The Effect of Remedies on Brown Soft Scale Insects on Dieffenbachia Plants

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Group 8: “The Parasite Prognosticators”

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Abstract

The experiment "The Effect of Remedies on Brown Soft Scale Insects on Dieffenbachia Plants" tested the question "Which is better at reducing brown soft scale insects: a store-bought remedy or a home remedy?" The hypothesis the whole group agreed on was "Horticultural oil will be more effective than isopropyl alcohol in removing brown soft scale insects." To test the effect of each remedy on the insects, the team applied a water and horticultural oil solution to half of one leaf and a 70% alcohol solution to half of another leaf. The masses of four hexagonal plastic trays were recorded and then one tray was placed under each leaf half to collect any honeydew the scale insects secreted. A smaller increase in honeydew production represented a decrease in the amount of scale insects. Each week, the masses of all four trays were measured and both solutions were reapplied. The experiment ran for four weeks, and the results showed that the tray under the side of the leaf coated with horticultural oil increased less in mass compared to its control than the leaf with the alcohol covering did. The results of the experiment supported the initial hypothesis.

Introduction

Plants can be extremely important for many different areas of scientific research, from finding cures to diseases to helping end world hunger. However, despite people's best efforts external factors sometimes make it much harder to maintain a plant's well-being. An example of one such factor is parasitic organisms. When we saw brown soft scale insects on our dieffenbachia plant, we knew that it would negatively affect the plant, so we decided to test ways of getting rid of these organisms to ensure the plant's overall health remained at a stable level.

We assumed that there were equal amounts of scale insects (and therefore honeydew production) on both halves of the leaves that we tested. This was a fair assumption because we were testing the overall change in production of honeydew, which is a variable that would change regardless of the amount of insects on the plant. We also assumed that the honeydew produced would be an accurate measurement of how many scale insects were still alive on the leaves because we figured that the fewer scale insects that are living, the less honeydew will be produced. It was also fair to say that the remedies used would not have an effect on the growth of the plant. Horticultural oil is a store-bought solution that was designed for these purposes, so it shouldn't affect the plant in this way. Secondly, it did not seem like the rubbing alcohol would affect the growth of the plant, as there would still be the same amount of sunlight and water available to it. Finally, we assumed that the honeydew produced on both halves of the leaf would drip directly downwards onto our measuring trays, and not towards the center: the leaves tested hung perpendicular to the table the plant was resting on.

Hypothesis

Alternate Hypothesis:

Horticultural oil will be more effective than isopropyl alcohol in removing brown soft scale insects.

Null Hypothesis:

There will be no significant difference between the effects of horticultural oil and isopropyl alcohol on removing brown soft scale insects.

Methodology: Materials, Equipment, and Facilities

Consumable Materials	Equipment	Facilities
● 80% Isopropyl Alcohol (131.25 mL) ● Horticultural Oil (1.5 mL) ● Cotton Swabs (9) ● Water (168.75 mL) ● Plastic Trays (4) ● Rubber Bands ● Spray Bottle ● Tape ● Paperclip ● 4”x12”x2” Piece of Wood ● Brown Soft Scale Insects ● Safety Goggles ● Pipette (with 0.5 mL increment) ● Glass Bottle ● Graduated Cylinder ● Paper ● Soil	● Dissecting Microscope ● Dieffenbachia Plant ● Digital Scale ● Phone Camera	● Classroom ● Sink ● Table

Experimental Design Diagram

Title: The Effect of Remedies on Brown Soft Scale Insects on Dieffenbachia Plants

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Independent Variable: Type of remedy

Levels of Remedies	Isopropyl Alcohol	Horticultural Oil	No Remedy (Oil Control)	No Remedy (Alcohol Control)
# of Trials	1	1	1	1
Control			Control	Control

Dependent Variable: Death of brown soft scale insects

Operational Definition of the Dependent Variable: Difference in mass of honeydew between remedy and control side

Constants:

Placement of plant

Plant (Dieffenbachia)

Placement of plastic trays

Soil

Ratio of each of the remedies (1:100 for horticultural oil:water; 87.5:12.5 for alcohol:water)

Methodology: Experimental Setup, Graphics, Illustrations

FIGURE 1: Image of the setup for leaf treated with horticultural oil

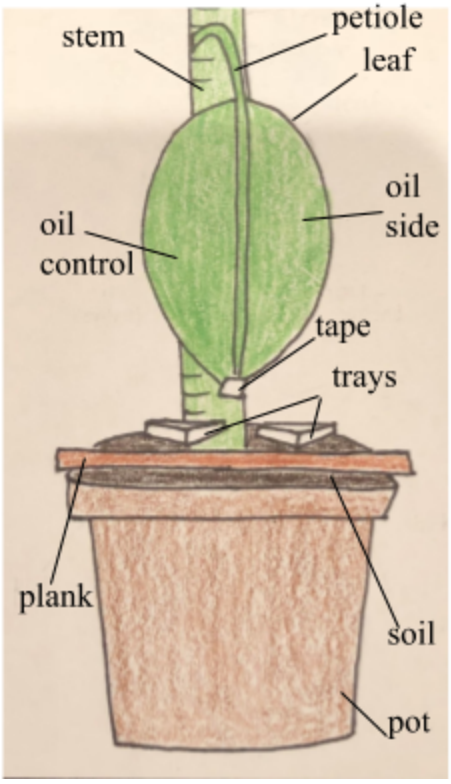

FIGURE 2: Diagram of the setup for leaf treated with horticultural oil

We set up the plants so that each side of the leaf has its own collecting tray. The control side of the leaf would drip honeydew into the control tray and vise versa. This leaf had a 2x4 plank to elevate the trays to get more accurate results. We later taped the leaf to the stem so that it wouldn't move when there was any wind or someone moving it to a different location (not shown in the image but shown in the diagram).

FIGURE 3: Image of the setup for leaf treated with isopropyl alcohol

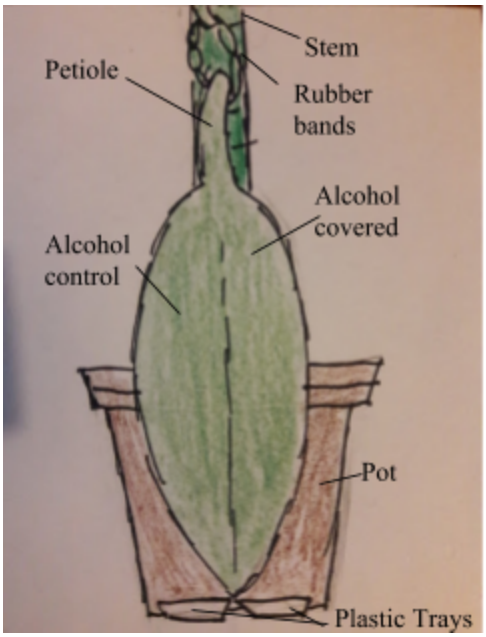

FIGURE 4: Diagram of the setup for leaf treated with isopropyl alcohol

The back leaf is set up the same way except it was not taped to the stem. Instead, rubber bands were used to slightly lift up the petiole, causing the entire leaf to lift by about one centimeter. This allowed for the leaf to come off the table and for us to have room to place the plastic trays under the leaf. This one is closer to the window, so it might have received more sunlight, which was not intentional.

Methodology Procedure

1. Wear safety goggles.
2. Shake the bottle of horticultural oil.
3. Measure 37.5 mL of water using a graduated cylinder and a pipette for more precision.
4. Pour the water into a small spray bottle.
5. Open the bottle of horticultural oil.
6. Measure 0.5 mL of horticultural oil using a pipette.
7. Pour the horticultural oil into the spray bottle.
8. Close the bottle of horticultural oil.
9. Put the lid back onto the spray bottle.
10. Tighten the nozzle to make sure nothing leaks.
11. Shake the solution very well for at least one minute or until it looks white and foamy.
12. Open the spray bottle.
13. Measure 12.5 mL of water using a graduated cylinder and a pipette for more precision.
14. Pour the water into the spray bottle.
15. Put the lid back onto the spray bottle.

16. Tighten the nozzle to make sure nothing leaks.
17. Shake the solution well again.
18. Loosen the nozzle to prepare for spraying the leaf.
19. Hold a piece of paper against the side of the leaf you are not spraying to cover it.
20. Spray the leaf with enough of the horticultural oil and water solution to cover it. This took our team 15 sprays.
21. Repeat steps 19 and 20 for the back side of the leaf. At the end of this step, both the front and back of the same side of the leaf should be sprayed.
22. Empty the spray bottle.
23. Rinse it out with water multiple times.
24. Get out 80% isopropyl alcohol.
25. Measure 43.75 mL of alcohol using a graduated cylinder and a pipette.
26. Pour the isopropyl alcohol into the rinsed spray bottle.
27. Measure 6.25 mL of water using a graduated cylinder and a pipette.
28. Pour the water into the spray bottle.
29. Put the lid back onto the spray bottle.
30. Tighten the nozzle to make sure nothing leaks.
31. Shake the solution well. This should make a 70% isopropyl alcohol solution.
32. Get cotton swabs.
33. Dip cotton swabs into the solution.
34. Use the cotton swabs to apply the solution and coat the entire half of the leaf, front and back.

35. Label four plastic, hexagonal trays with a number from 1 to 4.
36. Zero the balance.
37. Measure each tray and record the mass.
38. Wait for the horticultural oil to stop dripping off the leaf.
39. Place a wood plank on top of the rim of the pot.
40. Tape the leaf to the stem to make sure it stays in place.
41. Place two trays on top of the plank, one under each side of the leaf.
42. Make sure the other leaf is not too low to the table.
43. If it is, knot a few rubber bands together to form a longer rubber band and add a paper clip.
44. Tie the rubber band around the petiole of the experimental leaf and the petiole of a higher leaf using the paper clip.
45. Place the trays underneath the leaf, one on each side.
46. Wait one week.
47. To collect data, measure the mass of each tray.
48. Repeat steps 1 through 47, excluding 35, 43, and 44, each week.

Data: Tables/Graphs

TABLE 1: Raw data table of the mass of the trays by the amount of weeks after the first treatment in grams

Mass of trays (g)				
Date	Oil	Oil control	Alcohol	Alcohol control
Week 1	4.62	4.59	4.88	4.39
Week 2	4.64	4.60	4.90	4.40
Week 3	4.64	4.61	4.92	4.40
Week 4	4.64	4.61	4.96	4.44

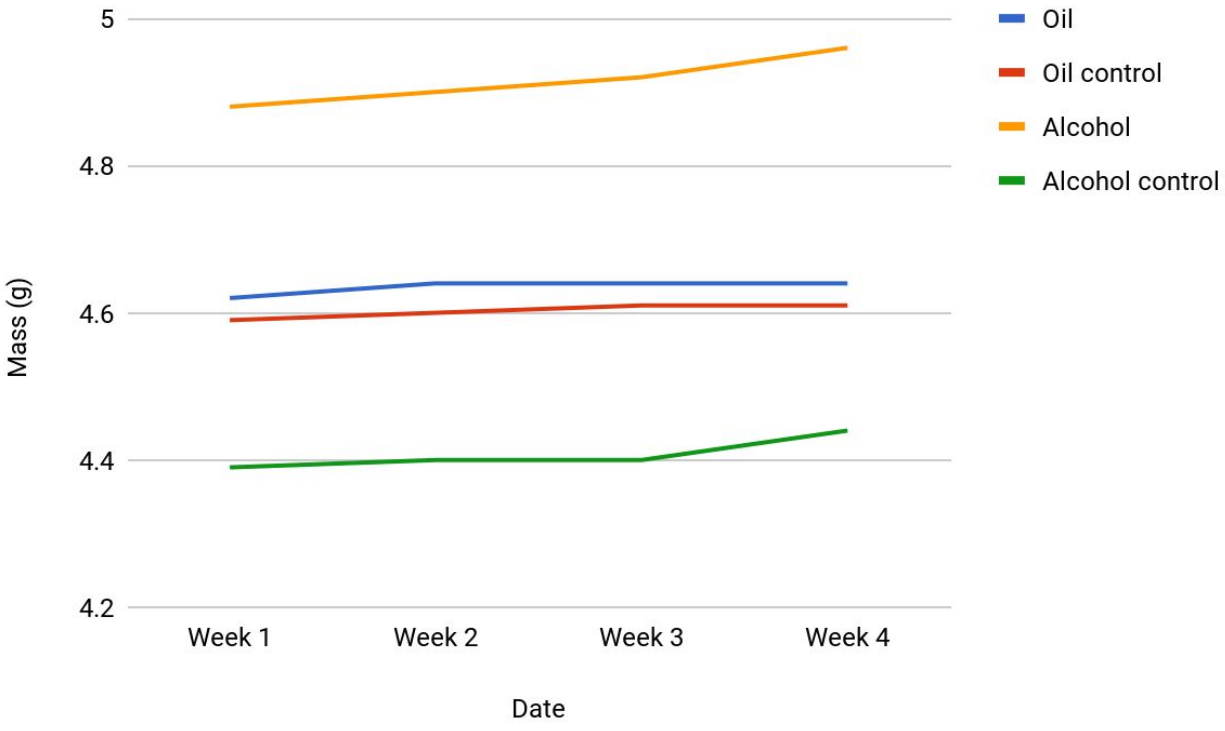

FIGURE 5: Graph of the mass of the trays by the amount of weeks after the first treatment in grams

TABLE 2: Raw data table of the change in mass of the trays by week interval in grams

Change in mass of trays (g)				
Week Interval	Oil	Oil control	Alcohol	Alcohol control
Week 1 to 2	0.02	0.01	0.02	0.01
Week 2 to 3	0.00	0.01	0.02	0.00
Week 3 to 4	0.00	0.00	0.04	0.04
Total	0.02	0.02	0.08	0.05

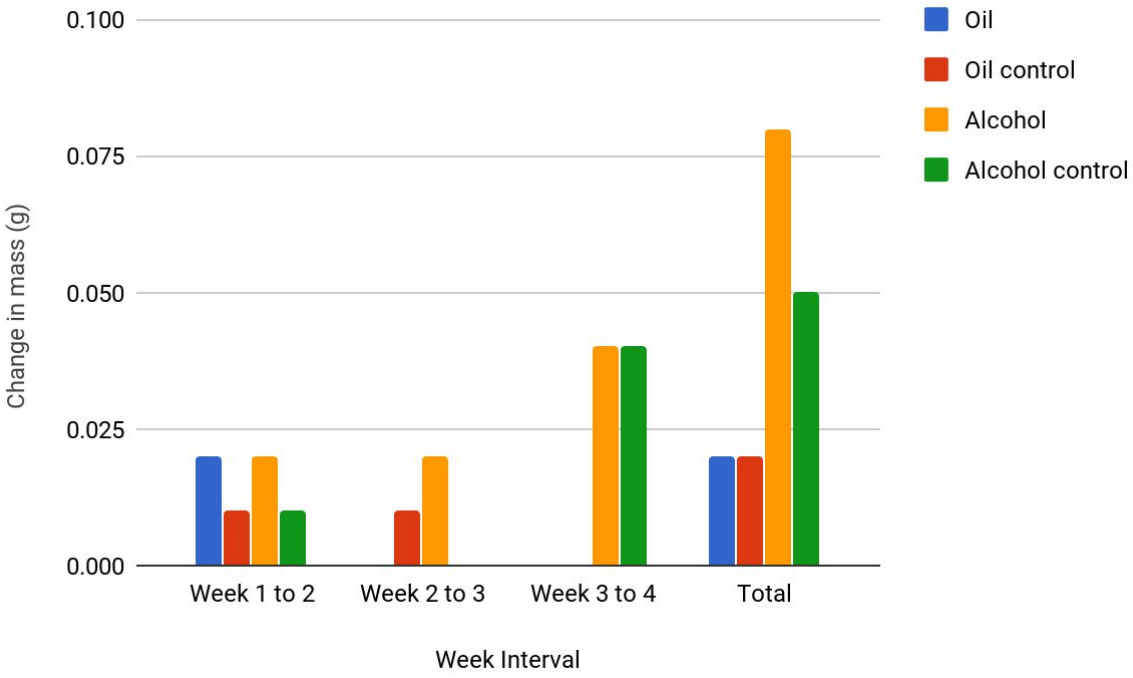

FIGURE 6: Graph of the change in mass of the trays by week interval in grams

TABLE 3: Summative data table of the change in mass of the trays by week interval in grams

Change in mass of trays (g)				
	Oil	Oil control	Alcohol	Alcohol control
Mean	0.007	0.007	0.027	0.017
Standard Dev	0.012	0.006	0.012	0.021
Variance	0.000	0.000	0.000	0.000
n	3	3	3	3

Findings

Since both remedies were being tested on two different leaves with different amounts of scale insects to start with, the only way we could compare the data of the remedies was by having two controls, one on each leaf. The mass of each remedy side would be compared to the control side, and then whichever remedy tray had a mass that was lesser compared to the control than the other remedy tray would be the better remedy in this experiment. The horticultural oil tray increased 0.02 grams in mass, and the control tray for that leaf increased by the same amount, 0.02 grams. Tray 3, the tray under the alcohol side, gained 0.08 grams in mass whereas the mass of the control tray only increased 0.05 grams. Our conclusion is therefore that our hypothesis is supported and horticultural oil is more effective than isopropyl alcohol in removing brown scale insects.

The expectation of the group was that the horticultural oil would have more of a positive effect than the alcohol would, which is supported by our study. However, we also had the expectation that both sides treated by the remedy would have less honeydew secretion than the control sides. As shown by our data, this is not the case for either of the remedies. The parasites

on the side coated with horticultural oil excreted the same amount of honeydew as the control. Even more surprisingly, the scale insects on the alcohol-coated side released more honeydew than the control.

There are a variety of variables that could have affected our experiment. By the end of our experiment, both leaves we applied the remedies to had died. Some members of our group think that the remedy is what caused the leaves to die. Others point to the fact that the entirety of both leaves died while only half of the leaf was coated in a remedy to support their opinion that the leaves died from some other cause. If this is the case, the most probable cause of the death of the leaves was the increasing heat and lack of humidity inside the building as the temperature outside gets colder. Another variable is the movement of the leaves. Occasionally, they would sway with the wind or with the table and then end up in a slightly different place than they started in. We solved this problem after a few weeks by taping the bottom of one of the leaves to the stem, but there was no way we could make sure the leaf that was low to the table would not move. Sunlight was an important variable. As a result of the positioning of the plant, the front of one leaf faced away from the window and the front of the other leaf faced towards the window for the length of the experiment. This variation in the amount of sunlight that was available to each leaf possibly could have affected our experiment. Another variable that could have had an impact on our experiment is the migration of the parasites. Migrating parasites affecting the levels of honeydew is a possibility our experiment did not take into account. These variables are a great starting point for thinking of how to better our experiment in future studies.

Suggestions for Further Study

If this question was to be studied again, more leaves should be treated with the remedies. If more results were taken from a variety of leaves, the trends of the data would be more perceptible and reliable. A variety of leaves would include leaves that were at different elevations on a plant, on different plants, and in different environments. While the horticultural oil was more successful on this leaf in this environment, this may not be consistent throughout other leaves. If more or less water or sunlight was present, or the temperature was different, the outcome of the experiment may have been altered.

One of the variables that affected the experiment was the health of the leaves. The variables of the environment such as the water that is given to the plant and the temperature of the plant should be kept track of to ensure that the plants are kept alive. Although much attention was given to the treatment of the leaves, the health of the plant was also neglected. Providing the plant with healthy living conditions is critical to being able to produce accurate results.

In future studies, the influence of remedies on parasite migration could be investigated. While examining the leaves, we noticed that some parasites had infested the petioles. To the eye, the petiole of the leaf that was treated with alcohol seemed to have more parasites on it than that of the leaf treated with horticultural oil. If this trend was found to be consistent throughout many trails, we may find that some remedies displace while others kill. The perceived effectiveness of the remedy may be inaccurate if the remedy is only displacing the scale insects.

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