FIELDCROPNEWS

Q&As

2024

CONTENTS

FIELDCROPNEWS

Q&As

Colin Elgie *Soil Fertility Specialist*

Why do I see nutrient deficiencies in my crops, even with moderate soil test levels?

Nutrient deficiencies occur regularly in Ontario and can be the cause of substantial yield loss depending on the type, severity and timing. Their presence is particularly frustrating when soil test levels show adequate levels of fertility.

The simple answer

Nutrient deficiencies can appear in soils testing moderate or high in plant nutrients given the right set of conditions. Extremes in soil temperature and moisture, soil compaction and other crop stressors (insect feeding, root diseases, weed competition and herbicide injury) can impede nutrient uptake and movement within the plant, making deficiency symptoms appear more frequently. These deficiencies are often temporary and the plants can outgrow them. However, depending on the cause, duration and severity, such deficiencies can lead to a major impact on crop yield.

A little more information

Nutrients are primarily absorbed into the plant via the roots, so healthy, active roots are critical for nutrient uptake. Knowing the nutrient availability in the soil solution, through soil testing, is important for profitable crop production and preventing nutrient deficiencies.

Environmental factors are often the difference between observing symptoms of nutrient deficiencies and not. Extremely dry conditions can prevent access of nutrients in the soil solution to roots. Saturated soil conditions can reduce root growth and nutrient absorption, while also promoting losses through the soil profile of soil-mobile nutrients such as nitrogen and sulphur.

Tillage or planting done when soil conditions are wet can cause compaction, which prevents root exploration and nutrient accessibility to the plant. The appearance of nutrient deficiencies will often occur because roots haven't been able to develop normally. (Figure 1).

Figure 1. Clumpy, hard soil conditions indicate less than ideal conditions during tillage. Root growth is inhibited leading to reduced phosphorus (P) uptake.

The full story

When a nutrient deficiency is found, identify the root cause of the deficiency first. If it's due to a shortage of plant nutrients in the soil, broadcasting granular fertilizer or foliar feeding the crop in season may offer a short-term fix. Building nutrient levels will be the long-term solution to low testing soils.

Why do deficiencies appear on soils with adequate fertility?

Symptoms may be influenced by an interruption to the nutrients supply chain from soil to plant, via impediments to root growth or nutrient mobility. In some cases, symptoms may not appear unless adverse environmental conditions are also present. Deficiencies can be triggered by these factors:

- Poor soil conditions for field operations – compaction above, below or beside emerging seedlings limits root growth
- Damage from insects or disease – corn rootworm pruning, for example, prevents proper nutrient uptake by roots
- Rotation with non-mycorrhizal crop species – corn following sugar beets or canola may exhibit P deficiency symptoms in early season
- Soil pH extremes – manganese (Mn) availability, for example, may be reduced in high pH soils (Figure 2)
- Errors in application – improper spreader setup, herbicide application overlaps, etc.

Figure 2. Mn deficiency symptoms in soybeans are more prevalent in high pH soils, especially when soil is dry.

Nutrient deficiencies can happen at any point during the season, but most often appear at certain points throughout the year:

- Early spring after planting – cool, wet soils inhibit root growth and plant uptake
- Mid-season during rapid crop growth – as vegetative growth takes off, nutrient mobility in the plant may take time to catch up
- Reproductive stages – mobile nutrients relocate from older leaves to grain and seeds, especially in dry conditions (Figure 3)

Figure 3. Potassium (K) deficiency symptoms appear in a field with moderate-high soil test levels because of dry conditions during reproductive stages. K is highly mobile in the plant, leading to deficiency symptoms starting with the oldest leaves.

How can you determine which nutrients are deficient?

Visual symptoms can give you a good indication of deficient nutrients but are most reliable when normal growth patterns occur for all but the area in question. When dealing with multiple stressors from the environment, field management issues or damage, it can be much more difficult to distinguish. And in some cases, symptoms may look like other stressors or damage to the crop, such as herbicide injury.

The best way to identify a nutrient deficiency is through plant tissue testing. Take two tests to compare an affected and non-affected area. Better still, take soil tests at the same time, in the same areas, to detect whether the issue lies with the low nutrient concentration in the soil, or whether there are other factors at play causing the deficiency to appear.

What can I do to my liquid manure storage to increase nutrient value and decrease application costs?

The soil fertility benefits of applying livestock manure are significant. But storage is key. Uncovered storage facilities result in manure with a high volume of water and low nutrient value being shipped to fields. Fortunately, changes to storage facilities can improve efficiency of nutrient transport.

The simple answer

By covering liquid manure storage and diverting wastewater, a 100-cow dairy herd operation with a manure storage capacity of one year could:

- Increase nutrient value by 50%
- Increase storage capacity by more than 70%
- Reduce application costs by more than $8,000
- Reduce manure storage odours

A little more information

Additional water that enters manure storage dilutes nutrients and adds to application costs. Nutrient losses during storage can be significant. Anaerobic conditions in liquid storages drive nitrogen loss and methane emissions, especially during warm temperatures.

Types of coverings

A straw or woodchip cover will reduce methane (CH_4) losses by forcing aerobic activity at the top of the pit to consume the methane before it is emitted. A geotextile cover at the surface of manure may reduce ammonia (NH_3) and nitrous oxide losses, but likely not CH_4 losses. Neither of those permeable covers would exclude rainwater. An impermeable storage cover over a pit will exclude rainwater. More information on storage coverings can be found at: https://www.ontario.ca/page/permanent-liquid-nutrient-storage-covers

The full story

Manure storage is used for many years, and over time the impact of reduced storage capacity and the cost of applying excess water may make it economical to cover an existing storage or consider a cover when constructing a new storage.

Rainwater

Ontario farms receive about 33 inches of rain per year. This can result in 134,000 Imperial gallons of rainwater going into an uncovered storage that is 100 ft in diameter (7,854 ft^2), reducing the days of storage by 18%.

Farmstead water

If runoff water from barn roofs and cement yards is added to the manure storage, approximately 1,140 Imp gallons of water are added to the storage for every 100 ft^2 of collection area. Divert rainwater away from a manure storage using eavestroughs, and sloped areas around the farmstead to prevent additional water in loafing yards. A year's worth of roof water from a 10,000 ft^2 barn entering a manure storage could reduce storage by an additional 35-40 days.

Wash water

Cleaning barns and milking centres is an important part of farm and food safety. However, wash water entering the manure storage adds significantly more water. Milking centre wash water can add an average of 3-7 Imp gallons/cow/day to the storage, or more than 250,000 Imp gallons for a 100 milking cow dairy. This extra water volume could reduce storage by almost 60 days. Alternatives could include a separate storage for wash water, a sediment tank with treatment trench (e.g. septic system), vegetated filter strip systems or engineered wetlands.

Separating solids/recycling water

Separating solids requires handling liquid and solid manure separately, but increases liquid storage capacity and provides an opportunity to use liquids that are less than 1% dry matter for irrigating crops during dry seasons. Recycling/re-using liquids for in-barn flush systems to move/ scrape manure from ally floors or using separated liquids to separate sand in a sand lane reduces the need for additional clean water.

Sand bedding

Although not a liquid, the use of sand bedding displaces storage capacity. Sand is inert and doesn't add any nutrient value, can increase nitrogen (N) loss in storage and is abrasive to manure handling equipment. The use of sand bedding is ideal for cow comfort but adds cost to manure handling. Separating and recycling sand is a best practice that will be easier to implement as technology options become more affordable.
A comparison of different manure storage approaches to a 100 dairy cow operation (Table 1) that provides an example of the potential value of covered manure storage.

Table 1. Comparing the economic benefits in less transported water and more concentrated nutrients for a covered and uncovered liquid dairy storage (with and without milkhouse wash water).

1,246,500 gal capacity	Uncovered	Covered	Covered (no wash water)
Rainwater ft^3	45, 204	0	0
Milkhouse wash water ft^3	43,928	43,928	0
Days of storage	**365**	**464**	**643**
Manure dry matter (DM) at application	5.8%	7.0%	8.6%
Total N lb/1,000 gallons	31	36	42
Value of available N in tank @$0.78/lb N	**$10,830**	**$12,800**	**$15,000**
P_2O_5 lb/1,000 gallons	10.3	13.4	17.3
Value of P in tank @$0.78/lb P_2O_5	**+$9,300**	**+$14,720**	**+$17,270**
K_2O lb/1,000 gallons	23.3	26.2	29.8
Value of K in tank @$0.53/lb K_2O	**+ $14,290**	**+ $16,700**	**+ $19.960**
Cost of transporting extra water @ $0.015/gal	**-$8,328**	**-$4,224**	**0**
NPK value of full storage	**$ 34,420**	**$ 44,220**	**$ 51,960**

Source: AgriSuite Manure Storage and Sizing tool www.agrisuite.omafra.gov.on.ca (with Oct 2023 fertilizer prices)

More concentrated manure can be applied at lower rates, reducing the number of loads taken to a field. Water content in manure from uncovered storage would increase application costs by more than $8,000 when transporting manure to fields further away from the storage.

Determining the return on investment to cover manure storage will vary from farm to farm. Considering the costs over the lifetime of the storage and the distance manure is applied in relation to its location will help determine if covering a storage and making other changes to reduce water content in manure is economical.

Should I use a plant growth regulator in my winter wheat?

Plant growth regulators (PGRs) are applied to winter wheat to reduce plant height and increase stem thickness. Reducing the risk of lodging or delaying the onset and amount of lodging that occurs makes it easier to manage and harvest wheat. PGRs can also improve yields, particularly where moderate to severe lodging occurs.

The simple answer

The decision to use a PGR is a function of variety selection, management, particularly the amount of nitrogen applied and the seasonal growing conditions (temperature, rainfall, etc.).

A little more information

The use of a PGR will bring the most benefit when:

- The variety has a high lodging score (check ratings at www.GoCereals.ca) or there is high lodging potential
- Winter wheat is planted early and has a thick crop canopy
- The field has a history of manure applications or high soil organic matter levels
- There is high yield potential, and an intensive management program is used including early planting, high seeding rates and aggressive nitrogen rates (≥150 lb/ac)

The use of PGR has less value when:

- The variety has a low lodging rating and there is lower lodging potential
- Split nitrogen applications are used in conjunction with lower nitrogen rates
- There is lower yield potential due to a late planting date and significant tillering and growth is not a concern
- High rates of manure are not used in current or previous years

The full story

In trials conducted by Dr. Dave Hooker, at the University of Guelph, Ridgetown Campus between 2021 and 2023, there were varying yield and lodging score responses to PGR applications. In 2021, when there was moderate to severe lodging, there was a significant yield response to a PGR application compared to the untreated check (UTC) (Figure 1). Lodging scores were also significantly reduced by a PGR application compared to the UTC across all locations (data not shown). Figure 1 shows that at locations with moderate to severe lodging there was a significant yield benefit to a PGR application over the untreated check. All plots received 150 lb/ac of nitrogen (N).

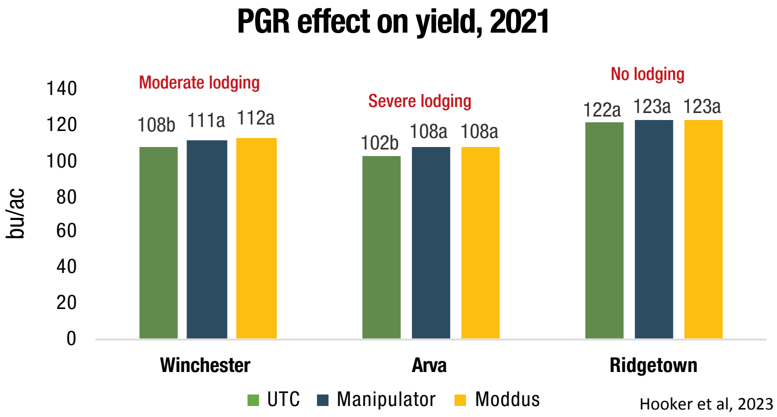

Figure 1. PGR effect on winter wheat yield at three locations in 2021 with no, moderate and severe lodging. Bars with the same letters are not statistically different.

In contrast, there was little to no lodging in 2022 and 2023 resulting in low yield responses in 2022 and no significant yield differences between the PGR treatments and UTC in 2023 (Figure 2 and 3).

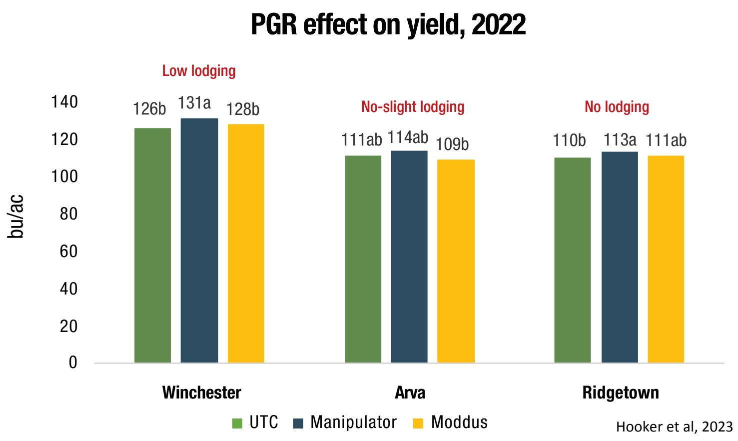

Figure 2. PGR effect on winter wheat yield at three locations in 2022 with little to no lodging. All plots received 150 lb/ac of N. Bars with the same letters are not statistically different.

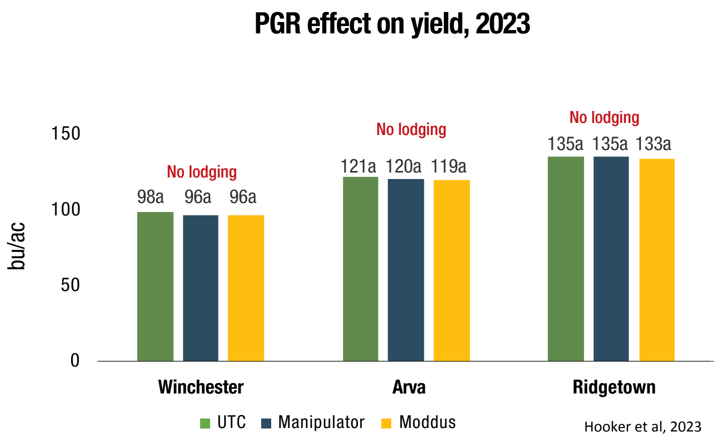

Figure 3. PGR effect on winter wheat yield at three locations in 2023 with little to no lodging. All plots received 150 lb/ac of N. Bars with the same letters are not statistically different.

Based on Ontario field research conducted to date, when there is a high risk of lodging, PGRs can be an effective tool at reducing or delaying the amount of lodging that occurs. Where moderate to severe lodging has occurred, PGRs can increase yields. However, when there is a low risk of lodging, you are unlikely to see a benefit and an economic response.

When making the decision to use a PGR or not, consider the following factors:

- A variety's response to PGRs.
- Crop establishment (planting date, seeding rate, etc.).
- The nitrogen management strategy being used – rate and application method (single vs split apps).
- Field-specific characteristics (organic matter levels, history of manure applications, etc.).

A look at the costs of a PGR application

Table 1. Application costs associated with and without a PGR application at 150 lb/ac of nitrogen applied.

	Single Application: ~GS30, No PGR, 150 lb N/ac	Split Application: <GS30, ~GS32-39, No PGR, 150 lb N/ac	Single Application: ~GS30, PGR, 150 lb N/ac	Split Application: <GS30, ~GS32-39, PGR, 150 lb N/ac
N Application (includes mixing and delivery)	$17.00	$17.00 x 2	$17.00	$17.00 x 2
Nitrogen cost	$151.50	$151.50	$151.50	$151.50
PGR Application	-	-	$18.65	$18.65
Total Cost	$168.50/ac	$185.50/ac	$187.15/ac	$204.15/ac
Additional yield needed to pay for a PGR application	-	**2.28 bu/ac** (compared to single N application, no PGR	**2.50 bu/ac** (compared to single N application, no PGR	**2.50 bu/ac** (compared to split N application, no PGR)

All costs are derived from *Publication 60: OMAFRA Cost of Production Budgets*.

Soft Red Winter (SRW) wheat price used was forward price of $7.45 bu/ac. price per lb of N was $1.01.

Christine O'Reilly *Forest & Grazier Specialist*

How do I manage potato leafhopper in alfalfa?

Potato leafhopper is a major alfalfa pest in Ontario. Yield losses may reach 50%, and crude protein content can drop 2-3% from heavy infestations. Potato leafhopper feeding decreases stand vigour, slows regrowth and increases winterkill.

The simple answer

As alfalfa gets taller it can tolerate more potato leafhoppers before action is necessary to protect forage yield and quality. quality (Table 1).

Table 1. Action thresholds for managing potato leafhopper in alfalfa.

Stem height	Average number of potato leafhoppers (PLH) per sweep[1]	
	Conventional varieties	PLH highly resistant varieties
9 cm (3 ½ in.)	0.2 adults	0.8 adults
15 cm (6 in.)	0.5 adults	2 adults
25 cm (10 in.)	1 adult or nymph	4 adults or nymphs
36 cm (14 in.)	2 adults or nymphs	8 adults or nymphs

[1] 1 sweep = one 180° arc with a 37 cm (15 in.) diameter net.

- Cutting alfalfa early can reduce potato leafhopper populations.
- Potato leafhopper-resistant varieties increase action thresholds after the seeding.
- Available insecticides offer suppression rather than control.

A little more information

The classic symptom of potato leafhopper feeding is V-shaped yellowing of alfalfa leaf edges. By the time this "hopper burn" is noticeable, economically significant damage has already been done to the crop. Left long enough, bronzing and wilting will occur. These late-stage symptoms are often confused with drought stress, herbicide injury or boron deficiency.

When alfalfa is harvested, potato leafhopper eggs are removed from the field and nymphs either dry out or starve. This reduces the population and usually gives alfalfa regrowth a chance to get ahead of feeding pressure.

Alfalfa varieties that are resistant to potato leafhopper are available. These varieties produce tiny hairs on their leaves, which make it difficult for potato leafhoppers to feed.

The Ontario Crop Protection Hub is OMAFRA's official crop protection resource. Products labeled for leafhopper control in alfalfa can be found there.

The full story

Potato leafhopper damage is most severe in new alfalfa seedings and young regrowth. Leafhoppers also feed on soybeans, clover, potatoes, apples and beans. Grasses are not a host plant, so growing alfalfa/grass mixes is another way to reduce the impact of potato leafhopper on forage crops.

Potato leafhoppers suck juices from alfalfa leaves. As they feed, they inject a protein into the plant that blocks the vascular system. This action causes the leaf edges to become yellow and puckered. Potato leafhopper feeding reduces stem elongation and root development, which stunts the crop.

Female potato leafhoppers inject their eggs into the stems of alfalfa plants. In addition to removing eggs and nymphs from the field, cutting also signals the alfalfa plant to grow new stems from the crown. This growth protects the yield potential for the next cut. Lengthening the cutting interval increases the stress on the crop and reduces plant vigour later.

Scouting tips

Scouting should begin after the first summer thunderstorm of the year. Potato leafhoppers are blown on storm fronts into Ontario from the southern U.S. To scout, walk in a zig-zag pattern and take 20 sweeps (1 sweep = one 180˚ arc). Close the net to capture the leafhoppers inside. Leafhoppers move quickly, so let them out gradually and count them as they escape. Repeat this in five locations across the field, for a total of 100 sweeps. Divide the total number of leafhoppers captured by 100 to get an average number of potato leafhoppers per sweep to compare to the action thresholds table above. Weekly scouting is recommended until mid-August since leafhopper populations can increase very rapidly.

A word on resistant varieties

Potato leafhopper-resistant varieties were bred using conventional methods to produce glandular hairs. This makes leafhopper-resistant varieties suitable for organic production systems and export markets, as well as fields not scouted frequently. The glandular hairs inhibit leafhopper damage in two ways. They provide a physical barrier making it more difficult for leafhoppers to feed, and the hairs excrete a sticky substance that can trap nymphs and slows down leafhopper movement between plants.

New restrictions on insecticides

As a result of the Pest Management Regulatory Agency re-evaluation, all feed uses for lambda-cyhalothrin products are cancelled, effective April 29, 2023. Any crops treated with lambda-cyhalothrin products can not be used directly or as by-products in feed to livestock. This includes any part of treated crops that were not intended for use as feed but could become downgraded or deemed unmarketable and could be diverted to livestock feed. Alfalfa is grown in Ontario exclusively for livestock feed, so lambda-cyhalothrin products (Matador, Silencer and Labamba) can not be used on alfalfa in Ontario.

Does ammonium sulphate (AMS) improve soybean yields on clay loam or silt loam soils?

Sulphur (S) is an essential nutrient necessary for plant growth. In the past it was assumed that soil sulphur supplies were adequate to meet soybeans full yield potential. Since air-borne sulphur emissions have been drastically reduced in the Great Lakes Basin, is it now necessary to feed soybeans sulphur?

The simple answer

In 2023 three trials compared a pre-plant application of 87 lb/ac urea and 110 lb/ac urea/AMS blend to untreated soybeans. There was no significant yield increase to the application of S on these clay loam and silt loam soils. These results agree with 15 trials conducted in 2018-19 which also showed no yield gain to S. There was a small yield gain (2.7 bu/ac) to the pre-plant urea but only on 30” rows in a late planting window. It should be noted that while we did not observe a benefit on the clay loam soils tested, S has been shown to provide yield gains on course texted (sandy) soils in other Ontario trials.

Figure 1. Sulphur deficiency in a soybean field where the effected areas will take on a greenish-yellow appearance. Photo: Horst Bohner, OMAFRA

A little more information

Much like nitrogen (N), sulphur moves quickly in the soil and can be depleted rapidly even if soil levels were adequate just a few years previously. One major challenge in assessing the need for S fertilizer is that soil tests for S are unreliable. S deficiency symptoms are also not obvious in soybeans. Soybeans are known to remove relatively little S compared to other crops such as canola or corn. An average soybean crop will remove 5 lb/ac of S while canola will remove 15 lb/ac of S and corn will remove 10 lb/ac of S.

Figure 2. Sulphur deficiency in soybean where the newer leaves will turn a greenish-yellow colour. Photo: Jake Munroe, OMAFRA

The full story

Three replicated trials were conducted in 2023 in both 15" and 30" rows and at two planting dates to assess the possible yield benefits of a small amount of pre-plant urea or a urea/AMS blend applied to soybeans. Trial sites were located near Stratford, Elora and Winchester. The soil at Stratford is classified as a clay loam, Elora as a silt loam and Winchester as a clay loam. The variety used was Viper R2X. When comparing N to the untreated control in the same row width, only the 30" rows showed a yield gain at the late planting date (2.7 bu/ac). This gain could be caused by a faster canopy closure, especially beneficial in a late planting window. The addition of the S in the urea/AMS blend did not provide any additional yield over the straight urea application, see Table 1.

Table 1. Soybean response to nitrogen and a nitrogen/AMS blend.

	Row width	Treatment*	Seeding rate	Planting** date	Yield bu/ac	Gain to N or AMS compared to untreated of same row width (bu/ac)
1	15"	Untreated	165	Early	80.7	
2	30"	Untreated	140	Early	76.6	
3	15"	N	165	Early	80.7	0
4	30"	N	140	Early	76.2	- 0.4
5	15"	N + AMS	165	Early	79.6	- 1.1
6	30"	N + AMS	140	Early	76.8	0.2
7	15"	Untreated	165	Late	75.5	
8	30"	Untreated	140	Late	70.6	
9	15"	N	165	Late	74.0	- 1.5
10	30"	N	140	Late	73.3	2.7
11	15"	N + AMS	165	Late	75.3	- 0.2
12	30"	N + AMS	140	Late	73.7	3.1

*N = 87 lb/ac (40 lb/ac actual N) of urea broadcast pre-plant.
Urea/AMS = 68 lb/ac urea + 42 lb/ac AMS (40 actual N and 10 actual S lb/ac).
Least Significant Difference (LSD) = 1.9 bu/ac.
**Early = the first planting window when the soil was fit (May 11-16). Late = (May 30 – June 1).

These trials were supported by Maizex Seeds and Grain Farmers of Ontario.

Dr. François Tardif *University of Guelph* and **Mike Cowbrough** *Weed Specialist*

Which residual corn herbicides allow cover crops to be inter-seeded?

With a narrow window to establish cover crops after corn harvest, some farmers have experimented with inter-seeding cover crops when corn is at the 6-8 leaf stage. However, the sensitivity of different cover crops to residual corn herbicides is unknown and could negatively affect their establishment. A multi-year study looked at the sensitivity of six different cover crop species to common corn herbicides used in Ontario.

The simple answer

Cereal cover crops (oats, rye, triticale) and oilseed radish were, in general, more tolerant to residual corn herbicides, and easier to establish than white and red clover. Integrity herbicide caused the least amount of injury across all cover crops. Acceptable levels of injury to cover crops existed with other herbicides but were species-specific. Converge Flexx, Primextra II Magnum, Acuron and AAtrex 480 caused the highest level of injury to all cover crops.

A little more information

Four experiments were conducted over two growing seasons. Eleven commonly used pre-emergence herbicides were applied to field corn. Six cover crop species were seeded with a drill that was modified to sow seed between the 30" corn rows at the 6-leaf stage of growth. Visible crop injury was evaluated at 28 and 56 days after cover crop planting. Biomass was collected the spring after application (data not shown). Oats and tillage radish did not overwinter. Biomass of surviving cover crops was closely associated with the level of crop injury observed. Table 1 shows the average visible injury observed by each cover crop species across all herbicides.

Figure 1. Cover crops species were inter-seeded into standing corn at the V6 stage of growth using a modifed seed drill that sows seed in between the 30" corn rows.

Table 1. Average visible injury to each cover crop species caused by all herbicides applied over two growing seasons and four experiments.

Species	Average injury
Oats (*Avena sativa*)	15%
Triticale (*Triticosecale rimpaui*)	23%
Cereal rye (*Secale cereale*)	33%
Oilseed radish (*Raphanus sativus*)	33%
Red clover (*Trifolium repens*)	70%
White clover (*Trifolium alba*)	78%

Figure 2. Tillage radish that has emerged in corn after inter-seeding.

Figure 3. Triticale biomass the following spring (April) after establishment.

The full story

The amount of visible crop injury observed was specific to the cover crop species and herbicide. There was significant variability in the amount of crop injury observed by each species across years and locations. This is not uncommon with soil applied herbicides since soil texture, chemical properties (e.g. pH) and rainfall after application will affect the amount of active ingredient taken up by germinating plant species. In general, visible injury ratings of 10% or less are considered acceptable, although individual growers may tolerate a higher level of injury if the cover crop is able to establish.

Table 2 provides specific details about the herbicides applied, active ingredient(s), rate applied per acre and the amount of atrazine applied per acre (if applicable). Table 3 provides an overview of the average visible injury observed to each cover crop species along with the range in visible injury from the least to greatest amount of injury observed across all four trials.

Table 2. Herbicide trade name, active ingredient(s), rate per acre and amount of atrazine applied per acre to field corn prior to its emergence and roughly 4-6 weeks prior to inter-seeding.

Trade name	Active ingredient(s)	Rate/acre	Atrazine rate/acre
AAtrex 480	atrazine	1.24 L	595 g
Acuron	bicyclopyrone, meostrione, s-metolachlor, atrazine	1.96 L	235 g
Callisto	mesotrione	120 mL	
Converge Flexx	isoxaflutole	176 mL	
Dual II Magnum	s-metolachlor	700 mL	
Engenia	dicamba	400 mL	
Frontier Max	dimethenamid-P	385 mL	
Integrity	saflufenacil, dimethenamid-P	440 mL	
Marksman	dicamba, atrazine	1.8 L	470 g
Primextra II Magnum	s-metolachlor, atrazine	1.6 L	512 g
Rimsulfuron 25% WDG	rimsulfuron	24 g	

Table 3. Average visible injury (%) along with the least and greatest amount of visible injury observed to each cover crop species after inter-seeding into field corn at the V6 stage where 11 corn herbicides were applied prior to planting.

Herbicide	Average visible injury (% out of 100)* (range in visible injury – low and high)					
	Oats	Triticale	Rye	Oilseed radish	Red clover	White clover
Integrity	5 (1-11)	2 (0-4)	5 (0-11)	5 (0-16)	30 (0-97)	48 (15-100)
Engenia	15 (0-58)	3 (0-13)	11 (0-29)	4 (0-13)	33 (0-66)	48 (8-77)
Frontier Max	8 (0-15)	17 (8-27)	29 (13-65)	13 (0-45)	36 (4-100)	57 (24-98)
Callisto	4 (0-10)	5 (0-11)	7 (0-13)	16 (0-38)	82 (45-100)	53 (20-90)
Dual II Magnum	9 (0-25)	38 (1-68)	46 (6-88)	6 (0-15)	33 (10-93)	78 (58-100)
Marksman	7 (0-18)	13 (1-30)	14 (0-28)	23 (10-40)	74 (29-100)	88 (73-100)
Rimsulfuron 25% WDG	10 (0-18)	15 (8-27)	37 (26-53)	19 (0-38)	69 (29-100)	85 (63-98)
AAtrex 480	22 (10-46)	31 (11-49)	37 (20-46)	61 (20-93)	88 (68-100)	89 (65-100)
Acuron	15 (0-25)	33 (5-69)	47 (2-98)	60 (11-99)	99 (98-100)	99 (98-100)
Primextra II Magnum	25 (8-38)	45 (8-88)	57 (10-97)	54 (20-86)	93 (73-100)	95 (83-100)
Converge Flexx	33 (8-65)	42 (17-55)	43 (10-75)	75 (24-98)	99 (96-100)	99 (98-100)

*0% injury = no observed injury, 100% injury = complete plant death

This research was supported by the Grain Farmers of Ontario.
Acknowledgments: Thanks to Peter Smith, Emily Priester and Shania Van Herk for their technical support with this project.

Introducing SHAP:
a new soil health tool for Ontario farmers

Soil Health Assessment & Plan (SHAP) is a new tool from OMAFRA to measure soil health on your farm and identify areas for improvement. Based on a laboratory soil test, SHAP evaluates key physical and biological indicators of soil functions. Healthy soil functions contribute to improved crop productivity and resilience.

SHAP guides users through sampling, evaluation and interpretation of results to come up with a tailored soil health management plan. There are optional add-on modules for the tool to evaluate risks, management and soil function which include compaction, erosion, tillage intensity, living roots and soil structure.

How it works

SHAP is designed to be completed through the Survey 123 app or on a browser. This online process simplifies data entry, performs calculations and can automatically pull information from soil maps based on your farm's GPS coordinates.

There are two parts to SHAP

1. A soil management survey collects background information about the soil, current management practices, soil health issues and goals.
2. In-field data collection & observations, including a soil sample for laboratory analysis of soil health indicators.

Customize your soil goals

The modular design of SHAP means you can use it as a simple test, a comprehensive assessment, or to select only the evaluations most relevant to your situation. Your own soil health goals will determine how and where to sample, and which modules to add. Common goals include setting a benchmark for future comparisons, understanding the limitations and risks to your soil's productivity, and comparing zones within a field.

Sample ID: Good Yield Region
Texture group: medium

Indicator	Measured Value	Score
SOM (%)	4	62
Aggregate Stability (%)	91	82
Active Carbon (ppm)	470	21
Respiration (mg CO2)	18	32
Potentially-mineralizable Nitrogen (ug N / g dry soil /week)	7	33

Download results

Sample ID: Poor Yield Region
Texture group: medium

Indicator	Measured Value	Score
SOM (%)	3	23
Aggregate Stability (%)	88	66
Active Carbon (ppm)	400	10
Respiration (mg CO2)	18	32
Potentially-mineralizable Nitrogen (ug N / g dry soil /week)	2	6

Download results

Example of SHAP test measurements from a good yield vs. poor yield region and corresponding score (100=best).

Add-on modules

There are optional modules available that provide additional information and a more in-depth view of soil health challenges and options for improved soil management.

- Tillage disturbance index
- Living roots index
- Water erosion risk assessment
- Compaction risk assessment
- Soil structure assessment

The OMAFRA Soil Team has published a SHAP Guidebook with step-by-step instructions that you can access on the SHAP landing page on fieldcropnews.com or with this QR code.

Does including wheat in rotation with corn and soybeans increase net returns?

Ontario research has demonstrated that winter wheat in rotation improves corn and soybean yields. But with greater returns on corn and soybean acres, do these yield benefits outweigh revenue reductions from wheat acres? We will answer that question using University of Guelph research to help you make the most profitable crop rotation decisions.

The simple answer

Rotations including winter wheat provided higher net returns compared to rotations with only corn and soybeans, when straw is sold. Grow winter wheat every 3-4 years in rotation.

A little more information

Winter wheat boosts corn and soybean yields. In long-term rotation-tillage system trials, crop yields increased an average of 5.2% and 2.9% for corn, and 12.5% and 7.7% for soybeans at Elora and Ridgetown, respectively (Figure 1).

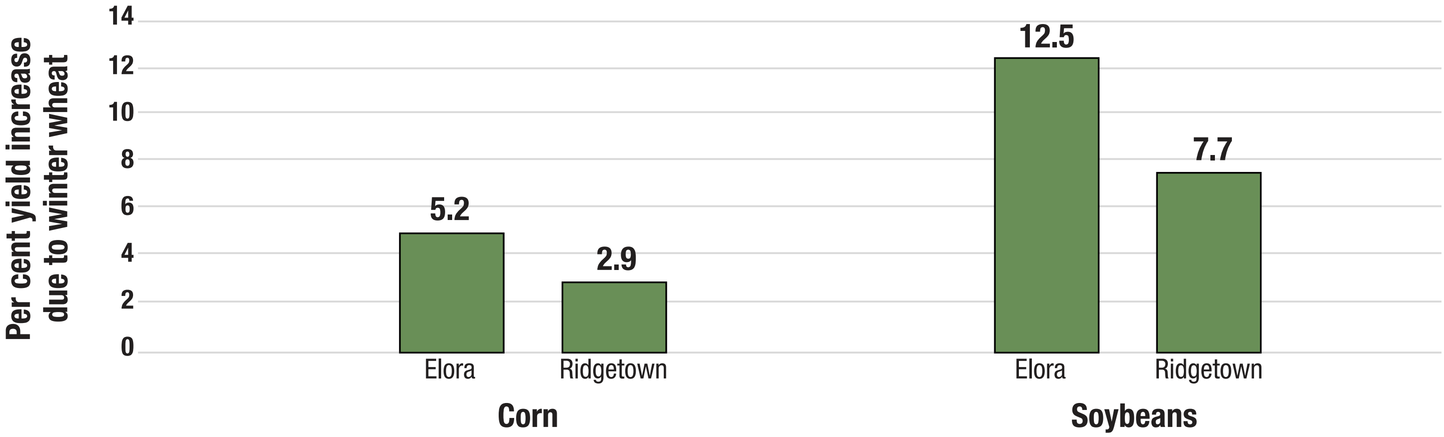

Figure 1. Per cent yield increase in first-year corn and first-year soybeans in a corn-corn-soybean-winter wheat vs. corn-corn-soybean-soybean rotation between 2002-2017 (Elora), and in a corn-soybean-winter wheat vs. corn-soybean rotation between 2012-2017 (Ridgetown). Data averaged across tillage treatments.

Wheat also increased net returns, but not immediately. At the Elora trial – established in 1980 – the benefits of winter wheat in rotation took several years to show up. Growing wheat once in four years did not lower net returns in the first 20 years of the experiment. But after 20 years, wheat provided an economic advantage – $14 more in annual net returns per acre (Figure 2). Revenue from straw was not included in the analysis, but if baled and sold would have boosted net returns by a further $20/acre/year for wheat-containing rotations in both eras.

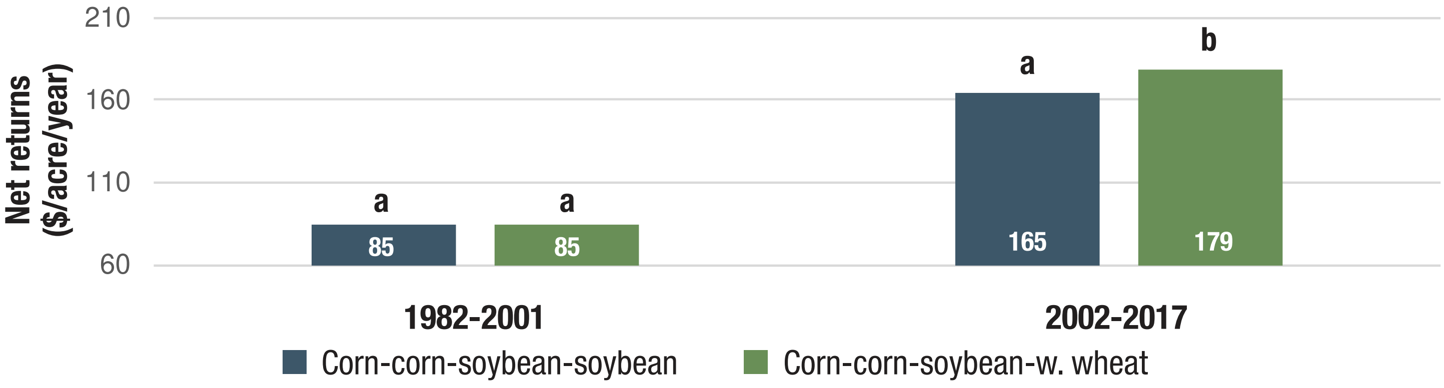

Figure 2. Annual net returns for corn-corn-soybean-soybean vs. corn-corn-soybean-winter wheat rotation averaged from 1982-2001 vs. 2002-2017 at the Elora long-term rotation-tillage system trial. Values with the same letter from the same era are not statistically different (P<0.05).

The full story

Economic assumptions

University of Guelph researchers conducted a detailed economic study of the long-term rotation-tillage system trials to draw the conclusions (Figure 2). In the study, cost assumptions were taken from the OMAFRA 2017 Field Crop Budgets publication. Crop prices were set at $4.93/bu for corn, $12.95/bu for soybeans and $5.63/bu for wheat.

Figure 3. The long-term rotation-tillage system trials at Elora and Ridgetown. Photos: J. Sulik and L. Van Eerd

Straw revenue plays important role

At the Ridgetown trial location (established in 1995), the corn-soybean rotation had a slight edge over corn-soybean-wheat, with a $21/ac higher net return (Figure 4). However, when straw revenue was considered, the three-crop rotation provided a slightly higher net return. This advantage was enhanced when an under-seeded red clover (RC) cover crop was grown (Figure 4). This economic advantage to wheat-containing rotations will likely grow over time (as seen at Elora).

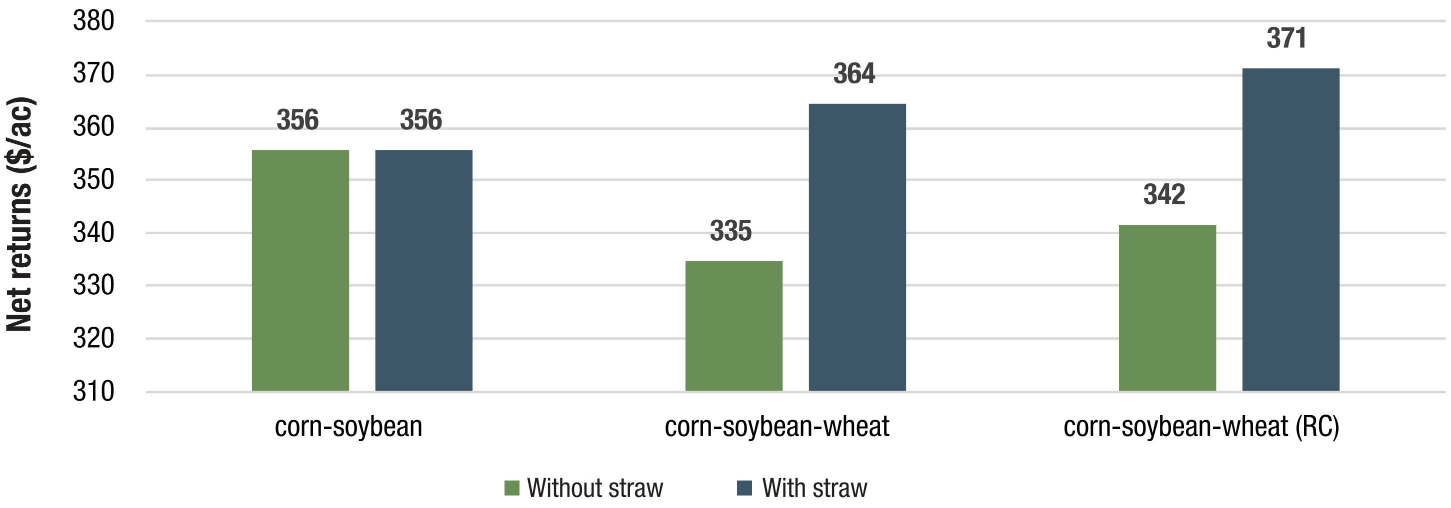

Figure 4. Average annual net returns across three different crop rotations from 2012-2017 from the long-term rotation-tillage system trial, Ridgetown, with and without straw sale. Assumes straw yield of 4 tonnes/ha (1.8 tons/ac) and cost of associated phosphorus and potassium nutrient removal.

Bottom line

Including winter wheat in rotation once every three or four years adds value to the entire cropping enterprise. Although the economic advantage of wheat-containing rotations can take time to occur, Ontario farmers are realizing immediate and additional value through practices such as seeding annual forages following wheat harvest, acquiring nitrogen credits with under-seeded red clover and minimizing compaction through summer manure applications.

To view the full research article: Janovicek K, Hooker D, Weersink A, Vyn R, Deen B. Corn and soybean yields and returns are greater in rotations with wheat. *Agronomy Journal*. 2021;113:1691–1711. visit https://doi.org/10.1002/agj2.20605

Meghan Moran *Canola and Edible Bean Specialist*

What do I need to consider before adding winter canola to my crop rotation?

Winter canola has proven to be a profitable field crop that provides diversity to crop rotations in Ontario. If you are considering winter canola, this planning checklist will increase the probability of growing a successful crop.

Location

Growing location is critical for crop success. Winter survival will be poor in regions with harsh, long winters. The crop is unlikely to be successful north of Muskoka, approximately (Figure 1).

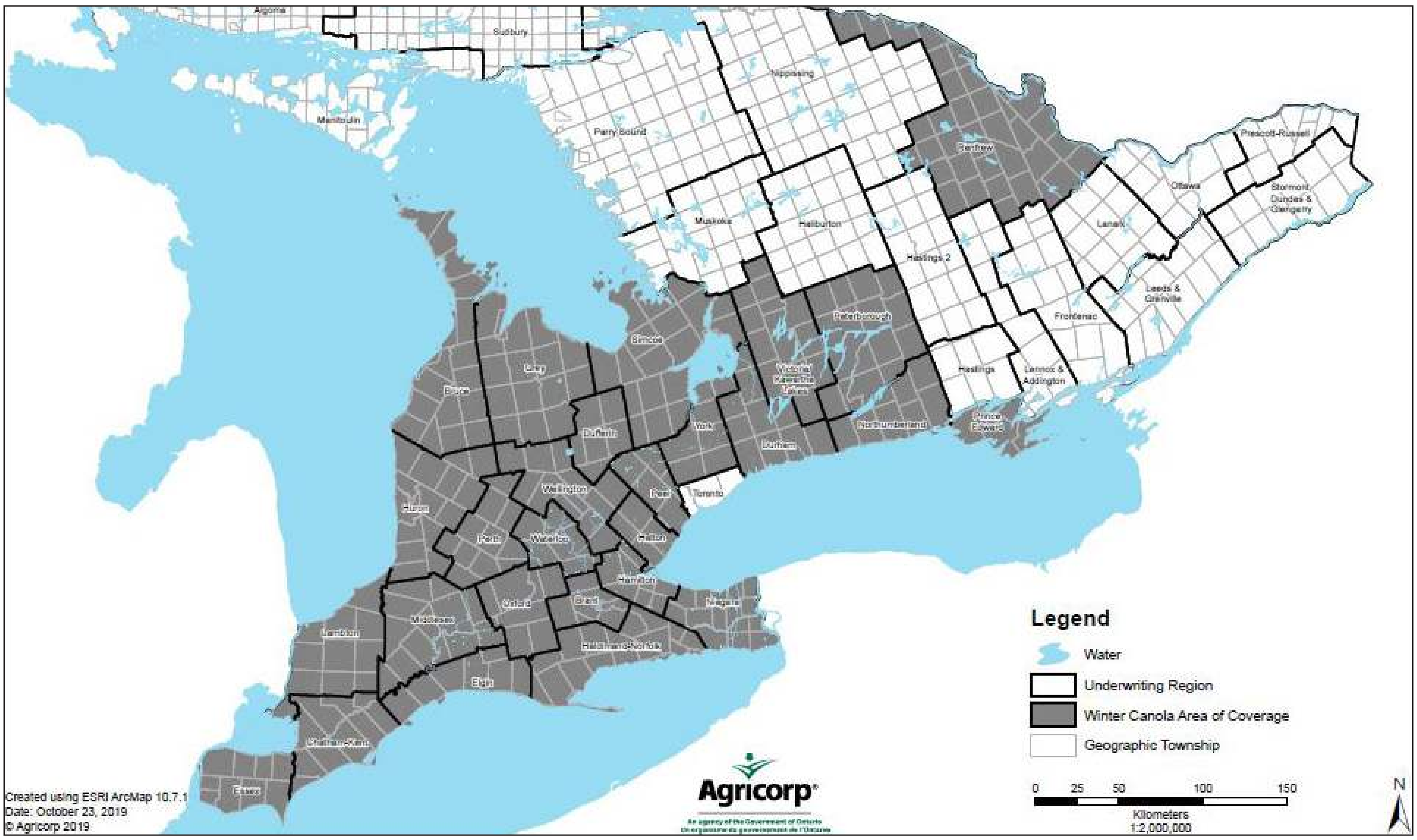

Figure 1. This map shows Ontario counties where winter canola can be insured against winter kill (shaded in grey) and where no insurance coverage currently exists (in white). Source: Agricorp

Order seed early

There is only one variety of winter canola registered for sale in Ontario (Mercedes) and seed is limited. Contact your local C&M seed dealer before June to order seed.

Seeding rate (lb/ac) and seed price are based on the number of live seeds in a bag. The seed dealer will provide guidance on how many pounds of seed per acre to plant, aiming for between 200,000 and 325,000 live seeds per acre. Higher rates may be used for less precise equipment like grain drills and lower rates for row unit planters.

Field selection

Select fields with good drainage and low clay content. Ponding and excess moisture can cause plant death and heavy soils are prone to heaving. Choose fields where winter wheat survival is strong.

Figure 2. Canola seedling heaving caused by poorly drained soils, resulting in exposed tap roots and significantly reduced yield potential.

Figure 3. Severe canola winter kill caused by excessive moisture and poorly draining soil.

Herbicide history

Review herbicide records for the past two years and check rotational restrictions for canola as some herbicides have a two-year plus restriction for planting canola.

Herbicide plant back intervals for canola that exceed two growing seasons

- 22 months: atrazine; imazethapyr (e.g. Pursuit); metribuzin (e.g. Sencor)
- 26 months: flumetsulam (e.g. Broadstrike RC)

Weed management

Winter canola is very competitive and yield loss from weed competition is typically low. Volunteer wheat is usually the most important weed to manage. Winter annual weeds are typically more common in winter canola and summer annual weeds are rarely found. Options for burndown, pre-plant and in-crop herbicides that are safe on canola are limited, and the winter canola variety available in Ontario is not herbicide tolerant (e.g. Roundup Ready or LibertyLink).

Crop rotation

Most canola follows winter wheat because of canola's late summer/early fall planting date. Seeding dates vary by region, but September 1st is generally a good target. Some winter wheat herbicides prevent winter canola from being planted in late summer/early fall following winter wheat harvest.

Winter wheat herbicide plant back intervals for canola after their application

- 1 month: 2,4-D; 2,4-DB; Achieve Liquid; bromoxynil (e.g. Pardner); bromoxynil/MCPA (e.g. Buctril M); MCPA
- 2 months: Boost; Express SG; Refine SG; Refine M
- 4 months: Truslate Pro
- 10 months: Barricade M; Enforcer M; Eragon LQ; Infinity; Infinity FX; Pixxaro; Prominex; Trophy; Valtera EZ
- 11 months: Simplicity GoDri; Varro

Source: Ontario Crop Protection Hub

There is some risk of phosphorous deficiency in corn when planted the year after canola. This risk decreases significantly if a species that is not a Brassica is grown in the field after canola harvest, such as oats or soybeans.

Tillage

There are many examples of canola failures in no-till fields. Slugs present a significant risk in fields with crop residue, and they are typically more injurious to canola than soybeans or corn.

Figure 4. Severe slug damage to newly emerged canola seedlings – these plants will not survive.

Figure 5. Foliar damage to canola seedlings caused by slug feeding – these plants will survive.

Good depth control with the small seed and shallow seeding depth is difficult where there is residue. Seedlings emerging in residue set their growing points above the residue rather than at the soil surface, which increases winter kill.

Figure 6. Shallow planting into heavy residue will cause the canola plants growing points (crowns) to set above the residue, making it more vulnerable to winter kill

Equipment

Canola can be seeded with a grain drill, air seeder or row unit planter with canola seed plates. Rows should be no wider than 15”. Specialized harvest equipment is not necessary, but seed is very small, harvest losses can be high and harvest is slow. Seek out experienced canola producers for advice on setting up equipment to seed and harvest.

Harvest timing

In some years, canola is ready to harvest at the same time as winter wheat. Be prepared for this logistical challenge.

Proximity to end users

Delivery points for canola are limited. Ensure there is a local elevator that will accept winter canola, or that you can deliver directly to crush facilities in Hamilton or Windsor.

Crop insurance

Crop insurance is available and coverage for winter kill is available in many regions, but not all (Figure 1).

Laura Scott *Cropping System Specialist*

Can I integrate manure into my crop rotation if I don't have any livestock?

Livestock manure is an excellent source of nutrients that can complement commercial fertilizer applications to produce high yielding, high quality crops. Studies have demonstrated improved yield and economic returns from the use of manure in cropping systems.

The simple answer

The short answer is yes. Manure (of any type) is found in most regions of the province where crops are grown and often, producers are looking to keep their storages as empty as possible.

A little more information

Manure storage capacity has always been a seasonal stressor for livestock producers across Ontario. Most have capacity for at least 240 days of storage to cover the winter season. The length of time they have storage capacity for can fluctuate based on the number of animals in production, the precipitation in any given growing season or the ability to empty the storage facilities regularly.

Purchasing manure is not commonly done in Ontario, but as yields in manure-applied fields continue to thrive, many growers are asking themselves how they can get those yields without purchasing livestock and the associated infrastructure required.

The full story

Livestock producers often apply manure to fields more than once annually, to ensure they have adequate storage. If they were able to sell manure off the farm to growers without livestock, it could greatly reduce their dependence on these time-sensitive applications.

Livestock manure should be tested regularly; ideally each time the storage facility is emptied, agitated or has contents applied on a field. Multiple manure sub-samples should be taken at each of these times and combined to create one or two composite samples that are submitted to accredited labs to properly represent what is being applied. Once manure has been sampled, valuing it can be quite simple; using the AgriSuite Organic Amendment Calculator to estimate the fertilizer equivalent value of each manure. If manure is sampled regularly, it becomes more predictable and can simplify valuing the product.

Manure applications do not need to be done every year. Manure can easily be incorporated into a once in three-year application, or twice in five years to spread it out. By not applying every year, manure applications can be done to a percentage of a grower's total acres to break up workload, demand and cost of application.

Do I need to adjust any practices if I start applying manure?

If manure is a new addition to your cropping system, there are a few key things to consider. If you are applying manure with a high ammonia concentration or at high rates and to fields within close proximity to surface water and residential areas, then tillage after application is highly recommended to minimize odour and losses. Ideally, all manure applications are injected or incorporated within a day or two of application – but they don't have to be. You can see some reduced nutrient uptake and some loss, especially with liquid manure, but lower application rates can be surface applied. Higher rates of application can require incorporation to avoid complications such as soil crusting, runoff or high nutrient losses. It can also create challenging conditions to plant into.

How do I know which fields should get manure?

It's important to soil sample every 3-4 years and work with current soil test values to determine soil needs. Soils that test high in phosphorus (P) and potassium (K) may not require manure (or any nutrients) and will not likely have an economic response to manure nutrients (P and K). Applying manure to high testing soils can be detrimental to both soil health and crop yields. Local Certified Crop Advisors (CCAs) or agronomists can be instrumental in determining soil test levels, nutrient demands and application timings.

Find out more with the Agrisuite Organic Amendment Calculator.

agrisuite.omafra.gov.on.ca

Can soybean yield loss associated with wide rows be “won back” with intensive management?

Some growers prefer 30” rows because of reduced seed costs and reduced white mould pressure. But it’s known that wide rows yield less, especially in northern climates. A number of research trials were conducted in 2022 and 2023 to determine if applying both starter nitrogen (N) and fungicides along with early planting could close the yield gap between wide and narrow rows.

The simple answer

The inherent yield loss associated with 30” rows can be mitigated with the use of starter N, foliar fungicides and early planting. Starter N fertilizer and the application of a foliar fungicide reduced the yield gap of 30” rows to only 1.3 bu/ac for the first planting date and 2.2 bu/ac for the second planting date. Keep in mind that in every comparison in this study, 15” rows yielded more than 30” rows. From an economic perspective the untreated 15” rows were clearly the best.

A little more information

Previous Ontario research has shown a yield reduction of 4 bu/ac when comparing 30” rows to 15” or 7.5” rows. The main reason 30” rows yield less is because of slower canopy closure and bare ground between rows, so not all available sunlight is captured by the crop early in the growing season. Starter N can help “fill” the canopy sooner with faster vegetative growth. Foliar fungicides keep leaves healthier and delay senescence which could further aid wide row performance. Timely planting can also improve wide row yields because plants have additional time to capture sunlight.

The full story

Six trials were conducted to improve wide row performance in 2022 and 2023. Trial locations were Tavistock, Stratford, Elora and Winchester. In 2022, the N starter treatment was 10 gallons/ac of 28% UAN surface applied in a stream on top of the row. In 2023 this was changed to a broadcast application of 87 lb/ac of urea broadcast at planting. The foliar fungicide applied was DELARO Complete applied at growth stage R2.5. Two planting dates were used. In 2022 the variety was Cyclone R2X. In 2023 Viper R2X was used.

Figure 1. The larger rows on the right side of the picture received 10 gallons/acre of 28% N. These rows were darker green in colour and filled the canopy 5 days earlier. June 30, 2022. Tavistock, ON

The yield loss associated with wide rows could largely be "won back" with a combination of starter N fertilizer and a foliar fungicide. The untreated 30" rows planted in early May yielded 74.3 bu/ac compared to the 15" rows which yielded 78.0 bu/ac (loss of 3.7 bu/ac). The 30" rows yield was increased to 76.7 bu/ac with the addition of starter N and a foliar fungicide for a yield loss of only 1.3 bu/ac compared to the 15" untreated rows. It must be noted that the 15" rows also increased in yield with the addition of inputs resulting in the highest overall yield of 80.4 bu/ac.

The June planting date results were similar although the overall yield potential was reduced in all cases compared to the early May date. Most of the yield gain came from the foliar fungicide not the starter N. When comparing the two planting dates the untreated 30" rows yielded the same as the 15" untreated rows seeded three weeks later. This shows that early planting is an important factor in getting the most out of wide rows. This study has demonstrated that wide rows can perform well but 15" rows still outyielded 30" rows in every comparison when planted on the same day.

Table 1. Soybean response to starter N and foliar fungicides.

	Row width	Treatment*	Seeding rate	Planting** date	Yield bu/ac	Loss of 30" rows compared to 15" untreated (bu/ac)
1	15"	Untreated	165	Early May	78.0	
2	30"	Untreated	140	Early May	74.3	- 3.7
3	15"	N	165	Early May	78.4	
4	30"	N	140	Early May	74.9	- 3.1
5	15"	N + Fungicide	165	Early May	80.4	
6	30"	N + Fungicide	140	Early May	76.7	- 1.3
7	15"	Untreated	165	Late May	73.4	
8	30"	Untreated	140	Late May	69.1	- 4.3
9	15"	N	165	Late May	72.8	
10	30"	N	140	Late May	70.6	- 2.8
11	15"	N + Fungicide	165	Late May	76.7	
12	30"	N + Fungicide	140	Late May	71.2	- 2.2

*N = 10 gallons/ac of 28% UAN applied on soil surface at planting streamed on the row in 2022. 87 lb/ac of urea broadcast in 2023.
Fungicide = DELARO Complete at growth stage R2.5.
**Early May = the first planting window when the soil was fit. (May 7-16) Late May = (May 30 – June 2).
These trials were supported by Maizex Seeds and Grain Farmers of Ontario.

How much rainfall will leach nitrogen in corn?

Heavy rainfall can cause nitrates to move down through the soil and possibly below the corn crop's root zone where it is less available for uptake. How much rainfall is needed to leach nitrogen (N)? Should we be applying extra N to corn to cover losses if a lot of rainfall has occurred in July and August? At the 2023 Southwest Crop Diagnostic Days we did an experiment to see how much water was needed to move nitrates.

The simple answer

A simulated 6" rain event in July caused the highest concentration of leachate to occur at a depth of 16-20", where it is still accessible for uptake by corn roots. Adding additional N would not be necessary. Heavy rainfall events in the spring, when soil is more likely to be saturated, would cause greater leaching potential in coarse-textured soils. This illustrates the benefit of split N applications to minimize the risk of leaching and to maximize availability during critical periods of crop development.

A little more information

The trial was completed at the end of June on a very dry sandy/fine sandy loam soil (Figure 1). Potash (KCl) was applied in the test area at 1,000 lb/ac. Water was later applied at various amounts (0-6"). Four soil cores were pulled from each water treatment and segmented into 4" increments to 36" depth to follow chlorides through the profile. As simulated rainfall amounts increased, the concentration of chlorides was highest at increasing depths with the highest concentration occurring at 16-20" after a 6" simulated rain event.

Figure 1. Soil profile of leaching experiment.

The full story

Why potash?

Chloride (Cl) from potash moves very similar to nitrate (NO_3) in soil water but is not susceptible to the same microbial transformations. This provides a similar but more stable representation of solute movements in soil water.

Measuring movement

Chloride movements are summarized in Table 1. Not surprisingly, with no rainfall, chlorides in the top 4" were very high as dry fertilizer granules remained on the soil surface. Also not surprisingly, chlorides moved deeper as more water was added. With the highest amount of water tested (6"), the chloride pulse moved down about 20-24".

Table 1. Chloride movement in soil profile.

Depth	Applied water 0"	1"	2"	3"	4"	6"
	% of Cl in the 36" soil profile					
0-4"	92%	64%	32%	29%	6%	9%
4-8"	3%	16%	16%	45%	27%	10%
8-12"	2%	3%	12%	15%	11%	17%
12-16"	0%	2%	9%	6%	21%	18%
16-20"	0%	2%	11%	1%	13%	29%
20-24"	1%	1%	7%	1%	8%	9%
24-28"	0%	1%	7%	1%	8%	3%
28-32"	0%	1%	3%	1%	3%	4%
32-36"	1%	10%	3%	1%	5%	2%

Corn rooting depth varies depending on factors like soil texture, compaction and water tables. In general, full-size corn in Ontario might be able to pick up nitrates within a 3' or 36" depth. If nitrates don't move below the root uptake zone of corn, they should still be available. In this experiment, N movement with even 6" of water should still be accessible by corn plants.

The soil factor

Soil acts like a sponge. Unless saturated, water does not usually just flow to depth with gravity. Capillary forces in small spaces are strong enough to hold water against the force of gravity. Before water can move deeper with gravity these small pores must be filled. Coarse-textured soils have fewer micropores and lower water holding capacity than fine-textured soils, and are more likely to see leaching losses as the water moves downward quicker through the soil profile, assuming there is sufficient water in the soil already.

From late June through July and August, potential evapotranspiration (water loss from evaporation from soil and transpiration from plants) is typically much greater than precipitation. This dries out the soil sponge. Before water moves below the rooting zone the soil must be fully saturated, which requires substantial amounts of precipitation at this time of year. This partly explains why leaching losses tend to be a more significant issue outside of the main growing season when soils are more easily saturated (e.g. late fall or early spring when evapotranspiration is lower than precipitation) than during warmer months.

However, if multiple heavy rainfall events occur in a relatively short time – keeping the soil saturated – there's more potential for the nitrate to leach below the rooting zone.

The bottom line

While there were inevitably some N losses in 2023, a single heavy rainfall during the middle of the growing season (e.g. late June through August) is less likely to cause a significant rate of N loss than if the same rainfall had been received earlier in the growing season.

The greatest N leaching losses occur after corn harvest if there's excess N fertilizer in the soil. That's why it's important to match the N rate to a realistic yield goal, and adjust based on the previous crop, soil type, application timing and manure application.

Ian McDonald *Crop Innovations Specialist and* **Alex Barrie** *Soil Management Engineer*

What is the best way to minimize soil compaction?

Soil compaction negatively affects crop health and grain yield. There are many factors that contribute to soil compaction, but what are the biggest contributors and how can their impact be reduced?

The simple answer

Focus on these five best practices for the greatest impact on minimizing soil compaction:

1. Conduct field activities only when soil conditions are "fit" (avoid wet and saturated soils)
2. Reduce the total weight of each equipment pass through the field
3. Reduce axle weight (i.e. more axles)
4. Increase tire size
5. Reduce tire pressure (i.e. use radial tire)

Figure 1. A tractor and grain cart. Reducing axle weight, increasing tire size and reducing tire pressure will lower the risk of compaction.

A little more information

Since 2017, eight compaction events have been held across the province. A wide range of equipment was brought in to measure the amount of soil pressure exerted under different conditions. The data collected from these events provided a general ranking of farm machinery from "bad" to "better" in terms of their contribution to soil compaction (Figure 2).

COMPACTION LOAD ON TOPSOIL			
BAD			BETTER
• Hay wagons • Gravity wagons • Sprayers • Trucks	• Balers • Forage harvesters • Hay equipment	• Grain carts • Manure spreaders • Combines	• Tractors

Figure 2. The relative amount of soil compaction that each type of farm machinery creates based on data collected from eight compaction events from 2017-2023.

Farm machinery ranking was strongly influenced by total weight, axle weight, tire size and tire pressure (low pressure = bigger footprint). Standard features on farm implements will greatly impact the level of compaction. For example, a gravity wagon with narrow width (220 mm) bias ply tires inflated to 100 pound per square inch (PSI) will exert more pressure than a similarly weighted tractor with wide radial tires (710 mm) inflated to 9 PSI. We know that implement compaction can be reduced significantly by reducing total weight load, axle load and tire pressure, and increasing tire size.

The full story

In the simplest sense, soil compaction is the reduction in pore space within a soil. An ideal soil is composed of 50% mineral content (a small portion is organic matter), 25% water filled pores and 25% air filled pores. These proportions are extremely important to all soil functions. Compaction tends to squeeze out water and air pores, changing the function of soil in the ecosystem and resulting in lost yield.

Traffic control

In an ideal world from a soil compaction standpoint, there would be a system where every vehicle and implement can drive in the same wheel tracks. This is manageable when equipment is all the right size, but cost is a huge barrier. A more achievable change in management would be to limit traffic through the field. Consider a manure spreading task. For each load spread, there are two trips in and out of the field where nothing is being done. Depending on field size, you could adjust the application rate so that you end up near one end of the field when the spreader is empty, or only fill up enough so that you end on a headland. This would avoid loaded trips into the interior of the field. But the cost is more trips between the manure storage and the field. When possible, consider having multiple points of field entry to reduce extra driving through the field.

Monitor moisture

Wet soils (at depth) are a major factor for subsoil compaction, which is also harder to correct. Soil may be dry on top in the spring, but it will likely be too wet as you go deeper. The compaction events have shown that wetter soils are weaker than dry soils. Wetter soil at depth will be affected by higher axle weights.

Figure 3. A manure tank with multiple axles, large tires and a centralized tire inflation system (CTIS).

Long-term mitigation

Within the five best practices outlined, there are additional ways to address soil compaction that require a longer period of time to implement.

1. Conduct field activities when soil conditions are "fit"
    - Add or improve tile drainage
    - Improve soil structure (increase organic matter, less tillage, perennial root systems)
    - Be patient
2. Reduce total weight of each equipment pass through the field
    - Smaller machinery or lower load weights
    - Fewer passes through the field or over areas within the field
    - Work toward a control traffic system
3. Reduce axle weight
    - More axles per implement
    - Dual wheels
4. Increase tire size
    - Increase width
    - Radial tire instead of bias tire
5. Reduce tire pressure
    - Add a centralized tire inflation system (CTIS) for road versus field travel

Ontario Corn Hybrid DON Screening Trials 2023 Report

Introduction. Gibberella ear rot concerns the industry because of DON concentrations. It is well known that DON concentrations are highly dependent on interactions among hybrids, pathogens, and the environment. Starting in 2019, the Ontario Corn Committee (OCC) refined protocols for testing hybrid sensitivity to DON accumulation with confidence based on an assessed risk. This inaugural report provides a risk assessment of hybrids entered in the 2023 trials, along with a multi-year assessment on the same hybrids if data were available. The current testing method was designed to identify the hybrid-specific relative resistance of hybrids across multiple environments produced at 2 locations and 3 planting dates at each location per year. The variability inherent in this work was sufficiently constrained to support statistical differences among hybrid entries. **It needs to be emphasized that this is a relative risk assessment of hybrids and that additional data sources (e.g., seed company information, field trial results, etc.) should be used for better hybrid decisions based on DON risk. Currently, there are no DON-resistant hybrids.**

Notes on inoculation trials. Briefly, the hybrids were voluntarily submitted by seed companies for testing from 2019 to 2023. Hybrids were tested in misted, inoculated disease nurseries at the Ridgetown Campus from 2019 through 2023, at the Huron Research Station (Exeter) from 2021 to 2023, and at AAFC-Ottawa in 2019. After 2019, it was determined that the Ottawa location was too far removed from the maturity zone of most hybrids, so trials were conducted at Ridgetown and Exeter in subsequent years. The hybrid entries varied each year depending on seed company decisions and hybrid turnover in the marketplace. Some seed companies chose not to participate in this study, while others entered only a few hybrids. Each hybrid entry was planted on three dates to expose various hybrid maturities to different weather conditions around silking and during grain-fill: relatively early (early to mid-May), mid (late May), and relatively late (early to mid-June), with three replications per planting date. Thus, each hybrid entry was exposed to six "environments" (two locations × three planting dates) with three replications for a total of 18 DON measurements per hybrid per year in most years. In 2023, the late-planted block at the Huron Research Station was not inoculated and was subsequently discarded because of late silking.

In all years, corn was planted in 30" rows to achieve a final stand of 34,400 plants per acre (see Appendix Figure 1). Each hybrid was planted in a single row of approximately 25 plants. Ten plants were inoculated in each row by hand at the optimal time for infection (from full silk to the first sign of silk browning). The trials were mist-irrigated on timers every day for approximately four weeks after inoculation (see Appendix Figure 2). At harvest, corn was hand-harvested, dried, shelled, and analyzed for DON.

Data were analyzed using PROC GLIMMIX with a lognormal distribution. Indices were calculated and compared based on the log means relative to the same (highly DON susceptible) check hybrid. In 2023, hybrids that were statistically different from the check hybrid were identified within each planting date. In the multi-year combined analysis, data were combined across all environments. Each combination of year, location, and planting date was treated as an "environment" in the analysis as a random effect.

Results. The data were analyzed over multiple years (Table 1) if data were available. The 1-year column is identical to the last column in Table 2 (i.e., 2023 data). Note that the hybrids were sorted according to the CHU rating. In general, hybrids with multi-year data ranked similarly across years using only 2 years of data, with only a few exceptions. Of the 45 hybrids entered in 2023, the DON in 16 hybrids was similar to the DON in the susceptible check (note "nd" or "not different" statistically in the last column to the right). Two hybrids were statistically higher than the susceptible check (note "+" in the last column).

A relative risk assessment of hybrid susceptibility to DON is presented as indices by environment in 2023 (see Table 2). The environments are based on location and planting dates. As expected, there was some variability across the five environments; however, there was sufficient consistency or evidence to identify statistical differences in hybrid sensitivity to DON accumulation.

Table 1. Relative DON risk assessment indices by hybrid relative to susceptible check from 2020-2023. Hybrids are sorted by CHU rating. Always use one-year data with caution. The colour scheme highlights hybrid effects within column. An index=100 means DON equal to the susceptible check.

Hybrid	Hybrid CHU	4-year		3-year		2-year		1-year	
DKC36-48RIB	2600			28	*	26	*	30	*
A5424G2 RIB	2625							44	*
A5959G2 RIB	2725			27	*	26	*	37	*
DKC39-55RIB	2725			59	*	59	*	59	*
P9316Q	2750							34	*
P9466AML	2800							45	*
DKC42-05RIB	2800	34	*	32	*	26	*	48	*
P9535AM	2825			62	*	55	*	56	*
P9624Q	2850							22	*
B96H83AM	2850			27	*	19	*	24	*
DKC44-80RIB	2850	30	*	34	*	24	*	32	*
A6566G8RIB	2850							43	*
NK9535-V	2850							76	nd
A6572G2 RIB	2850			60	*	81	nd	102	nd
NK9601-AA	2875							36	*
NK9653-DV	2875			34	*	37	*	48	*
DKC45-74RIB	2875							91	nd
*company removed	2875							209	+
DKC46-40RIB	2900			52	*	43	*	45	*
P97299AM	2900							86	nd
EXP9723-DV	2900							106	nd
P9823Q	2925			28	*	23	*	31	*
*experimental	2925							275	+
P9845PCE	2950							116	nd
DKC49-09RIB	2975	54	*	53	*	44	*	98	nd
B00R96AM	3000	42	*	37	*	26	*	22	*
P0035AM	3000			46	*	43	*	33	*
P0075AM	3000			55	*	44	*	35	*
NK9991-5122	3000			69	*	77	nd	73	nd
NK0007-AA	3000							166	nd
A7199G9 RIB	3025							84	nd
NK0243-D	3075			39	*	31	*	30	*
*experimental	3100							125	nd
B04S21AM	3125	62	*	61	*	56	*	33	*
B04D72Q	3125			62	*	61	*	57	*
P04922Q	3125							87	nd
P0404AM	3125			99	nd	136	nd	113	nd
P04511AM	3125							164	nd
P0529Q	3150							24	*
MZ 4577SMX	3150	66	*	66	*	57	*	41	*
SUSCEPTIBLE CHECK	**3175**	**100**		**100**		**100**		**100**	
MZ 4608SMX	3200			16	*	15	*	17	*
B07M64AM	3200			85	nd	95	nd	37	*
MZ 4799SMX	3250							14	*
P0806AM	3250							36	*
P0859AM	3250							89	nd
Hybrid diff (P-value)		<0.0001		<0.0001		<0.0001		<0.0001	
Average DON in Check (ppm)		**13.9**		**8.8**		**3.4**		**16.0**	
No. environments tested		23		17		11		5	
No. observations per hybrid		69		51		33		15	

Interpretation

For example, this hybrid produced 28% of DON compared to the susceptible check hybrid across 17 environments (over 3 years). Hybrids with an asterisk (*) are statistically lower in DON compared to the susceptible check hybrid.

Hybrids with "nd" are not different statistically compared to the susceptible check hybrid.

Hybrids with "+" have statistically higher DON compared to the susceptible check hybrid. In this hybrid, DON was 2.75x higher than the susceptible check hybrid. Only one-year data are available.

Susceptible check hybrid

Low statistical p-values indicate strong evidence that hybrid differences exist considering variability.

Table 2. Relative DON risk assessment indices by hybrid and environments in 2023. Hybrids are sorted by CHU rating. Always interpret one-year data with caution. The colour scheme highlights relative hybrid effects within column.

Hybrid	Hybrid CHU	Exeter environments 1	Exeter environments 2	Ridgetown environments 3	Ridgetown environments 4	Ridgetown environments 5	Overall mean	
DKC36-48RIB	2600	7	50	15	38	118	30	*
A5424G2 RIB	2625	10	91	36	36	132	44	*
A5959G2 RIB	2725	25	106	23	23	50	37	*
DKC39-55RIB	2725	30	108	33	18	379	59	*
P9316Q	2750	7	61	42	24	98	34	*
P9466AML	2800	14	69	69	18	139	45	*
DKC42-05RIB	2800	17	108	52	24	106	48	*
P9535AM	2825	47	75	23	32	198	56	*
P9624Q	2850	12	13	17	23	80	22	*
B96H83AM	2850	11	43	13	24	53	24	*
DKC44-80RIB	2850	12	54	16	52	56	32	*
A6566G8 RIB	2850	13	138	12	70	94	43	*
NK9535-V	2850	20	182	54	194	64	76	nd
A6572G2 RIB	2850	27	137	83	78	442	102	nd
NK9601-AA	2875	4	20	102	96	72	36	*
NK9653-DV	2875	5	47	88	100	110	48	*
DKC45-74RIB	2875	30	35	90	90	731	91	nd
*Company removed	2875	66	266	138	204	778	209	+
DKC46-40RIB	2900	35	174	32	21	30	45	*
P97299AM	2900	36	87	76	51	381	86	nd
*Experimental	2900	29	130	62	140	382	106	nd
P9823Q	2925	31	60	21	35	21	31	*
*Experimental	2925	107	445	124	247	1317	275	+
P9845PCE	2950	48	105	52	160	483	116	nd
DKC49-09RIB	2975	41	179	55	100	214	98	nd
B00R96AM	3000	8	6	66	40	33	22	*
P0035AM	3000	37	12	23	33	112	33	*
P0075AM	3000	22	21	12	42	206	35	*
NK9991-5122	3000	45	18	118	213	112	73	nd
NK0007-AA	3000	132	529	75	120	285	166	nd
A7199G9 RIB	3025	64	68	76	22	659	84	nd
NK0243-D	3075	23	11	45	46	41	30	*
*Experimental	3100	86	120	112	159	162	125	nd
B04S21AM	3125	18	7	35	60	154	33	*
B04D72Q	3125	24	10	101	63	384	57	*
P04922Q	3125	44	41	152	111	157	87	nd
P0404AM	3125	39	97	70	129	465	113	nd
P04511AM	3125	58	84	186	266	465	164	nd
P0529Q	3150	15	6	34	24	105	24	*
MZ 4577SMX	3150	30	39	49	33	57	41	*
SUSCEPTIBLE CHECK	**3175**	**100**	**100**	**100**	**100**	**100**	**100**	
MZ 4608SMX	3200	5	5	29	25	58	17	*
B07M64AM	3200	25	37	68	16	52	37	*
MZ 4799SMX	3250	4	5	17	48	33	14	*
P0806AM	3250	20	45	71	14	71	36	*
P0859AM	3250	23	182	39	135	246	89	nd
Hybrid difference (P-value)		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Average DON in Check (ppm)		**68.9**	**13.2**	**30.0**	**9.8**	**4.0**	**16.0**	
No. observations per hybrid		3	3	3	3	3	15	

Interpretation

For example, this hybrid produced 30% of DON compared to the susceptible check hybrid across environments. hybrids with an asterisk (*) are statistically lower in DON compared to the susceptible check hybrid.

Hybrids with "nd" are not different statistically compared to the susceptible check hybrid.

Hybrids with "+" have statistically higher DON compared to the susceptible check hybrid. In this hybrid, DON was 2.75x higher than the susceptible check hybrid.

An example of variability across environments

Susceptible check hybrid

For further information, please contact Dr. Dave Hooker (UG-Ridgetown) Email: dhooker@uoguelph.ca, or Albert Tenuta (OMAFRA Field Crops Pathologist) Email: albert.tenuta@ontario.ca

Acknowledgements: Ontario Corn Committee, Grain Farmers of Ontario, OMAFRA, OCC DON sub-committee, seed corn companies (listed below), Agricultural Research Institute of Ontario (ARIO) for research station infrastructure, Canadian Seed Trade Association (CSTA), and in alphabetical order: Dr. Nasim Alijanimamaghani (UG-Ridgetown), Ahmed Alim (UG-Ridgetown), Jonathan Brinkman (UG-Ridgetown), Josh Cowan (GFO), Darrell Galbraith (UG-Ridgetown), Scott Jay (UG-Ridgetown-OMAFRA), Dr. Katiana Eli (UG-Ridgetown), Michael Heaman (UG-Ridgetown), David Morris (OCC), Todd Phibbs (UG-Ridgetown), Ben Rosser (OMAFRA), Dr. Art Schaafsma (UG-Ridgetown), Carlene Scott (UG-Ridgetown), Cheryl Van Herk (UG-Ridgetown/OMAFRA), Ken Van Raay (UG-Ridgetown), Marty Vermey (GFO), and many summer students.

Sponsors:

Brand or identification, participating seed companies (2019-2023)	
Brevant, Corteva Agriscience	NK Brand, Syngenta Seeds Inc.
Country Farm, Country Farm Seeds Ltd.	Pioneer, Pioneer Hi-Bred Canada
CROPLAN, Winfield United	PRIDE Seeds, AgReliant Genetics Inc.
DEKALB, Bayer CropScience Inc.	Saatbau, Saatbau Linz
Maizex, Maizex Seeds Inc.	

Appendix

Figure 1. Precision planting the OCC DON experiment at Ridgetown.

Figure 2. Overview of the OCC DON trial showing the overhead misting lines at Ridgetown.

FIELDCROPNEWS

fieldcropnews.com

This publication is a group effort – thanks to the editorial work of Mike Cowbrough, Nicole Berardi and Deanna Nemeth, and the contributions of Francesco Piccioni and Jane Robinson.

Grassroots Innovation
Since 1939

GRAIN FARMERS OF ONTARIO

Ontario