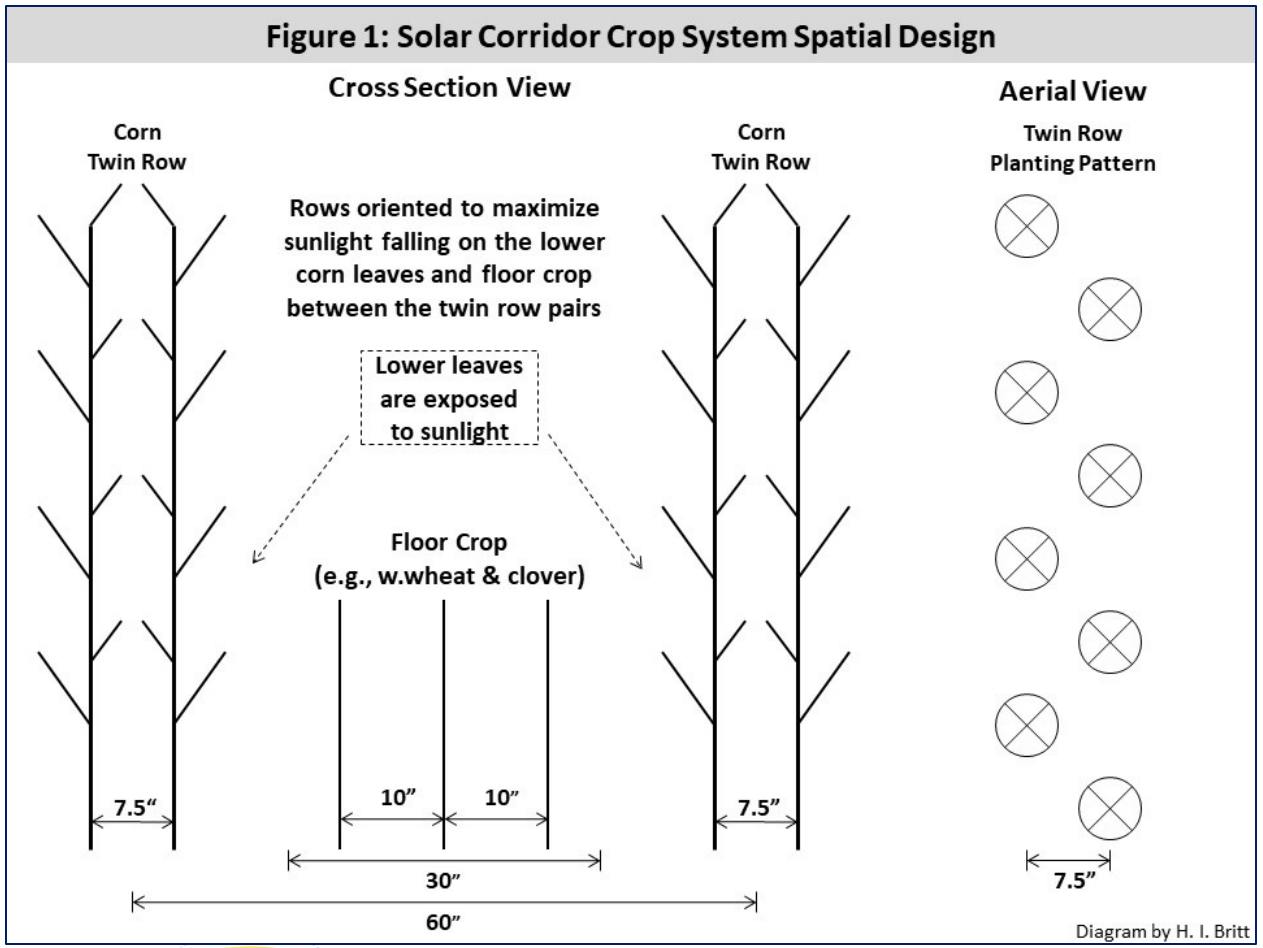
Selecting Corn Hybrids for the Solar Corridor Crop System

C. LeRoy Deichman, Solar Corridor Crop System, LLC

The Solar Corridor Strategy



Plant wide twin corn rows oriented to maximize the sunlight falling on the lower corn leaves between the twin row pairs

Produce another "sunlight compatible" floor crop that performs several additional functions where the vacated corn row would have been

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Introduction

- Capturing more Photosynthetically Active (Solar) Radiation (PAR) is a basic step to increase Radiation Use Efficiency (RUE)
- The Solar Corridor Crop System is our approach to maximizing the capture of PAR and increasing RUE
- The Solar Corridor Crop System design must be based on site and hybrid specific properties, to
  - Eliminate all identifiable limiting factors inherent to that site in its new solar corridor (canopy) architecture
  - Maximize the capture of the resulting new synergies

Introduction (continued)

- **Thus enabling increased sustainable productivity via**
  - **Yield increases from abundant low-cost production resources of sunshine and CO2 extend those increases to Net Operating Profit**
  - **Carbon exudates into the rhizosphere**
  - **Residual soil carbon deposition beyond the rhizosphere**
  - **Soil Microbial populations**
  - **Organic Matter**
- **That is (our) challenge - the task at hand**

The Solar Corridor in Practice

Farm Test Plot

Illinois, 2020

Seeking out ways of getting more photosynthetically active radiation (PAR) into the corn field

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The Solar Corridor in Practice

A Laredo forage soybean floor crop could be grazed after corn harvest, or the frost-killed residue could protect soil and be a source of mineralized N in the spring as well as benefit other soil health components

Note the weed suppression

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The Solar Corridor in Practice

Based on the almost infinite cultivar choices, floor crop selections for the solar corridor floor can be made to fill a wide range of specific objectives required to sustain our most finite (soil)resource while meeting increasing consumer demands

Organic Research Field, Illinois

Photo by Joel Gruver

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The Solar Corridor in Practice

Production Field
Illinois, 2021

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The Solar Corridor Paradigm

How can we produce as much corn with every other corn row missing?

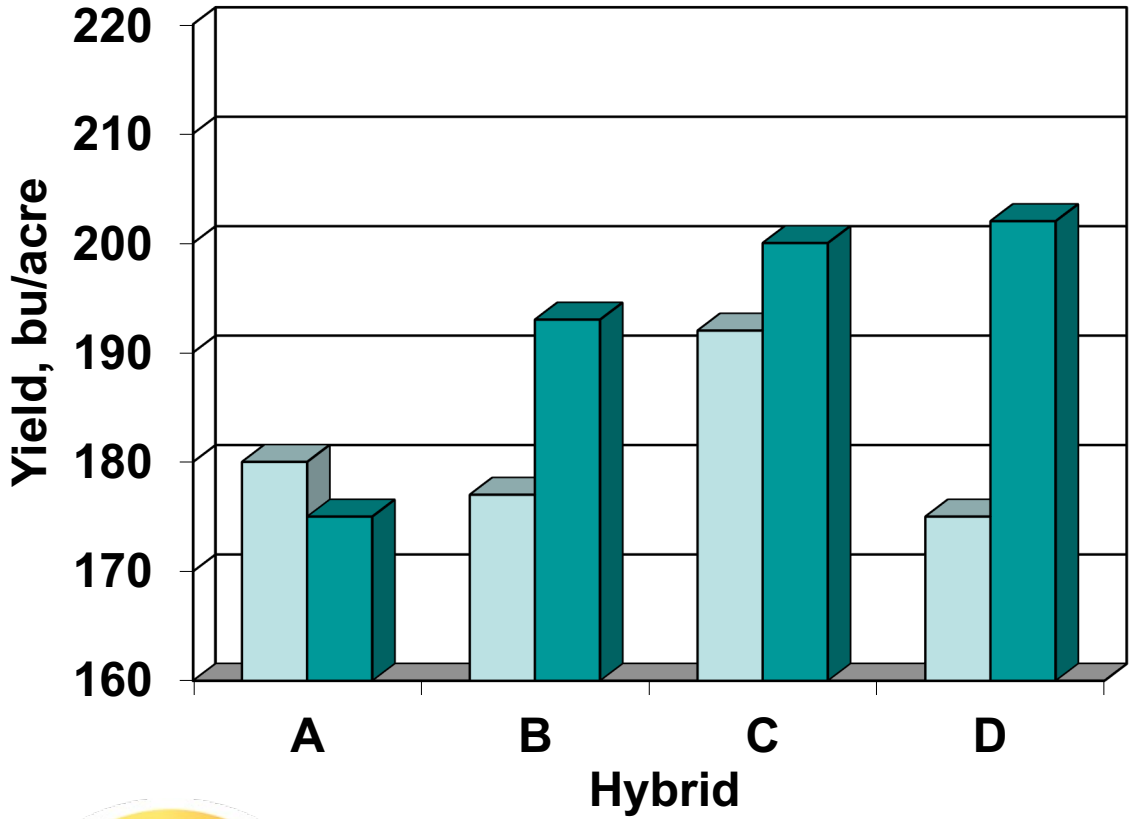
- **The remainder of the presentation provides answers to this question**
- **Consistent with US Patent 6052941, Plant Arrangement to Improve Crop Yield**

Treatments

- 12 Production Environments across 5 soils ranging from Brenton silt loam to Gilford sandy loam
- 4 Hybrids (Designated A, B, C, & D)
- 4 Plant populations (3 were suboptimal for hybrids A, B, & C) with 3 Replications
- Randomized Block Split/Split Plot design
  - 1st split by hybrid; 2nd split by plant population
- 2 Row width entries
  - Control: Single rows on 30 or 36 inch centers, using 30 or 36 inch equipment, respectively
  - Treatment: Twin rows on 60 or 72 inch centers, respectively
- All treatments were in north/south rows between 40 and 41 degrees North latitude in Eastern Illinois

Deichmann Maize Research Inc.

Hybrid Response to the Solar Corridor



Average Over 12 Environments
And 4 Plant Populations
3 Were Suboptimal for Hybrids A, B, & C

Although Hybrid A has proven to be a high yielding hybrid, it is not a good hybrid choice for the Solar Corridor. Hybrids B, C & D are good choices for the Solar Corridor

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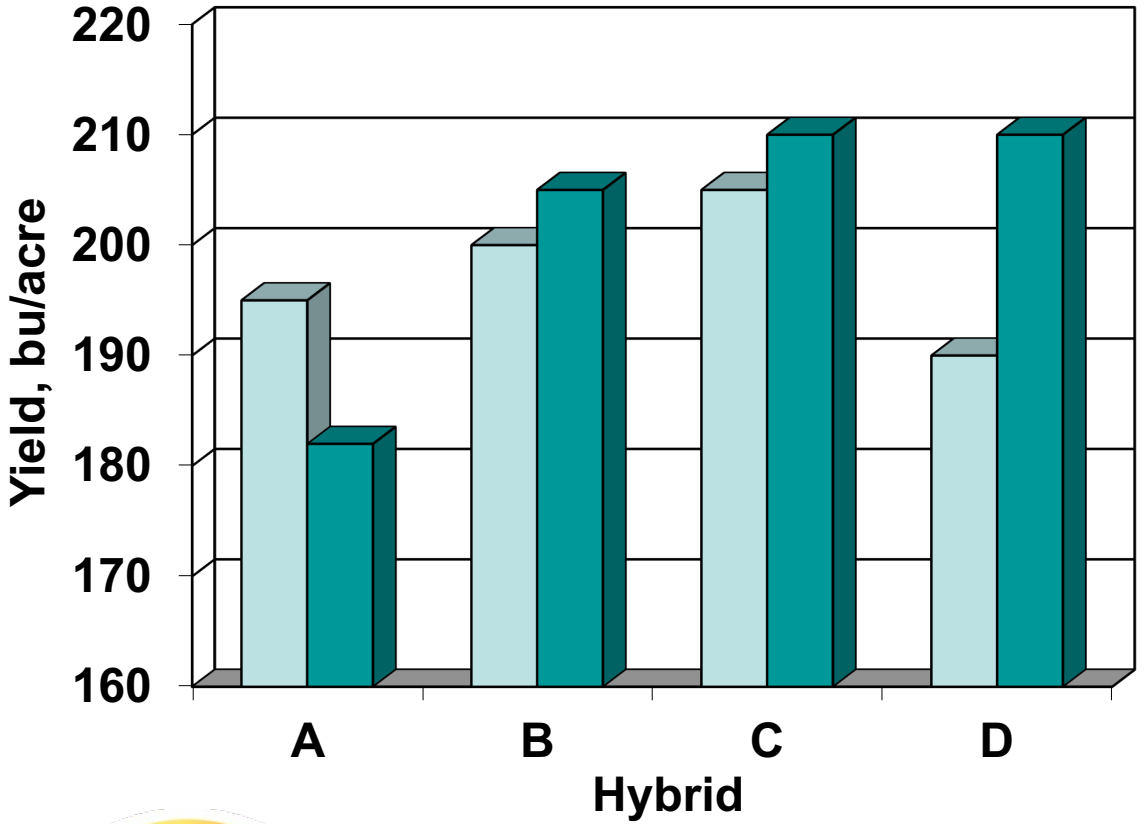
Hybrid Response to the Solar Corridor



Average Over 8 Highest Yielding Environments And 4 Plant Populations
3 Were Suboptimal for Hybrids A, B, & C

Results at the 8 higher yielding environments is the same as it was over all environments - just at a higher level - Hybrids B, C & D liked the corridor, Hybrid A didn't!

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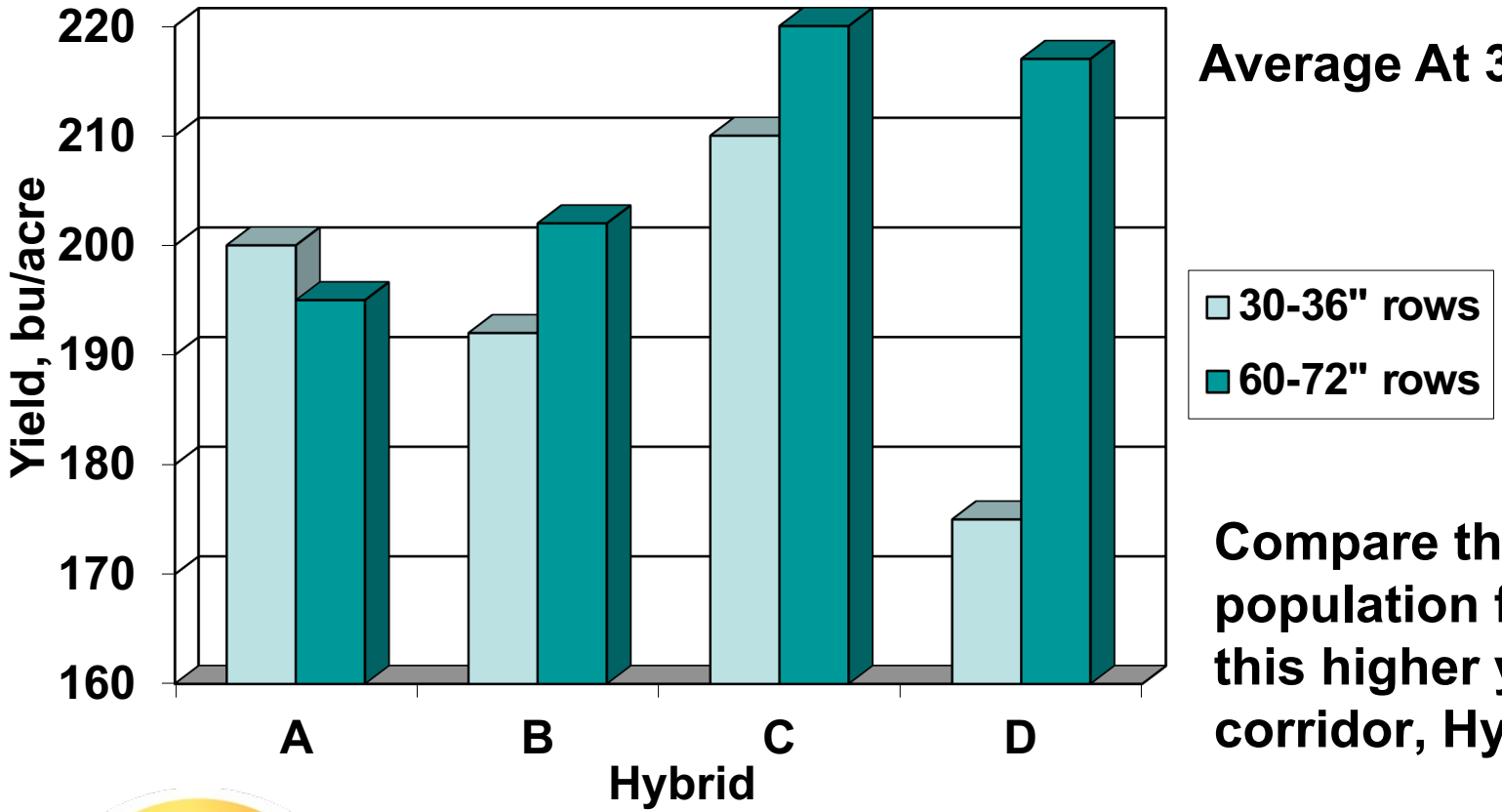
Hybrid Response to the Solar Corridor



Average At 30,000 Plant Population

Compare these results at the highest yielding population for Hybrids A, B & C. Once again, at this higher yield level, Hybrids B, C & D liked the corridor, Hybrid A didn't!

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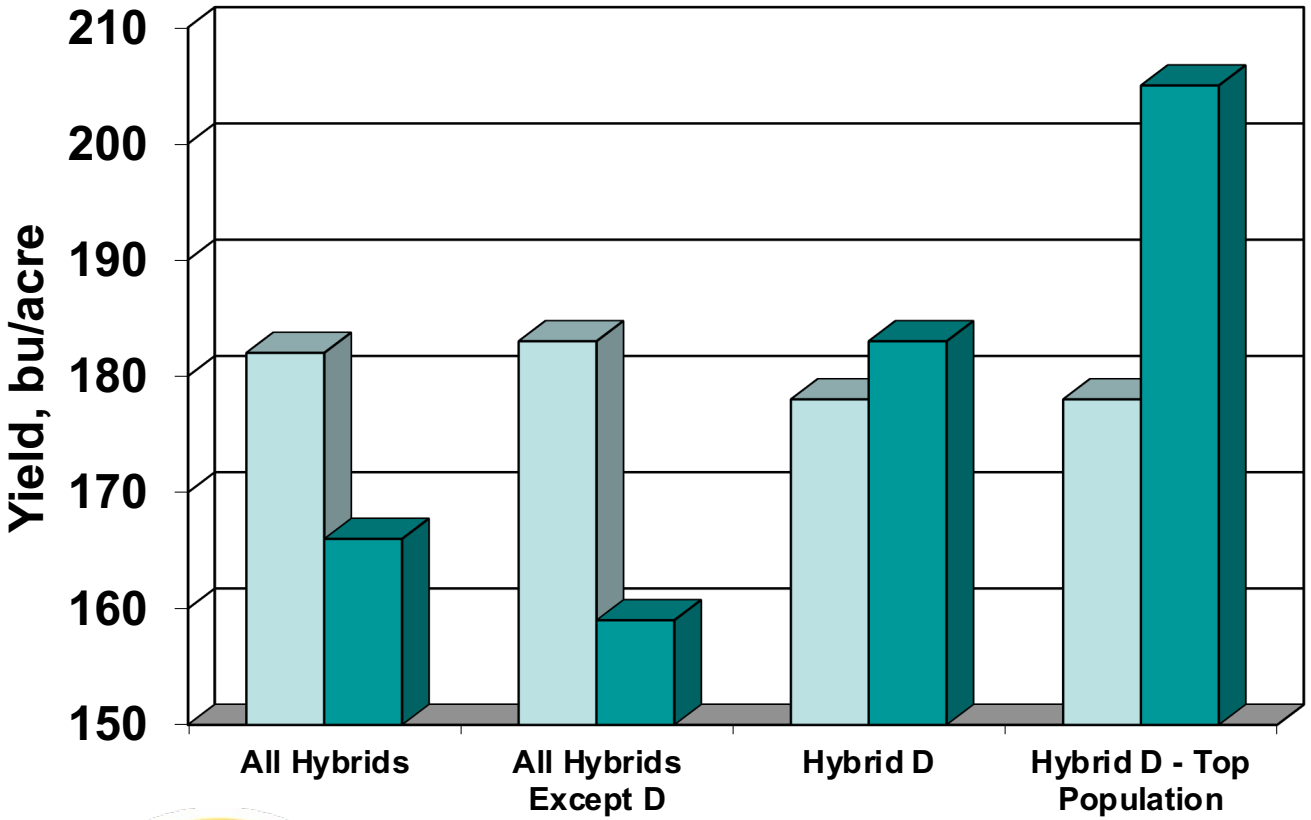
Single Row Hybrid Response



Average At 30,000 Plant Population for the Highest Yielding of the 4 Populations Studied for all but Hybrid D

Single rows didn't perform as well as twin rows in our Solar Corridor studies. The single row treatment was abandoned after consistently performing poorly, as shown

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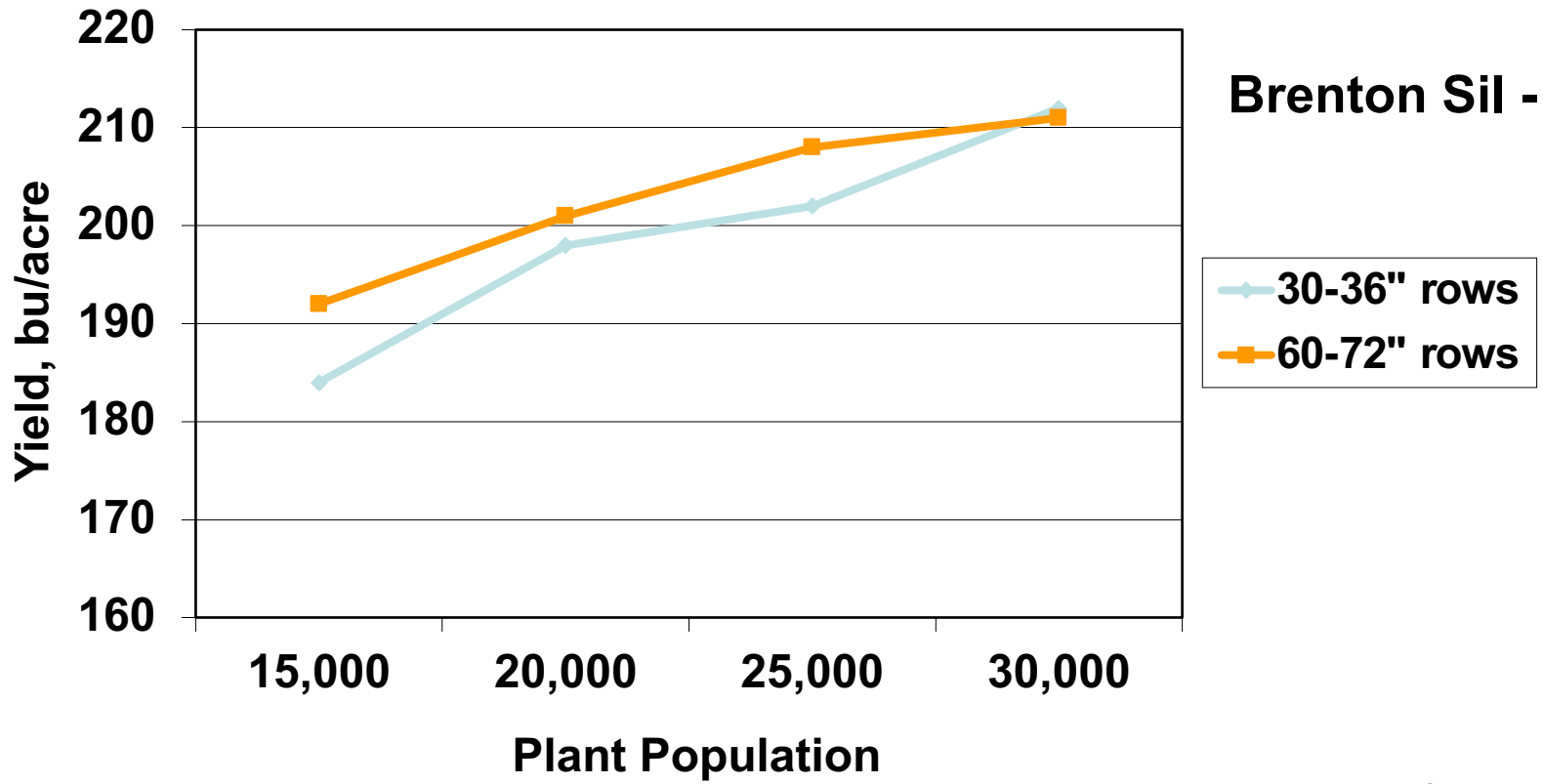
Typical Response to Plant Population



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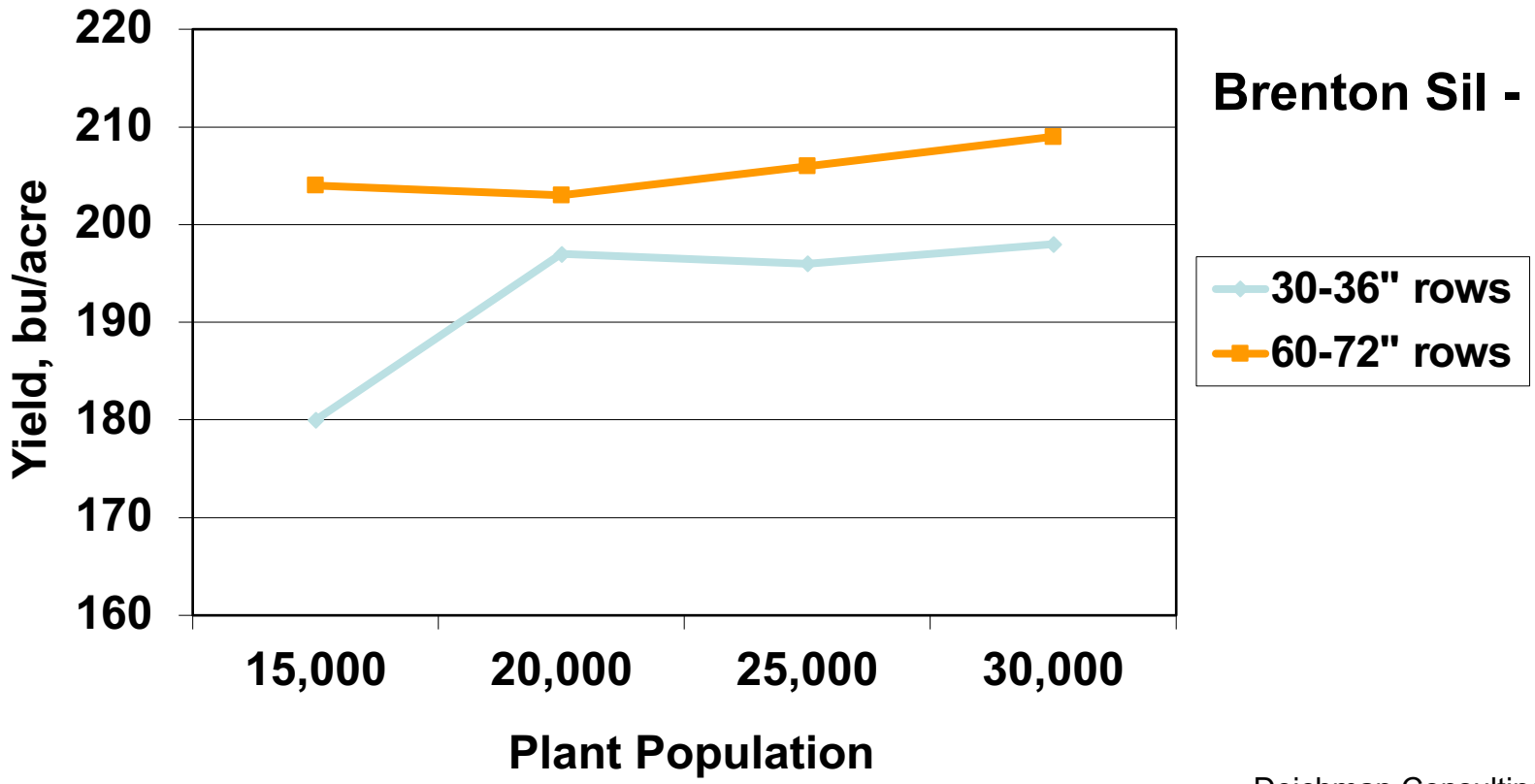
Atypical Response to Plant Population



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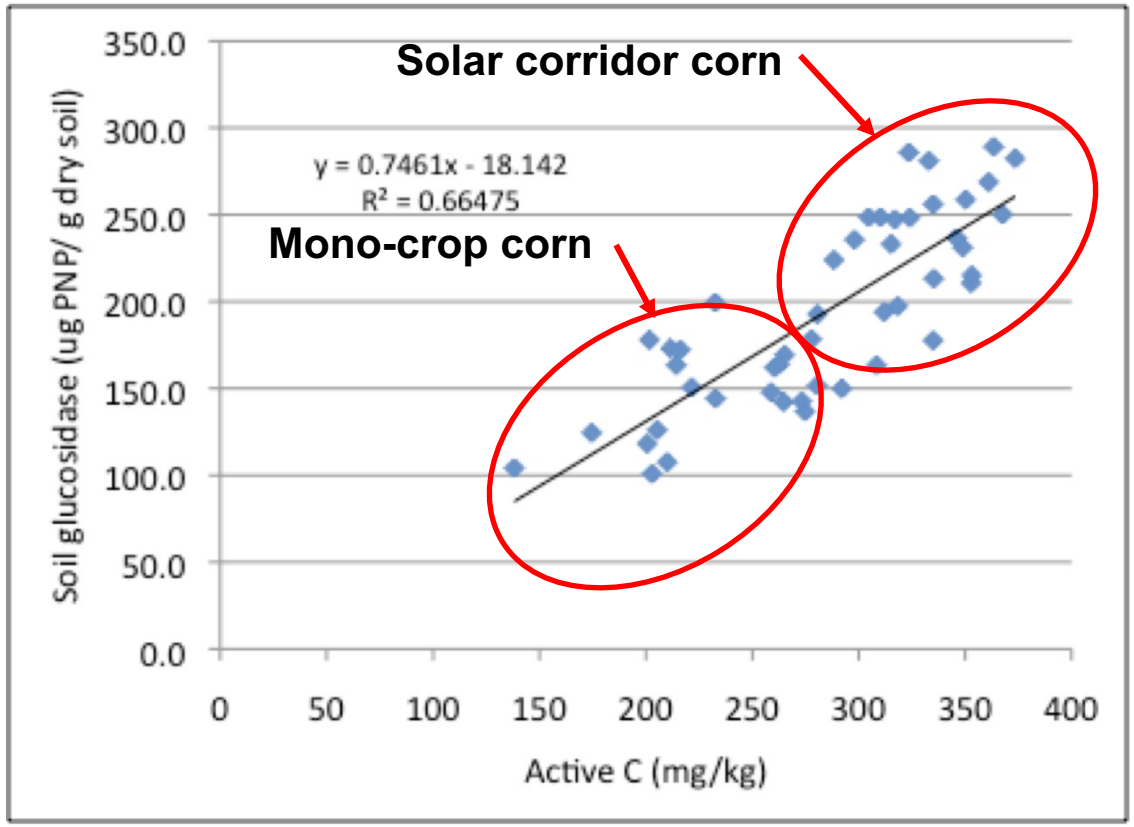
Increased Microbiological Activity



Active carbon, representing labile organic carbon and a readily available energy source for soil microorganisms, increases with solar corridor due to more input of fixed carbon from increased photosynthesis; soil glucosidase activity is an index of microbial activity and is correlated with active carbon showing that solar corridor contributes to higher soil biological activity

Deichman, C.L. & Kremer, R.J., Chapter 4, 1st Ed., Solar Corridor Crop System : Implementation and Impacts, Elsevier Academic Press (2019)
Kremer, R.J & Deichman, C.L., Solar Corridor Improves Soil Health, Agronomy Journal, Issue 106, Volume 5 (2014)

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Key Takeaways

1. **Our hybrid selection methodology worked**
   - **Hybrid A, representative of the 90% of the high performing commercial hybrids that failed to meet our preliminary screening criterion[1], was NOT a viable hybrid choice for the Solar Corridor!**
   - **Hybrids B, C, & D, chosen from the 10% that met our preliminary hybrid screening criterion, ALL responded positively to the Solar Corridor**
2. **Our yields were produced with twin rows**
   - **Single rows failed to meet our yield standard**
   - **Response to the Solar Corridor in upstate Missouri, under a different set of conditions and different era hybrids, replicated our results[2]**
3. **The Solar Corridor increases microbiological activity**

[1]Deichman, C.L. & Kremer, R.J., Chapter 2, 1st Ed., Solar Corridor Crop System : Implementation and Impacts, Elsevier Academic Press (2019)
[2]Nelson, K.A., Table 2, Corn Yield Response to the Solar Corridor in Upstate Missouri. Issue 106(5) Agronomy Journal

Supplemental Slides

From: Background of the Solar Corridor Concept

C. LeRoy Deichman, Deichman Consulting
Robert J Kremer, University of Missouri

Symposium -- The Solar Corridor's Potential to Capture Collaborative Synergy in the Development of Critical Solutions
ASA, CSSA, and SSSA 2015 International Annual Meeting
Minneapolis, MN
November 15-18, 2015

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Photosynthesis

"....90-95% of the total dry matter of higher plants usually consists of carbon compounds derived from photosynthesis....."

Loomis, R.S. and W.A. Williams. 1963.
Maximum crop productivity: an estimate. Crop Sci. 3:67-72

An objective of the Solar Corridor Crop System (SCCS) is to develop the design, scope and sustainability specifics of a crop system for maximizing photosynthesis (specifically, the biosynthesis of atmospheric CO2)

Photosynthesis

- The 1st production event that occurs when the new leaf emerges from the soil or whorl is Photosynthesis – the heart of the organic production process
  - Loomis & Williams say 90% of plant productivity is sourced in carbon based photosynthetic compounds
  - The Solar Corridor production system is designed to nurture and grow the process of photosynthesis
- To the extent that photosynthetic source is sufficient, genetically coded Enzymes direct and drive plant yield
- Rate x Duration = Yield, as governed by:
  - The Law of the Minimum
  - The value of input A (as a function of inputs B through Z)

SUNLIGHT in Corn Production

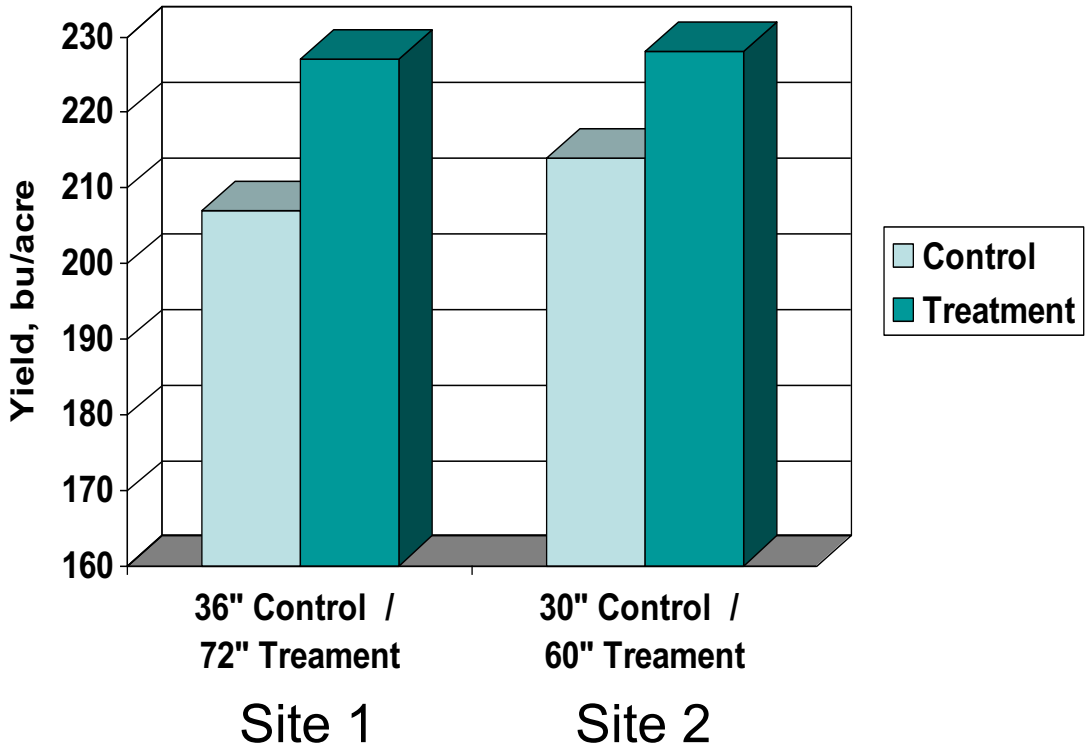
A Paradigm Shift

- **Staggered twin rows spaced far enough apart to enable sunlight to reach the lower leaves for the entire growing season**
- **Enabling the bio capture of more CO2 for BioSynthesis into more photosynthate derived carbon compounds**
- **Grow a shorter symbiotic crop on the vacated row that completes its peak demand for sunlight before the corn deprives it of critically needed incident sunlight**

The New Paradigm

- Enables mature chloroplasts to capture more CO2 and produce more photosynthates
- Enables the ***highest capacity*** reproductive sinks to access more photosynthates
- Enables vegetative sinks to access more photosynthates – more carbon exudates are released into the rhizosphere
- Cultivar and variety selection is site specific, production inputs then become cultivar and variety specific

HYBRID C – AT 30,000 POPULATION



Floor Crops and Effective Yields

As specifically demonstrated in Solar Corridor Floor Experiments (Deichman, 2005[1] and US Patent #6052941, claims 2 and 4), we can produce other specifically chosen crops between the corn twin rows without a reduction in corn yield. We have concluded that:

- Soybeans have not (yet) proven to add yield without a negative impact on corn yield.
- Winter small grains or oil seed crops with a cover/stubble crop selected for your site can add yield and sustainability benefits without a negative impact on corn yield. Also, many horticultural crops (see footnote reference) can add yield without a negative impact on corn yield.
- Therefore, ½ of the Solar Corridor crop acre can be assigned to corn, and the other ½ to a viable floor crop such as wheat.
- The effective yields per corn acre are therefore exactly double the yields per crop acre reported on the previous charts.

[1] Deichman, C. L., "Solar Corridor Floor Crop Experiments", ASA-CSSA-SSSA International Annual Meetings, November 6-10, 2005, Salt Lake City, 147-9