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VI- SUMMARY

Pesticides are of great importance in the field of agriculture and will continue during the current period and in the future because they are still of the most important means of pest control. Cotton leafworm, *Spodoptera littoralis* is one of the most important pests which cause a lot of damage to the cotton crop.

When sprayed, pesticides can cause unintended harm by killing beneficial insects such as pollinators and the natural enemies of the crop's pests.

The poisoning of honeybees (*Apis mellifera*) and other beneficial insects by pesticides can be a serious problem. Honeybees provide a valuable service to agriculture because they are the most important pollinators of cultivated crops. They also produce honey, royal jelly, and bee wax. In addition, its morphological and ethological features of the honeybee can be considered an excellent bio-indicator for environmental contamination.

Therefore, toxicity of insecticides against the beneficial insects is important as well as toxicity of insecticides against harmful insects. Therefore, this investigation aims to:

1. Show the effect of three insecticides {α-cypermethrin, emamectin benzoate, and imidacloprid} on the 2nd and 4th instars larvae of cotton leafworm (*S. lttoralis*) and honeybee (*A. mellifera*);

2. determine the effects of the tested insecticides on the activities of some *S. lttoralis* and *A. mellifera* enzymes these were: catalase (CAT), glutatione-*s*-transferase (GST) and glutathione peroxidase (GP_x); and

3. estimate the accumulated lipid peroxidation in the tissue by evaluating the level of Malondialdehyde (MDA).

• The obtained data could be summarized as follows:

(1) Insecticidal activity of α-cypermethrin, emamectin benzoate and imidacloprid against *S. littoralis* and *A. mellifera*:-

a. In case of *S. littoralis*:

It is evident from LC_{50} values of the tested compounds that emamectin benzoate was the most toxic to 2nd and 4th instars larvae of *S. lttoralis* with the LC_{50} values of (1.163, 5.788ppm); (0.465, 1.678ppm); (0.311, 0.381ppm); (0.052, 0.161ppm); (0.0057, 0.0310ppm); and (0.0013, 0.0044ppm) after 6, 12, 24, 48, 72, 96hrs exposure time, respectively, followed in decreasing order of toxicity to α-cypermethrin with the LC_{50} values of (46.6, 57.1ppm); (0.86, 1.93ppm); (0.47, 0.557ppm); (0.061; 0.186ppm); (0.042, 0.128ppm); and (0.030, 0.101ppm) after 6, 12, 24, 48, 72, and 96hrs exposure time, respectively, and finally to imidacloprid with the mean LC_{50} values of ($\geq 35\times10^3$, $\geq 2098\times10^3$); ($\geq 35\times10^3$, 2098×10^3ppm); (35×10^3, 501×10^3ppm); (104×10^2,

89×10^3ppm); (100×10^2, 32×10^3ppm) and (83×10^2, 15×10^3ppm) for 2nd and 4th larval instars after 6, 12, 24, 48, 72, and 96hrs time exposure, respectively.

The toxicities of the tested insecticides against *S. lttoralis* were increased as the larval stage decreased.

b. In case of *A. mellifera*:

It is evident from LC_{50} values of the tested insecticides that emamectin benzoate was the most toxic to honeybee workers with the mean LC_{50} values of 0.399, 0.320, 0.275, 0. 203, 0.193, and 0.184ppm after 6, 12, 24, 48, 72, and 96hrs time exposure, respectively, followed in decreasing order of toxicity to α-cypermethrin with the LC_{50} values of 13.129, 10.878, 5.411, 4.369, 3.861, and 3.267ppm after 6, 12, 24, 48, 72, and 96hrs time exposure, respectively, and finally imidacloprid was the least toxic insecticide with the LC_{50} values of 65.33, 37.8, 24.97, 17.29, 14.55, and 10.98ppm after 6, 12, 24, 48, 72, and 96hrs time exposure, respectively.

It is evident from LC_{50} values that, the toxicities of the tested insecticides against *S. lttoralis* and *A. mellifera* were increased as the exposure time increased.

According to toxicity index, the tested insecticides were arranged in decreasing order based on LC_{50} values to emamectin benzoate > α-cypermethrin > imidacloprid.

(2) Biochemical studies:

(1) Effects of tested insecticides on acetylcholinesterase (AChE) activity of *S. lttoralis* and *A. mellifera*:

a. AChE of *S. littoralis*:

The *in vivo* effects of the tested insecticides on AChE activity isolated from *S. lttoralis* 4th instars larvae head capsules revealed that imidacloprid at the concentrations of 125×10^3, 251×10^3 and 501×10^3ppm caused 11.2, 16.4, and 26.2% inhibition, subsequently. Also, α-cypermethrin caused inhibition percentages of 4.2, 6.1, and 8.9% when it was tested at the concentrations of 0.138, 0.276, and 0.552ppm, respectively. On the other hand, emamectin benzoate at the concentrations of 0.095, 0.191, and o.381ppm caused 56.1, 65.9, and 77.6% activation of *S. lttoralis* AChE activity, respectively.

b. AChE of *A. mellifera*:

The *in vivo* effects of the tested insecticides on AChE activity isolated from the head of surviving honeybee workers (*A. mellifera*) revealed that imidacloprid at the concentrations of 6.2, 12.5, and 24.97ppm caused 6.9, 16.5, and 23.4% inhibition, respectively. Also, α-cypermethrin caused inhibition percentages of 2.1, 5.1, and 7.5% when it was tested at the concentrations of 1.6, 2.7, and 5.4ppm, subsequently. On the other hand, emamectin benzoate at the concentrations of 0.07, 0.14, and 0.275ppm caused 60, 73.2, 82.8% activation of *A. mellifera* AChE activity, respectively.

The inhibition and activation of *S. lttoralis* and *A. mellifera* AChE activity using imidacloprid, α-cypermethrin, and emamectin benzoate concentration dependent.

AChE enzyme was effective as a biomarker of exposure of emamectin benzoate insecticides.

(2) Effects of tested insecticides on antioxidant enzymes activities of *S. lttoralis* and *A. mellifera*:

The *in vivo* effects of the tested insecticides on antioxidant enzymes activities of *S. lttoralis* and *A. mellifera* revealed that there was an increase in the catalase (CAT), glutatione-*s*-transferase (GST) and glutathione peroxidase (GP_x) activities depend on the concentration of insecticides used compared to the control.

(3) Effects of tested insecticides on Malondialdehyde level (MDA):

There was a significant decrease in the level of Malondialdehyde (MDA) (LPO indicator) in the case of α-cypermethrin and imidacloprid on both insects. On the other hand, emamectin benzoate caused slight elevation in the level of MDA in *S. lttoralis* and *A. mellifera* compared to the control.

Obiviously, the treatment of *S. lttoralis* and *A. mellifera* with α-cypermethrin and imidacloprid in the present study represent a model for reduction of lipid peroxidation and an enhancement of the insect antioxidant system for scavenging ROS resulted due to oxidative stress.

Therefore, this profile of biomarker variation could represent a useful fingerprint to characterize exposure to different groups of insecticides.

Also, the battery of honeybee biomarkers might be a promising option of biomonitor the health of aerial and terrestrial ecosystems and to generate valuable information on the mode of action of pesticides.

The use of biomarker is the promising approach in the assessment of ecosystem health. It might allow the detection of early biological change, which may result in long-term physiological disturbances.