Swarm Technology and Real-Time Drain Water Management

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Goal: Manage Ag Watershed Hydrology to Improve Ecosystem Services

PARTNERS

- Ecosystem Services Exchange
- Agri Drain Corporation
- EmNet
- Great Lakes Protection Fund
- Kieser & Associates, LLC
- Nicholas H2O
- Reetz Agronomics
- The Nature Conservancy
- University of Notre Dame

Ag Nutrient/Water Problems

- **System**: Aquatic ecosystems (streams, rivers, lakes, coastal waters
- **Stress**: Nutrient pollution
- **Source of Stress**: Fertilizer/Manure via runoff, tiles
- **Strategy**: Improve water flows by optimizing drainage for agriculture and clean water

Western Lake Erie Basin: 7.2MM acres 600K miles tile; 15K miles ditches

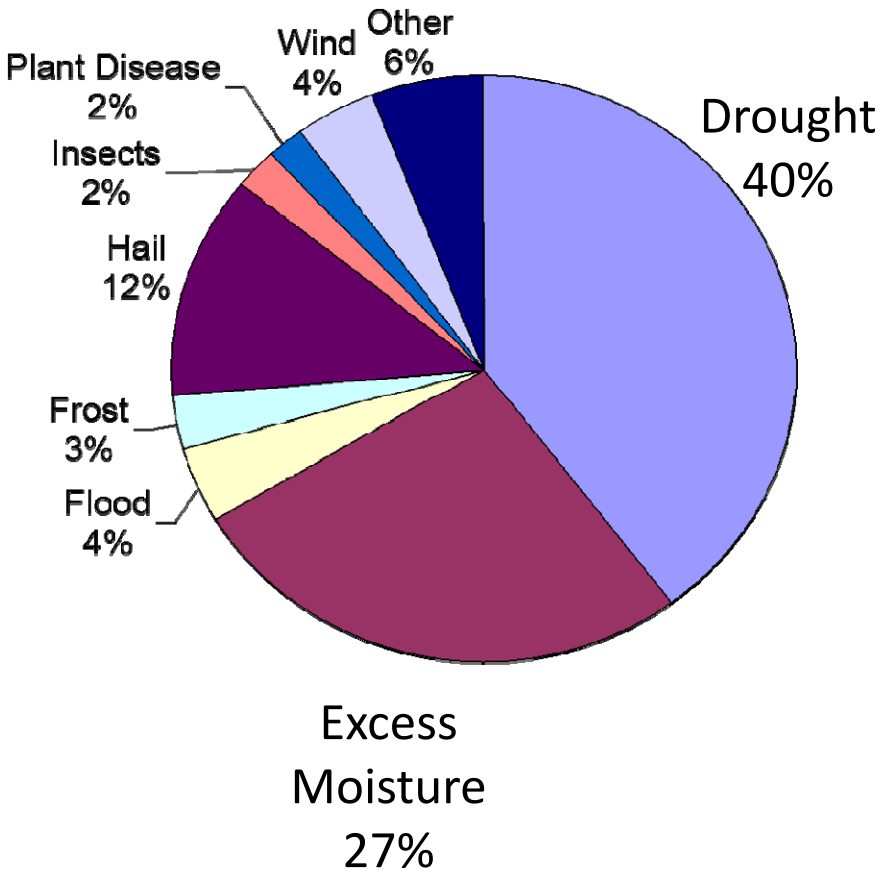
Intense Concentrations

Large Scale Impact

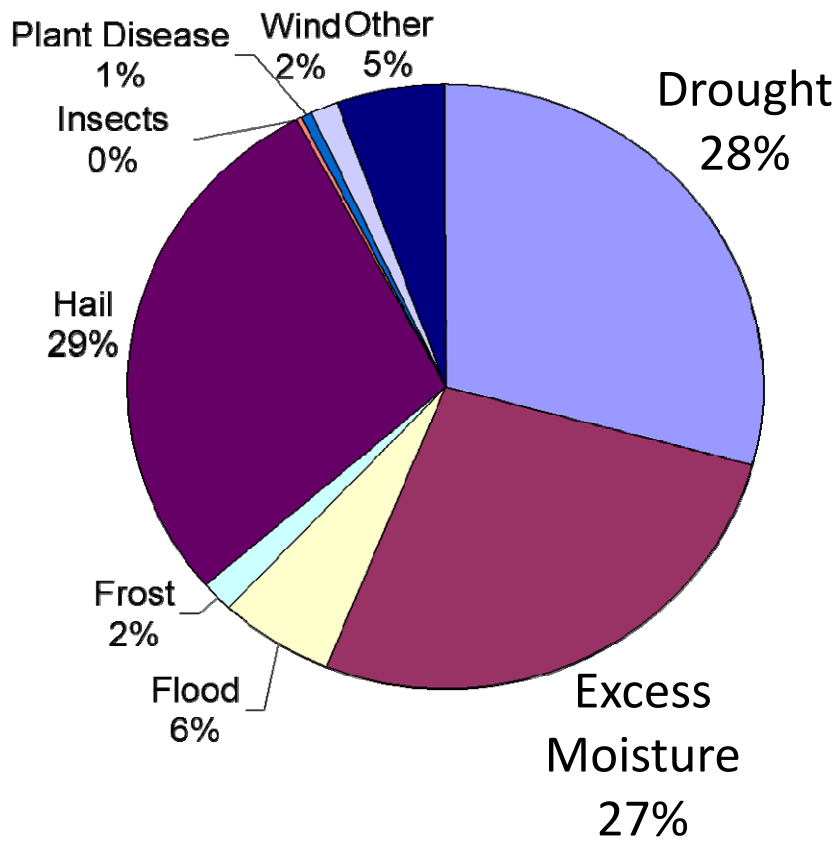
Water Flow “Drives” the Agronomic and Aquatic Systems

- WLEB 2011
  - Record Algal Blooms/Record Spring Rains
- WLEB 2012
  - No Algal Blooms/Very Dry Spring

Causes of Loss for Iowa Corn 1948-2010

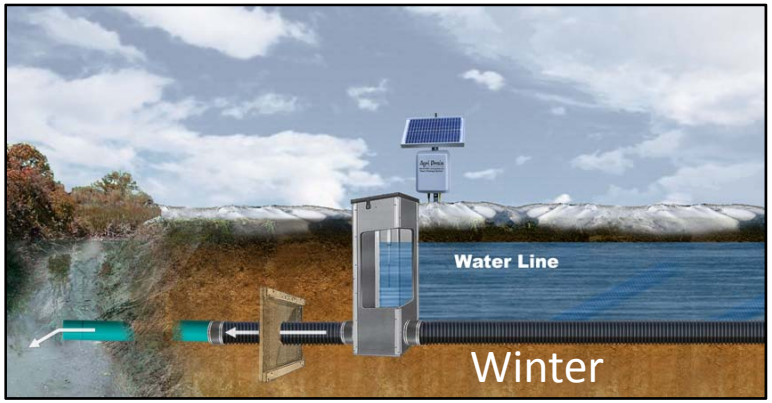


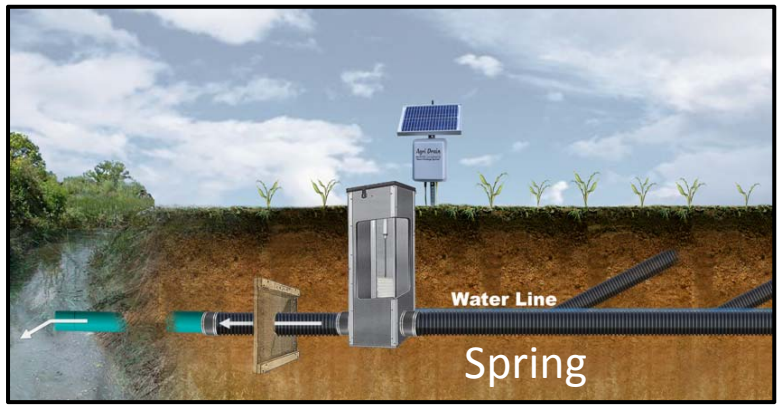
Causes of Loss for Iowa Soy, 1955-2010



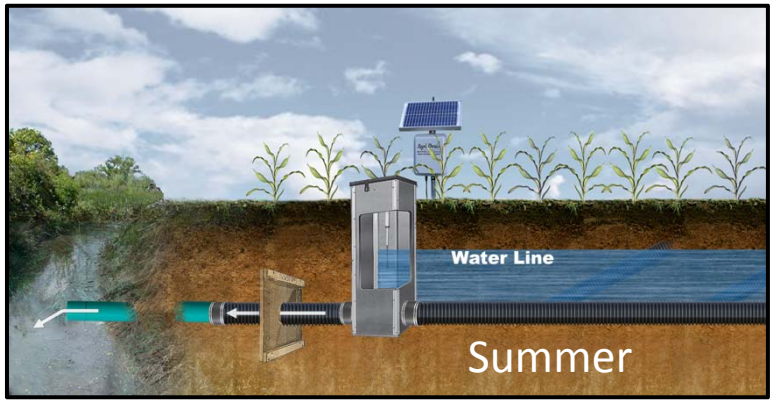
Charts courtesy of Chad Hart, Managing Risk in Agriculture, Iowa State University, June 2013

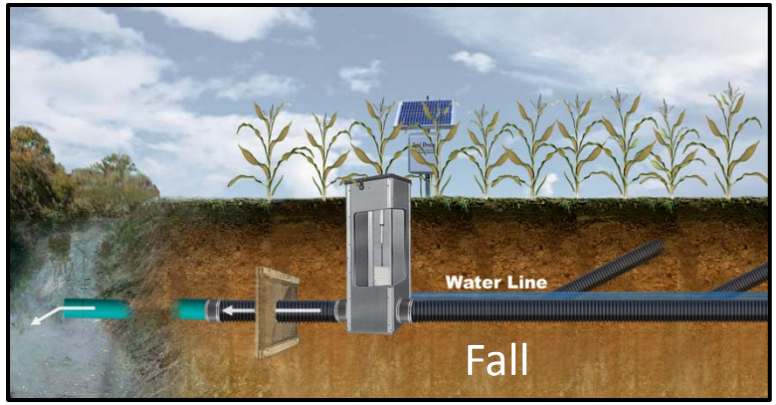
Drainage Water Management (Real Time)





Seasonal Schedule





Drain Water Management

- Proven conservation practice
- Not yet widely adopted
- Not managed to agronomic or environmental potential

  (Vast majority of today's tile system is still free-flow)

Have you wondered why……? Advantages to Collective Behavior

“Swarm” Technology

- Processing many signals simultaneously to reach some collective, optimum outcome
  - Medicine
  - Water Utility Storm Systems

What if ……?

Swarm Technology

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<u>Real-Time Drain Water Management</u>

* Improve environmental performance
* Improve crop production/ROI
* Manage risk

“Swarm” RT DWM Application in Ag Watersheds

Agronomic and Environmental Desired Conditions established

Anticipates, Measures, Integrates, Distributes Information

Manage Network of Tile Drain Outlets

Farm field- to Watershed-Scales

Optimizes Agronomic and Ecosystem Conditions

“Swarm” RT DWM Components

- Real-time Sensors (soil moisture, water levels, nutrients
- Real-time Drain Control Structures (remotely controlled drain tile units)
- Optimization Program (“swarm” data processing)
- Wireless Communication Network (knits together flow of information to structures)

Quantification

- Optimization decisions determined by agronomic and environmental goals
- Quantification allows for transactions (e.g. nutrient trading)
- Quantifiable goals inform management decisions

Last Word

- Field Testing
  - Technology
  - Behaviors
  - Agronomic and Environmental Impact (“Move the needle”?)
- Scaling
  - Significant scale potential
  - Anticipate phased adoption over long-term
  - Not silver bullet; couple with other BMP