4-H Ontario

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4-H ONTARIO PROJECT

Field Crops
Weeds, Insects and Diseases

REFERENCE MANUAL

4-H Ontario

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 and my country.

The 4-H Motto

Learn To Do By Doing

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INTRODUCTION

Welcome to 4-H Ontario's Field Crops: Weeds, Insects & Diseases project!

This project focuses on the 'villains' of field crops – the insects, weeds and diseases that damage plants, minimize crop yields and cost farmers money. Since the number of species and varieties belonging to each group of pest is so vast, this project reference material focuses on developing some practical detective skills to identify pests and then develop solutions in the form of pest control strategies.

Member Objectives

1. Learn how to collect and identify some of the weeds, insects and diseases which affect field crops.
2. Learn how to develop an Integrated Pest Management (IPM) program to control pests in field crops.
3. Learn basic information about using pesticides safely.
4. Gain experience working co-operatively as a member of a group, by participating in club activities.
5. Further develop judging and public speaking skills.
6. Have fun and "Learn To Do By Doing"!

How to Use This Manual

4-H Ontario's Field Crops: Weeds, Insects & Diseases project is made up of two parts:

1. **The Reference Book:**

   The reference book is comprised of six meetings:

   Meeting 1 – Those Pesky Creatures

   Meeting 2 – Introduction to Pest Management

   Meeting 3 – The Weed Race

   Meeting 4 – Disease Doctor

   Meeting 5 – Insect Invasion

   Meeting 6 - Putting it Together

   Each meeting has been broken down into an Introduction with sample meeting agendas, References and Resources, Topic Information, a Digging Deeper section and Activities.

Sample Meeting Agendas, found at the beginning of each meeting will give suggestions for topic information, activities, and judging and/or communications activities along with suggested times for each section. These are only guidelines – you will know your members best and will know the skill and attention level of your members. Many meetings also have several activity options, only a few of which will have been selected for the sample agendas. There may be other activities (even ones not in this book!) that may also be appropriate for your members.

The Digging Deeper sections contain more in depth, additional information that keen junior or senior members may want to learn about to expand their knowledge.

2. The Record Book:

This booklet is designed to make it easier for Members to record information about the club. Members should record their expectations and goals for the project in addition to recording club contact information, meeting dates, roll calls, field records and other club activities. Print or photocopy pages from the Reference Book that you think will benefit the Members either as a resource or an activity, to accompany their Record Books. Answers for Activity Pages can be found in the Activity sections of the Meeting that the activity relates to.

Planning a Meeting

Plan your meetings well. Review all the information well in advance so that you are prepared and so that meetings run smoothly.

Before Each Meeting

Read the topic information and activities. Photocopy any relevant resources for the Members' Record Books.

- Familiarize yourself with the topic information for each meeting. Think of creative ways to present information to the Members. Do not rely on strictly reading aloud from the manual. Review available materials, choose activities and themes that complement the ages and skill levels of your Members.
- Gather any equipment or resources that will be needed to complete the meeting.
- Contact members with any preparation instructions or things they need to bring to the meeting
- Have a couple of extra activities in your 'back pocket' in case your planned agenda runs more quickly than anticipated.
- Each 4-H project must be held over a period of at least 4 separate meetings, totalling a minimum of 12 hours. Typically, a 4-H project has 6 meetings that are approximately 120 minutes (2 hours) in length (the Sample Meeting Agendas provided will use this model). Before each meeting, create a timeline to ensure that you are providing an adequate amount of instructional time for club completion.

- The meetings should also include either a judging or public speaking activity.
- Judging gives the Members an opportunity to use judging techniques as a 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.
- Public speaking, or communications activities, have been provided for each meeting but may also be included in the Roll Call or social recreation time.

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

- Welcome and Call to Order
- 4-H Pledge
- Roll Call
- Parliamentary Procedure
    - Secretary's Report
    - Treasurer's Report
    - Press Report
    - New Business: local, regional and provincial 4-H activities/ opportunities, upcoming club activities
    - Meeting content – topic material and activities
    - Clean-up
    - Social recreation and/or refreshments
    - Adjournment

Guest Speakers:

4-H leaders do not need to be experts on the information being discussed. This project is well suited to having guest speakers lead information and activities. Suggested meeting speakers are:

- Certified Crop Advisors (CCA's)
- OMAFRA field crops staff
- Crop scouts
- Local farmers
- Local retailers/applicators of crop input materials

Leader Planning Guide:

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

As a club volunteer your responsibilities are to:

- Complete the volunteer screening process and attend a volunteer training session.
- Notify the local Association of the club, arrange a meeting schedule and participate in club meetings, activities and the Achievement program.
- Review the project material in the Reference and Record books 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.
- Have membership lists completed and submitted along with fee collected (if applicable) by the end of the second meeting.
- Have members fill out a Participant Agreement Form and identify any health concerns. 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.
- Additional project(s) as required by the club leaders.

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4-H Ontario

Glossary

Annual – plant that only lives for one growing season (one year life span)

Biennial – plant that lives for two years and does not flower until the second year

Cultivar –this is a type of a plant with specific genetic traits, such as a specific hybrid

Fungicide – chemical used to control (kill) fungi

Genetically Modified Organism (GMO) – an organism that has been genetically altered to possess specific , desirable traits

Herbicide – chemical used to control (kill) weeds

Insecticide – chemical used to control (kill) insects

Integrated Pest Management (IPM) – is an approach to pest control that requires farmers to monitor pests in order to consider all management options to maintain pests below an economic injury level

Perennial – plant that lives for two or more years

Pesticide – general term for chemicals used to control (kill) pests

Underseeding – a type of cropping where a crop is planted along with an already established plant.

Winter annual – plants that start to grow in the fall, die down for the winter and resume their life cycle, flowering when the weather is warmer again, and die before the next winter

Resources

- 4-H Ontario Judging Toolkit

  http://www.4-hontario.ca/uploads/userfiles/files/4.3%20judging%20crop%20samples.pdf

- A Field Guide to Broadleaf Weeds, OMAFRA, University of Guelph and Bayer CropScience.
- Diseases of Field Crops in Canada, The Canadian Phytopathological Society
- Identification and Management of Stem Rust on Wheat and Barley (distributed by OMAFRA)
- Identification Guide to the Weeds of Quebec, written by C. Bouchard and R. Neron, published by Conseil des productions vegetales du Quebec Inc. (Note that this is available in both French and English)
- Identifying Rust Diseases of Wheat and Barley (distributed by OMAFRA)
- Judging Standards: Handbook of Field Crops, Roots & Vegetables, Fruit, Maple Syrup, Honey Judging Standards: Handbook of Field Crops, Roots & Vegetables, Fruit, Maple Syrup, Honey, Ontario Association of Agricultural Societies
- OMAFRA factsheet: Cover Crops: Adaptation and Use of Cover Crops http://www.omafra.gov.on.ca/english/crops/facts/cover_crops01/cover.htm#reducepest
- OMAFRA Publications (see www.omafra.gov.on.ca for information on obtaining these guides):
  - Pub 60 2013 Field Crop Budgets (http://www.omafra.gov.on.ca/english/busdev/facts/pub60.htm#2010)
  - Pub 75 Guide to Weed Control
  - Pub 811 Agronomy Guide for Field Crops
  - Pub 812 Field Crop Protection Guide
- OMAFRA crops website: http://www.omafra.gov.on.ca/english/crops/index.html#field
  - http://www.omafra.gov.on.ca/IPM/english/weeds-herbicides/identification-keys/
  - http://www.omafra.gov.on.ca/english/crops/index.html#field
  - http://www.omafra.gov.on.ca/IPM/english/weeds-herbicides/identification-keys/
- Ontario Crop IPM Website: http://www.omafra.gov.on.ca/IPM/english/index.html

- Ontario Crop IPM Website Scouting section: http://www.omafra.gov.on.ca/IPM/english/ipm-basics/how-to-scout.html
- OMAFRA CropTalk newsletter: http://www.omafra.gov.on.ca/english/crops/field/news/croptalk/2006/ct_0606a9.htm
- OMAFRA Resource http://www.omafra.gov.on.ca/english/crops/hort/news/tenderfr/tf1302a3.htm
- Ontario Soybean Field Guide, Adapted from the Soybean Field Guide, 2nd edition, CSI 00010, Iowa State University, University Extension and Iowa Soybean Association, 2011. Modified for OMAFRA, the Agricultural Adaptation Council, Grain Farmers of Ontario and University of Guelph: Ridgetown Campus.
- Scouting for Corn Diseases, Iowa State University University Extension
- The Canadian Corn Pest Coalition www.cornpest.ca
- Using Pesticides in Ontario www.omafra.gov.on.ca/english/crops/reource/using-pesticides.htm#protect
- Wheat Disease Identification (distributed by OMAFRA)
- OMAFRA crops website: http://www.omafra.gov.on.ca/english/crops/index.html#field
- http://www.omafra.gov.on.ca/IPM/english/weeds-herbicides/identification-keys/
- Ontario Crop IPM Website: http://www.omafra.gov.on.ca/IPM/english/index.html

MEETING 1: THOSE PESKY CREATURES

Objectives:

- Learn the election procedure for establishing an executive.
- Help the members and leaders get to know each other
- Introduce members to the main types of pests that affect field crops
- Ensure that members understand what is required of them for club completion
- Schedule future meetings (if feasible)
- Practice Judging Skills

Roll Calls:

- Name one type of field crop
- Name one thing (good or bad) which can affect a plant
- What is one thing you would like to learn in the club this year?
- What has your favourite 4-H project been thus far? (If new to 4-H – what would they like to learn about the most in 4-H)

Sample Meeting Agenda – 2 hours, 5 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Public Speaking Activity	Activity #1 – Get to Know Each Other Game: Two Truths and a Lie	10 min
Parliamentary Procedure	Elect executive, hand out Record Books and discuss club requirement. Fill out club and member information in Record Books, and have each member fill out their "Member Expectations and Goals" page.	30 min
Topic Information Discussion	What are Pests? Pests in Field Crops Other Pests that Cause Damage	20 min
Activity Related to Topic	Activity #2 – Judging Field Crops	25 min
Topic Information Discussion	The Impact of Pests on Crop Budgets	15 min
Wrap up, Adjournment & Social Time!		10 min
Take Home Activity	Activity 3: Soybean Field Crop Budgets	

All activities can be found at the end of Meeting #1

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. Chair 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."

TOPIC INFORMATION

Each year, huge investments of time, money and technology are used to control pests in field crops to improve crop yield and quality.

What are Pests?

Pests are things that interfere with the growth or function of something else. In your house, mice are considered pests because they eat food that was intended for humans and pets and they sometimes chew things, like clothing, causing frustration for people.

In general, pests are considered to be things that bother us.

Pests in Field Crops

While plant growth can be affected by many factors, such as seeding rate, sunlight, water availability and soil fertility, there are three main categories of pests that can be present in a field and adversely affect field crops. These interferers are:

1. Insects
2. Weeds
3. Diseases

Photo credit: Elizabeth Johnston

Each of these categories affects crops in a different manner. It is also important to remember that not all insects, weeds and diseases hurt crops. Some of these 'pests' are actually beneficial for the crops that are their hosts.

PEST	INTERFERENCE WITH CROP	EXAMPLES OF CROP FRIENDS	EXAMPLES OF CROP FOES
Insects	• Eat leaves, stems, roots and seeds • Suck nutrients or juices from leaves and stems • Spread diseases	• Lady beetles • Ground beetles	• European corn borer • Aphids • Leafhoppers
Diseases	• Destroy roots • Attack leaves/stems • Attack seed/grain	• Mushrooms • Rhizobia	• Soybean cyst • Nematodes • Rust • Smut fungus
Weeds	• Crowd roots • Absorb water and nutrients required by the crop • Block out sun • Shelter insects • Causes harvest problems • Reduce yield	• Garden flowers	• Milkweed • Ragweed • Foxtail

How do these pests get here? How do they become a problem?

There are several reasons why weeds, insects and diseases become such a challenge in the areas they are found:

1. Introduced – Some pests are introduced to an area. This means that they have been brought to one area from another. It could be from one country to another or from a forest to a meadow. Since these pests have not evolved with the other plants and animals of the area, which are known as inhabitants, problems can arise. Sometimes the intruder will not survive. Other times, the intruder is capable of doing extensive damage to the ecological system which took thousands of years to evolve. There are no natural predators present to control the intruder in its new area.

2. Changing Environment – When humans change the environment weeds, insects and diseases can become a problem. For example, a meadow has a wide variety of plants, and is lush and healthy. When the meadow is converted to a field for single crop production then problems will occur because the plants of the meadow (whose seeds may still be present) are weeds for the new field crop. Those plants from the meadow will compete with the crop. Insects that feasted on plants in the meadow can seriously harm the crop. There may also have been diseases present in the meadow that affected some plants. In a mono-cropping situation, those diseases can be devastating.

3. Diversity – The more variety you have in an environment, the better chance that creatures will survive. For example, in a meadow there is a wide variety of plants. If that meadow has an insect that destroys all the daisies, it will not be a complete devastation as other plants will survive. But in a field of corn, an insect that feeds off of corn roots has the potential to devastate the entire crop.

It is important to know the background of weeds to try to control them. Since they are living things they are constantly evolving and sometimes evolve in such a way to become resistant to the control mechanisms that are used.

Are there other types of pests that affect field crops?

Yes! While this 4-H project focuses on weeds, insects and diseases, there are other things that can adversely affect plant growth. Examples include:

- Rodents, such as mice that feed on grain
- Other animals, such as deer, birds, raccoons, etc.
- A crop might even consider humans to be pests, driving over plants when spraying, or walking through fields and crushing plants under their feet

Judging Field Crops

Field crop judging coordinates well with the study of field crop pests. Pests cause damage to plants, resulting in crops being produced that may be of a lower grade (standard) than those that have not been damaged by insects.

We grow crops for several reasons:

- Seed for next year
- To feed livestock
- To process as food
- To process as biofuels
- To process into other useful products

The suitability of crops for their intended purposes depends on a variety of factors, such as:

- Maturity
- Machinery damage
- Weather damage
- Insect damage
- Disease
- Impurities

The impact of pest damage on the quality of field crops can be quite large. For example, when judging cobs of corn, “Freedom from Damage”, which indicates freedom from pest damage and sprouted or discoloured/bleached kernels (often caused by disease) accounts for 30% of the overall cob quality.

Photo credit: Elizabeth Johnston

The 4-H Ontario Judging Toolkit has scorecards available for the following field crops (http://www.4-hontario.ca/uploads/userfiles/files/4.3%20judging%20crop%20samples.pdf):

- Cob corn
- Seed samples
- Hay and haylage
- Sheaves
- Bean and corn fields
- Grain fields
- Corn silage
- Field – standing hay

More information on judging specific field crops is available from the Ontario Association of Agricultural Societies (Judging Standards: Handbook of Field Crops, Roots & Vegetables, Fruit, Maple Syrup, Honey).

DIGGING DEEPER

The impact of pests on crop budgets

Like people with other jobs, farmers are most often affected by things that impact their pocketbooks. Pests cause economic challenges in two ways:

- They damage crops, decreasing yields and thus **decreasing the amount of crop to harvest and sell**.
- Attempts to control pests cost money in insecticides, herbicides and tillage thus **increasing costs of production**.

For cash crop operators, where money is directly earned by crop sales, the impact of this is quite obvious. For livestock farmers, when yields are decreased, it may lead to further financial losses as farmers need to purchase more feed for their animals or the feed quality may be reduced, reducing the productivity of the livestock.

Photo credit: Elizabeth Johnston

The chart below, with a summary of production costs for selected crops indicates the costs in crop production that are related to fertilizer and pesticides and their application.

Sometimes the cost associated with controlling pests is not as obvious. For example, it may be hidden in the cost of seed. In the case of soybeans, the chart shows that non GMO (Genetically modified organism) soybean seed is much less than that of Roundup Ready soybean seed (seeds that have been modified so that they are resistant to herbicides that will kill the weeds competing with them). However, the cost of pesticides is much lower for the Roundup Ready Soybeans than the non-GMO soybeans.

In the example below, the cost per acre of pesticides and spraying alone for a conventional corn field is $13.15 + $10.20 = $23.35. If the total input cost is $549.15, the obvious pesticide related cost is $23.35/$549.15 x 100%= 4.25%. But remember that the direct cost of dealing with pests is more than that – some of the costs related to fertilizing and tillage would be attributed to pest control.

2012 Crop Comparison Summary Table for Selected Field Crops ($/acre)*

Note: Only the expense portions of the table are given below. They do not include the cost of land rent or other expenses that may not be categorized here.

	Corn Conventional Tillage	Herbicide e-Tolerant Spring Canola	Non GMO Soybeans No Till	Roundup Ready® Soybeans No Till
Seed	108.70	61.85	51.30	80.45
Fertilizer	127.95	96.15	28.45	28.45
Pesticides	13.15	11.50	43.80	13.80
Total Inputs	**249.80**	**169.50**	**123.55**	**122.70**
Tillage	49.90	43.90		
Planting	19.95	19.05	24.05	24.05
Spraying	10.20	10.20	20.40	20.40
Fertilizing	10.20	10.20	10.20	10.20
Harvesting & Trucking	77.15	50.40	50.15	50.15
Total Machinery	**167.40**	**133.75**	**104.80**	**104.80**
Drying	75.20		12.15	12.15
Crop Insurance	14.05	15.25	11.25	11.25
Interest @ 4.0%	9.75	5.30	4.55	4.50
Marketing & Other	32.95	3.65	10.70	10.70
Total Costs	**549.15**	**327.45**	**267.00**	**266.10**

	Coloured Beans	White/ Black Beans	Soft Winter Wheat No Till	Oats (South-ern Ontario)	Hard Red Spring Wheat
Seed	118.15	81.20	51.90	35.55	61.35
Fertilizer	52.95	52.95	86.45	40.90	78.90
Pesticides	102.15	102.15	23.00	23.00	23.00
Total Inputs	**273.25**	**236.30**	**161.35**	**99.45**	**163.25**
Tillage	73.25	49.80		43.90	43.90
Planting	20.05	25.05	24.05	19.05	19.05
Spraying	30.60	40.80	20.40	20.40	20.40
Fertilizing	10.20	10.20	10.20	10.20	10.20
Harvesting & Trucking	91.10	58.70	57.15	49.60	50.35
Total Machinery	**225.20**	**184.55**	**111.80**	**143.15**	**149.90**
Drying					
Crop Insurance	35.50	25.70	13.65	6.70	10.90
Interest @ 4.0%	8.50	8.15	8.45	3.40	5.30
Marketing & Other	4.30	6.90	4.20		2.60
Total Costs	**546.75**	**461.60**	**299.45**	**252.70**	**325.95**

***** The crop comparison summary table is derived from the individual budgets in the publication. Some expense items have been combined in the summary table.

Source: http://www.omafra.gov.on.ca/english/busdev/facts/pub60a1.htm

Author: John Molenhuis, Business Analysis and Cost of Production Program Lead/ OMAFRA

ACTIVITIES

Activity 1 – Get To Know You Activity Two Truths and a Lie

Objectives – To practice public speaking skills and help members get to know each other better.

Materials – Paper and pens

Instructions – Give members two minutes to write down two things that are true about themselves, and one thing that is a lie. Then, members, one by one (or two groups if the club is very large) should introduce themselves and state their three 'facts'. The rest of the club members should try to guess which statement is a lie and which are the truths.

Alternate Activity – An alternative activity could be selected to familiarize members with one another.

Activity 2 – Judging a Seed Sample

Objectives – The purpose of this activity is to help members practice their judging skills and to learn about the qualities of a desirable seed sample along with the negative impact that pests have on seed samples. (Note: another crop scorecard could be used for this activity).

Suggestion – A CFIA seed or grain inspector or someone from an elevator could be invited to talk about what they look for in a seed sample.

Materials – pens or pencils, Judging Reasons Worksheet from the Members' Record Book

Instructions – Review the scorecard and format for giving reasons with members before giving them time to judge a class of seed samples. Then, give members the opportunity to give reasons aloud.

Discussion - Offer encouragement and constructive comments.

SEED SAMPLE

	PERFECT SCORE
FREEDOM FROM DAMAGE	**30**
- no cracked, broken or dark brown kernels	
- weather damage reduces chance of germination	
- no discolouration, mold or sooty spores	
- no holes in seed or flour-like material	
FREEDOM FROM IMPURITIES	**30**
- no foreign seeds, straw, weeds, chaff, mud	
SIZE AND TEST WEIGHT	**15**
- varies according to crop	
- low weight indicates damage or immaturity	
UNIFORMITY	**15**
- uniform size, shape and colour	
MATURITY AND PLUMPNESS	**10**
- mature kernels are plump with normal colour	
- no green or shriveled seeds; correct moisture content	

Activity 3 - Soybean Field Crop Budgets

Objective – For members to consider the costs associated with planting, growing and harvesting field crops, particularly noting the cost of controlling weeds, insects and diseases.

Materials – Pens or pencils, copies of the Soybean Field Crop Budget from the Members' Record Book.

Instructions – Members are asked to complete the Soybean Field Crop Budget. They can use current crop prices to estimate revenues as well as the generalized budget information provided in the topic material for this meeting to complete the form. This is recommended for senior members or as an activity done by pairing senior and junior members.

Discussion –

- What were the total expenses and revenues that members estimated? Were they predicting that the crop would make money?
- How much more do GMO seeds cost than conventional seeds for the benefit of herbicide resistance?
- How much money was spent on pesticides and spraying?
- What other categories would be impacted by pest control methods? (i.e. tillage, fertilizer costs and applications, etc.)

MEETING 2: GET THOSE PESTS UNDER CONTROL!

Objectives:

- To provide an overview of how pest management strategies are created
- To learn about the safe use of pesticides

Roll Calls:

- Name one way to control a pest
- Did you plant a crop plot at home or at a neighbour's? If so, what did you plant?
- What type of tillage method(s) do you use at home. If not from a farm, report on the tillage method(s) used at a friend or neighbour's farm.
- If you were a genetic engineer, and you were able to put any desirable gene into a plant (i.e. to aid growth, reproduction or pest resistances) what characteristic would you give it and what type of plant would it be in?

Sample Meeting Agenda – 2 hours, 10 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	10 min
Topic Information Discussion	Managing Pests Integrated Pest Management	20 min
Activity Related to Topic	Activity 4: Keying Out Activity	10 min
Topic Information Discussion & Activity	Crop Scouting (5 minute explanation in field) Activity 5: Scout it Out (10 min scouting; 5 min for results)	20 min
Topic Information	Using Pesticides Safely	15 min
Activity Related to Topic	Activity 7: Pesticide Drama	30 min
Wrap up, Adjournment & Social Time!		10 min
Take Home Activity	Activity 9: Pest Management Crossword	

All activities can be found at the end of Meeting #2.

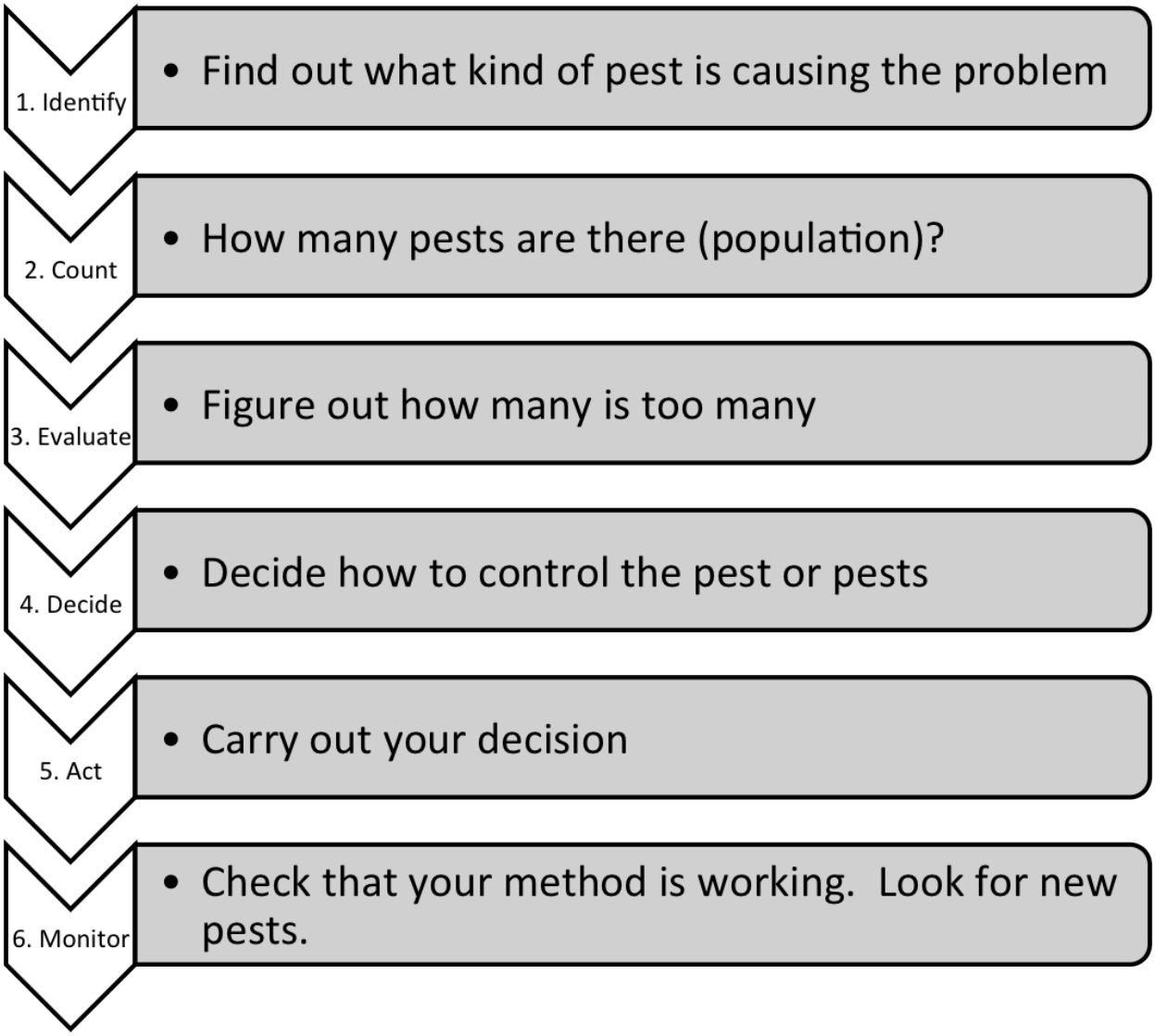
TOPIC INFORMATION

Managing Pests

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.

Let's look at the Six Steps to Better Pest Management:



Let's look at the six steps in more detail:

Step 1 – Identify

To control pests you must first find out what the pest is.

Three ways of identifying pests are:

1. Look through a picture guide book on insects, weeds or diseases
2. Ask someone who might know (i.e. a farmer, crop specialist)
3. Use an identification key. A key is a set of questions you ask yourself to find out what your sample is. Each question must have only two possible answers.

Photo credit: Jennifer Thompson

Step 2 – Count

Figure out how many pests you have in a field. It would be impossible to count all the pests in a field. It would even be impossible to count all the weeds in a vegetable garden.

Look at a sample of the crop and count the pests in that sample (i.e. one square metre). This will give you the "density" of the weed. In large fields, several of these samples should be taken. Look for changes in the number of pests over time to monitor if it is increasing or decreasing.

Step 3 – Evaluate

Once you know the density of the pests, figure out if this is a lot (high density) or few (low density).

The density at which significant damage to a crop will occur is different for every pest. Field guides are good resources to help determine if the pest level in your field has reached a critical level.

The decision to spray pesticides or use other measures of pest control is made at this density, and is referred to the **threshold** level. Once pests reach the threshold for a specific crop, it is time to make a decision and act!

Example: In a field sample you may have counted 10 weeds of one type and 50 insects of one type. Since you know the crop and the pests you can figure out that the 50 insects will do little harm but the 10 weeds could choke out and destroy your crop.

Step 4 – Decide

Now that you have all the facts you will decide what your options for control are. To make this decision you will need some tools, or methods, to control the pests.

There are four main tools that can be used for pest control:

1. Biological – A living plant or animal is used to manage a living plan or animal that is a pest (like a house cat used to catch mice, a cover crop to choke out weeds, or planting a resistant crop variety)
2. Cultural – Humans can change the environment, making it unsuitable for pests to live in. In the house, we control mold in this way by washing the dishes after a meal. In the field, this may include crop rotation, improving drainage or changing pH and soil fertility to benefit crop growth.
3. Mechanical – This is a physical way of controlling a pest. In the home, killing a fly with a fly swatter is a mechanical means of control. Field crop examples may include plowing, cultivating or pulling weeds out by hand. It could also include cleaning farm equipment in between fields.
4. Chemical – This involves the use of pesticides to control pests. They can be applied to the seed, soil or the plant or they may already be present in the plant itself. There are four types of pesticides:
    a. Herbicides – kill weeds
    b. Insecticides – kill insects
    c. Fungicides – kill fungus (disease)
    d. Nematicides – kill nematodes

The decision made to control pests should be the most practical, safest and economical method or a combination of methods.

Step 5 – Act

Once you have made your decision, you must act on it. If you are to use pesticides it is important to know the potential danger to the person applying the pesticide, the environment and the crop it is being applied to. You may not be able to take action now. The correct action may take place when plants reach a certain maturity level, or during the fall or next year. You also need to know a few other things such as weather condition requirements (i.e. how long until it rains), what temperature is too hot or cold to apply and be effective, the rate at which to apply and how much water is required (i.e. how much is needed for effective application). It is critical to know how to apply pesticides properly to minimize any adverse impacts.

The **Six Steps to Better Pest Control** will be discussed at future meetings as they relate to the three main types of pests: weeds, insects and diseases.

Step 6 – Monitor

Once you have acted on your decision it is important to walk your fields frequently and see if your plan worked. How well did it work? If it didn't work, why not? What else can be done? It is also important to continually monitor for other pests.

Integrated Pest Management (IPM)

The six steps that we have just reviewed develop a program that is called IPM, or Integrated Pest Management. This term refers to using a combination of methods to control pests, considering important factors such as the crop, the type and density of invading pests, and the control options that the producer is willing to consider.

Breaking down the acronym into its three parts makes understanding it very simple:

Integrated – means that more than one method of pest management can be used at the same time

Pest – includes weeds, insects, diseases, basically anything that can harm and cause damage

Management – refers to reducing the number of pests and reducing the amount of damage they cause. This could involve planning even before planting a crop.

Crop Scouting

Scouting is the most critical pest management tool. A few things that one might be looking for when scouting fields include:

- Crop emergence from the ground (did the seeds germinate and grow?)
- Are there poor areas of growth or washed out areas in the field
- Are there pests present? If so, what are they and how many of them are there?
- Are the plants healthy? Do they exhibit signs of nutrient or moisture deficiencies?

Crop scouts are like 4-H members – they "Dig Deeper" as many of the problems they find are below the soil surface, such as the wireworms below that were found feeding on the roots of corn plants

Who does the scouting?

- Farmers - it is important for crop producers to keep track of their crops by doing basic scouting
- OMAFRA crop specialists, local crop input suppliers, custom fertilizer and pesticide applicators and other crop protection companies are examples of people who could be asked to help scout fields

Photo source: Jennifer Thompson

How to Scout

Source: http://www.omafra.gov.on.ca/IPM/english/ipm-basics/how-to-scout.html

Systematic monitoring of pest populations, weather conditions, plant health and disease symptoms are critical components of an IPM program.

Tools needed to monitor pests

- a 16-20x hand lens
- traps
- collection bags and vials
- field maps
- flag tape
- shovel or sturdy trowel
- pocket knife
- scouting forms and record sheets

Monitoring strategies

- Review pest control calendars to know when certain pests will be active.
- Learn to identify life stages and damage caused by diseases and pests.
- Understand the biology and life cycle of pests and diseases.
- Recognize beneficial insects, as well as harmless insects.
- Use historical data to identify hot spots and previous problems.
- Keep a field map and record the location of damage.
- For each visit, record the stage of crop development, disease severity, population levels of insect pests and beneficials, and damage observed.
- Keep a journal or log of rainfall amounts, daily highs and lows, and weather events.
- Keep a record of pesticides applied and other control measures used.

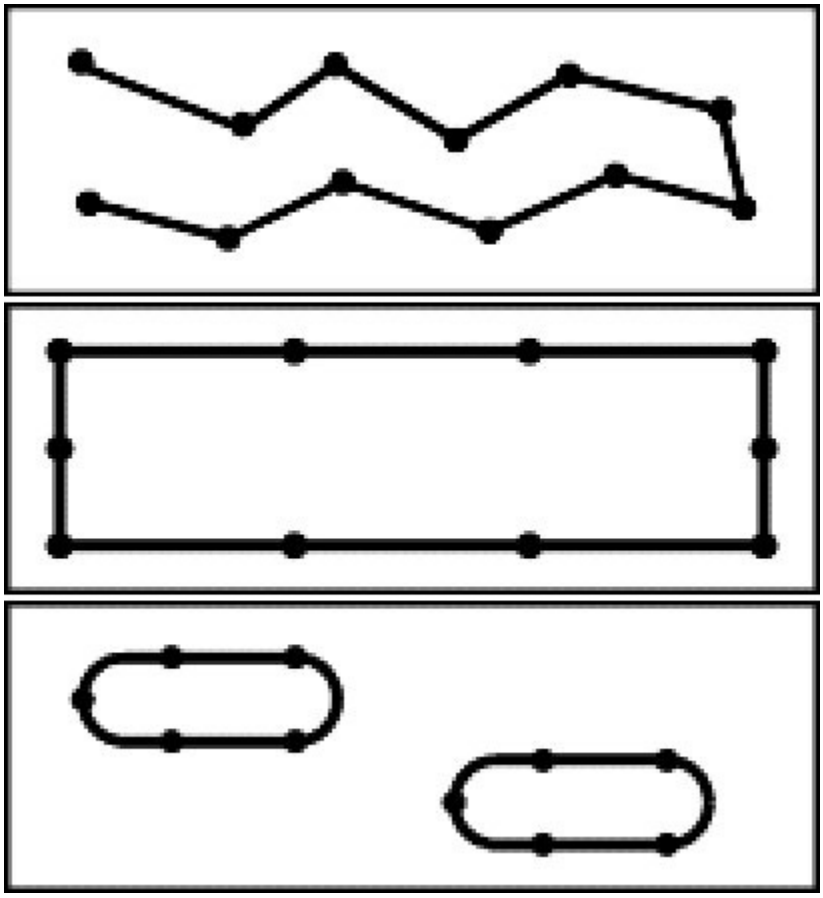
Monitoring procedures

- Monitor at least once a week and preferably twice a week during critical stages.
- Monitor at approximately the same time each day and keep the light behind you.
- Inspect plants in several areas across the field to get an accurate idea of pest pressure.
- Stand back and look for patterns, such as patches or areas of poor plant growth or where colour is off.
- Get close and examine the underside of leaves and inside the canopy, etc.
- Scout the edges of the field and interior of the field separately. Give special attention to border areas.

Sampling

Sample collection involves the collection of data to represent the entire area being monitored.

- Divide large areas into sample blocks.
- Walk in a W or zig-zag pattern across the field to collect samples from a representative area.
- Look away from the plant when you take samples of leaves and fruit, etc., otherwise you will tend to choose damaged leaves or fruit and bias the sample.



For more information about Crop Scouting for Field Crops check out the OMAFRA Agronomy Guide by visiting: **www.ontario.ca/crops** - then click on Publications and then click on Agronomy Guide.

Using Pesticides Safely

Integrated Pest Management Programs often involve the use of pesticides as a tool for controlling pests. They can be very effective, but it is important to remember that they can be very dangerous as well. There are potential dangers for both the pesticide operator and the environment.

To help explain pesticide safety, and illustrate the points from the following information, it may be helpful to bring pesticide container labels (copies can be printed from various company websites), safety clothing and equipment, natural control products (diatomaceous earth, foliar Bt sprays) or paraphernalia about pesticide safety.

The 4-H's of Pesticide Safety

HEAD – Use your head!

- Children should never use pesticides
- Pesticides should be used only when needed. Be sure to use one that is recommended for the pest that you need to control.
- The entire label on the pesticide container should be carefully read each time the chemical is used.
- Follow the instructions exactly. Pay special attention to precautions and to information about what to do in case of an accident.
- Take the Grower Pesticide Safety Course

HANDS – Handle with Care!

- Adults should do pesticide mixing. This should never be a job for children on a farm or in the home.
- Sprays must be mixed outside, where there is sufficient fresh air.
- Apply pesticides only as specified, and only for the pests listed on the label.
- Use only the amount prescribed (rate of application). Using more than the prescribed amount does not necessarily result in more pests killed – it may cause harm to the crop or environment.
- Left-over spray should be properly disposed of. Disposal methods are often described on the label. Never pour a pesticide onto the ground to leave puddles that animals could drink from or children could play in. Pesticides poured on the ground soak in and may eventually find their way to ground water and possibly your drinking water supply. Leftover mixed pesticides or rinsate from spray tanks can be applied back to the same field in order to dispose of the product.

HEART – Have a Heart!

- Never spray or dust on a windy day as the chemicals will end up beyond the areas intended for them.
- Be aware of water wells and open water like ditches and streams. Avoid spraying in the vicinity.
- Cover bird baths or animal dishes before spraying if they are in the vicinity.

- Keep pets and farm animals out of the way while spraying.
- Inform your neighbours that you are spraying.

HEALTH – Protect your Health

- Stand where the spray or dust will drift away from you.
- If the label says avoid skin contact, wear proper clothing. Wear long sleeved clothing and gloves when mixing or applying the pesticide.
- Avoid breathing in chemical fumes, mists or dusts. Wear a protective mask.
- If you accidentally spill a pesticide on yourself, STOP. Removed the soiled clothes and wash the exposed skin thoroughly. Check the pesticide label to see if there are instructions for dealing with skin exposure.
- Wash hands and face after using pesticides, especially before handling any food.

Pesticide Storage

- Pesticides should be kept in their own containers. The label will tell what it is and how to use it.
- Pesticides should be kept out of reach of children and pets, and away from food supplies. A locked storeroom away from the house and away from water sources like wells is required for storage of pesticides.
- Flammable pesticides must be kept away from flames and hot places and other flammable fluids like gasoline.

DIGGING DEEPER

When spraying pesticides goes wrong…

(Source: www.omafra.gov.on.ca/english/crops/reource/using-pesticides.htm#protect)

Even if pesticides are applied using safe handling procedures, problems can still occur. A couple of major problems that can result from pesticide applications are spray drift and herbicide damage.

1. Spray Drift– This is the aerial movement and deposit of pesticides outside of the target area. Not only does it waste chemical products and reduce the effectiveness of the pesticide applications, it can cause great harm to the environment, the crops that it does 'land' on, and wildlife. There are a few strategies to reduce the amount of pesticide that drifts outside of its intended area:
    - Avoid spraying when it is windy or gusty. Many pesticide labels give wind speeds for applications. Adjustments may need to be made to equipment to limit drift as these conditions change. Examples of changes include adjusting water volume upwards, minimizing nozzle-to-target distance, changing the type of spray nozzle, or changing fields until conditions improve.
    - Avoid spraying when the air is dead calm, such as in the early morning or late evening. The temperature is usually cooler then, and pesticide droplets may remain 'floating' in the air, ready to drift when the wind speed increases.
    - Use the recommended sprayer output
    - Make sure that a nozzle is used that is of the appropriate size. Fine droplet nozzles are seldom used.
    - Use the most appropriate nozzle. Air induction/venturi nozzles reduce drift when they can be used, as compared to conventional nozzles
    - Check the height of the spray boom from the target. Make sure that the distance is minimized as much as possible while still maintaining a uniform spray coverage.
    - Read the label to follow buffer zone requirements from neighbouring sensitive areas.
    - Use spray plume protection where practical (hoods, shrouds, screens, air curtains)
    - Use drift-reducing adjuvants in the spray tank as per label instructions.
    - Wick weeders (a contact herbicide applicator for weeds higher than the crop) can sometimes be used in place of spraying
    - Try to use non-volatile pesticides or products
2. Water Contamination – This should be avoided by using the following practices:
    - Load and mix pesticides away from water sources and other environmentally sensitive areas. Collect any drainage and run-off and

dispose of it in a safe manner.

- Do not clean spray equipment near areas of water. This includes not only surface water sources but also wells. Diluted rinse water can be applied to the crop being treated as long as the application rate is not higher than what is given on the pesticide label.
- No direct connections should be made between a water supply and a spray tank. Use anti-backflow devices or an intermediate system to prevent contaminating a water supply. Immediately clean up any spills.

3. Poisoning of Bees – Honey bees are a valuable commodity and care should be taken to avoid harming them.
    - Contact any neighbouring beekeepers if you are spraying so that they may take precautions to avoid harm from their end.
    - Time insecticide applications to when they will minimize bee poisoning, such as after 8pm or before 7am so that foraging bees can be avoided.
    - Avoid spray drift that can affect plants adjacent to the target field or can travel to hives outside of the target spray area
    - Avoid spraying on a flowering crop where bees are foraging

Photo credit: Elizabeth Johnston

4. Herbicide Injury (Source: Ontario Soybean Field Guide) – This type of plant disorder results when plants come into contact with a pesticide that they are not resistant to. It can be avoided by:
    - Cleaning the tank between pesticides so that it is not contaminated with spray that was intended for a previous crop
    - Ensure that there is an appropriate amount of time between burndown and the planting of the new crop
    - Avoid spray drift that can transfer chemicals beyond the targeted crop (see above)
    - Follow label instructions for application of pesticides
    - Consider the pesticides that are applied and the crops that will be later planted (i.e. leftover atrazine in soil can cause Photosystem II inhibitors in soybeans, resulting in leaf injury and death)
    - Avoid over-application

ACTIVITIES

Activity 4 - The Keying Out Game (10 min.)

Objective – The purpose of this game is to teach members how to use identification keys. More complex keys are used to identify pests. This activity may be particularly useful for junior members.

Materials – Pictures or the actual fruits: Grape, Peach, Orange, Grapefruit, Apple and Banana

Instructions

1. One member will select a fruit but will not tell any of the other members which one they have picked.
2. Each of the other members can help to ask the following questions about the fruit. The questions must be asked in the proper order for the ID key to work.

    1. A. Is the skin red, orange or yellow? Yes…….go to Question 2

        No……...go to B

        B. Is the skin any other colour? ……..GRAPE

    2. A. Does it have smooth skin? Yes…….go to Question 3

        No……go to B

        B. If the skin is not smooth, is the

            i. Skin fuzzy, thin……PEACH

            ii. Skin thick, oily, crinkled

                a) Colour orange……..ORANGE

                b) Colour yellow……GRAPEFRUIT

    3. A. Is the shape roughly round? Yes…….APPLE

        No……..go to B

        B. Is its shape long? …….BANANA

Advanced Alternative - Field Key to Insects of Corn

A. Areas of poor stand or stunted plants or lodged plants

1. Seed fails to germinate or wilts quickly after germination
   a. Spindle-shaped headless, legless maggots in seed or stalks -- seed corn maggot
   b. Elongate, hard larvae with definite heads and legs in seed- Wireworms
2. Plants cut at crown, dark caterpillars in soil near cut plants -- cutworms
3. Roots chewed, pruned, or tunnelled
   a. Fat, soft-bodied larvae that tend to curl into C-shape in soil-- white grubs
   b. Elongate, straight larvae in soil
      i) Larvae hard, cylindrical, 1.5 em or more in length, may be yellowish to brown -- wireworms
      ii) Larvae soft, somewhat flattened, up to 1em in length-- corn rootworms
4. No clear signs of insect damage - take soil sample for nematodes

B. Signs of insect feeding on plants

1. Holes eaten through leaves; soft, slimy, dark animals under trash near plants -- slugs
2. Leaves feed on from margins; active running or jumping insects with enlarged hind legs on plants -- grasshoppers
3. Hard shelled beetles on or in soil near plants
   a. Beetles with short antennae (feelers) around damaged areas on stalk or ears: black with four yellow to red spots on wings -- sap beetles (a common scavenger often blamed for damaging the plants)
   b. Beetles with long antennae
      i) Small, black, jumping beetles eating circular holes or pits in leaves -- flea beetles
      ii) Beetles with red pronota (neck) and metallic blue wings scraping the upper surfaces of the leaves -- cereal leaf beetle adults
      iii) Yellow, green, or reddish beetles feeding on the upper surface of the leaves, tassels, or silk-- corn rootworm adults
4. Caterpillars on or near plants
   a. White to tannish usually, with four black spots on top of each segment -- European corn borer
   b. White with dark stripes on each end and a broad dark “saddle” across centre of the body -- stalk borer

c. Dark with a broad, light stripe down each side

i) Skin velvety when viewed with a hand lens -- corn earworms

ii) Skin smooth -- armyworm

d. Plants or sections of leaves cut; variously marked dark caterpillars in soil near plants -- cutworms

C. Insects tunnelling the stalk or mid ribs of the plants

1. Caterpillars in the stalks

a. White with dark stripes on each end and a dark "saddle" across centre of body - stalk borer

b. White to tannish, usually with four black spots on top of each segment -European corn borer

D. Leaves discolored, curled, or spotted

1. Groups of inactive, soft, rounded insects usually at bases of leaves or ears - aphids

2. Very small, active, spindle-shaped, reddish to black insects in leaf sheaths; upper surface of leaves with small, white spots (stripping) - thrips

3. Very tiny (.05 cm) animals in silk tunnels on the underside of the leaf; leaf yellow to bronze - mites

Discussion – Review with members that this is the basic process of using an Identification Key. Members can use this type of key to identify different pests. Those keys may involve more questions but the basic process is the same.

Activity 5 - Scout it Out (15 min)

Objectives – To teach members some basic field scouting methods and put members in the mindset of identifying pests.

Materials – Scouting tools, pens and paper.

Instructions – Members should be separated in to groups of two or three to form teams. In the field, members should be reminded of details from the "How to Scout" section of the topic information. Teams are then given 10 minutes to find and collect and/or record the pests that they find during that time. Give bonus points to groups determining the populations of the pests they find. The team with the most pests recorded and bonus points accumulated is the winner.

For younger members – this activity could be done using wrapped candies as the pests for them to find.

Activity 6 - The Story of Marvin (10 min)

Objective – To learn about the safe use of pesticides.

Materials & Instructions – Read the Story of Marvin and ask the members the discussion questions. They can write down what Marvin does right and wrong while you are reading the story.

Story – A Case Study in Safe Pesticide Use

It was that time of year again. The days were getting longer and the fields were in need of some tender loving care. Work had to be done so that the fall harvest would provide enough money to pay the bills. Marvin had wanted to get the sprayer out for a while, but it had been raining so much he hadn't been able to get on the field. Today, however, it was sunny and no rain was in the forecast, although it was windy.

Marvin went down to the storage shed to get his materials out. He unlocked the storage locker and found the can he had used last year. The label was a bit messed up but he remembered what it said. "Two parts to one, or was it four parts water to one of pesticide?" Well Marvin wasn't too sure so just be safe he decided to go two parts water to one part pesticide. He figured it best to have too much than not enough. He sure didn't want to go and spray twice.

So Marvin got his mixture all done up but he spilt some on his pants. "Ah that doesn't matter." Said Marvin "These are my special pesticide clothes. I always make sure I am well protected. I wear long sleeved clothing and gloves when I mix the stuff. A little spill won't matter." So Marvin took the mixture out of the shed and put it in the applicator.

Rover, Marvin's pet dog started to follow Marvin's tractor into the field. He always did this in the hopes of getting a little extra attention from Marvin.

Soon it was lunchtime and Marvin was very hungry. His son brought his lunch to the field. He always liked taking that lunchtime break. But it was getting late and he wanted to finish the field before the end of the day so he had a short lunch and went back to work.

Finally he was finished. On his way home, Marvin flushed out the rest of the pesticides in the creek on his property. When he got home he realized there was still a bit left so he dumped it out. It left a bit of a puddle but it eventually soaked into the ground.

Marvin took off his pesticide clothing and carefully washed his hands and face before he sat down for a much needed rest.

Discussion –

Ask members what Marvin did right (locked pesticides in a storage shed away from the house, wore special protective clothing, filled his applicator outside the storage shed, washed up at the end of the day)

Ask members what Marvin did wrong (sprayed on a windy day, used a pesticide with no label, didn't know correct mixture so used more, after spilling pesticide he did not change or wash, let his dog follow him while he sprayed, did not wash up before eating lunch, flushed pesticides in creek, dumped pesticides on ground and left a puddle).

Activity 7 - Pesticide Drama (30 min)

Objective – To practice public speaking skills and to learn about using pesticides safely.

Materials and Instructions – In groups, members are given 20 minutes to prepare short (2-3 minute) skits highlighting the safe use of pesticides. The story of Marvin (from Activity 3) could be used to give them ideas. The groups must then present their skits to the rest of the club members.

Discussion – Reiterate the importance of using pesticides safely. What dangers were presented in the skits? What good practices were demonstrated?

Activity 8 - Public Safety Announcements (20 min)

Objective – To reinforce safe pesticide use and handling methods.

Materials – Poster paper or Bristol board, markers, publications that contain pictures of pesticides or application (that can be cut up)

Instructions – Ask members to make factsheets, posters or other publications on pesticides.

Discussion – Members can share their posters with the rest of the club to reinforce key safety concepts.

Activity 9 - Pest Management Crossword

Objective – To reiterate some of the terminology learned throughout the club meetings

Materials – Pens or pencils, copies of the Pest Management Crossword found in the Member Record Book

Instructions – Give members time to complete the crossword or request that they complete it at home following the meeting.

MEETING 3: THE WEED RACE

Meeting Objectives:

- The purpose of this meeting is to teach members how to identify weeds in their fields
- Learn how to determine control measures to reduce the weeds and allow the crop to win the 'race'

Roll Calls:

- Name a weed and a type of crop that it can affect
- Each member displays a weed that they brought to the meeting and tells the other members what it is. (Leaders or youth leaders could bring extra weeds to the meeting in case some people forget to bring theirs). This could also be done as an activity, taking more time to help members with the identification process (see Activity 2).

Sample Meeting Agenda – 2 hours

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	10 min
Topic Information Discussion	What are Weeds? Problems Caused by Weeds	20 min
Public Speaking/Judging Activity	Activity 11: Weed ID (weeds brought by members)	20 min
Topic Information Discussion	Weed Management Options Six Steps to Better Pest Management	20 min
Activity Related to Topic	Activity 15: Drying Weeds	15 min
Activity Related to Topic	Activity 12: Weed Identification Guide	10 min
Wrap up, Adjournment & Social Time!		10 min
Take Home Activity	Activity 13: Search a Weed	

All activities can be found at the end of Meeting #3.

***Specimen Collection* – For meetings 3, 4 and 5, identification activities are strongly recommended for weeds, diseases and insects, respectively. Members can either be asked in advance to bring a specimen collected at home or the club could go into the field and collect samples. It is important to plan meeting time accordingly.**

TOPIC INFORMATION

What are Weeds?

Weeds are plants which have something about them people do not like. Usually the problem with the plant is where it is growing. It could be in your lawn, garden, flower bed, field, or along the side of the road. Weeds can be native plants that have always been in the area or they can be plants that have been introduced to the area by people, animals or weather.

What one person may view as a weed may be a wildflower to another person.

Whether or not a plant is a weed may depend on when it is growing in a particular location. For instance, stalks of corn may comprise a field crop in a certain field this year, but if corn stalks are found growing when the field has been replanted with soybeans the following year, the corn stalks are then considered to be weeds.

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.

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.

Photo credit: Elizabeth Johnston

Plant Life Cycles

To control weeds it is important to know a little bit about their life cycles. Weed control strategies will disrupt weeds at an effective point in their 'lives'. Weeds, just like other types of plants, will have one of the four basic life cycles:

Plant Life Span	Type of Cycle	Description	Sample Weeds	Sample Crops
1	Annual	Live one growing season	Lamb's quarters Ragweed Pigweed	Corn Tomatoes
1+	Winter Annual	Seeds start to grow in the fall. After the winter the plant will continue to grow, flower, make seeds and then will die before the next winter.	Shepherd's purse Chickweed Stinkweed	Winter wheat Winter canola
2	Biennial	They flower and have seeds only in the second year.	Wild carrot Burdock	Red clover Mustard
2+	Perennial	Live for a number of years. Many will flower every year and die back to the ground, but their roots, or underground stems, live on and grow more with every year.	Thistle Quackgrass	Alfalfa Timothy

Weed Management Options

There are many strategies to help reduce the negative impact of weeds on field crops. Generally, different strategies are utilized together in an integrated plan to reduce weed damage as much as possible.

Some common methods of weed management include:

1. **Field Scouting –** Monitoring weed growth and development as well as their density and population in the field. Once weed control methods have been applied, scouting is an effective tool to monitor the effectiveness of the weed control method.

2. **Crop Rotations –** Rotating crops from year to year helps to control weeds in a couple of ways. It can kill perennial weeds that survive best with a particular crop. Rotating crops also allows different herbicides and tillage practices to be applied. Those different processes may be more effective on some weed species than others.

3. **Crop and Variety Characteristics –** Some crop species or hybrids may compete better than others when exposed to certain types of weeds. The type of crop can also impact the need for weed management. For example, cereal crops are generally harvested earlier than crops such as corn or soybeans. This means that the bare ground left behind after harvest allows weeds to grow back quickly and easily. It is thus important to start controlling weeds earlier in the season after cereals have been harvested. Control of annual weeds needs to start earlier than for perennial weeds.

4. **Cover Crops –** These are crops that are planted to cover the ground and can do a number of different things such as weed suppression. It is important to choose a cover crop that will work well with the succeeding crop. Examples of common cover crops include rye, red clover, buckwheat, oilseed radish, winter wheat and forages.

5. **Fertilizers –** Fertilizers, especially nitrogen, that stimulate the germination and growth of the crop can help to make the crop more competitive against weeds. When phosphorus and potassium are applied in bands, the nutrients are placed where the crop has the best access to them. When nitrogen is side-dressed, its application may disturb the soil and support some weed growth; however, most nitrogen is applied in a small band that is below the depth that most weeds germinate and grow.

6. **Mechanical Weed Control –** This type of control is very commonly used and involves utilizing different tillage practices to minimize weeds. There are a few different tillage methods that can be applied:

    a. **No-Till –** This involves using herbicides to burn down weeds before planting. It involves minimal disturbance to the soil. Since 75% of the weed seed bank is found in the top 5 cm of the soil, herbicides are very effective using this tillage method to reduce weeds.

    b. **Moldboard Plow –** This is the most soil disturbing form of tillage. It causes the seed bank to be spread more evenly through the depth that is plowed.

    c. **Blind Harrowing –** When done just before the crop emerges, this kills weed seedlings.

    d. **Rotary Hoe –** This machine has ‘fingers’ that rotate at 10-20km/hr, lifting and mixing the earth, while uprooting weeds. This process is an option for just prior to or just following crop emergence.

    e. **Inter-Row Cultivation (Scuffling) –** This method uproots weeds in between the rows of the crop. Timing is important, as it cannot be done when the crop gets too tall or the crop will be damaged.

    f. **Mowing –** Cutting can be one method of controlling weeds in forages, cereal crops or stubble left after the harvest of cereals. It is most effective when cutting occurs before weed seeds are formed and dispersed.

Selecting an Integrated Pest Management (IPM) Program for a Weed

Remember the **Six Steps to Better Pest Control** from the second meeting? Use that process to help decide what to do to control the weed.

Step 1

- **Identify**
- Look at the weed and compare it to some pictures or use an identification key
- Once you have identified the weed, determine what its life cycle is

Step 2

- **Count**
- Using a certain area, count the number of weeds in that given section

Step 3

- **Evaluate**
- Crop producers usually rely on experts to help evaluate the problem and find a solution.
- It is important for crop specialists to know:
  - What is the crop being grown?
  - What stage is the crop at?
  - What is the weed?
  - What stage of growth is the weed at?
  - What type of soil is in the field?

Step 4

- **Decision**
- Determine your control strategy - chemical or mechanical
- What solution will be cheapest? fastest? most effective?
- What are the weather conditions supposed to be?
- Compare the value of the crop to the cost of controlling the weed.
- Consider all factors and make a decision.

Step 5

- **Act**
- If applying a herbicide consider which one will work best and if it can be combined with other pesticides or fertilizers
- When and how should the herbicide be applied?

Step 6

- **Monitor**
- Go to the field a few weeks later and take samples to see what you find. While looking for the weed that was a problem initially, also look for other pests.

Expand on the Six Steps to Better Pest Control…

Step 7 – Prevention – Now that you know what weed is a problem in that 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!

DIGGING DEEPER

The Importance of Cover Crops is explained in OMAFRA's factsheet "Cover Crops: Adaptation and Use of Cover Crops" (http://www.omafra.gov.on.ca/english/crops/facts/cover_crops01/cover.htm#reduce pest) as seen in the excerpt below:

Reduce Pest Populations

Some cover crop species may be a non-host for a pest or may release materials that are toxic to the targeted pest. For example many common cover crops have been rated for their ability to support root lesion and other nematode populations. Cover crops like marigolds and pearl millet do not support or do not allow the nematode to reproduce. Other cover crops like some mustards, particularly those with high glucosinilate and euricic acid levels in the plant tissue can create a "natural fumigant" through the chemical breakdown of the these materials. The amount of green plant material that must be tilled into the soil for this to be effective, is often difficult to achieve under field conditions.Weeds are often alternate hosts for the nematodes. Good cover crop establishment, adequate plant stand and excellent weed control within the cover crop is critical for these methods of nematode reduction/suppression to be effective.

Soybean cyst nematode (SCN) causes the most economically important disease of soybeans in North America. The estimated annual loss in southwestern Ontario is $5 to 10 million. Research done at Harrow (AAFC) has indicated that rotational crops of red clover, Japanese millet, field corn and resistant soybeans have the greatest effect in reducing populations of SCN. Perennial ryegrass, alfalfa, sorghum, and hairy vetch are not as effective in reducing SCN populations. Unfortunately, most of these nematode reducing crops are not profitable enough to fit into most growers' rotations.

Further research is ongoing to develop crop rotations that are cost-effective and able to reduce the SCN pressure. Currently winter wheat (a non-host) with an underseeded legume crop (stimulates the SCN to hatch) is the favoured approach. Legumes for wheat underseeding that are most suited to encourage hatching are being evaluated. A similar approach is planned for underseeding in corn.

Figure 5 - Soybean Cyst nematode attached to roots. (Source: Crop-Pest, July 14, 2000).

Figure 6 - Adult female root-lesion nematode (150x magnification)

Figure 7 - Rye Cover Crops used as wind strips

Research work in Ontario on rye cover crops used as wind strips and in no-till systems for processing tomato production has found that rye will act as a physical barrier to pests. Dr. David Hunt and Dr. Al Hamill of AAFC in Harrow have documented that rye cover crops interfere with Colorado potato beetle movement early in the spring, during tomato transplanting.

Cover crops can be helpful in controlling or suppressing pests, however the opposite can be true. It is important to consider pest relations when choosing a cover crop.

Figure 8 - Similar to ground beetles, fireflies live part of their lifecycle in the soil and benefit from a habitat rich in ground cover from residue and cover crops.

Cover crops can also provide habitat for bees and beneficial organisms. Predatory mites, ladybug beetles and other beneficial insects benefit from the cover and protection that a cover crop provides.

Figure 9 - Cover crops can also attract beneficial insects – including pollinating insects.

ACTIVITIES

Activity 10 – Nutrient Uptake from the Soil

(10 min (5 min setup and 5 minute discussion at the end); however needs time to sit so another activity can be done while awaiting results)

Objective - One of the ways that weeds harm crops is by competing with crops for nutrients found in the soil. This activity demonstrates how nutrients are taken up by plants and helps members understand how weeds compete for these valuable nutrients.

Materials – celery stalks, clear glass, water, food colouring

Instructions – Place some water and a bit of food colouring in a glass. Take a piece of celery and cut the end off at an angle. Place the celery in the glass with food colouring and water. At the end of the meeting, come back and look at the celery. You may have to cut off a bit of the celery to see something.

An extension of this activity is to use two glasses with a small amount of water and food colouring. In the second glass, place several stalks of celery and compare what happens.

Discussion –

- What do members see has happened to the celery? (Food colouring and water should have started to go up the stalk). Can members see the vascular system of the celery? The food colouring should be visible traveling up the vessels.
- What does the food colouring represent? Discuss how this shows how nutrients and water go up the plant via the tubes inside it.
- What happens when a plant has more competition for nutrients and moisture? (Should see that in the second glass with several celery stalks that the food colouring did not travel as high up the stalk; therefore there was not as much available for each stalk. This is comparable to how weeds compete with crops for nutrients and moisture. When there are more plants competing, there are fewer resources available for each crop plant).

Activity 11: Weed ID (20 minutes (varies with difficulty of weeds to identify))

Objective – To teach members what different weeds look like as well as to use different resources to identify weeds.

Materials – Weeds collected from fields (leaders can ask members to bring weeds to the meeting), reference books, computer with internet if possible (for online weed ID key).

A couple of good resources to assist in weed identification are:

> *Identification Guide to the Weeds of Quebec, by C.Bouchard and R. Neron, Centre ARICO*
>
> *http://www.omafra.gov.on.ca/IPM/english/weeds-herbicides/identification-keys/*
> *www.weedinfo.ca*

Instructions – Members should show one weed at a time. If more than one person has the same weed, they should get together to try to do the identification. Using the references provided by the leader, members should try to identify the weeds. If there is a weed that cannot be identified, that is okay. After the meeting a crop scout or crop specialist could be asked for assistance and a report could be made back to the next meeting. Members should report back to the group on what their weed(s) were and what characteristics they used to identify them.

Alternate Activity – As a club or individually, members could complete OMAFRA's online Weed ID Quiz which is found at: http://www.omafra.gov.on.ca/english/crops/weedquiz/index.html

Discussion – Was this easy or hard? Does the stage of the weed's growth affect how easy or hard it is to identify?

Activity 12 – Weed Identification Guide (10 minutes)

Objective – To practice identifying weeds. Identification keys or other comparison pictures can be used if necessary to assist. Completing this activity will leave members with a guide to some common weeds.

Materials – Copies of the Weed Identification Guide from the Member Record Book, pencils, weed identification resources.

Instructions – Ask members to complete the activity from their Record Books. Assist them in the identification process where necessary.

Answers –

1. Lamb's quarters
2. Velvetleaf
3. Milkweed
4. Quackgrass
5. Dandelion
6. Common burdock
7. Common ragweed
8. Canada goldenrod
9. Bull thistle
10. Common mallow
11. Chicory
12. Wild carrot
13. Broad-leaved plantain
14. Wild mustard
15. Tufted vetch
16. Redroot pigweed
17. Black medick
18. Field violet
19. Canada fleabane
20. Shepherd's purse

Photo credit: Elizabeth Johnston

Activity 13 – Search a "Weed" (15 minutes)

Objective – Simple activity to expose members to the names of several different weeds

Materials – Weed word search found in the accompanying Record Book, pens or pencils.

Instructions – Give members an allotted amount of time to complete this puzzle before discussing the answers as a group.

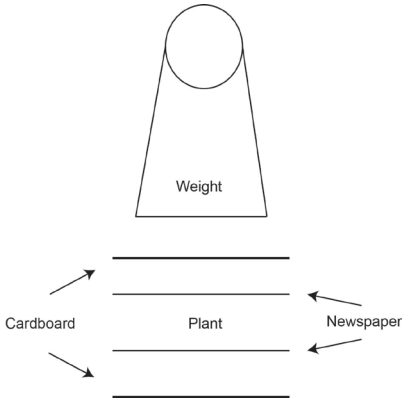
Activity 14 – Drying Weeds (15 minutes)

Objective – This activity teaches members how to properly dry weeds or other plants. It will enable them to preserve weeds so that they can ask a crop specialist to help identify them at a future meeting or to use them as part of an achievement project for the club if that is expected.

Materials – Weeds (could use weeds left from a Weed ID activity), 2 pieces of cardboard per weed (cut 50cm x 60cm), 1 piece of white paper per weed (cut 45cm x 55cm), newspaper

Instructions –

1. Take one piece of cardboard and place one piece of folded newspaper on it.
2. Lay your weed carefully on the newspaper, flattening the leaves. Make sure that some leaves have the top facing up and others have the bottom facing up. If there is more than one flower, try to do a front and a side view of the flower. Bend the stem, if required, to make the weed fit on your paper. If the roots are thick, you can trim the backside that will be against the newspaper.
3. Place another piece of newspaper on top of the weed and cover it with the other piece of cardboard. Think of it as a weed sandwich!
4. Store the weed and paper in a dry place with a weight on it.
5. Make a label for your weed. Include the following information:
    a. Common name, scientific name (if known)
    b. Collected by (member name)
    c. Date collected
    d. Place collected
    e. Habitat (what type of crop was planted in the field)
    f. Density (how many of the weeds were in a square metre in the field) (if known)
6. At a future meeting, take the weed you dried and place it on a sheet of white paper. Tape or glue the plant to the paper and then apply the label that you made. Repeat for any other dried weeds that you did.



Activity 15: What's In a Weed? (30 min)

Objective – To share information about various weeds, their characteristics, and how to combat them.

Materials – Poster board or chart paper, markers, resources on weeds.

Instructions – This activity could be done either individually, in pairs or small groups.

1. Members are asked to select a weed from what has been identified during the club meeting.
2. Investigate the weed and create a chart to share with the rest of the club members (30 min) that describes:
    a. Name of the weed
    b. Appearance of the weed as a seedling and adult
    c. Life Cycle of the weed (i.e. annual or biennial, etc.)
    d. When should you scout for this type of weed?
    e. What plant species or cultivars are susceptible invasion by this weed?
    f. What environmental or other growth conditions promote its growth?
    g. How do you control the weed?
3. Report back to the club about the weed you are now a 'specialist' on. (10 min)

MEETING 4: DISEASE DOCTOR

Meeting Objectives:

- To discuss diseases of field crops and review their causes, prevention and identification
- To learn the basics of creating an IPM program for addressing disease infestations

Roll Calls:

- Name a disease of people, plants or animals and state whether or not there is a cure for it.
- If you could create your own genetically modified plant, what type of special characteristic would you 'give' it?
- What is one way that people try to prevent contracting diseases. Is it something that can apply to plants as well?

Sample Meeting Agenda – 2 hours 20 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	10 min
Topic Information Discussion	Diseases in Plants are Like Human Colds Disease Prevention Types of Disease Optimal Conditions for Disease Growth	25 min
Public Speaking/Judging Activity	Note: Discussion on plant diseases and human colds may suffice as public speaking activity	
Activity Related to the Topic	Activity 18: House Call! Or Rather, 'Field Call'	30 min
Topic Information Discussion	Disease Management Strategies Selecting an IPM program for a disease	20 min
Activity Related to Topic	Activity 19: Disease Doctor	30 min
Wrap up, Adjournment & Social Time!		10 min
At Home Challenge	Activity 20 Fighting Crop Diseases	

All activities can be found at the end of Meeting #4.

***Specimen Collection* – For meetings 3, 4 and 5, identification activities are strongly recommended for weeds, diseases and insects, respectively. Members can either be asked in advance to bring a specimen collected at home or the club could go into the field and collect samples. It is important to plan meeting time accordingly.**

TOPIC INFORMATION

Diseases in Plants are Like Human Colds (Club Discussion)

Have the members of the club had colds?

Did they take medicine to cure it or just mask symptoms?

Is there a cure for the common cold?

What can you do to prevent catching a cold?

Often, when plants get diseases, there is little that can be done to cure them. By improving the growing conditions for the plant, you might be able to stop it from getting any sicker but it is doubtful that you will be able to cure it. That is why the best 'treatment' for plant diseases is prevention.

Disease Prevention

The table below compares the prevention of human colds to the prevention of plant diseases:

	Humans	Plants
Advance Treatment	• Take Vitamin C	• Plant seeds treated with substances to make them more disease resistant
Stay Strong	• Get sick easier when tired and weak	• Weak plants get sick easier than healthy ones; unless farmers have irrigation systems, it is hard to control the moisture available for plants, but fertilizers can be applied to help make sure the plants get enough nutrients
Resistance	• Some people catch fewer colds than others	• Plant more resistant varieties of crops (i.e. some soybean hybrids get fewer diseases than others). A crop that is resistant to a particular disease is called a 'resistant variety'
Spread of Disease	• Usually when one person gets a cold, everyone in the same household eventually gets it	• If a crop is diseased, the disease will grow and remain in the soil over the winter. If the same crop is planted the following year, it will also be affected by the disease. Without combatting the disease, it may get worse and worse each year. If you plant a crop that is not affected by the disease then the field will yield more.

Types of Disease

There are many different diseases that affect plants. They fall into five main categories: fungus, bacteria, virus, nematode and non-infectious.

Type of Disease	Disease Characteristics
Fungus	• The spores are carried in the mushroom (flower-like) part of the fungus • Takes water and food from living plants, or causes plants to decay and die(due to enzymes and toxins that break down cell walls) • Thread-like roots enter plant's cell walls and take food • Can affect any part of the plant, although many fungi are specialized to infect a specific area (i.e. leaves, roots, stems, flowers) • Seed-like spores spread by wind and water • Spores can last for several years
Bacteria	• Single-celled organisms • Spread by wind, water, insects and farm implements • Spread very rapidly under the right growing conditions, such as when there is a lot of moisture and temperatures are moderate • Usually present in the entire plant • Release toxins or enzymes that destroy plant cells • Symptoms include water-soaked spots or lesions on the stems, leaves or flowers of plants. Lesions may have a yellow border around them. • May be taken up by the plant's vascular system, blocking it and causing the plant to be wilted and eventually die
Virus	• Very tiny, much smaller than bacteria • 100 trillion could fit in a teaspoon • One virus usually only works on one cell within the plant • Spread by insects and weeds • Replication occurs in living cells and relies on the nutrients available via the host as well as the energy available • Symptoms often include stunted or malformed stems, with leaves that are a yellowed or mottled colour

Nematode Source (can be a vector of disease)	• Microscopic worms that feed on living plants by invading plant cells • Produce eggs that eventually reach adulthood • May live in the soil for part of their life cycle • Damage plant by feeding on roots, shoots, seeds or buds and causing the plant to be stunted and distorted • May be vectors of fungi or viruses • May cause plants to be more susceptible to viruses, bacteria or fungi
Non-Infectious	• Unhealthy growing conditions may cause a number of diseases in plants, such as nutrient deficiencies, chemical and environmental damage • Unfavourable conditions, such as extreme heat or frost may cause stress and physical damage to growing plants • Air pollution or improper chemical applications can also cause damage to plants • The damage caused may resemble the damage caused by plant pathogens such as fungi and viruses.

Examples of Common Diseases caused by the four types of pathogens (Source of photos unless otherwise indicated: www.omafra.gov.on.ca):

Rust diseases are very common in cereal crops and are caused by fungus. See above leaf rust (right) and stem rust (left):

One of the most damaging diseases to grains is fusarium head blight, which bleaches the heads of plants, often causing a pinkish appearance. It is also caused by a **fungus**.

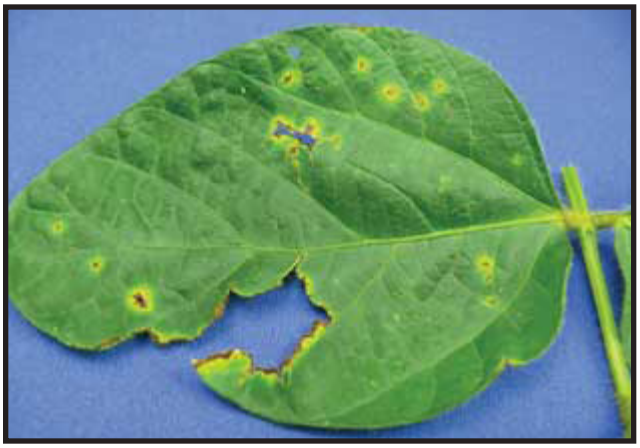
Northern corn leaf blight, also a fungal disease, is one of the most damaging diseases to corn crops.

Smut diseases affecting corn and other crops are also of fungal origin.

Photo source: Jennifer Thompson

Fungi are also the cause of downey mildew in peas.

Photo source: Jennifer Thompson



Bacterial blight in soybeans, seen above, is an example of a disease caused by **bacteria** that causes yield and economic losses when plants are exposed to cool and wet conditions:

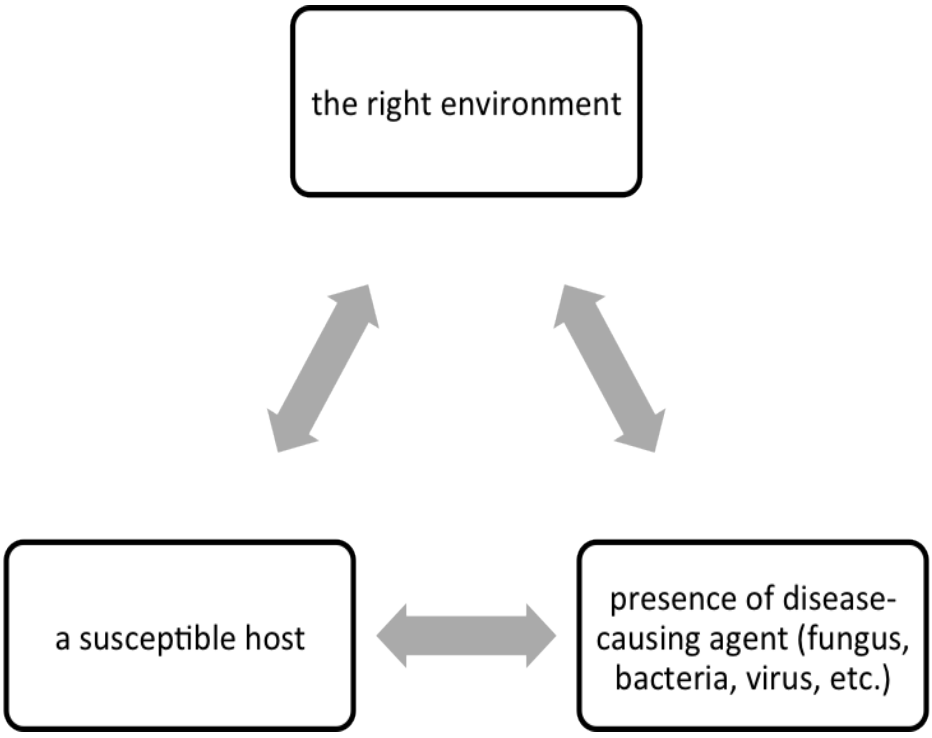
Soybean mosaic virus is an example of a **virus** that is spread by an insect (soybean aphids). It can cause stunting of plants and a shriveled appearance of leaves that is seen above.

Soybean cyst **nematode** causes the soybean plant to have a yellowed, unhealthy appearance (above left). The cause of damage can be seen when viewing the cysts present on the roots of the soybean plants (above right):

There are so many diseases affecting field crops, with different causes and controls for each, that it is impossible to review all of them at a meeting! Are there any diseases that members have seen examples of at home?

Optimal Disease Growth Conditions

In order for a disease to occur in a plant, the following elements must ALL be present:



Disease Management Strategies

There are several methods that can be employed to minimize the impact of diseases on a crop. A few of these strategies include:

1. **Planning and Information Resources –** Knowing what was planted in the previous growing season as well as what diseases commonly appear in the area will be helpful in managing the crop.

2. **Disease Avoidance –** Attempts to avoid diseases may occur in a number of ways:
   a. Plant susceptible crops at a time that reduces or delays their exposure to infection. For example, in the rust prevalent area of the prairies, winter cereals and early-seeded spring cereals often avoid disease damage by maturing before there is a lot of rust in the environment.
   b. Field location is another way to avoid disease. The risk of infection increases if a crop is planted beside a field where there is a known history of diseases. Likewise, planting the same crop year after year on a field increases infection risk. For example, spores from canola residue can be air-borne and result in blackleg in crops in nearby fields for several years to come.
   c. Plants with upright growth habits tend to be more disease resistant. For instance, bean varieties with vine-like growth habits experience a higher infection of white mold than varieties that grow upright.
   d. Some information shows that when crops are planted with wider spacing and lower seeding rates then air can move more freely through the crop and reduce humidity and moisture on the leaves, thus reducing infection. However, more space could also allow pathogens to be disseminated more easily. Also, remember from the last meeting, that higher seeding rates may allow crops to compete better against weeds.
   e. Open, well drained fields often favour lower disease levels than protected, low-lying fields that allow excess moisture to 'sit'.

3. **Sanitation –**
   a. Burndown of old crops may help to reduce some plant pathogens in the environment. A burndown is done by spraying a herbicide causing the drying of plant tissues.
   b. For some spring seeded crops, **tillage** may result in the burying of crop residues, causing places where pathogens may be under a layer of soil and unable to harm the crop sitting above the surface.
   c. Crop rotations, whereby a crop that is resistant to the diseases prevalent in the previous crop that was planted, Rotating year after year, is a good way of dealing with pathogens that lie in crop residues or soil. It may not always make sense for farmers to have a long crop rotation so this may not be entirely possible.
   d. Remove other hosts of pathogens that can allow the pathogen to survive around the field (i.e. barberry or buckthorn). Weed control also helps to eliminate alternative hosts that can allow the pathogens to exist.

4. **Fertility –** Planting a fertile crop with sufficient nutrients results in viable, healthy plants that are more tolerant of disease. For example, when wheat has enough phosphorus, its losses due to root rot are far less than in instances of phosphorus deficiencies. On the other hand, excessive nutrient applications could lead to a very heavy canopy that favours disease development.

5. **Resistant Cultivars –** Planting these is economical and efficient to help manage disease.

6. **Seed Selection –** It is important to plant high quality seeds with a high level of germination to help combat disease. Seeds with disease infestations or cracks will be more susceptible to disease as will seeds produced from an infected crop.

7. **Seed Treatment Fungicides –** Planting seeds that have been treated with a fungicide allows the seeds to germinate and start growing without the problems associated with the disease they have been treated for.

8. **Biological Control –** The concept of this is to apply biological control agents to combat disease without harming the plant. However, this practice is not widespread for field crops at this time.

9. **Seeding Depth –** Shallow seeding helps to prevent the risk of diseases early in the season as well as types of root rot. It also means that the new seedling does not have to expend as much energy to burst through the soil and can thus be stronger and more viable.

10. **Irrigation –** Irrigation may be helpful if providing plants with adequate moisture, however, when it is done at a time that increases humidity and moisture on plants, it can actually promote disease growth.

11. **Foliar Fungicides –** These are fungicides applied after plant emergence. This process can be expensive so it is important to weigh the costs versus benefits of spraying to see if it is warranted. Over-spraying could eventually lead to diseases that are resistance to the fungicides used.

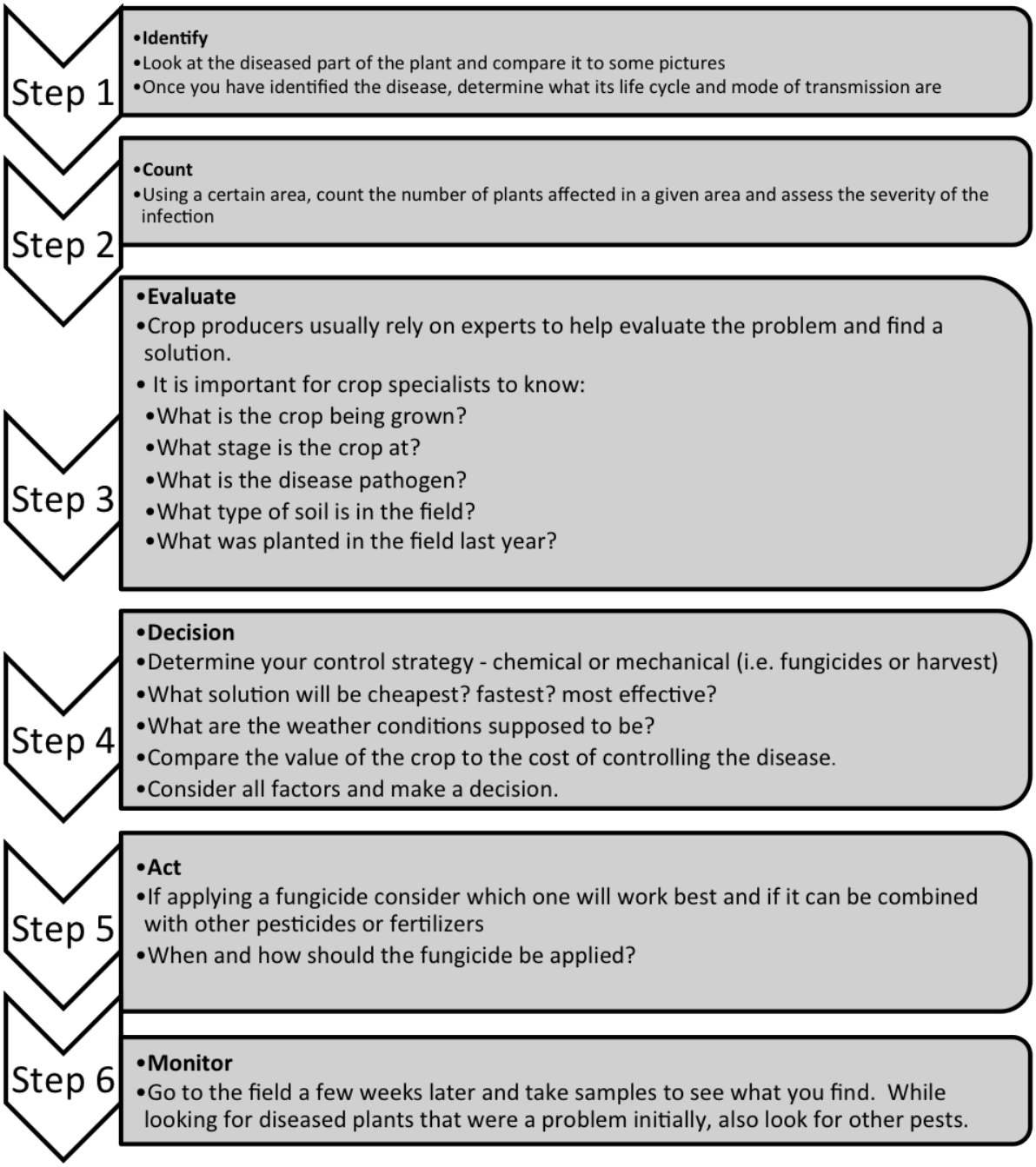
12. **Field Scouting –** Frequent monitoring of fields to identify the presence of disease or risk factors is important.

13. **Harvest Management –** The timing of harvest, as well as using harvest equipment that removes infected kernels (for example increasing the air flow on a combine to blow out the infected kernels) or leaves little residues on fields may be helpful in reducing the impact of disease, for both current and subsequent crops.

14. **Decision Support Systems –** In some areas (although not frequently in Canada) there are systems that assist with forecasting systems to assist with fungicide applications. These systems are more common in horticultural crops like tomatoes and apples.

Selecting an Integrated Pest Management (IPM) Program for a Disease

Just like with weeds, the **Six Steps to Better Pest Control** can be used to find appropriate measures to combat diseases in a crop.



Expand on the Six Steps to Better Pest Control… Just like we did with weeds!

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

Step 8 – Record Keeping – Take notes so that the next time you find this disease in your fields you know what to do or what not to do! Record keeping will also provide valuable information when planting crops in subsequent years.

DIGGING DEEPER

Crop rotations are an integral part of pest management strategies, not only for diseases, but for insects and weeds as well. Rotations also have an important role in nutrient management in the field. For example, plowing down a field of legumes adds nitrogen and other nutrients to the soil for use by the crop that follows it. Organic producers find this crop production method particularly valuable, since they are limited in their addition of fertilizers and pesticides to the soil.

Let's find out a little bit more about how this seemingly simple process is so effective at stopping those pests!

The following excerpt from one of OMAFRA's Crop Talk newsletters explains how crop rotation is effective (Source: http://www.omafra.gov.on.ca/english/crops/field/news/croptalk/2006/ct_0606a9.htm):

Disease

Good crop rotations help to develop healthy soils and are better able to suppress pests and improve the health of the crops. For example, there are approximately 50 diseases of beans (Phaseolis spp.). Crop rotation helps to eliminate about 33 of them, including bacteria and nematodes and nearly all fungi diseases. One of ways this works is that plant pathogen propagules have a lifetime in the soil, and a crop rotation that excludes host crops starves them out.

Diverse crop rotations lead to more diversity in the soil. Cover and rotation crops shift the composition of the non-pathogenic microbial community to be more suppressive to diseases. Many studies have shown Brassica cover crops to suppress diseases. It is felt that the glucosinolates, which break down to isothiocyanates, contribute to this, but there are also other compounds involved as well. Oat cover crops have also been shown to suppress root rot in peas.

Insects

Similarly, insects are suppressed by good rotations. When we grew a lot of continuous corn 25 years ago, even second-year corn needed a corn rootworm insecticide. During the past decade our use of corn rootworm control has declined to a fraction of usage in the 1980's due to the fact that we now rarely grow corn-after-corn.

Weeds

Crops can be planted in either spring or fall, which alters their abilities to compete with weeds. Related tillage activities can also kill germinating weed flushes in spring or fall. Cereals crops are planted in narrower rows which help them canopy and out-compete weeds. Forages crops are cut several times each summer which is an excellent way to suppress many perennial weeds.

Spread The Workload

A good crop rotation also spreads out the workload, which is a labour saving in the overall operation of the farm. Improving your crop rotation may also let you increase the size of your farm within your existing resources of labour and equipment.

Having a good crop rotation will make you money, both by increasing yield and by decreasing costs. Crop rotation takes planning to make sure it meets the needs of the farm and the flexibility to allow you to take advantage of market changes.

ACTIVITIES

Activity 16 - Identifying Crop Diseases (20 min)

Objective – To teach members what the damage caused by various diseases looks like and how to identify a variety of diseases.

Materials – Pictures of diseased plants OR samples of plants infected with disease, Resources to identify disease.

Instructions – Using the resources provided, members should try to identify the disease infecting the various crops. Plants with unknown diseases may be saved to ask a crop specialist following the meeting.

Discussion – Was it easy or difficult to identify the diseases? How did it compare to identifying weeds?

Activity 17 - Drying Diseased Plants (15 min)

Objective – To preserve diseased plants for later identification of an unknown disease or to preserve for use as a club achievement project.

Materials & Instructions – Follow the directions for drying weeds from Meeting 3 Activity 5.

The label for your plant should include the following information:

a. Name of crop
b. Collected by (member name)
c. Date collected
d. Place collected
e. Habitat (what type of crop was planted in the field)
f. Name of disease (i.e. leaf spot)
g. Describe the disease (i.e. brown spots on leaves and yellowing in between spots)
h. Density (how many diseased plants were in a square metre in the field) (if known)

Activity 18 - House Call! Or Rather, 'Field Call' (30 min)

Objective – While doctors sometimes make house calls to people with diseases, crop scouts head out to the field to investigate diseases. The purpose of this activity is to teach members about finding diseases in the field.

Materials – Pen and paper to take notes, metre stick, field with diseased crop

Instructions – As a club, go to a field to search for diseased plants. Measure a one square metre area (members can each measure their own area) and identify plants with diseases inside their research area. Members should count the number of diseased plants inside their square metre. If there appears to be more than one disease, count the population of each type of disease separately. The group can get back together and calculate their average findings to find the populations of diseased plants in the field.

Note: If a diseased field is not available you can create a disease scenario using a little spray paint to allow Members to assess the severity.

Discussion – Once the presence of disease has been determined and populations of diseased plants are known, members can identify and discuss the diseases that they found. Then, focus on strategies to combat those diseases for this year's crop as well as to prevent the disease from occurring in future crops in this field.

Activity 19 - Disease Doctor (30 min)

Objective – To share information about various crop diseases, their characteristics, and how to combat them.

Materials – Poster board or chart paper, markers, resources on plant diseases.

1. *Instructions* – This activity could be done either individually, in pairs or small groups. Members are asked to select a disease
2. Investigate the disease and create a chart to share with the rest of the club members (30 min) that describes:
    a. Name of the disease
    b. Appearance of the disease on plants
    c. What plant species or cultivars are susceptible to the disease?
    d. What environmental or other growth conditions promote disease development? How is it spread?
    e. How do you fight the disease?
    f. How do you prevent the disease?
3. Report back to the club about the disease you are now a 'specialist' on. (15 min)

Activity 20 - Fighting Crop Diseases (10 min)

Objective – To reinforce a key learning from this meeting

Materials – Pens, Fighting Crop Diseases Cryptogram from the Member Record Book

Instructions – Members are given time to solve the cryptogram. Pairing senior members with junior members may be helpful and save time.

Discussion – Reiterate the fact that once a plant is infected with a disease, curing it may be difficult. From the list of disease control strategies in the meeting topic material, there are a number of methods that can be used to prevent disease before plants are infected. As a crop producer, often waiting until the crop is infected is too late to deal with the problem and it is very costly due to the financial costs of fungicide applications and the reduced crop yield.

MEETING 5: INSECT INVASION

Objectives:

- To review some basic characteristics of insects and discuss how insects can be good or bad
- To learn the ways that insects can have a negative impact on field crops
- To practice identifying insects
- To learn different methods of controlling insect populations in field crops

Roll Calls:

- Name one insect that you have seen at home or in a field. Is it good or bad for people or crops?
- Give your opinion on whether all insects should be eradicated
- Give one characteristic of an insect (body type, life cycle, etc.)

Sample Meeting Agenda – 2 hrs. 20 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business	10 min
Topic Information Discussion	What are Insects They have a bad rep…but some insects are good Insect life cycle and how they cause damage	25 min
Activity Related to Topic	Activity #22: Constructing a Killing Jar (large group activity)	10 min
Activity Related to Topic	Club goes out to field to catch insects (use killing jar)	20 min
Topic Information Discussion	Insect Control Strategies Using Modern Biotechnology to Control Insects and Other Pests	20 min
Activity Related to Topic (Public Speaking Activity)	Activity #27: 4-H Member Entomologists (using insects from earlier activity)	30 min
Wrap up, Adjournment & Social Time!		10 min
At Home Challenge	Activity #26: Insect Word Search	

All activities can be found at the end of Meeting #5.

***Specimen Collection* – For meetings 3, 4 and 5, identification activities are strongly recommended for weeds, diseases and insects, respectively. Members can either be asked in advance to bring a specimen collected at home or the club could go into the field and collect samples. It is important to plan meeting time accordingly.**

TOPIC INFORMATION

What are Insects?

Insects are the most common type of animal on earth. They are actually probably the most successful of all living things. They first appeared around the same time as the first dinosaur, over 200 million years ago. While their much larger counterparts are long since extinct, insects continue to thrive, having adapted to every living condition imaginable. They can live on people, animals, plants, in the ground, in water, in cold or hot climates, and wet or dry conditions.

Photo: stinkbug on corn (courtesy of Jennifer Thompson)

Of course, each individual insect cannot survive under all of those situations. There are more different types of insects in the world than all other living things (plants and animals) combined. There are even types of insects that have yet to be identified and still more that humans have probably not even found yet!

Regardless of their environment, all insects share some characteristics:

- 3 body sections (head, thorax and abdomen)
- 3 pairs of legs
- 1 pair of antennae
- 2 sets of wings
- Compound eyes
- Small bodies
- Many undergo metamorphosis at some point in their life cycle

They have a bad reputation…but some insects are good!

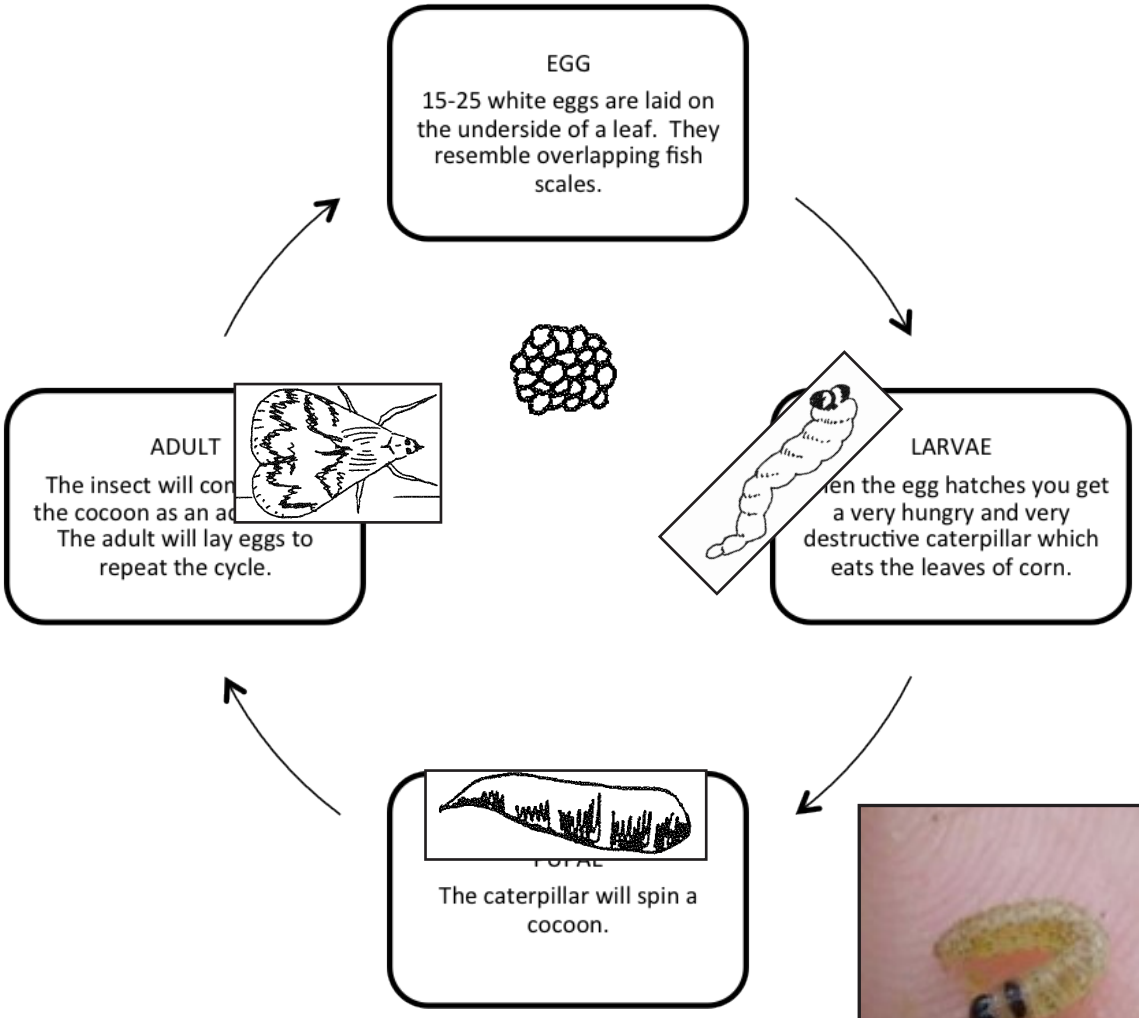
Most insects are very beneficial. If you had a jar containing 100 different insects in it, only one would be harmful. Without insects, our quality of life would not be as good. A few beneficial things that insects do includes:

- Make honey
- Make silk
- Clean up or eat garbage, dead plant and animal matter
- Food for many other animals
- Pollination
- Feed on the harmful insects
- Fly eggs laid in cow manure allow the fly larvae to turn the manure into soil

The harmful insects can have a huge impact on us though! They destroy billions of dollars worth of crops each year. Damage can be caused by both young and old insects, although they eat different food at different stages in their lives so that their impact on crops changes throughout their life cycle. It is possible that an insect may only be harmful to a crop during part of its life cycle.

Example Life Cycle

European Corn Borer



Source of Pictures: Jennifer Thompson

Photos from: Jennifer Thompson

Another insect that causes significant damage at the larval stage is black cutworm. These worms chew the plant, cutting it off at the ground.

Not all insects go through the four stages outlined above. For example, the grasshopper does not have a pupa stage. Instead, its wings grow slowly throughout the larval period to the adult stage.

Photo source: Jennifer Thompson

How do insects cause damage?

The number one way that insects harm field crops is by eating them. Some will chew on the roots, while others will eat the leaves or stem. Some insects are even capable of sucking juices (nutrients) from the leaves and stems of crops.

Insects will affect field crops at different stages of their lives. For some insects only the larva or adult is harmful. For others, the insect will affect different parts of the plant at different stages of its life cycle.

Just like weeds and disease-causing pathogens, the number of insects in a field impacts the amount of damage they do to crops. The insect population varies from season to season. Some of the things which affect the numbers are:

- Weather
- Natural enemies
- Crop species
- Stage of crop growth

Insect Control Strategies

Controlling insects can be very expensive, so it is important to weigh the cost of insect control versus the damage they will do to the crop to see if it economical to combat the invaders.

Just like with other pests, the best cure is usually prevention. It is important to look for insects sot that the following year measures can be taken to prevent their appearance or at least reduce their numbers.

Some methods of insect control include:

1. **Biological –**
    a. Introduction of a biological control to the field. An example is a parasite that will live off and eventually destroy the insect. Other examples include an insect or animal which eats other insects, such as toads in a vegetable garden or ground beetles in higher residue field crop fields.

    b. Using Bt technology to control pests (i.e. Bt corn to control European Corn Borer)

2. **Cultural –** A weed free crop will often reduce insects. Plant trap crops at field borders or plant resistant varieties of crops.

3. **Mechanical –**
    a. For some insects there are no controls. The infestation could get so bad that the only solution is to change the crop.
    b. Some farmers use large suction machines to suck the insects off of plants
    c. Propane flamers to kill insects

4. **Chemical –** This involves using insecticides to control the pests. When using an insecticide, it is important to know the effects it will have on helpful insects such as bees. For example, if there is an orchard beside the field which depends on bees for pollinating its fruits, some insecticides could kill the bees and interfere with the fruit crop.

Just like when controlling weeds and disease-causing pests, a combination of control methods may be used.

Using Modern Biotechnology to Control Insects and Other Pests

One component of biotechnology is using the DNA (genetic code) from one organism and placing it into a different species. The plants that have the new genetic material inside them are referred to as “transgenic plants”.

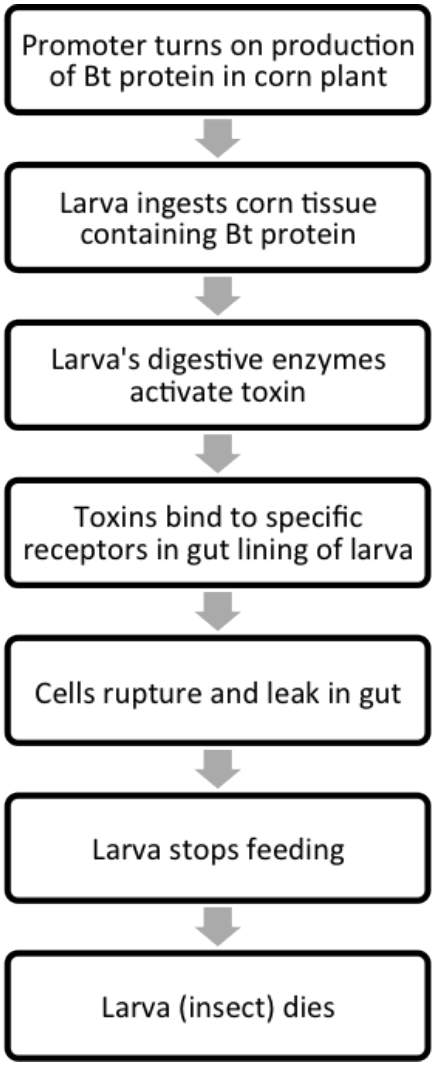
The genes that are contained in transgenic plants are put there because they either produce desirable products (such as increased oil or amino acid content) or they have desirable traits (such as herbicide, insect or disease resistance). When DNA is placed into a new plant, the following components are included:

1. Gene – that expresses the desired trait
2. Promoter – Controls where and how much of the desired protein is produced
3. Genetic marker – Included to identify when successful placements occur

An example of this technology is Bt corn. The transgenic corn plant has been modified to produce an insecticidal protein "Bt" (occurs naturally in the bacterium *Bacillus thuringiensis* which is often found in soil). The proteins are produced in the forms of crystals (called "Cry proteins") that are effective against some types of insects. In Canada, the most common Bt corn varieties are targeted at the European corn borer or corn rootworm.

These proteins are environmentally safe and they reduce the need for pesticide use. One major challenge for this type of technology is the development of insects that are resistant to the proteins released by the Bt corn.

How does this technology work? (Source: Controlling Corn Insect Pests with Bt Corn Technology A Grower's Handbook Second Edition)



Just like with weeds and diseases, the **Six Steps to Better Pest Control** can be used to find appropriate measures to combat diseases in a crop.

Step 1

- **Identify**
- Look at the damaged crop; also try to find insects, larvae or eggs
- Once you have identified the insect, determine what its life cycle is and when it is damaging to the crop

Step 2

- **Count**
- Using a certain area, count the number of plants affected in a given area and assess the severity of the infection

Step 3

- **Evaluate**
- Crop producers usually rely on experts to help evaluate the problem and find a solution.
- It is important for crop specialists to know:
  - What is the crop being grown?
  - What stage is the crop at?
  - What is the insect?
  - How much damage has the insect done? How bad is the infestation?

Step 4

- **Decision**
- Determine your control strategy - biological, cultural, chemical or mechanical
- What solution will be cheapest? fastest? most effective?
- What are the weather conditions supposed to be?
- Compare the value of the crop to the cost of controlling the insect
- Consider all factors and make a decision.

Step 5

- **Act**
- If applying an insecticide consider which one will work best and if it can be combined with other pesticides or fertilizers
- When and how should the insecticide be applied?

Step 6

- **Monitor**
- Go to the field a few weeks later and take samples to see what you find. While looking for insects that were a problem initially, also look for other pests.

Expand on the Six Steps to Better Pest Control… Just like we did with weeds and diseases!

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

Step 8 – Record Keeping – Take notes so that the next time you find this insect in your fields you know what to do or what not to do! Record keeping will also provide valuable information when planting crops in subsequent years.

DIGGING DEEPER

Pesticide Resistance – What it is and how to avoid it!

While it is easy to understand what pest resistance is – weeds, insects and diseases that are not controlled by pesticide applications – there are a lot of misconceptions about how it happens.

Many people believe that pest resistance occurs due to frequent pesticide use. In reality, it begins with a random gene mutation in the pest that enables it to survive pesticide applications.

Gene mutations have occurred many times in our evolutionary history. A good example involving humans is eye colour. It is believed that initially, our ancestors all had brown eyes. A random gene mutation that reduced melanin production resulted in the blue eyed trait. Since its introduction, the blue eyed trait has spread through parts of Europe and North America, although the majority of people in the world still have brown eyes. In the case of eye colour, it is not a trait that affects life or death, so the mutation spreads slowly in a population. If the trait was, for example, a resistance to a fatal disease, it would spread more rapidly through a population because those without the gene mutation would be more likely to succumb to the disease.

With pesticide resistance, the concept is similar. While most pests will die when a pesticide targeted at them is applied, there may be some that have developed or inherited a gene mutation that makes them resistant to the pesticide being used. Since the pests with the mutation are more likely to survive the pesticide application, they are able to grow and reproduce more than ones without the resistance gene. This way the gene spreads rapidly within the pest population. If a farmer continues to spray the same pesticide, it will be less and less effective as the resistant pest population grows.

Often, if a pest is resistant to one product in a chemical group, it is resistant to all of the similar chemicals in that group, which is called ‘cross-resistance’.

There are several strategies that can be used to limit the effects of pesticide resistance on crop production:

1. **Rotation of Pesticides** – If you always use a pesticide from the same chemical group, it makes sense that resistant populations would have the opportunity to grow. Some pesticides are not prone to resistance as they act on multiple sites of the pest.

2. **Tank Mixes** – A resistance prone pesticide could be combined with one that is multi-site and therefore less prone to resistance.

3. **Apply the pesticide at the optimal time** - At some stages of their life cycles, pests may be more susceptible to pesticides than at other stages.

4. **Follow label directions** – Use the proper amount of a pesticide. If not enough chemical is used, it might not be strong enough to kill the pest. If too much is used, it could damage the crop.

5. **Spray coverage** – Make sure that your equipment is doing a good job of getting the pesticide where it needs to be. Some pests, such as aphids, could be found under leaves and are not necessarily in the most obvious locations. Good equipment helps to ensure maximum coverage of the pesticide and thus, maximum pest control.

Pest resistance is a challenge not only for farmers, but for biotechnologists as well. Since the European Corn Borer (ECB) is known for developing resistances to pesticides, it is important to have a good insect resistance management strategy when growing (and developing) Bt corn.

The Canadian Corn Pest Coalition (www.cornpest.ca) gives the following example of resistance development of the European Corn Borer to Bt Corn:

How Resistance Could Develop in European Corn Borers (ECB)

In any population of European corn borers, a few of the borers will have two copies of genes for resistance (rr), some will have one copy of the gene (rs) and most will have none (ss). Resistance genes are believed to be rare. In ECB Bt corn, European corn borer with one or more copies of resistance genes (rr or rs) could perhaps survive and produce more offspring. Improved survival or reproductive success results in a "selective advantage." As the Bt corn acreage increases, and with it the proportion of the European corn borer population exposed to Bt corn, more larvae carrying resistance genes could survive to adulthood. The overall population of Bt-resistant individuals could increase with each generation. At some point, control failure could occur with resistant larvae reaching infestation levels in Bt corn fields similar to levels found in non-Bt corn fields, hence the necessity of implementing IRM on your farm and keeping good records.

The greater the proportion and duration of exposure of corn borer populations to the protein, the faster the selection process occurs. If all corn acreage in North America were planted to Bt corn, the selection pressure would be extreme and resistance could develop quickly (some estimate within 3-5 years).

Managing ECB Resistance Through the "High Dose/Refuge Strategy"

The North American corn industry has adopted a high dose/refuge strategy to manage corn borer resistance to Bt technology. The strategy involves exposing one portion of the pest population to Bt plants with an extremely high concentration (dose) of the Bt protein, while maintaining another part of the population as a refuge where the pests do not encounter any Bt protein.

Plant geneticists designed Bt corn to produce very high levels of Bt Cry proteins, much higher than levels found on corn treated with Bt insecticides. The intent is to kill all European corn borer (ECB) larvae with no genes for resistance (ss), plus those with one copy of a resistance gene (rs).

Re-printed with permission from the Canadian Corn Pest Coalition *www.cornpest.ca*

ACTIVITIES

Activity 21 - Identifying Insects (10 min)

Objective – To teach members what some different insects look like at various stages. Members can also examine them for the basic characteristics of insects.

Materials – Variety of insects collected by members, either during the meeting or prior to the meeting, resources to help identify insects.

Instructions – Give members time to use the resources to identify their insects, as well as to identify what crops they are a problem for.

Discussion – Were they able to identify all insects? Was this a difficult or easy process?

Activity 22 - Constructing a Killing Jar (10 min)

This may be the most safe done as a large group activity or demonstration, with one person responsible for killing the insects that others catch.

Objective – To teach members how to kill the insects that they collect in the field. This process will allow them to mount their insects completely intact for display without 'smushing' them.

Materials – Wide-mouth jar, sawdust or cotton, cardboard, poison (ethyl acetate)

Instructions –

1. Make a poison label and put it on the jar "POISON – ETHYL ACETATE"
2. Put sawdust or absorbent cotton in the bottom of the jar.
3. Make a tightly fitting piece of cardboard punched with holes to fit on top of the cotton or sawdust.
4. The leader will place some poison on top of the cotton or sawdust.
5. Put the cardboard on top of the poison.
6. Seal the jar.
7. Collect insects within a day of making the jar so that the poison is effective in killing them.
8. When the insect is dead, place it in a box, being careful not to damage it.

Alternative – If the insects being collected have very soft bodies do not use the killing jar. Insetad, use a jar with some rubbing alcohol in the bottom. Make sure that the jar is labeled "RUBBING ALCOHOL".

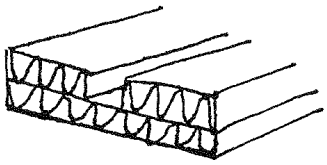
Discussion – This activity, which could be done as a club activity during a meeting, prepares insects for identification and mounting.

Activity 23 - Mounting Insects (15 min)

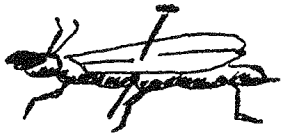
Materials – Insects, sample of plant to show insect damage, straight pins, cardboard or styrofoam, plain paper, shoe boxes

Instructions –

1. Ask members to catch insects in jars to bring to the meeting, along with a piece of the plant they found them on (this will make it much easier for the leaders). Members could also be asked to bring shoe boxes. If time is running short, the insects could just be mounted on cardboard with no shoe boxes needed.

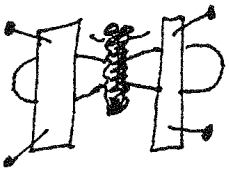


2. Prepare a mounting board with corrugated cardboard or cork sheet. Cut the cardboard to fit snugly into the shoe box.

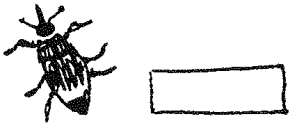


3. Take a pin and place it through the body of the insect. Set the insect on the board.

4. If the insect has large wings, such as a moth or butterfly, use strips of paper to fasten the wings into position.



5. Make up a label from information collected in the field. The label should contain the following information:



    a. Common name … (ie. Corn rootworm)

    b. Collected by … (member name)

    c. Date collected …

    d. Place collected …

    e. Habitat … (i.e. corn field)

    f. Density … (i.e. # seen on 5 plants or in 5 sweeps)

    g. Damage to crop … (i.e. parallel rows of small holes on leaves)

Discussion: These insects can be used for identification activities or for potential club achievement projects.

Activity 24 - The Caterpillar Experiment (10 min)

Objective – To investigate the amount of damage to leaves caused by caterpillars.

Materials – Jar with holes in the lid, graph paper and a pencil (There will be a couple of extra pages of grid paper in the back of the member manual)

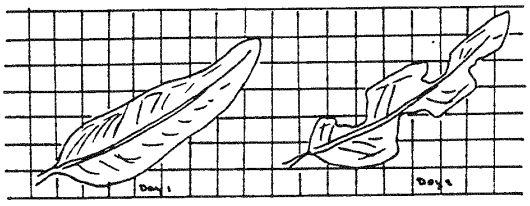
Instructions –

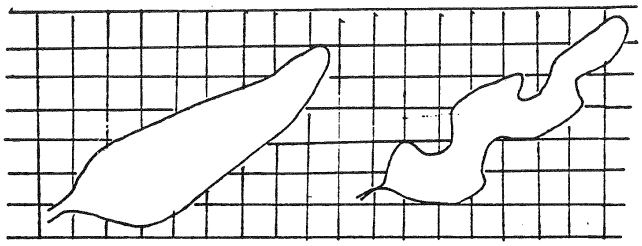
1. Go into a field or garden and collect a caterpillar and a leaf that it is on.
2. Put the caterpillar in the jar.
3. Trace the leaf on the sheet of graph paper. Then place the leaf in the jar with the caterpillar.
4. The next day, remove the leaf from the jar and trace it on the graph paper beside the first one.
5. If you know the type of caterpillar and what type of leaf it was, please make note of that information on the graph paper.
6. The caterpillar could be set free or saved for preserving.
7. Look at the leaf lines you drew on the paper. How many squares in the first drawing were covered by the leaf? ____ (**first number**)
8. Look at the lines in the second drawing. How many squares were covered by the leaf? ___ (**second number**)
9. Now perform the following calculation to determine the amount of insect damage:

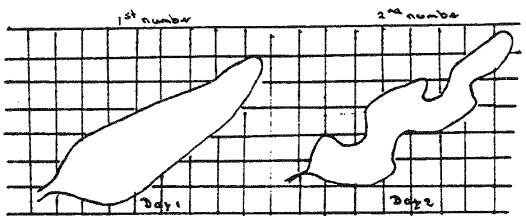
   SECOND NUMBER x 100% = % of leaf remaining
   FIRST NUMBER

   100% - % of leaf remaining = % eaten by a caterpillar in one day

   For example:







In this example, approximately 16.5 squares are covered by the leaf on day 1.

On day 2, approximately 12 squares are covered by the leaf.

12 x 100%=78% 100%-78%=22% of the leaf was eaten by the caterpillar/day

16.5

Discussion – What percentage of the leaves did the caterpillars eat? Were they the same for all members? Did the same type of caterpillars eat the same amount? What is the potential damage for a field crop infested with caterpillars?

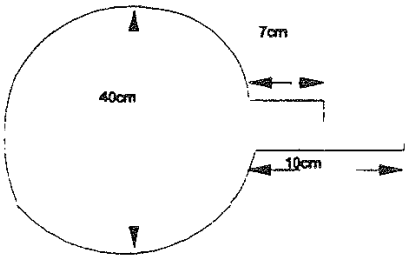
Activity 25 - Constructing a Sweep Net

Objective – Sweep nets are usually required to catch flying insects. This activity teaches members how to make one.

Materials – metal clothes hanger, heavy netting or muslin cloth, needle and thread, old broom handle, hose clamp.

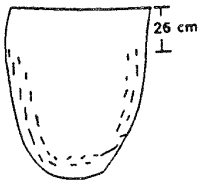
Instructions –

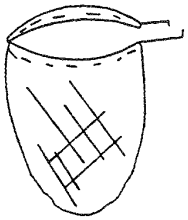
1. Take the hanger and bend it into the shape shown at right.

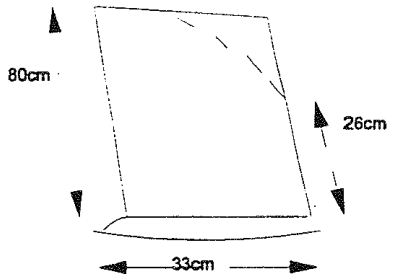


2. Take a piece of the netting or cloth, and cut it as shown below and sew it where indicated. Do not make the bottom of the bag pointy or it may damage insects.

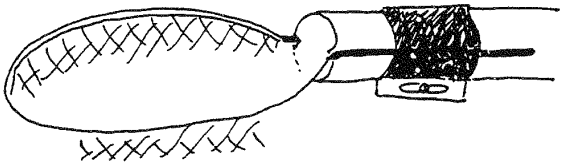
3. Stitch the net onto the wire as shown.







4. Attach the wire to a broom handle, holding it in place with a hose clamp.



Activity 26 - Insect Word Search (found in the Record Book)

(Can be completed as an At Home Challenge Activity)

Objective – To familiarize members with vocabulary related to this meeting

Materials – Pens, Insect Word Search from the Member Record Book

Instructions – Members are given time to solve the word search.

Activity 27 - 4-H Member Entomologists (30 min)

Objective – To share information about various insects, their characteristics, and how to combat them.

Materials – Poster board or chart paper, markers, resources on insects that impact field crops.

Instructions – This activity could be done either individually, in pairs or small groups.

4. Members are asked to select an insect
5. Research the insect briefly and create a chart to share with the rest of the club members (20 min) that describes:
    a. Name of the insect
    b. Appearance of the insect
    c. How does the insect cause damage to the field crop?
    d. What is the best time to scout for this type of insect?
    e. What plant species or cultivars are susceptible to this insect's invasion?
    f. How do you control this insect's population?
6. Report back to the club about the insect you are now a 'specialist' on. (15 min)

MEETING 6: PUTTING IT ALL TOGETHER

Roll Calls:

- What is one thing that you learned in the field crops club this year?
- What would you like to learn in the field crops club next year?
- What was the highlight of the club for you this year?
- What is your achievement project? What is the status of your project?
- Members with crop plots could report on the status of their crop or harvest results.

Sample Meeting Agenda – 2 hours, 20 minutes

Welcome, Call to Order & Pledge		10 min
Roll Call		5 min
Parliamentary Procedure	Minutes & Business Member Projects for Achievement	15 min
Topic Information Discussion	Putting the Pieces of the Puzzle Together Organic Crop Production	20 min
Activity Related to Topic	Activity 28: Creating a Crop Plan	60 min
Activity Related to Topic	Activity 30: Debate it Out	20 min
Wrap up, Adjournment & Social Time!		10 min

All activities can be found at the end of Meeting #6.

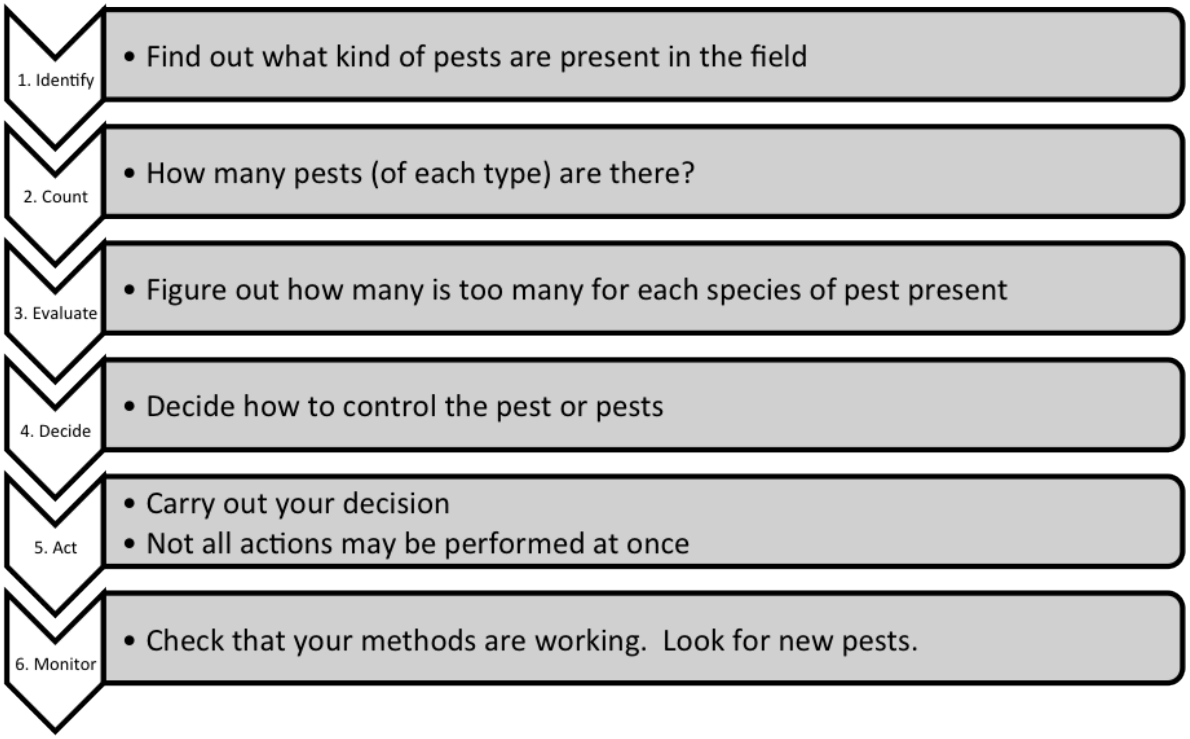
TOPIC INFORMATION

Putting the Pieces of the Puzzle Together

In Meeting 2, we learned Six Basic Steps to Better Pest Management. In Meetings 3, 4 and 5, we focused on weeds, diseases, and insects, respectively.

However, it is important to remember that when a crop producer is assessing challenges in the field, they are not just looking for insects or weeds or diseases. The actual approach is more holistic, searching for all possible pest problems and seeking solutions considering all problems and all possible strategies. Some types of pest management, such as tillage or crop rotation, may have an impact on controlling various types of pests.

When considering the Six Steps to Better Pest Management, it is important to consider all pests, while still following the steps below:



Some producers may not be open to all possible pest management options. For example, some farmers may operate entirely using conventional tillage methods while others may strictly operate no-till equipment. It is important when creating a plan to know the parameters in which the producer is willing to operate.

Organic Crop Production

Similarly, organic farming is becoming increasingly popular. This type of crop production has a huge impact on pest management strategies, because aside from a small 'permitted substances list' there is no use of pesticides as part of the IPM program.

Defining "Organic"

Source: http://www.omafra.gov.on.ca/english/crops/facts/09-077.htm

Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones.

Organic production is a holistic system designed to optimize the productivity and fitness of diverse communities within the agro-ecosystem, including soil organisms, plants, livestock and people. The principal goal of organic production is to develop enterprises that are sustainable and harmonious with the environment.

The general principles of organic production, from the Canadian Organic Standards (2006), include the following:

- protect the environment, minimize soil degradation and erosion, decrease pollution, optimize biological productivity and promote a sound state of health
- maintain long-term soil fertility by optimizing conditions for biological activity within the soil
- maintain biological diversity within the system
- recycle materials and resources to the greatest extent possible within the enterprise
- provide attentive care that promotes the health and meets the behavioural needs of livestock
- prepare organic products, emphasizing careful processing, and handling methods in order to maintain the organic integrity and vital qualities of the products at all stages of production
- rely on renewable resources in locally organized agricultural systems

Organic farming promotes the use of crop rotations and cover crops, and encourages balanced host/predator relationships. Organic residues and nutrients produced on the farm are recycled back to the soil. Cover crops and composted manure are used to maintain soil organic matter and fertility. Preventative insect and disease control methods are practiced, including crop rotation, improved genetics and resistant varieties. Integrated pest and weed management, and soil conservation systems are valuable tools on an organic farm. Organically approved pesticides include "natural" or other pest management products included in the Permitted Substances List (PSL) of the organic standards. The Permitted Substances List identifies substances permitted for use as a pesticides in organic agriculture. All grains, forages and protein supplements fed to livestock must be organically grown.

The organic standards generally prohibit products of genetic engineering and animal cloning, synthetic pesticides, synthetic fertilizers, sewage sludge, synthetic drugs, synthetic food processing aids and ingredients, and ionizing radiation. Prohibited products and practices must not be used on certified organic farms for at least three years prior to harvest of the certified organic products. Livestock must be raised organically and fed 100 per cent organic feed ingredients.

Organic farming presents many challenges. Some crops are more challenging than others to grow organically; however, nearly every commodity can be produced organically.

Growth of Organic Agriculture

The world market for organic food has grown for over 15 years. Growth of retail sales in North America is predicted to be 10 per cent to 20 per cent per year during the next few years. The retail organic food market in Canada is estimated at over $1.5 billion in 2008 and $22.9 billion in the U.S.A. in 2008. It is estimated that imported products make up over 70 per cent of the organic food consumed in Canada. Canada also exports many organic products, particularly soybeans and grains.

The Canadian Organic Farmers reported 669 certified organic farms in Ontario in 2007 with over 100,000 certified organic acres of crops and pasture land. This is an annual increase of approximately 10 per cent per year in recent years. About 48 per cent of the organic cropland is seeded to grains, 40 per cent produces hay and pasture and about five per cent for certified organic fruits and vegetables. Livestock production (meat, dairy and eggs) has also been steadily increasing in recent years.

Why Farm Organically?

The main reasons farmers state for wanting to farm organically are their concerns for the environment and about working with agricultural chemicals in conventional farming systems. There is also an issue with the amount of energy used in agriculture, since many farm chemicals require energy intensive manufacturing processes that rely heavily on fossil fuels. Organic farmers find their method of farming to be profitable and personally rewarding.

Why Buy Organic?

Consumers purchase organic foods for many different reasons. Many want to buy food products that are free of chemical pesticides or grown without conventional fertilizers. Some simply like to try new and different products. Product taste, concerns for the environment and the desire to avoid foods from genetically engineered organisms are among the many other reasons some consumers prefer to buy organic food products. In 2007 it was estimated that over 60 per cent of consumers bought some organic products. Approximately five per cent of consumers are considered to be core organic consumers who buy up to 50 per cent of all organic food.

Successful Organic Farming

In organic production, farmers choose not to use some of the convenient chemical tools available to other farmers. Design and management of the production system are critical to the success of the farm. Select enterprises that complement each other and choose crop rotation and tillage practices to avoid or reduce crop problems.

Yields of each organic crop vary, depending on the success of the manager. During the transition from conventional to organic, production yields are lower than conventional levels, but after a three to five year transition period the organic yields typically increase.

Cereal and forage crops can be grown organically relatively easily to due to relatively low pest pressures and nutrient requirements. Soybeans also perform well but weeds can be a challenge. Corn is being grown more frequently on organic farms but careful management of weed control and fertility is needed. Meeting nitrogen requirements is particularly challenging. Corn can be successfully grown after forage legumes or if manure has been applied. Markets for organic feed grains have been strong in recent years.

The adoption of genetically engineered (GMO) corn and canola varieties on conventional farms has created the issue of buffer zones or isolation distance for organic corn and canola crops. Farmers producing corn and canola organically are required to manage the risks of GMO contamination in order to produce a "GMO-free" product. The main strategy to manage this risk is through appropriate buffer distances between organic and genetically engineered crops. Cross-pollinated crops such as corn and canola require much greater isolation distance than self-pollinated crops such as soybeans or cereals.

Fruit and vegetable crops present greater challenges depending on the crop. Some managers have been very successful, while other farms with the same crop have had significant problems. Certain insect or disease pests are more serious in some regions than in others. Some pest problems are difficult to manage with organic methods. This is less of an issue as more organically approved biopesticides become available. Marketable yields of organic horticultural crops are usually below non-organic crop yields. The yield reduction varies by crop and farm. Some organic producers have added value to their products with on-farm processing. An example is to make jams, jellies, juice, etc. using products that do not meet fresh market standards.

For more information and current statistics regarding Organic Farming visit the Organic Council of Ontario's website at: www.organiccouncil.ca.

Weed and Nitrogen Management of Organic Crops

Source: http://www.omafra.gov.on.ca/english/crops/field/news/croptalk/2009/ct-0309a9.htm

The biggest production issues for organic field crop farmers are weed management, and nitrogen management in corn and cereals. The key to successfully managing weeds is to have a good crop rotation. Secondly, be timely with mechanical weed control, starting right after planting before the crop emerges. For corn and soybeans, this requires weekly passes over the field with a rotary hoe, weeder harrow or inter-row cultivation. This will likely cost less in total than a typical herbicide program. The third step is to be able to walk the fields with a hoe as needed to eliminate weedy patches and outbreaks or troublesome weeds. The key is to keep on top of your weeds and to prevent weeds from going to seed as much as possible.

Nitrogen is largely managed with cover crops such as red clover. Red clover is fairly easy to establish on most organic farms. Farms with access to manure can also use it are low. However, high rates of manure are discouraged in order to minimize weed pressure and environmental issues.

DIGGING DEEPER

Mother Nature's Role in Pest Control

When growing crops, we often think of the weather as impacting whether there is moisture available for plants to grow. However, the role of weather in cropping is much more than that. For example, cool, wet conditions favour pests like bacteria and nematodes. Another example is that Aphid populations typically increase after a rain.

The weather also impacts how we are able to control pests, by affecting when and how we are able to control weeds.

Pesticides should not be applied when heavy rains are expected, because they can easily wash off and contaminate surface and ground water supplies. Other weather related factors, such as temperature, can affect the breakdown of pesticides. Applying pesticides when there is a strong wind is not advisable due to the risk of drifting to off-site areas. Tillage in strong wind is also not recommended, as the risk for soil erosion increases.

OMAFRA Infosheet 20: Weather conditions (spraying for pest control and tillage for weed control)
Source: http://www.omafra.gov.on.ca/english/environment/efp/infosheet_20.htm

What can you do?

Option #1 - Action

Spraying or tillage plans are based on 24 hour forecasts for rain and wind, if rain or high winds begin spray or tillage operations are stopped.

Option #2 - Action

Do not spray or till if winds are greater than 10 km/hr and do not spray or till when heavy rain is expected within 24 hours:

- this speed of wind causes small branches to move in the wind and would result in substantial soil erosion and pesticide drift
- heavy rains would wash pesticides and soil away into nearby surface water.

ACTIVITIES

Activity 28 - Creating a Crop Plan (60 minutes, or more)

Objective – The purpose of this activity is to have members apply what they have learned during the project to a real-life situation as well as to consider the big picture as opposed to just looking at one type of pest as they did during most meetings.

Materials – Crop resource materials that have been used throughout the project, pens and paper.

Instructions –

1. Divide Members into 3 groups. One group will make management decisions based on no-till methods, the second on conventional tillage methods and the third will use organic practices to make decisions.
2. Select a field for the groups to scout. They should investigate the pest challenges in the current crop.
3. Groups should utilize the information gathered to develop an Integrated Pest Management Plan for the current crop.
4. If time permits, groups should establish a crop rotation that would help to minimize the presence of weeds, insects and diseases.
5. Groups should report back to the club on their plans.

Discussion – Encourage members to ask questions to the other groups. Suggestions and constructive comments are welcomed.

Activity 29 - Pest ID Quiz

Objective – To review pest identification by using a quiz that incorporates insect, weed and disease-causing pests.

Materials – Pictures of various pests for identification or a computer and projector to show the following quiz:

http://www.omafra.gov.on.ca/IPM/english/brassicas/test-your-knowledge/index.html

Instructions – Go through the quiz with members. This could either be done in the format of a group discussion or as a team game. The club could be divided into two teams and when a picture is shown, the first team to knock on the table in front of them gets the opportunity to answer the question. Points could be awarded for correct answers.

Activity 30 - Debate it Out (20 min)

Objective – To use knowledge gained from on-farm experiences and club activities to debate controversial topics. This activity also helps to hone public speaking skills.

Instructions –

1. Decide whether this should be a team activity or whether members should debate one on one.
2. Give members 5 minutes to think about their stance on the issue and the reasoning for it.
3. Debate it out! Make sure this is done in an orderly fashion, with each side having 2 min to explain their points and equal time for each to do a summation.
4. Other club members, or leaders can declare the winner of each debate.

Suggested topics:

- Use of GMO crops (genetically modified organisms)
- Organic versus non-organic farming
- Pesticide use
- Insects are living things too and should not be killed
- Other ideas…

Activity 31 - Wrap Up (10 min)

Use a few minutes at the last meeting to do an informal evaluation with the members. You could ask them to complete the following sentences (aloud) and record the answers to help plan for future years.

- I joined this club because…
- I really enjoyed …
- I didn't enjoy …
- I had a hard time …
- My favourite activity was …
- If I was to take this project again I would …
- I learned …
- I've changed …
- I'm glad …

Achievement Program and Project Ideas/Suggestions:

1. Create informational posters for display at a local fair or local Soil and Crop Improvement Association Field Day or Demo. Topic suggestions include:
    - Displaying weeds, insects or diseases
    - Safe use of pesticides
    - Organic pest control
    - Biotechnology and its role in controlling pests
2. Develop a multi-year crop plan for a field in groups (Similar to Activity 1 from Meeting 6).
3. Create a skit or scenario related to crop control or pesticide use that can be re-enacted for friends and family.
4. Keep excellent records of your crop plot for display along with samples from harvest.
5. For weeds, insects or diseases – Mount of collection of one type of these pests and describe them. Indicate where they are usually found, how they affect various field crops and how they may be controlled.
6. Problems in a Field Crop – Select a field crop and describe, with collected samples, the weeds, insects and diseases which can affect it. Design a suitable Integrated Pest Management program.
7. Research the history of pest control and pesticide use, predicting how pests will be controlled in the future.
8. Do a demonstration on the safe use of pesticides (i.e. use of protective clothing and equipment).
9. Survey – Find out the cost of naturally grown produce as compared to the cost of produce grown with chemicals. Using this information, do a survey to find out consumer demand for naturally grown products.
10. Pesticide Resistance – Select a crop rotation cycle and determine the weeds present for each crop. Suggest a weed management program that incorporates good resistance management.
11. Research pest control beyond the three types discussed in this manual. Construct a deadfall trap to catch small animals, as an activity example.
12. Organize a pest control information night for local agricultural producers. Club member pest presentations could be made, along with inviting expert guests on the topic.
13. Attend a crop diagnostics event or seminar or a local Soil and Crop Improvement Association field tour or demonstration day to sum up the key topics from the club.
14. Visit a crop plot to see how different varieties of a field crop are competing against each other in your area.
15. Interview someone involved with crop production and post the interview on You Tube
16. Have a crop specialist, member of local Soil & Crop Improvement organization, local cash cropper, fertilizer or pesticide supplier, etc. as a guest speaker.
17. Create a cost comparison chart of conventional, GMO, and organic types of crops.
18. Create a video about pesticide use and post on YouTube.
19. Create a video about collecting weed, insect or disease samples in the field and post on You Tube.
20. Visit a crop inputs company and tour facilities.
21. Track and collect during the growing season, stories from the farm media on pests affecting crops in the province.