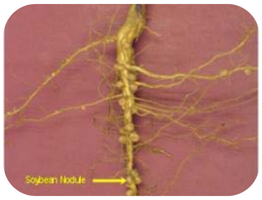

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Comments, suggestions or articles are welcome. To be added to the distribution list please contact:

Albert Tenuta or
Mirjam Hall
Phone 519-674-1690
Fax 519-674-1564
albert.tenuta@ontario.ca
or
mirjam.hall@ontario.ca

Lodging (Stalk Rot) and Corn Fungicides

Albert Tenuta, Field Crop Plant Pathologist, OMAFRA, Ridgetown
David Hooker, Corn and Soybean Agronomist, U of G—Ridgetown Campus

The impact of the cool temperatures leads to many questions, including the impact on stalk rots (lodging) in corn, and would a fungicide application benefit? When it comes to stalk rot, stress conditions are important contributors to infection and stalk strength. These stresses may include excessively wet or dry conditions, cool temperatures, lack of solar radiation (sunshine), the presence of leaf diseases (such as rust, Northern leaf blight and gray leaf spot), leaf and ear damage (from hail, birds or frost), incomplete pollination, unbalanced fertility, insect damage, excessively high plant populations, poor soil conditions, and hybrid susceptibility to all of these stresses. All of these factors can increase the incidence of stalk rots and impact stalk strength.

Trials in 2008 (and again in 2009) by the University of Guelph Ridgetown Campus and OMAFRA were established to answer some of these questions. In 2008, we observed an association between reduced lodging and a fungicide application (Headline) at the tassel to silking stage in 21-hybrid trials (see one trial in Figure 1). Due to limited space and resources we did not apply any other fungicides in this trial. Although 4 of the 21

...continued on page 5

Ministry of Agriculture, Food and Rural Affairs
Ontario

Soybean Inoculation

Horst Bohner, Soybean Specialist, OMAFRA, Stratford

Some soybean fields continue to look pale green. Pale green leaves can be caused by a number of factors but one that is sometimes overlooked is nitrogen deficiency. A number of first time fields that were inoculated this year did not nodulate properly. First time soybean fields should be inspected carefully. It is not uncommon to get poor nodulation on first time fields.

Nodule Formation

For proper nodulation to occur, a relatively high number of rhizobia must be present in the soil. Soybean plants secrete chemical signals (flavanoids) into the soil from the roots. These signals are picked up by the bacteria, 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 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 (see Figure #1).

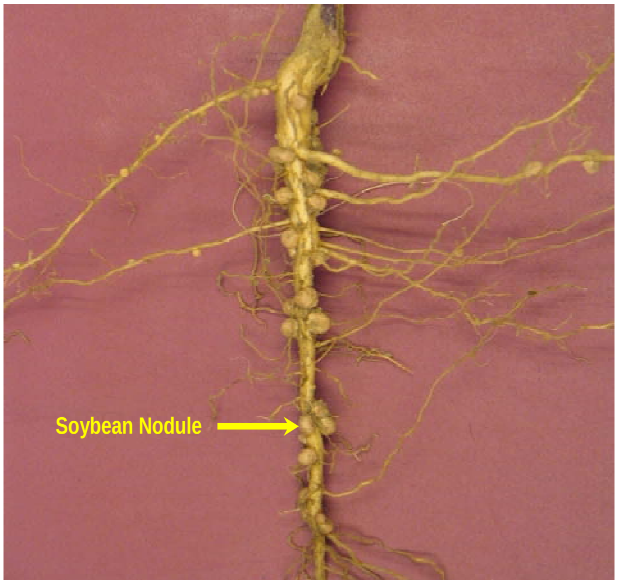


Figure #1. Rhizobial nodules created by B. japonicum on a soybean root

In order for the enzyme which fixes nitrogen (nitrogenase) to function, the environment within the nodule must be almost oxygen-free. The plant forms leghaemoglobin inside the cell to absorb the oxygen. Leghemoglobin is red, so the inside of a functioning node will be red or pink in colour. The nodule begins growing rapidly and will start to fix N at about V2 or V3. The nodule will reach full size in about four weeks and fix nitrogen for about 6-7 weeks. At that time it will begin to senesce and become dark brown or black in colour. The plant reaches maximum nitrogen fixation during the R5 crop stage (beginning seed).

OMAFRA Field Crop Staff Working for You!

Dawn Pate	Manager—Field Crops	519-826-3257
Joel Bagg	Forage Specialist	705-324-5856
Scott Banks	Emerging Crops Specialist	613-258-8359
Tracey Baute	Entomology, Field Crops Program Lead	519-674-1696
Horst Bohner	Soybean Specialist	519-271-5858
Christine Brown	Nutrient Management Field Crop Program Lead	519-537-8305
Mike Cowbrough	Weed Management Field Crops Program Lead	519-824-4120 ext.52580
Brian Hall	Edible Beans & Canola Specialist	519-271-0083
Peter Johnson	Cereals Specialist	519-271-8180
Adam Hayes	Soil Management Special-ist—Field Crops	519-674-1621
Ian McDonald	Applied Research Coordina-tor-Field Crops	519-824-4120 ext 56707
Gilles Quesnel	IPM Program Lead-Field Crops (Bilingual)	613-258-8250
Keith Reid	Soil Fertility Specialist	519-271-9269
Greg Stewart	Corn Industry Program Lead	519-824-4120 ext 54865
Albert Tenuta	Pathologist – Field Crops Program Lead	519-674-1617

Factors Affecting Biological N Fixation

There are a number of factors that influence nodulation, nodual growth, and N fixation. These factors include too much or too little moisture, soil temperature, soil pH, diseases, organic matter, and soil nitrate availability, as well as the rhizobial quality and bacterial strain in the soil.

Moisture

It is well recognized that N fixation in soybeans is highly sensitive to soil drying. N fixation is more sensitive to water-deficit stress than all other physiological processes in the plant. This may partially explain why soybeans do poorly in dry years compared to other crops.

The nodule is essentially a closed system and dependent almost entirely on phloem flow for water supply, photosynthate, and energy. The rhizobium uses this energy to extract the nitrogen from the air to make the nitrogen compounds which the plant will use to make protein.

Soybeans generally do not respond to preplant N fertilization. There are a few exceptions however. These include poorly drained soils, very low organic matter, very low residual N, acidic soils, or very dry conditions. Field experiments comparing yield between irrigated and rain-fed treatments found that dependence on N fixation resulted in a significant yield decrease in the rain-fed treatments compared to irrigated treatments. This is only the case when conditions are very dry.

Soil Nitrate and N Fixation

There would be a benefit to having soybeans with the dual capacity of using significant levels of nitrate from the soil and actively fixing N from the air at the same time. In this situation, roots could uptake nitrates during the first part of the cropping season (before the nodules were established) and then switch to N fixation later in the season, once the nitrates have been depleted. This cannot occur, however, because nodule formation is inhibited by the presence of high nitrate levels in the soil. If the soybean plant picks up too much N early in the season, it will delay or prevent nodulation. The reduction of atmospheric N to ammonia is energetically expensive, and costs more photosynthate than simply taking up nitrate, so the plant will naturally consume nitrates before attempting to nodulate. This fundamental inability to develop and sustain N fixation in the presence of soil nitrates at greater than very small "starter" fertilizer rates is largely why N fertilization does not pay in soybeans. Applying nitrogen fertilizer simply reduces the amount of N fixed from the air.

Why are fields a pale colour during the early part of the growing season?

Soybeans naturally go through a period when leaves are light green or even pale yellow. This is the period just before the nodules start to supply adequate nitrogen to the leaves. This is an import phase in the development of a healthy crop. Only in the absence of N (a pale looking crop) will the roots send the signal to the rhizobia to initiate nodulation. Once the nodules have established and start providing nitrogen, the leaves turn a dark green colour. If proper nodulation, sufficient nutrients and moisture are present, soybeans will remain yellow for only a few weeks.

Check roots for nodulation

Nodulation problems are very rare in fields that have previously grown a dark green crop of soybeans. In first time soybean fields, nodulation must be watched closely, because inadequate nodulation does happen on occasion. The symbiotic relationship between soybeans and the bacteria *rhizobium japonicum* can be seen shortly after emergence. Small nodules can be observed on the tap root 3-4 weeks after planting but nitrogen fixation does not occur until V2 or V3. In first time fields, it is important to check nodules early to allow for nitrogen application if a failure does occur. When checking roots, dig them out carefully to avoid sloughing off the nodules. Use a shovel to check at least 10 sites in the field. Adequate nodulation requires about 7-14 nodules per plant. If less than 5 nodules are present, wait for about a week and take another assessment. The number of nodules formed on the roots along with the amount of nitrogen fixed continues to increase until R5. Nodules that are fixing nitrogen are pink or red inside. White, green or brown nodules indicate that little or no fixation is occurring.

Why does nodulation sometimes fail?

Nodules form when bacteria infect a root hair. Infection can only occur if both the bacteria and root hairs are present. Root hairs are only formed on new root growth, and in first time fields bacteria is only present where the seed was placed. In that case nodules form on the tap root, since that is where the initial inoculant was placed at seeding time. Soils that have previously grown soybeans, on the other hand, will have bacteria spread throughout the soil so infection will occur across the whole root system. If the roots on first time fields do not nodulate within a few weeks after emergence, the roots will have grown past where the inoculant was placed.

Here are the main reasons why a field may not have nodulated:

First Time Fields

1. A lack of viable bacteria may have been placed on the seed. This could be due to improper storage of the product;
2. The inoculant did not stick to the seed or was added unevenly;
3. There is a problem with infection of the plant. **Excess nitrate in the soil at planting time will inhibit infection.** If there is excess N in the soil, the plant will first use that nitrogen before allowing proper nodules to form. In fields with a history of soybeans the nodules can form later, but in first time fields the opportunity may be missed. The roots may have grown past where the inoculant was placed or the bacteria may have died because of dry conditions. This may be the reason why old forage fields sometimes have nodulation failures when first seeded to beans. The initial high N level in the field may have delayed root infection.

History Fields

Once introduced the bacteria will survive for many years in most soils, but poor nodulation can occur even in an established field if:

1. The soil has a low pH or is sandy;
2. There is excess nitrate in the soil;
3. The soil is very dry.

Corrective Action

If plants remain pale green and no nodules are present, nitrogen should be applied. Although it is impossible to get the same amount of nitrogen to the plant as the nodules would supply, a profitable response has been found up to 50 kg/ha. Broadcasting urea or calcium ammonium nitrate at early flowering, when the foliage is dry, is the best timing. Higher rates of N can be applied but are not usually profitable.

Some questions around black point grading in wheat and the following is the Canadian Grain Commission standards:

Blackpoint (BLK PT)
Kernels with blackpoint have a distinct dark brown or black discolouration of the whole germ and surrounding area.

Representative portion for analysis

Minimum—25 g Optimum—50 g Export—50 g

Procedures

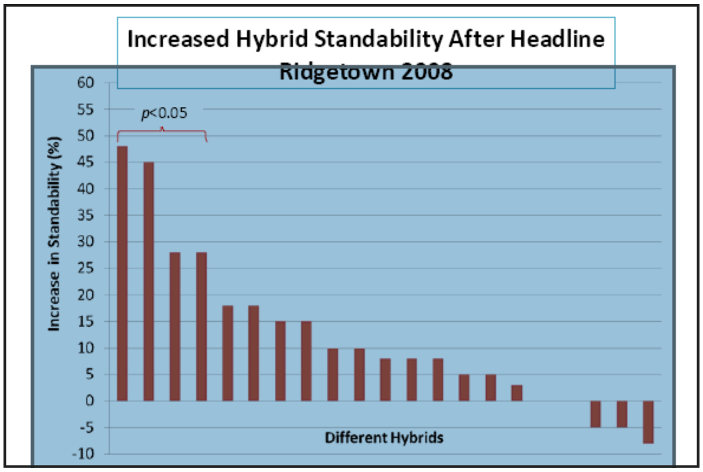
- Disregard a slight discolouration restricted to the germ.
- When the discolouration affects more than one-half of the kernel or extends into the crease, it is considered smudge.

In assessing blackpoint:

- Depending on the severity of the discolouration and the overall quality of the sample, established tolerances may be exceeded at the inspector's discretion.

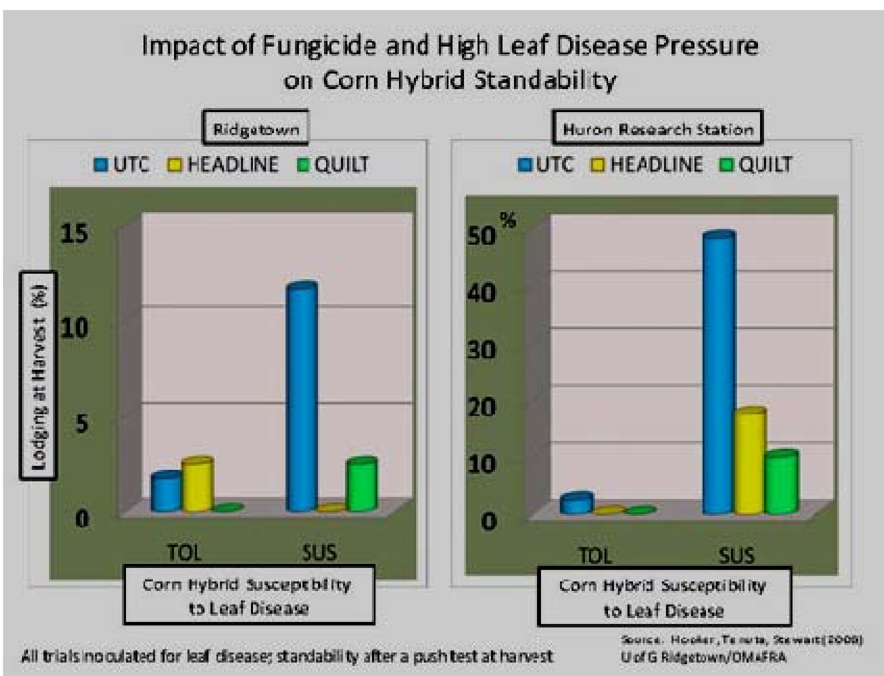
Martin Breton advises the tolerances for blackpoint, in Canada Eastern Soft Red Winter are as follows:

No. 1	**10%**
No.2	**20%**
No.3	**35%**
C.E. Feed	**no limit**



Each response average of 4 replications
Standability assessed after a push test before harvest
Hooker, Tenuta and Stewart (2008)
University of Guelph, Ridgetown Campus, OMAFRA

hybrids had a significant increase in standability (25% or more), the majority had more modest increases. It is important to note that these improvements in stalk strength were realized even when overall leaf disease pressure at this location (and others) was relatively low at less than 5%.



In other trials from 2008, 4 hybrids were chosen that ranged from tolerant to very susceptible to two pathogens that cause northern leaf blight and eyespot disease in corn. At both Ridgetown and the Huron Research Station, the greatest lodging occurred in the hybrid which was most susceptible to the foliar diseases, and as expected, it had the greatest amount of disease in the trial. These results are similar to other studies which often associate less lodging (stalk rot) with control of leaf diseases.

What is the impact of stalk rots? The distribution and prevalence of stalk and ear rot diseases vary from year to year, but the diseases are present in most years even though it may be at low levels. The majority of stalk rot damage in Ontario is caused by four fungi, namely *Anthracnose, Gibberella, Fusarium and Diplodia.* However, *Pythium* have also been observed in Ontario. Although these fungi cause different symptoms, their ultimate effect on the corn plant is the same. They reduce grain fill and stalk integrity and accelerate senescence. Stalk rot fungi affect the nutrient movement of the corn plant in three main ways.

1. Sugars (photosynthates) produced through photosynthesis and carbohydrates in the root and stalk are diverted to the fungus and not to the ear. These nutrients allow stalk rot fungi to grow and flourish.

2. There is a reduction in stalk integrity. To meet the nutrient needs of both the developing ear and the stalk rot organisms, the corn plant will begin to cannibalize itself by moving soluble carbohydrates from the root and stalk. Problems arise when the plant is unable to meet the nutrient requirements of the developing ear. The result is a weaker stalk (prone to lodging) and less resistance to stalk rot fungi.

3. Finally, the infection and colonization process inhibits or blocks many of the pathways that the plant would ordinarily use to move nutrients. Yield losses (generally 10%–20%) arise from poorly filled ears and harvest losses from lodging.

Harvest and Storage Strategies to Minimize Fusarium

Helmut Spieser, Engineer, Field Crop Conditioning & Environment, OMAFRA, Ridgetown

If you are harvesting wheat that has some Fusarium infected kernels there are some strategies that will eliminate many of these in the field and arrest the further development of this disease in storage. There is no rescue treatment available to combat the Fusarium that exists now in the wheat fields. Careful harvesting, drying and storage strategies are the farmers' best way to maximize grain quality. Following these suggestions will eliminate most of the infected kernels and stop the further spread of Fusarium infection in the harvested wheat.

- Harvest early, at 18% moisture content or higher
- Use high fan speeds to blow out infected kernels
- Immediately dry infected grain over 16% M.C. in a heated air dryer to stop the spread of infection

When to Harvest

Harvest should not begin above 18% moisture content if significant Fusarium is present. High moisture grain reduces the ability to blow out the lighter Fusarium-damaged kernels.

Harvest Speed

Reducing your combine travel speed when harvesting may reduce Fusarium levels. This slower combining speed allows for increased separation of the grain by allowing the increased air blast time to separate the good kernels from the infected kernels.

Fan Speed

Many of the Fusarium infected kernels are small, shrunken and lighter than sound kernels. It is possible to blow a large proportion of these Fusarium damaged kernels out the back of the combine by increasing the fan speed to deliver an air blast above normal ranges.

Testing at Ridgetown in 1996 found that high fan speeds blew out a significant percentage of tombstone kernels caused by primary Fusarium infection. There was a tenfold decrease in Fusarium damaged kernels in the grain sample when fan speeds were operated to deliver maximum air blast. Operating cleaning fans at these high speeds causes an additional loss of good kernels, up to 2 bushels per acre (0.13 t/ha). This small yield reduction is

Figure 1 - Effect of Different Fan-Speeds on Wheat Yield

	Fan Speed (rpm)			
	1,160	1,220	1,280	1,330
	Sieve Setting: (1/4")			
Good kernels on ground: (per ft^2)	16	31.6	35.2	43.6
Loss: (bu/ac)	0.83	1.58	1.76	2.18
Loss at 60 bu yield: %	1.38	2.63	2.93	3.63

Case International 1644, Harus Wheat, Essex County, July 17, 1996.
Travel speed 4.2 mph. Rotor speed 880 rpm.
Source: Dr. Art Schaafsma, University of Guelph, Ridgetown College, 1996.

insignificant if the crop can be made marketable, rather than being downgraded to feed, sample or salvage. To adjust your own combine, start at maximum fan speed and check the harvest sample. Reduce the fan speed if necessary and again evaluate your harvest sample for Fusarium-Damaged Kernels (FDK). Table 1 shows the effect of different fan speeds on wheat yields.

Chaffer Setting

Consider adjusting the cleaning sieves (chaffer) to a more wide-open setting. This directs the air blast vertically, slowing the rearward movement of the grain mass and aiding cleaning and separation. Caution must be used to keep wheat heads and straw pieces out of the grain sample if the chaffer is opened.

Maximum Drying Temperatures

A number of different types of dryers can be used to dry wheat with heated air. To maintain milling quality you should follow the recommendation on Table 2 Maximum Recommended Air Temperatures for Drying Milling Wheat. The baking quality of wheat is damaged if the temperature of the grain reaches 60°C (140°F) for any significant length of time. The kernel temperature of the grain is not the same as the plenum temperature of the drier. Kernel temperature should be measured by putting a sample of grain in a steel can and placing the thermometer in the centre of the sample. When heated air dryers are used, it is a worthwhile precaution to have samples evaluated to ensure the dried grain meets market standards.

Figure 2 - Maximum Recommended Air Temperatures for Drying Milling Wheat[1]

	Maximum Temperature	
Dryer Type or End Use	**ºC**	**ºF**
Non-recirculating batch dryers	60	140
Recirculating batch dryers	60-70	140-158
Cross-flow dryers	60	140
Parallel-flow dryers	70	158
Seed Wheat[2]	40	104

[1]Copyright: *Farm Drying of Wheat,* Canadian Grain Commission, Sept 1992

[2]Wilcke, William F., Hellevang, Kenneth J. *Wheat and Barley Drying,* FS-5949-GO, 1992. University of Minnesota, Extension Service

To Spray or Not to Spray the Aphids

Tracey Baute, Field Crop Entomologist, OMAFRA, Ridgetown

…..excerpt from

BauteBUGBlog.com

A lot of calls are coming in this week from growers and reps who have fields that are hovering around the 250 aphids per plant range. With the poor weather and wheat harvest some are anxious to make the call if they need to spray. In fact, there are some rumours out there that some are spraying before the field reaches 250 aphids per plant. I stongly DISCOURAGE this as I have witnessed many times that this does not save you a spray or your time but in fact increases the chances that you will need to spray again in the next 10 days or so because of the natural enemies that were making an effort were instead killed off, leaving the aphids that survived to live well and prosper.

The best way to increase your chances of only having to spray once is to spray well within the threshold, when you have been able to assess that the aphids are definetly on the increase past 250 per plant.

Figure 1. Heavy aphid populations

Here are my best recommendations for the current situation:

1) **In regions where the fields are quite dry and the crop is appearing stressed**, plan to spray just above 250 aphids per plant, after you have confidently determined that the aphid population is actually on the increase. This indicates that the natural enemies are not keeping up and are no longer valuable enough for you to save.

2) **In regions where there have been some timely rains and the crop is not stressed**, plan to spray when the aphids start to reach around 400-500 aphids per plant. The economic injury level (when the cost of spray is equal to the cost of control) is around 600-700 aphids per plant. In a healthy crop you can be a bit more patient and wait to see if the natural enemies kick it in gear and lower the aphid population. But experience has shown me that once you start to crack the 400-500 aphids per plant mark, there is less of a chance that there will be enough natural enemies and time for them to keep the aphids from reaching the economic injury level.

And keep an eye out for **SPIDERMITES,** especially in the regions that have not had these rains. Wheat harvest is starting and spidermites will be moving into soybean fields. Timely rains help manage them but not every field has had these rains.

Please let us all know if you are starting to see spidermite injury in your area!