



Notes

from the Lab:

The Latest Bee Science Distilled

by Scott McArt

Soybean yield increases when bee-friendly habitat is located next to fields

If you live east of the Rockies, chances are you live within a few miles of a soybean field. After corn, which covers 92.7 million acres in the United States, soybean fields cover the most land of any agricultural crop — 87.6 million acres. Soybean fields are a ubiquitous part of the landscapes that many of us see every day.

Conventional wisdom suggests that soybeans don't need bees. In other words, soybeans are generally considered a "pollinator-independent crop" that doesn't benefit when its flowers are visited by insect pollinators. Because of this, no soybean producer that I'm aware of rents honey bees or manages their land to promote populations of wild

pollinators in an effort to maximize pollination.

But are soybean farmers ignoring pollinators to their own detriment? Do bees visit soybean flowers and does yield increase when flowers are pollinated? Does pollination increase if pollinator-friendly habitat that promotes bees is located adjacent to soybean fields? These are the topics for the fifty-third Notes from the Lab, where I summarize "Evaluating the impact of increased pollinator habitat on bee visitation and yield metrics in soybean crops," written by Hannah Levenson and colleagues and published in the journal *Agriculture, Ecosystems and Environment* [2022].

In a previous Notes from the Lab [160(2):199-201], we learned that honey bee colonies in soybean-dominated landscapes are healthier and produce more honey when native prairie is located adjacent to soybean fields (Dolezal et al. 2019). The message from this study is clear: If we care about conserving bees and promoting pollinator health, we should make sure there's natural habitat next to soybean fields, especially in the Midwest and other areas where corn and soybean fields dominate the landscape.

But what about the complementary question? Do soybeans (and by extension, soybean farmers) also benefit when natural habitat is adjacent to soybean fields? To address this question, Levenson and colleagues took advantage of a 2015 initiative titled "Protecting NC Pollinators,"

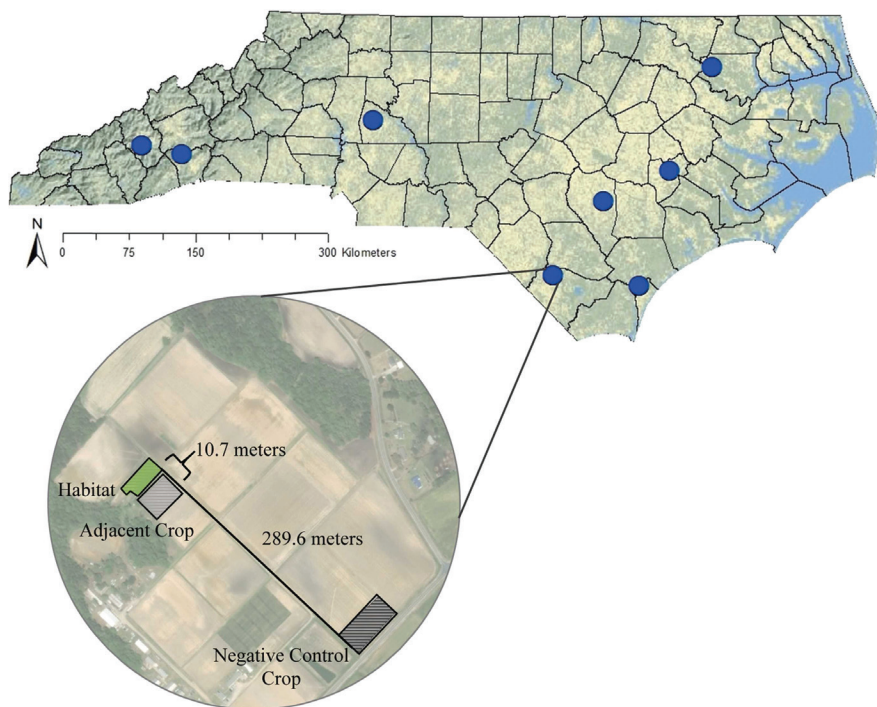


Figure 1 Map of research stations across North Carolina, located in the southeastern USA, where sampling took place. An inset map shows an example of how the three site-types were set up. Exact distances and orientations changed from station to station.



Photo 1 Pollinator-friendly wildflower habitat planted in 2015-2016 was mature and producing lots of flowers at the time of the study in 2019.

implemented by the North Carolina Department of Agriculture and Consumer Services (NCDA&CS), which mandates planting and continuous maintenance of pollinator habitat at all 18 NCDA&CS and NC State University Research Stations across the state.

The authors sampled pollinators, observed pollination behaviors, and assessed soybean yield at 8 of the 18 sites across North Carolina (Figure 1). Pollinators were collected and observed 2-3 times during soybean

bloom at three locations at each of the sites: wildflower habitat (see Photo 1), soybean fields adjacent to the wildflower habitat (see Photo 2), or soybean fields that didn't have adjacent wildflower habitat (negative control). An example of how the sampling locations were organized at each site is shown in the magnified portion of Figure 1.

All bees collected at each site were taken back to the lab and identified to the lowest taxonomic level possible using published keys and expertise

of the authors. Pollen was collected from the bodies of the three most abundant bee species — the Western honey bee (*Apis mellifera*), common Eastern bumble bee (*Bombus impatiens*), and Eastern carpenter bee (*Xylocopa virginica*) — and identified via microscopy to assess whether bees that were visiting soybean flowers collected pollen from the crop. Finally, several metrics of yield were compared between soybean fields with and without adjacent wildflower habitat. The number of seeds per pod, total number of seeds per plant, average seed weight per plant, and the number of deformed seeds per plant were determined for 30 plants in each soybean field.

So, what did they find? Do bees visit soybean flowers? Yes. As seen in Figure 2, a diverse bee community was found visiting soybean flowers regardless of whether the field was adjacent to wildflower habitat or not. The most abundant groups of bees visiting soybean flowers were honey bees and bumble bees, but several other groups were also observed, including sweat bees, parasitic bees, and carpenter bees (see Photo 3).

All bees that were sampled in soybean fields had soybean pollen on their bodies (see Photo 4), meaning they could potentially be moving pollen and therefore helping to pollinate soybean flowers.

Does having pollinator-friendly habitat next to soybean fields promote more pollinators? Sort of. Overall, different species of bees visited the wildflowers compared to soybean fields. Compared to the negative control fields, fields with adjacent wildflowers tended to host bee communities more similar to the wildflower habitat bee communities — though it was not a statistical difference.

What about pollination? Does soybean yield increase when pollinator-friendly habitat is located next to fields? Yes. And this is where Levenson and colleagues' study really breaks ground. Total seeds (beans) per plant didn't differ between the two types of soybean fields. But the authors found that average seed weight was 6.5% greater in soybeans that grew in fields adjacent to wildflower habitat vs. fields without adjacent wildflower habitat (negative controls), strongly suggesting that overall yield was greater in soybean fields with adjacent wildflower habitat. Interestingly, there were more



Photo 2 A soybean plot being surveyed for pollinator activity

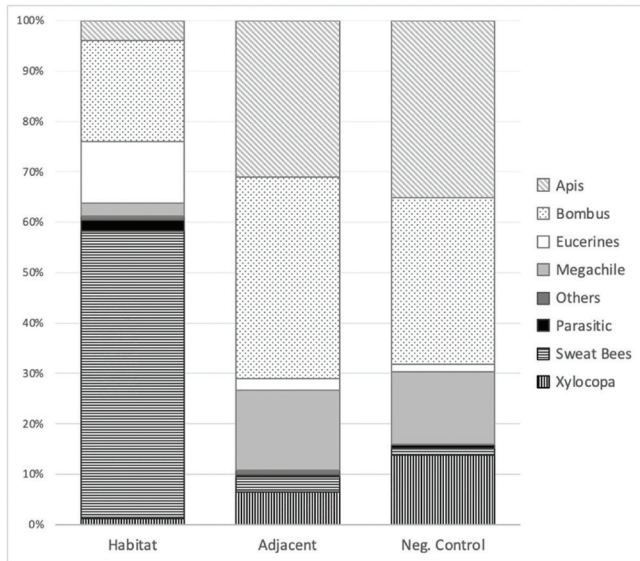


Figure 2 Overall bee community composition of the main taxonomical groups. The genera *Melissodes*, *Peponapis*, and *Svastra* are grouped into "Eucerines." The genera *Agapostemon*, *Augochlora*, *Augochlorella*, *Halictus* and *Lasioglossum* are grouped into "Sweat Bees." The group "Parasitic" bees consists of *Coelioxys*, *Holcopasites*, and *Triepeolus*. All other genera are placed into "Others."

increasing the bottom line for soybean farmers.

Until next time, bee well and do good work.

Scott McArt

REFERENCES:

Dolezal, A. G., A. L. St. Clair, G. Zhang, A. L. Toth and M. E. O'Neal. 2019. Native habitat mitigates feast-famine conditions faced by honey bees in an agricultural landscape. *Proceedings of the National Academy of Sciences of the United States of America*. 116:50. <https://doi.org/10.1073/pnas.1912801116>

Garibaldi, L. A., L. A. Schulte, D. N. Nabaes Jodar, D. S. Gomez Carella & C. Kremen. 2021. Time to integrate pollinator science into soybean production. *Trends in Ecology & Evolution* 36:573-575. <https://doi.org/10.1016/j.tree.2021.03.013>

Levenson, H. K., A. E. Sharp & D. R. Tarpy. 2022. Evaluating the impact of increased pollinator habitat on bee visitation and yield metrics in soybean crops. *Agriculture, Ecosystems and Environment* 331:107901. <https://doi.org/10.1016/j.agee.2022.107901>

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seeds per pod in negative control plants, but this didn't translate to more overall seeds.

The results from Levenson and colleagues' study add to a growing awareness that soybean yield is increased via insect pollination. One recent review of this topic estimates that current commercial varieties of soybean increase in yield by 21%, on average, when pollinated by insects (Garibaldi et al. 2021). That's a very big number for a crop in which the conventional wisdom of most farmers is that soybeans don't benefit from pollination!

Perhaps most importantly, Levenson and colleagues' study shows that creating pollinator habitat next to soybean fields increases yield for farmers. This means that locating pollinator habitat next to soybean fields is a win-win proposition for bees and farmers. Indeed, this is perhaps a prime example of how farming is not separate from nature, but instead can benefit from nature when done sustainably.

In other words, including pollinator habitat adjacent to soybean fields is good for pollinators, and those same pollinators return the favor by

Hannah Levenson



Photo 3 An Eastern carpenter bee (*Xylocopa virginica*) visiting a soybean flower

April Sharp

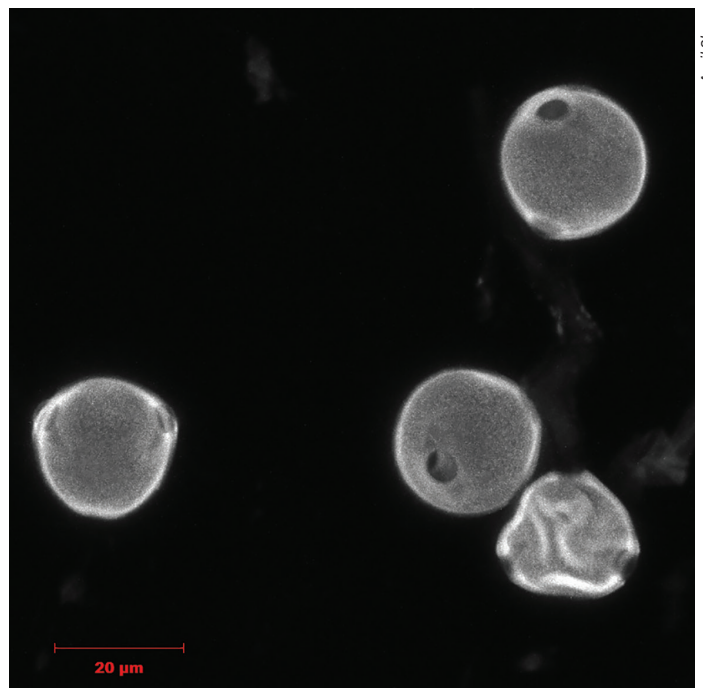


Photo 4 Soybean pollen (shown at 400X magnification) collected by one of the bees in the study