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Impact of tomato leaves extract on the greater wax worm *Bombyx mori* (Lepidoptera: Pyralidae)

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Abstract

The present study showed the effect of tomato leaf extract against the greater wax moth, *Galleria mellonella* L. (Lepidoptera: Pyralidae). Also, the extract was applied to the frames of a beehive to show the effect of the extract against *G. mellonella.* The results approved that the extract caused larval mortality for all tested concentrations, which were 500, 1000, 5000 and 10000 ppm with mortality of 23.33, 50, 70 and 80%, respectively. However, LC_{50} was 1565.46 ppm and LC_{90} was 23286.03 ppm. When LC_{50} was applied to the frames that were frozen before, the frames didn't get infested with larvae of *G. mellonella* in the next season compared with the untreated frames that were frozen before and got infested in the next season and, also, the frames that were untreated or frozen.

Introduction

Wax moths are dangerous pests of bees wax all over the world. The greater wax moth, *Galleria mellonella* L. (Lepidoptera: Pyralidae) is realized to be harmful to stored and deposited bees wax. It's harmful for apiaries and causes great losses every year represented by damage of wax combs by larval feeding and old frames in the hive. Also, adults and larvae of wax moths can transport dangerous diseases pathogens, such as foulbrood. The infested colonies showed huge amounts of causative bacteria spores, *Paenibacillus* larvae in found in wax moth feces (Charriere and Imdorf, 1999).

Because of economic reasons, it is necessary for beekeepers to control this dangerous pest. Many studies have been made to find ways to control (Burges, 1978). Although the most successful control measure was the use of insecticides at the larval stage, in recent years, the environmental problems caused by pesticide overuse made scientists search for alternatives. Natural products are good alternatives to synthetic pesticides that decrease negative effects on human health and the environment (Koul *et al*., 2008 and Fawzy *et al*., 2017).

Tomato is a good source of phenolic compounds, antioxidants and other nutrients, these compounds prevent the oxidative changes in cells by decreasing the level of free radicals (Norma *et at*., 2015). Tomato

leaf extract is effective in causing mortality of larvae of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) and *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) (Abd- Allah *et al*., 2019 and Hagar *et al*., 2022). This study aims to determine the toxicity of tomato leaf extract against *G. mellonella.*

Materials and methods

1. Insect culture:

The larvae of *G. mellonella*, were collected from a private apiary in Meet Salseel at Dakahlia Governorate and were kept in two glass containers (50-75 specimens); these containers contain honey wax and pollen grains. Filter papers were put in the containers for pupation. Glass containers of larvae, pupae, and adults were kept in darkness at 28-31ºC and 60% humidity.

2. Preparation of plant sample and extraction:

Leaves of a tomato plant, Elisa sort, were left to dry at room temperature for about one month, next, the dried leaves were ground into fine powder. Then the powder was soaked in a mixture of petroleum ether, acetone, and ethanol solvents of equal proportion in a flask for about one week. Later, the flask was shaken in a shaker and the contents were filtered. The mixture of solvents evaporated under reduced pressure. After that, the crude extract was weighed and kept in a deep freezer until use. Concentrations of tomato extract were prepared from the stock based on tested plant weight and volume of the distilled water (w/v) in the presence of tween 80 (0.1%) as an emulsifier. The concentrations were kept in glass stoppered bottles and then stored under refrigeration. Four diluted concentrations were used to draw the LC-P Lines and four replicates for each concentration.

3. Method of application:

3.1. Spray method on larvae:

The 3rd instar larvae of the *G. mellonella* were used for applying. Ten individuals of larvae for each replicate in each concentration were applied to estimate the mortality line. Different concentrations were sprayed directly on the larvae. The concentrations used were 500, 1000, 5000 and 10000 ppm. The same number of larvae per treatment was sprayed with distilled water as an untreated check. The percentage of mortality was recorded after one, three, five, and seven days and the data were corrected with control mortality (Abbott, 1925). LC_{50} value was determined using the probit analysis statistical method of (Finney, 1971).

Equation: Sun, 1950 (to determine LC_{50} index)

Toxicity index for LC_{50} =

LC_{50} of the most effective compound

---------- X 100

LC_{50} of the least effective compound

3.2. Spray method on frames:

In this experiment, 30 frames were used as follows: Put 20 frames in the freezer for 48 hrs. then remove and clean them from any wrested wax worm. Then spread LC_{50} of tomato leaves extract on 10 frames of them that were infested with wax worms wrapped them in sticky bags and stored them in a free hive. The other 10 frames were put in a hive free from honeybees and airtight, these frames were not treated with tomato leaves extract (As control), tell we needed them in the next season of clover honey and observed what happened.

Results and discussion

1. Efficiency of tomato leaves extract on larvae of *Galleria mellonella*:

Table (1) and Figure (1) show that the mortality rate of the larvae of *G. mellonella* was high when the concentrations increased. The mortality rate of 2nd instar larvae of *G. mellonella* with concentrations 500, 1000, 5000 and 10000 ppm were 23.33, 50, 70 and 80 %, respectively. However, LC_{50} was

1565.46 ppm and LC_{90} was 23286.03 ppm. In addition, slope value was 1.1 and LC_{90} / LC_{50} value was 14.87.

Table (1): Corrected mortality % of 2nd instar larvae of *Galleria mellonella* treated with tomato leaves extract under laboratory conditions 27±2 ◦C and 65±5% RH.

Treatments	Conc.	Corrected mortality%	LC_{50}	LC_{90}	Slope± S.D.	LC_{90}/ LC_{50}
Tomato leaves extract	500	23.33	1565.46	23286.03	1.1± 0.13	14.87
	1000	50				
	5000	70				
	10000	80				

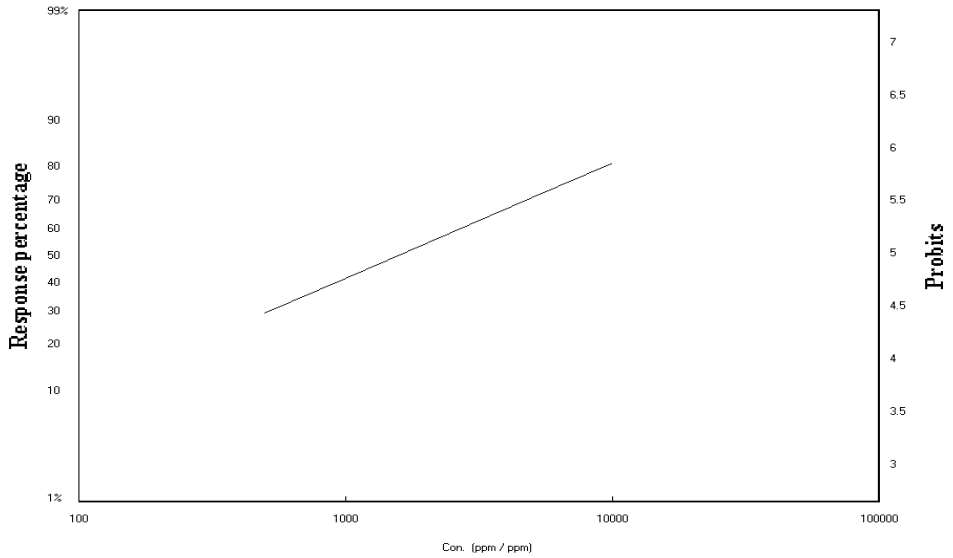

Figure (1): LC- P line of effect of tomato leaves extract on larvae of *Galleria mellonella.*

These results agreed with Abd-Allah *et al.* (2017) who proved the effectiveness of tomato leaf extract on *Aphis gossypii* Glover (Hemiptera: Aphididae). Also, Abd-Allah *et al.* (2019) confirmed that tomato leaf extract caused high mortality to both larvae of *T. absoluta* and *S. littoralis* and the mortality rate was higher against *T. absoluta* than *S. littoralis.*

2. Effect of tomato leaves extract on frames:

The frames which stored in the hive without treatment were damaged (Figure 2). The frames that were stored in the freezer without treatment were fine but infested when were used in the second season (Figure 3). However, the frames that were stored in the freezer with treatment were fine and didn't infest in the next season of collection of honey (Figure 4). Fawzy *et al.* (2017) approved the effectiveness of propolis ethanolic extract and cinnamon ethanolic extract in the management of wax worm. Saadiya *et al.* (2019) reported that the most effective essential oils of rosemary and lavender managed the wax worm. Hagar *et al.* (2023) proved the effectiveness of tomato leaves extract against eggs of *S.littoralis*. Also, Ekbal *et al.* (2022) emphasis the high impact of camphor oil against *G. mellonella.*

Figure (2): Un- treated and infested frame with *Galleria mellonella* without freezer use.

Figure (3): Un- treated and infested frame with *Galleria mellonella* with freezer use.

Figure (4): Treated and un-infested frame with *Galleria mellonella* with freezer use.

References

Abbott, W.S. (1925): A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 265-267.

Abd-Allah, G. E.; Elshaier, M. E.; Marouf, A. E. and Moafi, H. E. (2017): Application of tomato leaves extract as pesticide against *Aphis gossypii* Glover (Hemiptera: Aphididae). Int. J. Adv. Res., 5(4): 286-290.

Abd-Allah, G.E.; Moafi, H. E.; Marouf, A.E. and Aziz, W. Z. (2019): The toxic effect of tomato leaves extract against the leaf miner *Tuta absoluta* (Lepidoptera: Gelechiidae) and the cotton leafworm *Spodoptera littoralis* (Lepidoptera: Noctuidae). Egypt. J. Plant Prot. Res. Inst., 2 (3): 488- 492.

Burges, H.D. (1978): Control of wax moth: Physiological and biological methods. Bee World, 59: 129-38.

Charriere, J. D. and Imdorf , A. (1999): Protection of honeycombs from moth damage. Am. Bee J., 139(8): 627-630.

Ekbal, H. G.; Ali, A.M. M. and Ghazala, N. A. (2022): Evaluation of some essential oils against wax moth larvae (Lepidoptera: *Galleria mellonella* L.) and adult honeybee workers (Hymenoptera: *Apis mellifera* L.). Arab Univ. J. Agric. Sci., 30 (1): 157: 162.

Fawzy, A.M.; Al-Ahmadi, S. S. and Al-Hazmi, H.M. (2017): Influence of Some Natural Substances for Control the greater wax moth, *Galleria mellonella* L. (Lepidoptera: Pyralidae). J. Plant Prot. and Path., Mansoura Univ., 8 (8): 407 - 413.

Finney, D.J. (1971): Probit analysis. Cambridge univ., London pp 333.

Hagar, M. A.; El Sharkawy, A. Z.; Abd-Allah, G.E., Kadada, H. M. and Farghaly, D.S. (2022): Pesticidal effect of leaves extract of different plants on the larvae of cotton leaf

worm, *Spodoptera littoralis.* Pak. J. Biol. Sci., 25(12):1058-1065. Doi: 10.3923/pjbs.2022.1058.1065. PMID: 36978273.

Hagar, M. A.; Zuel- Hemma, A.; Saad, D. and Abd-Allah, G. E. (2023): Application of unused plant parts as plant extracts against eggs of cotton leafworm, *Spodoptera littoralis* and Gc- mass analysis of tested extracts. Egypt. Acad. J. Biology. Sci., 15(1):25-33.

Koul, O.; Walia, S. and Dhaliwal, G. S. (2008): Essential oils as green pesticides: potential and constraints. Biopesticides Int., 4(1): 63-84.

Norma P. S.; Saul, R. C. and Marquez, M. R. (2015): Total phenolic, flavonoid, tomatine, and tomadine contents and antioxidant and antimicrobial activities of extracts of tomato plant. Int. J. Chem., 10: 28- 71.

Saadiya, M. S.; Hammam, M. A. and Abd-El Kader, S. K. (2019): Insecticidal activity against the greater wax moth (*Galleria mellonella* L.) And chemical composition of five plant essential oils. Menoufia J. Plant Prot., (4): 145 – 161.

Sun, Y.P. (1950): Toxicity index an improved method of comparing the relative toxicity of insecticides. J. Econ. Entomol., 43: 45-53.