Water Quality Evaluation of Integrating Strips of Native Prairie Into Rowcrop Agriculture Fields

Chris Witte—assistant scientist, agricultural and biosystems engineering

Matt Helmers—professor, agricultural and biosystems engineering

Lisa Schulte-Moore—professor, natural resource ecology and management

Matt Liebman—professor, agronomy

Tim Youngquist—agricultural specialist II, agronomy

Tallgrass prairie once covered more than 85% of the total land area of the state of Iowa. Currently, less than .01% of that original ground cover remains. The remnant prairies largely exist in small blocks along railroad right-of-ways, cemetery edges, and other marginal locations. Prairie is a diverse ecosystem consisting of grasses, legumes, sedges, and non-legume forbs. In addition to the plant communities, prairie provides habitat for a wide range of native birds, mammals, and beneficial insects. STRIPS (Science-based Trials of Rowcrops Integrated with Prairie Strips) seeks to integrate conservation and rowcrop production and to use science to understand the effects prairie has on the surrounding cropland. The objectives of this study were to evaluate the water quality benefits provided by prairie strips.

Materials and Methods

The experiment was set up at the Iowa State University McNay farm, Chariton, Iowa, as a paired comparison trial in November 2015. A treatment field was selected as a location for the prairie strips. A control field, with similar land characteristics, same crop, and same management conditions also was chosen (Figure 1). The proliferation of species in a native prairie includes in the hundreds of species. Due to availability, cost, and practicality, this experiment seeks to mimic the natural system, rather than recreate it. A mix of 45 native prairie species were seeded. A seed drill was used to directly seed the native species into the field stubble on June 18, 2014.

A nurse crop of winter rye was seeded with the prairie species to provide faster, more substantial growth in the strips and reduce competition from noxious weeds. The seed drilling was hired and operated by a local prairie seed dealer. Following the seeding, instrumentation to measure surface runoff was installed in 2016 with monitoring beginning in 2017. The largest piece of equipment on site is the Hydrologic flume (H-flume). The H-flume was installed at the base of the watershed where flow of water is concentrated, and therefore, more easily measured and collected for nutrient and sediment analyses via autosampler (Figure 2). Collected water samples are analyzed for concentrations of total suspended solids, total nitrogen, total phosphorus, nitrates/nitrites, and orthophosphorus. Based on the size of the monitored drainage area, the exported load of each analyte is estimated.

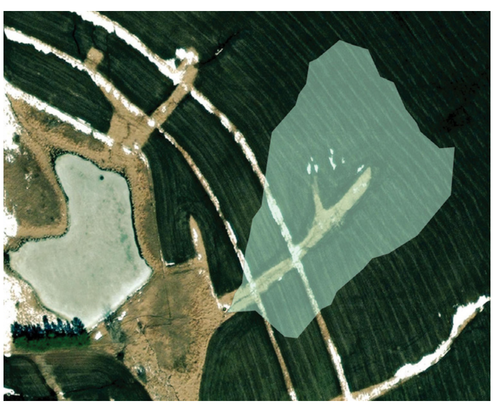

Figure 1: Monitored prairie strips site at the McNay research farm. The green highlighted area shows the contributing watershed being monitored for runoff.

Figure 2: Flume structure for monitoring runoff.

Results and Discussion

Rain and surface runoff. For the last six years, rainfall during the monitoring season (approximately beginning of April to end of October) has ranged from 9.9 to 39.8 in. (Table 1). Much of this rainfall, however, has not been intense enough to cause runoff from the monitored fields. Surface runoff from the control field has ranged from 0.02 to 2.78 in., while the treatment field has ranged from 0.34 to 4.8 in. There have been some issues with monitoring the control watershed (monitored field without prairie strips), as runoff was being diverted out of the grassed waterway, thus bypassing the monitoring equipment. Therefore, runoff estimates are less than what really occurred at this field. This issue was addressed during the 2021 season, and researchers believe the waterway is functioning properly now. Also, the treatment watershed does have a side-slope seep, which likely has contributed to an inflated estimate of runoff from this field.

Nutrient and sediment export. Due to the missed measured surface water runoff, the estimates of exported nutrients and total suspended solids from the control watershed also are low (Table 1). Therefore, confidence in these numbers from the control watershed are low, but are being listed for the sake of the report. Note that starting in 2021 the runoff has been greater in the control than the treatment watershed. Researchers believe this is the result of having repaired the control waterway. In addition, 2022 was the first complete monitoring season with the repaired waterway, when greater nutrient and sediment exports in the control watershed were recorded than in the treatment. This is what might be expected if prairie strips were affecting surface runoff water quality.

Acknowledgements

These sources should be acknowledged for helping to establish and maintain the experiment: USDA Farm Service Agency (AG-3151-P-14-0162), Iowa Department of Agriculture and Land Stewardship Division of Soil Conservation, Iowa Nutrient Research Center, and the US Forest Service Northern Research Station.

Table 1: End of monitoring season totals for rain and surface runoff (inches), as well as nutrient and sediment export (pounds/acre) from the field with (treatment) and without (control) prairie strips.

Year	Rain, inches	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
2017	13.3	1.18	1.77	2.20	5.31	3.18	5.55	0.14	0.05	0.41	0.18	192.33	66.26
2018	23.1	2.65	4.80	0.07	0.26	0.46	1.06	0.13	0.13	0.22	0.35	41.60	103.43
2019	22.0	0.72	4.15	0.80	3.03	1.40	4.28	0.10	0.28	0.24	0.62	122.92	304.78
2020	12.7	0.02	2.05	0.00	0.15	0.00	0.70	0.00	0.05	0.00	0.17	0.38	109.11
2021	39.8	2.78	2.07	0.92	1.00	1.36	1.54	0.13	0.06	0.18	0.09	19.72	24.15
2022	9.9	1.96	0.34	0.02	0.01	0.49	0.20	0.02	0.01	0.09	0.03	29.68	14.38