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Seeding Rate for Dryland Wheat

A. Schlegel, J. Holman, and L. Haag

Summary

Four winter wheat varieties (PlainsGold Byrd, Limagrain T158, Syngenta TAM 111, and WestBred Winterhawk) were planted at five seeding rates (30, 45, 60, 75, and 90 lb/a) in the fall of 2014 and 2015 at Colby, Garden City, and Tribune, KS. The objective of the study was to identify appropriate seeding rates for dryland winter wheat in western Kansas. Averaged across varieties, a seeding rate of 60 lb/a seemed to be adequate at all locations in 2015. However, with higher yields in 2016, a higher seeding rate (75 lb/a) was beneficial. The wheat variety T158 was the highest yielding (or in the highest group) at all locations in 2015. Other varieties may have been affected by differential response to stripe rust and winter injury resulting in lower yields. In 2016, the highest yielding variety varied by location. Variety selection appears to have more effect on wheat yields than seeding rate.

Introduction

The purpose of this project is to determine appropriate seeding rates for dryland winter wheat in western Kansas. In recent years, there appears to be an increase in seeding rate without corresponding increase in grain yields. A preliminary study conducted in 2014 found no yield benefit from increasing seeding rates from 30 to 75 lb seed/a for 4 wheat varieties at Tribune while a similar study at Garden City suffered severe hail damage, causing yields to be less than 10 bu/a. The objective is to evaluate seeding rates on grain yield of several popular wheat varieties under dryland conditions at three sites in western Kansas.

Experimental Procedures

Four winter wheat varieties (Byrd, T158, TAM 111, and Winterhawk) were planted at five seeding rates (30, 45, 60, 75, and 90 lb/a) in the fall of 2014 and 2015 at Colby, Garden City, and Tribune, KS. The date of seeding was October 20, 2014, and October 14, 2015, at Colby; October 9, 2014, and October 9, 2015, at Garden City; and September 26, 2014, and October 13, 2015, at Tribune. Seed size in 2015 was 15,839, 15,479, 17,627, and 12,921 seed/lb for Byrd, T158, TAM 111, and Winterhawk, respectively. All plots were planted on no-tillage fallow land. Harvest was done on July 4, 2015, and July 10, 2016, at Colby; June 29, 2015, and June 22, 2016, at Garden City; and June 30, 2015, and July 4, 2016, at Tribune. Growing season precipitation (October through June) for 2015 wheat was 14.03 in. at Colby, 12.18 in. at Garden City, and 12.83 in. at Tribune. For 2016, growing season precipitation was 12.36 in. at Colby, 11.31 in. at Garden City, and 14.32 in. at Tribune. Starter fertilizer was applied (5.5-26-0 (nitrogen, N; phosphorus, P; and potassium, K)) at Garden City and (6-20-0) at

Tribune in 2015 and 2016. The wheat was topdressed with 90 lb N/a at Colby, 30 lb N/a at Garden City, and 60 lb N/a at Tribune in 2015. In 2016, wheat was fertilized pre-plant with 90 lb N/a at Colby, and topdressed with 100 lb N/a at Garden City and 80 lb N/a at Tribune. Herbicides were applied in the spring for weed control: Ally Extra (0.5 oz/a) at Colby in 2015, and Huskie (15 oz/a) + Dicamba (2 oz/a) + Zidua (2 oz/a) in 2016; Starane Ultra (0.4 pt/a) + MCPA (0.75 pt/a) + Ally (0.1 oz/a) at Garden City in 2015 and 2016; and dicamba (4 oz/a) + Ally (0.1 oz/a) at Tribune in 2015 and 2016. Plot size was 7.5- by 30-ft at Garden City, and 5- by 40-ft at Colby and Tribune. Fungicide was applied for control of stripe rust at flag leaf emergence at Colby and Tribune in 2016. All treatments were replicated four times. Grain yields were determined by harvesting with a plot combine with moisture corrected to 13%.

Results and Discussion

Growing season precipitation was near normal for Garden City and Tribune and above normal for Colby in 2015. However, this was created by a wet May (6.38 in. in Garden City, 6.16 in. at Tribune, and 6.42 in. at Colby), making up for a dry winter and early spring. For 2016, rainfall was above normal for Tribune, slightly below normal for Garden City, and below normal at Colby. April was wet, with 5.16 in. at Tribune, 4.59 in. at Garden City, and 5.64 in. at Colby.

In 2015, averaged across seeding rates at Tribune, T158 and Winterhawk produced the greatest yields, with TAM 111 producing the lowest yields (Table 1). At both Colby and Garden City in 2015, T158 produced significantly higher yields than all other varieties. Stripe rust was prevalent in the 2015 growing season. Resistance ratings from the Kansas State University Department of Plant Pathology (publication MF991, Wheat Variety Disease and Insect Ratings 2016), with a scale of 1 being resistant to 10 being susceptible, were 8, 2, 8, and 6 for Byrd, T158, TAM111, and Winterhawk, respectively. Stripe rust infestation and associated yield reductions at Colby (and other locations) were consistent with these ratings.

At all sites averaged across varieties in 2015, there was a positive yield response to increased seeding rates, with greatest response when increasing from 30 up to 60 lb/a and minimal response above 60 lb/a.

Wheat yields were very good at all locations in 2016 (Table 2). The response to variety and seeding rate varied greatly across locations. Averaged across seeding rates, Byrd produced the greatest yields at Tribune, while it produced the lowest yields at Garden City. Winterhawk and T158 were the lowest yielding at Tribune, while they were the highest yielding at Garden City and Colby. There was a significant positive yield response to increased seeding rate at Tribune and Colby but no significant response to seeding rate at Garden City.

Based on 2015 results, it appears that a seeding rate of 60 lb/a was adequate for all locations. However, based on 2016 results and higher wheat yields (>70 bu/a), it appears that a seeding rate of 75 lb/a produced near maximum yields with little benefit from a 90 lb/a seeding rate. Variety selection had a significant effect on yield but was inconsistent across locations and years. There was no variety by seeding rate interaction at any location in 2016, showing that the seeding rate decision could be made independently of variety selection.

Table 1. Dryland wheat response to variety and seeding rate at three locations in 2015

Variety	Seeding rate	Grain yield			
		Tribune	Garden City	Colby	Average
	lb/a	bu/a			
Byrd	30	47	38	23	36
	45	53	42	25	40
	60	60	50	27	46
	75	54	51	29	45
	90	59	53	28	46
T158	30	59	72	45	59
	45	60	71	53	61
	60	64	79	56	67
	75	70	71	53	65
	90	71	65	55	64
TAM 111	30	39	34	20	31
	45	41	40	25	35
	60	43	44	28	39
	75	46	50	32	43
	90	45	52	34	43
Winterhawk	30	60	31	21	37
	45	67	41	25	44
	60	68	42	29	47
	75	64	51	34	50
	90	68	50	35	51

continued

Table 1. Dryland wheat response to variety and seeding rate at three locations in 2015

Variety	Seeding rate lb/a	Grain yield			
		Tribune	Garden City	Colby	Average
		----- bu/a -----			
ANOVA (P>F)					
Variety		0.001	0.001	0.001	0.001
Seeding rate		0.001	0.001	0.001	0.001
Variety × seeding rate		0.046	0.001	0.731	0.124
Location		---	---	---	0.001
Location × variety		---	---	---	0.001
Location × seeding rate		---	---	---	0.743
Location × variety × seeding rate		---	---	---	0.001
MEANS¹					
Variety					
Byrd		55b	47b	26b	43c
T158		65a	72a	53a	63a
TAM 111		43c	44bc	28b	38d
Winterhawk		65a	43c	29b	46b
LSD _{0.05}		2	3	3	2
Seeding rate (lb/a)					
30		51c	44c	27c	41c
45		55b	49b	32b	45b
60		59a	54a	35ab	49a
75		59a	56a	37a	50a
90		61a	55a	38a	51a
LSD _{0.05}		3	4	4	2

¹ Means within a column with the same letter are not statistically different at $P = 0.05$.

ANOVA = analysis of variance.

LSD = least significant difference.

Table 2. Dryland wheat response to variety and seeding rate at three locations in 2016

Variety	Seeding rate lb/a	Grain yield			
		Tribune	Garden City	Colby	Average
		----- bu/a -----			
Byrd	30	70	78	89	79
	45	76	79	100	85
	60	81	76	103	87
	75	86	79	116	94
	90	90	78	103	90
T158	30	60	107	102	90
	45	67	109	115	97
	60	69	110	107	95
	75	74	114	111	99
	90	73	115	115	101
TAM 111	30	63	89	95	82
	45	65	91	91	82
	60	72	90	106	89
	75	75	95	108	93
	90	77	96	110	94
Winterhawk	30	61	95	94	83
	45	65	99	100	88
	60	67	101	112	94
	75	70	105	111	95
	90	74	103	114	97

continued

Table 2. Dryland wheat response to variety and seeding rate at three locations in 2016

Variety	Seeding rate lb/a	Grain yield			
		Tribune	Garden City	Colby	Average
		----- bu/a -----			
ANOVA (P>F)					
Variety		0.001	0.001	0.029	0.001
Seeding rate		0.001	0.205	0.001	0.001
Variety × seeding rate		0.361	0.999	0.190	0.584
Location		---	---	---	0.015
Location × variety		---	---	---	0.001
Location × seeding rate		---	---	---	0.058
Location × variety × seeding rate		---	---	---	0.594
MEANS¹					
Variety					
Byrd		81a	78d	102b	90c
T158		68bc	111a	110a	96a
TAM 111		71b	92c	102b	88c
Winterhawk		68c	101b	106ab	91b
LSD _{0.05}		2	5	6	3
Seeding rate (lb/a)					
30		63d	92	95c	84d
45		68c	95	102b	88c
60		72b	94	107ab	91b
75		76a	98	112a	95a
90		78a	98	111a	96a
LSD _{0.05}		2	6	6	3

¹ Means within a column with the same letter are not statistically different at $P = 0.05$.

ANOVA = analysis of variance.

LSD = least significant difference.