Fruit and Vegetable Pollination

Tuesday morning 9:00 am

Where: Grand Gallery (main level) Room E & F

MI Recertification credits: 2 (1B, 1C, COMM CORE, PRIV CORE)

CCA Credits: PM(2.0)

Moderator: Rufus Isaacs, Entomology Dept., MSU

9:00 am The Status of U.S. Honey Bees and What Growers Can Do to Support Pollinator Populations

- Maryann Frazier, Entomology Dept., Penn State Univ.

9:40 am Wild Bees and Their Contributions to Fruit and Vegetable Production

- Jason Gibbs, Entomology Dept., MSU

10:00 am Pollination of Pumpkin in New York Farms

- Jessica Petersen, Entomology Dept., Cornell Univ., NYSAES, Geneva, NY

10:30 am Government Programs to Support Pollinator Habitat for Cost Share

- Dale Allen, Conservation Chief, Michigan Farm Service Agency

10:50 am Grower Input on Crop Pollination Practices

- Kelly Garbach, Environmental Science Dept., Loyola Univ., Chicago, IL

11:10 am Session Ends

Pumpkin Pollination: Effects of Supplementation with Managed Bees and Influence of Surrounding Landscapes

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Pollination is an essential ecosystem service provided by both managed and wild bees to a variety of fruit and vegetable crops. Pumpkin requires pollination by bees for fruit development, which occurs when bees transfer pollen from the anther of the male flower to the stigma of the female flower. Previous research has shown that with more bee visits to female pumpkin flowers, you can achieve greater seed set, fruit set, and larger fruit. Therefore, adding or supplementing pumpkin fields with bee hives when flowers are in bloom seems like a logical step to achieving greater production. Many growers supplement pumpkin fields with honey bee, *Apis mellifera*, hives during bloom. Unfortunately, due to significant losses in populations of honey bees throughout the US, fewer hives are now available for pumpkin growers and the cost of renting hives has increased. Given these circumstances, identifying alternative pollinators and the role that wild pollinators play in crop pollination is important to understand. Previous research has shown that on an individual basis, the common eastern bumble bee, *Bombus impatiens*, was the most efficient pollinator of pumpkin compared with other common species including the honey bee and squash bee, *Peponapis pruinosa*. The common eastern bumble bee is naturally abundant in the Eastern U.S. and available commercially, making it a perfect candidate as an alternative pollinator to honey bees in pumpkin fields.

Will fruit yield increase if bumble bee hives are placed in fields? In the Finger Lakes Region of New York in 2011 and 2012, we explored the potential of increasing pumpkin yield by either supplementing fields with commercially produced common eastern bumble bees or with locally rented honey bees and then compared yield from these fields with yield from fields that were not supplemented with bees. Fields ranged in size from 1 to 25 acres; fields of similar size were grouped and randomly assigned one of the three supplementation treatments (i.e., bumble bees, honey bees or no extra bees). The stocking densities for bumble bees was one QUAD (=4 colonies) per 2 acres and for honey bees was one hive per 3 acres. The average fruit weight per pumpkin plant in fields supplemented with commercial bumble bees did not differ significantly from fruit weight in fields supplemented with honey bees or those that were not supplemented (**Fig. 1**).

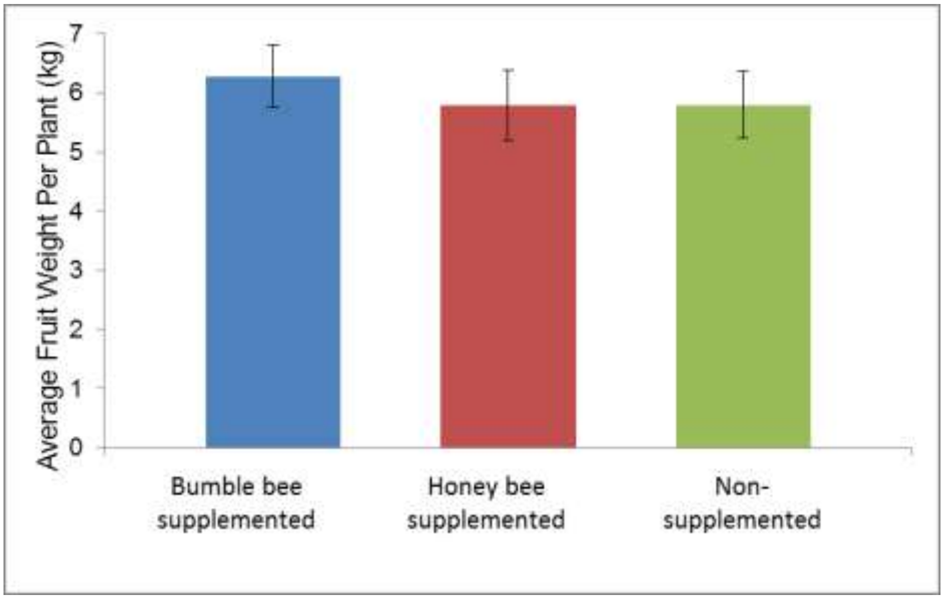

Fig. 1. Mean (± SEM) pumpkin, *Cucurbita pepo*, var. 'Gladiator', fruit yield from fields supplemented with commercial bumble bee colonies (*n*=12), honey bee hives (*n*=17) or were not supplemented (*n*=14) in New York averaged across 2011 and 2012. Plants typically produced 1.5 fruit per plant, regardless of treatment.

Will bumble bees and honey bees visit more pumpkin flowers in fields in which they are supplemented? In 2011 and 2012, bees visiting pumpkin flowers were recorded at three locations in each field and three times during the blooming period. Contrary to our expectations, there were no more visits to flowers by bumble bees in fields supplemented with bumble bees than in fields that were not supplemented (**Fig. 2**). Likewise, there were no more honey bee visits to flowers in fields supplemented with honey bees than in fields that were not supplemented.

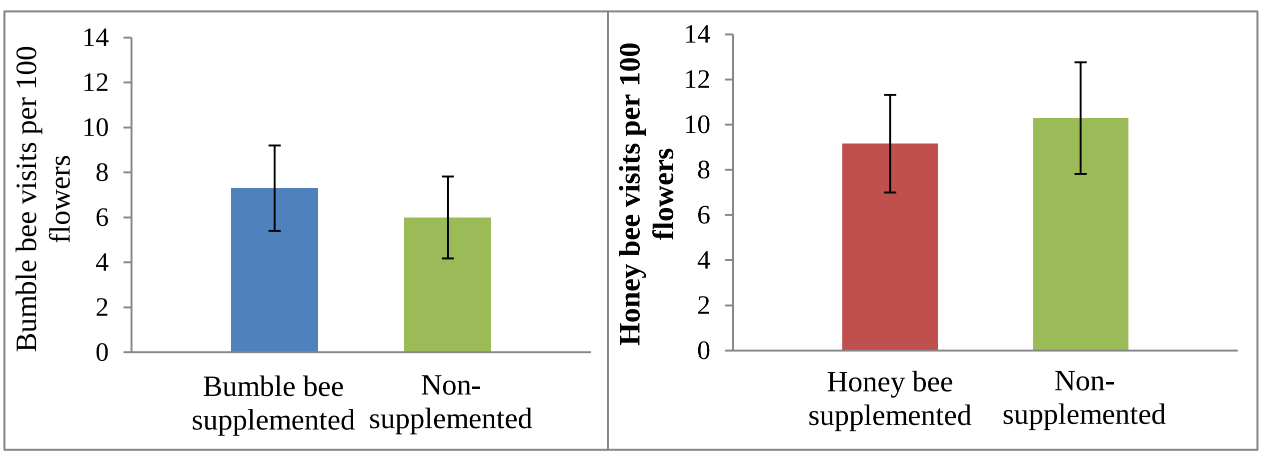

Fig 2. Bumble bee and honey bee visits to pumpkin flowers in bumble bee supplemented, honey bee supplemented and non-supplemented fields averaged across 2011 and 2012.

What are the bees foraging on if not pumpkin? Pollen on the legs of bees returning to their hives in bee-supplemented pumpkin fields was identified to determine where the bees were foraging. Bumble bees were sampled from 6 bumble bee-supplemented fields (*n*=152 bees) and honey bees were sampled from 4 honey bee-supplemented fields (*n*=146 bees) three times during bloom. A random sample of 100 pollen grains from each bee was counted and identified to the lowest taxonomic rank feasible. For each bee species, the pollen data were pooled across all collection sites and collection times and represent the percentage of pollen collected from each plant species. <u>Surprisingly, few bees foraged for pumpkin pollen</u> (**Fig. 3**). Pumpkin pollen only consisted of 2.5% and 0.2% of the total pollen collected from honey bees and bumble bees, respectively (**Fig. 3**). Both bee species foraged on pollen from many different weed species including ground cherry (Solanaceae), clover (Fabaceae), Queen Anne's lace (Asteraceae), dandelion (Asteraceae), goldenrod (Asteraceae), English plantain (*Plantago*), and pokeweed (Phytolacca) (**Fig. 3**). Also surprising was that 30% of the pollen collected by honey bees was from corn (*Zea mays*) and nearly 50% of the pollen collected by bumble bees was from solanaceous plants, which may have included crops such as tomato, peppers and potato.

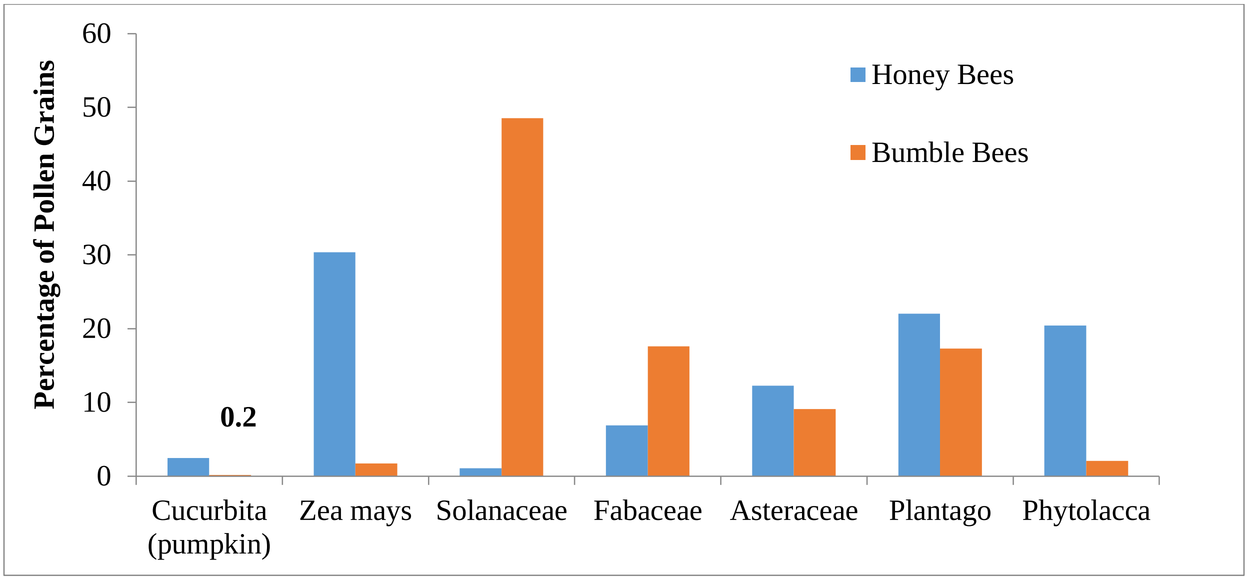

Fig. 3. Overall percentage of pollen grains returned to honey bee hives (*n*=146 bees) and bumble bee colonies (*n*=152 bees).

We also observed bees returning to their hives with pollen covering their bodies. We sampled these bees (*n*=28 honey bees, *n*=61 bumble bees) and confirmed that 100% were covered with pumpkin pollen. <u>These results indicate that honey bees and bumble bees were likely foraging for nectar in male flowers and accidentally contacted pollen. This foraging activity likely contributed to pollination of pumpkin fruit.</u>

Are wild bees doing all the work?

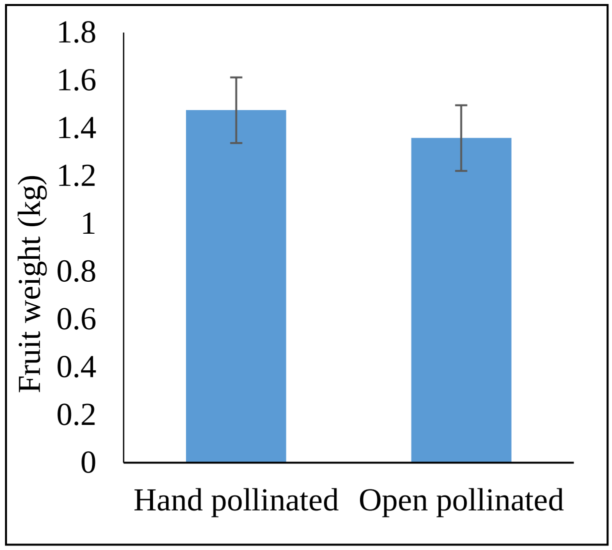

Fig 4. Average fruit weight (±SEM) of hand pollinated and open pollinated fruit from one representative field in 2013.

Supplementing pumpkin fields with bees did not increase fruit yield, so maybe the wild bees are doing just fine on their own. To answer this question we compared fruit yield from hand pollinated fruit with those that had been open pollinated by wild bees. Female flowers of different plants (10-20 plants per field) were pollinated by brushing the pollen from five male flowers onto the stigma in an attempt to create the maximum amount of pollen required for a plant to produce the largest fruit possible. Plants were monitored to ensure that the "treatment flower" and resulting fruit was the only fruit produced on the plant to avoid resource competition. This experiment was conducted in 2011 (n=1 field), 2012 (n=3), and 2013 (n=5). Fruit weights were standardized by field to account for differences in pumpkin varieties between fields. Standardized fruit weights of hand-pollinated fruit were compared with open-pollinated fruit and there were no differences (**Fig. 4**; P=0.725). <u>These results indicate that wild bees are maximizing pumpkin fruit yield in New York.</u>