

The Effect of Pyrethrin on Earthworm Burrowing

By: Anna Hughes and Jessica Paur

Divine Savior Holy Angels High School

Abstract:

Pyrethrin is a pesticide sprayed on soil in order to kill insects, but insects are not the only creatures that live in the dirt. Even though Pyrethrin comes from a plant, so it is considered safe to use as a way to repel insects without causing environmental harm, the group was curious to see how other creatures were affected. It is important that worms are not affected, because worms help to increase the amount of air and water that gets into the soil. They also break down organic matter, like leaves and grass into things that plants can use and then they leave behind castings that are a valuable type of fertilizer. In order to test our theory, that high concentrations will kill the worms, the group exposed different worms to the pesticide for contrasting amounts of time and then recorded how long it takes for the worms to burrow themselves into the dirt, and then compare the times to come to a conclusion. Shown in the graphs and data tables, the worms that had been exposed for longer periods of time, burrowed much more slowly than those that had been exposed to the pesticide for shorter amounts of time. If the pyrethrin is in soil, the worms will work less efficiently and slower, therefore the crops and plants that are relied on for food, won't grow.

Introduction:

Pyrethrins consist of as many as six mixtures of chemicals that are toxic to insects (1). Pyrethrin was first logged as an insecticide in 1950's for the use by United States Environmental Protection Agency (1). There are many forms of pyrethrin which include but are not limited to, aerosols, sprays, powders, and granules (1). Pyrethrin works by disturbing or arousing the nervous system, which ultimately leads to paralysis and eventually death. Common ways of being exposed to pyrethrin include ingestion, inhaling or physical exposure (1). Common side effects from exposure of the pesticide include, itching or burning to the skin, which can lead to numbness of the entire exposed area. Pyrethrin does not absorb through the skin, thus causing the irritation. However, within 48 hours the itching or numbness will pass and within 3-7 days the chemical will be flushed from your body (1). Course studies on rats have shown that exposure to higher concentrations of pyrethrin had led to liver tumors. However, this only occurred under extreme concentrations, and was proven that low concentrations led to minor developments of rats livers. Overall, the EPA has classified pyrethrin as noncancerous. Environmentally, pyrethrin does not cause a threat to polluting the water system or soil. Pyrethrin quickly breaks down and dissolves within. The pesticides half-life is 11.8 hours in water and 12.9 hours. However, in extreme circumstances the pesticide has been reported to stay in soil and water for up to 14-17 days. Because of this, worms are more likely to be exposed to the pesticide. The worms growth rates will also start to significantly decrease and the worms internal structures will decompose at a faster rate (2). The purpose of this experiment is to observe and detect the effects

on burrowing ability and the time it takes to burrow. If the concentration of the pesticide pyrethrin increases, then the worm's burrow time will increase, because the pesticide is absorbed through the worm's skin during their allotted exposure time.

Materials:

Pyrethrin (pesticide) Bonide (brand) Solution of 1%, 10%, and 50%
distilled water
red worms
filter paper
10 Plastic Solo cups
top soil
pipette
timer/ stopwatch

Method:

1. Place a filter paper at the bottom of 4 cups with the variable of solution followed by two worms and another sheet of filter paper over the worms and an additional cup on the top.
2. Start with a full pipet of the distilled water, and place the worms in each cup and expose them to distilled water for 2.5 minutes, 5 minutes, 10 minutes and 20 minutes.
3. Once the exposure time is complete for each chamber, transfer the two worms to the burrowing chamber
4. Record the burrowing time for each worm to bury itself completely.
5. Next take a full pipet of the 1% pesticide solution and place the moistened filter paper in the cup followed by the worm, then another piece of filter paper and a cup over it for each of the four timed exposures.
6. Expose the two worms to the solution of 1% for 2.5 minutes, 5 minutes, 10 minutes, and 20 minutes.
7. After the time is up, place the two worms in the burrowing chamber and record the time it takes to be buried completely.
8. Next take the solution of 10% and place the moistened filter paper in the cup followed by the worm, then another piece of filter paper and a cup over it for each of the 4 time exposures.
9. Expose the worms to the solution of 10% for 2.5 minutes, 5 minutes, 10 minutes, and 20 minutes.
10. After the time is up, place the two worms in the burrowing chamber and record the time it takes to be buried completely.
11. Next take a full pipet of solution of 50% and place the moistened filter paper in the cup followed by the worm, then another piece of filter paper and a cup over it for each of the four timed exposures.

12. Expose the worms to the solution of 50% for 2.5 minutes, 5 minutes, 10 minutes, and 20 minutes.
13. After the time is up, place the two worms in the burrowing chamber and record the time it takes to be buried completely. If the worm has not burrowed completely by 20 minutes, the time recorded will be 20 minutes, because 20 minutes is the maximum time allotted.

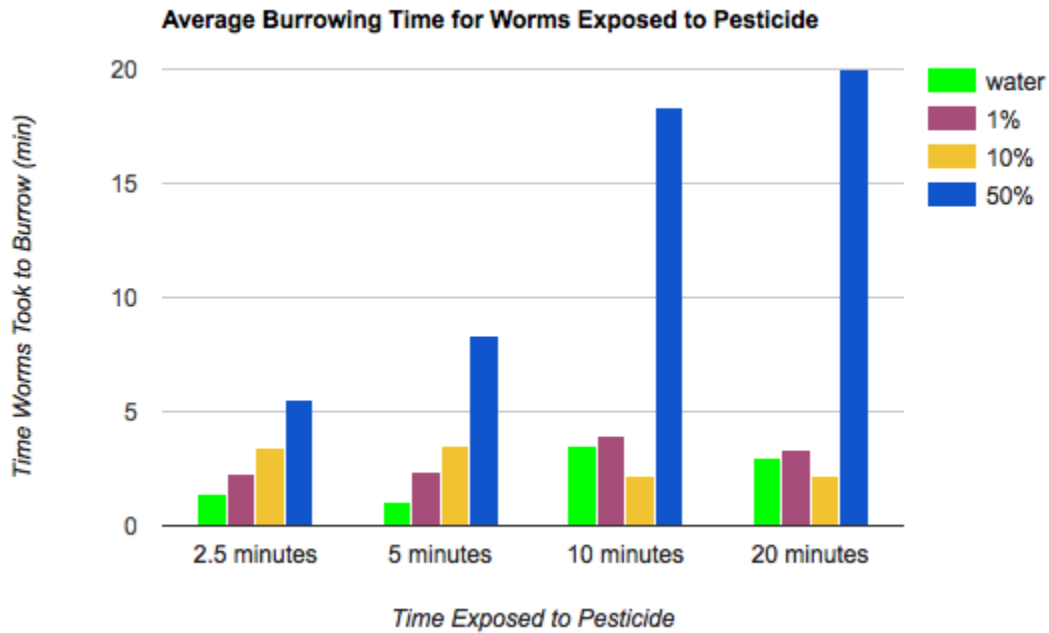
Burrowing Time for Worms Exposed to Pesticide (minutes)
(Figure 1)

Pesticide Concentration	2.5 minutes Exposure	5 minutes Exposure	10 minutes Exposure	20 minutes Exposure
Water (Control group)	Worm #1-1:36 min Worm #2-1:49 min	Worm #1-0: 57 sec. Worm #2 1:21 min	Worm #1-3:20 min Worm #2-4:15 min	Worm #1-0:45 sec Worm #2-4:14 min
1%	Worm #1-2:09 min Worm #2-2:55 min	Worm #1-2:22min Worm #2-2:58min	Worm #1-3:10 min Worm #2-3:09 min	Worm #1-3:22min Worm #2-:3:48min
10%	Worm #1-1:30 min Worm #2-3:37 min	Worm #1-4:13 min Worm #2-3:30 min	Worm #1-2:20 min Worm #2-2:24 min	Worm #1-2:17 Worm #2-2:17
50%	Worm #1-5:44 Worm #2-6:02	Worm #1-8:28 Worm #2-8:44	Worm #1-19:08 Worm #2-20:00	Worm #1-20:00 Worm #2-20:00

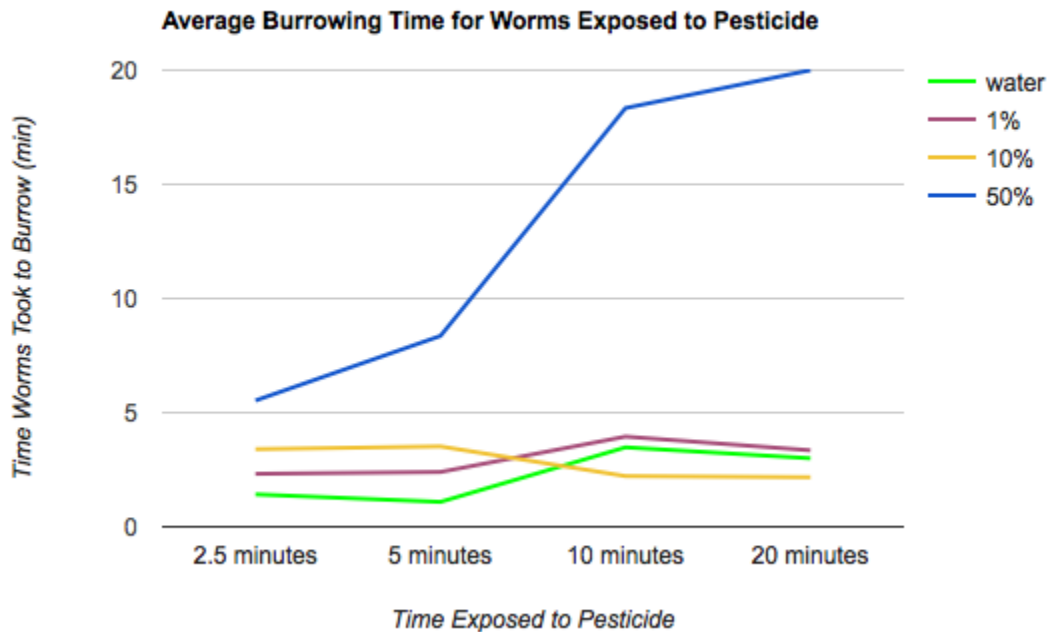
The Average Burial Time (Minutes) Between the Two Worms Exposed to Pesticides (Figure 2)

Pesticide Concentration	2.5 minutes exposure	5 minutes exposure	10 minutes exposure	20 minutes exposure
Water (Control group)	1:42	1:09	3:48	2:30
1%	2:32	2:40	3:95	3:35
10%	2:34	3:52	2:22	2:17
50%	5:53	8:36	19:34	20:00

(Figure 3)



(Figure 4)



Results:

The purpose of this experiment is to test if the pesticide Pyrethrin is added to the soil, then the deterioration of the worms magnetic field sensors will lead to burial adaptations because the high concentrations of pesticide would be absorbed through the worm's skin would affect a worms burrowing time. The independent variable measured in this experiment is the pesticide concentration in the solution and the exposure time. The effect of the independent variable is the dependent variable which is the amount of time in minutes it takes the earthworms to burrow after being exposed to the concentration. When the pesticide is added to the earthworms environment, the result is an increase in borrowing time when the worm is exposed to the higher concentration of pesticide. When the earthworms are exposed to the lower concentration of pesticide, their burrowing time is less than the higher concentration. The maximum amount of time given to burrow is 20 minutes which was exceeded during the 50% concentration shown in figure 3 and figure 4. The concentration of 50% had the biggest effect on the earthworms by tripling the average burrowing time results for each of the concentrations as seen in figure 3. The results shown in figure 4 show that the concentration of 1% has little effect on the earthworm because its results are similar to the controlled variable-water, each having an

increase in burrowing time when exposed for 10 minutes and decrease after the 20 minute exposure time. As shown in figure 4, the concentration of 10% ultimately had a decrease in burrowing time as the exposure time increased. The results of this experiment have shown the ultimate effect of pesticide when absorbed through a worm's skin, is that it causes burial adaptations which increase their burial time.

Discussion:

If the concentration of the pesticide pyrethrin increases, then the worm's burrow time will increase, because the pesticide is absorbed through the worm's skin during their allotted exposure time. The hypothesis highlights burial adaptations due to their exposure to the pesticide pyrethrin. The data signifies the drastic burial times between the controlled group of distilled water and the experimental test such as 50% concentration. To expand off of this, the distilled waters highest burial time occurred for 10 minutes of exposure with a 3:20 minute burial time. In comparison, 50% concentration with 20 minute exposure yielded over 20 minutes in burial times for the worm. These two high contrasted points relate to the main point in the hypothesis, which is that the greater the concentration and exposure time the longer the burial time. One source of error with the results is the exact amount of the pesticide throughout the whole lab procedure. The pipet was a non-exact measurement for each of the concentrations, leading to some worms exposed to larger amounts of pyrethrin. One limitation in the project was the burial space provided for the worms. This influenced the rate and space on a natural burial pattern for a worm. Another limitation with the project was not being able to analyze the long term effects on the worm's burial and internal changes. While long term side effects could not be reported and are often linked to human health. However, one comparison and conclusion can be linked to the human body. Exposure to pyrethrin caused neurological issues as burrowing ability was inhibited when exposed at high concentrations. The numerical results justify the claim and theory; however, we cannot directly link the same side effects and implications to humans.

Question/Further studies:

Will the pyrethrin impact the offspring of the worms whose parents were exposed to the pesticide?

Works Cited

- (1)"Pyrethrins." *Pyrethrins*. N.p., n.d. Web. 20 Feb. 2017.
- (2)"The Problem with Pesticides." *The Problem with Pesticides / Toxics Action Center*. N.p., n.d. Web. 20 Feb. 2017.