No-Till, Short- and Long-Run Economics

Cover Your Acres Winter Conference
The Gateway, Oberlin, Kansas
February 2, 2006

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No-till (NT) is a technology to consider

Potential benefits . . .

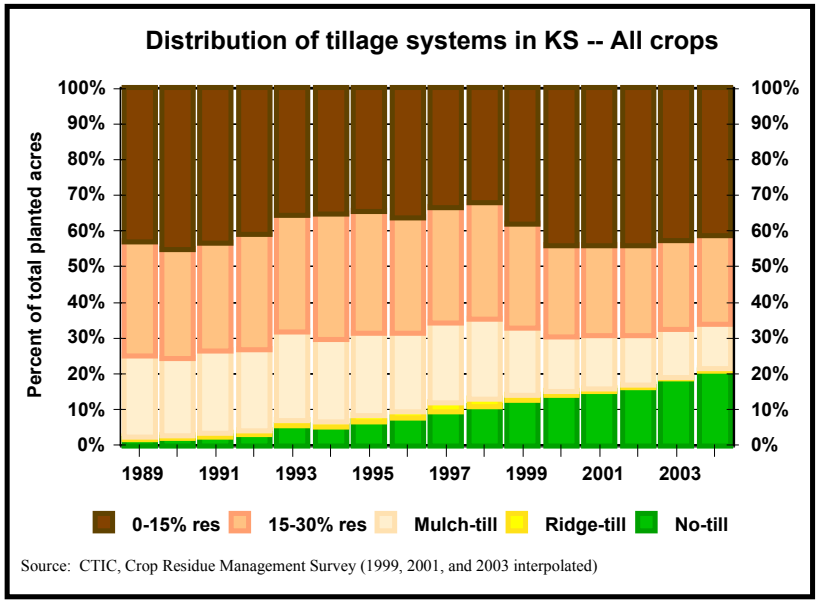
- Machinery cost savings
  - Reduces fuel and labor requirements
- Allows farm expansion
  - Dilutes fixed costs (spread over more land)
- May improve timing
  - Reduces land preparation time
  - Can increase cropping intensity
- Related to water savings
  - Can increase cropping intensity
  - Increases crop yields

Speed of technology adoption depends on

- Size of the expected profit
- Confidence in the outcome
- Investment amount required
- Keep in mind . . .
  - Late adopters adopt for survival
  - Early adopters adopt for profit
  - Speed of adoption is important only relative to your neighbors

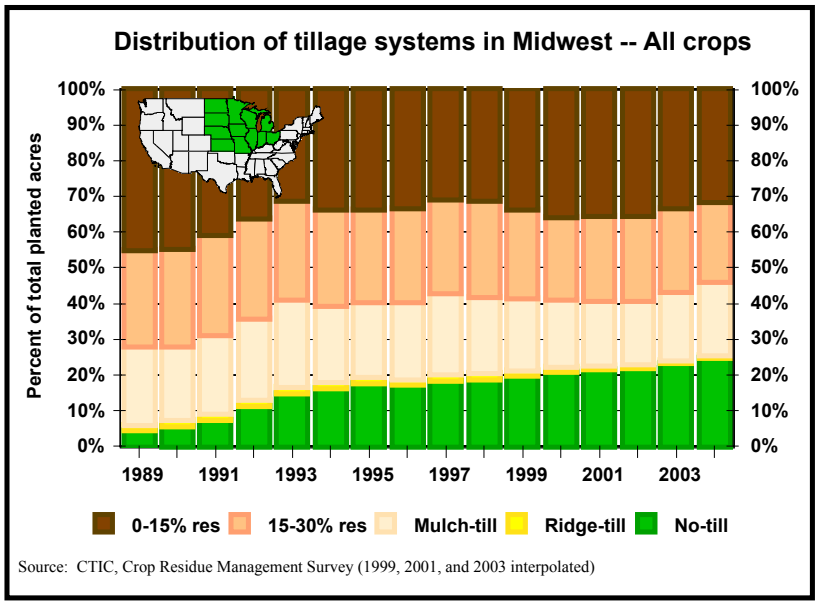
Is NT black and white?

- NT is not black and white
  - Moisture savings come from reducing tillage
  - May use NT on one crop and not another in a rotation
- But, years of soil change can be harmed with one year of tillage
- Adopting NT happens in stages for many
  - Later adopters can skip certain stages
  - But can't "skip" time it takes for soil improvement



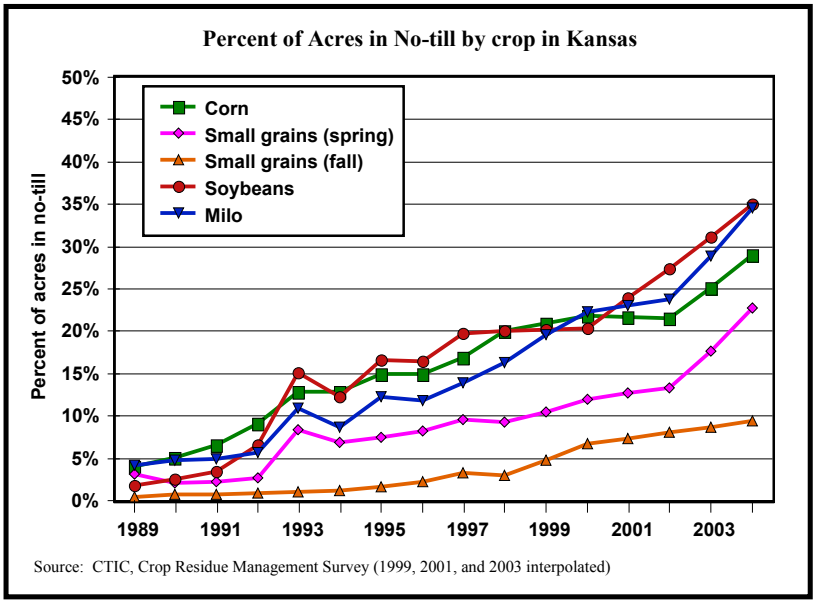
Source: CTIC, Crop Residue Management Survey (1999, 2001, and 2003 interpolated)

Most growth in no-till has come at expense of mulch-till



Source: CTIC, Crop Residue Management Survey (1999, 2001, and 2003 interpolated)

Midwest covers much of Corn Belt (much wetter climate)



Source: CTIC, Crop Residue Management Survey (1999, 2001, and 2003 interpolated)

Crops that grow in summer likely respond better to no-till

Possible reasons for switching to reduced or no-till ...

- ✓ **Increase profitability**
- ✓ **Reduce labor requirements**
- ✓ **Reduce machinery cost/acre**
- ✓ **Increase acres farmed**
- ✓ **Reduce moisture stress/increase yield**
- ✓ **Conservation compliance/soil erosion**
- ✓ **Other (e.g., wildlife, carbon sequestration)**

Profitability ...

Revenue (yield x price)

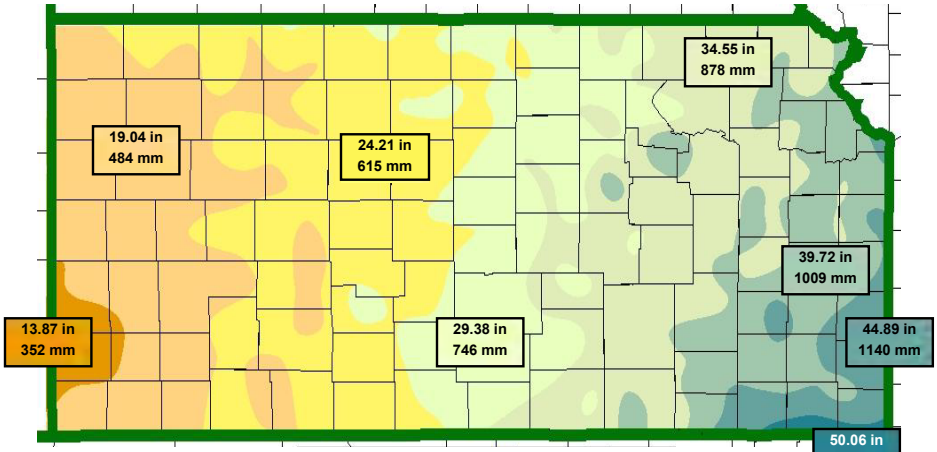
\- Cost (variable and fixed)

Profit or net returns

Tillage won't impact price, thus profitability will depend on how yields and costs are affected by reducing tillage.

Effect of no-till on *YIELDS*

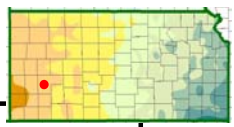
Kansas Annual Precipitation, 1971-2000

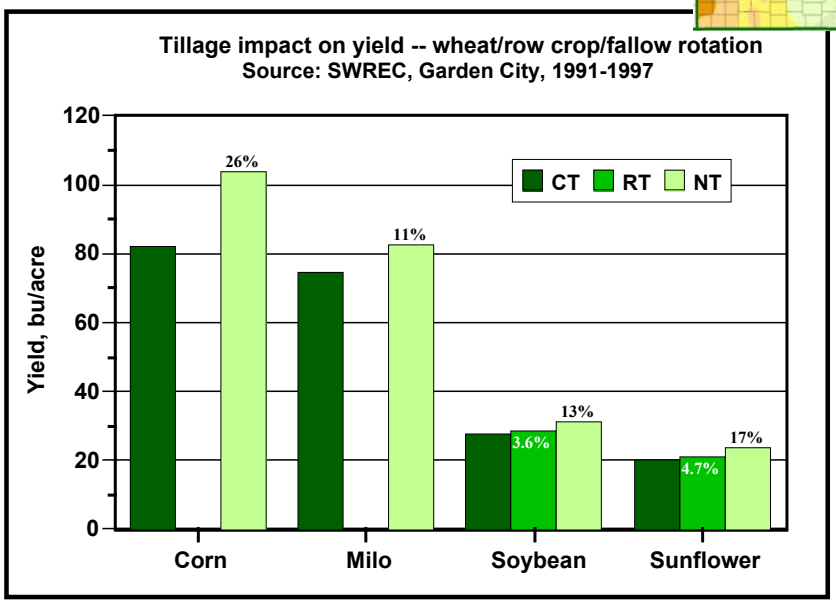


Source: K-State Weather Data Library -- www.oznet.ksu.edu/wdl

K-State research data

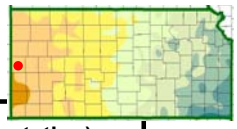
(19.0 in annual precipitation region)

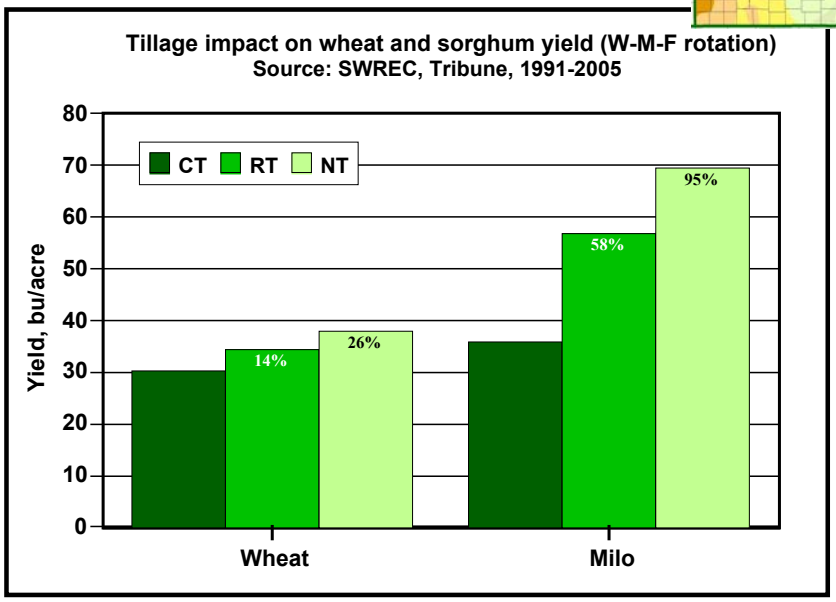




K-State research data

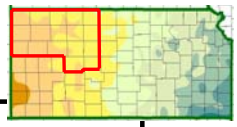
(19.0 in annual precipitation region)

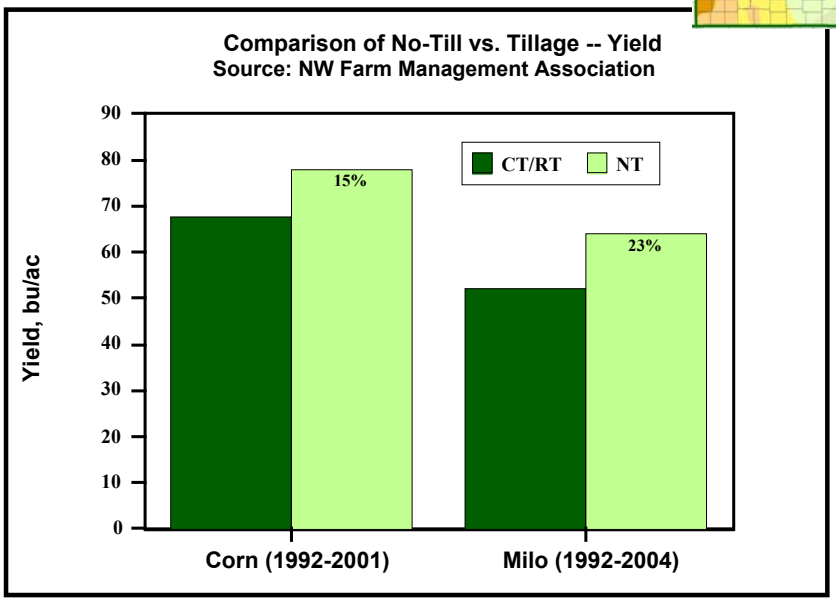




Farm-level data

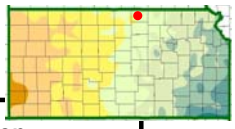
(19.0-24.2 in annual precipitation region)

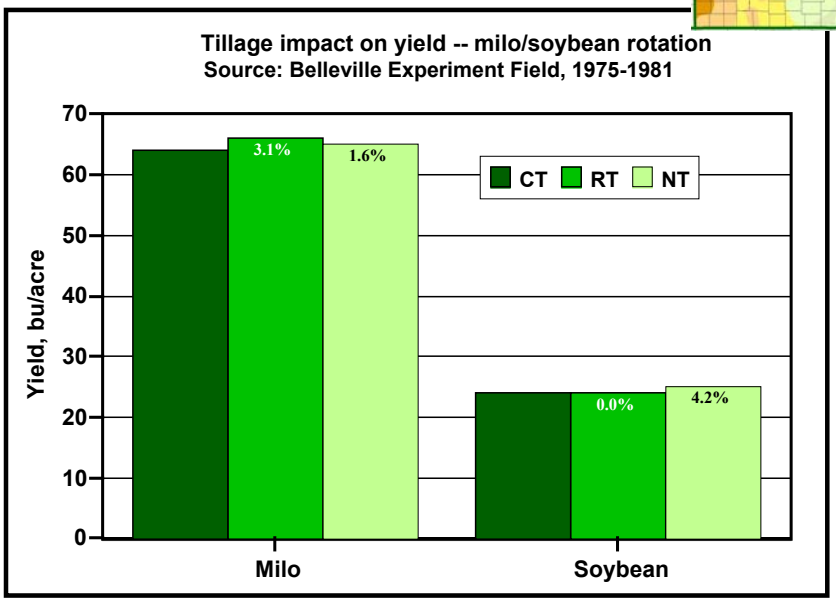




K-State research data

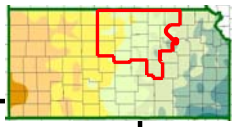
(29.4 in annual precipitation region)

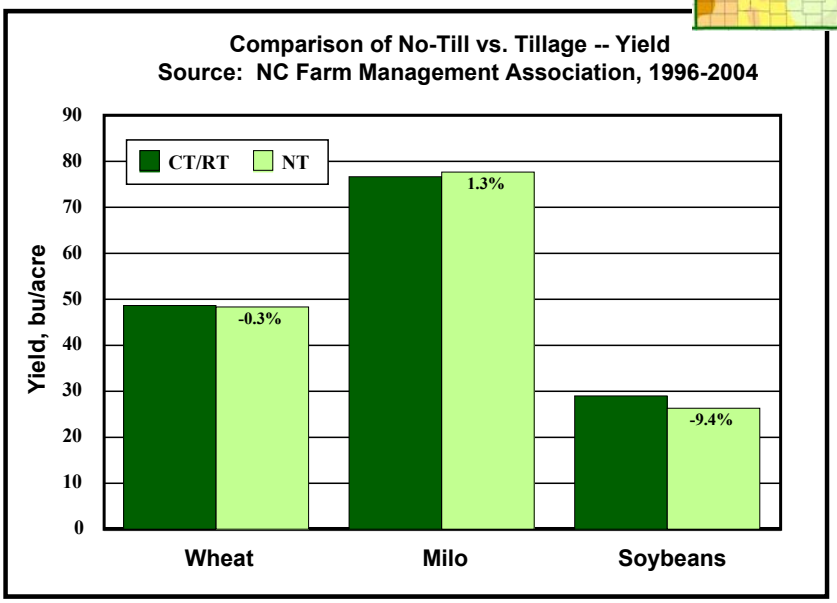




Farm-level data

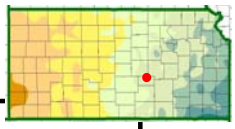
(24.2-34.6 in annual precipitation region)

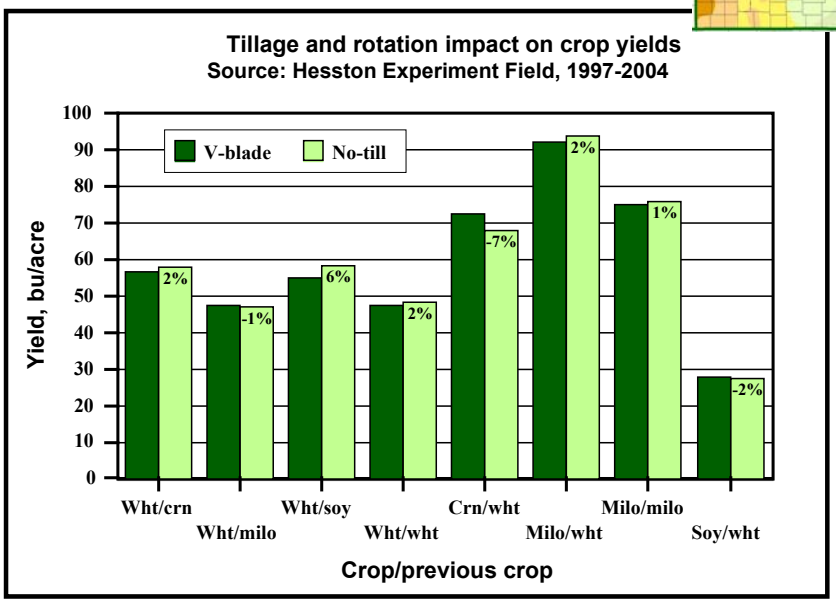




K-State research data

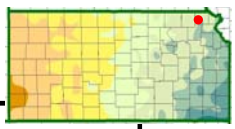
(29.4-34.6 in annual precipitation region)

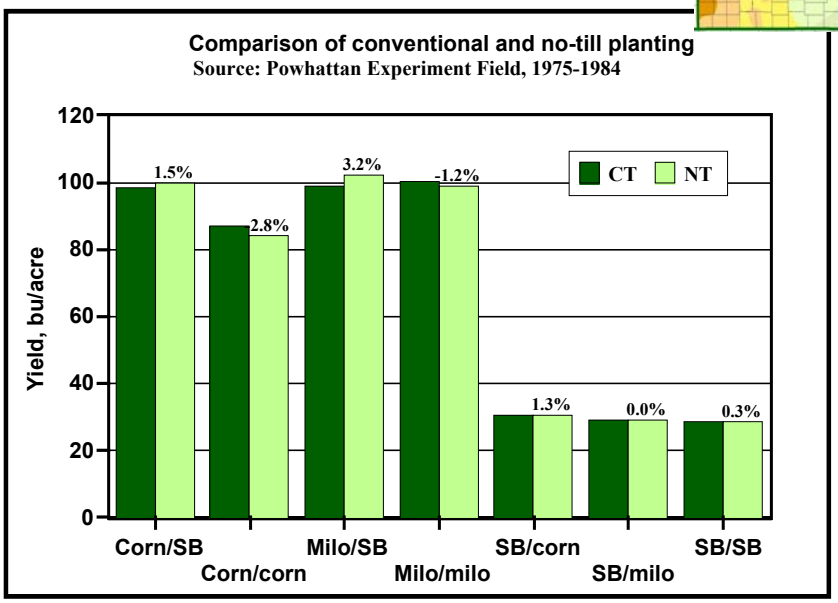




K-State research data

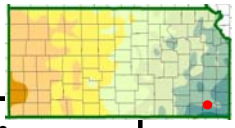
(34.6 in annual precipitation region)

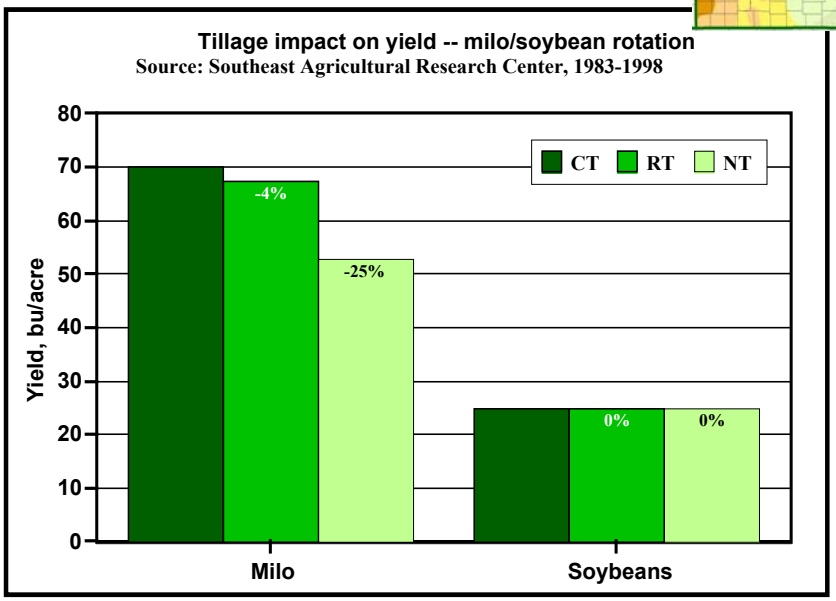




K-State research data

(44.9-50.1 in annual precipitation region)





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Effect of tillage on yields?

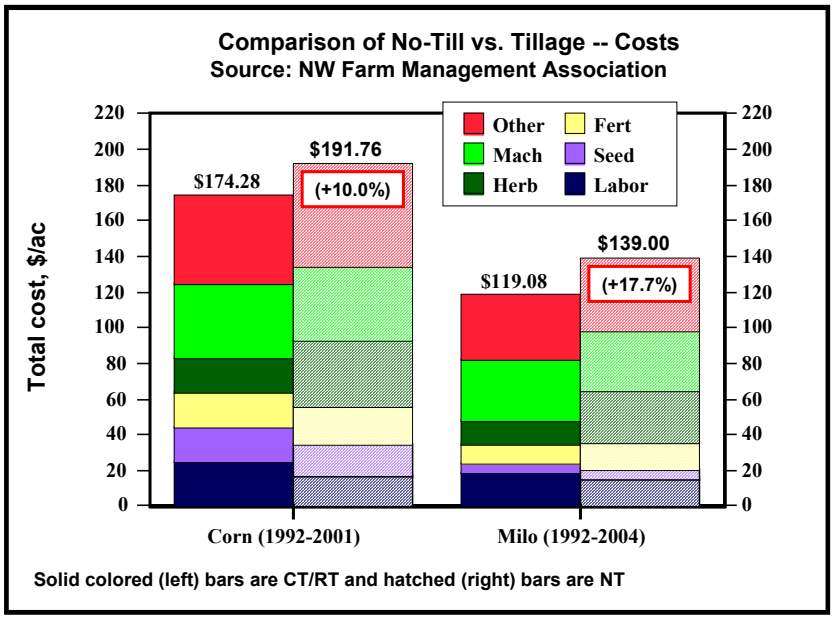
Research in central and eastern Kansas generally has shown little yield difference between tillage systems for wheat, milo, soybeans, and corn => NT cost driven.

Research in western Kansas has shown that yields increase as tillage is reduced, especially for summer crops such as corn and milo => NT revenue driven.

Effect of no-till on *COSTS*

- **Projected/simulated budgets**
- **Actual farm-level data**

Actual farm-level data



Higher yields allow adoption of this more costly technology

Actual farm-level data

No-Till cost study - NC Farm Management Association, 1996-2004

	$/land acre		$/harvested acre	
EXPENSE ITEM, $/acre	CT/RT	NT	CT/RT	NT
Direct input (seed, fert, chem, etc)	$41.26	$55.41	$42.04	$53.37
Machinery cost	$39.44	$35.60	$40.24	$34.27
Labor	$28.35	$24.42	$28.95	$23.50
Total asset charge	$38.59	$38.03	$39.38	$36.63
Building and conservation	$2.99	$2.09	$3.06	$2.01
Other	$11.94	$9.09	$12.18	$8.75
Total expense	$162.58	$164.63	$165.84	$158.53
Total acres	938	1,212	908	1,256
Harvested acres/land acres	xxxxx	xxxxx	96.8%	103.6%

NT farms are cropping more intensively

Effect of no-till on costs

- Central and eastern KS data indicate slight decrease to little change in total costs if acreage is held constant. Western KS data suggest costs increase with NT compared to CT.
- Changes cost "structure" --- i.e., herbicide is substituted for tillage-related expenses.
- Fixed costs (land, machinery, management, etc.) will depend on acreage and thus will vary between producers.

Profitability ...

Revenue (yield x price)

- Cost (variable and fixed)

Profit or net returns

Western Kansas – higher yields and higher costs

Central / eastern Kansas – similar yields & costs

Profitability complicating factors:

- **Cropping intensity**
- **Farm size**
- **Tillage x rotation interaction**

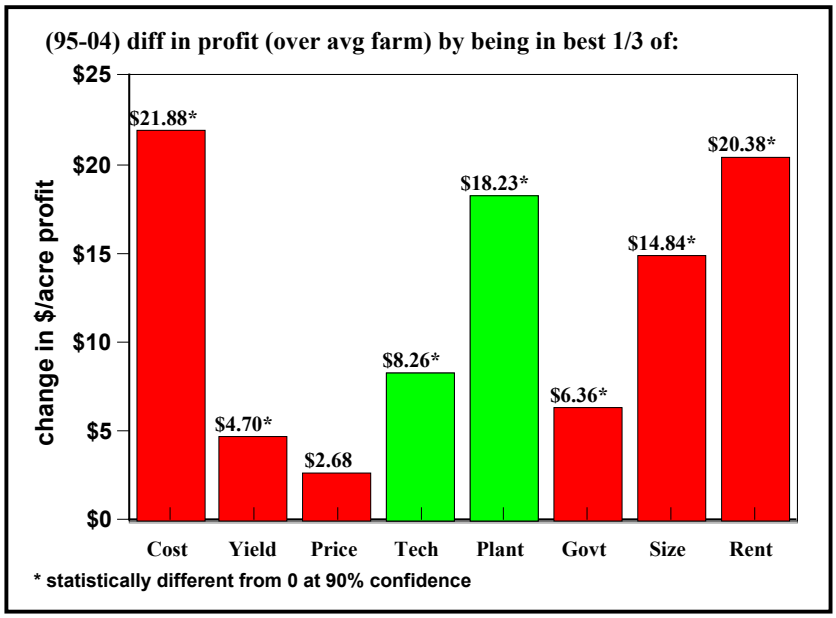
NT adoption is increasing, suggesting profitability

Economic analysis using Kansas Farm Management data

- **Which management factors impact profitability?**
- **10 years of data (1995-04)**
- **Approximately 900 farms**
- **Analysis focuses on crop producers**

Kansas Farm Management Association
Helping You Put Knowledge To Work

Factors affecting profits …



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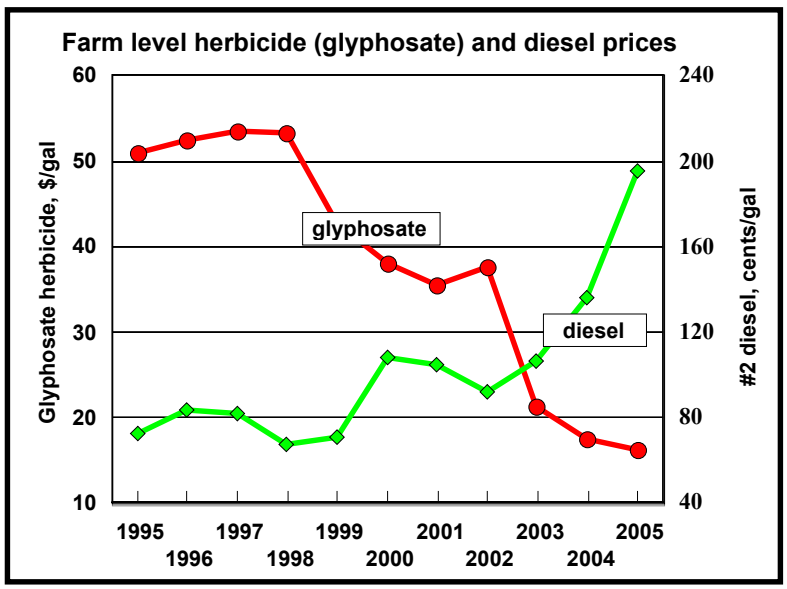

Trends favor herbicides over tillage – increase speed of adoption?

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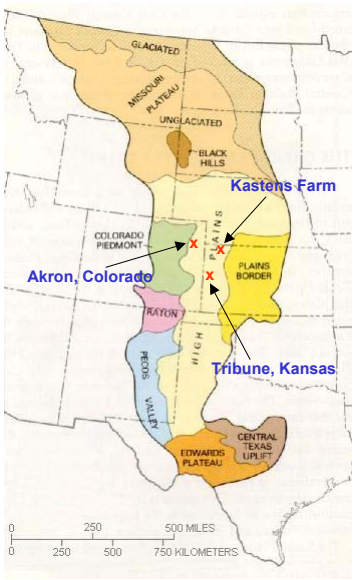
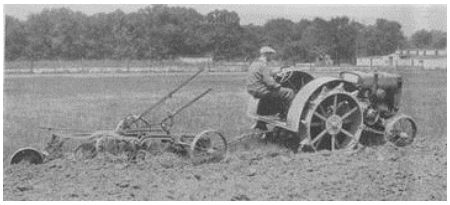
High Plains region of the U.S.



History of High Plains

- Land broke in late 1800s early 1900s
  - Continuous-cropped with wheat, corn, oats
  - Depended on the moldboard plow
- Summerfallow started in 1930s – WF
  - 14-15 months fallow before wheat planting
    - Fallow period includes summer months
  - One-way (1930s-1950s); sweep (1960s-1990s)
  - Water storage increased yields
  - N mineralization exploited organic matter
  - But inefficient water storage (25%)
  - Eventually depleted soils

Moldboard plow (pre-1930)



One-way disk plow (1930-1960)

Undercutter, sweep, v-blade (1960-2000)

Sprayer (2000+)

History of High Plains

- **WMF or WCF started in 1980s-1990s**
  - Sweeps saved soil & water
  - 10 months fallow before milo or corn
  - 11 months fallow before wheat
  - NT ahead of milo or corn crop; CT on wheat
- **In 2000s began to see NT ahead of wheat**
  - Just starting to be adopted today

WF (42 months out of 72 fallow)

Wheat (Sep-Jun)	Fallow (Jul-Aug)	Wheat (Sep-Jun)	Fallow (Jul-Aug)	Wheat (Sep-Jun)	Fallow (Jul-Aug)

WCF (42 months out of 72 fallow)

Wheat (Sep-Jun)	Fallow (Jul-Apr)	Corn (May-Sep)	Fallow (Oct-Aug)	Wheat (Sep-Jun)	Fallow (Jul-Apr)	Corn (May-Sep)	Fallow (Oct-Aug)

Water drives NT in the High Plains

- Water in soil at planting often as important as rainfall during growing season
- Questions are now emerging:
  - Tillage or chemicals during fallow period before wheat (referred to as chem-fallow)?
  - Intensify cropping beyond 2 crops in 3 years?
  - Follow a rotation or change crops based on available soil water at planting?

Continuous-crop long-term NT questions

- How fast does SOM build over time?
  - How deep in the soil are changes observed?
  - Why should I care about SOM?
- Does soil structure change?
- Many crops in rotation or few?
- Will NT rotations in one area work in other areas?
- Do soil changes impact yields, input costs, or profits?

Changes with continued NT

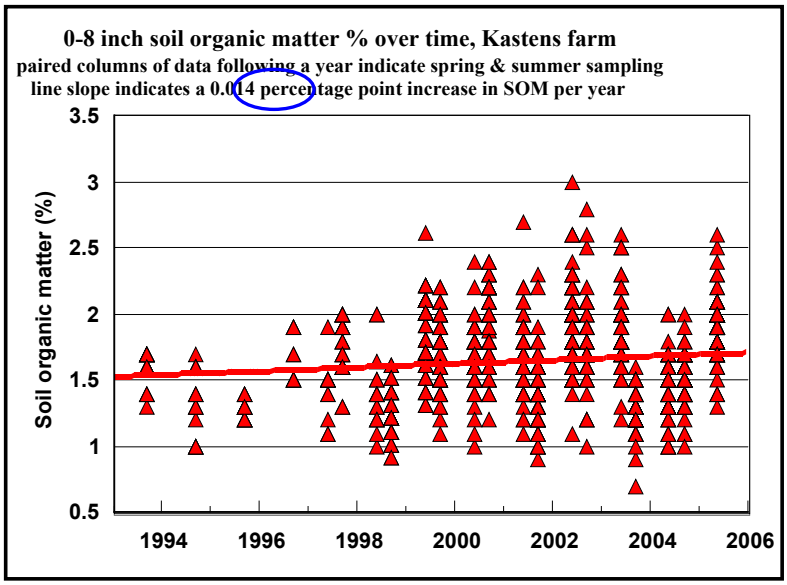
- Fast changes
  - Surface crop residue: improves water infiltration and reduces evaporation
  - Wheat stubble height especially important
- Medium changes
  - Soil structure (pore size) and strength:
    - Holds more water and water travels through faster
    - Surface doesn't seal off as fast during a rainstorm
    - Can support wheel traffic better
- Slow changes
  - SOM:
    - Indicator of positive change
    - Provider of mineralized crop nutrients (N & P)
    - Improves P solubility and availability

Residue: changes near the soil surface

- Get more rain in the soil and keep it there for plants
  - Crop residue improves water infiltration
  - Crop residue reduces evaporation
  - High wheat stubble better than short stubble, especially in low yielding situations
    - Akron field trial:
      - 4 inch stubble: evaporation is 80%
      - 12 inch stubble: evaporation is 50%
      - 20 inch stubble: evaporation is 38%
    - Tribune field trial (2001-2004):
      - Leaving about 13 inches rather than 6.5 inches resulted in 8.2 bu/acre increased yield for the following corn or milo crop

Organic matter: indicator of improvement

- NT induces very slow changes over time
  - Canada (0-15 cm deep):
    - Typical NT rotation, 0.02 percentage points/year
    - If continuous-cropped, perhaps 0.05 points/year
  - Colorado (0-20 cm deep):
    - If <100% cropping intensity then 0.009 points/year
    - If 100% cropping intensity then 0.017 points/year
  - Argentina, 36 in. rain; 4% SOM (0-15 cm):
    - 0.07 percentage points/year
  - Kastens Farm (0-20 cm deep):
    - 60% of crops following NT; 40% following CT
    - Cropping intensity went from 60% to 77% during period
    - 0.014 percentage points/year



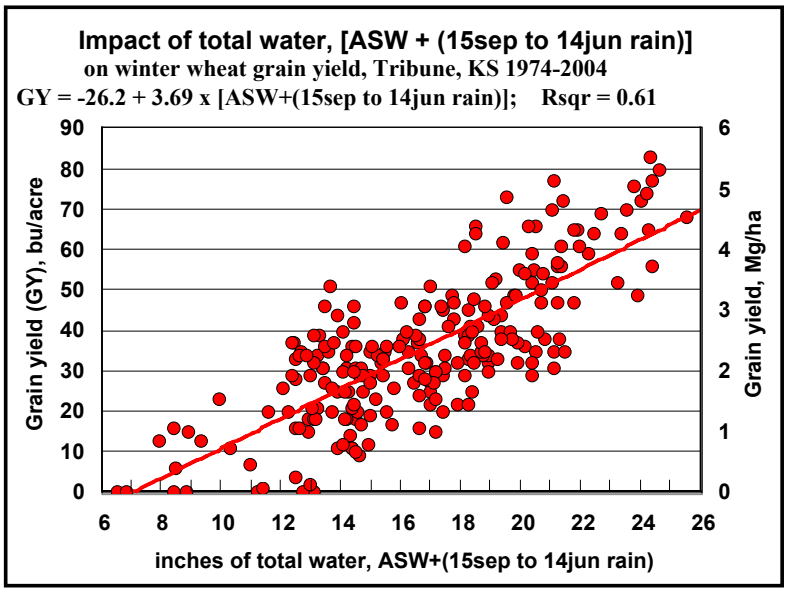
At this rate would take 70 years to build SOM by 1 percentage point!
And, that is at only the 0-8 inch (20 cm) depth.

NT-caused long-term changes in soils

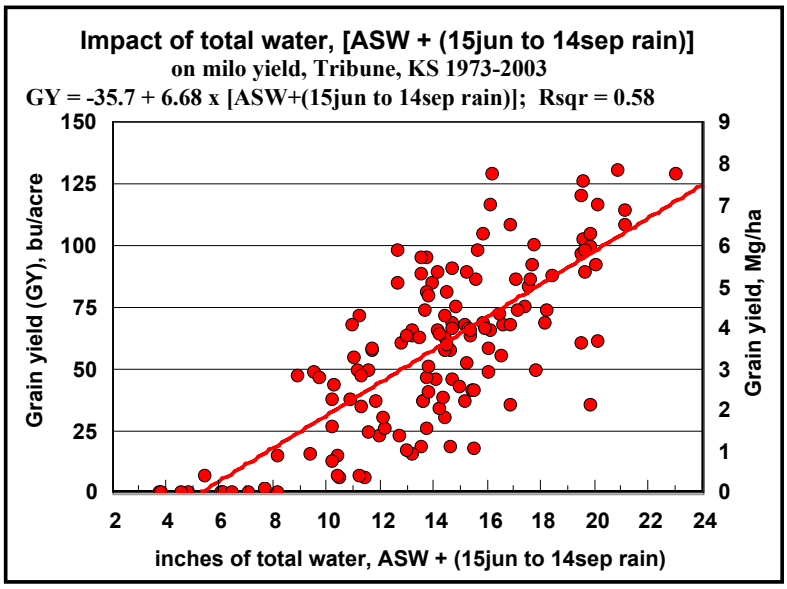
- Changes will NOT be deep in soil
  - Increased capacity of water storage not large
- Slow changes in SOM over time
  - Savings in fertilizer due to mineralization will eventually matter, but not for a long time and not as important as water savings
- But, small changes near the soil surface can be especially important in drier areas
  - It's all about getting more water in soil and retaining it
  - More water will be observed in NT soils than in CT soils, even through whole rooting zone

Tribune Kansas Research from Alan Schlegel's work

- Over 31 years (1974-2004), differences in available soil water (ASW) & rainfall explain:
  - 61% of differences in wheat yield
  - 58% of differences in milo yield
- A 15-year (1991-2005) wheat-milo-fallow (WMF) study compared CT to RT to NT for:
  - available soil water (ASW)
  - grain yields
  - water use efficiency (WUE)



61% of variation in wheat yields explained by ASW & rainfall

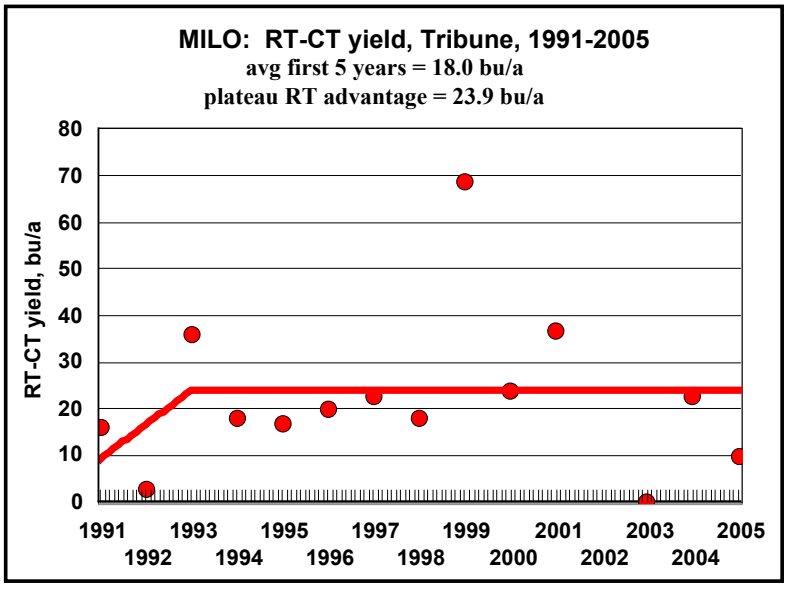


58% of variation in milo yields explained by ASW & rainfall

Tribune Kansas WMF rotation (NT vs. CT)

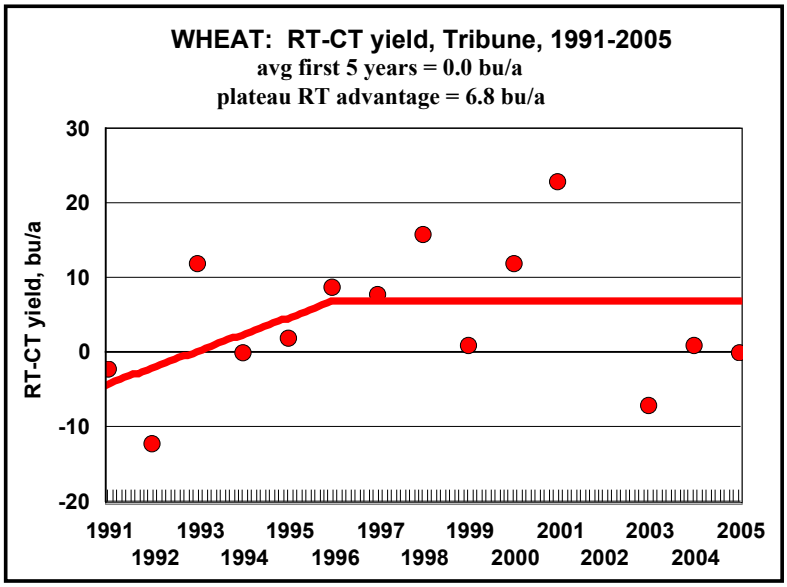
- **Wheat**
  - NT has 18% more ASW at planting
  - NT has 26% higher grain yields
  - NT has 23% higher WUE
  - NT ASW grows at 0.16 in. per year
  - NT WUE grows at 1.36 lb/in. per year
  - NT yield might grow 1 bu/acre per year
    - Using model of water on yield and growth in ASW and WUE
- **Milo**
  - NT has 28% more ASW at planting
  - NT has 95% higher grain yields
  - NT has 101% higher WUE
  - NT ASW grows at 0.09 in. per year
  - NT WUE grows at 10.15 lb/in. per year
  - NT yield might grow 3 bu/acre per year
    - Using model of water on yield and growth in ASW and WUE

RT is CT ahead of wheat and NT ahead of milo (milo goes to NT)



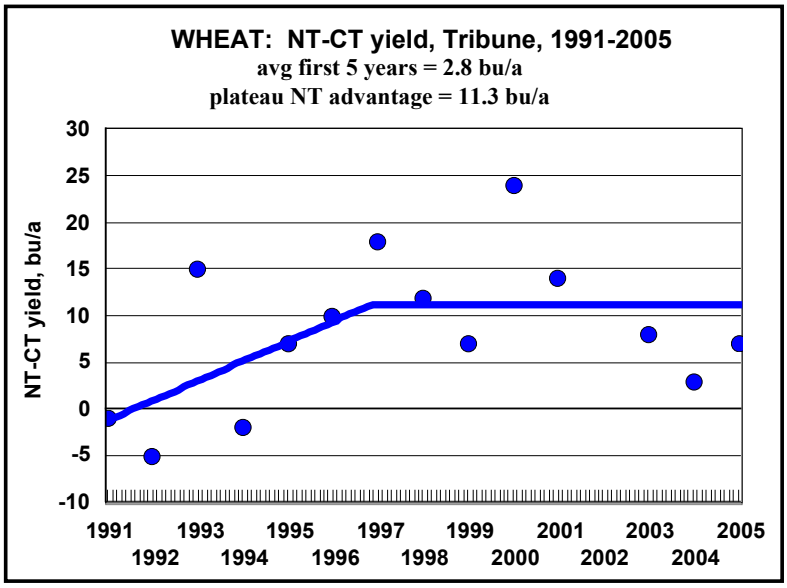
Don't need patience (immediate gains from NT on milo)

RT is CT ahead of wheat and NT ahead of milo (no change in wheat tillage)



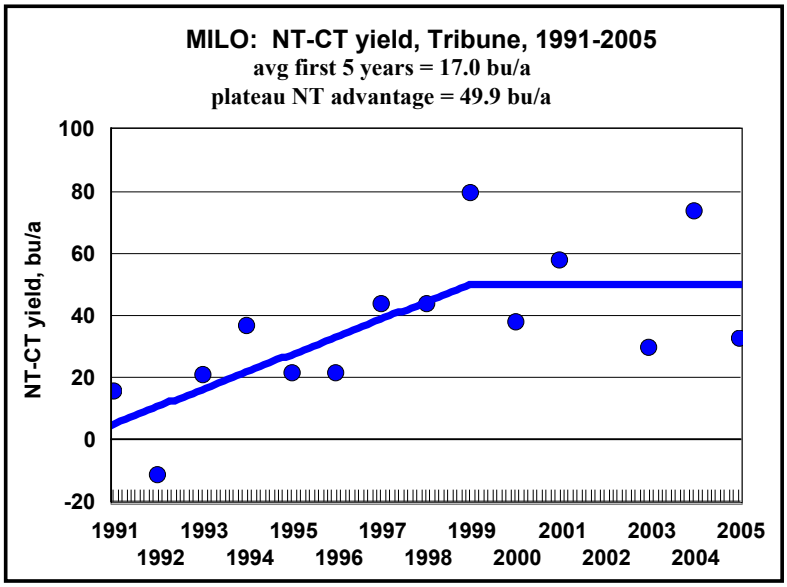
Must have a little patience here on the wheat leg (really, accidental)

NT here means chem-fallow ahead of wheat



This is the "hard" part (hard ground; chemical vs. tillage $)

Remember, wheat is chem-fallowed here



Milo yields continue to increase longer when wheat chem-fallowed

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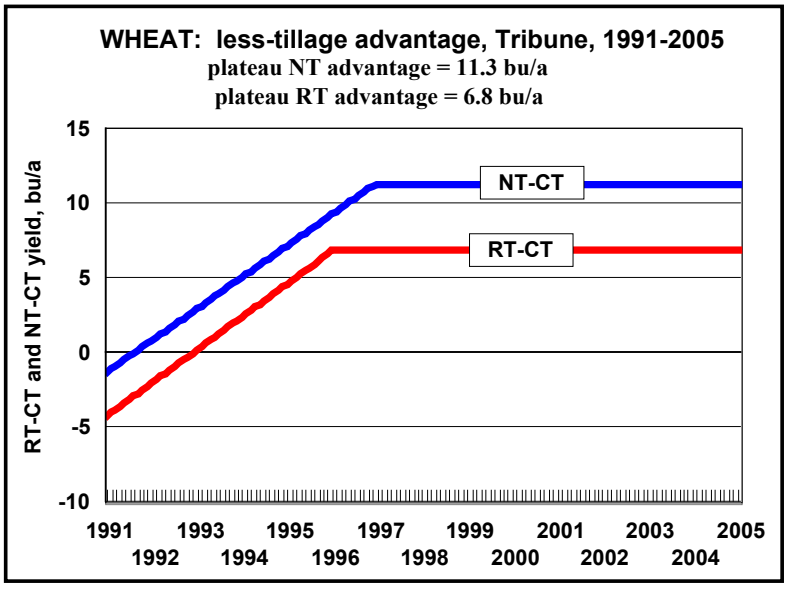

NT-over-RT: 4.5 bu/a (HUGE in this 35 bu/a environment)

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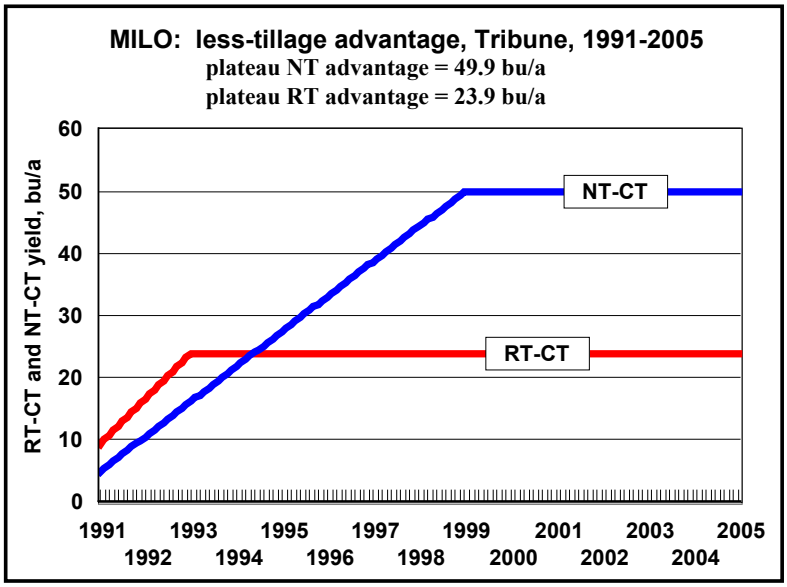
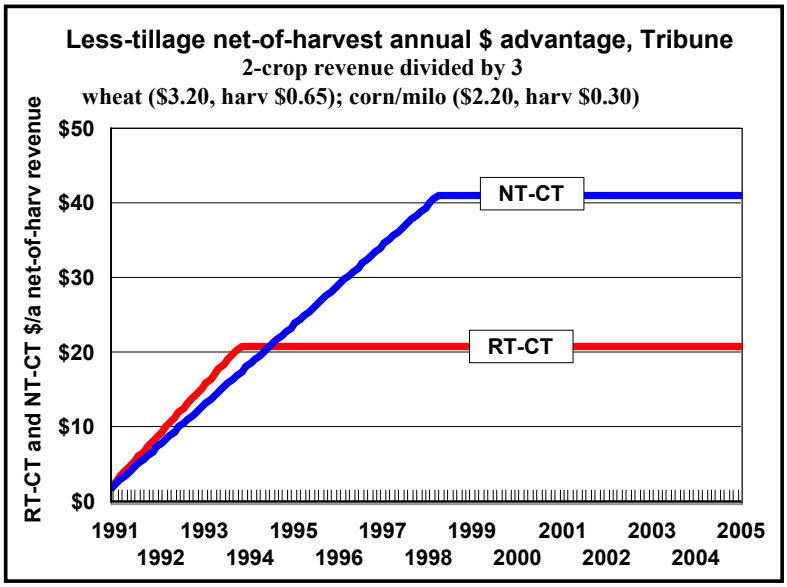
Difference in lines is benefit to chem-fallow

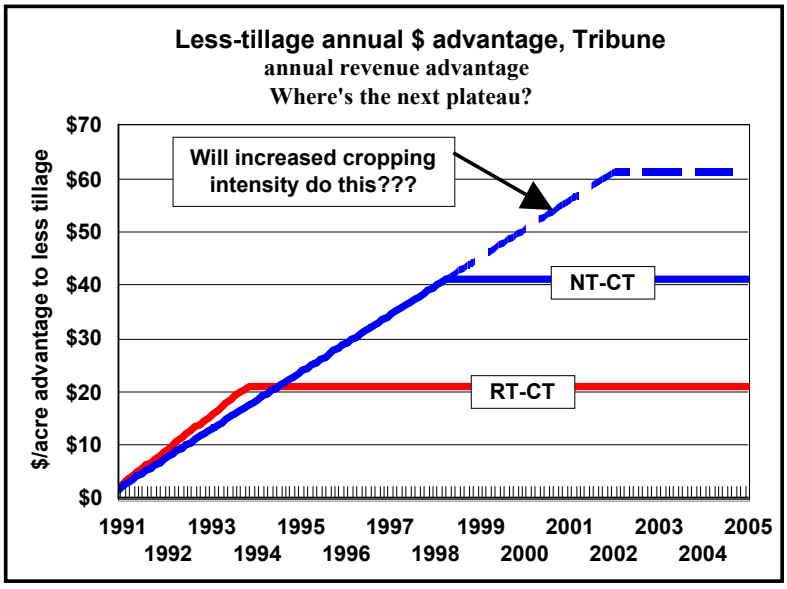


Okay to compare $ if cost of chem-fallow similar to tillage-fallow cost



Change in NT over CT advantage over time

- NT-CT yield difference appears to have grown for about 8-10 years, then leveled
- Do changes in soils and residue that improve water use stop after 8-10 years?
- Or, are we "leaving water on the table," implying that cropping intensity should be increased?
  - A potential advantage somewhat unique to drier areas of the country



What to think about . . .

- If you are currently in a wheat-milo-fallow CT program, move at least to ecofallow (i.e., NT ahead of milo), since well-proven:
  - Will gain 24 bu/a on milo nearly immediately
  - Will gain 6+ bu/a on wheat in 5-6 years
- Then think about continuous NT, i.e., chem-fallow on the wheat:
  - Will pick up *another* 4 bu/a on wheat in about 6-7 yrs
  - Will pick up *another* 26 bu/a on milo in about 7-9 yrs
- Then (or better yet, simultaneously) think about intensifying rotation:
  - To prevent "leaving water on the table"

Questions ???

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