Effect of Crop Stand Loss and Spring Nitrogen on Wheat Yield Components

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Objective:

- To quantify the affect of percent crop stand loss and spring nitrogen rate on soft red winter wheat yield.

Materials and Methods:

Field studies were conducted in the 2003-2004 winter wheat growing season at Columbia, Lamar, and Portageville, MO. The experimental design was a randomized complete block factorial design with four replications. The main plot factors were crop stand loss treatments of 0, 15, 30, 45, and 60% and spring nitrogen treatments of 0, 30, 60, 90, and 120 lbs. N acre^{-1}. Crop stand loss treatments were established by planting a mixture of spring oat and winter wheat in the fall of each year. Achieve herbicide was applied (0.625 lbs. acre^{-1}) at green up to control any spring oats that may have survived the winter. Spring N treatments were applied by hand at green up.

Truman wheat and Ogle oat seed were drilled on 7" centers at a seeding rate of 117#'s or 1,500,000 seeds acre^{-1} on October 7th, 22nd, and 23rd, at Columbia, Lamar, and Portageville, respectfully. Wheat followed soybean at Portageville and Columbia and corn at Lamar. A fall pre-plant application of 40-40-60 was applied at each location. Herbicide, insecticide, and fungicide were applied according to University of Missouri Extension recommendations. At each location tiller number (ft.$^{-1}$ row) was taken at green up and jointing. Wheat head number (3 ft.$^{-1}$ row) and crop height (inches) was taken just prior to wheat harvest. Wheat grain yield, test weight, thousand kernel weight, and kernel number head^{-1} were taken at crop physiological maturity and adjusted to 13% moisture.

Results and Discussion:

There was a significant location by main effect interaction ($P \leq 0.001$) for grain yield, test weight, thousand kernel weight, and kernel number head^{-1}, therefore data was separated by location. Within each location there was not a stand loss by N interaction ($P \geq 0.05$); therefore data were combined over main effects.

Crop tiller number at green up and jointing as well as wheat head number at harvest increased as percent stand loss decreased (Tables 1-3). The application of spring N stimulated wheat tiller formation at Portageville and Columbia, however additional tillers were not formed at Lamar. The application of spring N increased head number at Columbia and Lamar, but not Portageville. Crop stand loss and spring N had a variable affect on crop height depending upon location.

At Columbia and Lamar, grain yield decreased as percent crop stand loss increased (Figures 1-2). Grain yield also increased as spring N increased at these locations. At Portageville however spring N rate did not affect wheat yield (Figure 3). Crop test weight response to crop stand loss was variable among locations, however at each location test weight increased as spring nitrogen rate decreased (Tables 1-3). Thousand kernel weight increased as crop stand loss decreased and spring N increased at Columbia and Lamar. In contrast, at Portageville thousand kernel weight increased as crop stand loss increased and spring N decreased. At each location kernel number head^{-1} increased as crop stand loss and spring N increased.

Variability in the crop response to stand loss and spring N among locations may be a result of the residual soil N at each location. At Columbia, Lamar, and Portageville the wheat grain yield at the 0 pounds N acre^{-1} treatment were 50.1, 66.6, and 73.4 bu acre^{-1}. At Portageville wheat followed an 80 bu a^{-1} soybean crop whereas at Lamar wheat followed a 140.7 bu a^{-1} corn crop. Excess residual soil N may explain the variable crop yield response to spring N at Portageville.

Our results indicate the importance of accurately assessing residual soil nitrate levels in order to optimize crop yield and economic gain. Our results further suggest that even at a significant crop stand loss (up to 60%) wheat yield potential may be great enough as to not automatically warrant crop replacement. By incorporating wheat yield potential, previous crop contribution to soil residual N, spring N cost, and commodity price, growers may more accurately estimate whether a wheat crop should be kept or replaced.

Table 1. Effect of Wheat Stand Loss and Spring Nitrogen Rate on Truman Wheat Yield Components at Columbia, MO in the 2003-2004 growing season.

Treatment	Tiller number at green-up (ft^{-1} row) †	Tiller number at jointing (ft^{-1} row)	Head number ($yard^{-1}$ row)	Crop height (inches)	Grain yield (bu a^{-1})	Test weight	Thousand kernel weight (g 1000^{-1} kernels)	Kernels $head^{-1}$
Crop Stand Loss (Percent)								
0	64.3 a	63.5 a	91.1 a	34.8 a	71.1 a	59.2 ab	31.6 a	39.4 d
15	62.9 a	60.3 ab	86.5 a	35.2 a	66.1 b	59.7 a	31.5 ab	42.3 c
30	57.2 a	57.5 bc	84.5 a	35.3 a	68.6 ab	59.4 ab	31.3 ab	43.0 c
45	45.2 b	52.9 c	74.7 b	34.7 a	60.9 c	59.3 ab	31.4 ab	45.8 b
60	34.2 c	44.1 d	74.1 b	34.9 a	55.39 d	58.8 b	31.2 b	50.2 a
LSD: 0.05	7.7	5.8	8.4	0.6	4.4	0.6	0.3	2.0
Spring N Rate (pounds N a^{-1})								
0	54.2 a	45.4 c	65.6 d	32.4 d	50.1 d	60.0 a	31.9 a	41.2 c
30	51.8 a	54.5 b	79.6 c	34.6 c	60.1 c	59.9 a	31.4 bc	42.9 bc
60	51.1 a	57.0 ab	82.1 bc	35.7 b	65.4 b	59.2 b	31.7 ab	43.8 b
90	52.6 a	61.4 a	92.7 a	36.4 a	72.6 a	58.8 bc	31.1 cd	45.9 a
120	54.1 a	60.0 ab	89.9 ab	36.6 a	74.4 a	58.5 c	30.9 d	46.9 a
LSD:0.05	7.7	5.8	8.4	0.6	4.4	0.6	0.3	2.0

†Treatment means within the same column and treatment followed by the same letter were not considered different at $P \geq 0.05$.

Figure 1. Effect of Wheat Stand Loss and Spring Nitrogen Rate on Truman Wheat Yield at Columbia, MO in the 2003-2004 growing season.

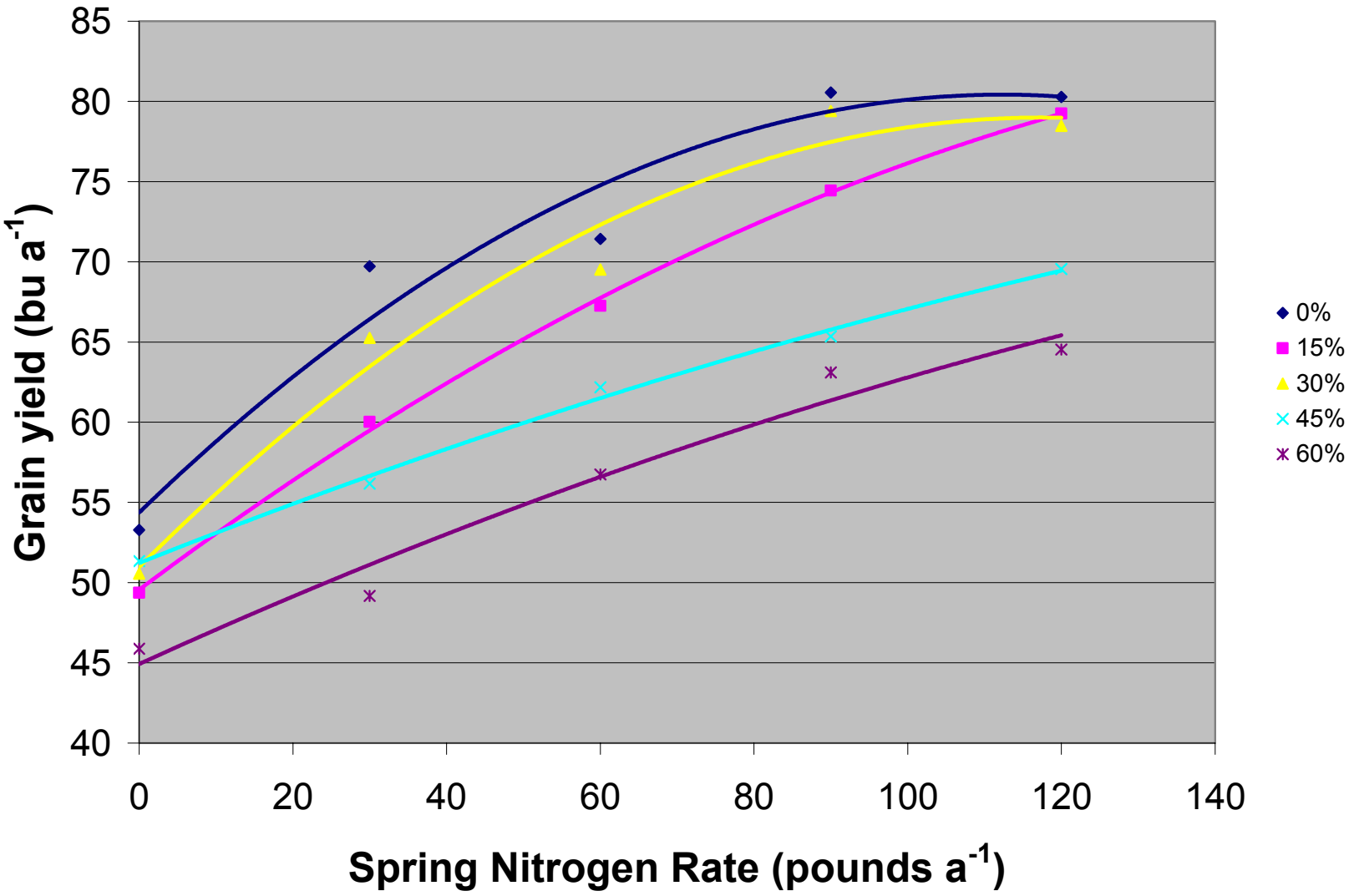

Table 2. Effect of Wheat Stand Loss and Spring Nitrogen Rate on Truman Wheat Yield Components at Lamar, MO in the 2003-2004 growing season.

Treatment	Tiller number at green-up (ft^{-1} row) †	Tiller number at jointing (ft^{-1} row)	Head number ($yard^{-1}$ row)	Crop height (inches)	Grain yield (bu a^{-1})	Test weight	Thousand kernel weight (g 1000^{-1} kernels)	Kernels $head^{-1}$
Crop Stand Loss (Percent)								
0	79.0 a	80.9 a	103.8 a	37.5 a	86.7 a	57.0 a	30.1 a	35.9 b
15	76.9 a	79.7 a	96.8 ab	37.4 ab	81.4 ab	57.0 a	29.9 ab	36.3 b
30	70.5 ab	72.4 ab	93.6 b	36.6 ab	76.8 bc	56.9 a	29.7 ab	37.5 b
45	65.7 b	69.0 b	91.6 b	36.6 ab	76.5 bc	56.6 a	29.4 bc	38.0 b
60	49.0 c	53.9 c	77.2 c	36.3 b	72.0 c	56.5 a	28.9 c	42.9 a
LSD: 0.05	9.5	9.9	9.3	1.1	5.5	0.5	0.6	2.4
Spring N Rate (pounds N a^{-1})								
0	66.7 a	67.6 a	83.6 c	34.1 c	66.6 d	57.1 a	30.1 a	35.3 b
30	73.0 a	74.4 a	89.4 bc	36.3 b	75.4 c	57.1 a	30.1 a	38.0 a
60	67.9 a	70.7 a	93.4 ab	37.8 a	80.2 bc	57.1 a	30.0 a	38.0 a
90	67.0 a	71.8 a	96.1 ab	38.0 a	85.0 ab	56.5 b	29.1 b	39.1 a
120	66.5 a	71.3 a	100.5 a	38.1 a	86.1 a	56.3 b	28.8 b	40.0 a
LSD:0.05	9.5	9.9	9.3	1.1	5.5	0.5	0.6	2.4

†Treatment means within the same column and treatment followed by the same letter were not considered different at $P \geq 0.05$.

Figure 2. Effect of Wheat Stand Loss and Spring Nitrogen Rate on Truman Wheat Yield at Lamar, MO in the 2003-2004 growing season.

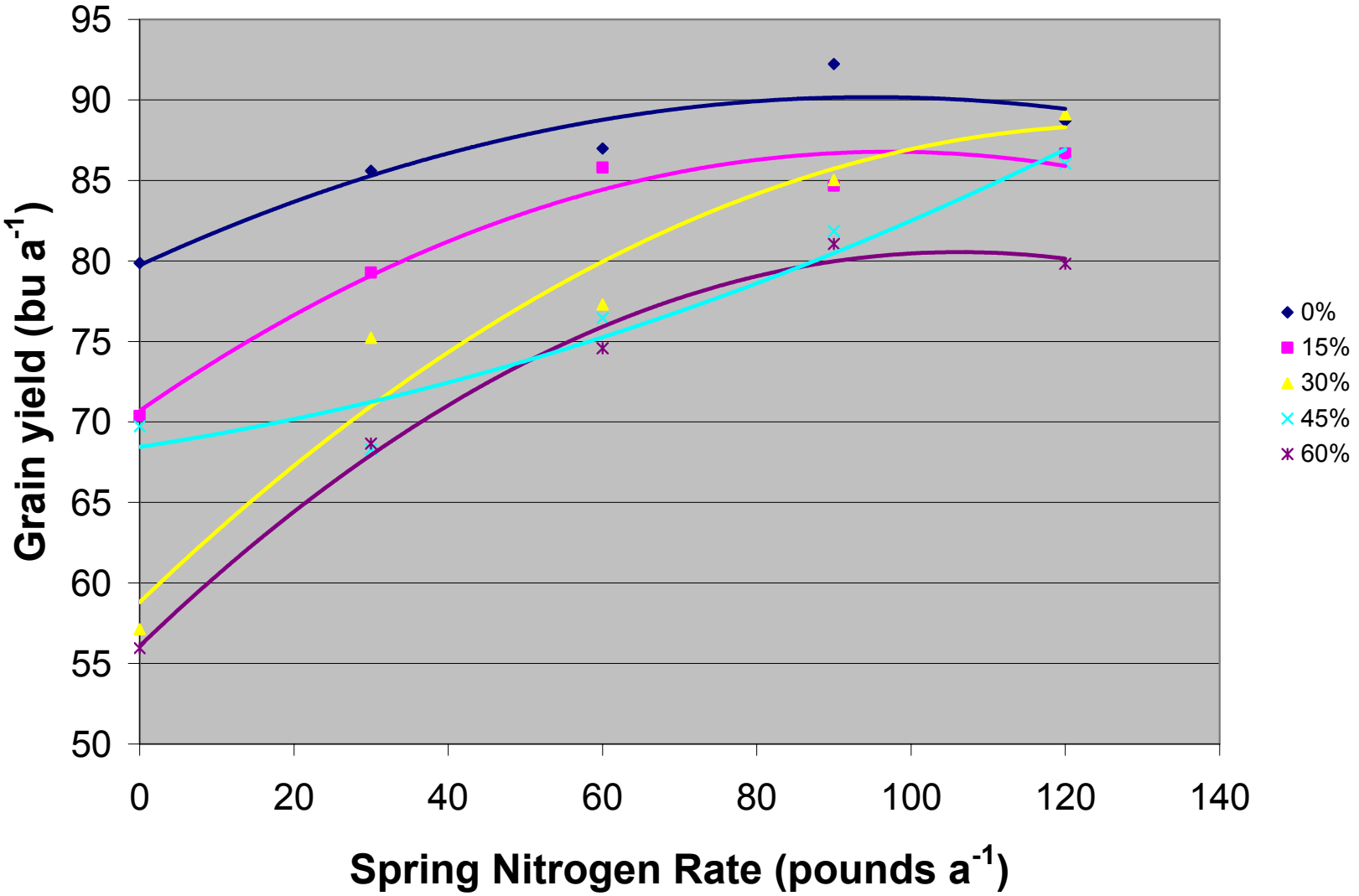

Table 3. Effect of Wheat Stand Loss and Spring Nitrogen Rate on Truman Wheat Yield Components at Portageville, MO in the 2003-2004 growing season.

Treatment	Tiller number at green-up (ft^{-1} row) †	Tiller number at jointing (ft^{-1} row)	Head number ($yard^{-1}$ row)	Crop height (inches)	Grain yield (bu a^{-1})	Test weight	Thousand kernel weight (g 1000^{-1} kernels)	Kernels $head^{-1}$
Crop Stand Loss (Percent)								
0	58.6 a	56.8 a	97.7 a	35.7 b	71.9 b	60.1 bc	26.2 c	50.0 b
15	53.5 ab	48.5 b	88.9 ab	36.9 ab	77.0 ab	59.1c	26.9 c	52.8 b
30	51.2 bc	44.7 bc	89.3 ab	37.2 a	80.6 a	59.9 bc	27.8 b	53.5 ab
45	46.1 c	42.8 c	81.6 b	36.3 ab	76.3 ab	61.2 ab	28.0 b	52.8 b
60	37.4 d	33.1 d	79.4 b	36.7 ab	73.8 b	61.5 a	28.8 a	57.0 a
LSD: 0.05	6.5	4.9	9.9	1.3	5.8	1.3	0.7	3.9
Spring N Rate (pounds N a^{-1})								
0	49.8 a	42.2 b	83.0 a	36.5 a	73.4 a	61.8 a	28.4 a	53.3 a
30	48.5 a	43.1 ab	86.3 a	36.8 a	77.2 a	59.9 b	27.8 a	54.4 a
60	50.8 a	46.9 ab	90.0 a	36.8 a	78.1 a	60.5 b	27.7 ab	53.8 a
90	50.6 a	46.2 ab	88.8 a	36.7 a	76.4 a	60.0 b	26.8 c	50.6 a
120	47.2 a	47.6 a	88.8 a	36.0 a	74.7 a	59.7 b	27.1 bc	53.9 a
LSD:0.05	6.5	4.9	9.9	1.3	5.8	1.3	0.7	3.9

†Treatment means within the same column and treatment followed by the same letter were not considered different at $P \geq 0.05$.

Figure 3. Effect of Wheat Stand Loss and Spring Nitrogen Rate on Truman Wheat Yield at Portageville, MO in the 2003-2004 growing season.