Soil Management for Continuous Corn

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What are the issues?

System issues

- Crop protection
  - Insects
  - Weeds
  - Fungicide
- Crop management
  - Hybrid selection
  - Seeding rate
  - Rotation considerations
- Grain handling & storage
- Economics
- Equipment
- Soil management

Soil management

- Management of crop residue
  - Tillage selection
  - Stalk chopping
  - N additions
- Fertility management
  - N
  - Starter
  - Manure
- Conservation planning
  - Soil loss
  - Soil quality
- Yield effects

Tillage management decisions are complex

- Performance on your soil
- Residue clearance
- Power requirement
- Soil conservation issues
- Secondary tillage practice
- Time and efficiency
- Cost of tool purchase and operation
- Crop rotation
- Weather

Tillage cost for continuous corn

Practice	Chisel	Strip-till	No-till
	---------- $/acre ----------		
Stalk Chopping	8.65	8.65	--
Primary Tillage	12.30	11.00	--
Secondary Tillage	9.05	--	--
Planting	13.05	13.95	13.95
Total	43.05	33.60	13.95

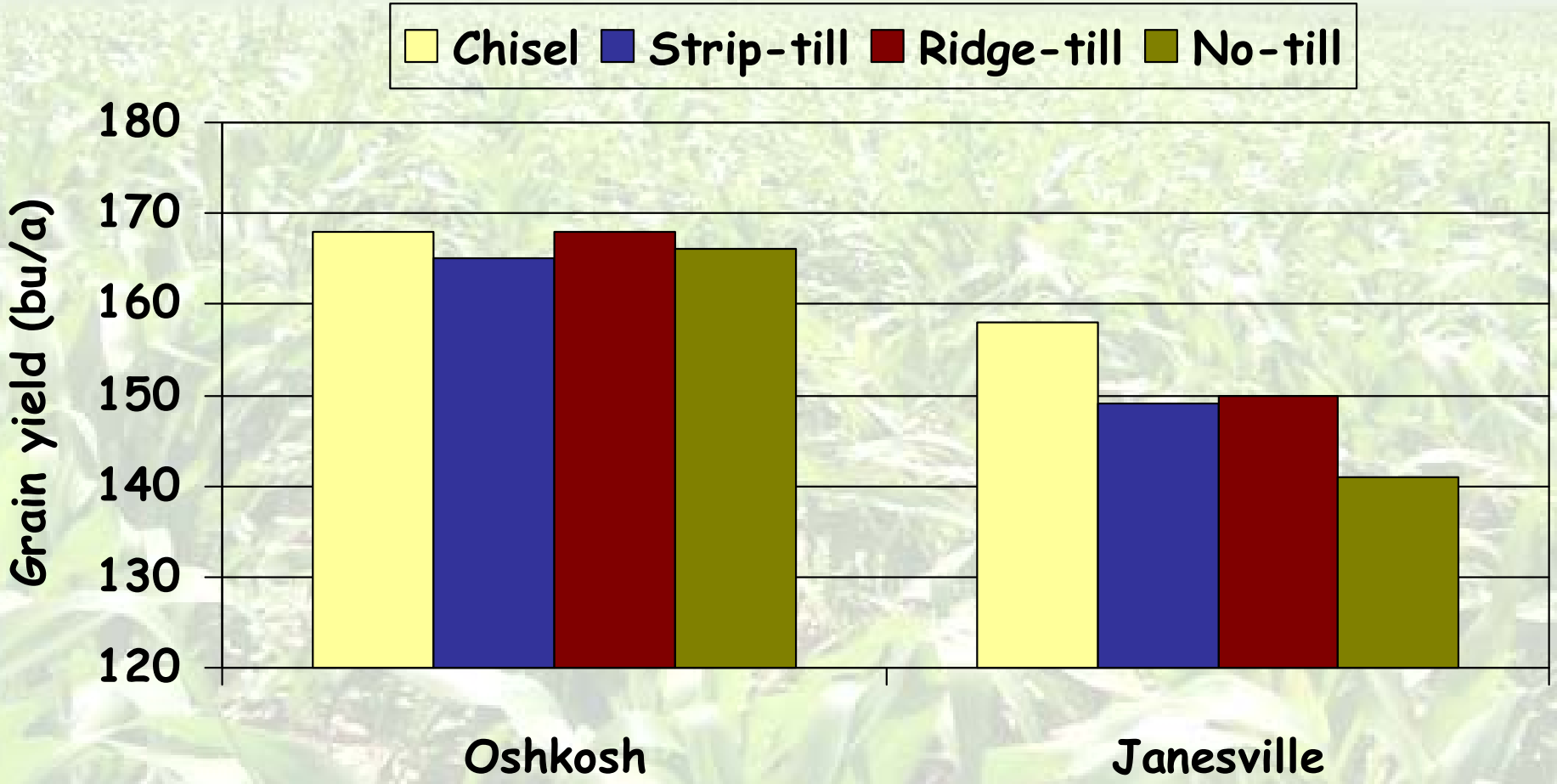
Source: 2007 Iowa Custom Rate Survey

Some tillage may be needed for continuous corn grown on heavy soils

Tillage	Early Stand	Early Height	Late Height	Grain Moisture	Grain Yield
	x 1000	------ in ------		%	bu/a
Fall moldboard	24.5	15	64	24.1	173
Fall chisel	24.8	15	62	24.5	169
Ridge-tillage	24.0	15	59	24.6	170
No-tillage	22.9	12	53	26.6	143

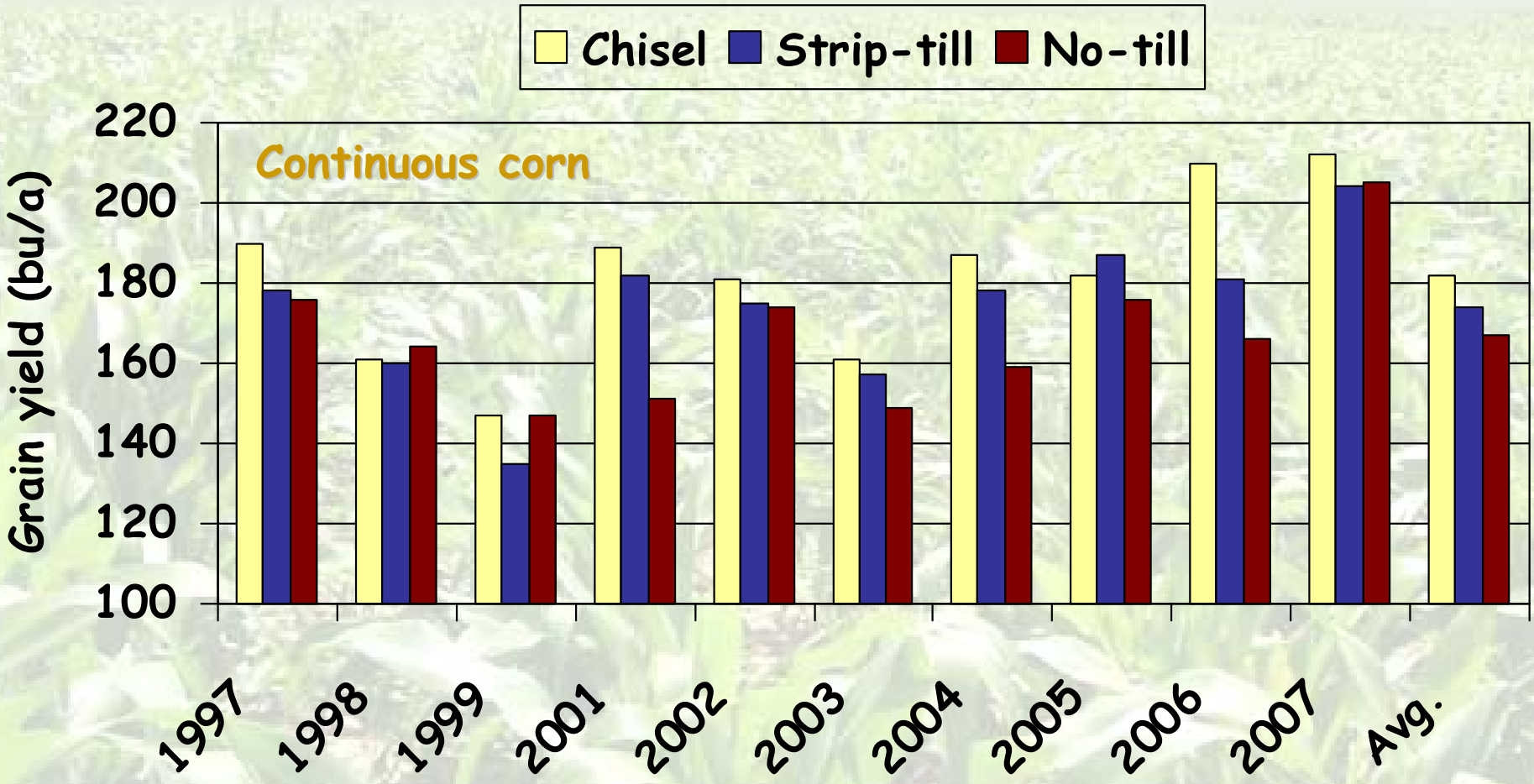
Source: West et. al., 1996 (Indiana - Chalmers silty clay loam) 15 year average

Response of continuous corn on two Wisconsin soils



Source: Bundy et. al., 1992 (3 year avg. @ 180 lb N/a)

Tillage effect on corn yield, Arlington, Wis. 1997 - 2007



Use the MRTN approach to select N rates

Nitrogen Guidelines for Corn in Wisconsin

SOIL	PREVIOUS CROP	N:Corn Price Ratio (see other side) 0.05	0.10	0.15	0.20
		LBS N/ACRE (total to apply)[3]			
high/very high yield potential soils	**Corn**, Forage legumes, Legume vegetables, Green manures[4]	**165**[1] 135-----■----190[2]	**135** 120--■--155	**120** 100---■--135	**105** 90--■--120
	Soybean, Small grains[5]	**140** 110-----■---160	**115** 100--■--130	**100** 85--■--115	**90** 70---■-100
medium/low yield potential soils	**Corn**, Forage legumes, Legume vegetables, Green manures[4]	**120** 100---■---140	**105** 90--■--120	**95** 85-■--110	**90** 80-■-100
	Soybean, Small grains[5]	**90** 75--■---110	**60** 45--■-70	**50** 40-■-60	**45** 35-■-55
sands/ loamy sands	Irrigated—**All crops**[4]	**215** 200--■--230	**205** 190--■--220	**195** 180--■--210	**190** 175--■-200
	Non-irrigated—**All crops**[4]	**120** 100---■---140	**105** 90--■--120	**95** 85-■--110	**90** 80-■-100

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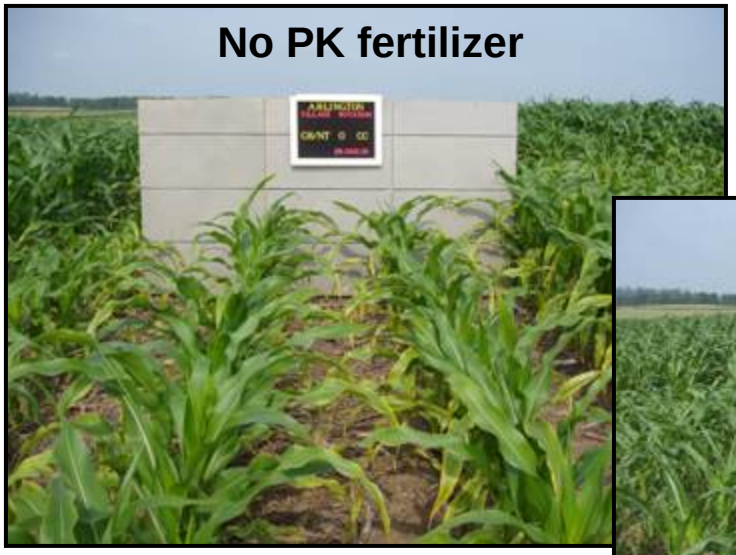
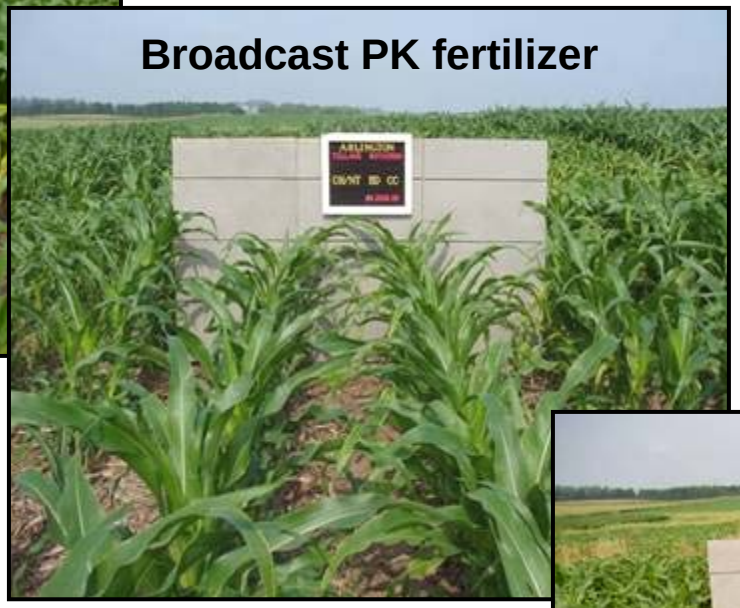
[1] Maximum return to N (MRTN) rate. [2] Range within $1/acre of MRTN rate. [3] Includes N in starter. [4] Subtract N credits for forage legumes, legume vegetables, animal manures, green manures. [5] Subtract N credits for animal manures and second year forage legumes.

Considerations for selecting a N rate within the MRTN range

Situation	Low	MRTN	High
No-tillage			
Chisel tillage			
Heavy manure history			
< 2 % soil organic matter			
Financial constraints			
Known N credits			

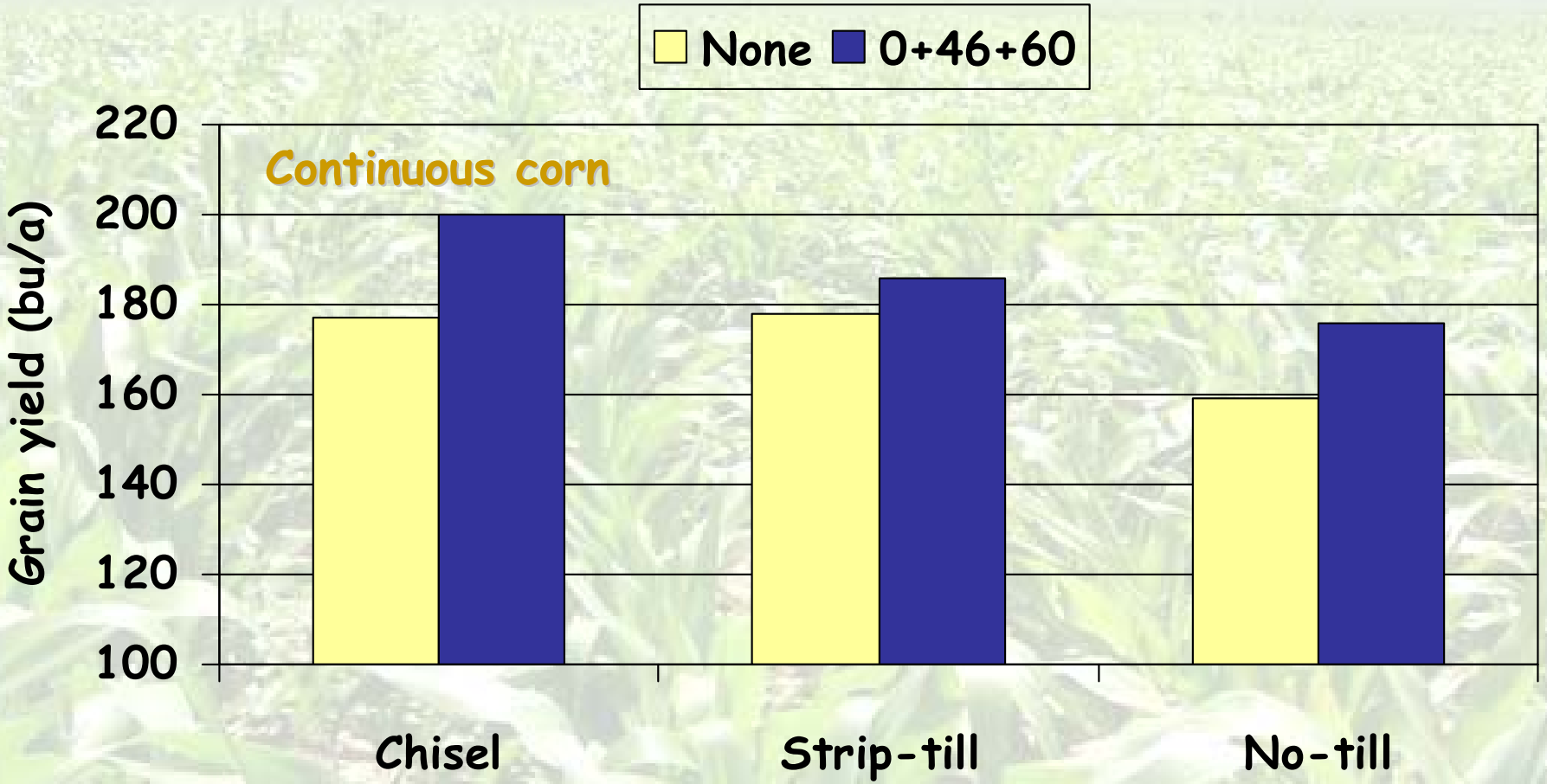
Fertilization effect on corn growth, Arlington, Wis., 2005





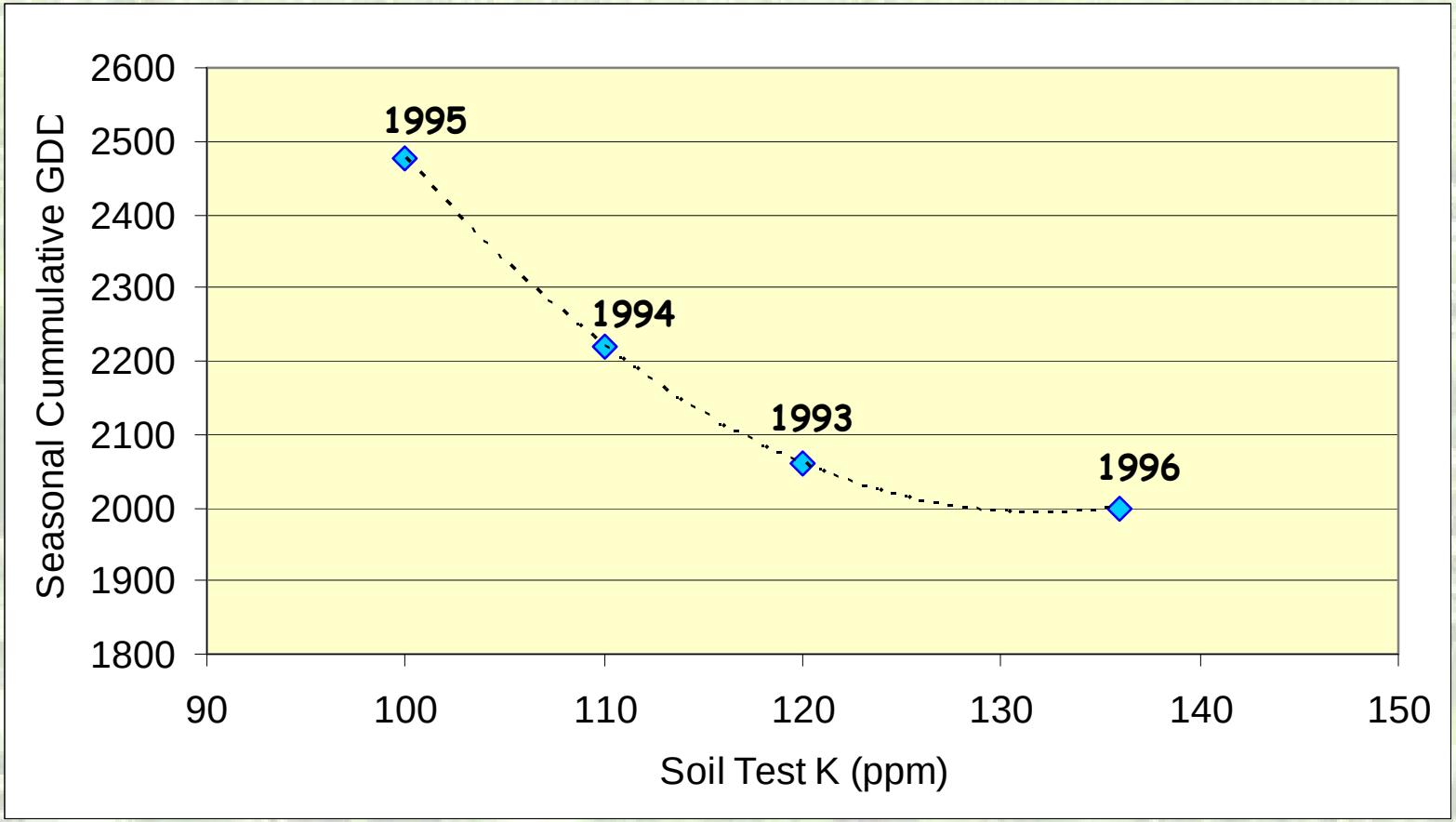
Continuous corn
200 lb 0-23-30/a
160 lb N/a to all plots

Tillage and PK fertilization effect on corn yield, Arlington, Wis. 2001 – 2007 (7 yr. avg.)



Fertilizer planter-applied as 200 lb 0-23-30/a
Soil test P = EH, Soil test K = Opt.

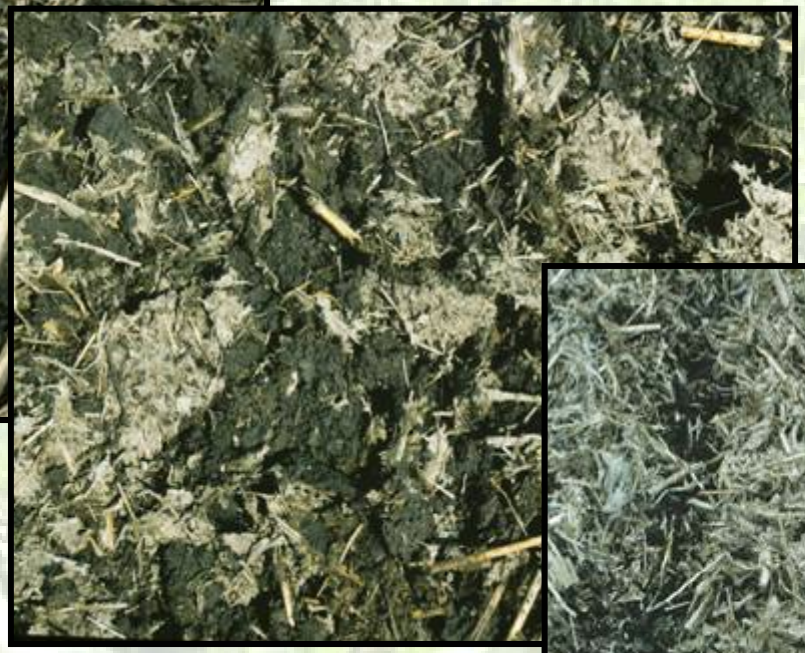
Relationship between temperature and maximum soil test K level where yield response occurred to starter fertilizer



Bundy and Andraski, 1999

Manure management challenge in continuous corn

NO-TILL

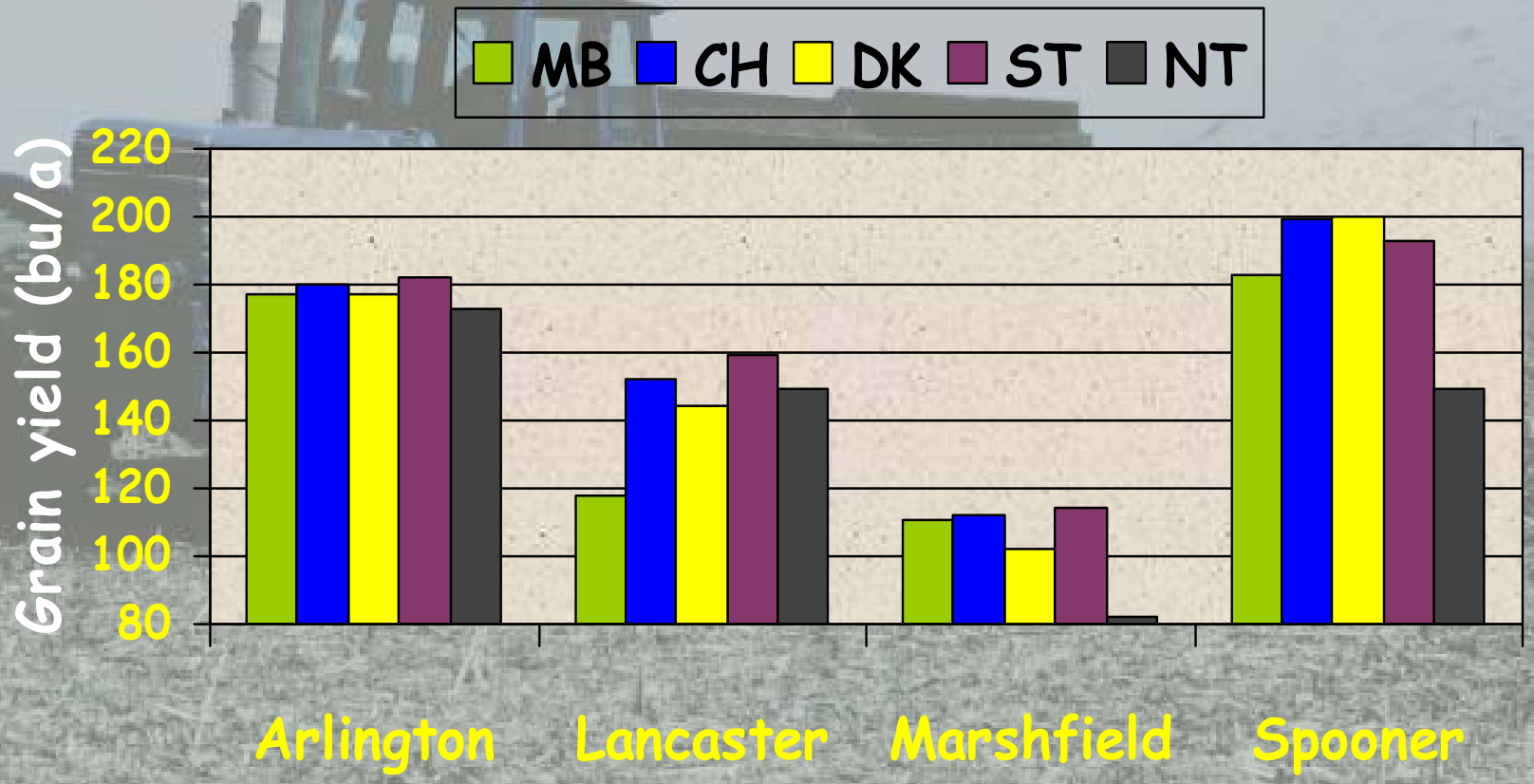


LIGHT DISKING

STRIP-TILL

Alternatives to full-width tillage

Effect of tillage and manure on corn yield at four Wisconsin locations, 2003



Wolkowski, 2003 (30 ton straw-bedded manure/a)

Stalks - Chop or not to chop?

- Improved flow through equipment
- Surface matting in no-till
- Cost for time, fuel, equipment
- 42 % vs. 56 % residue after chisel plowing chopped stalks

Stalks – A little N for decomposition?

Bundy and Andraski, 2002

- UAN or AmSul @ 30 lb
- Did not increase residue breakdown
- Did not affect N mineralization
- Did not increase spring soil temperature
- Did not increase yield

Continuous corn can maintain
soil quality compared to other rotations

The Soil Conditioning Index (SCI)

A tool that can be used to evaluate and modify crop production systems to maintain or improve soil quality

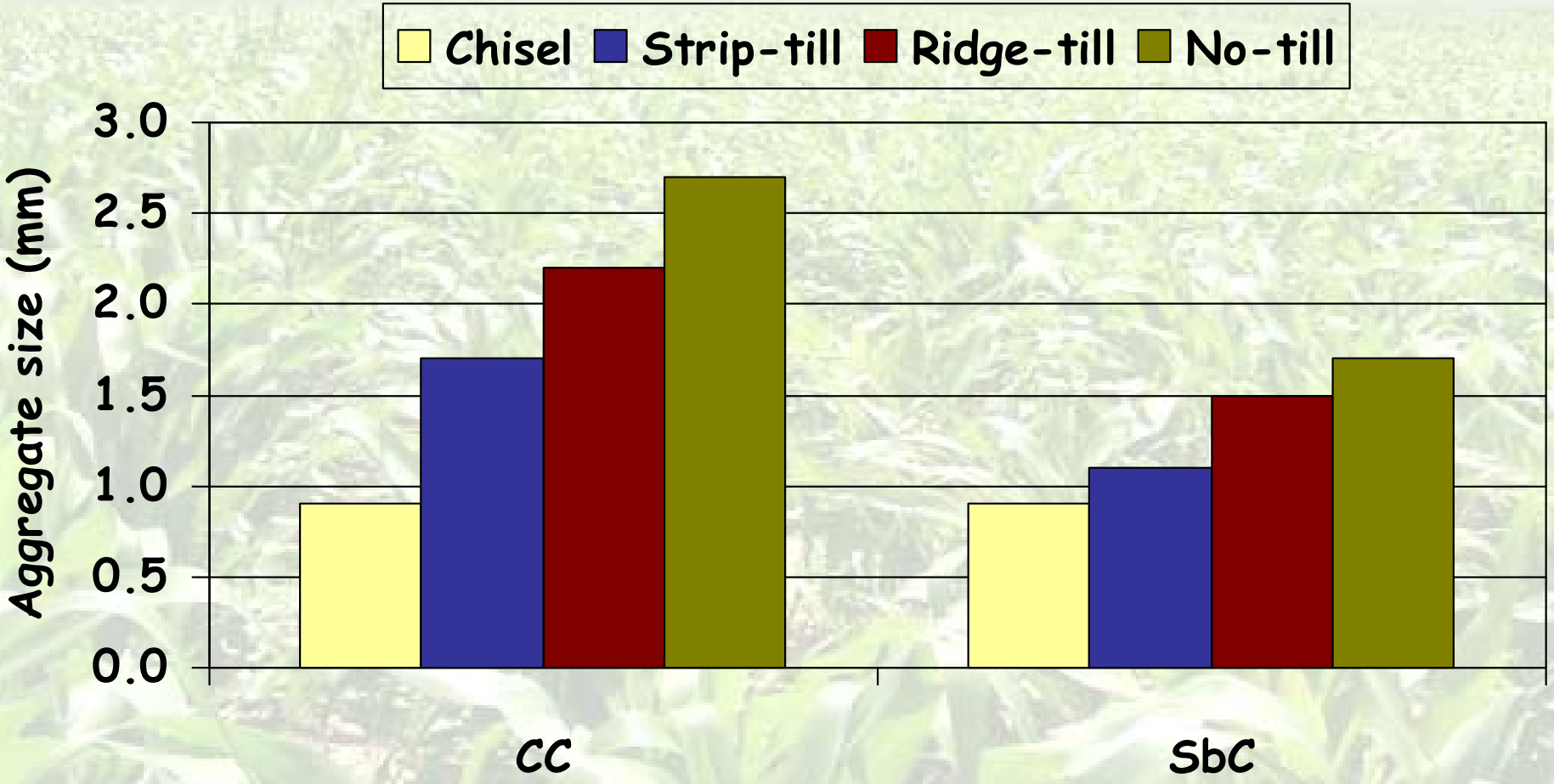
- Components of the SCI model
  - Organic matter returned to the soil
  - Field operations that affect OM breakdown
  - Erosion
- Increase a field's SCI
  - Grow crops that produce OM
  - Utilize manure and other organics
  - Maximize OM production
  - Reduce tillage
  - Plant cover crops
  - Limit erosion

Tillage effects on soil properties in long-term continuous corn, Lancaster, Wis.

Tillage	Aggregate Stability	Total C	Earthworms
	%	g/kg	No./m^2
No-till	46	24	78
Chisel	34	16	52
Moldboard	36	11	53

Karlen et al., 1994

Continuous corn maintains soil quality compared to soybean/corn



Source: Kladivko, 1994 (Indiana)

Soil loss and continuous corn production

		Tillage			
Soil	Region	Moldboard	Chisel	No-till	"T"
		---------- tons/acre/year ----------			
Plano	SC	6.3	2.8	0.1	5
Fayette	SW	10.4	4.6	0.2	5
Norden	WC	9.2	4.1	0.2	3
Kewaunee	EC	4.1	1.8	0.1	3
Loyal	NC	5.4	2.4	0.1	5
Hochheim	SE	6.4	2.9	0.1	5

Four years continuous corn, 8% slope, 150 ft. slope length

Summary

- Issues associated with continuous corn production are grower and soil specific
- Minimize tillage intensity when possible
  - More aggressive tillage may be needed on heavy soils
- Use the MRTN approach for N rate
  - Consider site/soil factors
- Fertilize to soil test
  - Row application more efficient
- Apply manure uniformly
  - Some tillage will likely be needed
- Return crop residue to maintain soil quality
- Aggressive tillage will increase soil erosion