ONcore
For Commerical Apple Producers

Volume 28, Issue 2, Spring 2024

Orchard Management

Crop Protection

REPLANTING
FOR A SWEETER TOMORROW

HOT TIPS FOR REPLANTING

- Remove old plant tissue
- Consider replant-resistant rootstocks
- Test and manage if needed:
  - Nematodes
  - Soil pH
  - Organic Matter
  - Nutrients
- Drain and grade soil
- Choose low rates or non-residual herbicides
- Control perennial weeds
- Stagger new planting rows

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ANNOUNCEMENTS

- Honey Bee Health Initiative
- Greenbelt Soil Health Assessment
- AgRobotics Demo Day

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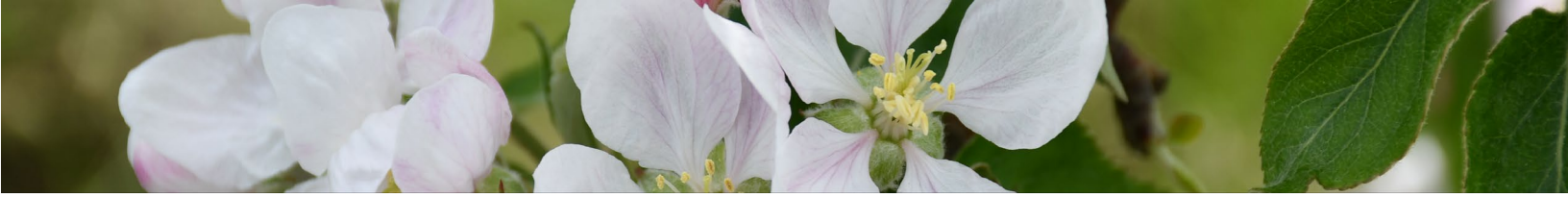


ORCHARD MANAGEMENT

Growing Future Opportunities Initiative:
Apple Replant Information

Replant Program Quick Tips:

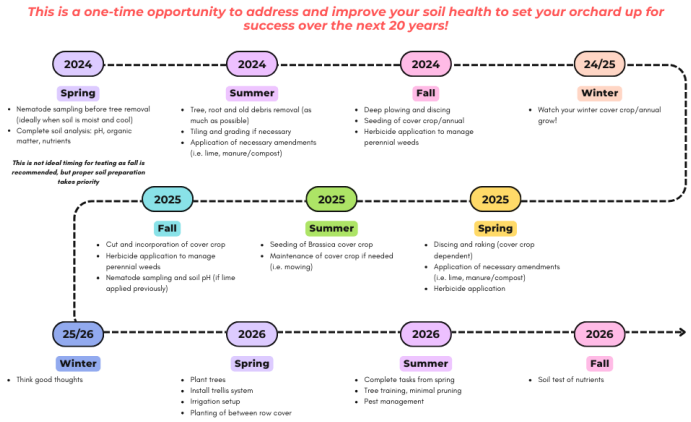
- Replacement trees can be the same variety, as long as the sport is different
- You must replant your new trees in the same area as you removed your old trees
- Areas where trees were removed longer than 3 years ago is not eligible.
  - You must be able to prove that area was in commercial production within the past three years
- You are able to replant your orchard until December 31, 2026
- You have until January 31, 2027 to submit claims and receipts to get reimbursed

Agronomic Advice for Replanting:

- We recommend you remove trees as soon as possible to properly prepare the soil for tree replacement
- Soil preparation and cover crops should be planted this season (2024), allowing for two seasons (2024 and 2025) to address any soil health concerns

An Example Replant Timeline for orchard preparation is available if trees have not been pulled already.

Example Replant Timeline



Click on graphic to view full size.

For further recommendations and best practices for apple replant, please read the article titled *Getting a Complex: Factors and Practices Involved in Apple Replant Disease Prevention*.

Further Information

- Agricorp Funding Program Information
- Planting New Apple Orchards in Ontario
- Ontario Cover Crop Information
- Weed Control for New Orchards in Ontario

Resources:

Washington State University. *Orchard Establishment*. https://treefruit.wsu.edu/orchard-management/orchard-establishment/

Miranda Sazo, M. and Hoying, S.A. *Planning Ahead with Midsummer Grasses.* https://rvpadmin.cce.cornell.edu/uploads/doc_90.pdf

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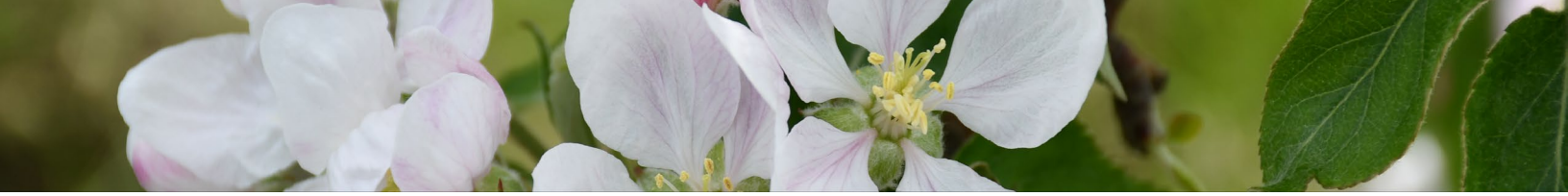
The Growing Future Opportunities Initiative is funded in part by the Governments of Canada and Ontario under the Sustainable Canadian Agricultural Partnership (Sustainable CAP), a five-year, federal-provincial-territorial initiative.



Soil Health to Optimize New Orchard Growth

Danny Jefferies *— Horticulture Soil Management Specialist*

Good soil management in advance of new orchard planting is essential. Beyond soil pest management there are additional soil functions which are important for new orchard success. A high functioning healthy soil should:

- Have sufficient fertility & organic matter
- Drain well but have good water holding capacity
- Have stable aggregates that resist erosion and runoff
- Have active beneficial biology

Fertility & Organic Matter

For any crop to grow well, sufficient soil fertility is required. This includes adequate levels of organic matter, appropriate soil pH and sufficient levels of macro and micro nutrients. After an apple orchard is established many of these soil attributes are difficult to manage and improve, consequently, prior to establishing an apple orchard it is best to address any deficiencies. Some of these deficiencies like soil pH can take a substantial amount of time to remedy, testing soil two or more years in advance of planting is ideal.

In order to properly manage soil fertility, a thorough assessment via soil sampling & laboratory analysis is required. Performing soil sampling at an appropriate scale to capture within field variability is very important in a high value crop like apples. Soils can vary in fertility for a variety of reasons, from natural soil forming factors to previous field management. When sampling soils, one composite sample should at a maximum represent 10 ha (25 ac). With the modern capabilities of technology relating to site-specific farming ideally a much small area should be represented by each sample to capture field variability.

Some advice related to soil sampling can be found in Chapter 4 of Publication 611: *Soil Fertility Handbook*. Ontario fertility nutrient recommendations are based on a soil test sample collected from 0-15 cm (0-6"). Based on the rooting of apple tree feeder roots, some jurisdictions suggest a deeper sampling depth. In some scenarios it may be beneficial to collect sub-samples at multiple depths (eg. 1-6" and 6-12") which could inform of underlying soil limitations. Generally in Ontario our topsoil is not very deep, hence why the fertility sampling is recommended in the upper 6" depths.

For apples an adequate pH range is 6-7, some varieties such as Honeycrisp prefer pH on the higher end of the range. If the pH is below 5.1 on fine textured mineral soils or 5.6 on coarse and medium textured soils soils, apply lime in the fall or before spring cultivation (it is always best to incorporate the lime product). The pH will not change immediately because lime reacts slowly in the soil.

If the soil test report recommends a lime application to increase soil pH, add lime at suggested rates one year prior to planting. For details regarding rates and suggested types of lime to use, refer to Soil pH and Liming. In situations where magnesium is required as well according to the soil test, dolomitic versus a calcitic lime may be used to correct soil pH and add magnesium fertility.

Based on the soil test, fertilizer amendments should also be made. Pay attention to the extractant used for your soil test. For example, the Olsen (or sodium bicarbonate) extraction is the OMAFRA-accredited test for phosphorus. More information on accredited tests and labs. Adequate soil nutrient levels are shown in Table 1 below. Action should be taken to apply fertilizer for tests indicating high, moderate and low response. Those tests which are rare or no response are unlikely to show benefit to the fertilizer application.

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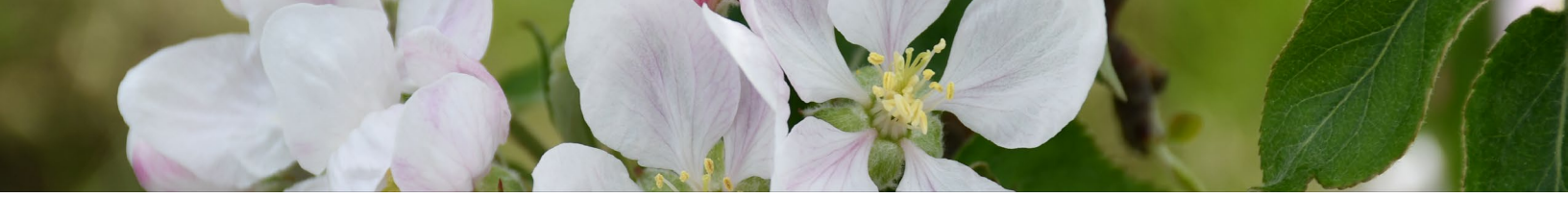


Table 1. General Soil Test Interpretation for Horticultural Crops Grown in Mineral Soils in Ontario[1]

		Response Level				
	Extraction Method(s)	High	Moderate	Low	Rare	No
pH	Saturated Paste, 1:1 Water	< 5.1 fine textured <5.6 on coarse/medium texture				6-7
Phosphorus (P), ppm	Olsen/Sodium Bicarbonate	<8	8-12	13-20	21-60	>61
Potassium (K), ppm	Ammonium Acetate	<80	80-150	151-210	211-250	>250
Magnesium, ppm	Ammonium Acetate	<30	30-100		100-250	>250
Zinc Index	DTPA, modified by soil pH	<8	8-14	15-24	25-100	>100
Manganese Index	H3PO4, modified by soil pH	<8	8-15	16-30	31-50	>50

[1] Likelihood of response to fertilizer amendment as approved by OSMRSC, 2017 Revision.

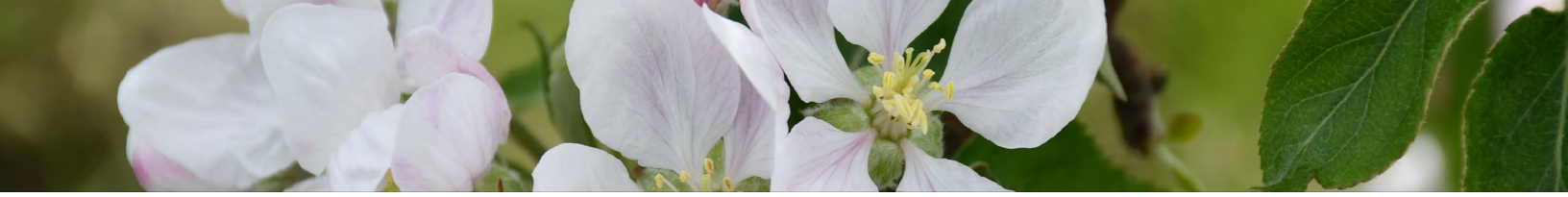
In terms of recommendations for fertilizer applications prior to apple tree planting based on soil tests, there are published recommendations for phosphorus & potassium. The specific recommendations for P2O5 and K2O quantities are shown in Table 2.. More OMAFRA recommendations relating to apple nutrition can also be found at this LINK.

Table 2. Phosphorus and Potassium Requirements for New Plantings of Apples

Phosphorus	P_2O_5 required		
Soil test (ppm P)[1]	kg/ha	lb/ac	
0-3	80	71	HR
4-5	60	54	HR
6-7	50	45	HR
8-9	40	36	MR
10-12	20	18	MR
13-20	0	0	LR
21-80	0	0	RR
80+	0	0	NR[3]

Potassium	K_2O required		
Soil test (ppm K)[2]	kg/ha	lb/ac	
0-15	180	160	HR
16-30	170	152	HR
31-45	160	143	HR
46-60	140	125	HR
61-80	110	100	HR
81-100	70	62	MR
101-120	40	36	MR
121-150	20	18	MR
151-210	0	0	LR
211-250	0	0	RR
250+	0	0	NR[3]

[1] 0.5 M sodium bicarbonate extract soil test method (Olsen).
[2] 1.0 N ammonium acetate soil test method.
[3] Adding nutrients to soils with these levels of nutrients may reduce crop yields or quality by interfering with the uptake of other nutrients.
Notes: HR, MR, LR, RR, and NR denote, respectively: high, medium, low, rare and no probabilities of profitable crop response to applied nutrient.



Organic matter is a key indicator of a healthy soil. It contributes to soils structure, water retention, nutrient cycling and availability. Lower organic matter soils are less resilient to environmental stresses. A topsoil survey was done in Ontario in 2019, through this work it provided a cross section of soil types from across the province & specific laboratory measurements of soil properties like Organic Matter. This work has formed the basis for the Soil Health Assessment and Plan (SHAP) scoring functions: SHAP Intro.

The scoring functions (Figure 1.) rank the organic matter level in your soil with a score from 0-100, you can utilize the **scoring calculator at this** LINK. Further, based on the data gathered during the topsoil survey, the mean level of organic matter by soil type is listed in Table 3.

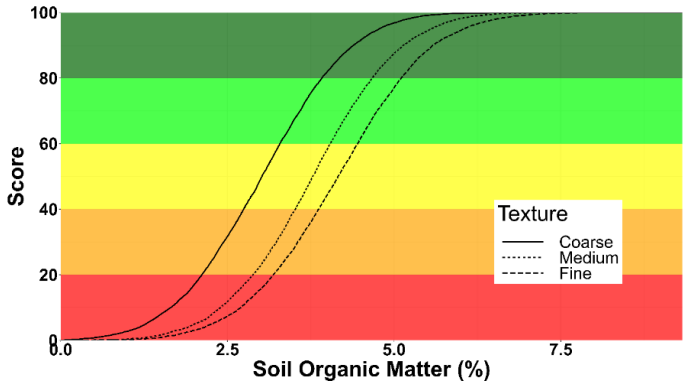


Figure 1. *Soil Organic Matter scoring function to rank from 0-100. Find your organic matter on the x-axis, and move straight up to where it intersects the line representing your soil texture, then follow that straight to the left to identify your score.*

Table 3. Based on a Dataset of 1841 Samples[1]

Texture group	Mean (SD)
Coarse	3.01 (1.07)
Medium	3.77 (1.06)
Fine	4.16 (1.12)

[1] SOM is scored using separate functions for coarse, medium, and fine textured soils. The scoring curve, mean and standard deviation (in parentheses) for each texture group are provided below.

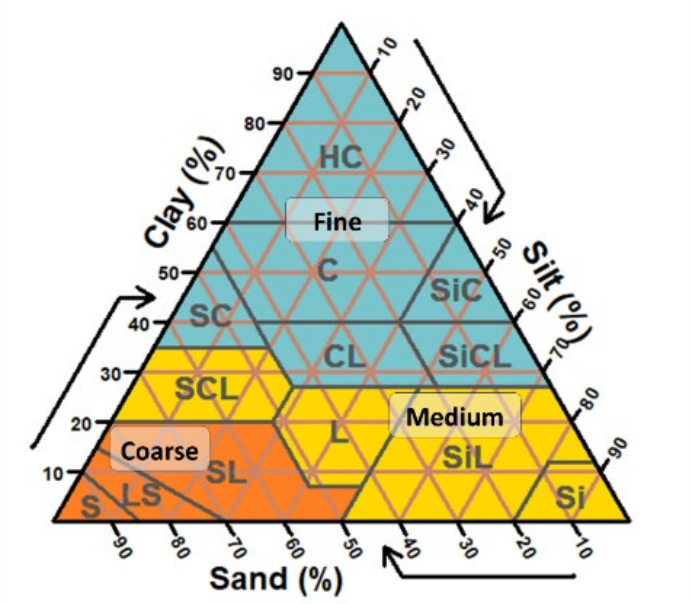
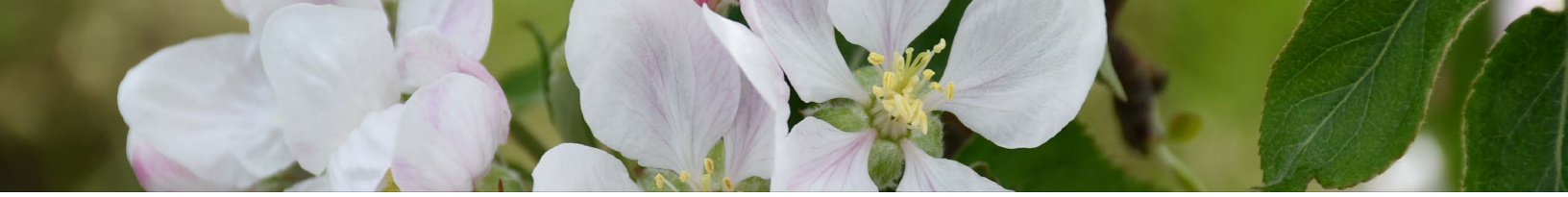


Figure 2. *Soil texture groupings for SHAP scoring.*

To increase your soil's OM content, consider incorporating organic amendments ahead of orchard planting such as manures, composts, and high biomass cover crops. It is important to be conscious of the C:N ratio of amendments being applied. As a rule of thumb immobilization of nitrogen can occur if C:N ratio is greater than 25:1. Ahead of orchard planting this is not as much of a worry, but if utilized in crop or close to planting it could significantly impact nitrogen availability to the young trees. To increase soil organic matter is a long-term endeavor, the earlier and more frequently you can make amendment applications in advance of orchard planting the better. As seen in the data from the SHAP framework, coarse textured soils inherently have less organic matter, consequently increasing organic matter in these soil types could be very beneficial – particularly for increased water holding capacity. When utilizing organic amendments it is important to make considerations for their nutrient content. This will ensure that a balance is made between increasing organic matter levels, improving soil fertility and minimizing environmental pollution. A blog post can be found at ONFruit.ca about using the Agrisuite Calculator, you can also find information on interpreting detailed organic amendment analysis.



Drainage and Water Holding Capacity

Within Ontario we are fortune to receive regular rainfall throughout our growing season. However, often our soil moisture conditions are not always ideal. It is common to receive heavy rainfall events which saturate our soils and require supplemental tile drainage, while at the same time not uncommon to have dry spells in which irrigation may be necessary.

A healthy soil has important functions related to both drainage as well as infiltration. We want the soil to have porosity within which to hold air and water and allow water to move through the profile when in excess – ideally keeping the root zone moist, but not saturated. Some rootstocks can be particularly sensitive to poorly drained soils, and generally if a soil is poorly drained this will stress the tree and limit root growth.

Soils inherently have properties Figure 2 which make them more easily drained. The most influential factor is soil texture, coarse sandy soils without underlying clays will drain well, whereas finer texture clay rich soils are more likely to have imperfect or poor drainage capabilities. The soil maps available within Ontario can give some general idea of a soils inherent drainage properties. You can access the Ontario soil mapping through OMAFRA AgMaps tool.

Management can also impact the ability of a soil to drain. Soil compaction from tillage, or heavy axle loads will impede water movement. Soil compaction results in a reduction of soil porosity and its connectivity, preventing water from infiltrating. Compaction can be evaluated using a tile probe or penetrometer. Penetrometers measure resistance to penetration usually expressed as pounds per square inch (PSI) of force. Compaction readings should be taken in unfrozen soil during moist-to-slightly dry field conditions. More explanation on using a soil penetrometer from Prince Edward Island (2022). Alternatively a quick assessment using a spade can be completed using the Visual Evaluation of Soil Structure (VESS). More on this method can be found on the Field Crop News website.

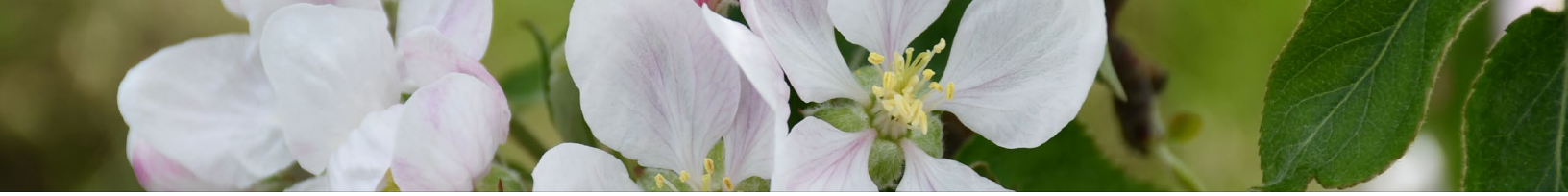
Surface compaction can often be managed with tillage before planting the orchard. The tillage must be performed when soils are dry and fracturing of the hardpan will occur – avoid using disks that may create new hard pans. Cover cropping before planting an orchard can be utilized to break up some compaction and improve soil structure. Specifically, there are some cover crops which are deep rooted such as sunflowers, sorghum-sudangrass, cereal rye, and alfalfa can assist with breaking up compaction. Grasses like oats or wheat have very fibrous roots which can help to promote aggregation and improve soil structure. There are many great resources relating to cover crops, Cover Crops & Midwest Cover Crop Council.

Drainage can also be improved through engineering. Orchard sites should be systematically tiled before planting or improved by installing an additional tile line between existing tiles. Another consideration is to plan the tile lines to avoid planting trees or support posts directly over them. Utilize the expertise of a Licensed Tile Drainage Contractor to properly design and engineer your drainage system.

Counter to drainage, we also want to ensure a soil has good water holding capacity to provide resiliency for when environmental conditions are dry. Soil texture again provides inherent properties which impact water holding capacity. Coarse textured soils by nature do not hold as much water as finer textured soils. Organic matter and soil structure also impact water holding capacity. A better structured soil with more porosity will hold more water and higher organic matter soils do not dry out as easily. Again, ahead of planting an orchard it could be beneficial to incorporate manures, compost, high biomass cover crops to improve soil organic matter, aggregation and with them the soils water holding capacity.

Resisting Erosion and Runoff

The topography, and soil type inherently bias a field's susceptibility to erosion and runoff. In advance of orchard planting, fields are particularly susceptible to erosion and runoff during the 'off-season' during winter months when soils often remain uncovered. During these months it is not uncommon to receive heavy rainfalls or snow melts which occur during a short time period. Without soil cover and living roots, or when soil is frozen it is difficult for the water to infiltrate, and consequently water will runoff and down slopes carrying soil and nutrients with it.



Under certain slope conditions runoff can be difficult to manage. In advance of spring orchard planting leaving the soil bare over winter could increase the severity and erosion potential. Cover crops can be utilized to help keep the soil covered and reduce erosion potential. There are many different species of cover crop, some of which will overwinter. Overwintering cover crops are best to keep living roots in the soil into the early spring, however, some can be a challenge if not properly terminated or termination is delayed too late prior to planting. Non-overwintering cover crops to a lesser extent can also assist with keeping soil in place, assuming their residue is left over winter.

With some effort seed drills can be modified to allow for planting of bio-strips of cover crops. This practice has been utilized in field crops recently, but could be applied to an orchard establishment setting. This is a combination of overwintering and non-overwintering cover crops seeded at the same time. By strategically placing non-overwintering cover crops where a subsequent crop will be planted – or in this case – where trees will be planted there are some benefits. The remaining over wintering cover crop will provide soil protection and pathways for farm equipment to travel on (wheel rows), while the non-overwintering strip should remain clear with minimal residue or weeds allowing for good transplanting conditions.

Soil aggregate structures provided both large and small pores. Large soil pores allow water to quickly infiltrate the soil. Smaller soil pores can store plant available water in times of limited rainfall. Overall, the soil function which keeps soils intact is aggregation, and aggregate stability. We can measure the aggregate stability of a soil through laboratory analysis assessed in the SHAP framework. This simulates and measures how well soil aggregates hold together through rapid wetting (rainfall) events. With better aggregate stability, the overall soil structure will be better – meaning more quantity and connectivity of porosity to allow for improved water infiltration and less soil crusting.

Aggregate stability is influenced by microbial activity. The biology within the soil creates exudates which act as glues that hold soil particles together forming aggregates. Improving biology by integrating organic amendments and minimizing soil disturbance will improve aggregate stability.

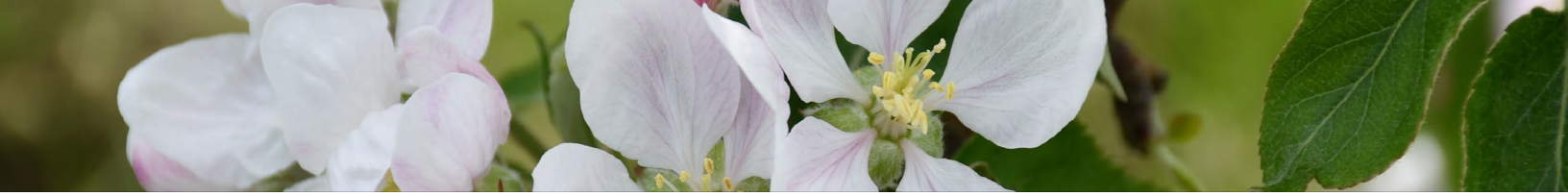
Have Active Beneficial Biology

Soils provide a home for a diverse number of organisms including bacteria, fungi, nematodes, earthworms and many others. Some of this soil biology are pests which can be detrimental to crop production, but a vast amount of the biology is beneficial. As previously mentioned these organisms contribute to building aggregate stability, creating glues that hold soil particles together. Some of the larger organisms like earthworms, add porosity to the soil improving infiltration of water. Some organisms are an active part of nutrient cycling – mineralizing organic nutrients from organic amendments or crop residues and releasing them as plant available forms.

A healthier soil will have increased biological activity. We can measure proxies for biological activity in soils using a metric called soil respiration, also available in the SHAP laboratory analysis. This metric measures the amount of carbon dioxide released from the soil over a given time period, the more released the more active the microbial community.

To improve biological activity it is important that soil disturbance is minimized – reducing or eliminating tillage, and reducing pesticide use will increase soil biology. Additionally, the soil biology is alive, so providing them a food source is essential. Applying organic materials like manure, compost or green manure will feed the soil biology.

One particular type of soil biology, a fungus called endo arbuscular mycorrhizal fungi has a symbiotic association with plant roots in which the fungi penetrates into the plant root. Some growers are inoculating their soils or tree roots with AMF at the time of planting the new orchards. Alternatively, certain fall cover crop species may be useful in increasing numbers of AMF within the soil. AMF will colonize most crops, however, those in the mustard family (canola and other brassicas do not). Some work in South Dakota found a 3x increase of AMF in soils with cover crops versus those without (South Dakota State University Extension).



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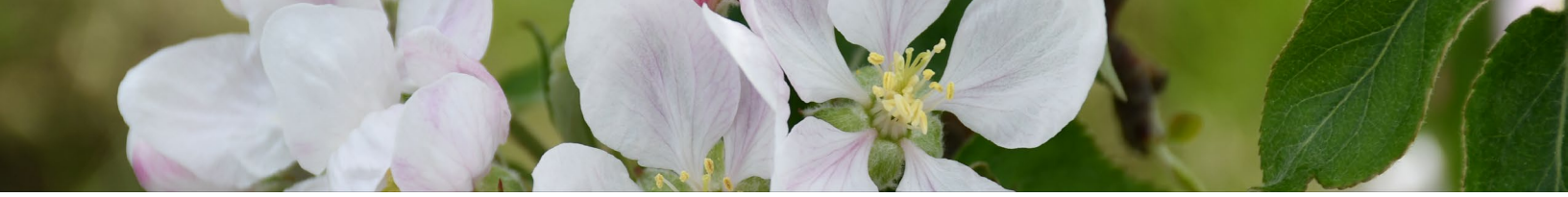

Cover Crops in Apple Orchards: What You Should Know

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General Overview

Cover crops can have multiple definitions when discussing an orchard:

- Vegetation underneath the tree
- Vegetation between the rows
- Vegetation in a crop rotation in preparation for orchard planting

For this article we will be ***focusing on all three definitions.*** The role of cover crops is to shield and enrich the soil. When establishing or in an already established apple orchard, the right cover crops bring various benefits to the health of the orchard. On the other hand, the wrong cover crops can invite pests. You may not have really considered cover crops to be that important, but they play a huge role in an orchard.

Choosing the Right Cover Crops

Ideally, a good cover crop should consist of a mix of grasses, legumes, and broadleaves. Having a mix of cover crops can ensure that the orchard receives all these benefits. Although, implementing a mix of crops can often be difficult to maintain. So, choosing one is just fine, but the benefits and disadvantages of that crop should be considered. For example, having a crop that dominates weeds, such as buckwheat, is a great option for your orchard as weeds can invite pests and take water and nutrients from the soil. However, if your soil often gets either too wet or too dry, than buckwheat won't be able to survive.

The right cover crop for your orchard should be one that will grow quickly and will be easy to maintain. You should also ensure that the crop won't outcompete the trees and that it does not encourage pests. As far as ground cover in alleyways, legumes are a good crop to use as they supply extra nitrogen into the orchard. Perennial crops that are low growing, such as rye grasses and fescues, give easy orchard access. Plenty of orchards even just use grass cover because of its ability to control broadleaf weeds with selective herbicides.

Types of Cover Crops

Cover crops consist of grasses, legumes, and broadleaves. They are a subsection of ground cover, which refers to the vegetation in the alleyways between rows. Together, cover crops and ground cover make up the orchard floor. Some examples of different types of cover crops can be found below. Each cover crop will have a symbol affiliated with common uses, although they can be used for multiple purposes:

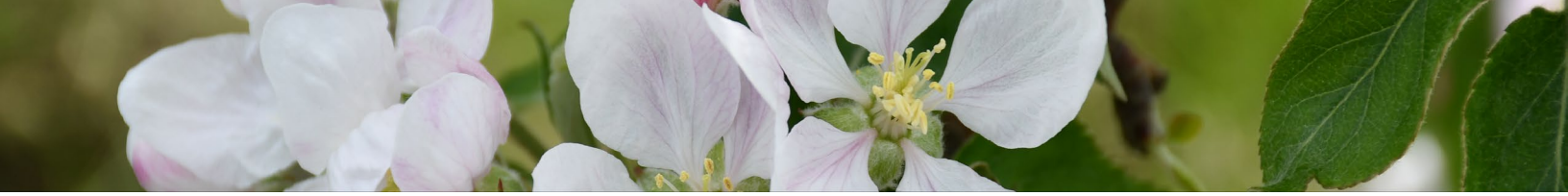
- Vegetation underneath the tree
- |↔| Vegetation between the rows
- Vegetation in a crop rotation in preparation for orchard planting

Grasses

Grasses are fast-growing and relatively easy to kill. They have fine, fibrous roots that are well-suited to hold soil in place and improve soil structure. Grasses do not fix nitrogen out of the atmosphere but accumulate it from the soil. Grasses include spring cereals, winter cereals and warm-season grasses.

|↔| Perennial Ryegrass: Also known as turf—type, this is a commonly used grass in apple orchards as it can tolerate shade and stagnant water. Its quick growth will take over weeds, therefore managing pests. However, ryegrass doesn't do well in dry soils and warm temperatures. It also tends to die out over time in orchards.

Figure 1. *Ryegrass (Grant)*



Barley: This annual excels with less moisture and in cooler temperatures. It is fast growing but doesn't grow as aggressively as ryegrass. This is an effective over wintering cover crop if planted like winter wheat.

Figure 2. *Barley (Indigo Herbs)*

Kentucky Bluegrass: Is a very low growing grass that is quite heat tolerant. It is commonly used for lawns, creating a dense sod. It requires fertilizer and irrigation. It can grow up to 10 inches or higher if left unattended.

Figure 3. *Kentucky Bluegrass (Catherine McQueen, Getty Images)*

Creeping Red Fescue: Is a very diverse cover crop which is drought and shade tolerant and can establish in poor and cold soil conditions. It also benefits the soil by mitigating erosion and suppressing nematodes. The downside is that it cannot withstand the high temperatures in orchards and can be difficult to establish.

Figure 4. *Creeping Red Fescue Grass (Seed World USA)*

Tall Fescue: Tends to establish in clumps. This fescue requires more mowing than creeping red fescue but is easier to establish. There are turf-type tall fescues available that require less mowing.

Figure 5. *Creeping Red Fescue Grass (Seed World USA)*

Legumes

Legumes can fix nitrogen from the air, add organic matter and protect soils from erosion. Nitrogen release can be inconsistent as excess nitrogen release late in the season could lead to excessive vegetative growth.

Red Clover: It's ability to grow on diverse soil conditions and its shade tolerance makes it a common cover crop in apple orchards. It has many benefits on the soil, including excellent erosion control and water holding capabilities. However, red clover is home to several pests and diseases.

Figure 6. *Red Clover (John Boy Farms)*

Alfalfa: Having alfalfa in your orchard for several years can aid in lowering the soil compaction. Not only that, but it also protects the soil from erosion over winter and improves the soil's structure. Alfalfa is commonly used because of these benefits to the soil. However, it is not able to survive in extremely compacted soils.

Figure 7. *Alfalfa (The Seed Company)*

|↔| Sweet Clover: It's ability to thrive on a variety of soil textures makes this a good cover crop. Sweet clover is a great use for effective nutrient movement into the soil, as it can move phosphorus and potassium down to the roots. However, sweet clover is very sensitive to herbicides.

Figure 8. *Sweet Clover (Advance Cover Crops)*

Non-Legume Broadleaves

Broadleaves can absorb large quantities of nitrogen from the soil where their growth will be minimal in low nitrogen and high compaction areas. Do not allow these crops to go to seed, as the volunteer seedings can become a significant weed problem.

|↔| Buckwheat: Commonly used as a weed suppressant, buckwheat grows and spreads quickly. In fact, it is one of the fastest growing cover crops. It even survives on infertile soils. However, buckwheat is not able to withstand too dry, too wet, or too compacted soils. It can also grow fairly tall, which many be a hindrance for some growers.

Figure 9. *Buckwheat (RealTree)*

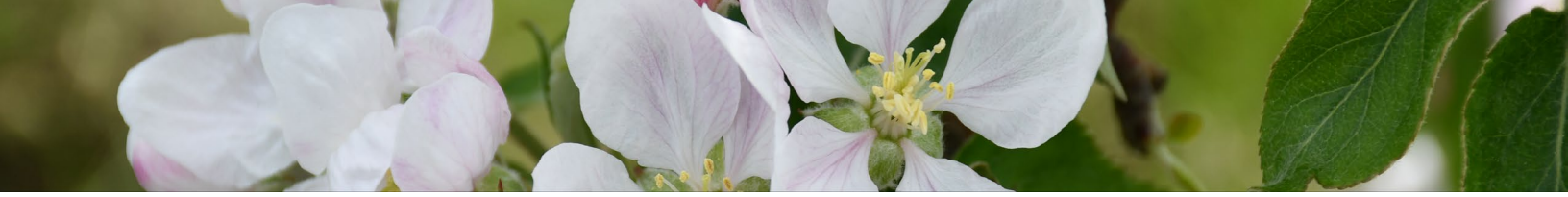
Oilseed Radish: This crop has great nitrogen holding capabilities – it can hold nitrogen in the soil and release it as the ground warms in the spring. Oilseed radish can withstand mild freezing temperatures but will die in temperatures below -4°C.

Figure 10. *Oilseed radish (Government of Ontario)*

Table 1. Selecting a Cover Crop

Function of the Cover Crop	Best Choice for Cover Crop
Nitrogen production	• Legumes - red clover, peas, or vetch
Nitrogen scavenging	• Fall uptake - cover crop radish and other brassicas, oats • Winter/spring uptake - rye, winter wheat
Weed suppression	• Cover crop radish and other brassicas • Winter rye, sorghum sudan • Buckwheat
Nematode suppression[1]	• Mustards: Caliente, Cutlass, Forge • Sudans/Sorghums: Sordan 79, Trudan 8 • Pearl millet: CFPM 101 • Marigold: Crackerjack, Creole • Oilseed radish: Adagio, Colonel
Soil structure building	• Grasses like oats, barley, rye, wheat, triticale, ryegrass • Fibrous root system plants such as red clover • Diverse cover crop mixtures
Compaction reduction	• Strong tap root plants that grow over time • Alfalfa, sweet clover
Biomass return to soil	• Fall: oats, oilseed radish, diverse cover crop mixtures • Summer: millets, sorghum sudan
Erosion protection (wind or water)	• Winter rye, winter wheat • Any well-established cover crop, e.g., ryegrass

[1] Nematode suppression is specific to the variety of cover crop, the species of nematode and the management of the cover crop materials



Benefits

There are lots of benefits that the right cover crops bring to an orchard. They benefit the soil in many ways, from easing the water percolation into the soil, to adding soil organic matter. Not only do cover crops benefit the soil, but they also benefit the wildlife, and provide better traction for machinery. These benefits all relate to a healthy and sustainable apple orchard.

Healthy soil full of nutrients is a crucial part to a crop field. This prevents flooding as well as runoff due to the water holding capabilities that is facilitated by the cover crops. Not only that, but cover crops also lower the leaching of both nutrients and chemicals, as well as shield the soil from erosion. Although cover crops allow the soil to hold more nutrients, they don't really affect nutrient uptake into the trees. Most importantly, the soil can retain more biodiversity in the microflora.

In addition, the root systems are what allow water to be penetrated into the soil, even through deep compaction. They play a big role in the addition of soil organic matter which therefore improves the structure of the soil. Furthermore, cover crops are an excellent solution to weed suppression, as they can defeat weeds in the competition for light, water, and nutrients. Another important benefits of cover crops are their ability to control come pests. Soil-borne pathogens such as nematodes can be controlled with these crops. Finally, one major benefit to growers is the very little maintenance needed to sustain cover crops.

Aside from the soil, cover crops also create habitat for wildlife, which is crucial for things like pollinators. Not only do cover crops have environmental benefits, but they also have some other abiotic benefits, too. Tractors and machinery used in apple orchards receive better traction when there's more than just soil. It also helps manage dust, which in fact makes growers happy.

Additional Resources

For information about cover crop seeding rates and timing please click here.

For more descriptive information about specific cover crops and for those not listed in this article, please click here.

Disadvantages

The main disadvantage to cover crops is that it makes excellent habitat for tree fruit pests. Apple leafcurling midge, tarnished plant bug, and twospotted spider mites are great examples of apple pests that thrive on the ground cover. These pests habituate mainly on weeds, so failing to maintain these weeds can result in an influx of damage to both the fruit and the vegetation.

Despite the significant water holding capabilities provided by the cover crops, a dry period can cause the cover crops to take most of the water, leaving the tree dry. Although, there are certain cover crops that can hold the water and transfer it down to the tree roots.

Summary

In conclusion, depending on the use of cover crop, Table 1 is a great reference.

- Underneath tree cover can benefit trees, but ultimately the timing of seeding along with the right cover will change in the success of establishment and maintenance of the cover crop
- A between row cover with a mix of grasses, legumes, and broadleaves would benefit the orchard in the long term. In the past 40% Creeping Red Fescue + 40% Turf-type + 20% Perennial Ryegrass has performed well
- A crop rotation of field crops, and/or mustard crops will aid in soil health for long-term success of orchards

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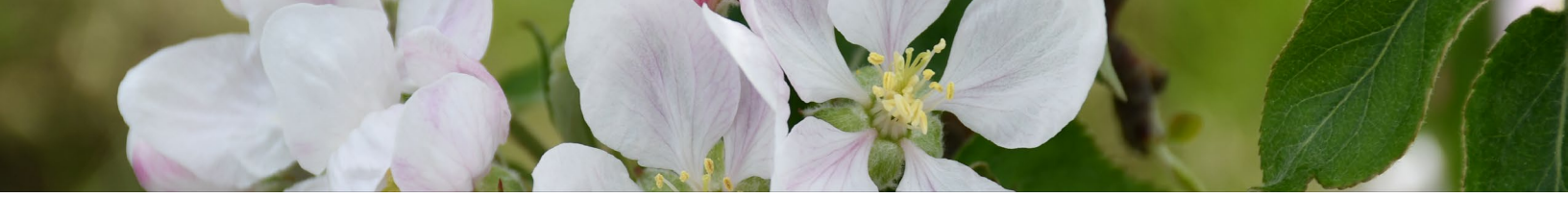

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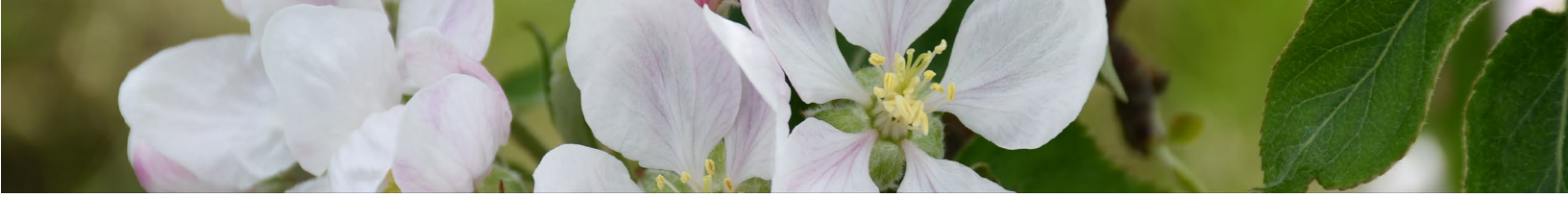


CROP PROTECTION

Getting a Complex:
Factors and Practices Involved in Apple Replant Disease Prevention

***Kristy Grigg-McGuffin**, Horticulture IPM Specialist*

Apple trees that do not establish well or fail to establish when planted on a site previously grown with apples are often considered to be suffering from a complex known as apple replant disease (ARD). Although thought to occur in sites replanted after removing very old fruit trees, ARD has been documented to occur within three years of establishing an orchard on new ground. Regardless, in high-density plantings, ARD can decrease orchard profitability by up to 50% over its lifespan.

Contributing factors

The causes and symptoms of ARD vary from region to region and even from site to site. While not well understood, several contributing factors are implicated in playing a role in this complex issue, including:

- **Biological**
  - fungal pathogens (*Ilyonectria* - formerly *Cylindrocarpon*, *Phytophthora*, *Pythium* spp., *Fusarium* and *Rhizoctonia*)
  - bacteria
  - parasitic nematodes
- **Abiotic**
  - soil pH
  - moisture stress (too much or too little)
  - soil compaction
  - toxins
  - soil structure
  - heavy metals
  - insufficient availability of nutrients (phosphorous)

However, research showing dramatic tree growth in response to soil pasteurization and fumigation to eliminate harmful microorganisms suggests ARD is primarily a biological phenomenon.

Symptoms

Symptoms of ARD include:

- stunting of the tree with short internodes
- small and light green rosette leaves
- small root systems
- decayed or discolored roots
- few new lateral or feeder roots
- delayed fruit bearing or decreased fruit yields

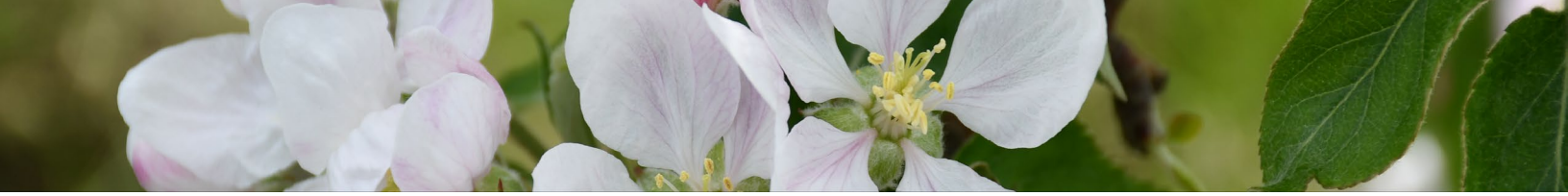
Vigorous young trees affected by ARD often stop growing in early summer. Affected trees leaf out in the spring but often produce little or no shoot growth. Severe ARD results in the death of young trees and even entire orchards.

Management

Prevention of replant problems is much easier and more successful than control. There is very little that can be done to correct replant problems once the trees are planted. The causes of ARD on different sites are highly variable. Not all soils respond in the same way to the various pre-plant treatments, and a treatment that is beneficial in one orchard may have no effect in another. Take a soil sample for nematodes and fungal or bacterial pathogens at a site before establishing a new orchard, particularly if the site was planted with apples or other fruit trees in the past. See Soil Sampling for Parasitic Nematodes for more information on how to collect soil samples for pest diagnostics.

The following cultural controls help prevent ARD:

- Avoid planting apples on the same ground where an old apple orchard has recently been removed. Rotating out of pome fruit for several years (two to eight years) is advised.

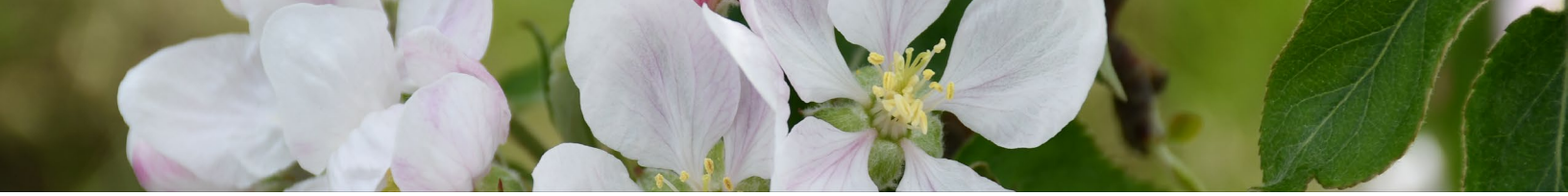


- Remove as much dead biomass (roots, bark, etc) from the old planting as possible to prevent decomposition that could impair growth of new trees.
- Adjust soil pH if too high or low prior to planting with a lime or sulfur application.
- Plant as early as possible in the spring, taking care not to skip important pre-plant operations.
- Provide adequate nutrition and irrigation as indicated by soil and tissue tests, and soil moisture monitoring equipment.
- Use rootstocks resistant to Phytophthora (e.g. CG.30, CG.6210 and CG.16) at sites where this pathogen is a contributing factor. See Insect and Disease Susceptibility Ratings of Common Apple Rootstocks in the Ontario Crop Protection Hub for more information on Phytophthora-resistant rootstock.
- Consider replant-resistant rootstock if available. Various Geneva rootstocks such as G.41, G214, G.935, G.202, G.30, G.210 and G.969 claim tolerance to the classic replant pathogens.
- Stagger planting rows to avoid planting directly in old tree sites.
- Grow nematode-suppressing cover crops in the years prior to orchard establishment.

Resources

For a complete list of registered crop protection products for nematode and pathogen management, see the Ontario Crop Protection Hub.

For information on biocontrol and rootstock research, see the University of Guelph Apple Replant Disease Research Blog. Details on this research was also published in the Winter issue of the ONcore Newsletter, titled *Approaches to Ontario Apple Replant Disease – Practices, Products & Rootstocks*.



The What, When and How of Sampling for Parasitic Nematodes

***Kristy Grigg-McGuffin**, Horticulture IPM Specialist*

What is a nematode?

Nematodes are microscopic eel-like organisms that live in soil and water (Figure 1). Most soil-dwelling nematodes are beneficial organisms that play a role in the breakdown and release of nutrients from organic matter. Some beneficial nematodes prey on other nematodes as well as soil-borne insect, fungal and bacteria pests. Unfortunately, there are several species of nematodes – known as plant parasitic nematodes (PPN) that feed on or in roots, stems or bulbs resulting in significant yield reduction in both field and horticulture crops grown in Ontario.

***Figure 1.** Root-lesion nematode (Photo: Matthew Piell, Perennia)*

Plant parasitic nematodes possess a hollow stylet mouth part which is like a hypodermic syringe. The stylet is forced into plant cells and enzymes are injected to decompose the cell content. The nematode withdraws the partially digested cell contents through the stylet. Some nematodes such as the root knot and cyst nematodes establish a specialized feeding site where they remain for the rest of their life cycle. Other nematodes such as the root lesion nematode burrow into the root, feeding and causing damage as they move through it. When infested plants and roots die in the autumn, root lesion nematodes will move out of the roots and into the soil.

Plant parasitic nematodes in Ontario fruit crops

When PPN are present in high numbers in soil, they can cause significant yield losses to horticultural crops. The extent of loss depends on the crop, nematode species and soil populations.

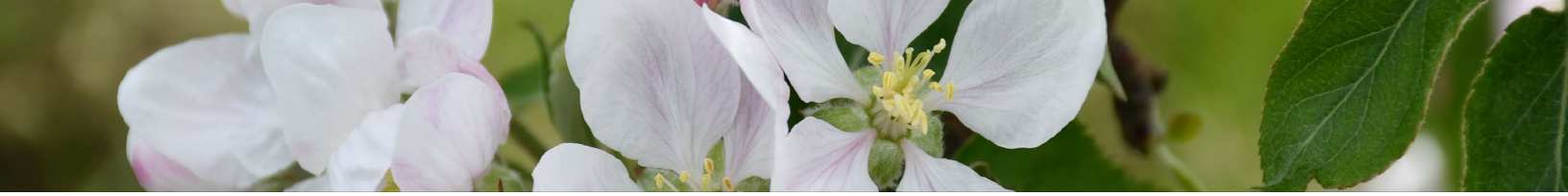
The most destructive and common PPN in Ontario fruit crops are root-lesion *(Pratylenchus penetrans)* and northern root-knot *(Meloidogyne hapla)*. The northern root-knot nematode is becoming more prevalent. The pin *(Paratylenchus sp.)* and dagger *(Xiphinema sp.)* nematodes occasionally cause yield losses to some fruit crops in isolated fields. The dagger nematode is mainly a virus vector on grape, raspberry and apple.

Symptoms of nematode damage

Generally, symptoms of nematode injury include:

- uneven plant growth
- poor plant establishment
- plants weakening over time
- poor root growth
- knots or galls on roots
- excessive branching of roots
- hairy root symptoms

Root-lesion nematodes can be a major cause of orchard replant failures. They can also cause a decline in vigour of existing peach and cherry orchards. These nematodes cause small brown lesions on the white lateral roots and kill the fine feeder roots. When lesions merge, the entire root system appears discoloured. Root lesions are frequently invaded by other pathogens which can cause root rot. Severely affected trees may lose all feeder roots. Young replant trees may die while existing trees lack uniformity.



When to sample for nematodes

Root samples

Root and soil samples containing roots can be taken at any time as long as the soil is not frozen. During the active growing season, however, nematodes live and feed inside or along roots particularly if it's hot and dry.

If nematodes are suspected of contributing to decline, collect entire root systems with surrounding soil separately from plants with symptoms and plants without symptoms. Carefully dig and sample from the feeder root zone approximately 10-20 g fresh weight of roots from the infected plants and submit for analysis.

Do not sample the roots from dead plants because the nematodes will have already died or moved away into the soil. Place samples in a plastic bag out of direct sunlight and in a cool place during transportation to the diagnostic lab.

Soil samples

The best time to sample soil for nematode population assessment is in the spring after the soil has warmed up or during the fall, soon after harvest. Do not take nematode samples when fields are very wet. Fields with a history of nematode problems may be sampled routinely to determine if the nematode population is approaching or has exceeded an economic threshold.

Soil populations of most PPN tend to be highest in September and October after crops have senesced and died. Sampling in the early fall also allows growers time to make decisions on whether to fumigate during the fall or spring or to select an appropriate nematode-suppressing cover crop. It also allows time to implement an integrated management strategy prior to growing a susceptible crop in that field. However, if the fall is too wet or too busy, sampling in the spring prior to planting may also be reliable.

Where to sample for nematodes

Where to sample soil for nematode assessment depends on the:

- purpose for taking the soil sample
- type of crop in the field
- type of nematodes being sampled

If the purpose of sampling soil for nematodes is to diagnose a problem during the growing season, take 8-10 soil cores from areas where plants are unhealthy or near plants along the margin of a severely affected area. Sample another 8-10 soil cores separately from areas of healthy growing plants for comparison (Figure 2). It is very important to get the feeder roots in the soil sample, since this is where many nematodes live.

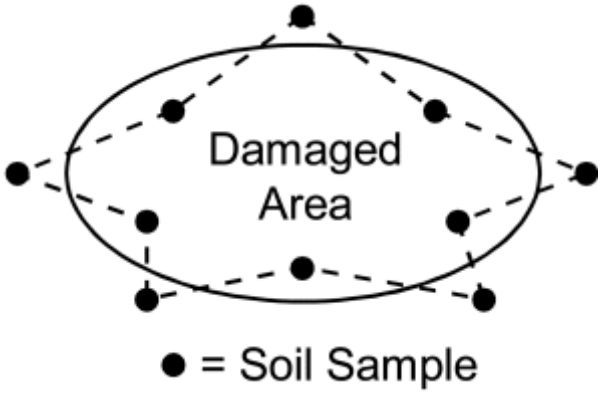


Figure 2. *Sampling pattern for damaged area of affected block.*

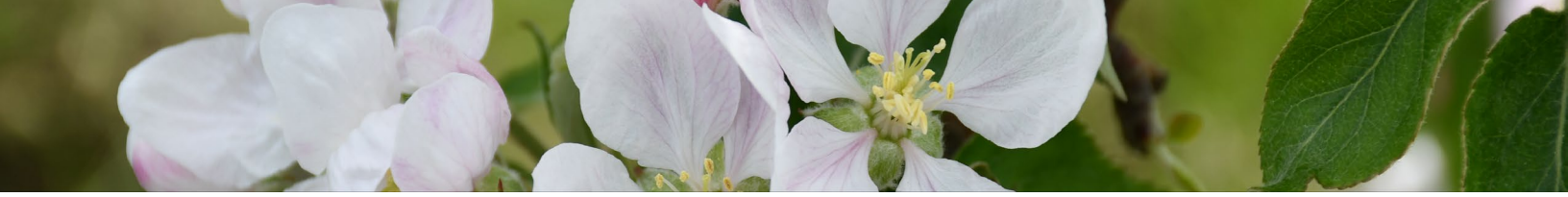
For individual fruit trees suspected of being infested with nematodes, it is best to take soil samples from just below the drip line and in the area between the outer branch tips and the tree trunk.

If the purpose of sampling a field is to determine whether the nematode population has reached an economic threshold, take soil cores within the row of actively growing plants to obtain samples that contain feeder roots.

When sampling from fallow fields, in the autumn after the crop has senesced or in the spring prior to planting, it is best to walk in a Z, W or M pattern across the field. The soil sample should represent no more than 2.5 ha.

Other considerations:

- Nematode problems are most often found in sandy-loam and sandy soils. Always sample these soils for nematode populations before replanting.
- Root-lesion and root-knot nematode problems are not usually found in clay or clay-loam soils. Sample these soils for nematodes before planting in replant sites or where susceptible crops have been recently grown.



- Sample clay or clay-loam soils for dagger nematode before planting on virus-susceptible grape, raspberry or tree fruit.

How to sample for nematodes

Nematodes are rarely distributed evenly throughout a field and populations fluctuate throughout the growing season. Consider the following when sampling soil:

- Samples should be made approximately 20 cm (8 in.) deep using a 2.5 cm (1-inch)-diameter soil core probe.
  - Alternatively, soil can be sampled with a narrow-bladed shovel or trowel; however, this method is less reliable than using a soil core probe.
- Extremely wet, dry, hot or cool seasons can influence the population levels particularly in the top 2.5-5 cm (1-2 in.) of soil.
  - Discard the top 2.5-5 cm (1-2 in.) of soil where nematodes would not usually live due to extreme environmental conditions.
- Collect soil cores in a clean bucket, mix the soil thoroughly but gently and place in a labelled plastic bag or container.
- Never allow soil samples to heat up or dry out.
- Place soil samples in a cooler with ice until they can be stored in a fridge or analyzed.

Number of soil cores per area

The number of soil core samples required to estimate nematode soil population levels depends on the size of the area under investigation (Table 1). The sample submitted to the laboratory should not represent more than 2.5 ha. Enough soil to give a good representation of the soil population is all that is necessary. The chart below is a guide of how many cores are necessary to make up a representative sample. If soil type changes within the field, take separate samples from each soil type. Send the soil samples to a pest diagnostic clinic or laboratory that is qualified to isolate, identify and enumerate nematodes.

Table 1. Number of soil core samples per area required to estimate nematode populations

Area	Number of soil cores / sample
<500 m^2	8-10
500 m^2 – 0.5 ha	25-35
0.5 – 2.5 ha	50-60

Economic thresholds

Nematode populations above economic thresholds can significantly reduce yields. The economic threshold for nematode populations refers to the population at planting. Planting a susceptible crop in soils with a population of nematodes near or above the economic threshold will result in crop losses over time. If the nematode soil analysis indicates populations higher than the threshold, an integrated nematode management strategy should be implemented. For economic thresholds, see Table 2.

Table 2. Nematode Thresholds for Apples

Type of Nematode	Economic Threshold (nematodes/kg soil)
Root-lesion	1,000
Root-knot	1,000
Pin	5,000
Dagger	100
Bulb and stem	100

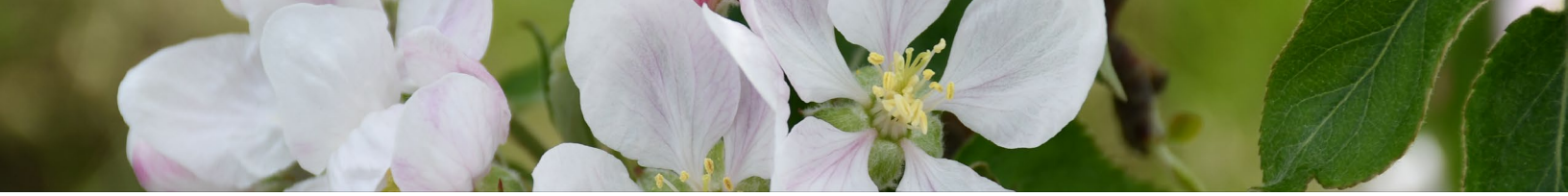
Nematode management

Preplant management

Nematode management starts a year before planting a susceptible crop like fruit trees. Try to reduce nematode populations so that clean stock can establish well before the nematodes rebound to damaging levels. Young trees tolerate much less nematode feeding than established trees.

Use a combination of the following methods to manage nematodes:

- Start new fields with stock (and soil, if not bare root) free from nematodes and grown by an accredited nursery.



- Rotate susceptible crops with non-host crops for several years.
- Grow nematode-suppressing cover crops in the years prior to establishing a new orchard.
  - In Ontario, the following nematode-suppressing cover crops have been successful: oilseed radish, certain white and oriental mustard, specific sorghum x sudan-grass hybrids, African marigold cultivars and Canadian Forage Pearl Millet 101 (root lesion nematode suppression).
  - Not all cultivars of the above cover crops reduce nematode populations – choose the right variety.
  - Exclude cover crops such as clover and buckwheat as these are excellent hosts for root lesion nematodes.
- Destroy residual crop roots.
- Plant resistant cultivars where available.
  - See *Insect and Disease Susceptibility Ratings of Common Apple Rootstocks* on the Ontario Crop Protection Hub.
- Control weeds in the years before replanting. Nematode populations can build on many weed species.
- Use soil fumigation before planting when nematode populations in soil reach or exceed thresholds.
  - For a list of registered preplant fumigants, see the Ontario Crop Protection Hub.
- Choose ground covers for planting between rows that do not support nematodes, such as annual or perennial ryegrass, or creeping red fescue.

Nematode suppression after planting

In apples, there are two registered control products that can be used to suppress nematode populations after planting:

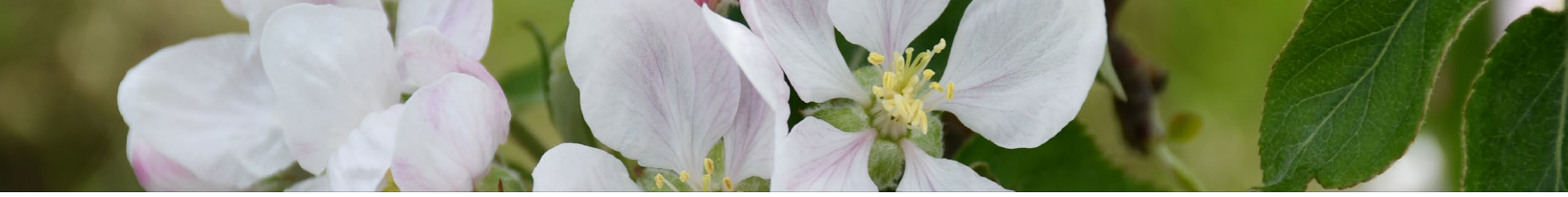
- **Velum Prime**
  - Broad-spectrum nematicide/fungicide (Group 7)
  - Apply through drip irrigation beginning at planting.
  - Suppresses root-feeding nematodes and moves into foliage to protect against fungal diseases such as powdery mildew.
- **Vydate**
  - Use on non-bearing trees only.
  - Apply as a soil drench around the base of each tree when actively growing in the spring. Follow up with a foliar application.
  - Does not control soil-borne or foliar disease.

Resources

More information on how to sample soil for nematodes and where to send the samples can be found at:

University of Guelph Agriculture & Food Laboratory:
https://afl.uoguelph.ca/sites/default/files/pdf/PDC%20Sampling%20%26%20Shipping%20Instructions.pdf

A&L Canada Laboratories Inc:
https://www.alcanada.com/pdf/technical/soil/Soil_Sampling_Guide_2013.pdf



Dealing with Pests in a New Apple Orchard

***Kristy Grigg-McGuffin**, Horticulture IPM Specialist*

Managing insect, disease and vertebrate pests in new high density orchards is critical to minimize impacts on young, rapidly growing trees, as well as to reduce future pest pressure. ***Typically, pest management in the initial years focuses on indirect, or foliar pests that can impede growth, as fruit damage is not a concern.*** However, with the promotion of early cropping in new high density orchards, implementing management programs for direct pests may also need to be considered in the first few years of production. This is especially important as control programs may be relatively minimal in the early years, which could result in a build-up of pest populations, or resident populations within the orchard and be difficult to manage in following years.

For new orchard plantings, the following insect, disease and vertebrate pests are of particular concern. For more information on the identification, biology and management of these and other apple pests, refer to Ontario Crop IPM and Ontario Crop Protection Hub.

Insect Management

Mites (European red mite, two-spotted spider mite, apple rust mite)

Feeding on leaves causes characteristic leaf injury referred to as bronzing. Severe infestations may result in defoliation. Prolonged feeding by unmanaged mite populations stresses the tree, leading to reduced shoot growth and fruit bud set the following year. Fruit colour, soluble solids, firmness, size and weight of the fruit are also affected. In severe cases, mite-induced tree stress may result in death during harsh winters.

Indirect pests like mites can be controlled by predators if insecticides are reduced. Monitor for both pests and beneficial insects to decide, but don't let populations explode.

Leafhoppers (white apple leafhopper, potato leafhopper)

Leafhoppers feed by sucking plant juices from leaves, reducing the photosynthetic area, affecting fruit size, colour, maturity and winter hardiness of the tree. Specifically, feeding by potato leafhopper, known as hopperburn, reduces plant vigour and plugs off the vascular system, preventing normal movement of water and nutrients to the affected area (Figure 1).

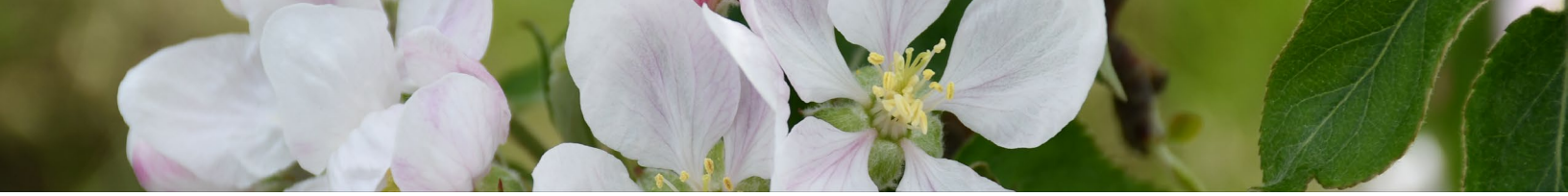
While these pests have the potential to transfer diseases such as fire blight from one plant to another, the importance of leafhoppers in the dispersal osf this bacterial disease is unknown.

In heavily infested orchards, white apple leafhoppers can fly into pickers' eyes, ears, noses and mouths. This irritation can reduce work efficiency and pose a safety threat if worker are distracted when operating equipment or climbing ladders.

***Figure 1.** Yellowing along leaf margins of apple, known as hopperburn caused by potato leafhopper feeding.*

Aphids (rosy apple aphid, green apple aphid, woolly apple aphid)

Heavy infestations of rosy and green apple aphid reduces vigour, growth of shoots, bud size, internode length, as well as stimulates lateral branch growth and affects tree shape (Figure 2). During feeding, rosy apple



aphids inject a toxin which translocates from the leaves to fruit, causing apples to remain small, deformed (pigmy fruit) and unmarketable. Toxic saliva also reduces growth of roots and other wood tissue and prevents fruit abscission (natural separation from the tree) at normal harvest.

Woolly apple aphid feeding forms knots or galls on twigs or roots, impeding growth. Areas damaged by these aphids are also more sensitive to frost and winter injury.

Apple leafcurling midge

Larval feeding on the margins of developing leaves by apple leafcurling midge causes leaves to become thick and curl inward tightly towards the midvein (Figure 3). These infested curled leaves often become discoloured (red or purple), brown and brittle, and eventually fall from the tree. High insect populations in young trees may result in reduced photosynthesis and stunt the growth of terminal shoots.

Oriental fruit moth

First generation oriental fruit moth larvae attack both apple shoots and developing fruitlets, causing direct and indirect damage. Feeding activity of larvae in apple shoots is easily overlooked or misidentified shoot blight, causing a similar shepherd's crook. Heavy twig infestations of young trees can adversely affect the shape of the tree. Axillary buds often begin to grow, causing the tree to have a bushy appearance.

Leafrollers or leaf-feeding capterpillars

Leaf-feeding caterpillars become active as soon as green tissue is visible, feeding on young developing leaves and boring into buds. Leaf feeding, if severe, can reduce photosynthetic activity and pests can quickly become a major problem in newly planted orchards if not controlled.

Scale

Heavy infestations of scale insects –particularly on young trees –seriously reduce tree vigour, growth and productivity. Severe infestations can kill whole limbs and even young trees in 2-3 years.

Carefully examine all nursery trees prior to planting and discard trees if insects are present. New plantings should be checked annually for signs of scale.

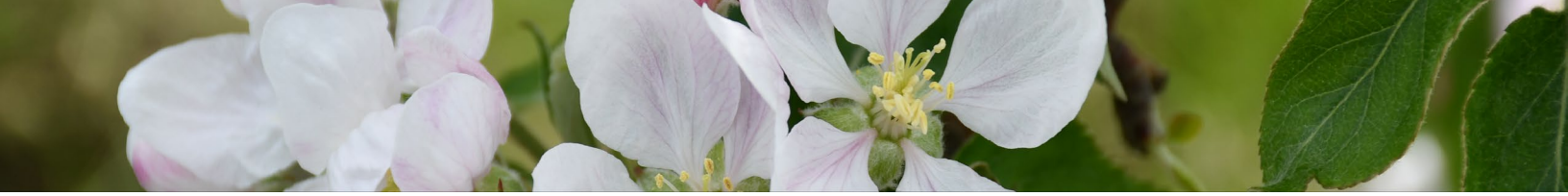
Figure 2. *Rosy apple aphid damage on a developing apple cluster.*

Figure 3. *Apple leafcurling midge damage on growing terminal.*

Disease Management

Apple scab

Apple scab infections need to be prevented until the end of primary scab season. Maintain protection on new growth to reduce overwintering inoculum and keep trees in good health for the next year. Verify there are no scab lesions before reducing your fungicide program.



Powdery mildew
Powdery mildew can cause extensive damage to shoots, leaves, flowers and fruit, especially to susceptible varieties like Gala, Honeycrisp, Jonagold, Idared, Cortland and Paulared. Infection continues to spread until young susceptible tissue is no longer present and can reduce vegetative shoot growth, tree vigour, winter hardiness and productivity. Choose fungicides that will control scab as well as powdery mildew and continue until terminal bud set.

Black rot
The black rot pathogen infects limbs, trunks, leaves and fruit resulting in reduced productivity, quality of yield and winter hardiness. Damage caused by cankers from other diseases or wounds caused by insects, pruning, hail or winter injury provide an entrance for the fungus to invade and become established.

Fire blight
Fire blight is a big risk in apple orchards as the weather changes to hot and humid. Watch for late bloom in new plantings. Young vigorous trees are very susceptible to fire blight as the bacteria can move rapidly into the trunk and down to the rootstock, killing the tree (Figure 4). This can occur in as little as 1-2 months from initial blossom or shoot infection. If fire blight strikes are present, prune at least weekly throughout the year.

Figure 4. *Fire blight infected shoot with signs of bacteria-laden ooze.*

Vertebrate Management

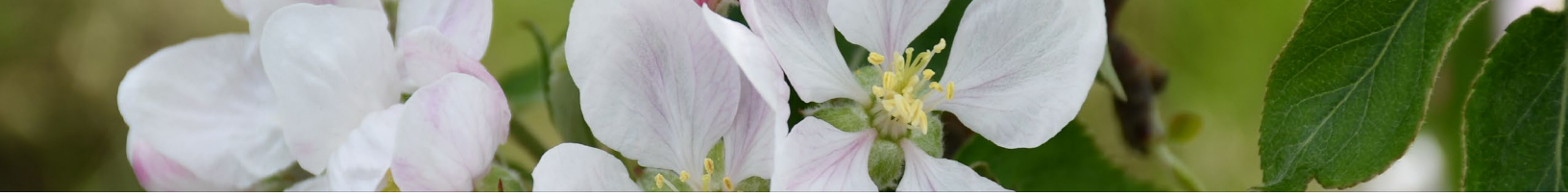
Deer
Deer feed on tender shoot tips (Figure 5) and fruit buds in the spring or late fall when little food is available for them. Small trees may also be damaged by antler polishing, which occurs in the fall when bucks seek to remove the dried "velvet" covering from their antlers by rubbing against the tree.

Deer fences, odour or taste repellents and hunting permits may be used to control damage by deer in high density orchards.

Figure 5. *Deer feeding on young apple shoot.*

Rodent (rabbit, vole)
Damage by rodents often occurs under grass during the season, or at or below the snow line during the winter. Bark may be pulled off in shreds, eventually girdling the trunk. Terminal growth and fruit buds can also be nipped off. This damage results in loss of tree vigour, susceptibility to entry by disease organisms or tree death.

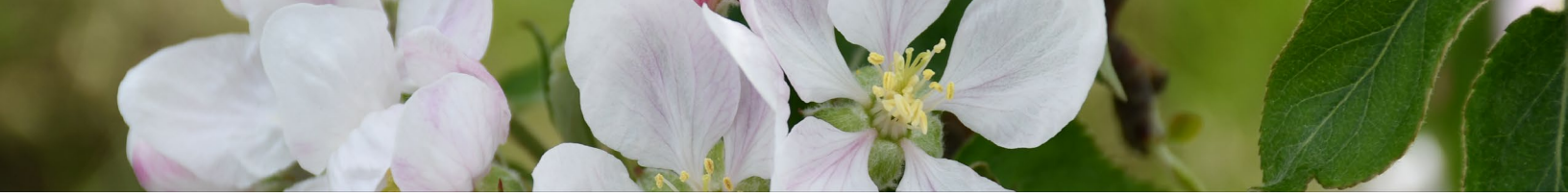
Wire or plastic guards around newly planted fruit trees may prevent feeding damage. A wide herbicide strip beneath the trees coupled with regular close mowing of row middles also helps to discourage rodents.



General Management

Consider some of the following general practices to achieve effective pest management in your orchard:

- Remove sources of inoculum, including dead or diseased tissue or trees, infected branches, cankers, and rotten or mummified fruit.
- Remove wood piles, fruit bins, stumps and loose bark that could provide overwintering sites for insects, such as codling moth and plum curculio, as well as vertebrate pests.
- Shred leaves with a flail mower to stimulate leaf decomposition. Rake or blow leaves from under trees into the middle of the row, or off-set the mower to reach them.
- Prune to increase air flow, promote faster drying time and ensure thorough spray coverage.
- Remove alternative hosts adjacent to or near a new orchard planting.
- If using tree guards, routinely clean out debris which can provide a good habitat for pests.
- Regularly monitor pests and/or their damage by visual assessments, pheromone or sticky traps, degree day or forecasting models, etc. and use this information with applicable thresholds for management decisions.
- If fruit can be harvested, conduct harvest assessments by recording damage levels of direct-feeding insects and disease levels. Use this information for the following year's management program.



Weed Management in New Orchard Plantings

***Kristen Obeid**, Weed Management Specialist — Horticulture Crops*

Weed Reduction/Avoidance: Preplant Year

- Select fields with low weed pressure or use a crop rotation that reduces weeds (e.g. field corn, winter cereals).
- Control perennial weeds with a 2-year strategy, targeting the most susceptible growth stage with herbicides, early bud in thistles, glowering in vetch species.
- Plant a cover crop to smother weeds, especially in the fall before planting. This will prevent winter annuals from establishing.
- Use herbicides to control weeds in the cover crop, e.g. 2,4-D in wheat or glyphosate in the spring to kill the cover crop.
- Mow weeds before they go to seed, especially around the field edges and neighbouring ditches. If desired sod can be established in the previous year and rows burnt out with glyphosate. Ensure a weed-free strip of at least 1.5 m wide to avoid competition from the sod.

***CAUTION:** Avoid herbicide residues by choosing low rates of non-residual herbicides.*

It is critical to control weeds in new plantings early, especially in the first three months after planting and continue at least until the end of July (known as the Critical Weed-free Period in orchards). Research has shown that any weed growth in the first three months after planting will reduce tree growth. Weeds allowed to grow near new trees will reduce yields even two years later.

Usually, the final tillage after the trees are planted will level the ground around the tree and remove early weeds. If you are planning to use a mulch (which will suppress weeds as well as preserve soil moisture, but may cause rodent and root health issues), apply it before the next weeds emerge.

There are several herbicides registered for newly planted trees (see Tables below or visit the Ontario Crop Protection Hub).

NOTE: rates are often lower for new trees to avoid tree damage. Make sure you match your soil organic matter percentage with your herbicide choices to avoid damaging the trees. Combining a preemergence herbicide with both grass and broadleaf control and a contact herbicide for emerged weeds will provide the best results. Preemergence herbicides are not effective when applied to mulch. Avoid using glyphosate products in the first few years, because there is the possibility of it being absorbed by the trees if there is any off-target movement of the herbicide at the time of application. This could result in weaker, stressed trees which are more susceptible to disease.

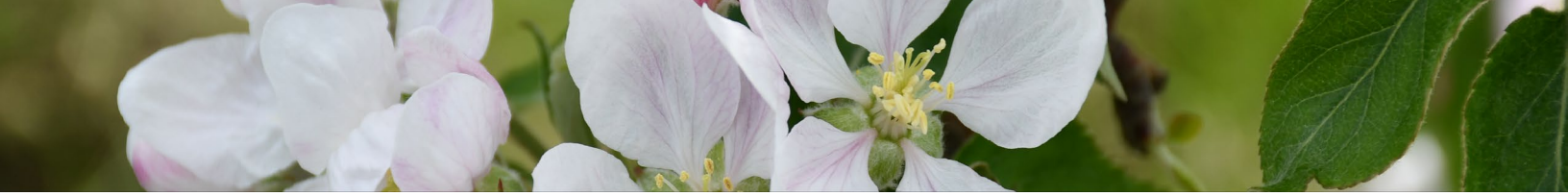


Table 1. Herbicides Registered for New Plantings (Pre-plant and Preemergence)

Weeds	Trade Name	Active Ingredient	Rate	Notes
Pre-plant Incorporated (PPI)				
Broadleaf and grassy weeds	Treflan/Thrill/Bonanza	*trifluralin*	1.2 – 2.4 L/ha	• Before planting trees as an orchard floor or pre-plant treatment. • Use higher rates on clay soils.
	Treflan/Thrill/Bonanza + Sencor DF	*trifluralin + metribuzin*	1.2 – 2.4 L/ha + 550 – 750 g/ha	• Before planting trees as an orchard floor or pre-plant treatment. • Use higher rates on clay soils.
Preemergence (PRE)				
Broadleaf and grassy weeds	Chateau EZ	*flumioxazin*	298 – 448 mL/ha	• DO NOT apply to trees established less than one year, unless protected by non-porous wraps, grow tubes or waxed containers
	Dual II Magnum/Komodo/ Metallica	*s-metolachlor*	1.75 L/ha	• Apply once per year as a band under the trees before weeds emerge.
	Dual II Magnum/Komodo/ Metallica + Princep Nine-T	*s-metolachlor* + *simazine*	1.25 – 1.75 kg/ha + 1.2 – 2.2 kg/ha	• Apply once per year as a band under the trees before weeds emerge, preferably after rain has settled the soil around the trees.
	Kerb SC	*propyzamide*	5.6 L/ha	• Established plantings of at least one year only. • Apple from September to mid-November when soil is cool and moist but not frozen
	Princep Nine-T	*simazine*	1.2 – 2.2 kg/ha	• Apply post planting, preemergence to weeds. Preferably after the soil has settled around the trees. • DO NOT apply to soils with < 2% organic matter.
	Prowl H20	*pendimethalin*	3.7 L/ha	• Apply as a broadcast or banded treatment using ground equipment before weed germination. • Apply the spray directly to the ground beneath the trees and/or in areas between the rows.
	Sinbar	*terbacil*	1.25 kg/ha	• Apply after planting trees, before weeds emerge. • DO NOT use on soils with less than 3% organic matter. • Avoid contact with tree trunks and leaves.
Broadleaf and yellow nutsedge	Sandea	*halosulfuron*	35 – 70 g/ha	• Maximum 2 applications, minimum 21 days between applications. • DO NOT apply more than 140 g/ha in one season. • DO NOT contact green tissue, such as foliage, fruit or green bark

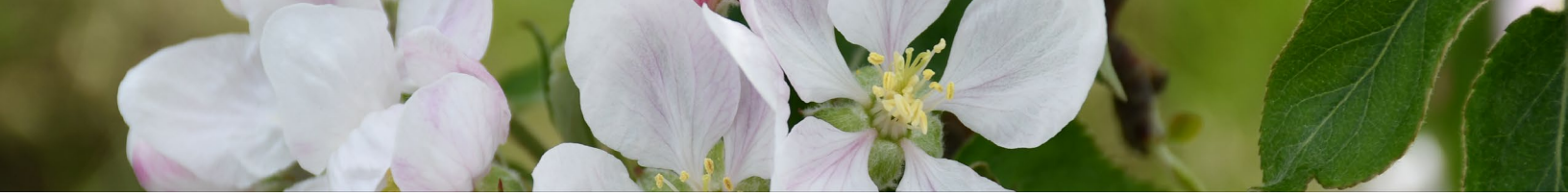


Table 2. Herbicides Registered for New Plantings (Postemergence)

Weeds	Trade Name	Active Ingredient	Rate	Notes
Postemergence (POST)				
Broadleaf weeds	Aim EC + Agral 90/Merge	*carfentrazone* + *surfactant/solvent*	37 – 117 mL/ha	• Apply with a hooded sprayer between the rows to control weeds < 10 cm tall.
	Basagran/Benta super/ Broadloom + Merge	*bentazon* + *surfactant/solvent*	1.75 – 2.25 L/ha + 1 – 2 L/ha	• Direct under the trees to small actively growing trees. • Use the lower rate of Merge under hot humid conditions. • Make only 2 applications, 10 days apart at the low rate during the planting year. • Avoid contact with tree foliage.
	Lontrel XC/Pyralid	*clopyralid*	340 mL/ha	• Trees should be established for 1 year. • For control of vetch at early flowering stage. Apply as a spot treatment. • Avoid contact with tree limbs.
Broadleaf and yellow nutsedge	Sandea	*halosulfuron*	35 – 70 g/ha	• Maximum 2 applications, minimum 21 days between applications. • DO NOT apply more than 140 g/ha in one season. • DO NOT contact green tissue, such as foliage, fruit or green bark.
Grassy weeds	Assure II + surfactant	*quizalofop-p-ethyl* + *surfactant*	380 – 750 mL/ha + 5 L/1000 L	• Use a directed spray application to minimize the amount of spray coming into contact with the fruit trees. • Apply to emerged annual grasses and volunteer cereals in the 2 leaf to tillering stage and to quackgrass in the 2–6 leaf stage of growth. • Use the 0.38 L/ha (0.15 L/acre) rate for annual grasses and volunteer cereals. • Use 0.5 L/ha (0.2 L/acre) to suppress quackgrass and also control barnyard grass. • Use the 0.75 L/ha (0.30 L/acre) rate for quackgrass.
	Poast Ultra + Merge	*sethoxydim* + *surfactant/solvent*	0.32 – 1.1 L/ha + 1 – 2 L/ha	• Apply to emerged annual grasses at the two to six leaf stage during active growth. • Use these rates for specific weeds: annual grasses 0.32 L/ha; volunteer grains 0.47 L/ha; quackgrass (up to 3rd leaf)1.1 L/ha. • Complete grass control will take 7 to 21 days
	Venture L	*fluazifop-p-butly*	0.6 – 2 L/ha	• One application per year in a band under the trees. • Apply at the 2-5 leaf stage of development at the following rates: 0.6 L/ha for volunteer corn; 0.8 L/ha for wheat & barley; 1 L/ha for annual grasses and 2 L/ha for quackgrass. • DO NOT apply more than once per season. Grasses emerging after the treatment will not be controlled.

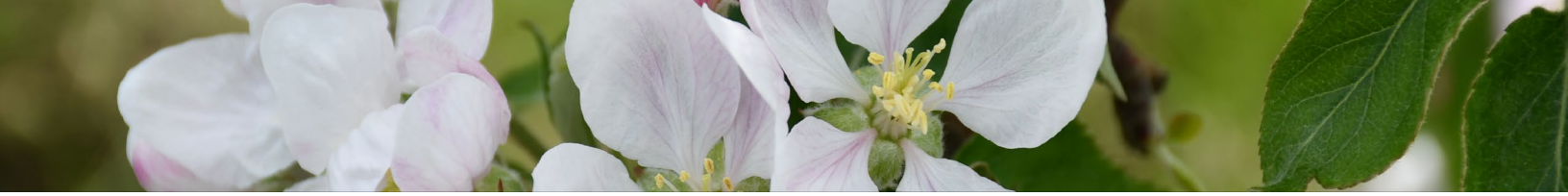
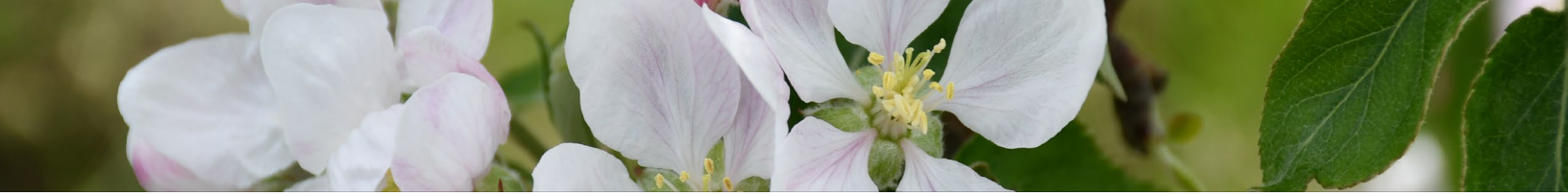


Table 3. Herbicides Registered for New Plantings (Contact)

Weeds	Trade Name	Active Ingredient	Rate	Notes
Contact Herbicides				
Broadleaf weeds and grassy weeds	Axxe Broad Spectrum Herbicide	*ammonium salt of fatty acid*	45 – 106 L/ha	• Non-selective herbicide designed for control or suppression of grass and broadleaf weeds, such as (but not limited to): crabgrass, pigweed, amaranth, carpetweed and liverworts. • Best results are obtained with young actively growing weeds < then 10 cm tall. The product works best during warm and dray conditions. • Use as a shielded spray application to control weeds around the base of trees.
	Biolink Herbicide	*caprylic acid, capric acid*	3 – 9% spray solutions	• A contact, postemergence, non-selective herbicide that works best on newly emerged actively growing weeds that < 15 cm tall. • For grass and perennial weeds and more mature broadleaf weeds, use the higher application rates.
	Serene	*acetic acid*	179 – 717.5 L/ha	• Established plantings of at least 1 year ONLY. • DO NOT allow spray to contact any green plant parts of desirable plants. • Do NOT apply directly over the top or crop injury can occur. • Apply as a uniform band or spot application directed at weeds on the ground between the trunks. Use higher volumes for larger weeds. • DO NOT apply after budbreak unless using hooded or shielded application equipment. • Retreatment is required for regrowth of weeds.



Closed Transfer Systems

Dr. Jason Deveau *— Application technology Specialist, OMAFRA*

What is a Closed Transfer System (CTS)?

According to a definition from the PMRA on a recent re-evaluation of Lorox L (linuron):

> *"A closed system means removing a pesticide from its original container, rinsing, mixing, diluting, and transferring the pesticide through connecting hoses, pipes, and couplings that are sufficiently tight to prevent exposure of any person to the pesticide or rinsing solution. Rinsing is not required with the pesticide is used without dilution."*

So, a CTS permits the direct transfer of pesticides from container to sprayer while isolating the process from the operator and the environment. The reason you should care is that Ontario now has four products sold in ≤10L jugs that require operators to use a closed transfer system: **Sevin XLR, Bravo ZN*, Lorox L and Etherel**. And it's very likely that's only the beginning.

**There are caveats associated with Bravo ZN (i.e. specific volumes and products, please refer to the label for further details)*

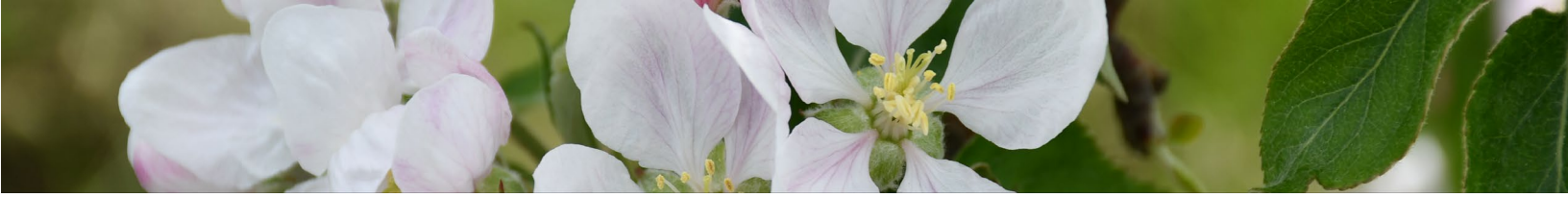
The reason behind the requirement is easy to appreciate. A CTS eliminates point source contamination from small spills, reduces operator exposure, and the best examples of these systems reliably meter small volumes or entire jugs faster and more accurately than an operator can. This is the new reality in Europe and the UK.

In Ontario, however, the concept is still new and we don't have as many commercial options for complying with the regulation. That's why Provide Agro recently hosted a demo of the two available systems: Goat Throat (US made) and Easy Flow M (German made and distributed throughout North America).

Figure 1. *Matt Peters tangled in hoses as we work out the fittings for two CTS systems.*

We showed a small group of orchardists the relative merits of each approach and walked them through the process of capping, dispensing, rinsing and storing (or disposing) of jugs. There are still a lot of questions about which jug formats will be compatible, how to attach the feed line to sprayer tanks, and how this works with dry formulations (spoiler: it doesn't) but we're all still learning and these are early days.

If you'd like to learn more about closed transfer, you can read up on it here: Closed Transfer Systems (Agritechnica 2023 Update) – Sprayers 101



ANNOUNCEMENTS

Honey Bee Health Initiative under the Sustainable Canadian Agricultural Partnership

Eligible Ontario beekeepers can again apply for cost-share funding under the Sustainable Canadian Agricultural Partnership (Sustainable CAP), Honey Bee Health Initiative for operational improvements that reduce biosecurity risks, help to prevent overwintering loss, and manage or prevent the introduction and spread of honey bee pests and diseases. The purchase of disease-free honey bee stock, including queens and queen cells, nucleus colonies, full size colonies and honey bee packages will also be supported.

The application intake reopens June 3, 2024. Applications will be accepted on a continuous basis while program funds remain available.

Who is Eligible to Apply?

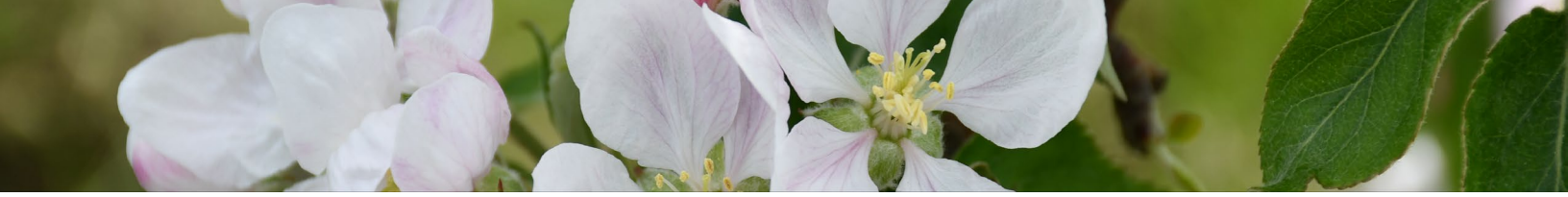
- To apply you must have ten (10) or more colonies registered with the Provincial Apiarist under the Bees Act for the current beekeeping season (2024).
- Applicants must have completed a pest management course related to honey bees, specific to Ontario, from a recognized institution within the last two years (e.g., Ontario Beekeepers' Association's Technology Transfer Program), or have completed a diploma or degree in beekeeping from a recognized college or university within the last five years (e.g., University of Guelph, Niagara College). For a list of eligible courses, click here.
- Applicants must be in compliance with the Bees Act and Regulation 57 during the current and previous beekeeping season.

Eligible Costs and Project Dates

- Eligible approved costs will be funded at 50% cost-share up to a maximum of $25,000 per registered commercial beekeeper or $4,500 per registered hobbyist beekeeper. Funding caps are inclusive of all applications approved since the Honey Bee health Initiative opened September 15, 2023.
- Costs for the purchase of honey bee stock are eligible retroactive to April 1, 2024; All other eligible costs cannot be incurred, invoiced, and/or paid for, prior to submitting an application and receiving written notification of application approval.
- The project completion and claim deadline for applications approved after June 3, 2024, is February 15, 2025.

The Honey Bee Health Initiative is delivered by the Ontario Soil and Crop Improvement Association (OSCIA). Program information can be found at: https://www.ontariosoilcrop.org/honey-bee-health-initiative/.

Sustainable CAP is a five-year (2023-2028), $3.5-billion investment by federal-provincial and territorial governments to strengthen competitiveness, innovation, and resiliency of the agriculture, agri-food and agri-based products sector. This includes $1 billion in federal programs and activities and a $2.5 billion commitment that is cost-shared 60 per cent federally and 40 per cent provincially/territorially for programs that are designed and delivered by the provinces and territories.



Greenbelt Soil Health Assessment & Plan Ground Truthing Project

Building a Robust Ontario Soil Health Database, Together

Soil health refers to the soil's ability "to support crop growth without becoming degraded or otherwise harming the environment" (Agriculture and Agri-Food Canada). It is typically evaluated by examining chemical, physical, and biological properties that serve as indicators of how well the soil functions. With repeated measurements, farm managers can track changes in soil health over time. Changes in soil health associated with implementing soil health-building typically occur over many years.

Want to monitor your orchard/vineyard's soil health for FREE? Then consider participating in the Soils At Guelph SHAP Ground Truthing Project. SHAP is OMAFRA's made-in-Ontario tool for Soil Health Assessment and Planning. More info on SHAP Framework. Soils At Guelph is working together with OMAFRA and others in the province to build a robust SHAP database with Ontario agricultural lands.

Getting Involved

Participating in the project means you will qualify for FREE soil health analysis for your orchard/vineyard. The SHAP Ground Truthing Project analysis includes organic matter, aggregate stability, active carbon, respiration and potentially mineralizable nitrogen. In addition, they will also pay for soil texture analysis, a standard fertility package (pH, CEC, K, P, Ca, Mg), and organic carbon and total nitrogen.

Growers that have farms located in the Greenbelt and interested in participating in the project, will need to collect soil samples in ***late spring (June),*** and the ***samples should be collected from under the tree or vine row.*** The program will provide ***1 FREE sample per unique vineyard/orchard location***, additional samples may be collected for comparison but would be paid for by Grower. Growers are also required to keep samples cool and ship to the Agri-Food Lab in Guelph within 24 hours of collecting the sample. Co-operating growers will be asked to fill out a survey about their production practices in their orchard/vineyard.

Your identity remains anonymous. Lab results are sent directly to the email address associated with the lab submission form and copied to Soils at Guelph. They feed the results into the provincial database anonymously to help OMAFRA and Soils at Guelph refine the Soil Health scoring functions, and possibly in future have specific scoring by cropping system. You will receive a report which summarizes your results and benchmarks them against samples collected in similar soil textures (across all crop types). These results will help collaborators, OMAFRA and researchers to develop management plans focused on improving soil health. **Expect that analysis & benchmarking will take much longer than traditional fertility sampling –final report to be delivered following crop harvest.**

Participation Steps

More detail about participation can be found here.

Register

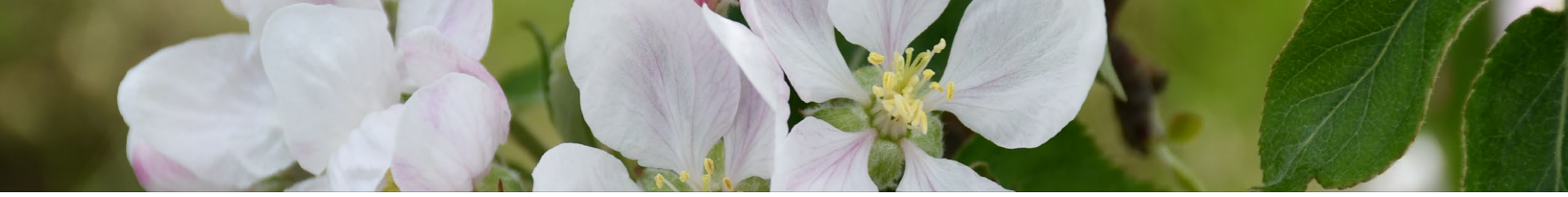
To register for the SHAP Ground Truthing Project, simply send an email to soils@uoguelph.ca. Tell them the # of orchards/vineyards/fields you'd like to sample and your county/district. In response, they'll send you an email with information about how to participate. Free analysis will only apply to one sample per field location. This is a first-come-first-serve offer with limited # of free samples.

Management History Survey

Following Registration, you will be sent a link to complete the Management History Survey. The survey will ask for a 4-year management history of the orchard/vineyard/field being sampled (which is essential for our data interpretation and for the SHAP scoring report). It takes about 10 minutes for each field being sampled. The survey questions are not specific to orchards/vineyards, so it is important to ***consider all questions from the perspective of under-vine or tree row management.***

Sample Collection

Utilize the ground truthing app to create a georeferenced location for the sample collection. You will collect the sample from a very site-specific



location, approximately 3 meters diameter circle or length of tree/vine row. It is important to collect 10-20 core samples to a 6-inch depth with a soil probe to create a composite sample. For further clarification please refer to the "Choosing why and when to sample" guide.

Ship Sample

Upon sample collection you will complete the lab sample form and ship to the Agriculture and Food Laboratory. More details will be provided once you register. Expect that analysis & benchmarking will take much longer than traditional fertility sampling –final report to be delivered following crop harvest.

More Information or Questions:

If you require more information or have questions, please contact:

Danny Jefferies
Horticulture Soil Management Specialist
danny.jefferies@ontario.ca
519-359-6707

AgRobotics Working Group Demo Day

Join the AgRobotics Working Group for in-field demonstrations of autonomous solutions, technology, and more! **Registration required**, click poster for full details.

This newsletter is made possible by the generous support of the following sponsors:

Example Replant Timeline

This is a one-time opportunity to address and improve your soil health to set your orchard up for success over the next 20 years!

2024 — Spring

- Nematode sampling before tree removal (ideally when soil is moist and cool)
- Complete soil analysis: pH, organic matter, nutrients

This is not ideal timing for testing as fall is recommended, but proper soil preparation takes priority

2024 — Summer

- Tree, root and old debris removal (as much as possible)
- Tiling and grading if necessary
- Application of necessary amendments (i.e. lime, manure/compost)

2024 — Fall

- Deep plowing and discing
- Seeding of cover crop/annual
- Herbicide application to manage perennial weeds

24/25 — Winter

- Watch your winter cover crop/annual grow!

2025 — Spring

- Discing and raking (cover crop dependent)
- Application of necessary amendments (i.e. lime, manure/compost)
- Herbicide application

2025 — Summer

- Seeding of Brassica cover crop
- Maintenance of cover crop if needed (i.e. mowing)

2025 — Fall

- Cut and incorporation of cover crop
- Herbicide application to manage perennial weeds
- Nematode sampling and soil pH (if lime applied previously)

25/26 — Winter

- Think good thoughts

2026 — Spring

- Plant trees
- Install trellis system
- Irrigation setup
- Planting of between row cover

2026 — Summer

- Complete tasks from spring
- Tree training, minimal pruning
- Pest management

2026 — Fall

- Soil test of nutrients

AgRobotics Working Group
Demo Day

Thursday, July 11, 2024
9:30am - 3 pm

Ontario Crops Research Centre - Simcoe
1283 Blue Line Rd
Simcoe, ON

Join the AgRobotics Working Group for in-field demonstrations of autonomous solutions, technology, and more!

REGISTRATION REQUIRED
To register visit
www.eventbrite.ca/e/agrobotics-demo-day-at-simcoe-research-station-tickets-918884376907

Lunch and refreshments provided with registration.

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