Evaluating the Effect of the *Spathodea campanulata* (African Tulip) as an Ant Repellent to Protect Beehives

Problem

Honeybee colonies are the most important pollinators for global agriculture, sustaining biodiversity and ensuring the productivity of numerous crops essential for human survival.

One of the growing problems that is causing serious consequences in beehives is the invasion of ants.

Ants can invade beehives in search of food (including honey and larvae) and attack the queen, leading to colony collapse and/or absconding (abandoning the hive).

Chemical repellents can be effective in preventing ant invasion, but they are expensive and pose significant risks.

There is a need for cost-effective and eco-friendly alternatives.

Background Research

Figure 1. *Spathodea campanulata* (African tulip tree). Photo taken by finalists, 2024.

Figure 2. *Spathodea campanulata* (African tulip flower and pouches). Photo taken by finalists, 2024.

- Honeybees are essential for the reproduction of many commercially cultivated crops that constitute a large part of the human diet (Lartey, 2024).
- Even though honeybees are strong and reproduce quicky, they have problems. Ants are invading beehives and killing the bees, posing as mechanical vectors of viral particles.
- Plenty diseases in bees are caused by positive-sense single-stranded RNA viruses, some of which can increase and lead to colony death (Dobelmann, Felder & Lester, 2023). Ants often displayed multiple infections, suggesting they may act as hosts that contribute to pathogen circulation in the environment (Tiritelli, Cilia & Grasso, 2024; Poinar, 2024; Champer & Schlenoff, 2024).
- *Spathodea campanulata* (African tulip tree) is considered one of the world's most aggressive invasive species (Sutton, Patterson & Paynter, 2017; Williams, 2023), has shown potential uses in pest management due to its bioactive compounds.

Objectives and Hypothesis

The researchers investigated the potential of *Spathodea campanulata* (African tulip) as a natural repellent to protect a beehive from ants' invasion, which threatens hive integrity and health.

Also, examined the effects of *Spathodea campanulata* (African tulip) on ant behavior to determine if it can serve as a cost-effective alternative to chemical repellents.

The researchers stated that *Spathodea campanulata* (African tulip) produces compounds that can naturally repel ants, thereby preventing invasions in the beehive.

Diagram created with Microsoft Word tool SmartArt. Photo taken by finalists, 2024.

Materials

1. Glue
2. Syringe
3. Scissors
4. Skewers
5. Spreader
6. Umbrella
7. Glass vial
8. Petri dishes
9. Spray bottle
10. Safety attire
11. Plastic bowl
12. Paper towels
13. Beekeeper suit
14. Plastic test boxes
15. Wood sticks/base
16. Natural honeycombs
17. African tulip pouches

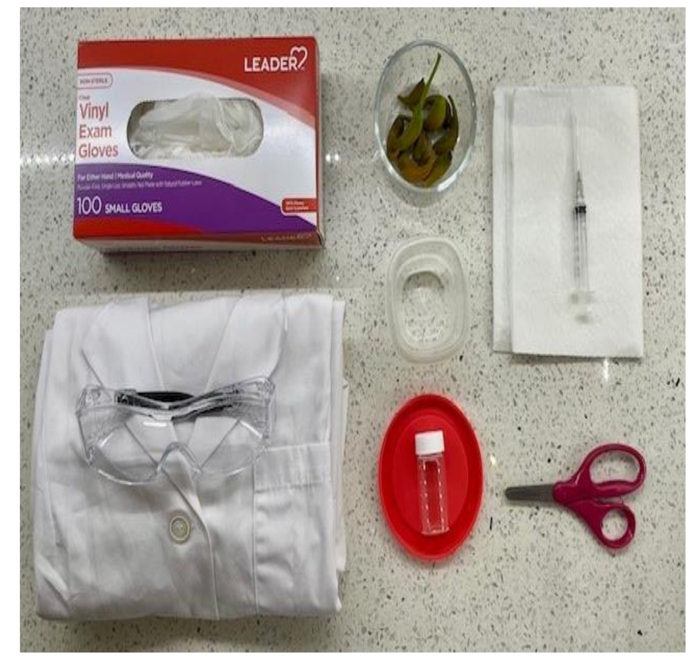


Figure 3. Materials used to extract liquid from the spathes. Photo taken by finalists, 2024.

Figure 4. Beekeeper suit used to get close to the bees. Photo taken by finalists, 2024.

Figure 5. Materials used to set up test boxes. Photo taken by finalists, 2024.

Researchers' electronic equipment (computers and mobile devices) were used to take pictures and/ or videos.

Procedure

Figure 6. *African tulip (Spathodea campanulata).* Photo taken by finalists, 2024.

Figure 7. Squirting African tulip liquid from a spathe. Photo taken by finalist parent, Legna Z. Villodas, 2024.

Figure 8. Attaching the petri dishes to the test boxes. Photo taken by finalist parent, Legna Z. Villodas, 2024.

Figure 9. Spraying African tulip liquid in Box B. Photo taken by finalist parent, Ilsa V. Castañer, 2024.

Figure 10. Placing the honeycomb in Box B. Photo taken by finalist parent, Ilsa V. Castañer, 2024.

Figure 11. Placing the test boxes outside. Photo taken by finalists, 2024.

African Tulip (*Spathodea campanulata*) tree was identified → African Tulip liquid was extracted from the spathes or buds → Elevated petri dishes were glued to the test boxes → African Tulip liquid was sprayed on to the Experimental Box B only → Natural honeycombs placed in both boxes → Both test boxes (Control A and Experimental B) were placed outside

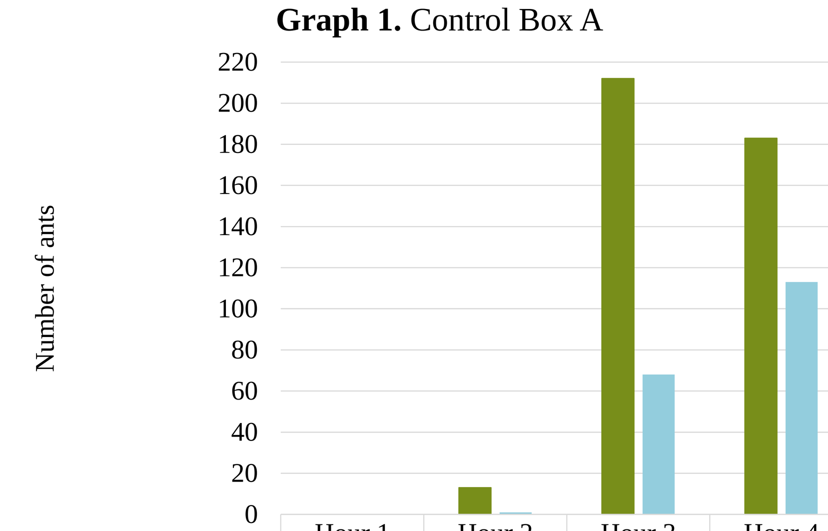
Diagram created with Microsoft Word tool SmartArt, 2024.

Results

Figure 12. 1 hour after being placed outside for experimentation - 0 ants entered Control Box A and Experimental Box B. Photo taken by finalists, 2024.

Figure 13. Control Box A and Experimental Box B - 4 hours after monitoring started, Box A had 183 ants alive, and Box B had 91 dead ants. Photo taken by finalists, 2024.

Graph 1. Control Box A

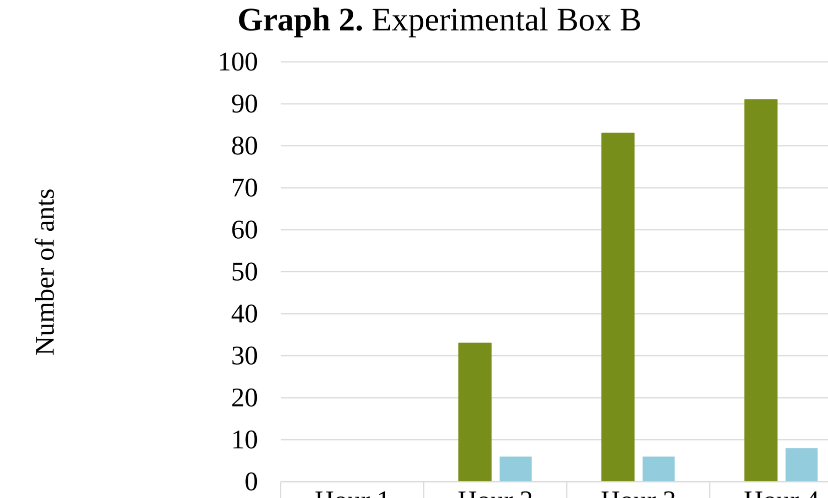


	Hour 1	Hour 2	Hour 3	Hour 4
Ants in testing zone	0	13	212	183
Ants that reached honeycomb	0	1	68	113

■ Ants in testing zone ■ Ants that reached honeycomb

Graphs 1 & 2 were created by finalists using Excel, 2024.

Graph 2. Experimental Box B



	Hour 1	Hour 2	Hour 3	Hour 4
Ants in testing zone	0	33	83	91
Ants that reached honeycomb	0	6	6	8

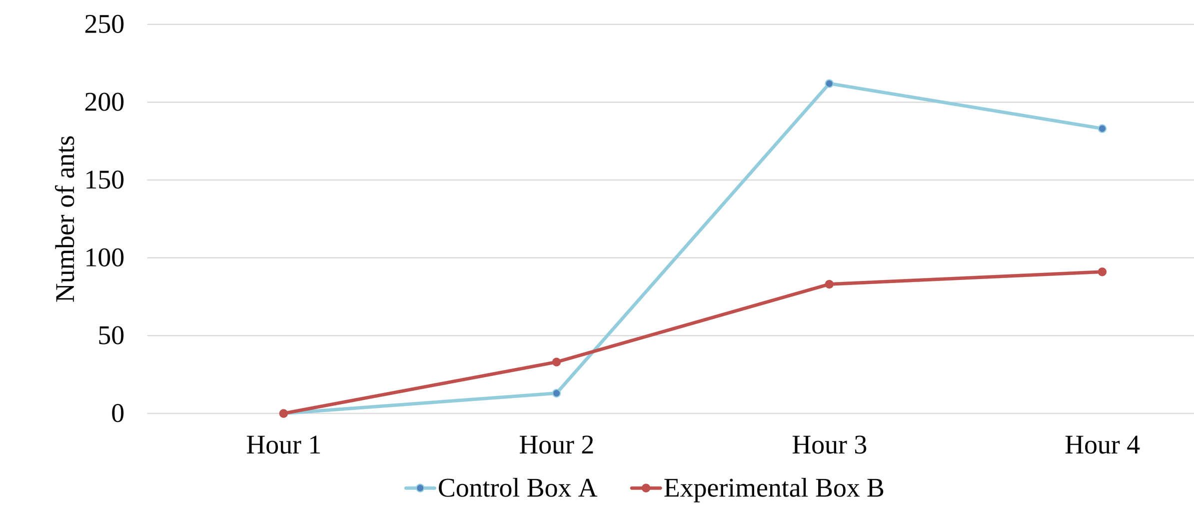
■ Ants in testing zone ■ Ants that reached honeycomb

Figure 14. Researcher opening a test box to allow bees to fly closer. Photo taken by finalists, 2024.

Figure 15. Bees consumed the honeycombs in both boxes (Control and Experimental) and remained unharmed. Photo taken by finalists, 2024.

Discussion

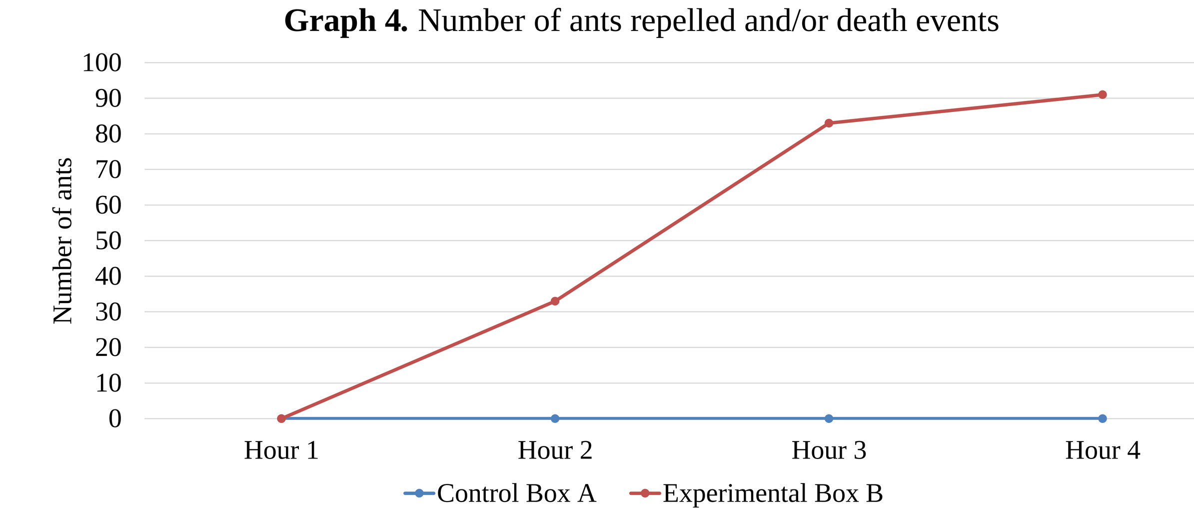
Graph 3. Number of ants observed per hour



Graph 3 created by finalists using Excel, 2024.

Upon analyzing the results, the researchers determined that the highest number of ants in Control Box A occurred during the third hour. It's worth mentioning that the number of ants in this box kept changing during the experimentation period because the ants were moving in and out of the testing zone as they were alive and well. As an additional note, the test boxes were placed in an area prone to bees. In a short amount of time, bees got close and inside both boxes consuming the honeycombs. Most of the bees flew into the honeycomb area while some landed in both boxes. No dead bees were observed in either box.

Graph 4. Number of ants repelled and/or death events



Graph 4 created by finalists using Excel, 2025.

Conclusion and Recommendations

The hypothesis was retained. After leaving the control and experimental boxes outside for four hours, *Spathodea campanulata* (African tulip) was capable of naturally repelling ants, thus preventing invasions of the "simulated hive". The experiment demonstrated that ants were significantly prevented from entering the box treated with the African tulip repellent liquid, as evidenced by the lower number of ants entering the experimental box compared to the control box. Furthermore, 100% of the ants that entered the treated box died, while the ants in the control box showed no signs of damage. Importantly, the bees came naturally into contact with the experimental setting, where the African tulip liquid was displayed without being repelled or harmed, suggesting the selective effect of the repellent on the ants. By reducing ant activity around hives, this could offer a cost-effective and eco-friendly alternative to harmful chemical repellents.

Future research approaches are needed to fully understand the specific compounds responsible for these repellent properties. → Also, implementing field trials to assess the long-term impact of *Spathodea campanulata* (African tulip) as a natural repellent in diverse environments.

Diagram created with Microsoft Word tool SmartArt. Photo taken by finalists, 2024.

References

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