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

RFR-A2099

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Introduction

Tallgrass prairie once covered more than 85 percent of the total land area of the state of Iowa. Currently less than 0.01 percent 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. The STRIPS project (Science-based Trials of Rowcrops Integrated with Prairie Strips) seeks to integrate conservation with rowcrop production and to use science to understand the effects prairie has on the surrounding cropland. The objective of this study was to evaluate the potential water quality benefits provided by prairie strips.

Materials and Methods

The experiment was set up at the ISU Armstrong Research Farm, Lewis, Iowa, as a paired comparison trial in November 2014. 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 nearby (Figure 1). Hundreds of plant and animal species can be present in native prairies. Due to availability, cost, and practicality, this experiment sought to mimic the natural system, rather than recreate it. A mix of 40 native prairie plant species was seeded. A seed drill was used to directly plant the native species into the field stubble November 11, 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 drill was operated by the Armstrong Farm staff. Following the seeding, instrumentation to measure surface runoff was installed. The largest pieces of equipment on site are the Hydrologic flumes (H-flume). H-flumes were installed at the base of each watershed where flow of water is concentrated and therefore more easily measured and collected for nutrient and sediment analyses via autosamplers (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 areas, the exported load of each analyte was estimated.

Results and Discussion

Rain and surface runoff. For the last five years, rainfall during the monitoring season (approximately beginning of April to end of October) has ranged from 9.9 to 28.8 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 0.17 to 1.12 in./year, and the treatment field has ranged from 0.05 to 0.13 in./year.

Nutrient and sediment export. Mostly due to the low amount of surface water runoff, the estimates of nutrients and total suspended solids also are relatively low (Table 1). In fact, neither the control or treatment fields in 2020 experienced runoff great enough to collect a water sample for nutrient and total suspended solids analyses (the NAs in Table 1). Overall, the treatment field with prairie strips had less runoff and sediment loss.

Acknowledgements

The following sources are acknowledged for helping to establish and maintain the experiment: Foundation for Food and Agriculture Research (CA18-SS-0000000278); USDA National Institute of Food and Agriculture (2015-67019-23002); USDA Farm Service Agency (AG-3151-P-14-0162, 12315118P0194, 19CPT0010516); Iowa Department of Agriculture and Land Stewardship Division of Soil Conservation; Iowa Nutrient Research Center; and the United States Forest Service Northern Research Station.

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

		Runoff (in.)		Nitrate-N (lb/ac)		Orthophosphate (lb/ac)		Total suspended solids (lb/ac)	
Year	**Rain (in.)**	**Control**	**Treatment**	**Control**	**Treatment**	**Control**	**Treatment**	**Control**	**Treatment**
2016	27.4	1.12	0.05	0.12	0.01	0.03	0	82.20	0.26
2017	24.4	0.67	0.06	0.21	0.00	0.02	0	52.53	0.24
2018	26.5	0.25	0.07	0.00	NA	0.01	NA	0.74	NA
2019	28.8	0.34	0.13	0.02	0.01	0.02	0	38.11	0.58
2020	9.9	0.17	0.06	NA	NA	NA	NA	NA	NA

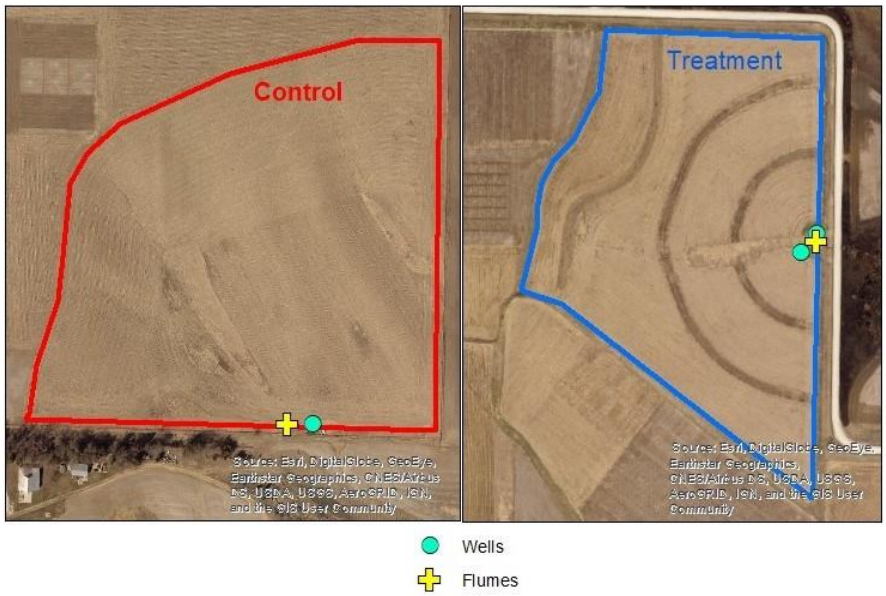

Figure 1. Monitored sites at the Armstrong Research Farm, Lewis, Iowa.

Figure 2. Flume structure at the control site, Armstrong Research Farm, Lewis, Iowa.