Do Small Grains Fit Future Crop Rotations

Agvise Seminars

Jochum J. Wiersma

Pledge

- I will never split in half ever again (to test a product/hybrid/practice) , call it research, and base any decisions on it.

Bread Basket of the World

Bread Basket of the World: Fargo, Grand Forks, and the Red River Valley (North Dakota Centennial Series)

- Author: Nancy Edmonds Hanson
- ISBN 13: 9780911007060
- Publisher: Dakota Books
- Date published: 1987-06

A Rich HRSW Tradition

Downtown Minneapolis (~1860)

Washburn ‘A’ Mill (~ 1875) : enough flour for 12 million loaves a day

Global Brands

- Cargill
- Pillsbury
- General Mills
- MGEX
- Nash Finch
- Super Value

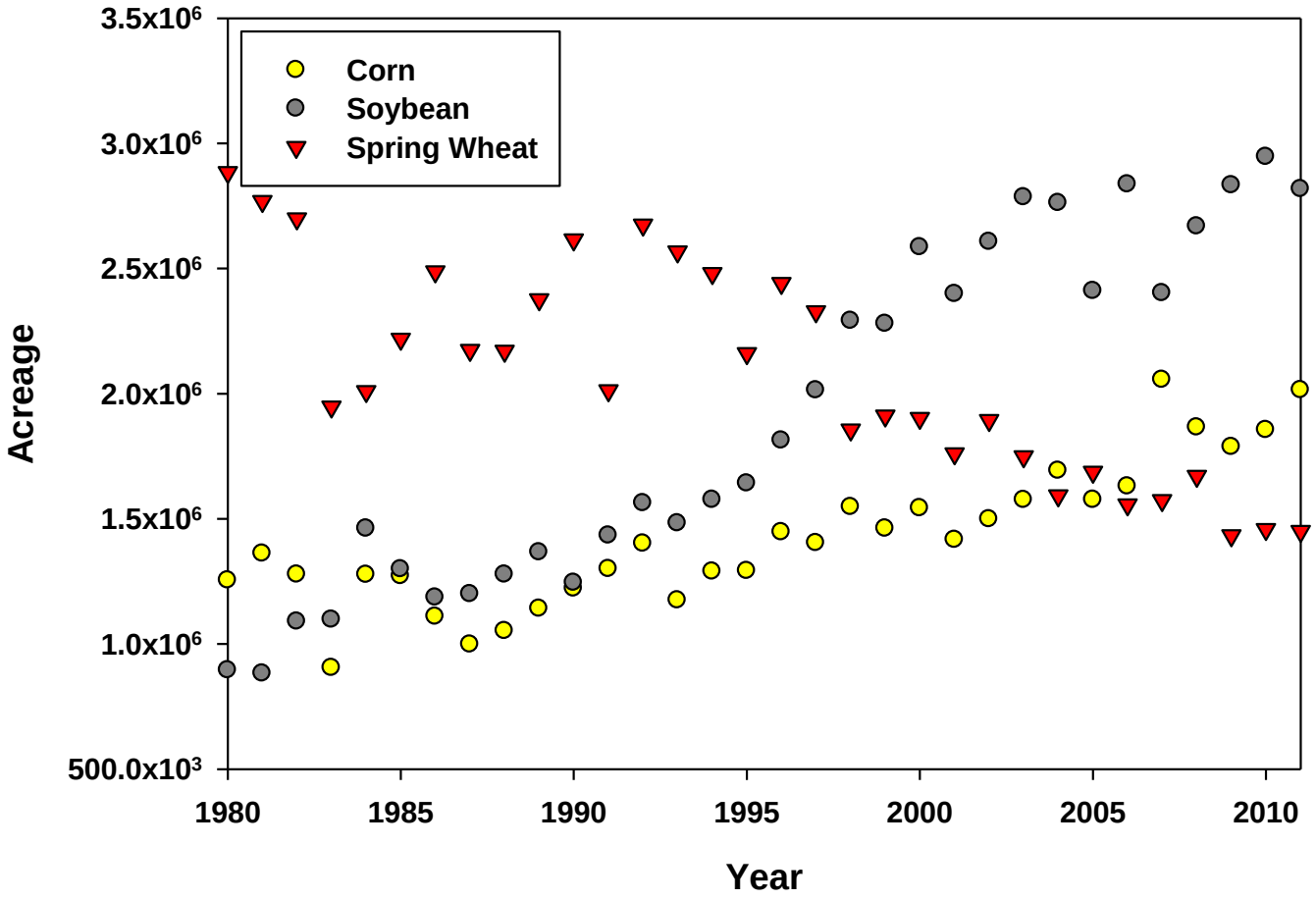
Bonanza Farms

Fall plowing at the Dalrymple Farms in 1876 near Casselton, ND

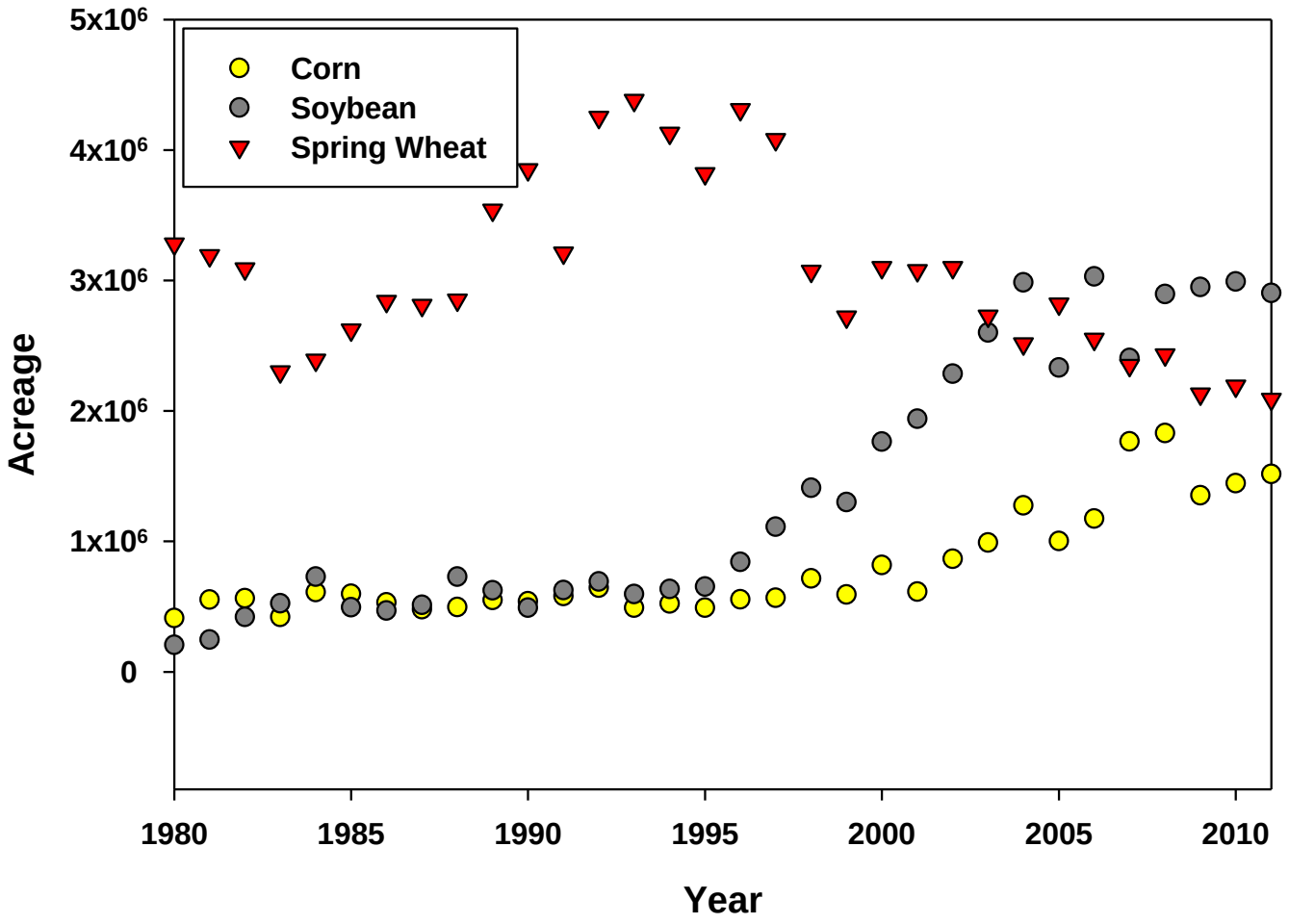
Forces at Play

- Farm Programs:
  - ‘Freedom to Farm’
  - Loan Rates
  - Crop Insurance
- Markets:
  - Tighter specifications
  - Record commodity prices for corn and soybean
- Production Challenges/Opportunities:
  - Genetic Improvements
  - Biological Stresses (FHB, rust)
  - ‘Roundup Ready’ crops
  - Climate Change?

Acreage Shifts MN



Acreage Shifts ND



Sustainable Development of Multifunctional Landscapes

- Why even talk about HRSW (and barley)?
  - Crop rotation advantages:
    - Non-pest related
    - Pest related (applying IPM principles)
  - Crop water usage:
    - Full season crops like corn, soybeans, and sugar beets use more water over the length of the growing season.

Water Usage

Crop	*Seasonal Water Usage*	*Daily Water Usage*	*Water Use Efficiency*
	(inch/season)	(inch/day)	(lbs/inch used)
Dry Edible Beans	10.2	0.14	218.7
Spring Wheat	11.9	0.16	128.1
Barley	12.6	0.15	222.1
Flax	13.7	0.13	41.5
Sunflower	14.9	0.14	119.7
Corn	16.3	0.14	307.3
Soybean	16.9	0.13	139.2
Sugarbeet	20.4	0.15	(1.0)

Source: Ennen, M.J. and J.W. Bauder. 1981. Water Use of Field Crops in Eastern North Dakota. Farm Research 38: 3-5.

Crop Rotations

- ‘Crop rotation has been used for thousands of years. During the 1950s and early 1960s, it was felt that synthetic fertilizers and pesticides could forever replace crop rotation without loss of yield, but that opinion has changed. The current consensus is that crop rotation increases yield and profit and allows for sustained production.’

  D.G. Bullock. 1992. Critical Reviews in Plant Sciences. 11:309-326.

Crop Rotations

- Rotational data in the absence of clearly identifiable pest problems.

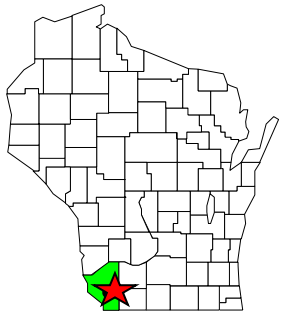
- Pest problems further complicate management

Rotational Research

Previous Crop	*Wheat Yield*			
	Conventional		*No-till*	
	Actual	*Relative*	*Actual*	*Relative*
Wheat	33.8	100	33.3	100
Soybean	45.3	134	44.9	135
Sugar beet	40.8	121	38.8	117
Sunflower	39.3	116	39.1	117
Corn	38.6	114	37.3	112
Flax	38.0	112	37.5	113
Barley	37.0	109	36.0	108

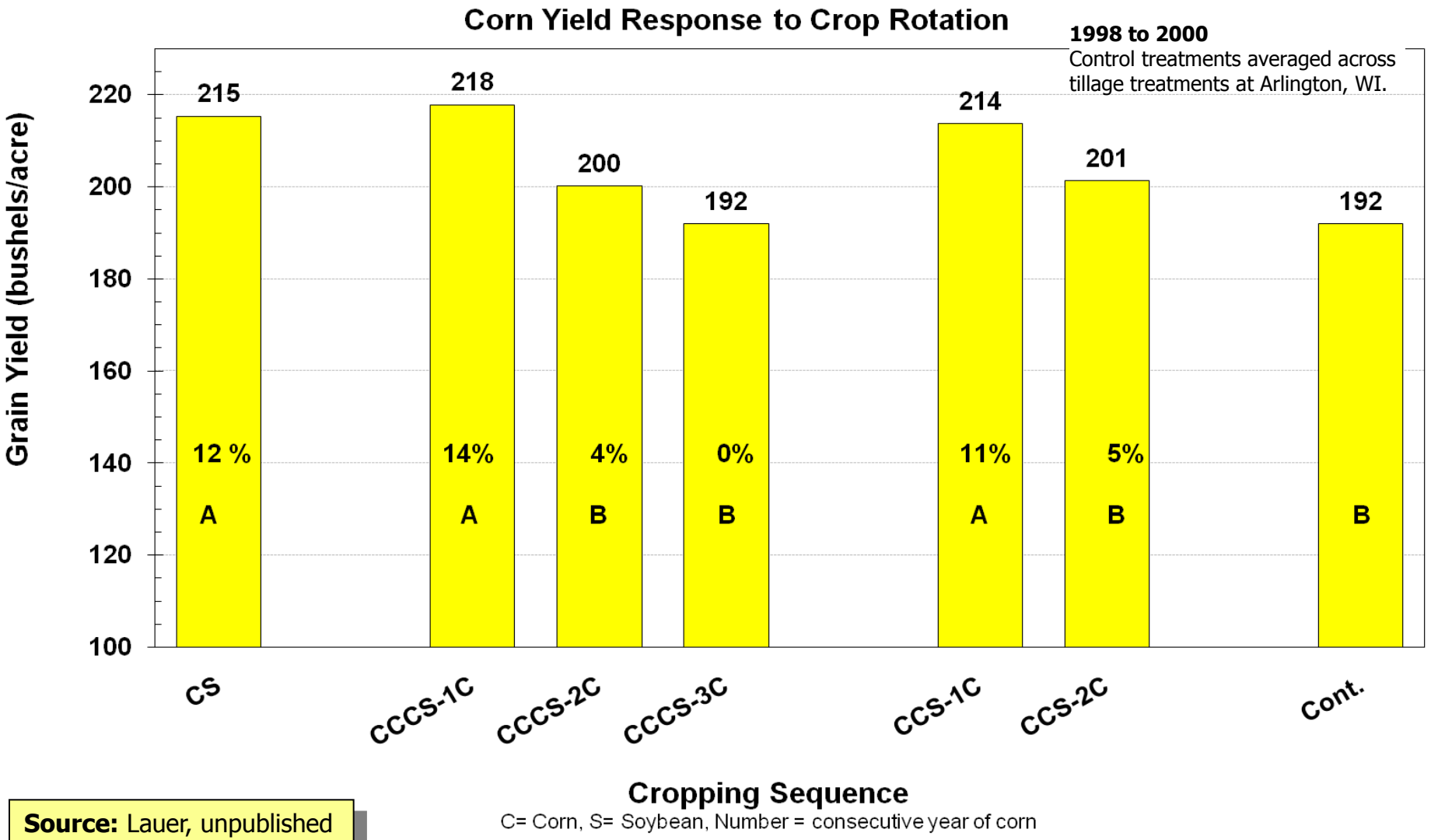
Source: 'Soybean Production' NDSU Extension Service

The Lancaster Rotation Experiment
A Long-Term Cropping System Study



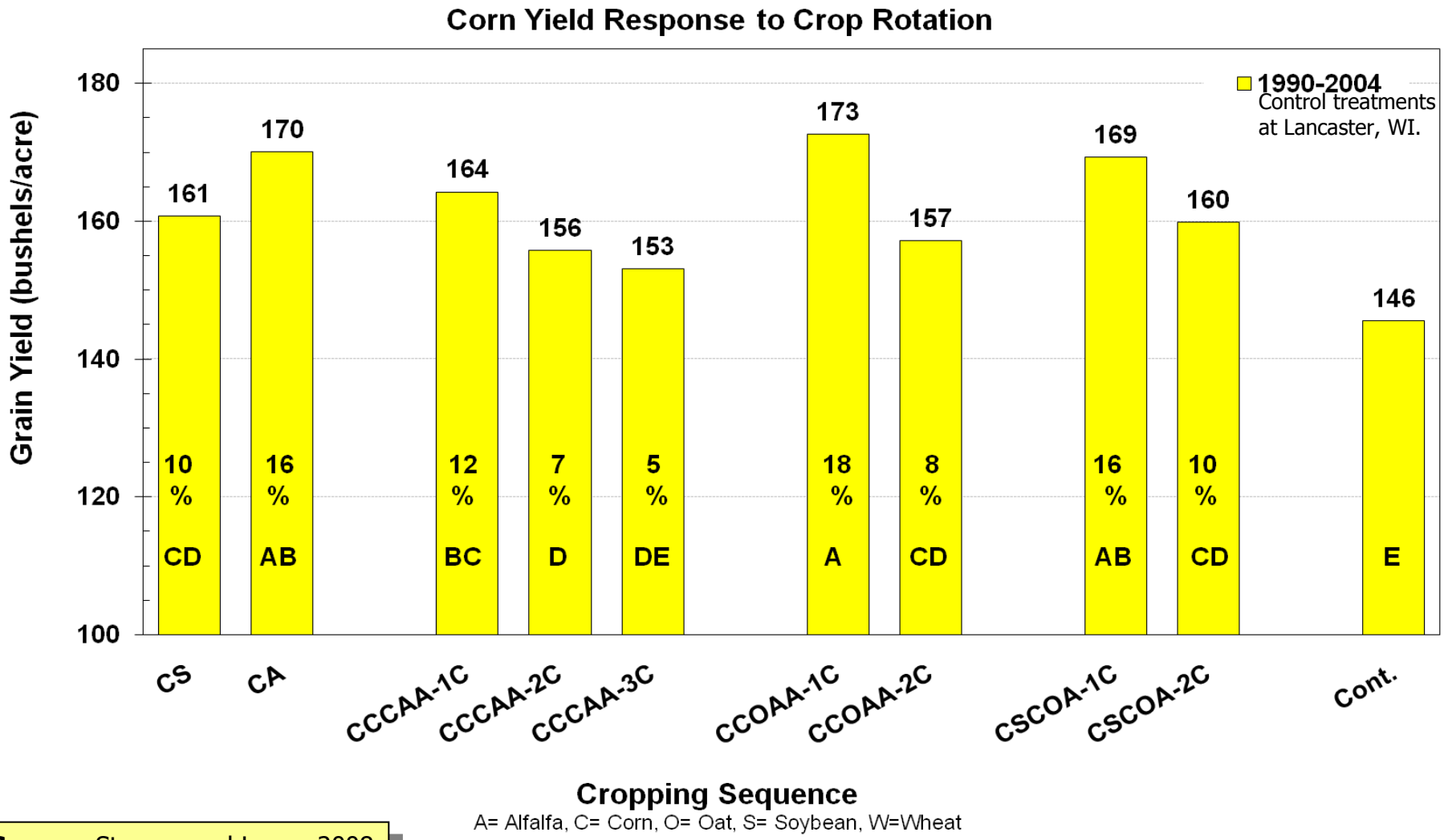
- **A multiple crop rotation experiment established in 1966**
- **Objective: To compare the benefits of growing corn continuously and in rotation using commercial nitrogen fertilizer.**
- **RCB in a split-plot arrangement with two replications.**
  - ✓ Main-plots= 21 rotations
  - ✓ Split-plots= four N levels in corn

A one year break using soybean reduces the rotation effect in the second phase



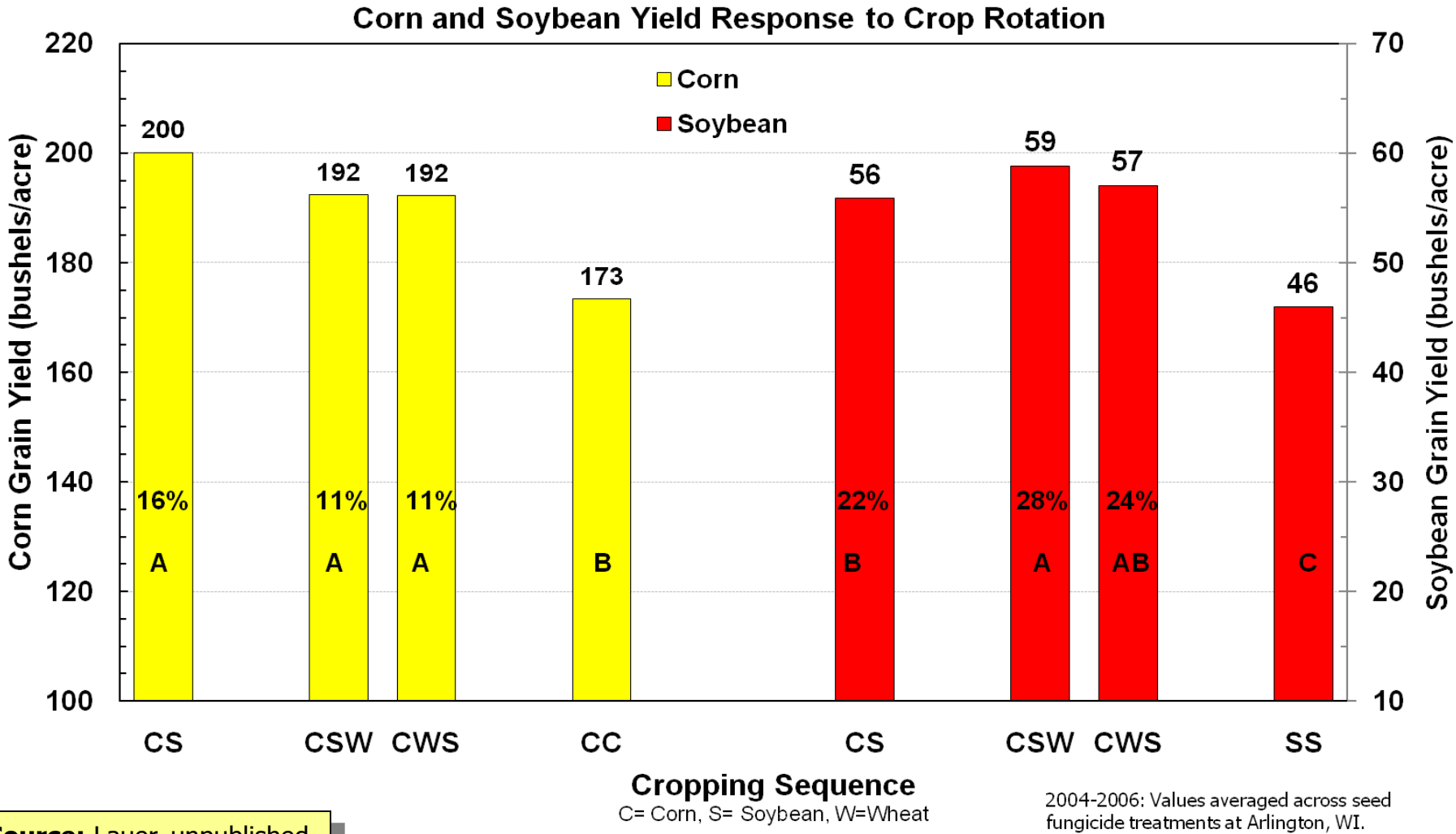
Source: Lauer, unpublished

At least two break years are needed to measure a response in the second crop phase



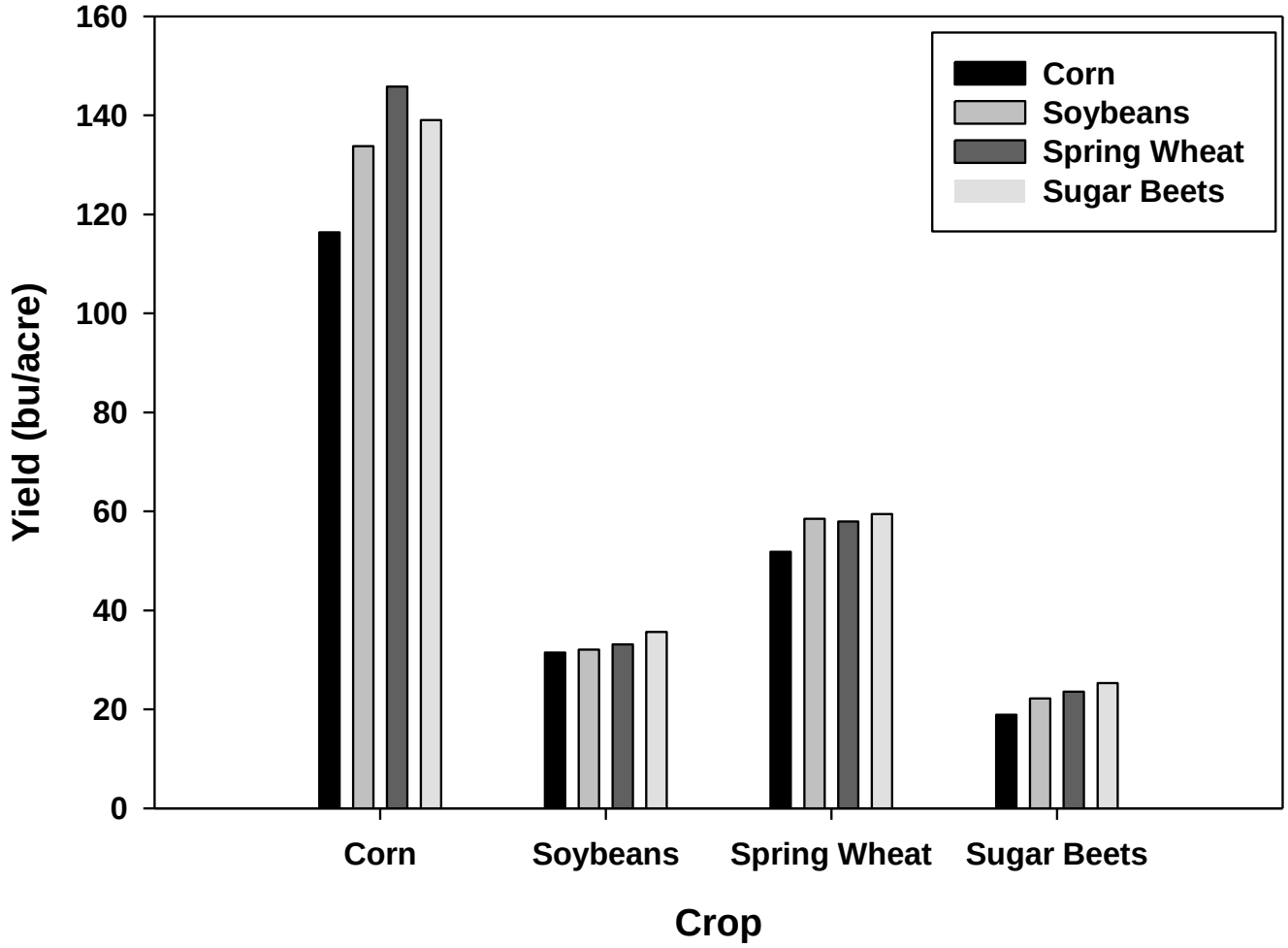
Source: Stanger and Lauer, 2008

Adding a third crop does not increase corn grain yield, but does improve soybean grain yield …



Source: Lauer, unpublished

FinBin Data



Source: NW District 2009-2011 Cash Rent

Rotational Studies

- What the data tells us:
  - Crop rotations work – there are advantages to include SGs in rotations, even in a CS or CC world
- What the data doesn't tell us:
  - No comprehensive enterprise/systems analysis:
    - Economies of scale
    - Labor film
    - Input cost differentials
  - Pest management not considered

Integrated Pest Management

- Crop rotation is an integral part of integrated pest management and can provide relief for, for example:
  - Soybean cyst nematode (>4 years and in combination with use of resistance genes)
  - Herbicide resistant weeds (>2 years)
  - Extended diapause corn rootworm (>2 years)
  - Transgenic corn rootworm events that are faltering (>2 years)

Herbicide Resistant Weeds

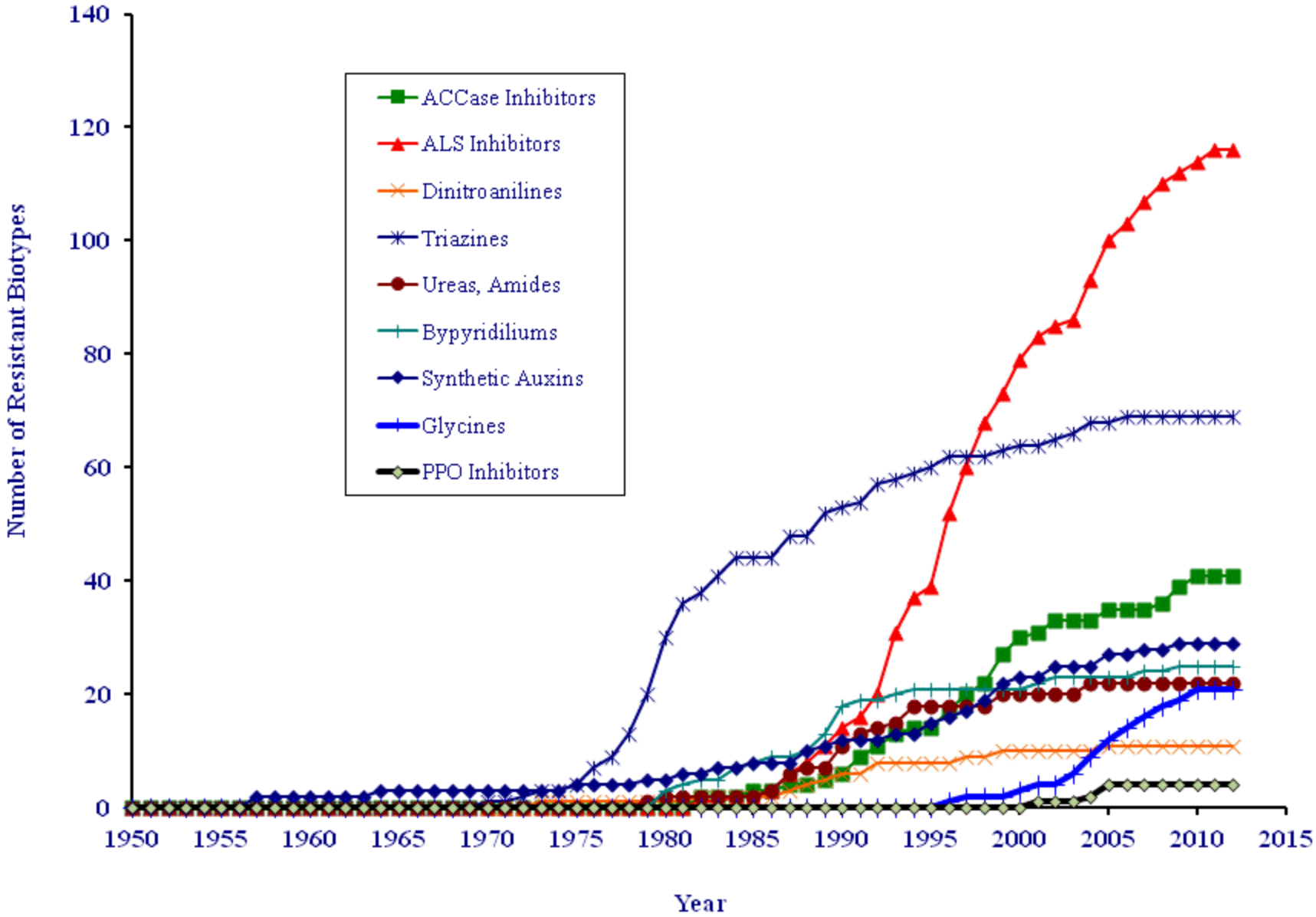
- Globally 396 herbicide resistant biotypes, belonging to 210 species have been confirmed (source: www.weedscience.org/In.asp):
  - 123 species are dicots
  - 87 species are monocots

  - 129 species are ALS inhibitor resistant
  - 69 species are photosystem II inhibitor resistant
  - 42 species are ACCase inhibitor resistant
  - 30 species are synthetic auxins resistant

Herbicide Resistant Weeds

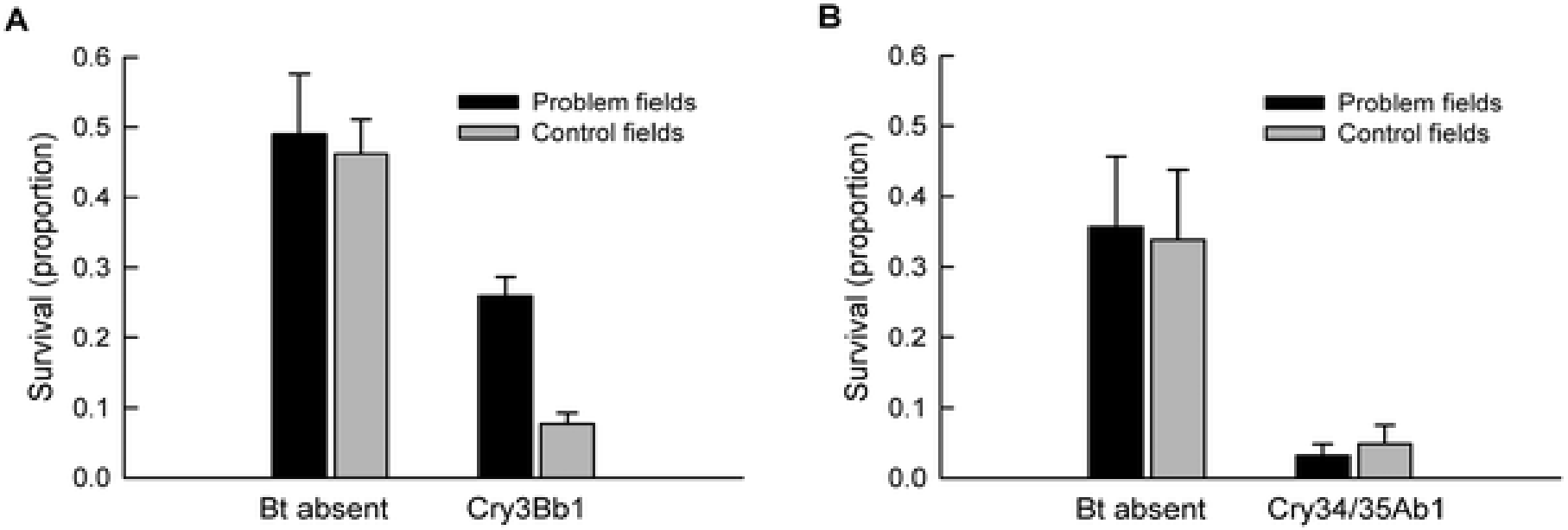
- In 1997 Laura Bradshaw et al. (Weed Technology 11: 189-198) argued that it would be highly unlikely that glyphosate resistant weeds would develop.

- As of this year there are 24 species known to have developed resistance to glyphosate worldwide, of which 12 have are also confirmed in the US ;
  - Kochia has been confirmed in North Dakota in 2012



Source: Ian Heap
http://www.weedscience.com

Field-Evolved Resistance to Bt Maize by Western Corn Rootworm

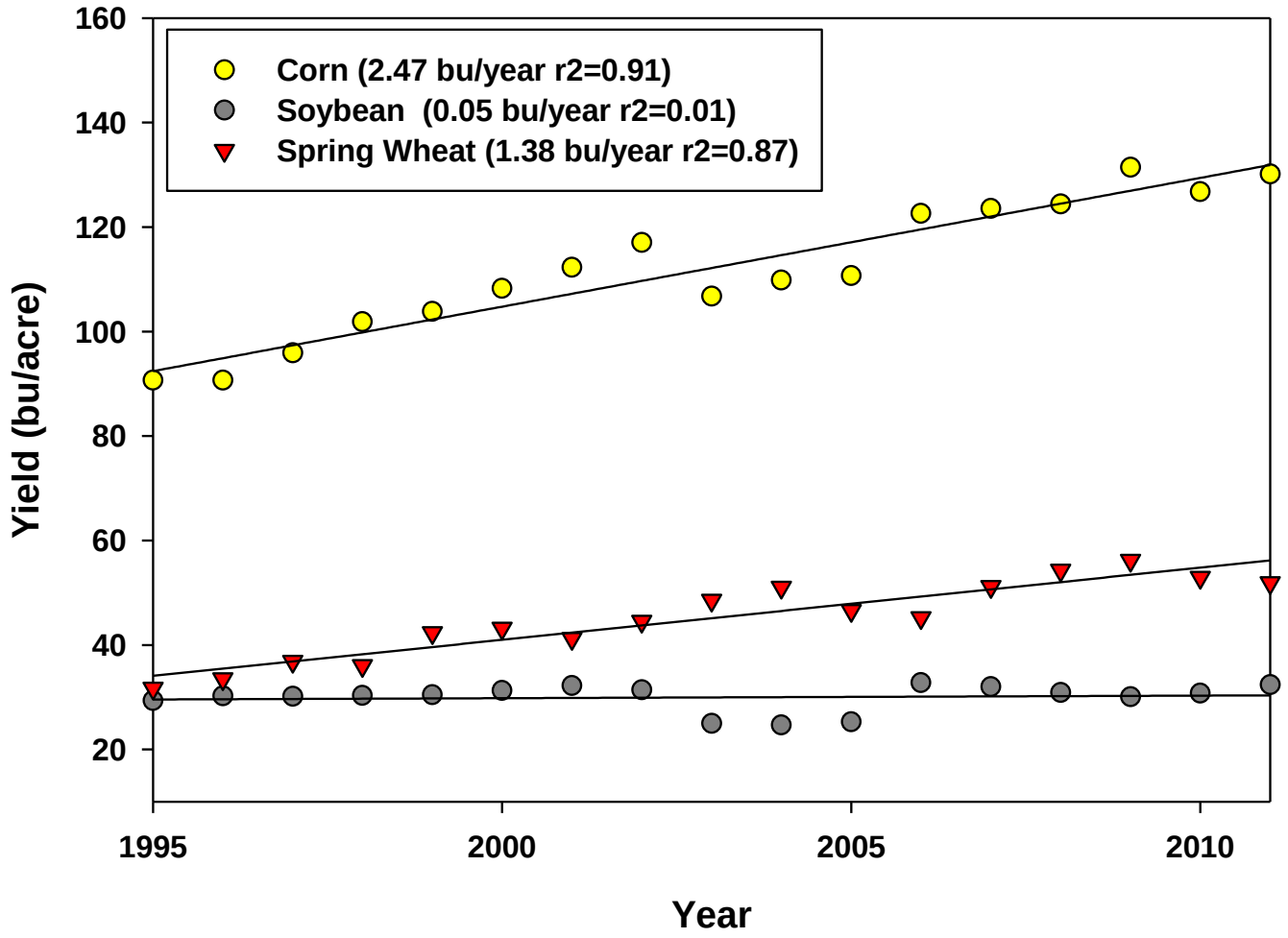


Gassmann AJ, Petzold-Maxwell JL, Keweshan RS, Dunbar MW (2011) Field-Evolved Resistance to Bt Maize by Western Corn Rootworm. PLoS ONE 6(7): e22629. doi:10.1371/journal.pone.0022629
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0022629

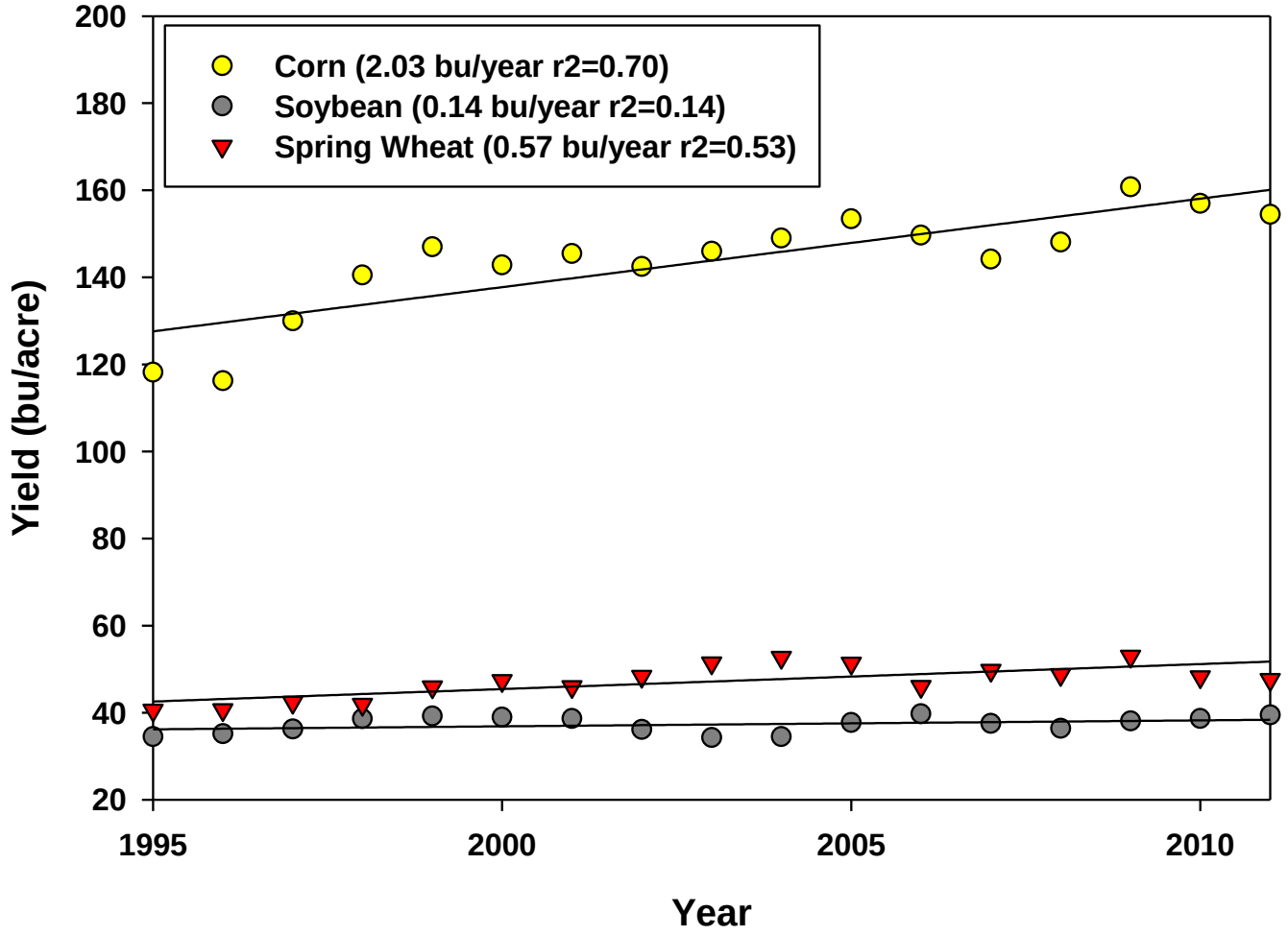
Opportunity Cost

- The cost of any activity measured in terms of the value of the next best alternative forgone (source: Wikipedia)
  - Monetary advantages resulting from rotational choices when compared to a monoculture ‘should’ be assigned to the previous crop(s) and not be included in enterprise analysis for the crop itself

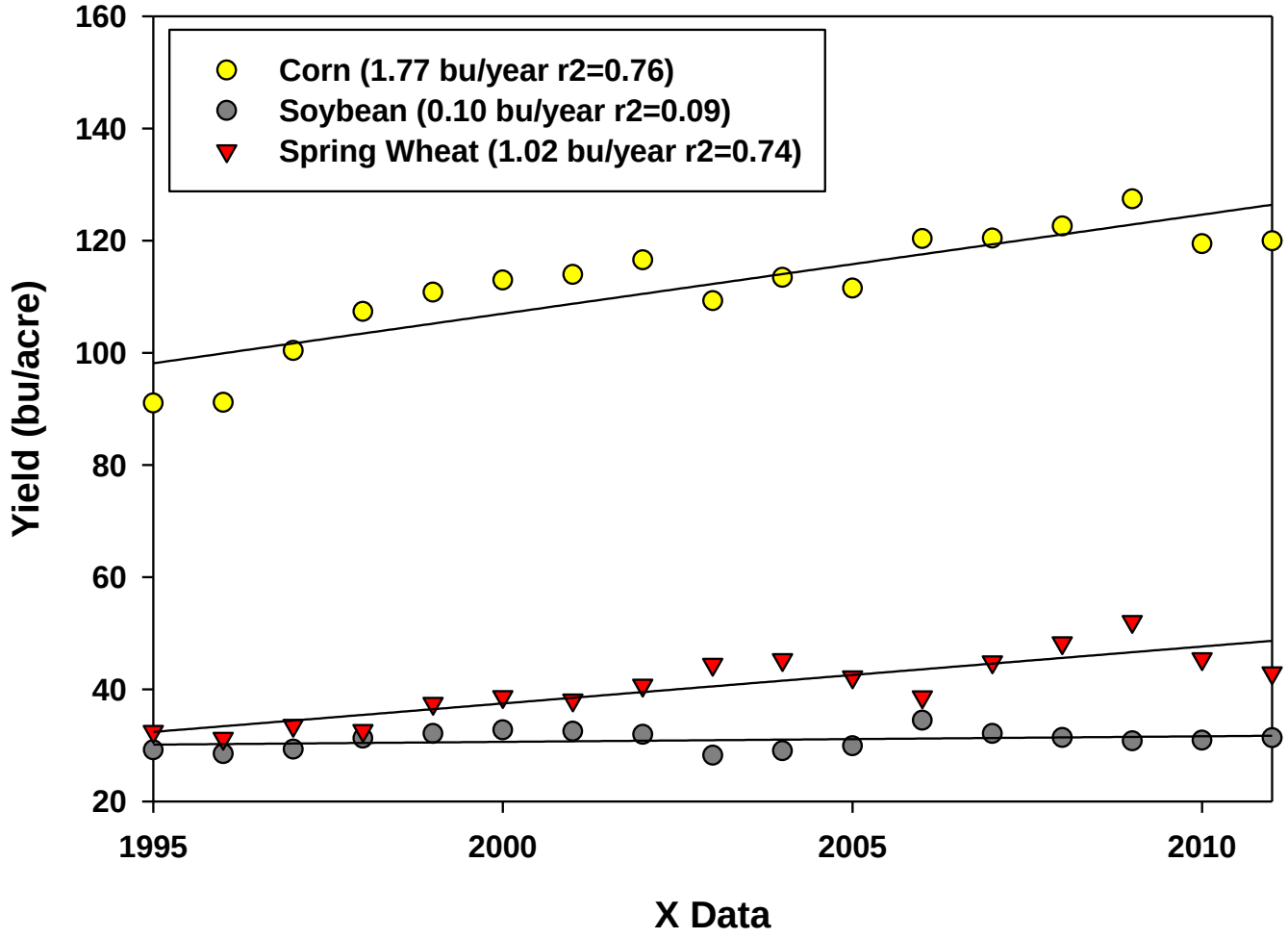
Yield Trends NW MN



Yield Trends in WC MN



Yield Trends in Eastern ND



Conclusion

- If technologies like fertilizers and pesticides can not replace crop rotation without loss of yield indefinitely.

- Then…maybe wheat does have a future in the crop rotations across the Northern Plains.
  (or we can wait for $20.- wheat…☺)