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Nutrient management and fertility considerations with cover crops

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Basics of Soil Testing

- Uses of soil testing
  - Predict fertilizer and lime needs prior to planting
  - Monitor nutrient status in season
  - Monitor soil test levels over time as a measure of the impact of the fertility program
  - Address environmental concerns related to potential nutrient runoff or leaching

In Nutrient Management the Primary Objectives are:

- Determine the fertility and pH status of an area, field or farm, with the goal of removing fertility as a yield limitation
- Use that information to predict where fertilizer responses will or will not occur
  - Increase the return on our fertilizer investment
  - Increase the efficiency of fertilizer use
  - Reduce the potential for environmental injury

Points to consider

- Establish sampling areas to address differences in soils and past management
- Sample to the appropriate depth, considering the soil test and tillage
- Take an adequate number of cores
- Sample regularly at an appropriate time and when possible the same time
- Take care in handling and shipping samples
- Consider the reliability of individual tests and interpret tests realistically, considering the goal of predicting where a response will or will not occur

Soil Sampling Approaches

- Divide fields into uniform areas.
- Soil color (Aerial photograph).
- Topography (uplands, sloping, bottomland).
- Past inputs (limed vs. unlimed).
- Use judgment on management size: One acre in 200 is probably not worth the cost.
- Soil series (NRCS Soil Survey, Web Soil Survey: http://websoilsurvey.nrcs.usda.gov/app/

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Nutrient management and fertility considerations with cover crops

Overview

- Improve nutrient availability with cover crops:
  - Decomposing biomass
  - Nutrient cycle (subsurface and surface)
- Considerations/effect of different types of cover crops

Nutrient management considerations

- Cover crops are expected to capture residual nitrate N.
- What amounts of nutrients will a cover crop accumulate in the top and root biomass?
- How will the accumulated nutrients affect nutrient availability in the soil?
- Are supplemental nutrients beneficial for stimulating growth?

Nutrient management considerations

- With increased biomass and soil cover, N fertilizer placement can be more relevant.
- Monitor key soil parameters such as organic matter: correct sampling is important!

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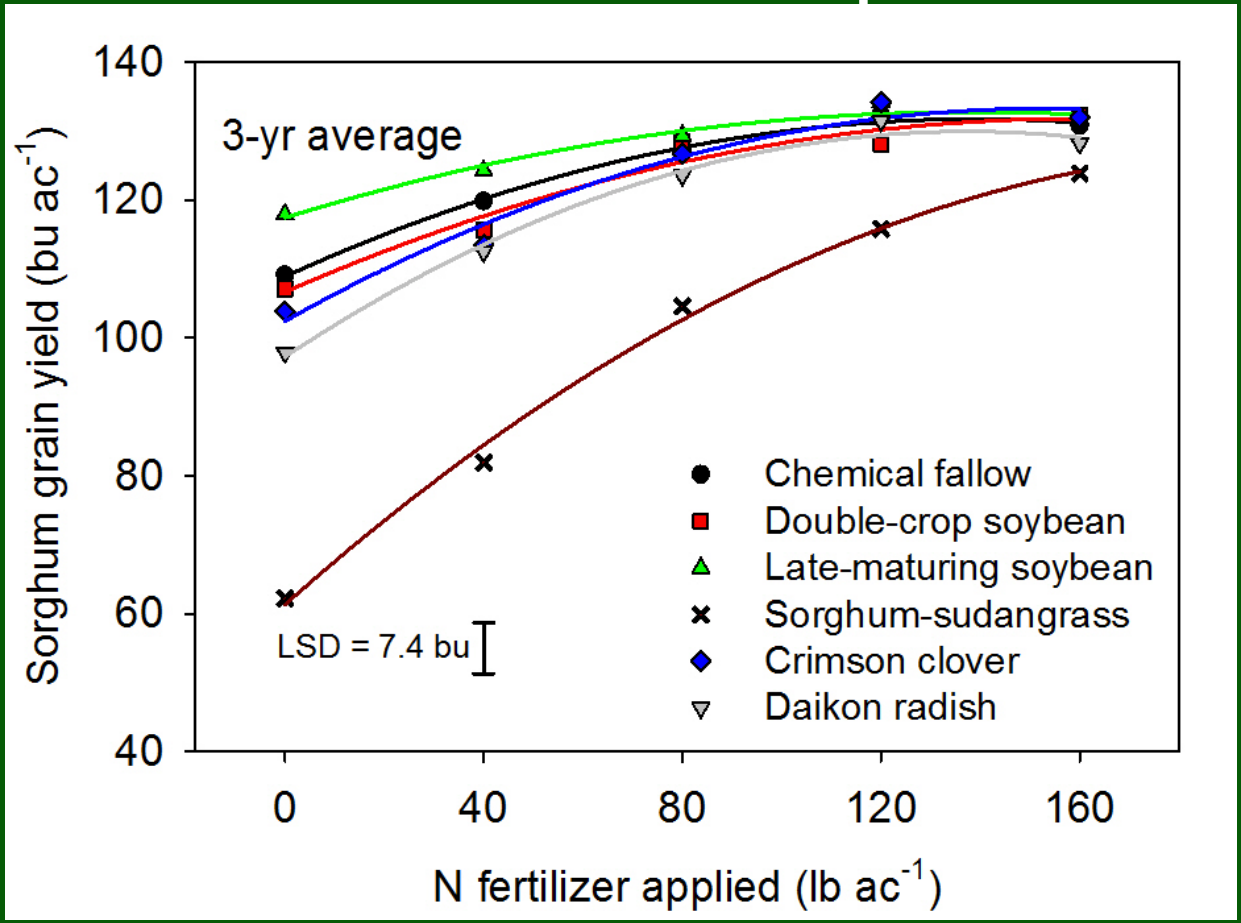
Nitrogen fertilizer replacement value provided to sorghum by cover crops

Ashland Bottoms, Kraig Rozeboom

Preza et al 2017. Agron. J.

Sorghum response to N fertilizer rate after cover crops



Preza et al 2017. Agron. J.

Estimated N fertilizer replacement value provided to grain sorghum by cover crops

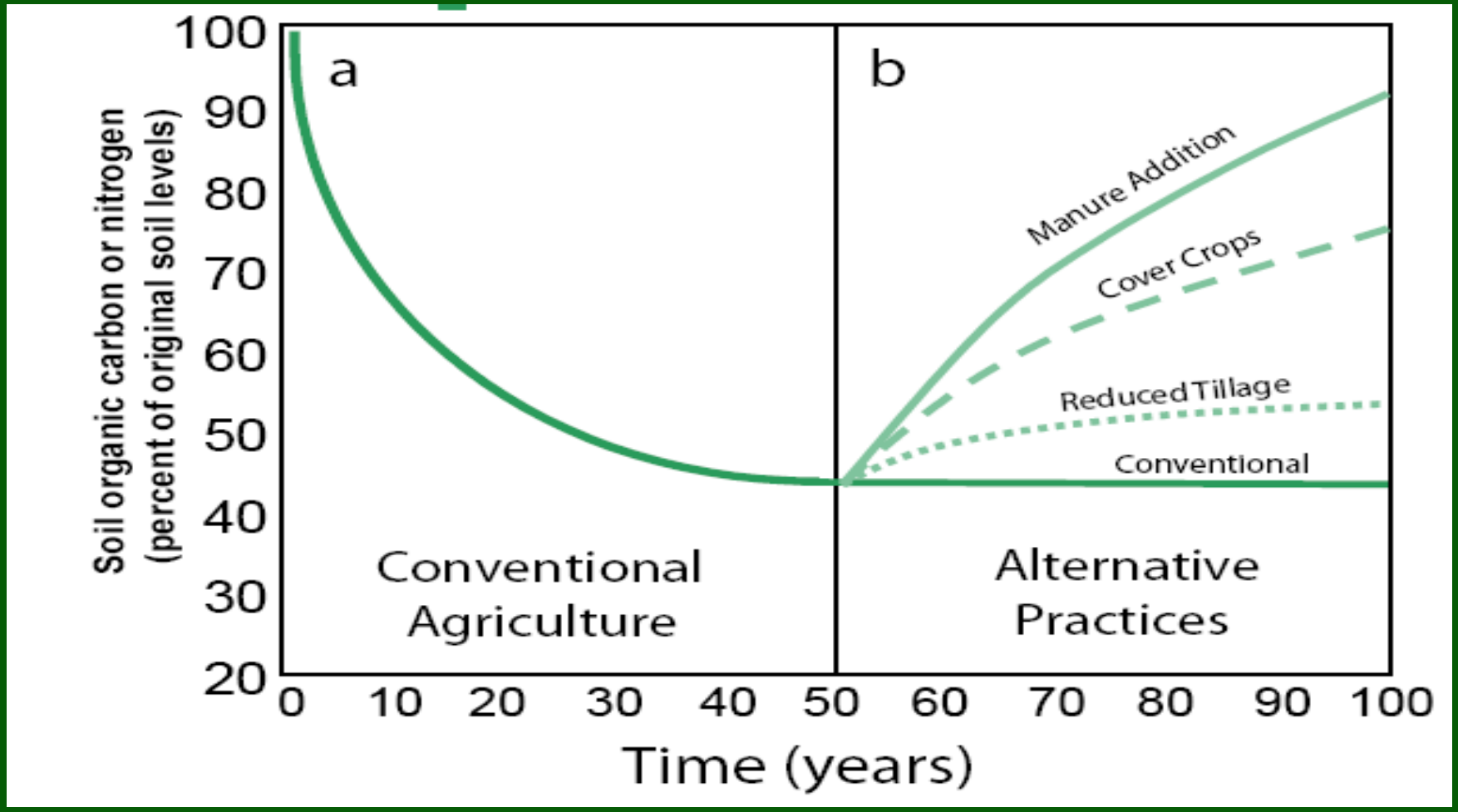
Cover crop	2014	2015	2016	Across years
	——— lbs N/ a ———			
Double-crop soybean	52	6	-74	-8 b
Late-maturing soybean	45	26	40	40 a
Sorghum–sudangrass	-55	-63	-239	-119 c
Crimson clover	31	-6	-68	-14 b
Daikon radish	6	-10	-103	-36 b

Preza et al 2017. Agron. J.

Nitrogen mineralization

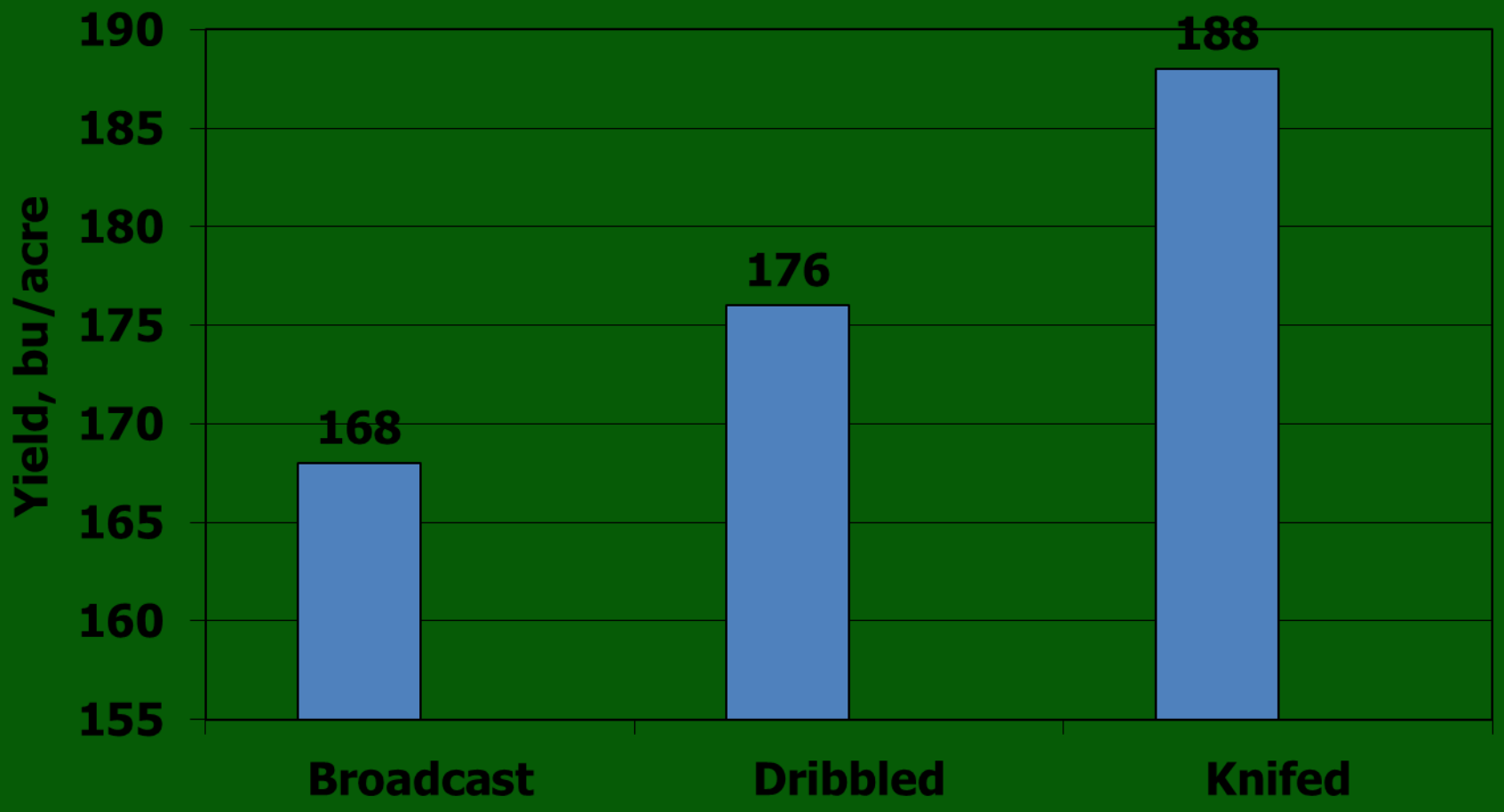
- Initial conversion to NT results in the accumulation of organic matter with a required accumulation of organic nitrogen
- Consider this:
  - 1% organic matter in 1 foot of soil
  - = ~40,000 lb organic matter/acre
  - = ~23,000 lb organic carbon/acre
  - = ~2,300 lb organic nitrogen/acre
- Transition period varies with environment and cropping system (5-10+ years commonly quoted)

How does management affect soil organic carbon?



(Modified from Tilman, 1998)

Corn Yield as affected by Method of UAN Application



Gordon, 5-year average

Immobilization and volatilization potential

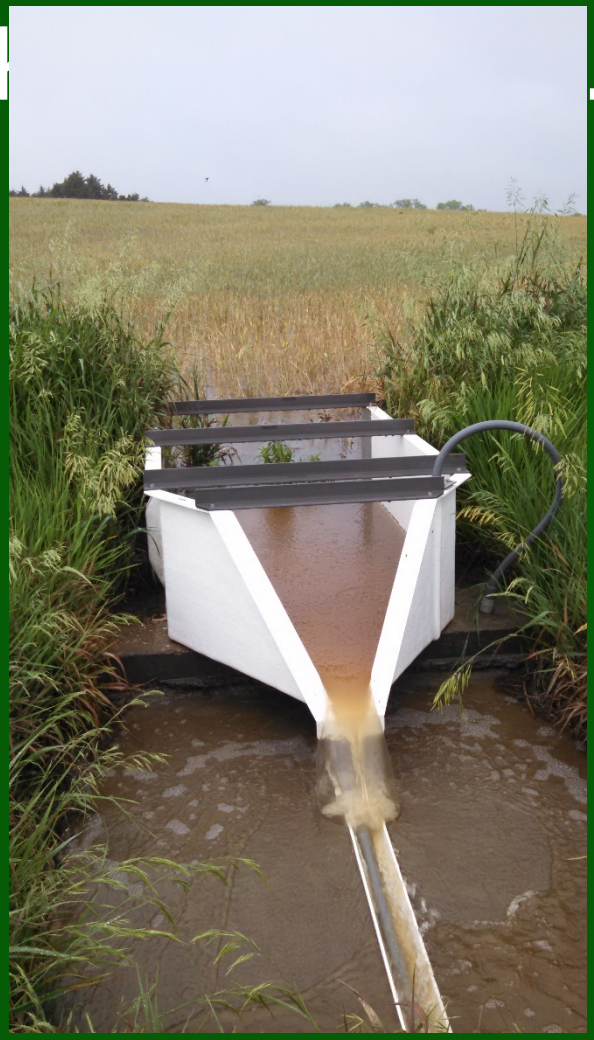
- Limited to surface broadcast applications of nitrogen for immobilization and urea-based forms for volatilization
  - Subsurface banding to place nitrogen below residue limit immobilization
  - Broadcasting nitrogen when temperatures are low and precipitation is imminent to limit volatilization

What about P and K?

- Cover crops can take up P and K and return to the upper soil layer (increase root access to the next crop?).

- Cover crop

+ Cover crop



N. Nelson, 2017

Should I fertilize my cover crops?

- Fertilizer application (N, P, K) can increase cover crop biomass production:
  - Response will vary by specie.
  - More biomass (grazing and soil cover).
- Can be an opportunity for nutrient application for the rotation.
- Decisions should be made based on soil test information.

Nutrients are cycled, but is there any net gain in available levels?

- Nutrient uptake reduces available soil levels by uptake, but then replenishes them as the biomass decomposes.
- For an increase in available nutrient levels in the soil there must be a net gain, not just cycling.
- Deep rooting crops bring nutrients from the subsoil to the surface.

Summary

- Cover crops provide a mechanism for:
  - Recovering residual nutrients
  - Cycling nutrients in the surface soil
  - Moving nutrients from the subsoil to the surface soil.

- With adequate soil nutrient levels adding supplemental fertilizer to cover crops may provide limited benefit.

Ongoing project – corn and soybean 2017-2018

- Evaluation of Soil Health Test to Determine Fertilizer Needs
  - Corn
  - Soybean
- Multi-location
- Different management system

Soil Sampling Depth

- Immobile nutrients accumulate in the top few inches of soil. Their availability should be measured using a 0 to 6” surface soil sample.
  - Shallower samples give high test results, over estimate nutrient supply, and under estimate fertilizer needs.
  - Deeper samples give low test results, under estimate nutrient supply and over estimate fertilizer needs.

Effect of tillage on soil test levels

depth	plow		chisel		no-till	
	P	K	P	K	P	K
	ppm					
0-4	30	191	43	242	49	270
4-8	28	188	31	178	35	197
8-12	22	189	13	162	19	185

Exceptions to the normal 0-6” Sampling Depth for pH and Lime Recommendations:

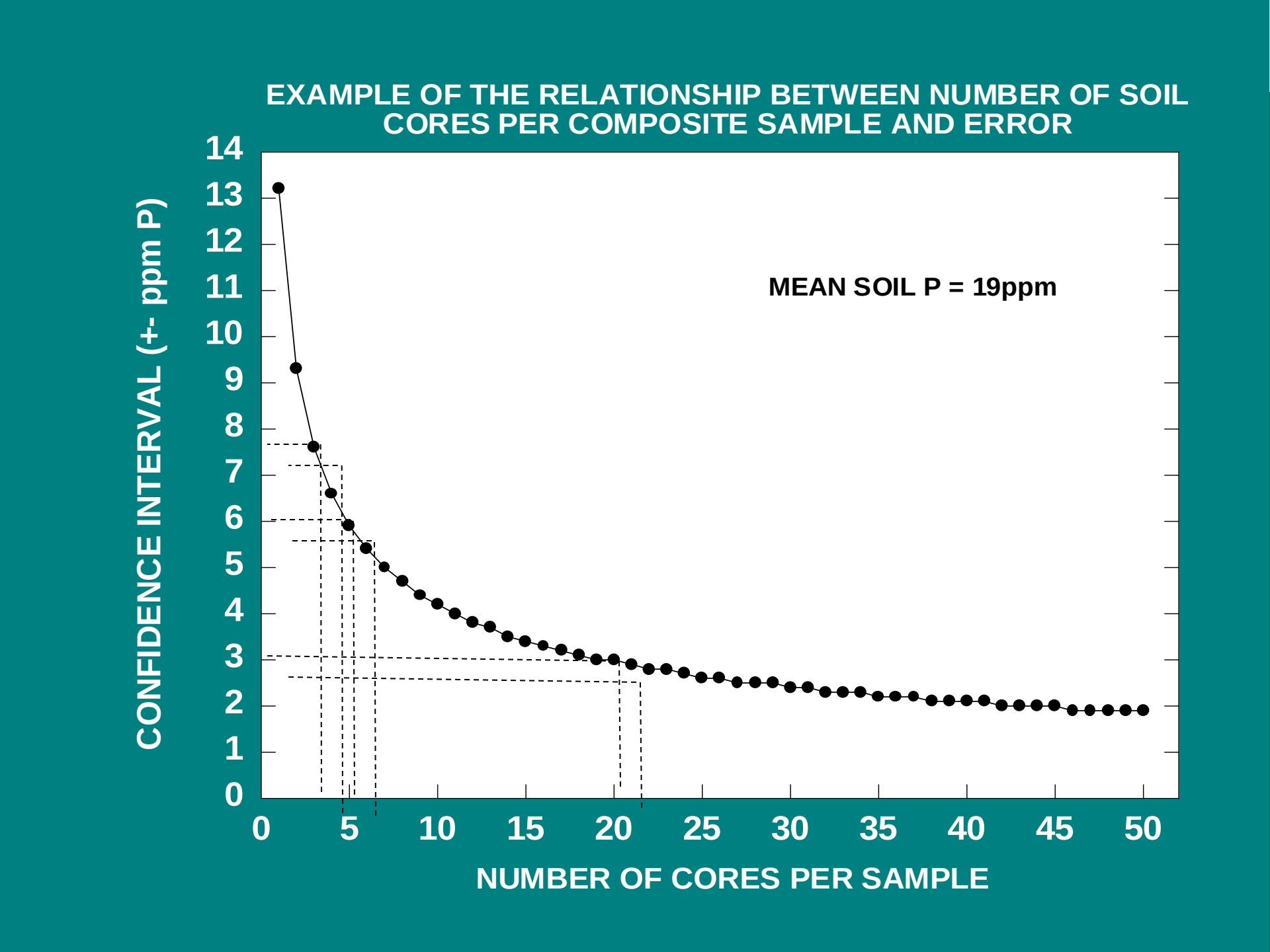
- In continuous no-till, pH and lime requirement should be measured using a 0-3” surface sample, unless you plan to incorporate lime with a plow.
- Perennial forage crops, pH and lime recommendations should be made from a 0-3” surface sample, unless you plan to incorporate lime with a plow.

Sampling Depths for Mobile Nutrients

- While P and K are relatively immobile in soils and accumulate in the surface few inches, Nitrate-N, Sulfur (S) and Chloride (Cl) are mobile and move through the soil profile.
- We recommend a 24” Profile Soil Sample to test for mobile nutrients such as nitrate-N in the soil. 10-15 cores are still needed to give a high quality sample
- I have taken the samples and know it is very hard work, so we only recommend profile testing to make N recommendations for corn, milo, cotton, canola and wheat, or for required environmental monitoring.

Number of Cores to Make a Good Sample

- Soils vary across very short distances in nutrient supply due to many factors including:
  - Position on the landscape
  - Past erosion
  - Parent material of the soil
  - Previous manure and fertilizer applications, including “Cow Pie Mosaic”
- To account for that variation you should take 20-30 surface cores and 10-20 subsoil per sample


EXAMPLE OF THE RELATIONSHIP BETWEEN NUMBER OF SOIL CORES PER COMPOSITE SAMPLE AND ERROR
MEAN SOIL P = 19ppm
CONFIDENCE INTERVAL (+- ppm P)
NUMBER OF CORES PER SAMPLE
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0
5
10
15
20
25
30
35
40
45
50

When to Take Soil Samples

- P, K, Zn and lime always the same time.
- Focus on times when soil conditions are good, long enough before planting to really use the information.
- Be consistent.
- Late fall, winter and early spring-November through March are good.

When to take soil samples?

- For N, S and Cl
- Summer crops: after harvest in the fall, but before the soil warms in the spring. (corn, grain sorghum and sunflowers)
- Fall crops: before planting in the fall.
  - Spring or winter samples to predict topdress N needs don't work real well. (wheat)

Handling samples before sending to lab

- Avoid contamination with dirty buckets, galvanized buckets, etc.
- Never oven dry soil samples! High temperatures can alter test results, especially K.
- Critical for nitrate-N samples to air dry if the sample won't be shipped for a few days.

Consider the accuracy and reliability of individual soil tests

- What constitutes a good soil test
  - Good relationship between soil test level and yield
  - Accurately predicts nutrient needs
  - Simple
  - Inexpensive
  - Precise
  - Reproducible

Reliability, usefulness and cost effective rating for soil test

Test	Scale
Water pH	100
Phosphorus	85
Potassium	80
Organic Matter	75
C.E.C	60
N (profile nitrate)	50
Total N	45
Zn	45
Ca	40
Mg	40
S	40
Molybdenum	0

Ted Peck, 2003

Conclusions: Where should I focus my attention in ST?

- In Kansas the greatest return to fertilization is from N, P, and Zn, but……
  - Sulfur and chloride responses can be seen on cereals
  - Iron chlorosis is also common, but pH and OM may be more useful than the soil test

Conclusion: Be consistent in sampling

- Sample the same areas to develop a good ST history
- Sample the same time of year
- Be careful to sample the same depth
- Use the same lab to ensure the same testing procedures are followed
- Don’t invest more time and money than you really will use

Conclusions

- For immobile nutrients and lime, use a surface 0-6” sample
  - In long-term no-till or forages, 0-3 for pH and lime
- For mobile nutrients use a 0-24” profile sample before planting.
- Take lots of cores
- Be consistent

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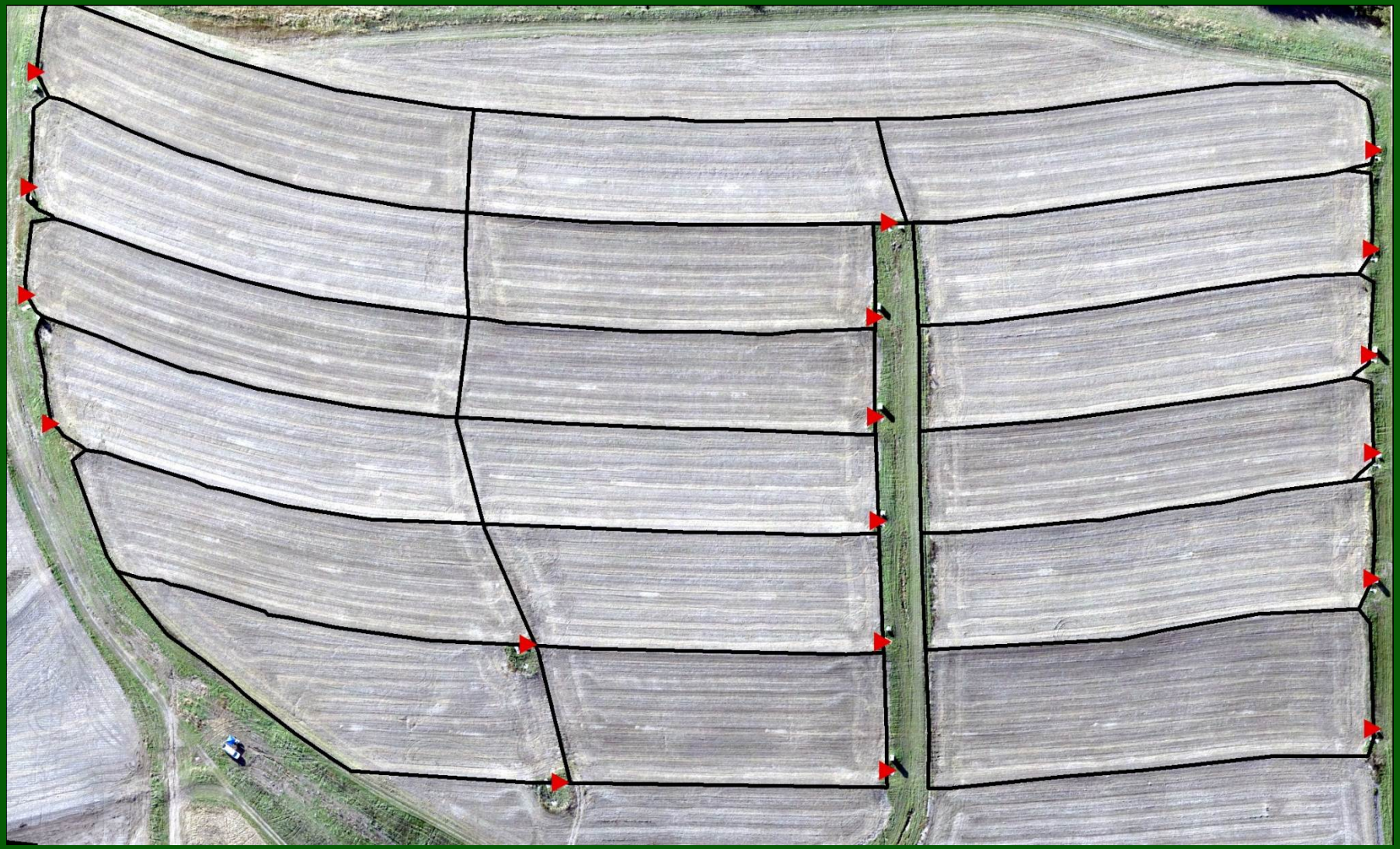
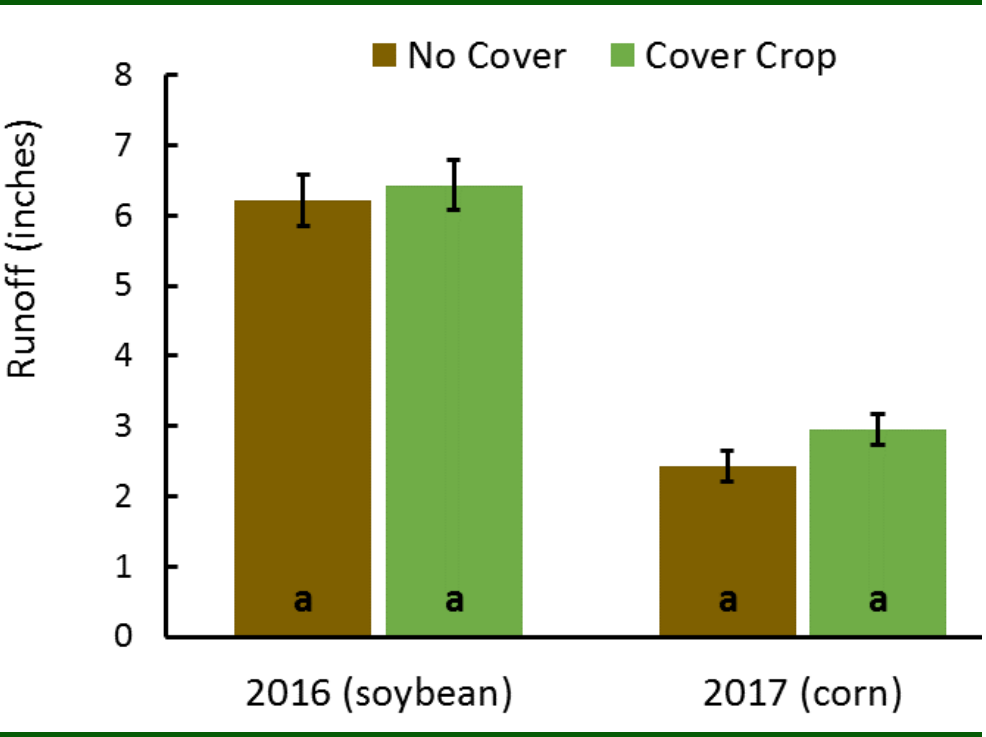
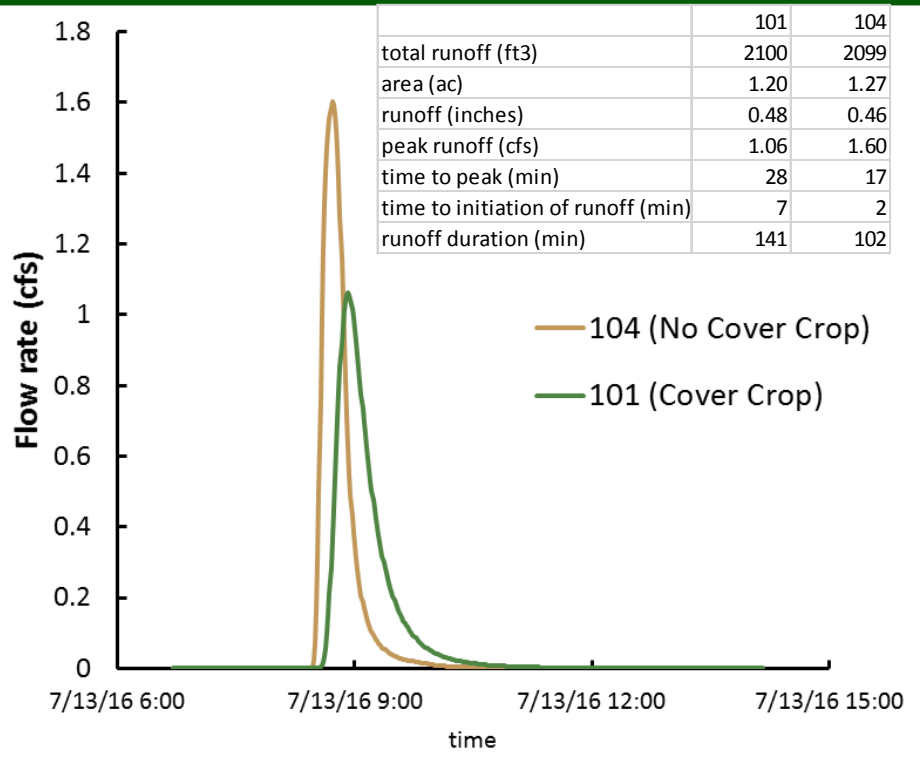


Cover crop effects on runoff



	101	104
total runoff (ft3)	2100	2099
area (ac)	1.20	1.27
runoff (inches)	0.48	0.46
peak runoff (cfs)	1.06	1.60
time to peak (min)	28	17
time to initiation of runoff (min)	7	2
runoff duration (min)	141	102



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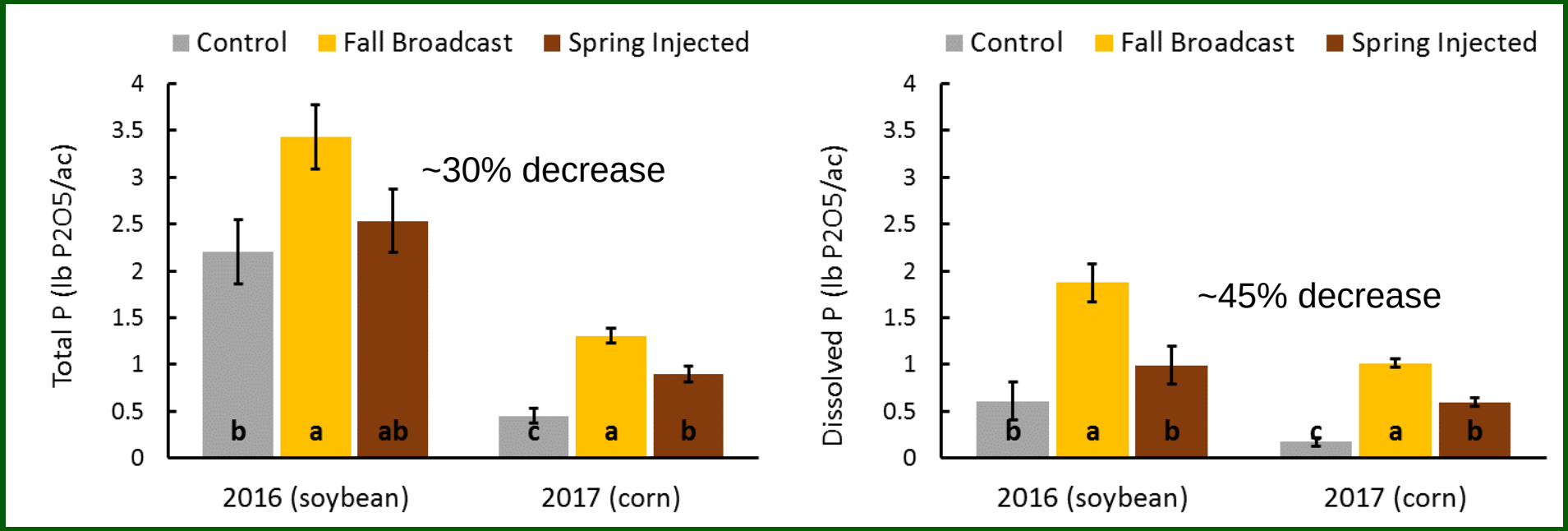
Fertilizer management effects on P loss



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Questions?

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