Cornell University
Cooperative Extension

Agronomy Fact Sheet Series Fact Sheet 88

Estimating Fall Nitrogen Uptake by Winter Cereals

Introduction

Nitrogen (N) is essential for crop production, but crop N needs are difficult to predict due to uncertainty of the weather and inability to accurately predict N supply and loss. Insufficient N will impact yield and crop quality while excess N can be lost to the environment through leaching (most typical in well-drained soils) or denitrification (more likely in poorly drained soils). Cover crops planted after the harvest of a main crop like corn can take up and sequester end-of-season N. Actual N uptake depends on growth (total biomass accumulation) prior to the winter.

Winter cereals, including wheat, cereal rye and triticale, are increasingly used as cover crops after corn silage as they can reduce erosion risk, add organic matter to the soil, and capture end of season nitrogen. These winter cereals have a greater cold tolerance than many other cover crops. In New York, winter cereal above ground biomass accumulation in the fall typically ranges from 0.25 to 1.5 tons per acre. This fact sheet shows the relationship between total N content in winter cereal cover crop and its above ground biomass (shoots), and also presents a step-wise method of determining total N uptake in the fall. Such assessments can guide nitrogen management.

Estimating N Content of Cover Crops

There is a strong linear relationship between the above ground biomass (shoot only) and total N uptake (roots and shoots combined) of wheat, cereal rye, and triticale grown as a winter cover crop in corn rotations in New York (Figure 1). The differences in N content among the three species are very small as long as the total biomass is less than 1.2 tons of dry matter per acre. The relationships between above ground biomass and total N uptake were very consistent among different locations (farm fields), suggesting that the equations in Figure 1 can be used independent of soil type. Thus, a farmer or farm advisor can determine the above ground biomass of these winter cereals in his or her fields and then estimate total (below and above ground) N in the cover crop.

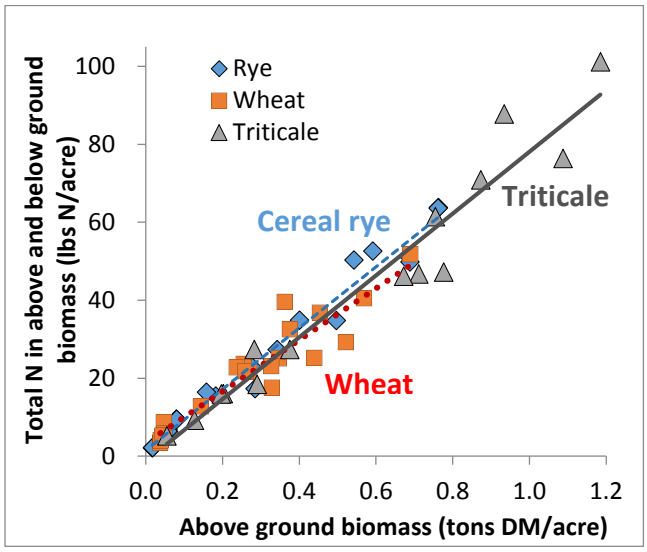

Figure 1: Relationship between above ground biomass of dry matter (tons/acre) and the total nitrogen (lbs/acre) uptake by winter cereal between seeding after corn silage and a killing frost in late fall or early winter.

Step-wise Protocol to Determine N Uptake

1. Create a sampling frame (for example a 24 by 12 inch wooden frame) and precisely measure its length and width in inches.
2. Place the sampling frame in a representative location of the field whose biomass and N content you want to estimate. Clip all above ground biomass of the winter cereal that is within the frame, as close to the soil surface as possible, while avoiding soil contamination, and place the sample within a bag large enough for samples from 3 frames. Sample when the plants are dry (avoid sampling when there is dew, rain, or snow).
3. Repeat the sampling process at two more representative sites in the field, collecting samples from all three locations in the same bag.
4. Measure the total weight of the sample collected in pounds (lbs). Make sure to subtract the bag weight itself so that only plant weight is included in the total.
5. If your sample does not have much external moisture, you can assume it has about 18% dry matter, then skip step 6 and continue

with step 7. If you want to estimate total biomass and N content more precisely, continue with step 6.

6. After carefully mixing the sample in the sampling bag, take a subsample of approximately 0.25 lbs from the harvested biomass, and determine the weight of the subsample in pounds (if the weight of the total sample is 0.25 lbs or less, skip the step of taking a subsample). Dry the subsample with a microwave until it has obtained a stable weight. Use short drying periods of 30-60 seconds and place an 8-oz glass of water in the corner to avoid burning of the sample. More detailed instructions of drying with a microwave can be accessed at http://extension.psu.edu/publications/i-106. Once the weight has stabilized, measure the final dry weight. The dry weight divided by the initial weight is the percent dry matter.
7. Once you have all data collected, access the Cornell University "Fall Nitrogen and Carbon Pools of Winter Cereals" calculator (http://nmsp.cals.cornell.edu/software/calculators.html). Select the species and enter your information for frame length, frame width, number of samples taken, total wet weight, subsample wet and dry weight. The calculator (Figure 2) will report the percent carbon (C) and N, the C to N ratio, estimated biomass (tons/acre dry matter), and total C and N pools (lbs/acre). Table 1 shows the N content of different winter cereals.

Table 1: Nitrogen content of different winter cereals seeded after corn silage harvest and measured before a killing frost in New York.

Cereal cover crop	Fall nitrogen (N) content
	---- %N of dry matter ----
Cereal rye	4.07
Wheat	3.72
Triticale	3.89

Summary

Cover crops are important for erosion control and soil health. In addition, winter cereals are effective in taking up N in the fall. A calculator is developed to estimate how much N is accumulated by the onset of the winter in winter cereals planted as cover crops (biomass less than 1.2 tons of dry matter per acre). This calculator converts estimates of the above ground biomass to total C and N uptake by the winter cereal (roots and shoot combined). The calculator can guide the determination of manure application rates in the fall.

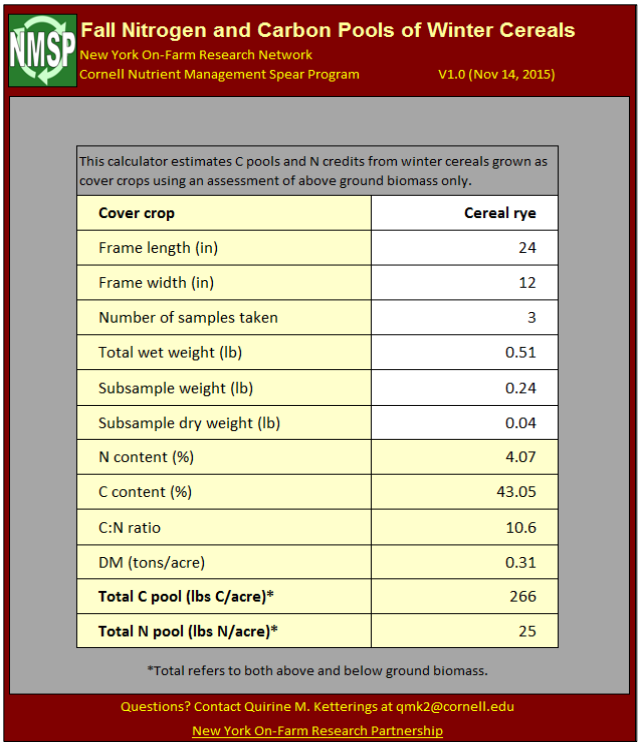

Figure 2: Cornell University "Fall Nitrogen and Carbon Pools of Winter Cereals" calculator.

Additional Resources

- Cornell University "Fall Nitrogen and Carbon Pools of Winter Cereals" spreadsheet calculator: http://nmsp.cals.cornell.edu/software/calculators.html.
- Penn State University "Determining Forage Moisture Content With a Microwave Oven": http://extension.psu.edu/publications/i-106.

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

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Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

Zhehan Tang, Quirine Ketterings, Karl Czymmek, Sheryl Swink and Paul Cerosaletti

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