

Updating the Tri-State Fertilizer Recommendations

Steve Culman, Anthony Fulford, Laura Lindsey, Anne Dorrance, Peter Thomison, Rich Minyo, many OSU extension educators, crop consultants and grain farmers

Background: Corn, soybean and wheat fertilizer recommendations in Ohio follow the *Tri-State Fertilizer Recommendations* and were last updated in 1995. Water quality challenges and changes in management practices have justified a comprehensive re-assessment of these recommendations.

Approach: From 2014– 2018, we worked with farmers, agronomists, educators and consultants to conduct extensive on-farm strip trials in 39 counties across Ohio. At each site, we collected: 1) soil samples for routine soil test, 2) leaf tissue concentration at flowering, 3) grain nutrient concentration at harvest, 4) grain yields and 5) management history information.

Table 1: Summary of fertilizer trials in Ohio

Nutrient	Corn	Soybean	Wheat	Total
Nitrogen	60	--	8	68
Phosphorus	54	50	17	121
Potassium	40	50	17	107
Sulfur	18	15	10	43

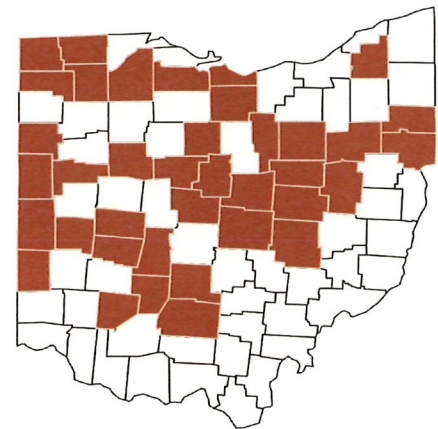


Fig 1: Distribution of fertilizer trials

Findings:

Phosphorous and Potassium Fertilizer Trials

- When soils were in or above maintenance range, yield responses to fertilizer were very rare
 - Current Tri-State maintenance range:
 - 15 – 30 ppm Bray P (20-40 ppm for Mehlich-3 P)
 - 100 - 150 ppm Mehlich 3 K
- Soils in the maintenance range can supply crops with P and K for many years
 - Long-term P & K trials started in 2006 on 3 OSU farms (Clark, Wayne, Wood Counties); Soils started in maintenance range
 - 9 years of continuous P &K fertilizer vs. unfertilized comparisons
 - Over first 9 years, only 9 out of 42 comparisons showed a significant yield increase to fertilizer

Nitrogen Rate Trials in Corn

- Ohio corn N rates were updated in March 2018
- Ohio + 6 other corn-belt states use an economic model to maximize profitability, not yields; Online calculator only requires 3 inputs:
 - Previous crop
 - Your N fertilizer cost
 - Price expected for grain
- Model calculates Maximum Return to N
- Ohio model draws on 281 corn N rate trials conducted across the state over the past 15 years (228 trials after soybean, 53 after corn)
- go.osu.edu/corn-n-rate

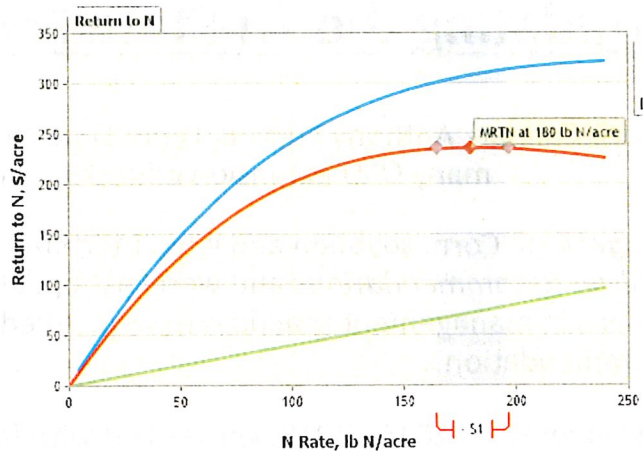


Table 2: Updated Ohio Corn Nitrogen Fertilizer Rate Recommendations

Price/ bushel corn	Price of Nitrogen Fertilizer (\$/ lb)				
	\$0.30	\$0.35	\$0.40	\$0.45	\$0.50
\$3.25	185	176	168	162	155
\$3.50	187	180	173	166	160
\$3.75	191	184	176	170	164
\$4.00	195	186	180	174	168
\$4.25	199	190	184	177	171
\$4.50	200	193	185	180	175

Grain Nutrient Removal Rates

- Over the past several decades, nutrient concentration levels in grain have dropped
- New varieties are more efficient

Table 3: Updated Grain Nutrient Removal Rates

Crop	Nutrient	Tri-State (1995) (lbs/ bushel)	New Data (lbs/ bushel)	Percent Decrease
Corn	P ₂ O ₅	0.37	0.35	5%
	K ₂ O	0.27	0.20	26%
Soybean	P ₂ O ₅	0.80	0.79	1%
	K ₂ O	1.40	1.14	19%
Wheat	P ₂ O ₅	0.63	0.49	22%
	K ₂ O	0.37	0.24	35%

Next Steps:

- Revised fertilizer recommendations in late 2018 (continue as Tri-State)
- More emphasis on fertilizer management by crop nutrient removal rates
- Mehlich-3 will be default soil test
- Leaf tissue sufficiency levels will likely be modified
- All data will be made available with farmer-friendly tools being developed