OPTIMIZING NITROGEN FERTILITY RECOMMENDATIONS IN WINTER WHEAT

MANITOBA CROP ALLIANCE

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.

TABLE 1. List of experimental treatments included in this study.

NITROGEN RATES	APPLICATION TIMING	APPLICATION METHOD	FORM	VARIETY
Check (0 N applied)				AAC Vortex AAC Wildfire
60 kg/ha (54 lbs N/ac)	Split: 50:50 Fall/Spring	Fall – Midrow Banded Spring – Broadcast	Fall – 50:50 Urea/ESN Spring – Urea + Agrotain	AAC Vortex AAC Wildfire
90 kg/ha (80 lbs N/ac)	Split: 50:50 Fall/Spring	Fall – Midrow Banded Spring – Broadcast	Fall – 50:50 Urea/ESN Spring – Urea + Agrotain	AAC Vortex AAC Wildfire
120 kg/ha (107 lbs N/ac)	Split: 50:50 Fall/Spring	Fall – Midrow Banded Spring – Broadcast	Fall – 50:50 Urea/ESN Spring – Urea + Agrotain	AAC Vortex AAC Wildfire
150 kg/ha (134 lbs N/ac)	Split: 50:50 Fall/Spring	Fall – Midrow Banded Spring – Broadcast	Fall – 50:50 Urea/ESN Spring – Urea + Agrotain	AAC Vortex AAC Wildfire
180 kg/ha (161 lbs N/ac)	Split: 50:50 Fall/Spring	Fall – Midrow Banded Spring – Broadcast	Fall – 50:50 Urea/ESN Spring – Urea + Agrotain	AAC Vortex AAC Wildfire
120 kg/ha (107 lbs N/ac)	Spring 100%	Spring – Broadcast	Spring – Urea + Agrotain	AAC Vortex AAC Wildfire

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.

Results

- ***Application Rates and Timing***
  - 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
  - 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)***.
  - 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***
  - 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 $p<0.05$.

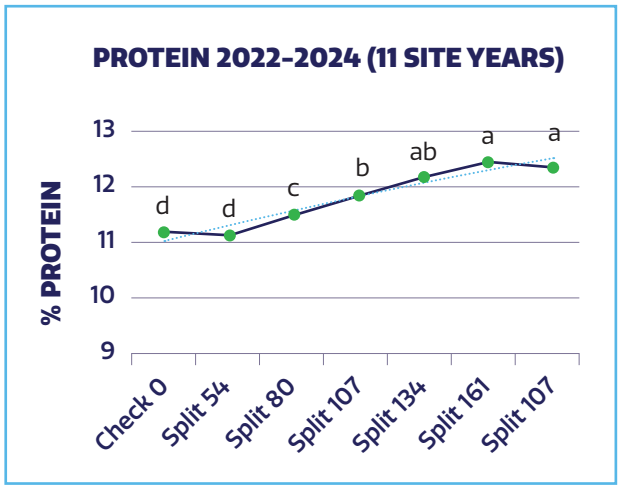

FIGURE 2. Winter wheat protein by nitrogen rate (lb N ac^{-1}) and application timing combined across site-years. Averages with the same letter are not significantly different at $p<0.05$.

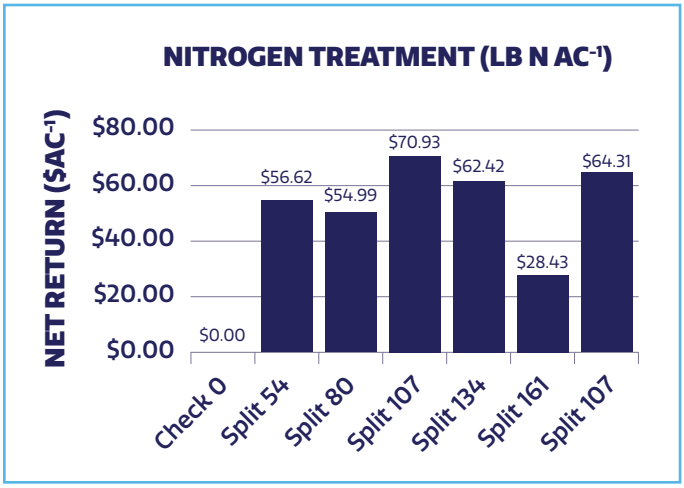

FIGURE 3. Return on investment for nitrogen rate and application timing based on average yield data. Crop value and fertilizer price based on $8/bu and $0.8/lb N.

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