Use by Honeybees of Flowering Resources In and Around Corn Fields

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Introduction

Corn seeds and seedlings are susceptible to attack by several early-season insect pests. Seed treatments have emerged as a means of reducing these insects. Seed-adhered insecticides include members of the class of chemicals referred to as neonicotinoids, which have been demonstrated to adversely affect honeybees. Pollen and nectar that foraging bees collect may be contaminated with neonicotinoids via direct spray, by plant translocation following treatment, and by contaminated dust generated during treated-seed planting.

The basis of this study was to examine the early-season weeds and other flowering plants in and around cornfields from which bees could collect pollen, as well as to identify pollen collected by bees and to analyze these pollens for neonicotinoid contamination from planting dust.

Materials and Methods

In 2013 and 2014, cooperating farmers in northwest Iowa provided eight corn production sites. Among these sites, both pneumatic (4) and finger type (4) planters were employed and no-till (5), strip-till (1), and conventional (2) cultivation used. Private landowners provided six sites and the ISU Allee (site 7) and Northwest (site 8) Research and Demonstration Farms provided the remaining two sites.

Each year two beehives were positioned at each site along the field margin. Hives were fitted with traps to sample corbicular pollen from returning forager bees prior to and following planting.

Pollen was collected from plant species in flower at each site each time corbicular pollen was sampled. A library of known pollens was assembled from these flower samples to use for identification of corbicular pollen. Using USDA National Agricultural Statistics Service CropScape – Dropland Data Layer and GIS, we analyzed the habitat types surrounding each site to a distance of three km (1.86 miles) from the hive locations. We then used these results to identify potential locations of habitat providing identified pollen.

We sub-sampled our identified corbicular pollen samples for detection of neonicotinoid contamination. Samples were sent to the USDA, AMS, National Science Laboratory, Gastonia, North Carolina, for analysis. These analyses utilized GC/MS with a limit of detection (LOD) of 1.0 ppb for each of the following neonicotinoids: clothianidin, thiamethoxam, and imidacloprid.

Results and Discussion

In 2013, pollen from 11 species were collected by foraging bees in quantities >20 percent of all pollen collected by weight each week. Several early-season species of pollen were of particular importance in terms of the number of sites at which they were collected and the percent total by weight; maple (*Acer sp.*) 71 percent on May 6, apple (*Malus domestica)* 72 percent and 49 percent on May 13 and 17, respectively, and willow (*Salix sp*.) 33 percent and forsythia (*Forsythia suspensa*) 12 percent on May 17. Detectible levels of neonicotinoids were found in samples of all of these important early-season pollen species except maple (*Acer spp*.), which was not collected by bees after week 1 (May 6 collection date), the week prior to corn planting at 7 of our 8 sites.

Neonicotinoids were detected in samples of seven pollen species over a 3-week period after planting began. The highest detected levels of neonicotinoids were among samples of apple, dandelion (*Taraxacum officinale*), rose (*Rosa multiflora*), and willow pollen collected on May 13, the week during which the majority of our cooperators were planting corn. Samples of apple, willow, and forsythia pollen collected the following week on May 17 also were contaminated but had consistently lower mean levels of combined chlothianidin and thiamethoxam than those from May 13. No neonicotinoids were detected in pollen samples collected after June 2.

Important forage species in 2014 again included maple (*Acer spp*.), which was particularly important as an early-season forage representing large proportions of total pollen collected over several dates; 72 percent on April 21, 95 percent on April 25, ≥46 percent on May 4 and 7. Similarly, apple (*M. domestica)* was of similar importance as a forage source accounting for nearly 60 percent of all pollen by weight collected on May 19.

Detectible levels of neonicotinoids were found in samples of all 12 species analyzed and from pollen collected at all study sites in 2014. Detection of neonicotinoids was most frequent beginning May 7 and again May 19, corresponding to peak corn planting activities among and adjacent to the study areas associated with precipitation levels extending the planting season. Planting in 2013 began later than in 2014. Thus, in 2014, maple pollens collected on April 21 and 25 and May 4 and 7 were contaminated with 48.6, 10.3, 9.1, and 177.1 ppb combined clothianidin and thiamethoxam, respectively.

These results identify the majority of bee-collected pollen at the time of corn planting to be from woody plants. These pollens were consistently contaminated with high levels of neonicotinoids. Woody vegetation in Iowa does not occur within cornfields or along the margins, but typically is found in farmyards, small woodlots, or along waterways and would not be impacted by cultivation or alterations in pre- or post-emergence herbicide treatments. The landscape analysis of each study site identified cover types that could potentially provide woody plant bee forage to include developed land, deciduous and mixed forest, and woody wetlands. Together these landscape cover types account for an average of only 9.71 percent of the landscape surrounding the hives due to the preponderance of corn and soybean. Elimination of these species could reduce the impacts of neonicotinoid contamination, however, bees would lose the few pollen sources currently available.

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