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Occasional Tillage in a Wheat-Sorghum-Fallow Rotation

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Occasional Tillage in a Wheat-Sorghum-Fallow Rotation

Abstract

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 2020. 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. In 2019 wheat yields at Garden City were less when tillage was implemented post-wheat harvest 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 7-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 7-year period, wheat yields were not different, but tended to be greater following a single one-time tillage prior to wheat. 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.

Keywords

no-till, herbicide resistant weeds, crop rotation

Cover Page Footnote

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

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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 2020. 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. In 2019 wheat yields at Garden City were less when tillage was implemented post-wheat harvest 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 7-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 7-year period, wheat yields were not different, but tended to be greater following a single one-time tillage prior to wheat. 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-yr 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 the 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 treatment 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. 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, wheat yields were slightly less in 2020 (40 to 45 bu/a) compared with 48 to 50 bu/a for the 7-yr average (Table 1). There were no significant yield differences among tillage treatments in any year or across years. Grain sorghum yields in 2020 (ranging from 94 to 102 bu/a) were about 20 bu/a less compared with the 7-yr average (Table 2). Similar to wheat, there were no significant yield differences among tillage treatments in any year. However, averaged across years, NT produced greater yields than tillage post-wheat harvest.

Precipitation pattern at Garden City tended to mostly occur during the summer period which favored grain sorghum yield and reduced wheat yields. Wheat yields at Garden City were highly variable depending on growing season, ranging from less than 10 bu/a in 2018 to 100 bu/a in 2019. The average wheat yield across years was about 35 bu/a, which would be similar to the long-term county average. Treatment differences varied across years, but there was a tendency for increased yield with a single tillage in fallow compared to no-tillage. There was no treatment difference in grain sorghum yield. Grain sorghum yield ranged from 40 bu/a in 2019 to 121 bu/a in 2016. Over the course of this study, grain sorghum yield averaged about 67 bu/a.

In other research (Schlegel et al. 2018), reduced tillage systems (with four tillage operations) produced lower yields than a complete NT 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. These results suggest that 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 U.S. Department of Agriculture 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. 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 Tribune, KS

	Year							
Tillage	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**
	bu/a							
No-tillage	28	24	75	30	57	93	45	50
June in fallow	22	22	81	25	58	89	40	48
July post-harvest	23	21	77	27	57	89	42	48
ANOVA (P > F)								
Treatment	0.427	0.599	0.174	0.477	0.857	0.202	0.130	0.097
Year	---	---	---	---	---	---	---	0.001
Year × treatment	---	---	---	---	---	---	---	0.461

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 220 near Tribune, KS

	Year							
Tillage	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**
	bu/a							
No-tillage	77	133	129	147	130	132	99	121a*
June in fallow	84	114	129	145	123	129	102	118ab
July post-harvest	86	108	126	141	115	131	94	114b
ANOVA (P > F)								
Treatment	0.573	0.104	0.280	0.567	0.065	0.779	0.259	0.034
Year	---	---	---	---	---	---	---	0.001
Year × treatment	---	---	---	---	---	---	---	0.120

ANOVA = analysis of variance.

* Means within a column with the same letter are not statistically different at $P = 0.05$.

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 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.

* Means within a column with the same letter are not statistically different at $P = 0.05$.

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 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.