

OPTIMIZING NITROGEN FERTILITY RECOMMENDATIONS IN WINTER WHEAT



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Background

Nitrogen (N) rate and application timing are crucial to optimize winter wheat yield, protein content, and profit. Because significant N uptake occurs early in crop development, adequate early-spring N is critical to maximize winter wheat yield and protein content. Manitoba winter wheat N recommendations were developed in 2000 and may not reflect the improved yield potential and nitrogen use efficiency of modern varieties. This study assessed the optimum N rates and application timings for new, high-yielding winter wheat varieties to maximize yield, protein and return on investment (ROI).

Materials and Methods

- ▶ Between 2022–2024, field studies were conducted at Carberry, Arborg, Melita, and Roblin Crop Diversification Centre sites.
- ▶ Soils contained between 23–36 lbs/ac of residual nitrogen. P2O5 was applied at 30 – 35 lbs/ac in the seed row as MAP (11–52–0). All fertility treatments included Agrotain and/or ESN.

Key Points

- ▶ When data were combined, the split 134 lbs N/ac was the highest yielding treatment, but not significantly different than split 107 lbs N/ac, split 161 lbs N/ac, or spring 107 lbs N/ac treatments.
- ▶ Split 107 lb N/ac had the highest return on investment (ROI), but had returns similar to the spring-applied 107 lb N/ac.
- ▶ Yield response depended on growing conditions: spring-applied N performed as well as or better than split applications in wet winters/springs, while split applications performed better under dry winter and spring conditions.
- ▶ Available early-spring N is key to maximize winter wheat yield. Ensure spring N application occurs early and prior to stem elongation.

TABLE 1. List of experimental treatments that were applied to AAC Vortex and AAC Wildfire varieties. Fall applications were 50:50 Urea/ESN midrow banded, spring applications were Urea + Agrotain broadcast.

NITROGEN RATES	APPLICATION TIMING
Check (0 N applied)	
60 kg/ha (54 lbs N/ac)	Split: 50:50 Fall/Spring
90 kg/ha (80 lbs N/ac)	Split: 50:50 Fall/Spring
120 kg/ha (107 lbs N/ac)	Split: 50:50 Fall/Spring
150 kg/ha (134 lbs N/ac)	Split: 50:50 Fall/Spring
180 kg/ha (161 lbs N/ac)	Split: 50:50 Fall/Spring
120 kg/ha (107 lbs N/ac)	Spring 100%

WADO trial site near Melita MB in 2024, two weeks before harvest. Image courtesy DUC.

Results

► Application Rates and Timing

- o Across site-years, yield was highest at 134 lbs N/ac but did not differ significantly from the split 107 lbs N/ac, split 161 lbs N/ac and spring 107 lbs N/ac treatments (**Figure 1**).
 - › Yield response varied by growing conditions. In 2022, wet winter and spring conditions likely increased N loss from fall applications, and spring-applied 107 lb N/ac produced the highest yield. In 2023, dry conditions likely increased N stranding, favouring split applications, although effects were significant only at Melita
- o All treatments including the untreated check were able to achieve a protein content above 11%. As expected, grain protein increased with nitrogen rate. The spring 107 lbs N/ac, split 134 lbs N/ac and 161 lbs N/ac treatment achieved similar protein contents (**Figure 2**).
- o Split 107 lb N/ac had the highest ROI followed by spring-applied 107 lb N/ac. The 161 lb N/ac treatment had the lowest ROI (**Figure 3**). Assumptions included \$8/bu wheat and \$0.80/lb N, application costs excluded. Results are sensitive to shifts in crop and fertilizer prices

► Varieties

- o Both varieties responded similarly to N rate and timing, with no significant yield differences overall. AAC Vortex had consistently higher protein than AAC Wildfire (12.1% vs. 11.4%).

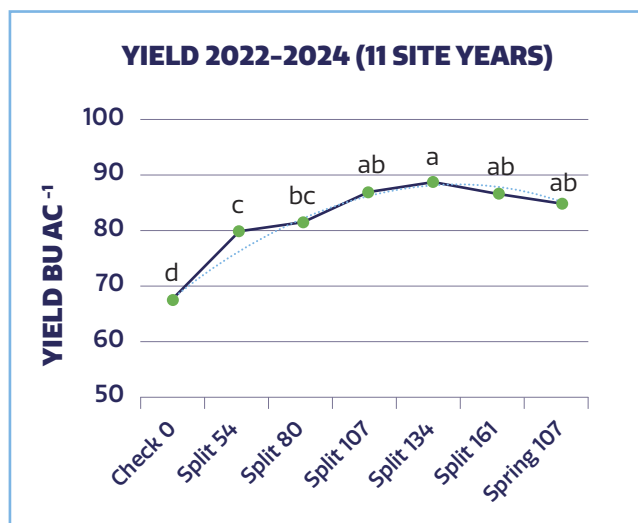


FIGURE 1. Winter wheat yield by nitrogen rate (lb N ac⁻¹) and application timing combined across site-years. Averages with the same letter are not significantly different at p<0.05.

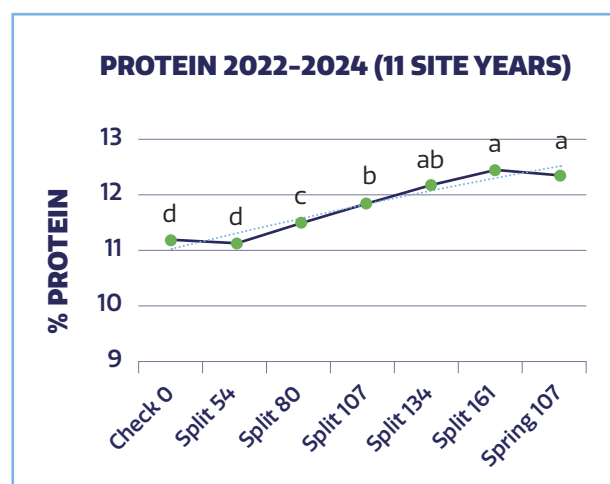


FIGURE 2. Winter wheat protein by nitrogen rate (lb N ac⁻¹) and application timing combined across site-years. Averages with the same letter are not significantly different at p<0.05.

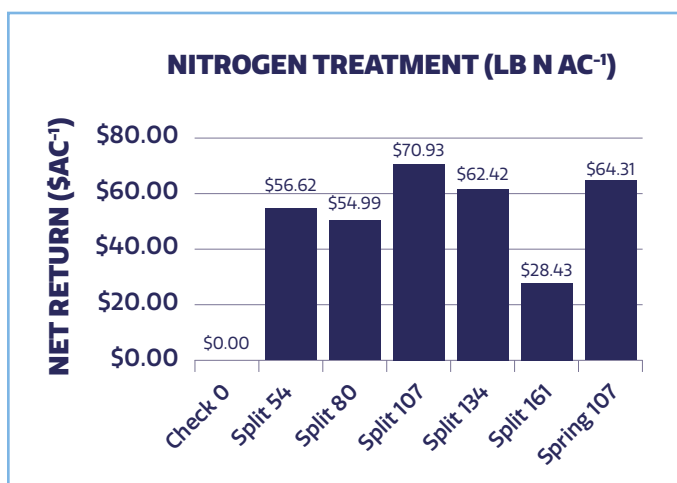


FIGURE 3. Return on investment for nitrogen rate and application timing based on average yield data. Crop value and fertilizer price based on \$8/bu and \$0.8/lb N.

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