



4Rs of N and P (Right Source, Rate, Time, Placement)

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4Rs OF NUTRIENT STEWARDSHIP

Economically, Environmentally & Socially
Sustainable Crop Nutrition



The 4Rs promote best management practices (BMPs) to achieve cropping system goals while minimizing field nutrient loss and maximizing crop uptake.

4R Principles of Nutrient Stewardship



RIGHT SOURCE

Matches fertilizer type to crop needs.



RIGHT RATE

Matches amount of fertilizer to crop needs.



RIGHT TIME

Makes nutrients available when crops need them.



RIGHT PLACE

Keeps nutrients where crops can use them.



RIGHT SOURCE

Matches fertilizer type
to crop needs.

Enhanced efficiency fertilizers

- higher value fertilizers
- may be intended for specific areas of a field
- need for equipment to handle multiple sources





RIGHT RATE

Matches amount of
fertilizer to crop needs.

- Equipment with solid calibration
- eliminate double applications
- variable rate applications





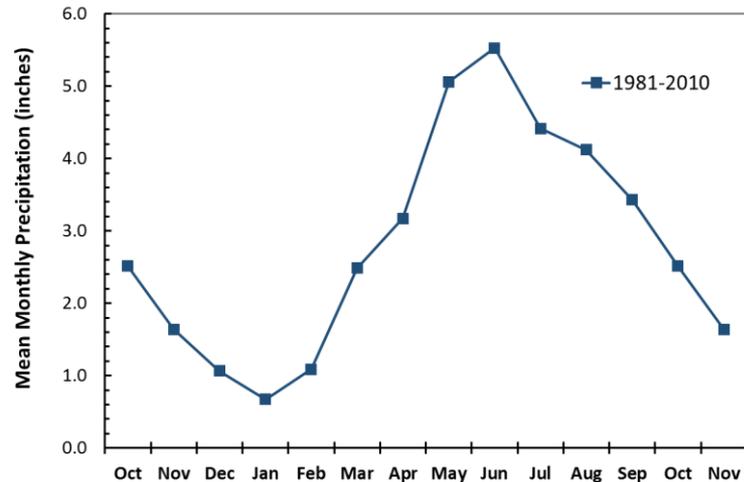
RIGHT TIME

Makes nutrients available
when crops need them.

Apply when the crop needs it

- Split applications
- high clearance

Apply when there is less chance
for loss





RIGHT PLACE

Keeps nutrients where crops can use them.

Location in soil

- sub-surface applications
- seed-placed

Geography

- The right source, time, and rates change over landscapes

Fall surface-broadcast P fertilizer



What management options will reduce P loss?

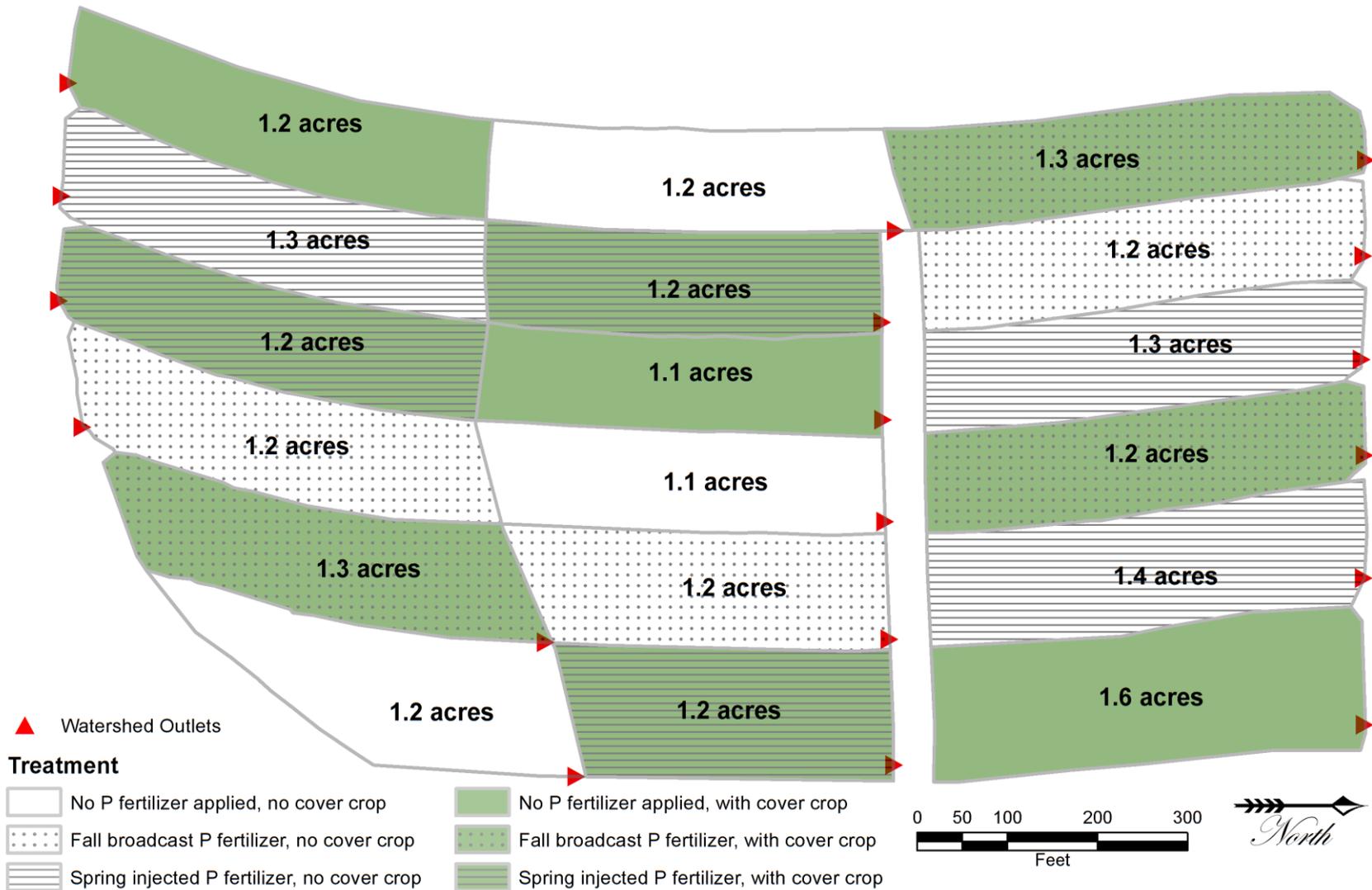
- Can we minimize P loss with surface broadcast fertilizer?
- Will planting a fall cover crop reduce P loss?











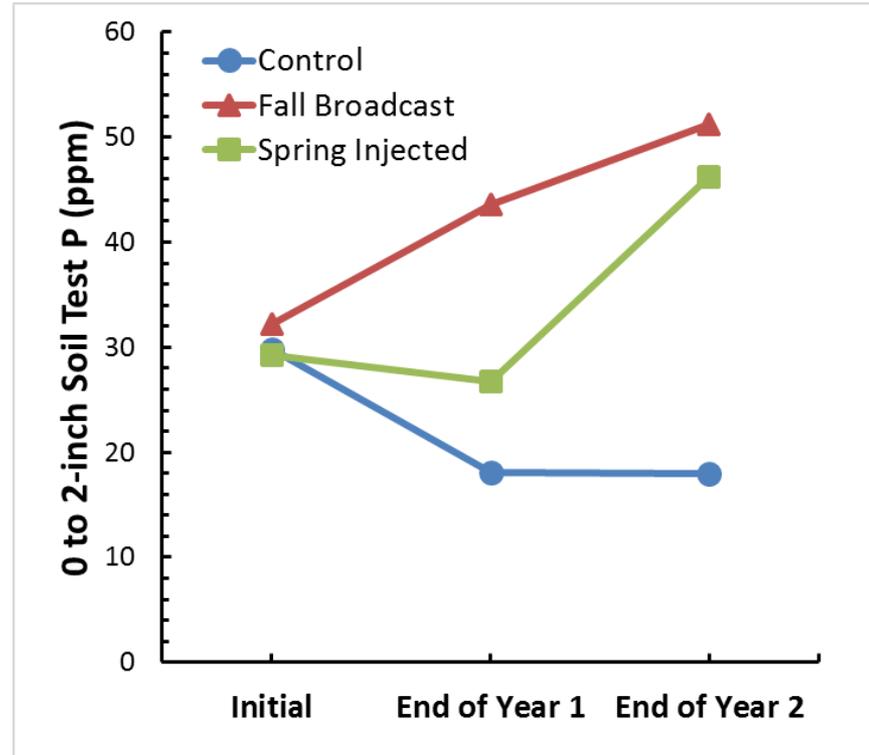
Event-based flow-weighted composite samples

- Runoff
- Sediment
- Total P
- Dissolved P

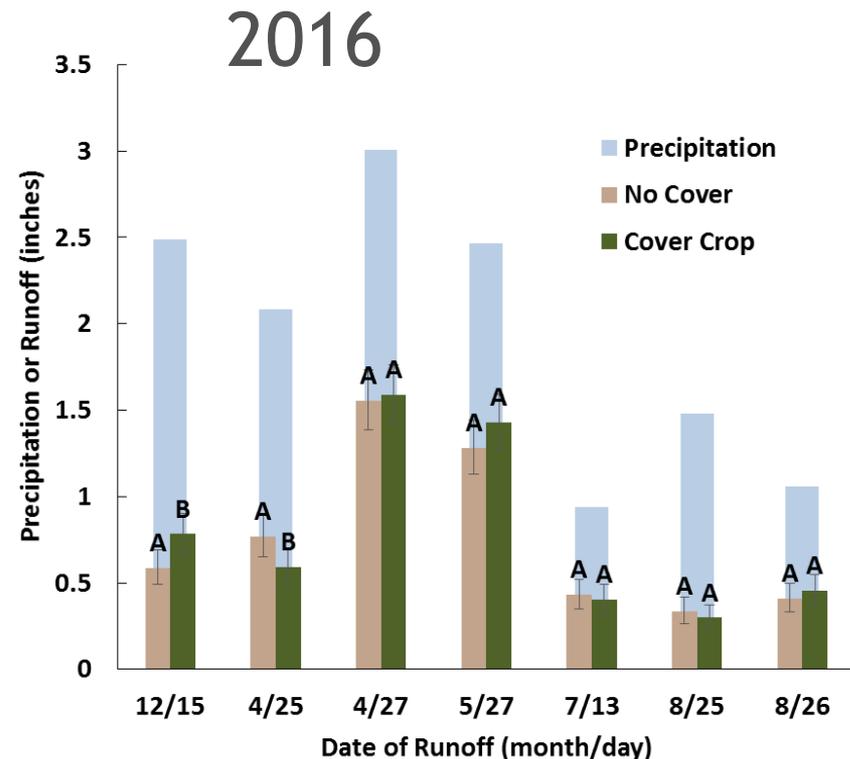
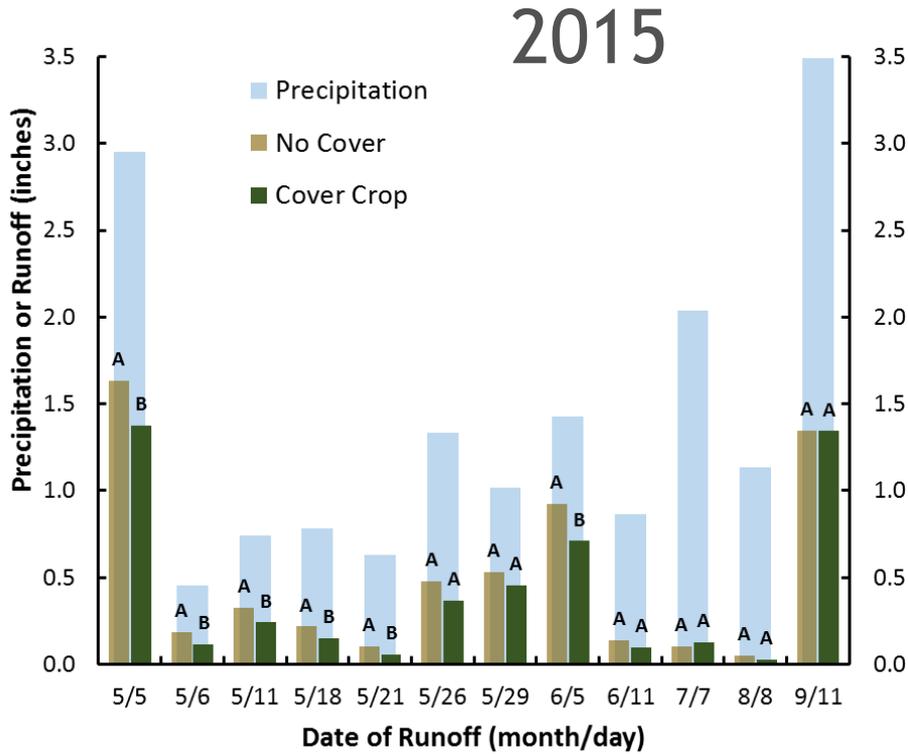


Agricultural systems require time to fully respond to treatments

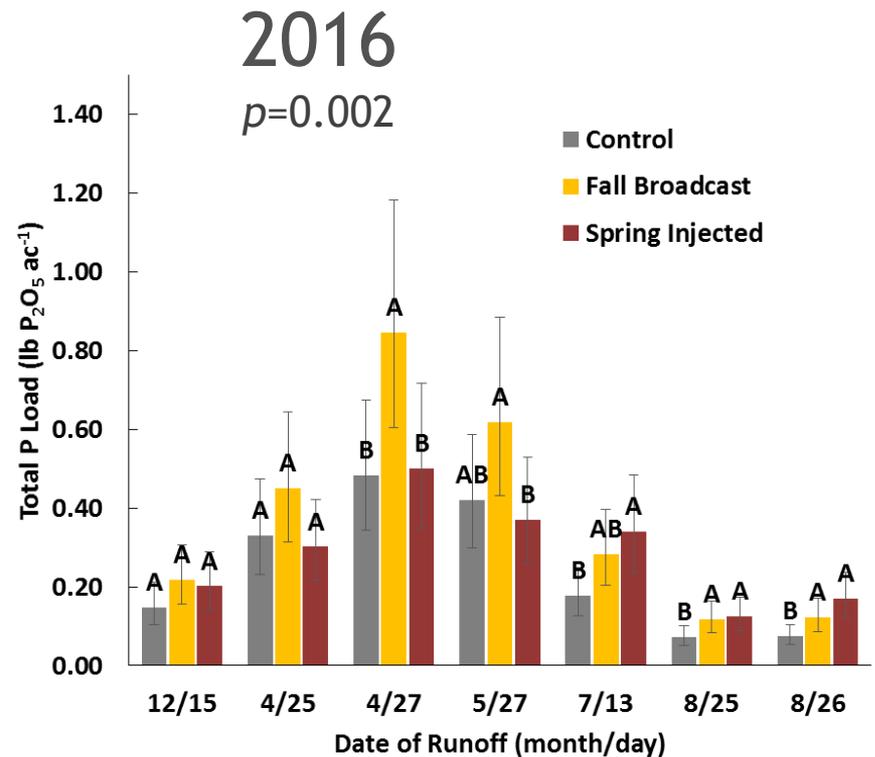
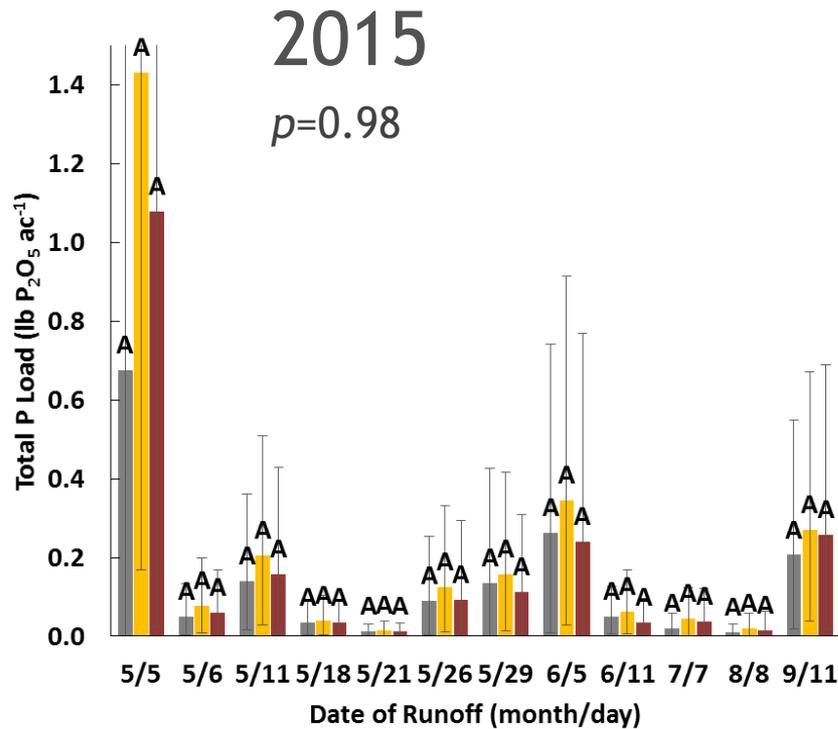
Completed 2 years of a 5-year study



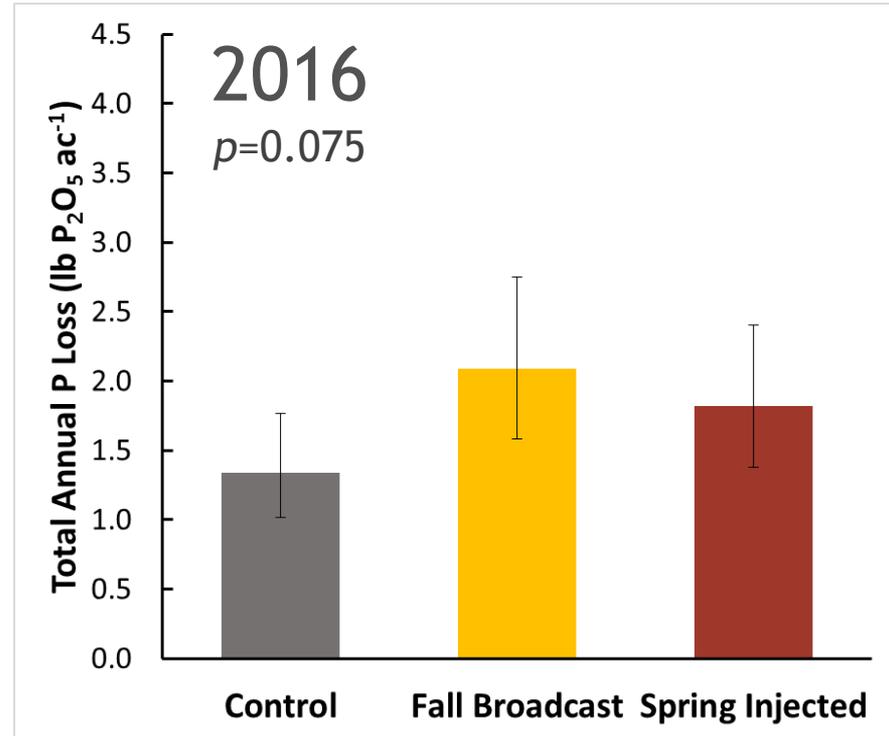
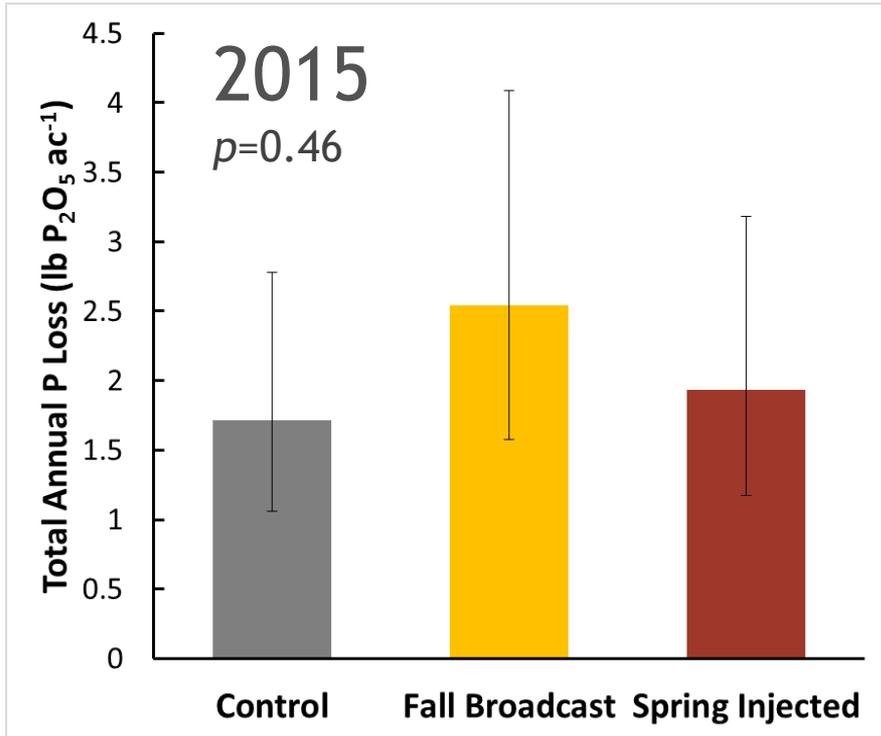
Cover crop impacts on runoff



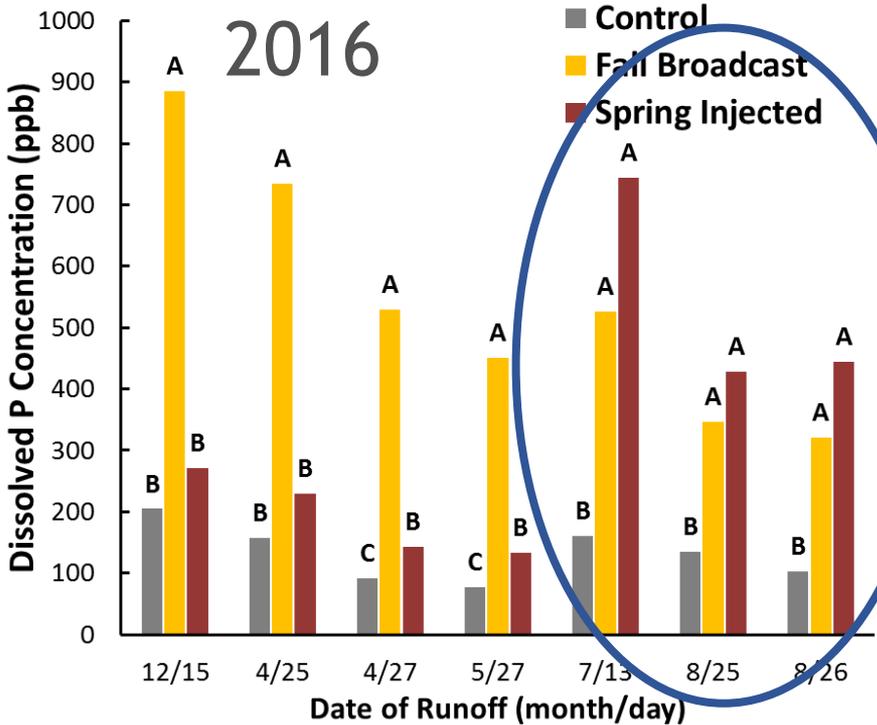
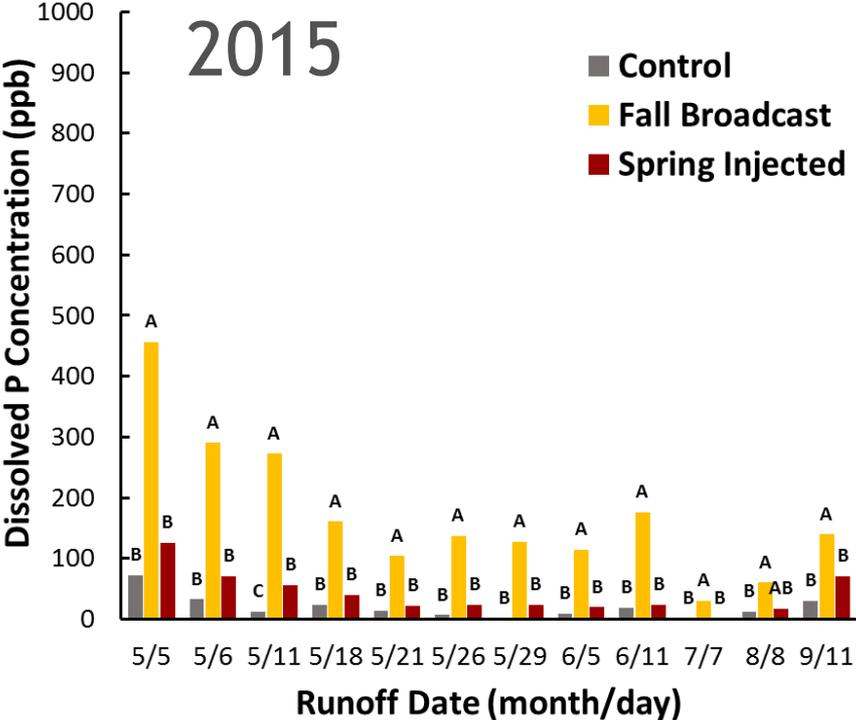
Fertilizer placement effects on total P loss in runoff water



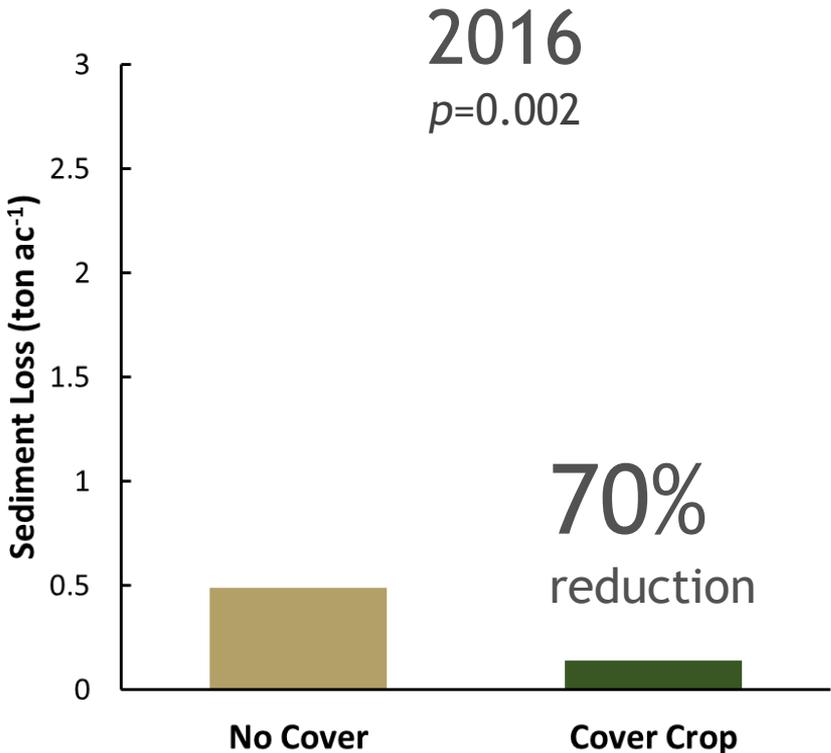
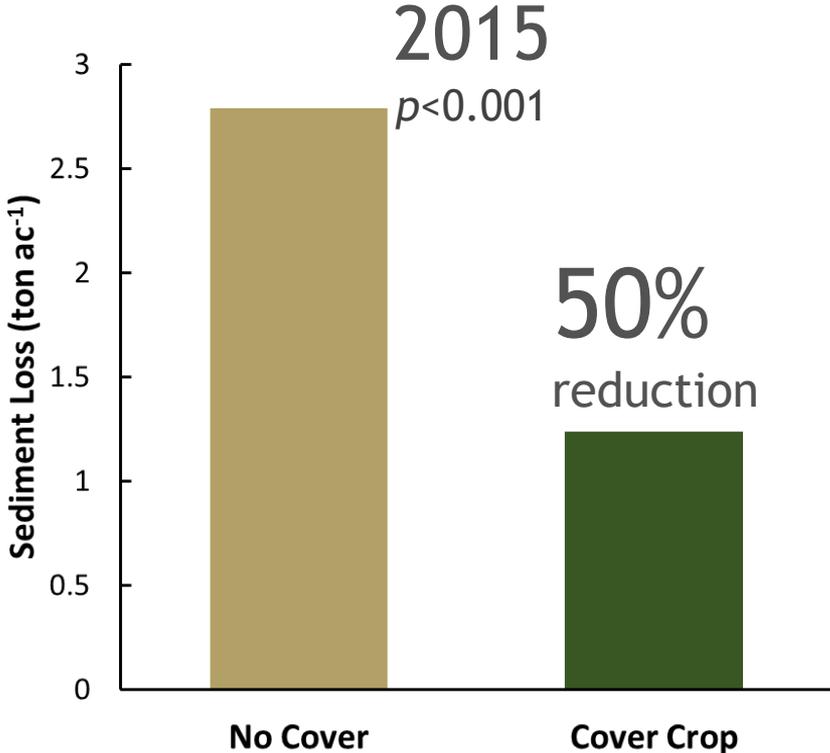
Fertilizer placement effects on total P loss in runoff water



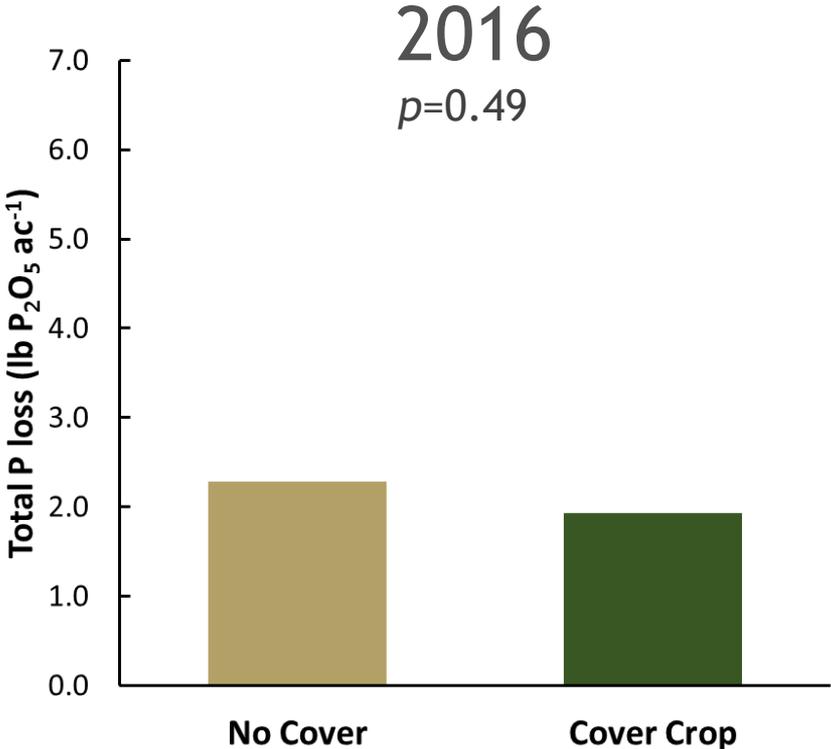
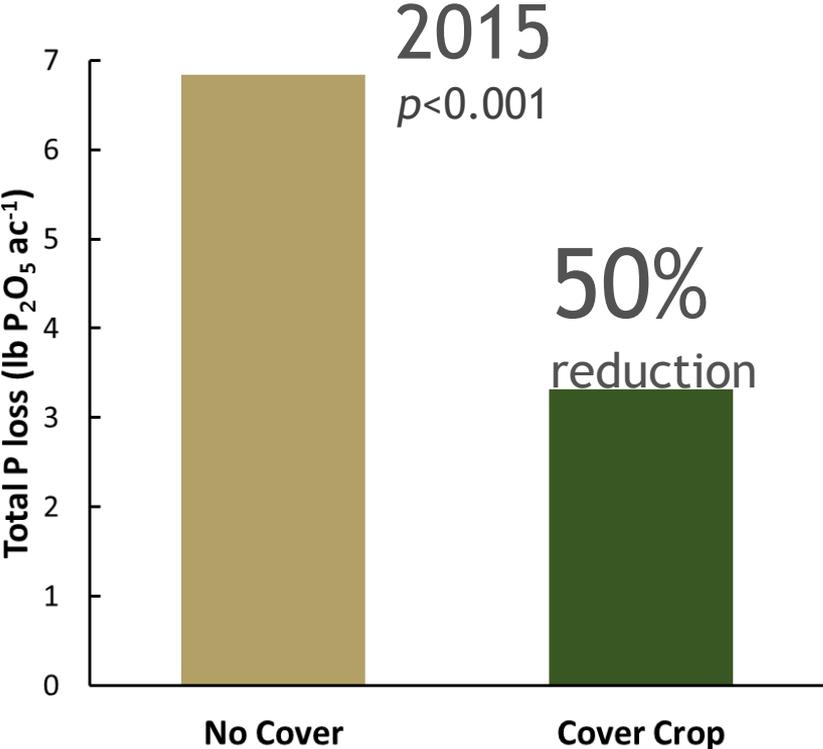
Fertilizer placement effects on dissolved P concentration in runoff water



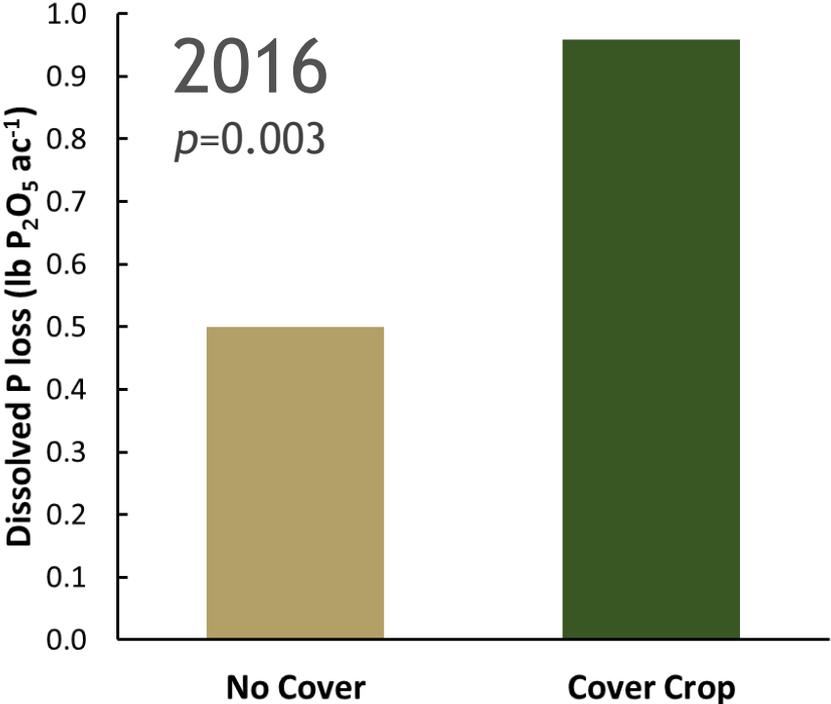
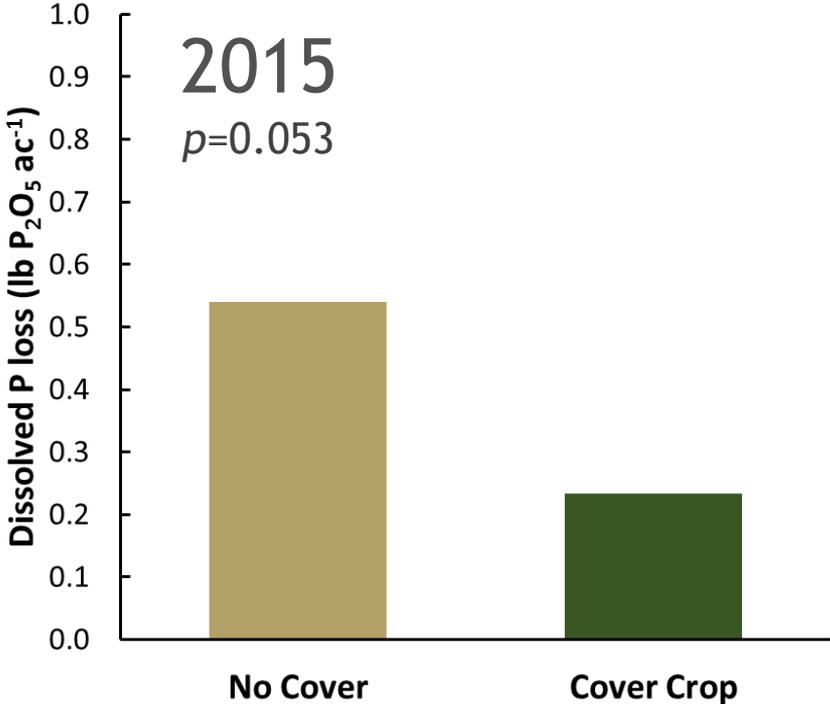
Cover crop effects on sediment loss



Cover crop effects on total P loss



Cover crop effects on dissolved P loss



Summary of Preliminary Data

- Placement had little effect on total P loss
if at the right time
- surface broadcast had higher surface soil test P and higher dissolved P loss.
- Cover crop reduces sediment loss
- Cover crop increases dissolved P loss



Related work - P loss from cover crops

- Species
- Termination methods
- Termination timing
- Fertility



Collaborative efforts: On-Farm Research



Thank you to our funding sources



Research
Fund

KANSAS STATE
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Department of Agronomy



United States Department of Agriculture
Natural Resources Conservation Service



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Questions?

