Field Crops, Forages and Soils Updates for NNY **February 2022**

Nitrogen Credit for a Winter Rye Cover Crop - Every Little Bit Helps

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With fertilizer prices continuing to rise to unprecedented highs, we've spent a lot of time and pencil lead working out strategies to stretch that budget line as much as possible this spring. We've written articles about manure value and how to use it as efficiently as possible, as well as making the most of sod and soil organic matter N credits. It makes sense to consider every potential source of N when fertilizer N costs $1.00 or more per pound. There is one more source of N to consider – winter cover crops.

North Country farms seem to have planted more acres of winter rye each fall over the past several years. What was uncommon a decade ago is now quite common in the north country – corn fields with a little green growth going into snow season. By the time we arrive at spring field-fitting time, there's usually not a lot of rye biomass there, but there's often enough to consider its N contribution, especially in a year with record-high N prices.

A winter rye cover crop provides several benefits to a farm field, including several impacts to N dynamics. The winter cereal, if planted early enough to provide good fall growth, will take up leftover fertilizer N, and fall-applied manure-N, and keep it from leaching away over the fall, winter, and early spring months. An inter-seeded or early-planted cover crop will scavenge more N than a late fall-planted rye crop. The winter cereal may also reduce leaching losses by simply taking up soil water, so depth of N movement is reduced. Another factor to consider is the maturity of the rye cover crop at termination. Small, vegetative stands of winter rye can contribute some N to a subsequent crop as those low C:N residues decompose. More mature stands of rye can decompose much more slowly and can have a temporary negative impact on N availability to a subsequent crop, due to N immobilization by a high C:N plant residues. Taking all this into consideration, there are a few guidelines for figuring N credits for the following crop. We need to know 3 things: how much biomass is present, what is the %N in that biomass and lastly, how much of that N will be available to the next crop this season?

Here in NNY, we typically plant winter rye cover crops quite late, after corn silage (or even after corn grain) is taken off in late September and early October. About 120 base 40 °F growing degree-days (GDD_{40}) are needed for winter rye to emerge, and another 120 GDD_{40} will push the rye to tillering stage. Average GDD_{40} over the past 15 years for 7 North Country locations from October 1 to April 30 are listed in Table 1. Planted on October 1, fall growth is relatively small, progressing beyond a single shoot but not typically to tillering. Fall development will typically be limited to reaching Feekes stages 1 or 2. Fall N capture is slight, with these small plants. Spring

Figure 1. Photo on the left shows about 50 lbs of winter rye biomass per acre. Photo on the right shows about 250 lbs of winter rye biomass per acre. (Photos by K. O'Neil, 2013.)

warmth will spur further growth, which will continue until termination, which commonly occurs in late April to late May, providing another 300-400 GDD_{40}. Growth stage at this point is likely to progress beyond tillering but not all the way to stem elongation, producing plants in Feekes stages 2 to 5. Depending on seeding date and rate, rye biomass accumulation could be as little as 250 or as much as 1000 lbs of plant DM per acre by May 1. So how would you know if it is closer to 250 or 1000 lbs of DM?

The best way to know how much biomass is present at termination is to use a standard sampling scheme to collect biomass from a few small precise areas, dry it and weight it and calculate a lbs-per-acre equivalent. After doing this a few times over a few springs, you may feel comfortable with a visual, ballpark assessment. Two pictures are shown here depicting 50 and 250 lbs per acre rye biomass in spring. Dry matter content of young vegetative rye is likely to be 14 to 20%. Cornell Nutrient Management Spear Program's Agronomy Factsheet #88 outlines how to convert winter cereal biomass determined for a small area to total DM estimated in the biomass

Table 1. Base 40 °F growing degree-day averages (15 years) for 7 locations in NNY.

Location	GDD_{40} Oct 1 through Dec 31	GDD_{40} Jan 1 through Apr 30	Total GDD_{40}
Talcottville	157	320	477
Evans Mills	237	413	650
Ogdensburg	194	364	558
North Lawrence	219	389	607
Chateauguay	180	345	526
Beekmantown	201	387	588
Whallonsburg	214	392	606
Average	200	373	573

With the biomass quantity calculated, the next step is to figure out %N of that biomass. The best approach will be to submit a few samples to a lab for a standard forage analysis, if time permits. (Time will likely permit this step as any N credit calculated for cover crop biomass should be applied to sidedress N, not starter N fertilizer.) Most forage analyses report crude protein (CP) as a % of DM. Like most grasses, cereal rye vegetative stages are relatively high in N content and this concentration decreases with advancing maturity. Keep in mind the speed that rye can grow and mature – both biomass quantity and %N can change significantly in just a few days. Rye at Feekes stage 2 to 4 will likely contain from 2.5 to 3% N or more, while Feekes stages 5-6 could decline toward 2% N. Once stems have elongated and the rye plants approach flowering, N content may decrease to 1% N or below. A stand of rye at more mature stages will contain more N per acre than a lower biomass stand of vegetative rye, but the N may well be less available to the subsequent crop due to a higher C:N ratio.

The third and last step is to estimate how much of rye biomass N will be available to the subsequent crop. We do not have much Northeast US research to base this estimate on, but Oregon State researchers suggest 30 to 40% of the N in young, vegetative rye will be available to the subsequent crop while less than 10% may be available for more mature rye. If vegetative rye residue is incorporated, this availability could increase to 50% according to Minnesota researchers. Putting this all together, here are a few examples that may describe some spring winter rye situations on NNY farms. These examples are not predictions or meant to substitute for real, accurate measurements on your farm.

Table 2. Two examples of rye cover crop N contributions that could apply to NNY farms.

Plant Date	Termination Date and Method	DM Yield	Harvested for spring forage?	%N in DM	C:N Ratio	Total N, lbs /acre	N fertilizer credit, lbs N/acre
Oct 1	May 5, tilled	800 lbs/acre	no	2.8	low	22	11
Oct 1	May 5, no-till	800 lbs/acre	no	2.8	low	22	9
Oct 1	May 20, no-till	2000 lbs/acre	no	1.5	high	30	3
Oct 1	May 20, mowed	2000 lbs/acre	yes	1.5	high	30	0

Research in NY and north central US have found rye cover crop to contain anywhere from 5 to 75 lbs of N when planted in October and terminated in May. The examples in Table 2 provide a modest amount of total N, but the maturity and termination differences determine widely different fertilizer credit estimates. Lastly, any credit calculated for winter rye cover crop N contributions should be credited against sidedress N applications. Starter N fertilizer should remain as normal based on other considerations.

Summary: A young, vegetative winter rye cover crop can contribute a small amount of N to a subsequent crop and in 2022, this small amount may have significant fertilizer value this spring, across a whole farm, when N costs $1 per pound or more. The amount of plant-available N provided will depend on the amount of biomass, the maturity and N content of that biomass and its availability to the subsequent crop. Sampling and analysis will provide the best method of estimating biomass and N content while the availability of that N must be estimated. Four examples of how this rye cover crop may potentially impact N fertility are summarized in Table 2.

Additional Resources:

1. Ketterings, Q., S. Swink, S. Duiker, K. Czymmek, D. Beegle, and B. Cox. 2008. Nitrogen Benefits of Winter Cover Crops. Cornell University Nutrient Management Spear Program, Agronomy Factsheet #43. http://nmsp.cals.cornell.edu/publications/factsheets/factsheet43.pdf
2. Tang, Z., Q. Ketterings, Q., K. Czymmek, S. Swink and P. Cersoletti. 2015. Estimating Fall Nitrogen Uptake by Winter Cereals. Cornell University Nutrient Management Spear Program, Agronomy Factsheet #88. http://nmsp.cals.cornell.edu/publications/factsheets/factsheet88.pdf
3. Andrews, N., and D. Sullivan. 2010. Organic Fertilizer and Cover Crop Calculator. Oregon State University Extension Service. http://smallfarms.oregonstate.edu/calculator
4. Sullivan, D., N. Andrews, C.S. Sullivan, and L.J. Brewer. 2019. OSU Organic Fertilizer & Cover Crop Calculator: Predicting Plant-available Nitrogen. Oregon State University Extension Service. https://catalog.extension.oregonstate.edu/em9235/viewfile

For more information about field crop and soil management, contact your local Cornell Cooperative Extension office or your CCE Regional Field Crops and Soils Specialists, Mike Hunter and Kitty O'Neil.

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