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Unravelling the Influence of Management Practices on US-North Central Soybean Yields

Juan I. Rattalino Edreira, Spyridon Mourtzinis, Shawn P. Conley, Adam C. Roth , Ignacio A. Ciampitti, Mark A. Licht, Hans Kandel, Peter M. Kyveryga, Laura E. Lindsey, Daren S. Mueller, Seth L. Naeve, Emerson Nafziger, James E. Specht Jordan Stanley, Michael J. Staton, Patricio Grassini

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Assessing causes of yield gaps

US soy area is **± 85 million a** and the **~30% of global soybean production**

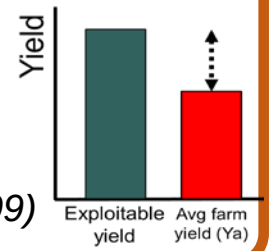
USDA-NASS (2011-2015)

North-Central US region represents the ~**80% US soybean production**

FAOstat (2011-2015)

Potential yield:
90 bu/ac
Actual gap:
45 bu/ac

Specht et al. (1999)



Main goal | To benchmark current yield and management practices in producer fields across the North-Central US region in order to identify KEY management factors that can help producers to increase yield and input-use efficiency

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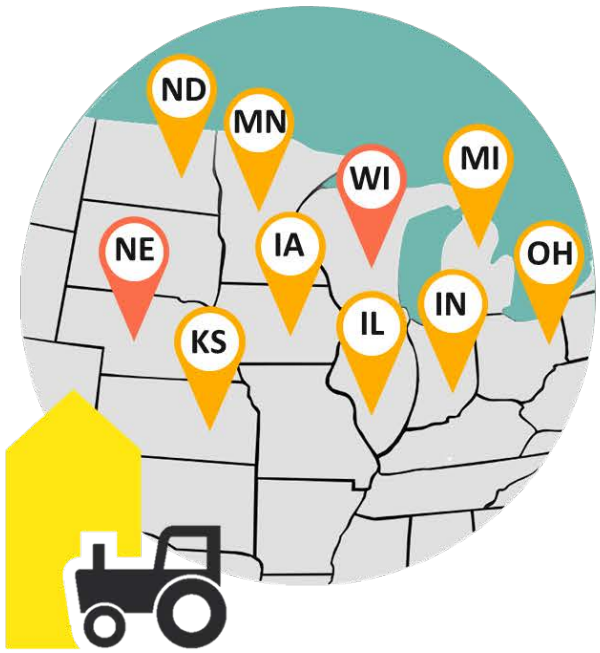
The team



Farmer data from 10 states

Core team

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(Univ. of Nebraska)

Shawn Conley
(Univ. of Wisconsin)

Juani Rattalino
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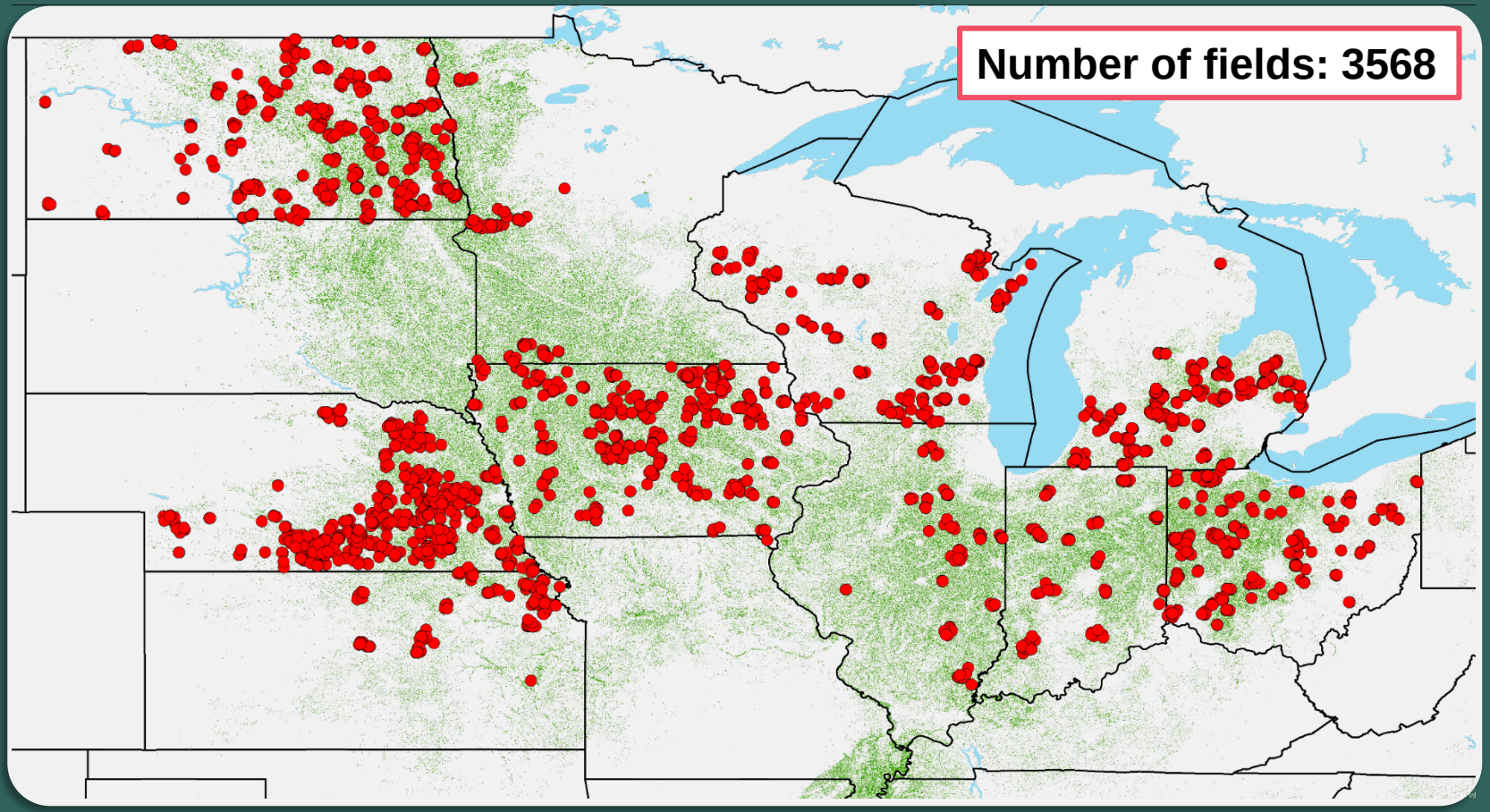
Farmer data

Location of surveyed 2014-2015 soybean fields



Data collection: survey form

Contact info and logos were customized for each state

- -Field location
- -Field boundaries
- -Irrigation type and amount
- -Drainage type
- -Field yield
- -Yield range
- -Planting date
- -Variety
- -Seeding rate
- -Row spacing
- -Seed treatment
- -Tillage
- -Fertilizer
- -Starter
- -Lime, Manure
- -Herbicide
- -Fungicide
- -Insecticide
- -SCN, IDC, others

PRODUCER NAME: [redacted] **MAILING ADDRESS:** [redacted]

Please provide information for four SOYBEAN fields on your farm in 2014. If you have questions, contact Professor Patricio Grassini (Phone: 402-472-5554 / e-mail: pgrassini2@unl.edu). Note that all provided info will be kept confidential! An EXAMPLE is shown in red.

	EXAMPLE:	2014 Soybean	2014 Soybean	2015 Soybean	2015 Soybean
Specify field location by Section: Township: Range. → Please sketch-in the boundaries of your field location within the Section →	NE ¼ 25 : 20N : 26W 	[redacted] 	[redacted] 	[redacted] 	[redacted] 
OR GPS coordinates of field centroid: OR County & field location relative to Rd Intersection:	41.678, -100.257 Saunders Co, SW of Rd 11 & N	[redacted]	[redacted]	[redacted]	[redacted]
Dryland? OR Pivot, Gravity? Indicate field size (acres)	Pivot (130 ac)	Pivot (137ac)	Gravity (30ac)	Pivot (84 ac)	Dryland (11ac)
Does this field have drainage? (no, old clay tile, new systematic tile, surface drainage, other)	No	No	No	No	No
Total Inches of Irrigation Applied to crop?	5 inches	3.5 in.	4.5 in	3.5 in	0
SOYBEAN YIELD (bushels/acre) for this FIELD:	70	80	70	85	39
Lowest | Highest Yield (bu/ac) of your soy fields that year *Use Irrigated fields yield range if this crop was Irrigated: *Use Dryland fields yield range if this crop was Dryland:	Low: 62 High: 80	Low: 61 High: 90	Low: 55 High: 86	Low: 61 High: 90	Low: 13 High: 66
Planting Date in this FIELD (Month/Day/Year):	5/15/2014	4/28/2014	5/2/2014	4/29/2014	5/4/2014
Variety Name (Brand & Number):	Pioneer P93M11	Channel 3402 RR2	Channel 3402RR2	Channel 2402RR2	Channel
Seeding Rate (seeds/ac):	125,000	140,000	140,000	140,000	140,000
Row spacing (inches):	30	30	30	15	15
Seed Treated (Yes/No)? What Brand Name Product(s)?	Yes (Cruiser-Max)	yes Acceleron	yes Acceleron	yes Acceleron	yes Acceleron
Prior Crop in this FIELD? Residue harvested or grazed?	Corn - Grazed	Corn - Grazed	Corn - No	Corn - Grazed	Corn - No
Tillage after prior crop? No-Till (NT); Ridge (RT); Strip (ST); Disk (D); Chisel (C); Vertical (V) – Indicate timing (month-year)	ST (March-2014)	NT	D (April 2014)	NT	NT
Any (non-starter) fertilizer after prior crop? Specify rate (pounds NUTRIENT/ac) and timing (month-year)	P_2O_5: 70 K_2O: 30 Other: S (11 lbs) Time: March-2014	P_2O_5: K_2O: Other: None Time:	P_2O_5: K_2O: Other: None Time:	P_2O_5: K_2O: Other: None Time:	P_2O_5: K_2O: Other: None Time:
Any STARTER fertilizer (Yes/No)? If Yes, specify nutrients	Yes (N, P, Zn)	No	No	No	No
Any Lime (L) or Manure (M)? If yes, specify timing (mm-yy)	M (Nov-2013)	No	No	No	No
PRE- or POST-emergence herbicide program or BOTH?	Both	Both	Both	Both	Both
Any in-season foliar fungicide (F) / insecticide (I)?	F and I	No	No	No	No
Soy Cyst Nematodes (Yes/No/I don't know)?	No	No	No	No	No
Iron Deficiency Chlorosis (Yes/No)?	No	No	No	No	No
Any significant yield loss due to Insects, Diseases, Weeds, Frost, Hail, Flood, Lodging? Specify problem	Frost (Sept-2014)	None	None	None	yes Hail (July 2014)

Materials and Methods

- Average pH values for topsoil (0-12 inches) and subsoil (12-60 inches) for each field were derived from the SSURGO database.

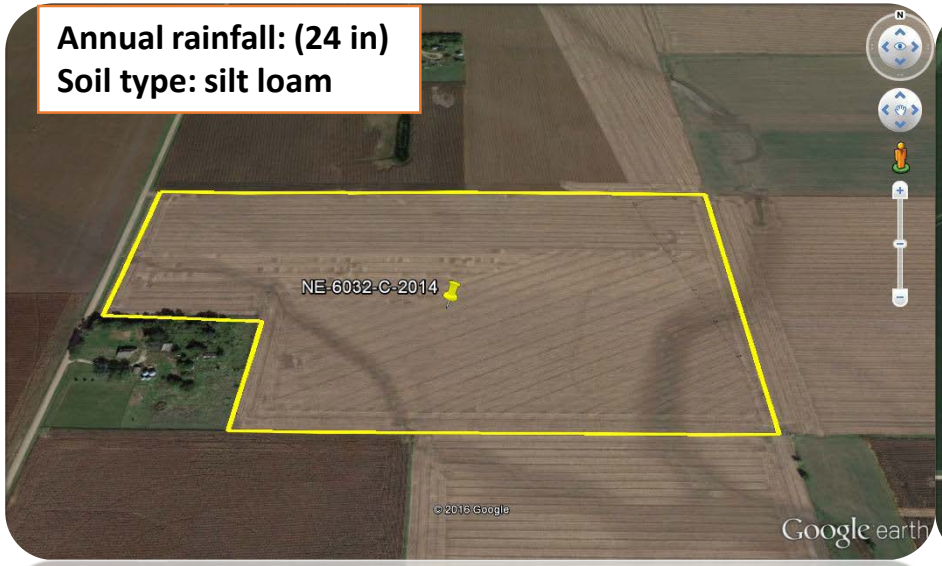
- To account for differences in slope and terrain across field, which could influence the crop water balance, we calculated average values of topography wetness index (TWI) for each field.

- Fields with large TWI values would be associated with greater water supply and fertility compared with fields with lower values.

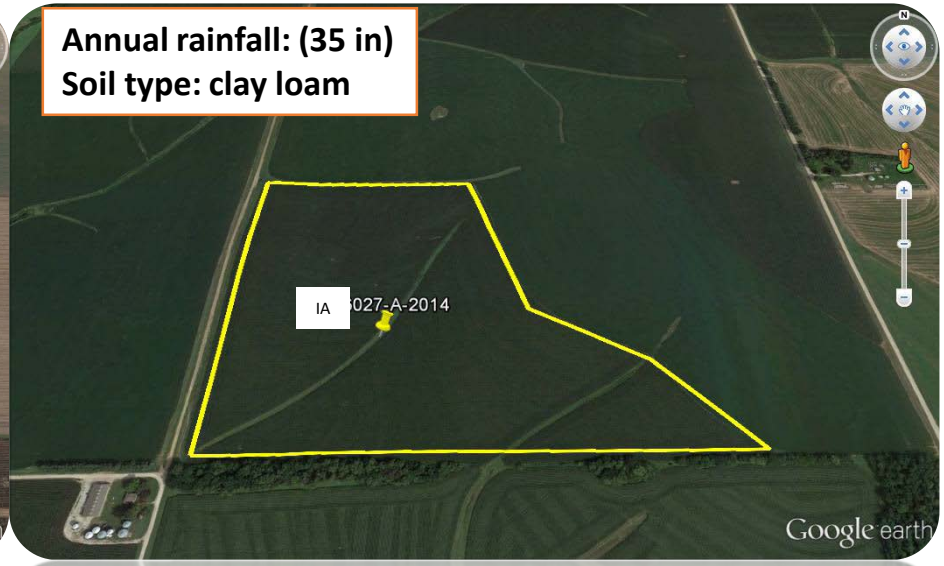
How to make fair comparisons among fields?

We hypothesize that collecting producer field data is equivalent to running field experiments to capture responses to management factors IF fields are properly contextualized relative to climate and soil.

Rainfed field in central NE



Rainfed field in central IA



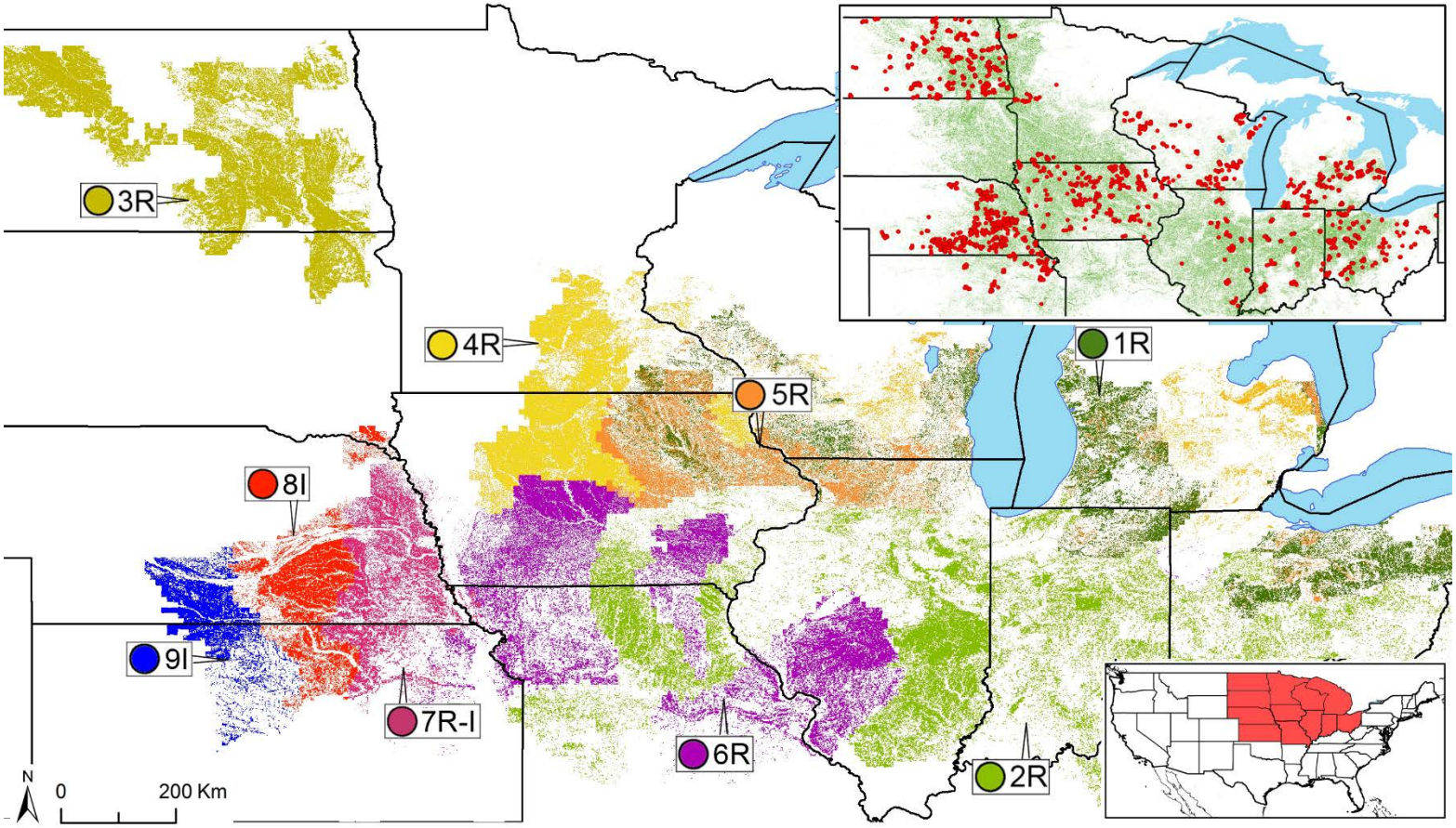
Materials and Methods *cont.*

- Briefly, TED framework delineates regions based on:
  (i) annual total growing degree-days,
  (ii) aridity index,
  (iii) annual temperature seasonality, and
  (iv) plant-available water holding capacity in the rootable soil depth.

- Each TED corresponds to a specific combination of the four parameters.

Field Survey Data & Technology Extrapolation Domain (TED)

Surveyed fields were clustered in 10 TEDs; each TED contains > 90 fields



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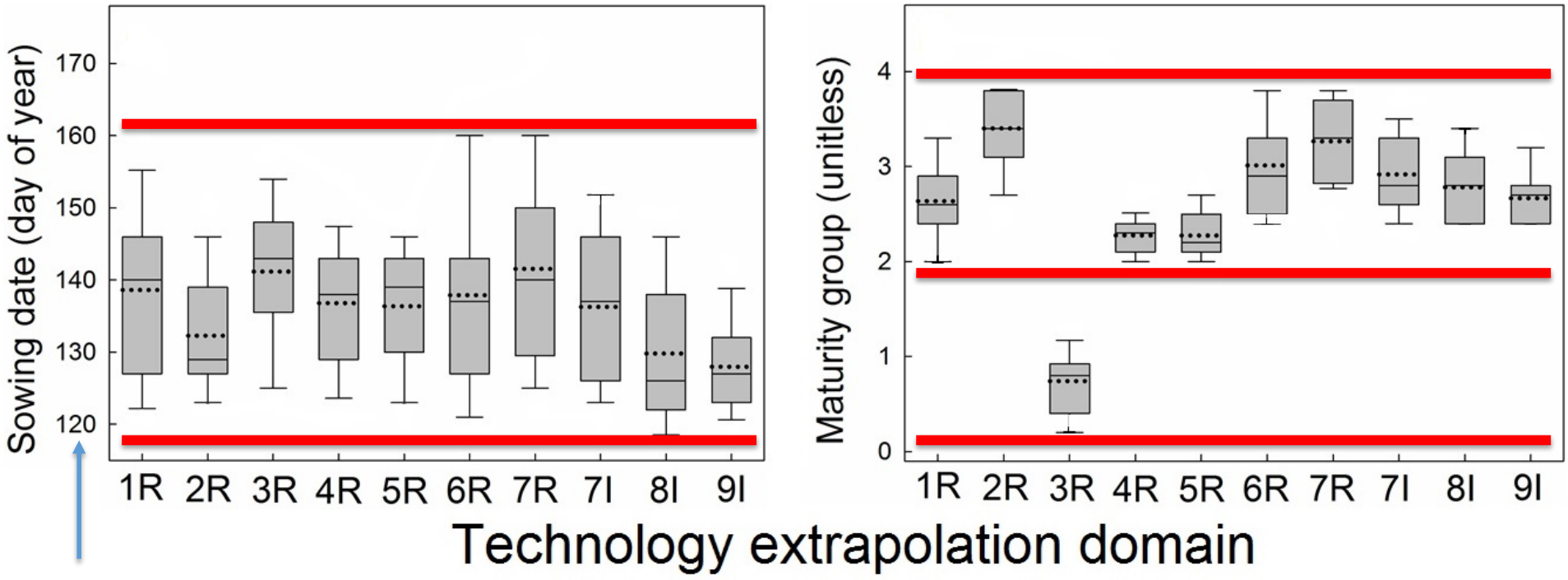
Management Practices Defined



April 30

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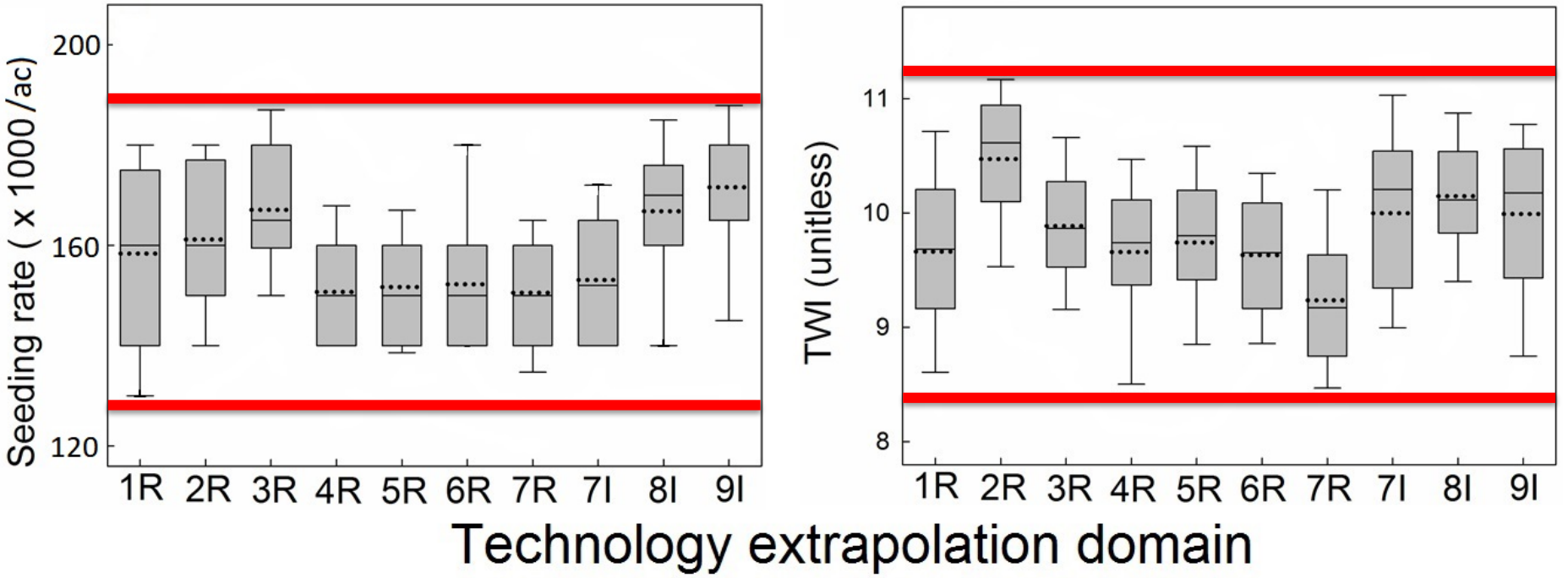
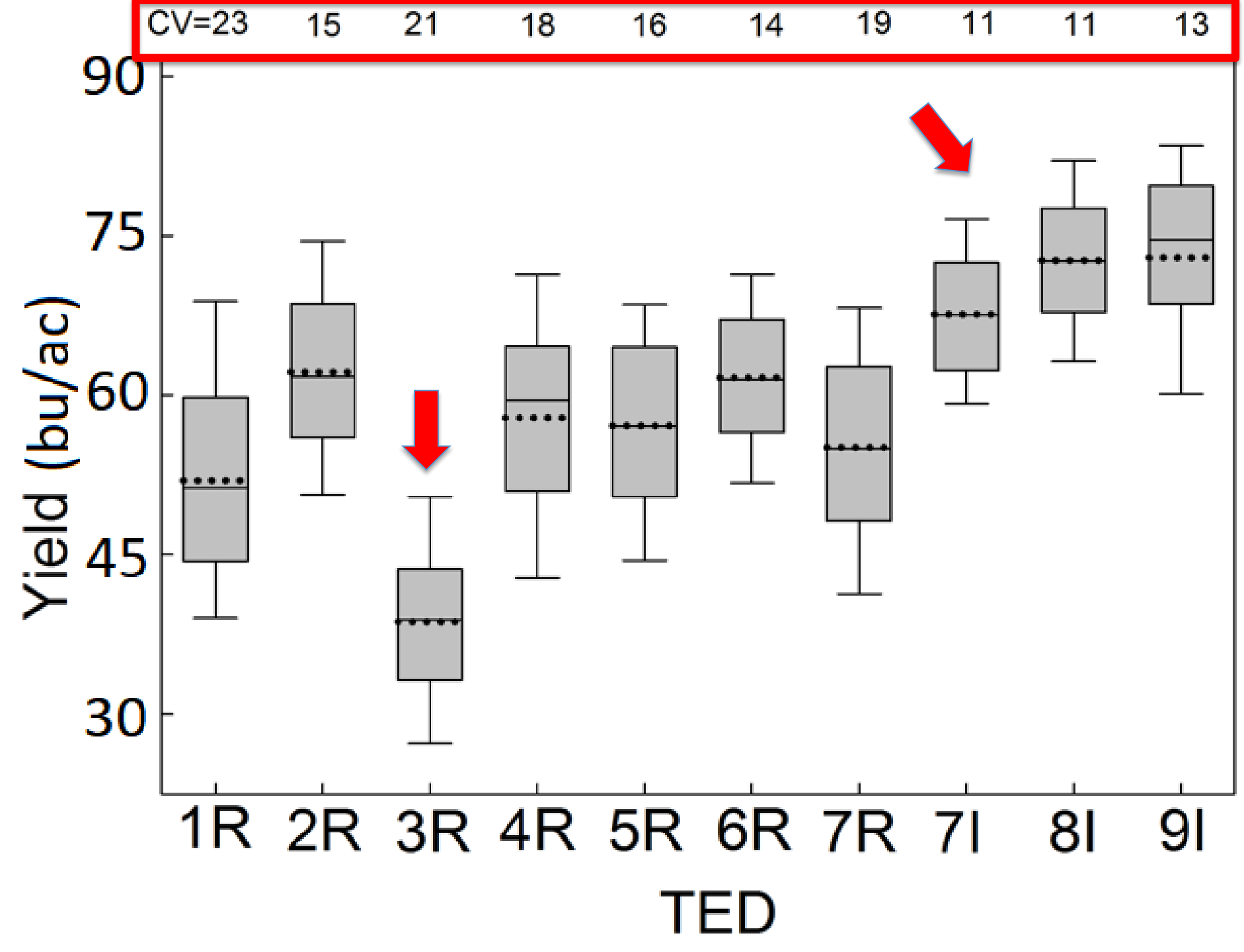
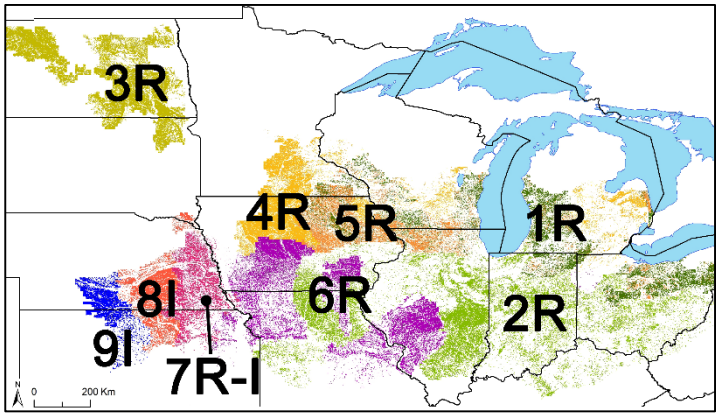
Management practices *cont.*

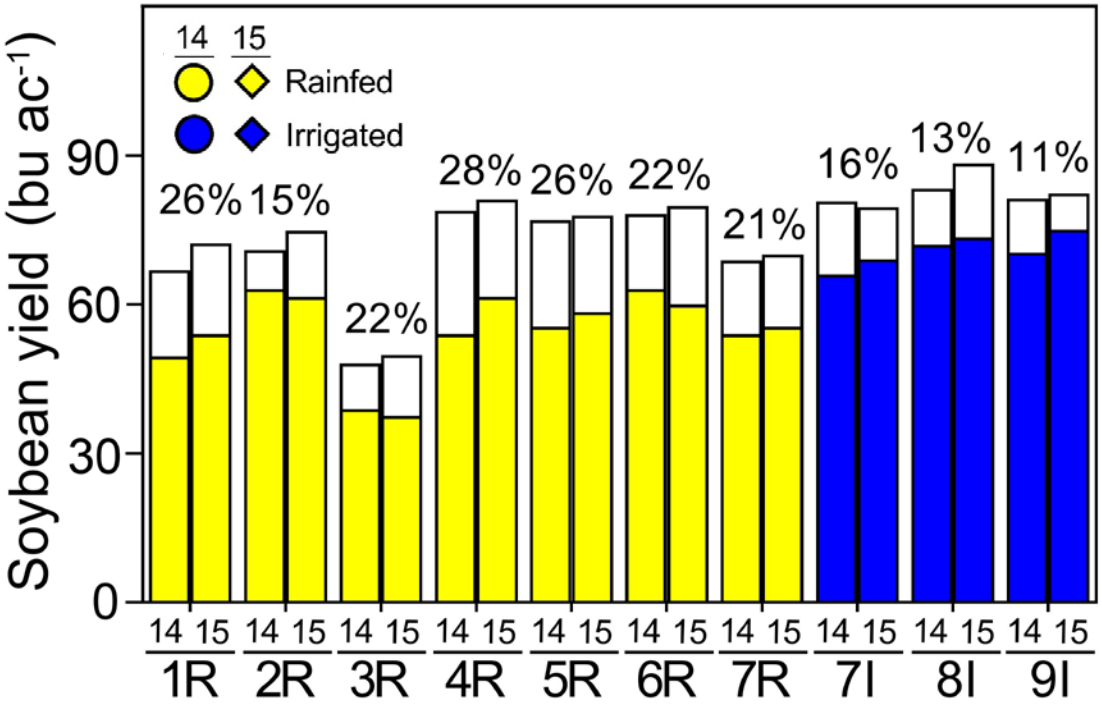



CV=23 15 21 18 16 14 19 11 11 13
90
75
60
45
30
Yield (bu/ac)
1R 2R 3R 4R 5R 6R 7R 7I 8I 9I
TED

What is the soybean yield gap in the NC USA region?

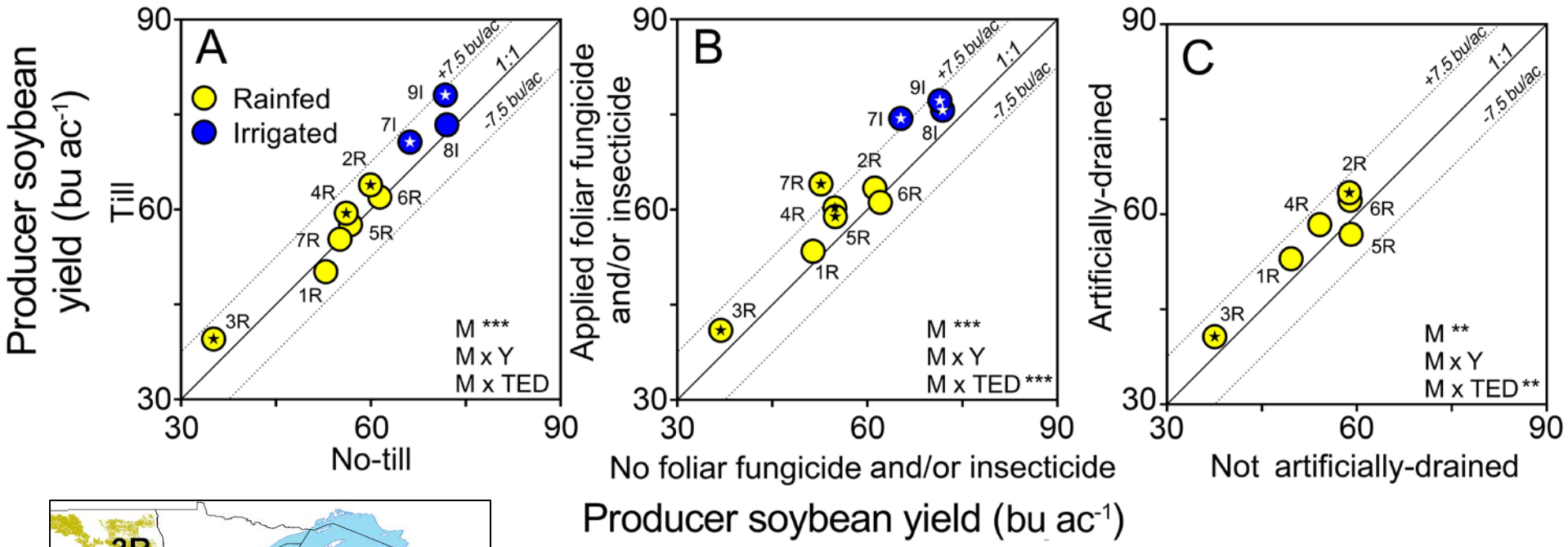
Soybean yield gap in the NC USA were relatively small, averaging 22% (rainfed; 67 vs 52 bu/a) and 13% (irrigated; 82 vs 74 bu/a) of the estimated yield potential.

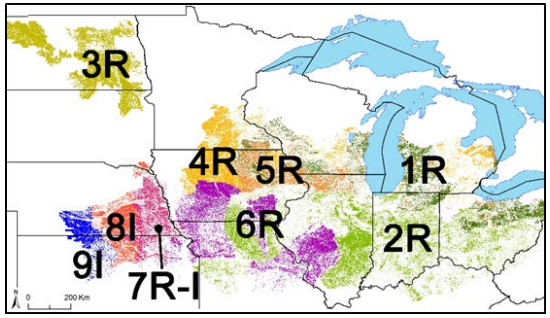




(Rattalino Edreira et al. 2017a, Agric. For. Meteorol. 247, 170-180)

Management factors influencing yield in your TED?





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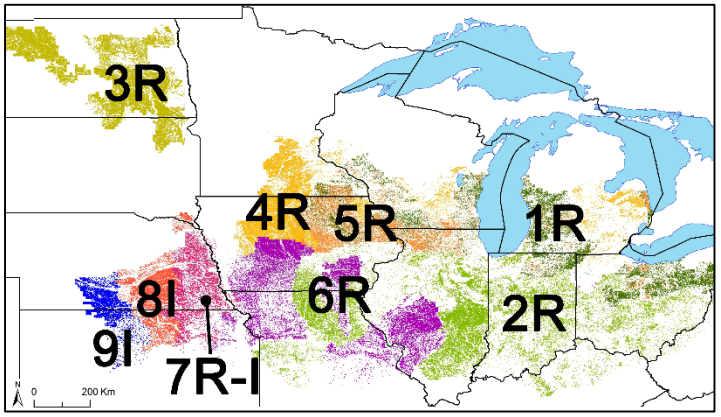
Influence of planting date on soy yield by TED

Late soybean planting reduces yield potential up to 0.5 bu a^{-1} per day of delay after late April, but the magnitude of yield penalty varies across TEDs.



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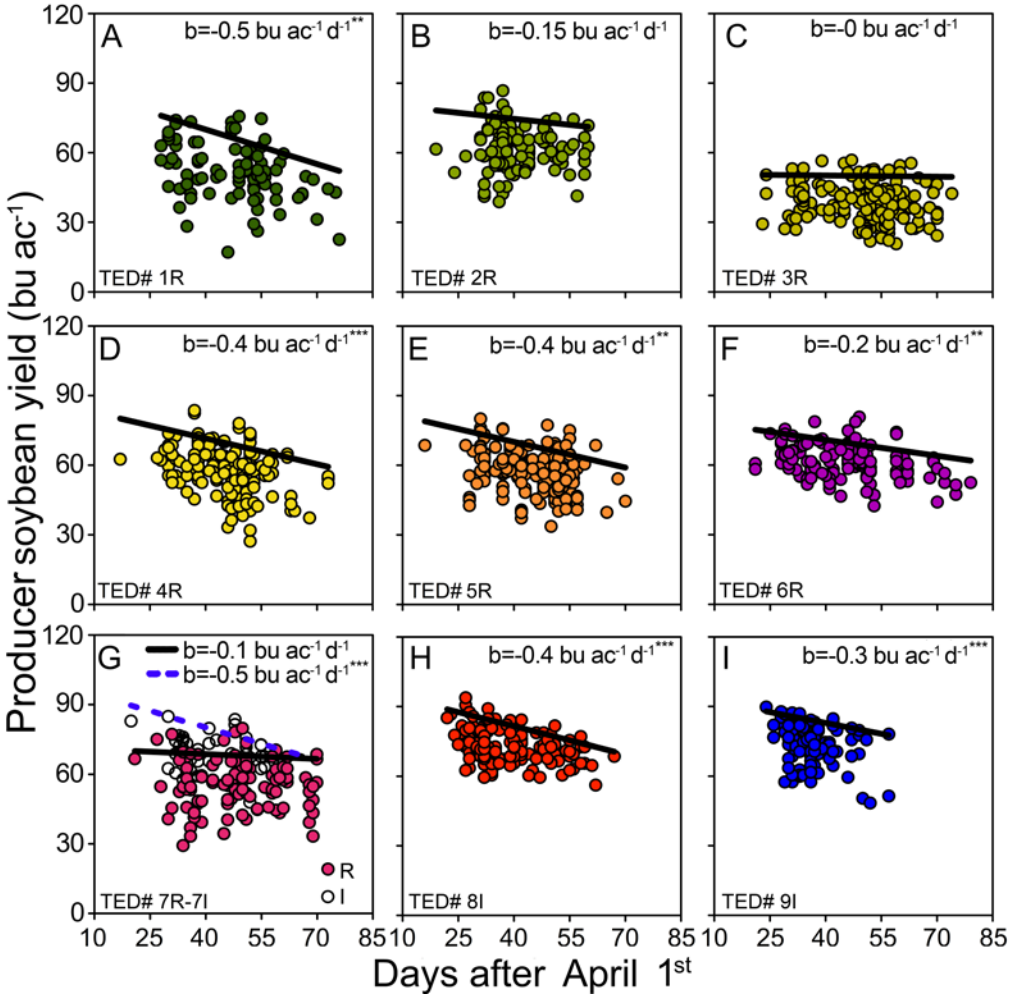

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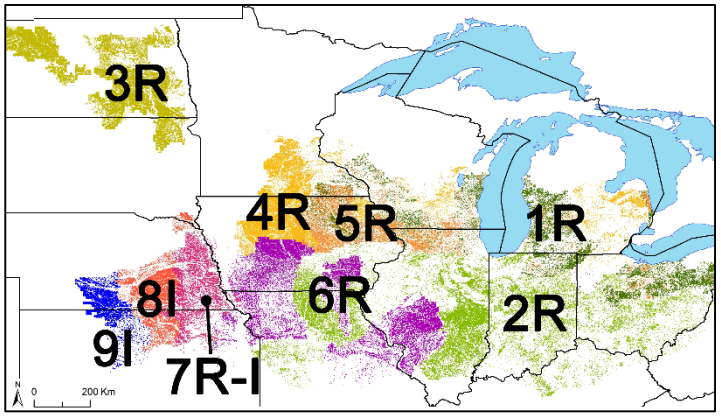
Water deficit influence in potential response to planting date

Yield penalty (or response) to sowing date was negligible when water deficit was < -4 in, but increased linearly up to nearly ~1 in



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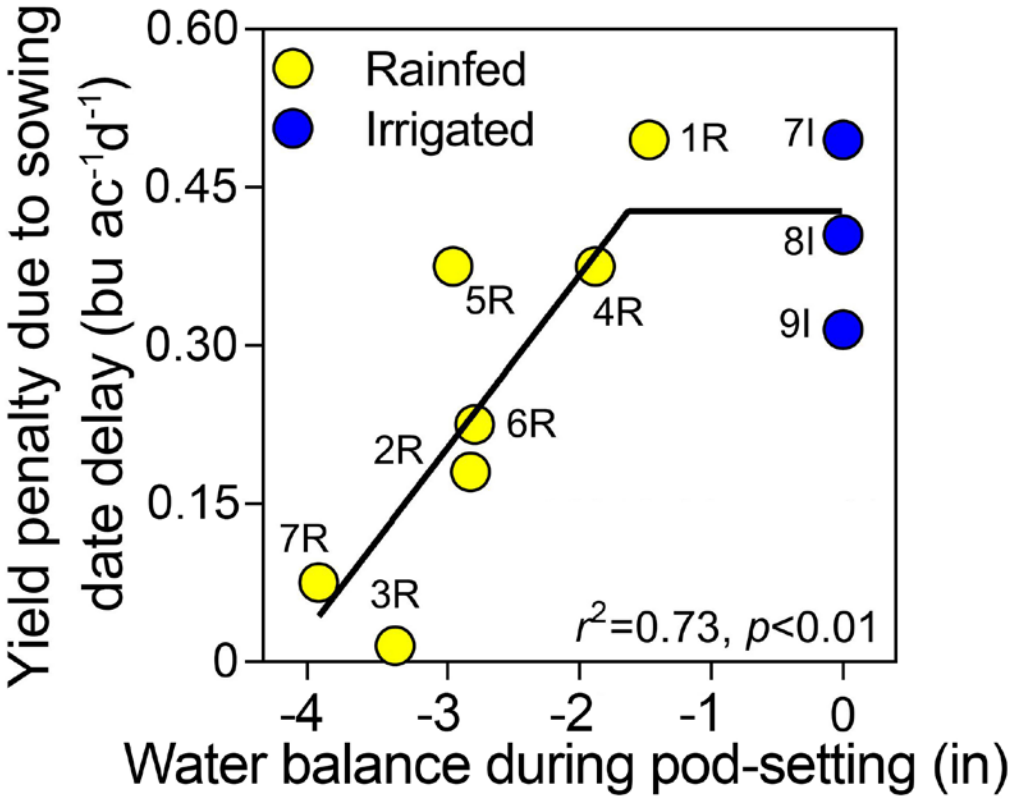

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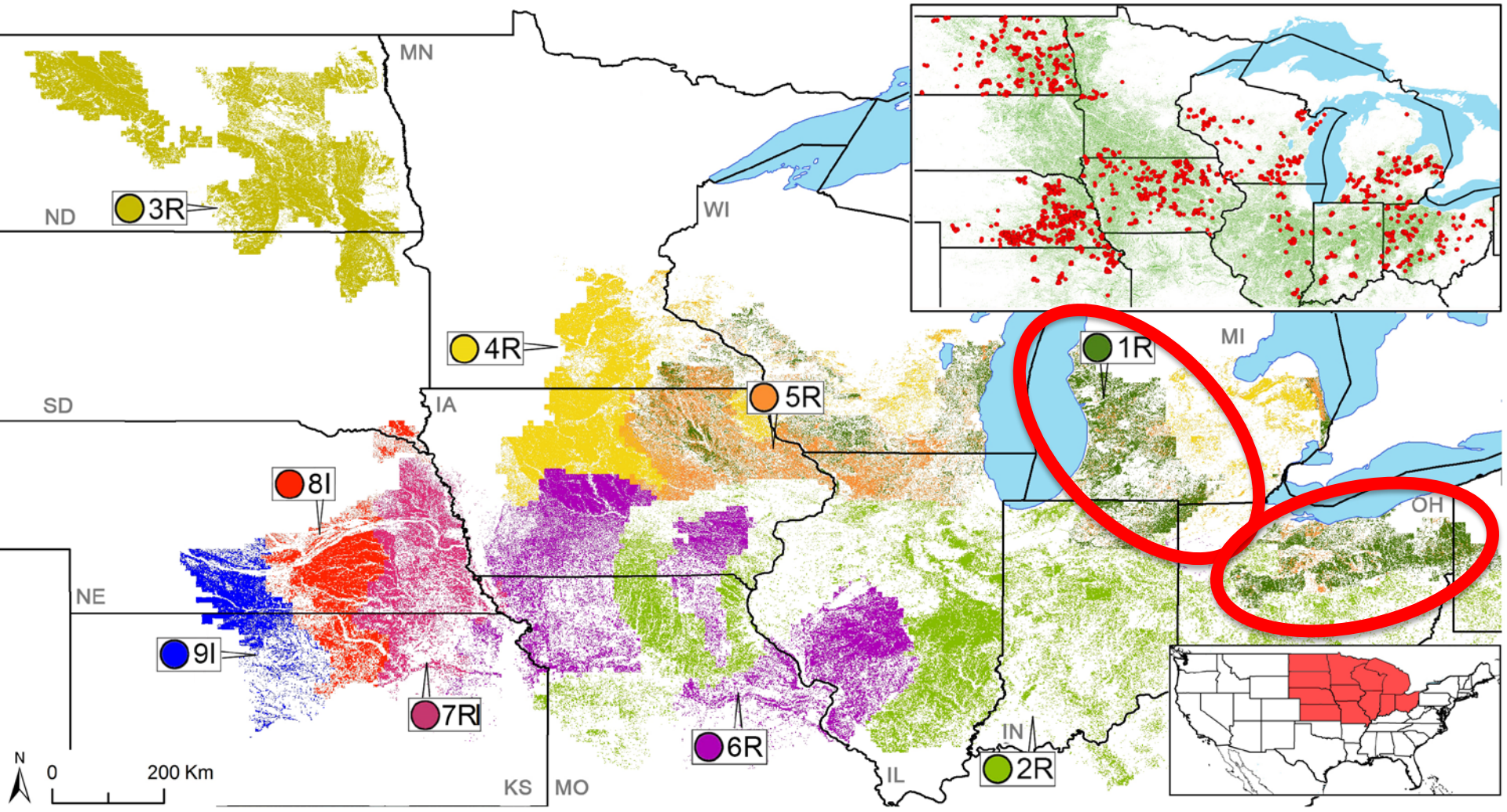
Results TED=1R



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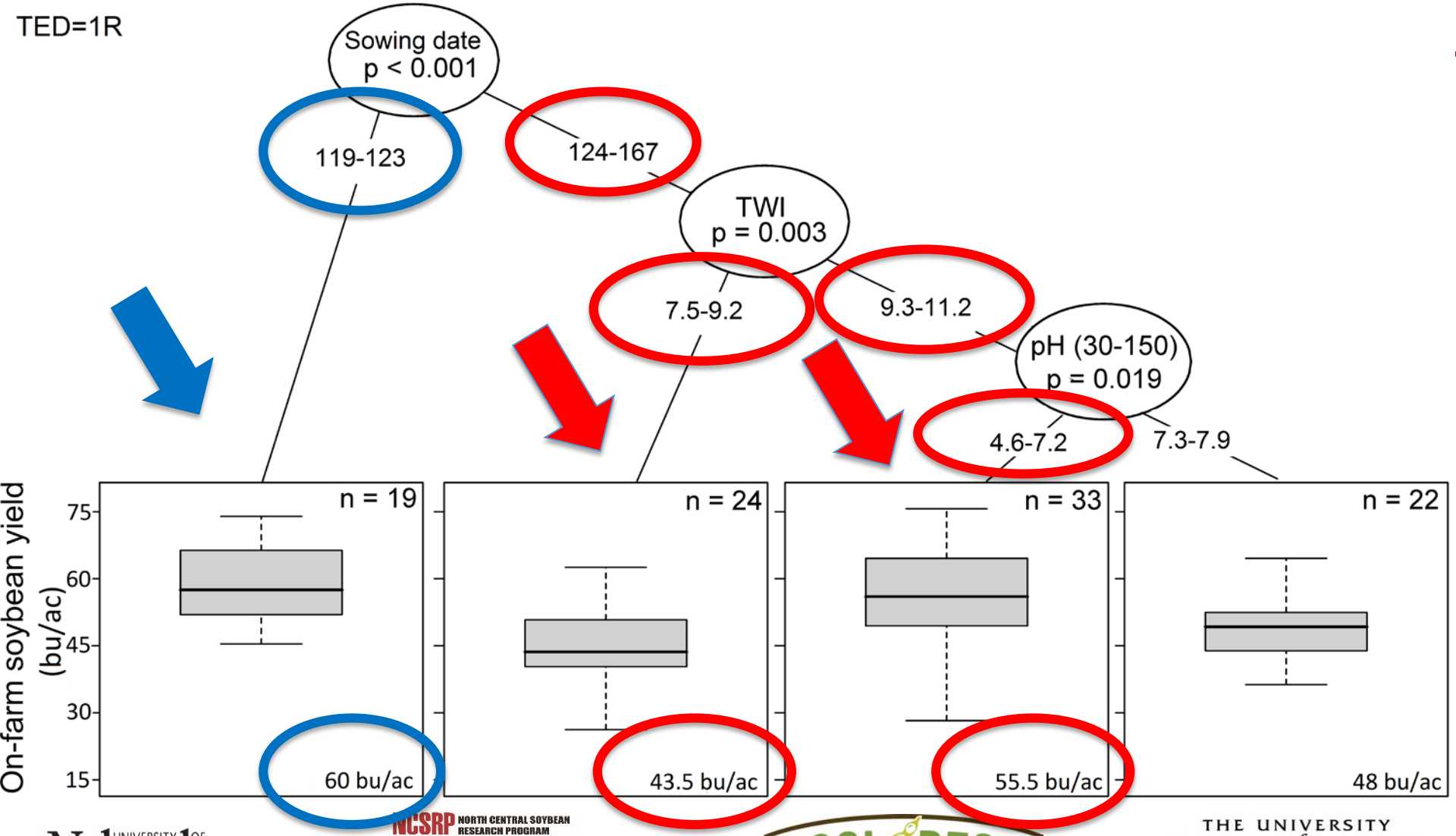
Results TED=1R



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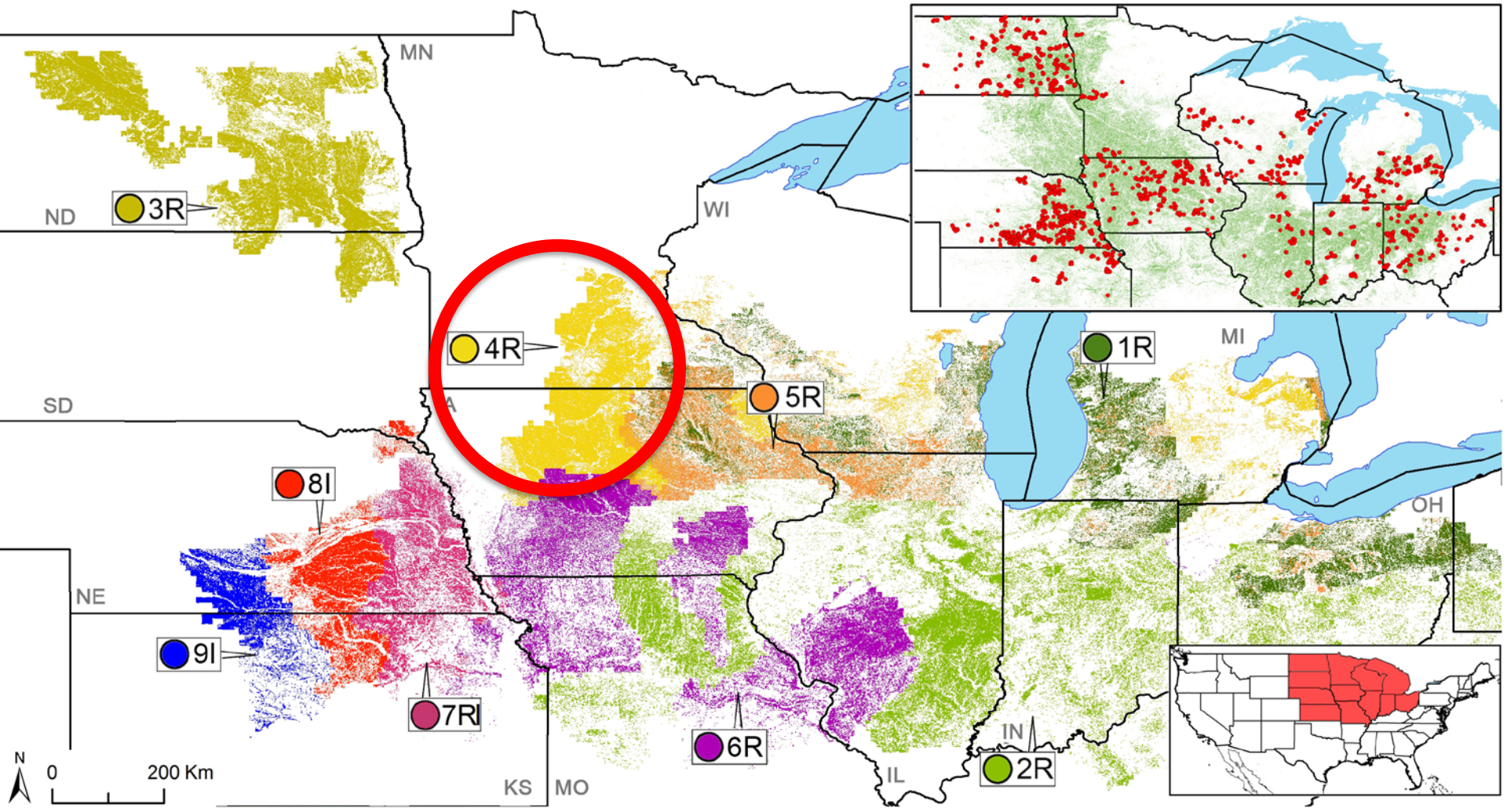
Results TED=4R



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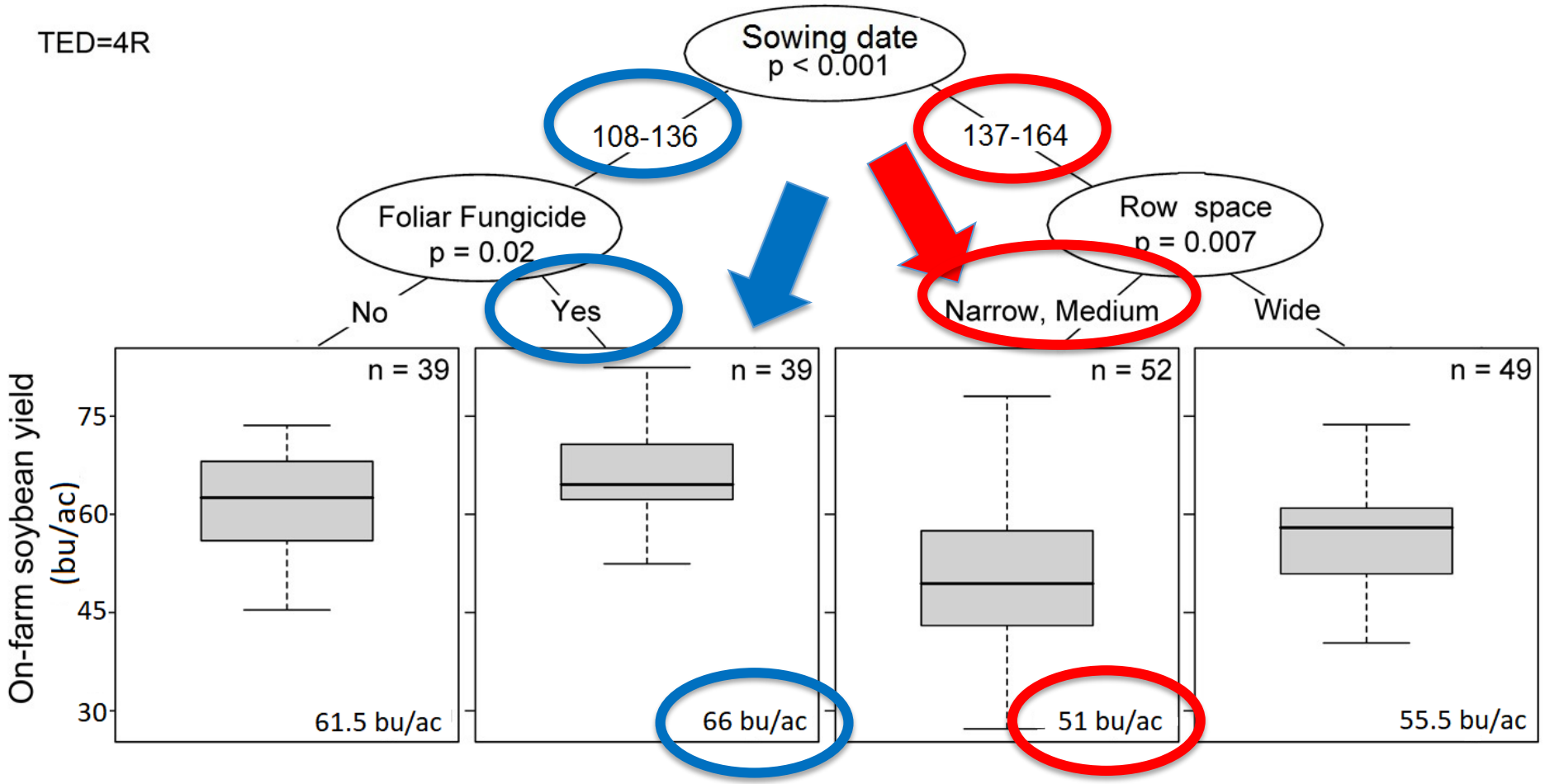
Results TED=4R



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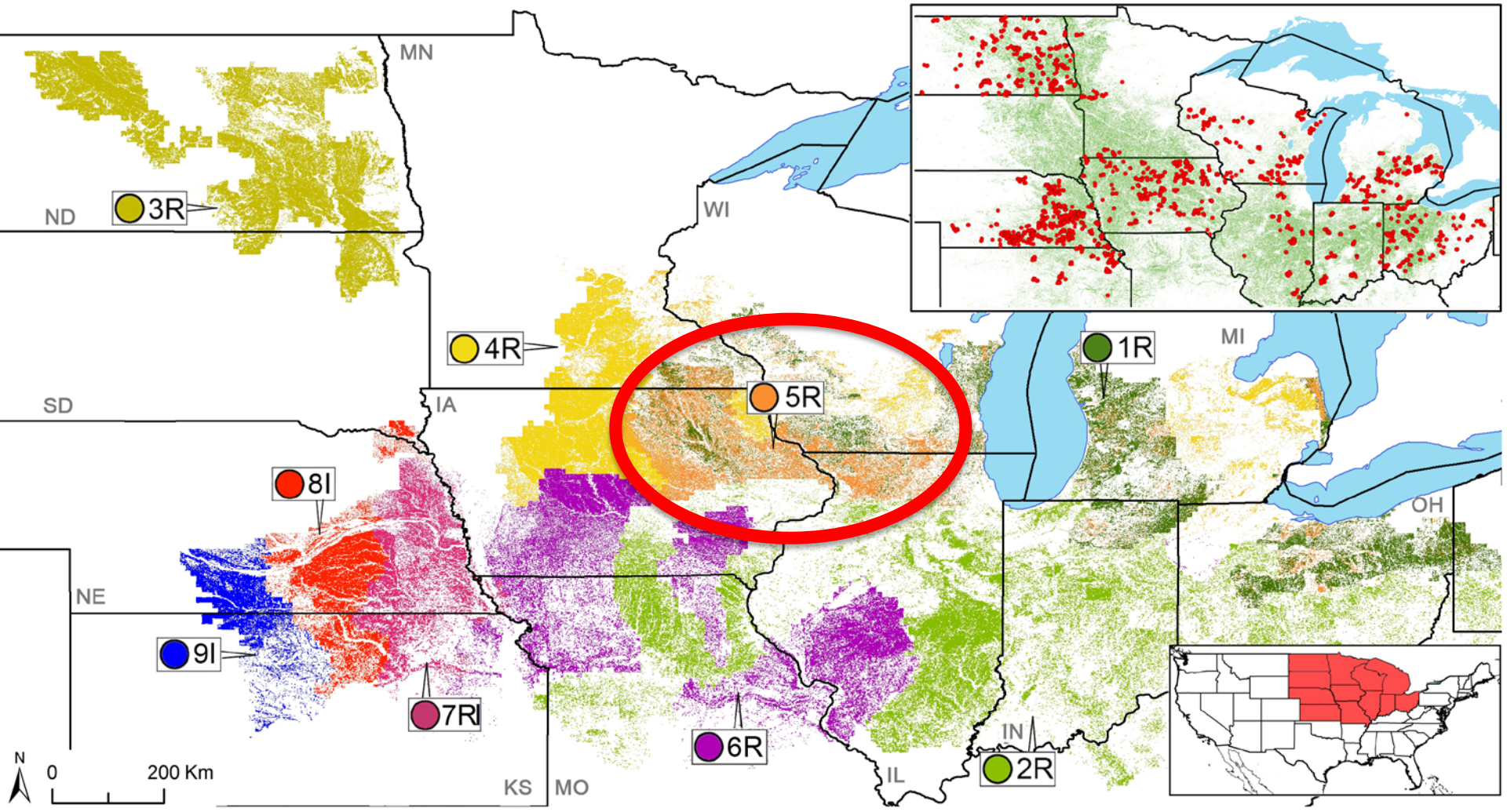
Results TED=5R



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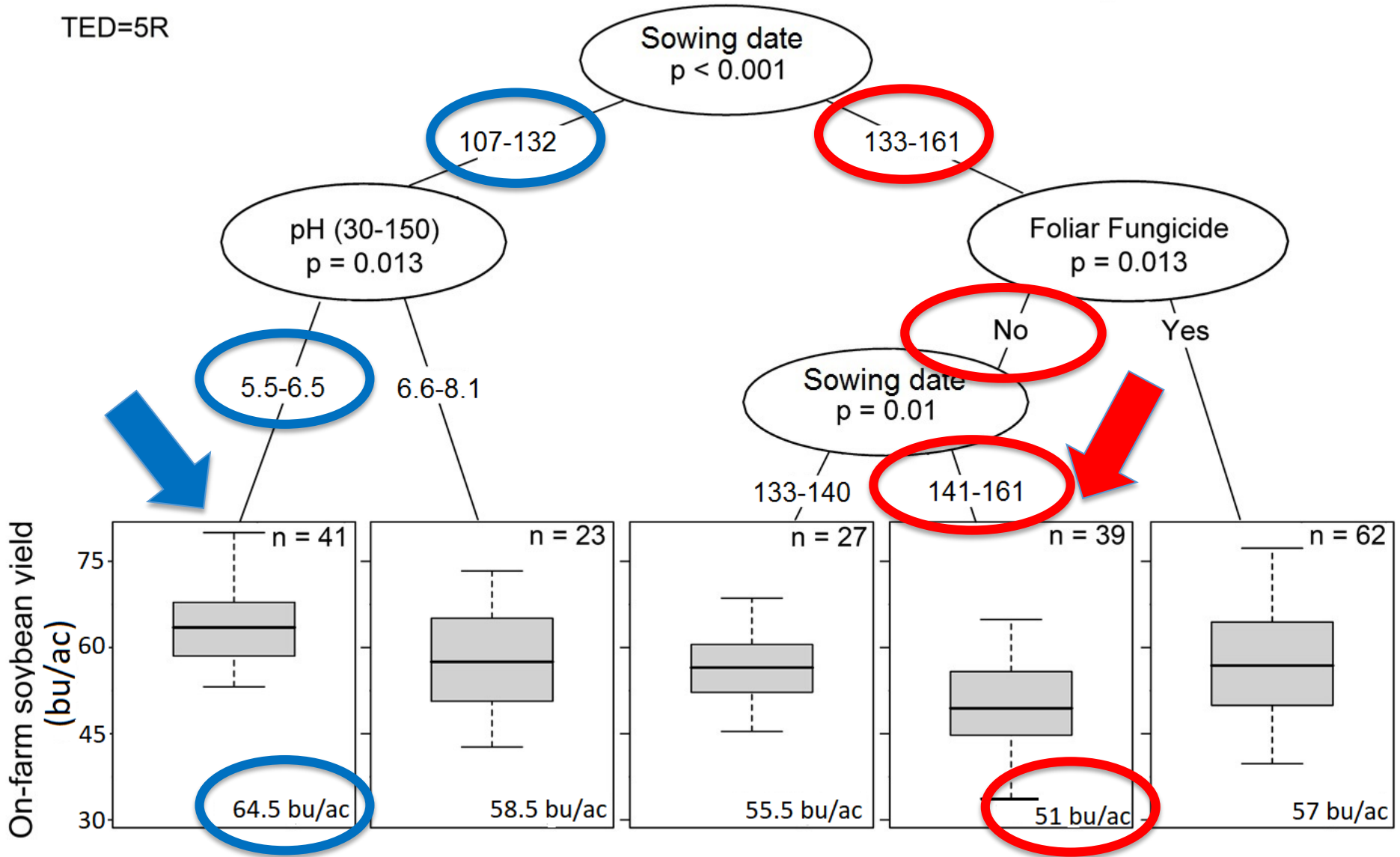
Results TED=5R



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