Wheat Yield and Economic Response to Nitrogen Rate and Timing of Application

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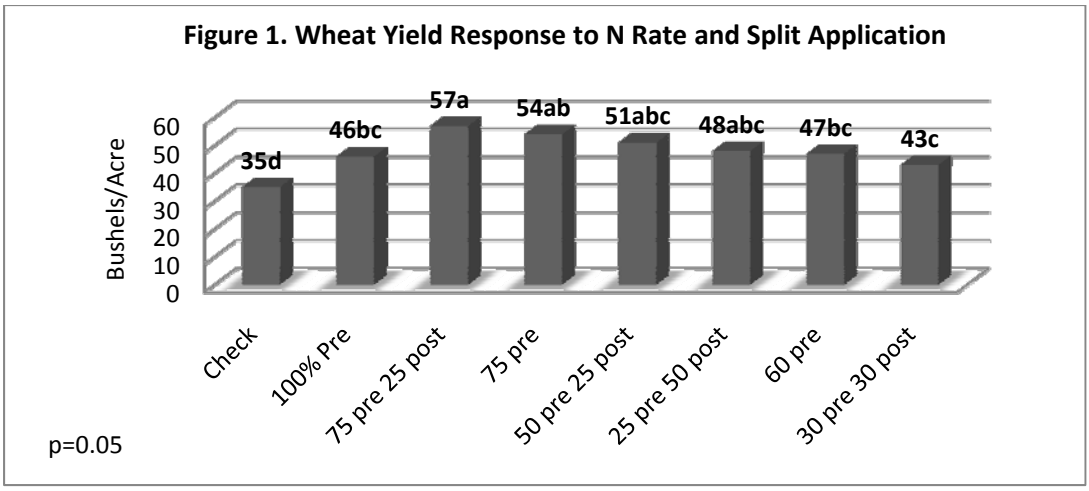
Introduction: Split nitrogen (N) applications to wheat are not a very common practice in ND. However, with wet soil conditions during the past several spring planting seasons, splitting N applications may decrease the loss of N applied at planting due to denitrification. Not only can crops more efficiently use N when split applications are made, but some producers wonder if the total N applied can be decreased with a split application. To address these questions, an experiment was initiated in 2009 at the CREC to look at the effects of split N applications and application rates less than the recommended rate on hard red spring wheat yield and kernel protein.

Experimental Design: A four replicate, randomized complete block study was initiated in the spring of 2009 with 8 treatments. Table 1 outlines the treatments used. The levels of N chosen are based on previous wheat research conducted at the CREC and other REC's showing some positive response of wheat to decreased N rates. The previous studies showed a significant drop in wheat yield when N rates were applied less than 60% of recommendations. Therefore, the base rates for this study were 100%, 75% and 60% of the total N recommendation. The three base rates were then applied all at planting or split into applications. To meet the fertility recommendations, the 100% rate required 102 lbs. of N/acre. The split applications were applied when the wheat was at the 3-4 leaf stage. Urea was the source of N at planting and 28% UAN was used as a spray over the top using a broadcast sprayer for postemergence applications. The pre-plant applications were made on 5/10/09 and the post applications were made on 6/10/09. The wheat was planted on 5/11/09. There was no visual leaf burning of the plants where postemergence N treatments were applied.

Table 1. Nitrogen Treatment Levels

Treatment	Treatment Description	Pounds of N applied/acre at planting	Pounds of N applied/acre postemergence
1	Check, no N applied	0	0
2	100% N applied at planting	102	0
3	75% N at planting, 25% applied postemergence	77	25
4	75% N at planting	77	0
5	75% of total N with 50% at planting, 25% applied postemergence	51	26
6	75% of total N with 25% at planting, 50% applied postemergence	26	51
7	60 % of total N at planting	62	0
8	60% of total N with 30% at planting, 30% applied postemergence	31	31

Results: Figure 1 shows that treatment 3, which was a split application of the full N recommendation with 75% applied at planting and 25% postemergence, had the highest yield of any treatment. The check treatment had the lowest yield. The 100% rate applied all at planting had the same yield as a 60% rate either applied at planting or split. Figure 2 shows that treatment 3 and treatment 2 had the highest protein levels. The check once again had the lowest protein levels.



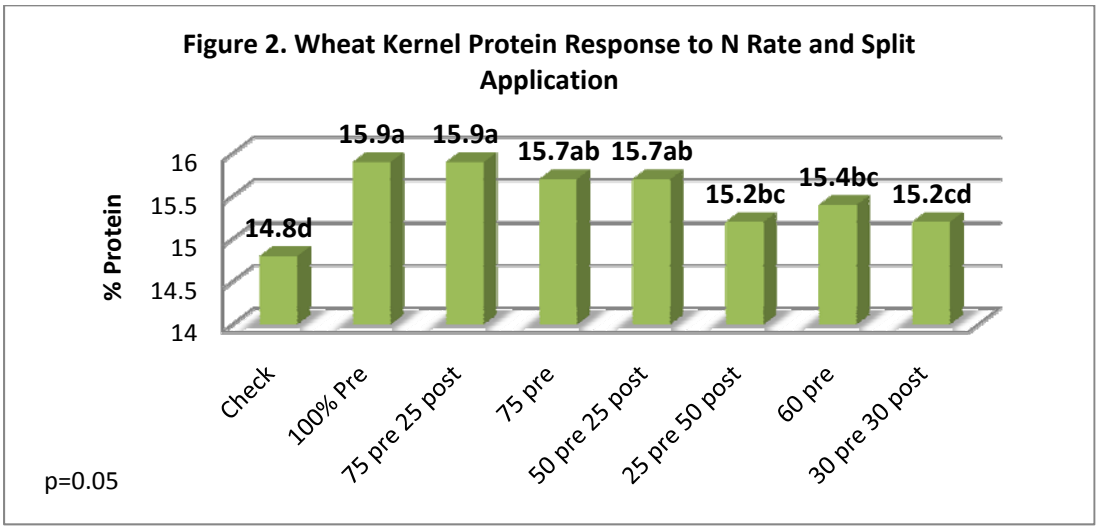


Table 2. Economic Return per Acre for Wheat Based on Nitrogen Inputs and Yield Using $0.30/lb N and $4.00/bu Wheat

Treatment	Bushels/Acre	Gross $/Acre	Nitrogen Cost/Acre	Return over total N cost/Acre ($)
Check, no N applied	35	140	0	**140.00**
100% N applied at planting	46	184	30.60	**153.40**
75% N at planting, 25% applied postemergence	57	228	30.60	**197.40**
75% N at planting	54	216	23.00	**193.00**
75% of total N with 50% at planting, 25% applied postemergence	51	204	23.00	**181.00**
75% of total N with 25% at planting, 50% applied postemergence	48	192	23.00	**169.00**
60 % of total N at planting	47	188	18.60	**169.40**
60% of total N with 30% at planting, 30% applied postemergence	43	172	18.60	**153.40**

Discussion: According to this single year study, a split application of the full N rate was the most effective method of supplying N to a wheat crop. Applying all of the N prior to planting wheat yielded similar or lesser yields than the split applications of N. Interestingly, the effect of the 75% N rate slightly lowered yield and protein numerically but was not clearly statistically less. The same effect is shown when comparing the 100% pre-plant N rate vs. any reduced N rate. Therefore, this study suggests that applying all of the N for wheat at pre-plant is not the most efficient. These results also help support wheat fertility recommendations based on economic yield vs. agronomic yield. As table 2 shows, the addition of fertilizer N regardless of treatment increased economic return. The brief economic analysis shown in table 2 does not account for any discounts for lower kernel protein. Therefore, the impact of a lower N rate on kernel protein has to be debated when deciding what is the best N rate that will give the highest economic return/acre for wheat production. This study will be repeated in 2010 to verify the results under different growing conditions.