Tillage Intensity in a Long-Term Wheat-Sorghum-Fallow Rotation

A. Schlegel
Kansas State University, schlegel@ksu.edu

A. Burnett
Kansas State University, alburnett@ksu.edu

Follow this and additional works at: https://newprairiepress.org/kaesrr

Part of the Agronomy and Crop Sciences Commons

Recommended Citation
Schlegel, A. and Burnett, A. (2021) "Tillage Intensity in a Long-Term Wheat-Sorghum-Fallow Rotation," Kansas Agricultural Experiment Station Research Reports: Vol. 7: Iss. 7. https://doi.org/10.4148/2378-5977.8104

This report is brought to you for free and open access by New Prairie Press. It has been accepted for inclusion in Kansas Agricultural Experiment Station Research Reports by an authorized administrator of New Prairie Press. Copyright 2021 the Author(s). Contents of this publication may be freely reproduced for educational purposes. All other rights reserved. Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. K-State Research and Extension is an equal opportunity provider and employer.
Tillage Intensity in a Long-Term Wheat-Sorghum-Fallow Rotation

Funding Source
The U.S. Department of Agriculture, Agricultural Research Service Ogallala Aquifer Program partially supported this research project.

This cropping and tillage systems is available in Kansas Agricultural Experiment Station Research Reports: https://newprairiepress.org/kaesrr/vol7/iss7/5
Tillage Intensity in a Long-Term Wheat-Sorghum-Fallow Rotation

A. Schlegel and A. Burnett

Summary
This study was initiated in 1991 at the Kansas State University Southwest Research-Extension Center near Tribune, KS. The purpose of the study was to identify the effects of tillage intensity on precipitation capture, soil water storage, and grain yield in a wheat-sorghum-fallow rotation. Grain yields of wheat and grain sorghum increased with decreased tillage intensity in a wheat-sorghum-fallow (WSF) rotation. In 2020, available soil water at sorghum planting was greater for no-tillage (NT) than reduced tillage (RT), which was greater than conventional tillage (CT). For wheat there was a similar pattern as sorghum, with available soil water at wheat planting being in the order of NT > RT > CT. Averaged across the 20-year study, available soil water at wheat planting was similar for NT and RT and approximately 1 inch greater than CT. Average available soil water at sorghum planting was greater in the order RT = NT > CT. Averaged across the past 20 years, NT wheat yields were 5 bu/a greater than RT and 8 bu/a greater than CT. Averaged across the past 20 years, sorghum yields with long-term NT have been 58% greater than with short-term NT (79 vs. 50 bu/a).

Experimental Procedures
Research on different tillage intensities in a WSF rotation at the Tribune, KS, unit of the Southwest Research-Extension Center was initiated in 1991. The three tillage intensities in this study are conventional, reduced, and no-tillage. The CT system was tilled as needed to control weed growth during the fallow period. On average, this resulted in 4 to 5 tillage operations per year, usually with a blade plow or field cultivator. The RT system originally used a combination of herbicides (1 to 2 spray operations) and tillage (2 to 3 tillage operations) to control weed growth during the fallow period; however, in 2001, the RT system was changed to using NT from wheat harvest through sorghum planting (short-term NT) and CT from sorghum harvest through wheat planting. The NT system exclusively used herbicides to control weed growth during the fallow period. All tillage systems used herbicides for in-crop weed control.

Results and Discussion
Soil Water
The amount of available water in the soil profile (0–8 ft) at wheat planting varied greatly from year to year (Figure 1). In 2020, available soil water at wheat planting was greater with NT than RT and least with CT. Averaged across the 20-year study, available soil water at wheat planting was similar for RT and NT (~ 8 inches) and approximately 1 inch greater than CT. Similar to wheat, the amount of available water in the soil profile at sorghum planting varied greatly from year to year (Figure 2). In 2020,
available soil water at sorghum planting was greater with NT than RT and least with CT. On average, available soil water at sorghum planting was similar for NT and RT and about 1.5 inches greater than CT.

**Grain Yields**

Wheat yields in 2020 were near the long-term average (Table 1). Since 2001, wheat yields have been depressed in 11 of 20 years, primarily because of lack of precipitation, winterkill (2015), and disease (2017). Reduced tillage and NT increased wheat yields. On average, wheat yields were 8 bu/a higher for NT (30 bu/a) than CT (22 bu/a). Wheat yields for RT were 3 bu/a greater than CT even though both systems had tillage prior to wheat. Yields of NT were significantly less than CT or RT in only 1 of the 20 years.

Grain sorghum yields in 2020 were near the long-term average (Table 2). Sorghum yields were 70% greater with NT than RT (90 vs. 53 bu/a) while CT yields were the least (17 bu/a). The yield benefit from reducing tillage is greater for grain sorghum than wheat. Grain sorghum yields for RT averaged 21 bu/a more than CT, whereas NT averaged 29 bu/a more than RT. For sorghum, both RT and NT used herbicides for weed control during fallow, so the difference in yield could be attributed to short-term compared with long-term NT. This yield benefit with long-term vs. short-term NT has been observed in most years since the RT system was changed in 2001. Averaged across the past 20 years, sorghum yields with long-term NT have been 58% greater than with short-term NT (79 vs. 50 bu/a).

**Acknowledgment**

The U.S. Department of Agriculture, Agricultural Research Service Ogallala Aquifer Program partially supported this research project.
Table 1. Wheat response to tillage in a wheat-sorghum-fallow rotation, Tribune, KS, 2001–2020

| Year | Conventional | Reduced | No-tillage | LSD (0.05) | Tillage | Year | Tillage × year |
|------|--------------|---------|------------|------------|----------|------|----------------|
| 2001 | 17           | 40      | 31         | 8          |          |      |                |
| 2002 | 0            | 0       | 0          | ---        | ---      |      |                |
| 2003 | 22           | 15      | 30         | 7          | 0.007    |      |                |
| 2004 | 1            | 2       | 4          | 2          | 0.001    |      |                |
| 2005 | 32           | 32      | 39         | 12         | 0.360    |      |                |
| 2006 | 0            | 2       | 16         | 6          | 0.001    |      |                |
| 2007 | 26           | 36      | 51         | 15         | 0.017    |      |                |
| 2008 | 21           | 19      | 9          | 14         | 0.142    |      |                |
| 2009 | 8            | 10      | 22         | 9          | 0.018    |      |                |
| 2010 | 29           | 35      | 50         | 8          | 0.002    |      |                |
| 2011 | 22           | 20      | 20         | 7          | 0.649    |      |                |
| 2012 | 0            | 1       | 5          | 1          | 0.001    |      |                |
| 2013 | 0            | 0       | 0          | ---        | ---      |      |                |
| 2014 | 10           | 11      | 18         | 12         | 0.336    |      |                |
| 2015 | 10           | 9       | 9          | 9          | 0.966    |      |                |
| 2016 | 72           | 85      | 82         | 18         | 0.239    |      |                |
| 2017 | 13           | 12      | 12         | 9          | 0.970    |      |                |
| 2018 | 46           | 48      | 64         | 4          | 0.001    |      |                |
| 2019 | 78           | 98      | 109        | 14         | 0.004    |      |                |
| 2020 | 29           | 31      | 33         | 9          | 0.565    |      |                |

Mean 22 c*, 25 b, 30 a

ANOVA = analysis of variance.

LSD = least significant difference.

* Means within a row with the same letter are not statistically different at $P = 0.05$. 
Table 2. Grain sorghum response to tillage in a wheat-sorghum-fallow rotation, Tribune, KS, 2001–2020

| Year | Conventional | Reduced | No-tillage | LSD (0.05) | ANOVA (P > F) |
|------|--------------|---------|------------|------------|---------------|
|      | Tillage      | Year    |            |            |               |
| 2001 | 6            | 43      | 64         | 7          | 0.001         |
| 2002 | 0            | 0       | 0          | ---        | ---           |
| 2003 | 7            | 7       | 37         | 8          | 0.001         |
| 2004 | 44           | 67      | 118        | 14         | 0.001         |
| 2005 | 28           | 38      | 61         | 35         | 0.130         |
| 2006 | 4            | 3       | 29         | 10         | 0.001         |
| 2007 | 26           | 43      | 62         | 42         | 0.196         |
| 2008 | 16           | 25      | 40         | 20         | 0.071         |
| 2009 | 19           | 5       | 72         | 31         | 0.004         |
| 2010 | 10           | 26      | 84         | 9          | 0.001         |
| 2011 | 37           | 78      | 113        | 10         | 0.001         |
| 2012 | 0            | 0       | 0          | ---        | ---           |
| 2013 | 37           | 51      | 78         | 32         | 0.053         |
| 2014 | 38           | 72      | 94         | 28         | 0.008         |
| 2015 | 56           | 60      | 102        | 55         | 0.153         |
| 2016 | 55           | 124     | 139        | 47         | 0.010         |
| 2017 | 121          | 163     | 159        | 33         | 0.038         |
| 2018 | 35           | 57      | 116        | 33         | 0.003         |
| 2019 | 23           | 85      | 127        | 7          | 0.001         |
| 2020 | 17           | 53      | 90         | 19         | 0.001         |

Mean: 29 c* 50 b 79 a 5 0.001 0.001 0.001

ANOVA = analysis of variance.
LSD = least significant difference.
* Means within a row with the same letter are not statistically different at P = 0.05.
Figure 1. Available soil water in the 8-ft profile at planting of wheat in a wheat-sorghum-fallow rotation as affected by tillage intensity, Tribune, KS, 2001–2020. The last set of bars (Mean) is the average across years. CT = conventional tillage, RT = reduced tillage, NT = no-tillage.

Figure 2. Available soil water in the 8-ft profile at planting of grain sorghum in a wheat-sorghum-fallow rotation as affected by tillage intensity, Tribune, KS, 2001–2020. The last set of bars (Mean) is the average across years. CT = conventional tillage, RT = reduced tillage, NT = no-tillage.