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Decision-Making Guide for Bee Supplementation of Pumpkin Fields

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Introduction

Vine crops such as pumpkin, squash, cucumber and watermelon are some of New York State's most valuable vegetable crops. These crops require pollination by bees, the most well-known of which is the honey bee, *Apis mellifera*. Honey bee hives are placed in vine crops during bloom when female flowers need to be pollinated. Unfortunately, Colony Collapse Disorder (CCD), parasitic mites, viruses and other pathogens continue to cause significant losses in populations of honey bees throughout the US. Fewer honey bee hives are now available for vine crop growers and the cost of renting hives has increased dramatically. Until the plight of the honey bee is resolved, growers will continue to pay more for renting hives, unless alternative pollinators are identified to service their vine crops, or if scenarios exist where managed bees might not be needed because wild bees can provide sufficient pollination services.

On an individual basis, the common eastern bumble bee, *Bombus impatiens*, is the most efficient pollinator of pumpkin compared with other common species including the honey bee and squash bee, *Peponapis pruinosa*. Not only are bumble bees efficient pollinators, but they are also naturally abundant and available commercially, making it a perfect candidate as an alternative pollinator to honey bees in pumpkin fields.

Common eastern bumble bee

Honey bee

Does supplementing with managed bees increase yield?

We investigated whether pumpkin fruit yield could be increased by supplementing pumpkin fields with commercially reared bumble bees, locally rented honey bees or no bees. Results from our 2-yr study revealed no difference in fruit yield, regardless of whether fields were supplemented with bees or not (**Fig. 1**). This study was instrumental in showing that wild bees, like bumble bees and feral honey bees, have the potential to provide excellent pollination of pumpkins and that supplementation of pumpkin fields with managed bees may not be needed in all fields.

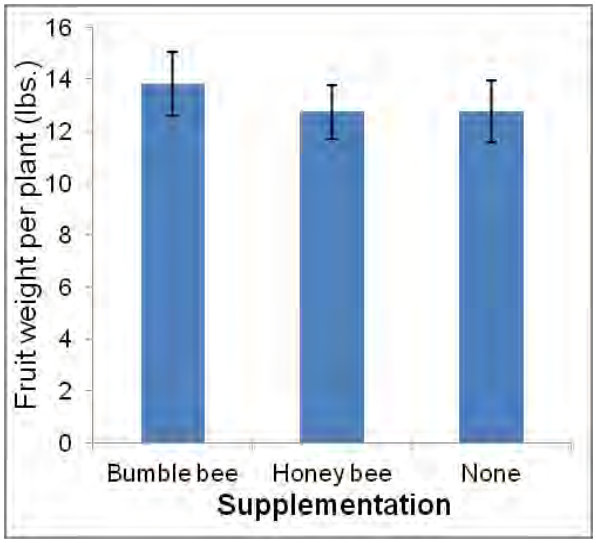

Fig. 1. Average (± SEM) pumpkin, *Cucurbita pepo*, var. 'Gladiator', fruit yield from fields supplemented with commercial bumble bee colonies (n = 12), honey bee hives (n = 17) or not supplemented (n = 14) in New York in 2011 and 2012.

When is supplementation necessary?

The landscape surrounding pumpkin fields and the population levels of wild bees are important in deciding whether to supplement fields with managed bees. Pollination service costs could be reduced by identifying scenarios where supplementation might not be necessary. To assess this situation, the first thing to do is estimate the number of bees in the pumpkin field as either high or low. In the field of interest, when pumpkin flowers are in bloom, count the total number of honey bees and bumble bees in 60 flowers (male and female), spending 5 seconds counting bees at each flower you watch and then moving on to the next flower. Sample three different locations of 60 flowers each to get an average of the number of each bee species per 60 flowers. A high bumble bee density would be greater than 3 bumble bees per 60 flowers. High honey bee density is anything greater than 10 honey bees per 60 flowers.

The next step is to identify two features of the landscape surrounding the field (within a 2 km [~1.25 miles] radius of the center of the field). One feature that influences bee populations and fruit yield is the diversity of land-use types in the landscape (**Fig. 2**). High diversity landscapes (many different land-use types and approximately even parcel sizes) have more bees and greater pumpkin yield compared with landscapes that are less diverse. A second feature important to bee populations and yield is the amount of grassland in the landscape (i.e., semi-natural, open-canopy habitats such as fallows, shrubland, weedy ditches and nature preserves). A landscape with greater than 20% grassland is considered sufficient to sustain an adequate population of bees for pumpkin pollination. These two landscape features could be estimated through direct knowledge of the land-use features surrounding the field or by consulting the Cropland Data Layer produced yearly by the USDA – National Agricultural Statistics Service (http://nassgeodata.gmu.edu/CropScape/).

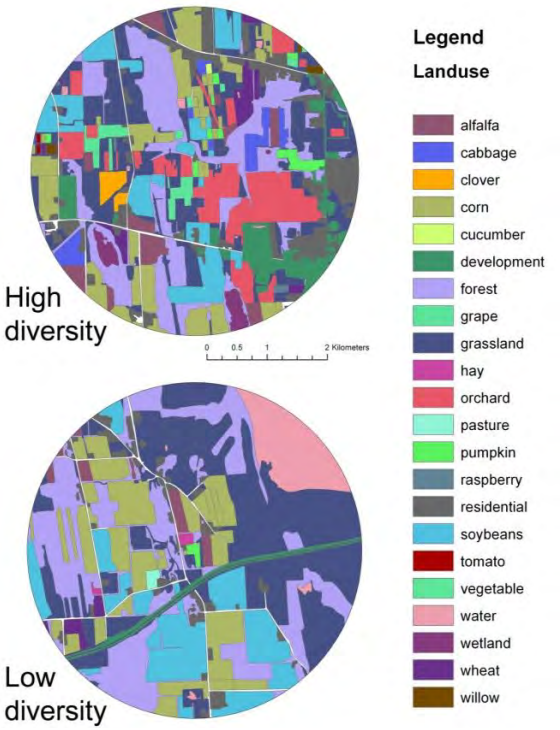

Fig. 2. Examples of high and low landscape diversity surrounding a pumpkin field in the center of each circle.

Combining knowledge of these factors (bumble bee and honey bee density, landscape diversity and percent grassland) will help inform what pumpkin fields will benefit from supplementation with managed bees (**Table 1**).

Table 1. Decision-making matrix for existing or background bumble bee and honey bee density and various types of landscapes surrounding each field of interest.

	Bumble bee density			Honey bee density	
Landscape diversity	High	Low	% Grassland	High	Low
High	Supplementing not necessary	Consider supplementing	High	Supplementing not necessary	Consider supplementing
Low	Supplementing recommended	Consider supplementing	Low	Supplementing recommended	Consider supplementing

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