Frankenberger, J. "Drainage Water Management in the Corn Belt." *Resilient Agriculture.* Aug. 2014: 14-15. Print.

Drainage Water Management in the Corn Belt

BY JANE FRANKENBERGER

Have you ever watched your tile drains flow in June and wondered how you could save some of that water for crops to use later in the summer? That is the idea behind drainage water management, a conservation practice that holds water in your field at times of year when more water won't harm the crop.

Drain tile systems do their job by draining away excess water, providing trafficable conditions for field work and increasing crop yields. However, water that is "excess" in the spring could be valuable later in the year when crop growth is at its peak and soil moisture cannot keep up with crop water demand. The potential benefits are especially evident in drought years. However even in normal years crops in most of the Corn Belt may experience some drought stress in July and August.

Drainage water management is the practice of installing a water control structure in a drain tile (photo right), which allows you to vary the depth of the drainage outlet. Raising the outlet level causes the water table to rise to the level of the outlet, storing water in the soil. The outlet is lowered sufficiently long before planting so that the field is fully drained. Drainage during the crop growing season is flexible — most producers raise the outlet as soon as possible after spring field work has ended to retain any available moisture (Fig. 1).

The practice was originally developed as a way to reduce the nitrate loss into streams and rivers that has been linked to water quality problems downstream such as hypoxia in the Gulf of Mexico. Holding the water back allows water to flow through longer pathways and seep into deeper soil layers. In addition to water quality benefits, it's possible that drainage water management also can boost crop yields.

^ Installation of a drainage water control structure in a drain tile.

FIGURE 1 | DRAINAGE WATER MANAGEMENT TIMELINE

A typical drainage water management timeline. The outlet is raised in the winter for water quality benefits, lowered several weeks before planting, then raised immediately after planting to hold back moisture for the crop.

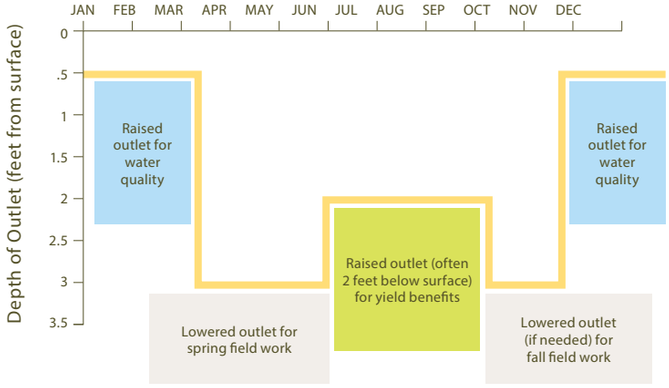
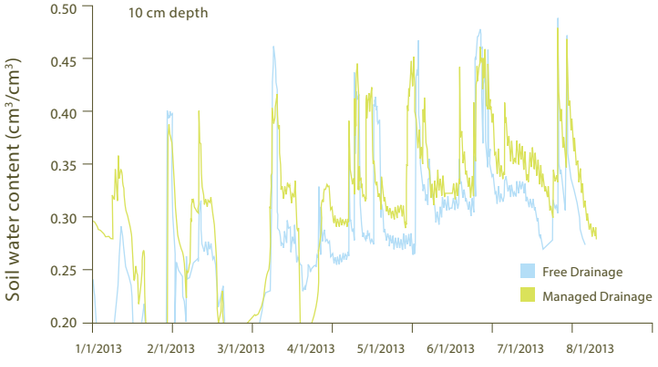


FIGURE 2 | DRAINAGE COMPARISON

This comparison, of conventionally drained fields to fields with managed drainage, illustrates that drainage water management stores water in the soil.



Brian Hicks, a corn producer in Redwood County, in southwestern Minnesota, has two corn fields that are a part of the Sustainable Corn Project's current drainage water management research. They have been a part of University of Minnesota research since 2005, when water control structures were installed in some of his fields. In the fields with managed drainage, Hicks says he has seen a "dramatic savings in nutrients every year since then."

"I spend a lot of money on my nutrients. The folks downstream in the Gulf of Mexico certainly don't want them. So, if I can keep them on my landscape, I'm happy with that," says Hicks.

Understanding yield benefits and soil moisture impacts

Researchers and producers know that holding drainage water in the soil provides some benefit, but the yield benefits vary by year, by climate, and by region, and are not yet fully understood.

Hicks says he has seen a yield advantage in the fields with managed drainage, but "the yield bump is not huge and not every year."

The Sustainable Corn Project is conducting research across the Corn Belt to better understand the varying impacts of drainage water management on soil moisture and crop yields. At four sites in Minnesota, Iowa, Indiana, and Ohio, researchers are comparing conventionally drained fields to drainage water management. Equivalent measurements are being taken of drain flow, water table depth, soil moisture at five depths, and crop yield in each field (conventional and managed drainage) (Fig. 2).

Holding the water back allows water to flow through longer pathways and seep into deeper soil layers. In addition to water quality benefits, it's possible that drainage water management also can boost crop yields.

The effects of drainage water management are probably highest in the southern and eastern portions of the Corn Belt (i.e., southern Indiana and Ohio), because drains usually flow throughout most of the fallow season (November to May) (Fig. 3). In parts of the Corn Belt further north (i.e., Minnesota and the Dakotas) drains do not usually flow during the winter because the soil is frozen (Fig. 2). Other states fall in-between these extremes, and the project is helping to show the extent of the variability of the impacts of drainage water management across the region.

Results from research on this promising practice across the entire region will help producers make decisions about drainage water management, including selecting a timeline for raising and lowering the outlet in their own fields to protect water quality and maximize their crop yields — to create a more resilient and sustainable cropping system.

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FIGURE 3 | ANNUAL WATER BALANCE

Components of the annual water balance for typical Corn Belt conditions. Evapotranspiration (orange line) exceeds precipitation (blue line) during the height of the growing season, but at other times, precipitation exceeds evapotranspiration leading to excess soil water and drainage flow (green line).