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Managing Water for Tomorrow's Agriculture

University of Minnesota

MN-REDWOOD3

Drainage Water Recycling

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SITE SUMMARY

The research is conducted at the University of Minnesota Southwest Research and Outreach Center (SWROC) located near Lamberton, MN. The climate of the region is characterized as interior continental with cold winters (21°F) and moderately hot summers (68°F) with occasional cool periods. The long-term total annual precipitation is 20.8 inches with most (76%) occurring during the growing season from April to September. The site consists of 24 individual plots equipped with subsurface tile drainage systems. The cropping system is a corn-soybean rotation, with each phase of the rotation present every year for a total of 12 plots for each crop. This layout will accommodate three replications of four water management treatments. Crop response to water management and the onset of crop water stress will be evaluated using four water management treatments. Crop response to nitrogen and water quality outcomes will be evaluated using six nitrogen rate treatments.

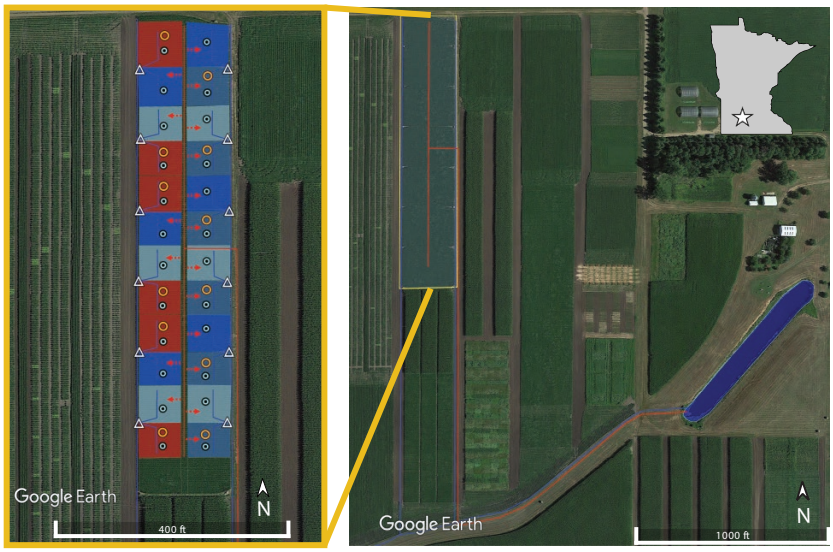

Figure 1. Plot map of water management treatments at the drainage research site at the Southwest Research and Outreach Center in Lamberton, MN.

Box 1. Site info

CHARACTERISTICS

- Drainage system installed in 1972
- Soil: Normania clay loam
- Rotation: Corn-Soybean

WATER MANAGEMENT PRACTICES

- Nitrogen rate treatments consisting of a no-nitrogen (0 lb N/ac) control and nitrogen rates of 80, 120, 160, 200 and 240 lb N/ac.
- Conventional drainage (depth 4 feet, spacing 90 feet)
- Water management treatments: rainfed, limited irrigation, full irrigation, and excess irrigation).

MEASUREMENTS IN DATABASE

DRAINAGE SYSTEM

- Tile Flow (2016-2017)

IRRIGATION SYSTEM

- Irrigation Flow (2016-2018)

CROP

- Crop Yield (2016-2017)
- Final Plant Population (2016-2017)
- Plant Biomass: Corn (2016-2017), Soybean (2016-2017)
- Leaf Area Index (2016)

SOIL

- Soil Moisture (2016-2017)

WEATHER

-Precipitation, Air Temperature, Relative humidity, Solar Radiation, Wind Speed, and Direction (2016-2018)

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.

SUMMARY OF RESULTS

POTENTIAL OF WATER CAPTURE AND REUSE

Crop response to water management for fine and coarse textured soils in Minnesota present some of the potential benefits of drainage water capture and reuse (Figure 2). The figures represent smoothed line histograms for corn grain yield in two years with similar precipitation patterns and amounts, in a separate field with varying soil types.

The line corresponding to 2013 shows corn yields before subsurface drip irrigation (SDI) was installed, and the 2017 shows yields after SDI was installed. For both soil types, the 2017 lines are shifted to the right, have a higher peak, and a more narrow spread in response to SDI with recaptured drainage water. This signifies an increase in mean corn yield and less yield variability with SDI for both soil types.

It is also important to note that even before SDI (2013 lines) the histogram for the fine textured soil (bottom graph) was shifted to the right and more narrow compared to the coarse textured soil (top graph). This is a reflection that the fine texture has greater water holding capacity and more soil water available to the plant compared to the coarse textured soil.

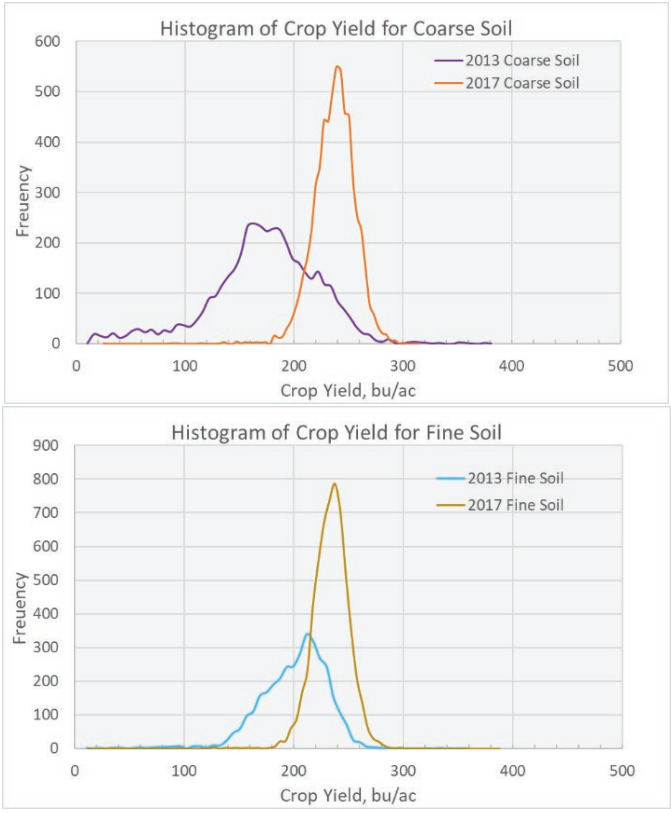

Figure 2. Histogram of corn grain yield for a coarse textured soil (top) and fine textured soil (bottom) with and without subsurface drip irrigation.

SUPPLEMENTAL IRRIGATION RESULTS FROM THE SOUTHWEST RESEARCH AND OUTREACH CENTER

Growing season precipitation during 2016 and 2017 was above average measuring 28.8 and 22.5 inches, respectively. Consequently, only small amounts of irrigation water were necessary. During 2016, water application amounts were 0.7 inch for the limited, 1.2 inch for the full, and 1.5 inch for the excess treatment. Likewise, during 2017 water applications amounts were 1.2 inch for the limited, 2.4 inch for the full and 3.0 for the excess treatment. Above average growing season precipitation coupled with no extended dry period during either growing season resulted In no significant treatment differences for corn or soybean yield (Figure 3).

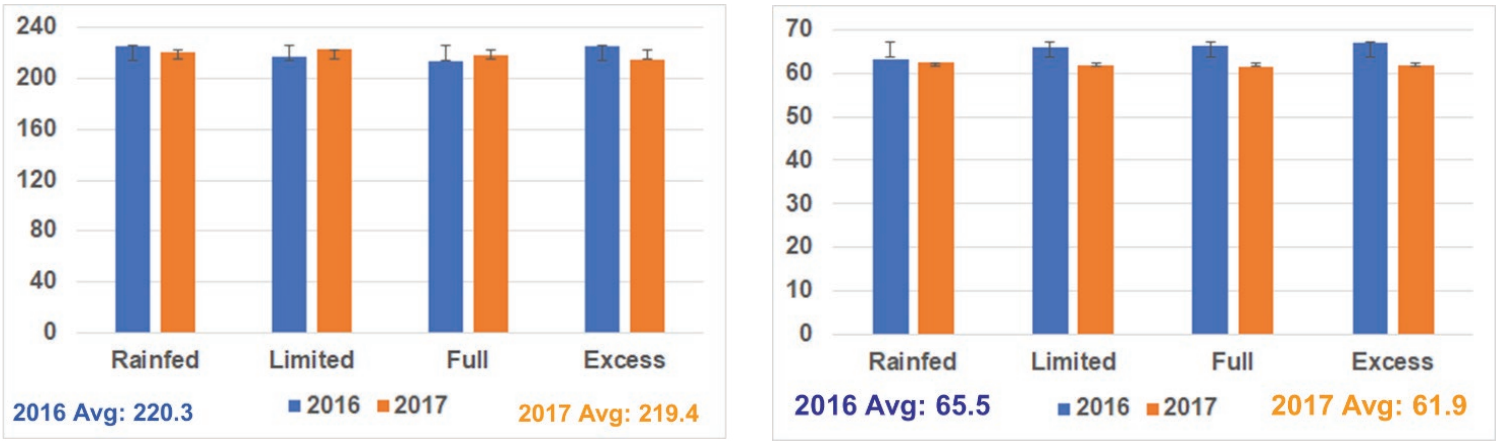

Figure 3. Corn yield (left, bu/ac) and soybean yield (right, bu/ac) during 2016 and 2017 for rainfed, limited, full, and excess irrigation treatments.

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

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