Thymol Oil and Imidacloprid Used as an Alternative Pesticide to Reduce Bee Population Decline

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ABSTRACT

Our group focused on the declining bee population, which has been a source of concern for the agricultural industry. Although pollinators are made up of a diverse variety of species, bees perform a majority of pollination, specifically in agriculture. The decline of bee pollinators inevitably has decreased crop yield, which is disadvantageous from an environmental and economic perspective. During the group's first semester (SCI 150), each member conducted various literature reviews to better understand the cause of bee population decline. The group assessed that traditional pesticides containing imploproclorid and neonicotinoids were the most prominent cause. Based on this research, the group decided to focus on the most abundant species locally, *Apis mellifera,* otherwise known as the Western honey bee. During the second semester (SCI 200), the group continued to conduct literature reviews on the effects of neonicotinoids pesticides and began researching safer alternatives. Eventually, the group transitioned into researching different components of current natural pesticides as well as ways to make them more effective via nanoparticles. By the current and last semester (SCI 250), the group initially planned to synthesize and test their own natural pesticide in the lab. However, due to COVID-19 restrictions, the group pivoted to an infographic aimed towards pesticides manufacturers and large agricultural land owners in California. Using the research from prior semesters, the groups wanted to convince others on the effectiveness of their natural pesticide. Besides the fiscal importance, the group's proposed natural pesticides is a major contribution to science, as it creates an effective yet sustainable way for farmers to improve their crop yields while keeping bee populations safe. Without the group's proposed solution, the current bee population would continue to decline into eventual extinction.

INTRODUCTION

- The Problem: the decline of pollinators caused by toxic pesticides, specifically bees
- Pollinators: maintain ecosystems and habitats, responsible for one third of US agriculture[8][13] (most of which bees are responsible for)
- Factors for decline: invasive species, mites, pollution, urbanization, climate change, and our focus- pesticides[8]
- Current Pesticides: classified as neonicotinoids (nicotine-like) which are permanently damaging to bees.[2]
- Our approach: develop a natural pesticide containing essential oils and free of neonicotinoids
- Previous attempts at resolution: past natural pesticides were not applicable due to high rates of degradability and not effective towards all species

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OUR APPROACH

- Decided to synthesize a natural pesticide made from essential oils that repels pests but is safe to bees
- Recent research has found that imidacloprid, a compound found in many pesticides on the market, and thymol oil, an essential oil, have synergistic insecticidal effects against the common pest, the Aphid, when combined[6]. However, high concentrations of imidacloprid has been known to be toxic to bees[7].
- Despite this toxicity, other researchers have discovered specific concentrations of imidacloprid that are safe to bees[7].
- Based on this research, our proposed pesticide would have been composed of thymol oil and imidacloprid at a concentration that is harmless to bees. The pesticide would be reinforced using diluted concentrations of zein nanoparticles to improve durability and effectiveness[15]
- Due to COVID-19, had to shift to creating an infographic directed to agricultural workers, containing the potential natural pesticide

CONCLUSION

- Combine essential oils and stabilize with nanoparticles before testing pesticide on *Apis mellifera (*track movement/behavior with time lapse camera)
- Our natural pesticide will avert the declining bee population → increase crop production → economically advantageous on a wide scale
- SCI 300: Utilize Makerspace (in Hashinger Science Center) to construct and test our natural pesticide
- Long term goals: (1) Disseminate findings and infographic to conservational and agricultural communities (2) Regenerate bee populations leads to reliable and sustainable pollinators
- How?: Presentations at Agricultural Conventions, Conservational Conventions, to Government Agencies, like Department of Agriculture, to publicize findings and encourage use of safer pesticides in agricultural works and possibly legislation to facilitate matters

REFERENCES

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