

CROP TALK

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Table of Contents

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Hugh Martin, Organic Crop Production Program Lead
Horst Bohner, Soybean Specialist
Ian McDonald, Applied Research Coordinator
Albert Tenuta, Field Crop Pathologist
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Cold Temperatures Delay Nodulation and Reduce Nitrogen Fixation

by Horst Bohner, Soybean Specialist, OMAFRA

The 2009 growing season has been one of the coolest in recent memory. Cool, wet conditions cause numerous problems for soybeans, including slow growth, low pod set, increased disease, and lower yields. Nitrogen fixation was also significantly inhibited or delayed by the cool soil temperatures.

Soybeans are a subtropical species. For optimal symbiotic activity, the soil temperature should be between 25-30°C. Poor nitrogen fixation is most evident in first-time soybean fields. There were numerous first-time fields where ample inoculant was applied, but nodulation did not occur. In other cases, nodulation did occur but not until early-August. Poor nodulation occurred across a wide geography, from North Dakota to Pennsylvania. It also occurred with several different inoculant products, so it was not a product failure. In a few cases, even second-time soybean fields failed to nodulate properly. Biological nitrogen fixation is essential for both first-time fields and fields with a history of soybeans, since it converts gaseous nitrogen in the air (N_2) to a form of nitrogen the plant can use.

How Does Nodulation Occur?

When soybean plants need nitrogen, they secrete chemical signals (flavanoids) into the soil from the roots. These signals are picked up by the rhizobia, which in return send a chemical signal back to the root. The signals sent back are lipochitooligosaccharides (Nod factors) which elicit nodulation in the plant. Within 10-14 days of colonization, a

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nodule will become visible. The return signal prepares the root for infection by the bacterium. Infection can only occur where root hairs are present. The Nod factor causes root hairs to curl and pick up rhizobia and allows them to invade the root. As the bacterial cells divide, they form a small tumor-like structure called a nodule.

Why Was Nodulation Poor This Year?

There are a number of factors that influence nodulation, nodual growth, and nitrogen fixation. These factors include too much or too little moisture, soil nitrate levels, soil pH, diseases, organic matter, soil temperature, as well as the rhizobial quality. Extremely cool temperatures along with excess moisture are largely to blame for poor nodulation this year.

The onset of N_2 fixation in soil temperatures between 17 – 25 °C was delayed by 2.5 days for each degree decrease in temperature in McGill University research [(1)]. Below 17 °C, each degree delayed the onset of N_2 fixation by 7.5 days. A root zone temperature of 17 °C seems to be the critical temperature for soybean nodulation and N fixation. By 49 days after inoculation, plants at temperatures between 17 – 25°C were fixing some nitrogen, but plants at
15 °C were not fixing any nitrogen. A decrease of only 2°C, from 21°C to 19°C, made an important difference in the time to onset of N_2 fixation, total N accumulation within the plant, and overall growth. Other research shows that nodulation can cease when temperatures fall to 10°C [(2)] and that a root zone temperature of 15 °C restricts both infection and nodule development, and delays the onset of N_2 fixation by 4-6 weeks [(3)]. Plants with a root zone temperature of 15 °C had only fixed 9% of the nitrogen fixed by plants at 25 °C, 6 weeks after inoculation.

This helps us understand why some soybeans did not nodulate until late-July or early-August this year. No-till fields, especially those with large amounts of crop residue, suffered more from a lack of nodulation, because these soils are generally cooler by about 2°C.

Soil Nitrate and N Fixation

High nitrate levels also caused some problems. Nodule formation is inhibited by the high soil nitrate levels. If the soybean plant picks up too much nitrogen early in the season, it will delay or prevent nodulation. The reduction of atmospheric N_2 to ammonia is energetically expensive, and costs more photosynthate than simply taking up nitrate. Therefore, the plant will naturally consume nitrates before attempting to nodulate. Nitrogen fertilization (at amounts greater than very small "starter" fertilizer rates) does not pay in soybeans because of the inability to develop and sustain N_2 fixation in the presence of soil nitrates. Applying nitrogen fertilizer simply reduces the amount of N_2 fixed from the air.

What About Next Year?

Temperatures in Ontario in June and July are usually sufficient for proper nodulation, so under normal conditions this will not be a significant problem. In first-time soybean fields, use two inoculant products, such as a peat and a liquid, at the high rate with good coverage. This helps to increase the number of live bacteria available for nodulation. Insecticide / fungicide seed treatments will impact the viability of inoculants. Refer to the inoculant label. In fields that have had a well nodulated crop in the past, shallow spring time tillage can increase soil temperatures. In our 2009 trials, the use of an inoculant also significantly increased the number of nodules, even in fields that had previously grown a well nodulated crop.

(1) Zhang F, Lynch D. H, and Smith D.L. (1995) Impact of low root temperatures in soybean on nodulation and nitrogen fixation. *Env. And Exp. Botony*, Vol 35, no3 pp. 279-285.

(2) Maatthews D.J. and Hayes P. (1982) Effect of root zone temperature on early growth, nodulation and nitrogen fixation in soya beans. *F. Agric. Sci* 98, 371-376.

(3) Lynch D.H. and Smith D. L. (1993) Soybean nodulation and N2 fixation as affected by period of exposure to a low root zone temperature. *Physiol. Plant*. 88, 212-220

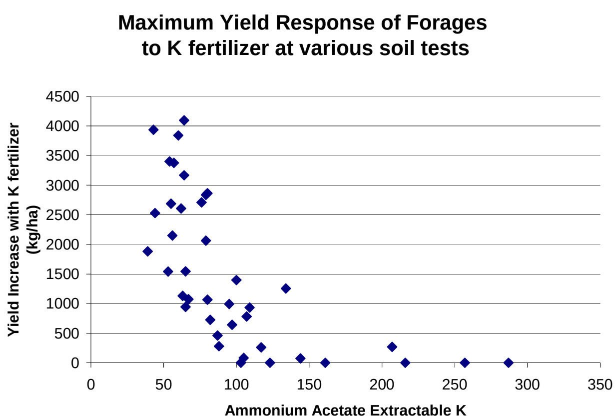
Potash Basics Revisited

by Keith Reid, Soil Fertility Specialist, OMAFRA

In the past three years, potash has gone from the cheapest ingredient in the fertilizer blend to the most expensive. This has many growers rethinking their old attitude towards potash of "put on lots…it's cheap". This is not to suggest that potash is not important for crop production. It is critical for maintaining proper moisture balance in the plant. It plays an important role in disease resistance, standability, crop yield and quality. However, we have opportunities to fine tune applications.

Step 1 - Know What Your Soil Can Provide

Most soils contain a lot of total potassium (K) – up to 40,000 pounds per acre – but most of this is bound up in unavailable forms. Slowly available forms that are released gradually as the soil weathers will make up 2-10% of this total. Only 1-2% will be immediately available to the crop, either as K in the soil solution or held on exchange sites. Soil testing measures this available portion. In general, tests from within the past three years provide an accurate picture of what is in the soil. The exception is on very sandy soil, where crops are grown that remove large amounts of potash, such as alfalfa, silage corn or tomatoes. These soils should be sampled more frequently.



Dr. Bob Sheard, University of Guelph

Low testing soils will respond to added potash almost every year. Yield losses from inadequate potash can be large, so it is a false economy to cut K rates on low testing fields. High testing soils will still occasionally respond to added potash, but only rarely would the response be large enough to pay for the fertilizer. This is clearly illustrated in the chart "Maximum Yield Response of Forages To K Fertilizer At Various Soil Tests". A similar pattern of response can be expected with grain and oilseed crops.

Do I Need More K On Clay Soils?

Some jurisdictions recommend higher rates of potassium on clay soils than on loams or sands, so we often get questions about why Ontario does not include this in our recommendations. There are two reasons why the recommendations for a clay soil might be higher:

1. the recommendation is based on building up soil tests (and it takes more potash to raise the soil test in a clay soil), or
2. there is evidence that crops actually respond to higher rates of K on the particular clay soils within a region.

One neighbouring state that does recommend higher potash rates on clays is Ohio. However, their field trials showed different response patterns depending on the part of the state. In southeast Ohio, the clay soils needed more potash fertilizer to reach optimum yields. In northern Ohio, on the lacustrine soils that are most similar to our soils in Ontario, there was no difference in potash requirements with clay content. Ohio decided to have one recommendation system for the whole state that included the clay content factor. Their trial results actually supported the Ontario studies that showed no difference in K requirements on clay soils.

The clay minerals in Ontario soils actually contain a huge reserve of potash that is slowly released. It could be argued that we will suffer less yield loss from cutting back on potash on clay soils than on lighter soils. The caution is that you need to know the fertility status of any soil before you start cutting back.

Are There Other Sources of K That I Can Use?

High potash fertilizer prices focus our attention on alternative sources of this element. A rich source of potassium is livestock manure, particularly from cattle.

For example, liquid dairy manure contains about 30 lbs available potash per 1,000 gallons. Applying this manure to meet nitrogen requirements will also provide enough potash to meet the requirements of even the most deficient soil. Sewage biosolids, on the other hand, have almost no potash.

Soybean Aphids and Yield Response In the Late R Stages

by Tracey Baute, Field Crop Entomologist, OMAFRA-Ridgetown

This has been one long season of scouting for soybean aphids. Some regions have been dealing with them since the middle of June and they don't seem to be giving up yet. Many growers are asking, "How much longer do we need to monitor and manage aphids to protect yield?", and "When can we finally walk away from these fields?".

Research has shown that yield is protected when the currently recommended threshold of "250 aphids per plant and increasing" is followed during the R1 (Beginning Flower) Stage to the end of the R5 (Beginning Seed) Stage of soybeans.

However, once the soybean plants have reached the R6 Stage, the situation changes. Admittedly, not as much research has been done on fields sprayed at R6 Stage. The trials that have been conducted indicate that you need a lot more aphids per plant before there is a yield response. On-farm research trials run in 2004 and 2005 in Ontario showed that there was not a significant yield response in the early R6 Stage of soybeans until there were at least 1,000 aphids per plant. That response was only experienced in the early stage of R6. Once the plants are in the later R6 stage and beyond, the plants are shutting down, and will not respond to insecticide application. Also, once into the R6 stage, you need to consider the pre-harvest intervals of the foliar insecticides registered. Matador or Silencer can be applied up to 21 days before harvest, while Cygon or Lagon can only be applied up to 30 days before harvest.

How To Determine R5 Or R6 Stage Soybeans?
R5 Stage Soybeans
The R5, Stage is known as the "Beginning Seed" stage, when the pods on the top 4 nodes of the plant have a tiny seed developing inside them. The threshold of 250 aphids per plant and rising on 80% of the plants is still valid for fields that are in this stage of soybeans.

R6 Stage Soybeans
The R6, or "Full Seed" Stage has been reached when the upper 4 pods of the plants are full of plump green seeds. More aphids (at least 1,000) per plant are required in the early R6 stage before a yield response occurs.

Increasing Accuracy of DON Measurement In Grain Corn

by Ken Janovicek, University of Guelph & Greg Stewart, Corn Lead, OMAFRA

Corn ear moulds can result in the production of mycotoxins that negatively impact grain quality, particularly as a feed source for swine. Deoxynivalenol (DON) has been identified as one of the key mycotoxins of concern. The acceptable maximum DON concentration has recently been reduced from 2 to 1 ppm by many corn processors in Ontario. Management decisions, such as hybrid choice, are important for reducing the chance of high DON concentrations. However, proper corn sample collection and analysis are important to ensure a low chance of false high DON readings.

Study Description

A project funded by the Ontario Corn Producers Association was conducted in the summer and fall of 2007 to evaluate DON sampling protocols for twenty-one 40 ton truck loads of Ontario corn. Ten samples were obtained per truck load using either grain probes or tailgate swiping.

Two sampling methods were studied:

1. Each of the 10 truck load probe or swipe samples were well blended and then divided into smaller sub-samples. One of the smaller sub-samples was analyzed to estimate the DON for the probe or swipe. DON concentration for the whole truck load could be obtained by averaging the DON from each of the 10 samples collected per truck.
2. Equal portions of grain from each of the 10 probes were mixed into a single composite sample. The composite was thoroughly blended, and then a single sample was drawn to provide an estimate of truck load DON concentration.

Sample Number Needed for Accurate Assessment

DON concentration for a single sample was within a range of 65 to 150% of the average of all 10 probes per truck, 9 times out of 10. Table 1, “DON Concentrations Of 10 Probes Collected From 2 Truck Loads of Ontario Corn”, shows the variability in DON concentrations. Similar variability was observed in each of the 21 truck loads in this study. It is clear that use of single probe sampling protocols provide an unreliable assessment of DON concentrations for the truck load as a whole.

Increasing sample number decreases the error associated with estimates of DON concentration. Increasing samples to 4 per truck reduced the range in DON concentration estimates by half, with a range between 80 to 125% of the actual concentration, 9 times out of 10. Taking more than 4 samples will further reduce the error, but reductions in the size of the errors are small, so it may not be worthwhile to collect more than 6 samples per truck.

Single samples can almost always identify truck loads of corn with actual DON levels of 0.5 ppm or less as having concentrations that are less than the 1 ppm limit. Similarly, a single sample will almost always identify loads that are actually 1.8 ppm or higher as exceeding the 1 ppm limit. For loads with actual DON concentrations that are within 0.5 to 1.8 ppm, accurate assessment of DON will require at least 4 to 6 samples per truck. For example, for a truck load with actual DON concentration of 0.8 ppm, there is about a 1 in 5 chance of a DON estimate that exceeds 1 ppm using a single sample. If six samples are taken, the chance of wrongly obtaining a DON estimate that exceeds 1 ppm is reduced to less than 1 in 50.

Sample Composition

Blending multiple samples taken from a truck can provide a reasonably accurate estimate of DON concentration. The accuracy of a DON concentration estimate obtained from blended samples can be improved by ensuring that equal amounts of corn are taken from the individual probes or samples and that the composite sample is thoroughly blended before a sample is taken for analysis. Averaged across the 21 trucks of this study, the blended composite samples provided an estimate of truck load DON concentration that was similar to the estimates obtained by averaging the DON concentrations from each of the individual probes or samples.

Assessment of Different Labs

Samples were also sent to 4 Ontario labs to determine the accuracy between labs. One of the labs did estimate DON concentrations that significantly differed from the other 3 labs. When this lab reanalyzed the samples, their results did not differ from the other 3 labs. Reasons for incorrect analysis are not clear, but could have been due to sample preparation or test kits. Lab analysis accuracy can be improved by routinely including samples of known DON concentration. Review or accreditation of lab protocols could help standardize results produced by the various labs.

Summary

Assessment of DON concentrations should be based on collection of 4 to 6 samples per truck. Samples should be collected in a manner representing the entire load and thoroughly blended. Collecting less than 4 samples can significantly increase the chance of incorrectly rejecting a truck load for DON concentration above 1 ppm when concentrations are actually less than 1 ppm. Similarly, it could significantly increase the chance of incorrectly accepting a truck with actual DON levels that exceed 1 ppm. Collecting more than 6 samples will increase accuracy of estimates, but the improvement may not be worth the effort required to collect the samples. Labs should conduct the analysis using a protocol that is verifiable and repeatable.

Table 1. DON Concentrations Of 10 Probes Collected From 2 Truckloads of Ontario Corn In Summer 2007.

Probe	Load A	Load B
	-- DON (ppm) --	
1	2.3	1.8
2	1.7	1.0
3	1.9	1.4
4	3.4	2.1
5	1.3	1.5
6	3.0	0.9
7	2.1	1.0
8	1.7	1.0
9	1.4	1.3
10	2.6	1.6
Average[1]	2.1	1.4
90% Confidence[2]	1.4 - 3.2	0.9 - 2.0
Composite Sample[3]	2.3	1.3

1. Average of DON concentrations for probes 1 to 10.
2. Expected range in DON concentrations for 9 out of 10 individual probes or samples taken from the truck load.
3. DON concentration based on analysis of a single composite sample. The composite sample was made up of 10 equal sized grain samples obtained from the 10 individual probes.

Rotational Grazing

by Jack Kyle, Grazier Specialist, OMAFRA, Lindsay

What is rotational grazing? As I talk to farmers across the province about grazing management, I have come to realize that rotational grazing means different things to different people.

The dictionary definition of rotation is “to change or alternate in a particular sequence; regular variation”. To a crop producer, rotation means a different crop or sequence of crops in a field over a number of years. When we talk about rotation in relation to grazing, the most important factor is the state of the grass growth. The guiding principal of rotational grazing is to give the grass crop every opportunity to grow and produce forage for the livestock. The rotation refers to the movement of the livestock from one paddock to another during the grazing season.

According to the University of Guelph and OMAFRA Beef Cow-Calf Benchmarking Study, the biggest cost component is feed. When asked about grazing practices, over half of the participants reported that they were rotational grazing. However, there was a big range in the results that they were achieving.

Grazing & Rest Periods

The concept behind rotational grazing is to harvest the grass quickly and then give the forage time to recover and re-grow. This is accomplished by giving the livestock enough grass for the prescribed feeding period and then moving them to a new field. The more frequent these moves, the more productive the pastures will be. The maximum length of time in a paddock should be 5 days. Why 5 days? Grass starts to re-grow five days after it is harvested. When does a hay field begin to green-up after being cut? There is usually new growth started in 5-6 days. In a pasture, this new growth is candy to the livestock and they quickly re-graze it. This re-grazing depletes the root reserves of the plants, reducing plant vigour and subsequent growth.

An optimal rotational grazing system has the livestock moving to fresh grass every 1 to 3 days. If the grazing period is longer, there will be reduced performance by both the livestock and the grass. Think of the pasture field as a feed bunk. Would you expect livestock to perform well if the feed bunk was only filled every five days? Fresh feed encourages consumption and increased consumption means increased performance.

Number of Paddocks Required

For each group of livestock that you have on pasture, there should be a minimum of 10 paddocks to give the grass an opportunity to recover from the grazing. Twenty paddocks will go a long way to encouraging increased animal intake. Thirty paddocks will allow you to realize the full potential of both the pasture and the grazing livestock. This may seem like a lot of paddocks, but with the use of electric fence, including some temporary or portable fence, it does not need to be insurmountable.

Cattle trained to electric fence and accustomed to moving every 1-2 days to fresh grass will meet you at the gate for their next move.

Increased Season Long Carrying Capacity

Grass growth varies during the season. Rapid growth occurs in May and June. Much slower growth happens during July and August, when temperatures tend to be higher and moisture is less available. Pasture managers who use an effective rotational system find that they have increased grass growth and carrying capacity throughout the season and a dramatically reduced need for feeding hay.

Rotational grazing means fresh grass every 1-3 days and a sufficient rest period for the grass to grow to the optimum grazing height (20-40 cm). Rotational grazing at this level will provide the most high quality forage at the least cost. Refer to the following websites:
www.omafra.gov.on.ca/english/crops/field/forages.html
www.ontarioforagecouncil.com
www.foragebeef.ca.

Simple Ways to Check the Health of Your Soil

by Adam Hayes, Soil Management Specialist, Field Crops, OMAFRA

As humans, many of us try to look after our health and go to the doctor regularly for a check up. Farmers take soil samples from their fields to check the fertility status every three years. Those who have implemented best management practices for their soil often wonder if their efforts are paying off. Good soil management can pay off in more consistent and higher yields. But, how do you know how healthy your soil is?

Cornell University in New York State has developed a Soil Health Assessment and set up a lab to do the analysis. OMAFRA is currently evaluating this for Ontario conditions and commercial viability. However, there are some simple assessments that can be done on-farm by the farmer or an agronomist. Ten easy soil health assessments include - soil structure, soil compaction, soil organic matter, soil colour, soil life, drainage, water-holding capacity, plant growth, root growth and nutrient levels.

Soil Structure

Soil structure is an important indicator of soil health. A well structured soil allows water and roots to move through it easily and facilitates good air exchange. A simple way to check soil structure is to cut a square of soil the width of a shovel and about 15 cm (6 in.) deep. Pick it up and drop it from waist height. If the soil breaks into many small aggregates or particles (about 12 mm or ½ inch or less) then it is well structured. If it doesn't break down much and there are a lot of larger chunks of soil, then it has poor soil structure.

Soil Compaction, Organic Matter & Colour

Detection of soil compaction has been discussed a lot, so it will not be covered here. Soil organic matter can be analyzed from samples that are taken for nutrient analysis. Samples from fence rows or neighbouring woodlots can be used for comparison. Soil colour is a fairly easy visual assessment to do. Soil colour should be relatively uniform across the field. If moisture levels are the same, darker soils will generally have higher organic matter levels. Areas that have experienced erosion or tillage that has mixed in subsoil will usually be lighter in colour.

Soil Life, Drainage, Water Holding Capacity

Soil life plays an important role in organic matter breakdown and nutrient cycling, as well as several other functions. Counting the number of earthworm holes (middens, small piles of soil and residue) found in a square metre is an easy way to estimate soil life. Ten or more per square metre is a good population. The smell of the soil is also an indicator of soil life. A sweet forest smell is good, while a swampy smell indicates a less than ideal situation. Good soil drainage is essential to a healthy soil and for good crop production. The soil has an adequate water holding capacity if the crop does not suffer during moderate dry spells.

Plant Growth, Root Growth, & Soil Nutrients

The crop should be a dark green colour. Growth should be rapid and relatively uniform. Yield maps are a good indicator of differences in crop growth in the field. Crop roots can tell a lot about the soil and crop growth. Carefully dig up the plant roots. There should generally be a uniform distribution of the roots. Roots that take a sudden turn likely encountered a compacted area or a soil texture change. Nutrient levels can be assessed with a standard soil test and can be corrected with nutrient applications.

Basic Soil Health Assessments

It is fairly easy to get some basic assessments of soil health. They can be done any time of the year, although certain times may be easier than others. Adequate soil moisture will make it easier to do some of the assessments. The newly revised OMAFRA Publication 811, *Agronomy Guide for Field Crops*, has more information on these assessments and on other aspects of soil management. It is available for purchase, or on the web at www.ontario.ca/crops.

Wheat Stubble, Weeds and Red Clover

by Mike Cowbrough, Weed Specialist, OMAFRA

"Cheap nitrogen" seems like an oxymoron, unless you have a nice stand of red clover following wheat harvest. The challenge becomes getting as much growth, and therefore soil nitrate next spring from that red clover, while managing weeds, volunteer wheat and ultimately the red clover. Failure to do so will negatively impact planting, establishment and the yield for next year's corn crop.

Managing the Red Clover

Fall plowing is the only effective tillage operation for managing red clover. If your preference is to use less aggressive tillage or no-till, then a herbicide burndown is needed. Research conducted by the University of Guelph has consistently shown that the best and most cost effective herbicide for controlling red clover is dicamba (i.e. Banvel II or Oracle) at 250 mL/ac (refer to Figure 1). The application timing of dicamba in many of these trials has gone into to mid- to late-October. This is also an opportune time to manage perennial weeds (using a glyphosate + dicamba tank-mix). The key is to ensure that the air temperature at application is greater than 10 ºC, and that the nighttime temperature after application stays ideally at 5 ºC or greater.

Can I Reduce the Rate of Dicamba or Use 2,4-D Instead?

No. When dicamba rates were reduced to 125 mL/ac, red clover control was unacceptable (refer tp Figure 2). 2,4-D (660 g/L) has never provided control of red clover in pubic research trials when applied at 500 mL/ac.

Table 1. Red Clover Control and relative cost of various fall management strategies.

Treatment	Rate	Control*	Price Index**
dicamba	250 mL/ac	99%	77
glyphosate + dicamba	500 mL/ac + 250 mL/ac	99%	133
fall plough		95%	177
Amitrol	1670 mL/ac	90%	97
glyphosate + amitrol	670 mL/ac + 1000 mL/ac	90%	134
glyphosate (540 g/L)	1000 mL/ac	85%	113
2,4-D Ester (700 g/L)	500 mL/ac	65%	44

Source: Dr. Peter Sikkema, Dr. Clarence Swanton and Dr. François Tardif

* Control evaluated in April following the fall applications

** Relative to the Average cost (100) of all treatments in Table 1.

What About Volunteer Wheat?

Since dicamba won't control any volunteer wheat, glyphosate will need to be tank-mixed. The lowest labeled rate of a glyphosate 540 g/L concentration (i.e. Roundup Weathermax) that can be tank-mixed with dicamba for the control of volunteer cereals is 0.5 L/ac.

Managing Annual Weeds

Annual weeds will typically start to flower and set seed very shortly after wheat harvest. Some producers have successfully "clipped" the red clover to cut off the flowering annual weeds. The red clover then grows back and provides a cover that reduces the amount of annual weed re-growth and germination of new plants. Failing that, the next step would be a tillage pass or herbicide application to manage both.

So you will have to make a decision. Do you want to minimize weed seed return (i.e. manage now) or do you want to maximize red clover growth (i.e. manage late September, October)?

Figure 1. Red clover control in April with dicamba applied in late October at 250 mL/ac.

Figure 2. Red clover control in April with dicamba applied in late October at 125 mL/ac.

Figure 3. Red clover control in April with 2,4-D Ester applied in late October at 500 mL/ac.

Frost Damaged Corn Silage

by Joel Bagg, Forage Specialist, OMAFRA, Lindsay

Late planting dates, low Crop Heat Unit (CHU) accumulations, and early frost may result in situations where corn is killed by frost before it reaches the normal stage of maturity for silage. Some fields planted for grain may not mature adequately for optimum yield, moisture and quality. Growers may be looking at salvaging these crops by harvesting or selling some of those fields for silage. A key to making the most of frost damaged corn silage is to harvest it at the correct moisture.

Nutrient Quality

Slightly immature, frost damaged corn that has dented can make good silage. Energy is partitioned differently in immature silage than in normal corn silage. Immature corn has lower levels of kernel starch, but there are higher levels of untranslocated sugars in the stalk. Kernel texture will be softer and starch more digestible. Kernel processing of wet, immature corn silage is not likely required. The fibre content will be higher, but it will be less lignified and more digestible than in mature silage. In general, slightly immature corn silage will have slightly higher fibre and crude protein and slightly lower energy levels than normal corn silage

For high quality silage, corn should be past the “late dough” or “early dent” stage of development. Very immature corn at the milk or early dough stages will have lower starch and higher fibre. Research shows that corn silage at the “dough” stage may be 3 percentage points lower in digestibility and 8 percentage points higher in Neutral Detergent Fibre (NDF) than normal. University of Wisconsin research indicates that harvesting silage before the late dough or early dent stage results in less “Milk Per Ton”. Very immature corn silage with less than ideal quality can be fed to animals with lower nutrient requirements. Storage of poorer quality silage in a separate silo, such as a bag silo, is also a consideration. Immature corn can be expected to yield less silage, so more acres will likely be required to fill the silo and meet forage requirements. Dough stage corn has about 65 to 85% of normal silage yield.

Laboratory Nutrient Analysis

Accurate laboratory analysis of corn silage is important to successfully predict energy values and balance rations. Wet chemistry, rather than NIR analysis is recommended for frost damaged or immature corn silage because it is so different. Digestible energy of corn silage is primarily determined by the relative amounts of starch and fibre (NDF) and their digestibilities. Immature corn silage has less starch but more fermentable plant sugars. In the past, ADF was used to estimate energy, and NDF was used to estimate intake, but these measures alone do not consider digestibility. Newer methods more accurately estimate corn silage digestible energy using crude protein, NDF, fibre digestibility (NDFD), starch, ash and fat. Starch digestibility can also be estimated using moisture, kernel processing scores and other laboratory starch digestibility tests.

Whole Plant Moisture Critical

Harvesting at the proper whole-plant moisture is critical for producing high quality corn silage. It is difficult to know when to harvest frost-damaged corn because we cannot use the “kernel milk line” guidelines.

Harvesting frost damaged corn silage too wet is the most serious problem. At moisture greater than 70%, clostridial fermentations produce butyric acid. Butyric acid results in high fermentation losses and gives the silage a “fishy”, rancid odour. Silage containing butyric acid results in lower intake, ketosis and poor cow performance. A fermentation analysis can be used as a diagnostic tool when there are suspected fermentation and feeding issues. Seepage results in a loss of highly digestible nutrients and is harmful to the environment. Very wet, frozen silage can be difficult to unload in the winter. Refer to OMAFRA Factsheet 07-047 “Harvesting Corn Silage At the Right Moisture” www.gov.on.ca/OMAFRA/english/crops/facts/harvesting_corn.htm.

Dry Down After Frost

Although dead, frosted leaves give the appearance of rapid dry down, most of the moisture is in the stalk and grain. Frosted corn often appears to be drier than it really is, and harvesting at a moisture that level that is too high is a common mistake. Immature, frozen corn often does not dry down significantly faster than unfrozen corn (typically about 0.5% per day), and may require many days of drying to reach the correct moisture content. When this is happening, dead plants will drop leaves and sugars leach from frosted leaves. Yield losses and moulds will increase with time. However, producers need to balance these losses against fermentation and butyric acid problems associated with silage that is too wet. What typically occurs is that a few days following a killing frost, everyone wants to harvest at the same time.

If you are in doubt about the whole-plant moisture, chop a sample to determine percent dry matter. Watch for moisture variability within fields. Keep in mind that Koster Testers and microwaves tend to under-estimate moistures by about 3% because it is so difficult to remove the residual. A 68% moisture sample reading is actually about 71%. In a typical year, that 3% is equivalent to almost a week in harvest time. If using a Koster Tester or microwave, taking the time to carefully dry the sample is important. The finer the sample is chopped, the easier it will be to dry, and the more accurate the result. A more accurate alternative is to courier a sample overnight to a forage laboratory for a moisture determined by oven drying.

Nitrates & Cutting Height

After a frost, if the leaf material is dead but stalks and roots are alive, nitrates can accumulate in the lower stalk. This increases the risks of nitrate toxicity and silo gas. Increasing cutting height by 30 cm (12 in.) can reduce yield by about 15%, but it will increase quality because the lower stalk has the lowest digestibility and the highest nitrate levels. Do not add non-protein nitrogen (NPN) to very immature corn silage, as seepage will concentrate NPN in the lower portion of the silo. Refer to OMAFRA Publication 811, *Agronomy Guide* for more information on silo gas and managing high nitrate levels.

2009 Performance Trials for Winter Wheat
www.omafra.gov.on.ca/english/crops/facts/wwperf-09.pd