Water ReUse

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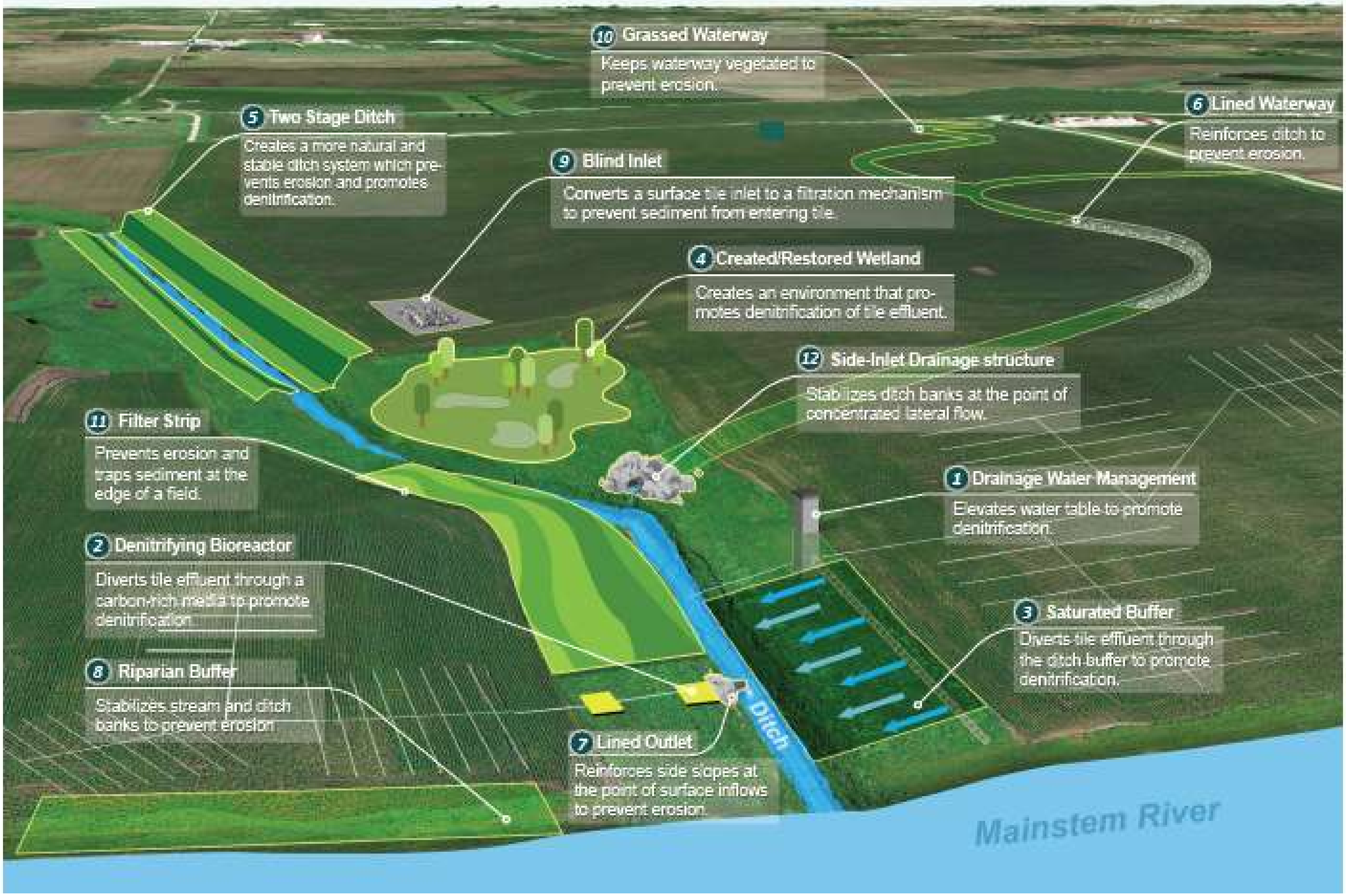
Agriculture Drainage Best Management Practices

This guide to agricultural drainage BMPs was generated in June of 2019 by Emmons & Olivier Resources to outline the most current and generally accepted drainage practices that will achieve reduction of phosphorus, nitrate, and/or sediment loading into Iowa's waters. The table (on the back of this page) provides a summary of the practices, their function in the watershed, and the applicable cost of pollutant removal. Below is an info-graphic depicting the locations of these practices on a typical landscape. Additional In-field & source reduction practices are not addressed here, but also present significant opportunities for water quality improvement & improved soil health.



Greenley Research Center
University of Missouri

MISSOURI CHAPTER LICA

USDA
United States Department of Agriculture
Natural Resources Conservation Service

University of Missouri Extension

Bobcat of Columbia

Agri Drain Corporation

Premium Ag Products

The Farm Shop

Crop Production Services

Prairieland FS, Inc.

Prins Insurance

ufg Insurance

Sydenstricker

United State Bank

AGPS

purple wave

ESE Ecosystem Services Exchange

Fratco

Prinsco — Engineered with Integrity

Springfield Plastics, inc.

Ennis Implement Co

Timewell Drainage Products

Landmark Irrigation and Drainage, Inc.

Hostetter Construction

Lance Construction

ADM

MissouriCorn — Planting Opportunity

Foley Equipment CAT

ADS

MFA Incorporated

Missouri Soybeans

Liles Enterprises, LLC

ZeaKal

Precision Tiling, LLC

Missouri Soybeans

LICA Contractors

- *Bauer Contracting Co.*
- *Bledsoe Farm's Custom Bulldozing & Excavating*
- *Gilbert & Sons Construction Inc.*
- *Gingerich Excavating & Hauling*
- *Holt Land Improvement LLC*
- *Hostetter Construction Co., Inc.*
- *K. Balkenbusch Construction Co.*
- *Krump's Ag Trenching*
- *L. Koenigsfeld Excavating*
- *Lance Construction*
- *Landmark Irrigation Inc.*
- *Liles Construction LLC*
- *Mera ExcavatingLLC*
- *Precision Tiling LLC*
- *Tom Lawlor Construction*
- *Witherow Construction*

Scheib Drainage Products, Inc.

Missouri One Call System

FCS Financial

COOP

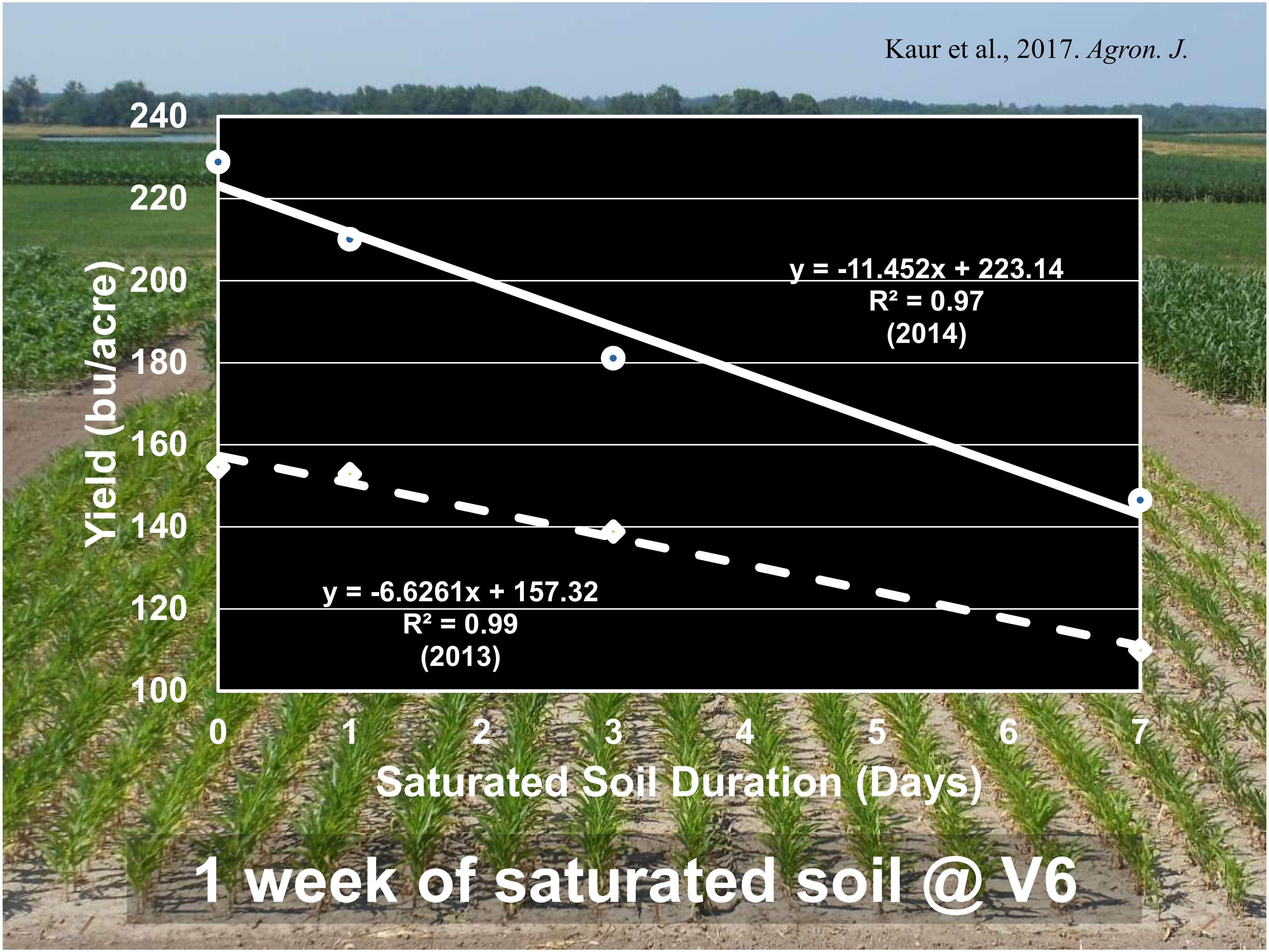
Knox County Farm Bureau

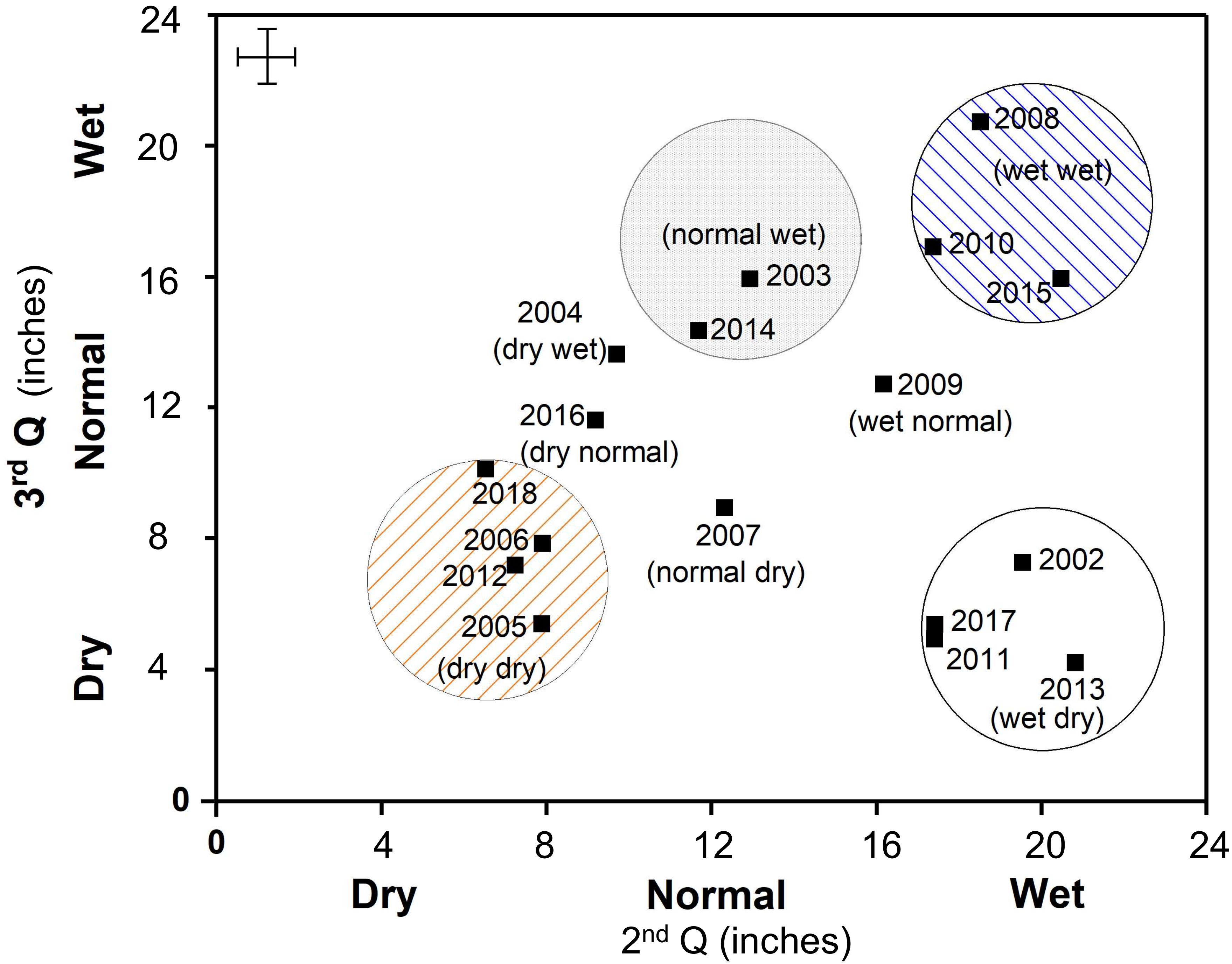
Precision Intakes, LTD

Sunbelt Rentals

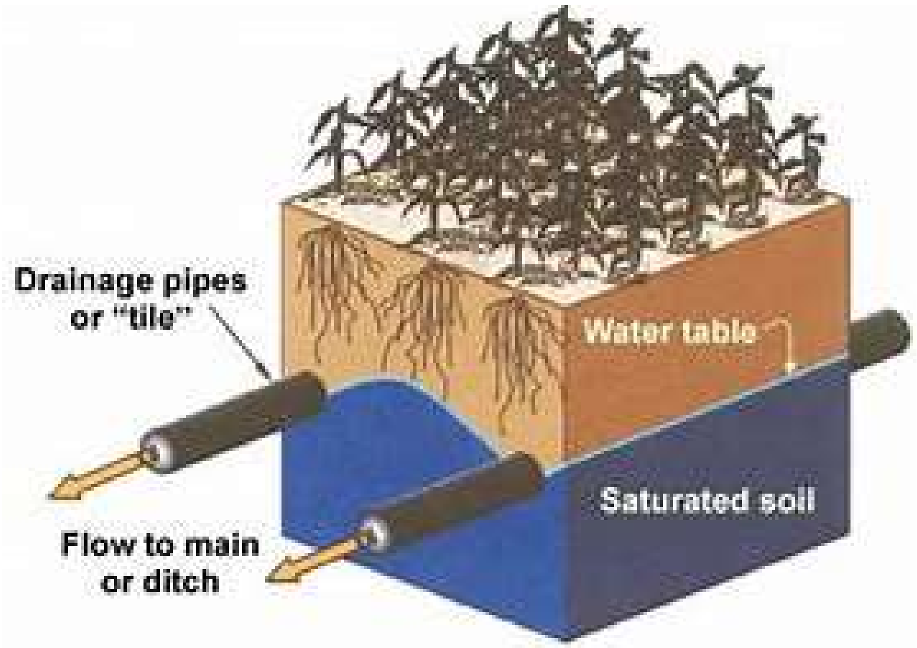
Vortex

….let the water under the sky be gathered to one place, and let dry ground appear….it was good. Genesis 1:9-10

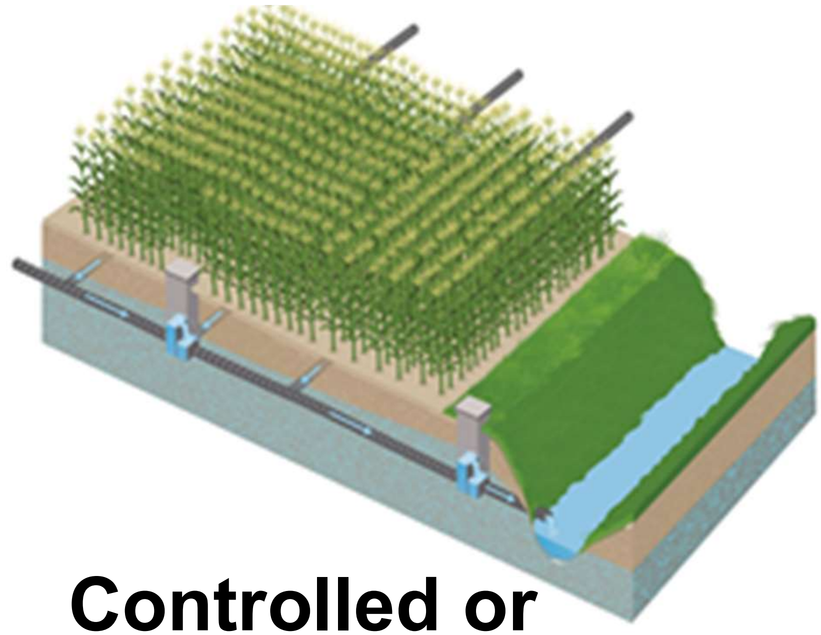

Kaur et al., 2017. Agron. J.
240
220
200
180
160
140
120
100
Yield (bu/acre)
y = -11.452x + 223.14
R² = 0.97
(2014)
y = -6.6261x + 157.32
R² = 0.99
(2013)
0
1
2
3
4
5
6
7
Saturated Soil Duration (Days)
1 week of saturated soil @ V6



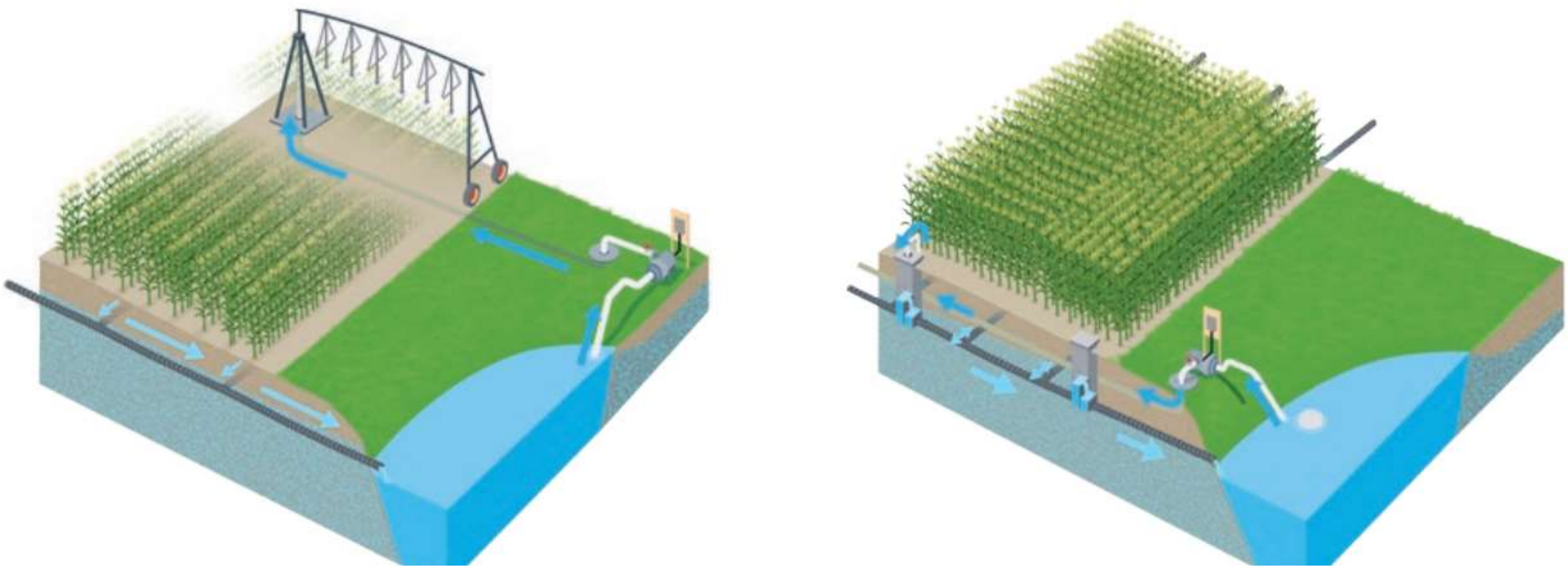
24
20
16
12
8
4
0
Wet
Normal
Dry
3rd Q (inches)
(normal wet)
2003
2014
2008
(wet wet)
2010
2015
2004
(dry wet)
2016
(dry normal)
2009
(wet normal)
2018
2006
2012
2005
(dry dry)
2007
(normal dry)
2002
2017
2011
2013
(wet dry)
0
4
8
12
16
20
24
Dry
Normal
Wet
2nd Q (inches)



Free Drainage



Controlled or Managed Drainage



Drainage Water Recycling

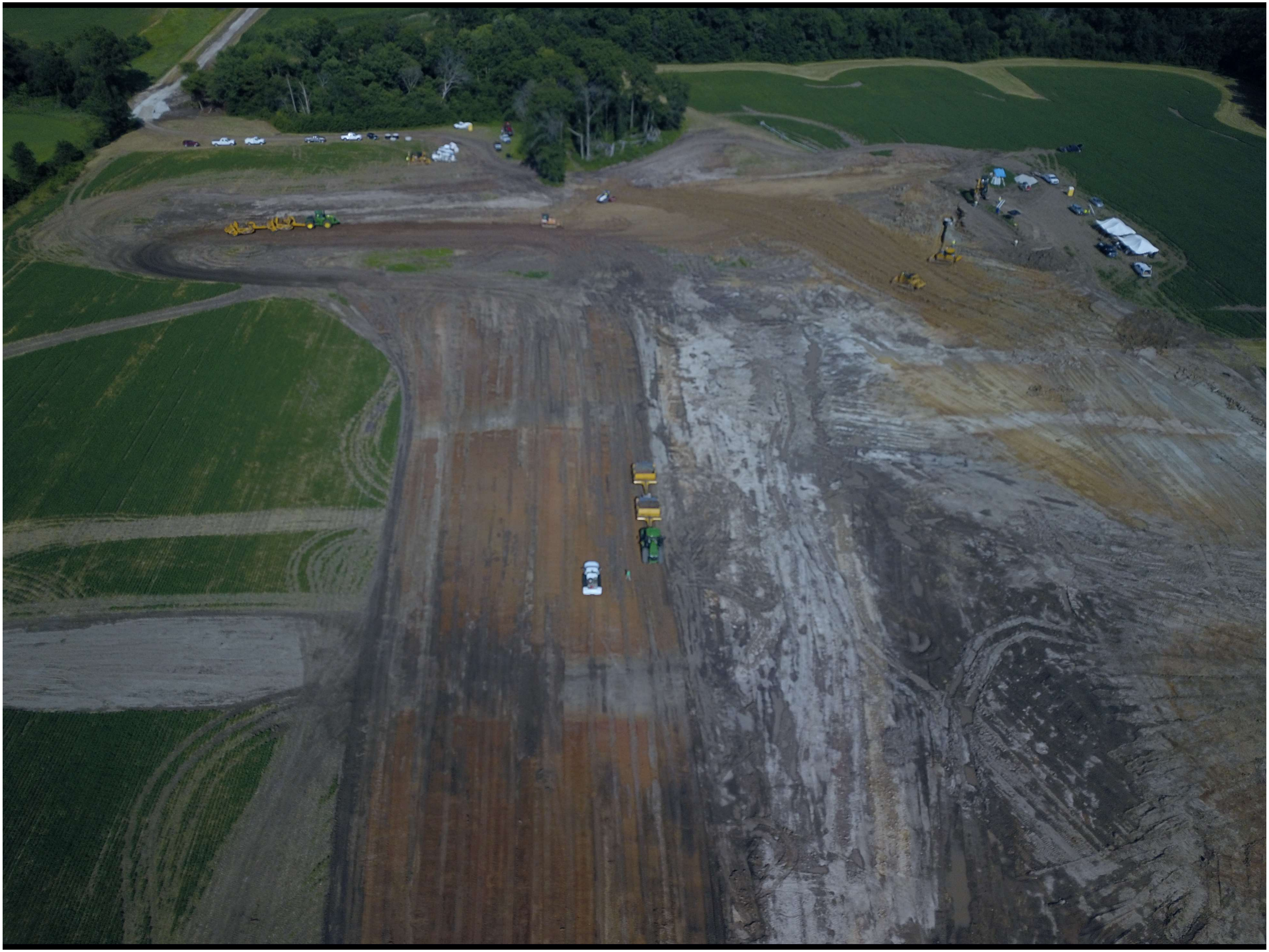
Site Selection

- Need for drainage
- During the winter and early spring, your soil has a shallow water table
- Soils have a grey color or mottling
- Slope, permeability, depth to bedrock, wetness classification

- Slope (<1%), permeability (> 1 inch/hr from 0-40 inches; < 0.02 inches/hr 40-60 inches deep), depth to bedrock (> 40 inches), and wetness classification (poor to poorly drained) (Belcher, 2002)

Benefits > Cost of the System

- How has the field been farmed?
- Closer spacing for shallow depths and the closer tile is to the impermeable layer
- Water supply: well, lake, river/stream, distance from supply
- Energy supply
- More costly than conventional drainage
- Good surface drainage, erosion controlled
- Farmer is capable of attaining good yields (timeliness, pop., pest control, nutrient management).



Proper Operation of the System

- Time to manage
  - Pump
  - Adjust WTC devices
  - Monitor water depth
- Yield reduction could result

- 3 modes of operation

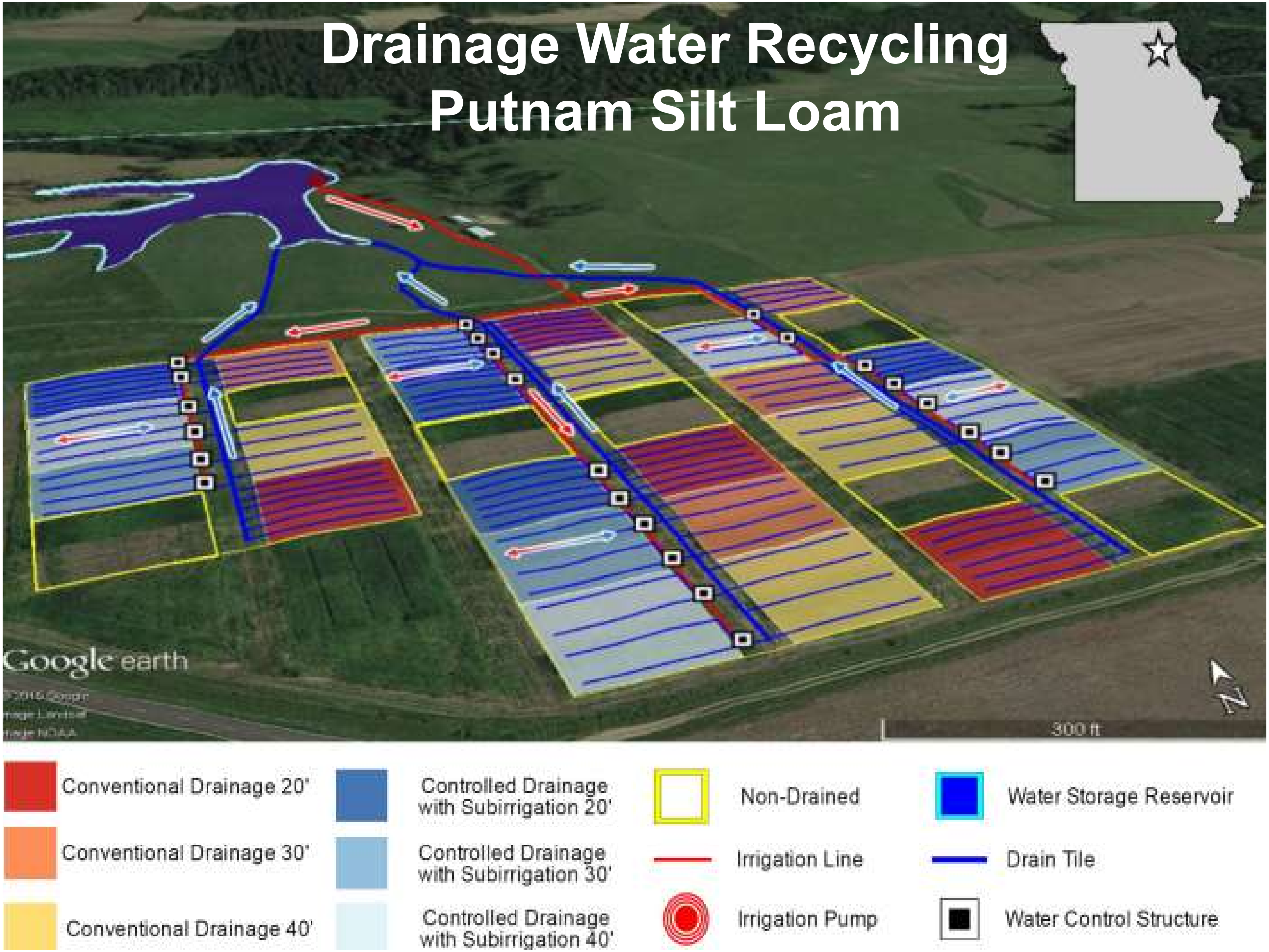
1. Subsurface drainage
2. Controlled drainage
3. Subirrigation

- What is required when it rains?


Agri Drain

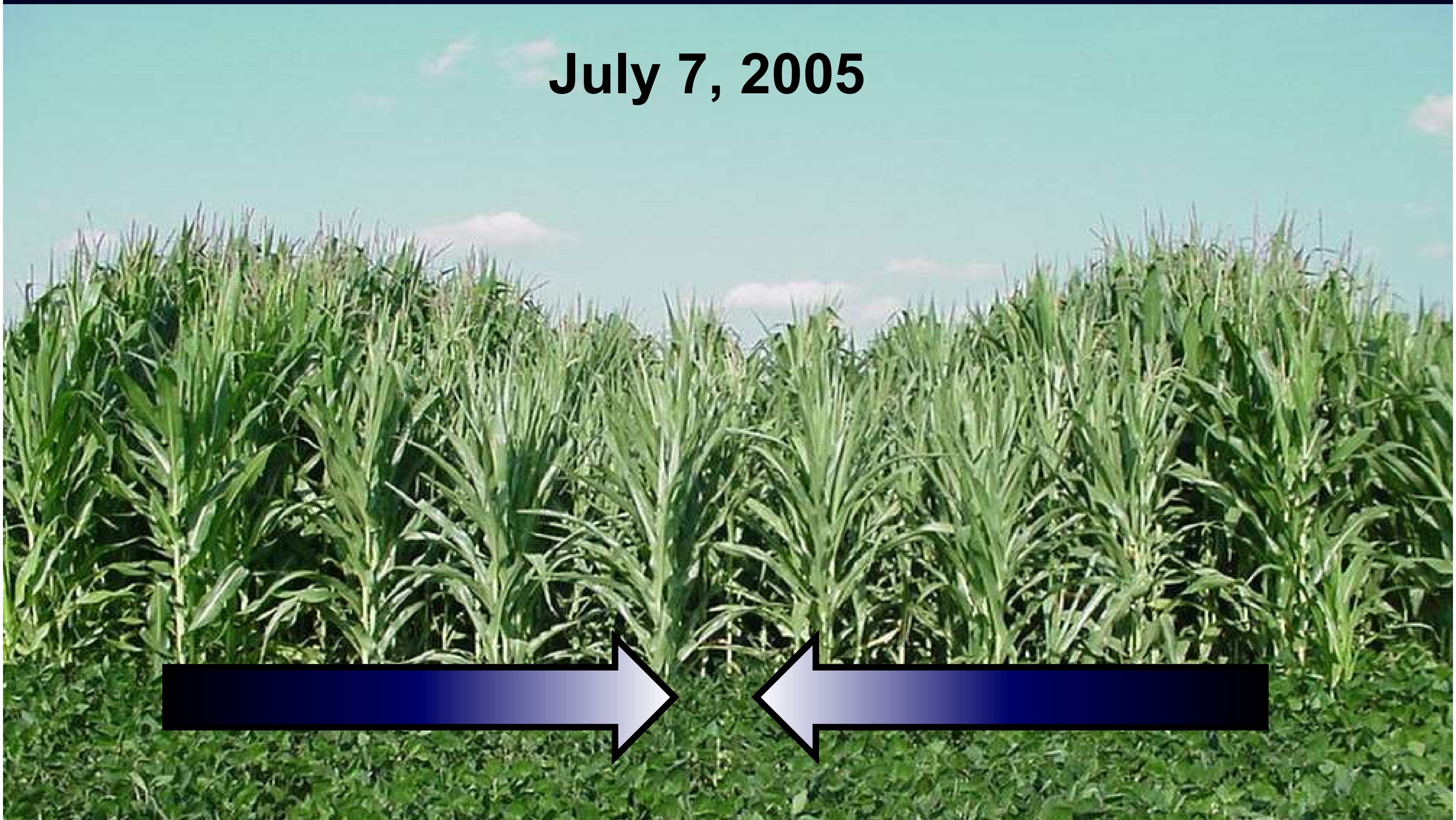
Operation

- Constant water table management
- Moist soil profile
- Capillary movement
- Simplest
- Plants do their own irrigation scheduling
- Works well for plants and water quality benefits
- Damage can occur

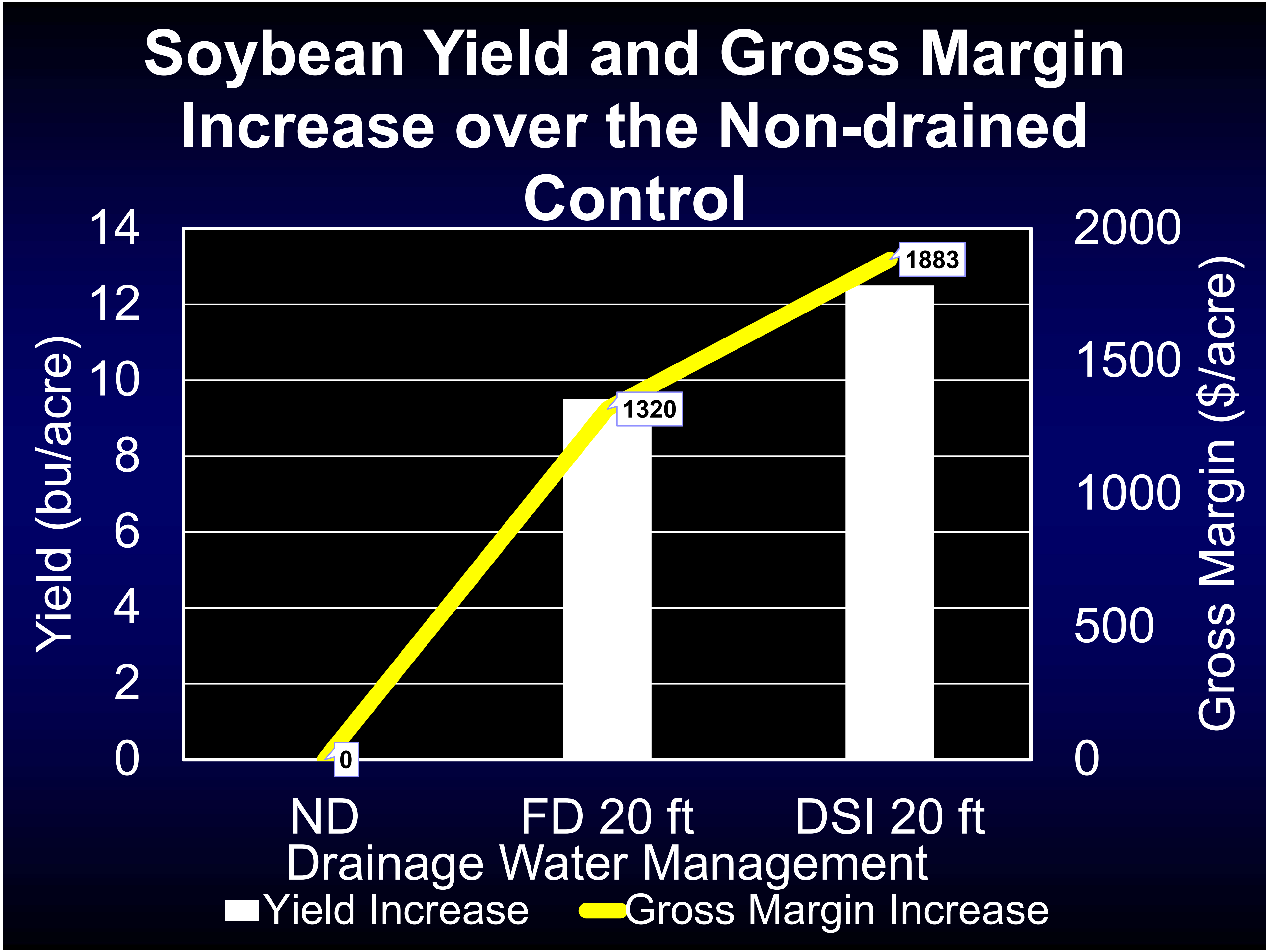

Drainage Water Recycling
Putnam Silt Loam
Google earth
300 ft
N
Conventional Drainage 20'
Conventional Drainage 30'
Conventional Drainage 40'
Controlled Drainage with Subirrigation 20'
Controlled Drainage with Subirrigation 30'
Controlled Drainage with Subirrigation 40'
Non-Drained
Irrigation Line
Irrigation Pump
Water Storage Reservoir
Drain Tile
Water Control Structure

Corn Response to Drainage (DO) and Subirrigation (DSI) (2002-16)

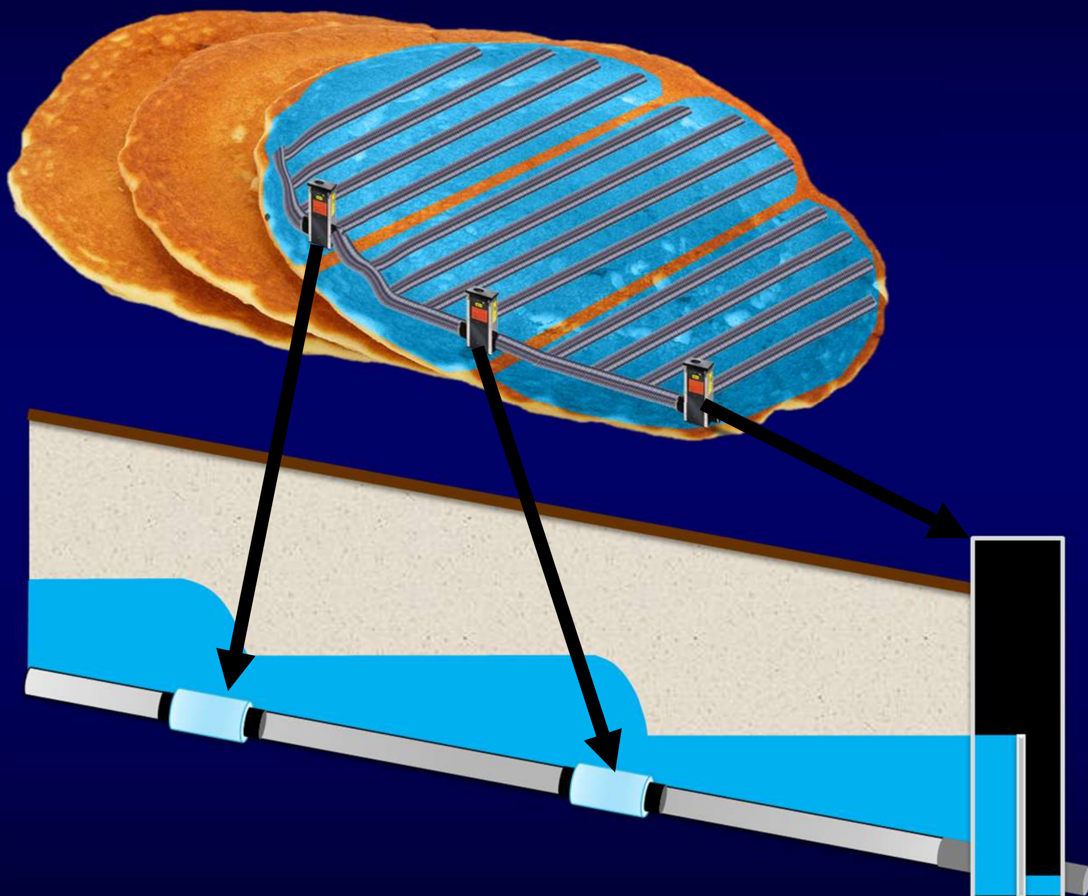
Year(s) and Environment	Yield increase		Gross margin	
	DO 20’	DSI 20’	DO 20’	DSI 20’
	---Bu/acre---		------- $/acre -----	
14: Dry-Wet	-4	-12	-16	-50
06,16: Dry-Moderate	15	33	66	238
02,05,12,13: Wet-Dry	14	70	236	1,180
03,07: Wet-Moderate	26	56	144	311
04,08-11,15: Wet-Wet	43	36	1,054	877
Average (bu/a) & Total ($)	26	50	$1,484	$2,556

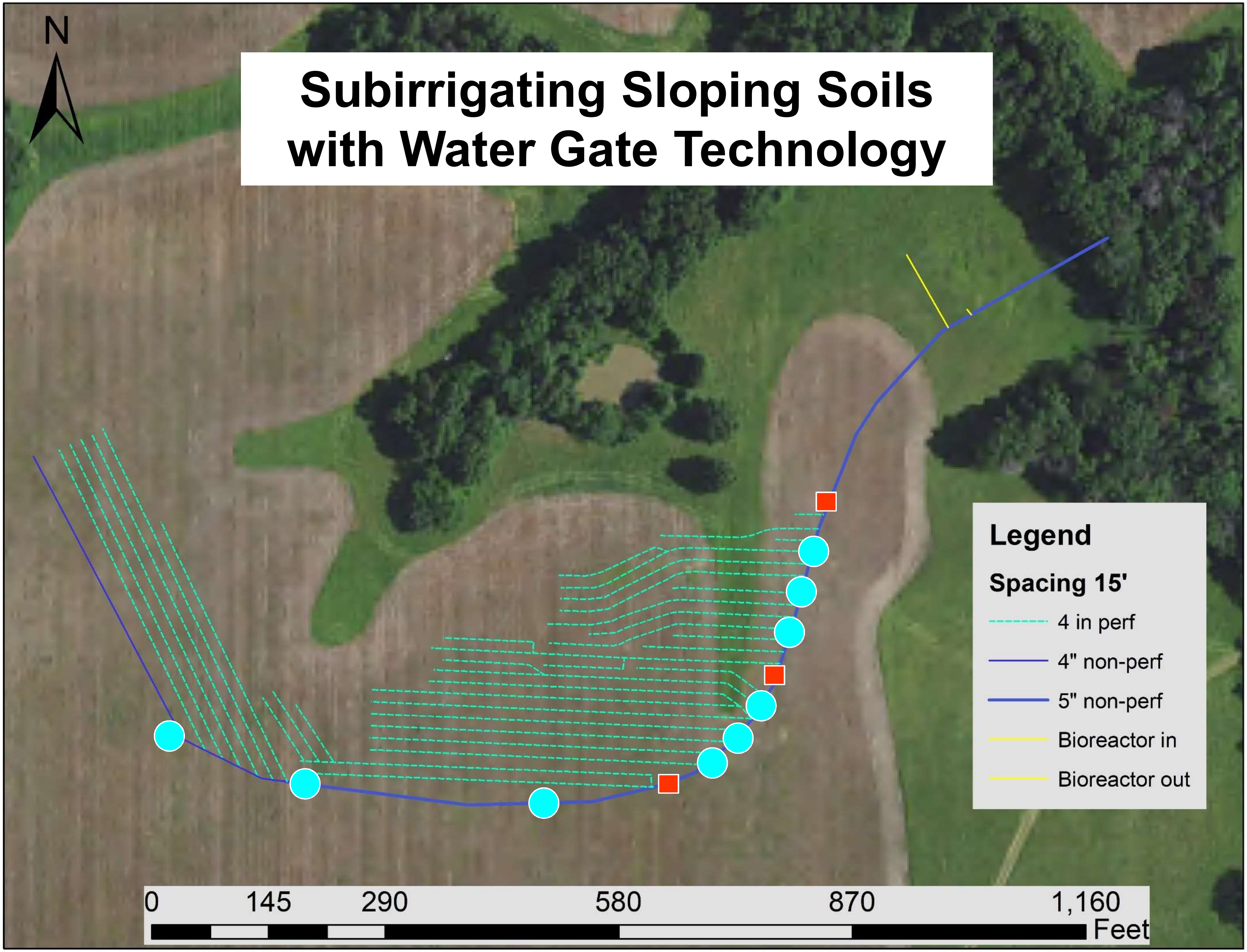


Lateral water movement & storage

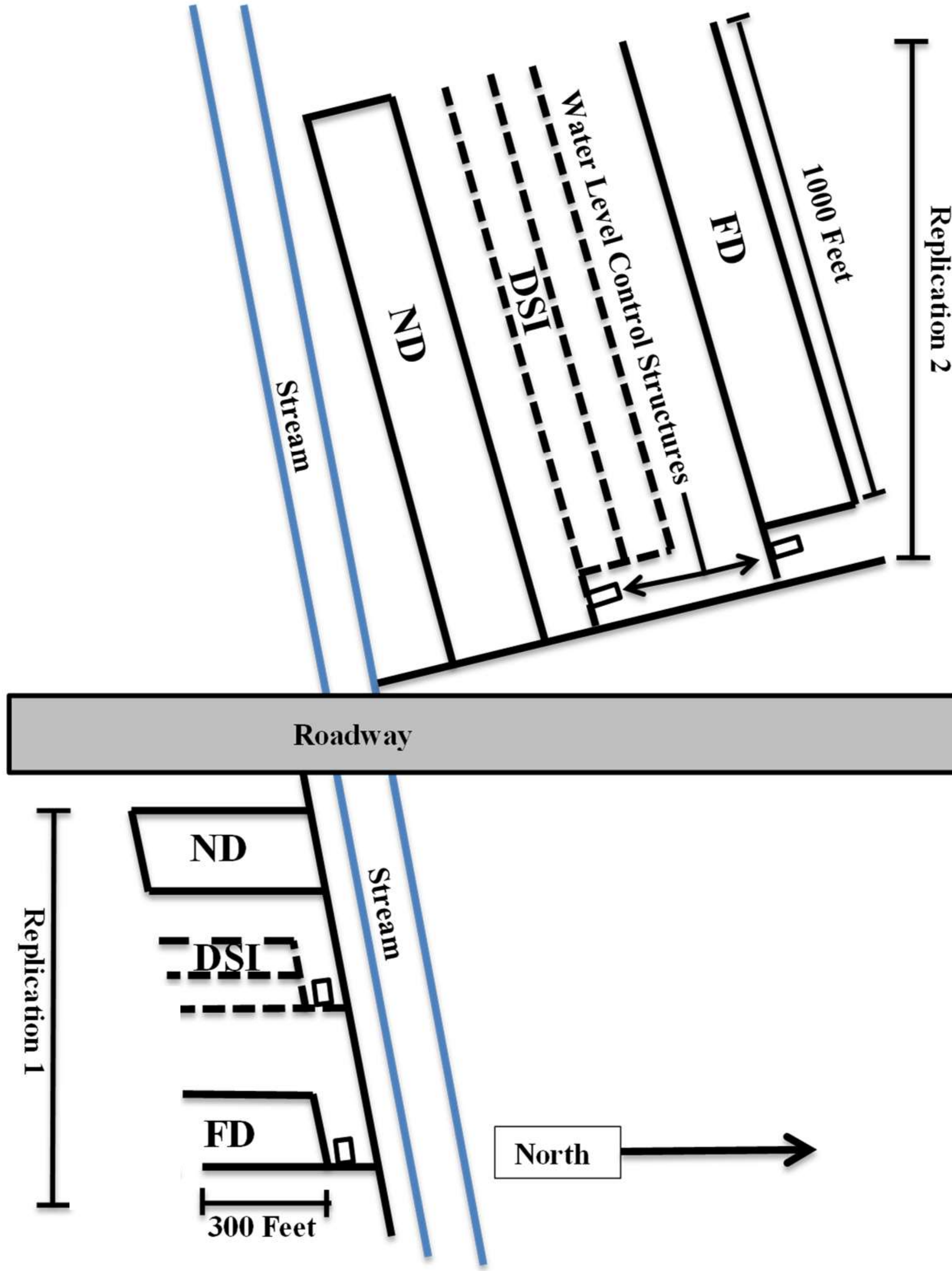

Soybean Yield and Gross Margin Increase over the Non-drained Control
Yield (bu/acre)
0
2
4
6
8
10
12
14
Gross Margin ($/acre)
0
500
1000
1500
2000
0
1320
1883
ND
FD 20 ft
DSI 20 ft
Drainage Water Management
Yield Increase
Gross Margin Increase

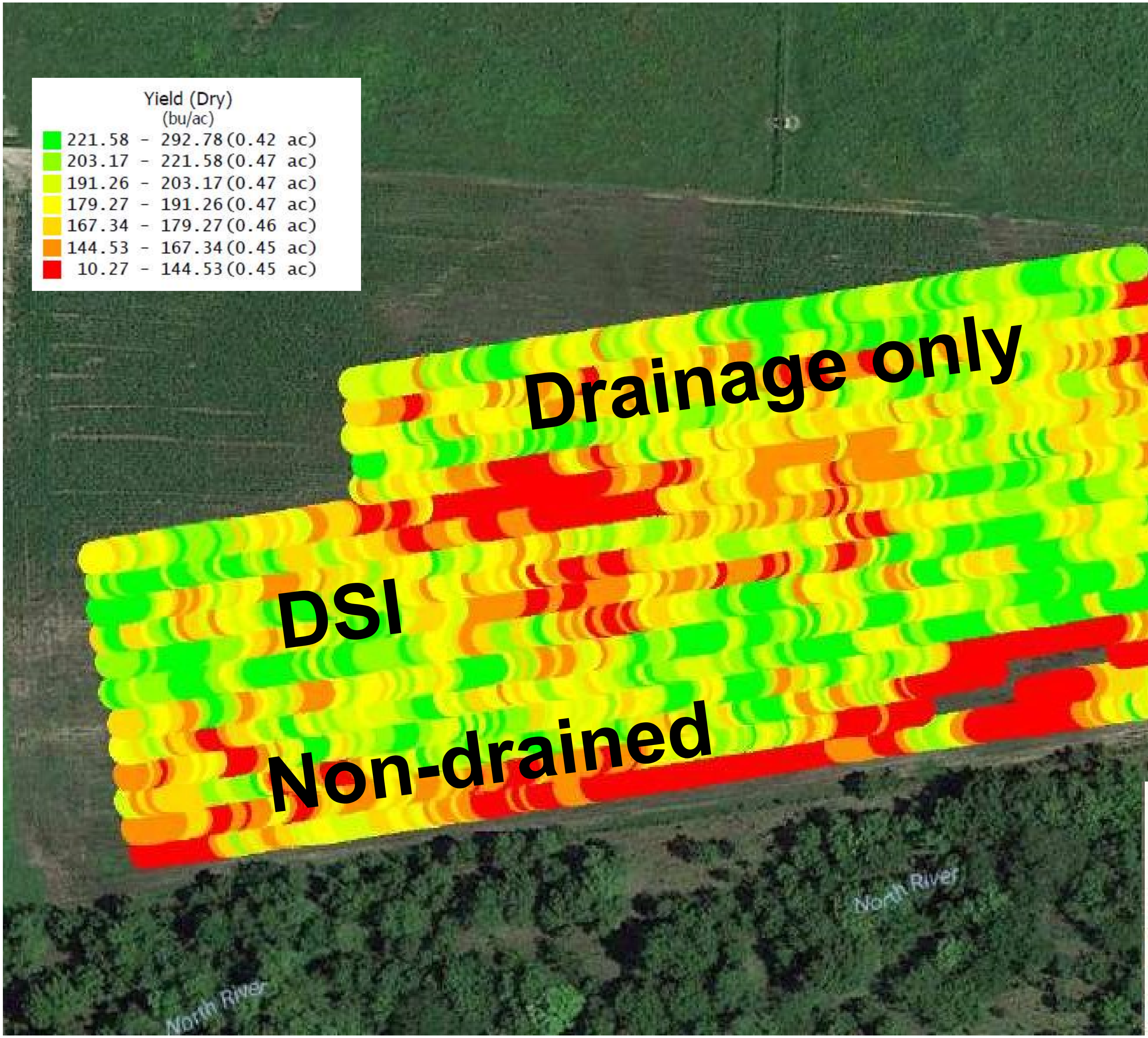
Water Gate Technology




Subirrigating Sloping Soils
with Water Gate Technology
N
Legend
Spacing 15'
4 in perf
4" non-perf
5" non-perf
Bioreactor in
Bioreactor out
0
145
290
580
870
1,160
Feet

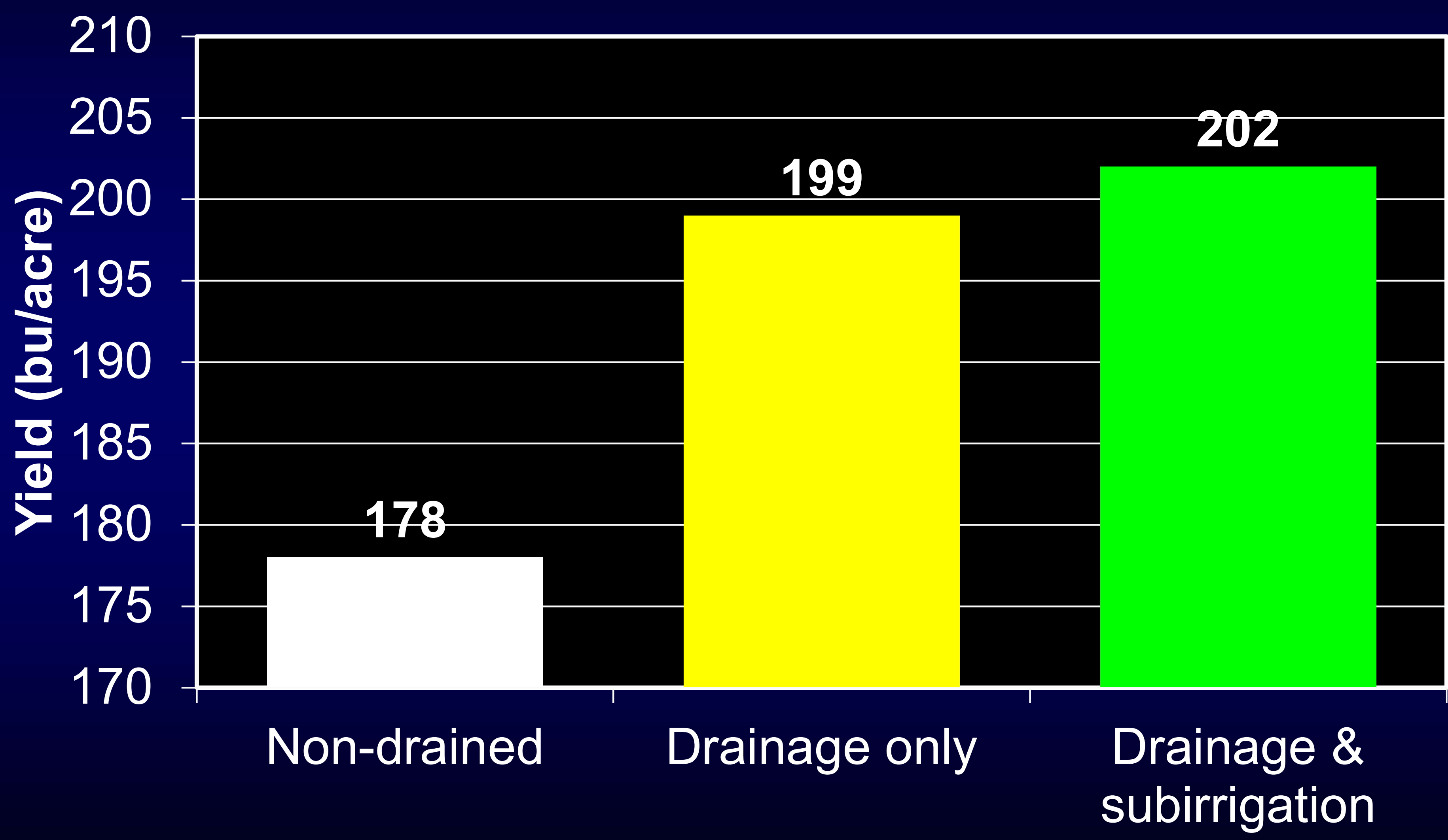

Blackoar Silt Loam


Water Level Control Structures
ND
DSI
FD
1000 Feet
Replication 2
Stream
Roadway
ND
DSI
FD
Stream
Replication 1
300 Feet
North



On Target Agriculture
Farm Services from the Ground Up

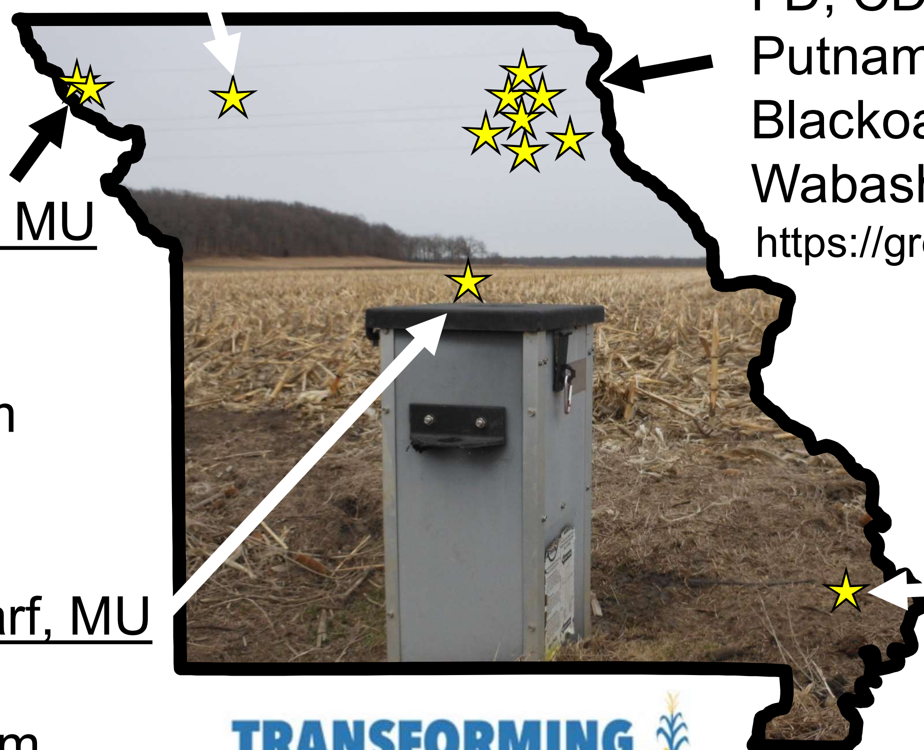
Corn Yield Response to Drainage Water Recycling in a Blackoar Silt Loam (2016-2017)



Drainage Water Management Research and Demonstration Sites in Missouri

<u>Bruce Burdick, MU</u>
FD, CD[†]
Zook silt loam

<u>Dr. Kelly Nelson, MU</u>
FD, CD, DSI, DWR[†]
Putnam silt loam
Blackoar silt loam
Wabash silty clay
https://greenley.missouri.edu/muds/



<u>Wayne Flanary, MU</u>
FD, CD[†]
Luton clay
Modale silt loam

<u>Dr. Peter Scharf, MU</u>
FD, CD[†]
Mexico silt loam

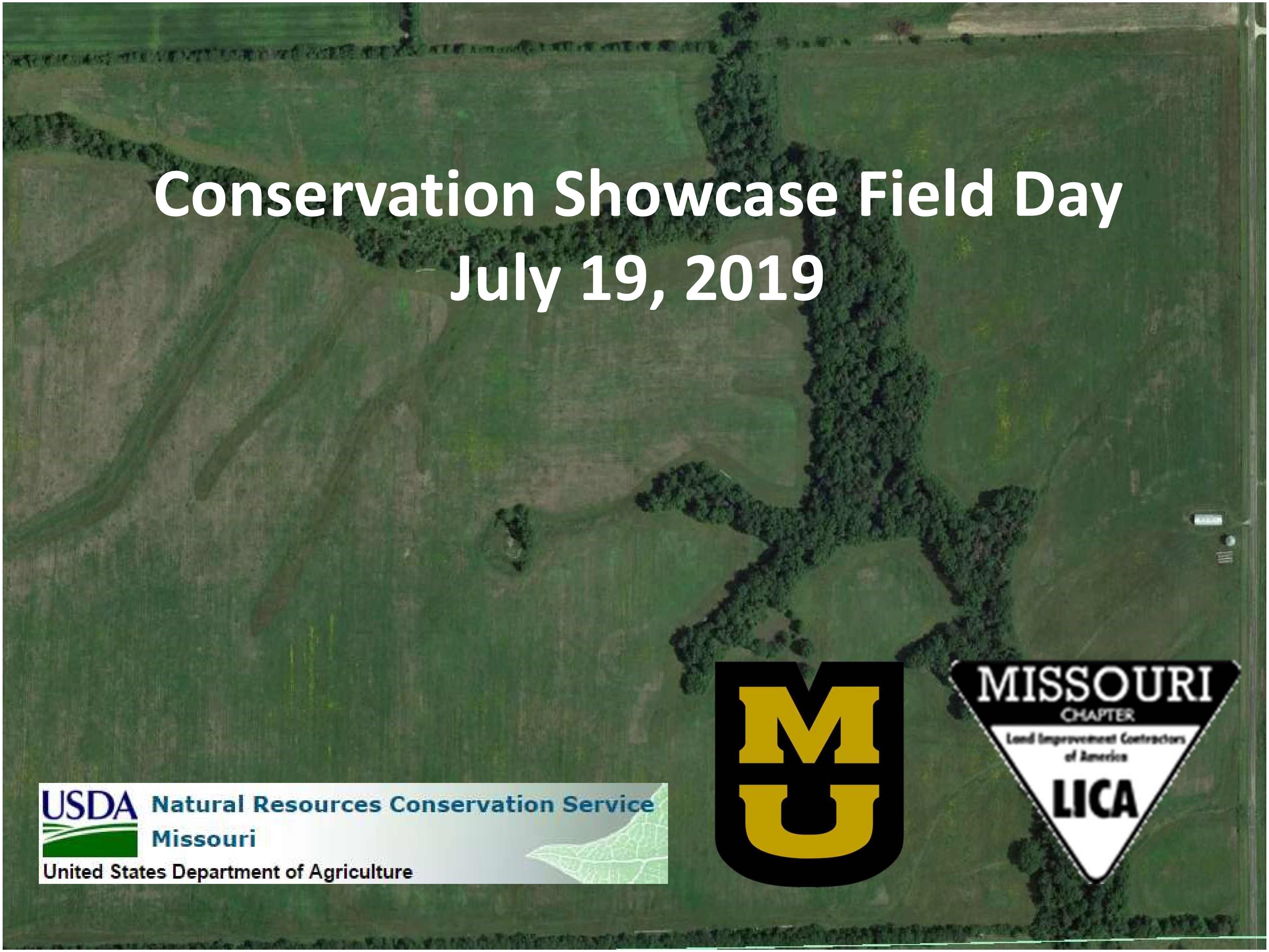
<u>Dr. Michael Aide, SEMO</u>
CD, DSI, DWR[†]
Wakeland silt loam
Wilbur silt loam

TRANSFORMING DRAINAGE.ORG
Managing Water for Tomorrow's Agriculture

[†]Abbreviations: Free Drainage (FD), Controlled Drainage (CD), Drainage plus Subirrigation (DSI), & Drainage Water Recycling (DWR)

DWR Synthesis Sites

Location, County	Latitude, Longitude	Years
Minnesota, Clay	46°59'15.9"N, 96°41'02.0"W	2012, 2013, 2015-2017
Minnesota, Redwood (SWROC)	44°14'17.2"N, 95°18'17.4"W	2016, 2017
Missouri, Knox	40°00'53.7"N, 92°11'34.7"W	2016, 2017
Missouri, Shelby	39°56'41.6"N, 92°03'13.2"W	2002-2017
Ohio, Defiance	41°20'15.1"N, 84°26'04.5"W	1997, 1999-2006
Ohio, Fulton	41°36'20.7"N, 83°59'10.3"W	1996, 1997, 1999-2006, 2008
Ohio, Van Wert	40°52'57.4"N, 84°33'55.7"W	1997-2001, 2004-2007
		54 site-years


Conservation Showcase Field Day
July 19, 2019
USDA
Natural Resources Conservation Service
Missouri
United States Department of Agriculture
MU
MISSOURI
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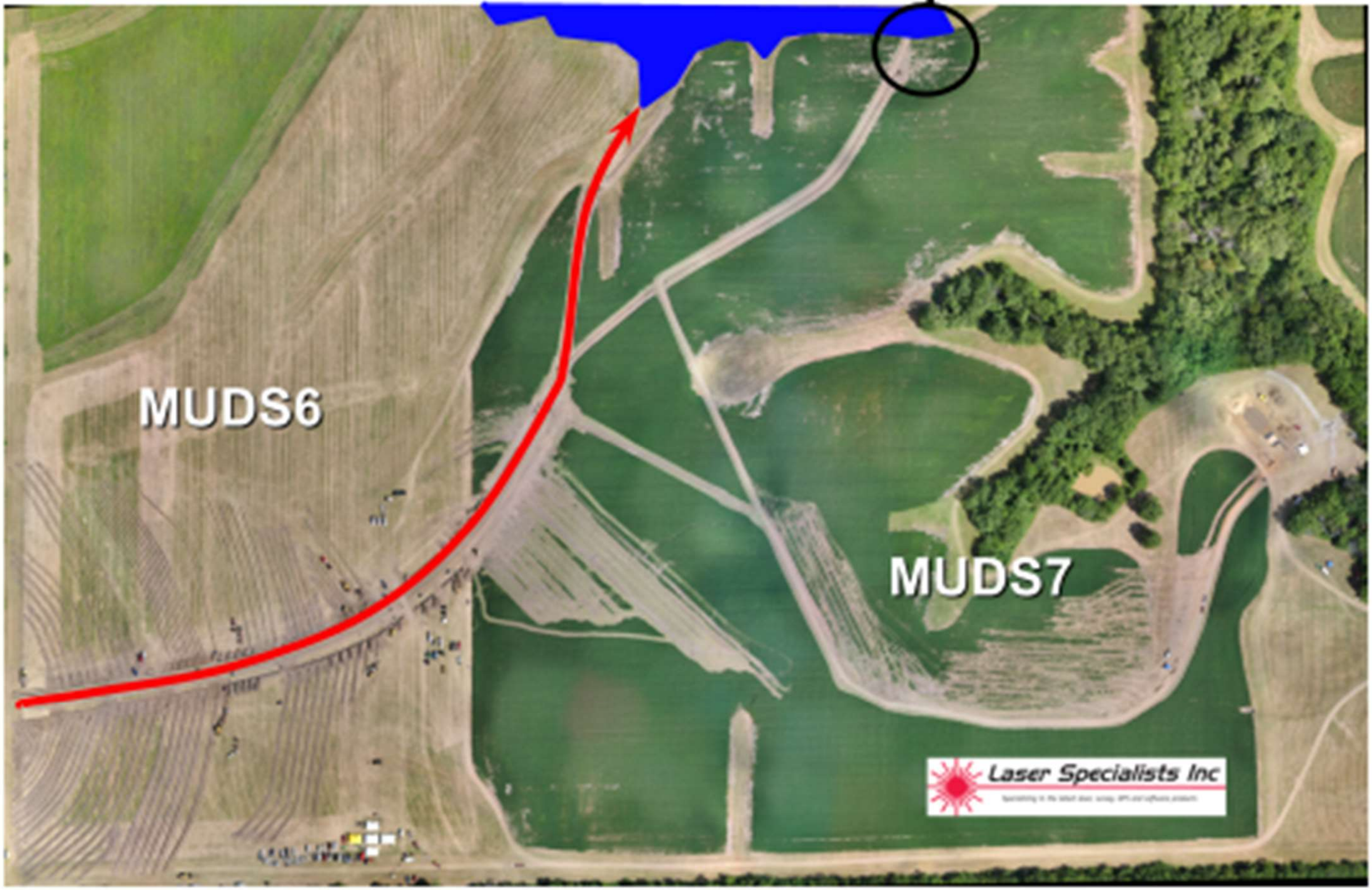
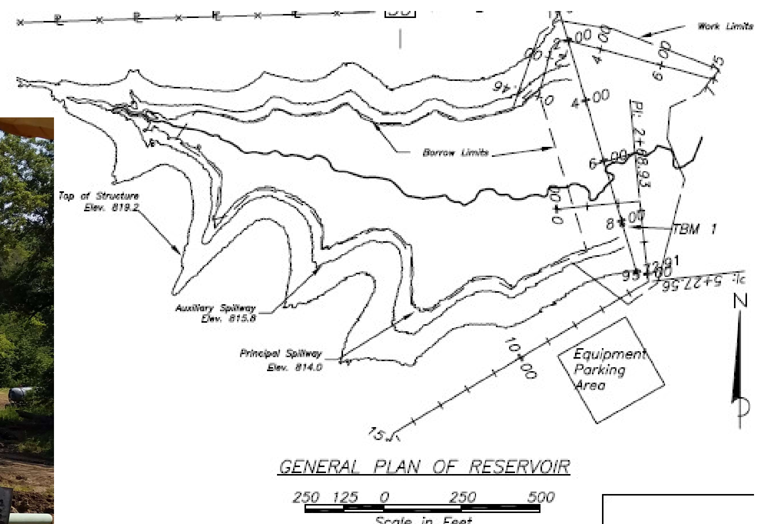
Land Improvement Contractors of America
LICA

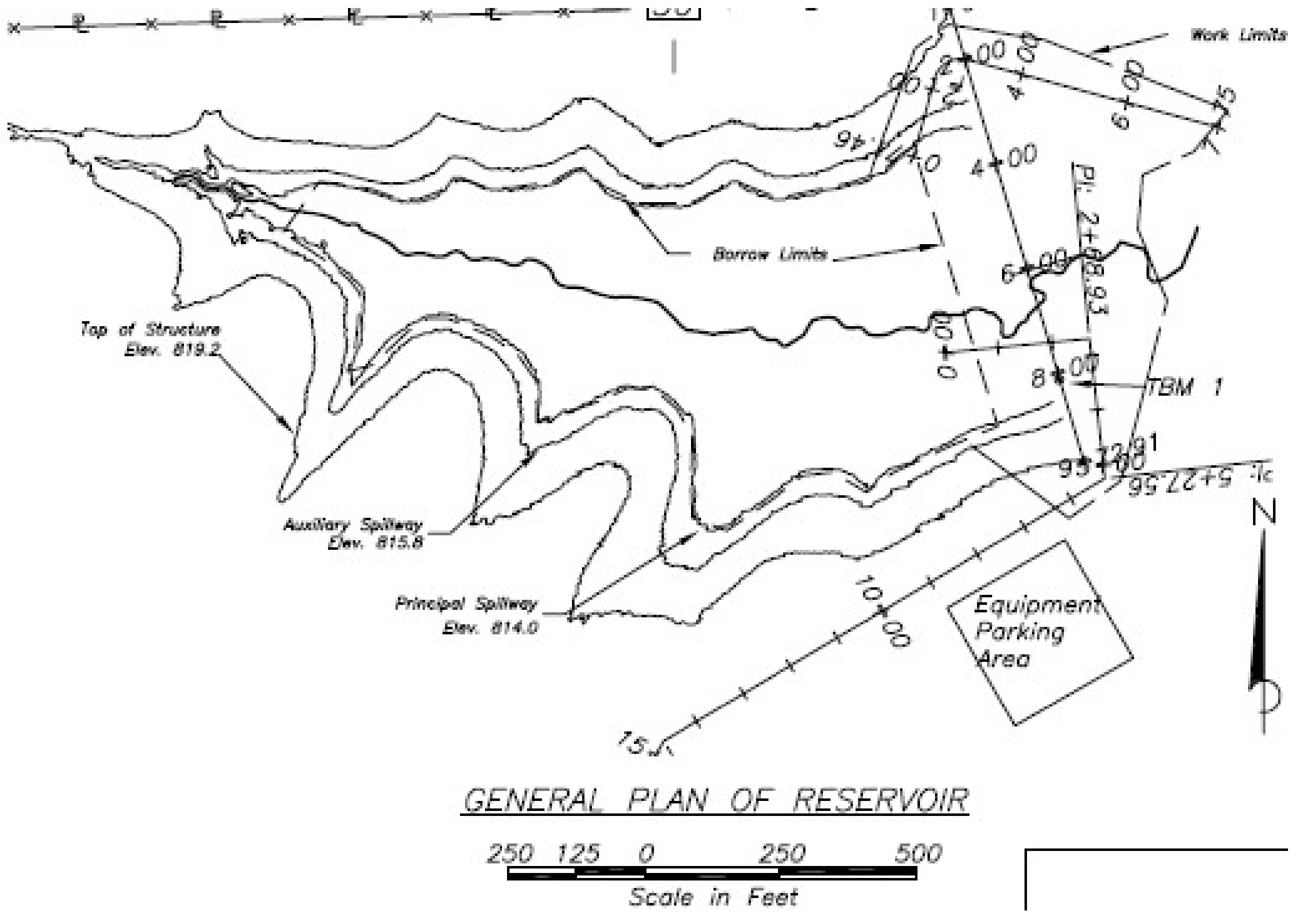
What is our next step?



Reservoir Training

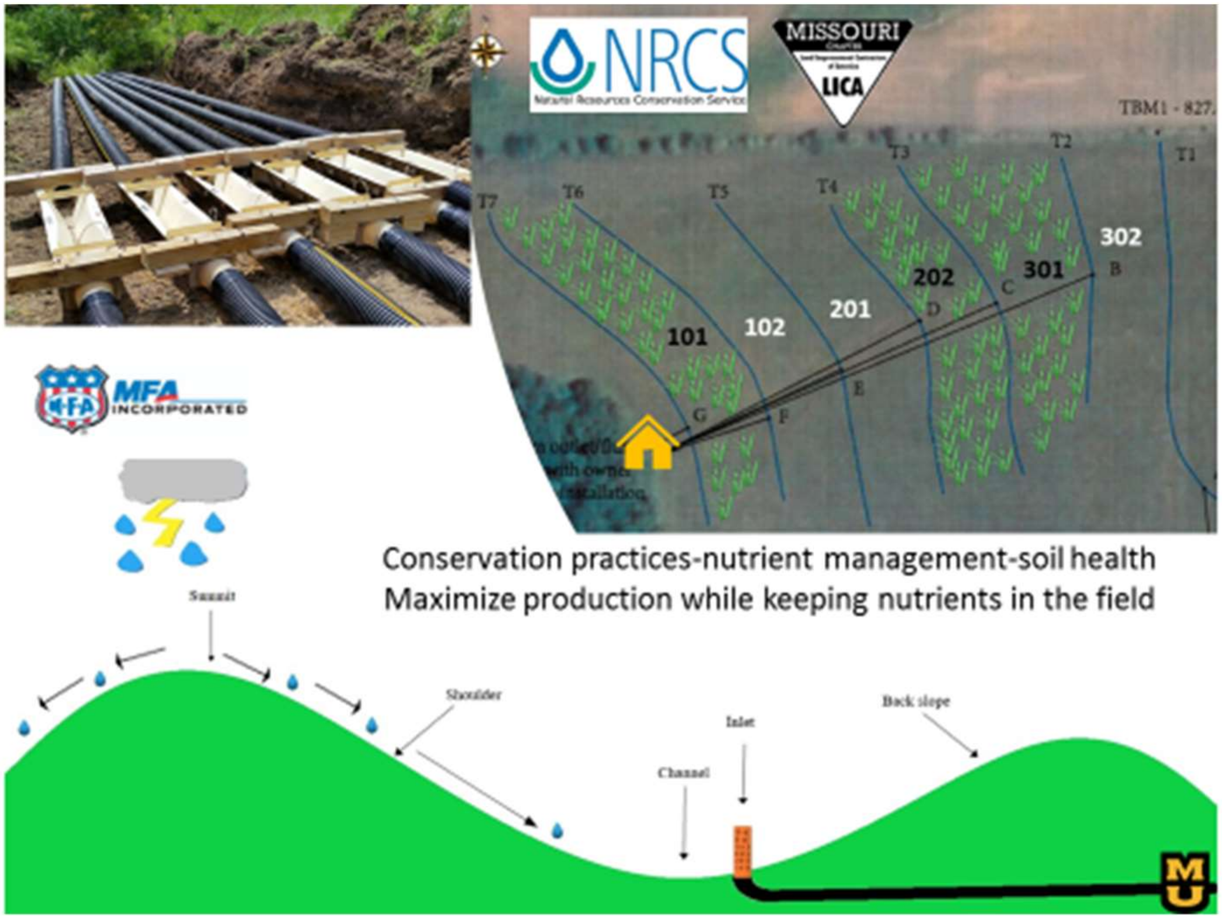
- Coordinated and accomplished by the project director and collaborators.
- Design plans to provide a backdrop for teaching
- Hands-on experience with equipment.
- Documentation of the process – videos





- **Water inlet for drainage water recycling.**
- **SPAW hydrology model for water budgets (soil water characteristics, evaporation, etc.)**
- **Geologic considerations for site selection**

Cover Crops in a Terraced Field



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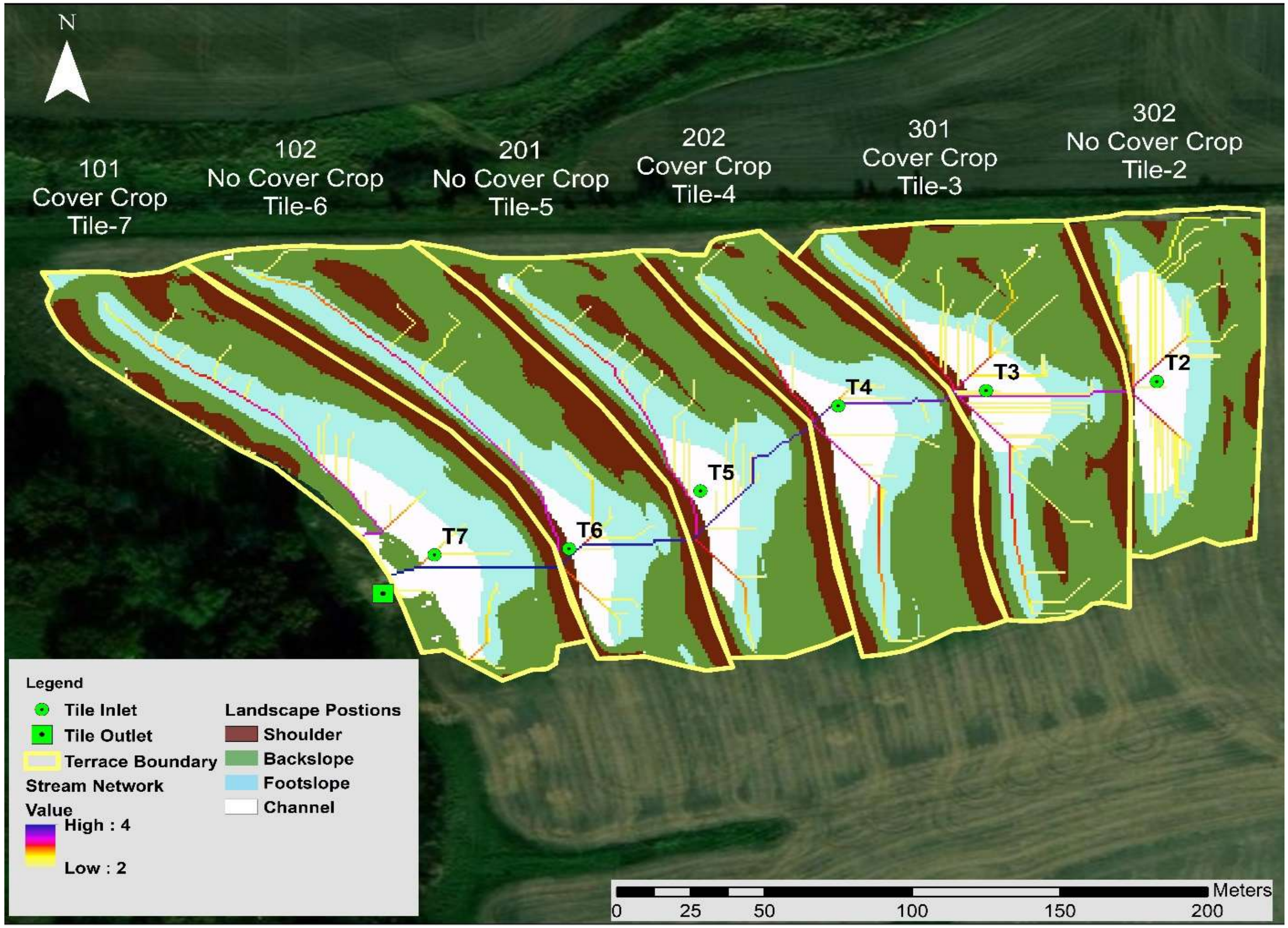
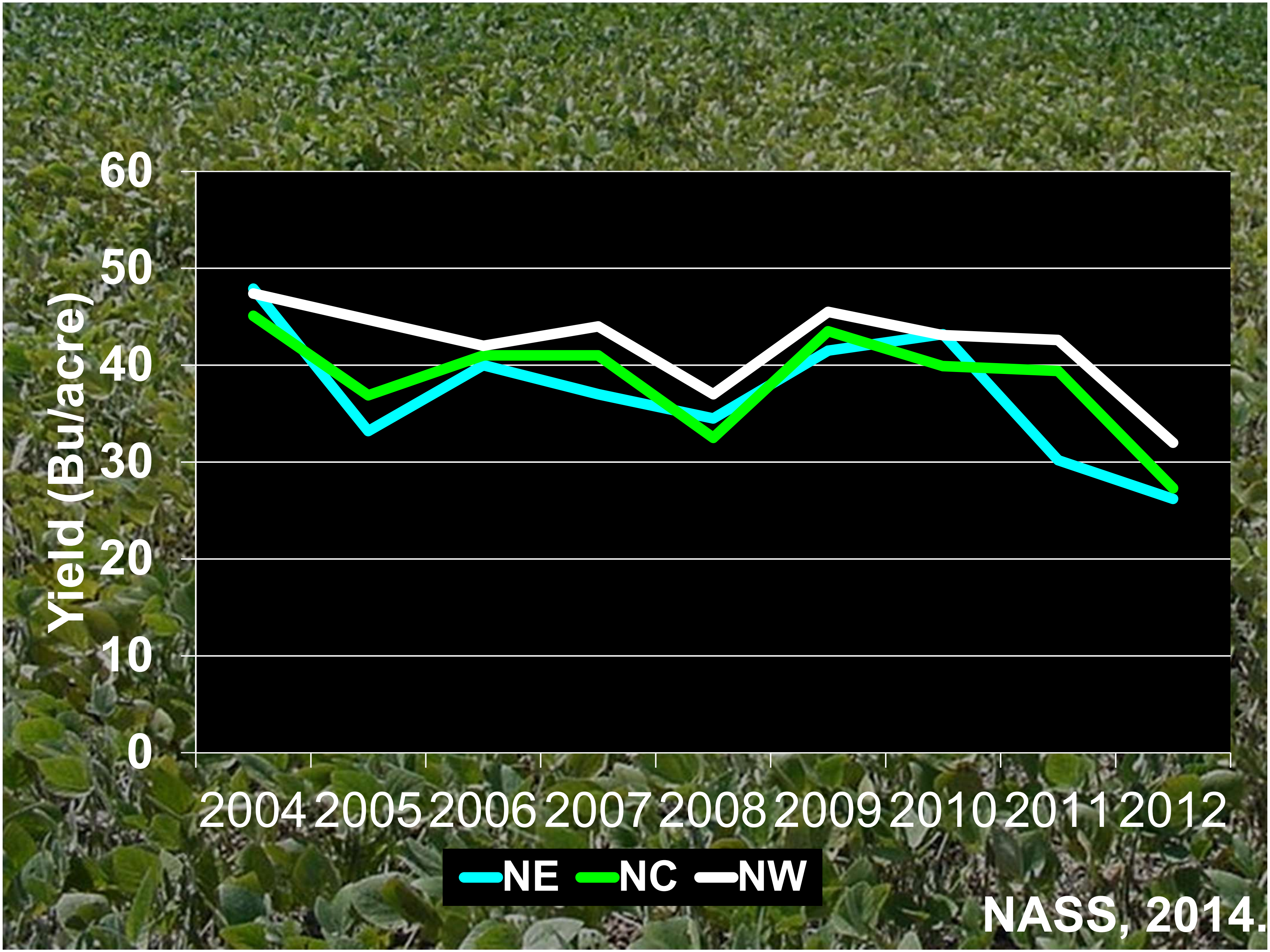
NRCS
Natural Resources Conservation Service

MFA
INCORPORATED



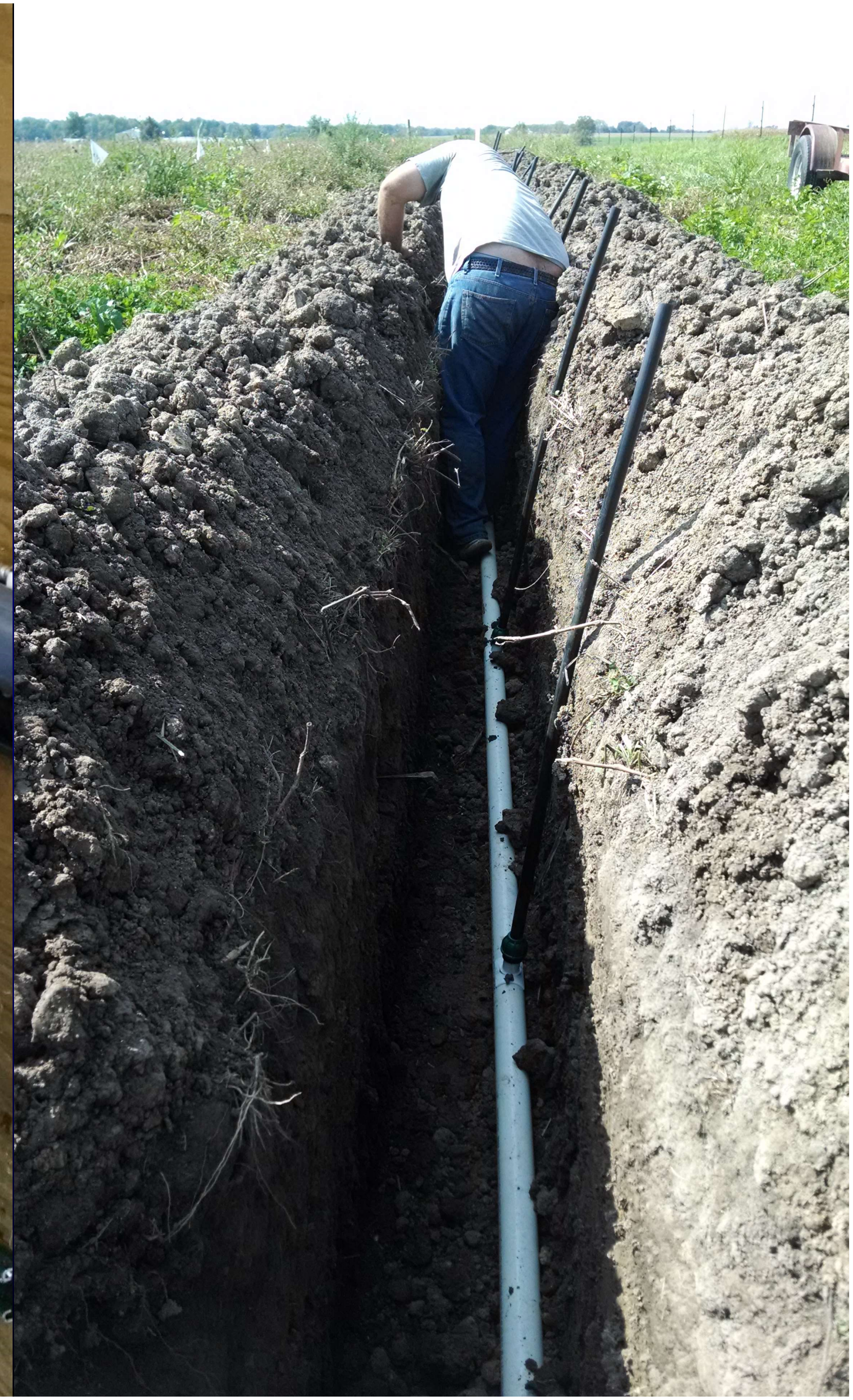

Subsurface
Drip Irrigation for
Water ReUse

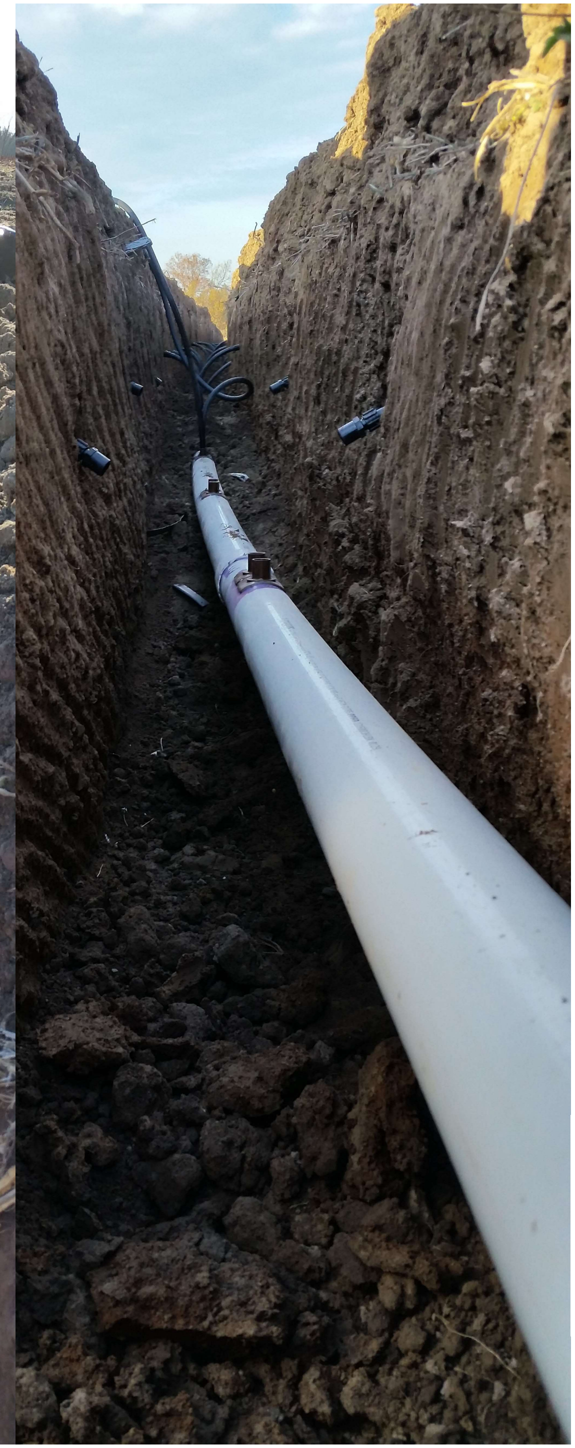


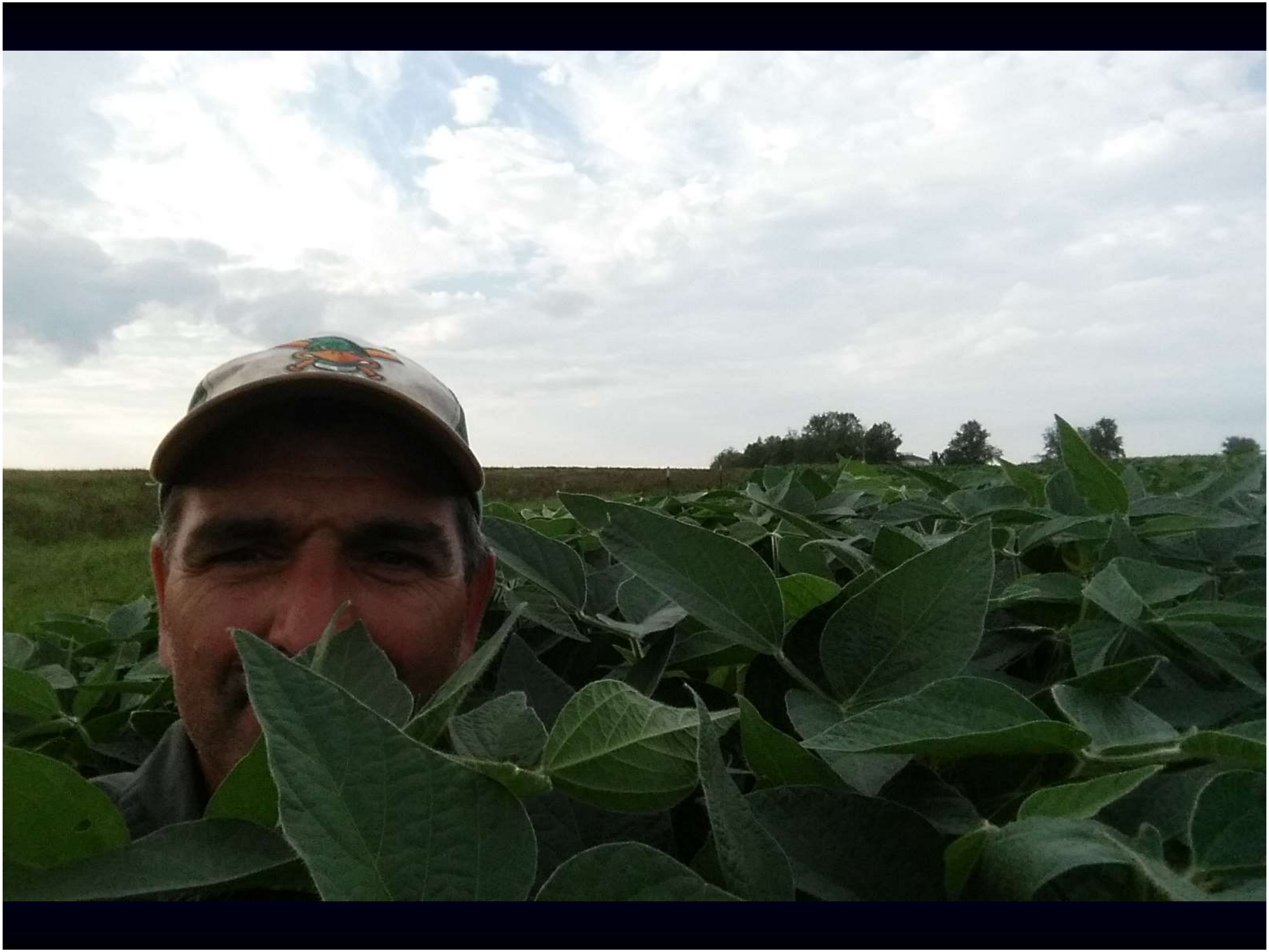
60
50
40
30
20
10
0
Yield (Bu/acre)
2004
2005
2006
2007
2008
2009
2010
2011
2012
NE
NC
NW
NASS, 2014.

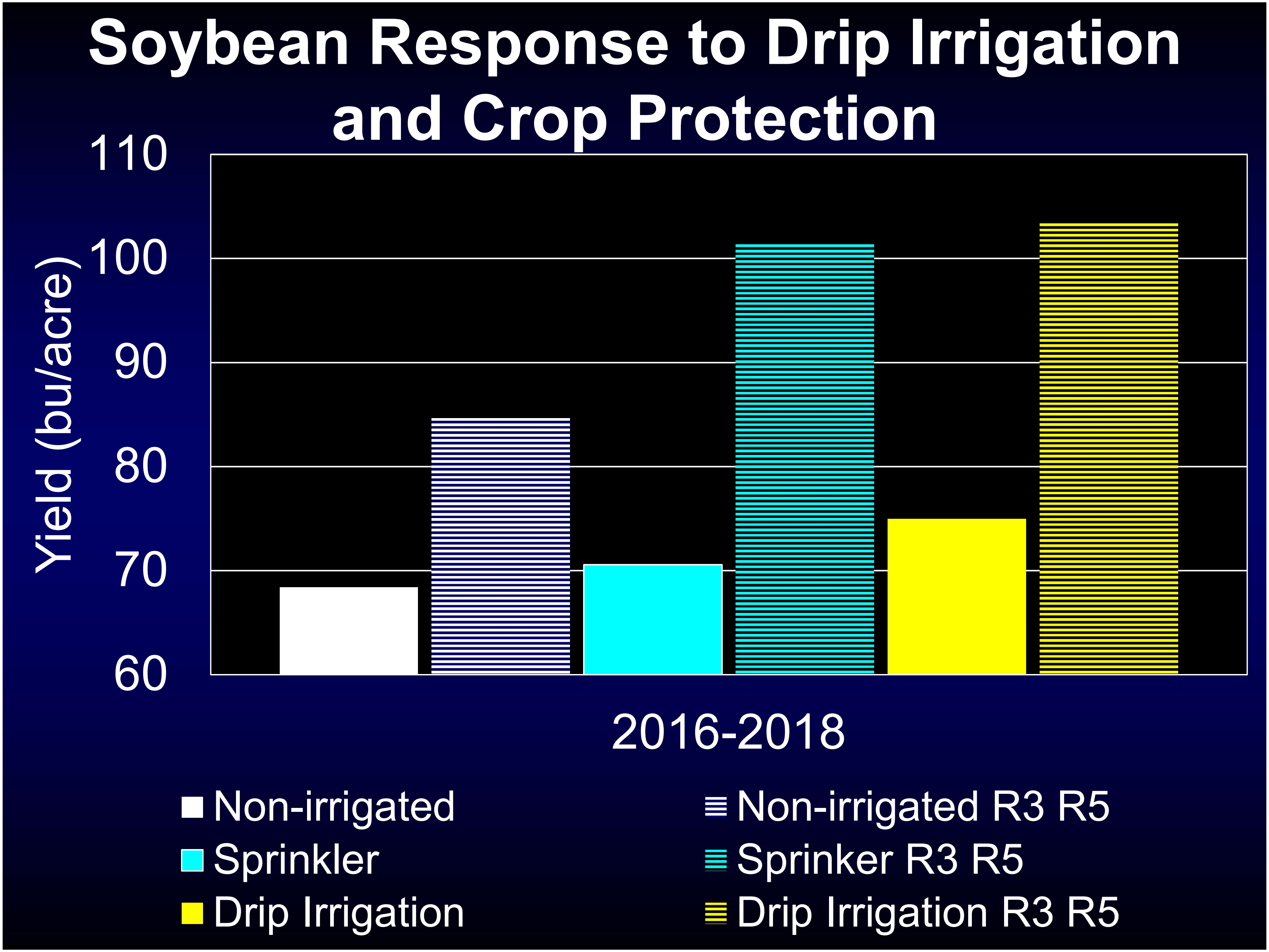

CASE
Helping


NETAFIM
NETAFIM
Outlet








Soybean Response to Drip Irrigation and Crop Protection
110
100
90
80
70
60
Yield (bu/acre)
2016-2018
Non-irrigated
Non-irrigated R3 R5
Sprinkler
Sprinker R3 R5
Drip Irrigation
Drip Irrigation R3 R5


Water leak

Acknowledgements:

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