Evaluating Impacts of Neonicotinoid Seed Treatments on Pests, Beneficial Arthropods and Yield in Grain Crop Rotations

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Background: Neonicotinoid seed treatments (NSTs) are one of the most convenient, economical and popular ways to protect a variety of crops from insect damage. Neonicotinoids have low toxicity to fish and mammals while seed treatments are a safer and less invasive way to apply pesticides, minimizing applicator exposure and off-site drift of the active ingredient. NSTs play an important role in grain crops, as they are used to control soil and seedling pests on the majority of corn and about half the soybean grown in the country, and their usage is also increasing in wheat. In the mid-Atlantic regions, these grain crops are typically grown in a crop rotation. Previous studies have shown that NSTs may improve yield under high pest pressure; however, treatment decisions are made before target pest populations are known. Therefore, if pest pressure is low, using NSTs over untreated seeds may not improve yield.

Repeated exposure to neonicotinoids could also lead to insect pests developing resistance against them. Additionally, research has found some negative impacts of neonicotinoids on beneficial insects. Therefore, we are conducting a three-year study to better understand both the benefits and risks of using two neonicotinoid seed treatments, Cruiser ® 5FS (Syngenta) and Gaucho 600 Flowable (Bayer) (thiamethoxam and imidacloprid, respectively) in a 3-year grain crop rotation of full-season soybean, winter wheat, double-cropped soybean and corn.

Objectives: To determine the impact of NSTs on 1) arthropod pests 2) beneficial arthropods and 3) plant growth and yield. By looking at a 3-year rotation, we are also evaluating whether the repeated use of NSTs back to back over multiple years has any cumulative effects.

Methods: The study is being conducted at two sites, in Beltsville, MD, and Queenstown, MD. At each site, we are planting four replicate plots of each treatment using standard mid-Atlantic production practices. Treatments include: Cruiser and fungicide treated seed, Gaucho and fungicide treated seed, fungicide treated seed, and untreated seed.

Figure 1: Insect sampling through visual counts, sticky cards, pitfall traps and litter sampling.

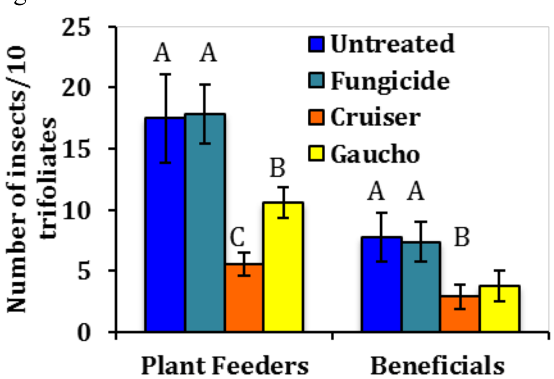
At each site, the abundance and diversity of invertebrate communities on plants and in the soil are determined throughout the season using various sampling methods, such as sweep-net samples, sticky cards, pitfall traps, litter samples, and visual counts (Figure 1).

This allows us to measure both pest and beneficial communities present in the field. To see if seed treatments increase yield by reducing pest damage or increasing plant growth and establishment, we will measure yield, as well as parameters such as stand density, plant height and tillering in wheat.

Preliminary Findings: Arthropods – In the 2015 soybeans, the most abundant arthropod pests that we observed during early season (V2 stage) visual scouting were plant thrips and leafhoppers, while the most abundant beneficial insects were predatory thrips and minute pirate bugs (Figure 2). Both Gaucho and Cruiser led to significant decreases in the levels of these pests and beneficials (Table 1).

Figure 2: Insects seen in soybean visual counts, including pests (top) such as leafhoppers and plant thrips and beneficials (bottom) such as minute pirate bugs and predatory thrips

Table 1: Levels of plant feeders and beneficial insects observed through visual counts in soybean in 2015 pooled across sites. Letters indicate significant differences.

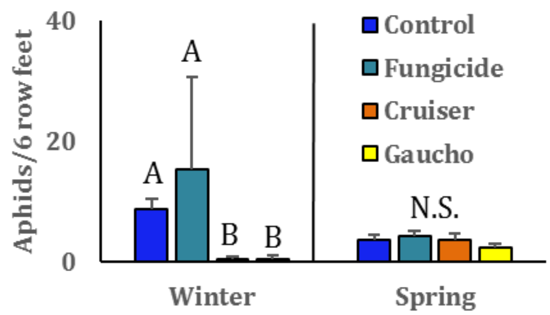


In our late seasons sweep net samples (R3 stage), we found that most arthropods were not impacted by the NSTs, as we expected, given that they only provide protection for a few weeks post planting. However, NSTs led to an increase in sucking pests such as stinkbugs, leafhoppers and aphids, possibly due to a decrease in predators early in the season.

In winter wheat, we conducted visual counts for pests twice in the winter and three times in the spring (Feekes stages 1, 2, 6, 10 and 11). In the winter, both Cruiser and Gaucho led to a significant decrease in the numbers of aphids, however in the spring there was no significant impact of NSTs on aphid or cereal leaf beetle populations (Figure 3 & Table 2).

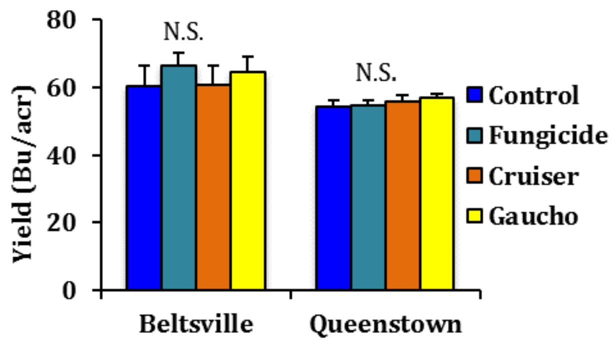
Figure 3: Pests of wheat – aphids and cereal leaf beetle.

Table 2: Number of aphids observed through visual counts at Queenstown site in wheat in 2016. Letters indicate significant differences; N.S. = No Significance



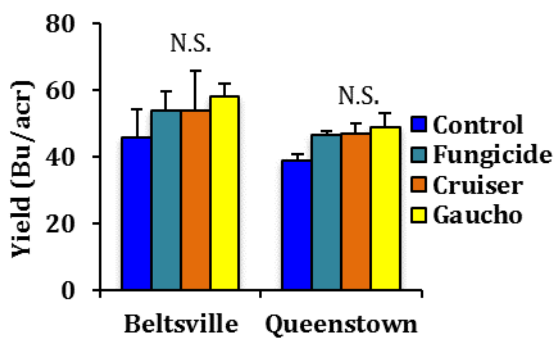
It is important to note that overall pest pressure was low in both soybean and wheat; all the pests mentioned were present in numbers well below treatment thresholds. NSTs did not have a significant impact on yield of soybean or wheat at either site (Table 3 & 4).

Table 3: Soybean yield in 2015. N.S. = No Significance.



Conclusions: These preliminary results confirm that although NSTs do reduce pest pressure, they are only effective early in the growing season. When pest pressure is low, the use of NSTs may not result in an increase in yield.

Table 4: Wheat yield in 2016. N.S. = No significance.



NSTs play an important role in grain crop systems and can be very beneficial, providing a convenient and economical ways to protect crops. However, our results so far suggest that the use of NSTs may not always be economically beneficial in mid-Atlantic grain crop production. We hope that our preliminary and future findings will help growers maximize the benefits of NSTs while using them in a sustainable way.

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