

Late Season Nitrogen Management: A Conversation with Elston Solberg



2019 has been another interesting year for many of our Crop Intelligence customers. Despite the early season challenges, it looks like there is a possibility that some crops will exceed yield goals. Last week, I (KG) asked Elston Solberg (ES) if he had any insight related to the potential for low protein wheat? For any of you interested in a little 'Norwegian Math' there were some great insights to be had.

KG: Farmer Sue has a yield goal of 60 bushels per acre (bu/ac) and Crop Intelligence tells her that the Water Driven Yield Potential is **+10** (70 bu/acre total). Enough groceries were added to achieve 60 bushels. The rains came late-ish in the season, but Farmer Sue and her agronomist both feel the crop is in good shape and the yield potential is at least 70. They are worried about protein because they know a wheat crop will dilute available nitrogen to grow more bushels, at the expense of protein content. Is there anything we can do now as the crop is already well into flowering?

ES: This is why I get so fired up about Crop Intelligence, because Sue and all the rest of our Crop Intelligence customers are already way ahead of the game. We are actively measuring crop available water and Water Driven Yield Potential. Water stress reduces yield and concentrates protein. Big yields dilute protein. The plant will most always make a bushel before it makes protein. If your target is 60 bushels, and we have the crop available water to grow 70+, then low protein is a given. Unless nitrogen rates are adjusted based on Water Driven Yield Potential.

First things first... when we talk about protein content in wheat – there are **three magic numbers**:

1. **13.5%:** Grain protein content of 13.5% in Hard Red Spring Wheat means your crop has achieved its yield potential for the overall water and management system. Protein content less than 13.5% means that yield was left on the table (as well as protein). The lower the protein, the more yield that was left on the table.

2. **4.7%:** When taken at early flag leaf, tissue tests with 4.7% nitrogen (or greater) are a good indicator that you are on track for optimal yield and protein.
3. **1/6th:** Protein is roughly 1/6th nitrogen. In other words, divide protein by 6 to determine the nitrogen content.

There are another couple of important assumptions based on the literature. For each pound of wheat grain, we also grow 1.3-1.5 pounds of straw and chaff (residue), which contains 1/4 - 1/3 the protein of the grain. The lower the grain protein, the lower the nitrogen content of the residue.

- 10 bushels @ **13.5%** = (600 lbs of grain x (13.5%/6)) = 13.5 lbs in grain + 4 lbs in residue = 17.5 lbs N (1.75 lbs/bu)
- 10 bushels @ **12%** = (600 lbs of grain x (12%/6)) = 12 lbs in grain + 3 lbs in residue = 15 lbs of N (1.5 lbs/bu)

KG: Wait a minute, why do we account for 2.3-2.7 pounds of nitrogen for each bushel when we are crop planning, while you are telling me that I only need 1.75 pounds of N to grow a bushel with optimal protein content?

ES: When you are crop planning, you need to account for all the management system inefficiencies, immobilization, nitrogen losses (volatilization, leaching, denitrification, weeds, etc.), nutrient imbalances (especially N:S, N:K, Ca:B), etc.

KG: Also wait! ... It only takes 2.5 pounds of nitrogen to increase 10 bushels protein by 1.5%!? What?!

ES: This question leads us to consider the efficiency of applied in-crop nitrogen as it relates to yield and protein increases. We can assume 50-80% efficiency depending on timing, product, application method, rate of application, weather, etc., etc., etc.

KG: OK, cool. But what does this all mean for Farmer Sue?

ES:

- 60 bushels at 13.5% means the crop contains 81 pounds of N in the grain and 32 pounds of N in residue = 113 pounds of N total.
- 70 bushels at 13.5 % means the crop contains 95 pounds of N in the grain and 37 pounds of N in residue = 132 pounds of N total.
- Difference = 19 pounds of N. So, if this crop hits 70+ bushels, the protein content will be diminished by at least 2% (to 11.5%), keeping in mind that total yield potential will also be reduced. Lose. Lose.

For this scenario, we would need to apply 19 pounds of nitrogen after anthesis to re-capture protein. This assumes 100% efficiency. In my experience, a realistic expectation for this timing would be 1% additional protein and if we assume 70% efficiency of applied N, then a responsible application rate would be 14-15 pounds of N per acre after anthesis.

KG: How late is too late?

ES: We have a window after anthesis to claw back some protein with foliar or streamed nitrogen.

KG: Yeah, but...what about all the other things that impact protein? Anything else Farmer Sue should be thinking about?

ES: Well, of course! Water and nitrogen are the two most important factors related to protein, but there are a lot of other agronomic considerations that play a role in achieving optimal protein:

- **Sulphur** – S is an important component of 2 specific amino acids which build protein. N:S balance is critical to optimize yield and enhance protein levels.
- **Potassium** – N:K balance is critical for lots of reasons. Once crops achieve N:K and N:S balance efficiency of yield and protein go up.
- **Other nutrients** – **Copper** is critical, **Boron** is as well. Low **Phosphorus** has the potential to mess things up by reducing yield potential and delaying maturity.

- **Agronomics** – seeding rate and depth play an important role. Seeding too light or too deep will cause excessive tillering, which will mess up yields and protein. There were a lot of cereal crops this year with lower than ideal plant stands as related to dry conditions earlier in the spring. These fields may similarly faced with yield limitations.

I hope some of you have made it to the end of this conversation. If you have positive Water Driven Yield Potential in a wheat crop, this is something you should be thinking about. Every farm is different, and this knowledge requires the context of the specific agronomy on your farm, and of the economics. When protein premiums are high, there are opportunities to increase net income. More importantly, avoiding the discounts for low protein is often more critical than gaining the premium for high protein as there have been years when the discount has been as much as three times the premium.

Crop Intelligence: Know your numbers. Realize your potential.

Written by Elston Solberg with Kendall Gee.