Benefits Down the Drain: Improving water quality and crop yields by managing your drainage

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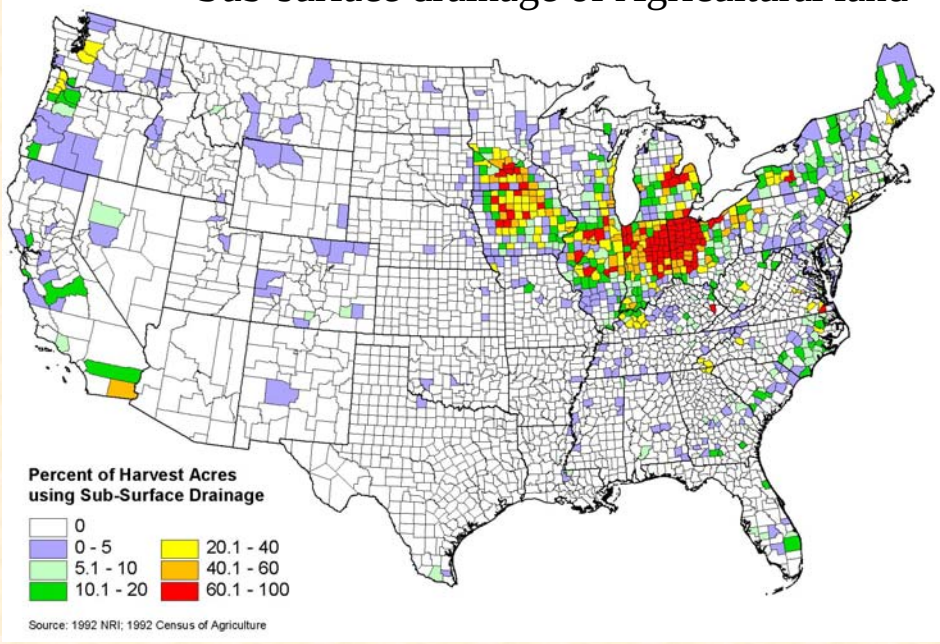
Ames, IA

The Midwest cornbelt is a drastically modified landscape.

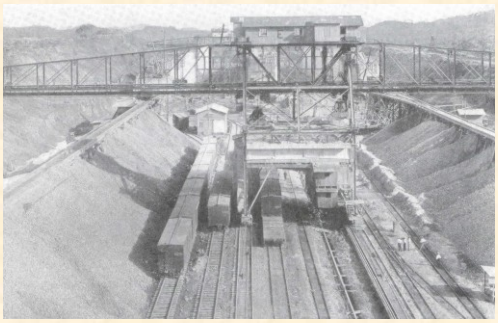
Sub-surface drainage of Agricultural land



The Midwest cornbelt is a drastically modified landscape.

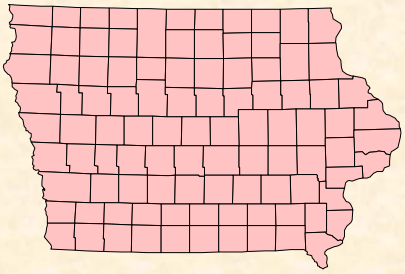
- Drained land in cornbelt = 51 x 10^6 ac.
- Total irrigated land in US = 57 x 10^6 ac.

Investment in Agricultural Drainage



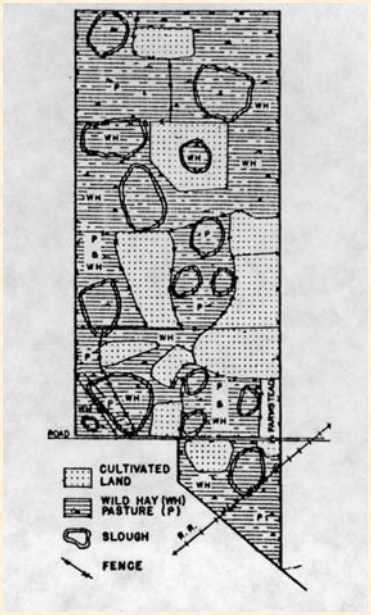
Panama Canal
$400,000,000

Drainage of Iowa
$450,000,000

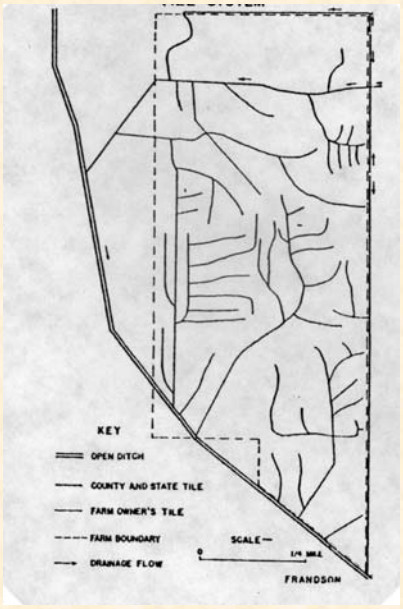


after F.W. Beckman, 1913

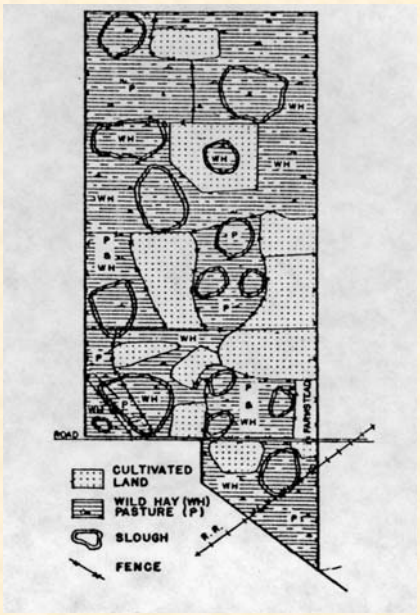
Frandsen farm ~ 1900



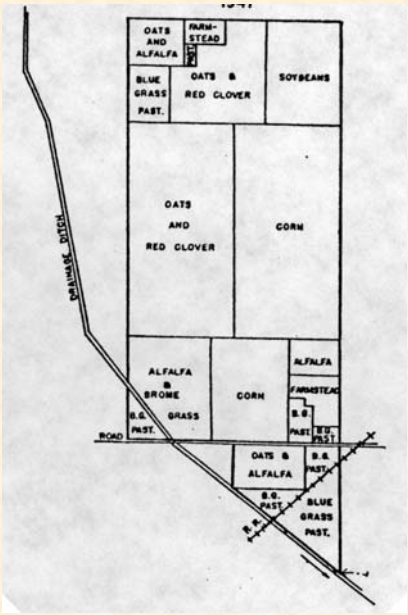
Drainage system



Pre-drainage, 1900



After drainage, 1947



Frandsen farm today

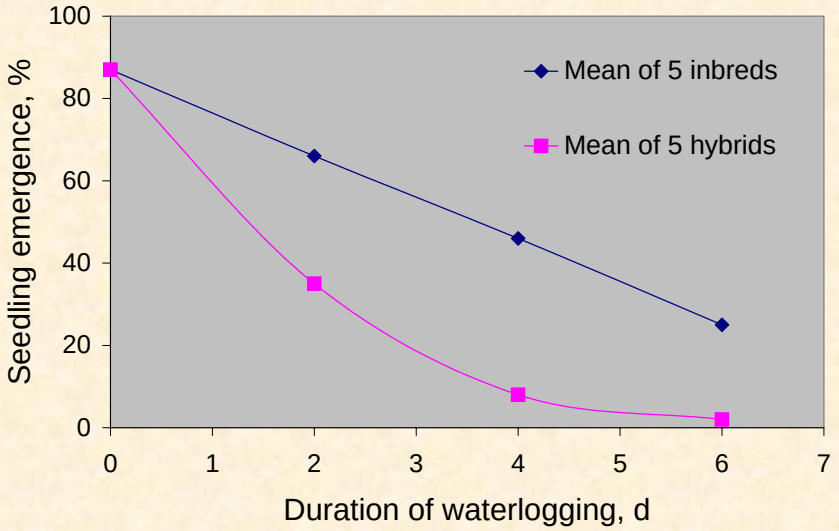
Why do we drain?

- Remove surface water
- Lower water table
- Remove excess salts

Benefits of improved drainage

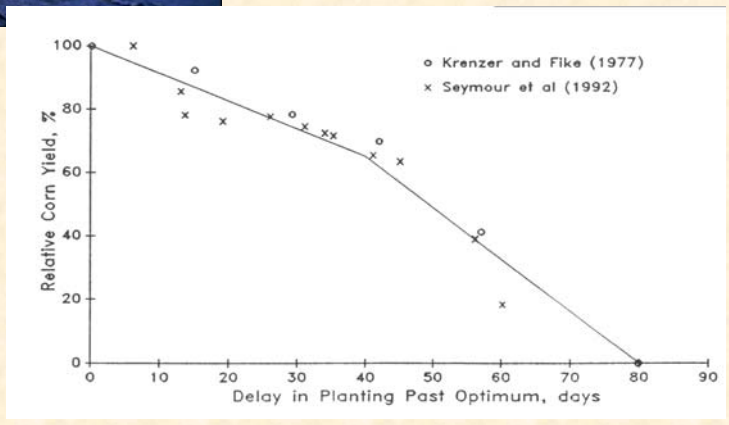
- Less flooding in low areas
- Less surface runoff
- More time for performing field operations
- Improved soil structure
- Enhanced rooting depth
- Higher yields
- Improved crop quality
- Greater fertilizer efficiencies, esp. N
- Human health

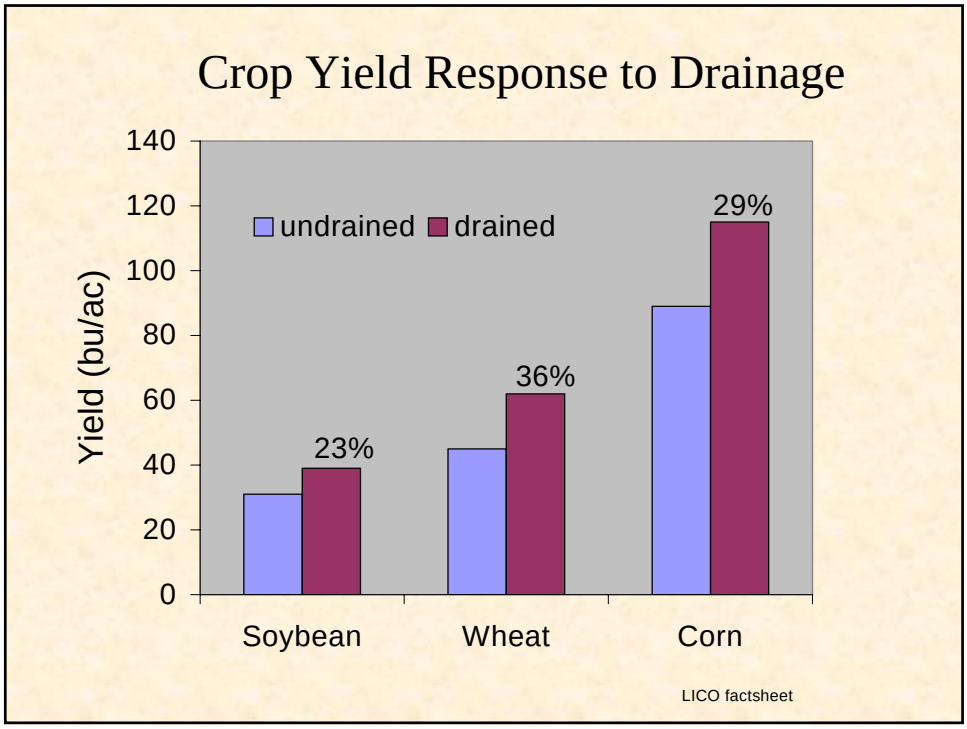
Effect of Water-logging on Corn Emergence

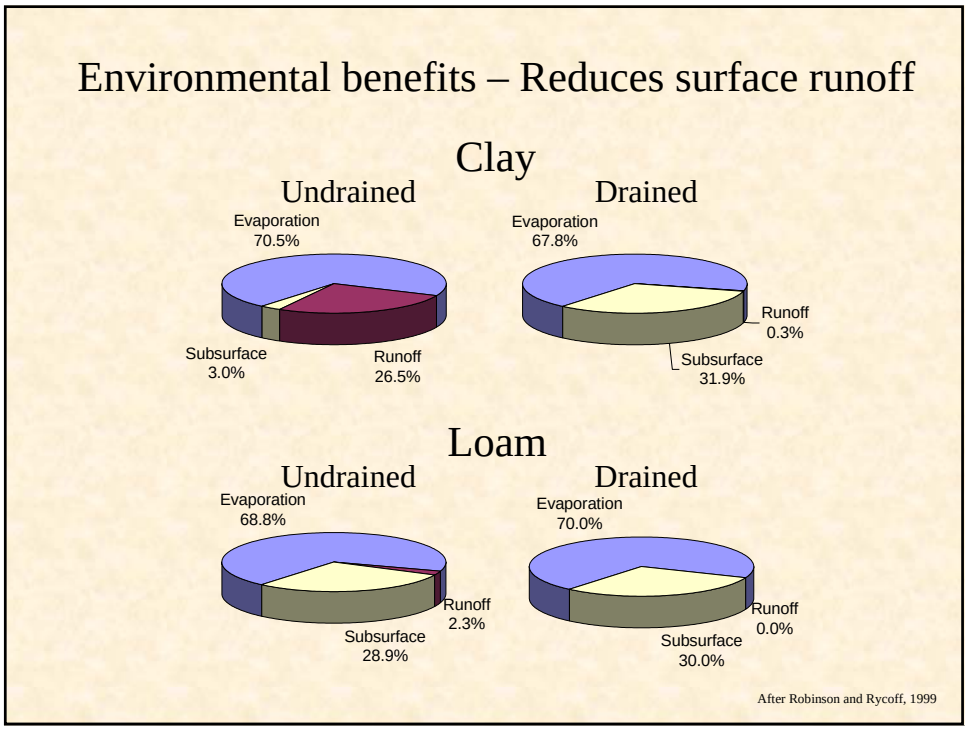


after Fausey et al., 1985

Improved Trafficability







Disadvantages of improved drainage

- More rapid recharge of rivers
- Possible loss of needed soil moisture
- Rapid conveyance of agricultural chemicals to surface waters.

Increased Stream Flooding

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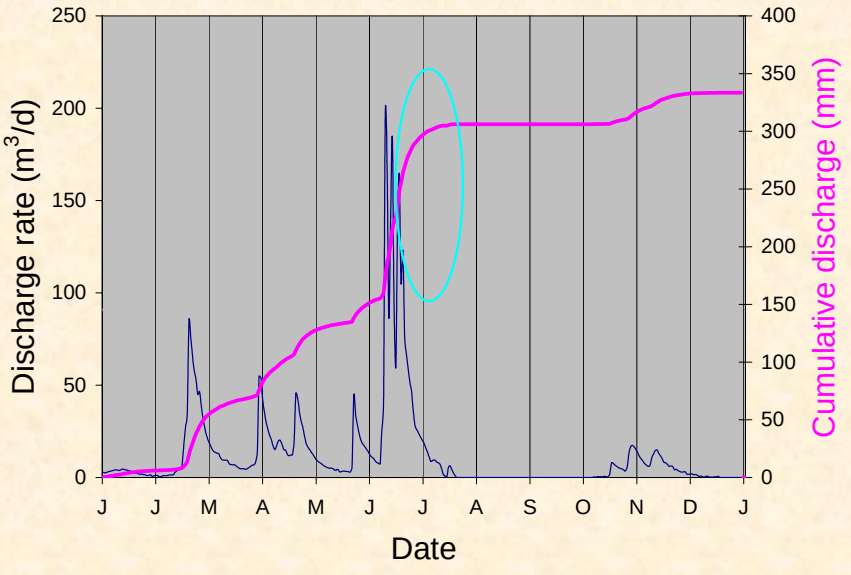
- Rapid conveyance of agricultural chemicals to surface waters.

Loss of soil moisture



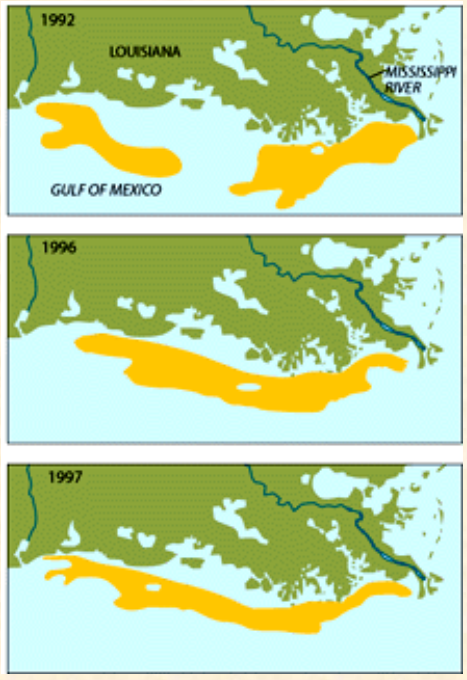
Disadvantages of improved drainage

- More rapid recharge of rivers
- Possible loss of needed soil moisture
- Rapid conveyance of agricultural chemicals (nitrate) to surface waters.

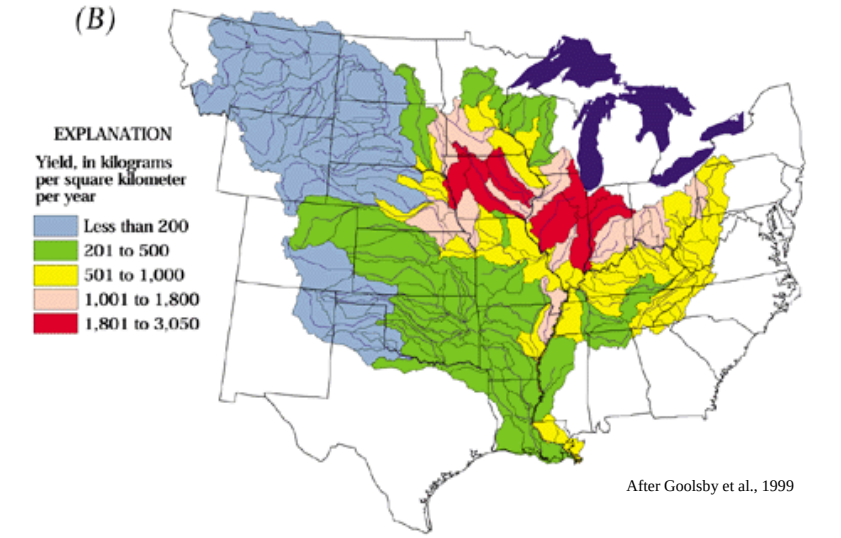
Health hazards of nitrate in drinking water

- Methemoglobinemia ("blue baby syndrome")
- Potential birth defects
- Formation of carcinogenic nitrosamines and nitrosamides (Neill, 1989)

Hypoxia in the Gulf of Mexico



N sources areas for the Gulf



Approaches for reducing nitrate concentrations in tile drainage:

- CROP MANAGEMENT
  - Change from corn/soybean rotation.
  - Improve N fertilizer management recommendations (improved timing, soil tests, plant sensors, accounting for all N sources, modeling, variable rate application).
  - Using cover or catch crops.

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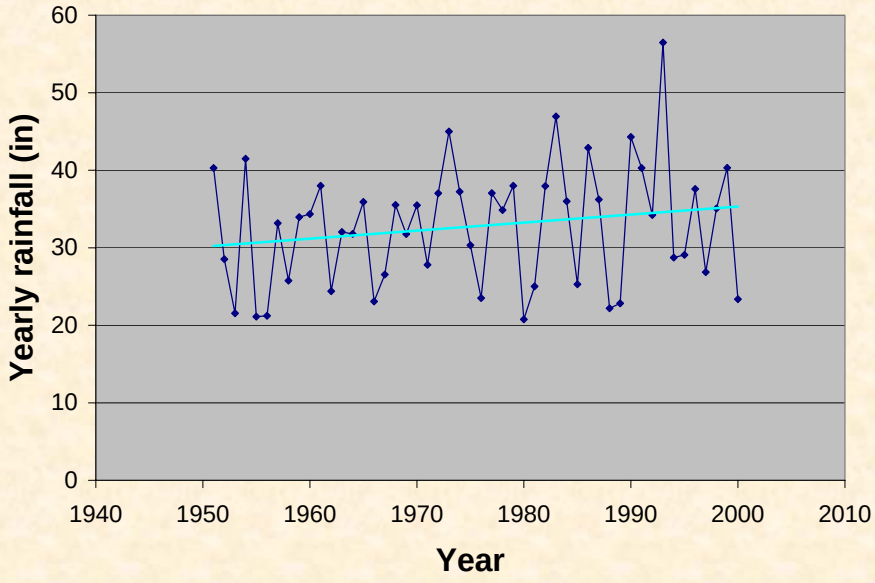
- FIELD MANAGEMENT
  - Remove or close drains

50 Year Precipitation Trend, Ames, IA



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- FIELD MANAGEMENT
  - Remove or close drains
  - Install buffers, biofilters, and end of pipe systems.

Buffers and riparian areas

Tile outlet = short circuit

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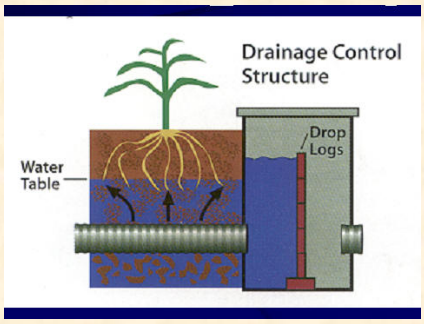
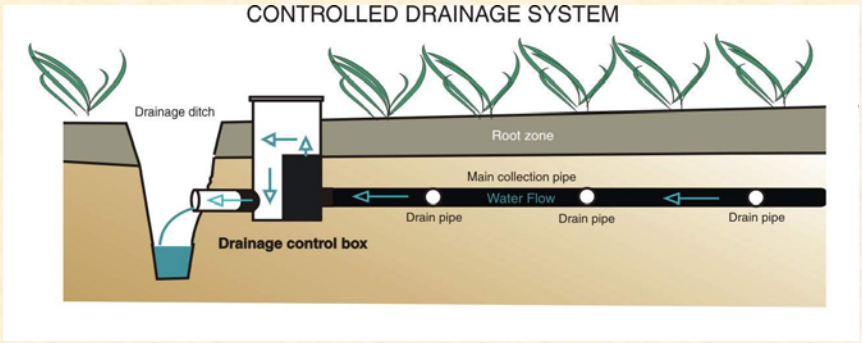
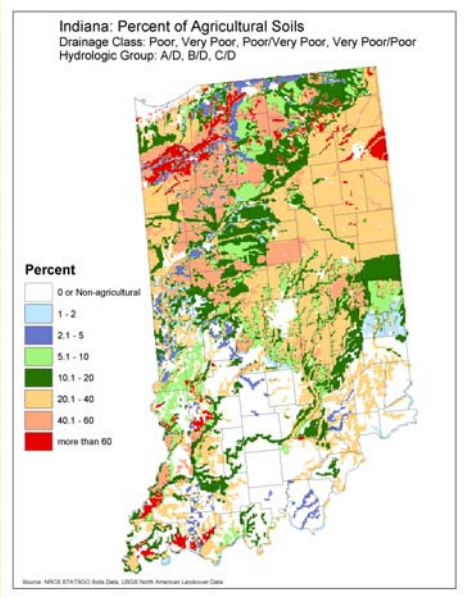
- FIELD MANAGEMENT
  - Remove or close drains
  - Install buffers, biofilters, and end of pipe systems.
  - Drainage system redesign.

Add drainage control to manage watertable depth and thus reduce losses of water and nutrients



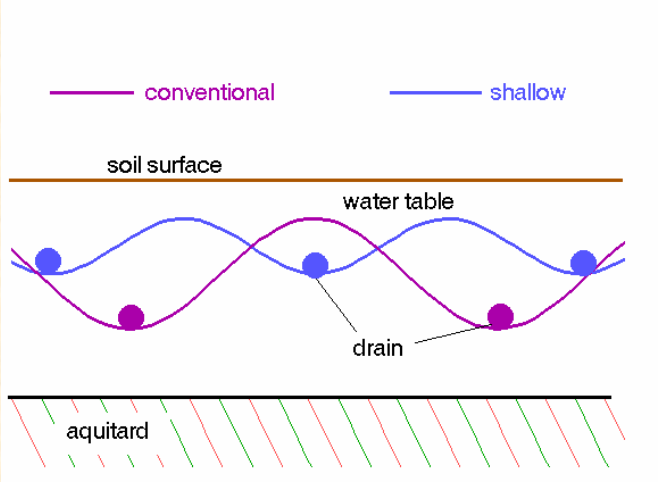


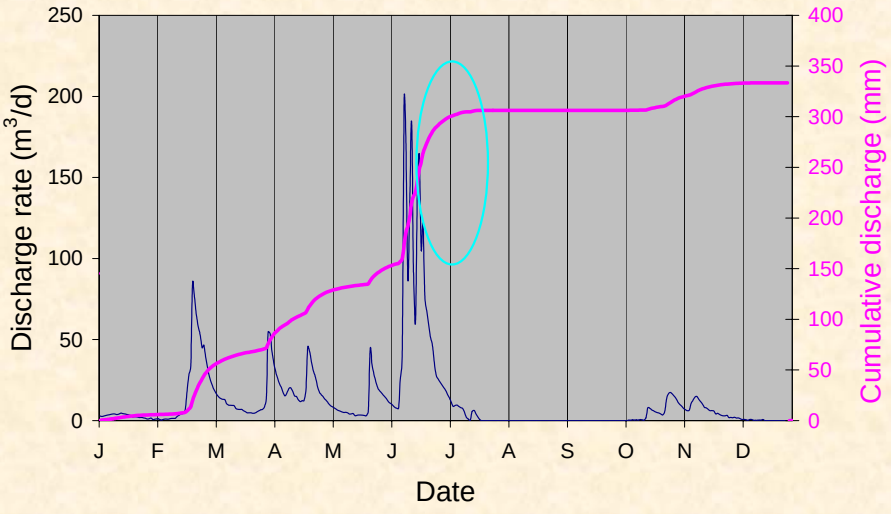
Indiana Soils Suitable for Controlled Drainage

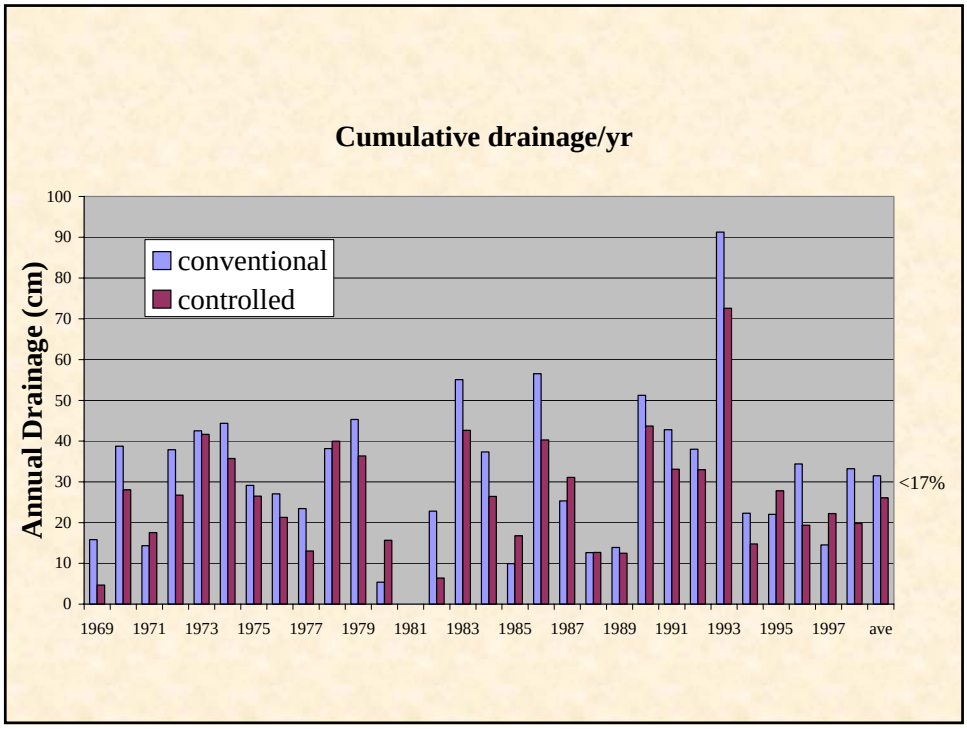


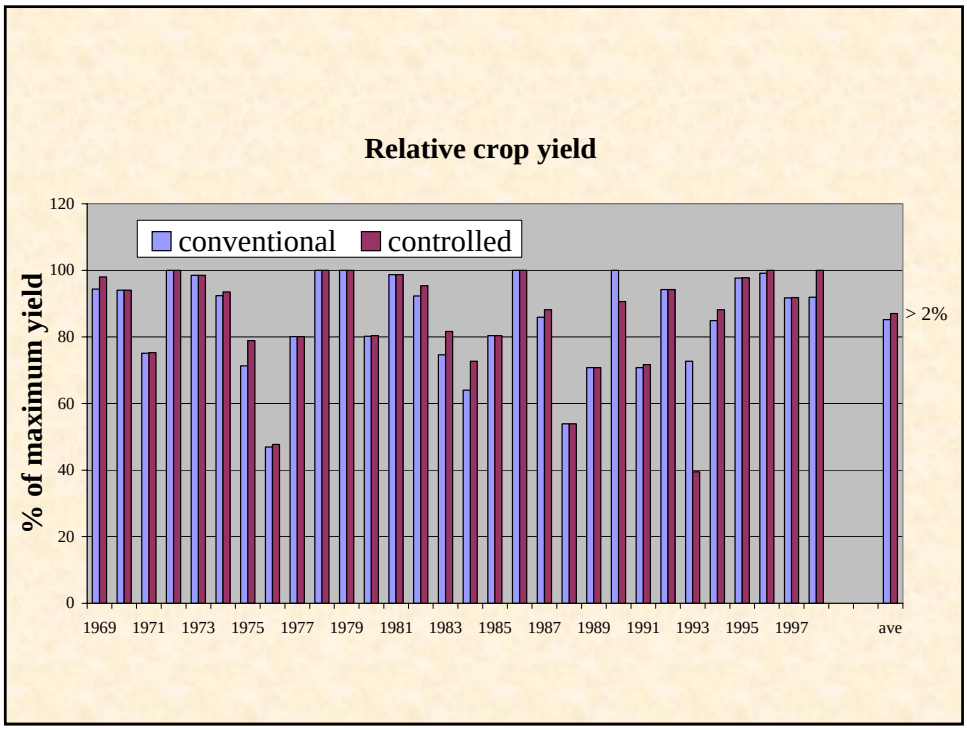
Install Shallower Drains to Prevent Over-drainage and Conserve Water and Nutrients for the Crop.

Less water drained for same water table control

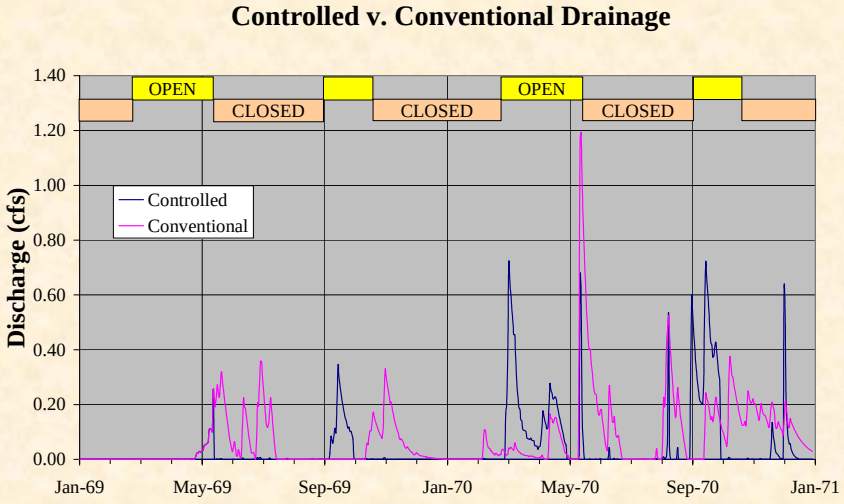








Can Manage Drainage During Winter for Even Greater Water Quality Benefits



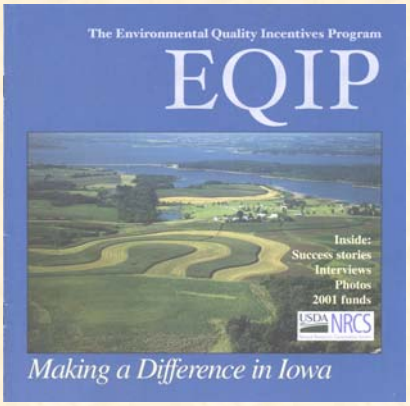
Nitrate Load Reductions under Controlled Drainage

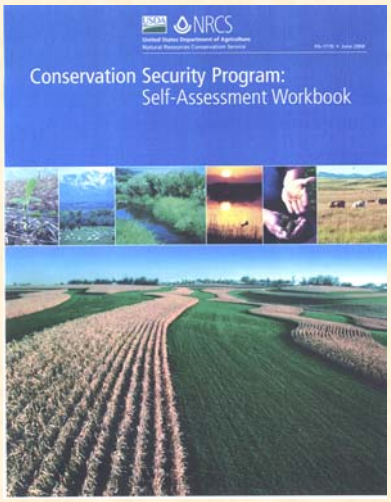
- IA simulations – 17%
- MN plot studies – 50%
- IL field studies – 50%
- NC plot &field studies – 40-50%

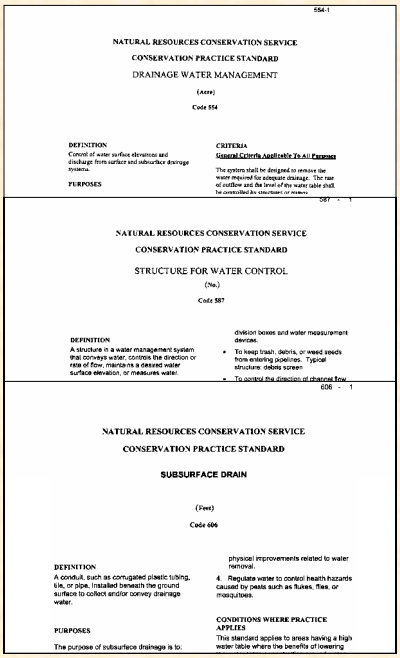
Nitrate Load Reductions under Shallow Drainage

- MN plot studies – 15-20%
- IA calculations – 15%

NRCS Cost share programs







NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
DRAINAGE WATER MANAGEMENT
(Acre)
Code 554

DEFINITION
Control of water surface elevations and discharge from surface and subsurface drainage systems.

PURPOSES

CRITERIA
General Criteria Applicable To All Purposes

The system shall be designed to remove the water required for adequate drainage. The rate of outflow and the level of the water table shall be controlled by structures or means.

554 - 1

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
STRUCTURE FOR WATER CONTROL
(No.)
Code 587

DEFINITION
A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation, or measures water.

division boxes and water measurement devices.
- To keep trash, debris, or weed seeds from entering pipelines. Typical structure: debris screen
- To control the direction of channel flow

606 - 1

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
SUBSURFACE DRAIN
(Feet)
Code 606

DEFINITION
A conduit, such as corrugated plastic tubing, tile, or pipe, installed beneath the ground surface to collect and/or convey drainage water.

PURPOSES
The purpose of subsurface drainage is to:

physical improvements related to water removal.
4. Regulate water to control health hazards caused by pests such as flukes, flies, or mosquitoes.

CONDITIONS WHERE PRACTICE APPLIES
This standard applies to areas having a high water table where the benefits of lowering

NRCS Standard Practice 504 Drainage Water Management: Cost share for operating drainage control.

NRCS Standard Practice 587 Structure for Water Control: Cost share for installation of drainage control structures.

NRCS Standard Practice 606 Subsurface Drainage: Drainage for conservation benefit.

Summary

- Drainage has been an unqualified success for boosting crop yields.
- Drainage is primary pathway for nitrate entering surface waters of the Midwest.
- Drainage management (CD and SD) can reduce nitrate concentrations and loads to streams.
- CD and SD may also boost yields, especially in dry summers.
- Cost share programs can be used to offset cost of installation and management of CD and SD systems.