CANADA
4-H Ontario

www.4-hontario.ca

4-H ONTARIO PROJECT

Field Crops - Species & Management

REFERENCE MANUAL

THE 4-H PLEDGE

I pledge my Head to clearer thinking,
my Heart to greater loyalty,
my Hands to larger service,
my Health to better living,
for my club, my community, my country, and my world.

THE 4-H MOTTO

Learn To Do By Doing

CANADA
4-H Ontario

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CANADA
4-H Ontario

4-H Inclusion Statement

4-H in Canada is open to all* without discrimination based on race, national or ethnic origin, colour, religion, sex, age or, mental or physical disability.**

4-H is dedicated to providing a safe and inclusive environment that allows for universal access and participation. Where barriers to participation are identified, 4-H will, with reasonable accommodation, adapt programs, rules, policies, or expectations to reduce or remove the barriers.

Any accommodations, changes or exceptions will be assessed on an individual basis, taking into account the individual experience of the member and their family. The physical safety and emotional well-being of members, leaders, staff and volunteers is 4-H's highest priority, and is the ultimate consideration in final decisions.

4-H Canada and local 4-H organizations consider inclusion a priority. Leaders are encouraged to work with individuals and their families to identify and discuss accommodations as required, and to reach out to provincial or national office staff for help with unresolved concerns.

**This applies to youth members (ages 6 to 21), volunteers, leaders, staff and professionals.*
***Definition of discrimination as per Canadian Charter of Rights and Freedoms.*

Déclaration sur l'inclusion des 4-H

L'adhésion aux 4-H au Canada est ouverte à tous les jeunes* sans discrimination fondée sur la race, l'origine nationale ou ethnique, la couleur de la peau, la religion, le sexe, l'âge ou le handicap mental ou physique. **

Les 4-H ont pour mission d'offrir un environnement sécuritaire et inclusif qui permet l'accès et la participation de tous. Lorsque des obstacles à la participation sont décelés, les 4-H adapteront, à l'aide de mesures d'adaptation raisonnables, les programmes, les règles, les politiques ou les attentes afin de réduire ou d'éliminer ces obstacles.

Toute mesure d'adaptation, modification ou exception sera évaluée au cas par cas, en tenant compte de l'expérience personnelle du membre et de sa famille. La sécurité physique et le bien-être émotionnel des membres, des animateurs et des animatrices, des membres du personnel et des bénévoles sont la priorité absolue des 4-H et constituent le facteur ultime à considérer lors de la prise des décisions définitives.

Les 4-H du Canada et les organisations locales des 4-H considèrent l'inclusion comme étant une priorité. Les animateurs et les animatrices sont encouragés à collaborer avec les personnes et leurs familles afin de définir et d'examiner les mesures d'adaptation, selon les besoins, et de communiquer avec le personnel du bureau provincial ou national pour obtenir de l'aide en cas de préoccupations non résolues.

**Ceci s'applique aux jeunes membres (âgés de 6 à 21 ans), aux bénévoles, aux animateurs, aux membres du personnel et aux professionnels.*
***Selon la définition de discrimination en vertu de la Charte canadienne des droits et libertés*

INTRODUCTION

WELCOME TO 4-H ONTARIO'S FIELD CROPS SPECIES & MANAGEMENT PROJECT!

The purpose of the 4-H Field Crops Species & Management Project is to provide you with general knowledge on crop management. This project focuses on crops grown in Ontario and will create awareness of scientific, technological and environmental factors that can influence crop production.

OBJECTIVES:

Increase your knowledge of the various Ontario field crop species and production techniques

1. Develop your skill in identifying plants and seeds of the commonly grown crops in Ontario
2. To start you on a path of continual learning about crops by directing you to more in-depth information
3. Expand your skills in problem-solving, judging, communication and leadership
4. To gain an appreciation for careers related to the field crops industry
5. To learn the proper use of parliamentary procedure

HOW TO USE THIS MANUAL

THE REFERENCE MANUAL AND ACTIVITY GUIDE:

The reference book is laid out into 6 meetings:

Meeting 1 – What's Growing in Ontario

Meeting 2 – The Environment

Meeting 3 – Various Varieties

Meeting 4 – Digging In

Meeting 5 – Feeds and Weeds

Meeting 6 – Harvesting and More

There is more information in this project than what can be covered in 12 hours of a typical 4-H project. A member could take this project for multiple years and learn different content each year.

Each unit contains Setting Objectives, Suggested Learning Outcomes, Roll Call questions, a suggested agenda, Topic Information, Activities and a Digging Deeper section. Activities should be used in combination with the discussion of topic information to teach members in a hands-on, interactive learning environment.

INCLUDING STEM IN THE 4-H FIELD CROPS SPECIES & MANAGEMENT PROJECT

WHAT IS STEM AND WHY IS IT IMPORTANT?

Since 1915, 4-H in Ontario has engaged youth in science, technology, engineering, and math (STEM). This has traditionally meant a solid focus on agricultural science, mechanics, entrepreneurship, natural sciences and household science. Today, 4-H has grown to include rocketry, robotics, computer science, environmental sciences, and more. 4-H provides hands-on learning experiences to encourage learning about the world around us. Our lives are completely immersed in science and technology.

Understanding how science, engineering, and technology impact our lives, solve problems and create new ones makes it easier to navigate our modern world.

In school, science classes need to cover a broad range of topics in a limited amount of time while STEM in 4-H allows members and leaders time to dig deeper into ideas and concepts and to spend as much time as desired to work on projects based on personal interests, questions, and skills.

STEM in 4-H allows a person to work on their own questions, design their own tests, create their own models, build their understanding, and share their work with others – learn to do by doing. That's what science and engineering are, trying to understand the natural universe and develop solutions to the problems faced in our world today. Science is inquiry that uses specific approaches and skills. But all learning is an inquiry process so working with science helps develop your learning muscles.

Within 4-H, the STEM process can go even further to include the Arts, thus changing the acronym to STEAM – Science, Technology, Engineering, Art & Math.

STEAM IN 4-H ONTARIO PROJECTS

As you work through the Field Crops Species & Management Project, you will see STEAM integrated throughout the project within almost all of the activities provided. Examples of activities include 'Calculating Crop Heat Units, Gather a Soil Sample, Seed Identification and The Worm Test' amongst many others.

STEAM can be challenging but it can also be fun! Be sure to try out the activities. Observe what works and what doesn't and how activities can be changed slightly to get different results. It's all a part of the STEAM learning process!

PLANNING A MEETING

Plan your meetings well. Review all the information well in advance so you are prepared and ready!

BEFORE EACH MEETING:

- Read the topic information and activities and photocopy any relevant resources for the members' Record Books.
- Be familiar with the topic information for each meeting. Think of imaginative ways to present the information to the members. Do not rely on just reading the information out loud. Review available resources, plan the meetings and choose activities and themes that complement the ages and interests of your members. Gather any equipment and/or resources that will be needed to complete the meeting.
- At least 12 hours of club meeting time is required for every project; including club business, specific project information and social recreation. The delivery format for that material is left to the discretion of the leaders. Before each meeting, create a timeline to ensure that you are providing an adequate amount of instructional time for club completion. **Note:** the best practice recommendation is that a club have multiple meeting times for each project. Included on the following page is a Leader's Planning Chart to help with the planning of meetings. In addition to the chart, keep track of what went well and what could be changed next time. That way, each time this project is run, the content of the meetings can be different!

When planning each meeting, a typical 4-H meeting agenda should include the following:

- Welcome & Call to Order
- 4-H Pledge
- Roll Call
- Parliamentary Procedure:
    - Secretary's Report
    - Treasurer's Report (if any)
    - Press Report
    - New Business: local and provincial 4-H activities/opportunities, upcoming club activities
- Meeting content and activities
- Clean-up
- Social Recreation and/or refreshments
- Adjournment

JUDGING AND COMMUNICATIONS:

Each meeting must include either a judging or public speaking activity.

- Judging gives the members an opportunity to use judging techniques as part of the learning process. Through judging, members learn to evaluate, make decisions and communicate with others. They also develop critical thinking skills, confidence and self-esteem. Many examples are used in this reference book but use your imagination! As

long as members are setting criteria and critically thinking about where items fit within that set of criteria, they are learning the basic skills of judging!

- A communications activity has been provided for each meeting but can be included in the Roll Call or social recreation time. These activities do not need to involve the topic of field crops as the outcome is more about understanding the concepts of effective communication.

ELECTING YOUR EXECUTIVE

Elections can be chaired by a youth leader, senior member or club leader. The person chairing the elections is not eligible for any positions.

Procedure:

1. All positions are declared vacant by the chairperson, who indicates this by saying "I'd like to declare all positions vacant."
2. The group decides on the method of voting (i.e. show of hands, ballot or standing).
3. The chairperson accepts nomination from members for each position being filled. Nominations do not require a seconder. Nominations are closed by motion or declaration by the chairperson.
4. Each member nominated is asked if he/she will stand for the position. Names of members who decline are crossed off.
5. Voting takes place by selected method and majority rules (i.e. member with most votes).
6. Announce the name of the successful member. Offer congratulations and thank all others that ran for the position.
7. If ballots are used, a motion to destroy the ballots is required and voted on.

STEPS IN MAKING A MOTION

The motion is a very important key to having good meetings. Motions are a way of introducing topics for discussion and allowing each member to speak and vote. Any member can make a motion.

Steps in Making a Motion:

1. Address the chairperson (i.e. raise your hand).
2. Wait for the chairperson to acknowledge you.
3. Make the motion: "I move that…"
4. Another person seconds the motion: "I second the motion."
5. Chairperson states the motion.
6. Chairperson calls for discussion of the motion.
7. Chairperson restates the motion.
8. Chairperson calls the vote: "All in favour? Opposed?"
9. Chairperson announces the result of the vote: "Motion carried" or "Motion defeated."

LEADER'S PLANNING CHART

Meeting #	Date/Place/ Time	Topics Covered	Activities	Materials Needed

As a club volunteer your responsibilities are to:

- Be a Volunteer in Good Standing by completing the volunteer screening process, attend a volunteer training session and adhere to the 4-H Code of Conduct.
- Notify the local association of the club, arrange a meeting schedule and participate in club meetings, activities and the Achievement program, assuring that all meetings and activities are accessible and inclusive for all participants.
- Review the project material in the Reference Manual and Activity Guide to familiarize yourself with the information and adapt it to fit your group. Be well organized and teach the material based on your group's age, interest and experience level.
- Organize the club so members gain parliamentary procedure, judging and communication skills.
- Ensure that members are registered for the club using the online registration system.
- Review the Participant Agreement Form (PAF) that members will be completed when registering online. Ensure that all members, leaders and parent helpers know the appropriate actions during any emergency. Check with members for any food allergies or dietary restrictions and plan snacks accordingly.

As a club member your responsibilities are to:

- Participate in at least 2/3 of his/her own club meeting time. Clubs must have a minimum of 12 hours of meeting time.
- Complete the project requirement to the satisfaction of the club leaders.
- Take part in the project Achievement Program.
- Fill in and complete the Record Book.
- Complete any other project as required by the club leaders.
- Adhere to the 4-H Code of Conduct at all times.

ACHIEVEMENT PROGRAM IDEAS/SUGGESTIONS:

- Have members create an exhibit or enter a float in the parade at a local fair/show.
- Have members make a presentation at school about the 4-H Field Crops Species & Management Project and/or their crop if they grew one for this project.
- Have members make a presentation at school or a community event about how to be safe around farm machinery.
- Create a skit about field crops and farming and perform it at school, at a senior's home, at another organization's meeting, etc.
- Have members participate in a Foodgrains Project in your area.

SPECIAL PROJECTS

These projects are done outside of meeting time and are for members interested in doing more – often senior members. Its up to you as the leader to decide if you will require members to complete a Special Project for club completion. Some ideas include:

- Create a display about a topic related to field crops and display at a local fair or community event.
- Create a video about a topic related to field crops. Post on YouTube.
- Interview a farmer or someone who works in the field crop industry. Write a blog or an article for your local newspaper about a crop that they grow.
- Enter the field crops competition at a local fair.

Individual clubs can decide if junior and/or senior members will be required to grow their own crop as part of this project.

- Each member could plant, cultivate, harvest and keep records for their crop. This crop could be a food crop such as sweet corn or cucumbers or a field crop such as corn, forages, barley or soybeans. The crop should be approved by the 4-H Leaders at the second meeting. The Crop Project Records, found on page ##, should be completed and submitted to the club leaders by the end of this project.

TOUR & GUEST SPEAKER IDEAS

- Visit a field crop test plot.
- Visit a machinery dealership.
- Have guest speakers attend meetings to supplement the material in the Reference Manual. Speakers could include an agronomist, seed salesperson, farmer, field crops researcher, custom sprayer, etc.
- Tour a seed processing facility.
- Tour a facility that sells crop inputs.
- Tour a crop test plot – tour could include topics such as seed selection, soil fertility and crop protection.
- Visit a field during various stages of growth from planting through to harvest and on to a processing facility.

FIELD CROP REFERENCES/RESOURCES

Agriculture and Agri-Food Canada https://www.agr.gc.ca/

AgScape https://agscape.ca/

Canadian Grain Commission https://www.grainscanada.gc.ca

Canola Council of Canada https://www.canolacouncil.org

Corteva Agriscience https://www.corteva.com/

CropLife Canada https://croplife.ca/

GoCereals.ca www.gocereals.ca

GoCorn.net http://www.gocorn.net/

GoSoy.ca www.gosoy.ca

Grain Farmers of Ontario https://gfo.ca/

OMAFRA http://www.omafra.gov.on.ca/

OMAFRA Agronomy Guide for Field Crops, Publication 811 http://www.omafra.gov.on.ca/english/crops/pub811/pub811.pdf

OMAFRA Guide to Weed Control, Publication 74 http://www.omafra.gov.on.ca/english/crops/pub75/pub75toc.htm

Ontario Bean Growers http://ontariobeans.on.ca

Ontario Canola Growers https://www.ontariocanolagrowers.ca/

Ontario Cereal Crops Committee https://www.gocereals.ca/

Ontario Fruit & vegetable Growers' Association https://www.ofvga.org/

Ontario Soil Network http://ontariosoil.net/

Ontario Ministry of Agriculture Food & Rural Affairs http://www.omafra.gov.on.ca

University of Guelph https://www.uoguelph.ca/

CROP PROJECT RECORD

Record the following information on your crop as each stage is reached.

CROP: _____ VARIETY: _____

Primary Tillage - Type: _____

Date: _____

Secondary Tillage - Type: _____

Date: _____

Type: _____

Date: _____

Type: _____

Date: _____

Planting - Method: _____

Date: _____

Inter-row cultivation Method: _____

for weed control Date: _____

Fertilizer Analysis: _____

Date: _____ Rate: _____

Analysis: _____

Date: _____ Rate: _____

Pest Control Date: _____

Method: _____

Date: _____

Method: _____

Date: _____

Method: _____

Date: _____

Method: _____

Weather Comments - Planting Time: _____

At flowering/pollination: _____

Growing Season: _____

Near Maturity: _____

At Harvest: _____

MEETING 1:
WHAT'S GROWING IN ONTARIO

SETTING OBJECTIVES:

To create an understanding of which crops are grown in Ontario and the environmental factors that affect which crops can and cannot grow in Ontario.

Suggested Lesson Outcomes

- ☐ To understand which main crops are grown in Ontario
- ☐ To realize the environmental factors that determine which crops will grow best in certain areas
- ☐ To appreciate the size of the field crop industry in Ontario
- ☐ To learn what some of the end uses are of crops grown in Ontario
- ☐ To start 4-H members on a path of continual learning about crops by directing members to more in-depth information

SAMPLE ROLL CALL QUESTIONS

- Name a crop grown in Ontario that you have eaten today
- Name a crop that is grown in abundance in Canada.
- Name a crop grown in another country that is not grown in Canada
- Name a crop grown in Ontario that is not grown in your area

Sample Meeting Agenda **Time: 2 hours 30 minutes**

Welcome, Call to Order & Pledge Review 4-H Code of Conduct		10 min
Roll Call		5 min
Parliamentary Procedure	Election of Officers	30 min
Topic Information, Discussion & Activities	Topic Information • What Grows Here in Ontario? – Environmental Factors • Crops Grown in Ontario – Field Crops – Horticulture – Specialty Crops Activity #1 Crops Globetrotting Activity #2 Seed Identification Activity #3 Crops Grown in Ontario Wordsearch	30 min 20 min 20 min 20 min
At Home Activity	Top Crop in Ontario	5 min
Wrap up, Adjournment & Social Time		10 min

TOPIC INFORMATION
WHAT GROWS HERE IN ONTARIO?

Have you ever wondered why we cannot grow pineapple as a crop in Ontario? There are many different environmental factors that determine which crops are grown in Ontario and which have to be grown somewhere else in the world.

ENVIRONMENTAL FACTORS

Most environmental factors are affected by geographic location. These factors include:

1. **Light** – not enough (change in day length)
2. **Temperature** – it may get too hot for some crops, too cold for others
3. **Rainfall** – too much or too little
4. **Growing Season** – too short
5. **Humidity** – too high
6. **Soil** – different soil types favour different types of crops
7. **Topography** – if on a steep hill, it may be best to only grow certain crops
8. **Air Quality** – presence of air pollutants

Share It!

Tell the group which crops are grown on your farm or in the area where you live.

Discuss It!

Why can we grow certain crops in Ontario while we can't grow other types of crops? What is the single most important factor why some crops can't grow here?

CROPS GROWN IN ONTARIO
FIELD CROPS

Barley

Barley is typically planted in early spring and harvested in late August. Barley is used mainly for animal feed or for the production of malt for brewing. Barley is also used for human consumption as whole-grain, pearled, raw-grain flour, whole roasted-grains mature barley flour and roasted-grain flour. Once barley has been combined, the leftover chopped stalk is baled as straw for livestock bedding plus other uses such as mulch in the horticulture sector.

Source: Joanna Follings, Cereals Specialist, Ontario Ministry of Agriculture, Food & Rural Affairs

In 2016 there were 41,973 hectares (104,000 acres) of barley grown in Ontario. This is down significantly from the 124,938 hectares (309,000 acres) grown 15 years earlier in 2001.
Source: OMAFRA calculations adapted from Statistics Canada

Canola

Canola Field, Tobermory, Ontario
Source: https://www.reddit.com/r/ontario/comments/906175/canola_field_in_tobermory_oc/

Canola was developed in the 1970's by Canadian plant scientists. The name comes from *Can* as in Canada and *ola* as in oil. Its is an oilseed crop well suited to the cool, temperate areas of Ontario. There are two types of canola grown in Ontario; spring canola (planted early May and harvested late August to late September, depending on the area of the province) and winter canola (planted late August and harvested the following year late June to late July, depending on the area of the province). The oil from canola is used for cooking and baking at home, restaurants and in food processing plants. It is also used sometimes in biodiesel and bioplastics production.

In 2018, a total of 18,858 hectares (46,600 acres) of canola were grown in Ontario. *Source: OMAFRA calculations adapted from Statistics Canada*

Corn

Corn is planted in the spring and is harvested in the fall. It is harvested as either grain corn, cobmeal or as corn silage. Grain corn produced within Ontario is used for both feed (60%) and industrial (40%) uses. A significant acreage is also planted for cobmeal and corn silage for livestock feed.

Grain corn planted in Ontario is also processed for use in human foods. Industrial uses of corn also include ethanol fuel, biochemicals and bioplastics.

In 2016 there were 874,932 hectares (over 2.1 million acres) of grain corn and 119,649 hectares (almost 300,000 acres) of corn silage grown in Ontario.

Source: OMAFRA calculations adapted from Statistics Canada

EDIBLE BEANS

Beans go by a number of different general names such as legumes, dry bean, common bean, and pulses. Beans are divided into two broad subdivisions – coloured beans and white beans. As of 2020, there are approximately 1200 farmers growing eight types of edible beans in Ontario. Edible beans are planted in the spring and harvested in early fall.

White Beans Source: OMAFRA Field Crop News https://fieldcropnews.com/2019/01/sulphur-fertilizer-trial-in-dry-edible-beans/

- White (also called pea beans or navy beans)
- Black turtle beans
- Dark red kidney beans
- Light red kidney beans
- White kidney beans
- Cranberry beans
- Adzuki beans (also called azuki beans)
- Otebo beans

Other bean types grown in Canada (but not regularly in Ontario) include Great Northern Beans, Pinto Beans, Small Red Beans and Yellow Beans. It is estimated that there are well over 400 different types or varieties of edible beans grown throughout the world.

In 2016 there were 52,872 hectares (130,600 acres) of dry field beans grown in Ontario.

Source: OMAFRA calculations adapted from Statistics Canada

Mixed Forages (Hay and Haylage)

*Source: OMAFRA Virtual Beef article http://www.omafra.gov.on.ca/english/livestock/beef/news/vbn0212a2.htm © Queen's Printer for Ontario, ** Reproduced by permission*

Forages are whole plants harvested for livestock feed. Forages are a major Ontario crop, providing feed for Ontario's livestock industry. As of 2017, hay and haylage were grown on 831,000 hectares (2,000,000 acres) of land, while there are 239,000 hectares (600,000 acres) of seeded pasture and 415,000 ha (1,037,000 acres) of natural pasture.

Source: OMAFRA calculations adapted from Statistics Canada

Corn silage is also considered a forage but is covered in the corn section of this meeting.

Mixed Grain

Mixed grain consists of any mixture of wheat, rye, barley, oats, triticale, wild oats and domestic or wild oat groats. They are planted late winter/ early spring and typically harvested in August. The majority of mixed grain that is grown in Ontario is used for livestock feed.

In 2016 there were 37,570 hectares (93,000 acres) of mixed grain grown in Ontario.

Source: OMAFRA calculations adapted from Statistics Canada

Oats

Oats are typically planted as soon in the spring season as possible, typically in early April (Southestern Ontario), mid-April (central and Eastern Ontario) and mid-May (Northern Ontario) and harvested in late summer/early fall. While the majority of oats grown in Ontario are for forage or feed, many of these oats could enter the human food market. Oats for human consumption (milling oats) are high-quality oats that meet or exceed milling standards.

In 2016 there were 33,268 hectares (82,200 acres) of oats grown in Ontario.

Source: OMAFRA calculations adapted from Statistics Canada

Source: Michigan State University Extension Field Crops https://www.canr.msu.edu/news/oat-varieties-and-production-featured-at-july-19-oat-field-day

Rye

Rye is planted in the fall and harvested the next summer. End uses for rye include livestock feed as well as a variety of foods and some alcohols for human consumption.

Hybrid rye is also grown in Ontario and is primarily used for distilling and livestock.

In 2016 there were 22,074 hectares (54,550 acres) of fall rye grown in Ontario.

Source: OMAFRA calculations adapted from Statistics Canada

Soybeans

Soybeans are planted in the spring and harvested in the fall. End uses for Ontario soybeans includes specialty food grade markets, oil production and livestock feed. Some farmers bale the residue (stalk) left from combining to use as bedding for livestock.

In 2016 there were 1,126,419 hectares (almost 2.8 million acres) of soybeans grown in Ontario.

Source: OMAFRA calculations adapted from Statistics Canada

Wheat

Wheat can be planted in the fall and over-wintered or can also be planted in early spring. It is typically harvested in July/August. Wheat is used for livestock feed and a variety of foods for human consumption. Once wheat has been combined, the leftover chopped stalk is baled as straw for livestock bedding plus other uses such as in the greenhouse industry.

In 2016 there were 437,213 hectares (almost 1.1 million acres) of winter wheat and 48,757 hectares (120,500 acres) of spring wheat grown in Ontario.

Source: OMAFRA calculations adapted from Statistics Canada

HORTICULTURE

Peaches, Niagara Region
*Image credit: Ontario Ministry of Agriculture, Food & Rural Affairs - Best Management Practices: Soil Health in Ontario (2017) © Queen's Printer for Ontario, ** Reproduced by permission*

As of 2020, over 125 different fruit and vegetable crops are grown on 245,000 acres of land in Ontario with an estimated annual farm gate value of more than $2.3 billion.

Unlike some of the other crops grown in Ontario, horticultural crops are usually grown on smaller acreages but are very valuable and require intensive, skilled management. Horticultural crop

Discuss It!

Are there crops grown in your area that weren't grown in your area 20 years ago? 50 years ago? Why is this?

Talk About It!

Create a list of the four most important crops grown in your area. If your group has trouble deciding which four crops, have each member give their reasons for why they chose the crops they think are most important.

growers share many of the same management concerns of other producers. Although horticultural crops vary substantially, they all require skilled management to produce a high-quality product. These crops rely on intensive management of soil, water, nutrient resources and pest populations.

Fruit

The most common fruits grown in Ontario are apples, grapes, peaches and strawberries. Major fruit crops grown in Ontario include:

- Apples
- Apricots
- Blueberries
- Grapes
- Melons
- Nectarines
- Peaches
- Pears
- Sweet cherries
- Sour cherries
- Plums
- Prunes
- Raspberries
- Strawberries

Vegetables

The most common vegetables grown in Ontario are potatoes, sweetcorn, peas and field tomatoes. Major vegetable crops grown in Ontario include:

- Asparagus
- Beans
- Beets
- Broccoli
- Brussel sprouts
- Cabbage
- Carrots
- Cauliflower
- Celery
- Cucumbers
- Leeks
- Lettuce
- Mushrooms (classified as fungi but considered a vegetable for nutritional purposes)
- Onions
- Parsnips
- Peas
- Peppers
- Potatoes
- Pumpkin
- Radishes
- Rhubarb
- Rutabagas
- Spinach
- Squash
- Sweetcorn
- Tomatoes
- Zucchini

Most vegetable crops are grown outdoors but tomatoes, cucumbers, lettuce and peppers are also grown in greenhouses in Ontario.

SPECIALTY CROPS

Edamame

Source: OMAFRA Specialty Cropportunities http://www.omafra.gov.on.ca/CropOp/en/spec_veg/pea_bean/edam.html

Specialty crops can be described as low-acreage crops that fill a niche. Some of these crops are new to Ontario while others are re-emerging crops such as hops. Other speciality crops now making an appearance in Ontario include edamame, pawpaw, Haskap grapes, tiger nut and quinoa. For a full list of specialty crops grown in Ontario visit OMAFRA's Specialty Cropportunities website at: http://www.omafra.gov.on.ca/CropOp/en/index.html

Experience It!

Invite a farmer to your meeting that grows a specialty crop. Find out why they grow this crop, when planting and harvesting takes place and how they market their crop.
Or, if possible, tour their farm and see the specialty crop.

Did You Know?

As of 2020, the Ontario fruit and vegetable sector employs over 30,000 people directly on-farm, and every on-farm job generates approximately 2.2 jobs downstream (an additional 66,000 indirect jobs).
Source: Ontario Fruit & Vegetables Growers' Association

Judge It!

There are many products grown in the field or greenhouses that can be judged. Choose 4 apples and judge the apples based on the scorecard for Fruits and Vegetables found in the 4-H Ontario Judging Manual.
Other classes of fruits, vegetables and field crops can be judged at this meeting and/or future meetings. Scorecards for various classes can be found in the 4-H Ontario Judging Toolkit or the Ontario Association of Agricultural Societies' Judging Handbook.

Check It Out!

Discover Canadian agriculture by taking a virtual farm tour (video) produced by Farm & Food Care at: http://www.farmfood360.ca/ There are videos that highlight a grain farm, an oat farm & processing and a feed mill in addition to many other videos that showcase other sectors of the agriculture industry.

Do It!

Remember, with any tour that you might take during this project that you are a guest. Be polite, respectful and grateful to the host(s) that have opened up their facility/ fields for your 4-H club to tour.

AT HOME ACTIVITY

Top Crop in Ontario

Which field crop grown in Ontario has the highest number of hectares planted? Do some research and be prepared to share your answer at the next meeting.

DIGGING DEEPER

For Senior Members

Specialty Crops

Choose one specialty crop grown in Ontario and find out more about it. Answer questions such as:

- What type of climate does the crop need to grow?
- How many hectares of the crop are grown in Ontario each year?
- What are the end uses for this crop?
- What types of equipment are needed for planting and harvesting?
- Any other information you think is interesting about this crop

Be prepared to share your findings with the group at the next meeting.

ACTIVITY #1: CROPS GLOBETROTTING

DO	Time: 20 minutes Materials Needed: • Globe of the world Instructions: • Designate one of the club members to be the traveller • Have the traveller spin the globe and stop somewhere on the globe by pointing with one finger (hopefully its not in the middle of an ocean!) • As a group, list what type of crops might be grown there and why
REFLECT	Learning Outcomes: To allow members to discover what crops grow in various parts of the world. To allow members to think critically about the reasons why some crops grow well in certain areas while other crops may not.
APPLY	Processing Prompts: • Was it easy or hard to create a list of crops for each area chosen on the globe? • Did you have any areas that you couldn't think of any crops that would be grown in that area? • Were there any crops listed that surprised you? • What was the main factor that determined whether or not a particular crop could or couldn't be grown in a certain area?

ACTIVITY #2: SEED IDENTIFICATION

DO	Time: 20 minutes Materials Needed: • Closed jars with a different type of seed in each jar – have a number on each jar • Paper and a writing utensil Instructions: • Have members number their paper for the number of jars in this activity • Have members try to identify the seeds in the jars and have them write down their answers
REFLECT	Learning Outcomes: To allow members to discover what the seeds look like that crops are grown from.
APPLY	Processing Prompts: • Was it easy or hard to identify the seeds? Were some seeds harder than others to identify? • Are all the seeds in this activity able to be grown in your area? • Have you seen any of these seeds planted as a crop? • Do you grow any of these seeds on your farm?

ACTIVITY #3: CROPS GROWN IN ONTARIO WORDSEARCH

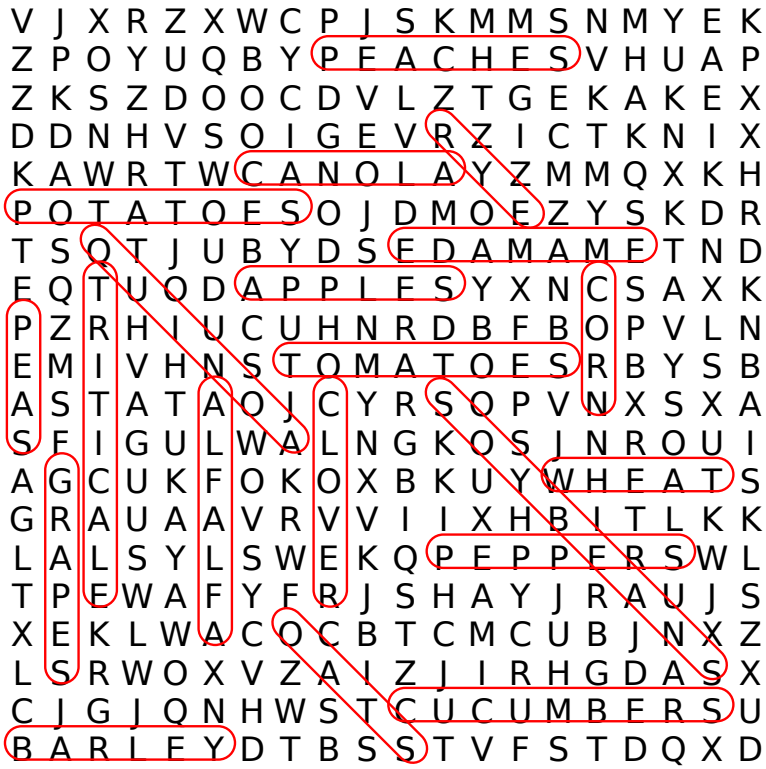
DO	Time: 20 minutes Materials Needed: • Wordsearch (found at the end of this meeting and in the Record Book) • Wordsearch answer key (found at the end of this meeting) • Pen/pencil Instructions: • Give each member a copy of the wordsearch • Have members work individually to find all of the words • Discuss as a group which crops could have also been listed that don't appear in the wordsearch
REFLECT	Learning Outcomes: To allow members to become more familiar with crops grown in Ontario.
APPLY	Processing Prompts: • Why is it important to know which crops grow in Ontario? • Which crops are grown in your area? • Are there any crops listed that you would like to try growing?

Crops Grown in Ontario

V J X R Z X W C P J S K M M S N M Y E K
Z P O Y U Q B Y P E A C H E S V H U A P
Z K S Z D O O C D V L Z T G E K A K E X
D D N H V S O I G E V R Z I C T K N I X
K A W R T W C A N O L A Y Z M M Q X K H
P O T A T O E S O J D M O E Z Y S K D R
T S Q T J U B Y D S E D A M A M E T N D
E Q T U O D A P P L E S Y X N C S A X K
P Z R H I U C U H N R D B F B O P V L N
E M I V H N S T O M A T O E S R B Y S B
A S T A T A O J C Y R S O P V N X S X A
S F I G U L W A L N G K O S J N R O U I
A G C U K F O K O X B K U Y W H E A T S
G R A U A A V R V V I I X H B I T L K K
L A L S Y L S W E K Q P E P P E R S W L
T P E W A F Y F R J S H A Y J R A U J S
X E K L W A C O C B T C M C U B J N X Z
L S R W O X V Z A I Z J I R H G D A S X
C J G J Q N H W S T C U C U M B E R S U
B A R L E Y D T B S S T V F S T D Q X D

cucumbers	triticale	soybeans	potatoes
tomatoes	edamame	peaches	grapes
alfalfa	apples	peppers	clover
quinoa	barley	wheat	oats
canola	corn	rye	peas

Crops Grown in Ontario



cucumbers	triticale	soybeans	potatoes
tomatoes	edamame	peaches	grapes
alfalfa	apples	peppers	clover
quinoa	barley	wheat	oats
canola	corn	rye	peas

MEETING 2 : THE ENVIRONMENT

SETTING OBJECTIVES:

To create an understanding of which environmental factors affect crop growth and how those factors decide which crops can be grown in particular areas.

Suggested Lesson Outcomes

- ☐ To have an understanding of what environmental factors affect crop growth
- ☐ To gain an appreciation of why certain crops can only grow in certain areas
- ☐ To learn how to take a proper soil sample for testing purposes
- ☐ To start 4-H members on a path of continual learning about crops by directing members to more in-depth information

SAMPLE ROLL CALL QUESTIONS

- Name one type of weather or environmental factor and explain how it can reduce or increase crop yields.
- Name a crop that cannot be grown in your area due to environmental factors.
- Why is it important to understand how environmental factors play a part in choosing which crops should be grown in your area?

AT HOME ACTIVITY (FROM MEETING #1) ANSWER SHARING

- Which field crop grown in Ontario has the highest number of hectares planted? Do some research and be prepared to share your answer at the next meeting.

DIGGING DEEPER (MEETING #1)

- For Senior Members, do a short presentation on the Specialty Crop they researched.

Sample Meeting Agenda Time: 3 hours 20 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	30 min
Topic Information, Discussion & Activities	Topic Information • The Environment – Climate – Soil – Air Activity #1 Calculating Crop Heat Units Activity #2 Gathering a Soil Sample Activity #3 Judging Soil Samples Activity #4 Looking for the Best Type of Soil	40 min 20 min 30 min 20 min 30 min
At Home Activity	#1 - Changes in Varieties and Yields #2 - Recording Rainfall and Temperatures	5 min
Wrap up, Adjournment & Social Time		10 min

TOPIC INFORMATION

THE ENVIRONMENT

Where we live determines our environment. Our environment determines what we can and cannot grow.

Crop Fact!

Location determines Environment which determines Crop

To select a crop that will grow on your land you must:

1. Be able to measure the different parts or components of the environment
2. Be able to determine what that crop's environment needs are

When looking at the different parts of the environment that affect a crop, there are three factor major factors:

1. Climate
2. Soil
3. Air

Climate

Look online or through an atlas to find the climate maps. They are maps of the weather or environment for those areas.

There are five climatic factors that affect the suitability of a crop:

1. **Length of growing season:** The growing season is determined by the number of frost-free days. This is the number of days between the latest spring frost and earliest fall frost where the temperature is over 5°C.
2. **Rainfall:** The average amount and the distribution of rainfall during the growing season determines what type of crop is grown and affects how well it produces.
3. **Humidity:** This is water vapour in the air. *Relative humidity* is the amount of water vapour in relation to the temperature. The rate at which water evaporates from the soil and from the plant into the air (a process known as transpiration) depends on the temperature and the humidity or the relative humidity. This can affect how much use a crop gets from a rainfall or how easily a crop will dry. Relative humidity can also affect the growth of diseases, most of which do best in warm, humid temperatures.
4. **Hours of Sunlight:** The higher the number of sunlight hours a crop can experience during its growing season, the more it will produce.
5. **Temperature:** The average monthly temperature will directly affect a crop's rate of growth and productivity.

Length of Growing Season

The length of the growing season is usually the number of frost-free days. Maps clearly illustrating these dates geographically are available.

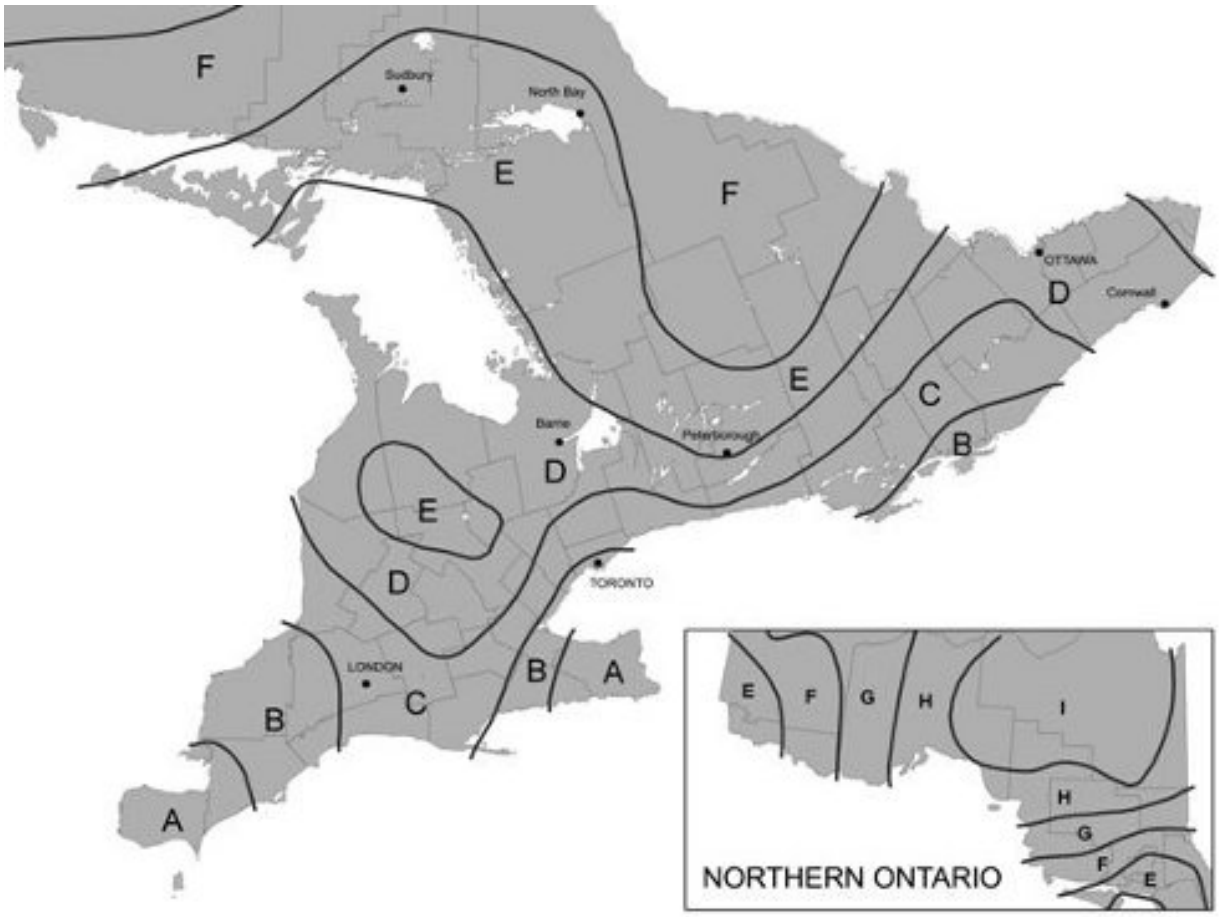


Figure 1. Climate Zone Map of Ontario (1976-2005). Source: Weather Innovations Incorporated

Table 1. Average Frost-Free Period in Climatic Zones of Ontario (1976-2005)

Zone	Frost-Free Period (Average in Days)	Average Date of Last Spring Frost	Average Date of First Fall Frost
A	170-190	April 25	October 20
B	160-170	April 30	October 13
C	150-170	May 3	October 8
D	130-165	May 11	October 1
E	125-145	May 17	September 26
F	115-125	May 24	September 22
G	100-115	May 27	September 17
H	100-110	June 3	September 16
I	90-100	June 7	September 9

Source of Map and Table: Climate Zones and Planting Dates for Vegetables in Ontario, Ontario Ministry of Agriculture, Food & Rural Affairs, 2005 http://www.omafra.gov.on.ca/english/crops/facts/climzoneveg.htm *© Queen's Printer for Ontario, ** Reproduced by permission*

Rainfall and Humidity

Rainfall is very important to crop growth. Growing areas are determined by the amount of rainfall that they receive as well as the distribution of that rainfall over the growing season. How much use crops make from rainfall depends on what time of year it rains and how much. The critical period for moisture for most crops typically occurs just before and after flowering. For example, corn is most sensitive to yield losses from dry weather around tasselling and silking.

Discuss It!

What is the average yearly precipitation amount in your area? Does most of the precipitation arrive as rain or snow? How does this affect which crops are grown in your area?

Average Yearly Precipitation (data collected from 1981 to 2010)

Days	City	Inches	Millimetres
179	Abbotsford, British Columbia	60.5	1538
156	Barrie, Ontario	36.7	933
136	Brantford, Ontario	34.1	867
112	Calgary, Alberta	16.5	419
123	Edmonton, Alberta	17.9	456
167	Guelph, Ontario	36.7	931
162	Halifax, Nova Scotia	57.8	1468
149	Hamilton, Ontario	35.3	897
120	Kelowna, British Columbia	13.6	345
159	Kingston, Ontario	37.8	960
166	Kitchener - Waterloo, Ontario	36.1	916
168	London, Ontario	39.8	1012
161	Moncton, New Brunswick	44.3	1124
163	Montréal, Quebec	39.4	1000
146	Oshawa, Ontario	34.3	872
161	Ottawa, Ontario	36.2	920
147	Peterborough, Ontario	34.3	870
175	Québec, Quebec	46.6	1184
118	Regina, Saskatchewan	15.3	390
198	Saguenay, Quebec	36.6	931
87	Saskatoon, Saskatchewan	14.4	365
187	Sherbrooke, Quebec	43.3	1100

Days	City	Inches	Millimetres
151	St. Catharines - Niagara, Ontario	34.7	880
158	Saint John, New Brunswick	51.0	1295
212	St. John's, Newfoundland	60.4	1534
167	Sudbury, Ontario	35.6	903
143	Thunder Bay, Ontario	26.9	684
145	Toronto, Ontario	32.7	831
161	Trois-Rivières, Quebec	44.2	1123
168	Vancouver, British Columbia	57.3	1457
148	Victoria, British Columbia	27.8	705
150	Windsor, Ontario	36.8	935
125	Winnipeg, Manitoba	20.5	521

Source: Current Results – Weather and Science Facts https://www.currentresults.com/Weather/Canada/Cities/precipitation-annual-average.php

Hours of Sunlight

Light is necessary for photosynthesis. Photosynthesis is the process a plant uses to manufacture its food. The rate of the plant's growth increases with more and stronger light.

Research It!

How exactly does photosynthesis work? Does it work the same for different types of plants? Share your findings with the group.

Temperature

The average monthly temperature is also available in map or chart forms. Temperature can be used to match the geographical location to the proper corn hybrid for that area's length amount of heat accumulation during it's growing season. This system is called Crop Heat Units or CHU. Each location in the province of Ontario has a CHU rating and all corn varieties are assigned a CHU rating which matches the length of time it takes them to mature. The calculation of an area's CHU is based on daytime and night-time temperatures.

Choosing a soybean variety in Ontario has traditionally been based on CHU. This works well for corn but is not accurate for predicting soybean maturity. Because soybeans are unique in the way they grow, most growing regions use a relative maturity (RM) system to rank soybeans.

Maximum Daytime and Nighttime Temperatures

Corn emerging from the ground

For daytime temperature, 10°C is used as the base temperature since warm season crops will not grow until the air temperature is at least 10°C. Crops grow fastest at 30°C however, its rate of growth will begin to decrease when the temperature exceeds 30°C.

For night-time temperature, 4.4°C is used as the base air temperature. The rate of growth at nighttime is greatest when the temperature is high.

- Quantifying Corn Development
  - Crop Heat Unit (CHU) is measure of temperatures that best reflects corn growth and development
  - CHU = (Y max + Y min)/ 2

Y max = (3.33 x (T max-10)) - (0.084 x (T max-10)^2) (If values are negative, set to 0)

Where T max = daily high temperature in degrees Celsius

Y min = (1.8 x (T min - 4.4)) (If values are negative, set to 0)

Where T min = daily minimum temperature in degrees Celsius

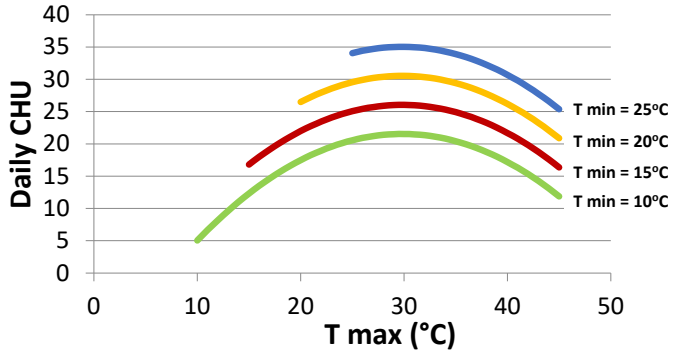


Image Credit: Ben Rosser, Corn Specialist, Ontario Ministry of Agriculture, Food & Rural Affairs

Daily CHU is calculated from the maximum and minimum temperatures recorded for the day. The chart on the next page has been developed to quickly determine daily temperatures.

Table 10–4. Daily crop heat unit accumulations based on maximum and minimum temperatures

LEGEND: – = not applicable

Daily Recorded Maximum Temperature	Daily Recorded Minimum Temperature																				
	<5°C	5°C	6°C	7°C	8°C	9°C	10°C	11°C	12°C	13°C	14°C	15°C	16°C	17°C	18°C	19°C	20°C	21°C	22°C	23°C	24°C
<10°C	0	1	1	2	3	4	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11°C	2	2	3	4	5	6	7	8	–	–	–	–	–	–	–	–	–	–	–	–	–
12°C	3	4	5	5	6	7	8	9	10	–	–	–	–	–	–	–	–	–	–	–	–
13°C	5	5	6	7	8	9	10	11	11	12	–	–	–	–	–	–	–	–	–	–	–
14°C	6	6	7	8	9	10	11	12	13	14	15	–	–	–	–	–	–	–	–	–	–
15°C	7	8	9	10	10	11	12	13	14	15	16	17	–	–	–	–	–	–	–	–	–
16°C	8	9	10	11	12	13	13	14	15	16	17	18	19	–	–	–	–	–	–	–	–
17°C	10	10	11	12	13	14	15	16	16	17	18	19	20	21	–	–	–	–	–	–	–
18°C	11	11	12	13	14	15	16	17	17	18	19	20	21	22	23	–	–	–	–	–	–
19°C	12	12	13	14	15	16	17	17	18	19	20	21	22	23	24	25	–	–	–	–	–
20°C	12	13	14	15	16	17	17	18	19	20	21	22	23	24	25	26	26	–	–	–	–
21°C	13	14	15	16	16	17	18	19	20	21	22	23	24	25	25	26	27	28	–	–	–
22°C	14	14	15	16	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	–	–
23°C	15	15	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	29	30	31	–
24°C	15	16	16	17	18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33
25°C	16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33
26°C	16	16	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	33
27°C	16	17	18	18	19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34
28°C	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34
29°C	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34
30°C	17	17	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	31	32	33	34
31°C	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34
32°C	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34
33°C	16	17	17	18	19	20	21	22	23	24	25	26	26	27	28	29	30	31	32	33	34
34°C	16	16	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	32	33

Source: OMAFRA Agronomy Guide Publication 811
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Crop Heat Unit Rating

The CHU rating for an area is calculated by accumulating all of the daily CHU for the period from May 1st to the first of either:

i) date of the first frost (the first temperature at or below -2°C) or

ii) 30-year average date of first mean daily air temperature (average of day and night temperatures) of 12°C or less.

A CHU rating has been calculated for each locations in Ontario. This map illustrated CHU ratings. Areas with equal ratings are joined by lines.

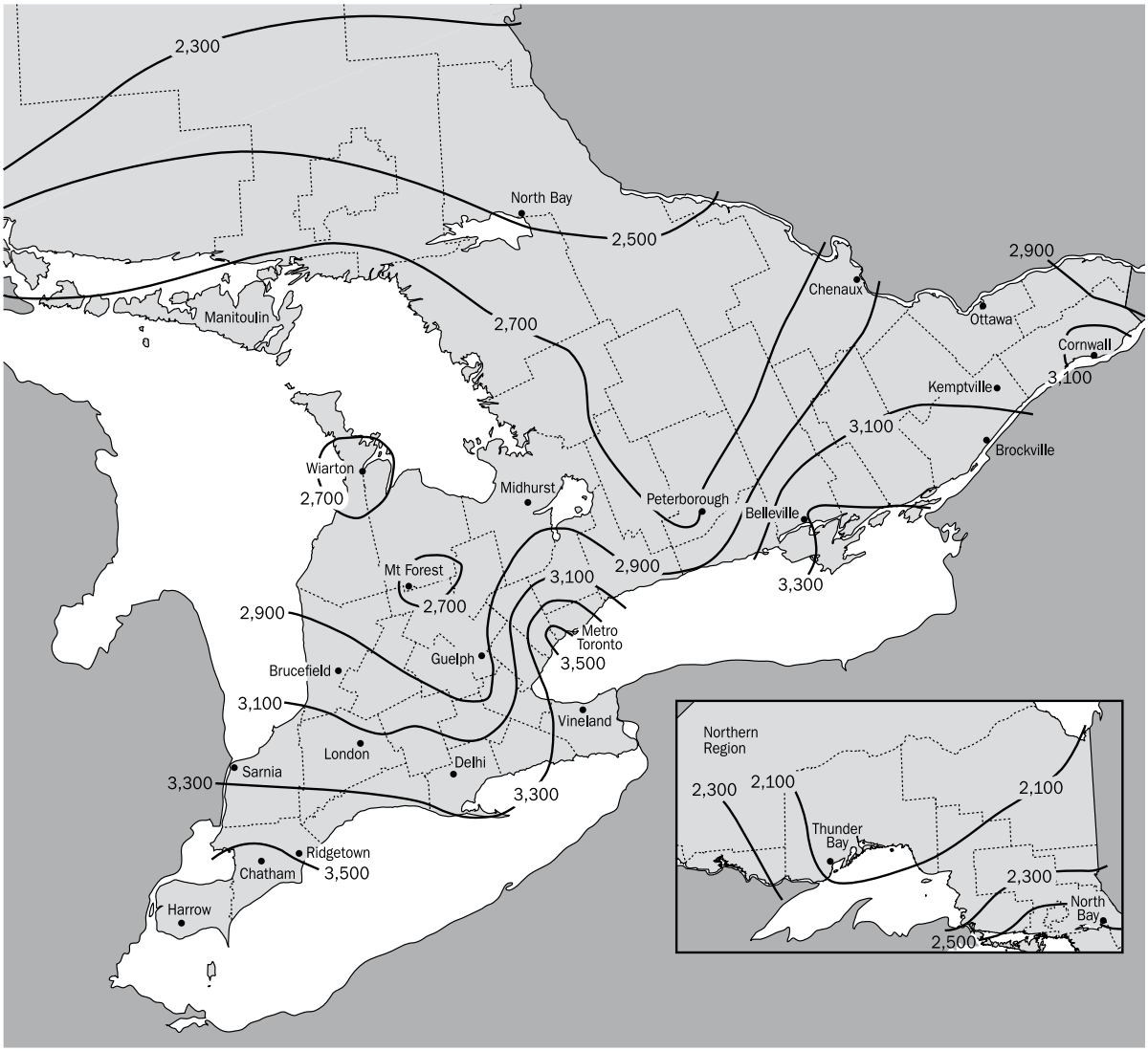

Figure 1–1. Crop heat units (CHU-M1) available for corn production.

This map is based on weather data from 1971–2000 with a common season start date across the province of May 1.
Source: Weather Innovations Inc. (WIN)

Source: OMAFRA Agronomy Guide Publication 811
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Discuss It!

What is the CHU rating for your area? What are the CHU ratings for the counties surrounding yours?

Crop Heat Units and Corn Production

There is a general relationship between the level of CHU and the yield potential of corn.

Corn:
Harvested yields (2015)

Maïs :
Rendement des récoltes (2015)

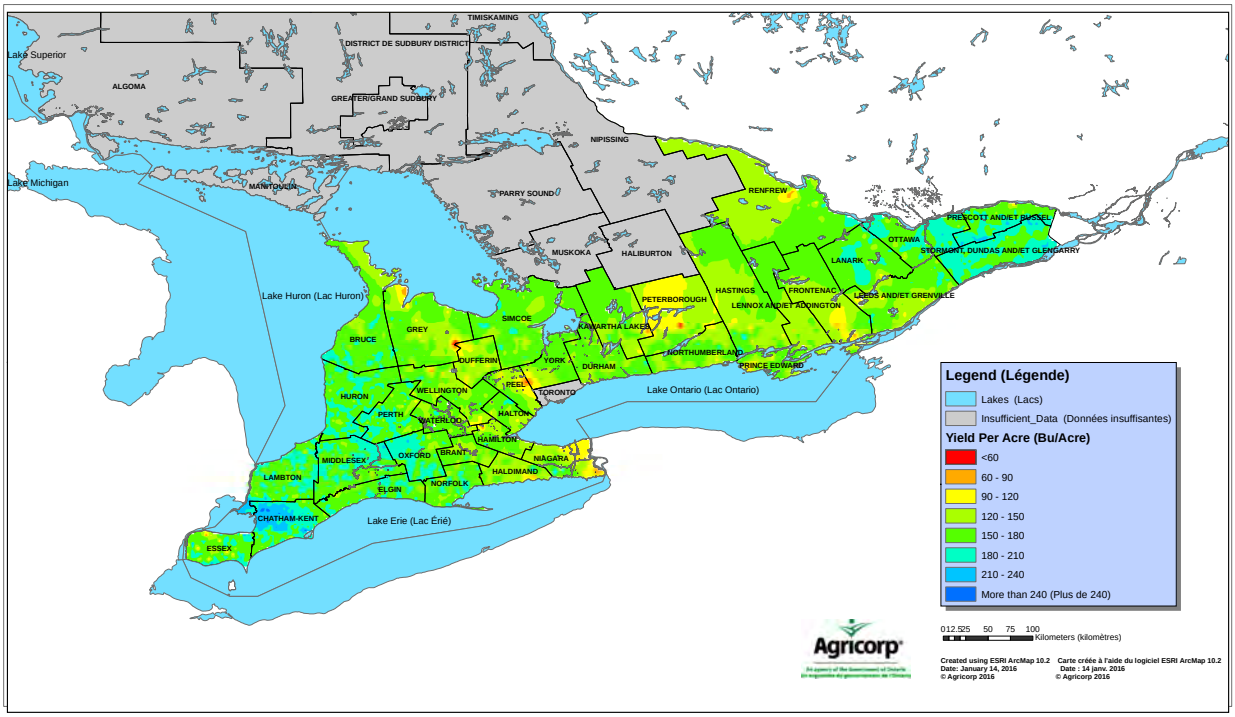

Image Credit: Agricorp *https://www.agricorp.com/en-ca/News/2016/Pages/PI-SoyCornYieldMapsAvailable.aspx*

Field conditions may delay planting and necessitate switching to less than full-season hybrids. Research results indicate that for every day after mid-May that you are late planting corn,

Table 1–8. Recommended dates to switch from full-season hybrids across various heat unit zones

Heat Unit Zone (CHU-M1)	Switch Date
>3,200+	May 30–early June
2,800–3,200	May 20–25
<2,800	May 15–20

Source: Adapted from R. Iragavarapu. *Basing Hybrid Maturity Switches on Long-Term Data.* Pioneer Hi-Bred Ltd.

Source: OMAFRA Agronomy Guide Publication 811
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you can lose up to one bushel of corn per acre and this yield loss can accelerate the longer planting is delayed.

Look It Up!

Using either the tags off of corn seed bags or a corn seed guide (either a paper copy or download from a manufacturer), look at the CHU levels for various hybrids of corn. If possible, have tags and/or corn seed guides from a variety of corn seed manufacturers.

A general rule has been to reduce hybrid maturity by 100 CHU for every week that planting is delayed beyond the cut-off date for full-season hybrids.

Relative Maturity and Soybean Production

Soybeans emerging from the ground

There is a direct relationship between the relative maturity and the yield potential of soybeans. Soybean development is affected by temperature as well as day length, or photoperiod. In order for a soybean plant to begin flowering it requires a minimum day length as well as adequate temperature, generally the higher the temperature the faster it will begin to flower. Due to photoperiod sensitivity, varieties are adapted for growth in a relatively narrow latitude range.

Soybean plant in the flowering stage

Bean starting to grow on the stalk

Figure 1: Ontario Soybean Relative Maturity Map

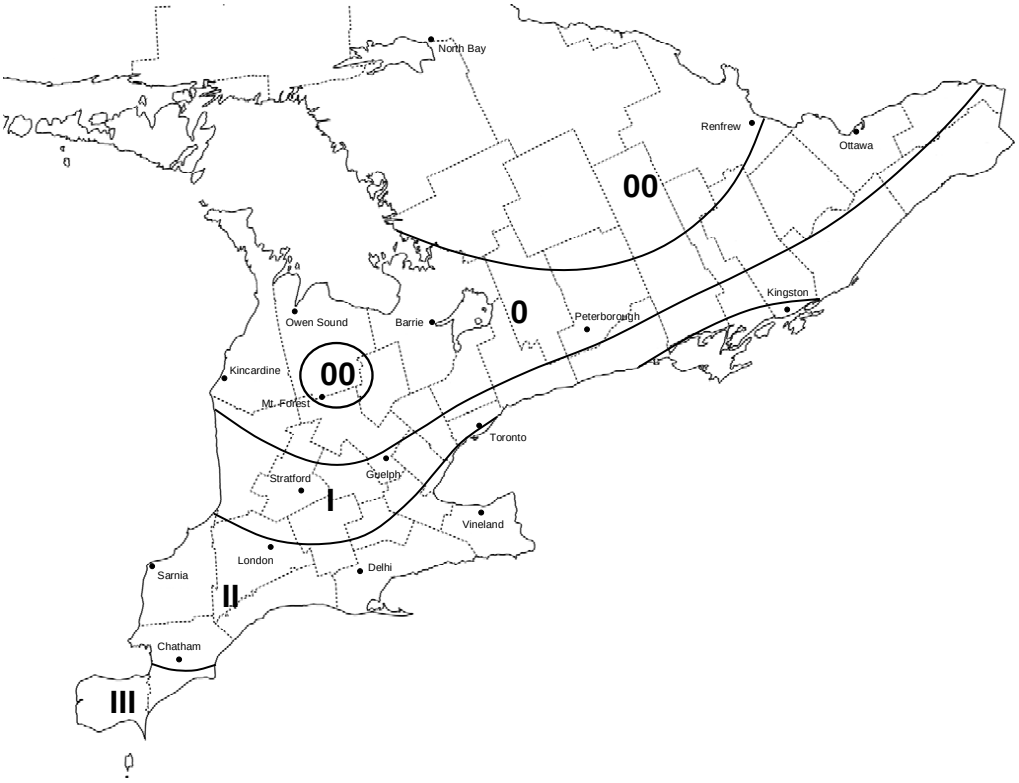

Table 1: Relative Maturity Value

Relative Maturity Zone	Approximate Crop Heat Unit Rating
00	2400
0	2600
I	2800
II	3000
III	3300

Source: New Ontario Soybean Maturity Map (SOY4-2011), Horst Bohner, OMAFRA
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Look It Up!

Using either the tags off of soybean seed bags or a soybean seed guide (either a paper copy or download from a manufacturer), look at the relative maturity levels for various hybrids of soybeans. If possible, have tags and/or soybean seed guides from a variety of soybean seed manufacturers.

SOIL

Although less important than climate, soil texture and reaction play a major role in determining which crops are grown.

The most important ways in which soil affects a crop are:

1. The amount of air and water it receives throughout the growing season
2. The nutrients it makes available to the crop
3. The type of soil

Soil Testing

Soil tests determine the chemical make-up of soil. Knowing the make-up of your soil will help you select a fertilizer for your crop. It is important to know the phosphorus, potassium and nitrogen levels in your soil in addition to the levels of other nutrients and the pH level (the acidity or alkalinity level) of your soil.

There are three ways to describe soils when you test for pH level:

1. Soils with a pH of less than 7 are acidic.
2. Soils with a pH of greater than 7 are basic (alkaline)
3. Soils with a pH of 7 are neutral

Health soils range from a pH of 6.0 to 7.5. Neutral soils with a pH of 6.0 to 7.5 are good for growing most crops and other plants.

Experience It!

Invite an agronomist, a certified crop advisor or anyone knowledgeable about taking soil samples to your meeting. Discuss why soil sampling is an important tool for a farmer to use.

AIR

When air contains high concentrations of chemical substances, it will hamper plant growth. For example, too much reduction in the ozone layer from fuel burning engines or smoke from factories causes injury to plant leaves from UV rays. This hinders the photosynthetic process and slows down plant growth.

AT HOME ACTIVITY #1: CHANGES IN VARIETIES AND YIELDS

Interview a farmer that has been farming for at least 10 years. Ask them some or all of the following questions:

- How long have you been farming?
- Do you grow any crops now that you didn't grow when you first started farming? If so, what are those crops? Why are you growing these crops now? Why did you stop growing certain crops?
- Has the overall yield of your crops changed over the years?

Experience It!

Invite a seed salesperson to your meeting to discuss what seed varieties are best suited for your area because of the environment. Also discuss how the end goal of your crop can also determine which seed variety you choose (i.e. silage corn, grain corn). Find out what training they had to become a seed salesperson and how STEM (Science, Technology, Engineering & Math) relates to their profession.

Research It!

Which counties/regions in Ontario might have their crops affected by high concentrations of chemicals in the air? Why?

Crop Careers!

Crop scientists study a variety of different aspects of the crop cycle. Creating new seed varieties is one important aspect of that cycle. Why is it important to continue to have new varieties created? Discuss this from a provincial, national and global perspective.

Do It!

Learn how to take your own soil sample at home by following the instructions in Activity #2 found at the end of this meeting. Send your sample away for analysis so you will have the results for Meeting #5. Contact your local crops input supplier about soil sample analysis in your area or visit the OMAFRA website for a list of Accredited Soil Testing Laboratories in Ontario http://www.omafra.gov.on.ca/english/crops/resource/soillabs.htm

Check It Out!

Look at your own farm using Google Earth and Google Maps. Take a look at the variability in soil types on your farm or in the area where you live. Look at neighbouring areas to see if it looks different than your area.

AT HOME ACTIVITY #2: RECORDING RAINFALL

Record daily rainfall for a two week period and plot the information on a graph (or use a computer to create a graph).

As a step #2 for this project, record daily rainfall for the duration of this project. Document how you recorded the rainfall (rain gauge, app on your phone, etc.). Compare the rainfall in your area to other areas of the province. What did you notice? How did this affect crop growth?

Recording Temperatures

Record daily maximum and minimum temperatures for the same two week period. Plot the maximum and minimum temperatures on a graph, using red for the maximum temperatures and blue for the minimum temperatures.

As a step #2 for this project, record temperatures for the duration of this project. Document how you recorded the temperatures (outside thermometer, app on your phone, etc.). Compare the daily temperatures in your area to other areas of the province. What did you notice? How did this affect crop growth?

DIGGING DEEPER I For Senior Members

CROPS & GLOBAL WARMING

Over the years, the types and varieties of crops grown in certain areas has changed. Is this due to the creation of new hybrids, the clearing of more land in remote areas for growing crops, global warming or a combination of all of these factors?

If possible, speak to a crop scientist or agronomist and get their perspective on this topic. Does it match what you found in your research?

Write a blog, write a short media release or create a short presentation to present to the group at the next meeting.

DIGGING DEEPER II For Senior Members

Choose three nutrients that are taken in a soil test and write a blog or create a presentation for the group to present at the next meeting on the importance of these nutrients for field crop production.

ACTIVITY #1: CALCULATING CROP HEAT UNITS

DO	Time: 20 minutes Materials Needed: • Daily Crop Heat Units (CHU) Values for °C Temperature Recordings Chart (found on pg. ## in this manual) • Crop Heat Units worksheet (found on the next page) • Paper and writing utensil Instructions: • Have members work either individually or in small groups of 2 to 3 people. • Using the Daily CHU Values for °C Temperature Recordings Chart have members determine the CHU for the various dates listed on the Crop Heat Units worksheet • Discuss the results that each individual/group determined for each date
REFLECT	Learning Outcomes: To create an understanding of how crop heat units are determined based on temperature.
APPLY	Processing Prompts: • Was it easy or hard to determine crop heat units for the various dates? • Do you think there could be an easier way to determine CHU values? • Did the values surprise you? • How would these values affect your choices of which hybrids of corn seed you might grow? • How do you think climate change might affect CHU values in the future?

CALCULATING CROP HEAT UNITS (CHU) WORKSHEET

Determine the daily CHU for the following dates:

Date	Daily Maximum Temperature	Daily Minimum Temperature	Daily CHU
May 10	10	6	
June 13	14	10	
July 26	26	20	
August 18	23	23	
September 27	17	12	

ACTIVITY #2: GATHERING A SOIL SAMPLE

(activity taken from the 4-H Ontario Loyal to the Soil project)

*Image credit: Ontario Ministry of Agriculture, Food & Rural Affairs - Best Management Practices: Soil Health in Ontario (2017) © Queen's Printer for Ontario, ** Reproduced by permission*

DO	Time: 30 minutes Materials Needed: • A spade, trowel or soil probe • Clean plastic containers • Plastic bags NOTE: Soil probes are available to borrow from the 4-H Ontario office Instructions: • Ask members to think about this statement ***'A soil test is only as accurate as the sample taken.'*** • Discuss the importance of taking a proper sample of soil and teach the steps to take a sample. • Discuss the various kinds of tests available and determine which tests each member will do. *The basic steps to collect a soil sample are as follows:* 1. Decide on the sample area (the size of the area can affect the sample). 2. The normal sampling depth for nutrients is about 15 cm (6 inches), however, when sampling for soil nitrates, a sample down to a depth of 30 cm (1 foot) will provide amore accurate indication of the amount of nitrate available to the crop.

	3. Collect a representative sample from the field, including enough cores collected randomly from across the entire area. Use a shovel or a spade, but a probe or auger is more accurate. Because soil nutrients typically exist in a decreasing gradient with depth, shovel or spade samples are only accurate if an equal amount of soil is taken from throughout the whole sampling depth. Note: soil probes are available to borrow from the 4-H Ontario office. 4. Often the most overlooked step in collecting a soil sample is the thorough mixing of soil cores before the sub-sample is collected. Sampled soil cores should be mixed in the bucket until no evidence of soil cores exist. Heavy clay soil cores sometimes need to be dried before they can be sufficiently mixed to allow for a suitable sub-sample. The sub-sample should be no more than 400 grams or about 1 cup of soil. 5. Store collected samples at room temperature, with the exception of soil nitrate samples which should be kept cool (below 4°C) and delivered to the lab within one day for immediate analysis. To find further information to accurately select, collect and submit a soil sample for testing, review the OMAFRA Guide: Soil Samples and Analysis for Managing Crop Nutrients (2016) at this web link: http://www.omafra.gov.on.ca/english/engineer/facts/06-031.htm Alternatively, instructions for taking a soil sample can be found in the OMAFRA Soil Fertility Handbook (Publication 611) (2018) available at: http://www.omafra.gov.on.ca/english/crops/pub611/p611order.htm
REFLECT	Learning Outcomes: To learn how to take a proper soil sample. To learn the importance and value of testing soil

APPLY	Processing Prompts: • Why is it important to use a plastic (or stainless steel) container to collect the soil samples? (Metal from other containers can contaminate the soil and alter the test) • Why is it necessary to take samples from a variety of areas? (discuss various soil sampling areas such as site specific, bulk sampling, zone sampling, and grid sampling that are all used at field scale sampling) • Why bother to take a soil sample? Is it really necessary?

NOTE: the results of the soil test will be used in Meeting #5

Additional Resource: See handout 'Accredited Soil Testing Laboratories in Ontario' found on the next page

ACCREDITED SOIL TESTING LABORATORIES IN ONTARIO

(as of July 2020)

NOTE: Please check the OMAFRA website for a current list of accredited soil labs. http://www.omafra.gov.on.ca/english/crops/resource/soillabs.htm

Laboratory Name	Address	Telephone/Fax	Contact
A & L Canada Laboratories Inc.	2136 Jetstream Road London, ON N5V 3P5	tel: (519) 457-2575 fax: (519) 457-2664 aginfo@alcanada.com	Greg Patterson Ian McLachlin
Eurofins Environment Testing Canada Inc.	8-146 Colonnade Road, Ottawa, ON K2E 7Y1	tel: (613) 727-5692 fax: (613) 727-5222 infocanada@eurofins.com	Rebecca Koshy
SGS Agrifood Laboratories	503 Imperial Road, Unit #1 Guelph, ON N1H 6T9	tel: (519) 837-1600 1-800-265-7175 fax: (519) 837-1242 ca.agri.guelph.lab@sgs.com	Jack Legg Dr. David Boyle
Brookside Laboratories, Inc.	200 White Mountain Drive New Bremen, OH 45869	tel: (419) 977-2766 fax: (419) 977-2767 jbrackman@blinc.com	Jackie Brackman
University of Guelph, Laboratory Services	University of Guelph P.O. Box 3650, 95 Stone Rd., West, Guelph, ON N1H 8J7	tel: (519) 767-6299 fax: (519) 767-6240 aflinfo@uoguelph.ca	Nick Schrier
Stratford Agri-Analysis	1131 Erie St., Box 760 Stratford, ON N5A 6W1	tel: (519) 273-4411 1-800-323-9089 fax: (519) 273-2163 info@stratfordagri.ca	Keith Lemp Mark Aikman
Activation Laboratories Ltd.	41 Bittern Street Ancaster, ON L9G 4V5	tel: 905-648-9611 or 1-888-228-5227 fax: 905-648-9613 victoriapechorina@actlabs.com	Rob Deakin Victoria Pechorina
Honeyland Ag Services	3918 West Corner Drive, Ailsa Craig, Ontario N0M 1A0	tel: (226) 377-8485 croelands@honeylandag.com	Chris Roelands

The OMAFRA-accredited soil testing program is the main guide, along with help from plant analysis and nutrient deficiency symptoms, in determining the fertilizer requirements for a specific crop on a specific field. The OMAFRA-accredited soil-testing program provides assurance of appropriate analyses to support recommendations for nitrogen, phosphate, potash and magnesium fertilizer, along with recommendations for the amount and type of lime to apply. The analytical methods used are chosen to provide accurate results on the range of soils found in Ontario.

ACTIVITY #3: JUDGING SOIL SAMPLES

DO	Time: 20 minutes Materials Needed: • Samples of different types of soil (4) • Criteria to look for when judging soil • Paper and writing utensil Instructions: • Have members either search for a scorecard for judging soil or create a list of criteria to look for in a soil sample • Have members work individually to judge the soil samples. Have members rub some of the soil between their index fingers and thumbs using the ribbon test method to feel for the presence of sand, silt and clay • Have members give reasons as to why they placed the samples in the order they chose.
REFLECT	Learning Outcomes: To allow members to discover the criteria they should be looking for in soil.
APPLY	Processing Prompts: • Was the activity difficult or easy? • Were your placings different than others in your group? Why do you think that is? • Did you find someone else's placings and reasons surprising? • After hearing other member's reasons, does it change the placings you made? • How does this activity apply to a livestock farm?

ACTIVITY #4: LOOKING FOR THE BEST TYPE OF SOIL

(Activity source: National Agriculture in the Classroom https://agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=147)

DO

Time: 20 minutes

Materials Needed:

- Funnels (2-litre plastic bottles cut in half, 1 per group)
- Coffee filters (cupcake-shaped, 4 per group)
- 2 cups (500 mL) each of 4 to 5 different dry soil samples (use a variety of textures from sandy to clay)
- Measuring cups
- Water
- Stopwatches or a clock with a second hand
- Comparison Graph activity sheet (found at the end of this activity)
- 4 to 5 cups (1000 to 1250 mL) of potting soil

Instructions:

Part One

- Prepare the funnels made from 2-litre plastic bottles as shown in the picture (make a mark 13cm (5 ½ inches)) up from the bottom of each bottle. Cut each bottle in half at the mark. Invert the bottle top and nestle the tops into the bottoms.

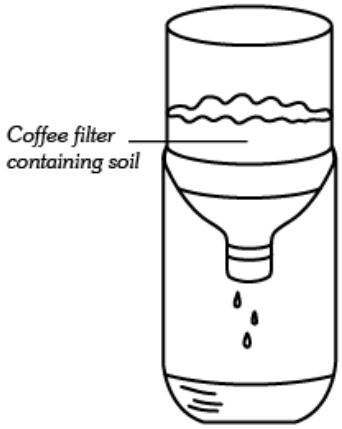


Image source: National Agriculture in the Classroom www.agclassroom.org

- Divide the members into groups of two or three, depending on how many soil samples you have. Provide each group with a funnel and bottom, 2 coffee filters, 1 cup of a soil sample, a measuring cup and water. Make sure each group has a different type of soil sample.

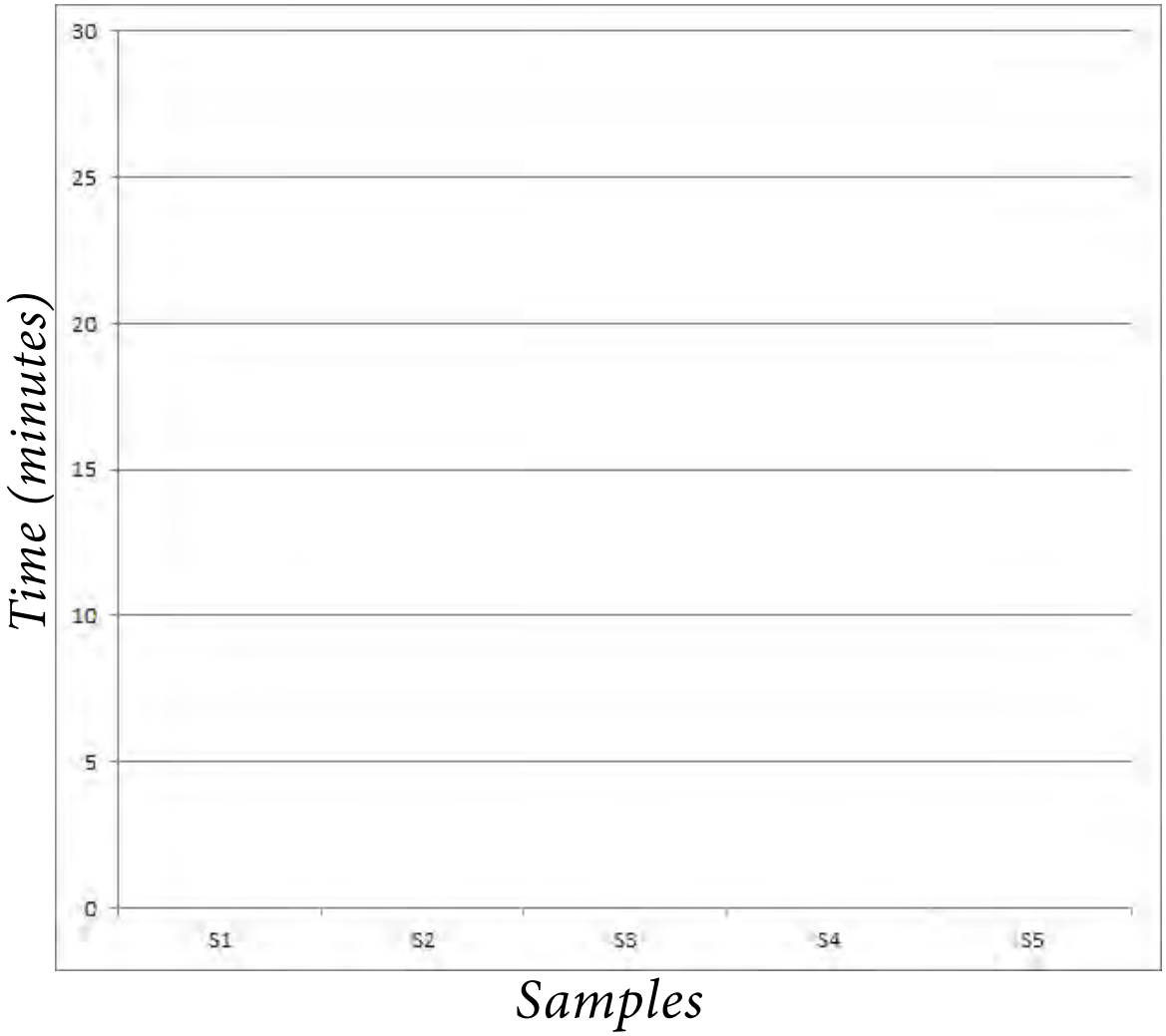
- Designate one person in each group as a time keeper and another as the water pourer. When the time keeper says “go,” the water pourer should pour 1 cup of water into the funnel.
- Time should be kept until most of the water has gone through the soil sample. Some samples will drain quite quickly while others could take 30 minutes of more. Proceed with Part 2 of this activity while keeping an eye on the samples and waiting for them all to finish draining.
- Compare the time it took for water to percolate (drain) through each sample. Add the data to the Comparison Graph activity sheet.
- Pour out and measure the water that percolated (drained) through each sample. Record this on the activity sheet as well.
- Instruct groups to place one coffee filter into the funnel and then add 1 cup of soil into the filter. Cover the sample with another filter. This will ensure even coverage and avoid splashing.

Part Two – Adding Organic Matter

- Instruct each group to empty out their funnels. Starting with new, dry soil will ensure consistent results. Extra funnels may be needed if some groups still have their sample from Part One still draining.
- Duplicate Part One of this activity with one change. After placing a new, dry coffee filter into the funnel, add ½ cup (125 mL) of dry soil into the filter and ½ cup (125 mL) of potting soil (to increase organic matter; most potting soils are largely made up of organic matter). One student should mix in the organic matter with his or her finger, being careful not to puncture the filer. Cover the sample with another new filter.
- Duplicate steps 4 through 7 in Part One. Be sure to record the data on the Comparison Graph activity sheet.
- Discuss the background material and groups to identify which sample had the most sand and which had the most clay. Add this evaluation to the graph.

REFLECT	Learning Outcomes: To determine the water holding and draining capacities of different soils and investigate how organic matter affects the amount of water soil will hold.
APPLY	Processing Prompts: • Was the activity difficult or easy? • Why do some soils drain very quickly while others drain very slowly? • Did adding organic matter change the results? If it did, why do you think this is? • How does drainage affect crops grown in a field?

Comparison Graph



What was the amount of water collected after percolation in each sample?

_____ S1 _____ S2 _____ S3 _____ S4 _____ S5

Which samples do you think had the most sand? _____

Which sample had the most clay? _____

Which sample had the most organic matter? _____
(*Hint: Compare the amount of water collected, the speed of percolation, and the visual evidence.*)

MEETING 3 – VARIOUS VARIETIES

SETTING OBJECTIVES:

To assist members in being able to choose the most beneficial varieties of crops for their area and circumstances.

Suggested Lesson Outcomes

- ☐ To ensure members have an understanding of how plants are classified
- ☐ To gain an understanding of how to use performance trials to select the best varieties for your area
- ☐ To appreciate the mechanics of plant breeding and pollination
- ☐ To understand what GMO crops are, why they were developed and which GMO crops are currently grown in Canada
- ☐ To start 4-H members on a path of continual learning about crops by directing members to more in-depth information

SAMPLE ROLL CALL QUESTIONS

- Name a plant that is an annual plant.
- Name a plant that self-pollinates.
- Name a GMO crop.

AT HOME ACTIVITY (FROM MEETING #2) ANSWER SHARING

- Share results to date from tracking either rainfall or daily temperatures.

DIGGING DEEPER (FROM MEETING #2)

- Share your blog post or present your findings about crops and global warming

Sample Meeting Agenda **Time: 2 hours 20 minutes**

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	10 min
Topic Information, Discussion & Activities	Topic Information • Classification • Selecting A Variety • Plant Breeding • Genetically Modified Organisms (GMO) Crops Activity #1 Selecting Grain Corn Activity #2 Cereal Variety Selections Activity #3 Judging Seeds	30 min 30 min 20 min 20 min
At Home Activity	Grasses and Legumes	5 min
Wrap up, Adjournment & Social Time		10 min

TOPIC INFORMATION

CLASSIFICATION

You now know how to measure the environment in order to determine what you can grow. But in order to know what you can grow, you also need to know something about crops. The first thing is to know how to group (or classify) plants. Most crops are classified in the following way:

1. How they are used:
    - **a. Forage** – The leaves and stems are used as animal feed e.g. corn , silage, haylage
    - **b. Root** – The enlarged roots of these crops are eaten by humans or animals, e.g. potatoes, carrots
    - **c. Grain** – Seeds from the plant are eaten by humans and animals e.g. wheat, barley
2. Plant families:
    - a. **Grasses** - The leaves have veins that run parallel to each other. The leaves are also made up of two parts: a sheath that envelopes the stem and a blade. Their roots are fibrous.
    - **a. Legumes** - Plants have branched stems. Their leaves come out in a bunch or are compound. The veins on the leaves look like a net. They may have one long main root called a tap root. There are "nodules" in the roots where bacteria "fix" or "take in" nitrogen from the air.

A third very useful way of classifying plants is according to how they spend their lives or "life cycles."

Life Span	Name	Description	Example
1 yr.	Annual	Live one growing season	corn, tomatoes
1+ yrs.	Winter annual	Seeds start to grow in the fall but it won't be until the next season that the plant flowers, makes seeds and dies.	winter wheat, winter rapeseed (canola)
2 yrs.	Biennial	They flower and have seeds only in the second year	carrots, sweet clover
2+ yrs.	Perennial	Live for a number of years. Many will flower every year and die back to the ground but their roots, or under-ground stems, live on and grow more with every year	timothy, alfalfa

SELECTING A VARIETY

When selecting the best variety for your area, you will probably need some help. Depending on what crop you are growing, reports and publications are available which compare varieties of different types of crops. Examples include the Ontario Hybrid Corn Performance Trials, Ontario Soybean Performance Trials and Ontario Cereals Performance Trials.

Search For It!

Look online for the latest performance trials for corn, soybeans and cereals for your area.

PLANT BREEDING

Have you ever wondered how there could be so many varieties of crops? Its all because of plant breeding.

Plant breeding has been used by farmers for over 10,000 years to help produce crops. Farmers were the first to breed plants. They watched their crops and chose the best plants to use as seed for the next year. The early settlers brought with them the types of wheat grown in their homeland. Many of these varieties matured too late for our weather conditions. Its lucky that they brought some different varieties and the pioneers quickly discovered that seeds harvested from early maturing plants produced early maturing offspring.

Only when we began to understand how plants reproduce could actual plant breeding occur.

Experience It!

Invite an agronomist or seed sales rep from a seed company as a guest to your meeting. If running this project over multiple years, invite a guest from a different seed company each year.

To understand plant breeding, it is essential to understand the reproduction of plants. Field crops have female and/or male parts. The male part, called the **stamen**, supports the **anther** which produces the pollen. The female part, called the **pistil**, produces one or more eggs.

There are two methods of pollination:

- **Cross-pollination** is the most common and occurs when the pollen goes from the stamen of one flower to the pistil of another flower. This happens when either insects, birds, small mammals, wind or water transfer the pollen.
- **Self-pollination** takes place when pollen is transferred from the stamen of one flower to the pistil of the same flower or plant.

Most cereal crops and soybeans are self-pollinated. Most of the forage grasses, legumes and corn are cross-pollinated.

Pollination Process

Type of Crop	Type of Pollination
Alfalfa	Cross-pollinated
Apples	Cross-pollinated
Barley	Self-pollinated
Beans	Self-pollinated
Blueberries	Cross-pollinated
Canola	Cross-pollinated
Clover	Cross-pollinated
Corn	Cross-pollinated
Grapes	Self-pollinated
Peaches	Self-pollinated
Peas	Self-pollinated
Potatoes	Cross-pollinated
Oats	Self-pollinated
Tomatoes	Self-pollinated
Wheat	Self-pollinated

The whole process of developing a new variety, testing it and getting it registered can take ten to twelve years. For each one variety that shows promise, hundreds are discarded. A combination of all the good features is rare.

Check It Out!

For more information about pollinators and the pollination process, check out the 4-H Ontario Pollinator Project!

GENETICALLY MODIFIED ORGANISMS (GMO) CROPS

Developments in biotechnology and plant breeding now allow scientists to introduce useful genes into plants. GMO crops are developed using precise plant breeding to achieve benefits such as resistance to certain insects and diseases, herbicide tolerance, enhanced nutritional value and reduced food waste. For example, a gene resistance to white mould in one plant could be introduced into a plant that has no resistance. Such developments quickly provide farmers with better varieties of crops.

GMO crops were first introduced in North America in the mid-1990's and farmers in Canada have been growing GMO products such as corn, canola and soybeans since 1996.

There are six GMO crops currently produced in Canada as of 2020:

- Canola
- Corn
- Potatoes
- Soybeans
- Sugar beets
- Alfalfa

A further five GMO crops – apples, cotton, eggplant, papaya, and squash – are grown around the world.

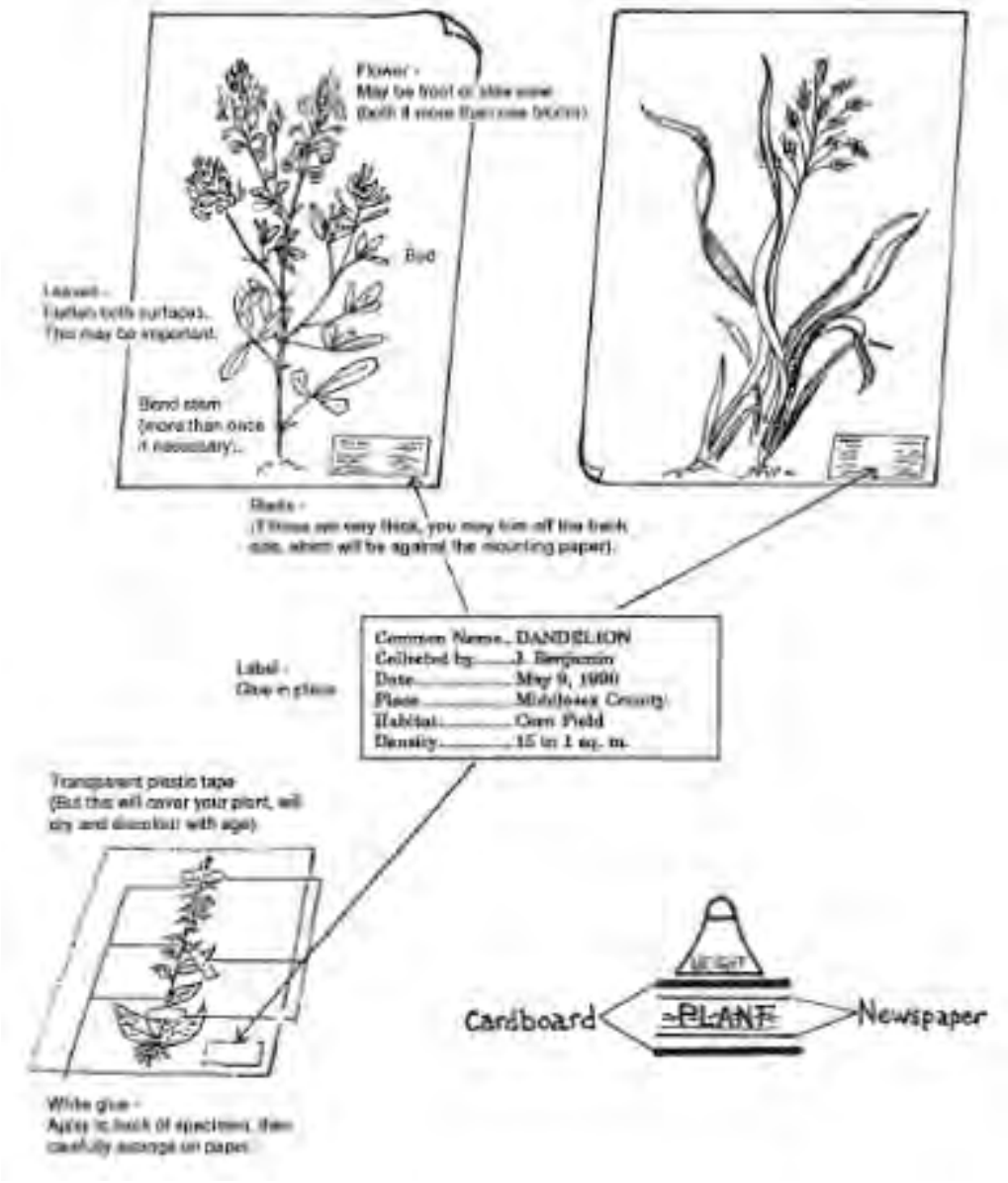
The Canadian Food Inspection Agency (CFIA) is responsible for regulating genetically modified (GM) plants and approving GMO feed for animals.

Research It!

There are many career choices in the field of plant breeding and development. Either by looking online or talking to someone in the crops industry, create a list of various possible careers.

AT HOME ACTIVITY: GRASSES AND LEGUMES

Find an example of a grass and a legume. Mount and label each of these plants using the following instructions:



DIGGING DEEPER For Senior Members

GMO Crops

GMO crops have a lot of benefits but they also come with a lot of controversy as well. Search to find one reason GMO crops are controversial and determine if the science supports the claim.

Many food products are marketed as GMO free. Create a list of 10 items found at the grocery store that claim to be GMO free. Determine if they are created from a food ingredient that could potentially be a GMO crop or if the item contains no GMO crop. Be prepared to share your findings at the next meeting.

ACTIVITY #1: SELECTING GRAIN CORN

DO	Time: 30 minutes Materials Needed: • Access to the Internet • Corn Heat Units Map (found on page ## of this manual) • Selecting Grain Corn worksheet (found at the end of this activity) • Writing utensil Instructions: For this activity, you will select a grain corn hybrid for your area. Part A • Look at the CHU map and determine the Corn Heat Units for your area to the nearest 100. • Look at the Ontario Hybrid Corn Performance Trials online and refer to the table of "Recommended Hybrids." It lists the hybrids that are grown in each CHU area. These will be the hybrids of corn that should reach maturity before killer frost or harvest time. Maximum yields come from plants that have reached their full maturity levels. • If planting will occur later than May 15, select a hybrid that requires 100 fewer CHU for each week after May 15 that planting occurs. • Select a hybrid that will result in: 1. A high Yield Index. The Yield Index compares the average yield of all hybrids grown in the test area. 2. A low Moisture % since a hybrid with a high moisture rating will need a longer growing season, or more expensive drying costs to dry the corn to a safe storage moisture. 3. A high Standability % since a high percentage of broken stalks would mean difficulty in harvesting and therefore lower yields. Part B Pretend you are a farmer in your county/district and you have been forced, due to equipment breakdown, to start planting on May 22nd. Use the performance trials information to select 3 varieties you would consider planting.

REFLECT	Learning Outcomes: To give members the tools to be able to choose the most beneficial varieties of corn for their area.
APPLY	Processing Prompts: • Was it easy or difficult to figure out which hybrids would be best? • How would your results change if your planting date for corn was June 1st? • Was it difficult to find a hybrid that met all three criteria (yield index, moisture percentage and broken stalk percentage)?

SELECTING GRAIN CORN ACTIVITY WORKSHEET

Part A

Hybrid Chosen (if planting is on or before May 15th): _____

Part B:

New CHU because of planting delay (May 22nd): _____

HYBRID	% BROKEN STALKS	% MOISTURE	YIELD INDEX
1.			
2.			
3.			

ACTIVITY #2: CEREAL VARIETY SELECTION

DO	Time: 20 minutes Materials Needed: • Access to the Internet • Paper and writing utensil Instructions: Select a cereal variety for your area. • Determine which cereal crop you want to 'plant' in your area (winter wheat, spring wheat, barley, oats) • Visit the website for the Ontario Cereal Crop Committee for performance results *https://www.gocereals.ca/* for the cereal crop you are looking to plant • For crops such as barley and oats, height, rate of maturity, susceptibility to diseases and yields should be considered. If mixed grain is to be grown, barley and oat varieties should grow to about the same height and mature at the same time. • Use the information to select a variety of the cereal crop you want to plant in your area.
REFLECT	Learning Outcomes: To give members the tools to be able to choose the most beneficial cereal crop for their area.
APPLY	Processing Prompts: • Was it easy or difficult to choose which variety would be best for your area? • Did the planting date make a difference in your choice? • Is this a crop you have grown before or would consider growing?

ACTIVITY #3: JUDGING SEEDS

DO

Time: 20 minutes

Materials Needed:

- Seed samples of the same crop (4 samples)
- Scorecard (as appears below)
- Judging Worksheet
- Paper and writing utensil

The general scorecard breakdown for seeds is:

Freedom from damage	30
Freedom from impurities	30
Size and test weight	15
Uniformity	15
Maturity and plumpness	10
	100

Instructions:

- Have members work individually to judge the samples of seeds.
- Have members give reasons as to why they placed the seeds in the order they chose.

REFLECT

Learning Outcomes:

To allow members to discover the criteria they should be looking for in a field crop seed sample.

APPLY

Processing Prompts:

- Was the activity difficult or easy?
- Were your placings different than others in your group? Why do you think that is?
- Did you find someone else's placings and reasons surprising?
- After hearing other member's reasons, does it change the placings you made?

PREPARATION TIPS FOR SHOWING SEEDS

Soybeans, Beans and Peas:

1. If possible, get your sample cleaned with a series of sieves. You local seed dealer may be able to do this for you. If this isn't possible, seed cleaning can be done carefully using a variety of different sizes of kitchen sieves. CAUTION: Too much handling can make your seed samples crack and split.

2. Spread out a layer of beans on a tray and pick out the undesirable ones. These will include cracked or broken beans, discoloured beans, very small beans and very large beans.

3. Pick out any impurities such as stones, hulls or other seeds.

4. When you are finished cleaning your sample, put it in a cotton bag and shake it around. This will give your beans or peas an extra shine.

5. Weigh your sample to ensure that it meets the specifications set out by the fair board.

Cereal Grains (oats, barley, wheat):

Preparing cereal grains for show is basically the same as the preparation involved with soybeans and peas. With cereal grains you may find some kernels which have lost their hulls (outside coat) or pieces of their hulls and you may find some kernels with green tips (indication of immaturity). You should remove these from the sample. Kernels with black tips, caused by disease should also be removed.

Be careful with oats and barley as they are easily injured and great care is needed when polishing these grains. The hull should not be worked down so close as to expose the starch.

Check It Out!

Find the Prize Book for your local agricultural fair and see what competitions are listed for field crop competitions and in particular, seed categories.

MEETING 4 - DIGGING IN

SETTING OBJECTIVES:

An understanding of how various types of tillage and planting practices can affect crop growth.

Suggested Lesson Outcomes

- ☐ To create an understanding of various types of tillage practices that can be utilized
- ☐ To realize which types of equipment are needed for each type of tillage
- ☐ To appreciate the various factors that need to be considered for optimal planting of crops
- ☐ To start 4-H members on a path of continual learning about crops by directing members to more in-depth information

SUGGESTED ROLL CALL QUESTIONS

- Name an implement or tool that is used for tilling soil and describe what effect it has on the soil.
- Name one factor to consider when deciding when is the right time to plant a crop.
- What type of tillage practice do you use on your farm (or have you seen being used on a farm)?

AT HOME ACTIVITY (FROM MEETING #3) ANSWER SHARING

- Share the display you made with an example of a grass and a legume.

DIGGING DEEPER (FROM MEETING #3)

- Share which GMO crop you chose, what the controversy behind that crop is and if science supports the claim.

Sample Meeting Agenda Time: 2 hours 20 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	20 min
Topic Information, Discussion & Activities	Topic Information • Tillage • How Do You Decide What Type of Tillage To Use? • Planting Activity #1 The Worm Test Activity #2 Soybean Nodules Activity #3 Judging Hay	30 min 20 min 20 min 20 min
At Home Activity	Fertilizer and Weed Control	5 min
Wrap up, Adjournment & Social Time		10 min

TOPIC INFORMATION

TILLAGE

Once you have purchased the right seed for your field, it has to germinate or start growing. Before the seeds can germinate, seeds need heat and moisture from the soil.

Tillage loosens soil and incorporates air to help it warm up faster. Tillage also breaks large clods of soil into smaller pieces. This allows a small seed to be in contact with more soil and to absorb water faster.

Think of the seed as a baseball surrounded by basketballs (large soil clods) instead of being surrounded by golf balls (tilled soil) or marbles (highly tilled soil). The seed (the baseball) has more contact with the highly tilled soil (the marbles) and has the potential for more contact with moisture and heat. A seedbed of very fine soil particles may give faster germination but it also destroys soil structure. Soil structure keeps the soil in place and reduces erosion (from wind and water). Over tilling also dries the soil and may slow germination if the seed cannot get water. The goal of tillage is to break down the soil enough but no more than enough to give a good seed bed. Other benefits of tillage include killing any weeds that have started to grow.

Fall Chisel Plowing

Conventional and Minimum Tillage

These are the steps used both of these tillage systems:

1. **Primary tillage** – the purpose is to break up the soil for the next crop. It is recommended that this first tillage not be done any deeper than 15 cm. The most common pieces of equipment used for primary tillage are mouldboard plows, chisel plows, disc rippers and offset discs.
2. **Secondary tillage** – this is done to prepare the seedbed. This tillage should be no deeper than 7 cm. The most common pieces of equipment used are the disc, cultivator, harrows and roller/packer.
3. **Inter-row tillage** – the purpose is to break up a crust and to control weeds after planting. The equipment used here would include the rotary hoe and inter-row cultivators.

Conventional tillage usually relies on primary and secondary tillage and possibly inter-row cultivation. Minimum tillage may use some of all or these tillage practices but at a reduced

Culti-packer

rate to increase the amount of soil residue. In minimum tillage, usually 20% or more of the soil surface is left covered with residue after planting.

Strip-Till

Strip tillage is a form of modified tillage, meaning narrow strips are tilled in the soil, but the plant residue between the rows is left undisturbed. In Ontario, this is typically done no more than 15 cm in depth. This allows for good soil drainage, air flow, and the soil's biological health. It results in a good environment for quick germination and strong early plant growth.

Because the soil in the strips has been tilled, it warms faster than untilled areas. The deep tillage that takes place in the zones breaks up compacted soil, allowing for water and air movement. Areas in between rows are left undisturbed. That crop residue helps hold the soil in place, reducing water and soil erosion. It requires fewer passes across the field than with conventional tillage.

Nutrients can be placed right in the zone where the crops need them and can most efficiently use them. Because fertilizer can be placed exactly where it's needed, plants have easier access to the nutrients they need to thrive. Crops more fully utilize what has been applied, plus the risk of runoff is reduced.

Yields in strip-till systems are comparable to those with conventional and minimum tillage and are sometimes higher than those in no-till systems.

Vertical Tillage
Image Credit: Adam Hayes, OMAFRA

Vertical Tillage

Vertical tillage involves the mixing of soil and residue, typically while incorporating crop nutrients without creating horizontal compaction layers. True vertical tillage lifts soil in a desired seedbed zone leaving the majority of the soil and crop residue undisturbed.

No-Till

No-till means almost exactly what it says – no tillage is done before planting. The crop is planted with a drill or planter modified to work in high residue. The purpose of no-till is to leave as much plant material (residue) on the surface as possible to reduce the amount of water and soil erosion. No-till practices allow the soil structure to stay intact and also protect the soil by leaving crop residue on the soil surface. It requires fewer passes across the field than with conventional or minimum tillage.

Share It!

What type of tillage do you use on your farm or do you see being used in your area?

Why Doesn't Everyone No-Till?

There are both advantages and disadvantages to no-till farming. Before choosing what's best for your farm's needs, research needs to be done into factors such as soil health, cost and yield potential. No-till works extremely well for some farms but it isn't right for everyone's situation. Sometimes farms will do a combination with some fields or crops conventional or minimum tilled with other fields or crops no-tilled.

HOW DO YOU DECIDE WHAT TYPE OF TILLAGE TO USE?

Every field is different and requires different tillage practices. There are a few things you need to know before making tillage decisions.

1. **The soil texture of the field:**

   The finer textured soils will, in most cases, need more tillage than coarse textured soils. Fine textured soils include sandy clay, silty clay and clay-silt loams. Coarse textured soils include sandy and sandy loam.

2. **Previous crop grown:**

   Many crops are beneficial to the soil as they add a significant amount of organic matter. Samples of such crops include perennial grasses, legumes and forage. With these crops, tillage need not be as intensive because the crop will have improved the structure of the soil. Other crops leave residues that must be cleared to aid in seedbed drying, fitness and seed placement in the spring (i.e. corn stalks or wheat residue).

Disking

3. **Crop to be grown:**

   How fine and how deeply you work the seedbed depends on the seed size of the crop to be grown.

Caution – Wet Soil!

Wet soils should not be tilled. Heavy equipment will compact the soil and subsoil. This results in impaired drainage, increased erosion during heavy rains, reduced root growth and reduced crop yields. Determine if there is any research that gives data on the effect of tilling soil when it is too wet.

Experience It!

Invite someone from your local machinery dealership to come and discuss various pieces of tillage equipment used in your area. Or, visit a local machinery dealership and see each piece of tillage equipment in person.

PLANTING

Planting Guide

Crop	Depth of Planting	Optimum Planting Date	Optimum Seeding Rate
Corn	3.8 cm (1.5 inches)	late April to mid-May	See Table 1-11 below
Soybeans	3.8 cm (1.5 inches)	May 1-May 30	See Table 2-11 below
Oats, Barley	2.5 cm (1 inch)	April 10 – Southwestern Ontario April 15 – Central & Eastern Ontario May 10 – Northern Ontario	See Table 4-7 below
Winter Wheat	2.5cm (1 inch)	Sept.15-Oct.15 – Southern & Eastern Ontario Aug.21-Sept.15 – Northern Ontario	See Table 4-7 below
Spring Canola	2 to 2.5 cm (0.8 to 1 inch)	As early as possible (early April)	3-9 kg/ha (depending on seed weight)
Winter Canola (rapeseed)	2 to 2.5 cm (0.8 to 1 inch)	Aug.20-Sept.10 – Southwestern Ontario Aug.15-Aug.30 – all other areas of Ontario	3-9 kg/ha (depending on seed weight)
Forages	1 cm (shallow) (0.4 inches)	Early to late April	9-24 kg/ha (depending on forage mix)

*Source of chart information compiled from: Agronomy Guide Publication 811, Ontario Ministry of Agriculture, Food & Rural Affairs. © Queen's Printer for Ontario, ** Reproduced by permission*

Seeding Rate for Corn

Table 1–11. Seed spacing to achieve various populations

Final population	Distance between in-row corn plants: Row width: 51 cm (20 in.)	Row width: 76 cm (30 in.)	Row width: 91 cm (36 in.)
54,300 plants/ha (22,000 plants/acre)	36 cm (14.3 in.)	24 cm (9.5 in.)	20 cm (7.9 in.)
59,300 plants/ha (24,000 plants/acre)	33 cm (13.1 in.)	22 cm (8.7 in.)	18 cm (7.2 in.)
64,200 plants/ha (26,000 plants/acre)	31 cm (12.1 in.)	20 cm (8.1 in.)	17 cm (6.7 in.)
69,200 plants/ha (28,000 plants/acre)	29 cm (11.2 in.)	19 cm (7.5 in.)	16 cm (6.2 in.)
74,100 plants/ha (30,000 plants/acre)	27 cm (10.5 in.)	18 cm (7.0 in.)	15 cm (5.8 in.)
79,000 plants/ha (32,000 plants/acre)	25 cm (9.8 in.)	17 cm (6.6 in.)	14 cm (5.4 in.)
84,000 plants/ha (34,000 plants/acre)	23 cm (9.2 in.)	16 cm (6.1 in.)	13 cm (5.1 in.)
88,900 plants/ha (36,000 plants/acre)	22 cm (8.7 in.)	15 cm (5.8 in.)	12 cm (4.8 in.)
93,800 plants/ha (38,000 plants/acre)	21 cm (8.3 in.)	14 cm (5.5 in.)	12 cm (4.6 in.)
98,800 plants/ha (40,000 plants/acre)	20 cm (7.8 in.)	13 cm (5.2 in.)	11 cm (4.4 in.)
Row Length for 1/1,000 of an acre	**7.9 m (26.1 ft)**	**5.3 m (17.4 ft)**	**4.4 m (14.5 ft)**

1 ha = 2.47 acre; 1 cm = 0.39 in.

*Source: Agronomy Guide Publication 811, Ontario Ministry of Agriculture, Food & Rural Affairs © Queen's Printer for Ontario, ** Reproduced by permission*

Seeding Rate for Soybeans

Table 2–11. Soybean seeding rate guidelines

Seeding rates are based on having a germination of 90% and an emergence of 85%–90% (plant stand of 76%–81% of seeding rate).

Number of seeds	Parameters: 19 cm (7.5 in.) row 480,000 seeds/ha (194,000 seeds/acre) 9 seeds/m of row (2.8 seeds/ft of row)	38 cm (15 in.) row 437,000 seeds/ha (177,000 seeds/acre) 17 seeds/m of row (5.1 seeds/ft of row)	56 cm (22 in.) row 425,000 seeds/ha (172,000 seeds/acre) 24 seeds/m of row (7.2 seeds/ft of row)	76 cm (30 in.) row 400,000 seeds/ha (162,000 seeds/acre) 30 seeds/m of row (9.3 seeds/ft of row)
4,400 seeds/kg (2,000 seeds/lb)	109 kg/ha (97 lb/acre)	99 kg/ha (89 lb/acre)	98 kg/ha (86 lb/acre)	91 kg/ha (81 lb/acre)
4,900 seeds/kg (2,200 seeds/lb)	98 kg/ha (88 lb/acre)	89 kg/ha (80 lb/acre)	88 kg/ha (79 lb/acre)	82 kg/ha (74 lb/acre)
5,300 seeds/kg (2,400 seeds/lb)	91 kg/ha (81 lb/acre)	82 kg/ha (74 lb/acre)	82 kg/ha (72 lb/acre)	76 kg/ha (68 lb/acre)
5,700 seeds/kg (2,600 seeds/lb)	84 kg/ha (75 lb/acre)	77 kg/ha (68 lb/acre)	76 kg/ha (66 lb/acre)	70 kg/ha (63 lb/acre)
6,200 seeds/kg (2,800 seeds/lb)	77 kg/ha (69 lb/acre)	70 kg/ha (63 lb/acre)	70 kg/ha (62 lb/acre)	65 kg/ha (58 lb/acre)
6,600 seeds/kg (3,000 seeds/lb)	73 kg/ha (65 lb/acre)	66 kg/ha (59 lb/acre)	65 kg/ha (58 lb/acre)	61 kg/ha (54 lb/acre)
7,100 seeds/kg (3,200 seeds/lb)	68 kg/ha (61 lb/acre)	62 kg/ha (55 lb/acre)	61 kg/ha (54 lb/acre)	57 kg/ha (51 lb/acre)
7,500 seeds/kg (3,400 seeds/lb)	64 kg/ha (57 lb/acre)	58 kg/ha (52 lb/acre)	58 kg/ha (51 lb/acre)	53 kg/ha (48 lb/acre)

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Seeding Rate for Cereals

AGRONOMY GUIDE FOR FIELD CROPS

Table 4–7. Guidelines for cereal crop plant populations

Crop	Target Plant Population	
	Number of Plants	Seeds Required (x 1,000)
Barley	250–350 plants/m^2 (23–33 plants/ft^2)	2,500–3,500 seeds/ha (1,000–1,400 seeds/acre)
Oats	200–300 plants/m^2 (19–28 plants/ft^2)	2,000–3,000 seeds/ha (800–1,200 seeds/acre)
Mixed grain	200–350 plants/m^2 (19–33 plants/ft^2)	2,000–3,500 seeds/ha (800–1,400 seeds/acre)
Spring wheat	300–400 plants/m^2 (28–37 plants/ft^2)	3,000–4,000 seeds/ha (1,200–1,600 seeds/acre)
Winter wheat	350–450 plants/m^2 (33–42 plants/ft^2)	3,500–4,500 seeds/ha (1,400–1,800 seeds/acre)

Source: Agronomy Guide Publication 811, Ontario Ministry of Agriculture, Food & Rural Affairs
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Planting Corn

Corn is normally planted in the end of April to mid-May (depending on where you are in the province of Ontario) to allow it to make use of the full growing season. Soil temperatures need to reach 10°C before germination and emergence will occur. If soil conditions are fit for planting and the forecast is favourable, corn planting often starts before soil temperatures reach 10°C. Young corn leaves can be easily frozen in the spring, but this rarely kills the plant. This is because the growing point of the plant remains underground until the 6 leaf stage.

A corn seed that is placed into moisture at least 3.8 cm (1.5 in.) deep will have excellent performance.

Corn seed germination before emergence

Since not all seeds emerge, it is necessary to seed at slightly higher rates. When planting early in the season or when the soil is cold, a seeding rate 10% higher than the desired final stand is suggested. When soils are warmer, an adjustment of 5% is sufficient.

Planting Wheat

Adequate fall growth must occur for root development and tillering to be sufficient in order to improve winter survivability. Wheat is often planted after soybeans are harvested as well as canola and edible beans. A grain drill with 18 cm (7.5 inch) spacings between the rows is an effective method of planting. Aerial seeding has variable results depending on rainfall after planting and is not a preferred method of planting wheat. Broadcasting the seed onto the field can also be an effective planting method if the seed is shallowly incorporated with a harrow; however, results are variable.

Winter wheat can tolerate extremely cold temperatures (-23°C) in its most hardy state. While the threat of cold temperature injury often exists, Ontario conditions rarely cause plant death, except where freeze-thaw events and icing occurs. Snow offers excellent insulation from cold temperatures, while ice conducts cold directly to the plant and cuts off oxygen to the crown.

Wheat seed germination before emergence

Talk About It!

What is the most popular way for sowing wheat in your area?

Planting Spring Cereals (Oats, Barley, Mixed Grain)

Early seeding results in higher yields as the cool moist spring conditions promote plant growth. Grain drills (conventional or no-till) are the normal method of planting.

Planting Soybeans

Image credit: Ontario Ministry of Agriculture, Food & Rural Affairs - Best Management Practices: Soil Health in Ontario (2017)
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1. Soybeans are susceptible to frost damage and should be planted after the last chance of frost in the spring. A hard spring frost can kill early-planted soybeans, since the growing point of the emerged seedling is above the soil surface. However, soybean plants can withstand temperatures as low as -2.8°C for a short period of time.

   If springtime conditions are favourable, planting in late April or early May can result in a yield advantage over planting in the middle of May, depending on where you are located within Ontario. Soybean planting should be initiated based on calendar date, seedbed conditions, soil temperature and the weather forecast for 48 hours after planting. It is critical to have a good seedbed. If significant rainfall is forecast, wait until conditions improve before planting. A cold rain immediately after seeding can impact emergence.

2. Soybeans, like other legumes, have the ability to supply their own nitrogen needs. Soybean inoculant contains these nitrogen-fixing bacteria which infect the soybean

Talk About It!

How are most soybeans in your area planted? (i.e. air seeder, seed drill)

roots and form nodules. These bacteria take nitrogen from the air and turn it into forms readily available to the plant.

3. Inoculation is critical on fields that have not grown soybeans before or in the past several years. Sufficient rhizobia will exist in the soil if nodulated soybeans have been grown in the field within the last three years.

Soybean seed germination before emergence

Seed germination can vary greatly in soybeans and should be checked. Planting equipment must be adjusted to compensate for different seed sizes. Grain drills or corn planters fitted with soybean seed cups can be used to plant soybeans. Most soybeans grown in Ontario are solid seeded (19 cm or 7.5 in. spacing) or intermediate row widths (38–56 cm or 15–22 in.).

Increase planting rates by 10% with late plantings into mid-June. Varieties respond similarly to changes in seeding rate.

Soybean Tip!

On first time soybean fields, the use of two different inoculants is suggested to avoid a nodulation failure.

Planting Forages

Success is highest with early spring seedings but summer seedings will succeed if adequate moisture falls after seeding. Planting certified seed will ensure purity, germination and freedom from weed seeds. Legumes will require appropriate inoculation with nitrogen fixing bacteria at planting if they have not been grown in the field before.

A companion crop such as oats or barley is sometimes planted with the forage seeds to provide erosion control, some weed control and to protect the seedlings from the wind and sun.

Direct seeding (without a companion crop) eliminates competition from the small grains and is gaining popularity. The grain drill with a small (or fine) seed attachment is the most common method of seeding forages. Packer seeders or broadcast seeders are also used.

Planting Spring Canola

A firm seedbed with adequate soil moisture is ideal. A seeding depth of 2 to 2.5 cm is preferred. Seeding should be as early as possible. April or early May are the desired planting times, with later plantings results in lower yields. Canola will germinate and grow at soil temperatures of 2°C, but 10°C is ideal for rapid emergence.

Early April seeded canola has higher risk of mortality from seedling disease, soil crusting, and flea beetles. Early planted canola also has a higher risk of infestation by cabbage seedpod weevil during the flowering/early pod stage.

Canola can be planted using grain drills or broadcasting. Some experimentation is being done

seeding with narrow or twin row unit corn planters for more precise placement and metering seeding rates. Broadcast seeding of canola should only be practiced where there is no option of using a seed drill.

Planting Winter Canola

Seedbed preparation and equipment are the same as with Spring Canola. Seed winter canola between August 15 and August 30, or in southwestern Ontario between August 20 and September 10. Delays beyond these dates greatly increase the risk of winterkill. If canola is planted too early and bolts in the fall it will not survive through winter.

Seed winter canola so that canola develops 4–6 leaves and an adequate root system (1.25 cm (0.5 in.) diameter) before winter. Adequate fall growth will reduce risk of frost heaving and spring dehydration.

Experience It!

Invite an agronomist to your meeting to discuss planting dates and ideal planting conditions for your area.

Research It!

The OMAFRA Agronomy Guide for Field Crops (Publication 811) is a great resource for all crops grown in Ontario. Choose a crop that is grown in Ontario that isn't listed in this section and find out how and when it should be planted. The guide is available online at: http://www.omafra.gov.on.ca/english/crops/pub811/pub811.pdf

AT HOME ACTIVITY: FERTILIZER AND WEED CONTROL CHART

Complete the chart below by listing fertilizers and weed control methods used on crops or on your garden. Record safe handling techniques as well. Be prepared to share this at the next meeting.

CROP	FERTILIZER/WEED CONTROL METHOD	SAFE HANDLING TECHNIQUES
Corn	• Apply starter fertilizer at planting • Apply herbicide pre-emergent, side dress aqua-ammonia	• Avoid contact with skin or inhaling fumes

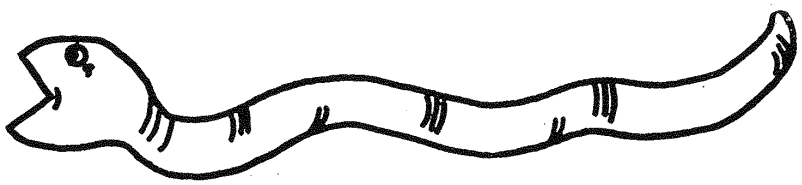
DIGGING DEEPER For Senior Members

Why Doesn't Everyone No-Till?

No-till can present a lot of advantages for a farm but it can also have its drawbacks. Research to find out what those advantages and disadvantages are and create a chart based on your findings. Decide if no-till is something you would want to implement for your farm (or for someone that would want to practice no-till) and what the cost would be for the equipment for each of conventional, minimum, strip tillage or no-till.

Or, if you already practice no-till on your farm, what is the cost of the equipment you have that is needed for no-till and what would be the cost of equipment if you decided to switch to conventional or minimum tillage.

ACTIVITY #1: THE WORM TEST



DO	Time: 20 minutes Materials Needed: • Soil • Measuring tape/ruler Instructions: This is an easy method of determining if soil is dry enough for secondary tillage. This test is appropriate for soils heavier than a loam soil. • Grab a handful of soil from the top 7.5 cm of the soil surface • Squeeze the soil into a hard "ball" with your hands. Do not add water to the "ball." • Roll the ball back and forth in your hands (like playdough) to form a worm. • If the soil falls apart before the worm gets to be 1 cm in diameter, it is dry enough to till. • If the soil can be rolled into a long, thin worm less than 1 cm in diameter, it is too wet to till!
REFLECT	Learning Outcomes: To allow members to determine when soil is ready for tillage.
APPLY	Processing Prompts: • How would different types of soil affect the outcome of this activity? • What happens if the soil is tilled when it is too wet? • Do you think this is an effective test for soil moisture?

ACTIVITY #2: SOYBEAN NODULES

DO	Time: 20 minutes Materials Needed: • Soybean plant including the roots • Knife (optional) Instructions: • Have members examine the soybean plant, focusing on the roots and nodules • Break open a nodule (using either fingers or a knife) and examine the inside of the nodule
REFLECT	Learning Outcomes: To have members discover what the root and nodules look like on a soybean plant and their importance.
APPLY	Processing Prompts: • Why is it important to know what the root and nodule of a soybean plant looks like? • Why is it important to understand the function of the root and nodules of a soybean plant? • Did anything surprise you when the nodule was opened? • What would happen if the soybean root didn't have nodules?

ACTIVITY #3: JUDGING HAY

DO	Time: 20 minutes Materials Needed: • Samples of dry hay (4) • Scorecard (as appears below) • Judging Worksheet • Paper and writing utensil The general scorecard breakdown for hay is: Maturity 40 Leaf to Stem Ratio 20 Colour, Odour and Disease 20 Legume-Grass Balance 15 Purity 5 100 The usual requirement for displaying a hay sample is two 10cm flakes. These are shown in clean plastic bags, which your local Agricultural Society might provide. It is wise to take your sample from the middle of a bale since the flakes will be more square and less damaged. *Maturity (maximum 40 points):* There is one characteristic in hay which is extremely important and is emphasized on the scorecard. This is maturity. Hay should be cut when legumes such as alfalfa and clover are at first flower and grasses such as timothy and orchard grass heads are just emerging (in the boot stage). If you see a sample with many flowers, grasses that are losing seeds or hay with thick, coarse stems, it is a good indication that the sample is too mature. If it is cut this late, the proten level and therefore the feed value of the hay will be lowered. *Legume-grass balance (maximum 15 points):* If the hay is meant for cattle or sheep consumption, the sample should be high in legumes.

	However, if the hay is designated for horse feed, it should be higher in grass content than legume. If you have a class of hay at your meeting, judge it first just solely on maturity. Then evaluate it again using the whole scorecard. Instructions: • Have members work individually to judge the samples of hay. • Have members give reasons as to why they placed the hay in the order they chose.
REFLECT	Learning Outcomes: To allow members to discover the criteria they should be looking for in hay samples.
APPLY	Processing Prompts: • Was the activity difficult or easy? • Were your placings different than others in your group? Why do you think that is? • Did you find someone else's placings and reasons surprising? • After hearing other member's reasons, does it change the placings you made? • How does this activity apply to a livestock farm?

MEETING 5 – FEEDS AND WEEDS

SETTING OBJECTIVES:

An understanding of the nutrients required for good crop growth and how to control pests that may harm a crop's growth.

Suggested Lesson Outcomes

- ☐ To have an understanding of which nutrients are required for good crop growth
- ☐ To gain an appreciation of the value of manure for crop growth
- ☐ To gain knowledge about the pests that can affect crop growth and how to control these pests in a variety of ways
- ☐ To start 4-H members on a path of continual learning about crops by directing members to more in-depth information

SUGGESTED ROLL CALL QUESTIONS

- What is the most nutritious thing you have eaten today?
- Name a pest that can affect crop growth.
- Name a weed found in crops in your area.

AT HOME ACTIVITY (FROM MEETING #4) ANSWER SHARING

- Share the Fertilizer and Weed Control Chart you have created.

DIGGING DEEPER (FROM MEETING #4)

- Share the chart you have created outlining the advantages and disadvantages of no-till and any additional information you collected.

Sample Meeting Agenda Time: 2 hours 30 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	10 min
Topic Information, Discussion & Activities	Topic Information • Plant Nutrition – Nitrogen – Phosphorus – Potassium – Soil Test – Mixed Fertilizers – Fertilizer Application Methods – Manure – Plants as a Source of Nutrients • Pest Control – Six Steps to Better Pest Management – Types of Pesticides – Other Options Besides Pesticides – Weed ID Activity #1 Personal Protective Equipment Activity #2 Judging Cob Corn and Corn Silage	40 min 30 min 20 min 20 min
At Home Activity	Crop Consultant's Report Crop Consultant's Report – Part Two	5 min
Wrap up, Adjournment & Social Time		10 min

TOPIC INFORMATION

PLANT NUTRITION

Why do we eat nutritious food? Why do people take vitamin or mineral supplements?

The reasons people eat are the same reasons that plants take in nutrients – so they can grow and maintain themselves. Soils are low in nutrients. We supply the nutrients the plants need in the form of fertilizers. Fertilizers consist of animal manures, bio-solids, plants in the form of green manures and commercial fertilizers in the form of mineral and chemical substances.

There are many essential nutrients that plants get from the soil. Three of the most important are **nitrogen**, **phosphorus** and **potassium** (also known as NPK).

Nitrogen

Nitrogen stimulates growth and gives leaves their dark green colour. It is very plentiful in the air, but plants cannot use it in that form. Legumes convert it to a form that they can use.

Nitrogen fertilizer materials are available in dry, liquid or gaseous forms. Some of these forms are toxic to plants or seeds and must be applied at the correct time. In most cases, the different types of nitrogen provide equal results. The choice of material depends on availability, equipment for handling, cost per kilogram of nitrogen, safety and comfort level of handling and the cost of application.

Phosphorus

The plant uses phosphorus to build a strong root system and add strength to the plant stems of seedling plants. It is essential for good growth.

Most of the phosphorus in the soil is contained in a form that plants cannot easily use. This type of phosphorus breaks down over time, changes form and becomes available to plants very slowly.

Only 15 to 20% of the phosphorus applied by the farmer is used by the plant in the year it is applied. The plant makes the most efficient use of phosphorus when it is placed in a band at the side of the seed, instead of being broadcast over the soil

Analyze It!

What are the results from your soil test? Did the results surprise you? Share your findings with the group.

Potassium

Potassium fosters vigour and strength in a plant, which helps it to resist disease. A plant needs large amounts of potassium compared to the amount of phosphorus it requires.

Muriate of potash (0-0-60) is the most common source of potassium in fertilizers.

Soil Test

How can you tell if your soil has enough of these nutrients for the crop you are growing? The

best thing to do is to have your soil tested as was outlined in Meeting #2.

Once you know what nutrients you have and you have checked the Field Crop Recommendations to see what type and amount of nutrients your crops needs, you may discover that you need to fertilize or add nutrients.

Mixed Fertilizers

Mixed fertilizers contain two or more fertilizer elements. A combination of fertilizer sources is then mixed to provide the desired nutrient levels. Their fertilizer is priced on the basis of its composition.

The fertilizer formula indicates the composition of the mixture in terms of the three nutrients – nitrogen, phosphate and potash.

Experience It!

Invite an agronomist or someone from a local company that does soil testing to discuss how they do soil testing, analyze results and what their next steps are. Find out how they became an agronomist and what they like best about their job.

Example of a Fertilizer Formula:

8 -	32 -	16
8% nitrogen	32% phosphate	16% potash

Top dressing is applied on top of the crop. You might top dress winter wheat in March or April by broadcasting nitrogen. Side dressing is applying fertilizer between rows. To do this you might apply or knife urea-ammonium nitrate (28%) liquid or anhydrous ammonia gas into the ground between rows of corn when the plant is 40 cm high. The practice of applying anhydrous ammonia within Ontario is fairly localized though and is no longer common practice for most farms.

Fertilizer Application Methods

There are four basic methods of applying commercial fertilizer:

1. Broadcast commercial fertilizer before planting
2. With the planter during seeding
3. Top-dressing after planting
4. Side-dressing after plant has emerged

Manure

The value of manure in crop production is often underestimated. Manure contains all of the nutrients needed by crops but not necessarily in the proportions needed for specific soil and crop conditions. In addition to nitrogen, phosphorus and potassium, manure contains many secondary nutrients and micronutrients, as well as organic matter that help build and maintain soil structure.

Manure is used most effectively when applied to crops that require nitrogen and on soils that require phosphorus and potassium. Corn and grasses have higher nitrogen requirements than other types of crops and respond well to the nitrogen in manure. Legumes, for example, do not make efficient use of the nitrogen in manure because they can produce their own nitrogen.

For the most effective use of the nitrogen in high ammonium manures (liquid manure, dry poultry manure), it should be applied in the spring and incorporated into the soil the same day. If the manure is not worked into the soil the same day, nitrogen is lost to the air. If these manures are applied in the fall, some nitrogen is lost to the air or is leached into the soil over the winter. Solid manures (high straw content) require time for soil microbes to breakdown organic nitrogen and fall applications may be more appropriate to release in time for growing crops the following year. Phosphorus and potassium content does not change either in fall or spring.

Because manure is rich in nitrogen and phosphorus, it can contaminate water sources if improperly applied. This is particularly true when the soil is frozen or snow-covered, since this increases the potential for runoff to surface water.

The Ontario Nutrient Management Act, 2002 addresses two time periods when manure should not be applied to fields that may or may not overlap. The first is based on calendar dates - December 1 to March 31 or “winter”. The second period is any other time when the soil is frozen or snow-covered. Frozen soil is any 5 cm layer of frozen moisture in the top 15 cm of soil. Snow-covered soil is soil with a layer of snow on the surface with an average minimum depth of 5 cm.

Check It Out!

All Ontario Statutes (acts (laws)) can be found online at ‘elaws.’ Search for the acts that pertain to the spreading of manure and surface water protection.

There are several environmental laws that make it an offence when manure enters surface water. The main pieces of legislation are the Environmental Protection Act, the Ontario Water Resources Act, and federally, the Fisheries Act.

Nutrient Management Plans

A nutrient management plan matches the nutrients from the soil and those available from manure, cover crops, and commercial fertilizer, to the nutrients required by the crop. Analysis of nutrients contained in the manure, along with soil test results and crop requirements, helps determine the manure application rate and additional commercial fertilizer requirements.

A nutrient management plan may limit the rate of manure or fertilizer applied if that application creates certain risks, as shown below:

CRITERIA	RISK
Nitrogen	Nitrate leaching into groundwater
Phosphorus	Phosphate movement into surface water
Volume of Liquid	Direct runoff, carrying ammonia, phosphate

Economic Value of Manure – Manure Credits

The nutrients from manure have a nutrient and economic value. Calculation of plant available nitrogen (N) from manure for livestock producers is an important step in a cropping system budget. However, there is some difficulty associated with sorting through the numerous tables of coefficients in order to calculate plant available nitrogen from manure.

For some Ontario producers the tables in OMAFRA Publication 811 (Field Crop Agronomy Guide) can be used to calculate manure credits, for others the NMAN2 or Agrisuite software is used to arrive at these available nutrient estimates for manure.

Look It Up!

OMAFRA Publication 811 – Field Crop Agronomy Guide is available online. Look up the tables in the guide to calculate manure credits for a particular type of manure.

Plants as a Source of Nutrients

There are some crops such as forage legumes which will add nitrogen to the soil. It is good farming practice to grow these crops the season before a nitrogen demanding crop such as corn will be grown. This can be accomplished by **crop rotation**. Many farmers practice this in order to keep their soil fertile. An example is a three year rotation that may include one year grain corn, one year soybeans and one year winter wheat.

There are other benefits to crop rotation. Pests such as insects, weeds and diseases may affect one crop but might not affect another. Crop rotation can actually reduce pest problems.

Talk About It!

Can you think of other examples of crop rotations?

Benefits of Crop Rotation

- **Reduced pest problems**
- **Improved soil structure**
- **Weeds less prevalent**
- **Crop disease less frequent**
- **Better time management for farmer**

INTEGRATING COVER CROPS INTO THE ROTATION

Oilseed Radish Cover Crop
Image Credit: OMAFRA Cover Crops Factsheet (2001) http://www.omafra.gov.on.ca/english/crops/ facts/cover_crops01/cover.htm

Resilient crop yields can be maximized by improving soil health, which is enhanced through the use of cover crops. Cover crops should be considered as part of the overall crop rotation and especially on soils with lower organic matter, or on fields with short rotations and little return of crop residue or manure. Cover crops can help to ensure appropriate ground cover over the non-growing season to help protect the soil. It is important to know the goal or expected benefit from a cover crop.

Matching Cover Crop Choices to Function

Agronomy Guide for Field Crops

Table 8–3. Matching cover crop choices to function

Cover Crop Function	Best Choices for Cover Crops
Nitrogen production	Legumes — red clover and other clovers, alfalfa, peas, vetch
Nitrogen scavenging	Fall uptake — oilseed radish and other brassicas, oats, barley Winter/spring uptake — cereal rye, winter wheat
Weed suppression	Fast-growing/shading plants — oilseed radish and other brassicas, winter rye, buckwheat
Soil structure building	Fibrous root systems from oats, barley, rye, wheat, triticale, ryegrass or clovers
Compaction reduction	Most cover crop roots will assist in reducing compaction Moderate compaction — radish More severe compaction requires strong, dense tap roots that grow over time — alfalfa, sweet clover
Biomass return to soil	Fall-seeded — spring cereals, oilseed radish Summer-seeded — millets, sorghum, sudangrass, sorghum-sudan
Erosion protection (i.e., wind, water)	Most cover crops once well established Winter rye, winter wheat, ryegrass (well-established), spring cereals seeded early
Emergency forage	Fall — oats, barley, wheat, rye, forage brassicas Summer — millet, sorghum, sudangrass, sorghum-sudan See Table 3–2 in Chapter 3, *Forages* for more annual forage options
Nematode suppression	Cutlass mustard, sudans/sorghums (Sordan 79, Trudan 8), pearl millet (CFPM 101), marigold (Crackerjack, Creole), oilseed radish (Adagio, Colonel) Not all cover crops have the ability to suppress nematode populations; some will even act as hosts. Cover crop activity is variety- and nematode-specific. To get the most activity, cover crops should be weed free and may require specific handling.

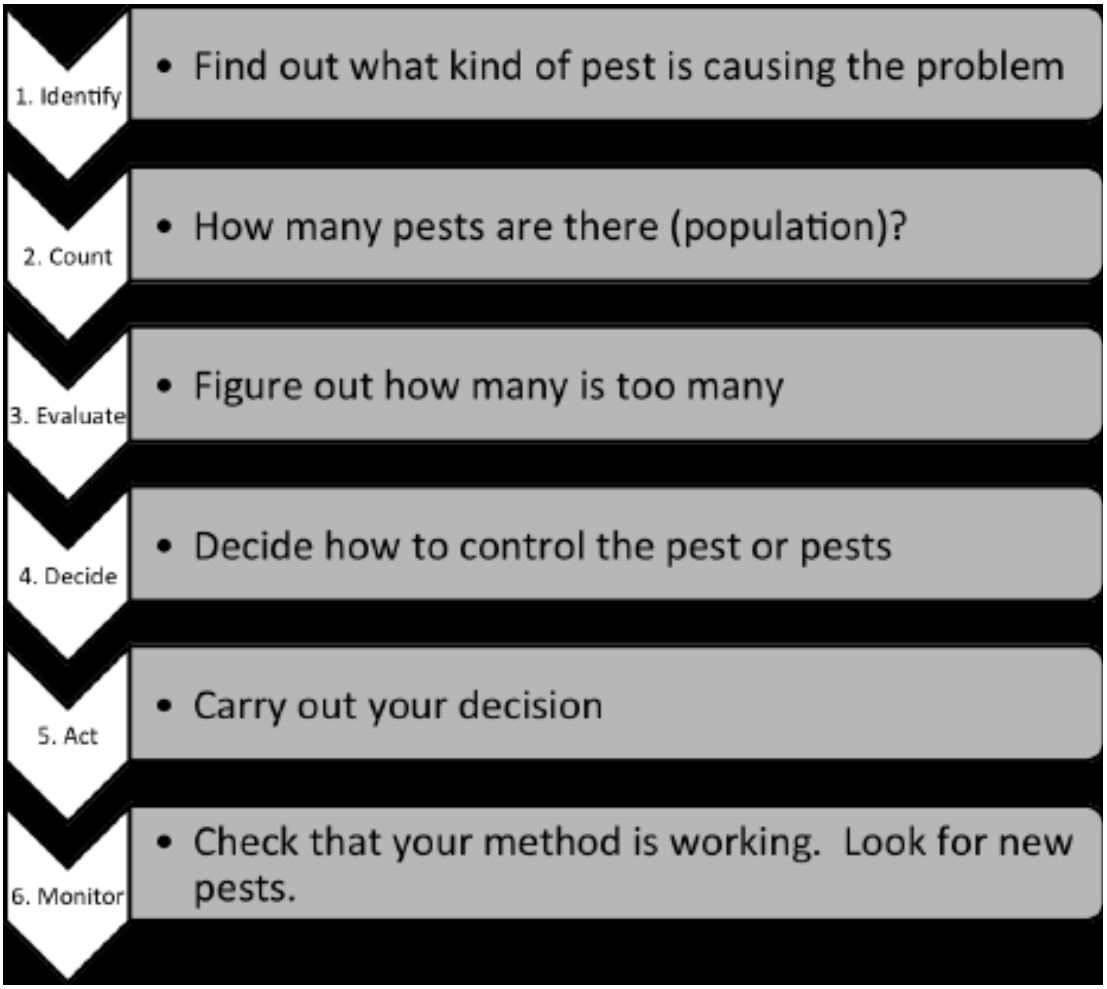
Source: OMAFRA Agronomy Guide Publication 811

PEST CONTROL

Weeds, insects and diseases can all interfere with the crop you're trying to grow. Insects can eat the crop's leaves, stems, roots and seeds or suck the nutrients from the leaves and stems. Diseases can destroy roots and attack leaves, stems and seeds. Weeds can steal much needed nutrients or light from plants or negatively influence crop growth.

There is no way to completely eliminate or control the pests in your fields. The goal of pest management is to find a combination of control practices that will keep pest populations low and minimize their adverse effects on crops. Effective pest management is a six step process.

Six Steps to Better Pest Management



This method is called Integrated Pest Management or IPM. It is a system used by many producers to ensure that the right control is used for the problem.

The most frequently used method of controlling pests are crop rotation, varieties or hybrids with pest control traits (e.g. Bt corn) and the use of pesticides. Some consumers are beginning to demand produce that has not been treated with pesticides.

Expand on the Six Steps to Better Pest Control…

Step 7 – Prevention – Now that you know what weed is a problem in your field, you can decide on preventative measures to keep that weed from creeping up in the future.

Examples of preventative measures include:

- Biological – plant crops in the field in the future that are known to successfully compete against that weed
- Mechanical – clean your equipment when you leave the field that is 'infected' with that weed so that you do not spread the weed into other fields

Step 8 – Record Keeping – Take notes so that the next time you find this weed in your fields you know what to do or what not to do!

Look It Up!

For detailed information on each step of the Six Steps to Better Pest Management, look it up in the 4-H Ontario Weeds, Insects and Diseases 4-H Project Manual.

Types of Pesticides

- Herbicides
- Fungicides
- Insecticides
- Rodenticides
- Larvicides
- Bactericides

In addition to crop rotation, some producers use the IPM program and exact calibration of spray equipment to ensure that they only spray as much pesticide as they need and only when they need it. This practice alone can greatly reduce the amount of pesticides used in our fields. Researchers continue to work at developing new methods of controlling pests with reduced amount of or no pesticides.

Other options besides Pesticides

Biopesticides

Biopesticides are pest management agents and chemicals derived from natural sources such as bacteria, fungi, viruses, plants, animals and minerals. Also known as biological pesticides, they can provide an alternative to synthetic chemicals used to control pest populations in crop production and other settings. Biopesticides can be used by anyone looking for an alternative pest management approach, such as commercial growers, specialty crop growers, ornamental plant growers, or household gardeners. Like synthetic chemical pesticides, however, biopesticides must be registered by Health Canada's Pest Management Regulatory Agency (PMRA) before becoming available for use in Canada.

Pests include diseases, insects, mites and weeds that damage crops and reduce crop yield and quality. Many biopesticides are more environmentally friendly than synthetic pesticides. For instance, many biopesticides target specific pests and have little negative impact on the surrounding ecosystem and human health.

Research It!

There are three types of biopesticides.

- **Microbial pesticides**
- **Semiochemicals**
- **Non-conventional pest control products**

Visit the Agriculture and Agri-Food Canada website to find out what the differences are between these three types of biopesticides.

Natural Predators and Beneficial Insects

Any creature that feeds on or otherwise reduces the numbers of another creature is its "natural enemy". All crop pests have natural enemies, which are often referred to as beneficials, and the reduction of pest populations by these natural enemies is called biological control. Natural enemies provide an important free service to farmers - both organic and conventional - however they are often overlooked. Many farming practices (tilling, cover crops, choice and use of pesticides) can impact natural enemy populations.

When developing any IPM program, remember the valuable contributions natural enemies make in reducing pest populations. Many orchard pests are attacked by beneficial insects or mites and by various fungal, bacterial and viral agents. Often these natural enemies provide good suppression of pest populations, particularly indirect pests (e.g, aphids, mites, leafminers) - those that feed on or in leaves rather than on the fruit itself.

There are three general groups of natural enemies of pests:

- Predators
- Parasitoids
- Pathogens

Predators overcome, capture and consume their prey items. Most predators are large relative to their favourite prey items. A predator usually consumes many prey items over the course of its lifetime. While some predators are specialized, many are generalists and found in diverse habitats.

Predator	Description	Prey
Lady beetles and larvae	Eggs - small, ova, bright yellow and laid in clusters. Larvae - Black with yellow-orange patches, alligator shaped and covered in spines Adults - Broad, oval, convex, often with bright spots	aphids, mites, thrips, adelgids, mealybugs and other small insects and eggs
Ground beetles	Adults - Long, flat bodies, 0.3-8.5 cm long, often dark in colour. Prominent mandibles, long legs, threadline antennae	caterpillars and other immature insects, eggs, slugs, some weeds
Syrphid flies	Larvae - slug-lie, mottled brown to green semi-transparent body, no legs, 5-12 mm long Adults - resemble bees or wasps but with only one pair of wings	aphids and small caterpillars
Lacewing larvae	Eggs - laid singly on stalks (brown lacewing eggs not on stalks are harder to spot) Larvae - Long pointed, mottled body with long legs and sickle-shaped mandibles on head; may be covered with debris (ie dead and previously consumed prey)	aphids, insect eggs, thrips and other small insects and larvae
Assassin bugs	Nymphs - light to black with wing pads, resemble adults but with wing pads Adults - dark, enlarged front legs, large beaks, elongated head	aphids, insect eggs, leafhoppers, flies, other small insects and caterpillars
Aphid midge	Only larvae is predatory - small, orange maggots	aphids, mites, other small insects
Flower/Pirate bugs	Nymphs - yellow-orange, teardrop shaped, wingless Adult - Small, dark, shiny and oval, fast moving	mites, thrips, aphids, scales, leafhoppers, caterpillars, psyllids, other insects/eggs
Predatory stink bugs	Eggs - barrel-shaped egg masses with circle of spines at one end Nymphs - red to orange with black borders Adults - brown, pointed shield on back	mites, thrips, aphids and other small insects and larvae, insect eggs and caterpillars
Predatory mites	Similar to pest mites but faster-moving, fewer hairs, often tear-drop shape	

Source: OMAFRA Factsheet: Natural Enemies 101

A *parasitoid* lives in or on the body of a single host individual, feeding on and eventually killing that individual over the course of its own development. Parasitoids are often smaller than their prey and their presence is easily missed by casual observations. Parasitized insects do not always die quickly. They may continue to feed and develop normally until they reach a certain stage of development.

Parasitoid	Description	Prey
Chalcidoid wasps	Parasitized hosts - parasitized aphids are hardened, black, slightly swollen, sometimes with exit holes, parasitized eggs appear black Adults - small, yellow, brown or black, slightly smaller than host or small and metallic	Depending on the species: aphids, scale, whiteflies, leafminers, caterpillar eggs
Braconid wasps	Parasitized host: caterpillars surrounded by multiple small cocoons, or swollen, papery aphid mummies Adult: Dark, 2-15 mm, long antennae	caterpillars, flies, beetles, aphids, leafminers
Ichneumonid wasps	Adults: variable in colour, 5-40 mm long, long antennae, abdomen often long and narrow	caterpillars, flies, beetles, aphids, leafminers
Tachninid flies	Larvae - maggots found inside host Pupae - dead host with exit hole and brown ovoid pupa beside it Adults - medium to large, housefly-like, covered in bristles	caterpillars, beetles, bees, wasps, sawflies, stink bugs, grasshoppers

Source: OMAFRA Factsheet: Natural Enemies 101

Pathogens are often overlooked as biological control agents or natural enemies. They include bacteria, viruses, fungi and other microorganisms, as well as insect parasitic (entomopathogenic) nematodes. Bacteria and viruses must be ingested by the host, while fungi and nematodes invade through the cuticle or openings (mouth, anus, spiracles). Sickly looking individuals (sluggish, shrunken, discoloured) or those covered with a woolly mycelium may have been affected by a pathogen

Pathogen	**Symptoms in Host**	**Hosts**
Bacteria	Initially hosts stop eating, cadavers are limp, dark, shrivelled bodies	caterpillars, beetles, flies, others
Viruses	Cadavers are limp, dark, oozing, appear "melted". May be firmly attached to plant and arched backwards.	caterpillars, beetles, others
Fungi	Cadaver swollen and covered in fungus. Fungus may be less prominent under dry conditions	Wide host range - caterpillars, beetles, aphids, flies, thrips, sucking insects, mites, others
Nematodes	Cadavers limp, dark or reddish, sometimes nematodes can be seen oozing out of cadaver	commonly soil dwelling beetles and other soil insects

Source: OMAFRA Factsheet: Natural Enemies 101

WEED ID

Problems Caused by Weeds

The key problem with weeds is that they compete against the crop that is intended to be grown. Essentially, it is a 'race' to see which can out compete the other. There are many ways that weeds can cause problems in fields:

1. Weeds can reduce crop yields by competing with the crop for water, nutrients, light and space. Over-crowding can destroy a field crop.
2. Some weeds release poisons that can harm crop growth.
3. Some weeds provide homes for insects and diseases that attack crops.
4. Weeds can interfere with harvesting operations. They can plug up the equipment and make it very difficult to harvest the crop.
5. Weed seeds or other weed plant parts in a harvested crop may make that crop less valuable or unfit for market.

Comparison of weed control on the left and no weed control on the right.

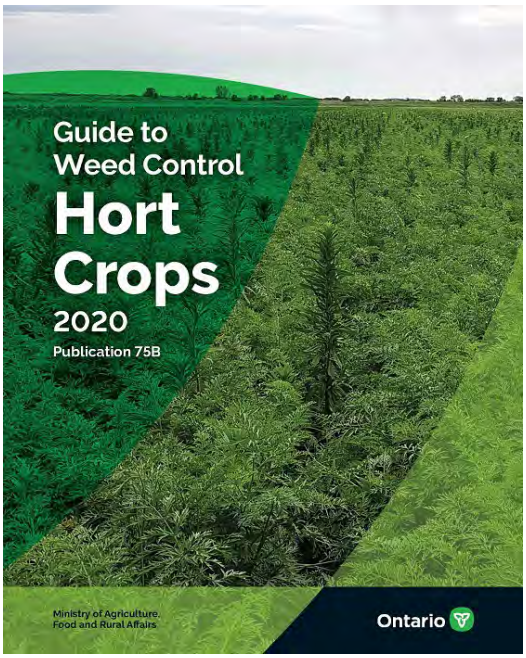
The losses due to weeds are even bigger than usual when the weeds are emerging from the ground before or at the same time as the crop, when it is dry and they are competing for moisture in the soil, and when there are broadleaf weeds present. Broadleaf weeds are more competitive than grass weeds so they have a greater potential to harm the crop.

Weed Identification

OMAFRA has a number of publications to assist with weed identification. Publication 75 – Guide to Weed Control has two sections: Crops and Horticulture. Links to both versions can be

found at: http://www.omafra.gov.on.ca/english/crops/pub75/pub75toc.htm

The Pest Manager App is also available to assist with weed identification. A cooperative effort between Grain Farmers of Ontario (GFO) and OMAFRA, the app can be downloaded from the GFO website at: https://gfo.ca/about/mobile-apps/



AT HOME ACTIVITY - CROP CONSULTANT'S REPORT

Now that we've covered seed selection, planting, fertilizer and weed control, you're ready to become a crop consultant! Complete the crop consultant's report (found on the following pages) for a crop on your family's farm or a neighbouring farm. You may have to interview a farmer to be able to find all of the information for your crop report. Be ready to share your crop consultant's report at the next meeting.

CROPS CONSULTANT'S REPORT – PART TWO

Take it to the next step and prepare a Crop Consultant's Report for one of the Crop Management Case Studies found on page 108. Use the Crop Consultant's Report forms found on the next page to complete your report.

DIGGING DEEPER For Senior Members

Pesticides vs. Biopesticides

What are the similarities and differences between pesticides vs. biopesticides? Make a list of advantages and disadvantages of each including but not limited to effectiveness, ease of use, availability and cost.

4

CROP CONSULTANT'S REPORT
(JUNIOR MEMBERS)

CASE STUDY #____

LOCATION _____ Corn Heat Units available _____

Crop _____

Variety Recommended _____ or Mixture _____

TILLAGE - Primary Recommended - Type _____

- Time _____

- Secondary Recommended - Type _____

- Time _____

- Type _____

- Time _____

PLANTING - Method Recommended _____

- Time _____

- Amount of residue to be left after planting ____%

Fertilizer Recommendations	
Weed Control Recommendations	
Insect Control Recommendations	
Disease Control Recommendations	
Harvest Recommendations	
Marketing Recommendations	
Other Comments	

*Includes-seed treatments

5

CROP CONSULTANT'S REPORT
(EXAMPLE FOR SENIOR MEMBERS ONLY)

CROP YEAR _____

TILLAGE AND CROPPING

1. **Field #** _____ Name _____ Date _____
2. **Current crop** _____ Previous crop _____
3. **Tillage**

	Equipment	Source	Expected # of Passes	Expected Date
Primary	_____	_____	_____	_____
Secondary	_____	_____	_____	_____
Weed Cultivation	_____	_____	_____	_____

Type of residue (previous crop) _____

Amount of residue to be left after planting ____%

Comments _____

4. **Planting** Variety _____ Expected date _____

Equipment _____ Source _____

Row width _____ Tractor wheel width (if using PWP planter) _____

Seed rate _____ Seed depth _____

Comments _____

5. **Fertilizer**

	Soil Test Results Phosphorous	Potassium
Actual level (ppm)	_____	_____
Recommendation (kg/ha)	_____	_____

Comments _____

	Equipment	Source	Analysis	Rate	Expected Date
Broadcast	_____	_____	_____	_____	
At planting band	_____	_____	_____	_____	_____
pop-up	_____	_____	_____	_____	_____
Side-dress	_____	_____	_____	_____	

6. **Pesticides**

Fungicide	**Pre-plant**	**At plant**	**Post plant**
Equipment			
Source			
Product Name			
Formulation			
Expected Rate			
Expected Date			

Insecticide	Pre-plant	At plant	Post plant
Equipment			
Source			
Product Name			
Formulation			
Expected Rate			
Expected Date			

Herbicide	Pre-plant	At plant	Post plant
Equipment			
Source			
Product Name			
Formulation			
Expected Rate			
Expected Date			

Comments _____

_____

SPECIFICATIONS: PLANTER SET-UP

1. Field # _____ Name _____ Date _____

2. Planting

Date _____ Crop _____ Variety _____

Planting speed _____

Desired seed rate _____

Closest mechanical rate _____

Sprocket # driver _____

driven _____

Desired seed depth _____

Planter depth setting _____

Equipment _____

Source _____

Row width _____

Tractor wheel width (if using PWP planter) _____

Coulter/unit alignment _____

Row marker length _____

% residue after planting _____

Type of residue from previous crop _____

CROP MANAGEMENT CASE STUDIES

Choose one of the following case studies. Review it and prepare a Crop Consultant's Report.

Junior Members – use the form on page 104 for your Crop Consultant's Report

Senior Members – prepare and design your own format for your Crop Consultant's Report. You may wish to use the form on pages 105 to 107 as a basic guideline.

CASE STUDY #1

Helga and Hans Schmidt have just purchased a 100 acres farm in your neighbourhood. They both have well paying positions off the farm and have purchased it as an investment. Having grown up on farms in Germany, they are keenly interested in growing crops on their farm. They have already acquired a tractor, a plough and a cultivator and intend to buy more equipment. They have asked you for some direction as to which crops to grow and which cultivation methods to use.

CASE STUDY #2

Last year Bill Smith grew 100 acres of corn on his farm which is located in your neighbourhood. His yield was a disappointing 118 bushels/acres testing 34% moisture, when combined on November 17th.

He has asked you for recommendations on growing a better corn crop this year. Other information on last year's crop includes:

- Spring plowed
- Disked twice
- Planted on May 30 (2900 corn heat unit variety)

CASE STUDY #3

Fred Jones grew 100 acres of mixed grain last year on his farm in your neighbourhood. His yield was below the county average but he wishes to grow mixed grain again this year and underseed for hay. His land is poorly drained. He has asked for your advice.

ACTIVITY #1: PERSONAL PROTECTIVE EQUIPMENT

DO	Time: 20 minutes Materials Needed: • Various pieces of personal protective equipment used when applying pesticides (if possible, have a different piece of equipment for each member) Instructions: • Have members each member choose a piece of personal protective equipment to dress up in • Have each member describe what the item is, how it is used properly, why it is necessary to wear and the importance of the item
REFLECT	Learning Outcomes: To allow members to realize the importance and value of using personal protective equipment when working with pesticides.
APPLY	Processing Prompts: • Did you recognize all of the pieces of personal protective equipment? Do you know how to properly use them? • If pesticides are used on your farm, does the person working with pesticides use all or some of the items in this activity? • What might happen if someone didn't use personal protective equipment when working with pesticides?

ACTIVITY #2: JUDGING COB CORN AND CORN SILAGE

DO

Time: 20 minutes

Materials Needed:

- Cobs of field corn (4)
- Samples of corn silage (4)
- Scorecards (as appear below)
- Judging Worksheet
- Paper and writing utensil

When judging cob corn and corn silage, we are evaluating samples that are to be used as feed.

The general scorecard breakdown for Cob Corn is:

Maturity and moisture	30
Freedom from damage	30
Uniformity	20
Development of the ear	20
	100

Maturity and moisture are very important in cobs because the corn must be dry enough to store well. Kernels that are completely dented give the best indication of maturity and kernel dryness. Freedom from damage is also very important. This damage may be mechanical damage, mold, smut or bird and rodent damage.

Since harvesting your corn can cause some mechanical damage, you should go right into the field to select your sample. Pick a sample that is mature, uniform in size and filled to the tip with kernels. Husk your cobs and break off the core as closely as possible to the butt of the cob. Know how many cobs are required for the show (usually 10) and pick out some extras too.

The general scorecard breakdown for Cob Silage is:

Stage of maturity	30
Grain content	25
Colour	20
Odour	20
Impurities	5
	100

	After harvesting, corn silage must go through the process of fermentation inside the silo. In order to have a good fermented product for feed, it is important that the silage be at the right stage of maturity and therefore the right moisture level. As with the cob corn, the kernels should be dented and there should be many of them. The grain content determines the nutritional value of the feed, so the more the better. Very little preparation is required for corn silage. The specified sample weight is usually exhibited in clear plastic bags. Do not collect a sample fresh from the wagon – part of the judging is based on how well the silage has fermented in the silo. A sample of corn silage should come from the silo the day of judging. When silage is exposed to the air, it will heat and spoil rapidly. Instructions: • Have members work individually to judge the cobs of corn. • Have members give reasons as to why they placed the cobs in the order they chose.
REFLECT	Learning Outcomes: To allow members to discover the criteria they should be looking for in cob corn and corn silage for livestock feed purposes.
APPLY	Processing Prompts: • Was the activity difficult or easy? • Were your placings different than others in your group? Why do you think that is? • Did you find someone else's placings and reasons surprising? • After hearing other member's reasons, does it change the placings you made? • How does this activity apply to a livestock farm?

MEETING 6 – HARVESTING AND MORE

SETTING OBJECTIVES:

After working all season to grow a crop, it is extremely important to know how to harvest and store the crop properly to maximize yield and maintain the quality of the crop until it is sold or fed to livestock.

Suggested Lesson Outcomes

- ☐ To appreciate the size of the grain industry in Ontario
- ☐ To gain an understanding of various ways particular crops can be harvested
- ☐ To know which various types of crop storage are available in Ontario
- ☐ To be able to do common conversions from tonnes, pounds and bushels for various crops
- ☐ To understand what winterkill is and how to avoid it
- ☐ To start 4-H members on a path of continual learning about crops by directing members to more in-depth information

SUGGESTED ROLL CALL QUESTIONS

- Name one danger you might encounter when harvesting a crop or storing a crop.
- Name one method of storing a crop on farm in Ontario.
- If you are growing a crop this year, what is your expected crop yield? Do you consider this a good yield?

AT HOME ACTIVITY (FROM MEETING #5) ANSWER SHARING

- Share your completed Crop Consultant's Report and the reports your created for one of the case management studies.

DIGGING DEEPER (FROM MEETING #2)

- Share your list of advantages and disadvantages comparing pesticides and biopesticides.

Sample Meeting Agenda Time: 2 hours 15 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	10 min
Topic Information, Discussion & Activities	Topic Information • Harvesting – Corn – Soybeans – Wheat, Oats, Barley – Canola – Forages Activity #1 Judging Horticultural Crops Activity #2 Judging Sweet Corn	40 min 20 min 20 min
At Home Activity	Preparing for Achievement Day	20 min
Wrap up, Adjournment & Social Time		10 min

TOPIC INFORMATION

HARVESTING

Harvesting methods and storage facilities are very different, depending on the use of the crop. The crop could be sold directly from the field or stored for livestock feed or to be sold at a later time.

Grain Farmers of Ontario

As of 2020, Grain Farmers of Ontario is the Ontario's largest commodity organization, representing Ontario's 28,000 barley, corn, oat, soybean and wheat farmers. The crops these farmers grow cover 6 million acres of farmland across the province, generate over $4.1 billion in farm gate receipts, result in over $18 billion in economic output and are responsible for over 75,000 jobs in the province. https://gfo.ca/

Corn

Corn can be harvested as silage, cobmeal, shelled corn or ear corn.

Silage

As silage, maximum dry matter yield results when harvested at 65% moisture on a whole plant basis. Grain moisture content is approximately 45% at this stage. Maximum intake by animals occurs at 55-70% moisture.

Discuss It!

Corn is harvested for livestock feed is harvested in various ways depending on the type of livestock the feed is intended for. Discuss which types of livestock would consume corn silage, high moisture corn, cobmeal/ear corn and/or grain corn. Why are there differences?

Desired Silage Moisture Levels When Stored in Different Silo Structures

Silo Structure	Moisture Level
Sealed silo	55% water
Large open top silo	60% water
Small top silos	65% water
Bunk silo (horizontal silo)	70% water
Silo bag	65% water

Corn silage is usually harvested in September with the exact time depending on the whole plant moisture of the hybrid. When very wet silage is stored, many water-soluble nutrients (those that dissolve in water) are lost through seepage. If silage is too dry, it may not pack, ferment or store properly.

Shelled Corn

Combining grain corn is a common way to harvest. In Ontario, corn is usually combined at grain moisture level of 20-30% in October. If the moisture content is too high, the producer faces:

1. High drying costs
2. Handling problems
3. Reduced quality
   - Cracked kernels
   - Light bushel weight

If the crop is harvested very late, the ears may fall off and there may be lodging and/or ear mold.

Shelled corn is handled either as high moisture corn ensiled in silos for feed or as dry corn. Shelled corn that is to be stored as dry corn is dried in one of the following types of dryers:

DRYER TYPE	CHARACTERISTICS
Continuous flow	Expensive Fits high volume harvest flow
Batch	Economical Requires more management
In-bin	Economical Grain is stored in the same bin
Natural air	Slow, no heat required Suitable for smaller farms

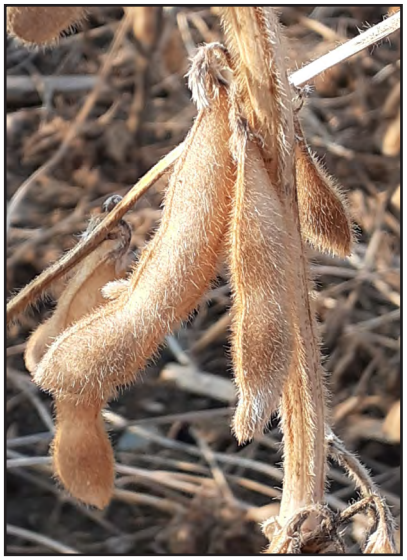
The preferred method of storing dry corn is in bins or silos with aeration systems so that air can be circulated as required to prevent spoilage.

Cobmeal/Ear Corn

Cob corn can be ground and used as high moisture ear corn in a silo for feed (cobmeal). It can also be stored in cribs and dried naturally. The corn is then shelled at a later date after it has dried.

Common Calculations, Conversions and Facts

- 1 metric tonne = 39.4 bushels
- There are 56 lbs (25.45 kg) in 1 bushel of corn



Soybeans

Soybeans are usually harvested in September or October at 14% seed moisture. The cutterbar on the combine has to be very close to the ground to pick up lodged plants, reduce pod shattering and harvest pods set low near the ground. Shattering can occur when pods become dry and brittle. The pods can open and release the beans before they get into the combine. Even with slow ground speeds, a 10% yield loss is average. Floating cutterbars have improved the situation.

Soybeans are either sold at an elevator to be crushed for their oil or fed to livestock on the farm after being treated with heat (roasted).

If combining soybeans is delayed there may be:

- Loss of beans due to shattering
- Lodging
- Discolouration
- Mold

Common Calculations, Conversions and Facts

- 1 metric tonne = 36.74 bushels
- There are 60 lbs (27.27 kg) in 1 bushel of soybeans

Did You Know?

Caution needs to be taken when feeding soybeans to livestock. Raw soybeans have enzymes that can inhibit digestion and reduce the use of nutrients or food intake, which affects livestock's growth. Roasting inactivates these substances. Monogastrics, like swine and horses are especially affected by this, as are nursing calves or calves under 300 pounds (136kg).

Do not feed cattle larger than 300 pounds raw soybeans with other supplements containing urea. Raw soybeans contain urease which breaks urea down into ammonia. This rapid breakdown of urea into ammonia in the rumen can potentially led to ammonia toxicity and cattle death.

Wheat, Oats, Barley

Wheat is harvested from early July to early August, depending on the area of the province and the weather, and is harvested at about 14% moisture. Sprouting of the kernels in the heads can occur if wet, humid weather sets in at harvest time and can cause the wheat to be downgraded.

Oats and barley are usually harvested in August at about 14% moisture as well.

The standard moisture content required for storage is:

Wheat……	14.0%
Oats……..	14.0%
Barley……	14.8%

Direct combining is the fastest method of harvest but fields with uneven maturity and weeds are sometimes best swathed first and then combined when everything reaches the desired moisture content.

- wheat is primarily used for a variety of foods for human consumption and livestock feed
- while the majority of oats grown in Ontario are for forage or feed, many of these oats enter the human food market as well
- barley is used for livestock feed and for human consumption
- bins used to store grains should be cleaned and fumigated, if necessary, before filling and checked periodically after filling to ensure safe storage

After combining and removing the grain from the plant, the remaining stalk (straw) is baled and stored for use throughout the rest of the year. Most straw is used for bedding although some straw is chopped further and used in feed rations for cattle.

Common Calculations, Conversions and Facts

Wheat

- 1 metric tonne = 36.74 bushels
- There are 60 lbs (27.27 kg) in 1 bushel of wheat

Barley

- 1 metric tonne = 45.93 bushels
- There are 48 lbs (21.82 kg) in 1 bushel of barley

Oats

- 1 metric tonne = 64.7 bushels
- There are 34 lbs (15.45 kg) in 1 bushel of oats

Canola

Winter canola is direct harvested because there is lots of time for it to mature in the field. Spring canola is increasingly direct cut as well, but some swathing still occurs in the very short season areas of far Northern Ontario. Canola should be swathed or combined when 25%-50% of the seeds in the pods from the middle part of the plant have turned from green to red or brown. Shattering will be severe if over-ripe canola is swathed. Seven to ten days of good drying weather will lower the moisture content to the desired 10% range.

Canola can be delivered to a number of elevators or directly to the crushers. Its main use is for canola oil for human consumption.

Common Calculations, Conversions and Facts

- 1 metric tonne = 44.09 bushels
- There are 50 lbs (22.73 kg) in 1 bushel of canola

Forages

The timing of harvest is the most important consideration when trying to produce high nutrient quality forage. Cutting alfalfa too early at the pre-bud or early-bud stage will result in reduced yields and may weaken the stand. Extremely low fibre levels may result in nutritional problems.

Forage crops decline in feeding value as they mature. Once alfalfa buds appear, feeding value declines about 0.2% per day in protein and about 0.4% per day in digestibility.

Digestibility and protein of alfalfa and bromegrass at various stages of maturity

Table 3–9. Digestibility and protein of alfalfa and bromegrass at various stages of maturity

		% Digestibility		% Crude Protein	
Stage of Maturity	**Date**	**Alfalfa**	**Bromegrass**	**Alfalfa**	**Bromegrass**
medium bud	June 4	72.6	73.8	21.5	13.4
early flower (heads emerged)	June 20	65.2	67.2	17.0	10.0
full flower	June 30	62.1	60.6	16.2	6.7
early seed	July 6	60.9	59.7	15.6	5.8

Source: OMAFRA Agronomy Guide Publication 811

Short delays in cutting result in significantly lower forage nutrient quality. Finding a window of dry weather can complicate things even further. Delayed harvesting of forages will give higher yields and greater plant persistence, but lower feed quality.

Subsequent second and third cuttings of alfalfa may be at intervals of approximately 30 days (mid-bud) to 40 days (early flower) or more, depending on whether the goal is high quality or maximum persistence and yield.

Weeds

Weeds are competition for nutrients, space and sunlight when they are present in a forage stand.

Weathering Losses

Rain on cut forage leaches sugars and protein, bleaches colour and increases leaf loss. Sun bleaches colour and breaks down carotene. Carotene is orange in colour and is broken down into Vitamin A when eaten.

Leaf and Stem Loss

It is important to minimize leaf loss during harvest. At the recommended stage of harvest, leaves make up 50% of the yield and 79% of the protein.

Potential haymaking losses

Table 3–10. Potential haymaking losses

Source of Loss	Loss of Dry Matter
Respiration	2%–16%
Cutting and conditioning	2%–5%
Raking	5%–25%
Baling small bales	3%–8%
Baling large bales	1%–15%
Transportation	1%–10%
Potential total loss	10%–71%

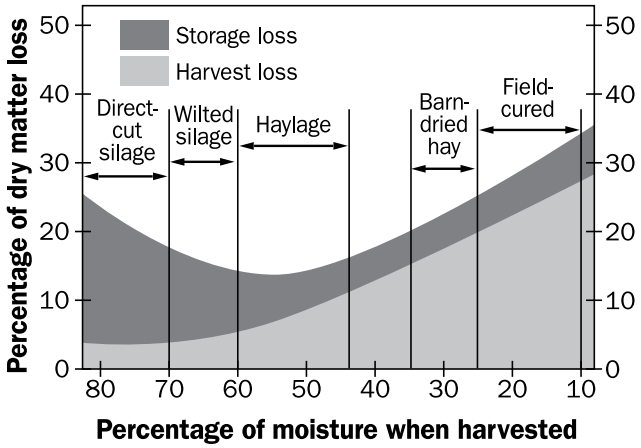
Source: OMAFRA Agronomy Guide Publication 811

Storage Losses

Haylage can be stored in an upright silo, bunk silo or wrapped in plastic and stored as bales. Large bale haylage (also sometimes called baleage), with its potential for high-quality feed, very low waste and moderate costs, has been gaining popularity with Ontario's livestock farmers. In a haylage system, nutrient losses occur from seepage and fermentation.

Hay is baled as either large square, large round or small square bales. Most losses in baled hay are from leaf and stem loss in handling.

Estimated hay and haylage harvest and storage losses.



Source: OMAFRA Agronomy Guide Publication 811
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The advantages of haylage over dry hay bales are:

- Reduced labour
- Lowest harvest losses
- Less risk of weather damage

The advantages of dry hay bales over haylage are:

- More marketable
- Lower cost system
- Lower cost storage

Discuss It!

Silo gas is produced almost immediately after filling a silo. The greatest risk is the first 12 to 60 hours after filling the silo, and then risk declines for approximately 4 - 6 weeks when silage fermentation is complete. Silo gas has a bleach-like odour and may be visible as a reddish-brown haze. However, it is not always visible. People exposed to silo gas (nitrogen dioxide, NO2) are at risk of severe respiratory distress, permanent damage to lungs, and even sudden death.

Discuss what precautions should be in place to ensure the safety of everyone when filling silos with feed. Visit Workplace Safety and Prevention Services (formerly the Ontario Farm Safety Association) at: https://www.wsps.ca/Home.aspx for a list of precautions and their Stop, Think, Act Program.

Other methods of harvesting forage include:

- Pasture
- Seed
- Direct cutting for zero grazing systems

Winterkill

Alfalfa must store food reserves in its taproot during the fall to prevent it from dying over the winter. This food makes the plant resistant to low winter temperatures. Each region in the province has a period in the fall when cutting or grazing will weaken plants to the level where they will winterkill. In order to avoid winterkill, do not cut or graze alfalfa during the critical harvest period shown on the map for your area.

Start of the six-week alfalfa critical fall harvest period

Image credit: OMAFRA and Weather Innovations

Horticultural Crops

For in-depth information about harvesting horticultural crops, check out the 4-H Ontario Farm Machinery – Harvesting 4-H Project for a section dedicated to horticultural crops.

DIGGING DEEPER For Senior Members

Comparing Storage Systems

There are various ways of storing silage and haylage in Ontario (upright silos, bunk silos, wrapped in plastic). Compare the costs of building each one of these storage systems (for a similar amount of feed), the cost to operate, the cost of maintenance, the ease of use and the effectiveness of each for maintaining the quality of feed.

ACTIVITY #1: JUDGING HORTICULTURAL CROPS

DO

Time: 20 minutes

Materials Needed:

- Potatoes (4) (or any four horticultural produce from the same crop)
- Scorecard (as appears below)
- Paper and writing utensil

Note - When judging horticultural crops, the samples should not be handled.

The general scorecard breakdown for Fruits & Vegetables is:

(scorecard can also be found in the 4-H Judging Toolkit under Scorecard for Fruits & Vegetables)

Uniformity and trueness to type	30
Condition	30
Form and colour	25
Size	15
	100

Judging Potatoes

The scorecard breakdown for potatoes is:

Uniformity, size and trueness to type	40
General appearance – clean, bright, attractive	10
Condition	50
	100

Condition considers evidence of diseases such as scab, blight and scurf and freedom from cuts, bruises, sunburn and insects.

The size most desirable for table potatoes is 250g. When a potato is exposed to sun or artificial light it will turn green. This is sometimes called sunburn. Pick out a sample of potatoes that are uniform in size and shape. Make sure that they are free of scab, cuts, greenness, etc. After digging your potatoes, let them dry out before preparing them. Don't let them dry in the sunlight or they will be green. Clean off your potatoes with an old sock.

	Do not wash your potatoes with water!!! After you have prepared your sample, wrap the potatoes individually with newspaper to prevent exposure to sunlight and to keep them firm. If you plan on showing them at more than one show, you should prepare and wrap extra potatoes because the bright lights at the fair will damage your exhibit. Instructions: • Have members work individually to judge the items. • Have members give reasons as to why they placed the items in the order they chose.
REFLECT	Learning Outcomes: To allow members to discover the criteria they should be looking for in a potato (and/or other horticultural crops).
APPLY	Processing Prompts: • Was the activity difficult or easy? • Were your placings different than others in your group? Why do you think that is? • Did you find someone else's placings and reasons surprising? • After hearing other member's reasons, does it change the placings you made?

ACTIVITY #2: JUDGING SWEET CORN

DO

Time: 20 minutes

Materials Needed:

- Cobs of sweet corn (4)
- Scorecard (as appears below)
- Judging Worksheet
- Paper and writing utensil

Note - When judging horticultural crops, the samples should not be handled.

The general scorecard breakdown for Sweet Corn is:

Uniformity and trueness to type	25
Condition	20
Colour of kernel	15
Tips and butts	15
Tenderness	15
Rowing of kernels	10
	100

As with field corn, the cobs should be well matched with the ear well filled from tip to butt. The kernels should be well filled, even, closely spaced and well rounded. These kernels should form straight rows.

When showing sweet corn, as in all other crops, make sure that you have the right number of cobs for the class. The husk should be opened so as to expose one third of the cob.

Instructions:

- Have members work individually to judge the cobs of corn.
- Have members give reasons as to why they placed the cobs in the order they chose.

REFLECT	Learning Outcomes: To allow members to discover the criteria they should be looking for in sweet corn.
APPLY	Processing Prompts: • Was the activity difficult or easy? • Were your placings different than others in your group? Why do you think that is? • Did you find someone else's placings and reasons surprising? • After hearing other member's reasons, does it change the placings you made?