

Occasional Tillage in a Wheat-Sorghum-Fallow Rotation

A. Schlegel and J. Holman

Summary

Beginning in 2012, research was conducted in 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. Grain yields of wheat and grain sorghum were generally not affected by a single tillage operation every 3 years in a WSF rotation. Grain yield varied greatly by year from 2014 to 2019. Wheat yields ranged across years from mid-20s to 90 bu/a at Tribune and less than 10 to near 100 bu/a at Garden City. Grain sorghum yields ranged from 40 to greater than 140 bu/a, depending upon year and location. In 2019, wheat yields at Garden City were less when tillage was implemented post-wheat in 2016. There were no other years or locations where grain yields were significantly affected by a single tillage operation. However, at Tribune, when averaged across the 6-year period, a single tillage after wheat harvest reduced grain sorghum yields compared to a complete no-till (NT) system. At Garden City, averaged across the 6-year period, wheat yields were greatest following a one-time tillage prior to wheat. This indicates that if a single tillage operation is needed to control troublesome weeds, tillage during fallow prior to wheat planting may be better than tillage after wheat harvest. Furthermore, if herbicide-resistant weed populations were 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 NT 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 NT system may not be economical and tillage may be needed for effective control. The objective of this research project is to determine the effect of a single tillage operation every 3 years on grain yields in a WSF rotation.

Procedures

Research 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, KS, was initiated in 2012. The three tillage treatments in this study are a single tillage in May or June during fallow, a single tillage after wheat harvest, and a complete NT system. 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 and there were no visual differences in weed population across treatments.

At Tribune, wheat yields were much greater in 2019 (89 to 93 bu/a) compared with 49 to 51 bu/a for the 6-year average (Table 1). There were no significant yield differences among tillage treatments in any year or across years. Grain sorghum yields were very good in 2019 ranging from 129 to 132 bu/a (Table 2). Similar to wheat, there were no significant yield differences among tillage treatments in any year. However, averaged across years, no-till produced greater yields than tillage post-wheat harvest.

At Garden City, wheat yields in 2018 were very low at 2 to 7 bu/a (Table 3). Between November 1, 2017, and April 1, 2018, 0.4 inches of precipitation was received, compared to the long-term period average of 3.46 inches. Wheat yields in 2014 were severely reduced by hail. Wheat yield in 2019 was much greater (83 to 100 bu/a) compared with the 40 to 44 bu/a 6-year average (Table 1). Across the 6 years, wheat yields averaged greater with a single tillage ahead of wheat planting. At this location, winter triticale forage yields have been more with a single tillage compared to NT due to more plant available water at wheat planting with a single tillage (Holman et al., 2020). In 2019 wheat yields at Garden City were less when tillage was implemented post-wheat in 2016. It is possible the lower wheat yield in 2019 was a result of lower average grain sorghum yield in the post-wheat tillage treatment in 2017. However, grain sorghum yield was not affected by treatment in any year or across years. Grain sorghum yields in 2018 were good, with all yields near 90 bu/a or greater (Table 4). Grain sorghum yields were lower in 2019 averaging 40 bu/a. Across years, there were no differences in grain sorghum yields averaging 70 bu/a.

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. However, in this study, a single tillage operation during fallow prior to wheat planting in a 3-year WSF rotation generally had little effect on wheat or grain sorghum yields from 2014 to 2019 at Garden City or Tribune, KS.

There is 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 single tillage prior to wheat. These results suggest if a single tillage is needed for weed control the best timing may be prior to wheat during the fallow year.

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

- 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.

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 2019 near Tribune, KS

Tillage	Year						Average
	2014	2015	2016	2017	2018	2019	
	----- bu/a -----						
No-tillage	28	24	75	30	57	93	51
June in fallow	22	22	81	25	58	89	50
July post-harvest	23	21	77	27	57	89	49
ANOVA (P > F)							
Treatment	0.427	0.599	0.174	0.477	0.857	0.202	0.204
Year	---	---	---	---	---	---	0.001
Year × treatment	---	---	---	---	---	---	0.453

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 2019 near Tribune, KS

Tillage	Year						Average
	2014	2015	2016	2017	2018	2019	
	----- bu/a -----						
No-tillage	77	133	129	147	130	132	125
June in fallow	84	114	129	145	123	129	121
July post-harvest	86	108	126	141	115	131	118
ANOVA (P > F)							
Treatment	0.573	0.104	0.280	0.567	0.065	0.779	0.045
Year	---	---	---	---	---	---	0.001
Year × treatment	---	---	---	---	---	---	0.099

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 2014 to 2018 near Garden City, KS

Tillage	Year						Average
	2014	2015	2016	2017	2018	2019	
	----- bu/a -----						
No-tillage	8	34	55	20	4	90ab	40
June in fallow	6	35	60	19	3	100a	44
July post-harvest	9	30	56	23	7	83b	40
ANOVA (P > F)							
Treatment	0.601	0.363	0.369	0.420	0.199	0.029	0.117
Year	---	---	---	---	---	---	<0.0001
Year × treatment	---	---	---	---	---	---	0.061

ANOVA = analysis of variance.

Table 4. 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 2018 near Garden City, KS

Tillage	Year						Average
	2014	2015	2016	2017	2018	2019	
	----- bu/a -----						
No-tillage	58	63	116	51	98	41	71
June in fallow	57	62	121	46	88	41	69
July post-harvest	47	73	118	44	93	40	69
ANOVA (P>F)							
Treatment	0.110	0.464	0.642	0.579	0.572	0.946	0.913
Year	--	--	--	--	--	--	<0.0001
Year × treatment	--	--	--	--	--	--	0.986

ANOVA = analysis of variance.