The Effect of a Calcium Blocker on *Dionaea Muscipula* Gland Stimulation

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Introduction

- The Venus flytrap is a carnivorous species of plant native to small areas of the coastal plain in North and South Carolina.
- Currently facing risks of extinction as a result of habitat loss from biological resource use and pollution.
- Pollution, specifically neurotoxic pollution from pesticides, tends to runoff into areas that contain wild Venus flytrap populations[1].
- The Venus flytrap relies on physical stimulation and electrical impulses involving the movement of calcium ions and the release of digestive fluid[2].

Dionaea Muscipula (Wild)

Green Swamp, Wild Flytrap Habitat

Methods

Hypothesis: As the concentration of $GdCl_3$ increases, the digestion activity will decrease.

Three traps in each treatment group for a total of 18 traps maintained in the same water and light conditions.

Control: 2μL of H2O
Treated Traps: 2μL of the following solutions

- 1mM $GdCl_3$
- 4mM $GdCl_3$
- 7mM $GdCl_3$
- 10mM $GdCl_3$
- 13mM $GdCl_3$

1. Treat trap with 2µm of $GdCl_3$ or H2O
2. Wait 5 days for trap reopening
3. Feed trap with 1 ant
4. Wait 7 days for trap reopening
5. Observe results

Purpose

- Goal: To identify a correlation between a calcium blocker ($GdCl_3$) and glandular activity in Venus flytraps.
- Results can guide the development of policies in the use of neurotoxic pesticides near protected land.
- Increase the range of protected areas for wild flora.

Dionaea Muscipula (Wild)

Results (see table below)

- Traps treated with concentrations less than 7 mM of $GdCl_3$ showed extreme to moderate ant change than traps treated with concentrations 7 mM and above.
- Slower trap closure rate was observed in traps that contained 4mM or 7mM of $GdCl_3$.
- Traps that contained concentrations of 7mM or 10mM $GdCl_3$ did not fully close when triggered.
- Traps that contained 13mM concentration of $GdCl_3$ never reopened for feeding.
- All traps were mostly or fully dead 12 days after treatment whereas controls remained alive.

Control	1mM	4mM	7mM	10mM	13mM
CA	1A	2A	3A	4A	5A
CB	1B	2B	3B	4B	5B
CC	1C	2C	3C	4C	5C

Most Digested — Least Digested — No Data

The data was categorized twice more by unbiased participants. Each photo of ant was labeled based on physicality from most altered to least altered. The results were similar.

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Conclusion

Higher levels of change in the ant suggest higher levels of digestion. As such, we make the following conclusions:

- Digestion potential decreases as the concentration of $GdCl_3$ increases.
- Trap closure rate decreases as the concentration of $GdCl_3$ increases.
- 10mM $GdCl_3$ is the concentration in which total paralysis of the trap is likely.
- The calcium blocker $GdCl_3$ is determined to cause partial or total paralysis preventing the movement of energy in a snap trap eventually leading to death of the trap.

Follow-up Questions and Ideas

- Absorption of calcium blocker through roots.
- The effect of calcium blockers on the whole plant.
- The effect of a calcium blocker on other carnivorous plants.

- Follow up Experiment of with 10mM and 13mM $GdCl_3$ (Fed ant and treatment at the same time)
  -Ant was fully intact and there was little to no sign of digestion.
  -Most of the treated traps reopened and remained alive.
  -Supports original hypothesis.

References

1. Jennings, D. E., & Rohr, J. R. (2011, April 3). *A review of the conservation threats to carnivorous plants*. Biological Conservation. Retrieved April 20, 2022, from https://www.sciencedirect.com/science/article/pii/S0006320711001078

2. Scherzer, S., Huang, S., Iosip, A., Kreuzer, I., Yokawa, K., AL-Rasheid, K. A. S., Heckmann, M., & Hedrich, R. (2022, February 18). *Ether anesthetics prevents touch-induced trigger hair calcium-electrical signals excite the venus flytrap*. Nature News. Retrieved April 20, 2022, from https://www.nature.com/articles/s41598-022-06915-z