

# **AFFECTS OF ORTHO-® BUG-B-GON® MULTI-PURPOSE INSECT KILLER ON MONARCH BUTTERIES (*DANAUS PLEXIPPUS*)**

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## **Summary**

I studied the effects of pesticide residue on the development and growth time of monarch butterfly larvae. I sprayed pesticide on milkweed plants, and then introduced monarch larvae to the plants on the same day after spraying. Some of the plants were sprayed at given intervals to simulate the effects of rain. Spraying significantly decreased development and increased mortality rates when larvae were introduced to freshly sprayed leaves, while rain has a positive effect.

## **Introduction**

My project determined how the time period between pesticide spraying and application of monarch larva to the sprayed plants affected the growth and development of monarchs. I also determined the impact of rain on the growth and development of monarchs when plants had been treated with pesticide. Common milkweed plants (*Asclepias curassavica*) were used, since they are a primary food source for monarchs.

My first hypothesis was that the sooner a larva was introduced to a plant after spraying with pesticide, the higher the mortality rate of the monarch, the smaller the monarch, and the slower the development rate would be when compared to a larva that was introduced to a plant that was sprayed later. If rain was simulated on the plant, I expected the mortality rate of the monarch to decrease, the size of the adult to increase, and development rate to be faster compared to a monarch that was on a plant that had no rainfall.

The future use of this project is to prevent the high mortality rate of monarchs that feed on the milkweed growing between corn stalks. This issue was addressed in the 2001 Monarch Population Dynamics Meeting, which is held annually to discuss how to better understand the annual dynamics of migratory insects with a continental distribution. An issue that arose from those discussions was how pesticide use affects the size of first generation monarch butterflies. Many monarchs die from feeding on plants with Ortho-® Bug-B-Gon® Multi-Purpose Insect Killer, this insecticide 0.0033% esfenvalerate and 99.9967% petroleum distillate, and is commonly used in cornfields to kill ladybugs and other types of insects that present a hazard to the corn crops. My project may help farmers apply pesticides to their crops in a more effective way. The farmers would be able to coincide the application of the pesticide and the life cycle of a monarch butterfly.

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## **Procedure**

I used 140 wild monarchs eggs that were all laid on the same day, and I grew 140 common milkweed plants that were all approximately the same size and grown from seeds collected from Minnesota gardens. I purchased Ortho Bug-B-Gon Multi-Purpose Insect Killer from Frank's Garden and Nursery. The active ingredients in this pesticide are 0.0033% esfenvalerate and 99.9967% petroleum distillate. Since the pesticide is environmentally hazardous, being highly toxic to fish and other wildlife such as monarchs, I read the instructions on the pesticide before applying and wore protective gear and applied the pesticide in an open outdoor environment that was off limits to other people. I did not apply the pesticide when weather conditions favored drift from treated areas, and I only applied as specified on the label.

As seen in Table 1, two weeks before I introduced a larva onto each milkweed plant, I sprayed 80 plants each with 5 squirts of the pesticide and one week after this application, I simulated rain on 40 of the sprayed plants by moving a hose back and forth over them at a height of 5 feet from the soil for ten minutes. On the same day that I simulated rain, I sprayed 80 new plants by applying 5 squirts of the pesticide on each plant and four days later, I simulated rain on 40 of these plants in the same manner as before. Two days later, I sprayed 80 new plants each with 5 squirts of the pesticide, and six hours later, I simulated rain in the same manner as before. I had twenty milkweed plants, where no pesticide or rain treatment was applied and these were the controls of the project.

**Table 1 – Pesticide and Rain Application Time Table**

	<b>2 wks before larva app</b>	<b>1 wk before larva app</b>	<b>1 day before larva app</b>	<b>Control</b>
<b># of plants sprayed w/pesticide</b>	40	40	40	20
<b># of plants w/pesticide app and simulated rain fall</b>	20	20	20	20

All on the same day, I placed one monarch larva that was in the first instar onto the top leaf of 20 milkweed plants from each treatment. If a larva ate all of the plant before pupation, I changed the plant with a plant that received the same treatment as the one on which the larva began. I covered the plants by inserting two stakes in each pot and then placed a mesh bag over the pot.

I recorded the date that all the larva were laid, and then after placing them on plants, I recorded data such as mortality of larva, date change of plant, date of pupation, and date of emergence. After emergence from the chrysalis, I recorded whether the monarchs were male or female by observing them, measured the wing lengths with a calibrator, and spore checked them by taping their abdomens, placing the tape on an index paper and then observing them under the microscope for tiny splotches that are spores.

## Results

**Table I: Statistical Analysis of Wing Length**

<b>Time</b>	<b>n<sub>1</sub></b>	<b>n<sub>2</sub></b>	<b>Average Value 1 (mm)</b>	<b>Average Value 2 (mm)</b>	<b>p-value</b>	<b>%-confidence</b>
<b>C-2WN</b>	16	19	50.51	46.76	$1.825 \times 10^{-5}$	99.99%
<b>2WR-1DR</b>	14	8	48.20	47.73	0.2375	76.25%
<b>2WN-2WR</b>	14	19	48.20	46.76	0.03527	96.47%

As seen in Table I, when I compared control butterflies (referred to as C) to butterflies that hatched on plants that had been sprayed with pesticide two weeks before larvae application (2WN), I found the average wing lengths to be 50.51 mm compared to 46.76 mm respectively with a p-value of 0.00001825 and a percent confidence of 99.99%. When I compared butterflies that hatched on plants that had been sprayed with pesticide two weeks prior to larvae application and had experienced rain fall (2WR) to the butterflies that were on plants sprayed with pesticide one day before larvae application and experienced rain fall (1DR), I found the average wing length value to be 48.20 mm and 47.73 mm respectively with a p-value of 0.2375 and a percent confidence of 76.25%. When I compared the 2WN butterflies to the 2WR butterflies, as shown on the table, I

found the average wing length value to be 48.20 mm and 46.76 mm respectively with a p-value of 0.03527 and a percent confidence of 96.47%.

**Table II: Statistical Analysis of Development Time**

<b>Time</b>	<b>n<sub>1</sub></b>	<b>n<sub>2</sub></b>	<b>Average Value 1 (days)</b>	<b>Average Value 2 (days)</b>	<b>p-value</b>	<b>%-confidence</b>
<b>C-2WN</b>	18	19	17.3889	18.5263	0.002329	99.7680%
<b>2WR-1DR</b>	18	8	17.3889	19.3750	0.02015	97.9846%
<b>2WN-2WR</b>	18	15	17.3889	17.5333	0.3931	60.6860%

As seen in Table II when I compared control butterflies to butterflies that were on plants sprayed with pesticide two weeks before larvae application (2WN), I found the average development time of the control to be 17.3889 days compared to 18.5263 days respectively. The p-value is 0.002329 and the percent confidence level was 99.7680%. When I compared the butterflies that were on plants that were sprayed with pesticide two weeks prior to larvae application and had rain fall on them (2WR) to the butterflies that were on plants sprayed with pesticide one day before larvae application and had rain fall on it (1DR), I found the average development time to be 17.3889 days and 19.3750 days respectively. The p-value was 0.02015 and the percent confidence level to be 97.9846%. When I compared the 2WN butterflies to the 2WR butterflies, as shown on the table, I found the average development time to be 17.3889 days and 17.5333 days respectively. The p-value was 0.3931 and the percent confidence level was 60.6860%.