**Controlling the codling moth Cydia pomonella in Granny Smith apple by Bio T Plus**

(Malkia 2019)

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**Aim**

To test the effectiveness of the Bio T Plus in preparation controlling codling moth (*Cydia pomonella*) compared to Mospilan and to determine its safety.

Variety: Granny Smith x 18

Planted at: 2009

Spacing: 1.75 m X 4.0 m

Irrigation: drip

**Experiment setup:**

Experimental design: randomised blocks

Number of treatments: 5

Number of repeats: 4

Repeat size: 4­−5 trees (2 trees at the repeat’s centre were tested).

Spray type: Pressure sprayer with a gun

Spray pressure: 25 atm

Nozzle: ceramic with a radius of 1.5

Spraying volume: Until runoff

Spraying dates: 2.5.19, 12.5.19, 27.5.19, 6.6.19. A total of 4 continuous spray applications were performed during the experiment.

**Comments:**

1. The first spray application was conducted at 100 growing degree days on 2.5.19 (Biofix 6.4.19, according to Matitiahu).
2. All sprayings were applied very early in the morning, at a frequency of 10−14 days from the last spraying, with weather-dependent changes.
3. The peak of Granny Smith flowering in the plot was on 21.4.19. The first spraying was conducted at the late flowering stage and in very young fruitlets, 4 mm in radius.

**Preparations:**

1. Mospilan, containing 200 gr/L Acetamiprid, made by Nippon Soda, Japan, and distributed in Israel by Agan Ltd.
2. Bio T Plus, containing Bacillus thuringiensis subsp. Kurstaki at 16,000 international units (ITU)/mg. Manufactured by Bio Dalia and distributed by BioYome Ltd.
3. Mahatz surfactant, containing 62% Ethoxylated Polydimethylsiloxane, distributed by BioYome Ltd.

**Treatments:**

1. Bio T Plus 0.2% + Mahatz surfactant 0.035%
2. Bio T Plus 0.4% + Mahatz surfactant 0.07%
3. Bio T Plus 0.8% + Mahatz surfactant 0.14%
4. Mospilan 0.02%
5. Control

**Evaluation dates:**

2.5.19 (baseline), 27.5.19, 6.6.19, and 13.6.19

**Methods**:

Three traps were hung in the experimental plots to monitor and determine degree dates: one PSI funnel for capturing codling moths and two white delta sticky traps. We used 10 X concentrated pheromones from BioYome in all the traps.

Beginning from the initial continuous capture of codling moths, we measured the minimum and maximum daily temperature and converted the results to degree dates of codling moths.

The first spraying (2.5.19) was applied at 100 degree dates = the start of larvae hatching. The following sprayings were applied at approximately 10-day intervals. The third spraying was applied after a two-week interval. The second spraying was applied on 12.5.19, the third on 27.5.19, and the fourth on 6.6.19.

**Fruit evaluation:**

At baseline = 100 degree dates, there was no infestation in the young fruit.

On the second evaluation date, 27.5.19, 100 apples were sampled in each repeat, 50 from each side of the repeat (a total of 400 fruit/treatment). Each fruit was examined for the presence of codling moth or codling moth damage. The fruit was cut with a pocket knife to examine the damage and the presence of live larvae.

**Statistical analysis:** We used one-way ANOVA with post hoc Tukey-Kramer to determine the statistical significance (P<0.05) of differences between the average number of infested apples per tree in the different treatment groups.

**Results:**

The experiment started with the first generation of codling moths in the plot, on 2.5.19 = approximately 100 degree dates. There were no infested fruits at baseline.

On the first evaluation date (27.5.19), we found 4 infested fruitlets out of the 100 sampled from the treetops of the control, untreated group. In the treatment groups: Bio T Plus 0.2%, 0.4%, and 0.8% in combination with Mahatz oil, we found 2.0, 1.25, and 2.0 infested fruitlets out of 100 examined, respectively. In the standard treatment group, 0.02% Mospilan, there were 0.0 infested fruitlets out of 100 examined.

On the second evaluation date (6.6.18), 100 apples (50 from each side) were sampled from the central trees of each repeat. The fruits were sampled randomly from the tops and the centre of the trees without a search for damaged fruit.

We found that 14% of the fruit in the untreated control was infested. Trees treated with Bio T Plus at 0.2%, 0.4%, and 0.8% in combination with Mahatz oil had 5.75%, 2.75%, and 2% infested fruit, respectively, whereas those treated with 0.02% Mospilan had 1.25% infested fruit.

On the third evaluation date (13.6.18), 100 apples (50 from each side) were sampled from the central trees of each repeat. The fruits were sampled randomly from the tops and the centre of the trees without a search for damaged fruit. We found that 22.0% of the fruit in the untreated control was infested. Trees treated with Bio T Plus at 0.2%, 0.4%, and 0.8% in combination with Mahatz oil had 4.5%, 4.0%, and 3.5% infested fruit, respectively, whereas those treated with 0.02% Mospilan had 3.25% infested fruit.

The number of male codling moths captured in the traps during the experiment, until 13.6.19, was 3 moths in the PSI trap, and 6 and 7 moths in the white sticky delta traps #1 and #2, respectively.

The results are presented in Table 1.

**Table 1. Percentage/number of apples infested by codling moth**

|  |  |  |
| --- | --- | --- |
| **No.** | **Treatments** | **Percentage of fruit infested by codling moth per tree** |
| **Baseline****2.5.19** | **27.5.19****+15 days from spray #2** | **6.6.19****+10 days from spray #3** | **13.6.19** **+7days from spray #4** |
| **1** | **0.2% Bio T Plus + 0.035% Mahatz** | **0.0 a** | **2.0 b** | **5.75 b** | **4.50 b** |
| **2** | **0.4% Bio T Plus + 0.07% Mahatz** | **0.0 a** | **1.25 bc** | **2.75 bc** | **4.00 b** |
| **3** | **0.8% Bio T Plus + 0.14% Mahatz** | **0.0 a** | **0.75 bc** | **2.00 bc** | **3.50 b** |
| **4** | **0.02% Mospilan** | **0.0 a** | **0.00 c** | **1.25 c** | **3.25 b** |
| **5** | **Control** | **0.0 a** | **4.00 a** | **14.00 a** | **22.0 a** |

**Phytotoxicity:**

No damage was observed in the fruitlets and the foliage from the Bio T Plus and Mahatz surfactant at the concentrations tested.

**Conclusions:**

Bio T Plus at the tested concentrations of 0.2%, 0.4%, and 0.8% (in combination with Mahatz mat at 0.035%,0.07%, and 0.14%, respectively) is effective in controlling codling moth and is similar to the standard preparation 0.02% Mospilan. All treatments were significantly different from the untreated control.

At the lowest concentration, Bio T Plus was significantly less effective than the standard treatment on the first two evaluation dates.

Bio T Plus is effective from a concentration of 0.4% in combination with 0.07% Mahatz surfactant.

Bio T Plus is safe to use in apple. No damage was caused to the fruit or foliage of the tested apple variety after four Bio T Plus spray applications at the double concentration of 0.8% in combination with 0.14% Mahatz surfactant.

**Acknowledgement**

We thank Shai Golani for allocating the plot for the experiment.