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Biohumus Effect on Detoxification Rate of Some Pesticides in Tomato and Cucumber

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ABSTRACT

The dynamics of detoxification of a number of pesticides in cucumber and tomato was studied. The preparations were mixed in the water solution of biohumus. In the control variant ordinary water served as the experimental fluid. Studies have shown that when the water solution of biohumus serves as a working fluid, the process of detoxification of cypermethrin and topaz is accelerated in tomato, and that of actellic in cucumber.

Introduction

In Armenia tomato and cucumber are among the most important vegetable components of the diet which are consumed raw, cooked or processed. Nevertheless, tomato and cucumber plants are susceptible to several pests and diseases that have been controlled through the application of pesticides. But the pesticides are highly toxic compounds, and they can have undesirable effects on human health if their amounts are exceeding the maximum residual level (MRL) (Carvalho, 2006; Ecobichon, et al, 1990; Jouany , 1993; Lozowicka, et al, 2015; Yaser, 2010).

Timely fruit harvesting is very important. Harvesting in protected ground is carried out if not every day, but at most every 2-3 days.

Our long- year research has shown that not always do the crops become safer 3 days after preparation introduction. Depending on the environmental conditions (temperature, humidity, ventilation, etc.) pesticide residues can be stored longer in some cases even exceeding the maximum residual level (Atshemyan, et al, 2017; Edvards, 1975; Edvards, 1994; Kah, Beulke, & Brown, 2007).

The goal of this work is to develop measures to accelerate the process of pesticide detoxification in protected crops.

In our opinion, plant stimulants can produce such effect. The priority was given to the biohumus water solution which is the cheapest and the most available among the stimulants.

Materials and methods

Studies have been conducted in conditions of protected ground (tomato), as well as in field conditions (cucumber) in the farms of Merdzavan village in Armavir marz of RA. In protected ground tomato plants were sprayed with combined solution of 0.05% cypermethrin and 0.07% topaz. Cucumber plants were sprayed with 0.2 % solution of actellic. Preparations were developed in the biohumus water solution. In the control variant ordinary water was used. Samples of tomato fruits were taken 1, 3 and 5 days after spraying. Sampling of cucumber was done 1, 3 and 8 days after the spraying.

The residual amounts of cypermethrin, topaz and actellic were determined by thin-layer chromatography (MUK N 2085-79, MUK N 2473-81). To determine the amount of pesticides inside the fruit, the tomato surface was carefully washed with wet cotton several times.

Preparation of biohumus water solution: 2 cups of biohumus were added to 10 liters of boiled and cooled-to- room- temperature water, well stirred and left for 24 hours. The brown liquid formed on the solvent surface was used as a working solution.

Results and discussions

The results are represented in curves and columns.

It is clear that in case of combined application of cypermethrin and topaz (Fg.1.) the most significant content of pesticides is decomposed during the first 3 days after spraying: cypermethrin –

61.1%-77.6 %, topaz – 62.8%-72.0%. Later on (five days after spraying), the rate of detoxification of preparations diminishes and their residues are still detected in all variants: cypermethrin – 0.08 mg/kg, topaz – 0.1 mg/kg -0.2 mg/kg.

Studies also reveal that cypermethrin and topaz have been detoxified faster in the fruits of biohumus (the lower curve) variant.

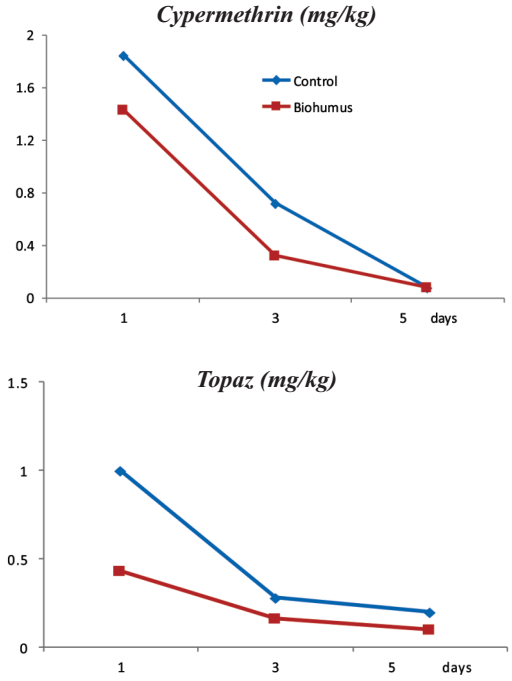

Figure 1: Dynamics of detoxification of cypermethrin and topaz in tomato fruit when using biohumus solution

Figure 2 depicts the residual amounts of cypermethrin on the surface of tomatoes and inside the fruit 1, 3 and 5 days after spraying.

It is clear that one day after the treatment, the level of insecticide in the tomato fruit of the biohumus variant is lower as compared to the control one: 0.95 mg/kg and 0.7 mg/kg respectively. Studies also reveal that the detoxification process inside the fruit is much faster in case of preparing the solution with biohumus. Thus, the amount of cypermethrin within 3 days after the application decreases by 80% inside the fruit of biohumus variant and only by 64.2% in case of water. 5 days after spraying, the residues of cypermethrin are still found only on the surface of the fruits both in the control (ordinary water) and biohumus variants.

As to topaz, a significant decline in the residual amount of the preparation on the tomato surface is observed when using biohumus, where the removal of toxicity is much more intensive in comparison with control (water solution) variant. Meanwhile, the amount of preparation decreases more intensively inside the tomato fruit. Thus, if 1 day after the application the residual amount of the topaz inside the fruits of the biohumus variant is just 8% less against the control one, it decreases by 33.3% within 3 days, and by 50% within 5 days.

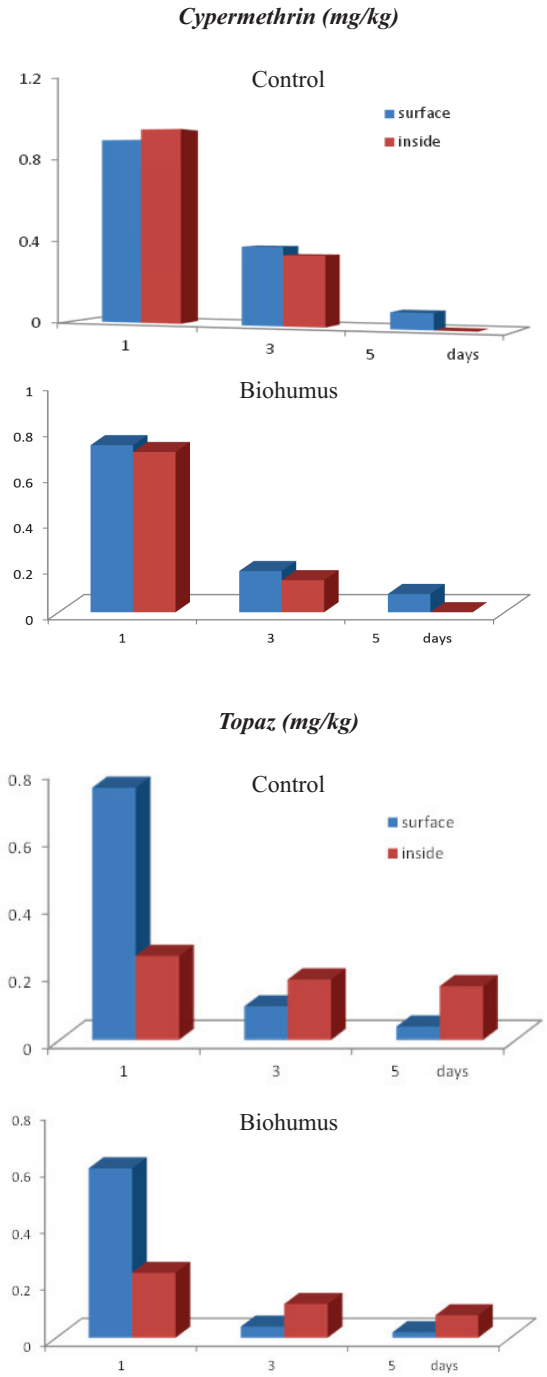

Figure 2: Residues of cypermethrin and topaz on surface and inside the fruit of tomato when using biohumus solution

However 5 days after the treatment, residual amount of topaz is still detected both on the surface and inside the fruit.

It should be noted that the waiting period is 3 days for protected tomato. The Codex MRL value for tomato is 0.1 mg/kg for cypermethrin and 0.2 mg/kg for topaz.

In none of the samples the cypermethrin residues are below the detection limit 3 days after application. However, it is only 0.22 mg/kg higher in biohumus variant, while it is more by 0.62 mg/kg

in case of water (Control).

As for topaz, the residual amount of fungicide found within the waiting period (3 days) is lower than the stated one (0.2 mg/kg) only in the biohumus variant.

Similar studies have been also carried out in the open ground. The detoxification rate of actellic offered for pest management of cucumber (greenhouse whiteflies, mites, aphids, thrips, etc.) has been studied.

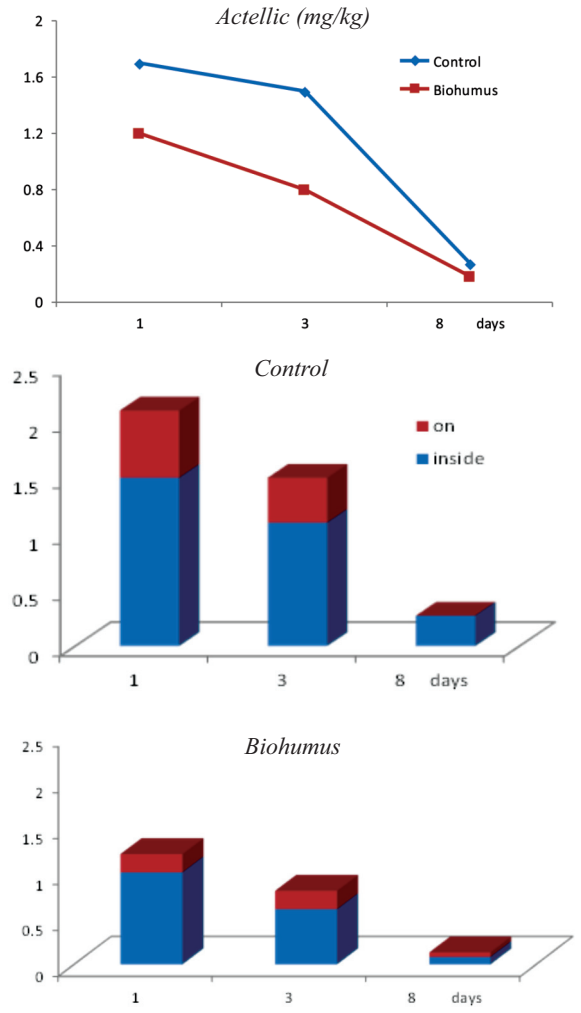

Figure 3: Dynamics of detoxification of actellic in cucumber fruit under the impact of biohumus solution

In the open ground the phenomenon of accelerated detoxification of pesticide under the impact of biohumus solution is more obvious (both inside the fruit and on the surface) (Fig. 3).

It should be noted that for the cucumber cultivated in the open ground there is a "waiting period" for actellic which makes 20 days. MRL value for cucumber is 0.2 mg/kg.

The remarkable thing here is that already 8 days after spraying the total amount of actellic detected in cucumber fruit of the biohumus variant is less by 0.02 mg/kg against the limit.

Conclusion

Thus, the results of our experiments can be summarized as follows:

1. When biohumus solution serves as an applied fluid, the detoxification process of cypermethrin and topaz is accelerated in tomatoes, and that of actellic in cucumber.
2. The "waiting period" for cucumber cultivated under the open ground is reduced by half as much when dilution of the preparation is carried out through biohumus water solution.

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