Economics of Occasional Tillage

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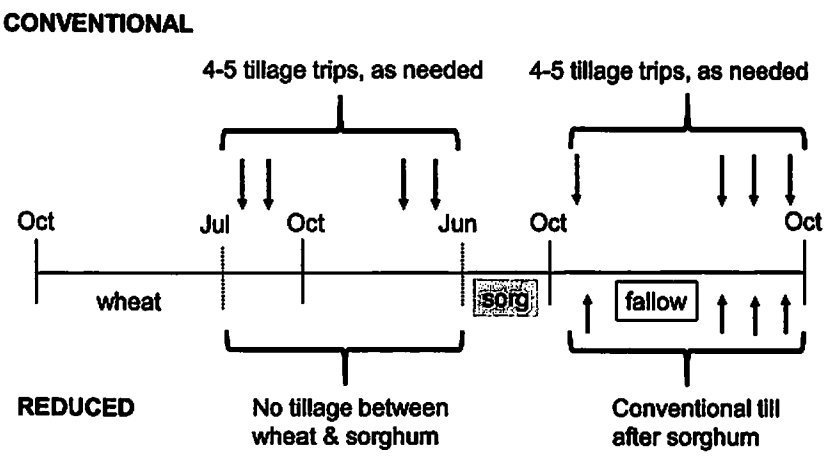
The move toward less tillage...

- Some intended goals
  - Conserve soil moisture, improve soil structure, health
  - Higher yields
  - Fewer tillage passes through the field
- But...
  - Do higher yields offset the higher chemical costs in no-till / reduced till systems?
  - Growing herbicide resistance in some weeds
  - Will occasional tillage hurt yields or reduce income?

Original study: compare 3 tillage systems

- ***Conventional***
  - Tilled as needed to control weeds
  - 4-5 times/year with blade plow or field cultivator
- ***Reduced tillage***
  - No-till from wheat harvest through sorghum planting
  - Regular tillage from sorghum harvest through wheat planting
- ***No till***
  - Exclusive use of herbicide for weed control
- Compared using a W-S-F rotation in a study at Tribune from 2001 through present

3 tillage systems for W-S-F rotation



Notes on input costs

- Use custom rates to estimate machinery costs
- Include cost of preceding fallow period with cost of crop production
- Economic comparison of systems
  - Do higher yields pay for higher chemical costs?

Fertilizer use

- Nitrogen
  - NH3 used when using tillage
  - UAN-28 liquid applied in no-till regime
  - Wheat: 2 lbs N for each bushel of average yield
  - Sorghum: 1.2 lbs N for each bushel of average yield
- Phosphate
  - MAP (11-52-0) for wheat, 26 lbs P per acre
  - APP (11-34-0) for sorghum, 27 lbs P per acre

WHEAT: chemical use

- **NO-TILL system**
- **Fallow period prior to wheat**
- Scoparia, 3 oz/a
- Dicamba, 16 oz/a
- Metribuzin, 8 oz/a
- Paraquat, 48 oz/a
- 2,4-D, 16 oz/a
- Paraquat, 48 oz/a
- 2,4-D, 16 oz/a
- Glyphosate, 32 oz/a
- 2,4-D, 16 oz/a
- Dicamba, 16 oz/a
- Glyphosate, 32 oz/a
- 2,4-D, 16 oz/a
- Dicamba, 16 oz/a
- **Wheat crop**
- Ally, 0.1 oz/a
- Dicamba, 4 oz/a

- **CONVENTIONAL system:**
- Retains only those herbicides used on wheat crop

- **REDUCED system:**
- Fallow after sorghum: use tillage
- Same herbicides for wheat crop

SORGHUM: chemical use

- **NO-TILL system**
- **Fallow period prior to sorghum**
- Glyphosate, 32 oz/a
- 2,4-D, 32 oz/a
- Paraquat, 48 oz/a
- 2,4-D, 16 oz/a
- Glyphosate, 32 oz/a
- 2,4-D, 16 oz/a
- Atrazine, 1 lb/a
- Dicamba, 16 oz/a
- Glyphosate, 32 oz/a
- 2,4-D, 16 oz/a
- **Sorghum crop**
- Lumax, 2.5 qt/a
- Atrazine, 0.25 lb/a
- Paraquat, 48 oz/a

- **CONVENTIONAL system:**
- Retains only those herbicides used on sorghum crop

- **REDUCED system:**
- Fallow after wheat: use no-till
- Same herbicides for sorghum crop

Wheat costs using 2018 input prices

	NT Rate	NT Price	NT Total	RT Rate	RT Price	RT Total	CT Rate	CT Price	CT Total
Seed	50	0.20	10.00	50	0.20	10.00	50	0.20	10.00
Fertilizer									
UAN	145	0.12	17.76	0	0.12	0.00	0	0.12	0.00
NH3	0	0.24	0.00	40	0.24	9.60	35	0.24	8.40
MAP	50	0.26	13.13	50	0.26	13.13	50	0.26	13.13
Actual N, P	46 lbs N, 26 lbs P			38 lbs N, 26 lbs P			34 lbs N, 26 lbs P		
Herbicide									
Scoparia	3	4.88	14.65	0	4.88	0.00	0	4.88	0.00
Dicamba	52	0.31	16.25	4	0.31	1.25	4	0.31	1.25
Metribuzin	0.5	13.05	6.53	0	13.05	0.00	0	13.05	0.00
Paraquat	96	0.23	21.75	0	0.23	0.00	0	0.23	0.00
Glyphosate	64	0.13	8.50	0	0.13	0.00	0	0.13	0.00
2,4-D	64	0.16	10.50	0	0.16	0.00	0	0.16	0.00
Ally	0.1	7.37	0.74	0.1	7.37	0.74	0.1	7.37	0.74
Machinery									
Sweep	0	11.00	0.00	4	11.00	44.00	4	11.00	44.00
NH3 appl	0	15.00	0.00	1	15.00	15.00	1	15.00	15.00
Dry/liq fert appl	1	6.00	6.00	0	6.00	0.00	0	6.00	0.00
Herbicide appl	6	5.50	33.00	1	5.50	5.50	1	5.50	5.50
Plant	1	13.50	13.50	1	13.50	13.50	1	13.50	13.50
Total			172.30			112.71			111.51

* Input costs do not include harvest costs, which vary with yield.

Sorghum costs using 2018 input prices

	NT Rate	NT Price	NT Total	RT Rate	RT Price	RT Total	CT Rate	CT Price	CT Total
Seed	3	2.80	8.40	3	2.80	8.40	3	2.80	8.40
Fertilizer									
UAN	286	0.12	35.04	172	0.12	21.07		0.12	0.00
NH3		0.24	0.00		0.24	0.00	33	0.24	7.92
APP	80	0.22	17.20	80	0.22	17.20	80	0.22	17.20
Actual N, P	89 lbs N, 27 lbs P			57 lbs N, 27 lbs P			36 lbs N, 27 lbs P		
Herbicide									
Glyphosate	96	0.13	12.75	96	0.13	12.75	0	0.13	0.00
2,4-D	80	0.16	13.13	80	0.16	13.13	0	0.16	0.00
Paraquat	96	0.23	21.75	96	0.23	21.75	48	0.23	10.88
Atrazine	1.25	3.00	3.75	1.25	3.00	3.75	0.25	3.00	0.75
Dicamba	16	0.31	5.00	16	0.31	5.00	0	0.31	0.00
Lumax	80	0.47	37.50	80	0.47	37.50	80	0.47	37.50
Machinery									
Sweep	0	11.00	0.00	0	11.00	0.00	4	11.00	44.00
NH3 appl	0	15.00	0.00	0	15.00	0.00	1	15.00	15.00
Dry/liq fert appl	1	6.00	6.00	1	6.00	6.00	0	6.00	0.00
Herbicide appl	6	5.50	33.00	6	5.50	33.00	1	5.50	5.50
Plant	1	17.00	17.00	1	17.00	17.00	1	17.00	17.00
Total			210.51			196.55			164.15

* Input costs do not include harvest costs, which vary with yield.

Cost comparison: wheat

ITEM	No-Till	Reduced	Conventional
Seed	10.00	10.00	10.00
Fertilizer	30.89	22.73	21.53
Herbicide	78.91	1.99	1.99
Field operations	52.50	78.00	78.00
TOTAL	172.30	112.71	111.51

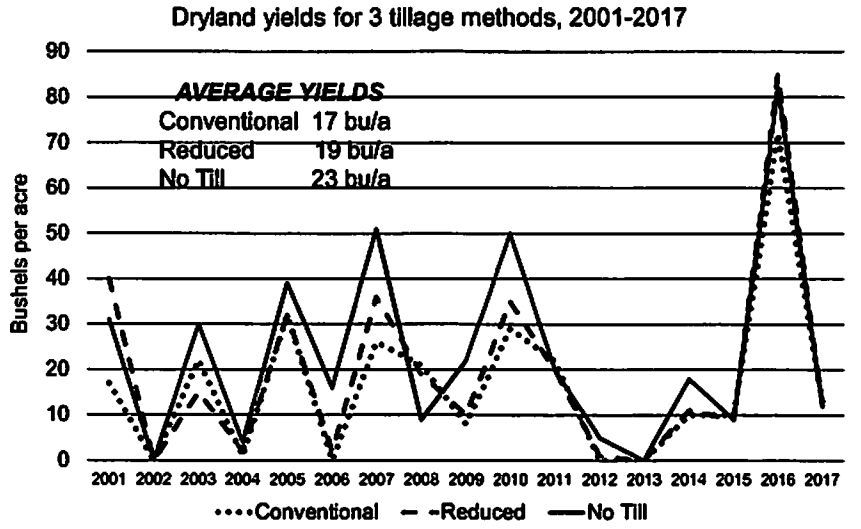
* Input costs do not include harvest costs, which vary with yield.

Cost comparison: Sorghum

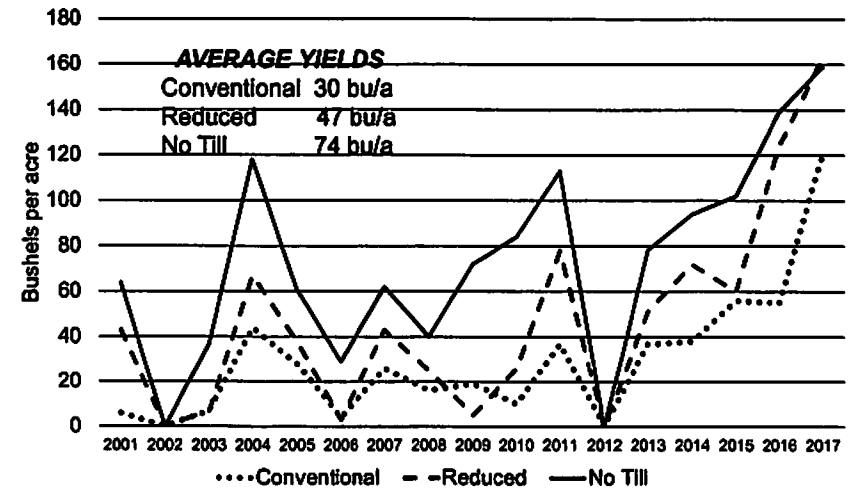
ITEM	No-Till	Reduced	Conventional
Seed	8.40	8.40	8.40
Fertilizer	52.24	38.27	25.12
Herbicide	93.88	93.88	49.13
Field operations	56.00	56.00	81.50
TOTAL	210.51	196.55	164.50

* Input costs do not include harvest costs, which vary with yield.

Wheat yields in W-S-F rotation: Tribune



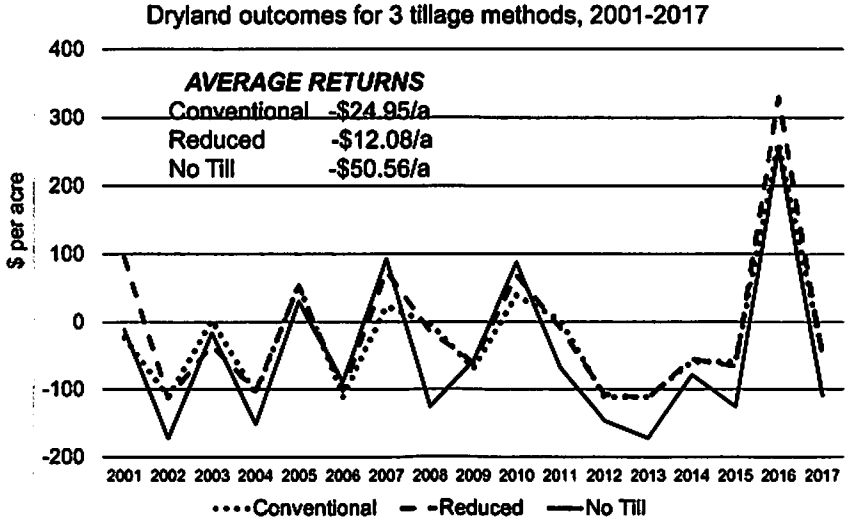
Sorghum yields in W-S-F rotation: Tribune



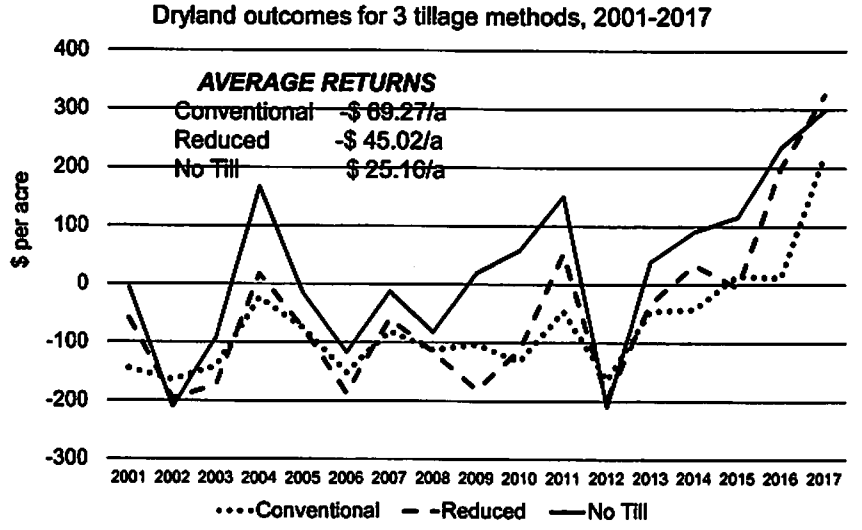
Comparing net returns

- Compare costs and returns across tillage systems
  - By crop
  - For entire W-S-F rotation
  - Harvest costs included (custom rates)
- Crop prices:
  - Wheat $5.20/bu, sorghum $3.20/bu
  - How sensitive to these assumptions?

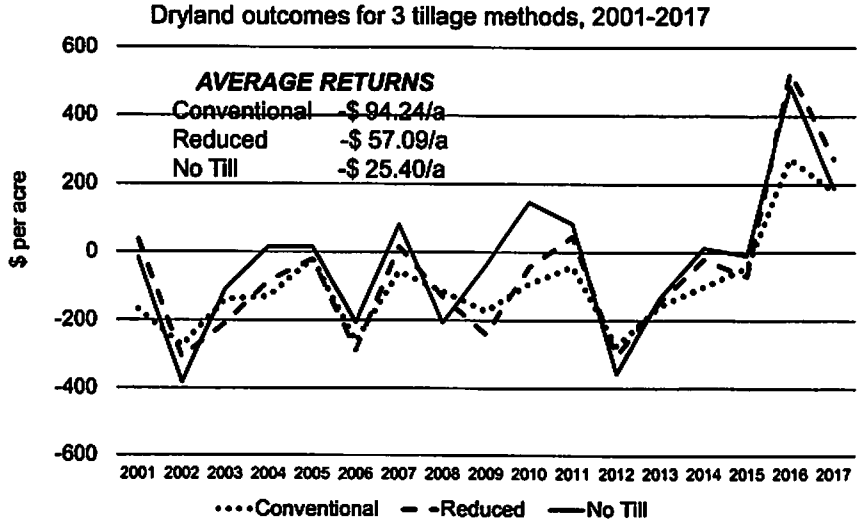
Wheat net returns



Sorghum net returns



Net returns over entire W-S-F rotation



Sensitivity to crop prices?

- Drop crop prices to loan rates?
  - Wheat: $2.94/bu
  - Grain sorghum: $1.95/bu
  - RT had highest return: higher yields than CT, lower costs than NT
- Once grain sorghum prices reach $2.35/bu, NT dominates, regardless of wheat price

SUMMARY

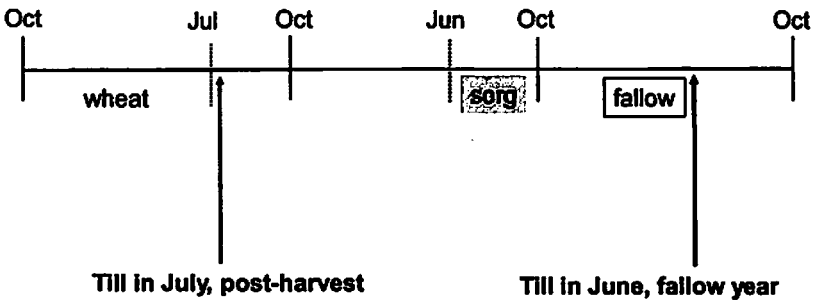
- WHEAT: small yield advantage with no-till
- SORGHUM: huge yield advantage to no-till
- Entire W-S-F rotation:
  - ***NO-TILL***: yield advantage to no-till sorghum more than offset no-till cost disadvantage for wheat
  - ***REDUCED TILL***: better sorghum yields than conventional, but still far below no-till
  - ***LOW PRICES***: prices at loan rate favor RT, but grain sorghum prices above $2.35 favored NT

Occasional ("strategic") tillage study

- ***PROBLEM:*** growing herbicide resistance in weeds in our no-till systems
- If occasional tillage is necessary....
  - How much might yields be affected?
  - How would net returns be affected?
  - Which time in rotation is best to use tillage?
- Studies at both Tribune and Garden City

Occasional ("strategic") tillage study

Drop one herbicide treatment, add tillage pass instead



Wheat costs with occasional tillage: Tribune

	NT Rate	NT Price	NT Total	OT-June Rate	OT-June Price	OT-June Total	OT-July Rate	OT-July Price	OT-July Total
Seed	50	0.20	10.00	50	0.20	10.00	50	0.20	10.00
Fertilizer									
UAN	259	0.12	31.73	259	0.12	31.73	252	0.12	30.87
MAP	50	0.26	13.13	50	0.26	13.13	50	0.26	13.13
Actual N, P	78 lbs N, 26 lbs P			78 lbs N, 26 lbs P			76 lbs N, 26 lbs P		
Herbicide									
Scoparia	3	4.88	14.65	3	4.88	14.65	3	4.88	14.65
Dicamba	52	0.31	16.25	52	0.31	16.25	52	0.31	16.25
Metribuzin	0.5	13.05	6.53	0.5	13.05	6.53	0.5	13.05	6.53
Paraquat	96	0.23	21.75	48	0.23	10.88	48	0.23	10.88
Glyphosate	64	0.13	8.50	64	0.13	8.50	64	0.13	8.50
2,4-D	64	0.16	10.50	48	0.16	7.88	48	0.16	7.88
Ally	0.1	7.37	0.74	0.1	7.37	0.74	0.1	7.37	0.74
Machinery									
Sweep	0	11.00	0.00	1	11.00	11.00	1	11.00	11.00
Dry/liq fert appl	1	6.00	6.00	1	6.00	6.00	1	6.00	6.00
Herbicide appl	6	5.50	33.00	5	5.50	27.50	5	5.50	27.50
Plant	1	13.50	13.50	1	13.50	13.50	1	13.50	13.50
Total			186.26			178.26			177.41

* Input costs do not include harvest costs, which vary with yield.

Sorghum costs, occasional tillage: Tribune

	NT Rate	NT Price	NT Total	OT-June Rate	OT-June Price	OT-June Total	OT-July Rate	OT-July Price	OT-July Total
Seed	3	2.80	8.40	3	2.80	8.40	3	2.80	8.40
Fertilizer									
UAN	431	0.12	52.80	428	0.12	52.43	413	0.12	50.59
APP	80	0.22	17.20	80	0.22	17.20	80	0.22	17.20
Actual N, P	146 lbs N, 27 lbs P			145 lbs N, 27 lbs P			140 lbs N, 27 lbs P		
Herbicide									
Glyphosate	96	0.13	12.75	64	0.13	8.50	64	0.13	8.50
2,4-D	80	0.16	13.13	48	0.16	7.88	48	0.16	7.88
Paraquat	96	0.23	21.75	96	0.23	21.75	96	0.23	21.75
Atrazine	1.25	3.00	3.75	1.25	3.00	3.75	1.25	3.00	3.75
Dicamba	16	0.31	5.00	16	0.31	5.00	16	0.31	5.00
Lumax	80	0.47	37.50	80	0.47	37.50	80	0.47	37.50
Machinery									
Sweep	0	11.00	0.00	1	11.00	11.00	1	11.00	11.00
Dry/liq fert appl	1	6.00	6.00	1	6.00	6.00	1	6.00	6.00
Herbicide appl	6	5.50	33.00	5	5.50	27.50	5	5.50	27.50
Plant	1	17.00	17.00	1	17.00	17.00	1	17.00	17.00
Total			228.27			223.91			222.07

* Input costs do not include harvest costs, which vary with yield.

Cost comparison: wheat (Tribune)

ITEM	No-Till	OT June fallow	OT July post-harv
Seed	10.00	10.00	10.00
Fertilizer	44.85	44.85	44.00
Herbicide	78.91	65.41	65.41
Field operations	52.50	58.00	58.00
TOTAL	**186.26**	**178.26**	**177.41**

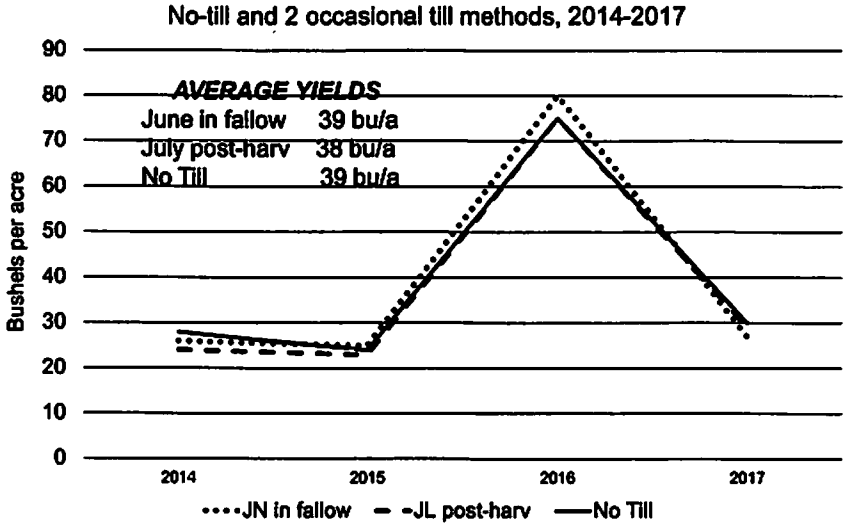
* Input costs do not include harvest costs, which vary with yield.

Cost comparison: Sorghum (Tribune)

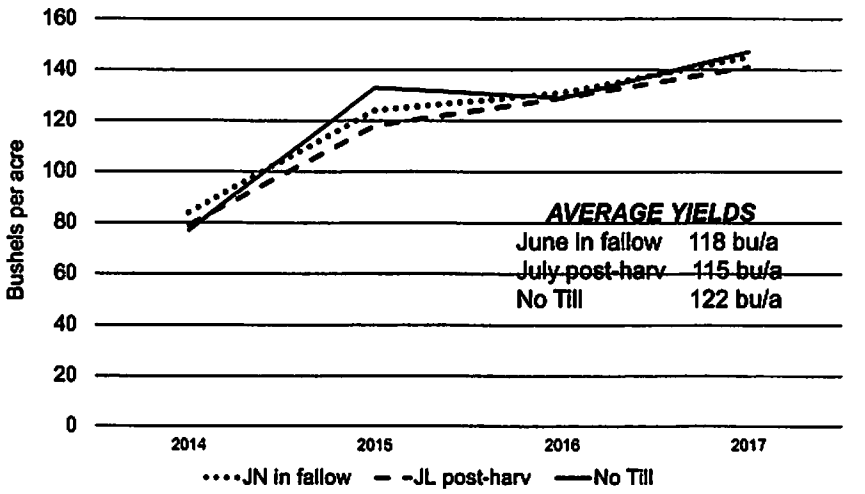
ITEM	No-Till	OT June fallow	OT July post-harv
Seed	8.40	8.40	8.40
Fertilizer	70.00	69.63	67.79
Herbicide	93.88	84.38	84.38
Field operations	56.00	61.50	61.50
TOTAL	**228.27**	**223.91**	**222.07**

* Input costs do not include harvest costs, which vary with yield.

Tribune wheat yields in WSF rotation

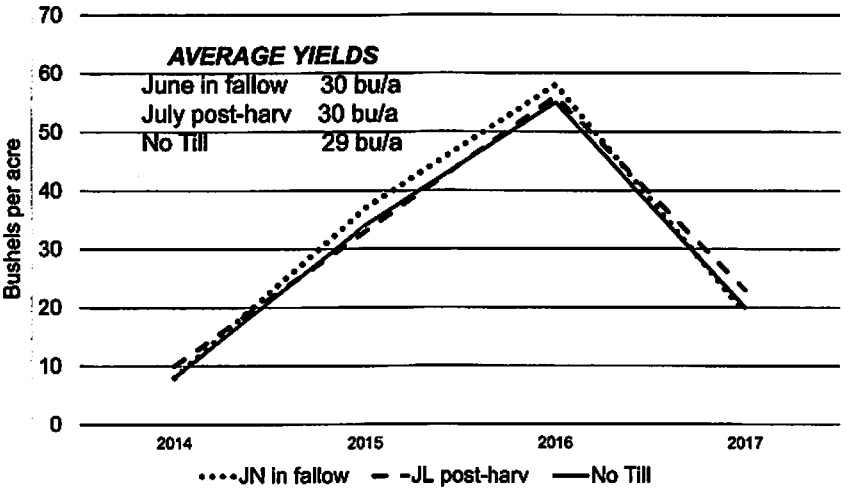


Tribune sorghum yields in WSF rotation



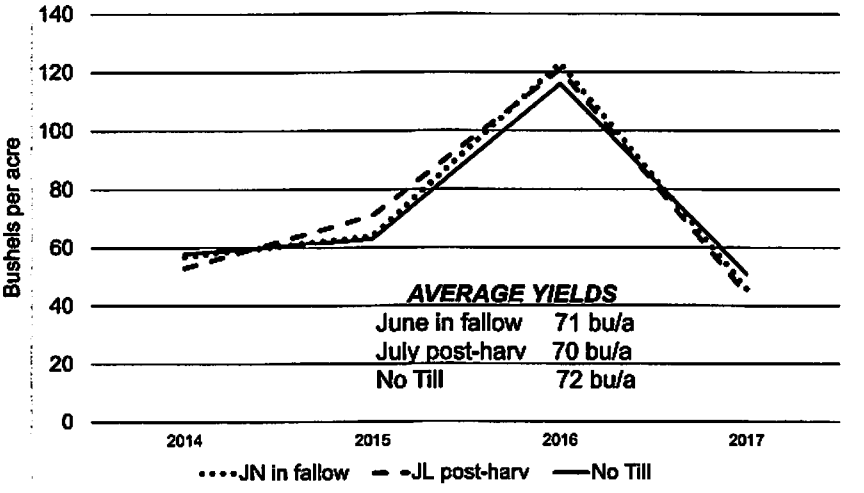
Garden City wheat yields in WSF rotation

No-till and 2 occasional till methods, 2014-2017

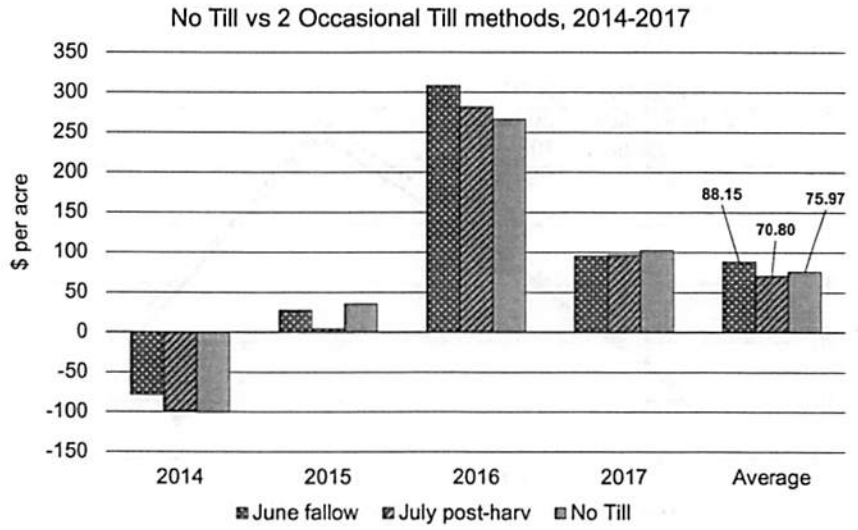


Garden City sorghum yields, WSF rotation

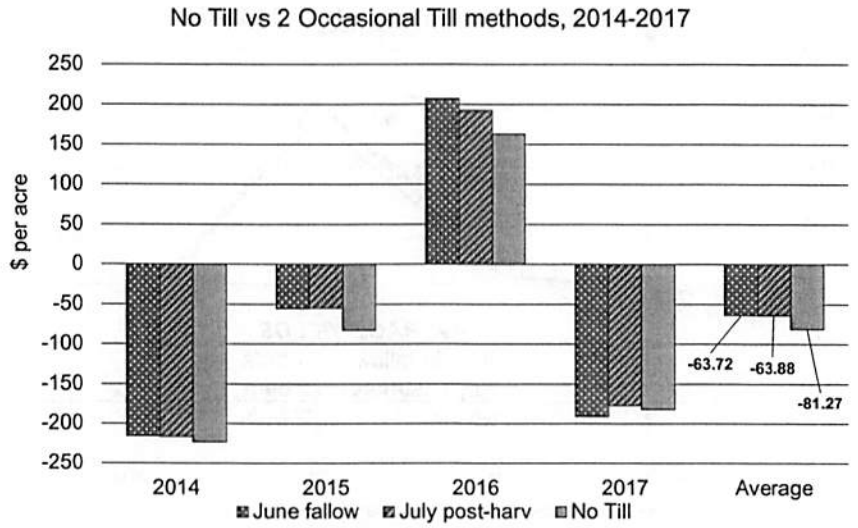
No-till and 2 occasional till methods, 2014-2017



Tribune: returns over entire WSF rotation



Garden City: returns over entire WSF rotation



SUMMARY: Occasional Tillage study

- No significant yield decline after 1 tillage pass
- Change in net returns by using OT?
  - Herbicide savings was $12-$19/acre, including sprayer cost
  - Cost of extra tillage was $11/acre
  - Cost savings in OT is small, also small changes in yields
- Which OT system?
  - Slight advantage to June-in-fallow (after-sorghum)?

Questions?
Comments?
Thank you!

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