BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

Monitoring is the first step in the IPM process. The second is interpreting the data and choosing appropriate control strategies for your operation. Ask yourself these questions:

Cost
- ▸ what is the value of the crop versus the cost of the solution?
- ▸ will you need to purchase new equipment?

Impact on the environment and fish and wildlife
- ▸ will there be negative effects on soil, water, wetlands or fragile areas?
- ▸ will there be negative effects on naturally occurring organisms such as invertebrates (e.g., insects), fish, amphibians, reptiles, waterfowl and mammals?

Timing
- ▸ will strategies fit in with your work schedule?

Success rate
- ▸ have the strategies been tested?

Availability of components
- ▸ are key components available, such as resistant varieties, registered pest control products and mechanical alternatives?

Versatility
- ▸ can the choice solve more than one pest problem?

Long-term consequences
- ▸ will the choice of control options affect economic competitiveness?
- ▸ will long-term planning prevent or delay problems with pesticide resistance?
- ▸ will the control option be acceptable to consumers?
- ▸ will the control reduce the risk of damage to the environment or wildlife?

Let's look now at pest control methods that make up an IPM system. They can be used alone or in combination, depending on the crop and the pest complex.

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SITE SELECTION

Site selection involves choosing a field or growing area that is best suited to growing and maintaining healthy, stress-free plants, and is least hospitable to pests.

Factors to consider include:

Soil type

- clay, silt, sand and organic matter content is important, since each crop has an optimal soil type. Some pests also prefer certain soil types. For example, nematodes prefer sandy soils.

Water drainage

- poor drainage leads to root rot problems, such as phytophora and pythium root rots on alfalfa

Isolation

- for many crops, it's advantageous not to be near a large, established pest reservoir

Exposure and slope

- maximum air drainage is important for many berry and tree-fruit crops to minimize disease infection periods

Previous crop

- need to anticipate problems presented by the previous crop, such as herbicide residues or pest carryover
- many diseases are soil-borne, such as wilts caused by fungi. Fungi (e.g., verticillium) can infect a very broad spectrum of crops, such as a potato-tomato-alfalfa rotation.

This alfalfa plant has been infected with verticillium, causing wilt symptoms.

An apple orchard planted on rolling land has good air drainage, which lowers the incidence of disease.

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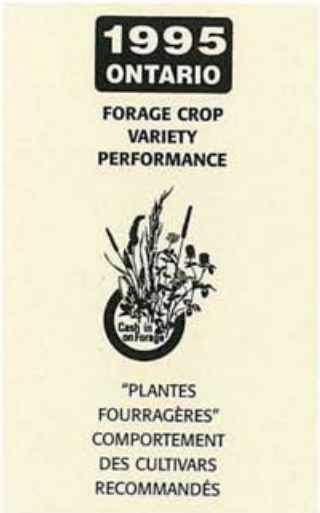
CULTIVAR SELECTION

Cultivar selection involves choosing a cultivar or variety based on its genetic characteristics and ability to tolerate or resist a pest. Resistant seed or plant material is usually inexpensive, and can eliminate the need for other costly methods of pest control.

The cost of developing a new soybean variety is in the $250,000 to $1-million range, and is recouped through the sale of seed as long as the variety is accepted by the market. For field crops, this cost is spread over large areas, whereas the initial cost of developing a variety for a small-area horticultural crop cannot be spread out. This makes new varieties very expensive on a per-unit basis.

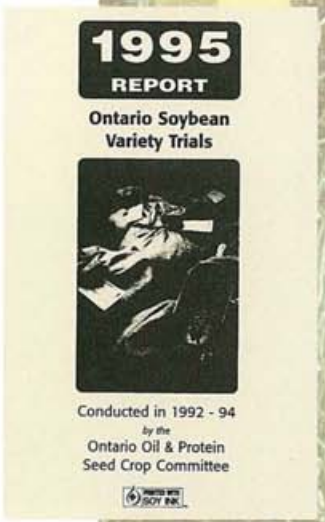
Cultivar selection has worked especially well with field corn. Breeders have selected for stalk strength so that European corn borer may be present, but the stalks are strong enough to stand in spite of the feeding damage.

However, some challenges remain. One is that the variety must be marketable. Scab-resistant apples, for example, have never become established in the marketplace. Another challenge is that pests can overcome resistance. Despite the development of crown rust-resistant oat varieties, rust returned within two years. In this case, genetic change in the crop was not sufficient to overcome the huge pool of alternate hosts in adjacent areas. Also, there are many strains of rust.



You can use the most recent *Ontario Forage Crop Variety Performance* report to choose varieties that are resistant to diseases.

The findings of the *Ontario Hybrid Corn Performance Trials* can be used to identify varieties that are most resistant to corn borer. These are determined by percent broken stalks.



The *Report of the Ontario Soybean Variety Trials* can be used to choose varieties most resistant to Phytophthora root rot.

BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

CROP ROTATION

As an IPM strategy, crop rotation involves alternating crops to meet specific objectives such as reduced pest habitat, soil improvement, and reduced pest food source. It can be successful under the following conditions:

- a marketable alternative crop is available
- sufficient land base exists
- alternative crop has a different set of pests and will not act as a food source for the resident pests in the field
- target pests are resident in the field and don't fly in from a great distance.

In Ontario, the use of corn rootworm insecticides has been cut by 50 percent since 1986 due to rotation. The rootworm adult lays its eggs in the fall, and if the crop is rotated to wheat or soybeans, there is no food source for the rootworm the next spring.

Soybeans are another success story. The soybean cyst nematode has been spreading in Ontario since 1987. A five- or six-year crop rotation using non-hosts and resistant soybean varieties has reduced the population in infested fields.

Crop rotation has its limitations. Vegetable growers, for example, don't have a big enough land base to use a long rotation. Also, perennial crops like tree fruits are in the ground for up to 20 years. Low prices for crops such as winter wheat make it a difficult choice in the traditional corn-wheat-soybean rotation.

A healthy cornfield is largely the result of crop rotation and choosing the best variety to plant.

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SANITATION

Pest numbers can be controlled in part by eliminating materials or places where pests live and reproduce. Sanitation can also involve the purchase of clean seed complete with a phytosanitary certificate, and the removal of contaminated crop refuse from past crops to reduce problems in future crops. Many bacterial diseases result from the use of infested seed stock.

Sanitation practices can have many benefits. In the Bradford Marsh area, onion cull piles are diverted from landfill sites to highland farms for spreading.

By cleaning storages and seed-handling equipment, seed potato growers are eliminating the carryover of disease-causing organisms on surfaces or in potato debris. Pressure washing and disinfecting surfaces help control ring rot bacteria, which can live for two to five years on dry surfaces and survive freezing temperatures.

Farmers who store grain are able to exclude pests and prevent their re-entry. Measures include vacuuming storages and maintaining tight seals on all entry points.

Manure piled outside for long periods can create a perfect breeding environment for flies.

If onion cull piles are left near fields, they become sources of insects and diseases for the next crop.

BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

BIOLOGICAL CONTROL

By utilizing a pest's natural enemies – predators, parasites and pathogens – it's possible to keep pests below treatment thresholds. There are two approaches:

Encouraging natural enemies

- using selective pesticides that aren't harmful to the beneficials, while killing the target pest
- knowing life cycles of beneficials – allows you to time operations such as spraying, cultivating, mowing and harvesting so that most beneficials can survive
- providing food for them by not eradicating the pest populations, but rather allowing a low level of pests to act as a food source
- being patient by allowing up to two years for their establishment, once broad-spectrum pesticides have been eliminated from the spray program
- sampling periodically for beneficials to track the beneficial:pest ratio and to recognize changes in it as a consequence of operations in the crop

Releasing natural enemies

- classical – introducing natural enemies from a pest's native range into a new area where natural enemies don't provide control, e.g., alfalfa weevil and blotch leaf miner in Ontario
- inoculative – releasing natural enemies periodically to re-establish a balance that hasn't been maintained naturally, e.g., in greenhouse tomatoes, release the parasitic wasp, *Encarsia formosa,* for whitefly control with each new crop.

The whitefly is one of the most important pests of greenhouse tomatoes.

BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

MINI CASE STUDY

***Amblyseius fallacis* to control mites in Ontario apple orchards.**

Problem

Mites are normally controlled by predators, but broad-spectrum insecticides used to control other apple pests often kill predators. Mite populations explode when broad-spectrum insecticides kill their natural predators.

Solution

Re-introduce a mite predator. This required:

- grower awareness of the problem and growers using fewer, better timed pyrethroid sprays
- rearing of organophosphate resistant mite predator, *A. fallacis*
- 1993 commercial availability of mite predator to re-establish predator numbers
- available list of pesticides least toxic to the predators.

The mite predator, *Amblyseius fallacis*, travels along the underside of an apple leaf, where the pest mites accumulate.

NUTRITION AND WATER NEEDS

Generally, a healthy plant or animal can withstand more pest pressure and higher thresholds for control. Be aware that some nutritional disorders and other stresses can look like pest damage. Ensure correct diagnosis.

Overfertilizing plants can cause pest problems. For example, too much nitrogen causes excessive sucker growth, favouring infestations of aphids on apple, and psylla on pear. Excessive nitrogen may also increase disease problems such as Botrytis grey mould on strawberry.

Take soil and leaf samples regularly to monitor nutrient balance, and be aware of water requirements of the crop.

Blossom end rot on tomatoes may look like a disease. In fact it's caused by a calcium imbalance.

Nutrient deficiency, e.g., magnesium deficiency, may be mistaken for leafhopper or other insect damage.

BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

Proper management of grapevines results in less disease.

REMOVAL

DISEASES

The physical removal of infection sites, such as black knot of plum and fireblight of pear, and removal of alternate hosts from fencerows can help to control diseases without chemicals.

Proper canopy management through pruning, plant spacing and trellising in some crops can make the crop less likely to become infected because of better air movement.

WEEDS

The physical removal of weeds by cultivation can replace a herbicide. However, you must factor in the cost of fuel, machinery, time and the potential for soil erosion or degradation.

To control weeds through hoeing or hand weeding, consider availability of the labour force, value of crop and time involved.

Mulching can be used to smother weeds, prevent weed germination and help conserve soil moisture. Mowing can be important in pasture management to prevent the unwanted establishment of perennials.

BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

INSECTS

The physical removal of insects is done on a small scale in home gardens and on a large scale in some commercial potato fields in Ontario. Propane flamers are used where the problem of resistance has meant that chemicals no longer work to control Colorado potato beetles. Plastic-lined ditches around potato fields are used to prevent the entry of Colorado potato beetles in the spring. These expensive and difficult procedures are done as a last resort.

Cedar-apple rust spends part of its life cycle on cedar, where it produces these orange telia.

The disease infects apple foliage, producing characteristic lesions.

Cedar-apple rust also attacks apple fruit.

Tarnished plant bug attacks many fruit crops, and has a wide host range.

Two-spotted spider mites use many crops – from tree fruit to soybeans – as a food source.

BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

PLANTING AND HARVESTING DATES

Planting and harvesting dates can be manipulated to avoid some pests. However, only some pest-crop combinations can benefit from this practice. There are three approaches:

Planting late

- ▸ early generations of pests can be avoided by late planting
- ▸ challenge: planting late may result in soil moisture problems, poor germination, lower yields, and not enough heat units to mature the crop

Planting early

- ▸ resistant varieties of field corn are planted early so they will be unattractive to second-generation European corn borer in Southwestern Ontario

Early harvest

- ▸ used in alfalfa to control both alfalfa blotch leaf miner and alfalfa weevil. The benefit to producers is that the early harvested crop has higher digestible protein for livestock.
- ▸ challenge: harvesting early may result in lower yields, poor storage ability and a product that is less marketable and not mature.

BEST MANAGEMENT PRACTICES FOR IMPLEMENTING IPM

A row of potatoes has been planted in a tomato field to act as a trap crop for Colorado potato beetle. This row was not sprayed.

This trap crop row was sprayed to control Colorado potato beetle.

TRAP CROPS

Trap crops lure pests away from primary crops. A trap crop can be planted to surround a crop, or be interspersed in it. Here are some examples:

Colorado potato beetles in processing tomatoes

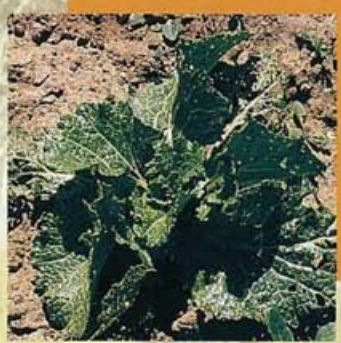
- Colorado potato beetles prefer potato to tomato. Potatoes are planted and ground in the tomato field. When beetles attack the potatoes, they can be managed with insecticides or propane flamers. This reduces the area of the field requiring controls.

Flea beetles in cole crops

- Indian mustard var. crispafolia is planted at the edge of broccoli fields and along laneways, and eliminates sprays for flea beetles – from four sprays to zero in 1994.

There are some problems with trap crops. They take up space and nutrients, and won't work if pest pressure is too severe. For example, the Colorado potato beetle may eat all of the potato plants, then move to tomatoes if the population is high.

Growers need to be able to manage both the trap crop and the commercial crop. The trap crop should not become a weed problem, and it needs to be inexpensive and easy to obtain.



Indian mustard has been used as a trap crop and shows damage by flea beetles.

Flea beetles attack the row of mustard on the right, leaving the crucifer crop on the left undamaged.

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PESTICIDE REGISTRATION AND SELECTION

In Ontario, over 53,000 growers have been certified in the safe handling and application of pesticides. The Grower Pesticide Safety Course was implemented in 1988, and became mandatory in 1991.

A pesticide is a chemical that kills pests, and can be synthetic or natural in origin. The pest could be a weed, disease, nematode or rodent. The Government of Canada has defined the following pest control products as pesticides: insecticides, fungicides, herbicides, rodenticides, miticides, plant growth regulators and fumigants. There are currently no defined protocols for new types of pest control products such as beneficials and biotechnology products.

Before pest control products can be sold in Canada, they must be registered by the federal government. This can take up to 10 years for a new chemical, and can cost between $50- and $100-million.

Once registered, some provinces review the data and the pesticides are classified into schedules to control who may buy and use each product. In Ontario, farmers must be certified in the safe use and handling of pesticides through the Grower Pesticide Safety Course. Vendors must also pass a course. Vendors must have an employee who has passed the Vendors Certification course at each sales location during business hours.

Pesticides are highly regulated when they are transported and distributed.

Health Canada establishes maximum residue limits on crops and conducts residue testing on our food. Crops can be seized if excessive residue levels are found at harvest and the crops may not be marketed.

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SELECTION

When deciding to use a pest control product, try to ensure:

- ▸ it's effective against the pest problem
- ▸ it's registered for the intended use in your area
- ▸ it's compatible with your work schedule, labour costs and harvest dates
- ▸ it's easy on beneficials and other non-target fish and wildlife
  - ▷ you understand the effects of a product on non-target organisms, such as those in sensitive areas near ponds or streams (fish and wildlife), and around farm buildings (humans, pets, livestock)
- ▸ it's least hazardous to applicator, e.g., soluble packaging, lower mammalian toxicity
- ▸ it's least hazardous to the environment, i.e., not easily moved into ground water, not persistent in soil
- ▸ it can be alternated with other pest control methods to discourage the development of pesticide resistance
- ▸ the selected pest control product will not encourage the development of secondary pests
- ▸ chemical persistence will not be harmful to future cropping plans
- ▸ affordability – some new IPM-compatible products can be more expensive than traditional ones
- ▸ you know whether the pesticide will be applied as a broadcast, spot or border spray
- ▸ you know the best timing for its use – every pest has a part of its life cycle that is most vulnerable to controls.