Effect of Starter Phosphorus and Microbial Inoculants on Corn Growth and Yield after a Fallow Period

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Objective

Assess the efficacy of starter phosphorus applications and microbial inoculants on reducing the impacts of fallow syndrome in corn.

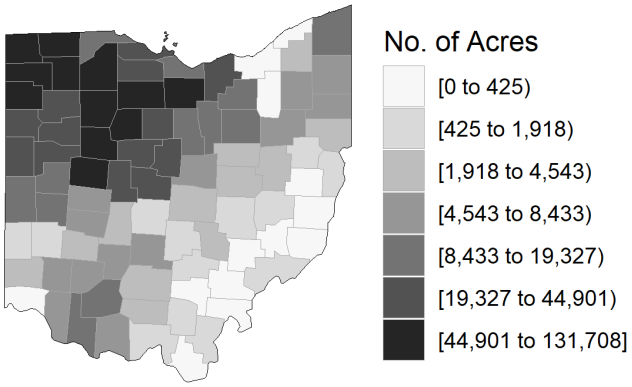

Figure 1. Number of reported Prevented Planting acres by county in Ohio as of January 1, 2020
(Source: Farm Service Agency)

Background

Wet weather conditions in the spring of 2019 prevented Ohio farmers from planting over 1.5 million acres (Figure 1). A decline in beneficial mycorrhizal fungi that aid in plant water and nutrient uptake may occur in absence of host root tissue in fields left unplanted. It is hypothesized that corn (*Zea mays*) planted into these fallow fields may exhibit nutrient deficiencies due to a reduction in mycorrhizal root colonization. This phenomenon is commonly referred to as fallow syndrome. Fallow syndrome is poorly reported in Ohio, and few on-farm studies have been conducted to justify potential remediation options. We hypothesized that plots treated with starter phosphorus alone or in combination with a microbial inoculant will have higher corn biomass and grain yield than untreated plots.

Methods

After a fallow period, corn was planted on May 13, 2020, in Marion Township (Henry County) following a conventional tillage pass in the fall and vertical tillage in the spring. The planting rate was 35,000 seeds per acre with 20-inch row spacing and hybrid Stine 9654-0 with Acceleron® (imidacloprid, tebuconazole, fludioxonil, metalaxyl) seed treatment. The desired nitrogen rate for the field was 193 pounds nitrogen per acre. Herbicide burndown was applied on May 13 consisting of glyphosate, atrazine, and Acuron® (S-metolachlor, atrazine,

mesotrione, bicyclopyrone). The field was tiled with the following soil types present: Hoytville Silty Clay Loam, Haskins Loam, and Mermill Loam. No foliar fungicide or insecticide applications were made.

The study was randomized in a complete block design with four replications. Plot size was 40 feet wide and field length. Treatments included a control without any phosphorus applied, starter phosphorus fertilizer (7-16-3 at 5 gal/ac for a total of 4 lb. N, 8 lb. P_2O_5, and 2 lb. K_2O per acre) applied in-furrow; 3Bar Bio-YIELD® microbial inoculant (*Pseudomonas brassicacearum*) with starter phosphorus fertilizer applied in-furrow; and Valent MycoApply® EndoPrime® SC mycorrhizal inoculant (*Glomus spp.*) with starter fertilizer applied in a 2x2 band.

Composite soil samples consisting of 10-15 8-inch soil cores were taken at planting from each plot in a zig-zag pattern to characterize soil test levels and overall fertility. Ten aboveground corn biomass subsamples were collected from each plot at V5 growth stage, and biomass and nutrient content was normalized on a per plant basis to assess early treatment effects on growth. Precipitation data was obtained from cocorahs.org and recorded daily. Plots were machine harvested on November 2 and yield and moisture data were obtained using a calibrated yield monitor. Yields were standardized to 15.5% moisture. Treatment comparisons were made using Fisher's Protected Least Significant Differences test.

Results

Plots treated with starter phosphorus alone or in combination with either inoculant had significantly higher individual plant biomass and lower phosphorus tissue content than the control treatment where no phosphorus was applied. However, starter phosphorus and inoculants did not significantly increase yield when compared to the no-phosphorus control (Table 1).

Table 1. Biomass, Biomass Phosphorus Concentration, and Yield Response by Treatment

	Dry Biomass (g per plant)	P Concentration (%)	Dry Yield (bushel/acre)
Control	1.22 B	0.38 A	163.6 A
Starter P	1.74 A	0.32 B	163.2 A
Starter P + Bio-YIELD®	1.81 A	0.32 B	160.5 A
Starter P + MycoApply®	1.56 A	0.34 B	156.6 B
	LSD (0.1) 0.30	**LSD (0.1) 0.03**	**LSD (0.1) 3.29**

There was no evidence of fallow syndrome at this site, and soil test phosphorus levels being within the recommended range.

Summary

We evaluated the impact of starter phosphorus and microbial inoculants on corn growth and yield after a year-long fallow period and observed no yield benefit from either starter

phosphorus or microbial inoculant applications. This suggests that remediation treatments are not necessary after a year-long fallow period when soil test phosphorus is within the maintenance range of 20-40 ppm Mehlich-3, based on the Tri-State Fertilizer Recommendations (Culman et al., 2020). The control treatment with no starter phosphorus or microbial inoculant did have a significantly higher phosphorus tissue concentration as a percentage. However, this is likely due to a dilution effect, as all other treatments had significantly higher dry biomass per plant than the untreated control. Future work is needed to assess the use of starter phosphorus and microbial inoculants across varying soil test phosphorus levels with and without the use of an overwintering cover crop with additional soil health measurements. Overall, these data will inform future management recommendations to growers planting corn after a fallow period.

References

Culman, S., Fulford, A., Camberato, J., & Steinke, K. (2020). *Tri-State Fertilizer Recommendations*. Bulletin 974. College of Food, Agricultural, and Environmental Sciences. Columbus, OH: The Ohio State University.

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