Effect of Starter Phosphorous Fertilizer on Corn Yield - 1

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Objective

Evaluate the agronomic and economic impacts of phosphorus (P) fertilizer applications in corn.

Background

The addition of P to a cropping system has been a longstanding practice within the agriculture industry. P is often the nutrient of concern regarding water quality and the formation of toxic algal blooms (LaBarge, 2023). This study was conducted in the Western Lake Erie Basin, an area where producers are actively exploring strategies that are agronomically, economically, and environmentally sound when contemplating P amendments. This study took place in Fulton County, Ohio on a Blount loam soil. This farm's management includes no-till across all acres, pattern drainage tile, and a seeding rate of 34,000 seeds per acre. The producer wanted to reintroduce P into this system after nine years of no P applications to evaluate if there would be any yield advantages to added P. The optimal P levels for Ohio field crops range from 20-40 parts per million for a traditional corn and soybean rotation (Culman et al., 2020).

Methods

This study utilized a randomized complete block design (RCBD) with seven replications. Pioneer P0859AM seed corn was planted on May 24, 2023. The two treatments in this study were 1) No P added to the starter fertilizer blend (32 gallon 28% UAN and 3 gallon 12-0-0-26) and 2) 5 gal of 10-34-0 (equivalent of 19.9 lbs. P_2O_5/ac) added in the starter fertilizer applied 2x2. Each treatment replication was 20 feet wide by 1,330 feet long. All treatments received the same inputs except for starter phosphorus fertilizer. On September 15, 2022, cereal rye cover crop was flown on at a rate of 60 lbs./acre before soybean harvest.

On July 5, 2023, at the V7 growth stage, soil cores were pulled for a standard soil test, Haney soil health test and PLFA soil samples were collected at 0–6-inch depth from a composite sample. Soil cores were taken every 3 inches between two rows of corn, from row middle to row middle. Plant tissue samples were collected from corn ear leaves on July 25, 2023, at the R1 growth stage. Yield and grain moisture data were obtained using a weigh wagon. Yields were adjusted to 15.5% moisture.

Results

Table 1. Impact of Phosphorous (P) Fertilizer		
Starter P Rate (gal/ac of 10-34-0)	Yield (bushels/acre)	Return Over P ($/ac)
0 gal/acre	196.5 a	884
5 gal/acre	195.5 a	857
C.V.=4.55 %; LSD (0.05) = 10.40		

Table 2. Weather Data		
	2023 Local Rainfall (Border View Weather Link)	Historic Rainfall (Archbold, OH)
May	1.33 in	2.28 in
June	2.34 in	2.60 in
July	5.32 in	2.17 in
August	3.13 in	2.13 in
Total	**12.08 in**	**9.18 in**

Table 3. Standard Soil Test Results (V7)					
Test Parameter	Baseline (Pre-Planting)	No P	5 gal 10-34-0	CV (%)	LSD (P<.05)
OM %	2.8	2.9	3.0	10.9	NS
Phosphorous P-M3 (ppm)	17.6	17.7	17.7	17.2	NS
Potassium (ppm)	76	80.7	74.3	14.1	NS
pH	6.3	6.2	5.9	4.0	NS
CEC	11.7	15.6	15.9	7.3	NS
Ca %	-	64.1	62.5	8.7	NS
Mg %	-	16.6	13.7	8.4	2.88

Table 4. Haney Soil Health Test (V7)				
Test Parameter	No P	5 gal 10-34-0	CV (%)	LSD (P<.05)
CO_2 (ppm CO_2-C) Respiration	56.8	62.1	22.9	NS
Organic Carbon (ppm C)	165.7	158.0	6.6	NS
MAC % (Microbially Active C)	34.3	39.3	21.1	NS
C:N	9.8	11.2	15.7	NS
SHC (Soil Health Score)	10.7	10.8	14.7	NS
Available N (lbs./ac)	136.3	119.8	17.1	NS
Available P (lbs./ac)	15.4	17.9	22.4	NS
POxC (ppm) (Active Carbon)	481.0	482.3	14.3	NS

Table 5. Phospholipid Fatty Acids (PLFA) Test (V7)				
Test Parameter	**No P**	**5 gal 10-34-0**	**CV (%)**	**LSD (P<.05)**
Total Biomass (ng/g soil)	2680	2613	40.3	NS
Functional Group Diversity	1.3	1.3	10.7	NS
Total Bacteria (% of Biomass)	45.5	39.8	8.8	NS
Total Fungi (% of Biomass)	4.2	4.3	47.0	NS
Protozoa (% of Biomass)	0	0	-	-
Undifferentiated (% of Biomass)	50.3	55.6	5.7	NS

Table 6. Plant Tissue Analysis (R1)					
Test Parameter	**Normal Range**	**No P**	**5 gal 10-34-0**	**CV (%)**	**LSD (P<.05)**
N %	3.0-4.0	3.7	3.6	4.0	NS
P %	0.25-0.45	0.3	0.3	9.3	NS
K %	2.0-2.5	2.1	1.9	8.7	NS
Mg %	0.13-0.3	0.3	0.4	13.1	NS
Ca %	0.25-0.5	0.6	0.6	9.7	NS
S %	0.15-0.5	0.26	0.25	5.0	NS

Summary

There was not a statistical difference in corn yield with the addition of P in the starter fertilizer blend. Additionally, there was an economic disadvantage to the amendment. With a baseline soil test of 18 ppm P, one would expect a greater probability of response to a P amendment. It could be interpreted that the remaining P in the soil is not plant available. The P amendment returned a $27 per acre loss after the P cost was realized (Table 1). Soil and plant testing showed no significant difference with a P amendment (Table 3-6). Further studies should be conducted to observe P levels and crop removal year-over-year.

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