Impacts of Covers Crops on Phosphorus Loss

R. Elliott Carver, Nathan O. Nelson, Gerard J. Kluitenberg, Kraig L. Roozeboom, and Peter J. Tomlinson

Kansas State University
Department of Agronomy

Background and Justification

Phosphorus (P) loss from non-point agricultural sources is a key contributor to eutrophication and decreased water quality. Cover crops are often touted as a good conservation practice. However, there is limited research about the impact of cover crops on P inputs to surface waters. In particular, there is not enough data to determine the impacts of cover crops on P concentration of surface runoff from natural precipitation events.

Objective

Determine the impacts of cover crops as an agricultural best management practice on the concentration of P in surface runoff from natural precipitation events in a no-tillage corn-soybean rotation

Methods

Field Site

- This study was conducted at the Kansas Agricultural Watershed Field Laboratory (KAW) located near Manhattan, Kansas, from October 1, 2015-Septeberber 30, 2017.
- The KAW contained eighteen 1.2 acre watershed each fitted with a 1.5 ft H-flume and ISCO 6700 or 6712 automated water sampler
- Flow-weighted composite water samples were collected for each runoff event with one 200 mL sample for each 0.02 in of runoff.
- Collected samples were analyzed for total P, ortho-P and total suspended solids (TSS).

Experimental Design

- Treatment structure was a 2x3 complete factorial, arranged in a randomized complete block design with three replicates
  - ➢ Two levels of cover crop management practices:
    - No cover crop
    - Winter cover crop (mix of winter wheat OR triticale plus rapeseed)
  - ➢ Three levels of P fertilizer management practices:
    - Control – 0 kg P/ha
    - Fall Broadcast (FB) – 55 lb P_2O_5/ac
    - Spring Injected (SI) – 55 lb P_2O_5/ac

Cropping System

- No-till corn-soybean rotation
- 2016 – soybeans
- 2017 – corn

Statistical Analysis

- Cover crop effect on total P, dissolved reactive P, and TSS was analyzed with ANOVA by precipitation event using PROC GLMMIX in SAS 9.4 (α =0.05).
- All data required either square root or logarithmic transformation to normalize residuals. Results are presented as back-transformed means.
- Asterisks indicate difference between treatment within an event at $p<0.05$.

Surface runoff from no cover crop (left) and cover crop (right) plots at the KAW for 5/20/17 event.

Results

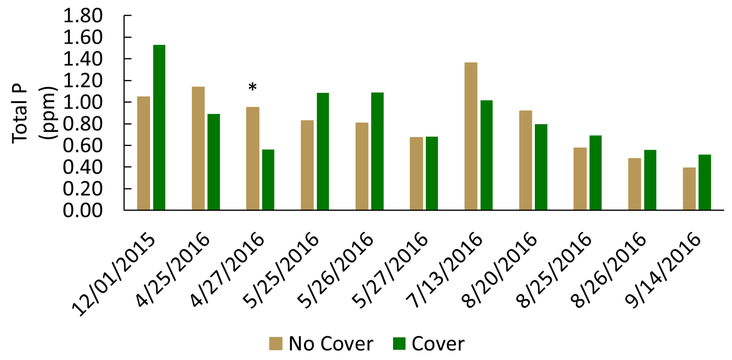


Figure 1. Event by cover interaction for total P concentration of surface runoff f in 2016 cropping year. Asterisk indicates difference between treatment within event at $p<0.05$.

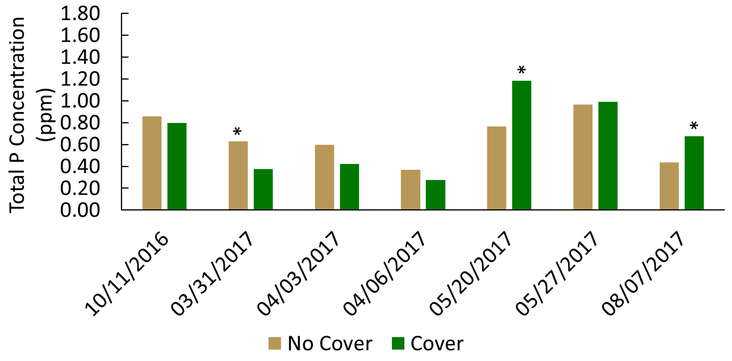


Figure 2. Event by cover interaction for total P concentration of surface runoff in 2017 cropping year. Letters show event by cover interaction at $p<0.05$.

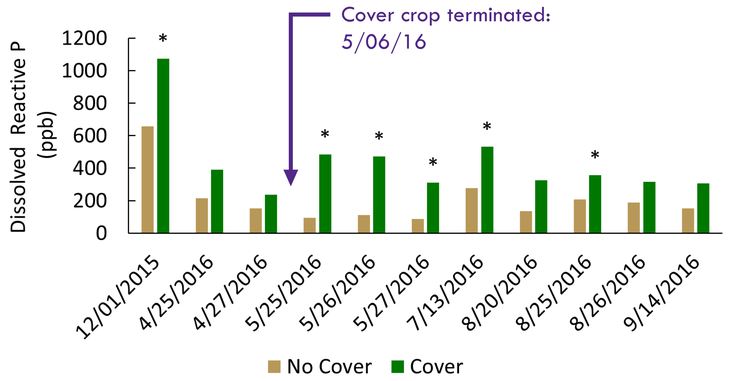


Figure 3. Event by cover interaction for dissolved reactive P concentration of surface runoff for 2016 cropping year. Asterisks indicate difference between treatment within an even at $p<0.05$.

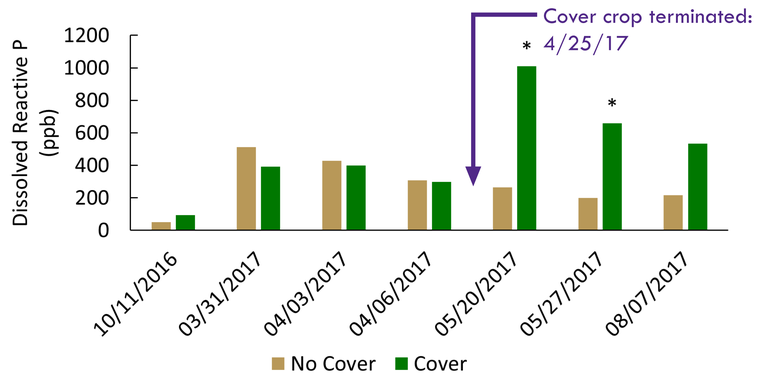


Figure 4. Event by cover interaction for dissolved reactive P concentration of surface runoff from 2017 cropping year. An asterisk indicates difference between treatments within an event at $p<0.05$.

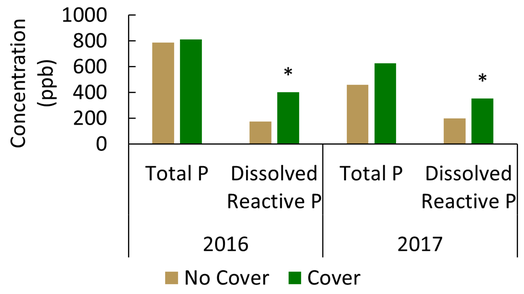


Figure 5. Cover crop effect on both total and dissolved reactive P concentration of surface runoff for both 2016 and 2017 cropping years. Asterisk indicates difference between treatment within category $p<0.05$.

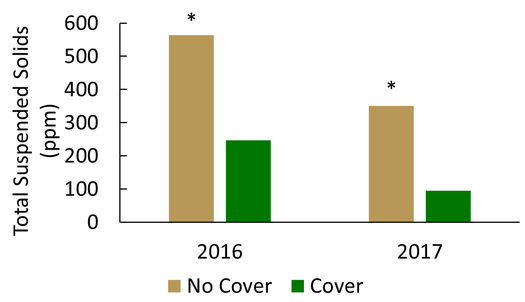
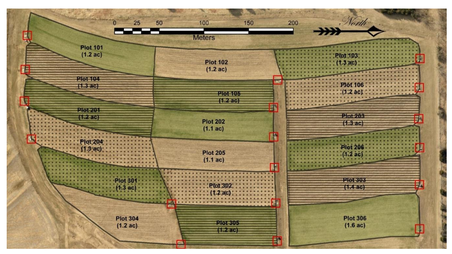


Figure 6. Cover crop effect on TSS concentration of surface runoff for 2016 and 2017 cropping years. Asterisk indicate difference between treatments at $p<0.05$.

Additional Site Description



Site map and location of treatments for KAW.

View from northeast corner of plot 306 at KAW.

H-flume and automated water sampler shelter

Conclusions

Through one cycle of the rotation:

- ➢ Cover crops had an inconsistent effect on total P concentration in runoff, increasing it in some events and decreasing it in others..
- ➢ Cover crops resulted in greater dissolved P concentration in runoff, particularly for events after cover crop termination.
- ➢ Cover crops decreased TSS of surface runoff

Acknowledgements

Research Team: Connor Kijowski, Tara Wilson, Cassandra Schnarr, Laura Starr and Lucian Menezello De Souza
Farm Staff: Dustan Ridder, Russell Dille and Kevin Ascher
Kansas State Soil Testing Lab: Kathy Lowe, Lynn Hargrave and Jacob Thomas

Funding provided by:

4 Research Fund
Kansas Soybean Commission
Kansas Corn Commission
K-State Research and Extension
USDA NRCS U.S. Department of Agriculture Natural Resources Conservation Service