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Cover crop benefits to pollinators and the agroecosystem

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COVER CROP BENEFITS TO POLLINATORS AND THE AGROECOSYSTEM

Do cover crops in a rest-year crop rotation provide benefits to pollinators and other agroecosystem services, such as weed suppression and water quality impacts?

Bees are important for crops and may increase crop yields in about 70% of the world's primary crops[1]. Even in self-pollinated crops, like soybeans, honey bees may increase yields by 15%[2]. However, pollinator declines have been documented globally, with a 60% loss in honey bee populations since the 1950's[3]. Less is known about native bee losses. In 2016, multiple agencies came together to address this basic lack of knowledge on pollinator diversity, abundance, and conservation in southern Illinois agriculture. A project was established to research and optimize agricultural practices at Crab Orchard National Wildlife Refuge, where the crop rotation is corn (year 1), soybean (year 2), and winter wheat-rest-year fallow growing season (year 3). During year 3, one of five cover crop treatments was seeded in one-half of 25 agricultural fields, while winter wheat was seeded in the other half. Cover crops were cut for hay in mid-June. Fields were surveyed 6 times throughout the growing season to determine cover crop benefits to pollinators, weed suppression, and water quality impacts. Water quality impacts were monitored in a separate study in 2017 and 2018.

While fallow growing season is not a typical practice in Illinois, the results of this project may be applied in the case of marginal lands taken out of cultivation or field margin pollinator plantings in a typical corn-soybean rotation.

COVER CROP PLANTING TREATMENTS (T) AND SCIENTIFIC NAMES:

T1: Crimson, Red, and Ladino Clover & Bob Oats (*Trifolium incarnatum*, *T. pratense*, *T. repens*, *Avena sativa*)

T2: Crimson Clover & Bob Oats (*T. incarnatum*, *A. sativa*)

T3: Red Clover & Bob Oats (*T. pratense*, *A. sativa*)

T4: Ladino Clover & Bob Oats (*T. repens*, *A. sativa*)

T5: No Cover Crop

T6/Control: Winter Wheat (*Triticum aestivum*)

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COVER CROP MANAGEMENT IMPLICATIONS:

Pollinator Conservation

- Flowering cover crop mixtures that provide bloom durations throughout the growing season support the highest bee diversity and abundance (T1).
- Red clover (T1 & T3) is particularly important to declining bumblebee (*Bombus*) species.
- Refuge-specific practices already in use may be having a positive effect on pollinator conservation (non-GMO, fallow-year rotations, semi-natural features surrounding agricultural fields, reduced mowing schedules) and could be considered in private farms where pollinator conservation is of interest. More research is needed.
- In non-fallow conventional systems, taking marginal lands or a percentage of acreage out of rotation each year to plant a flowering cover crop could benefit pollinator conservation.
- No-till practices may promote survival of ground-nesting native bees[4].

FLORAL RESOURCES

- Late season floral resources are important for bees and are seemingly limited across the landscape (T1 & T4)
- Some agricultural weeds provide important floral resources.
- Floral "recovery" occurred following a mid-June hay cutting, and the clover continued to support pollinators.
- Floral diversity is potentially less important than bloom abundance, timing or nectar quality for supporting pollinator diversity, supporting the value of a monoculture clover cover crop (T1-T4).
- Management that promotes floral resource availability across the landscape is critical.

WEED SUPPRESSION

- Weed diversity was greatest in the no cover crop treatment (T5) and least in the winter wheat (T6) but the cover crop treatments (T1-T4) were intermediate between and not statistically different from T5 and T6.

- All treatments had similar abundances of "driver" weeds (weeds that drive management decisions due to potential economic impact).
- Clover cover crops may provide additional benefits (floral resources, nitrogen fixation, building soil).
- Not planting a cover crop will likely result in a higher diversity of weeds and will not provide the other pollinator benefits of cover crops.
- If cost is a limiting factor, wheat may provide some weed suppression but will not offer pollinator benefits.

WATER QUALITY CONSIDERATIONS

- In 2017, treatments with clover cover crops (T1-T4) resulted in greater nitrate and ammonium leaching; however, in 2018 there were no significant differences among the treatments (T1-T6).
- Nitrate was the dominant form of nitrogen in the soil solution and the dominant form leached.
- Precipitation timing and amount was the likely cause of variability of nitrogen beneath the treatments at different sampling periods.
- When using clover cover crops in pollinator conservation, it is important to consider proximity to water resources and the soil's susceptibility to leaching.

BEES FOUND IN AGRICULTURAL FIELDS

Sampling efforts at Crab Orchard National Wildlife Refuge in 2017 yielded the collection of 5,898 bee specimens, representing a total of 5 families, 28 genera, and 106 species. Apidae, which includes honey bees, bumble bees, and carpenter bees, represented the greatest species richness with 14 genera and 35 species. However, this family accounted for only 32% of the entire collection with non-native honey bees accounting for 14% of all specimens collected. Halictidae, or sweat bees, represented the next highest species richness with 6 genera and 28 species. This family also made up the bulk of the survey collection at approximately 56%. Andrenidae (mining bees) and Megachilidae (leaf-cutter and mason bees) each accounted for approximately 6% of the collection. Andrenidae represented 2 genera and 20 species, while Megachilidae were composed of 4 genera and 19 species. Lastly, representing less than 1% of the total number of bees collected was Colletidae (the polyester bees) with only five individuals sampled. Colletidae was also the least diverse family, composed of 2 genera and 4 species. *Lasioglossum* made up the most diverse genus with 21 species, followed by *Andrena* with 19 species. There are nine significant species findings for this geographical area either because they are considered rare records (*Andrena macra, Andrena flexa, Osmia chalybea, Osmia subfasciata, Megachile albitarsis, Megachile xylocopoides, Cemolobus ipomoeae*), are a species of conservation concern (*Bombus pensylvanicus*), or illustrate a considerable range expansion (*Lasioglossum creberrimum*).

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