POTENTIAL IMPACT OF DRAINAGE WATER RECYCLING IN IOWA

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Managing Water for Increased Resiliency of Drained Agricultural Landscapes
The project covers ten states
Issue 1: Nutrient loss from tile drainage is causing issues of national concern.
Issue 2: Despite excess water in spring, yields are often limited by lack of water in late summer.
Retaining drained water at the farm and field level addresses both these issues
Long term vision:

The process of designing and implementing ag drainage will be transformed to include water retention and even water recycling.
We can store water in the field

Photo: TransformingDrainage.org
Controlled drainage
We can store water at the field’s edge

Photo: Chris Hay
Saturated buffers
We can store water in ponds or reservoirs
Drainage water recycling
Research sites are a mix of new, existing, and historical.

The database now holds 186 site-years of data from historic and current drainage projects.
Project goals are to convert research results into usable tools and information

Field Research

Strengthen and Broaden the Network (Researchers, Industry, Contractors, Agencies)
"If we’re going to transform drainage, we need partners"
Modeling will allow us to extend the results across space and time
DWR Feasibility

Demand

Supply

Impact
Calculated Irrigation Requirement
Net irrigation requirement

- Precipitation
- Evaporation
- Transpiration
- Evapotranspiration

Photo: United Soybean Board
Crop evapotranspiration

Reference ET

Crop ET

Photo: Chris Hay

Graphic: Kansas State University
Effective precipitation (TexasET Network):

- Assume first 0.1 inch of rain is lost to evaporation
- Full credit for rain between 0.1 and 1.0 inch
- 2/3 of rain between 1 and 2 inches
- Assume rain above 2 inches is lost to runoff, drainage, or deep seepage
Study sites consisted of ISU Ag Met weather station sites.
Results
Mean growing season ET at Ames was 22 in.
Mean growing season effective precipitation was 16 in.
Mean growing season NIR was 6.4 in.
Gilmore City mean drainage depth was 8.9 in.
Mean cumulative deficit at Ames was 1.6 in.
Soybean irrigation requirement ranged from 4.1 in. to 10.2 in.
Corn irrigation requirement ranged from 4.5 in. to 10.6 in.
Modeled Irrigation Requirement
What is the water-limited yield gap?

- **Yield potential**
  - CO₂
  - Solar radiation
  - Temperature
  - Genotype
  - Crop canopy

- **Attainable yield with available water supply (rainfall, irrigation)**

- **Limit factors:**
  - Water
  - Nutrients
  - Pests
  - Others

Source: Yang et al. (2016)
Four sites modeled in areas with significant drainage
Soils

Ames: Clarion loam

Castana: Onawa silty clay

Nashua: Kenyon loam

Sutherland: Galva silty clay loam
Inputs

- Plant date: 4/23
- GDD maturity: 2650
- Plant pop.: 34,000
- Max. root depth: 60 in.
- Top soil moisture: 75% AW
- Subsoil moisture: 100% AW
- Residue coverage: 30%
- Slope and drainage class per soil

Photo: Chris Hay
NASS county average yields were used to calibrate inputs and as a reality check.
Modeled irrigation requirements were much less because of stored soil moisture.
Irrigation needed in 12 to 20 years out of 23
Greatest need and greatest benefit at Castana and Sutherland
Mean water yield gap ranged from 22 to 64 bu./ac.
Next steps:

Integrate Drainage Water Recycling Evaluation Tool and crop modeling

Evaluate different irrigation scenarios

Evaluate the economic feasibility of drainage water recycling
In summary:

- There was an irrigation requirement in 12 to 20 years out of 23

- Mean irrigation requirement ranged from 1.4 to 3.3 inches

- There is generally adequate drainage water to meet demand

- Results suggest potential yield impacts of 22 to 64 bu./ac.

Questions?