Kansas Agricultural Experiment Station Research Reports

Volume 7
Issue 7 *Southwest Research-Extension Reports*

Article 2

2021

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Recommended Citation

Schlegel, A.; Burnett, A.; and Haag, L. (2021) "Wheat Stubble Height on Subsequent Corn and Grain Sorghum Crops," *Kansas Agricultural Experiment Station Research Reports*: Vol. 7: Iss. 7. https://doi.org/10.4148/2378-5977.8101

Wheat Stubble Height on Subsequent Corn and Grain Sorghum Crops

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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 2020 were near the long-term average despite lower than normal precipitation. When averaged across years from 2007 through 2020, corn grain yields were 8 bu/a greater when planted into either high or strip-cut wheat stubble than into low-cut stubble. Average grain sorghum yields were 5 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 greater for high-cut stubble for grain sorghum than for low-cut stubble. Harvesting wheat stubble shorter than necessary causes a yield penalty for the subsequent corn and grain sorghum crops.

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-grain 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 2020, 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 2020, these heights were 20, 12, and 29 in. (cut after 2018 wheat harvest) for high, low, and strip-cut stubble, respectively. In 2020, 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 100 lb/a. Starter fertilizer (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 2020 growing season was below normal in precipitation (14.62 inch in 2020 vs. normal of 17.90 inch) and above normal in open pan evaporation (74.19 in. vs. normal of 71.40 in.). Despite these conditions, near average yields were produced for both corn and sorghum (Tables 1–4). Wheat stubble height had little effect on corn yield or other parameters (Table 1). When averaged across 2007 to 2020, corn yields were 8 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 2020 were also not affected by stubble height (Table 3). When averaged across years from 2007 through 2020, sorghum yields were 5 bu/a greater with high-cut stubble compared with low-cut stubble (Table 4). Water use efficiency was also greater for high-cut stubble compared with low-cut stubble. None of the other measured parameters for grain sorghum were affected by wheat stubble height.

Table 1. Corn yield, biomass, and yield components as affected by stubble height, Tribune, KS, 2020

Stubble height	Yield	Plant population	Ear population	Biomass	Residue	1,000-seed weight	Kernels	WUE[1]
	bu/a	----------- 1000/a -----------		---------- lb/a ----------		oz	no./ear	lb/in.
Low	88	14.7	15.3	10939	6783	8.95	576	357
High	92	14.5	14.5	12589	8235	9.38	606	370
Strip	87	14.0	14.9	12963	8848	9.08	578	353
$LSD_{0.05}$	11	0.7	1.0	2580	2499	0.78	54	36
ANOVA (P > F)								
Stubble height	0.561	0.150	0.259	0.227	0.217	0.468	0.425	0.586

[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, 2007–2020

Stubble height	Yield	Plant population	Ear population	Biomass	Residue	1,000-seed weight	Kernels	WUE[1]
	bu/a	----------- 1000/a -----------		---------- lb/a ----------		oz	no./ear	lb/in.
Low	86 b	13.9	14.0	10408 b*	6346 b	10.90 b	531	316 b
High	94 a	14.0	14.2	11262 a	6802 ab	11.21 a	526	347 a
Strip	94 a	13.9	14.4	11638 a	7184 a	11.12 ab	548	347 a
$LSD_{0.05}$	4	0.4	0.5	546	489	0.23	61	16
ANOVA (P > F)								
Year	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Stubble height	0.001	0.981	0.286	0.001	0.004	0.032	0.761	0.001
Year × stubble height	0.989	0.993	0.981	0.351	0.084	0.910	0.968	0.949

[1]Water use efficiency (lb of grain/inch of water use).
LSD = least significant difference. ANOVA = analysis of variance.
* Means within a column with the same letter are not statistically different at $P = 0.05$.

Table 3. Sorghum yield and yield components as affected by stubble height, Tribune, KS, 2020

Stubble height	Yield	Head population	Biomass	Residue	1,000-seed weight	Kernels	WUE[1]
	bu/a	1000/a	---------- lb/a ----------		oz	no./head	lb/in.
Low	106	69.8	14105	8894	0.82	1677 b*	428
High	111	68.9	14291	8845	0.80	1811 a	453
Strip	107	68.8	13518	8259	0.81	1727 b	435
LSD $_{0.05}$	7	5.4	2160	2277	0.04	83	23
ANOVA (P > F)							
Stubble height	0.273	0.898	0.716	0.792	0.680	0.015	0.100

[1]Water use efficiency (lb of grain/inch of water use).
LSD = least significant difference. ANOVA = analysis of variance.
* Means within a column with the same letter are not statistically different at $P = 0.05$.

Table 4. Average sorghum yield, biomass, and yield components as affected by stubble height, Tribune, KS, 2007–2020

Stubble height	Yield	Head population	Biomass[2]	Residue[2]	1,000-seed weight	Kernels	WUE[1]
	bu/a	1000/a	---------- lb/a ----------		oz	no./head	lb/in.
Low	105 b*	57.5	11462	6346	0.89	1882	403 b
High	110 a	59.3	11973	6604	0.89	1939	429 a
Strip	107 ab	58.6	11517	6273	0.88	1876	417 ab
LSD $_{0.05}$	4	1.9	465	421	0.02	87	16
ANOVA (P > F)							
Year	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Stubble height	0.016	0.160	0.062	0.268	0.169	0.300	0.005
Year × stubble height	0.999	0.936	0.990	0.922	0.751	0.013	0.980

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