

High-Yielding Irrigated Soybean Production

North Central USA Soybean Benchmarking Project

How Soybean Producers Benefit From Completing & Submitting the Soybean Benchmark Yield-Management Survey Forms

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Presentation at the 6 February 2017

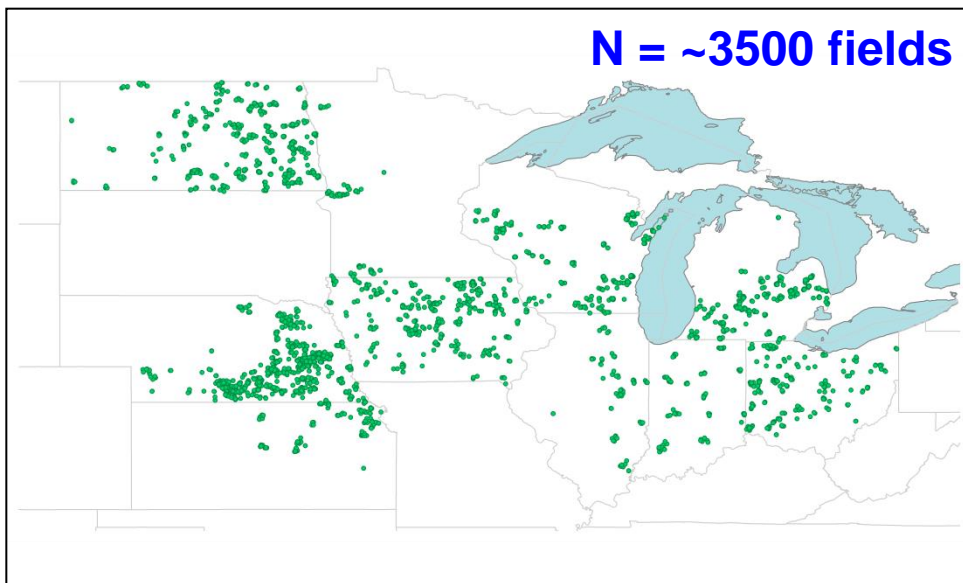
Irrigated Soybean and Corn Production Conference Shipshewana, IN

NOTE: The slides presented herein are Nebraska Soybean Benchmark Project results that my University of Nebraska Colleague Dr. Patricio Grassini and I collaborated on before my retirement in July 2014.

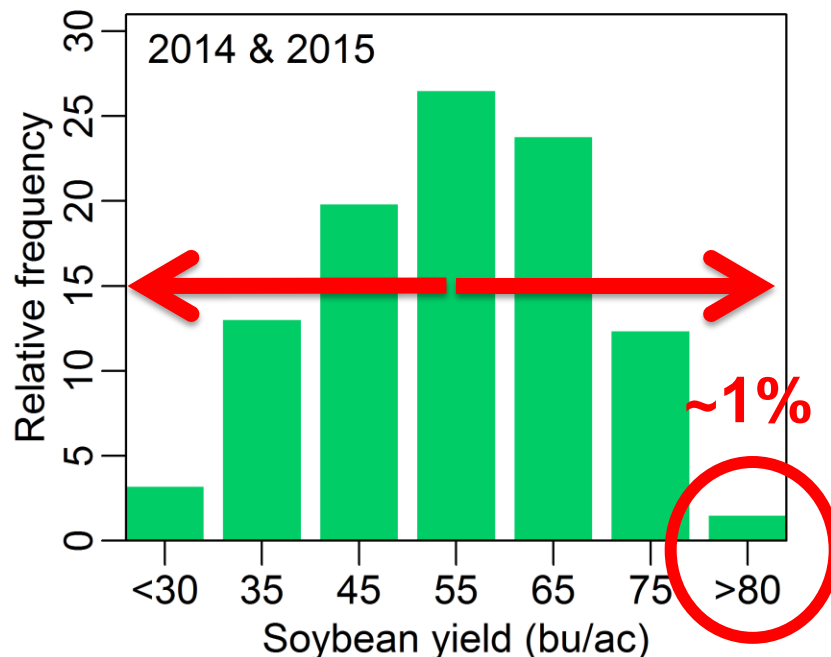
Dr. Grassini is now a co-PI of a much larger Soybean Benchmarking Project that spans 10 states in the North Central USA. Non-Nebraska producers should contact their State's Benchmark project leader.

Benchmarking Soybean Yields in the NC USA Region

A regional project (funded by NCSRP & NSB), collecting data from 3,500 producer soybean fields in the US North-Central region, indicates that only 1% of fields achieve 80+ bu/ac



Rattalino-Edreira *et al.* (unpublished)



Source of Slide: Dr. Patricio Grassini, UNL

The Power of Producer-Reported Data

Farmer
data

We argue that collecting producer data is equivalent to running thousands of field studies to capture soil x climate x management interactions

Enormous potential for use of PRODUCER DATA to:

- Identify causes of yield gap and inefficiencies in the use of inputs
- Improve crop management decisions for a given soil type, climate, and cropping system

Cost-effective (low cost, minimal time for growers) approach to:

- Justify current management production practices
- Identify emerging problems and innovations
- Inform investments on agricultural research ("*biggest bang for the buck*")
- Monitor impact of new technologies and policies
- Better orient and target costly field trial evaluations of agronomic practices

Source of Slide: Dr. Patricio Grassini, UNL

The first soybean benchmarking project was conducted in Nebraska.
Dr. Grassini spoke to NE Soy Producers this spring about the results.

*What does it take to routinely produce **80+** bu/ac soybean yields?*

Patricio Grassini, Jenny Rees, Jessica A. Torrion, Haishun Yang, Kenneth G. Cassman, Daryl Andersen & James E. Specht

**Department of Agronomy & Horticulture
University of Nebraska-Lincoln**



2016 Crop Production Clinic Proceedings
p. 11-12. See: <http://agronomy.unl.edu/cpc>

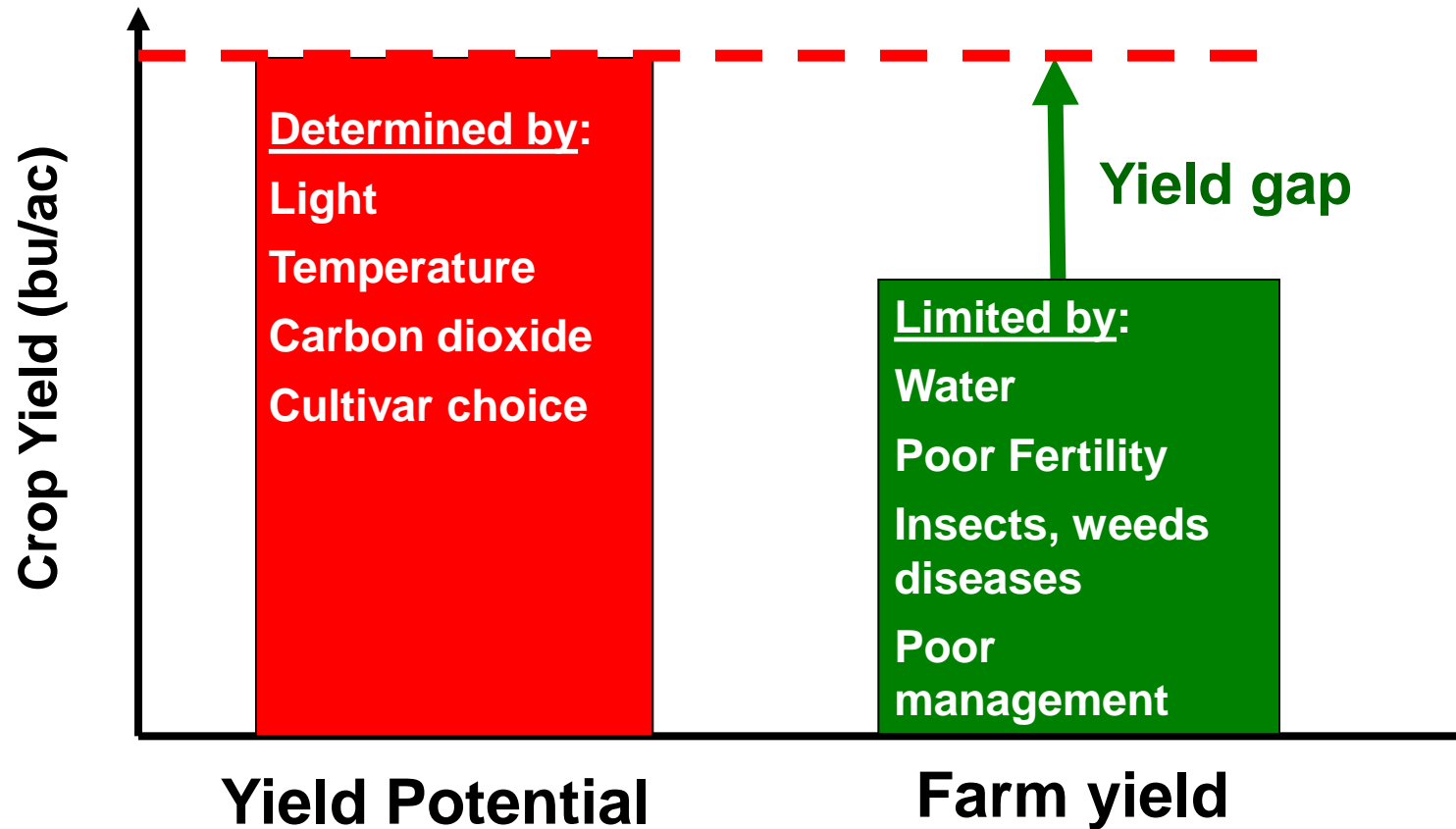
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Soybeans
Nebraska Soybean Board



Water for Food
ROBERT B. DAUGHERTY INSTITUTE
University of Nebraska

Yield potential, farm yield, and yield gaps

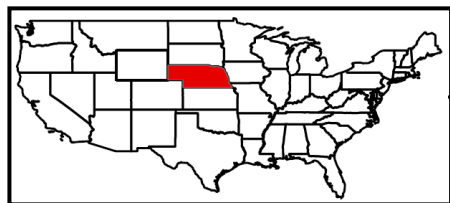


Source of Slide: Dr. Patricio Grassini, UNL

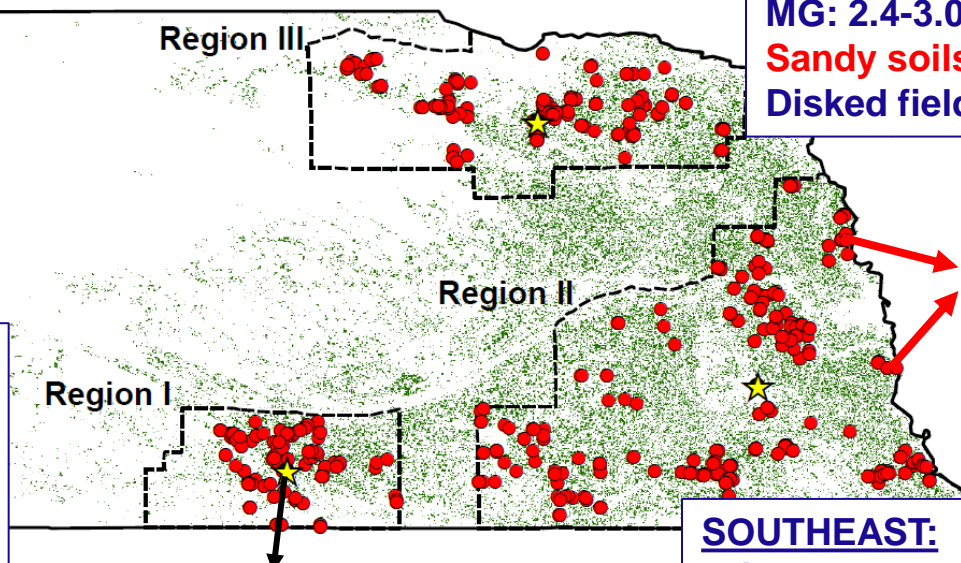
Modified from van Ittersum and Rabbinge (1997)

Soybean in Nebraska: Benchmarking Project

Data from 500+ dryland and irrigated soybean fields in NE planted in 2010, 2011, and 2012



Soybean harvested area is indicated in green



NORTHEAST:
Irrigated & dryland
MG: 2.4-3.0
Sandy soils
Disked fields

SOUTH-CENTRAL:
Only irrigated
MG: 2.7-3.0
Silt loam soils
No- or reduced-tilled fields

Red dots indicate location of surveyed fields

Stars indicate location of a representative weather station in each region

SOUTHEAST:
Irrigated & dryland
MG: 3.0-3.5
Silt loam & silty clay loam soils
No- or reduced-tilled fields

Source of Slide: Dr. Patricio Grassini, UNL

Grassini et al. (2015)

Benchmark Survey Form: example of a 4-field form submitted by a NE producer

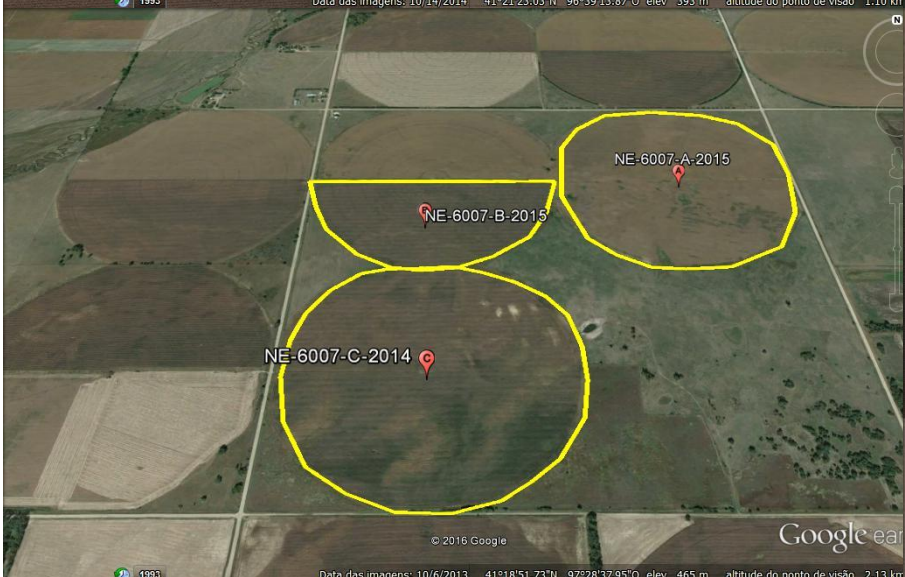
Source of Slide:
Dr. Patricio
Grassini, UNL

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.

- 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

	EXAMPLE:	2014 Soybean	2014 Soybean	2015 Soybean	2015 Soybean
Specify field location by Section: Township: Range. →	NE ¼ 25 : 20N : 26W	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Please sketch-in the boundaries of your field location within the Section →					
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 (137 ac)	Gravity (20 ac)	Pivot (84 ac)	Dryland (111 ac)
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 3402 RR2	Channel 2402 RR2	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 ₂ O ₅ : 70 K ₂ O: 30 Other: S (11 lbs) Time: March-2014	P ₂ O ₅ : K ₂ O: Other: None Time:	P ₂ O ₅ : K ₂ O: Other: None Time:	P ₂ O ₅ : K ₂ O: Other: None Time:	P ₂ O ₅ : K ₂ O: 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)

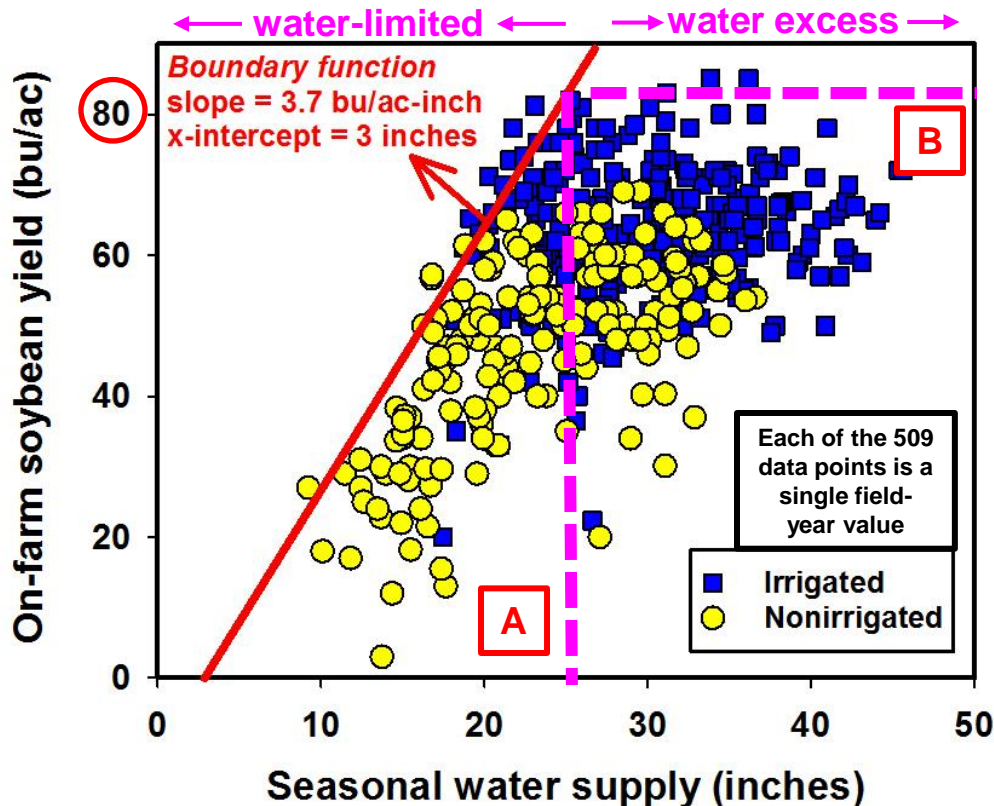
How to Specify Field Boundaries on Benchmark Survey Form



Water supply sets an upper limit on soybean yields

With **optimal agronomic management** and **an in-season uniform distribution of about 25 inches of total water supply** (dashed vertical pink line), an **irrigated yield of 80+ bu/ac** soybean yield (dashed horizontal red arrow) is possible. Field data points (blue-Irrig; yellow-Rain) located close to the solid red diagonal line have a **water productivity** denote producers who are getting **3.7 bu/ac per in of rain and/or irrigation!**

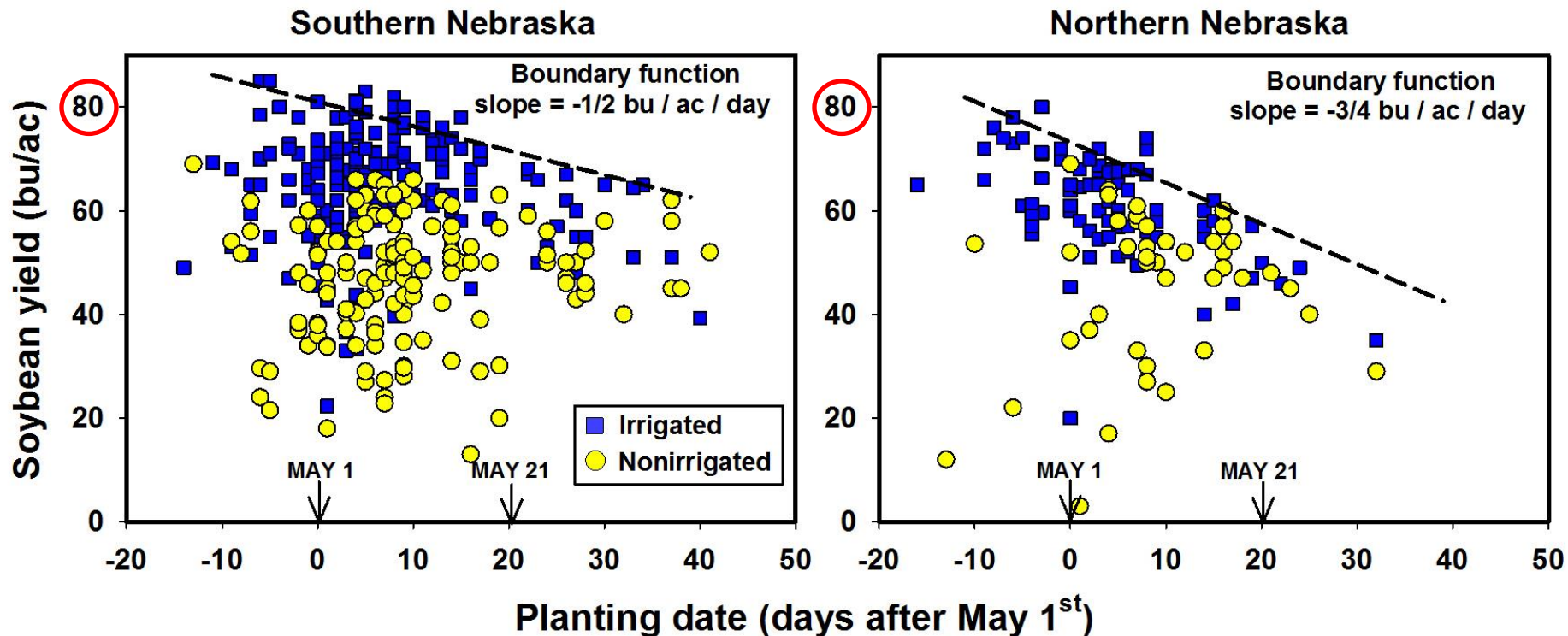
Reference: Grassini et al. (2015)



Seasonal water supply includes available soil water (0-5 feet) at planting, and in-season rainfall and any applied irrigation. The **red diagonal line** indicates the likely **maximum yield (boundary function)** possible for any **limited** seasonal water supply value (i.e., left of dashed pink line). **Rainfed** producers on the **A side of the pink line** can move their field yields **UP** by improving their soybean management skills. **Irrigated** producers on the **B side** can also do that as well, but many use too much excess water to get 80+ bu/ac yields; Use irrigation scheduling to get those high yields with timely but less irrigation!

Planting date also sets an upper limit on soybean yields

There is a yield penalty of $\frac{1}{2}$ bu/ac in southern NE and $\frac{3}{4}$ bu/ac in northern NE per day of delay in planting (this is consistent with Bastidas et al. 2003-4 plant date experiments in Lincoln, NE)



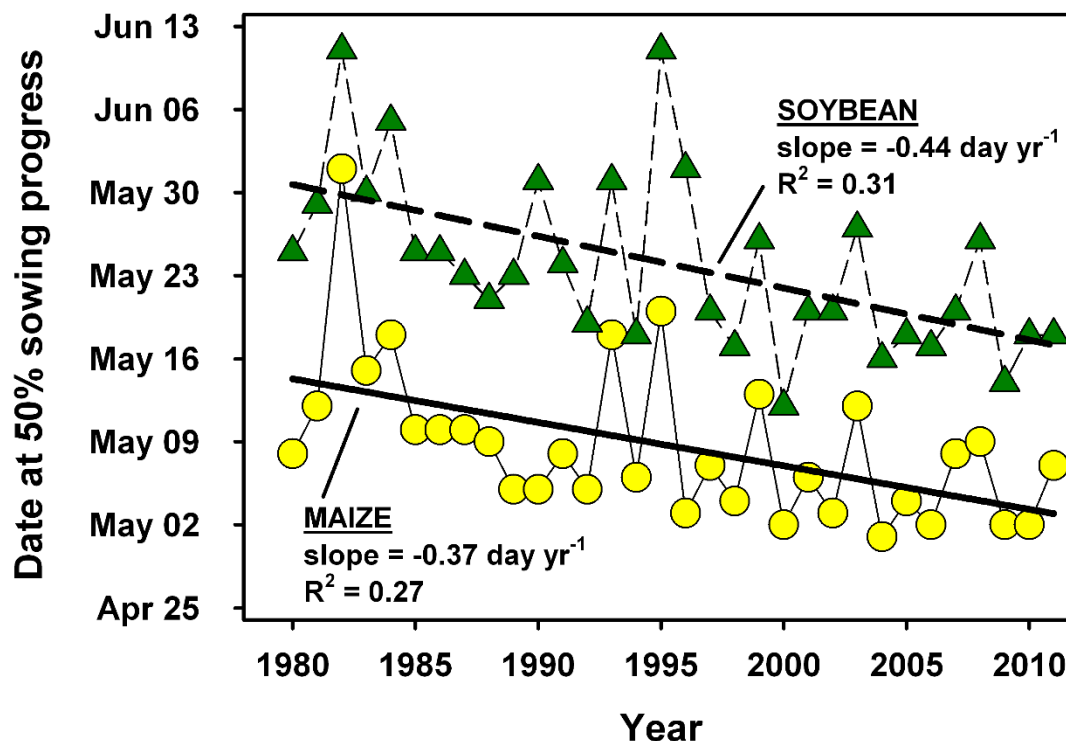
Source of Slide: Dr. Patricio Grassini, UNL

Grassini et al. (2015, *Field Crops Research*)

Quantifying impact of agronomic practices

Over the past three decades, NE producers have shifted their soybean and maize planting time to earlier calendar dates: **average soy planting date was May 30 in early 1980s and now May 15 as of 2010.**

Given an average $\frac{1}{2}$ bushel soy yield penalty per day of delay in planting, the shift towards **earlier planting can account for a THIRD of the NE irrigated soybean yield increase over the last 30 years!**

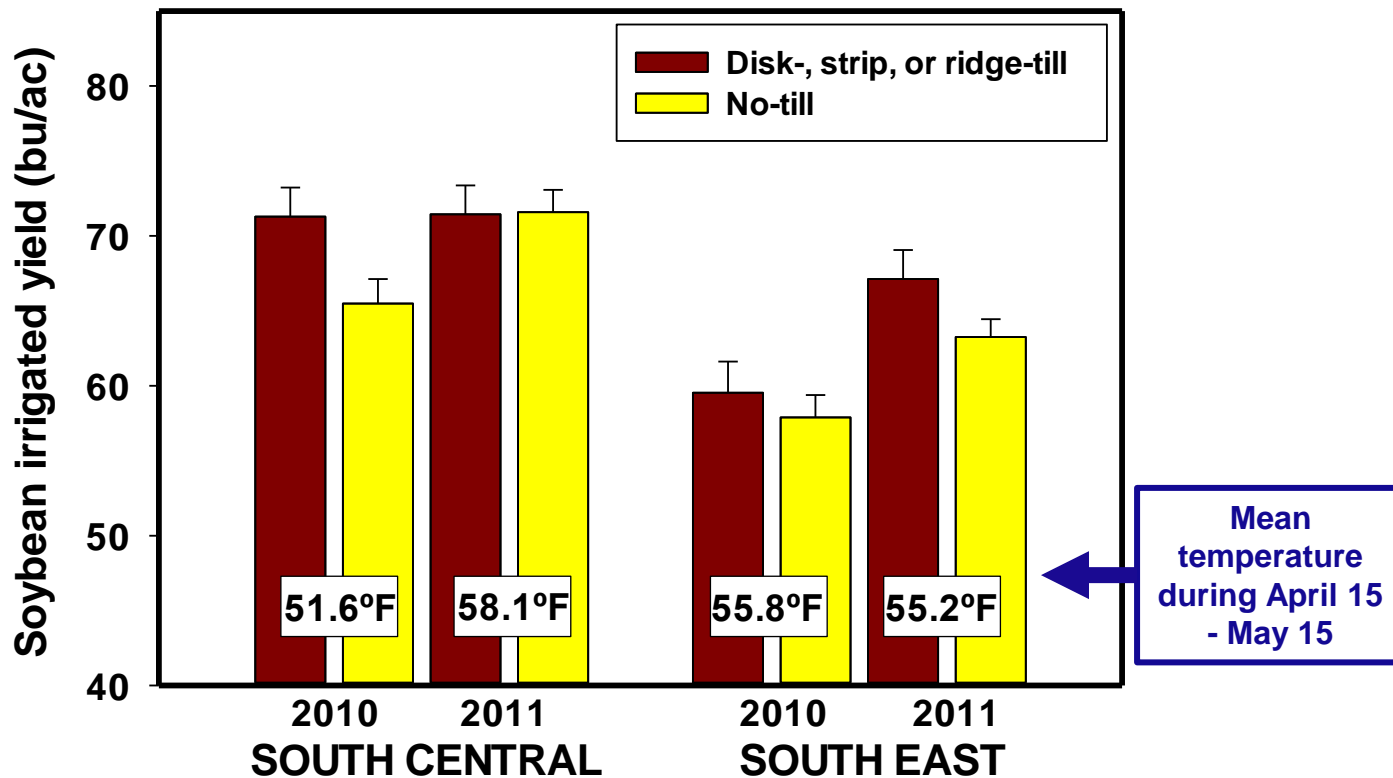


Source of Slide: Dr. Patricio Grassini, UNL

Source: Grassini et al., *Crop Physiology* (2015), 2nd Edition

Influence of tillage on irrigated yields

No significant yield advantage in no-tilled fields *versus* reduced- or disk-tilled fields. Indeed, a yield penalty occurred in no-tilled fields in years with colder springs.

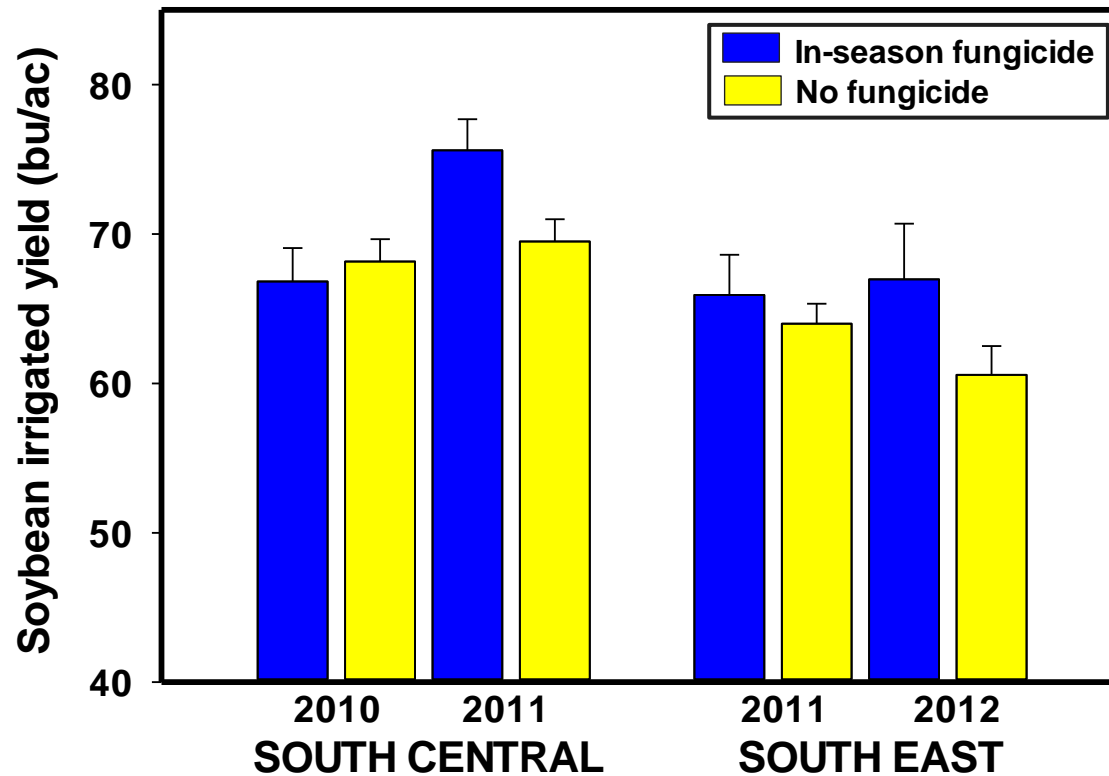


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Grassini et al. (2015, *Field Crops Research*)

In-season fungicide & irrigated yields

The practice of applying fungicide to the canopy (ca. R3 stage) without visual evidence of the pathogen generates a yield response in many region-years

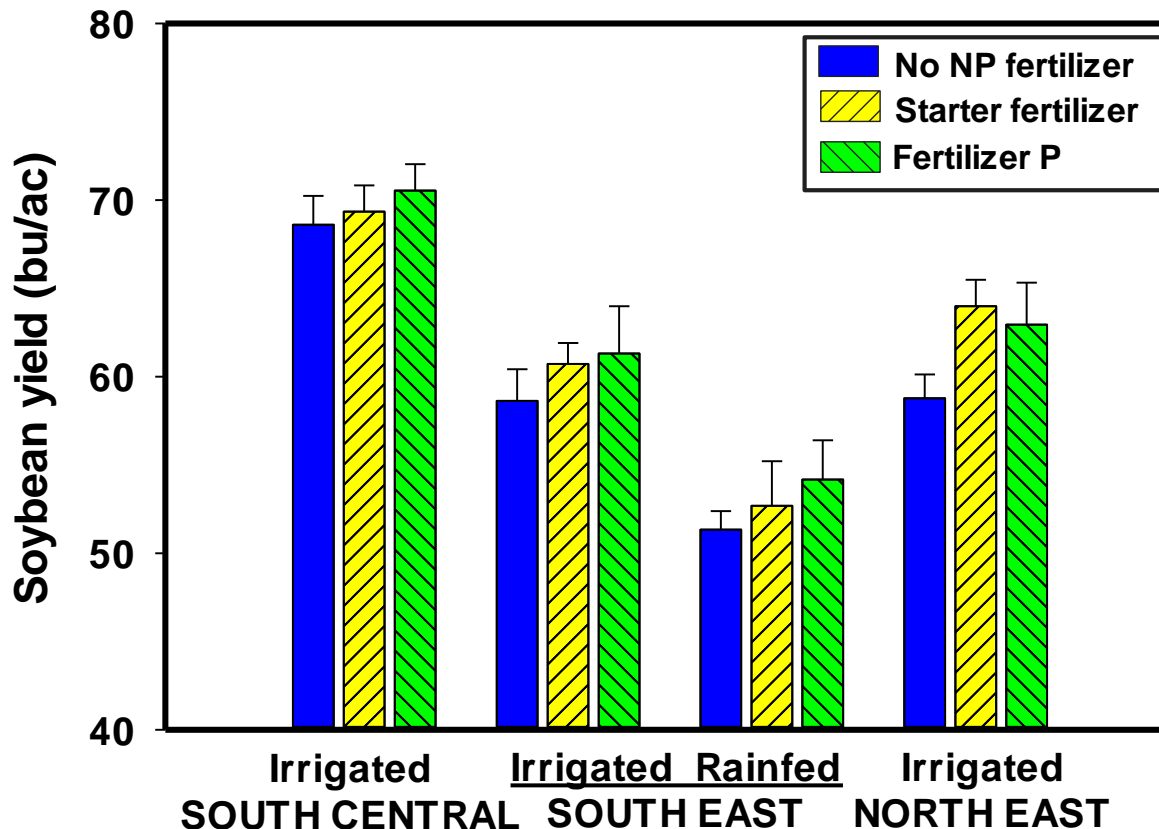


Source of Slide: Dr. Patricio Grassini, UNL

Grassini *et al.* (2015)

Fertilizer inputs & soybean yields

Higher yields in fields that received starter N or N+P fertilizer, or a large P application indicate that N (early in the season) and P may be limiting yields in a fraction of all fields.



Source of Slide: Dr. Patricio Grassini, UNL

Grassini *et al.* (2015)

Nebraska Soy Benchmark Conclusions

- When we acquire self-reported soybean producer yield and management data and get thousands of single field-year data reports, we find that we can dissect out of that pooled data the degree to soybean management practices – as used by producers – represent opportunities to increase yield, or reduce costs, or both **ON YOUR FARM.**
- **YOU CAN HELP US BY FILLING OUT AT LEAST ONE SURVEY FORM (if possible one per year)! Our objective is to WORK FOR YOU and to use the data to help YOU get YOUR yields closer to potential field yield and to be more input-efficient!**
- The Nebraska Benchmark study was quite successful and is **now being expanded to North Central USA States. If you are not a Nebraska soybean producer, you will want to contact your State extension office to get your State-specific form.**

Thanks!

Questions?

Note: More details about the Initial Nebraska Soybean Benchmark Project can be found in this recently Published Nebraska Extension Circular.

Go to: <http://extensionpublications.unl.edu/assets/pdf/ec3000.pdf>