Efficacy of Chemical and Biological formulations, and Plant extracts on the mortality of the third larval stage of tomato leaf moth *Tuta absoluta* (Meyrick 1917) (Lepidoptera: Gelechiidae) in vitro

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Abstract

Tomato in Iraq and most Middle East areas can be infected by tomato leave moth which contributes to reducing the total yield. Utilization of pesticides may lead to resistance problem in most of treated pests, which make the control of this difficult. In addition, chemical pesticides can cause climate pollution, and high cost if use continuously. Thus, this study investigates the efficacy of some of chemical and biological formulations and two plant extracts and its combinations in killing of the third larval stage of the insect. Three concentrations (field dose -50%, field dose and field dose +50%) for each of chemical insecticides (Coragen, Simpleo, and Acetamprid) and bioformulation of (*Bacillus thuringiensis*), and the mixture of oil extraction of garlic and Neem. Result showed that there is a significant variation between the concentration of treatments, third concentration (field recommended dose + 50%) gave the higher mortality. Treatment with Acetamprid insecticide showed a significant efficacy after 72 hours which achieved 83.33%, then Coragen insecticide by 56.66%. While, Sumipleo insecticide gave the lower mortality 36.66% of the third larval stage. The combination of evaluated factors and time exposure showed the superiority of (Bt + Coragen + Mixture of neem and Garlic oils) integrated treatment by achieving mortality of 86.66% after 72 hours of treatment, followed by mixture of garlic and neem oils 76.66% and treatment of (Bt + mixture of neem and Garlic oils) by 71.65%, while the treatment of (Bt+ Sumipleo + mixture of garlic and neem oils) gave the t mortality of 45.00% only.

Keywords: Tomato leaves moth, Neem oil, Garlic oil, Plant extracts and insecticides.

Introduction

Solanaceae families involve tomato, pepper, and aborigine which are the most important vegetable in the world and Iraq as well. Tomato plant now growing at all season, this is due to increasing of consumption of this plant. It's important resource of vital compound such as phenol, tryptophan, vitamins, and some chemical that may affect negatively on tomato which make it prefer by pests and used as egg nest [1]. Used

of pesticide in same way continuously contribute of appearance insect tolerance [2]. Also, using pesticide cause a pollution on ground water through polluted the irrigation water, water surface and soil as well [3]. According to the evolution of vegetables, growing around the world, demand to use different sources of pesticides, and other compounds to control pest. Plant extract and bio compound are alternative ways to control pest, that due to the safety, cheap, less toxicity, and can be decomposition easily [4 , 5]. Neem (*Azadirachta indica*) also called Margosa is a tree can be grown rabidly which can be used as drug, organic pesticide, and used as a compound to control fungi, bacteria, and spider, or it can be a source for pesticide. Main effect of this plant is to disruption of growing hormones and to forbid insect adult [6]. Garlic can use in control program, which is containing anti oxidation, source of organic sulphur that involve aliin, glutathione and flavonoids. These contribute in controlling the pest. Biological control through used the insect, fungi, bacteria, and some baricites can be control the pest. These ways featured that are effectively in controlling the pest. It can be used in small amount and cheaper in comparison with pesticides, in another way these are clean compound which mean have less residues in soil and air. Thus, make less pollution in environment.

Materials and Methods

Collect the samples

Tomato leave moth insects have collected from infected leaves of tomatoes at different growth stages. These kept in a wooden box 100*50*80 cm, then covered by muslin to prevent escape of insects. To provide the food, green leaves of tomato was provided to the insect daily. And this contentious till caterpillar stage and then adult stage. These adults were diagnosed by the classification key [7].

Insect growing in vitro

Adults of both sex of insect were taken; they put in the box 100*50*80 cm with to gates and fully covered by muslin. Inside the box put a glass petri dishes involve cotton was soaked by 10% of sugar syrup for feeding the adults. Also leaves of tomato with branch they put inside the box to provide a convenient place to put the egg. This box put it in a chamber room (Geio tech, GC-1000LTH), under $25C^0$, humidity 70 %, and rate of light 14:10 hours (light: dark).

Oil extraction of Garlic and Neem

20 gm of fresh Garlic were taken then extract by adding di-ethyl ether for 4 hours daily and this contentious for three days through Soxhlet, 2.5 ml of Garlic oil was collected, this repeated until collected 200ml, then put it in a dark bottled and keep in the fridge until using [8]. Same process they follow to get Oil extraction of Neem.

Table (1): Tested concentrations of Plant extracts and Chemical and Biological formulations on the mortality % of the third larval stage of tomato leave moth *Tuta absoluta.*

Treatments	1st Conc.	2nd Conc.	3rd Conc.
Bt+ Coragen+ Mixture of neem and garlic oils 1:1	1.25g/L+1ml/L+ (1.25/Lml+1.25 ml/L)	2.5g/L+2ml/L+ (2.5ml/L+2.5 ml/L)	3.75g/L+3ml/L+ (3.75 ml/L+3.75 ml/L)
Bt+ Sumipleo+ Mixture of neem and garlic oils 1:1	1.25g/L+0.25ml/ L+(1.25/Lml+1. 25 ml/L)	1.25g/L+0.5ml/ L+(2.5 ml/L+2.5 ml/L)	3.75g/L+0.75ml/ L+(3.75 ml/L+3.75 ml/L)
Mixture of neem and gar- lic oils 1:1	1.25ml/L+1.25 ml/L	2.5 ml/L+2.5 ml/L)	3.75 ml/L+3.75 ml/L
Bt+ Mixture of neem and garlic oils 1:1	1.25g/L+(1.25/L ml+1.25 ml/L)	2.5g/L+(2.5ml/ L+2.5 ml/L)	3.75g/L+(3.75m l/L+13.75 ml/L)
Bt	1.25g/L	2.5g/L	3.75g/L
Sumipleo 50% EC	0.25ml/L	0.5ml/L	0.75ml/L
Coragen 200 SC	1ml/L	2ml/L	3ml/L
Acetamprid 20% SC	0.5 ml/L	0.75 ml/L	1 ml/L

Test of the efficacy of Chemical insecticides, Bt bioformulation, and Plant extracts on the third larval stage of tomato leave moth:

Three concentrations (field dose -50%, field dose and field dose +50%) for each of chemical insecticides (Coragen, Simpleo, and Acetamprid) and bioformulation of (*Bacillus thuringiensis*), and the mixture of oil extraction of garlic and Neem were prepared. Upper green leaves soaked in the solutions of the treatments for 2 minutes [9], then put it at whatman paper till dried. These put it in a Petri dish then 20 larva at third stage were placed then covered that have been hole after that incubated at $25c^0$, humidity 75%, and light 12:12 hours. Results recorded of the mortality larva after 24, 48, and 72 hours.

Results and Discussion

Results showed that there is a significant difference between the concentrations which used in this experiment; third concentration gave higher larval mortality at its third stage. In addition, Acetamprid achieved a higher efficacy at the third age of larva after 72 hours 83.33%, then treatment of Collagen which gave 56.66%. While, Sumipleo gave less mortality 36.66% (table, 2).

Table (2): Effect of pesticide concentrations and time application on larval mortality

Treatment	Efficacy %			
	Conc.	After 24 hr.	After 48 hr.	After 72 hr.
Acetamprid 20% SC	1st Conc.	53.33	55.00	61.66
	2nd Conc.	61.66	63.33	71.66
	3rd Conc.	68.33	76.66	83.33
Coragen 200 SC	1st Conc.	30.00	35.00	35.00
	2nd Conc.	35.00	41.66	41.66
	3rd Conc.	41.66	48.33	56.6
Sumipleo 50% EC	1st Conc.	1.65	18.33	20.00
	2nd Conc.	13.3	26.66	30.00
	3rd Conc.	23.3	31.66	36.33

Interaction result between treatments and period of exposure showed that treatment (Bt + Coragen + mixture of Garlic and Neem oils) after 72 hours gave significant larval mortality which reach to 86.66%% followed by mixture of Garlic and Neem oils treatment 76.66% , then Bt + mixture of Garlic and Neem oils treatment by 71.65 and Bt alone which gave 65.66%, while treatments of (Bt+Sumpleo+ mixture of Garlic and Neem oils) gave the lowest mortality of third larval stage of tomato leave moth 45.00% (table 3,4).

Table (3): Efficacy of Plant extracts on the mortality % of the third larval stage of Tomato leave moth *Tuta absoluta*.

Treatment	Efficacy %			
	Conc.	After 24 hr.	After 48 hr.	After 72 hr.
Mixture of Neem and Garlic oils 1:1	1st Conc.	41.66	55.00	56.66
	2nd Conc.	51.66	61.66	66.66
	3rd Conc.	60.00	65.66	76.66

Table (4): Efficacy of Plant extracts integrated with Chemical and Biological formulations on the mortality % of the third larval stage of Tomato leave moth *T. absoluta*

Treatment	Efficacy %			
	Conc.	After 24 hr.	After 48 hr.	After 72 hr.
Bt+ Mixture of Neem and Garlic oils 1:1	1st Conc.	46.66	50.00	56.66
	2nd Conc.	53.33	58.33	60.00
	3rd Conc.	60.00	65.66	71.65
Bt+ Coragen+ Mixture of Neem and Garlic oils 1:1	1st Conc.	41.66	60.00	68.33
	2nd Conc.	56.66	68.33	78.33
	3rd Conc.	63.33	78.33	86.66
Bt.	1st Conc.	35.00	45.00	53.33
	2nd Conc.	40.00	50.00	56.66
	3rd Conc.	45.00	58.3	65.66
Bt+ Sumipleo+ Mixture of Neem and Garlic oils 1:1	1st Conc.	16.65	23.33	31.66
	2nd Conc.	23.33	31.65	36.66
	3rd Conc.	30.00	36.65	45.00

[10,11] found that, the toxic efficacy of protein that produce by bacteria inside the middle alimentary canal of larva which not work by palpation [12]. confirm that, the Belthirul product led to cause a high mortality which reach to 66.55, 65.92, 64.98, and 70.78% for different larva stage of *Tuta absoluta* respectively [13]. mentioned that bacteria product contributed in enhance the role of pesticides that when mixed with it in case of controlling the Lepidopterain integrated pest management program [14]. Found that *Conocarpus erectus* leaf Plant, Pesticides and *Metarhizium anisopliae* significat to control *T. absoluta* in the Field.

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