Maximizing Pollination Services for Blueberry Production in Pennsylvania

Progress report for ONE19-340

Project Type: Partnership
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Projected End Date: 03/31/2022
Grant Recipient: The Pennsylvania State University
Region: Northeast
State: Pennsylvania
Project Leader:

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Penn State University

Project Information

Project Objectives:

This proposal seeks to understand three aspects of blueberry pollination that will directly benefit our partner growers and others in Pennsylvania:

* Objective 1: Quantify the level of free pollination services provided by wild bee species. This information will benefit farmers by indicating the degree to which they could exclusively rely on free pollination services or need to augment this input with honey bee rentals.

* Objective 2: Determine what bee species are providing pollination services. By identifying the key wild pollinators of blueberry farms, farmers will be able to design informed management practices to enhance bee populations of the key pollinators (e.g., through pollinator plantings, additional nesting habitat, timing of crop protection practices on other flowering species in their farm, etc.)

* Objective 3: Determine whether blueberry farms in Pennsylvania are pollination limited. Quantifying the level of pollination limitation will allow farmers to determine whether or not they would improve productivity and receive economic gains by increasing pollination services.

The combination of these pieces of information will allow growers to understand their pollination needs, make informed decisions about how to maximize pollination services and focus their bee-conservation efforts for their farms.

Introduction:

Pollinator-dependent crops are increasingly at risk of reduced yields and less marketable fruit because of poor pollination. Declines in wild bee populations, the high rental costs of honey bees and climate unpredictability have led to less stable pollination services across the United States. Therefore, appropriate farm management practices to ensure optimal pollination services are necessary to maximize crop yields.

Blueberries are an economically important fruit crop that requires insect-mediated pollination to obtain profitable yield levels. Blueberry bushes produce more seeds, larger fruit, and higher yields with greater bee pollination services (Isaacs and Kirk 2010). Wild bees are on average three times more effective pollinators of blueberries than honey bees (Apis mellifera) on a per visit basis (Rogers et al 2014; Javorek et al 2002). In addition, blueberry flowers need to be sonicated (through buzz pollination) to release the pollen from flowers. Honey bees cannot perform buzz pollination, making them effective pollinators for blueberry only when wild bees are also present to release the pollen. Therefore, optimal management practices that support wild bee pollination can improve crop production while reducing honey bee rental costs, which would translate into a significant net gain for farmers.

* Problem 1: Honey bee colonies are regularly rented to achieve optimal pollination in blueberry farms due to the perception that native bee population sizes are unreliable and hard to monitor (Hanes et al 2015). While managed honey bees can be reliably rented for blueberry pollination every year, their numbers have declined in the past 15 years which has significantly increased honey bee rental costs (currently at ~$100/hive). This increase in honey bee rental costs translates into increased production costs for farmers and prices for consumers.

* Problem 2: Even with honey bee rentals, blueberries can be pollination limited. Blueberries require buzz pollination to release pollen from flowers, and honey bees are not capable of buzz pollination. Therefore, unless quantified, growers may not be aware that their yields could increase if pollination services improved in their farms.

* Problem 3: Blueberries are one of the fastest growing crops in Pennsylvania and there is not a single study assessing pollination services to blueberries in the region. Given the nature of diversified farms nested within complex landscapes in Pennsylvania, the need for pollination services in blueberries may not be comparable to systems of different scales and landscape contexts that have been heavily studied (see below).

Our collaborating farmer partners and results of surveys to blueberry farmers in Pennsylvania indicate the importance of understanding who pollinates their crops to better manage and protect these pollinator populations while reducing pollination limitation and ensuring fruit set and maximum fruit size. We will work with our partners to provide this information that will directly improve productivity and economic gains while facilitating future efforts across multiple diversified direct-retail farms in our region.

Cooperators

- Mark and Laura McDonald - Producer

  Bee Tree Berry Farm

- Jarod & Robyn Scheiber - Producer

  Greenbarn Farm

Research

Materials and methods:

We have been in contact with our two farmer partners to estimate the time of bloom of blueberry flowers. Spring 2020 has been warmer than usual so we expect that flowers will be in bloom early April. Our first visit to the farm is planned for the 1st week of April, when we will choose 2 rows of shrubs for sampling (of the variety Bluecrop). In each row, we will choose 5 shrubs and mark 3 flower clusters with flagging tape (about 30 unopened flowers per cluster) in each individual shrub. The 3 clusters will be used for the 3 pollination treatments: (1) open pollination, (2) selfing, and (3) hand pollination. During this first visit, the flower clusters for treatment #2 will be bagged to avoid biotic pollination.

After the flowers are in full bloom (one week later), we will visit the farms again to collect the bee visitation data. To estimate visitation, we will walk two rows of Bluecrop for 10 minutes and we will count the number of flower-visiting insects. We will also distinguish between insects that are pollinating flowers and those that are nectar robbing. The pollinating species will be recorded in five categories that we can accurately identify on the wing: (1) honey bees; (2) bumble bees (queens & workers); (3) carpenter bee; (4) mid-size bee; (5) green bee; (6) small black bee. Each person in the team (3 people) will repeat the time trials 2 times every collecting trip. At the end of the visit, we will bag the flowers from the open pollination treatment (treatment #1). We will also hand pollinate the flowers in treatment #3, and bagged them as well.

We will continue to be in communication with our farmers to visit the farms again when pollination is completed. In about 3 months, we will visit the farms again to harvest all the fruit from the branches included in the 3 treatments. We will collect data on the percent fruit set by counting the number of berries on each cluster excluding the unpollinated berries drop. Berries will be brought to the laboratory and weighted to estimate yield under the 3 treatments.

Research results and discussion:

Since we have not completed the project, I would like to write a short summary of what we have learned about the pollinator communities of the two blueberry farms that we are studying. Due to COVID-19, we did not collect any data on 2020 but we did collect a preliminary dataset in 2019. This past summer, our goal was to work on the species identification of the pollinator communities of the farms, and we found 21 species of bees and a number of fly species. In addition, we found significant differences in the pollinator community across sites. One of our farms had a significantly higher abundance of honey bees, while in the other farm most of the visits were from native pollinators (bumble bees and mining bees).

Participation Summary

2 Farmers participating in research

Learning Outcomes

Key areas in which farmers reported changes in knowledge, attitude, skills and/or

awareness:

Nothing to report yet

US Department of Agriculture

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