

## Occasional Tillage in a Wheat-Sorghum-Fallow Rotation

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### Summary

Beginning in 2012, research was conducted near Garden City and Tribune, KS, to determine the effect of a single tillage operation every 3 years on grain yields in a wheat-sorghum-fallow (WSF) rotation. Treatments included no-till, single tillage post wheat harvest in mid-August, and single tillage in mid-June during the fallow phase. This study was revised with the addition of two more intensive tillage treatments since 2019. The two additional treatments were 1) two tillage operations during the fallow phase, and 2) one tillage during fallow phase and one tillage post wheat harvest. Grain yield varied greatly by year and location. Wheat yields ranged across years from mid-20s to 90 bu/a at Tribune and less than 10 to 100 bu/a at Garden City. Grain sorghum yields ranged from 40 to greater than 140 bu/a, depending upon year and location. Drought and hail at Garden City resulted in several years of no harvestable grain sorghum at Garden City. Wheat yields were greater when tillage occurred during the fallow phase at Garden City. There were no differences in wheat yield at Hays or Tribune. Grain sorghum yield was greater in no-till at Tribune. There were no differences in grain sorghum yield at Garden City or Hays. There are some year-by-treatment differences, and treatment differences might be increasing over time. For these reasons, more years of data are needed. Currently, this study supports the hypothesis that if herbicide-resistant weed populations are a challenge, an occasional tillage operation will have little effect on crop yield.

### Introduction

Previous research showed lower dryland wheat and grain sorghum yields with reduced tillage compared with no-tillage in a wheat-sorghum-fallow (WSF) rotation near Tribune, KS (Schlegel et al., 2018). The reduced tillage systems generally used four or more tillage operations in the 3-year rotation. With the increased incidence of herbicide-resistant weeds, the use of a complete no-tillage system may not be economical, and tillage may be needed for effective control. The objective of the research project is to determine the effect of occasional tillage (1-2 tillage operations every 3 years) on wheat and grain sorghum yields in a WSF rotation.

### Procedures

Research on occasional tillage in a WSF rotation at the Kansas State University Southwest Research-Extension Center research stations at Garden City and Tribune was initiated in 2014 and at Hays in 2015. Initially, three tillage treatments were compared: 1) single tillage in May or June during fallow, 2) single tillage after wheat harvest, and 3) no-tillage system. Beginning in 2017, two additional treatments were added: 4) single

tillage in fallow plus single tillage after wheat harvest, and 5) two tillage operations during fallow. All treatments are arranged in a split-plot randomized complete block with four replications. The main plot is crop phase (all crop phases present each year), and split-plot was tillage treatment.

A sweep plow (Minimizer by Premier Tillage) was used for all tillage operations. Herbicides were used to control weeds across all treatments. All other cultural practices (variety/hybrid, seeding rate, fertilization, etc.) varied by location but were consistent within a location for all treatments.

## Results and Discussion

Weeds were effectively controlled in all treatments although herbicide resistant kochia and Johnsongrass at Garden City were difficult to control.

At Garden City, treatment differences varied by year, but in most years and across years the tillage during the fallow year increased yield (Table 1). Drought and hail damage resulted in some years of no sorghum yield at Garden City. No treatment differences in grain sorghum yields occurred at Garden City (Table 2).

At Hays, wheat and grain sorghum yields were not affected by treatment (Table 3 and Table 4).

At Tribune, treatment did not affect wheat yield (Table 5). Grain sorghum yield was greatest in no-till and least in the treatment with both tillage in fallow and post-wheat harvest (Table 6).

In other research (Schlegel et al. 2018), reduced tillage systems (with four tillage operations) produced lower yields than no-till in a WSF rotation. Yield differences in this prior study became more apparent after 10 years. Yield differences in the current study may also start to become more apparent with time. With the exception of maybe Tribune, an occasional tillage operation to manage herbicide-resistant weeds appeared to have little effect on crop yield.

## Acknowledgment

This research was supported in part by the Ogallala Aquifer Program, a consortium between USDA Agricultural Research Service, Kansas State University, Texas AgriLife Research, Texas AgriLife Extension Service, Texas Tech University, and West Texas A&M University.

## References

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**Table 1. Occasional tillage treatment effect on wheat yields, 2014 through present at Garden City, KS**

Year	No-till	June tillage in fallow	July after wheat	June and July in fallow	June in fallow and July after wheat	<i>P</i> > <i>F</i>
2014	7.3	5.7	8.0	---	---	---
2015	31.7	32.6	28.3	---	---	---
2016	51.5	55.8	52.4	---	---	---
2017	20.0	19.5	23.0	---	---	---
2018	3.6	3.4	6.6	8.6	7.4	0.04
2019	89.5	100.3	83.0	95.2	100.0	0.00
2020	26.9	29.0	24.3	32.1	32.4	0.01
2021	41.3	72.8	46.1	65.1	66.1	0.00
2022	22.9	30.1	17.1	26.1	28.1	0.04
2023	24.2	23.4	18.4	15.3	21.8	0.01
2024	42.5	43.0	47.5	42.9	46.5	0.72
Average						
2014-present	32.9	37.8	32.2	---	---	---
2018-present	32.9b	37.8a	32.2b	40.8a	43.2a	<0.0001

Letters different within a row significant at  $P \leq 0.05$

**Table 2. Occasional tillage treatment effect on sorghum yields, 2014 through present at Garden City, KS**

Year	No-till	June tillage in fallow	July after wheat	June and July in fallow	June in fallow and July after wheat	<i>P</i> > <i>F</i>
2014	54.3	53.4	44.1	---	---	---
2015	58.6	57.4	67.7	---	---	---
2016	108.5	112.8	65.8	---	---	---
2017	50.6	46.4	44.1	---	---	---
2018	97.7	88.5	93.1	---	---	---
2019	40.7	40.9	39.8	41.8	37.9	0.8
2020	46.8	46.3	47.2	44.4	45.0	1.0
2021	---	---	---	---	---	---
2022	10.4	10.4	3.7	11.7	7.1	0.1
2023	---	---	---	---	---	---
2024	---	---	---	---	---	---
Average						
2014-present	58.4	57.0	50.7	---	---	---
2019-present	32.6a	32.5a	30.2a	32.6a	30.0a	0.8

Letters different within a row significant at  $P \leq 0.05$

**Table 3. Occasional tillage treatment effect on wheat yields, 2015 through 2024 at Hays, KS**

Year	No-till	June tillage in fallow	June and July in fallow	July after wheat	June in fallow and July after wheat	<i>P</i> > <i>F</i>
2015	12b	16.3a	14.3ab	---	---	0.06
2016	60.3ab	58.3b	63.7a	---	---	0.09
2017	35.0a	43.0a	33.7a	---	---	0.28
2018	29.0a	28.3a	26.7a	---	---	0.79
2019	42.3a	52.7a	46.7a	---	---	0.21
2020	57.3a	62.7a	58.7a	---	---	0.45
2021	---	---	---	---	---	---
2022	36.7a	39.7a	39.7a	39.3a	38.7	0.96
2023	14.0a	12.7a	16.7a	18.7a	21.3a	0.69
2024	27.3a	24.3a	26.0a	26.7a	25.3a	0.82
Average						
2022-present	26.0a	25.6a	29.0a	28.2a	26.9a	0.82
2015-present	34.9a	37.6a	36.6a	---	---	0.96

Letters different within a row significant at  $P \leq 0.05$

**Table 4. Occasional tillage treatment effect on grain sorghum yields, 2015 through 2024 at Hays, KS**

Year	No-till	June tillage in fallow	June and July in fallow	July after wheat	June in fallow and July after wheat	<i>P</i> > <i>F</i>
2015	102.6a	85.0b	90.3ab	---	---	0.07
2016	97.7a	97.3a	91.0a	---	---	0.40
2017	92.0a	80.0a	95.0a	---	---	0.27
2018	95.3a	98.0a	87.7a	---	---	0.21
2019	106.0a	96.0ab	92.0b	---	---	0.10
2020	105.7a	97.0 b	91.3b	---	---	0.08
2021	73.0 a	67.3a	76.0a	62.3a	65.0a	0.404
2022	46.7 a	33.0 a	34.0 a	36.0 a	31.7 a	0.50
2023	42.3a	52.3a	36.3a	42.0a	51.7a	0.21
2024	62.7a	55.7abc	51.3bc	49.0c	59.0ab	0.06
Average						
2021-present	56.2a	50.8a	49.4a	48.9a	51.8a	0.85
2015-present	82.4a	75.6a	74.5a	---	---	0.42

Letters different within a row significant at  $P \leq 0.05$

**Table 5. Occasional tillage effect on wheat grain yields, K-State SWREC-Tribune**

Year	No-till	June in fallow	July after wheat harvest	June in fallow and July after wheat harvest	June and July in fallow
2014	28.0	22.3	23.2	---	---
2015	23.7	21.7	20.6	---	---
2016	74.7	81.3	76.8	---	---
2017	30.2	24.6	26.6	---	---
2018	57.3	58.0	56.8	---	---
2019	93.4	89.3	88.9	92.4	88.2
2020	45.1	40.1	42.3	40.7	40.3
2021	68.8	64.5	66.6	69.5	71.4
2022	---	---	---	---	---
2023	16.1	21.3	25.3	30.3	22.9
2024	29.2	29.5	29.8	30.1	31.6
Average					
2014-present	46.7	45.3	45.7	---	---
2019-present	50.5a	48.9a	50.6a	52.6a	50.9a

Letters different within a row significant at  $P \leq 0.05$

**Table 6. Occasional tillage effect on sorghum grain yields, K-State SWREC-Tribune**

<b>Year</b>	<b>No-till</b>	<b>June in fallow</b>	<b>July after wheat harvest</b>	<b>June in fallow and July after wheat harvest</b>	<b>June and July in fallow</b>
2014	77.0	84.2	86.1	---	---
2015	132.8	113.7	107.9	---	---
2016	129.4	128.6	126.5	---	---
2017	147.3	145.3	140.9	---	---
2018	130.0	123.2	114.9	---	---
2019	132.0	128.7	130.7	132.0	133.3
2020	98.9	102.2	94.0	86.3	95.5
2021	120.5	109.8	115.3	115.9	120.0
2022	75.0	66.0	60.9	64.0	73.9
2023	86.3	74.4	77.5	55.0	65.6
2024	99.7	77.6	72.3	45.8	71.7
Average					
2014-present	111.7a	104.9b	102.5b	---	---
2019-present	102.1a	93.1b	91.8b	83.1c	93.3b

Letters different within a row significant at  $P \leq 0.05$