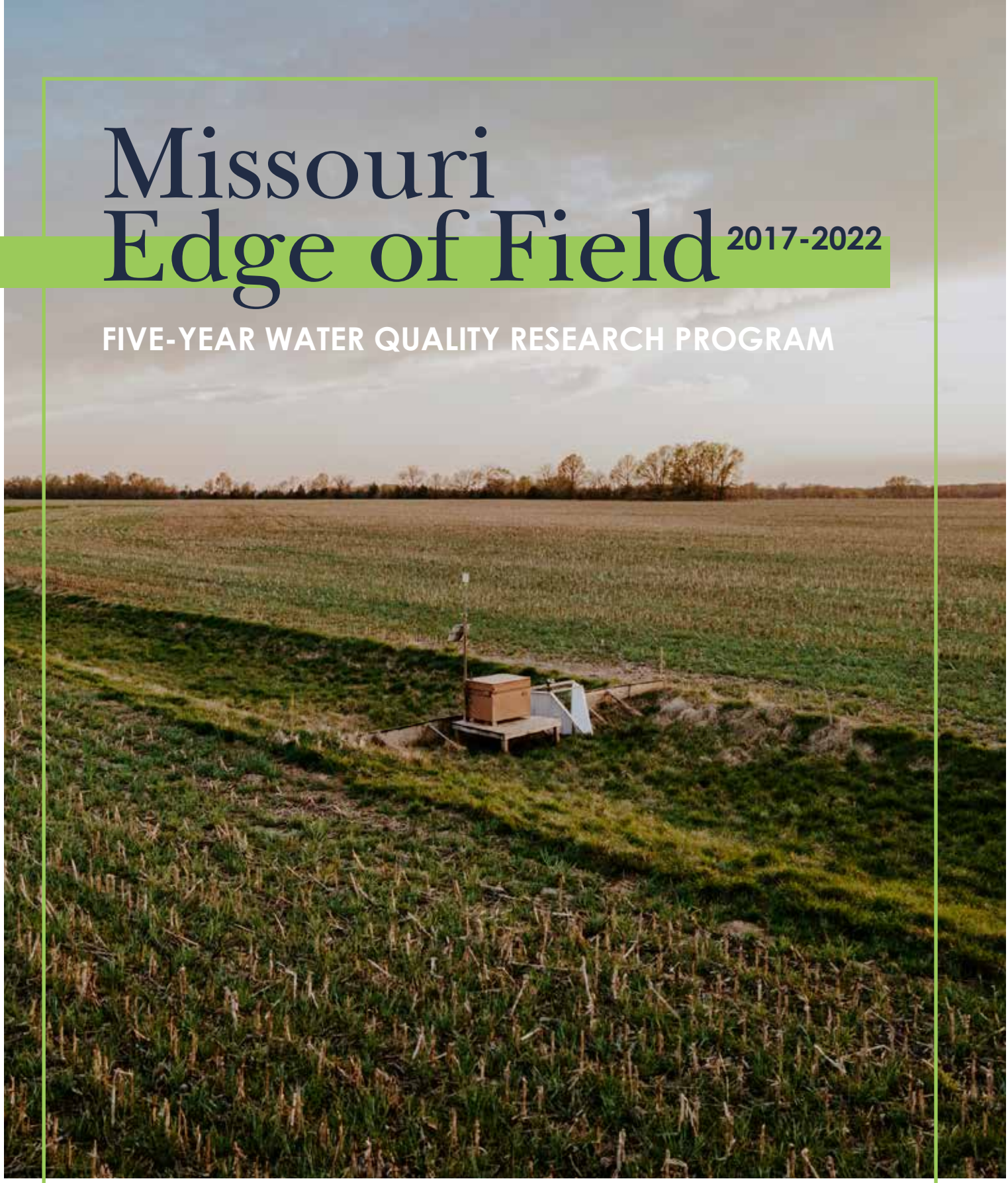
Missouri Edge of Field 2017-2022

FIVE-YEAR WATER QUALITY RESEARCH PROGRAM



MissouriCorn

Missouri Soybeans

Missouri Fertilizer Control Board

Missouri Department of Natural Resources

Project Overview

Through the investment of the Missouri Soybean Merchandising Council (MSMC) and the Missouri Corn Merchandising Council (MCMC), the Edge of Field (EoF) Water Quality Research Program was a farmer-driven collaboration conducted from 2017 through 2022. The goals of this five-year research were to (1) quantify the effectiveness of on-farm practices, (2) demonstrate the benefits of voluntary agricultural conservation, and (3) support water quality efforts aimed at meeting state soil and water stewardship goals.

The program was committed to:

Collecting reliable water quality information on working privately operated farms to realistically capture the variability of water quality changes due to weather and corn/soybean crop rotation.

Improving communication among farmers, industry, policymakers, and regulatory agencies regarding the environmental performance and effectiveness of conservation practices.

Taking a proactive approach and supporting voluntary-based water resources management and improvement

Invest in science, technology, and **data** to increase understanding of the effectiveness of practices and provide farmers and conservation professionals with the facts necessary to foster EoF practice implementation.

RESEARCH GOALS

01 Quantify the effectiveness of on-farm practices

02 Demonstrate the benefits of voluntary agricultural conservation

03 Support water quality efforts aimed at meeting state soil and water stewardship goals

CONTENTS

LEARN MORE

Discover the extensive benefits of this cutting-edge research for Missouri growers. Scan the QR code to hear from them about how these practices are enhancing their soil health. For additional information or specific on-farm research data, contact Kurt Boeckmann at kboeckmann@mocorn.org

SCAN ME

Monitoring Stations

As part of this study, a field approach was utilized, comparing two similar plots at each location: one containing an identified best management practice and the other employing conventional methods.

GRASS WATERWAY

COVER CROP

TERRACE — TILE DRAINED

TERRACE — WITHOUT TILE

Site	Watershed	Crop	Runoff (ac)	Monitoring Station Location
1	Lower Missouri — Moreau	Corn-Soybean Rotation	14	Grassed Waterway
2	Lower Missouri — Moreau	Corn-Soybean Rotation	11	Terrace Tile Outlet
3	Lower Missouri — Moreau	Corn-Soybean Rotation	31	Grassed Waterway
4	Lower Missouri — Moreau	Corn-Soybean Rotation	15	Field Edge
5	The Sny	Corn-Soybean Rotation	15	Grassed Waterway
6	The Sny	Corn-Soybean Rotation	10	Field Edge
7	North Fork Salt	Corn-Soybean Rotation	12	Terrace Tile Outlet
8	North Fork Salt	Corn-Soybean Rotation	12	Terrace Tile Outlet

"The unique part of this program is that we are setting up water quality monitoring stations at the edge of a farmer's field. Those monitoring stations are capturing runoff... and we can show the farmers that when they implement these practices they have a reduction in soil loss and they are keeping their nutrients on the ground where they need them."

— KURT BOECKMANN
DIRECTOR OF ENVIRONMENTAL PROGRAMS
MISSOURI CORN MERCHANDISING COUNCIL

"The data obtained from the program is very beneficial to a farmer because it puts a number on it…. It's return on investment. And if they can see that they are saving those nutrients that they are spending money on and returning them back to the fields they put a lot of blood, sweat and tears into, they are going to see the benefits of it and give it a go."

— MATT LAMBERT
UPTOWN FARMS; LACLEDE, MO.

Grassed Waterways with Conventional Terracing

METHODOLOGY

To evaluate the effectiveness of grassed waterways in Missouri, a paired-field experimental approach was utilized with a study area consisting of two fields/plots in farm terracing that drained to a grassed waterway (treatment) with conventional farm terracing (control). (Figure 1) Both the control site and the treatment site were measured by H-Flumes at the edge of field. (Figure 2)

Figure 1 (Site LMM 03, 04) Control (terrace) and treatment (grassed waterway).

Figure 2 (Site LMM 03, 04) H-Flumes were installed and fitted with ultrasonic sensors to measure runoff.

SITE LMM 03, 04

CONTROL
- Terrace
- 9.7 Acres

TREATMENT
- Grassed Waterway
- 31.8 Acres

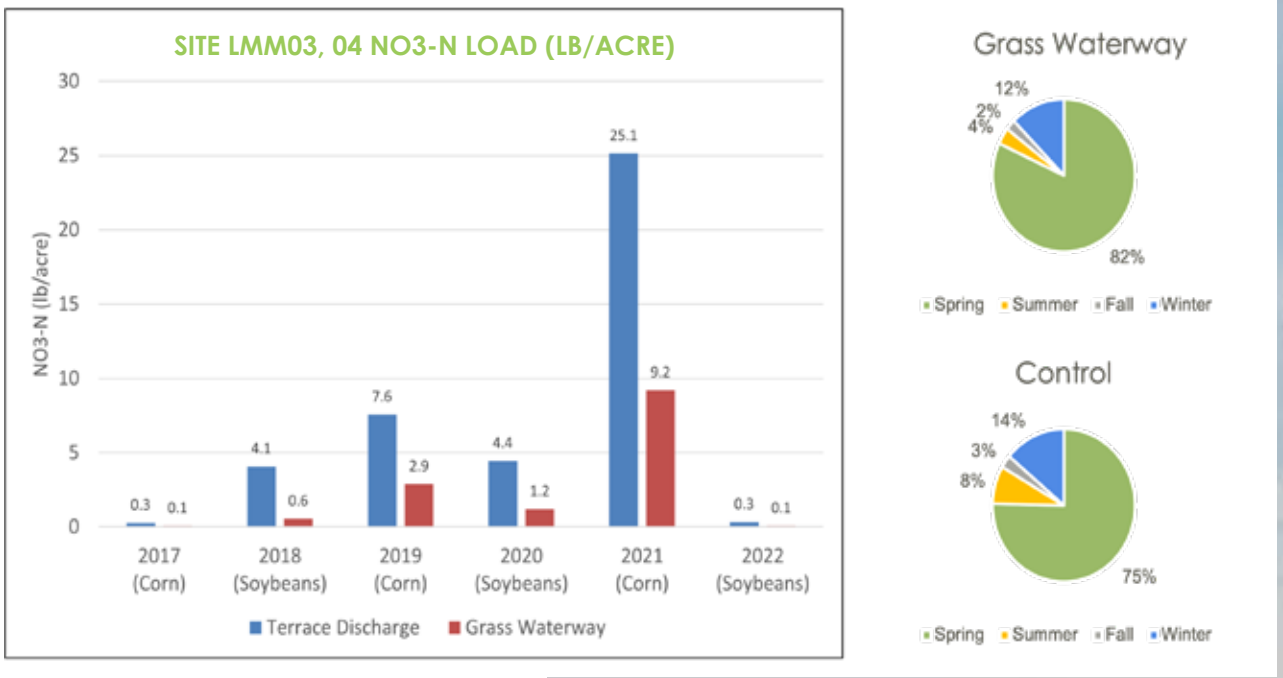


Figure 3 (Site LMM 03, 04) Annual totals for nitrate-nitrogen in lb/ac. The percentage of load associated with each season is recorded in the pie graphs to the right. Grass Waterway = treatment.

Grassed Waterways with Conventional Terracing

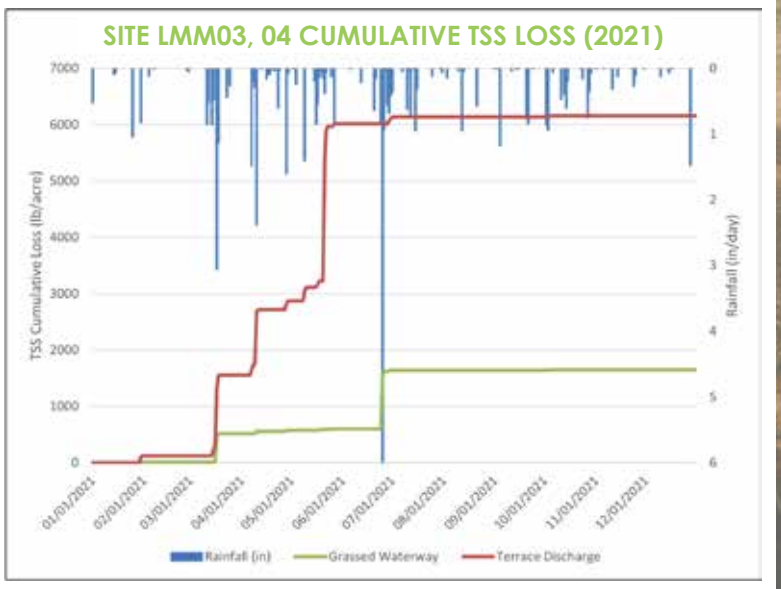
RESULTS

The annual results from the multi-year EoF monitoring study for runoff, precipitation, nitrate (No3-N), total Kjeldahl nitrogen (TKN), total phosphorus (TP), and total suspended solids (TSS or sediment) show that most runoff and load leaving the field occurred during the spring. This is typical for an agricultural field in the Midwest due to increased precipitation and field operations (e.g., planting, applications, etc.) during this time.

CUMULATIVE LOSS

The highest annual loads for Total Suspended Solid (TSS or sediment) were observed in 2021; however, the total runoff in 2021 was slightly higher than the annual average. The increase in sediment loss at the control site can be attributed to early precipitation events before corn was planted in spring. (Figure 4) The grassed waterway proves to be effective in spring precipitation events before corn can mature and close canopy.

Upon comparison of the annual runoff and loads leaving the grassed waterway and control plot, values leaving the grassed waterway were found to be significantly lower in all years.



▲ ***Figure 4 (Site LMM03, 04) Total Suspended Solid (sediment) loss during spring precipitation events at grassed waterway versus terrace discharge.***

SUMMARY

Overall, the results from the EoF monitoring study demonstrate and confirm the ability of grassed waterways to reduce runoff, decrease soil erosion, and improve water quality. While these results may not be applicable to all fields and conditions in Missouri, they represent typical farming practices that are transferable to most conventional farms.

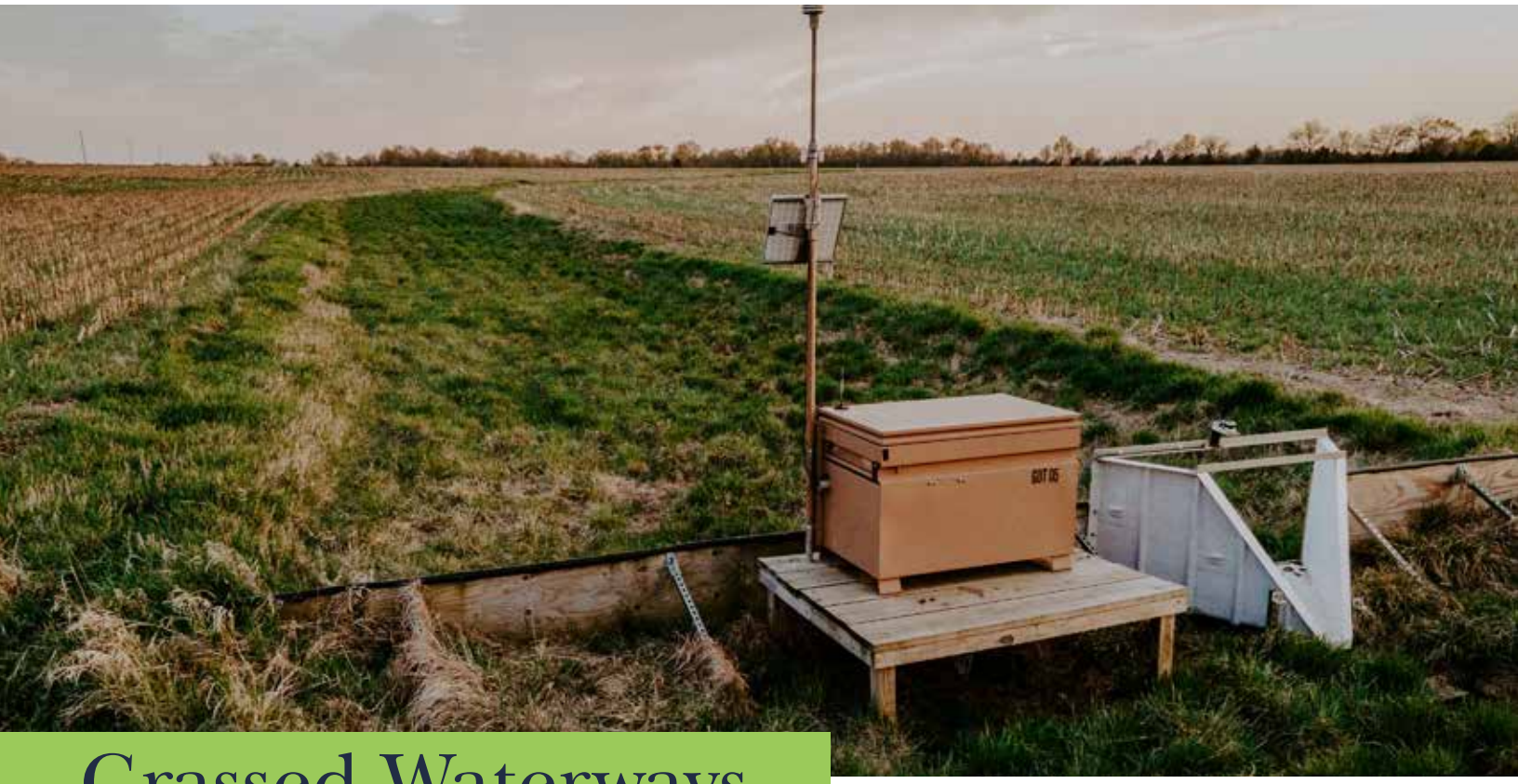
AVERAGE PERCENT REDUCTIONS

Runoff.....	50%
Nitrate (NO3-N).....	67%
Total Kjeldahl Nitrogen (TKN).....	45%
Total Phosphorus (TP).....	57%
Total Suspended Solids (TSS or sediment).....	64%

FIVE-YEAR AVERAGE EFFECTIVENESS

"You can never control Mother Nature 100%, but you can put in practices that will eliminate some of the damage that it does."

— TIM GOTTMAN
GOTTMAN FARMS; MONROE CITY, MO.



Grassed Waterways with Cover Crops

METHODOLOGY

To evaluate the effectiveness of a grassed waterway and cover crop combination in Missouri, a farm was selected in northeast Missouri on an area consisting of two fields/plots: one ~15 acres in size with a cover crop that is drained to a grassed waterway (treatment), and the other ~10 acres in size was recently taken out of Conservation Reserve Program (CRP)(control). Over the first three years, the drainage area developed into an ephemeral gully (Figure 5). Conventional farm terracing was adopted on the control plot in 2020 to address erosion issues associated with the ephemeral gully. Aside from the differences resulting from terrace implementation, all other factors pertaining to the two plots were as identical as possible. Both the control site and the treatment site were measured by H-Flumes at the edge of field (Figure 6).

SITE SNY 05, 06

CONTROL

- Gully/Terraces
- 10 Acres

TREATMENT

- Grassed Waterway
- 15.1 Acres

▶ ***Figure 5 (Site SNY 05, 06) Treatment and control drainage areas.***

▲ ***Figure 6 (Site SNY 05, 06) H-Flumes were installed and fitted with ultrasonic sensors to measure runoff.***

Grassed Waterways with Cover Crops

RESULTS

Upon comparison of the annual runoff and loads leaving the treatment and control plots, values leaving the grassed waterway and cover crop combination were found to be significantly lower in all years. Due to delayed field operations at the control plot in 2020, caused by the installation of terraces, the treatment and control plots had different crops planted that year. In 2020, the treatment plot followed the typical crop rotation and had corn planted, while the control plot had soybeans planted. Following the installation of terraces, the sediment load leaving the control plot was dramatically reduced by ~97%, revealing the effectiveness of terraces at reducing erosion and controlling ephemeral gulleys. Despite this improvement at the control plot, the sediment loads leaving the grass waterway and cover crop combination were still significantly lower each year. (Figure 7)

SITE SNY 05, 06 TSS (LB/ACRE)

Year	Crop	Ephemeral Gully Load	GW/CC Load	% Change
2017	Soybeans	9,108	87	-99%
2018	Corn	17,469	135	-99%
2019	Soybeans	9,515	148	-98%
2020	Soybeans/Corn	17,318	118	-99%
2021	Soybeans	723	29	-96%
2022	Corn	23	4	-83%
Average		**9,026**	**87**	**-99%**
Total		**54,156**	**521**	**-99%**

Figure 7 (Site SNY 05, 06) Total Suspended Solids (lb./acre).

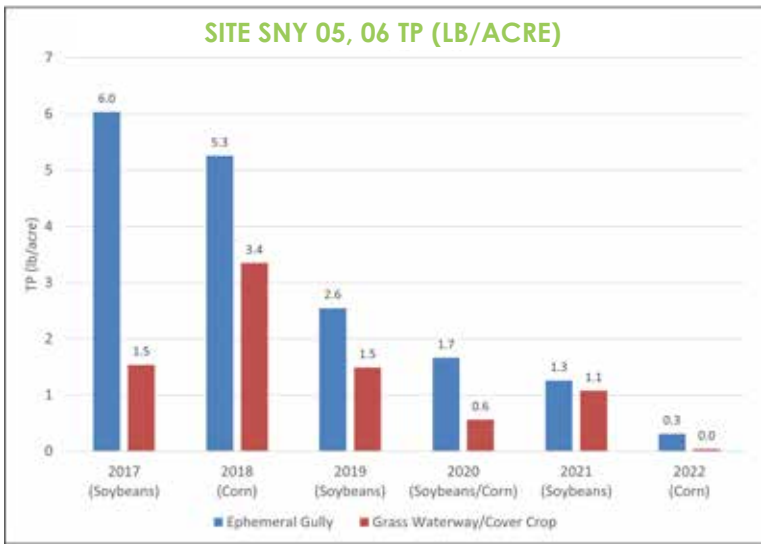


Figure 8 (Site SNY 05, 06) Despite the installation of terraces at the control plot in 2020, the phosphorus loads leaving the grass waterway and cover crop combination were still lower.

TOTAL PHOSPOROUS

By reducing the erosion rate, the total phosphorus (TP) loads also decreased in 2020. Phosphorus is known to bind with sediment, which explains the reduction of phosphorus loss with respect to sediment loss. The grass waterway was still effective at reducing phosphorus loading compared to a terraced field with sheet and rill erosion. (Figure 8)

Overall, the annual results demonstrate the consistent effectiveness of a grassed waterway and cover crop combination at reducing runoff, nitrogen, phosphorus, and sediment.

SUMMARY

Overall, the annual results demonstrate the consistent effectiveness of a grassed waterway and cover crop combination at reducing runoff, nitrogen, phosphorus, and sediment.

AVERAGE PERCENT REDUCTIONS

Runoff	**22%**
Nitrate (NO3-N)	**64%**
Total Kjeldahl Nitrogen (TKN)	**77%**
Total Phosphorus (TP)	**54%**
Total Suspended Solids (TSS or sediment)	**99%**

FIVE-YEAR AVERAGE EFFECTIVENESS

Cover Crop vs. Non Cover Crop on Surface Tile-Drained Field

METHODOLOGY

To evaluate the effectiveness of cover crops, a farm was selected in northeast Missouri, based on site evaluation determining the site's suitability to represent typical farming practices. This study utilized a paired-field experimental approach with a study area consisting of two fields/plots: one ~12 acres in size with a cover crop that is surface tile drained (treatment), and the other ~12 acres in size, without a cover crop, that is also surface tile drained (control). (Figure 9) Both the control site and the treatment site were measured by H-Flumes at edge of field. (Figure 10)

SITE NFS 07, 08

CONTROL
- No Cover Crop
- 12 Acres

TREATMENT
- Cover Crop
- 12 Acres

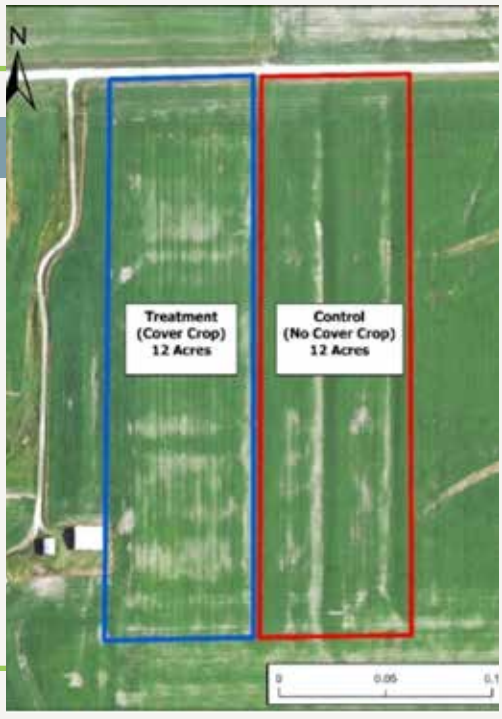


Figure 9 (Site NFS 07, 08) Surface tile drained /cover crop versus surface tile drained /no cover crop.

Figure 10 (Site NFS 07, 08) H-Flumes were installed and fitted with ultrasonic sensors to measure runoff.

RESULTS

Upon comparison of the annual runoff and loads leaving the cover crop and control plot, values leaving the cover crop were found to be significantly lower in most years, with average yearly reductions ranging from 12-25%. The largest annual reduction was observed in 2019 when runoff and loads were highest. (Figure 11)

While annual reductions were observed on average, there were a few individual years where runoff, total phosphorus (TP), and total suspended solids (TSS or sediment) from the cover crop were higher than the control, although generally by negligible amounts. Meanwhile, there were no annual results where nitrogen from the cover crop was higher.

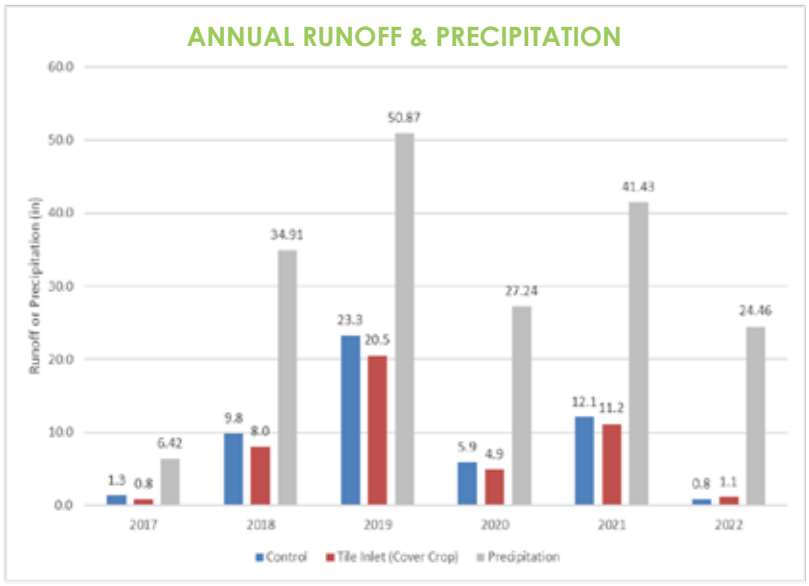
Figure 11 (Site NFS 07, 08) Annual Runoff and Precipitation.

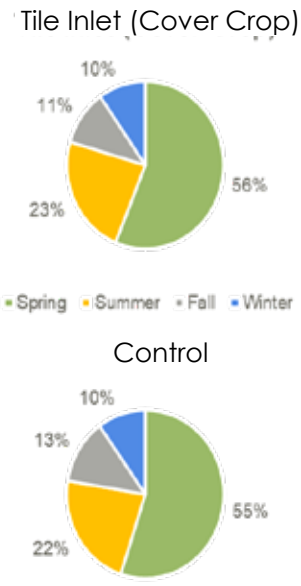
SUMMARY

Overall, these results demonstrate the consistent effectiveness of cover crops in reducing runoff, nitrogen, phosphorus, and sediment.

AVERAGE PERCENT REDUCTIONS

Runoff	**12%**
Nitrate (NO3-N)	**25%**
Total Kjeldahl Nitrogen (TKN)	**19%**
Total Phosphorus (TP)	**19%**
Total Suspended Solids (TSS or sediment)	**20%**





FIVE-YEAR AVERAGE EFFECTIVENESS

Conclusion

The results from the EoF monitoring study demonstrate and confirm the ability of conservation practices to reduce nutrient runoff, decrease soil erosion, and improve water quality. While these results may not be applicable to all fields and conditions in Missouri, they represent typical farming practices that are transferable to most conventional farms. Thus, this research should be utilized to inform future on-farm management decisions, as appropriate, and can be employed by farmers and stakeholders to develop a strong environmental record by measuring the value of past, current, and future conservation. Ultimately, the studied best management practices should be encouraged by farmers and stakeholders to support and promote proactive water quality efforts aimed at meeting soil and water stewardship goals, including Missouri's Nutrient Loss Reduction Strategy.

SCAN ME

Learn more about how this research is benefiting Missouri growers and soil health.

This collaborative research coalition will continue monitoring conservation practices. The results of this effort can also benefit organizations and agencies to evaluate the benefits of carbon sequestration. The existing partnership will utilize this research as an educational/outreach tool for researchers and farmers. This will give the farmers the resources to make on-farm management decisions while improving productivity, profitability, and water quality.

Contact Kurt Boeckmann for additional information or specific research data: kboeckmann@mocorn.

This comprehensive research program was made possible with the support of the following organizations:

MissouriCorn · Missouri Soybeans · Missouri Fertilizer Control Board · Missouri Department of Natural Resources