THE EFFECT OF PRE-BLOOM PESTICIDES ON SUCCESSFUL BLUEBERRY POLLINATION

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Background/ Motivation

- *Synthetic pesticides can be very beneficial in insect pest management, but many have been shown to be harmful to key pollinators, such as honey bees* (Mallinger, Werts, & Gratton, 2015).
- *Organic pesticides have recently been touted as being less toxic for non-target insects and the environment in general (Joshi, Leslie, Rajotte, & Biddinger, 2020).*
- *Successful pollination rate can be a good indicator for pollinator population size in an agricultural setting (Potts, Imperatriz-Fonseca, Ngo, 2016).*
- *Blueberries are an ideal crop to observe pollinator impact on successful pollination rates as they cannot easily self-pollinate and have the majority of their pollination carried out by insects(Gibbs, Elle, et al., 2016) (Image 1).*

Objectives

- *We wish to study how synthetic and organic pre-bloom pesticides impact the pollinators of a blueberry field by looking at the successful pollination rate of blueberries. We hypothesize that there is a relationship between type of pesticide used and successful pollination rate. We predict that the use of synthetic pre-bloom pesticides has a negative impact on successful pollination of blueberry plants., while organic pre-bloom pesticides will not meaningfully affect successful pollination rate of blueberries (Table 1).*
- *A smaller successful pollination rate suggests that the population of insects that pollinate blueberry plants are negatively effected by the use of pesticides.*

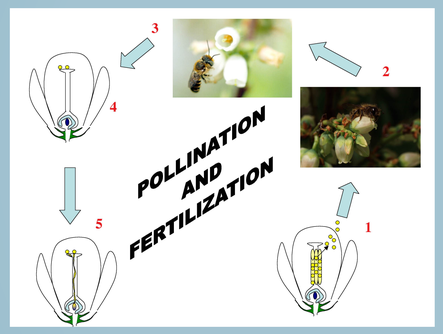

Image 1: Insect pollinator are crucial for successful pollination of blueberries, as their pollen is heavy and sticky, making self pollination or wind pollination difficult. Image provided by The University of Maine

Image 2: After petal drop occurs, small green grown can be observed at base of stem, indicating successful pollination. This is the growth stage in which we will hand-count the amount of blueberries that are successfully pollinated. Image provided by MSU College of Ag. And Natural Resources

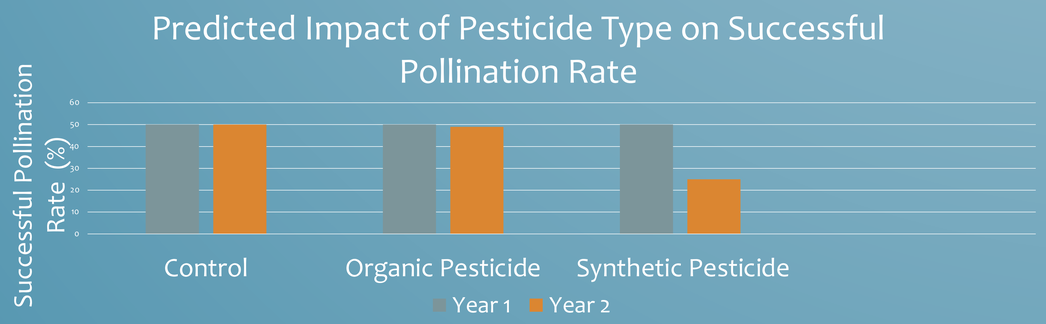

Table 1: Predicted Impact of Pre-Bloom Pesticide Type on Successful Pollination Rate of Blueberry Bushes over Two Years.

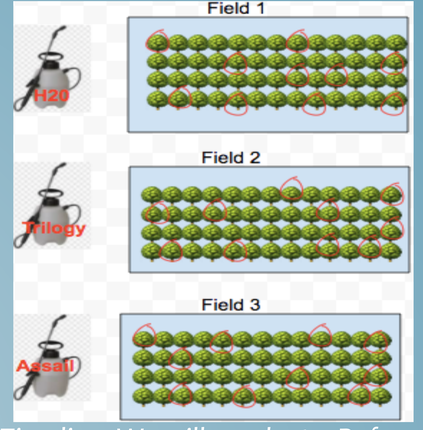

Figure 2: Visual Depiction of experimental design during the second year of study. Treatments include a pre-bloom organic pesticide spray (Trilogy), a pre-bloom synthetic pesticide spray (Assail) and a water spray for the control. Treatments are applied at the same time and are applied to entire field. Circles represent randomly selected blueberry bushes to be sampled . Image provided by Pngwing.com.

Study Design

- *Experimental design/ Timeline: We will conduct a Before-After Control- Impact (BACI) field experiment at three randomly selected mature blueberry patches in Vermont over the course of two years. The first year, no treatment will be applied to any patch. The second year, we will randomly select which blueberry patch gets the organic pesticide, which gets the synthetic pesticide, and which is the control. One blueberry patch will have an organic aphid pesticide (Trilogy) applied, and the other will have a synthetic aphid pesticide (Assail) applied (DeFrancesco, Pscheidt, &Yang, 2018). One patch will have water sprayed on the bushes instead of pesticides and will be the control. These pesticides will be applied at the same time, during plant pre-bloom, and will be applied using the same spray method (Figure 1).*
- *Sampling Method: After petal drop has occurred, we will randomly select 10 blueberry bushes from the patch and will hand count the number of berries that appear to be pollinated (small green fruit growth visible) (Image 2) .*

Intended Analysis

- ***The Predictor variable is whether organic pesticide or synthetic pesticide was applied, and is categorical. The Response variable is the percentage of fruit that have set, and is continuous. Therefore, we will use a T-test to whether there is a statistically significant different between number of blueberry fruit set in a blueberry patch that has organic or synthetic pesticide applied.***

- ***Limitations: Because it is a field study, there are some limitations to this experiment. The three different blueberry patches are not identical, and we also will only be replicating the experiment within each blueberry patch (i.e. recording data from several random blueberry bushes in the same patch). These factors will limit the strength of the inference. However, the blueberry patches have been randomly selected, meaning that the results can be generalized to all blueberry patches in Vermont. The treatment (control, organic or synthetic pesticide) has also been randomized.***

Management Implications

- *Managing insect pests is incredibly important in order to have productive blueberry farms, but pollinator health and population is equally important for high yield.*
- *Our study will help determine the impact of pesticides on successful pollination, and will potentially update best management practices for blueberry farmers so that pest pressure is low while the pollinator population is not impacted and successful pollination rates remain high .*
- *Additional studies are needed to determine the specific reason(s) , if any, that successful pollination rate is different based on pesticide use.*

Literature cited:
Potts, S., Imperatriz-Fonseca, V., Ngo, H. *et al.* Safeguarding pollinators and their values to human well-being. *Nature* 540, 220–229 (2016).
Mallinger, R. E., Werts, P., & Gratton, C. (2015). Pesticide use within a pollinator-dependent crop has negative effects on the abundance and species richness of sweat bees, lasioglossum spp., and on bumble bee colony growth. *Journal of Insect Conservation*, 19(5), 999-1010.
Joshi, N. K., Leslie, T., Rajotte, E. G., & Biddinger, D. J. (2020). Environmental impacts of reduced-risk and conventional pesticide programs differ in commercial apple orchards, but similarly influence pollinator community. *Chemosphere*, 240
Gibbs J, Elle E, Bobiwash K, Haapalainen T, Isaacs R (2016) Contrasting Pollinators and Pollination in Native and Non-Native Regions of Highbush Blueberry Production. PLoS ONE 11(7): e0158937.
Joe DeFrancesco, Jay W. Pscheidt, and Wei Yang. (2018). 2018 Pest Management Guide for the Willamette Valley (Report No. EM 8538). Oregon State University Extension Service.