MONITORING NUTRIENT RUNOFF FROM COTTON ON THE ARKANSAS COTTON DISCOVERY FARM

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Introduction

Arkansas cotton farmers are under increasing pressure to operate with environmental sustainability. To help agricultural producers take ownership of documenting environmental impact and water-related sustainability, the University of Arkansas' Division of Agriculture in conjunction with many stakeholder groups launched the Arkansas Discovery Farm (ADF) program in 2011 and established a Cotton Discovery Farm in 2013 on the C.B. Stevens farm in Desha County. This program utilizes a unique approach based on agriculture producers, scientists and natural resource managers working jointly to collect economic and environmental data from real, working farms to better define sustainability issues and find solutions that promote agricultural profitability and natural resource protection.

Within the Mississippi River drainage basin, large–scale, basin-wide, water quality modeling efforts by the United States Geological Service projects agriculture in States along the Mississippi River corridor as the leading source of nitrogen and phosphorus delivery to the Gulf of Mexico where excessive nutrients are thought to be the cause of large hypoxic (waters with low dissolved oxygen) zone within the Gulf. However, little data exists that quantifies edge-of-field losses from agricultural operations and tracks these losses through drainage pathways to streams and rivers. Edge-of-field data is needed to truly determine agriculture's impact on these issues. One objective of this Cotton Discovery Farm was quantify sediment and nutrient losses in runoff generated from precipitation and irrigation

Methods

The Arkansas Discovery Farm is located in Desha County near Rowher, Arkansas on the C.B. Stevens farm. Three cotton fields, Shopcot (22 acres), East Weaver (38 acres) and Homeplace (39 acres), were selected for monitoring the quantity and quality of both inflow (precipitation and irrigation) and outflow (runoff). All three fields were planted to cotton in late May. Stale seed bed with minimum tillage was utilized in the East Weaver and Homeplace fields. However due the residue from the cover crop, the middles in the Shopcot were plowed to ensure that water would move freely down the field. On June 13, nitrogen and phosphorus fertilizer was broadcast at the rates of 20 Lbs./A of N and 27 Lbs./A of P in all fields. On June 17, an additional 89 Lbs./A of N as liquid urea was knifed into the soil along the rows.

At the lower end of each field, automated, runoff water quality monitoring stations were established to: 1) measure runoff flow volume, 2) to collect water quality samples of runoff for water quality analysis and 3) measure precipitation. The ISCO 6712 automated portable water sampler was utilized to interface and integrate all the components of the flow station. Runoff flow volume (discharge) was collected with a trapezoidal flume especially designed to measure flow in agricultural drainage channels. Discharge data were utilized to trigger flow-paced, automated collection of up to 100, 100-ml subsamples which were composited into a single 10 liter sample.

A subsample of the 10 liter sample was collected, processed in the field for preservation and shipped in insulated shipping vessels to keep samples chilled to meet EPA guidelines for prepping and handling samples. Samples were shipped to the University of Arkansas' Water Resources Lab (certified by the Arkansas Department of Environmental Quality) to determine concentration of ortho-Phosphorus, nitrite-nitrate-Nitrogen, total nitrogen, total

phosphorus and total solids according to handling, prepping and analytical methods outlined by EPA (http://www.uark.edu/depts/awrc/pdf_files/Labpreserveamts.pdf., 2014).

Results

Total Nitrogen losses in runoff from each field were very low compared to the nitrogen applied as fertilizer (Table 1 and Figure 1). This study wasn't designed to do a mass balance of nitrogen applied as change in soil nitrogen levels were not measured, however, losses in runoff were compared to the nitrogen applied as a way to put losses in runoff in perspective in terms of management. Nitrogen loss in the shopcot field was an order of magnitude greater than in the other fields. However, much of this nitrogen loss occurred during rainfall events in May before nitrogen was applied in June. Two possible explanations include the facts that a cover crop was established in Shopcot and that cotton followed corn in this field while cotton followed cotton in the other fields. Nitrogen mineralization from the decaying cover crop may have acted as a source of nitrogen during May or residual soil nitrogen left from the previous corn crop may have been a source. Either way, it appeared that very little of the applied N was lost in runoff.

Total phosphorus losses were also very low in runoff (Figures 2). Phosphorus losses were also were very low compared to the phosphorus applied (Table 2).

Table 1. Seasonal Total N loss as compared to N applied.

Field	N-Applied	N Loss	% Loss	Total
Name (Acres)	----------Lbs/A------		%	Lbs
Shopcot (22)	108	11.4	10.5	251
Weaver (38)	108	0.7	0.7	27
Homeplace (39)	108	1.8	1.7	70

Table 2. Seasonal Total Phosphorus loss in runoff compared to Phosphorus applied.

Field	P-Applied	P Loss	% Loss	Total
Name (Acres)	----------Lbs/A------		%	Lbs
Shopcot (22)	27	2.2	8.1	48
Weaver (38)	27	0.5	1.9	19
Homeplace (39)	27	0.8	3.0	31

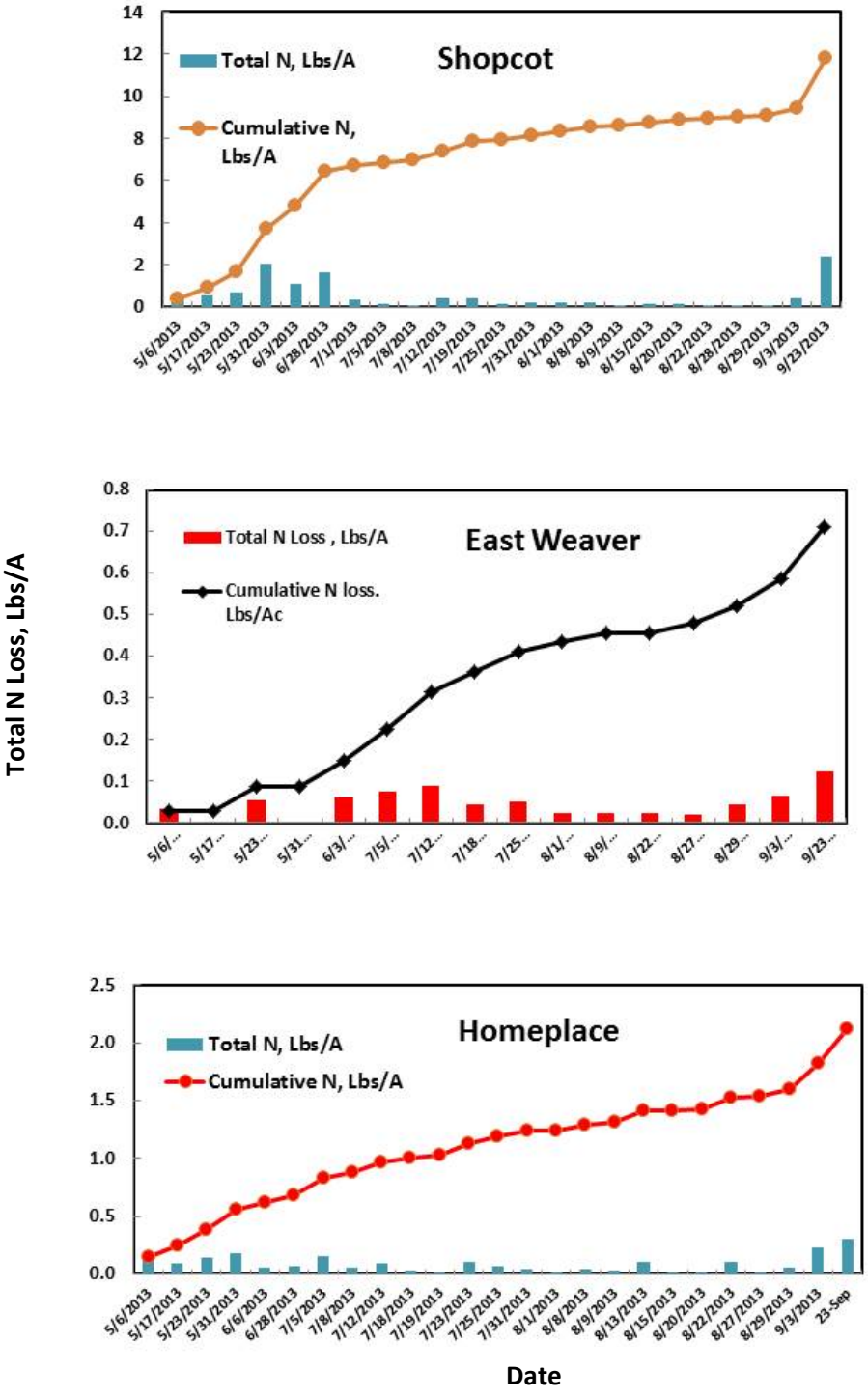

Figure 1. Total nitrogen losses in runoff from three cotton fields during the 2013 growing season.

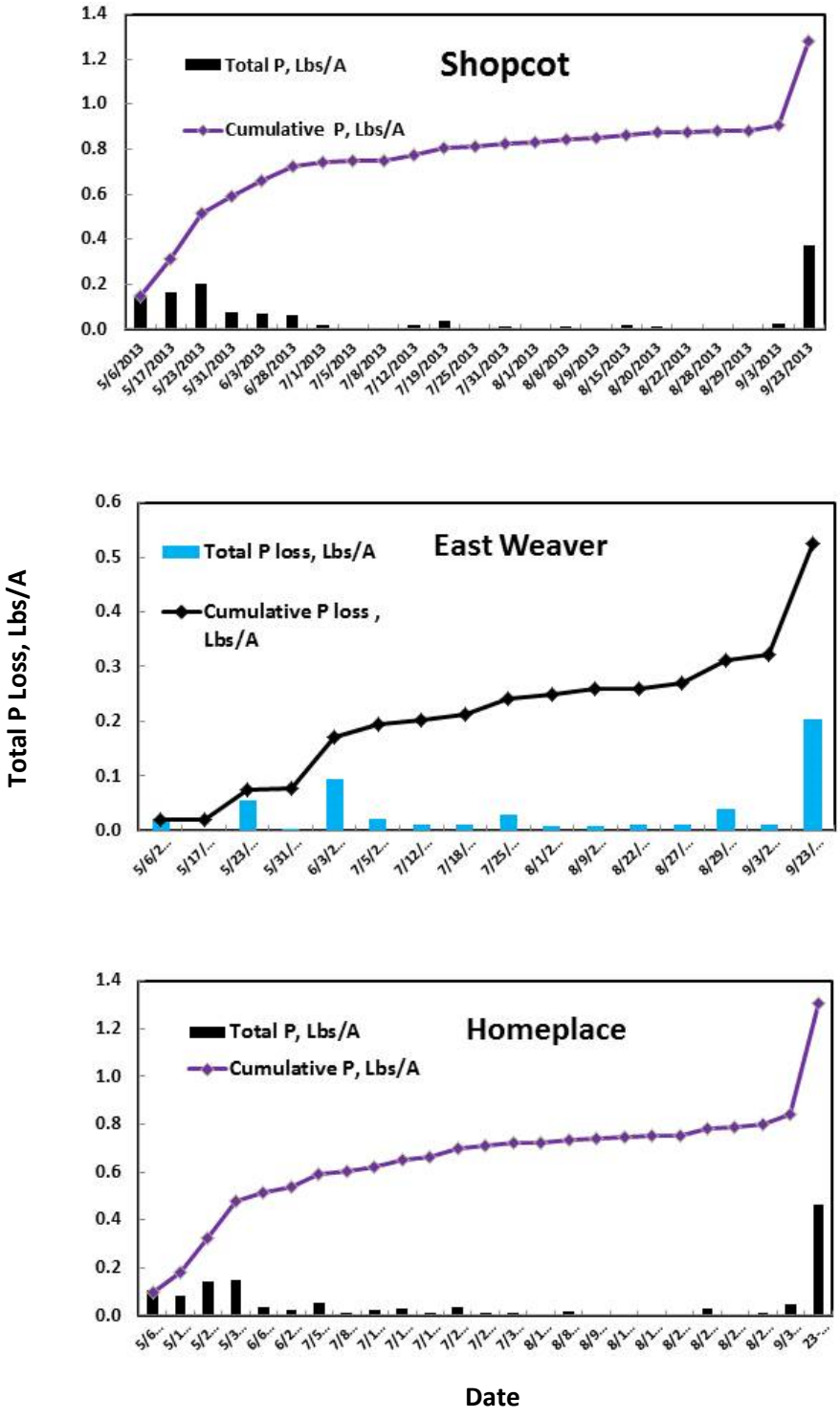

Figure 2. Total phosphorus losses in runoff from three cotton fields during the 2013 growing season.

Summary

The data collected during this first year indicates low nutrient losses in runoff to off-farm water bodies, which provides encouragement that our cotton production systems are efficient in terms of nutrient loss to runoff. It is still preliminary as it is generally accepted by the scientific community that runoff studies should be conducted for a minimum of five years to account for climatic and hydrological response variability.

Literature Cited

The Arkansas Water Resources Center. 2014. http://www.uark.edu/depts/awrc/pdf_files/Labpreserveamts.pdf. Accessed on March 17, 2014.