OH-DELAWARE

Controlled Drainage

Kevin King, Norm Fausey, Mark Williams, Vinayak Shedekar

SITE SUMMARY

The research was conducted at Upper Big Walnut Creek (UBWC) site on a private farm located near Galena, OH. Two outlets, B2 and B4, drained two distinct zones of the same farm field that was systematically subsurface drained. The outlet B4 drained an area of 14.9 ha (37 acres) and outlet B2 drained an adjacent portion with a contributing area of 13.8 ha (34 acres). The primary soils in both drainage areas are associations of Bennington silt loam and Pewamo clay loam. The distribution of the two soil types was similar in each drainage area (approximately 50% each). The farm field was managed with a corn-soybean rotation with rotational tillage (King et al., 2016). Tillage generally consisted of a spring chisel and disk operation prior to planting corn. Soybeans were no-till planted into corn stubble. Nutrient management for the corn-soybean rotation generally included a single spring application of P fertilizer at corn planting time and a split application of N on corn, with a portion at planting followed by side-dressing approximately one month later. In fall of 2007, a single application of chicken litter was applied to the field and incorporated. The crop rotation, nutrient management, and tillage operations during the study period are summarized in King et al. (2016).

Both outlets were monitored under "free" (conventional) drainage from 2005 through 2008. From January 2009 through December 2014, drainage water management was implemented on B4 to control the outlet elevation at approximately 1.5 feet below the field surface, while B2 remained under "free" drainage mode.

SITE INFO

CHARACTERISTICS

- Drainage system installed in 1970's
- Soil: Bennington silt loam, Pewamo clay loam
- Rotation: Corn-Soybean

WATER MANAGEMENT PRACTICES

- Conventional Drainage (depth 3 feet, spacing 50-foot)
- Controlled Drainage (depth 3 feet, spacing 50-foot)

MEASUREMENTS IN DATABASE

DRAINAGE SYSTEM

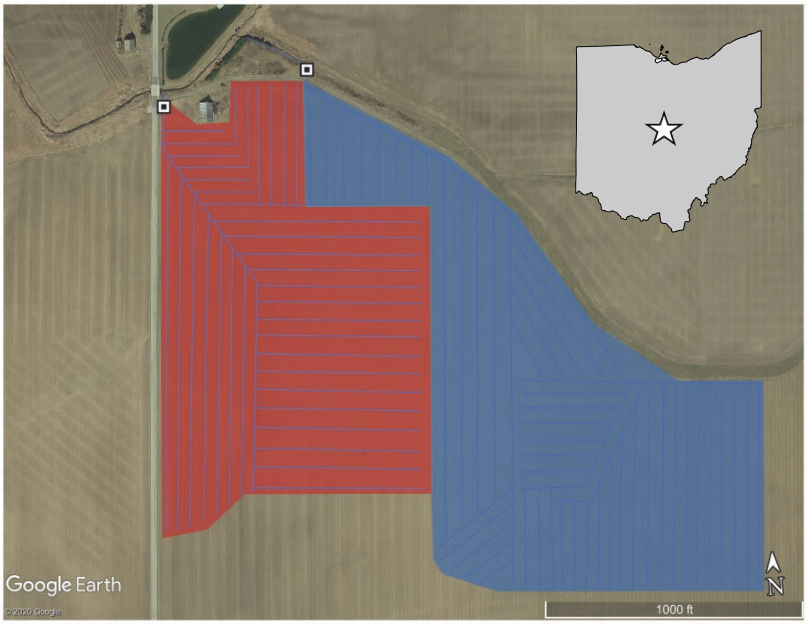
- Tile Flow (2005-2012)
- Tile Water Quality: Nitrate-N, Reactive P, Total P (2005-2012)

SOIL

- Soil Texture (1 year)
- Soil P (1 year)

WEATHER

- On-Site Weather Station: Precipitation (2005-2012)



Controlled Drainage
Conventional Drainage
Tile Line
Control Structure

This material is based upon work that is supported by the National Institute of Food and Agriculture , U.S. Department of Agriculture , under award number 2015-68007-23193 , "Managing Water for Increased Resiliency of Drained Agricultural Landscapes", http://transformingdrainage.org. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SUMMARY OF RESULTS

FLOW

Mean daily tile flow varied between 2006-2008 and 2009-2012 ($p < 0.001$) with greater mean daily flow rates observed from 2006 to 2008. A significant time (before-after) x treatment (control-impact) interaction was also found ($p < 0.001$), indicating that DWM significantly impacted daily tile flow at B4 (Williams et al. 2015).

DWM decreased annual tile flow between 11 and 178 mm, with an average reduction of 69 mm. This is equivalent to a 7.5 to 33.6% decrease in annual tile flow. DWM had the largest impact on tile flow at B4 during years when the precipitation amount was average or above average, compared to years with below average precipitation (Williams et al. 2015).

A modeling study for the same site concluded that under DWM: drainage discharge reduced by 8 to 23%, runoff increased by 50% but accounted for a small portion of the total water budget (only 3 to 4% of annual precipitation), total water loss (runoff plus drainage) was reduced by 25%, ET and seepage increased, but by smaller magnitudes compared to other water budget components, and the number of days with drainage flows decreased and those with runoff flows increased (Shedekar et al. 2021).

WATER QUALITY

The implementation of DWM at B4 did not influence mean weekly NO3-N and DRP concentrations (Williams et al. 2015).

DWM reduced the average annual flow by 23.1% (69 mm), average annual NO3-N load by 21.3% (9.4 kg ha−1) and average annual DRP loads by 55.9% (0.19 kg ha−1) compared to FD. The impact of DWM on NO3-N load tended to be greater during years with average or above average, compared to years with below average precipitation. However, the impact of DWM on DRP load did not appear to be related to precipitation amount. In general, the impact of DWM on tile flow and nutrient loads in this study was not as large as reported in other studies (Williams et al. 2015).

A modeling study for the same site concluded that under DWM: NO3-N concentrations in drainage discharge increased in non-growing season months, and NO3-N loads in drainage discharge reduced by 9 to 25% (Shedekar et al. 2021).

Year	Observed (CD)	Predicted (FD)	% Reduction
Flow (mm)			
2009	140	203	31.0
2010	135	146	7.5
2011	351	529	33.6
2012	97	121	19.8
Average	181	250	23.1
NO_3-N(kg/ha)			
2009	34.3	61.1	43.9
2010	15.5	14.2	-8.4
2011	30.1	40.8	26.2
2012	7.8	9.2	15.2
Average	21.9	31.3	21.3
DRP(kg/ha)			
2009	0.06	0.10	40.0
2010	0.08	0.18	55.6
2011	0.24	0.75	68.0
2012	0.08	0.20	60.0
Average	0.11	0.30	55.9

Table 1: Effect of drainage water management (CD) on annual discharge, NO3-N load, and DRP loads at outlet B4 (Source: Williams et al. 2015)

PUBLISHED WORKS FROM THE SITE

King, K. W., Williams, M. R., & Fausey, N. R., 2016. Effect of crop type and season on nutrient leaching to tile drainage under a corn-soybean rotation. Journal of Soil and Water Conservation, 71(1), 56-68. doi:10.2489/jswc.71.1.56

Williams, M. R., King, K. W., & Fausey, N. R. 2015. Drainage water management effects on tile discharge and water quality. Agricultural Water Management, 148 (January), 43-51.

Shedekar, V.S., King, K., Fausey, N.R., Islam, K.R., Soboyejo, A.B., Kalcic, M.M., & Brown, L.C. 2021. Exploring the effectiveness of drainage water management on water budgets and nitrate loss using three evaluation approaches. Agricultural Water Management, 243, 106501. https://doi.org/10.1016/j.agwat.2020.106501

Data Access

Data from this site are available through the USDA National Ag Library Ag Data Commons repository (https://doi.org/10.15482/USDA.ADC/1521092) or the interactive website at Iowa State University with visualization and querying capabilities (https://drainagedata.org).

ACKNOWLEDGEMENTS

TRANSFORMING DRAINAGE PROJECT

The Transforming Drainage project was supported by the USDA National Institute of Food and Agriculture under award number 2015-68007-23193, "Managing Water for Increased Resiliency of Drained Agricultural Landscapes." opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. This summary was created by Ben Reinhart, Jane Frankenberger, Kevin King, and Vinayak Shedekar.

USDA United States Department of Agriculture National Institute of Food and Agriculture

This material is based upon work that is supported by the National Institute of Food and Agriculture , U.S. Department of Agriculture , under award number 2015-68007-23193 , "Managing Water for Increased Resiliency of Drained Agricultural Landscapes", http://transformingdrainage.org. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.