

Minimizing Phosphorus Loss with 4R Stewardship and Cover Crops

Nelson, N.O., K.L. Roozeboom, P. Tomlinson, P.L. Barnes, J.R. Williams, and G.J. Kluitenberg

Project dates: October 2014 to September 2019

Annual Report – February 15, 2015

The overall objective of this research is to determine how interactions between cover crops and P fertilizer management impact P loss, P use efficiency, crop yield, and net return. We have established a replicated small watershed study to achieve this objective. The study site is at the Kansas Agricultural Watershed (KAW) Field Laboratory near Manhattan, KS. The KAW field lab consists of 18 small watersheds (1.2 to 1.5 ac in size) equipped with automated runoff monitoring equipment. The following treatments have been applied to the watersheds (replicated 3 times):

1. No P fertilizer applied, no cover crop
2. No P fertilizer applied, with cover crop
3. Fall broadcast P fertilizer, no cover crop
4. Fall broadcast P fertilizer, with cover crop
5. Spring injected P fertilizer, no cover crop
6. Spring injected P fertilizer, with cover crop

The KAW field lab was established during the summer and fall of 2014 and the treatments were initiated in November of 2014. We have had 3.27 inches of precipitation since treatment initiation, however, there has not been any runoff since treatment initiation. This is as expected because winter precipitation is generally low intensity. Because we have not collected any data since treatments were applied, this progress report will focus on describing the site establishment and field activities up to date.

Site Establishment

During July and August we reconstructed terraces, re-graded terrace channels, constructed a new waterway, and installed pipe outlets to segment the research site into 18 small watersheds ranging from 1.2 to 1.5 ac in size (Figures 1 to 3). From August through November, the outlet of each watershed was equipped with a 1.5 ft. H-flume permanently mounted on a concrete pad equipped with an ISCO 6712 automated water sampler, bubble-type pressure transducer, data logger, batteries, and solar panel for continuous measurement of runoff and automated collection of water samples (Figures 4 and 5). Although the majority of the instrumentation was installed by early November, due to complications, the last two watershed outlets were not fully instrumented until mid-December.



Figure 1. Reconstructed terrace to assure water flow in the correct direction (July 24, 2014).



Figure 2. Waterway construction (July 18, 2014).



Figure 3. Installation of pipe outlets (Aug. 29, 2014).



Figure 4. Outlet of watershed 102 looking down the new waterway (outlets of watersheds 105, 202, 205, 302, and 305 in the distance). Taken Feb. 10, 2015.



Figure 5. Outlet of watershed 101 (Feb. 10, 2014).

Preliminary Data and Field Preparations

Three composite soil samples were collected at 0-5 and 5-15 cm depths from each watershed during the end of October and analyzed to establish initial soil chemical properties (Table 1). Because soil pH of individual plots ranged from 5.8 to 6.3, we applied lime at a rate of 3800 lbs ECC/ac on November 7 to increase pH of all plots to between 6.0 and 6.5. Following lime application, the site was tilled with a chisel followed by disking. The tillage was necessary to incorporate lime and to reduce variability in residue cover and alleviate compaction resulting from the terrace re-grading.

Table 1. Initial soil analysis averaged by treatment for soil pH, SMP buffer ph (BpH), Mehlich 3 P (M3P), extractable K (Ext. K), total N (TN) and total C (TC). Values are depth-weighted averages for the 0-15 cm depth. Samples were taken prior to treatment application and statistical analysis show there are not any treatment effects ($p>0.05$).

Cover Crop trt.	Fertilizer trt.	pH	BpH	M3P	Ext. K	TN	TC
				mg/kg	mg/kg	%	%
No Cover Crop	Control	6.00	6.36	17.7	315	0.139	1.138
	Fall Broadcast	5.99	6.38	16.3	325	0.140	1.134
	Spring Injected	6.09	6.47	15.3	339	0.136	1.057
Cover Crop	Control	6.16	6.43	15.4	322	0.135	1.059
	Fall Broadcast	5.92	6.34	18.7	314	0.140	1.128
	Spring Injected	6.13	6.42	18.2	321	0.143	1.167
	Standard Error	0.09	0.04	1.8	10	0.003	0.040

Initialization of Treatments

The treatments were established according to Figure 6 and a cover crop mix consisting of hairy vetch, rapeseed, and winter wheat was planted in watersheds on November 13, 2014. The planting date was late due to delays caused by late soybean harvest and the time required to apply lime and till the fields. Because of the late planting, we selected cover crop species that can survive the winter and have the potential to add biomass in early spring before corn planting. Considering the late plating, the cover crop germination and emergence is good and the growth we get will depend on weather over the next two months (Figure 7).

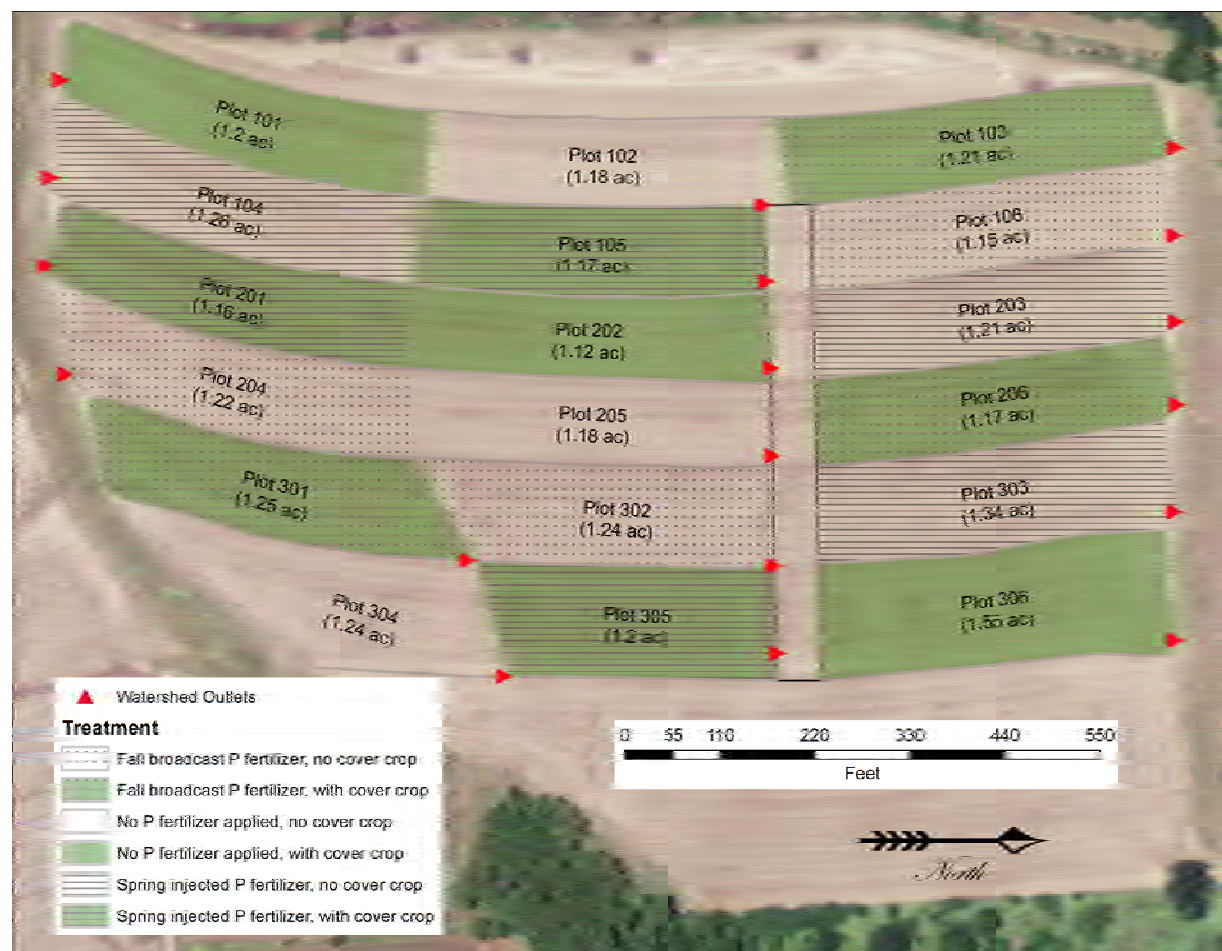


Figure 6. Watershed layout and treatment map.



Figure 7. Cover crop growth near the outlet of watershed 202 on February 10, 2015.

Fertilizer (DAP) was surface broadcast with a barber spreader on treatments 3 and 4 on January 12, 2015. The fertilizer application was delayed until after all watershed outlets were completely instrumented so that we could capture any potential post-application runoff events. The fertilizer was applied to dry ground. The first post-application precipitation was 1.09 inches of rain that fell on non-frozen ground from January 30 to February 1 (18 d after application) without any runoff generated.

Plans for the 2015 Growing Season

Corn will be planted following cover crop termination in April, at which time the remaining fertilizer treatments will be applied. We acknowledge that this first year of the study is a transition year as we convert the field from past management of a continuous-till wheat-soybean rotation to a no-till corn-soybean rotation. Data from this year may be influenced by this conversion process, as well as the delayed cover crop planting and fertilizer application, and it may need to be analyzed separate from subsequent years. Furthermore, we acknowledge that the first year of water quality study like this generally has greater than average equipment errors. We have made plans to double check field equipment, download data more frequently, and make frequent field visits during the first year to reduce the possibility of missing data.

Cover crop biomass and nutrient uptake will be measured at the time of termination. Corn growth will be monitored throughout the 2015 growing season. The corn biomass will be measured at maturity

along with grain yield, nutrient uptake, and nutrient removal. The second year of the study will begin following corn harvest when cover crops will be direct seeded into corn residue.