2011

Subsurface Drainage Water Management

Greg Brenneman
Iowa State University, gregb@iastate.edu

Matthew J. Helmers
Iowa State University, mhelmers@iastate.edu

Subsurface Drainage Water Management

Abstract
Drainage water management, in the context of subsurface agricultural drainage, consists of managing outflow with a goal of reducing drainage volume. Because less water is leaving the system, a corresponding reduction in the amount nitrate-nitrogen can be expected, although concentrations tend to be similar when compared with conventional drainage. The objective of this work is to determine the impact of drainage water management on drainage outflow, water table depth, and crop yields.

Keywords
RFR A1071, Agricultural and Biosystems Engineering

Disciplines
Agricultural Science | Agriculture | Bioresource and Agricultural Engineering

Subsurface Drainage Water Management

RFR-A1071

Greg Brenneman, extension ag engineer
Matthew Helmers, associate professor
Department of Ag and Biosystems Engineering

Introduction

Drainage water management, in the context of subsurface agricultural drainage, consists of managing outflow with a goal of reducing drainage volume. Because less water is leaving the system, a corresponding reduction in the amount nitrate-nitrogen can be expected, although concentrations tend to be similar when compared with conventional drainage. The objective of this work is to determine the impact of drainage water management on drainage outflow, water table depth, and crop yields.

Materials and Methods

The drainage water management study is located at the Southeast Research Farm near Crawfordsville, IA. The site consists of Taintor silty clay loam and Kalona silty clay loam soils. The research site has eight plots with two replications for each treatment (Figure 1). Individual plots range in size from approximately three to six acres for a total project area of 42 acres. Plots are split down the middle and cropped east to west in both corn and soybeans each year. The four treatments are:

- No drainage.
- Conventional drainage (48-in. tile depth with 60-ft spacing).
- Shallow drainage (30-in. tile depth with 40-ft spacing).
- Controlled drainage (48-in. tile depth with 60-ft spacing with controls during the winter and summer and free flow during planting and harvesting).

Tiles lines are laid out in a North-South orientation with interior tiles continuously monitored for flow rate. Water samples for nitrate-nitrogen levels were taken on a weekly basis. The control gates for the controlled drainage plots are opened in early April prior to planting and closed after planting is completed generally in the first two weeks of June. Control gates are then reopened in early to mid-September prior to harvest and closed again after fall tillage is completed, generally in early November.

Results and Discussion

Annual drainage in the conventional tile plots is noticeably more than drainage from the shallow and controlled tile systems (Table 1). Averaging treatments over the three-year study period, accounting for annual variation, shows a major increase in drainage volume coming from the conventionally drained plots.

Water table monitoring midway between tile lines show water tables responding very rapidly to rainfall events. Following rainfall events, the undrained plots would often have a water table within 1 to 1.5 ft of the soil surface. The shallow and controlled drainage plots track similarly throughout the year with the shallow drain plots and have a water table at about 3 ft. The controlled drain plots have a water table at about 3.5 ft. The conventional drained plots had the deepest water table at 4 to 4.5 ft deep (Figure 2).

Average yields varied widely over the years and treatments. In three of the four years, the undrained treatment had the lowest yield for both corn and soybeans. Averaged over the four years, the drained plots had soybean yields 6 to 10 bushels/acre and corn yields 8 to 14 bushels/acre more than the undrained plots. Over the four-year study period, the drainage water management treatments did not produce

crop yields that were different from the conventional drainage treatment.

Acknowledgements

Appreciation is extended to Kevin Van Dee, Southeast Farm superintendent and his staff for their assistance in data collection on this study. Also, appreciation is expressed to the following companies for their donation of time and materials for the installation of the project: Agri Drain, Advanced Drainage Systems (ADS), Hancor, Prinsco, Springfield Plastics, Timewell Tile, D.A. Drish Drainage, G & R Miller Construction, Joe Beck Tiling, Samson Industries, and Springsteen Tiling. This project has been supported by a USDA-NRCS Conservation Innovation Grant and the Agricultural Drainage Management Coalition.

Table 1. Total annual drainage – inches.

Year	Conventional	Control drain	Shallow drain	March-Oct. rainfall
2007	10.1	7.1	7.2	42.7
2008	12.1	9.1	5.6	35.5
2009	15.0	9.7	9.1	44.2
3-year avg.	12.4	8.6	7.3	40.8

Table 2. Corn and soybean yields by year.

Drainage	Soybeans					Corn				
system	2007	2008	2009	2010	Avg.	2007	2008	2009	2010	Avg.
No tile	46.7	47.7	45.7	46.3	**46.6**	167	177	146	156	**162**
Conventional	57.8	46.9	67.4	52.8	**56.2**	178	172	182	170	**176**
Shallow	51.3	45.2	62.6	49.8	**52.2**	177	176	184	162	**175**
Controlled	55.9	47.6	63.4	52.8	**54.9**	171	168	180	159	**170**

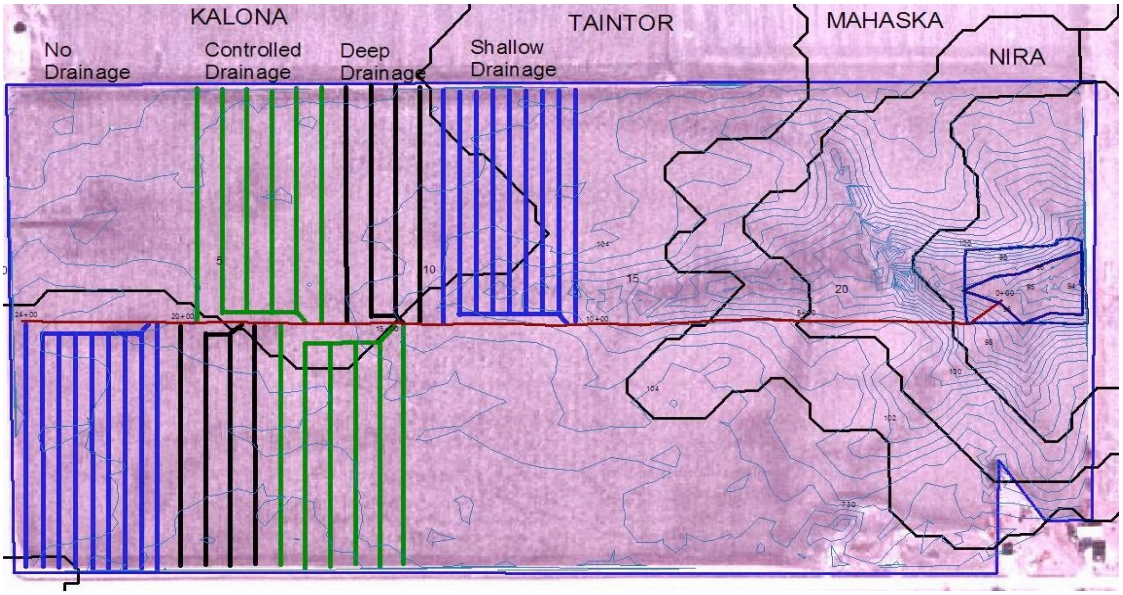

Figure 1. Drainage water management layout.

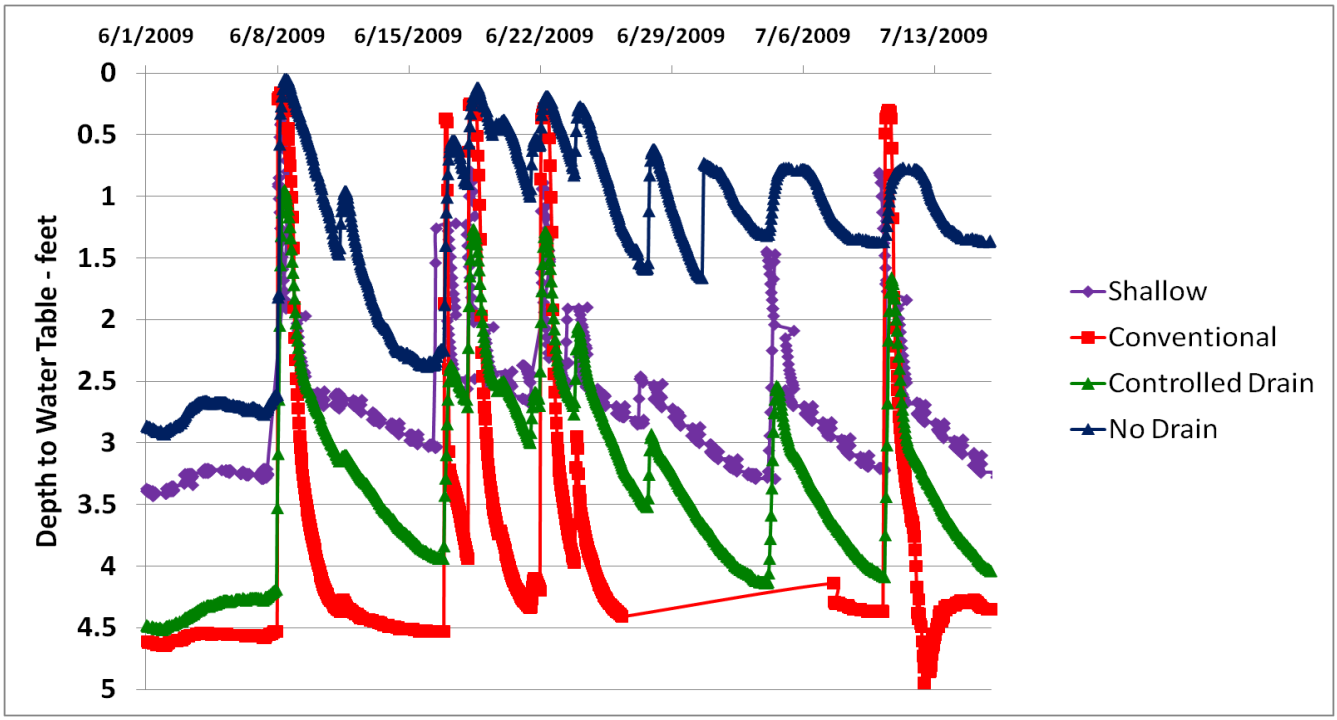

Figure 2. Depth to water table – 2009.