Optimum Nitrogen Management in Spring Wheat Production

Location: Northwest and West-Central Minnesota

Variety: Knudson

Fertilizer: 40 lb P₂O₅, 60 lb K₂O, and 15 lb S

Seeding Rate: 32 plants ft²

Experimental Design: Randomized complete block with four replicates

Purpose of Study: To determine optimum nitrogen rates for maximizing grain yield and protein of spring wheat growth in northwest and west-central Minnesota.

Results:

Five locations were selected across MN. Soil test values and soil types varied by location (Table 1).

Yield and protein level varied by location (Table 2). Yields averaged around 100 bu/ac at all locations (not shown). The economic optimum nitrogen (N) rate (at the 0.05 price ratio) varied from between 108 to 127 lbs of N per acre except for at Site 3 in which there was no response to N due to high residual nitrate levels.

At individual locations yield responded differently (Figure 2). Yields where highly responsive to applied N up to the EONR value at Sites 1, 4, and 5. There was a small response to N at Site 2, but the relative increase per pound applied was small.

Protein levels averaged around 13.0 percent for all locations (Table 2). Nitrogen rates needed to maximize protein were higher than rates for yield at all locations (Figure 2).

Across locations the total N needed to maximize yield was 155 lbs of N per acre (Figure 1). Maximum yield was nearly 100 bu. per acre which equates to 1.5 lbs N per bu. to maximize yield. This level is nearly 1 lb lower than the recommended rate of 2.5 lbs of N per bu. Previous crop did not appear to be a factor in N response.
Relative protein potential increased linearly up to 208 lbs of N per acre (Figure 3). The amount of protein produced by only soil N was around 20% of the maximum protein across locations. On average it took 50 lbs of additional N applied at seeding to maximize protein over yield.

The relative amount of protein produced per acre (Figure 4) increased in a curvilinear fashion until a maximum at 220 lbs of total N (N applied in fertilizer + N in the 2’ soil nitrate test). Patterns of response were similar at all locations. At the maximum yield level (100 bu/ac) the amount of N needed to produce maximum protein yield was 2.2 lbs per bu. This amount is near the current recommended value for spring wheat.

** All N was applied as Urea broadcast and incorporated prior to seeding at each location.

Figure 3. Total nitrogen applied (fert. + soil) versus relative grain protein content (%) across locations in 2008 and 2009.

Figure 4. Total nitrogen applied (fert. + soil) versus relative protein produced per acre across locations in 2008 and 2009.