Evaluation of Phosphorus Fertilizer, Sandusky County

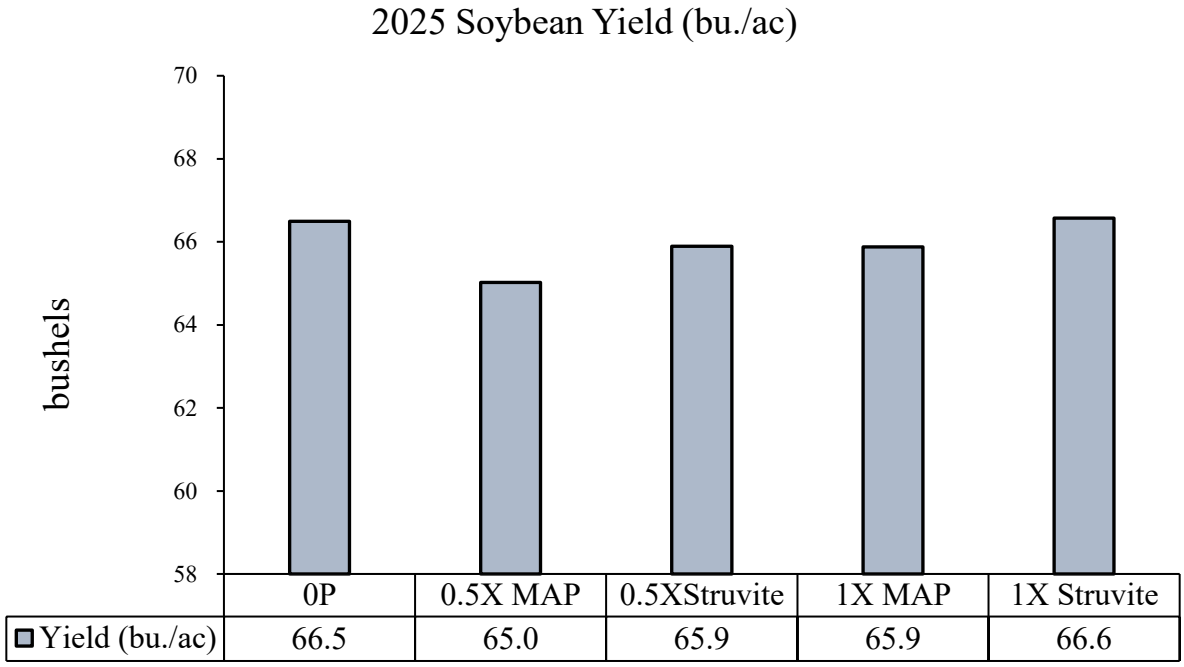
Objective: Determine the agronomic response to crop production and soil health of no phosphorus starter fertilizer versus with phosphorus and no Struvite versus with Struvite overlaid on the phosphorus study.

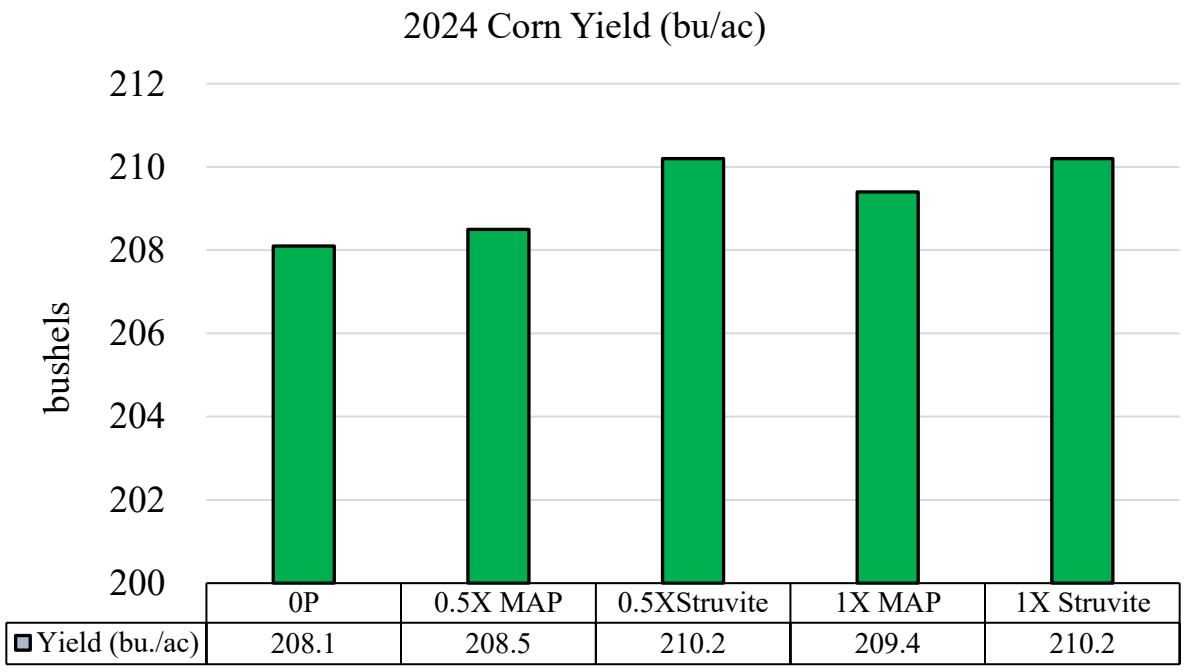
Background: This study supports the H2Ohio goal of reducing phosphorus fertilizer application. The plot is located in Sandusky County, Ohio. Field length treatment strips (60 feet wide by 1500 feet long) are maintained throughout the multi-year study. Struvite (SmartPhosDG analysis 4-22-0 with 8% Mg)) is a slow-release phosphorus byproduct from wastewater treatment plants. In 2024, corn was planted in the same treatments and data collected according to the location of 2023 fall strip-till treatments. MAP fertilizer was applied at full rate (115 lb/ac) and half rate. Struvite fertilizer applied at full rate (275 lb/ac) and half rate. A zero-phosphorus treatment was also included. In 2025, soybeans were planted in the same treatment areas with no additional fertilizer applied. Yields and moistures were obtained by using a calibrated yield monitor.

Experiment design:

- This experiment is a randomized complete block design having 5 treatments replicated thrice based on half and full rate of P from MAP (11-52-0) and struvite (4-22-0).
- The treatments are as:
    - 0P (no phosphorus),
    - 0.5X MAP (half rate)
    - 0.5X struvite (half rate)
    - 1X MAP (full rate
    - 1X struvite (full rate)

Data Collected





PLFA - Phospholipid Fatty Acids (Regen lab)

2025 averages of 3	0 Phos	.5 x MAP	.5 x struvite	1 x MAP	1 x struvite
Total Biomass(ng/g soil)	4710.0	4452.0	2525.3	1584.0	3932.3
Functional Group Diversity	1.4	1.3	1.3	1.3	1.3
Total Bacteria (% of Biomass)	36.7	29.1	37.8	35.3	37.2
Total Fungi (% of Biomass)	5.2	3.0	4.8	4.1	4.7
Protozoa (% of Biomass)	0.2	0.1	0.0	0.0	0.0
Undifferentiated (% of Biomass)	57.9	67.9	57.4	60.6	58.0

Haney Soil Health Test (Regen lab)

2025 averages of 3	0 Phos	.5 x MAP	.5 x struvite	1 x MAP	1 x struvite
CO2 (ppm) Respiration	107.2	115.1	131.5	73.6	122.5
Org.C (ppm) C (organic C)	306.7	301.3	382.3	365.3	388.0
MAC % (microbially active C)	41.9	38.4	34.4	20.5	32.2
C:N (carbon:nitrogen ratio)	11.4	10.3	11.7	11.3	9.8
SHC (soil health score)	18.5	18.4	21.9	17.9	22.4
Available N (lbs/ac	55.1	62.2	70.7	61.3	80.1
Available P (lbs/ac)	93.2	52.2	37.2	54.6	45.7
POxC(ppm) (active carbon	333.7	262	310	286	310

Standard Soil Test (A & L lab)

2025 averages of 3					
	0 Phos	.5 x MAP	.5 x struvite	1 x MAP	1 x struvite
OM %	3.7	3.6	3.7	3.5	3.7
Phosphorus P-M3 (ppm)	65.0	44.7	39.7	52.3	44.0
Potassium (ppm)	238.0	219.7	192.0	225.0	218.7
pH	6.6	7.3	5.8	6.1	6.1
CEC	15.6	20.7	14.0	14.7	13.1
Ca %	74.4	83.2	60.8	62.1	67.8
Mg %	10.3	11.4	12.5	15.1	13.5

Plant Tissue Analysis (Ward lab)

Average of 3	Normal Range	0 Phos	.5 x MAP	.5 x struvite	1 x MAP	1 x struvite
Nitrogen %	3.0-4.0	2.89	2.98	2.86	2.79	2.72
Phosphorus %	0.25-0.45	0.30	0.29	0.32	0.34	0.32
Potassium %	2.0-2.5	3.16	2.63	3.09	3.24	3.10
Calcium %	0.13-0.30	1.30	1.40	1.36	1.28	1.32
Magnesium	0.25-0.50	0.31	0.34	0.33	0.34	0.32
Sulfur %	0.15-0.50	0.19	0.21	0.23	0.21	0.22

Impact of Phosphorus (P) Fertilizer

Initial Starter P Rate (lb/ac of MAP)	Bean Yield (bu/ac)	Value of Grain ($/ac)	Cost of P/Yr ($/ac)	Return Minus P Cost ($/ac)	
0	66.5	$665.00	0	$665.00	base
1/2 rate 57.5	65.0	$650.00	$11.50	$638.50	-$ 26.50
Full rate 115	65.9	$659.00	$23.00	$636.00	- $ 29.00

Based on $10.00/bu beans price and $800/ton MAP ($0.40/lb.) at 2023 price. Cost of P factored over 2 years (Initial rate/2years = cost per year) 57.5 lb MAP x $0.40 = $23.00 /2 years = $11.50

Summary

- No significant difference in crop yields among treatments. Soil and plant testing showed no significant difference. No phosphorus deficiency symptoms were observed. In 2025 there was no economic advantage to applying phosphorus or Struvite fertilizer. Struvite has the potential to maintain corn yield sustainability as compared to soluble MAP fertilizer.
- The addition of Phosphorus (P) to a cropping system has been a longstanding practice within the industry. P is often the nutrient of concern in regard to water quality and the formation of toxic algal blooms. 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. (K. Lovejoy)
- Support for this trial was from The Andersons, the Conservation Action Project. (www.capofohio.org) and the H2Ohio program administered by the Ohio Department of Agriculture. (www.h2.ohio.gov)

H2Ohio