A Comparison of Recommended and High Seeding Rates and Zero-Fungicide and Recommended Fungicide Treatments

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Objectives:

The objectives of this study are to determine if (1) seeding rate, (2) fungicide applications, and/or (3) their interactions affects spring wheat yields.

Justification:

Currently, the SDSU Extension Service has two seeding rate recommendations for spring wheat in South Dakota. Planting 1.2 million pure-live-seeds (PLS)/ac or about 28 PLS/ft^2 was the standard recommended plant rate for many years. Agri-business agronomists have suggested that a seeding rate of 2.4 million PL/ac or 56 PLS/ft^2 is more realistic for producers using intensive management practices. Past research by Hall et al. at SDSU has indicated there were no significant yield advantages to raising the recommended seeding rate of 28 PLS (1X), to rates of 42 PLS (1.5X), and to 56 PLS (2X)/ft^2. These seeding rates are equal to 1.22, 1.83, and 2.44 million PLS/ac, respectively. Hall et al. also determined the 1X, 1.5X, and 2X seeding rates resulted in 1.8, 1.4, and 1.1 harvested heads for each seed planted in the spring. The 1X rate produced one main and 0.8 secondary heads/plant, while the 2X rate resulted in one main and only 0.1 secondary heads/plant, or essentially one main head per plant.

In 2007, the SDSU Extension Service, as the result of testimonials from individual growers and agribusinesses, compromised and recommended that growers using intensive management practices plant 1.83 million PLS/ac or 42 PLS/ft^2. Many field agronomists felt, that although higher seeding rates did not increase yields, it did produce more main but fewer secondary heads. This was important to them because, main heads flower first, followed by any secondary and tertiary heads. Thus, the flowering period would be more uniform and shorter because nearly all of the plants would be main heads with few later-flowering secondary heads. Consequently, many field agronomist and spring wheat producers speculated they would gain more benefit from fungicide treatments applied at flowering, because the more uniform and shorter flowering period would afford better coverage and protection of the heads during the grain-filling period.

Although, SDSU currently has two spring wheat seeding rate recommendations, the 1.22 million rate (standard) and a higher 1.83 million PLS/ac rate (intensive management), there are still questions regarding the seeding rate issue for South Dakota. Questions include (1) is the intensive management seeding rate of 1.83 million sufficient or should it be raised to 2.44 million PLS/ ac? and (2) does either the 1.83 or 2.44 million PLS/ac really result in more uniform flowering, a shorter flowering duration, and better fungicide coverage and/or higher yields compared to the standard seeding rate of 1.22 million PLS/ac? In addition, with the emphasis on delivering crop biotechnology to the farm via seed, the potential for higher priced seed is real. Thus, a resolution to the seeding rate recommendations for spring wheat in South Dakota may be a very significant factor in determining production input costs in the future.

Materials and Methods

This study will be conducted at two locations (Table 1). The South Shore study will be located on or near the NE Research Farm and the second study will be located on the Allen and Inel Ryckman Farm of Warner, SD. Varieties will include Brick, Briggs, and Howard. Seeding rates will include a recommended 1X rate of 28 PLS, a 1.5X rate of 42 PLS, and a high 2X rate of 56 PLS/ft^2.

Plots will measure 5 feet wide by 20 feet long and will be seeded with a small plot cone-drill. The experimental design at all locations will be a stratified split-plot design. The design factors included variety, seeding rate, and fungicide treatment. There will 72 total plots per location (3 varieties x 3 seeding rates x 2 fungicide treatments x 4 blocks). Soil samples will be collected and tested prior to planting to determine how much fertilizer (soil test-N + applied-N) is needed to attain a 100 bu/ac yield goal at each location. Following crop emergence, two 2-foot sections of row will be randomly selected and flagged for the later collection of plant sub-samples prior to harvest.

A "moderately intensive fungicide" program will be compared to "no fungicide" for all variety*seeding rate combinations. This program will include Headline, applied at 6 oz/ac at flag leaf emergence (Feekes 8-9) followed by Prosaro applied at 5.7oz/ac when most main tillers are in flowering stage (Feekes 10.51). Prior to and following fungicide treatments, disease incidence will be determined as percent leaf area affected for each plot. Weed control will be applied as necessary.

Table 1. Summary of materials or soil tests required for spring wheat seeding rate study.

Materials	Location					
	South Shore			Warner		
Variety- maturity, days	Brick-0	Briggs-2	Howard-5	Brick-0	Briggs-2	Howard-5
Pure-live-seed rate/ft^2:	1X 28/ft^2	1.5X 42/ft^2	2X 56/ft^2	1X 28/ft^2	1.5X 42/ft^2	2X 56/ft^2
Soil fertility levels:						
Pre-plant soil test levels	N *lb*	P *ppm*	K *ppm*	N *lb*	P *ppm*	K *ppm*
Nutrients for 100 bu/ac yield goal:	N *lb*	P *ppm*	K *ppm*	N *lb*	P *ppm*	K *ppm*
Test recommendations	TBD[1]	TBD	TBD	TBD	TBD	TBD
Nutrients applied	TBD	TBD	TBD	TBD	TBD	TBD
Total requirements	TBD	TBD	TBD	TBD	TBD	TBD
Fungicide treatments: FL=flag leaf application H= headscab timing	0-Check[2]	FL+H[3] Headline, 6 oz/ac, Feekes 9.0		0-Check	FL+H Headline, 6 oz/ac, Feekes 9.0	
		Prosaro, 5.7 oz/ac, Feekes 10.51			Prosaro, 5.7 oz/ac, Feekes 10.51	
Herbicide(s) if needed Bronate, 1.0 pt/ac	2-leaf to early boot stage			2-leaf to early boot stage		

[1] TBD – to be determined. [2] 0-check or untreated. [3] Fungicide application.

Plots will be harvested with a Massey Ferguson 8XP small plot combine. Prior to harvest, whole-plants within each flagged section of row for sub-sample collection will be hand-pulled and bagged.

These sub-samples will be used to determine what effects variety, seeding rate, and fungicide treatment have on the density variables spikes (heads)/ft^2, seeds/spike, seeds/lb, and spikes/seed kernel. The first three density variables will indicate if the treatments influence yield by affecting spikes/ft^2, seeds/spike, and seeds/lb (seed size). The last variable spikes/seed kernel will determine if the treatments affected the number of spikes produced/seed kernel planted. The number of spikes and seeds (seed counter) in each sample will be counted. Spikes/ft^2, spikes/seed kernel, seeds/spike and seeds/lb (seed size) will then be calculated. A sub-sample of grain from each bagged subsample will be ground and submitted for vomitoxin (deoxynivalenol) testing. The harvested plot yield will be combined with the yield of the two sub-samples to obtain the final plot yield. Significant treatment effects and interactions (.05 level of probability) will be identified using the Statistical Analysis System (SAS) data analysis procedures.

The analysis of variance (ANOVA) model and plot layout this research trial is shown below.

Analysis of Variance (ANOVA) Table	
No. & Source	Degrees of freedom – *d.f.*
2—Spray–SP	1
4—Block–B	3
Error (a)–V x B	3
Total (a)	*(7)*
3—Variety–V	2
V x SP	2
Error (b)–(V x B) + (V x SP x B)	
Error (b)–6 + 6	12
Total (b)	*(16)*
3—Seeding rate–SR	2
SR x SP	2
SR x V	4
SR x B	4
SR x SP x V	6
Error (c)–(SR x SP x B) + (SR x V x B) +(SR x SP x V x B)	
Error (c)–6 + 12 +12	30
Total (c)	*(48)*
Total	71

Block-4

Variety	Seeding rate			Variety	Seeding rate		
Brick	V1SR1	V1SR2	V1SR3	Brick	V1SR1	V1SR2	V1SR3
Briggs	V2SR2	V2SR3	V2SR1	Briggs	V2SR3	V2SR1	V2SR2
Howard	V3SR3	V3SR1	V3SR2	Howard	V3SR2	V3SR3	V3SR1

Block-3

Variety	Seeding rate			Variety	Seeding rate		
Howard	V3SR2	V3SR3	V3SR1	Briggs	V2SR3	V2SR1	V2SR2
Brick	V1SR3	V1SR1	V1SR2	Howard	V3SR2	V3SR3	V3SR1
Briggs	V2SR1	V2SR2	V2SR3	Brick	V1SR1	V1SR2	V1SR3

Block-2

Variety	Seeding rate			Variety	Seeding rate		
Howard	V3SR3	V3SR1	V3SR2	Howard	V3SR2	V3SR3	V3SR1
Briggs	V2SR1	V2SR2	V2SR3	Briggs	V2SR1	V2SR2	V2SR3
Brick	V1SR2	V1SR3	V1SR1	Brick	V1SR3	V1SR1	V1SR2

Block-1

Variety	Seeding rate			Variety	Seeding rate		
Briggs	V2SR1	V2SR2	V2SR3	Brick	V1SR3	V1SR2	V1SR1
Howard	V3SR3	V3SR1	V3SR2	Briggs	V2SR1	V2SR3	V2SR2
Brick	V1SR2	V1SR3	V1SR1	Howard	V3SR2	V3SR1	V3SR3
	0-Check, untreated				Fungicide applied		

Project Deliverables: The preliminary first-year results from this study, were presented at the Ag. Horizons Conference at Pierre last November. In addition, the initial 2010 yield response to seeding rate has been incorporated into the Planting Guide chapter for the Best Management Practice production guide for wheat.

Conclusions for 2010 research results:

Although yield did respond to variety, seeding rate, and the variety x seeding rate interaction there was no consistent advantage to increasing seeding rates. This likely resulted from the fact the number of heads harvested per seed planted was 50 to 100% more at the 1X seeding rate compared to the 1.5X and 2X rates, respectively. Although, fewer seeds were planted at the 1X seeding rate, the increased number of heads produced by tillering compared to the 1.5X and 2X seeding rates, enabled the 1X rate to produce similar yields. The application of fungicide in 2010 was increased yields at South Shore and Warner, 13 and 4%, respectively. In addition, fungicide increased the seed size by 8 and 13% at South Shore and Warner, respectively.