Pest Management
June 12, 2010
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Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is a system for optimizing pest management decisions based on both ecological and economic considerations.

Fundamental to Integrated Pest Management are a number of assumptions:

- Optimal pest management is achieved by employing a variety of techniques.
- Pest management techniques should be used in a coordinated (integrated) manner so that their effects complement each other.
- Since eradication of many pests is not often achievable or desirable, controls should be applied only when pest populations are so disruptive as to justify their action. Monitoring pest populations is usually necessary to achieve this goal.
- Pest management techniques should consider the long-term costs of the practice, including their effects on beneficial organisms, health, and the environment. The performance of any pest management practice should be continually reevaluated to determine whether it is achieving the desired result in the most effective manner. (1)

(1) Pests of the West; revised, Whitney Cranshaw

Biological Control Organisms (1)

Lady Beetles (Lady bugs) – Adult and larval lady beetles feed on large numbers of small, soft-bodied insects such as aphids. Lady beetles also eat the eggs of many insects.

Green Lacewing – Lacewing larvae, sometimes called "aphid lions", are capable of feeding on small caterpillars and beetles as well as aphids and other insects.

(Praying) Mantids – Mantids ability to control pest insects is overrated for several reasons. Their choice of foods is composed primarily of non-injurious flies and bees, they feed on insects that are fast moving not the slow moving aphids, caterpillars and beetle larvae that leisurely munch on plants.

Aphid Predator Midge – Aphids are rendered immobile by a paralyzing toxin that the maggots inject and which quickly dissolves their body contents. Each predator midge may feed on between 10 to 100 aphids during its development.

Trichogramma Wasp – These tiny wasps attack and kill insect eggs, specifically the eggs of caterpillar pests, such as cabbage loopers and corn earworms. Insect larvae that have already hatched are not susceptible to trichogramma attacks.

Bacillus Thuringiensis (Bt) – Bt works by disrupting the gut lining of susceptible insects, ultimately killing them by a type of starvation or blood poisoning. The outstanding advantages of Bt are its highly specific action and associated safety. Commercial names include, Dipel®, Thuricide®, and Caterpillar Attack®.

Nosema Locustae – A protozoan parasite of many grasshoppers. It is most effective against younger stages of grasshoppers and is used to control grasshoppers in breeding areas. Commercial formulations (NoLo Bait®, Semaspore®) are mixed with a bran-based bait carrier designed to be broadcast.

(1) Pests of the West, revised, by Whitney Cranshaw

Insect Control: Soaps and Detergents

Insect Control: Soaps and Detergents

by W.S. Cranshaw [1]

Quick Facts...

- Soaps can be used to control a wide range of plant pests. Small, soft-bodied arthropods such as aphids, mealybugs, psyllids and spider mites are most susceptible to soaps.
- The ease of use, safety and selective action of soaps appeal to many people.
- Limitations of soaps include the need to wet the insect during application, absence of any residual effectiveness, and potential to damage some plants.
- Soaps or detergents used for control of insects are applied as dilute sprays, mixed with water to produce a concentration of about 2 percent.

Soaps have been used to control insects for more than 200 years. Recently, there has been increased interest in and use of these products. This change is due to a better understanding of how to use soaps most effectively and a desire to try insecticides that are easier and safer to use than many currently available alternatives.

How soaps and detergents kill insects is still poorly understood. In most cases, control results from disruption of the cell membranes of the insect. Soaps and detergents may also remove the protective waxes that cover the insect, causing death through excess loss of water.

Soap-Detergent Sprays

Soaps and detergents act strictly as contact insecticides, with no residual effect. To be effective, sprays must be applied directly to and thoroughly cover the insect.

Several insecticidal soaps are distributed for control of insects and mites. Available under a variety of trade names, the active ingredient of all is potassium salt of fatty acids. Soaps are chemically similar to liquid hand soaps. However, there are many features of commercial insecticidal soap products that distinguish them from the dishwashing liquids or soaps that are sometimes substituted. Insecticidal soaps sold for control of insects:

- are selected to control insects;
- are selected to minimize potential plant injury; and
- are of consistent manufacture.

Some household soaps and detergents also make effective insecticides. In particular, certain brands of hand soaps and liquid dishwashing detergents can be effective for this purpose. They are also substantially less expensive. However, **there is increased risk of plant injury with these products.** They are not designed for use on plants. Dry dish soaps and all clothes-washing detergents are too harsh to be used on plants. Also, many soaps and detergents are poor insecticides. Identifying safe and effective soap-detergent combinations for insect control requires experimentation. Regardless of what product is used, soap-detergent sprays are always applied diluted with water, typically at a concentration of around 2 to 3 percent (Table 1).

Susceptible Insects

Most research with insecticidal soaps and detergents has involved control of plant pests. In general, these sprays are effective against most small, soft-bodied arthropods, such as aphids, young scales, whiteflies, psyllids, mealybugs, and spider mites. Larger insects, such as caterpillars, sawflies and beetle larvae, generally are immune to soap sprays. However, a few large insects, including boxelder bugs and Japanese beetles, are susceptible.

Insecticidal soaps are considered selective insecticides because of their minimal adverse effects on other organisms. Lady beetles, green lacewings, pollinating bees and most other beneficial insects are not very susceptible to soap sprays. Predatory mites, often important in control of spider mites, are an exception: a beneficial group of organisms easily killed by soaps.

Application

One of the most serious potential drawbacks to the use of soap-detergent sprays is their potential to cause plant injury -- their phytotoxicity. Certain plants are sensitive to these sprays and may be seriously injured. For example, most commercial insecticidal soaps list plants such as hawthorn, sweet pea, cherries and plum as being sensitive to soaps. Portulaca and certain tomato varieties also are sometimes damaged by insecticidal soaps. The risk of plant damage is greater with homemade preparations of household soaps or detergents. When in doubt, test soap-detergent sprays for phytotoxicity problems on a small area a day or two before an extensive area is treated.

Plant injury can be reduced by using sprays that are diluted more than the 2 to 3 percent suggested on label instructions. To reduce leaf injury, wash plants within a couple of hours after the application. Limiting the number of soap applications can also be important, as leaf damage can accumulate with repeated exposure.

However, because of the short residual action, repeat applications may be needed at relatively short intervals (four to seven days) to control certain pests, such as spider mites and scale crawlers. Also, application must be thorough and completely wet the pest. This usually means spraying undersides of leaves and other protected sites. Insects that cannot be completely wetted, such as aphids within curled leaves, will not be controlled.

Environmental factors also can affect use of soaps. In particular, soaps (but not synthetic detergents) are affected by the presence of minerals found in hard water, which results in chemical changes producing insoluble soaps (soap scum). Control decreases if hard-water sources are used. Insecticidal soaps may also be more effective if drying is not overly rapid, such as early or late in the day.

Soaps and detergents can offer a relatively safe and easy means to control many insect pests. As with all pesticides, however, there are limitations and hazards associated with their use. Understand these limitations, and carefully follow all label instructions.

Table 1: Approximate mix to produce various dilute soap sprays.

Percent dilution desired	Approximate amount of soap to add to water to produce:		
	Gallon	**Quart**	**Pint**
1	2 1/2 Tbsp (-)	2 tsp (+)	1 tsp (+)
2	5 Tbsp (-)	4 tsp (+)	2 tsp (+)
3	8 Tbsp (+)	2 Tbsp (+)	1 Tbsp (+)
4	10 Tbsp (-)	2 1/2 Tbsp (+)	4 tsp (+)

(+) Will produce a solution of slightly higher concentration than indicated.
(-) Will produce a solution of slightly lower concentration than indicated.

[1]Colorado State University Extension entomologist and professor, bioagricultural sciences and pest management. 12/96. Reviewed 3/08.

Protection against animals (1)

Rabbits – Rabbits can simply be excluded from gardens with fencing. A 2-foot-high chicken wire fencing, buried shallowly in the soil, prevents most rabbits from entering gardens during the summer. Holes in fencing should not be larger than ½ inch to exclude small rabbits. Rabbits tend to avoid open areas where they are particularly vulnerable to predators. Keeping areas mowed and landscaping to provide open areas will deter rabbits.

Voles – Natural predators of voles include large snakes, owls and weasels, however cats rarely pass up an opportunity to feed on voles. Voles require cover and ready access to food. Periodically spading or tilling a garden, reduces the available cover favored by voles.

Birds – The most effective control is netting to exclude birds from fruit trees and berries. The netting must completely enclose the plant, since the birds seek out any openings. Mesh bird netting, as well as cheesecloth or shade cloth, will do the trick. Injury to fruit crops may be reduced by offering alternative foods for fruit-feeding birds such as elderberry, mulberry, hawthorn and mountain ash.

(1) Pests of the West, revised, by Whitney Cranshaw

Nonchemical Disease Control

Nonchemical Disease Control

by B. Edmunds and L.P. Pottorff [1] (5/09)

Quick Facts...

- Many disease problems can be prevented or controlled without pesticides.
- Always choose plants that are adapted to Colorado growing conditions.
- Avoid bringing diseases into the garden or moving them around within your garden.
- Eliminate the disease-causing organism after it has become established on a plant.

With the increasing concern about use and misuse of pesticides in commercial agriculture and home gardens, there are more and more inquiries for organically grown commodities every year. Nonchemical control practices for plant diseases have been known and recommended for years. The backbone of any integrated pest control program must always include cultural and sanitation practices, two important components of nonchemical disease control.

Unfortunately, disease problems may begin as soon as seeds are planted and can continue into harvest and storage. Plant diseases may be caused by several pathogenic organisms, such as fungi, bacteria, viruses, mycoplasmas and nematodes. In addition, nonliving factors, such as deficiencies or excesses of water, light, temperature, air pollution, pesticides and nutrients, can either predispose a plant to disease or directly cause plant injury.

Fortunately, many disease problems can be prevented or controlled without pesticides. Effective plant disease control begins at the onset of disease or even before symptoms appear.

Resistance

Effective disease control through resistance (a plant's tolerance or immunity to a disease) is based on knowledge of the diseases that occur in an area. Always choose varieties of plants that are adapted to Colorado growing conditions. Many vegetable, fruit and ornamental plant varieties are available with resistance to one or more diseases.

For example, when purchasing tomato varieties, always select plants labeled "VFN," "VFNA," "VFNT," etc. This indicates that the plants are resistant to Verticillium wilt (V),

Fusarium wilt (F), southern root-knot nematode (N), early blight (A), or tobacco (tomato) mosaic virus (T). Selecting resistant plants may eliminate many disease problems. Contact your Colorado State University Extension county office for lists of plant varieties that are successfully grown in this area.

Exclusion

Exclusion is preventing the entrance and establishment of disease-causing organisms (pathogens) into areas where plants are grown. This means avoid bringing diseases into the garden or moving them around within the garden.

Use certified, disease-free seed or transplants. Examine the leaves and root systems of transplants and eliminate or destroy diseased plants. Either raise your own transplants in sterilized beds or buy them from a reputable dealer. Do not purchase transplants with galls or swellings on their roots or plants that have a brown discoloration on the stem at the ground line. Galls or swellings may indicate root-knot nematode infection. A brown stem discoloration may mean the presence of damping-off organisms.

Also, avoid transporting soil or tools from known disease areas to disease-free areas.

Eradication

Eradication is the elimination of the disease-causing organism after it has become established on a plant. Eradication can be accomplished by several methods.

Sanitation

Plant pathogens are less likely to survive if organic matter is quickly decomposed. Remove plant debris or infected plant parts after each growing season. Turn the soil after harvest to help break down small roots that may harbor nematodes, fungi or bacteria. Gardeners may compost dead plants if they have a good composting system; otherwise, these piles may serve as a source of pathogens.

Prune or remove twigs and branches of woody plants affected with fire blight and other bacterial or fungal canker diseases.

Keep gardens weed free. Weeds often are another source of pathogens. Eradicate weeds to break the life cycle of pathogens and control them. Weed removal also can increase air movement and thus decrease conditions that favor disease development.

So that pathogens do not spread from one area to another, always disinfest machinery and other tools with steam, hot water under pressure, or a 10 percent solution of household bleach diluted with water.

Crop Rotation

Avoid planting the same crop in the same area of the garden year after year. Continuous culture of the same kind of crop provides an opportunity for pathogen buildup.

For example, rotate leafy vegetables with grains or corn, or rotate annuals or biennials in seed and flower beds. It is best to grow the same or closely related plants in the same soil only once every three to five years. This practice starves out most pathogens that cause leaf, flower and stem diseases.

Crop rotation is not as effective against soil-borne organisms, those fungi, bacteria and nematodes that persist in the soil for up to 10 years or more.

Soil Sanitation Treatments

Occasionally, disease-causing organisms that live in the soil may build up and prevent satisfactory growth of plants. Pathogen-free soil is desirable for houseplants, transplants and garden plots. Sterile potting mixes are available at many garden centers. However, it may be desirable to sanitize small quantities of soil on your own.

There are several nonchemical methods available to eradicate or reduce pathogens in the soil. The use of dry, steam or solar heat are the most effective nonchemical means to sanitize soil. The time to treat soil is before seeding or transplanting. Soil to be treated must be easily crumbled and without clods or large pieces of plant debris. Add any amendments (manure, compost, peat moss, etc.) **before treatment**. Soil also must have proper moisture. To test for this, gently squeeze a handful of soil. When the hand is opened, the soil ball should break apart somewhat. If it doesn't and the ball cannot be broken apart by gently pushing down on top of the ball, the soil is too wet.

Oven sterilization. Place soil evenly but not more than 4 inches deep in nonplastic containers, such as seed flats, clay pots, and glass or metal baking pans. Tightly cover each container with aluminum foil. Insert a meat or candy thermometer through the foil into the center of the soil. Set the oven temperature between 180 and 200 degrees F.

Heat the soil to at least 180 degrees and allow it to remain at this temperature for 30 minutes. Do not allow the temperature to go above 200 degrees, because this may cause products that are toxic to plants. After heating, cool and remove containers from the oven. Leave the aluminum foil in place until you are ready to use the soil. The heated soil will give off an odor. Microwaves or outdoor cookers also can be used.

Pressure-cooker sterilization. Pour several cups of water into the cooker. Place no more than 4 inches of soil in shallow containers on a rack out of the water. Level the soil, but do not pack it down. Cover each container with aluminum foil. Stack the containers to allow steam circulation. Close the lid, but leave the steam valve open until all the air is forced out and steam begins to escape. Then close the steam valve and heat at 10 pounds

pressure for 15 minutes. Turn off the heat, allow the containers to cool, and remove. Leave the aluminum foil in place until you are ready to use the soil.

Steam sterilization without pressure. Pour about 1 inch of water into the sterilizing container. Follow the soil preparation procedures listed earlier. Place filled soil containers on a rack that will hold them out of the water. Close the lid and bring the water to a boil. Open the lid just enough to prevent pressure from building up. When the steam begins to escape, continue boiling for 30 minutes. Turn off the heat and replace the lid. Remove the soil when cool.

Soil solarization. This method uses the sun's energy to heat small areas of soil to temperatures that are lethal to many soil-borne organisms and weed seeds. Treat during the summer when there are high air temperatures and intense solar radiation. With a tiller or a shovel, loosen the soil to be treated, wet it and cover it with a thin, clear, polyethylene (plastic) film. Seal the edges of the plastic sheet with soil to prevent heat loss and retain moisture. Leave the plastic in place for several weeks. The longer the soil is exposed to the heat generated by the solarization process, the greater the kill of undesirable organisms. For more information, contact your Colorado State Extension county office.

Avoid toxicity from heated soil. With heavier soils and soils that contain a large amount of organic matter (manure, compost or peat moss), a toxic effect from heat sanitation may occur. This can cause poor seed germination, plant growth abnormalities or plant death. The toxicity is caused by an accumulation of ammonium compounds, soluble organic compounds, minerals or salts when the soil is heated too long or at too high a temperature. If soil toxicity is a problem, heavy irrigation of the treated soil may leach out many of these substances. Storing the soil two to three weeks without a cover also reduces soil toxicity.

Cultural Management

Cultural management involves avoiding the onset of disease. To accomplish this without pesticides, create an environment unfavorable to pathogens.

- Don't work in the garden when plants and soil are wet. Spores and cells of disease-causing organisms can spread from one plant to another and initiate new disease. Wet soils are easily compacted, which can decrease the amount of oxygen in the soil.
- Make sure plants are spaced properly. Air movement decreases when plants are grown too close together. This allows moisture to remain on leaves for longer periods of time. Wider spacing in beds and landscape plantings promotes rapid drying after wet periods and stops development of foliage, flower and fruit pathogens.
- Avoid excessive soil moisture. Overwatering enhances seed decay, damping-off and root rot diseases. Try not to plant in areas that have poor drainage or where water stands for several days following rains.

- Fertilize plants properly based on soil nutrient analyses using either organic or commercially prepared (inorganic) fertilizers.

In other words, use good cultural management. Healthy plants are less likely to have disease problems than weak, undernourished ones. Grow plants under optimum conditions and there will be fewer disease problems.

Control of most plant diseases **can** be accomplished without pesticides. Use sound cultural practices, sanitation and well-adapted plant varieties to reduce disease problems. It is important to realize that you must accept some disease loss. Don't expect a perfect garden or plant if you do not want to use chemicals.

[1]B. Edmunds, Colorado State University Extension regional specialist, commercial greenhouse and nurseries, Adams County. Originally written by Laura Pottorff, former plant pathologist and horticulturist, Integrated Pest Management Program, Jefferson County. 7/96. Reviewed 5/09.