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Abstract

A field study initiated in 2006 at the Southwest Research-Extension Center near Tribune, KS, was designed to evaluate the effects of three wheat stubble heights on subsequent grain yields of corn and grain sorghum. Corn and sorghum yields in 2018 were greater than the long-term average. When averaged from 2007 through 2018, corn grain yields were 9 bu/a greater when planted into either high or strip-cut stubble than into low-cut stubble. Average grain sorghum yields were 6 bu/a greater in high-cut stubble than low-cut stubble. Similarly, water use efficiency was greater for high or strip-cut stubble for corn and high-cut stubble for grain sorghum than for low-cut stubble. Harvesting wheat shorter than necessary causes a yield penalty for the subsequent row crops, especially dryland corn.

Keywords

water use efficiency, soil water, stripper head

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A. Schlegel and L. Haag

Summary
A field study initiated in 2006 at the Southwest Research-Extension Center near Tribune, KS, was designed to evaluate the effects of three wheat stubble heights on subsequent grain yields of corn and grain sorghum. Corn and sorghum yields in 2018 were greater than the long-term average. When averaged from 2007 through 2018, corn grain yields were 9 bu/a greater when planted into either high or strip-cut stubble than into low-cut stubble. Average grain sorghum yields were 6 bu/a greater in high-cut stubble than low-cut stubble. Similarly, water use efficiency was greater for high or strip-cut stubble for corn and high-cut stubble for grain sorghum than for low-cut stubble. Harvesting wheat shorter than necessary causes a yield penalty for the subsequent row crops, especially dryland corn.

Introduction
Seeding of summer row crops throughout the west-central Great Plains often occurs following wheat in a 3-year rotation (wheat-summer crop-fallow). Wheat residue provides numerous benefits, including evaporation suppression, delayed weed growth, improved capture of winter snowfall, and soil erosion reductions. Stubble height affects wind velocity profile, surface radiation interception, and surface temperatures, all of which affect evaporation suppression and winter snow catch. Taller wheat stubble is also beneficial to pheasants in postharvest and overwinter fallow periods. Using stripper headers increases harvest capacity and provides taller wheat stubble than previously attainable with conventional small-grains platforms. Increasing wheat cutting heights or using a stripper header should further improve the effectiveness of standing wheat stubble. The purpose of this study is to evaluate the effect of wheat stubble height on subsequent summer row crop yields.

Experimental Procedures
This study was conducted at the Southwest Research-Extension Center dryland station near Tribune, KS. From 2007 through 2018, corn and grain sorghum were planted into standing wheat stubble of three heights. Optimal (high) cutter-bar height is the height necessary to maximize both grain harvested and standing stubble remaining (typically around two-thirds of total plant height), the short cut treatment was half of optimal cutter-bar height, and the third treatment was stubble remaining after stripper header harvest. For 2018, these heights were 16, 8, and 24 in. (cut after 2017 wheat harvest). In 2018, corn and grain sorghum were seeded at rates of 15,000 seeds/a and 45,000 seeds/a, respectively. Nitrogen was applied to all plots at a rate of 80 lb/a. Starter fertil-

izer (10-34-0 nitrogen–phosphorus–potassium (N-P-K)) was surface-dribbled off-row at a rate of 7 gal/a. Plots were 40 × 60 ft, with treatments arranged in a randomized complete block design with six replications. Two rows from the center of each plot were harvested with a plot combine for yield and yield component analysis. Soil water measurements were obtained with neutron attenuation to a depth of 6 ft in 1-ft increments at seeding and harvest to determine water use and water use efficiency.

Results and Discussion

The 2018 growing season was drier than normal through March but near or above normal for the remainder of the year, with above normal precipitation for the year (19.81 inch in 2019 vs. normal of 17.90 inch). This produced above average yields for both corn and sorghum (Tables 1–4). With the good growing conditions, stubble height had little effect on corn yield or other parameters. When averaged across 2007 to 2018, corn yields were 9 bu/a greater in high or strip-cut than low-cut wheat stubble (Table 2). Biomass production and water use efficiency were also greater with the taller stubble.

Grain sorghum yields in 2018 were not affected by stubble height (Table 3). When averaged across years from 2007 through 2018, the highest yields were obtained in the high-cut stubble and the lowest yields in the low-cut stubble (Table 4). None of the other measured parameters for grain sorghum were affected by wheat stubble height except for greater water use efficiency in high-cut vs. low-cut stubble.

Table 1. Corn yield, biomass, and yield components as affected by stubble height, Tribune, KS, 2018

Stubble height	Yield	Plant population	Ear population	Biomass	Residue	1,000-seed weight	Kernels	WUE[1]
	bu/a	----------- 10^3/a -----------		----------- lb/a -----------		oz	no./ear	lb/in.
Low	104	13.6	13.6	11645 b	6720	13.89	492	386
High	112	13.5	13.9	12548 ab	7233	14.28	506	395
Strip	114	13.9	14.5	13231 a	7850	14.08	501	404
$LSD_{0.05}$	15	0.7	1.0	1199	1178	0.57	46	44
ANOVA (P > F)								
Stubble height	0.340	0.407	0.202	0.043	0.152	0.344	0.815	0.672

[1]Water use efficiency (lb of grain/inch of water use).
LSD = least significant difference.
ANOVA = analysis of variance.

Table 2. Average corn yield, biomass, and yield components as affected by stubble height, Tribune, KS, 2007–2018

Stubble height	Yield	Plant population	Ear population	Biomass	Residue	1,000-seed weight	Kernels	WUE[1]
	bu/a	----------- 10^3/a -----------		----------- lb/a -----------		oz	no./ear	lb/in.
Low	83 b	13.9	13.8	9982 b	6061 b	11.06	516	307 b
High	92 a	13.9	14.1	10866 a	6511 ab	11.38	508	341 a
Strip	92 a	14.0	14.3	11069 a	6696 a	11.29	536	342 a
$LSD_{0.05}$	5	0.4	0.5	584	516	0.26	71	18
ANOVA (P > F)								
Year	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Stubble height	0.001	0.920	0.238	0.001	0.047	0.056	0.733	0.001
Year × stubble height	0.993	0.996	0.982	0.371	0.118	0.868	0.955	0.955

[1]Water use efficiency (lb of grain/inch of water use).
LSD = least significant difference.
ANOVA = analysis of variance.

Table 3. Sorghum yield and yield components as affected by stubble height, Tribune, KS, 2018

Stubble height	Yield	Head population	Biomass	Residue	1,000-seed weight	Kernels	WUE[1]
	bu/a	10^3/a	----------- lb/a -----------		oz	no./head	lb/in.
Low	116	64.0	12554	6847	1.01	1624	438
High	124	67.9	12339	6251	1.00	1652	453
Strip	125	67.6	11090	4942	0.98	1701	453
$LSD_{0.05}$	10	4.0	1748	1533	0.06	168	37
ANOVA (P > F)							
Stubble height	0.146	0.099	0.182	0.052	0.619	0.607	0.590

[1]Water use efficiency (lb of grain/inch of water use).
LSD = least significant difference.
ANOVA = analysis of variance.

Table 4. Average sorghum yield, biomass, and yield components as affected by stubble height, Tribune, KS, 2007–2018

Stubble height	Yield	Head population	Biomass[2]	Residue[2]	1,000-seed weight	Kernels	WUE[1]
	bu/a	10^3/a	----------- lb/a -----------		oz	no./head	lb/in.
Low	103 b	56.0	11155	6128	0.90	1887	398 b
High	109 a	57.8	11681	6404	0.90	1944	425 a
Strip	105 ab	57.1	11188	6026	0.89	1879	412 ab
$LSD_{0.05}$	4	2.1	510	460	0.02	101	18
ANOVA (P > F)							
Year	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Stubble height	0.039	0.222	0.077	0.248	0.116	0.384	0.015
Year × stubble height	0.996	0.911	0.985	0.891	0.749	0.018	0.964

[1]Water use efficiency (lb of grain/inch of water use).
[2]2015 values not included in average - no samples collected.
LSD = least significant difference.
ANOVA = analysis of variance.