Survey of pollinators on pumpkin and squash (*Cucurbita* spp.) crops in Ontario, with special emphasis on the native squash bee (*Peponapis pruinosa*)

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Figure 1. Map of 14 farms in Ontario sampled during this study

Figure 2. Female squash bee on female pumpkin flower

Purpose and Context

Purpose: The project is part of a larger study of the effects of management practices on squash bee populations on farms. Pumpkin/ squash crops were surveyed in Ontario during the 2016 growing season to (1) determine the size and composition of the pollinator population, and (2) develop a method for growers to reliably evaluate the pollinator population on their own farms.

Context: Farms surveyed reflected the diversity of production of pumpkin, squash or gourds on Ontario farms. They include both organic and conventionally managed farms, wholesale, pick-your-own, agri-entertainment, and mixed vegetable operations.

Background

In Ontario, about 3000 hectares of pumpkins and squash are grown, valued at $23 million/year[1]. Native pollinators provide critical pollination services to many key crops, including pumpkin and squash (*Cucurbita* spp.)[2].

Understanding the components of pollinator populations on pumpkin or squash crops in Ontario is important because yield and fruit quality are affected by the number and type of bees that pollinate the flowers[3].

The squash bee (*Peponapis pruinosa*: Figures 2 and 4) is a wild, ground-nesting solitary bee that forages almost exclusively on pumpkin/squash[4], reliably recruiting to the crop and pollinating over greater distances than honey bees[5,6].

In Ontario, the bee's activity cycles are well synchronized with pumpkin and squash bloom times[7]. In the US, squash bee densities on farms were sufficient to fully pollinate all pumpkin flowers surveyed[8] but the extent and size of squash bee populations on Ontario farms is unknown.

Other bees also visit pumpkin and squash flowers, including managed honey bees, bumble bees and other solitary bee species[9]. Bumble bees appear to provide better pollination services to pumpkins than managed honey bees[10]. The importance of other solitary bee species is currently unknown.

Methods

- Sampling was undertaken on 14 farms across Ontario (Figure 1) on two days (early & late season) between July 19-August 31 during crop bloom.
- Flower visitors were counted and classified by type (squash bee, bumble bee, solitary bee, honey bee) on 4 x 25 randomly selected flowers at 7, 8, and 9 a.m. on each day when flowers were open.
- Squash bee counts were analyzed to determine if there was an effect of farm, season (early, late) or time of day on squash bee populations.

Table 1. Composition of flower visitor populations on pumpkin and squash crops on 14 farms in Ontario.

	Squash bees	Honey bees	Bumble bees	Solitary bees	Total bees
Total # bees observed	1143	240	97	42	1522
Mean # bees/ sample	3.40	0.71	0.29	0.13	4.53
Min-Max # bees/ sample	0-27	0-18	0-5	0-3	0-30
Percent (%) by farm	100.0	92.9	71.4	63.7	-
Percent (%) by samples	62.8	32.4	17.3	8.9	-
Percent (%) by total bee population observed	75.1	15.8	6.4	2.8	-

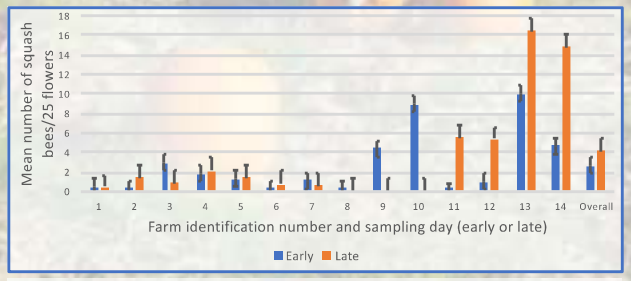

Figure 3. Change in mean squash bee population by farm and day.

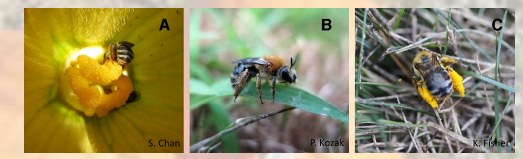

Figure 4. Female squash bees (A) foraging for nectar, (B) resting, and (C) bringing pollen back to the nest.

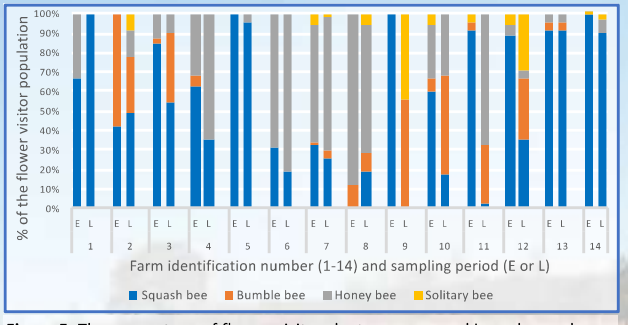

Figure 5. The percentage of flower visitors by type on pumpkin and squash flowers sampled early (E) and late (L) by farm.

Results

- The composition of the flower visitor population to pumpkin and squash crops is summarized in Table 1.
- We observed considerable variation in the size of squash bee populations among farms, increasing on average from early to late season (Figure 3).
- We observed considerable variation in the composition of flower visitor populations from farm to farm and over the season (Figure 5).
- Our flower visitor data showed no predictable variation in observed squash bee activity with time of day during the 7-9 am period.

Conclusions

Squash bees are present on all farms surveyed although the size of populations varies considerably among farms, likely due to differences in cropping history, rotation, tillage, and insecticide use.

Squash bees are the most abundant flower visitor on pumpkin and squash crops, comprising 75% of the bees observed overall. As such, conserving squash bee populations on farms for their pollination services is vitally important.

Growers may evaluate pollinator populations on their farms using the simple methodology described here to compare to provincial averages presented in Table 1. An evaluation tool is available by contacting the author.

Further study is needed to

- determine the minimum squash bee population required for effective pollination of Ontario pumpkin/squash crops; and
- determine causes of the variation in squash bee populations among farms.

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Funders

We gratefully acknowledge funding support from Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), Fresh Vegetable Growers of Ontario (FVGO), Ontario Soil and Crop Improvement Association (OSCIA), and The W. Garfield Weston Foundation for this work.

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