Considerations for Cover Crops

By Matt Ruark and Francisco Arriaga, UW-Madison Extension Soil Scientists; Kevin Shelley, UW-NPM Program; Jim Stute, Michael Fields Institute (former UW-Extension Rock County Ag Agent)

During concerns of drought, it is likely that residual nitrate concentrations in the soil will be high, especially if corn was harvested early as silage or if yields are well below expected. One benefit of planting cover crops after corn silage, small grain, or a processing vegetable crop, or after a manure application is that the cover crop can take up residual nitrate and reduce the risk of nitrate leaching between harvest and planting. Other benefits of cover crops include reduction in soil erosion and weed suppression. This article focuses on using cover crops for nutrient conservation benefits rather than growing cover crops for forage.

Cover crops to trap nitrate. The ideal cover crops for a nitrate trap crop are grass crops that establish quickly, such as cereal rye (aka winter rye), oat, barley, annual ryegrass (aka Italian ryegrass), and sorghum-sudangrass. These cover crops also have a fibrous root system. Brassicas (e.g. radish, turnip, mustard) and legumes (clover, hairy vetch) will also take up residual nitrate, but do not establish as quickly. Radish has been popular cover crop in no-till systems and, if planted early enough, radish can take up as much or more N compared to grass cover crops during the winter, but grass cover crops can scavenge N deeper into the soil profile. The radish will winterkill, while rye will continue to grow (and take up N) in the spring. Oats, barley, sorghum-sudangrass, and annual ryegrass will typically winterkill during Wisconsin winters. However, growers have noted that annual ryegrass can be difficult to control if it survives the winter and is not completely killed with tillage.

The planting timing and seeding density of these cover crops is very important for establishment. Our recommendations for seeding rates (drilled) are 90-112 lb/ac for rye, 15-20 lb/ac for annual ryegrass, and 80-110 for oat, 60-90 lb/ac for barley, and 35-40 lb/ac for sorghum-sudangrass. Apply toward the higher end of the range with later plantings (especially after Sept. 15th), in weedy fields, or if broadcast seeded. Grass cover crops are more likely to establish during the fall months, while legumes and brassicas need to be planted in summer months to ensure a quality stand.

Legume cover crops (i.e. green manure crops) will also take up residual N; high residual nitrate environments will cause nodulation to be delayed. However, if the goal is to trap N or grow a cover crop to provide soil conservation benefits, we would not recommend planting legumes. If the goal is to supply N to the subsequent crop, then legumes would be recommended. The N contribution from a green manure crop is called "nitrogen credits". This N credit means that when you terminate the legume prior to planting, you can reduce your N fertilizer by the value of the credit. The total amount of N in the biomass will be greater than the "credit", as not all of this organic N will be mineralized for the subsequent crop. The credit is based on field research, comparing optimum N rates when using green manures to optimum N rates when not using green manures. Late plantings of legumes are not ideal, as at least 6" of growth is needed to produce a predictable N credit.

Do we get the "trapped" N back? The N taken up by a cover crop is cycled back into the soil during the decomposition of the plant biomass. The release of N into the soil is, in-part, a function of the carbon to nitrogen (C:N) ratio of the plant material. In general, the decay of plant material with a C:N ratio between 20 to 30 results in no net contribution to, nor consumption of, plant available N. Plant material with a C:N ratio less than 20 can result in a net excess of N after microbial decomposition. As the microbes breakdown the material, N is produced in excess of what the microbes need to function, and thus, this N is available for plant uptake. As a result, the termination of a cover crop like red clover, which typically has a C:N ratio of 15, is equivalent to an application of 40 to 80 lb/ac of N fertilizer depending on plant height. However, grasses and brassicas have a C:N ratio of 20 or greater, resulting in no net effect to available N. If the C:N ratio of the plant material is greater than 30:1, net immobilization can occur, meaning that N from the soil is consumed (i.e. immobilized) by microbes during the decomposition process, resulting in a decrease in plant available N. Grasses tend to increase in C:N ratio as they grow. For this reason, we recommend killing rye cover crops as early as possible in the spring to minimize any effect of immobilization.

The low C:N ratio materials (e.g. red clover) also breakdown much more rapidly compared to grasses and brassicas. This results in greater synchrony of N release with periods of high N uptake by the corn crop. Release of N from the grass crops does occur, but often occurs later in the growing season, after peak N uptake rate for corn has occurred. Thus, we do not recommend taking an N credit for grass cover crops. However, the slow breakdown of grass crops, along with their higher C:N ratio, can lead to a greater contribution of organic material to the soil, which can increase the soil organic carbon and soil organic nitrogen content over time. The extensive root system also can lead to an increase in soil organic carbon in the subsurface soil, which can be beneficial for fertility and water retention. These types of soil building benefits will not be realized after only one year of cover cropping, but instead, is a long term effect of using cover crops as part of the cropping system.

There are tremendous benefits to water quality with growing a cover crop after manure application in the late summer or fall. While this trapped N will not likely become plant available the following year, as previously mentioned, there are other long-term benefits of trapping the manure nitrate in plant biomass and incorporating this biomass into the soil. If concerned about the amount of time required for application of both manure and cover crops, slurry seeding of cover crops has been shown to be a viable method. The slurry seeding method creates a one-pass system where cover crop seeds are tank mixed with the manure.

Continued on next page...

Continued from previous...

What about water use? Another reason to kill the rye as early as possible in the spring is to minimize water uptake. After a drought year, severe yield losses on corn are expected on fields where rye was harvested as a forage crop in May (following a previous crop of corn silage). The deep, fibrous root system consumed too much subsurface water and with the drought conditions, this subsurface water was not replenished, thus creating a worse-case scenario for this type of double forage-cropping system.

Popular options for cover crop use:

- If interested in scavenging excess N, plant rye, oats, or ryegrass to get quick establishment and soil coverage. Of these three crops, only rye will survive the winter. Make sure you kill the rye as early as you can in the spring.
- If interested in supplying N, grow a legume. An option that would be recommended through August 15th is planting berseem clover with a companion crop of oats. The oats will establish first and take up some of the excess N in the root zone, and if planted early enough, the berseem clover will establish nicely, outgrow the oats, and provide an N credit for the following crop. Oats/berseem can be planted in August, but good growth will depend on adequate moisture. A recommended seeding rate would be 8 to 10 lb/ac for berseem clover and 40 to 55 lb/ac for oats. Both the oats and berseem clover will winterkill.

Drought Stress Reduces Corn Silage Yield More Than Quality

By Joe Lauer, UW-Madison Extension Corn Agronomist

Farmers trying to decide about using drought affected corn fields must first determine success of pollination. If pollination will affect grain yield, then growers must follow directions given by hail adjusters to ensure insurance payment. If the decision is made to harvest the field for silage, then it must be cut at the proper moisture; the crop is usually wetter than it appears.

Yield of drought affected fields is usually reduced. But buyers and sellers of corn silage often ask, "How does drought affect corn silage quality?" Sellers look at drought affected corn and either are disappointed and just try to get what they can for the field, or give up, plow it down, and start planning for next year. Buyers look at a drought affected corn field and wonder how well cattle can produce milk or beef from the silage and what additional feed supplements will be necessary for the feed ration.

Environments with drought stress prior to pollination

Two environments (Arlington-2005 and Marshfield-2006) had drought stress prior to pollination, followed by timely rains during pollination and grain-fill. Plants in these environments were short (i.e. < 6 feet tall), but had average to above average grain yield for the location. Forage yield tended to be reduced slightly in these drought affected environments compared to normal environments. For example at Arlington during 2005, forage yield of 55 hybrids was 8.9 T/A while 2003, 2004, and 2006 forage yield averaged 9.1 T/A. NDF content was lower and starch content was greater resulting in higher than average Milk per Ton. Corn plants were shorter but had a greater proportion of grain in the silage. Thus, quality as measured by Milk per Ton was not affected, and yield as measured by Milk per Acre and forage yield was similar to other environments.

Environments with drought stress extending into grain filling

Environments that had drought stress extending into grain filling were Chippewa Falls-2005,2006, Marshfield-2003, 2005, and Spooner-2005, 2006. At Spooner the same hybrids were planted on a dry land silt loam site and under a site with center pivot irrigation.

Drought stressed environments extending into grain filling had 18 to 46% lower forage yield than normal environments (drought v. normal environments: Chippewa Falls= 6.2 v. 7.6 T/A= 18%; Spooner silt loam= 3.6 v. 6.6 T/A= 46%). Usually starch content was reduced. Silage quality, as measured by Milk per Ton, was reduced 3 to 8% in drought stressed environments (Chippewa Falls= 8%; Spooner silt loam= 3%). Milk per Acre was reduced 24 to 50% in drought stressed environments (Chippewa Falls= 24%; Spooner silt loam= 50%).The Spooner irrigated site followed similar trends although the magnitude of the difference between drought stressed and normal environments was not as great.

Summary

Environments where drought stress occurs prior to pollination and is followed by rainfall during pollination and grain filling, produced corn silage with increased NDF and starch content, but no change in forage yield, Milk per Acre or Milk per Ton. Environments where drought stress extends into grain filling, produced corn silage with lower starch content, 18 to 46% lower forage yield, 24 to 50% lower Milk per Acre, but only 3 to 8% lower Milk per Ton. Plant height is reduced in both of these environments. Success of pollination influences grain and silage yield, the proportion of grain in silage, but little impact is measured on silage quality.