Fertilizer Facts: June 1998, Number 20

Economic Value of Late-Season N Applications to Irrigated Spring Wheat

Mal Westcott, Gregg Carlson, Jeff Jacobsen, Joyce Eckhoff, Grant Jackson, and Bob Stougaard

Western Ag Research Center, Eastern Ag Research Center, Northern Ag Research Center, Land Resources & Environ. Science Dept., Eastern Ag Research Center, Western Triangle Ag Research Center and Northwestern Ag Research Center, Montana State University

The most effective N fertilization program for boosting yield and grain protein in irrigated spring wheat is to apply an initial rate of N targeted for optimum yield, followed with a topdressing at heading for enhancement of grain protein (Fertilizer Facts No. 11). Initial N rates should be based on soil nitrate testing in the spring, and late-season applications should be based on flag leaf N diagnosis (Fertilizer Facts No. 12). This approach is more N efficient and results in less residual soil nitrate than a program that attempts to achieve both yield and protein goals solely with early-season N fertilization (Fertilizer Facts No. 13).

When considering late-season N application, producers must be concerned with a sufficient increase in crop value to justify the extra cost of production. Since grain yields do not generally respond to N topdressing at heading, the increase in crop value is realized in the premium given with higher protein levels. The material cost of 40 lbs N/a fertilizer suitable for application through an irrigation system is currently about $12/a. In order to justify the late-season N application, the producer must realize an increase in crop value that exceeds $12/a.

Our objective was to analyze the economic value of late-season N. Does it pay? Is there a net gain in crop value resulting in a benefit to the producer? We addressed these questions by assigning dollar values to grain yield and protein response data collected from the ten experimental site-years reported in Fertilizer Facts No. 11. This work documented grain yield and protein responses to various initial N rates, with and without an additional application of 40 lbs N/a at heading, for three varieties of spring wheat (Len, Newana, and Hi-Line) at irrigated sites across Montana. Since none of the responses interacted with varieties, we report the data as averages across varieties. We specifically addressed the situation where initial N rates were optimal for yield, in order to avoid the exaggerated grain protein responses to late-season N found where initial N rates were low. We also ignored the situation where initial N rates were excessive for yield, since flag leaf diagnosis indicated little likelihood for grain protein response to late-season N in these cases.

First, the grain yield at the optimal rate of initial N fertilization was identified at each site (Fertilizer Facts # 11, Table 1). We then listed the grain protein levels attained with and without late-season N topdressing in that specific case at each site. A monetary value in $/bu was determined for each protein level each year based on the average daily market values for the Pacific Northwest as supplied by the Montana Wheat and Barley Committee. This value was multiplied by the yield level (bu/a) in order to determine the crop value ($/a). The crop value without N topdressing was then subtracted from the crop value with topdressing to determine the gross increase in crop value due to late-season N. The application cost of $12/a was then subtracted to determine the net increase in crop value.

There was a consistent, positive economic benefit from late-season N application in both years and at all sites (Table 1). In 1994, the grain protein increases due to late-season N resulted in bushel price increases of $0.29 to $1.10/bu and crop value increases ranging from $26.10 to $104.50/a. Net increases in crop value were all positive, ranging from $14.10 to $92.50/a, with a mean of $47.81/a.

Table 1. Effect of late-season N for irrigated spring wheat on grain protein levels, grain values, and crop values with optimum N rates.

Location	Optimum Yield		Late Season N		Gross Increase in Crop Value	Net Increase in Crop Value*
			none	40 lbs N/a		
	--bu/a--				*--$/a--*	*--$/a--*
1994						
Bozeman	90	Grain Protein, %	14.10	14.80		
		Value, $/bu	5.20	5.49		
		Crop value, $/a	468.00	494.10	26.10	14.10
Conrad	75	Grain Protein, %	12.30	14.30		
		Value, $/bu	4.20	5.30		
		Crop value, $/a	315.00	397.50	82.50	70.50
Huntley	95	Grain Protein, %	12.30	14.30		
		Value, $/bu	4.20	5.30		
		Crop value, $/a	399.00	503.50	104.50	92.50
Kalispell	69	Grain Protein, %	14.10	15.50		
		Value, $/bu	5.20	5.58		
		Crop value, $/a	358.80	385.02	28.00	16.00
1995						
Bozeman	58	Grain Protein, %	13.30	14.10		
		Value, $/bu	5.13	5.35		
		Crop value, $/a	297.54	310.30	12.76	0.76
Conrad	100	Grain Protein, %	13.30	13.80		
		Value, $/bu	5.13	5.28		
		Crop value, $/a	513.00	528.00	15.00	3.00
Corvallis	75	Grain Protein, %	11.70	13.20		
		Value, $/bu	4.86	5.13		
		Crop value, $/a	364.50	378.75	14.25	2.25
Huntley	72	Grain Protein, %	11.20	13.10	Improved marketability	
		Value, $/bu	no price quote	5.05		
		Crop value, $/a	no price	363.60		

			quote			
Kalispell	80	Grain Protein, %	12.80	14.10		
		Value, $/bu	5.00	5.35		
		Crop value, $/a	400.00	428.00	28.00	16.00
Sidney	60	Grain Protein, %	13.50	14.90		
		Value, $/bu	5.20	5.47		
		Crop value, $/a	312.00	328.20	16.20	4.20

*Based on an application cost of $12.00/a.

In 1995, the protein premiums were less than in 1994, so the increases in bushel prices ($0.15 to $0.35/bu) due to increased grain protein levels were not as great. Even so, the net increases in crop value were all positive, ranging from $0.76 to $16.00/a, with a mean of $6.44/a. At the Huntley site, where initial N was optimum for yield and no additional N was topdressed at heading, grain protein levels were 11.2%, below quoted price classifications. It is, therefore, difficult to place a firm value on late-season N in this specific case, but the increase to 13.1% protein with N topdressing greatly improved the marketability of grain.

The average net increase in crop value was $24.17/a across both years. This value may be skewed due to the very highly responsive sites at Huntley and Conrad in 1994, so the median value of $14.10/a (Bozeman 1994) may be a more realistic assessment of net value increase. Given these two estimates and an average of 181,000 acres of irrigated spring wheat harvested each year in Montana for 1994 and 1995 (Montana Agricultural Statistics), the potential value of late-season N application was $2.5 to 4.5 million/yr for Montana in this period.

Growers know that the market premium for higher protein levels will vary from year to year. That is why the economic benefits from late-season N were greater in 1994 than in 1995. In some years, there may be limited price advantage for higher protein levels. Awareness of market factors that add value to a product is important in considering late-season N application. Some examples of how varying yield levels and protein premiums can interact to affect the profitability of late-season N application are presented in Table 2. As is apparent, there are potential cases where an increase in grain protein level will not justify a late-season N application. For historical reference, the average premium for 14% wheat vs. 13% wheat was $0.38/bu for the period from 1994-1997, and $0.28/bu for the ten-year period of 1988-1997.

Table 2. Effect of yield levels and protein premiums on gross and net increases in crop value for hard red wheat.

Grain Yield, bu/a	**30 bu/a**			**50 bu/a**			**70 bu/a**		
Protein Premium, $/bu	0.20	0.30	0.40	0.20	0.30	0.40	0.20	0.30	0.40
Gross increase in crop value, $/a	6.00	9.00	12.00	10.00	15.00	20.00	14.00	21.00	28.00
Net increase in crop value,* $/a	-6.00	-3.00	0	-2.00	3.00	8.00	2.00	9.00	16.00

*** Based on an application cost of $12.00/a.**

Fertilizer Facts:

- **Late-season N application of 40 lbs N/a to irrigated spring wheat consistently increased net crop value by boosting grain protein levels at sites across the state of Montana in 1994 and 1995.**
- **The potential value of late-season N application to Montana's irrigated spring wheat crop is estimated at $2.5 to 4.5 million/yr for the two years of this study.**
- **Net increases in crop value due to late-season N application averaged $47.81/a at four sites in 1994 and $6.44/a at five sites in 1995. The mean across both years was $24.83/a and the median was $14.10/a.**

Edited by Jeff Jacobsen, Extension Soil Scientist