33rd Annual NATIONAL NO-TILLAGE CONFERENCE®

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Drainage for the Long-Haul

Eileen Kladivko

So, you want to improve your crop productivity on your farm,

- You're considering growing cover crops,
- You're considering no-till or strip-till,
- And you're looking at other practices to improve soil health

- But you have fields that look a lot like this…

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Naturally poorly-drained soils present many challenges for crop production.

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Why is tile drainage so important?

- And how does this relate to cover crops or no-till/strip-till?

Drainage pays!

- Drainage improves timeliness of field work
- Drainage improves crop yields
- Drainage improves cover crop growth
- Drainage enables other conservation practices to work better, to improve soils
- Drainage is a long-term investment

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Department of Agronomy

https://www.agry.purdue.edu/drainage/

SEPAC Drainage Research

Home

Yields

Water Quality

Layout & Design

Publications

Related Links

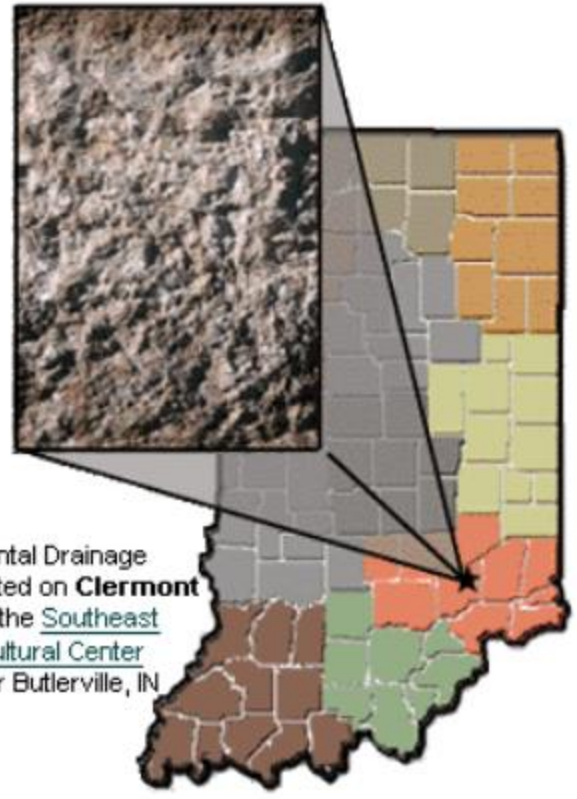
Agricultural Drainage

Water Quality Field Station

Experimental Drainage Plots

The Experimental Drainage Field at the Southeast Purdue Agricultural Center (SEPAC) was initiated in 1983 by researchers in Purdue's Departments of Agronomy and Agricultural & Biological Engineering.

The original goal of the project was to evaluate the effectiveness of modern subsurface drainage practices on both soil drainage and crop yield, on a soil that was traditionally not subsurface- ("tile-") drained. Additional goals were added with time and included study of nitrate and pesticide leaching into drain water as well as impacts of drainage and agronomic management practices on soil quality.



The Experimental Drainage Plots are located on **Clermont Silt Loam** at the Southeast Purdue Agricultural Center (SEPAC), near Butlerville, IN.

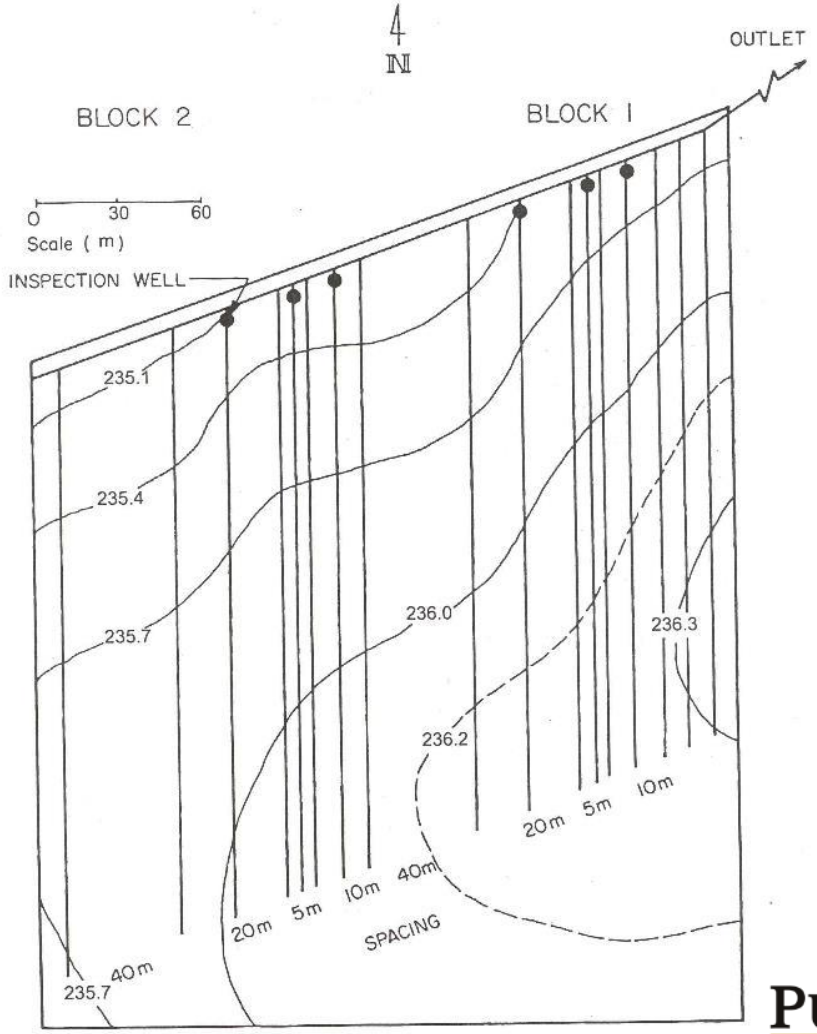
Goals of SEPAC studies

On the poorly structured, low organic matter, naturally poorly-drained, Clermont silt loam soil, to:

- Improve drainage
- Improve soil physical properties
  - Reduce crusting and erosion
  - Increase infiltration and permeability
- Improve crop growth and yield

SEPAC drainage research site

- Drainage installed at four spacings to research spacing effect on yield.
- 5m, 10m, 20m, 40 m
- (16 ft, 33 ft, 66 ft, 132 ft)
- 2.5-3 ft depth
- 4-inch plastic drain tube, no sock or filter



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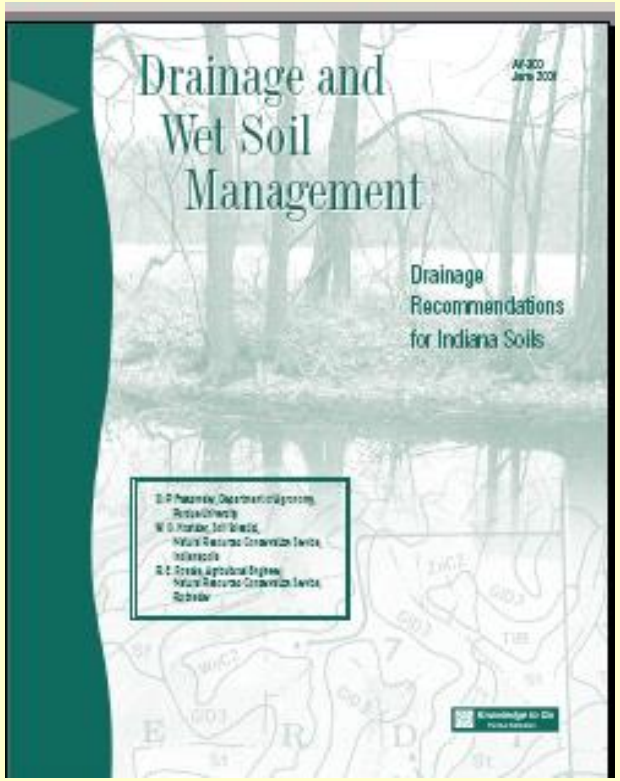
We design different drainage intensities

- Not simply “yes” or “no” for tile drains
- Designing for:
  - How fast to remove water
  - How deep will the water table then be
- Spacing and depth of tiles as main design factors
- Soil properties affect design

Drainage Recommendations for Indiana Soils
(AY-300) by Don Franzmeier (Purdue), Bill Hosteter and Roger Roeske (NRCS).



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Drainage pays!

- **Drainage improves timeliness of field work**
  - During first 10 yrs, different drain spacings were chiseled and planted when soil was “ready”.
  - The undrained control plots were delayed between 1 to 15 days compared to narrowest drain spacing.
  - More timely access to field is a major benefit to most farming operations.

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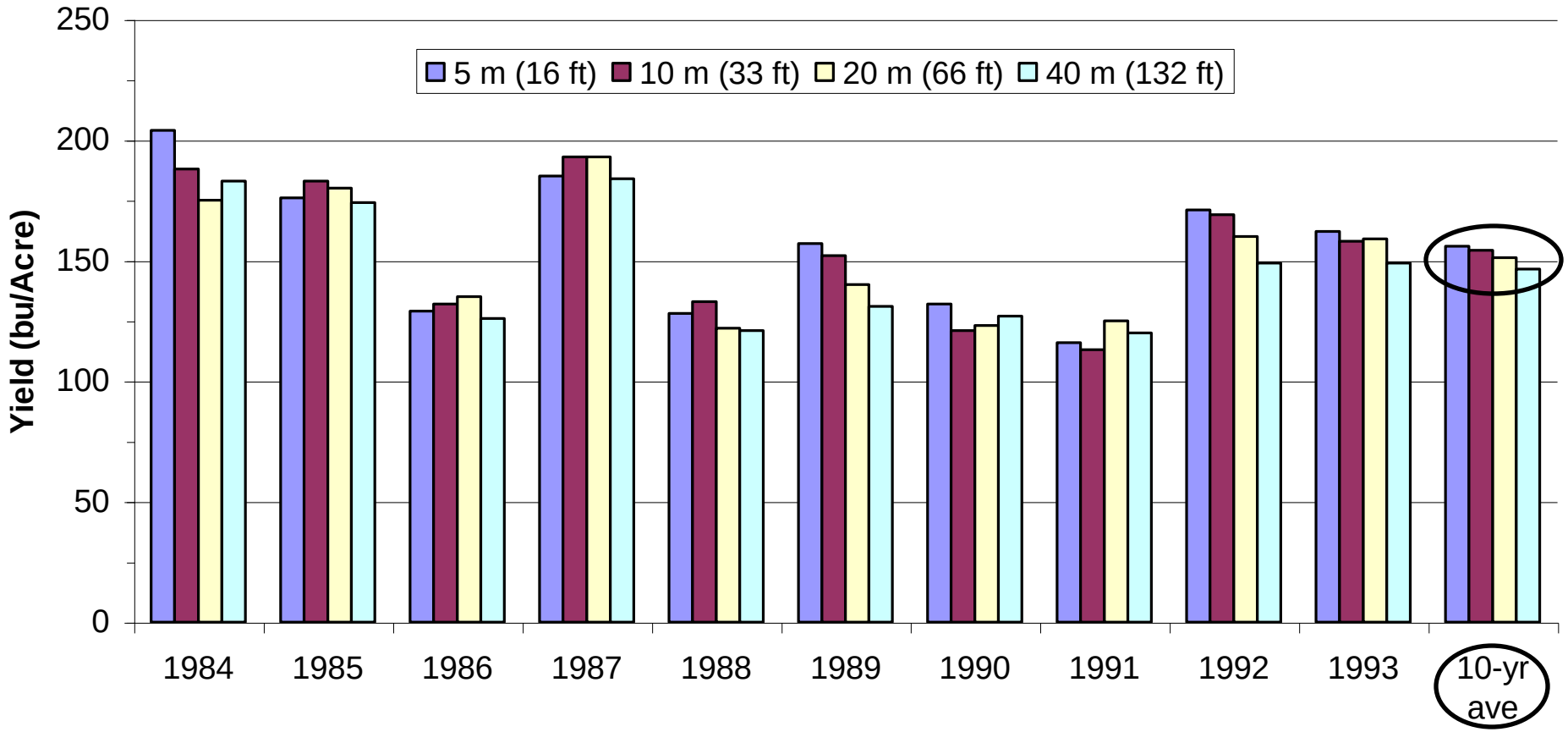
Effects vary year by year -- Continuous Corn Yield at SEPAC over first 10 years



See https://www.agry.purdue.edu/drainage

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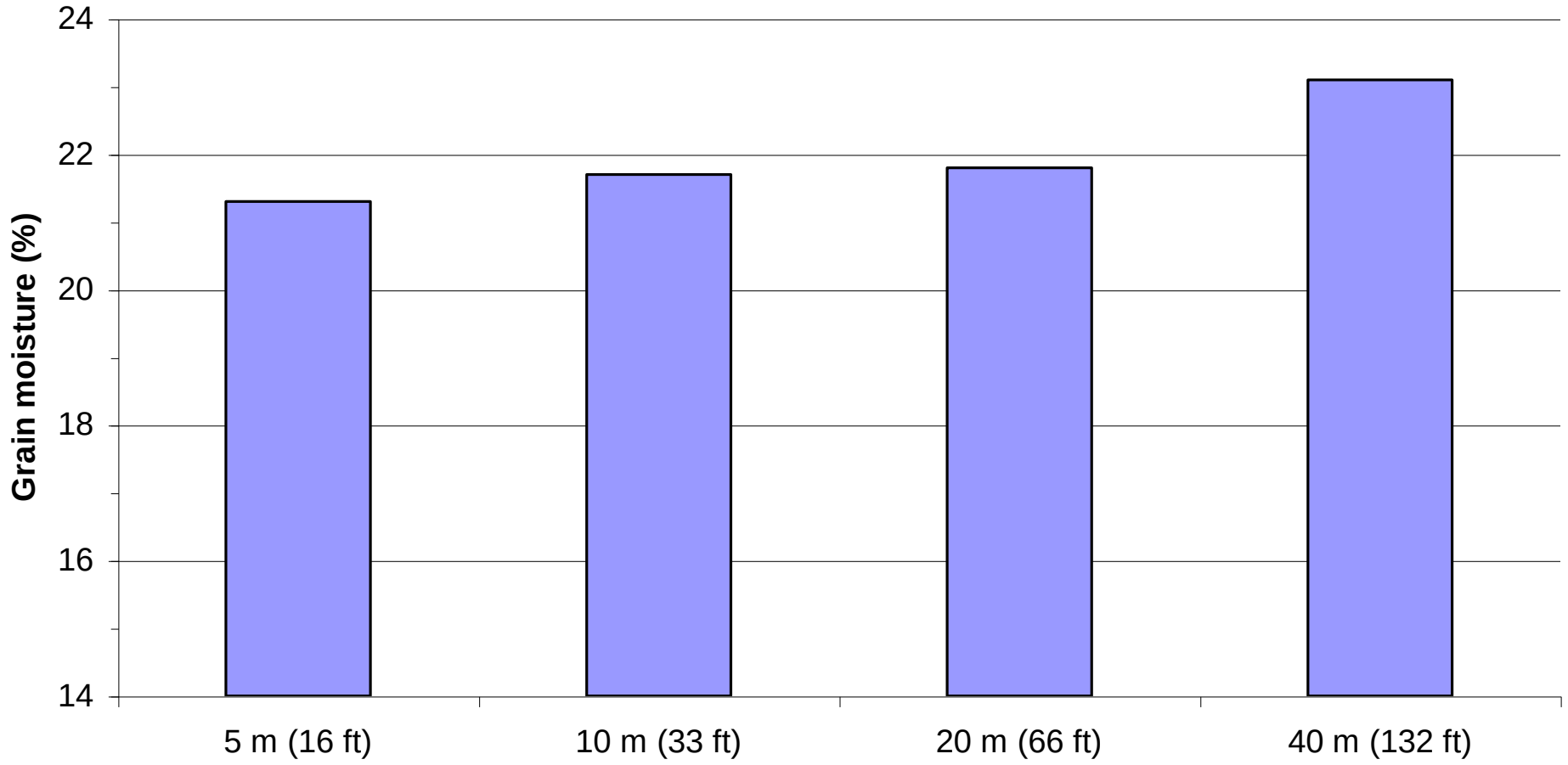
SEPAC 10-yr continuous corn grain moisture averages



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Another aspect of timeliness to consider--replant

- All plots were planted the same day, during 1994—2017.
  - No longer needed to wait until top 6-8 inches were suitable for tillage, since now No-till, but just top 1-2 inches for seeding
- But if continued wet after planting, in extremes, may need replanting if undrained. See 2017 example……

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SEPAC L4 06/12/17
40M West Location (after replant of 06/02/17)
Note: No stand from original planting. Tiled areas had sufficient stands from 5/16/17 planting date

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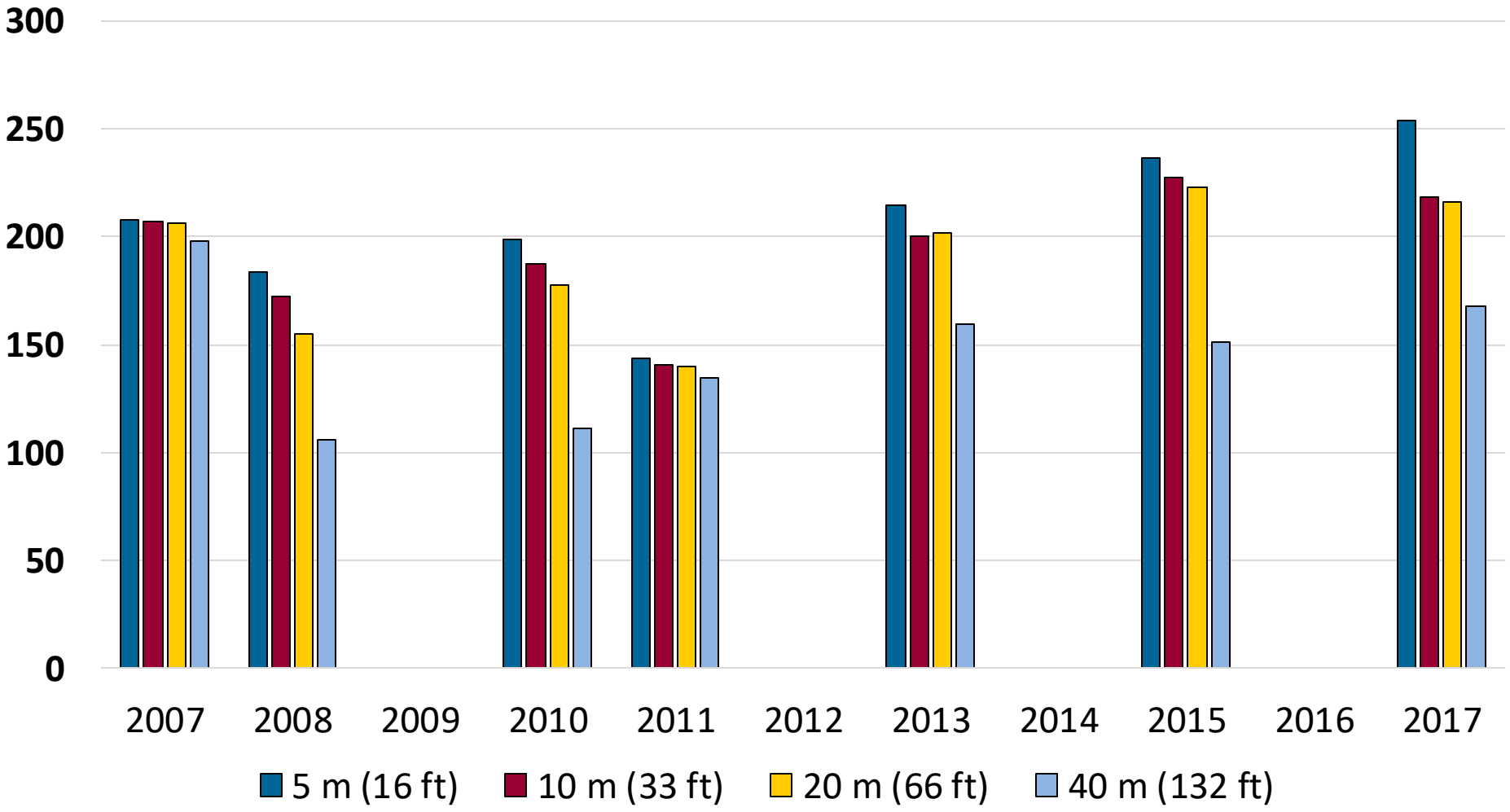
SEPAC Drainage Spacing Corn Yields (bu/A) 2007-2017



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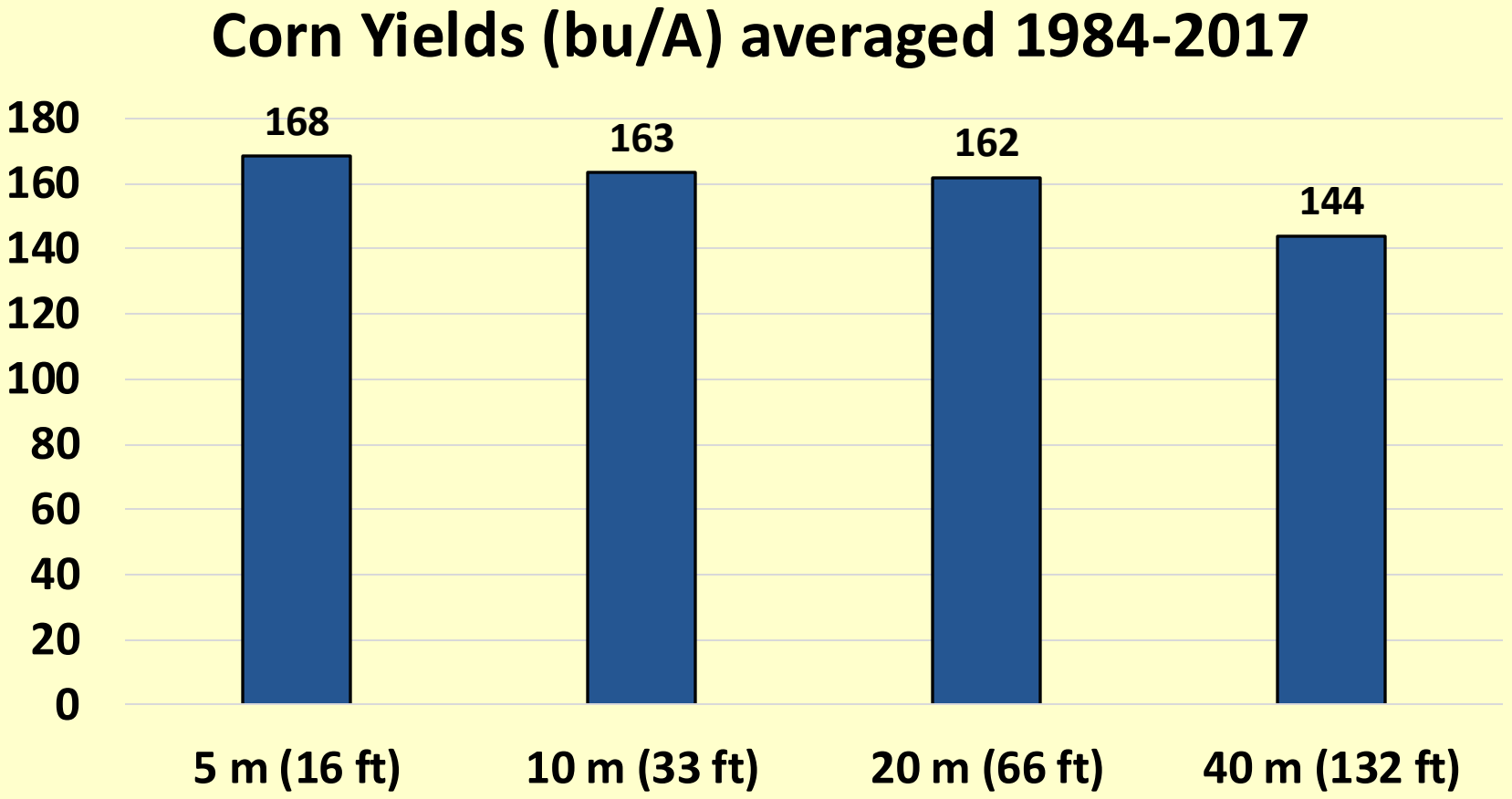
Drainage pays!

- Drainage improves crop yields



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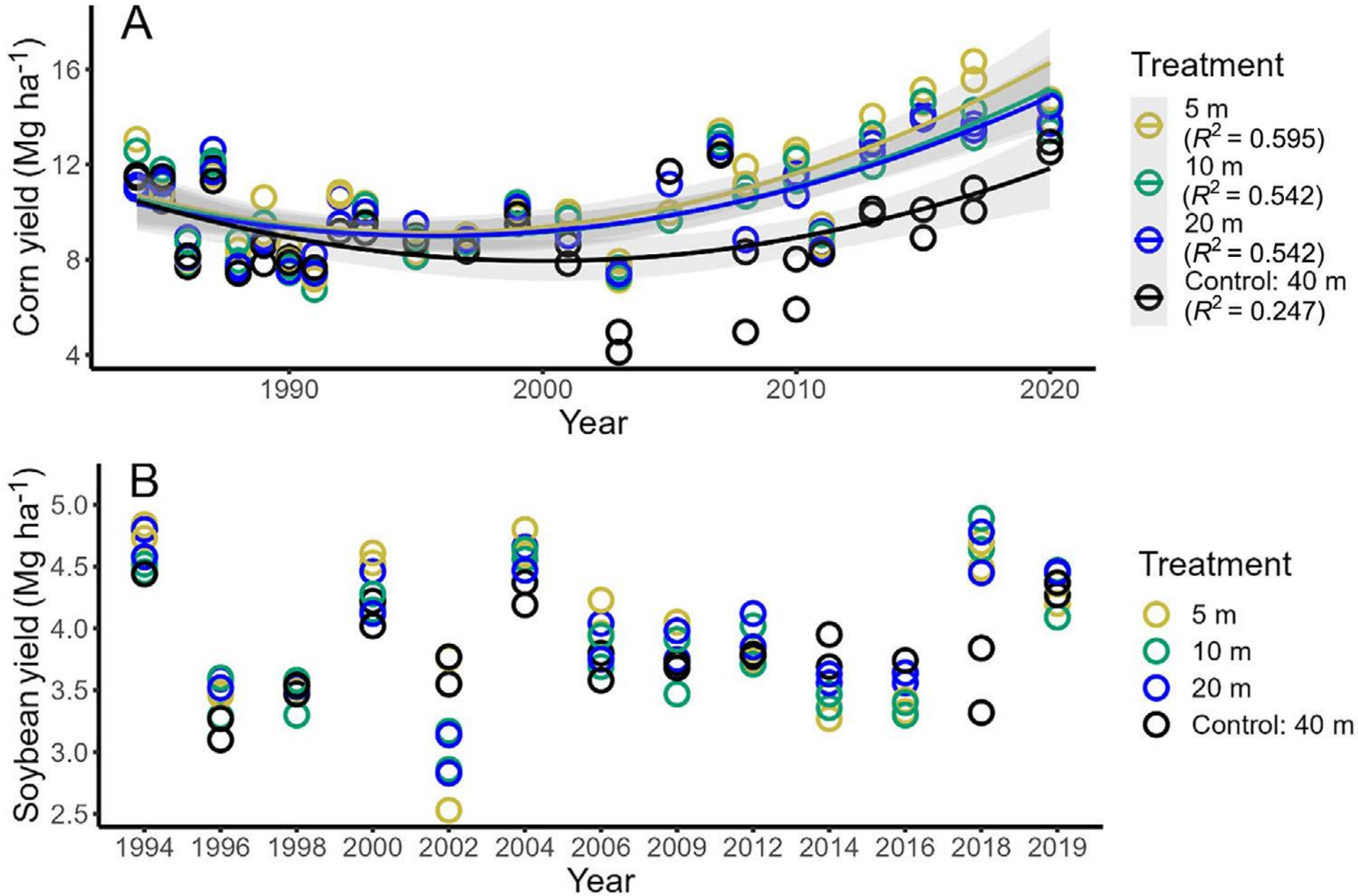

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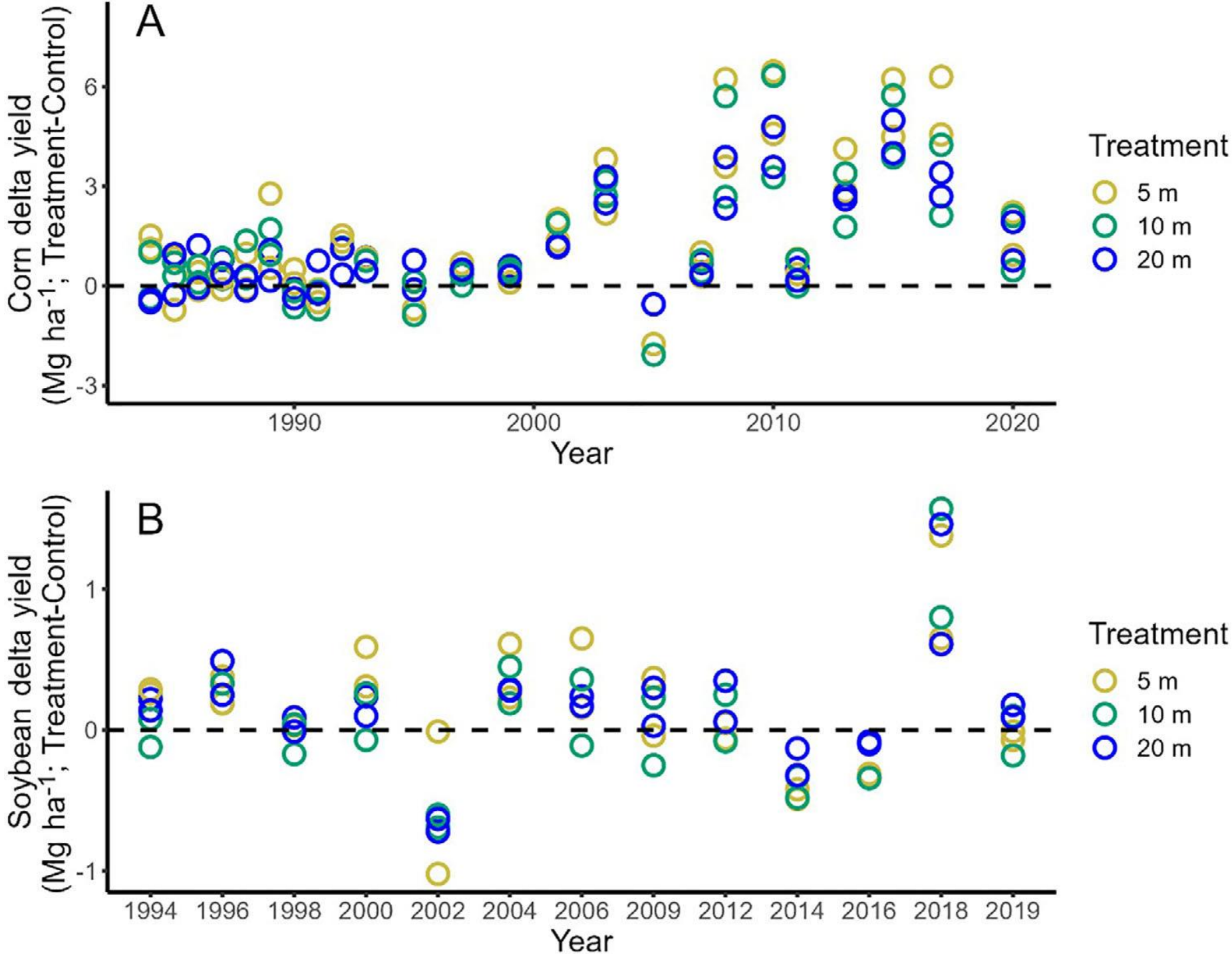

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Main points

- Corn yield trend over 37 yrs
  - Yes for drained
  - No for undrained
  - ➢ Need drainage to reap benefits of genetics, technology, and other improvements
- "Delta yield" greater in later years
  - Not primarily due to wetter conditions
  - Soil health improvement from NT, cover crops, crop rotation, but not effective when undrained
  - Undrained too wet to benefit from improved genetics over time

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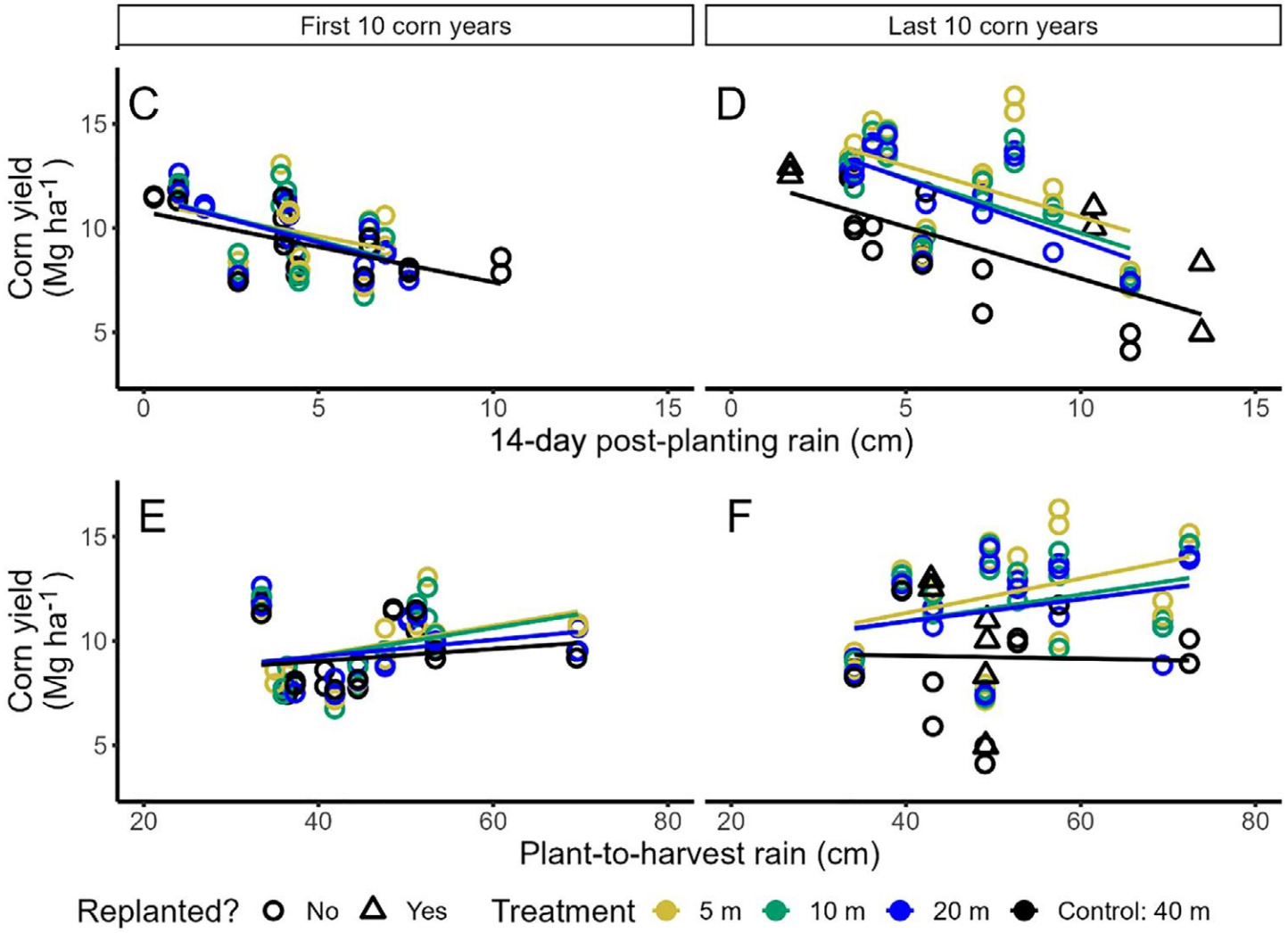
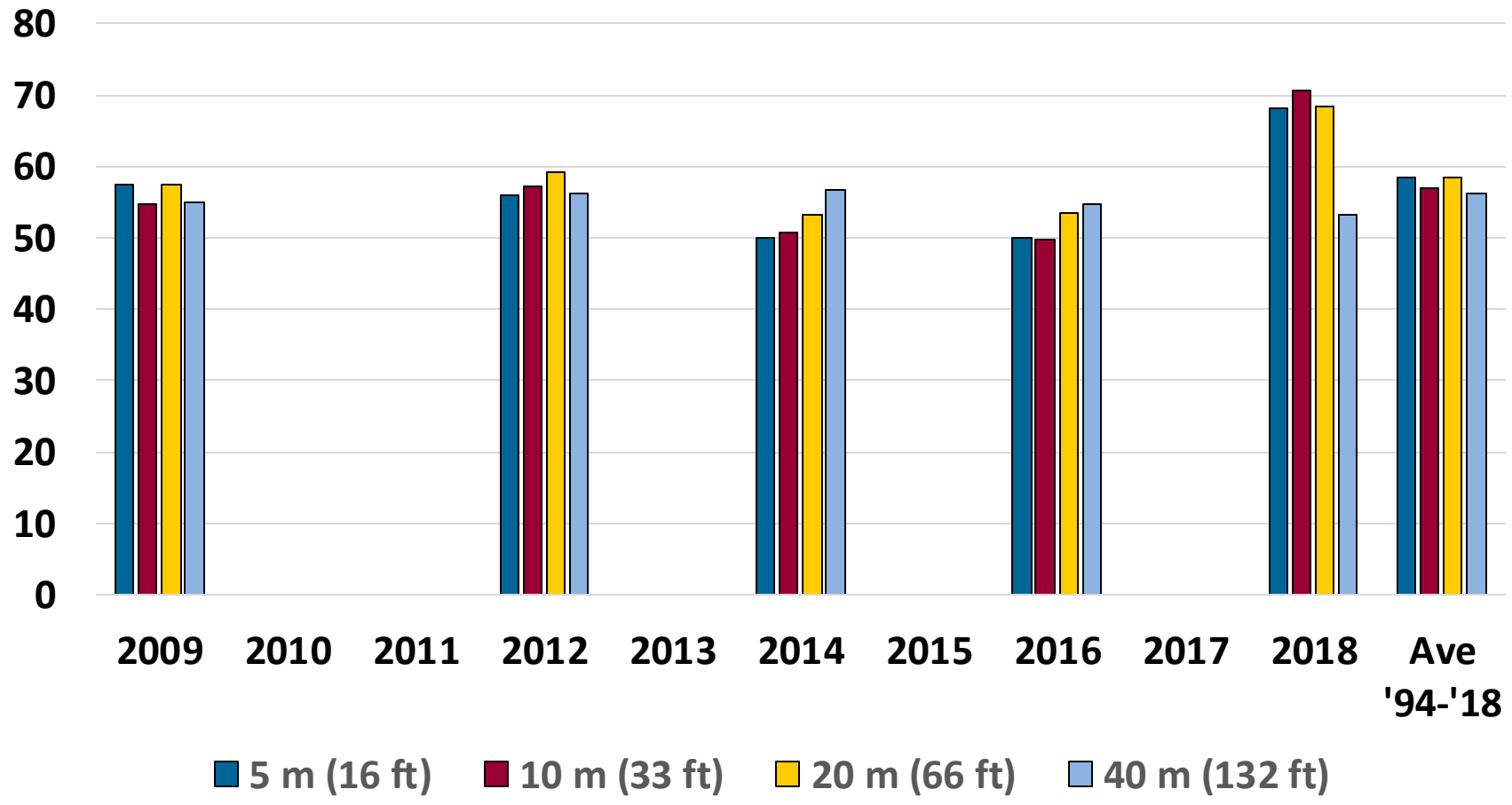


Post-14day rain—negative effect. Mitigated somewhat by drainage in later years.

Growing season rain–positive effect for drained plots in later years, none for undrained.

SEPAC Drain Spacing Soybean Yields (bu/A)



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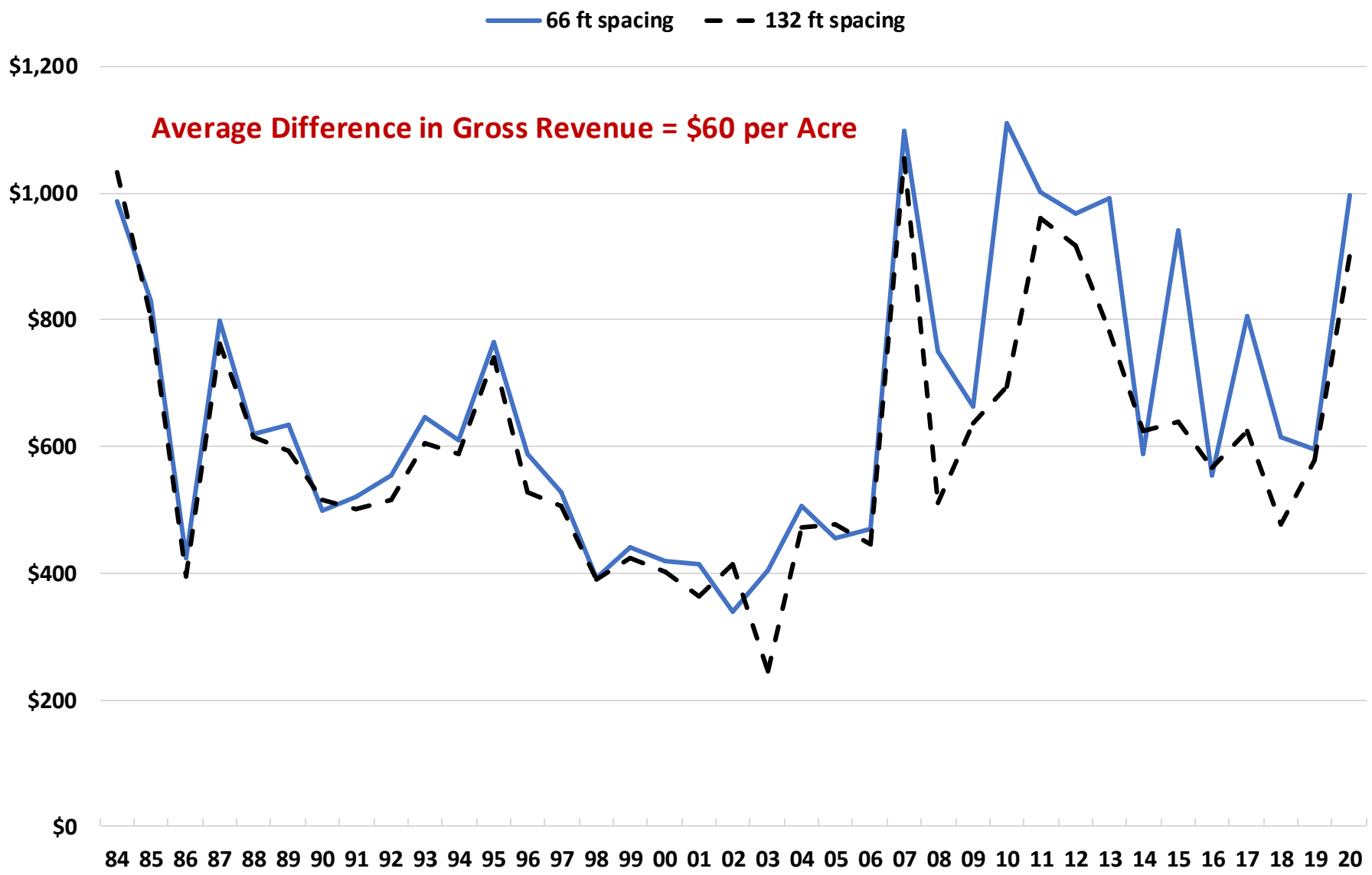
Gross Revenue per Acre

SEPAC Drainage Project



What about surface drainage?

- Good surface drainage on this field. Slightly more slope than many Clermont fields, according to local farmers.
- Thus, the importance of subsurface drainage is not as dramatic as on more typical fields.
- Notice the impact of tiles vs. none, on another part of same field with less ideal surface drainage…….

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Drainage pays!

Drainage improves cover crop growth

May 13, 2016

Tiled

~3100 lbs biomass/A

Untiled

~700 lbs biomass/A

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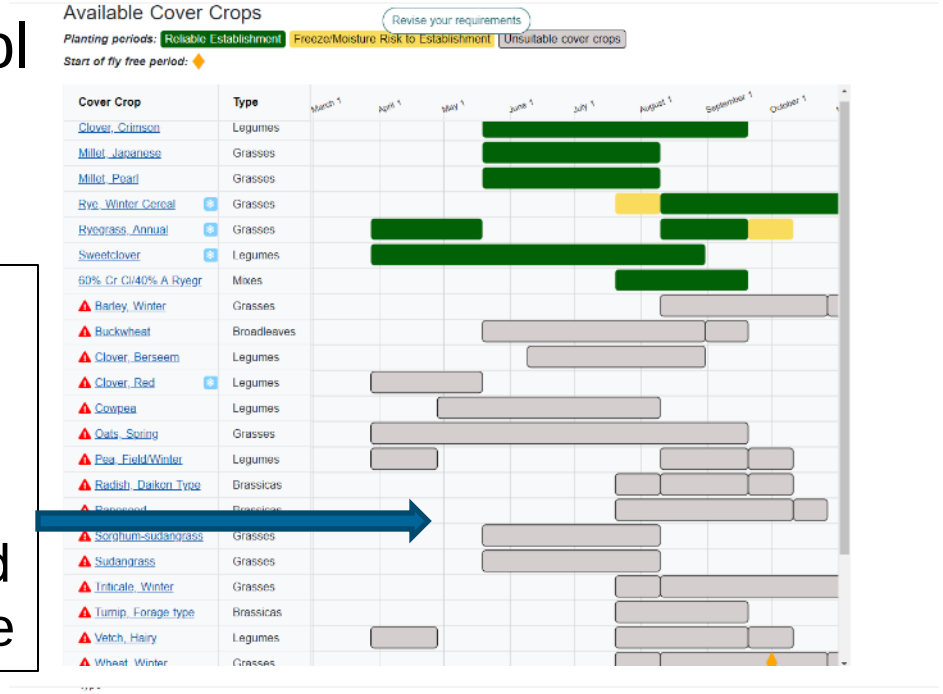
MCCC Cover Crop Decision Tool

www.midwestcovercrops.org

Parke Co., IN

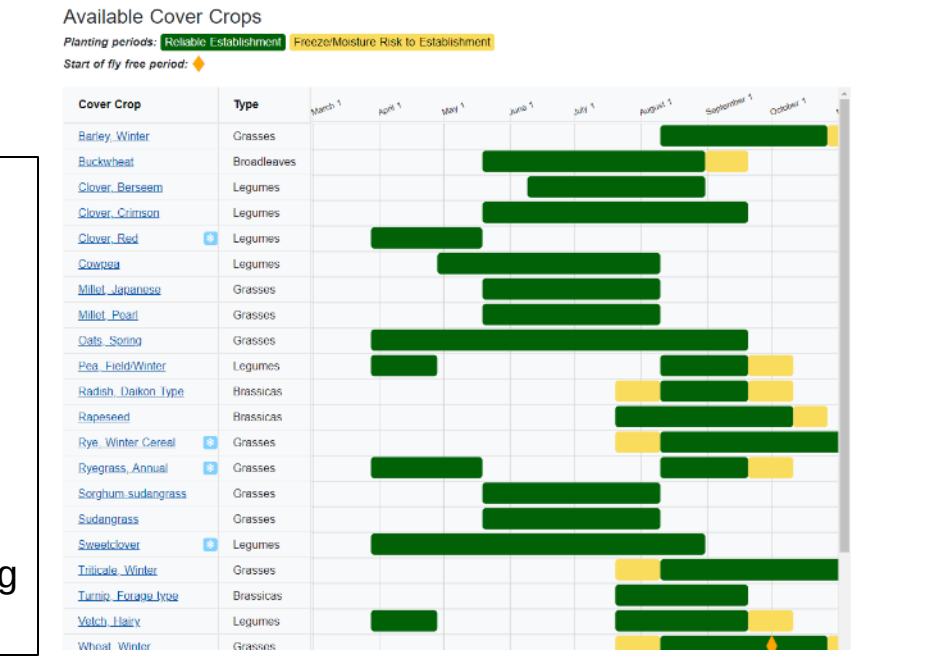
Poorly-drained soil, no tile

Note most cover crops are “grayed out”, ie unsuitable



Poorly-drained soil, with tile

Note most cover crops are now suitable to grow.
(Green is reliable seeding dates)



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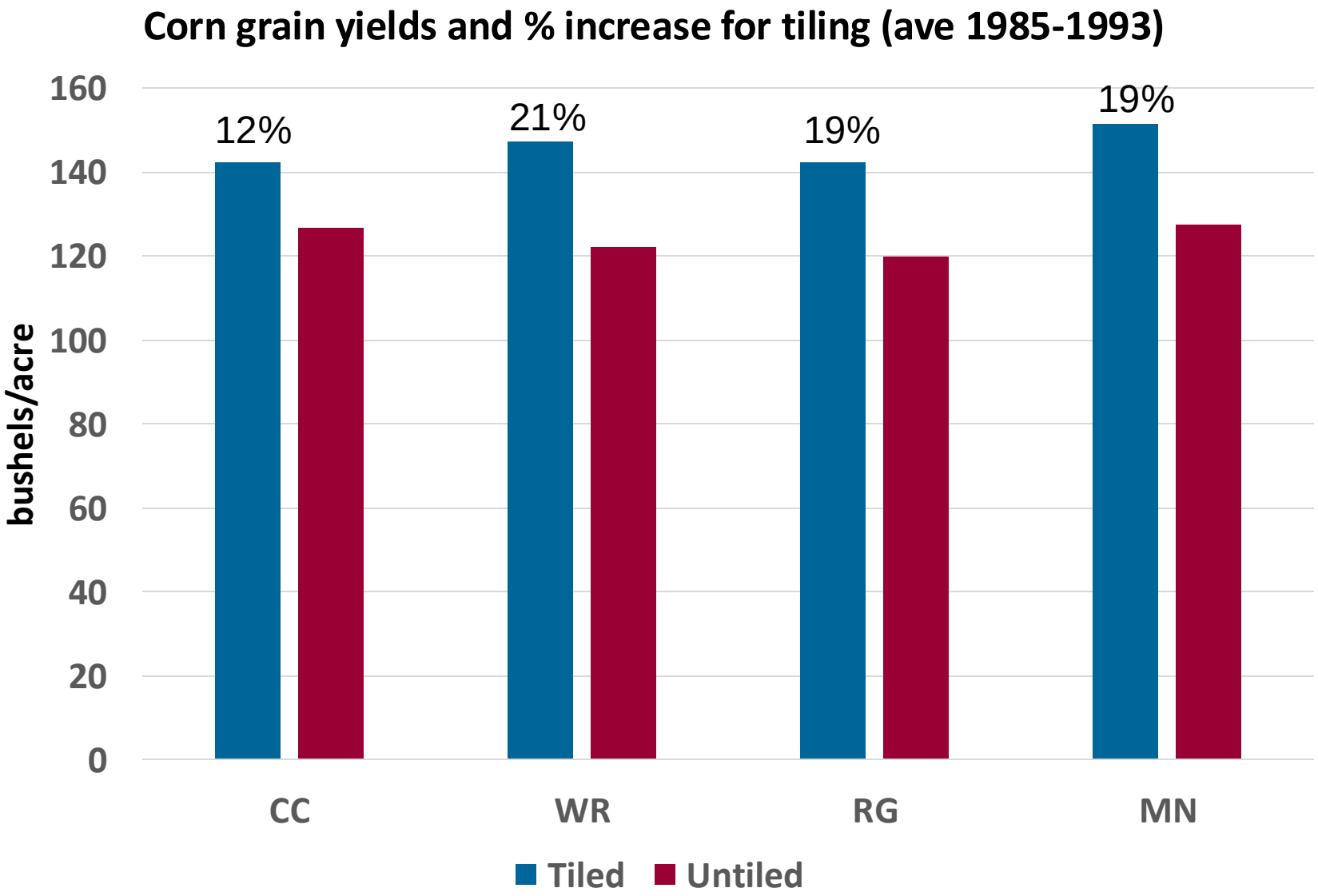
Field Experiments

- Drainage 2
  - Subsurface “tile” drainage vs. none (2 subfields)
  - Chisel vs. no-till
  - 5 agronomic practices
    - CC: (cont.corn) only
    - WR: CC with winter cover of wheat or cereal rye
    - RG: CC with winter cover of annual ryegrass
    - MN: CC with dry manure spring application
    - RO: 3-yr rotation, corn-wheat-orchardgrass/redclover
    - (covers hand-broadcast into standing corn each autumn)


Corn grain yields and % increase for tiling (ave 1985-1993)
bushels/acre
160
140
120
100
80
60
40
20
0
12%
21%
19%
19%
CC
WR
RG
MN
Tiled
Untiled

Summary- Agronomic plots

- Average continuous corn yields were 16 to 25 bu/A higher in tiled than in untiled subfield, depending on agronomic trt.
- Cover crops, rotation, and manure had equal or greater corn yields than control in tiled subfield, but equal or lower than control in untiled subfield

➢A good drainage system is a necessary first step to improving crop yields. Agronomic practices alone are not likely to make up for an inadequate drainage system.

Earthworms and soil properties

- Earthworm populations were generally higher in:
  - No-till vs. chisel
  - Tiled vs. untiled
  - Covers, rotation, manure vs. control
- Soil physical properties tended to be improved by cover crops and rotation (aggregate stability, infiltration)

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Drainage pays!

- **Drainage enables other conservation practices to work better**
  - In naturally poorly-drained soils, conservation practices such as no-till, cover crops, and rotation with hay crops, are more effective in increasing crop yields, and improving soil physical properties, in tiled vs untiled fields.
  - ➢ **Adequate drainage is a necessary first step to improving crop yields and soil health.** Agronomic practices alone are not likely to make up for an inadequate drainage system.

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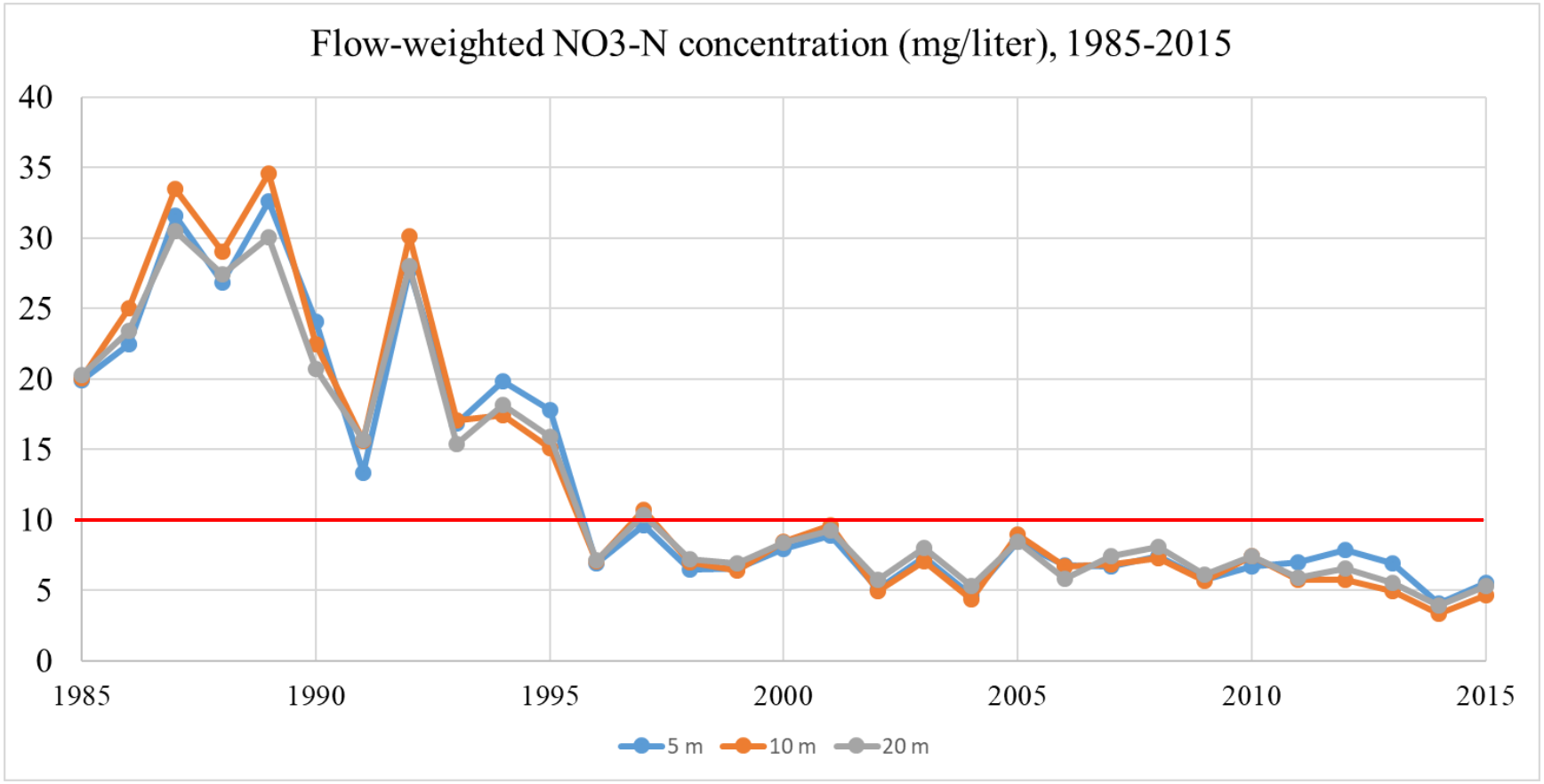
SEPAC Drainage Site



Kladivko, SEPAC

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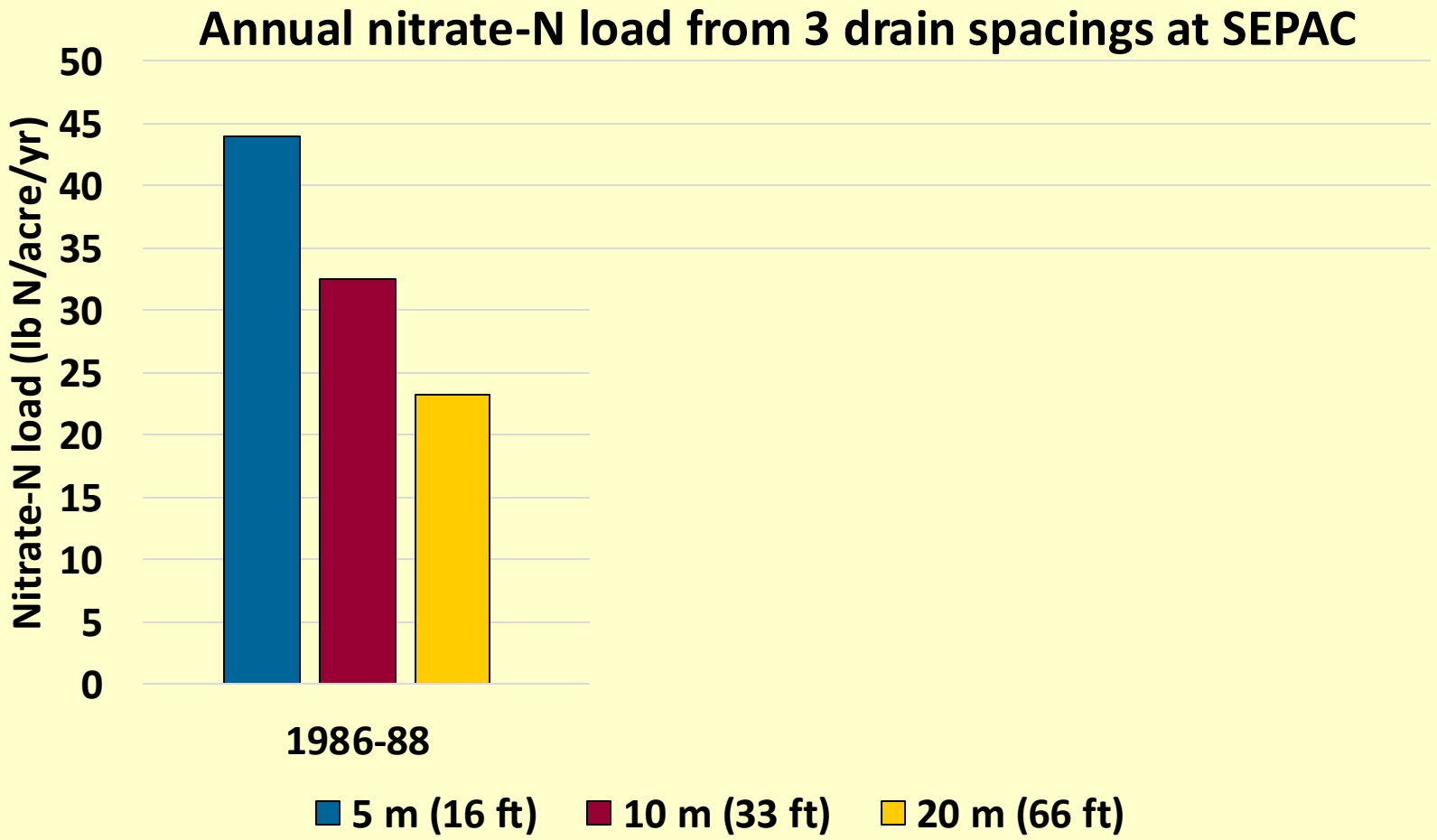
Drainage affects water flow/quality

- **Closer drain spacings lose more water and nitrate in tile drainflow**



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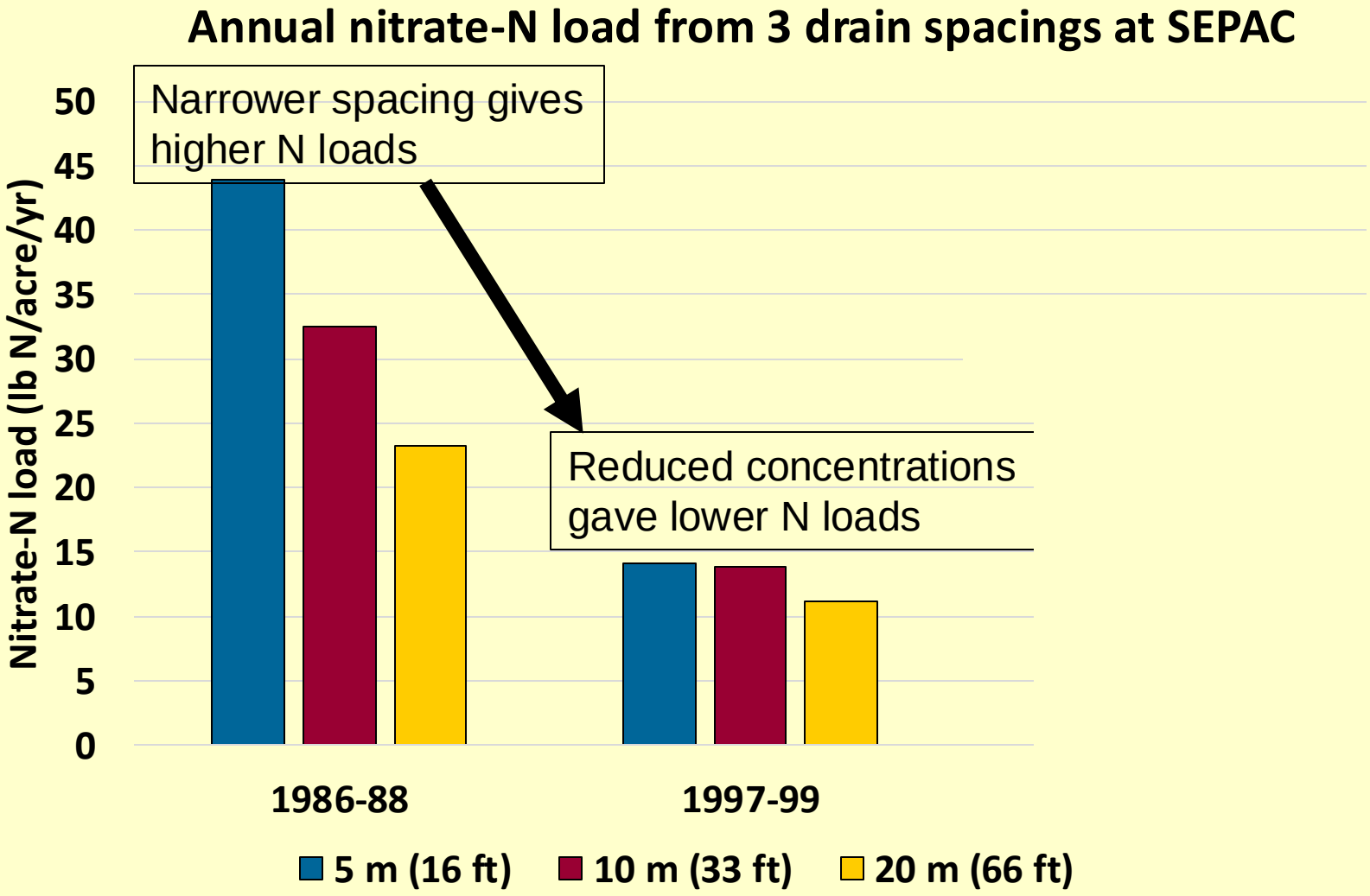
Drainage affects water flow/quality

- **Cover crops reduce nitrate losses from tiles**



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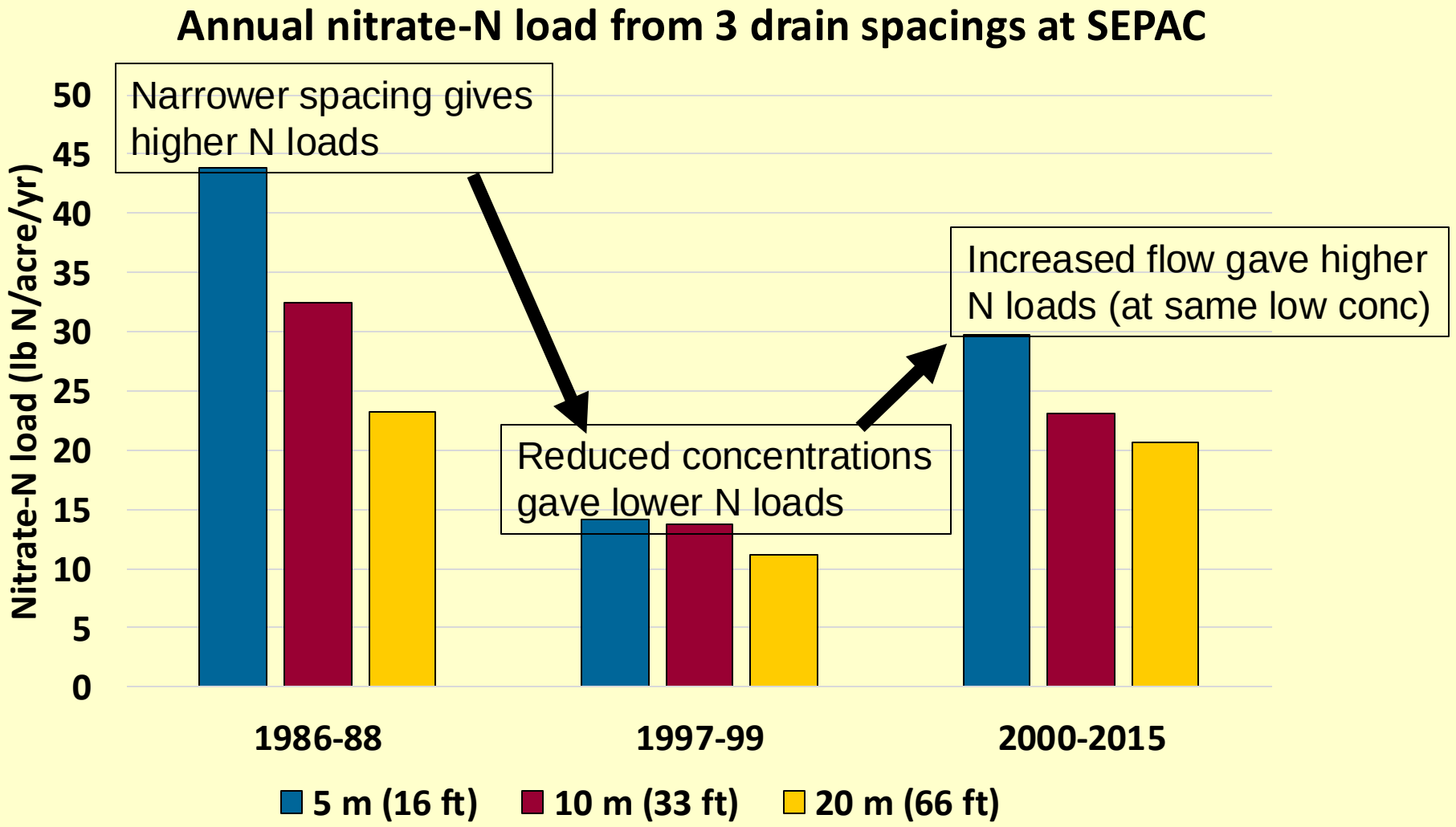

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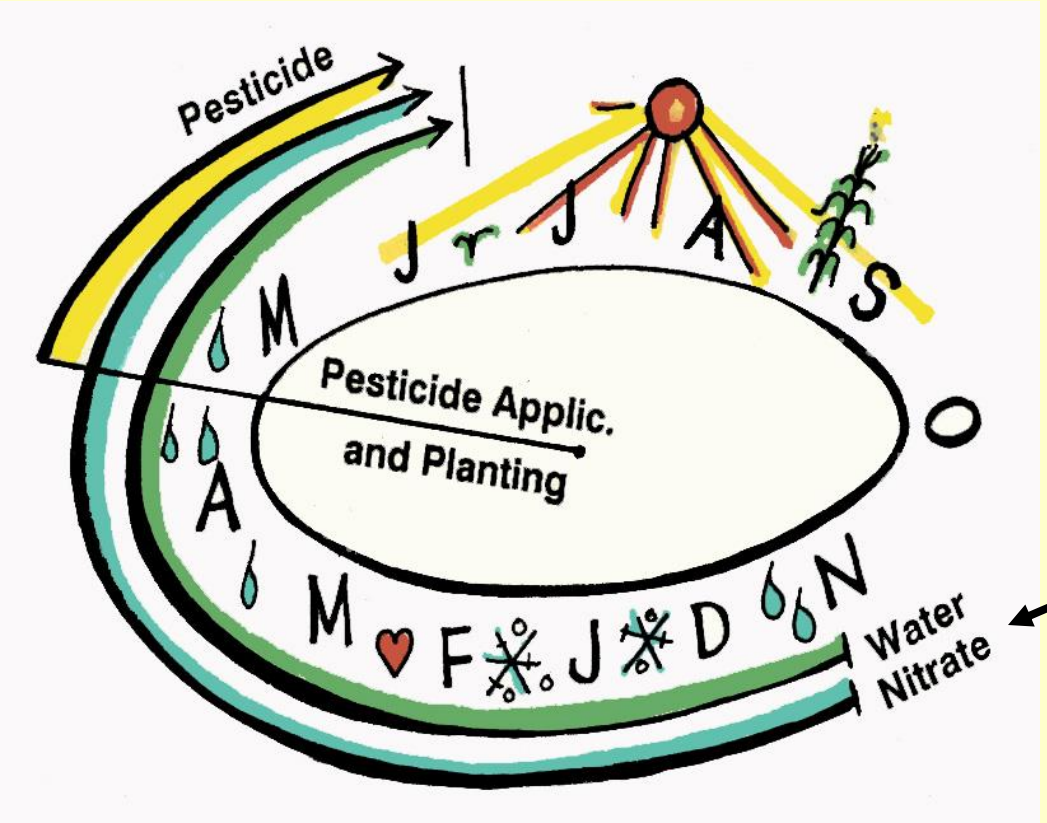
Corn-soybean system normally fallow from Oct – April.



A winter cover crop takes up (or "traps") some of the nitrate that otherwise leaches out during fallow season

Majority of drainflow and N-loads occur in fallow season (at SEPAC)

(64% Nov. – March; 80% Nov. – April)

Bottom line

- Drain spacing matters
- Rainfall (excess) matters
- N fertilizer rate and form matter
- Cover crops reduce NO3-N concentrations, loads

- If we intensify drainage, then we should also intensify management of other aspects of that system, such as cover crops and controlled drainage, to reduce the “leakiness” of the system.

Drainage (summary points)

- Needed for soil health; first step
- Affects:
  - Cash crop growth and yields
  - Soil physical properties, potential to improve
  - Cover crop growth, potential to improve biology
- Also changes hydrology, water quality
- So don’t do excessively close spacings, &/or do additional practices to manage N (more than just 4Rs)

Long-term investment

- Drain flow develops over time
- Yield effects vary from year to year
- Conservation practices take time to improve soil health
- But the long-term improvement in cash crop yields, cover crop growth, and effectiveness of other conservation practices make tile drains a good investment

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Want more details?

- Watch Parts 1, 2, and 3
  1. Yields and timeliness
  2. Cover crops and conservation practices
  3. Drainflow, nitrate-N loads, and cover crops to reduce N loads

  Google "purdue sepac drainage"

- Read Extension publications
  - AY- 397, 398, 399-W (and 396-W summary)

  www.edustore.purdue.edu

  Or Google "purdue sepac drainage"

- Database of all measured data from Sepac drainage study, 1984-2020, https://purr.purdue.edu/publications/3954/1

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- SEPAC Farm Crew
- Graduate students and post-docs
- Faculty colleagues
- NRCS colleagues
- Purdue Agricultural Research Programs, for financial and moral support!

Thank you!