

CROP TALK

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A Good Time to Review Resistance Management Strategies for Bt Corn

Tracey Baute, Field Crop Entomologist, OMAFRA

Over the last few years a number of corn insect pest populations have developed resistance to at least one Bt trait used in corn hybrids. From western bean cutworm (WBC) resistance to Cry1F, corn earworm (CEW) resistance reported to Cry1Ab, Cry1A.105 and Cry2Ab2, to the latest confirmation of European corn borer (ECB) resistance to Cry1F in the Maritimes. Although companies have moved towards pyramiding multiple traits that control the same pest (mostly targeting ECB or corn rootworm) into their hybrids to reduce the risk of resistance, not all Bt corn hybrids sold have more than one effective trait to control the primary target pest. This is especially true in cases where resistance to one of those traits in the pyramid has already developed. The pyramided hybrid in these cases become essentially a single trait hybrid. There is only one Bt trait, Vip3A, that effectively controls WBC, so no hybrids currently contain more than one effective trait against WBC. And given that Vip3A has no activity on ECB, growers need to select different pyramided hybrids if ECB is their primary target pest.

Refuge strategies have also evolved over time. Single trait hybrids require a 20% structured refuge of non-Bt corn planted in the same field or within 400 metres away to ensure that the target insect population surviving in the Bt corn planting would mate with populations from the refuge planting that were not exposed to the Bt. This reduces the chance of the resistance being passed on to the next generation. As we moved towards pyramided hybrids with multiple traits against the same pest (usually ECB or corn rootworm), the refuge size requirement shrank to 10% then 5% and now as Integrated Refuge for some hybrids, where 5% of the seeds in the same bag are the refuge plants. This is because there were two effective traits which reduced the risk of resistance developing. However, there has been a cost to this transition. Although it does ensure that every grower has planted a refuge, the integrated refuge is not always effective at reducing the risk of resistance, especially for the later season ear feeding pests (i.e. western bean cutworm and corn earworm). It may have also caused growers to have assumed that all hybrids have integrated refuge now, even though their hybrid of choice might only contain one effective trait against their target pest. In the case of the ECB resistance development to Cry1F, single trait hybrids were still being marketed in the shorter season growing regions of Canada and the US. These single trait Cry1F hybrids require a 20% non-Bt structured refuge since they only contain one trait to control ECB. Growers may have also assumed their "two trait" hybrid was safe but in fact contained only one trait for ECB and one trait for rootworm.

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Without the 20% structured refuge accompanying these single effective trait hybrids, the risk of resistance was much higher and would evolve much sooner.

One thing is clear, we need to make sure that we are doing everything we can in following resistance management strategies. A few important measures for Bt Corn Resistance Management include:

1. Know which traits are in the hybrids you plant and make sure they contain more than one trait to control your primary pest issue. For many in Ontario, WBC is the primary pest not ECB, even though most pyramid hybrids are targeting ECB. To know how many traits control each pest in your favourite brand, refer to the newly modified Bt hybrid table: http://fieldcropnews.com/wp-content/uploads/2019/05/Modified-Bt-Trait-Table-for-2019-English-with-MOA.pdf
2. Know what the refuge requirement is for the hybrid that you are planting. This is also provided within the table mentioned above.
3. Avoid planting hybrids that only contain one trait against your primary target pest. If you do plant a one trait hybrid for your pest, ensure you use the correct amount of refuge to accompany it and rotate away from using the same trait year after year. Rotate from that Bt trait to foliar insecticides, and rotate the chemical families of your foliar insecticides too. Relaying solely on one method of control increases the risk of resistance.
4. Scout for any unexpected damage, no matter what hybrid you plant. A minor amount of feeding (i.e. small holes and scrapes on the leaves or tassel) is expected. The pest has to do a little feeding to be exposed to the Bt toxin. But if the feeding damage continues and progresses from small holes to larger holes, scars, tunnels etc. then report it. Check the Agronomy Guide for Field Crops, Field Crop News, Pest Manager App and the Canadian Corn Pest Coalition website to see what the damage looks like for your target pest. In the case of ECB, refer to the Signs of ECB Activity and Damage document: http://fieldcropnews.com/wp-content/uploads/2019/05/Signs-of-ECB-Activity-and-Damage-to-Scout-for-in-Bt-Corn-Fields.pdf
5. Report any unexpected damage to your extension entomologist and seed company agronomist. We can then investigate further, take samples and test whether resistance has occurred. Reporting right away enables us to scout while the pest is still present and help the grower implement the correct additional measures needed to eliminate the resistant population before it spreads. Simply applying a foliar insecticide may not be the correct measure to take.

Bt corn has been a valuable tool for pest management for decades. Following all of the necessary steps required in resistance management will ensure we have this tool for years to come.

Managing Alternative Forages

Christine O'Reilly, Forage and Grazing Specialist, OMAFRA

Reports indicate widespread alfalfa winterkill due to several thaws that reduced snow cover and created ice in fields. Many stands were either patched or put into an annual forage. Here are some tips on managing alternative forage crops.

First cut is usually (but not always) 60 days after planting

Table 1. Harvest guidelines for alternative forage crops

Crop	Planting to 1st cut (days)	Cutting Interval (days)	Cut Height	Stage for maximum quality	Stage for maximum yield
Red clover	60-70	30-35	5 cm (2 in.)	Late bud to 20% bloom	After 20% bloom
Italian (or annual) ryegrass	Head emerges at 55-60	30-40	10 cm (4 in.)	Before boot stage	Head emerged
Cereals	For "grass": 45-50 For whole-crop: 60	Highly dependant on summer rainfall	7-10 cm (3-4 in.)	Before boot stage	Heads emerged to soft dough
Cereal/pea	45-50	Highly dependant on summer rainfall	7-10 cm (3-4 in.)	Before cereal boot stage	Emergence of head complete (cereal)
Sorghum-sudangrass, forage sorghum	60, but crop must be >65 cm (26 in.) tall	Wait until crop is >65 cm (26 in.) tall	10 cm (4 in.)	Boot or early heading	Multiple-cut system; see max quality.
Millet	55-60	Pearl and Japanese: 30-35 Foxtail and Proso do not regrow very well	Pearl and Japanese: 10 cm (4 in.) Foxtail and Proso: 5 cm (2 in.)	Pearl and Japanese: 36 in. Foxtail and Proso: before heading	Cut for quality

Red clover harvested for quality has more rumen by-pass protein and NDFd than alfalfa. Quality does not decline as quickly as alfalfa.

Italian ryegrass prefers cool temperatures and consistent rainfall. Some producers graze the lower yielding mid-summer cut rather than running harvesting equipment across the field, but this requires grazing infrastructure.

Cereals provide options. Maximum protein content and fibre digestibility occurs before boot stage. Producers looking for more yield and starch content could wait until soft dough stage and ensile the crop to get something that feeds out more like corn silage than haylage. Producers could plant a warm-season grass after harvesting the cereal, provided there is enough soil moisture for germination.

Grasses lose their quality faster than legumes, so any time a mix is grown it should be harvested when the grasses are at the ideal maturity. In this case, cereals are grasses!

Don't make dry hay

Red clover takes a long time to dry which increases the risk of mouldy or dusty hay. Clover silage is generally very dark in colour, so can look like spoiled alfalfa. It resists protein breakdown during the ensiling process and has about 40% less non-protein nitrogen than alfalfa.

Cereals can be made into dry hay but take longer to dry than perennial grasses. Peas wilt more slowly than cereals, so producers should pay close attention to the crop's moisture content when working with mixtures.

Just like ensiling alfalfa or corn, the correct moisture content (Table 3), proper packing density, and a good seal are critical to preserving alternative forages. Baleage is most successful when crops are put up in dense bales and wrapped with 6-8 layers of 1 mm thick plastic.

Table 2. Suitability of alternative forages for different storage/ feeding methods

Crop	Dry Hay	Baleage	Silage	Green Chop	Grazing
Red clover	difficult	✓	✓		✓
Italian (or annual) ryegrass		✓	✓	✓	✓
Cereals		✓	✓		✓
Cereal/pea		✓	✓		✓
Sorghum-sudangrass		✓	✓	✓	✓
Millet	Foxtail or Proso	✓	✓	✓	✓

Table 3. Correct moisture content for silage crops.

Type of Silo	Moisture Content	Dry Matter Content
Horizontal silo (bunker or bag)	65-70%	30-45%
Tower silo	62-67%	33-38%
Oxygen-limiting tower silo	55-60%	40-45%
Baleage	45-55%	45-55%

Be aware of possible toxins!

Nitrate poisoning

Except red clover, all the crops discussed here are fast-growing grasses with high nitrogen demands. These crops can accumulate nitrates under certain growing conditions:

- Very high soil levels of nitrogen (i.e. excessive rates of fertilizer or manure, or combinations of these following a legume crop – such as winterkilled alfalfa);
- After the rain that breaks a long dry spell. In this situation, delay harvest by 10 days to allow nitrates to be converted to protein;
- Any condition that kills the leaves while roots and stems remain active (frost, hail, sometimes drought)

If any of the above factors are present, allow crops to ferment for 3-5 weeks before feeding. Be aware of deadly nitrogen dioxide gas around silos.

Prussic acid poisoning

Sorghum, sudangrass, and their hybrids produce prussic acid (hydrogen cyanide) when stressed. To reduce the risk of prussic acid poisoning:

- Do not pasture or green chop stands less than 60 cm (24 in.) tall.
- Do not ensile or green chop sorghum over 76 cm (30 in.) tall for 3–5 days after a killing frost. Silage should be completely fermented before feeding (6–8 weeks).
- Immediately after a frost, remove the livestock from the pasture until it has dried out (usually 6–7 days). If new shoots develop, harvest the field as silage rather than pasture.
- After a drought-ending rain, do not graze animals on new growth.

Red clover can contain high levels of phytoestrogens which can interfere with breeding and early-stage pregnancy in sheep. Grasses and cereals may develop leaf or stem rusts under damp conditions. While rust reduces nutritional value and palatability, it does not produce toxins.

Alternative forage crops can make great feed. The trick is to not manage them like alfalfa.

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Manage Risk in Dry Beans by Testing for SCN

Meghan Moran, Canola and Edible Bean Specialist, OMAFRA

Ontario's dry edible bean producers are top notch farmers. They invest a great deal of time and money in managing this high risk, high reward crop. To keep the scales tipped towards 'high reward', dry bean producers need to know the soybean cyst nematode (SCN) status of their fields.

SCN is now present in 22 counties (Figure 1), including the province's key dry bean producing regions. Recent surveys in southwestern Ontario found 80% of the fields tested were positive for SCN. Unfortunately, SCN will continue to move across the province into previously non-infested fields and counties.

SCN can reproduce on all types of dry beans and may negatively impact yield. Dry bean susceptibility to SCN depends on the market class and may also depend on the variety. While local research conducted to date is limited, we know that:

- **Aduzki** beans are the most susceptible to SCN, more so than susceptible soybean varieties, and should not be grown on infected fields
- **Kidney** and **cranberry** beans show similar or slightly less SCN reproduction compared to susceptible soybeans
- **White** (navy) beans generally display less SCN reproduction than susceptible soybeans, but they are not resistant and there can be large differences between varieties
- **Black** beans appear to be the most tolerant to SCN compared to other dry beans, and are generally much more tolerant than SCN susceptible soybeans
- other types of dry beans, such as otebo, have not been tested locally.

Researchers in North Dakota have conducted several studies on SCN in dry beans which agree with the statements above, although the specific varieties studied are often different than those commonly grown in Ontario. Recent reports from the US have stated that SCN is "a major yield limiting threat to dry beans in Minnesota and North Dakota", and the same is true in Ontario. Local studies on SCN in dry beans have included commonly grown varieties in each of the market classes mentioned above, but extensive research on susceptibility by class or variety has not been conducted. Within the available data, cyst scores for each variety are quite variable from one year to the next and across different trials. The available data does not include yield results.

There are currently no SCN resistant dry bean varieties available, although US researchers have begun breeding for resistance. There are also no foliar or seed treatment products registered in dry beans for SCN management. Chris Gillard, University of Guelph – Ridgetown Campus, has begun evaluating the effectiveness of nematicide seed treatment products on dry beans; the products are registered in soybeans. VOTiVO, ILeVO and Clariva have been tested in controlled environment growth cabinet studies but results have been mixed. Only ILeVO has provided some consistent results in reducing cyst numbers on roots. While the products may have value in dry beans, the growth cabinet trials were not taken to yield and at this time it is unclear if the level of cyst reduction will be meaningful in a field scenario. Attempts at studying the products in naturally SCN-infested Ontario fields produced highly variable results.

SCN symptoms in dry beans will be similar to symptoms in soybeans. Stunting, poor canopy closure, and chlorosis may be evident. Plants may have fewer pods or mature early, and damage may show up earlier in sandy areas.

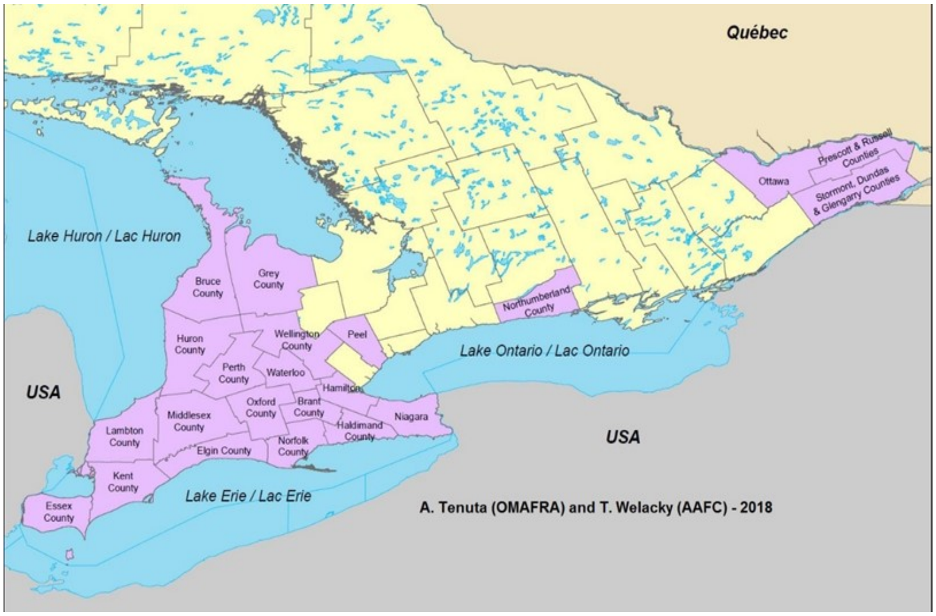

Figure 1. Ontario counties where SCN has been confirmed.

Often there are no above ground symptoms at all. Check plant roots 30 to 45 days after emergence by gently digging up plants, rather than pulling them out. Look for pearl white to yellow cysts that are much smaller than root nodules.

Ontario dry bean growers should manage their risk by testing their fields for SCN. Plan on taking soil samples this fall, shortly before or after bean harvest. Use a soil probe to take samples at a depth of 6-8 inches. Sample directly in the row, before tillage is conducted. The first time a field is checked for SCN, sample areas where SCN is likely to establish first including near the field entrance, along fence lines, areas that have been flooded, and areas of high soil pH (greater than 7).

More information on SCN and soil testing can be found at www.soybeanresearchinfo.com under “Soybean Diseases”. While the details are focused on soybeans, the general information on SCN is applicable for dry bean growers.

Interseeding Early Cover Crops into Corn

Sebastian Belliard, Soil Management Specialist, OMAFRA

We all know about the many benefits that cover crops can provide, from erosion control to forage production and overall increased soil health. But there are limited opportunities to establish cover crops in typical Ontario field crop rotations. There is simply not enough time, temperature, or sunlight to get a worthwhile cover crop established after corn or soybean harvest most years, and not enough cereal acres to reap the well-established rewards of summer/fall cover crops.

To overcome the limitations of our short Northern seasons and rotations, some growers are turning to interseeding, the practice of establishing a cover crop in the cash crop during the growing season. This practice will be familiar to those still underseeding clover into wheat, but it is still relatively new in corn and soybeans. In both of those crops there is a window for interseeding in the later reproductive stages, but in corn specifically there is growing interest in the early window. That one is coming up soon, so here are some things to consider if you are going to try interseeding cover crops early into corn.

Timing

Across North America, growers are typically interseeding cover crops into corn between the V4 to V7 stages, though some are stretching that on either end from V2 to V10. In Ontario, interseeding red clover and annual ryegrass has been most successful between V4 and V6. There is a delicate balance to strike between avoiding competition and stress to the crop during the critical weed-free period and establishing the cover early enough to get good growth before the canopy closes and lack of sunlight effectively puts it into standby mode. Although some would argue that corn resents any companions during this period - be it a cover crop or a weed - Ontario research has shown there is no negative impact on corn yields from interseeded red clover or annual ryegrass at the V4 to V6 stage, and research from Cornell University, Michigan State University, Quebec, British Colombia, and South America has found similar results for a range of species.

Another consideration is avoiding having to make an extra pass through the field just for the cover crop. More traffic equals more risk of compaction and crop damage, not to mention the extra costs. Ideally, interseeding would be combined with another previously planned field operation such as side-dressing. Farmers are champion innovators in this space – ask around to see what has worked for others, or make something new!

Species Selection

Interseeding does not change the fact that you can only be successful with a cover crop if you know your goal.

There are several excellent guides and tools for deciding on one or more goals. Once you have clarified your goal and narrowed down the list of species that could help you achieve it, you will need to narrow it further for intercropping by selecting for species that will survive the extended period of shade under the crop canopy. This is often the most limiting factor to success with interseeding into high-yielding corn, and cover crops often look much better from the road than further into the field for this reason.

Throwing Shade

Table 1. 50% and 90% Shade Tolerance Index of selected cover crop species. (Shared with permission from Haden, Yost, and Kuether, Ohio State University - ATI, Wooster)

Cover Crop	50% Shade Tolerance Index	90% Shade Tolerance index
Forage Collard	100.81	45.00
Tillage Radish	85.67	52.30
Balansa Clover	69.91	13.15
Berseem Clover	66.18	13.59
Crimson Clover	64.72	16.93
Hairy Vetch	65.14	22.52
Red Clover	87.13	25.17
Subterranean Clover	60.88	11.81

There isn't a great deal of research on shade tolerance, but what does exist shows that brassicas tend to be relatively tolerant of even heavy shade. Red clover, crimson clover, and hairy vetch perform relatively well (Table 1), but the shade index (biomass under X% shade / biomass at full sun) for legumes is more mixed and declines more rapidly (Figure 1). As for grasses, annual or Italian ryegrass are the top performers, though they can be tricky to manage from a termination standpoint. Tall fescue and orchardgrass have worked well in some studies, but cereals generally do not. It is interesting to note that plant height is not always correlated to biomass.

Establishment

As with almost any seed, you will get better results from drilling or otherwise increasing seed-to-soil contact. More ways to do this have been thought up than could be covered here, but see the links below (or here and here if you are reading online) for some examples.

Of course, Mother Nature also has a say in our success, and germination is dependent on adequate summer moisture. That's not usually a problem in our humid climate, but it may be in some years and adds to the need for proper soil contact.

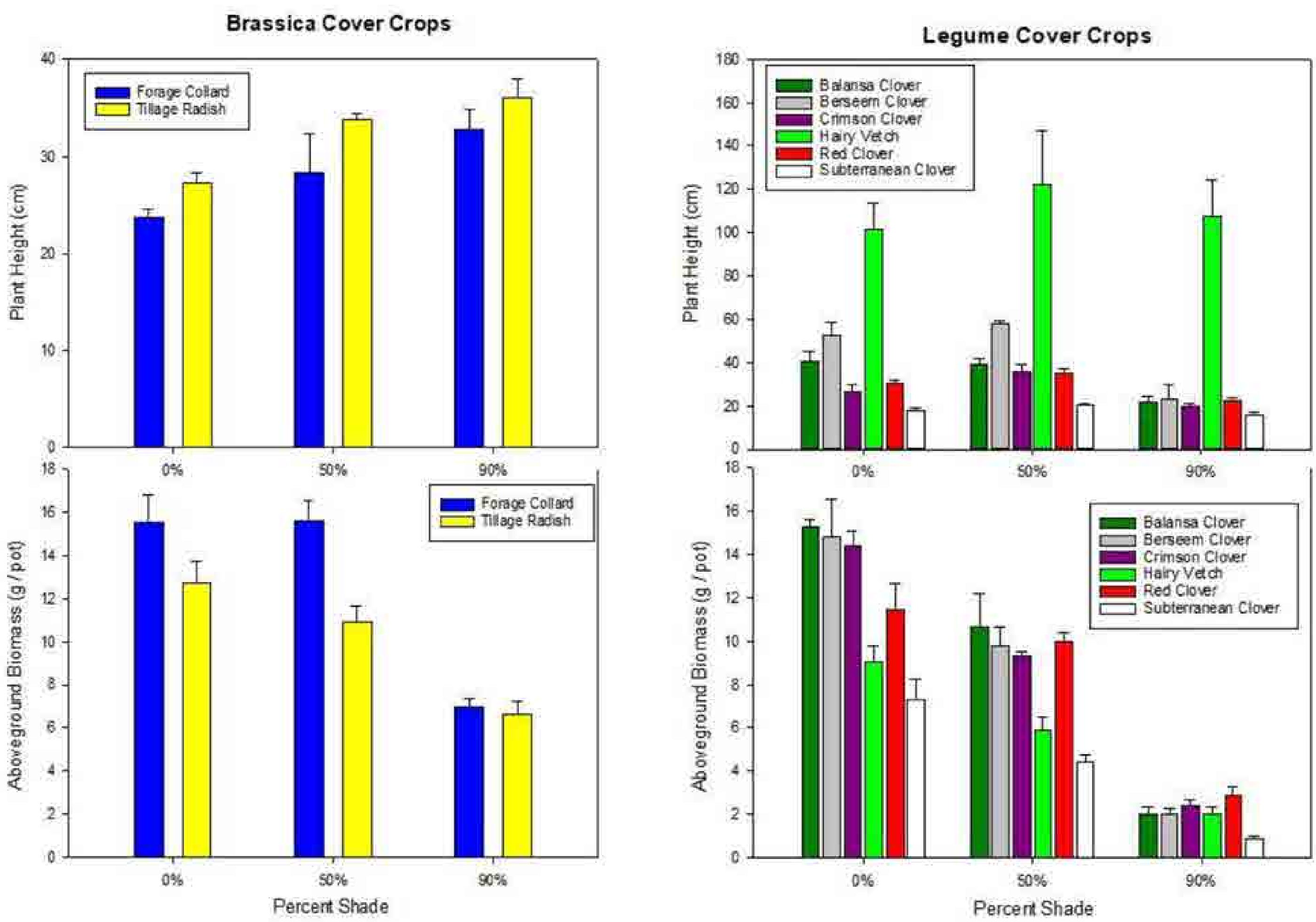

Figure 1. Plant height and above-ground biomass of cover crop species grown under 0%, 50%, and 90% shade. (Shared with permission from Haden, Yost, and Kuether, Ohio State University - ATI, Wooster)

Herbicide Program Compatibility
Many soil-applied residual herbicides can impact cover crop establishment and growth. See the article, "Annual rye grass and clover sensitivity to herbicides" by Mike Cowbrough, OMAFRA Weed Specialist on FieldCropNews.com for specific information. While a good cover crop stand can suppress weeds, you may want to consider a weed control pass before cover crop emergence at the time of interseeding for any weeds which might have escaped the pre-plant pass. A study across the Northeast US found a 31% reduction in weed biomass in October with interseeded cover crops with no impact on corn yield (Youngerman et al., 2018).

Crop Management
Shade from the cash crop limits cover crop biomass, and thus benefit. The following are options for increasing sunlight penetration, though some might incur trade-offs or yield penalties:

- Plant crop rows North-South
- Select a shorter corn hybrid with more upright leaf architecture
- Keep corn populations on the low end
- Increase row spacing
- Avoid harvest methods that smother the cover crop with residue

Low soil fertility, especially nitrogen, may also limit cover crop growth, though this might not be as much of a concern if one of your goals is to scavenge excess nutrients. On the other hand, a growing cover crop provides an excellent place to put manure after silage. An innovative farmer may find a way to interseed a cover crop during manure application.

Stepping Back
As with any practice new to your farm, you should experiment with interseeding cover crops on a small scale. Ignore the thought of "what will the neighbours say" and put it somewhere where you'll see it often. Make sure to walk into the field when you make observations, and don't take any single year too seriously.

While it is possible to establish a respectable cover crop early into corn most years, biomass production is often low in our latitudes and climate. If your cover crop goal is related to biomass, that's a problem. Interseeding cover crops early in the season can work, but it simply cannot substitute for a proper rotation nor provide the full, proven benefits of adding small grains and their cover crop window to a corn-soy rotation.

Additional Resources
Annual rye grass and clover sensitivity to herbicides, by Mike Cowbrough:
http://fieldcropnews.com/2016/04/annual-rye-grass-and-clover-sensitivity-to-soil-applied-corn-herbicides/

Midwest Cover Crop Council – Cover Crop Decision Tool:
http://mccc.msu.edu/covercroptool/covercroptool.php

Equipment Examples:
https://www.scrca.on.ca/wp-content/uploads/2018/04/Interseeding-Case-Study.pdf
http://northeastcovercrops.com/wp-content/uploads/2018/02/Tips-for-Interseeding-Cover-Crops.pdf

Plant Growth Regulators – The Why, Where and When

Joanna Follings, Cereals Specialist, OMAFRA

With new plant growth regulators (PGRs) entering the Ontario market, many are asking, when and where should a PGR be used? First, it is important to know what the purpose of a PGRs is. PGRs can be applied to winter wheat to reduce plant height and increase stem thickness. This reduces the risk of lodging, making managing and harvesting a tall winter wheat crop easier. Additionally, it can also help with reducing harvest losses that come from lodging. Although PGRs are a helpful tool, they are not necessarily needed every year or in every field.

The use of a PGR will bring the most benefit to a winter wheat crop when:

- You have an early planted winter wheat crop with lots of growth
- You are growing a variety that is prone to lodging
    - You can determine the lodging potential of your variety by visiting www.GoCereals.ca
- Your winter wheat field has a history of manure applications and is highly fertile
- You are implementing an intensive wheat management program (i.e. aggressive nitrogen rates) and have a high yield potential

The use of a PGR has less value when:

- Your crop was planted late and too much growth is not a concern

- You are growing a variety that is **not** prone to lodging
- You are not implementing an intensive wheat management program (i.e. aggressive nitrogen rates) and you have a low yield potential

Generally speaking, PGRs are not a tool for improving your plant population and creating more straw. On a year such as this when the crop was planted late, the spring was cool and wet and nitrogen applications were delayed, lodging is generally not a concern and therefore, a PGR is not necessary or in many cases, is not economical. However, if the winter wheat crop had been planted early, had many tillers going into winter, and the spring was warm and promoted lots of growth, a PGR may have been a tool to consider if trying to manage lodging.

Currently there are a number of PGRs available in Ontario. Selecting a PGR for your field is often based on whether you are able to get the product on according to its labeled application window and whether you want the PGR to reduce lodging by reducing plant height or by promoting fall growth which results in a more robust plant.

Ethephon (Ethrel)
Ethephon, commonly known as Ethrel, is a PGR that when applied to wheat releases ethylene into cell tissue. Ethylene then causes a reduction in cell elongation and crop height which is effective in reducing lodging.

The application window for Ethephon can be quite tight, with the ideal timing being between GS37 to 45 (flag leaf just visible up to boot just swollen). If you miss the application window and more than 10% of the awns have emerged Ethephon cannot be applied. Applying Ethephon outside of the ideal application window can cause crop damage and ultimately reduce yield. That is why it is important to scout your fields regularly as the optimal timing approaches to ensure the product is applied at the appropriate time.

Chlormequat chloride (Manipulator)
Gibberellins are plant hormones that regulate various developmental processes, including the stimulation of cell elongation and cell division which gives plants their height. Chlormequat chloride, commonly known as Manipulator, is a plant growth regulator that inhibits the early stages of gibberellin production in winter wheat. What this means is that the application of chlormequat chloride to your wheat crop results in a reduction in plant height while the stems are thickened. This in turn results in a reduction in lodging.

The full application window for Manipulator is GS 12-39. However, the ideal timing is GS 30-32 (stem elongation - 1st to 2nd node). Additionally, chlormequat chloride can be applied when temperatures reach as low as 1°C making it ideal for when spring temperatures dip down at night. The application window for chlormequat chloride is earlier and longer than ethephon and may be better suited for your operation if a tight application timing is a challenge for you.

Gibberellic acid, GA3 (Proliant)
Gibberellic acid (Proliant) is slightly different from some of the other types of PGRs available. Unlike other PGRs, gibberellic acid is used to enhance early growth in winter wheat rather than hinder it. Gibberellic acid elongates plant cells and encourages cell division. The result is more robust plants that can handle stress (i.e. cold temperatures and drought).

Gibberellic acid can be applied up to GS30 (stem elongation). However, the biggest benefit has come from when it is applied in the fall because gibberellic acid is generally used to promote early growth of the crop. While the early growth of the plants is enhanced, lodging is not a concern as long as it is used at the correct time.

If choosing to use a plant growth regulator, always follow the label for application recommendations.

Re-cap:

Product	Application Window	Ideal application stage	Function
Ethephon	GS 37 - 45	GS 37 (flag leaf)	Reduces cell elongation and plant height
Chlormequat chloride	GS 12 - 39	GS 30 - 32	Reduces cell elongation and plant height
Gibberellic acid	Up to GS 30	Fall application	Encourages cell division, resulting in a more robust plant

Trinexapac-ethyl
Trinexapac-ethyl is a new PGR that will shorten the internodes in wheat which ultimately results in a reduction in lodging. Trinexapac-ethyl will likely be available in 2020.

References:
Ethrel Label
Manipulator Label
Proliant Label

Heartland and Eastern Valley Soil and Crop Tier Two Project, 2018-2020: Pushing the Management of Cover Crop Rye

Jake Munroe, Soil Fertility Specialist – Field Crops, OMAFRA

Achieving sufficient biomass from cover crops is essential to reaping their soil benefits. Dr. Humberto Blanco, Professor of Soil Management and Applied Physics at University of Nebraska-Lincoln, spoke recently at the University of Guelph about his cover crop research. He concluded that when cover crop biomass is less than 0.5 ton/acre (see Figure 1), benefits – such as improved soil structure and water infiltration – are rarely seen. Weed control benefits may also be enhanced by extra cover crop growth. Given the short growing season in Ontario and sometimes limited opportunities to integrate cover crops in the rotation, special management may be required to hit that target. That is the motivation behind the Tier Two project by Heartland and Eastern Valley SCIA regions.

Figure 1. Cereal rye one day after planting soybeans “green” in a termination timing trial (right). Rye biomass was just over 0.5 tons/acre. May 24, 2017, Brant County.

In Nebraska, as Dr. Blanco shared, strategies to increase cover crop biomass have included earlier planting, aerial seeding and later termination. Cover crop species also plays an important role. As in Nebraska, one of the hardiest and most versatile cover crops in Ontario is cereal rye. On-farm Brant County trials over the past two years have shown that delaying cereal rye termination in spring by two weeks (until planting) increases biomass over four times – from 0.2 ton/acre to 0.8 ton/acre of dry matter. Also, the “plant green” treatments yielded the same as soybeans planted into early-terminated rye.

Over the next two years, across eight on-farm sites and two research stations, Heartland and Eastern Valley SCIA regions will be further evaluating strategies to maximize cereal rye cover crop benefits ahead of soybeans. The OSCIA Tier Two project has two components: first, it will evaluate the termination timing question for cereal rye before soybeans by comparing no rye to early and late-terminated rye; second, it will compare a cover crop-based, herbicide-free no-till system with a traditional soybean production system. In the second part of the trial, cooperating farmers will use roller crimpers to terminate rye and create a thick mulch into which soybeans will be planted.

The cover crop based no-till system is already being used successfully by a handful of innovative organic farmers in the province. One such farmer, near St. Marys, achieved a 50+ bushel/acre soybean yield in 2018 across a 100-acre farm. By seeding rye early and heavily enough the previous fall, he grew a thick, weed-suppressive mulch (Figure 2). Shortly after using a roller crimper to kill the rye and lay it down flat, he planted soybeans, using RTK, at 15-inch spacing. While there were weed escapes in parts of the field (Figure 3), overall the rye did an excellent job suppressing weeds throughout the season (Figure 4). The Tier Two project will be the first replicated trial in Ontario to evaluate the cover crop-based, herbicide-free no-till system – four out of nine project sites will focus on this comparison in 2019.

Figure 2. Cereal rye mulch, shortly after roller crimping and planting. The critical biomass for sufficient weed control is considered to be 8,000 lbs/acre. This field had 8,600 lbs/acre. May 30, 2018, Perth County.

Figures 3 and 4. Weed escapes in part of the organic no-till field (Fig. 3, left) and a weed-free portion of the field (Fig. 4, right). August 13, 2018, Perth County.

Several different measurements will be taken throughout the season at each of the replicated trial sites. Cover crop biomass will be measured (Figure 5), and soybean stands estimated. Soil nitrate samples will be taken at the time of soybean planting and soil temperature and moisture will be monitored at the Elora research station plot from April to harvest (Figure 6). Weed abundance and species counts will be done at critical time points during the season. Soybean yield will be measured using weigh wagons and calibrated yield monitors.

Figures 5 and 6. Square foot sample of rye biomass, which is collected, dried and weighed to contribute to a per acre biomass estimate (Fig. 5, left). May 30, 2018, Perth County. Photo of soil temperature and moisture data loggers at the Elora research station plot (Fig. 6, right). April 23, 2019.

The overall goals of the project are to:

- Find out how to minimize risks to yield and learn about weed impacts in “plant green” soybeans
- Compare cover crop-based no-till to tillage-based organic soybean production practices

To learn more and get in-season updates, visit the cover crops page of www.fieldcropnews.com, watch out for summer twilight tours in Heartland and Eastern Valley regions and look for the OSCIA Crop Advances report at the end of the year.

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