly, these components are inversely correlated with certain insect pest infestations. Epstien (1972) [33] and Mortvedt *et al.* (1991) [53] added that the importance of fertilization with micronutrients (*i.e.*, iron, zinc and manganese) can be accounted by its essential role in many biological processes inside plants. So, studies of Fouda & Niel (2021) [35] and Luo *et al.* (2022) [47] revealed that the application of compost tea can significantly influence micronutrient levels in the soil; which play a crucial role in various physiological processes in plants (Bhat *et al.*, 2020; Rahman *et al.*, 2020 and Cakmak *et al.*, 2023) [18, 68, 22].

Abamectin (as one of avermectin group of insecticides) is belonging to macro cyclic lactones metabolites produced by a natural fermentation of the soil bacterium *Streptomyces avermitilis* (Omura & Shiomi, 2007 and Pitterna *et al.*, 2009) [59, 66]. Abamectin blocks the transmittance of electrical activity in nerves and muscle cells by stimulating the release and binding of gamma-aminobutyric acid (GABA) at nerve endings, which causes an influx of chloride ions into the cells, leading to hyperpolarization and subsequent paralysis of the neuromuscular system (Longato, 2024) [46]. In the present study, abamectin was evaluated against both *M. persicae* and *M. hirsutus* (as a recommended insecticide against these pests). The obtained data on *M. persicae* revealed that abamectin exhibited the highest reduction percentages on the pest population on eggplant under rooftop cultivation conditions in comparison with compost and compost tea treatments. The results are in agreement with those of Wang & Shen (2007) [74] and Attia *et al.* (2025) [14]; they reported that abamectin exhibited high effects on *M. persicae* under laboratory and field conditions. On *M. hirsutus*, the obtained results showed that abamectin showed an effect which was near to some treatments of compost and compost tea. This means that abamectin showed a relatively low effect on *M. hirsutus* population in comparison with *M. persicae* population. Also, El-Fakharany (2020) [30] and Ahsan *et al.* (2024) [2] found that abamectin showed moderate effects on the cotton mealybug

Phenacoccus solenopsis Tinsley. The present results are in the same line of the studied of Ali & Aly (2020) ^[5] and Ahsan *et al.* (2024) ^[2]; these studies concluded that abamectin was highly effective on aphid (*Breviory brassicae* (L)) more than mealybug (*P. solenopsis*).

Spinosad group of insecticides; which alter the function of nicotinic and GABA-gated ion channels, causing rapid excitation of the insect nervous system, leading to involuntary muscle contractions, tremors, paralysis, and death (Orr *et al.*, 2009) ^[60]. In the present study, spinosad showed an effective role in controlling *P. operculella* population infesting eggplant plants in comparison with the control under rooftop cultivation conditions. Meabed *et al.* (2011) ^[50] were found that spinosad was effective against *P. operculella* population under field conditions; but it was less than other biocontrol agents used, while Temerak (2003), Gomaa & El-Nenaey (2006) ^[73] and Mandour *et al.* (2009) ^[49] reported that spinosad was as effective against *P. operculella* (showed 100% protection) up to three months under storage conditions and, Gamal El-din *et al.* (2022) ^[36] found that spinosad was the highest effective treatment against *P. operculella* under laboratory conditions. The discrepancy between these studies may be attributed to differences in experimental conditions.

The present results showed that the effects of compost and compost tea on *M. persicae*, *M. hirsutus* and *P. operculella* populations increased by the elapsed time after application of treatments more than the increases of the effectiveness of the tested insecticides. This may be attributed to that compost and compost tea take sufficient period to decompose in the soil, and then then get absorbed by the roots of plants; subsequently, delayed its effect on pests' populations (this is supported by the relatively low initial effect of compost and compost tea treatments). For insecticides used, their initial effects on the tested insect pests were relatively high; which may be due to the direct effects of these insecticides on the tested pests' populations. These results may be supported by the studies of Phelan *et al.* (1996) ^[65] and Phelan (1997) ^[64]; they reported that a better balance of mineral levels is predicted under organic management because the soils have an inherent buffering capacity which results in a slowly release nutrients. The same authors added that plants can achieve better growth and lower pest pressures under optimal nutritional conditions; which provide absolute levels and proportions of nutrients in the soil solution. On the other hand, under nutrient imbalances, the metabolic machinery of the plant are impaired resulting in accumulate simple structural compounds (such as free amino acids and sugars) which favor insect nutrition (Andersen *et al.*, 2009 and Altieri *et al.*, 2012) ^[9, 7]. Accordingly, this must be verified and taken into consideration to achieve the desired results regarding pest suppression when incorporating organic fertilizers into integrated pest management (IPM) programs.

Conclusion

Finally, it is evident from the results that compost and compost tea achieved very satisfactory outcome in reducing *M. persicae*, *M. hirsutus* and *P. operculella* populations, which makes the use of these organic fertilizers a promising and respectable method that can be combined with integrated pest management (IPM) programs, especially since this effect, even if indirect, extends to suppressing the pest by making the plant unsuitable and thus undesirable,

which is not achieved by insecticides in the long term, as most pests acquire resistance due to their frequent use, which may threaten to cause outbreaks, in addition to their other disadvantages on the agricultural system and the environment that cannot be ignored.

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