MSU professor recommends methods to boost wheat grain protein mid-season

July 5, 2017 -- MSU News Service

BOZEMAN – Clain Jones, Montana State University soil fertility Extension specialist, suggests Montana irrigated wheat farmers consider providing additional nitrogen to their crop, calling it the most important management factor to produce high protein levels this year.

In an effort to maximize the amount of nitrogen absorbed by the crop and increase protein for the 2017 harvest, Jones recommends several nitrogen application methods for Montana farmers. In general, Jones said, protein is more likely to increase with late-season nitrogen. He said the decision to apply late-season nitrogen to increase protein depends on whether nitrogen can be applied without substantially damaging the crop and if the expected protein response and discount are sufficiently high to justify the cost of fertilizer and application.

Jones, who manages MSU's Soil Fertility Extension Program in the Department of Land Resources and Environmental Sciences in the College of Agriculture, encourages agricultural producers to consider using nitrogen to boost protein sooner rather than later.

"Timing of in-season nitrogen application should be based on plant growth stage rather than a particular date," Jones said. "The weather is also an important factor. It's not recommended growers apply nitrogen for dryland fields, unless significant rainfall is predicted."

Nitrogen applied before heading will most likely improve yield if soil moisture is available, while nitrogen taken up during and after heading should increase protein, he said.

The ability to incorporate nitrogen fertilizer with rain or irrigation is more important than application exactly at flowering, according to Jones. The later that foliar nitrogen is applied, the greater the risk of leaf burn, Jones said.

"A consideration of nitrogen application with irrigation water is the risk of scab, which increases with irrigation within five days of flowering," he said.

Nitrogen concentration in the flag leaf (uppermost leaf of the stem) at heading can be measured to determine whether a late-season nitrogen application will boost protein, according to Jones.

"Based on Montana research, grain protein is likely to increase with late-season nitrogen if the flag leaf nitrogen concentration at heading is less than 4.2 percent," he said. "The potential response to nitrogen increases as the flag leaf nitrogen concentration decreases, but low flag leaf nitrogen concentrations also mean it will take more nitrogen to make high protein."

The ratio of fertilizer cost to protein discount may influence whether applying additional nitrogen is justified at a given flag-leaf concentration. For example, according to Jones, with a 45 cent discount per one percentage point protein and urea at $433 per ton, the flag leaf nitrogen concentration needs to be below about 4 percent to cover the fertilizer expense. If either the protein discount is lower or the cost of fertilizer higher, then the critical flag-leaf nitrogen needs to be lower yet, to justify additional nitrogen, Jones said.

“Unfortunately, flag-leaf analysis cannot tell you how much nitrogen to add, or the final protein level,” Jones said. "More late-season nitrogen is required to increase protein by a point as yield potential increases.”

For example, 30 pounds nitrogen per acre is expected to boost irrigated wheat protein by about one point for a 60 bushel-per-acre yield, but only half a point for a 120 bushel-per-acre yield, according to Jones’s review of the research pubished in the MSU Extension bulletin, Practices to Increase Wheat Grain Protein.

However, Jones cautions that there may be a limit to how much late-season nitrogen can be applied to boost protein due to increased risk for lodging and leaf burn at high nitrogen rates.

Applying liquid nitrogen with fertigation is the best mid-to-late-season application option to limit stand damage and prevent leaf burn, Jones said. If nitrogen is applied with a flat fan, Jones suggested that no more than 30 pounds nitrogen per acre of urea ammonium nitrate solution, or 45 pounds nitrogen per acre of liquid urea, should be applied to minimize burn and yield loss.

“Little nitrogen is actually taken up through the leaf surface,” he said. “Foliar nitrogen needs to be washed off the leaf and moved into the soil by a half-inch of water in a single event. For this reason, combined with a hot and dry forecast through at least July 13, 2017 additional nitrogen is not recommended on dryland fields unless the chance for rain greatly improves.”

Response to nitrogen is also dependent on sufficient sulfur, Jones said.

“If a grower sees yellowing upper leaves, the crop may be sulfur deficient, whereas nitrogen deficiency shows up as yellowing lower leaves,” Jones said. “A foliar application of three to five pounds sulfur per acre as ammonium thiosulfate or ammonium sulfate should correct the problem, but, as with nitrogen fertilizer, foliar sulfur is dependent on sufficient rain or irrigation water to wash the sulfate into the root zone.”

While nitrogen for boosting protein should be addressed now, especially on spring wheat fields where yield goal will likely be met or exceeded, Jones recommends reading an issue of The Soil Scoop, “Nitrogen Management for Grain Protein," which presents a synopsis of overall management practices to improve grain protein in the future on both dryland and irrigated fields. The Soil Scoop is a publication by the Soil Fertility Extension Program. More information about soil fertility is available at http://landresources.montana.edu/soilfertility.

Contact: Clain Jones; 994-6076; clainj@montana.edu