Optimizing Wheat Nitrogen Fertilizer Rates
A New Tool For North Carolina Producers

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Historical Spring Nitrogen Rate: Nitrogen (N) fertilizer rate recommendations developed in Virginia and based on GS-30 tissue test N level have been available for many years. They use the N concentration detected in a tissue sample collected at GS-30 to optimize spring wheat N rates. Research in North Carolina, however, has shown that the Virginia recommendations can overestimate the required N for our growing conditions. Therefore, a new system has been developed that is helpful in optimizing wheat N fertilizer rates specifically for North Carolina producers. This research indicates that N rates based on a tissue test are most reliable for wheat grown on well-drained soils. This new system and subsequent recommendations are critical for a successful wheat crop when N prices are high and growers need to minimize input costs without compromising yield. Following are the steps and information needed to determine the optimum N rate.

Step 1: Determine the Growth Stage: As temperatures warm in spring, tillering stops, and the wheat crop’s demand for N increases rapidly. This is the beginning of stem elongation, often referred to as growth stage 30, or just GS-30. GS-30 is the best time to apply N fertilizer to winter wheat.

When wheat reaches GS-30 is influenced by variety, planting date and environmental conditions. Early-heading varieties can reach it in February. Late-heading varieties may not reach GS-30 until mid-March. One clue that the wheat is at GS-30 is that the plants start to stand up and get taller. However, the best way to tell if wheat is at GS-30 is to pull up several plants and split the stems down their centers all the way to the base where the roots grow. Prior to GS-30, the growing point will be at the very bottom of the stem just above the first roots. At GS-30, the growing point will have moved 1/2 inch up the stem. After GS-30, it will move further up the stem and be above the soil surface.

Step 2: Collect Tissue and Biomass Samples: Two pieces of

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2 Randy Weisz: Crop Science Department at NC State University. Ben Knox: Regional Agronomist with NC Department of Agriculture & Consumer Services. Some materials in this publication have been adapted from Intensive Soft Red Winter Wheat: A Management Guide, Blacksburg: Virginia Polytechnic Institute Cooperative Extension Service.
information are needed to determine the optimum N rate: tissue %N and biomass. At GS-30, a tissue sample is taken by cutting wheat plants from 20 to 30 representative areas in the field. The plants should be cut 1/2 inch above the ground. Soil and dead leaf tissue must be removed and the cuttings placed in a paper bag labeled “tissue.” The %N is detected in this tissue sample. For the most accurate N rate recommendation, an estimate of above-ground biomass is also required. At one representative location in the field, cut all the wheat along a 36-inch section of row, remove any soil and weed tissue, and place the entire sample in a second paper bag labeled “biomass.” The biomass or weight is detected in this sample. The two samples should be shipped to the NCDA&CS Agronomic Division immediately. If samples have to be stored for more than 24 hours after collection, they must be dried to prevent spoilage and loss of biomass.

**Step 3: Use the Chart and Table with the Plant Report:** An example of the NCDA&CS plant report is shown in Figure 1. In this example, the dry weight of the biomass cut from the 36-inch length of row was 36 grams and the tissue %N was 3.5. Using the biomass dry weight and the %N values, N fertilizer recommendations are determined using either the BLUE, RED or GREEN line in Chart 1. Low biomass wheat fields use the BLUE line. Medium biomass fields use the RED line. High biomass fields use the GREEN line. The easiest way to determine which line to use is with Table 1. Find the “biomass” value on the left side of Table 1. Look across the table to find the drill row spacing used in the field. The intersection of the correct drill-row column and the dry-weight row indicates which colored line to use. If the drill row spacing in the “SHOP” field (Figure 1) was 6 inches, then Table 1 indicates the GREEN line should be used to get a N fertilizer rate recommendation.

If the wheat was broadcast there will not be any drill rows to sample and Table 1 cannot be used. In broadcast fields, the biomass dry weight in a square yard will need to be estimated. Low biomass fields are defined as those with less than 84 grams of dry biomass per square yard. Medium biomass fields are defined as those with 84 to 157 grams dry weight per square yard. High biomass fields have more than 167 grams dry weight per square yard.
**Example 1: Low Wheat Biomass Example**: The plant report shows the biomass sample weighed 8 grams and the tissue sample had a N content of 3.5%. The wheat was planted in 6-inch rows. Table 1 indicates the BLUE line in Chart 1 is the correct one to use as this is a low biomass wheat field. Finding 3.5% on the horizontal axis of Chart 1 and using the BLUE line show the recommended N fertilizer rate is 71 lb per acre. Thin wheat fields could result from late planting or from fall temperatures that were too low to promote tillering and growth. In fields like this, the Virginia (dashed line) and North Carolina system (BLUE line) make very similar N rate recommendations.

**Example 2: Medium Wheat Biomass Example**: The plant report shows the biomass sample weighed 25 grams and the tissue sample had a N content of 3.5%. The wheat was planted in 7-inch rows. Table 1 indicates the RED line in Chart 1 is correct for N fertilizer rate recommendations as this is a medium biomass wheat field. Finding 3.5% on the horizontal axis of Chart 1 and using the RED line show the recommended N fertilizer rate is 46 lb per acre. In medium biomass fields, the Virginia system (dashed line) tends to overestimate the N fertilizer rate required to optimize yield and economic return especially for wheat with N content greater than 3.5%.

**Example 3: High Wheat Biomass Example**: The plant report shows the biomass sample weighed 36 grams and the tissue sample had a N content of 3.5%. The wheat was planted in 7-inch rows. Table 1 indicates the GREEN line in Chart 1 is correct for N fertilizer rate recommendations as this is a high biomass wheat field. Finding 3.5% on the horizontal axis of Chart 1 and using the GREEN line show the recommended N fertilizer rate to be 0 lb per acre. High biomass fields can result from high carry-over N from a previous crop, fall manure application, or unusually warm fall and winter weather that promoted excess tillering. In these fields, the VA system (dashed line) overestimates the GS-30 N fertilizer rate.
Don’t Let a Sulfur or Potassium Deficiency Rob Wheat Yield Potential

Sulfur-deficient wheat does not assimilate N fertilizer efficiently so it is important to make sure adequate sulfur (S) is available at GS-30. In addition to the percent N content, the NCDA&CS plant report also gives levels of other plant nutrients, including S. These levels can be checked against the critical values shown in Table 2.

A tissue S content less than 0.25%, or a nitrogen-to-sulfur ratio greater than 15, indicate that S is limiting and the wheat will likely benefit from an application of 20-30 lb S per acre at GS-30.

Coastal Plains wheat producers who have deep sandy soils can also use the GS-30 tissue test to optimize potassium (K) fertilizer inputs. This is especially important for producers who may have skipped or reduced preplant K fertilizer for their wheat and for the following double-cropped soybeans. Ideally, growers who have wheat on deep sandy soils should submit both a GS-30 tissue sample and a diagnostic soil sample from the same field. Tissue K levels less than 2.0% indicate that the wheat crop is deficient. If the soil sample also shows low K-index levels, K fertilizer will be needed as soon as possible for the wheat crop, and certainly before the subsequent soybean crop is planted.

Getting On-farm Help with Tissue Testing

For assistance with GS-30 tissue testing, North Carolina wheat producers can call on their NCDA&CS regional agronomists and/or county extension agents. Growers can find contact information for their regional agronomists at http://www.ncagr.gov/agronomi/rahome.htm and for their county extension agents at http://www.ces.ncsu.edu.

This publication and additional wheat production information can be found online at http://www.smallgrains.ncsu.edu.