Strip-Tillage Option for Continuous Corn

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Challenges in Managing Continuous Corn

- Residue management
  - Residue distribution (Uniformity)
- Soil quality:
  - Soil C loss
  - Soil structure
  - Soil compaction
- Water quality and N use

Challenges in Managing Continuous Corn

- Residue & soil temperature:
  - Reduction of soil moisture evaporation
  - Wet-cold soil and low soil temperature
  - Corn germination problem

Strip-tillage Concept...

- Builds mini-ridge or “berms” speed up water evaporation.
- Strip-tillage is a “transitioning system” to No-till and used on fields relatively flat, heavy soils, and poorly drained.
- Strips are tilled typically in the fall provide better seed-bed.

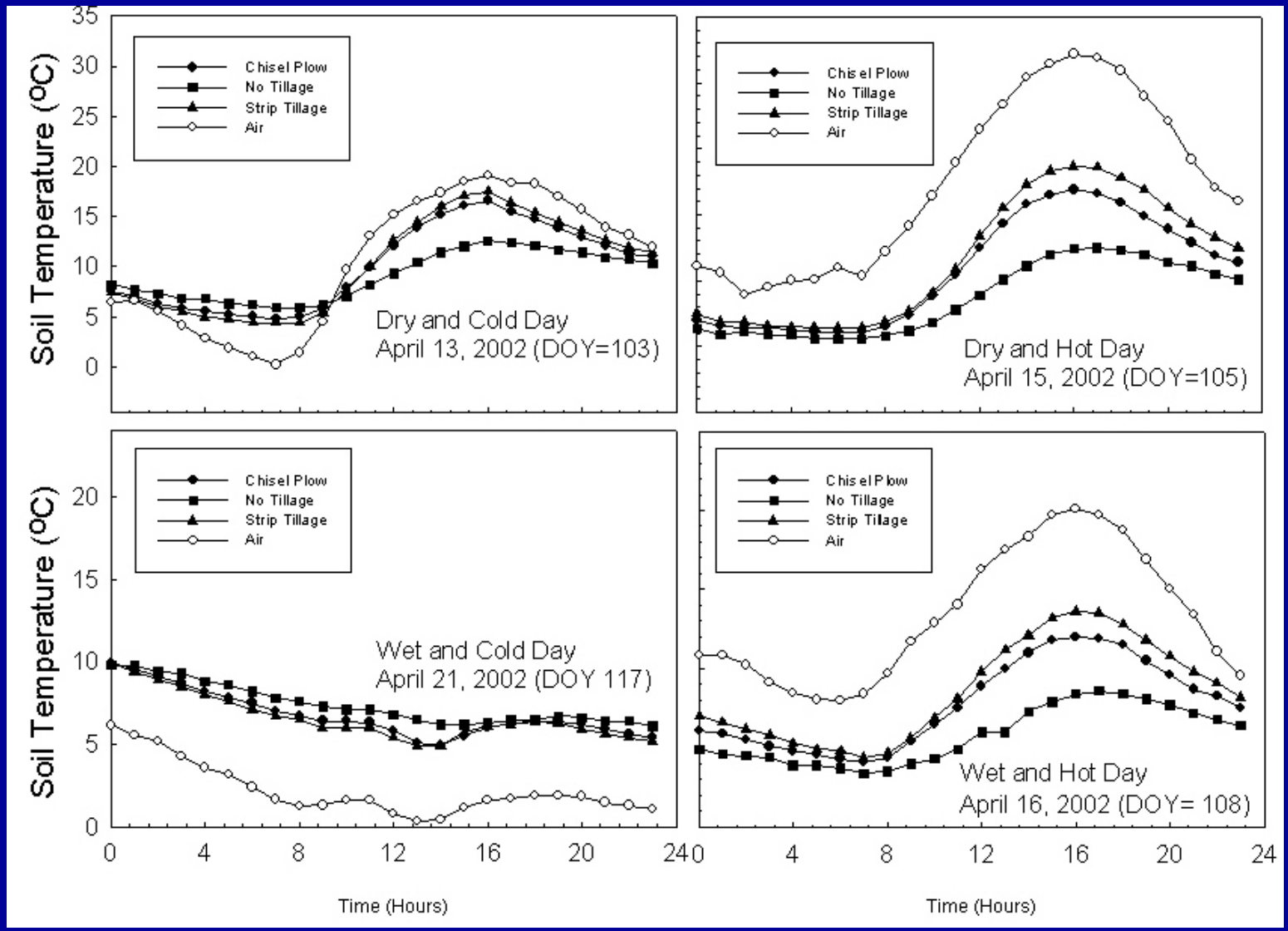
Strip-tillage Concept...

- Mole knife, 18-in. covering discs, residue cleaners, row marker
- Anhydrous, P & K - liquid or dry can be applied at the same time of pulling the strips.
- Planting must be done in the tilled zone.

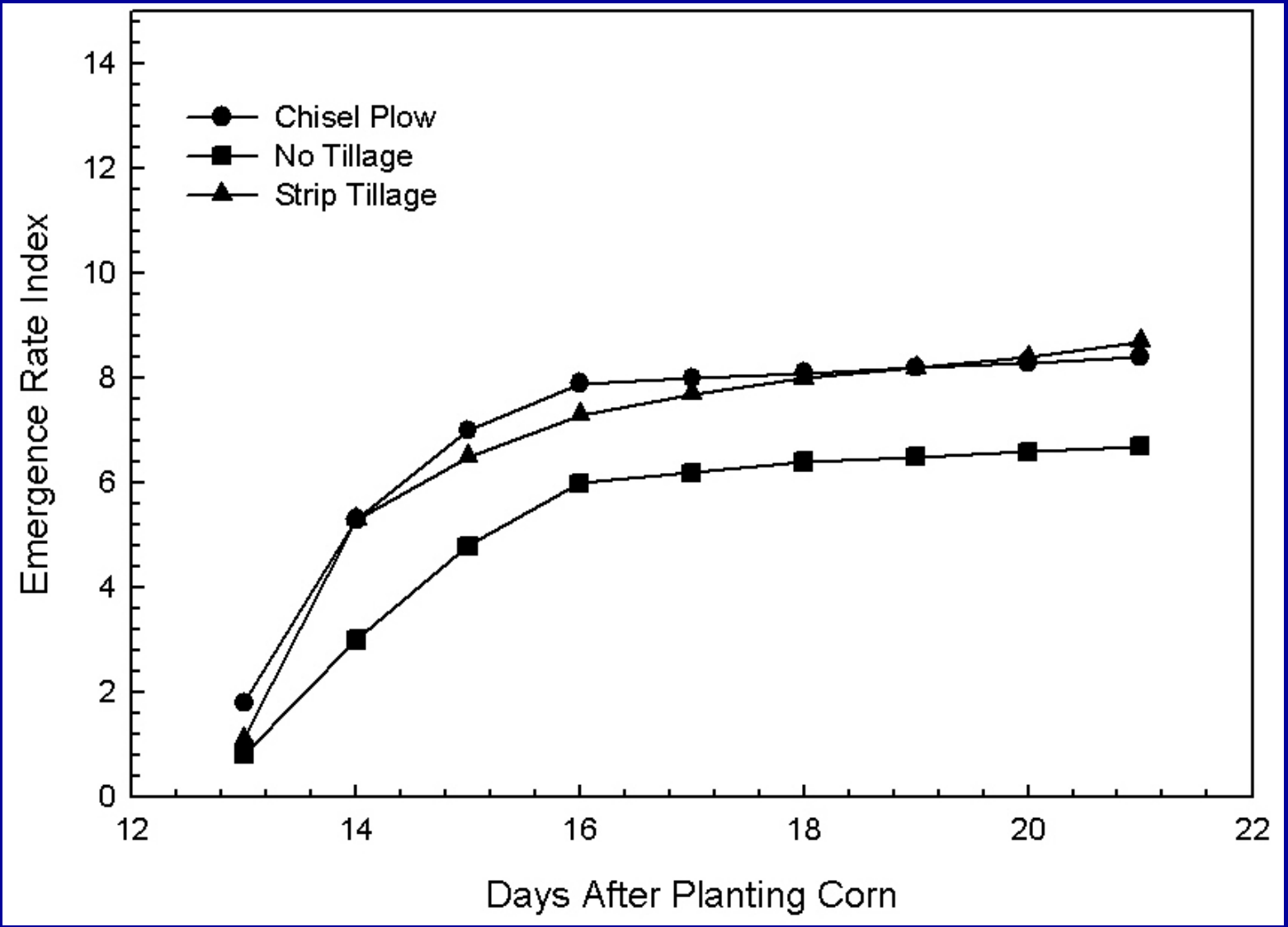
Complete Fall Strip-till Tool System

Fall Strip-tilled Field After Planting

Tillage System Effect on Soil Temperature



Tillage system Effect on Seed Germination

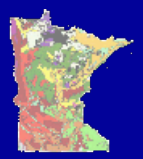


Corn Yield of C-C and C-s from 1997-2006, on Loam (Indiana) (Vyn et al, Purdue)

Tillage System	1997-2006		2001-2006	
	C-s	C-C	C-s	C-C
	Yield (bu/acre)			
Fall CP	193.5	181.9	198.0	186.7
Fall Disk	197.4	187.3	204.3	186.5
ST	---	---	203.2	186.6
NT	189.7	167.2	197.1	175.6

Continuous corn yield as affected by tillage at Rochester, MN.

Tillage for Corn	Year				4-Yr Avg.
	1997	1998	1999	2000	
	- - - - - yield (bu/A) - - - - -				
No-till	160	162	151	148	155
Rawson zone-till	166	171	159	156	163
Strip-till	152	172	164	158	162
Chisel plow +	161	170	171	163	166
LSD (0.10):	5	NS	6	8	3



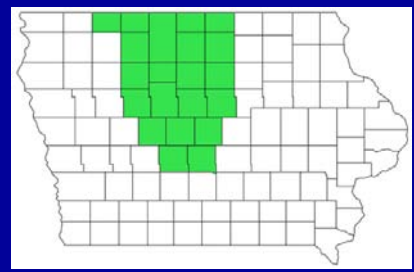
Long-Term Tillage Study Description...

- Eight locations across Iowa
- Two crop rotations: S-C and S-C-C
- Each site study replicated 4 times
- N Rates: 130-135 lb/acre for s-**C** and 160-170 lb/acre for s-c-**C**
- Standard management for each sites (i.e., weed control, pesticides, etc.)

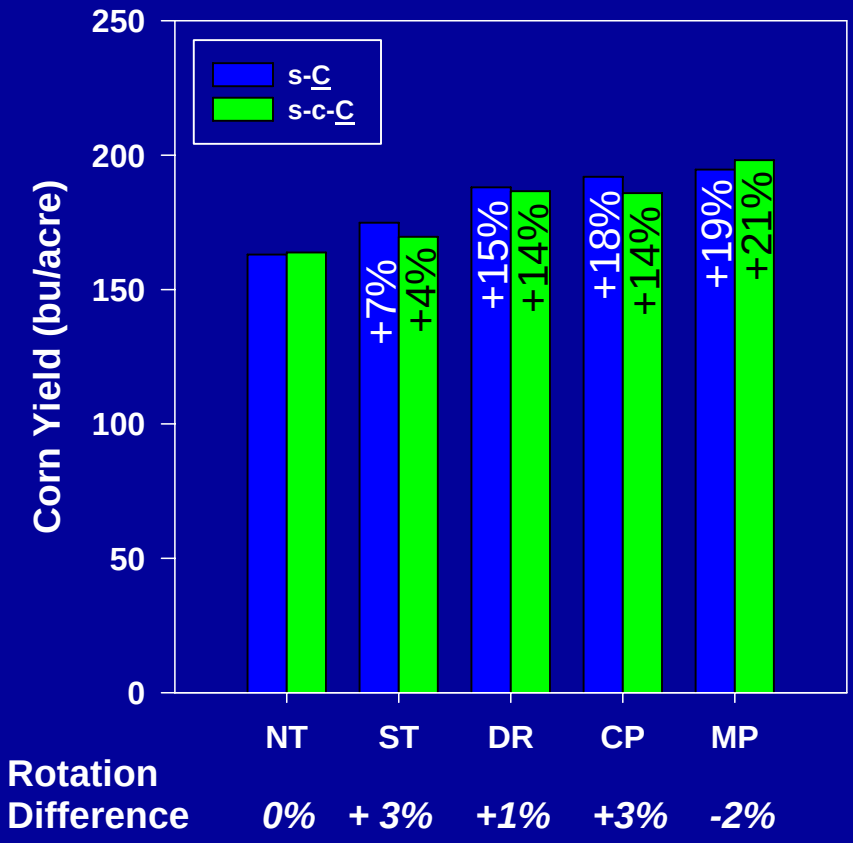
Field Operations and Management Practices for Different Tillage Systems

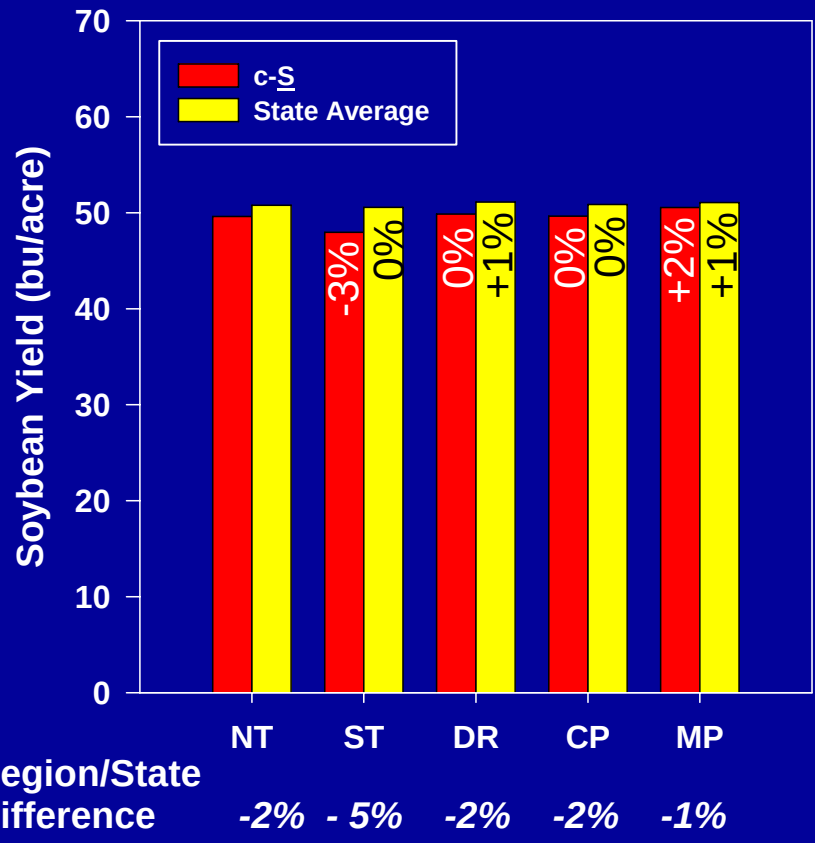
Operation	MP	CP	DR	ST	NT
Stalk chopping	1	1	1		
Primary tillage	1	1	1	1	
Secondary tillage	1	1	1		
Injected nutrient application	1	1	1		
Surface nutrient application					1
Planting	1	1	1	1	1
Spraying	1	1	1	2	2
Row cultivation	1	1	1		
Harvest	1	1	1	1	1
Total number of trips	8	8	8	5	5

- Across both rotations NT and ST corn yielded 6-21% less than other tillage systems.
- No differences between crop rotations.
- No tillage effect on soybean yield.

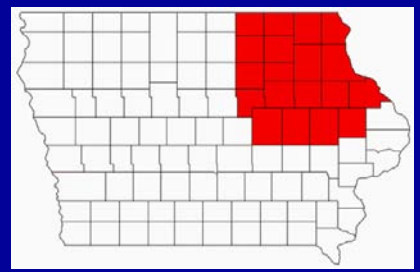


Yield Response:
North Central Region, Ames & Kanawha, IA





- ST corn yield 3-10% over NT and similar to other systems with s-C rotation.

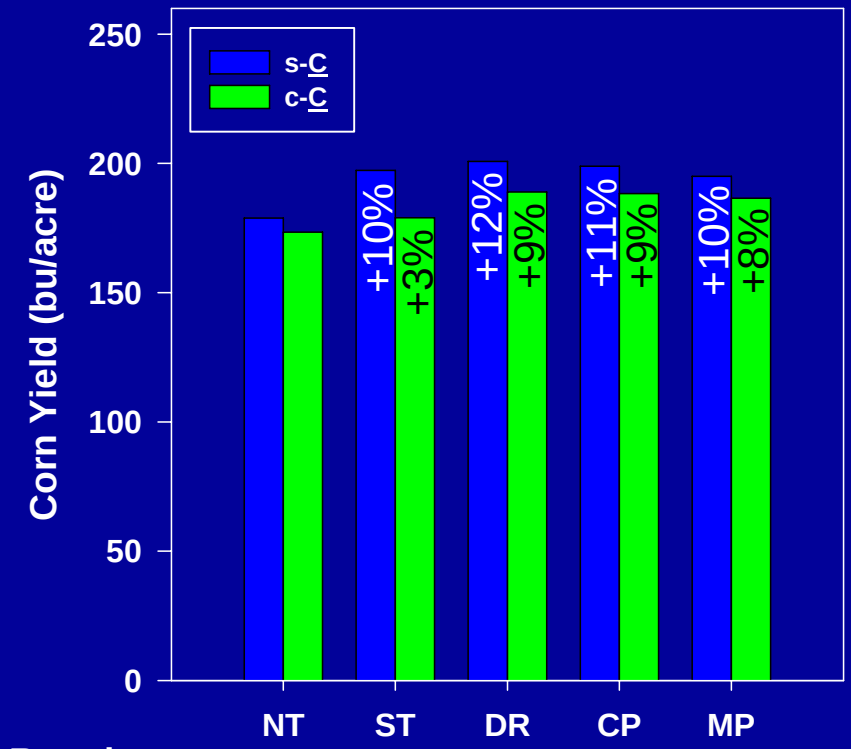


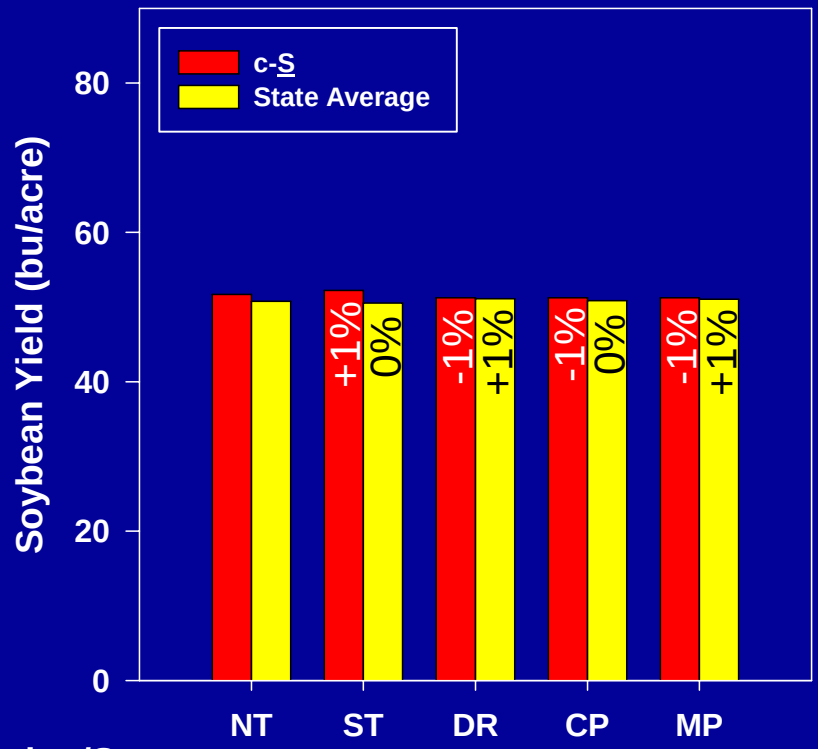
Yield Response:

- s-C 3-10% over 2nd-yr corn with all tillage

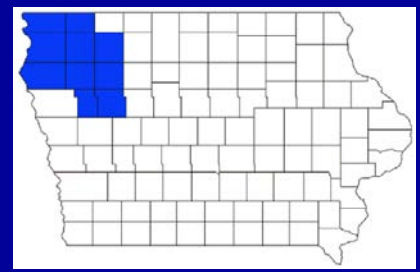
Northeastern Region, Nashua, IA

- No tillage effect on soybean yield





- ST 2% over NT compared to 4-11% with other systems in both rotations.

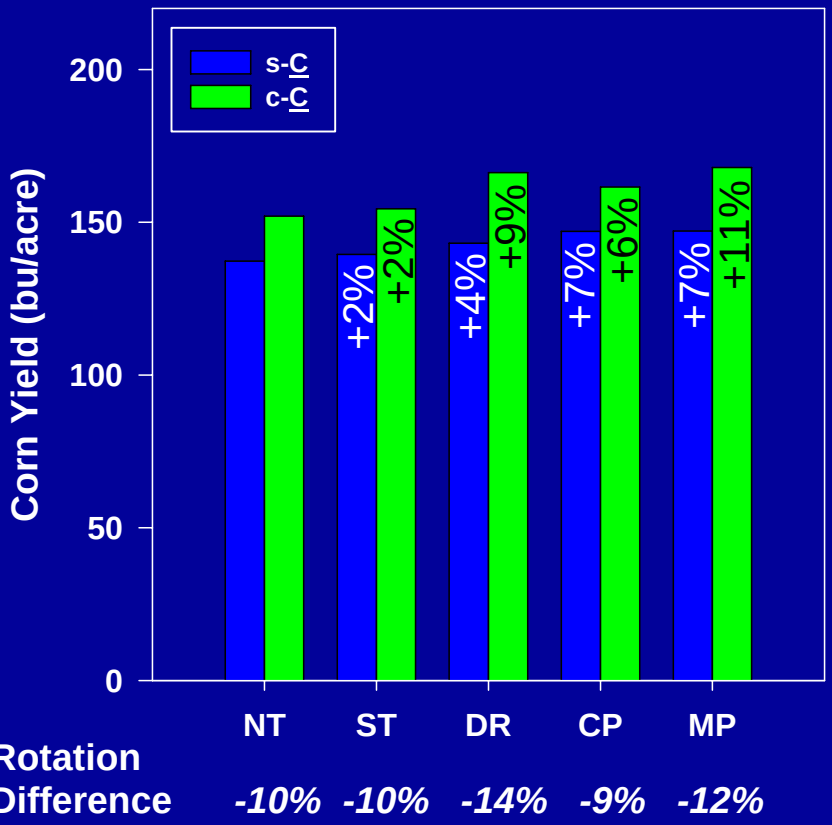


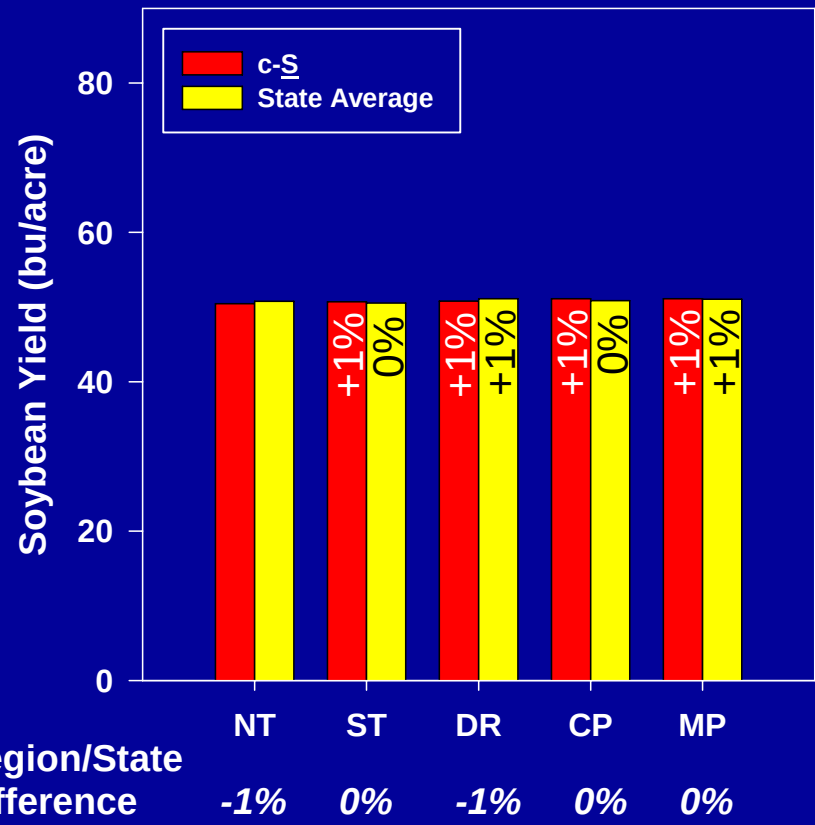
Yield Response:

- 2nd-yr corn 9-14% over s-C with all systems

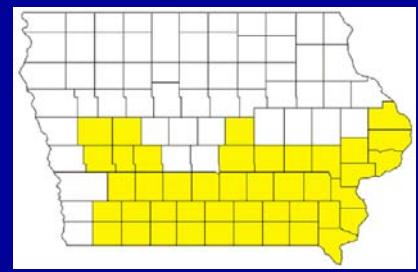
Northwestern Region, Sutherland, IA

- No tillage effect on soybean yield

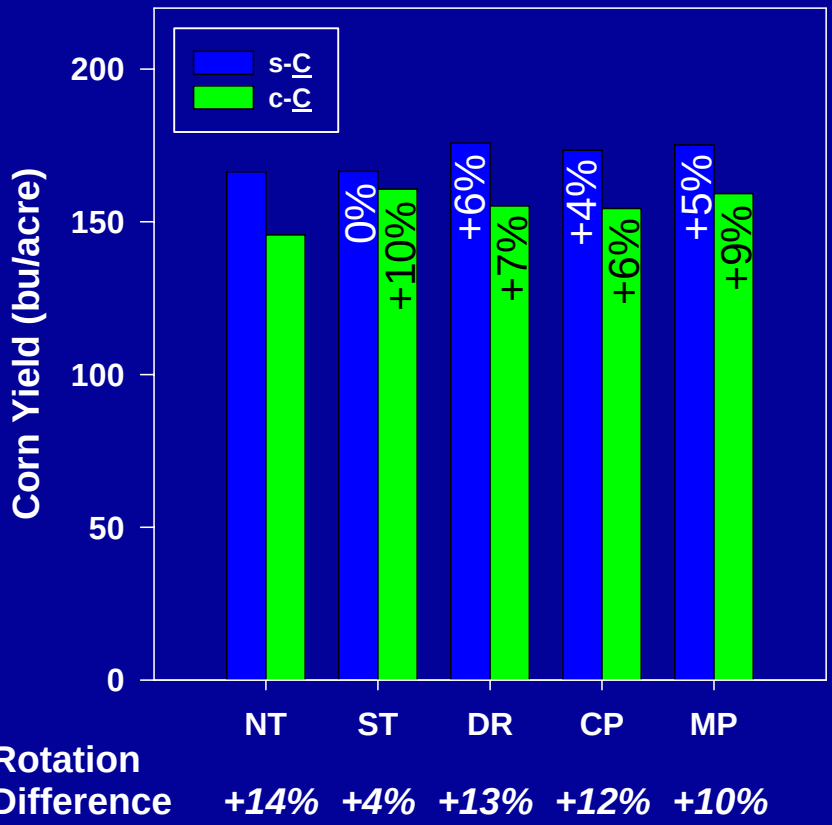


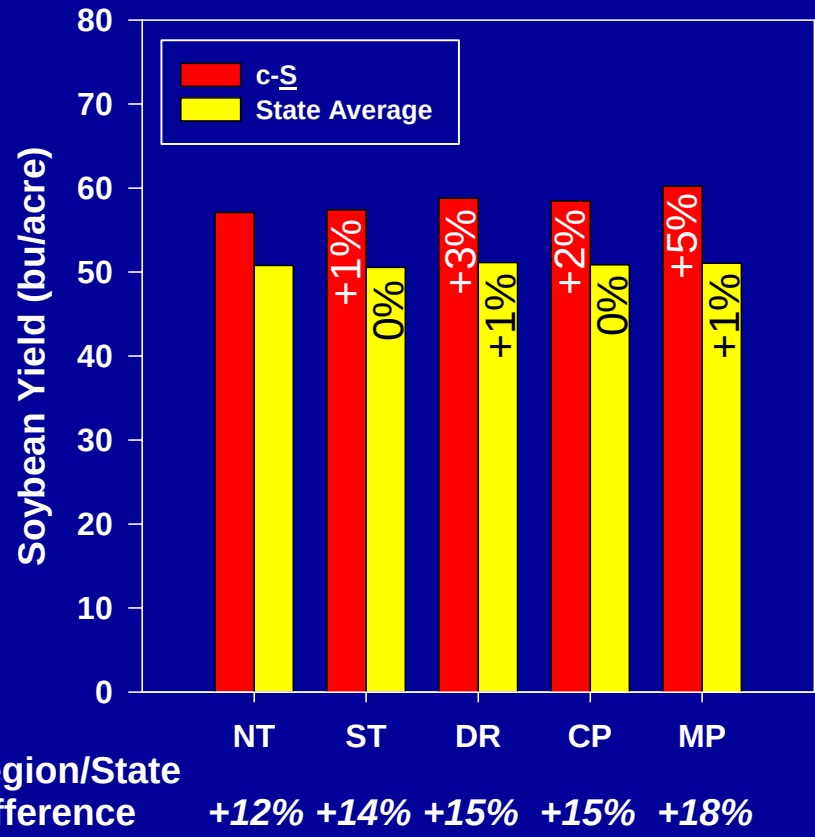


- ST and NT yielded 4-10% < systems
- ST 2nd-yr corn 10% over NT
- s-C over yielded s-C-C with all systems
- No tillage effect on soybean yield

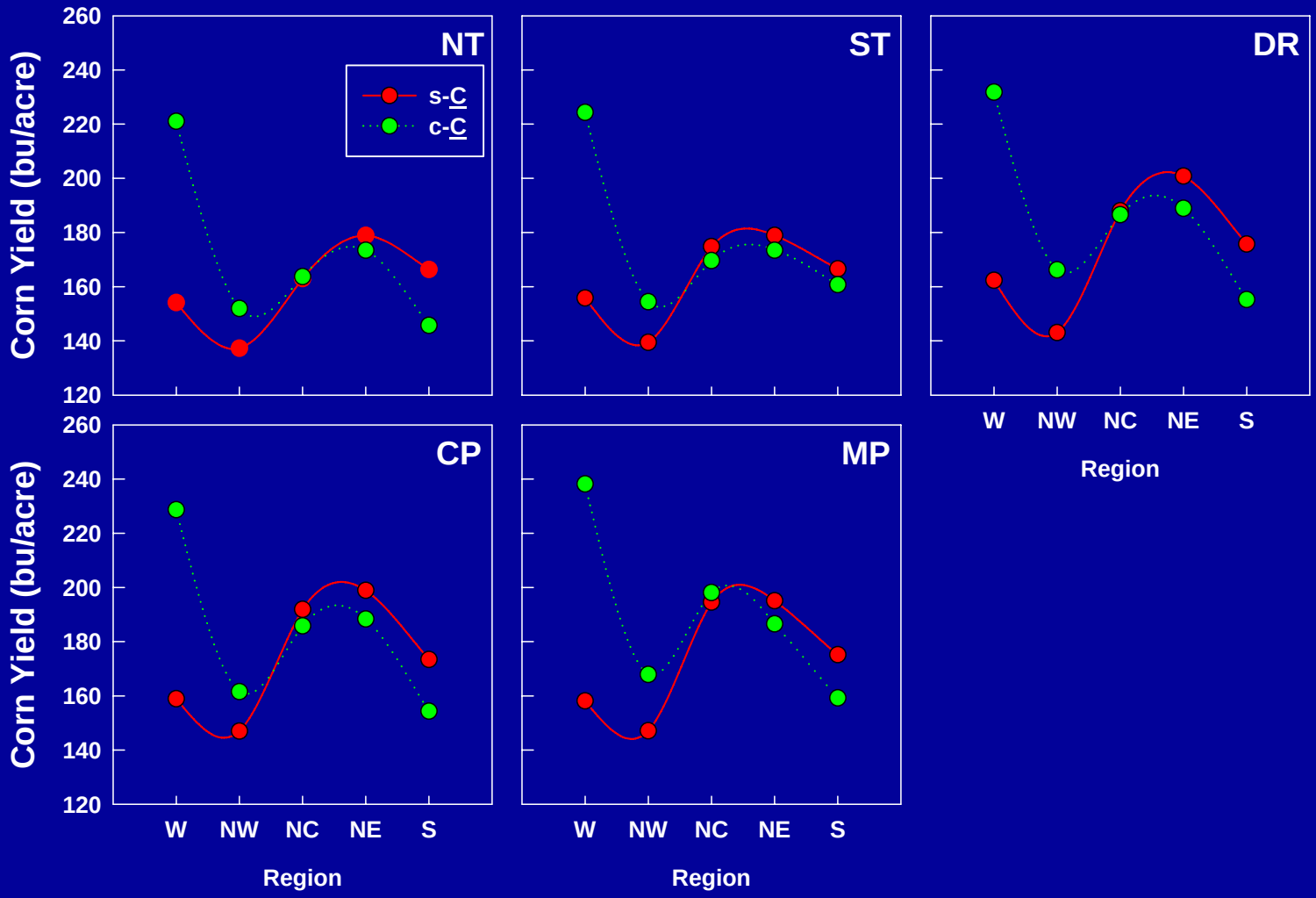


Yield Response: Southern Region, Crawfordsville & Chariton, IA





Regional Tillage Differences



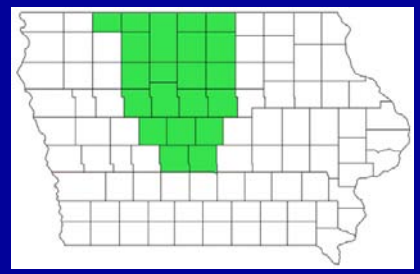
Tillage and Management Cost Inputs ($/acre)

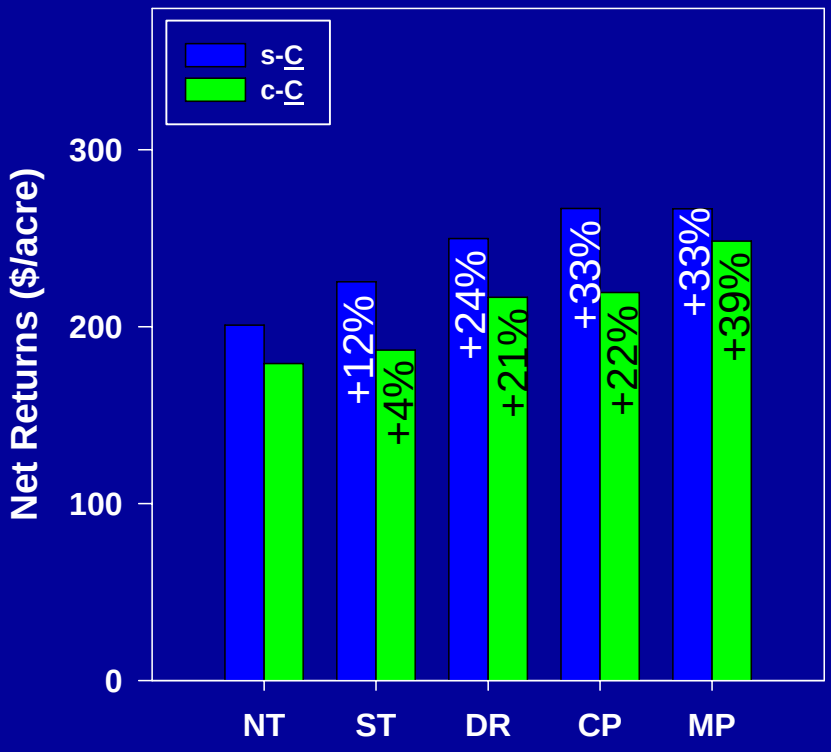
	Corn after Soybean	Corn after Corn	Soybean after Corn
No-tillage	$288	$312	$147
Strip-tillage	$299	$322	$157
Deep rip	$314	$343	$173
Chisel plow	$309	$338	$168
Moldboard plow	$317	$346	$177

- Cost inputs accounts for machinery costs, labor, seed, nutrients, chemicals, and insurance. Cost inputs does not include land rental ($155 cash rent equivalent).
- Labor was figured at $9.50/hr, nutrients are based on crop removal rates, and insecticides were accounted for in corn after corn.
- Herbicide tolerant soybeans were used in cost inputs considerations.
- Cost inputs based from ISU Extension publication FM 1712 and Ag Decision Maker file A1-20.

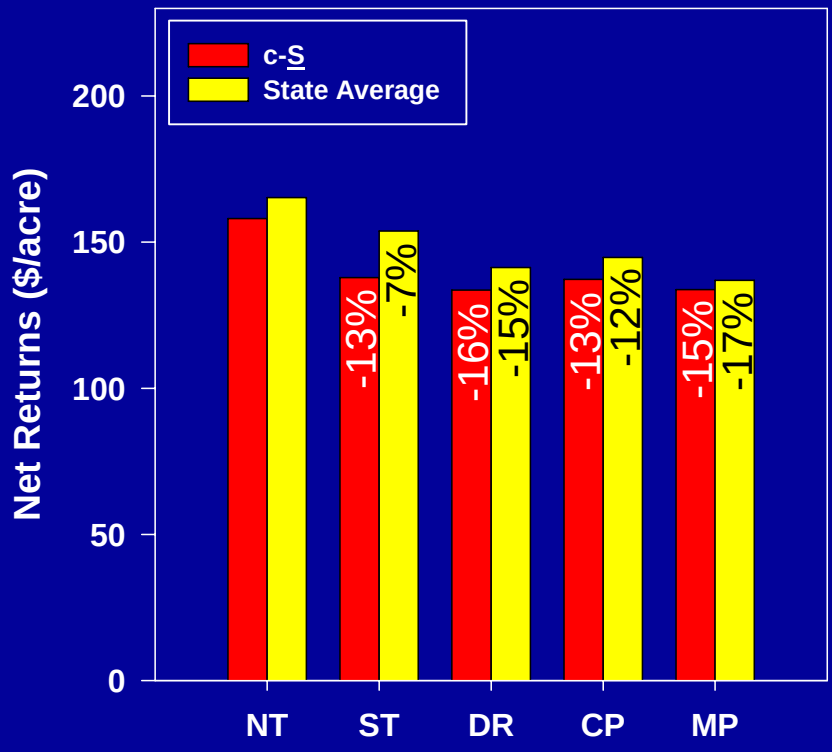
Economic Returns: North Central Region, Ames & Kanawha, IA

- Highest returns for corn with tillage
- NT Soybean returns 13-16% higher
- Soybean returns between DR, CP, MP





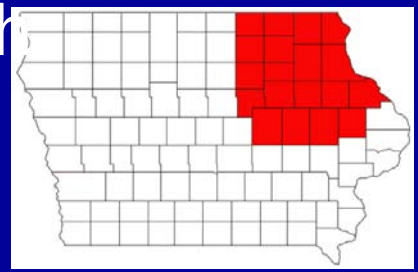
Rotation Difference: *+12% +21% +15% +22% +7%*



Region/State Average Difference: *-4% -10% -6% -6% -2%*

Net returns are based on $3.00/bushel corn and $6.15/bushel soybean prices and previously mentioned cost inputs.

- ST net return 18% over NT s-C and 3% with 2nd-yr corn.

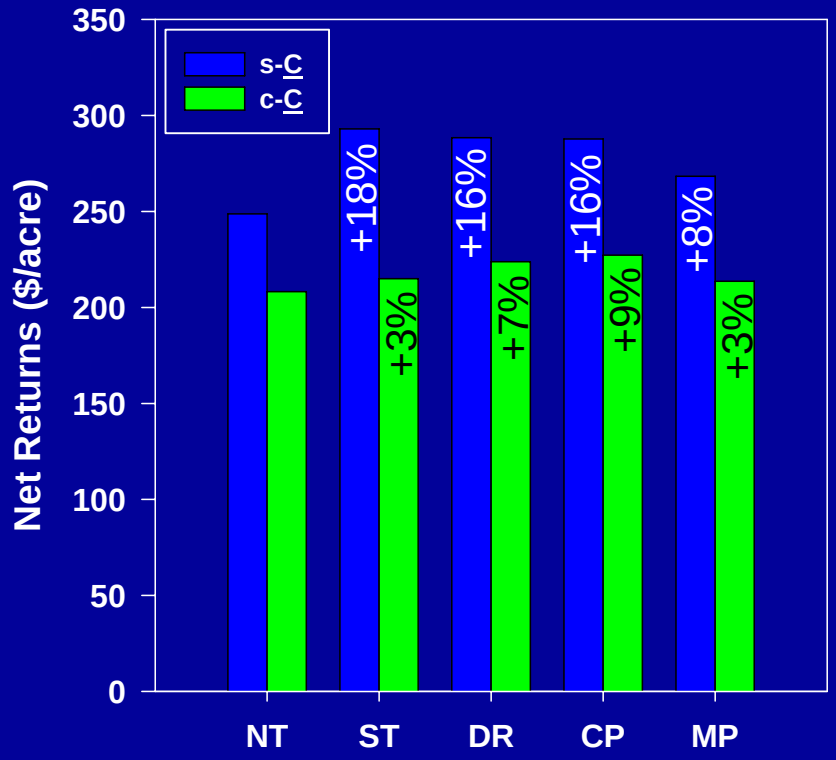


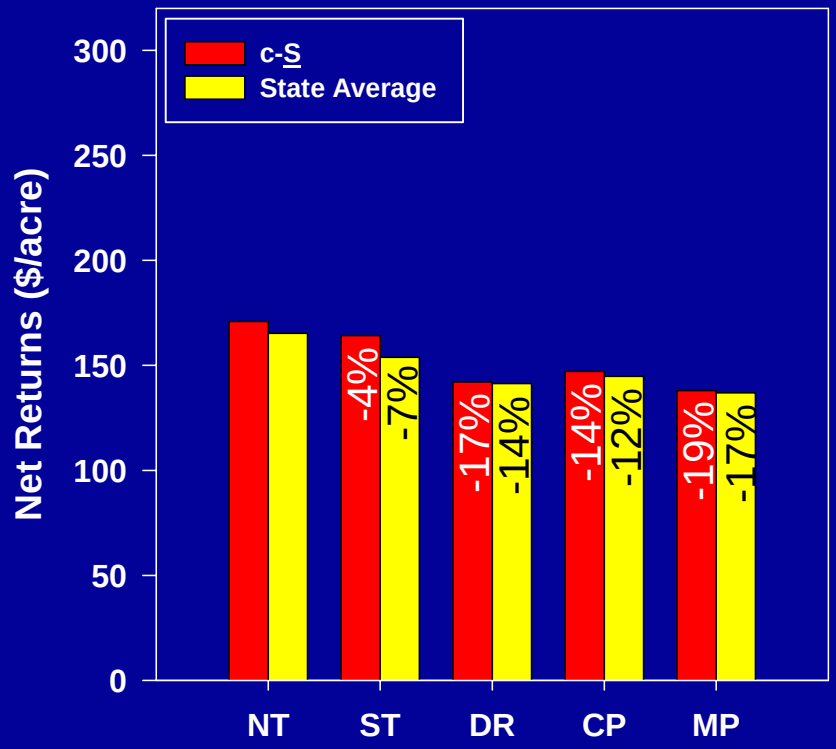
Economic Returns:

- s-C net return 20-27% over 2nd-yr corn.

Northeastern Region, Nashua, IA

- Soybean – Highest returns occurred in ST& NT



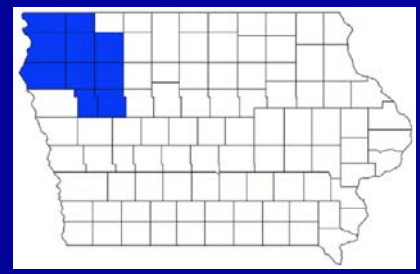


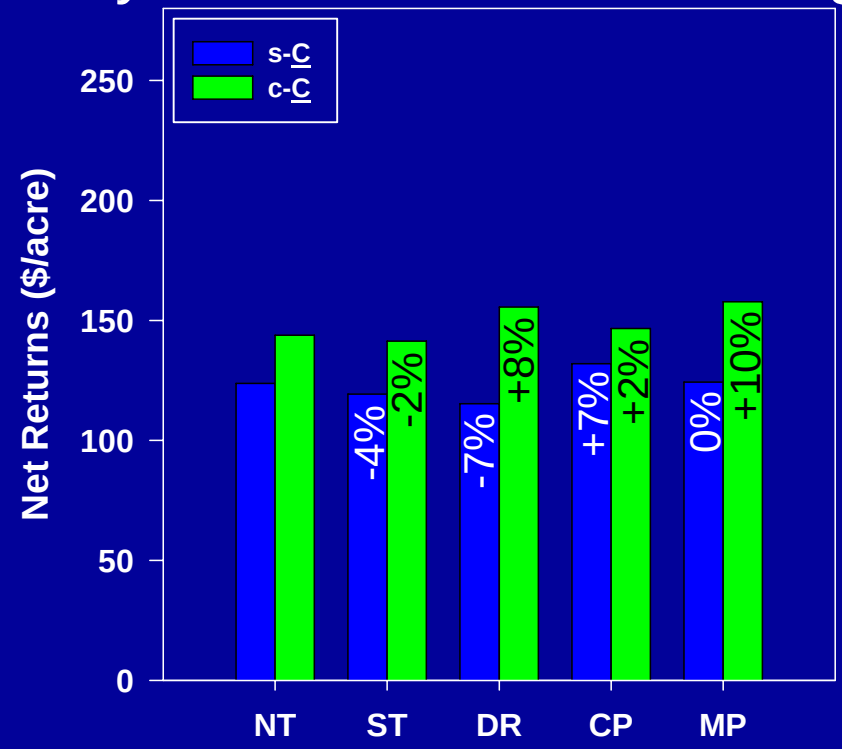
	NT	ST	DR	CP	MP
Rotation Difference	*+20%*	*+26%*	*+29%*	*+27%*	*+26%*
Region/State Difference	*+3%*	*+7%*	*+1%*	*+2%*	*+9%*

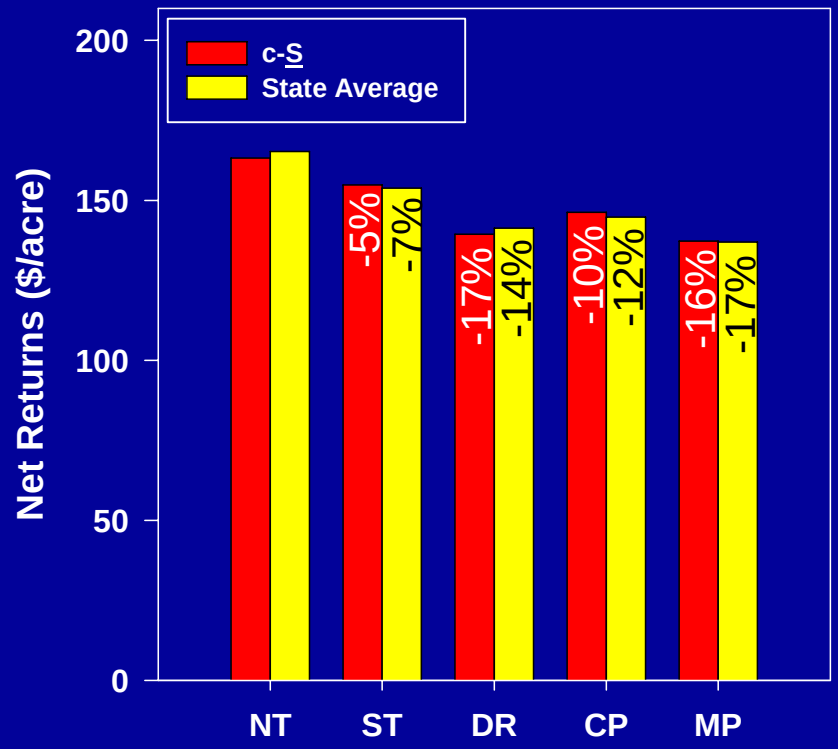
Net returns are based on $3.00/bushel corn and $6.15/bushel soybean prices and previously mentioned cost inputs.

Economic Returns: Northwestern Region, Sutherland, IA

- ST and NT returns 5-10% less with 2nd-yr corn. NS differences with s-C.
- 10-26% higher returns with 2nd-yr corn in all systems.
- Soybean - NT had 5-17% higher returns







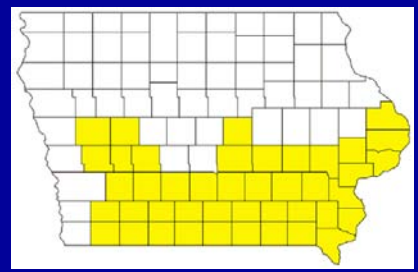
Rotation Difference	-14%	-16%	-26%	-10%	-21%

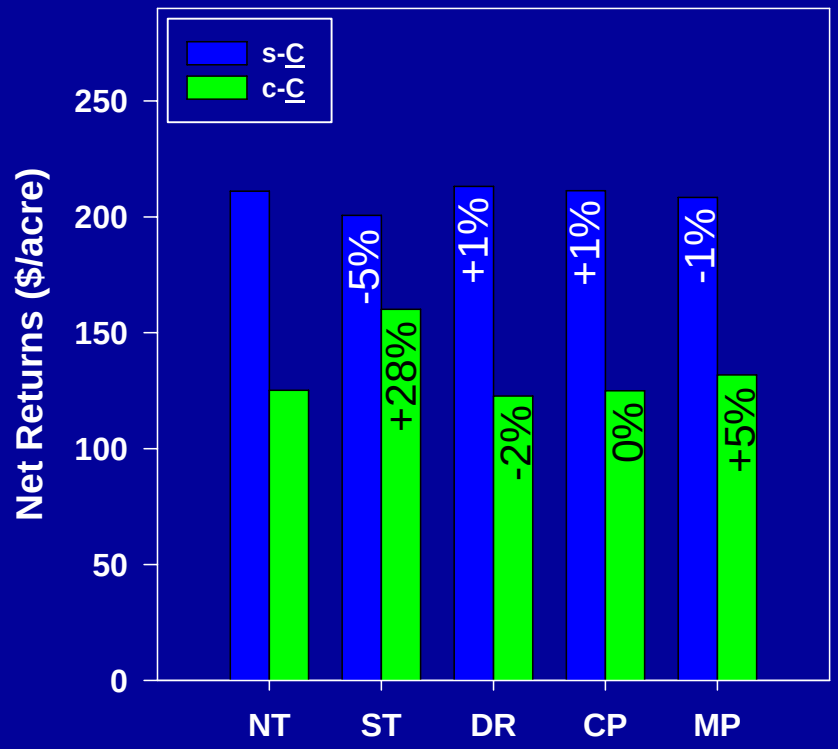
Region/State Difference	-1%	+1%	-1%	+1%	+2%

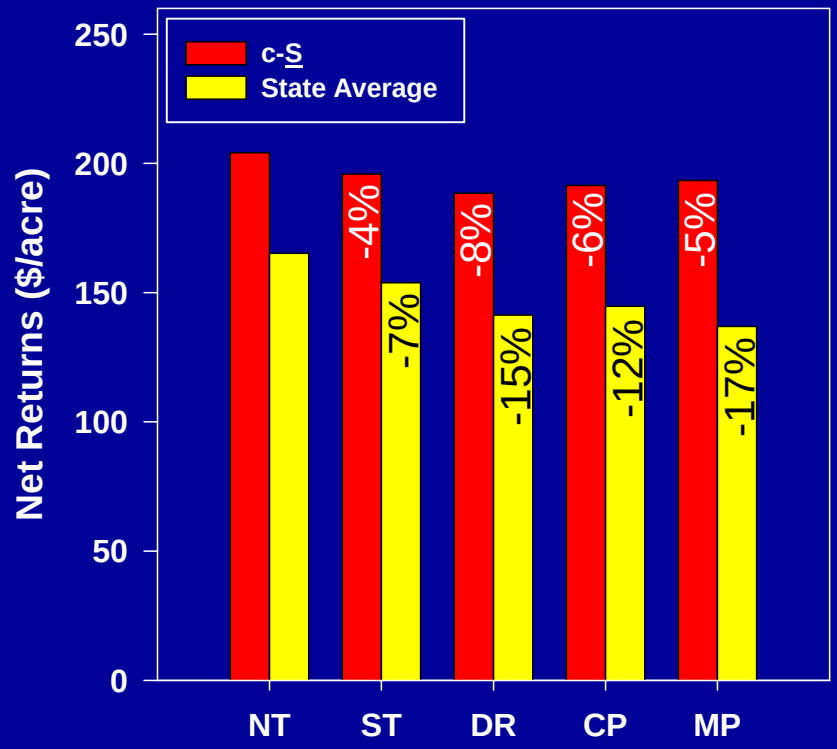
Net returns are based on $3.00/bushel corn and $6.15/bushel soybean prices and previously mentioned cost inputs.

Economic Returns: Southern Region, Crawfordsville & Chariton, IA

- Net return for s-C is the same for all systems
- ST 2nd-yr corn was 28% over all systems
- s-C 25-74% higher net return over 2nd-yr corn
- Soybean – NT had 4-17% higher returns







	NT	ST	DR	CP	MP
Rotation Difference	*+69%*	*+25%*	*+74%*	*+69%*	*+58%*
Region/State Difference	*+24%*	*+27%*	*+33%*	*+32%*	*+41%*

Net returns are based on $3.00/bushel corn and $6.15/bushel soybean prices and previously mentioned cost inputs.

Strip-tillage Benefits

- Phosphorus (P)
  - held tightly to soil particles, little in solution
  - roots must explore soil volume to take up P
  - cold soil, high pH soils limit availability
- Potassium (K)
  - more available in soil solution
  - cold soils limit root growth and uptake
- Strip-tillage (deep banding) provides P and K in concentrated band for early season uptake

Strip-tillage Benefits

- Soil Temperature
  - Enhances soil warming and drying in the spring ahead of corn planting.
  - Elevated residue-free strip warms quickly as high as conventional tillage at planting.
- Allows for no-till corn planting without yield loss
- Soil Borne Diseases
  - pythium thrives in 40 degree soils, kills plants, reducing stands
  - because of warmer soil temperature in the strip, little to no seedling blights occur

Strip-tillage Disadvantage

- Pulling heavy load when applying fertilizer.
- Weight and rolling resistance of the tank and dry fertilizer.
- Needs high horsepower tractor due to the depth of tillage 20-30 hp per knife is needed.
- Special Guidance equipment on the planter.

Challenges For Strip-tillage Adoption

- Farmer
  - Time demands of harvest operations may prevent getting strips in on timely basis
  - Added expense of nitrogen stabilizer if applied after soybean harvest and soils are still warm
  - Needs high horsepower tractor
  - Needs labor source to run strip-till unit
  - Has to trust someone else to put the strips in properly (i.e. placing next year's rows)