Kansas Agricultural Experiment Station Research Reports

Volume 9
Issue 6 *Western Kansas Agricultural Research*

Article 4

2023

Occasional Tillage in a Wheat-Sorghum-Fallow Rotation: 2022 Growing Season

John D. Holman
Kansas State University, jholman@ksu.edu

Augustine K. Obour
Kansas State University, aobour@ksu.edu

Lucas A. Haag
Kansas State University, lhaag@ksu.edu

See next page for additional authors

Recommended Citation

Holman, John D.; Obour, Augustine K.; Haag, Lucas A.; and Lawrence, Mikaela A. (2023) "Occasional Tillage in a Wheat-Sorghum-Fallow Rotation: 2022 Growing Season," *Kansas Agricultural Experiment Station Research Reports*: Vol. 9: Iss. 6. https://doi.org/10.4148/2378-5977.8488

Occasional Tillage in a Wheat-Sorghum-Fallow Rotation: 2022 Growing Season

Funding Source

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.

Authors

John D. Holman, Augustine K. Obour, Lucas A. Haag, and Mikaela A. Lawrence

K-STATE Research and Extension

2023 WESTERN KANSAS AGRICULTURAL RESEARCH

Occasional Tillage in a Wheat-Sorghum-Fallow Rotation: 2022 Growing Season

J.D. Holman, A.K. Obour, L.A. Haag, and M.A. Lawrence

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 mid-June during the fallow phase. This study was revised with two additional 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. Wheat yields tended to be greater with a single or two tillage operations during the fallow phase, and less with single tillage post wheat harvest at Garden City. Grain sorghum yield was less at Tribune when tilled post wheat harvest. This indicates that if a single tillage operation is needed to control troublesome weeds, that tillage during fallow prior to wheat planting may be better than tillage after wheat harvest. This study supports the hypothesis that if herbicide-resistant weed populations are high enough to cause yield reductions, then tillage might improve yields.

Introduction

Previous research has shown lower dryland wheat and grain sorghum yields with reduced tillage compared with no-tillage in a wheat-sorghum-fallow (WSF) rotation (Schlegel et al., 2018). The reduced tillage systems generally used four or more tillage operations in the 3-year rotation. With 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 a single tillage operation every 3 years on grain yields in a WSF rotation.

Experimental Procedures

Research was initiated in 2012 on occasional tillage intensities in a predominantly no-tillage WSF rotation at the Kansas State University Southwest Research-Extension Center research stations at Garden City and Tribune. The three tillage treatments' intensities in this study are a single tillage in May or June during fallow, a single tillage after wheat harvest, and a complete no-tillage system. Beginning in 2017, two additional treatments with more tillage were added, replacing a single tillage operation performed every six years either in fallow or after wheat harvest, since a single tillage every 3 years had no affect on crop yield. The revised treatments were in proper phase beginning

in 2019. These treatments were two tillage operations during the fallow phase, and a combination of both one tillage during fallow phase and one tillage post wheat harvest. A sweep plow (Minimizer by Premier Tillage) was used for all tillage operations. When needed, herbicides were used to control weeds during fallow for all treatments. All treatments used herbicides for in-crop weed control. All other cultural practices (variety/hybrid, seeding rate, fertilization, etc.) were the same 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 Tribune, in the three treatments with the most years of data, wheat yield was similar among tillage treatments in any individual year. However, in an across-years analysis, yields were marginally greater in a no-till system, 48 bu/a, than either of the tillage treatments, which both averaged 46 bu/a across years (Table 1). Wheat yields were reduced in 2022 by hail damage immediately prior to harvest. Grain sorghum yields did not differ among tillage treatments from 2014 through 2020. In 2021 and 2022, yield differences among tillage treatments were observed (Table 2). When analyzed across years, sorghum in a no-till system has produced greater yields than tillage treatments done every third year. Across years, grain sorghum yields in no-till were greater than tillage post-wheat harvest. To date, no differences in profile soil water at planting of either wheat or sorghum have been observed (data not shown), suggesting that the effect of tillage was related to an in-season component of water availability. An analysis of data beginning in 2019, with the additional 2 treatments of tillage intensity, showed no differences in yield for either wheat (Table 3) or grain sorghum (Table 4).

At Garden City there was no yield difference for wheat or grain sorghum between no-till or single tillage every 3 years (Tables 5 and 6). Wheat yields were greater with either a single or two tillage operations during the fallow period in the second phase of this study (Table 7). Drought resulted in no grain sorghum yield in 2021 or 2022. There was no difference in grain sorghum yields (Table 8).

In other research (Schlegel et al., 2018), reduced tillage systems (with four tillage operations) produced lower yields than a complete no-tillage system in a WSF rotation. In this research, there was a tendency for wheat yields at Garden City and grain sorghum yields at Tribune to be less following a single tillage post-wheat compared to no-till or a single tillage prior to wheat. Between 2014 and 2020, economic returns were greatest at Tribune with single tillage during fallow or NT, and greatest at Garden City with single tillage during fallow. Returns were less at Garden City than Tribune due to lower wheat yields. These results suggest if a single tillage is needed for weed control the best timing may be prior to wheat during the fallow year.

Acknowledgments

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

Holman, J., A. Obour, A. Schlegel, and L. Simon. 2020. Long-term forage rotation yields, soil water use, and profitability. Proceedings of the Great Plains Soil Fertility Conference. Vol. 18, p.158-164.

Schlegel, A.J., Y. Assefa, L.A. Haag, C.R. Thompson, and L.R. Stone. 2018. Long-term tillage on yield and water use of grain sorghum and winter wheat. Agron. J. 110:269-280.

Schlegel, A., J. Holman, and Y. Assefa. 2020. A single tillage in a long-term no-till system on dryland crop performance. AJ. 112:3174-3187. *https://doi.org/10.1002/agj2.20284*

Table 1. Grain yield response of dryland wheat to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2014 to 2022 near Tribune, KS

	Year									
Tillage	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Average**
	bu/a									
No-tillage	28	24	75	30	57	93	45	69	14	48a
June in fallow	22	22	81	25	58	89	40	65	13	46b
July post-harvest	23	21	77	27	57	89	42	67	13	46b
ANOVA (P > F)										
Treatment	0.427	0.599	0.174	0.477	0.857	0.202	0.130	0.365	0.628	0.034

ANOVA = analysis of variance.

Table 2. Grain yield response of dryland grain sorghum to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2014 to 2022 near Tribune, KS

	Year									
Tillage	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Average**
	bu/a									
No-tillage	77	133	129	147	130	132	99	121a	75a	116a
June in fallow	84	114	129	145	123	129	102	110c	66b	111b
July post-harvest	86	108	126	141	115	131	94	115b	61b	109b
ANOVA (P > F)										
Treatment	0.573	0.104	0.280	0.567	0.065	0.779	0.259	0.002	0.012	0.004

ANOVA = analysis of variance.

Table 3. Grain yield response of dryland wheat to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2019 to 2022 near Tribune, KS

	Year				Average
Tillage	2019	2020	2021	2022	2019-22
	bu/a				
No-tillage	93.4	45.1	68.8	14.1	55.4
In fallow 1×	89.3	40.1	64.5	12.6	51.6
In fallow 2×	88.2	40.3	71.4	11.2	52.8
Post-wheat 1×	88.9	42.3	66.6	13.2	52.8
In fallow and post-wheat 1×	92.4	40.7	69.5	11.1	53.4
ANOVA (P > F)					
Treatment	0.4455	0.1304	0.3286	0.2704	0.0881

ANOVA = analysis of variance.

Table 4. Grain yield response of dryland sorghum to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2019 to 2022 near Tribune, KS

	Year				Average
Tillage	2019	2020	2021	2022	2019-22
	bu/a				
No-tillage	132.0	98.9	120.5	75.0	106.6
In fallow 1×	128.7	102.2	109.8	66.0	101.7
In fallow 2×	133.3	95.5	119.9	73.9	105.7
Post-wheat 1×	130.7	94.0	115.3	60.9	100.2
In fallow and post-wheat 2×	132.0	86.3	115.8	64.0	99.5
ANOVA (P > F)					
Treatment	0.8653	0.2590	0.1998	0.7034	0.1986

ANOVA = analysis of variance.

Table 5. Grain yield response of dryland wheat to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2014 to 2020 near Garden City, KS

	Year							
Tillage	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**
	bu/a							
No-tillage	8	34	55	20	4	90ab	27	34
June in fallow	6	35	60	19	3	100a	29	36
July post-harvest	9	30	56	23	7	83b	24	33
ANOVA (P > F)								
Treatment	0.601	0.363	0.369	0.420	0.199	0.029	0.1582	0.1124
Year	---	---	---	---	---	---	---	<0.0001
Year × treatment	---	---	---	---	---	---	---	0.0584

ANOVA = analysis of variance.

Table 6. Grain yield response of dryland grain sorghum to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2014 to 2020 near Garden City, KS

	Year							
Tillage	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**
	bu/a							
No-tillage	58	63	116	51	98	41	47	68
June in fallow	57	62	121	46	88	41	46	66
July post-harvest	47	73	118	44	93	40	47	66
ANOVA (P>F)								
Treatment	0.110	0.464	0.642	0.579	0.572	0.946	0.9942	0.918
Year	---	---	---	---	---	---	---	<0.0001
Year × treatment	---	---	---	---	---	---	---	0.9946

ANOVA = analysis of variance.

Table 7. Grain yield response of dryland wheat to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2019 to 2022 near Garden City, KS

	Year				Average
Tillage	2019	2020	2021	2022	2019-22
	bu/a				
No-tillage	90	27	41	23	45
In fallow 1×	100	29	73	30	**58**
In fallow 2×	95	32	65	26	**55**
Post-wheat 1×	83	24	46	17	43
In fallow and post-wheat 1×	100	32	66	28	**57**
LSD	8	5	17	8	5
ANOVA (P > F)					
Treatment	0.003	0.01	0.005	0.042	<0.0001
Year	---	---	---	---	<0.0001
Year × treatment	---	---	---	---	0.0722

ANOVA = analysis of variance.

Table 8. Grain yield response of dryland sorghum to a single tillage operation (sweep plow) in a 3-year wheat-sorghum-fallow rotation grown from 2019 to 2022 near Garden City, KS

	Year				Average
Tillage	2019	2020	2021	2022	2019-22
	bu/a				
No-tillage	40.7	46.8	---	---	43.7
In fallow 1×	40.9	46.3	---	---	43.6
In fallow 2×	41.8	44.4	---	---	43.1
Post-wheat 1×	39.8	47.2	---	---	43.5
In fallow and post-wheat 2×	37.9	45.0	---	---	41.4
LSD					-
ANOVA (P > F)					
Treatment	0.8271	0.9938	---	---	0.6043
Year	---	---	---	---	<0.0001
Year × treatment	---	---	---	---	0.6328

ANOVA = analysis of variance.