Oakland CUSD #5

Landscaping

April 20-24, 2020

Jeff Coon

Week of April 20-24, 2020

All of these assignments are on google classroom. You must pick one of the 3 listed and complete by next Monday April 20 for credit. If you would like to use google docs to complete the work that would be most efficient, just remember to start a new copy with your own work please. Paper copies can be returned to the school.

Class	Choice 1	Choice 2	Choice 3 (Enrichment)
Ag Science	Common Breeding	Starting an sae	FFA Official dress
Ag Business Mang	MaInvestments	Life Insurance	Business Plan
BSAA	Advanced DNA	Animal Repro Systems	Domestic Animals
Landscape Design	Environment	Landscape tools	Landscape IPM
Intro To Ag	FFA Creed	Parly pro	World food supply
Ag Mech.	Profile Leveling	Power tools	Precision Ag

Period 1

Mr. Coon Landscape/Turf Environment and the Landscape April 20 -24

Checking Your Knowledge:

1. Define abiotic, biotic, and ecology.

2. What is an invasive plant?

3. How do point source and nonpoint source pollution differ?

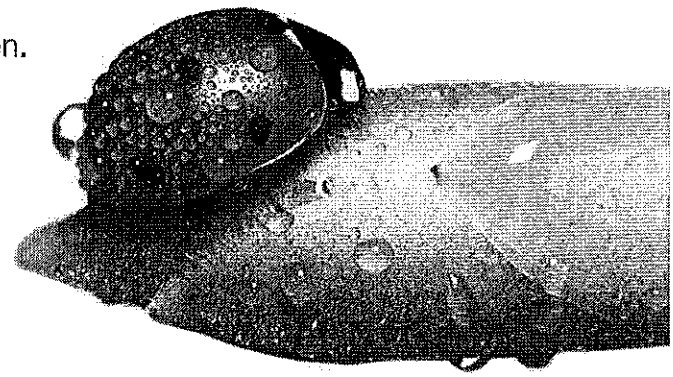
4. How is wildlife habitat affected by horticultural practices?

5. What is eutrophication?

Coon April 20-24 Choice 1

Understanding Environmental Impacts of Horticulture

HORTICULTURE is the culture of a garden. Horticulture may involve rose gardens, vegetable gardens, and perennial gardens, among others. In each case it alters the environment. Some changes to the environment caused by horticultural pursuits are detrimental, and some are beneficial.



Objective:

Discuss the impact of horticulture on the environment.

Key Terms:

abiotic
biotic
condensation
ecology
ecosystem
environment
eutrophication
evaporation
habitat
hydrologic cycle
infiltration
intensive land use
invasive plants
nitrogen cycle
nonpoint source pollution
point source pollution
pollution
precipitation
transpiration
wetlands
wildlife

Horticulture and the Environment

Horticulture and the environment are intertwined. The **environment** is the nonliving, or **abiotic**, aspect of an organism's immediate habitat. It includes physical and chemical features, such as rocks, minerals, air, and water. Living things, such as horticultural plants, animals, and microorganisms, are referred to as **biotic**. The study of living things in relation to their envi-

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ronment is called **ecology**. An **ecosystem** is a community of organisms and its nonliving environment.

One cannot ignore the fact that horticultural practices influence an ecosystem. Some practices disturb the ecosystem. However, proper horticultural practices can limit the negative impact on the ecosystem.

ENVIRONMENTAL ISSUES

Public demand for a high-quality product, growers concerned about how to produce a high-quality product at a low cost, and the impaired health of the ecosystem are some issues associated with horticulture.

Intensive land use involves using production practices on large fields to get top yields. These practices can greatly affect the natural resources in an area by altering the natural environment.

The use of integrated pest management is a biological control method used to fight pests. Integrated pest management (IPM) limits damage to the ecosystem. IPM is a strategy that uses a combination of measures to reduce pest damage with the least disruption to the ecosystem.

Biotechnology and genetic engineering have been used to help produce new plant varieties and improve others. Some people are concerned with the environmental impact of these genetically altered plants.

Horticultural practices often introduce new plant species to an area. Some of these species escape cultivation and out-compete native species, disrupting the ecological balance. Plants that can thrive and spread aggressively outside their natural range are called **invasive plants**. Purple loosestrife, multiflora rose, and the tree-of-heaven are three examples of invasive plant species.

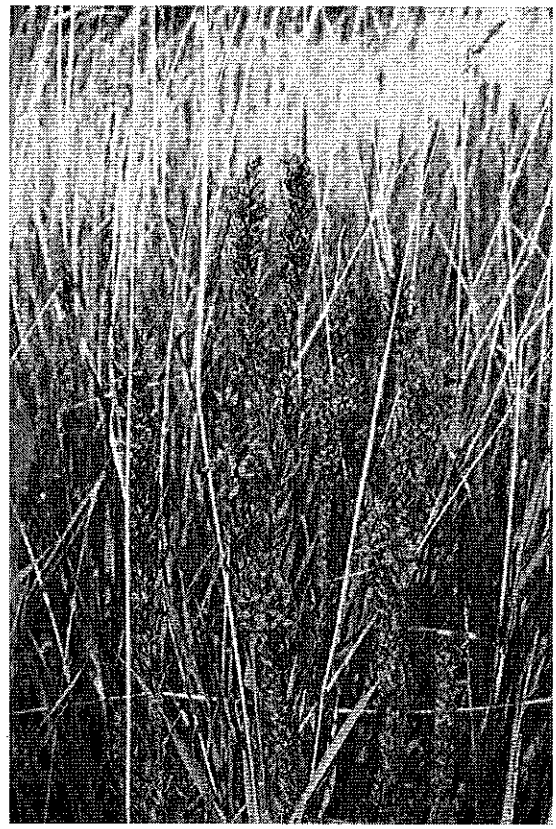

FIGURE 1. Purple loosestrife is an example of an invasive plant species that can thrive and spread aggressively outside its natural range.

HORTICULTURAL BENEFITS

Some horticultural practices are beneficial to the environment. The benefits can be both personal and biological. Plants can be used for personal benefit in recreational settings, such as golf courses and public parks. Biological benefits of horticulture include the use of plant parts to help prevent erosion, slow water runoff, absorb pollutants, control dust, and provide wild-

Coon April 20-24 Choice 1

life habitat. Landscaping can also help improve the value of real estate by increasing the beauty of an area.

HARM CAUSED BY HORTICULTURAL PRACTICES

Many horticultural practices cause disruption of the ecological balance. Pollution of water, damage to natural resources, and misuse of chemicals are some harmful results of horticultural practices.

Pollution

The application of chemicals can damage wild populations. Improper management and excessive or improper use of chemicals or water supplies are examples of ways horticulture can damage the environment. If not applied as directed, chemicals can become pollutants. Pollution is a hazard of horticultural practices.

FIGURE 2. Excessive or improper use of chemicals can damage the environment.

Pollution occurs when harmful or degrading materials get into the environment. Pollution can be from point or nonpoint sources. **Point source pollution** comes from sources that are easily identified. An example would be severe soil erosion from a landscape construction site. This type of pollution is easier to control than nonpoint source pollution. **Nonpoint source pollution** can come from few to many different sources. Widespread use of chemical fertilizers and pesticides on lawns in urban areas can lead to pollution of waterways. This type of pollution cannot be traced to a single place of origin.

Natural Resources

Water resources, wetlands, and wildlife are all natural resources that can be affected by horticultural practices. The effects can be adverse or beneficial. Water resources are essential to the environment. All living things need water. When water is used, nature has its way of restoring it. The hydrologic cycle and infiltration are two ways nature restores water.

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The **hydrologic cycle** is the way water flows through the environment. Water moves through a series of processes, including:

- **Precipitation**—the depositing of water on the earth as rain or snow
- **Evaporation**—the changing of water from a liquid to a vapor while passing through the air
- **Transpiration**—the movement of water in vapor form
- **Condensation**—the changing of water from a vapor to a liquid

Major sources of water in the hydrologic cycle are oceans, lakes, rivers, streams, groundwater, and reservoirs.

Wetlands are an important part of the hydrologic cycle. **Wetlands** include swamps, bogs, marshes, mores, ponds, or other places where water stands. Wetlands are protected by law, and

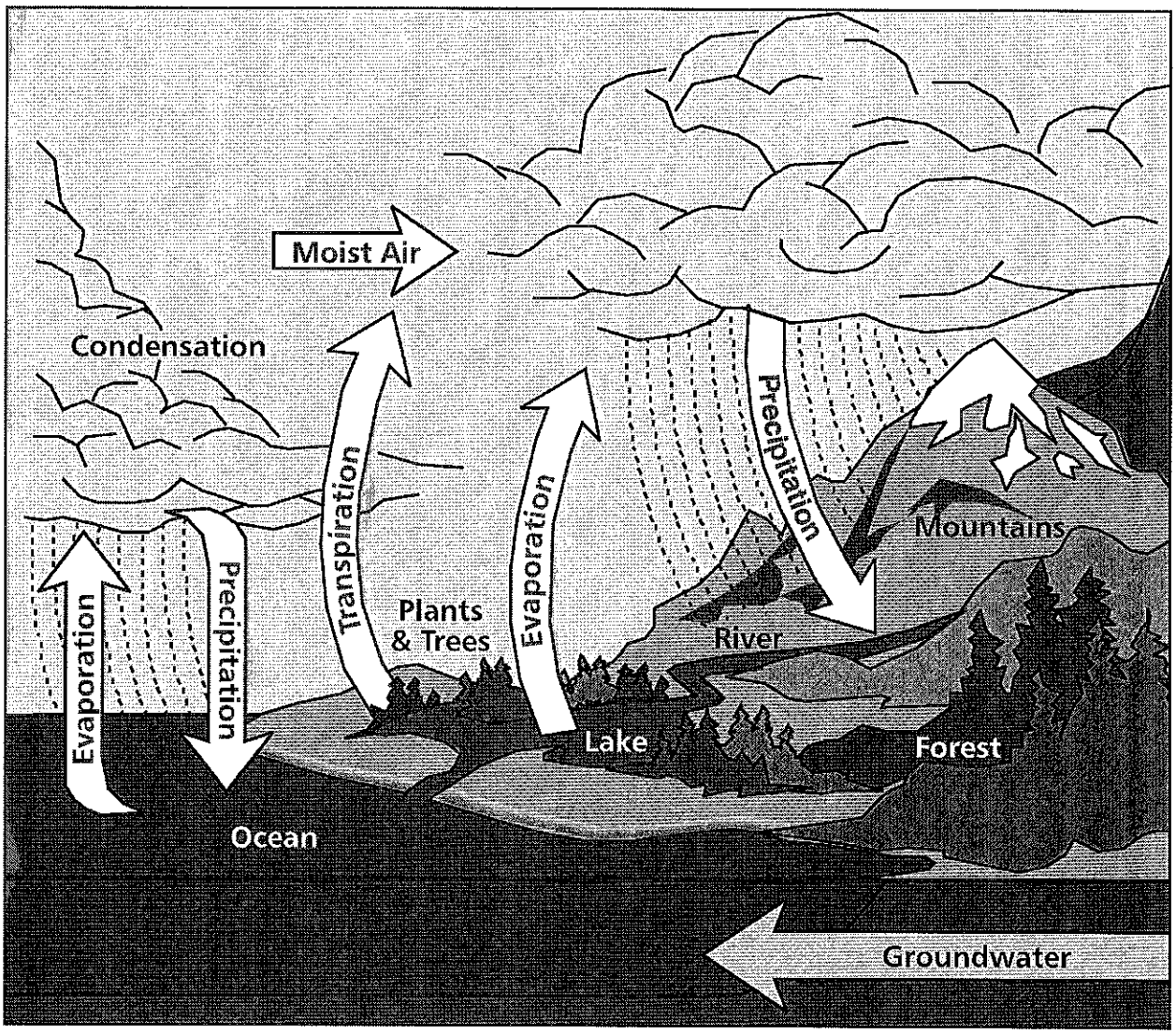

FIGURE 3. The hydrologic cycle.

plans are being made or are in place to restore or enhance most wetlands. Wetlands are essential to the environment as flood control, wildlife habitat, and shoreline erosion control. Maintaining wetlands is important when using horticultural practices. Wetland ecosystems can also be used to enhance an environment. They can provide recreation, such as fishing and hunting, or provide beauty and comfort for people to enjoy.

Infiltration is the movement of water through the soil. Proper land management practices in horticulture can affect both the quantity and quality of water that will eventually become groundwater.

Wildlife habitats can also be threatened by horticultural practices. **Wildlife** is plants or animals that are not domesticated. With planning, areas can be created for wildlife to live. **Habitat** is the place where wildlife lives in nature. Habitats can be natural, such as forests or wetlands, or human-made, such as golf courses or parks.

To reduce chemical hazards to wildlife, understanding wildlife habits is important. Applications should be made when they will cause the least harm to wildlife.

Using the correct pesticide formulations is important. Granular formulations can be especially dangerous to birds.

Chemicals and the Environment

Fertilizers and pesticides are the two main types of horticultural chemicals that affect the environment. When fertilizers and pesticides are used as directed, harmful effects on humans, plants, animals, and the environment are limited. Used inappropriately, both can be detrimental to living organisms.

Fertilizers are used to achieve optimal plant growth. Growers strive to provide plants with the level of fertilizers needed for the best growth. Excessive fertilizer use is both financially wasteful and harmful to the environment. **Eutrophication** is an overabundance of nutrients in a body of water; it is caused by excessive fertilizer running off a field and into a pond, river, or lake. Eutrophication can be harmful to aquatic life because it depletes the oxygen supply in the water.

Fertilizers are often high in nitrogen and phosphorus. When needed and used by plants, nitrogen is not harmful to the environment. The **nitrogen cycle** is the circulation of nitrogen throughout the environment. When excess nitrogen is introduced to the nitrogen cycle and mixed with nitrates found in the soil, the result can be an increase in nitrates found in groundwater. This is a major concern to the health of humans who use groundwater as a source of drinking water. Phosphorus loss through surface runoff is also an environmental concern. Well-placed turfgrass and ground covers can help reduce phosphorus leaching.

Pesticides are chemicals used to kill plant and animal pests. When used correctly, pesticides cause little harm. Risk in using pesticides is associated with residues. Pesticide residues have been proven to cause problems such as water contamination, emergence of resistant pest populations, and decline in certain bird populations. To reduce the need for pesticides, keeping plants healthy is important. Healthy plants can defend themselves against pests, and they can tolerate low pest populations.

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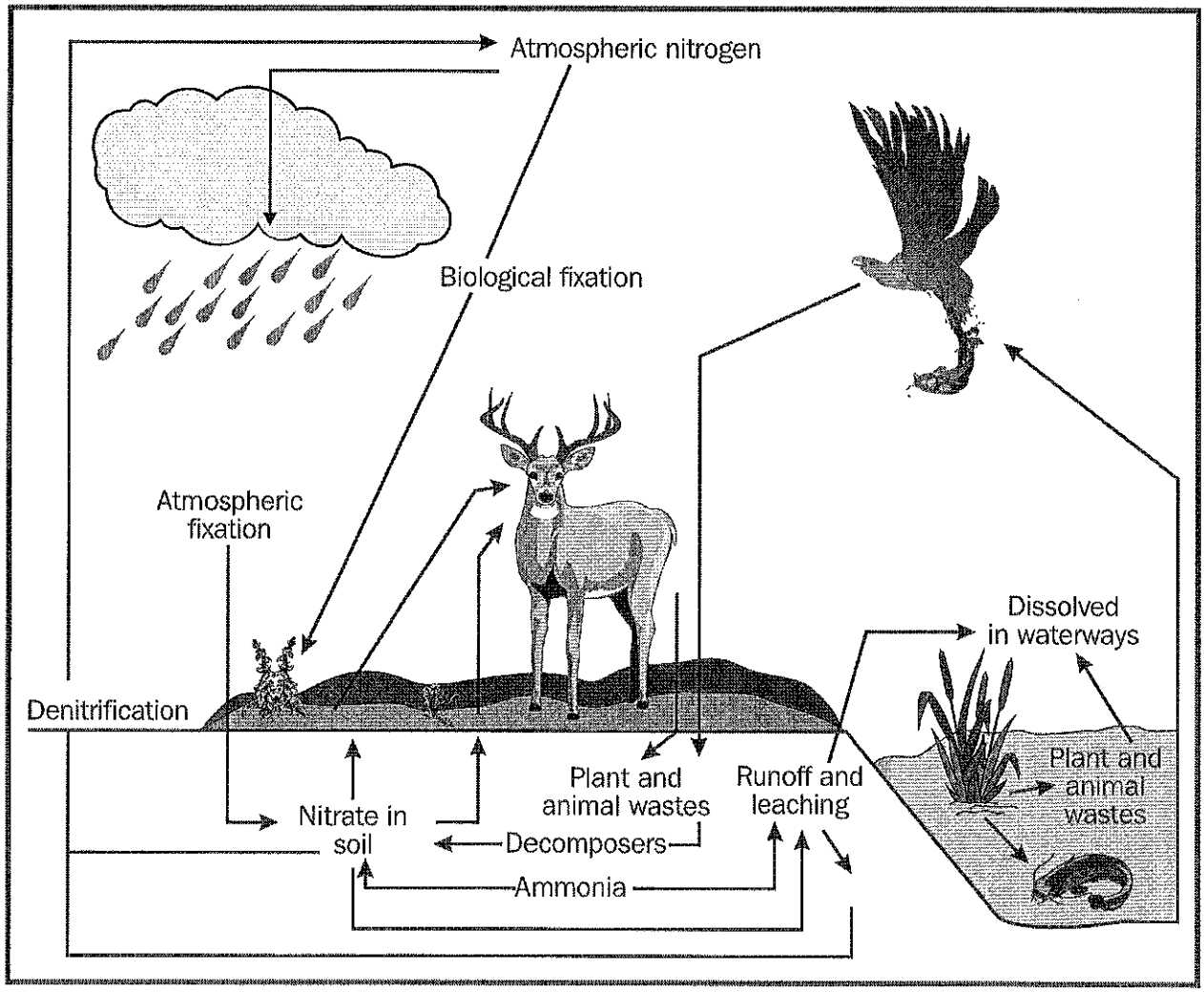

FIGURE 4. The nitrogen cycle.

Pesticides enter the environment in many ways. Some are vaporized, others leach through the soil, and others travel in surface runoff. Using pesticides as specifically directed is important because they decompose slowly in the environment.

Summary:

Horticulture and the environment are intertwined. The environment is the nonliving aspect of an organism's immediate habitat. The nonliving environment, along with living things, including horticultural plants, makes up an ecosystem. Horticultural practices influence an ecosystem.

Public demand for a high-quality product, growers concerned about how to produce a high-quality product at a low cost, and the impaired health of the environment are some issues associated with horticulture.

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Horticultural practices can be beneficial or detrimental to the environment. Biological benefits of horticulture include the use of plant parts to help prevent erosion, slow water runoff, absorb pollutants, control dust, and provide wildlife habitat. Pollution of water, damage to natural resources, and misuse of chemicals are some harmful results of horticultural practices.

Checking Your Knowledge:

1. Define *abiotic, biotic,* and *ecology.*
2. What is an invasive plant?
3. How do point source and nonpoint source pollution differ?
4. How is wildlife habitat affected by horticultural practices?
5. What is eutrophication?

Expanding Your Knowledge:

Get involved with a local environmental group and volunteer to help manage plant species that have become invasive in your area.

Web Links:

Backyard Wildlife Habitats
http://www.ext.vt.edu/pubs/wildlife/426-070/426-070.html

Preventing Pollution Problems from Lawn and Garden Fertilizers
http://www.extension.umn.edu/distribution/horticulture/DG2923.html

Invasive Plants
http://www.usna.usda.gov/Gardens/invasives.html

Agricultural Career Profiles
http://www.mycaert.com/career-profiles

Mr. Coon Turf Management Tools April 20-24

Checking Your Knowledge:

1. What are the common hand tools used in the turfgrass industry?

2. How do the different types of shovels and rakes compare?

3. What are the common power tools used in the turfgrass industry?

4. How do the different types of mowers compare?

5. What are the common pieces of heavy equipment used in the turfgrass industry?

Corn April 20-24 Choice 2

Identifying Tools and Equipment Associated with Turfgrass

CAN YOU IMAGINE life without tools? It is not easy. We do so many tasks with the aid of tools. Tools and equipment are especially important in landscaping and in turfgrass establishment and care. This unit presents the most common tools and equipment used in the industry.

Objective:

Identify tools and equipment used in the turfgrass industry.

Key Terms:

backhoe
backpack sprayer
blower
boom sprayer
compression sprayer
core cultivator
disk
drop spreader
edger
field cultivator
forklift
front-end loader
garden hoe
garden rake
grading hoe
ground driven
grubbing hoe
hand-crank spreader
harrow
Hover mower®
hydraulic cylinders
hydraulic driven
landscape (grading) rake
lawn roller
lawn/utility cart
leaf rake
measuring wheel
mulch mower deck
pitchfork
power rake
power takeoff (PTO) shaft
reel mower
rotary mower
rotary (broadcast) spreader
rototiller
round-point (round-nose) shovel
scoop fork
scoop
skid steer loader
spading fork
spade
square-point (square-nose) shovel
string trimmer
thatch rake
trencher
trowel (hand spade)
utility vehicle
weeding hoe
wheelbarrow

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Tools and Equipment

Tools and equipment are designed to make work easier. Some have been specifically designed for work associated with the turfgrass industry. Knowing the tools and equipment by name and how to use them properly improves the efficiency and safety of work.

HAND TOOLS

Tools are devices that give a mechanical advantage to the accomplishment of a physical task. Hand tools used in the turfgrass industry include a variety of shovels, forks, rakes, hoes, spreaders, sprayers, and other tools.

Shovels

Shovels are tools used for all kinds of digging and scooping work. There are many designs of shovels. A **round-point (round-nose) shovel** is long handled and has rounded sides that come to a point. It is used for general digging. A **square-point (square-nose) shovel** is long handled and has straight sides with a square end. It is designed for scooping materials off flat surfaces.

A **spade** has a short handle, and the grip is usually D shaped. There are tiling spades for digging narrow trenches, balling spades for digging trees and shrubs, and other kinds of spades.

A **trowel (hand spade)** is designed to be used with one hand. It has a short handle and a small pointed blade. It is used to dig holes in order to plant flowers or groundcovers.

A **scoop** is a short-handled, broad shovel with high sides. The design allows the worker to move a large volume of material, such as peat moss, sand, or crushed stone. Scoops are not intended for digging.

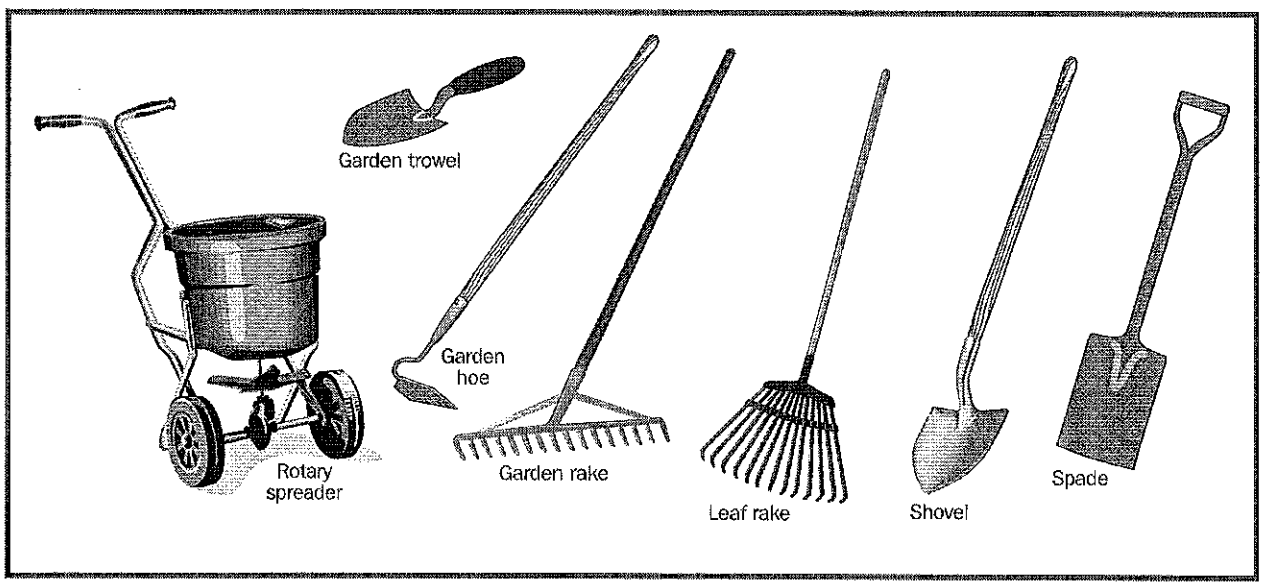

FIGURE 1. A variety of hand tools.

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Forks

Forks are also used for digging and moving materials by hand. A **spading fork** is a short-handled tool with four heavy tines, or prongs, used for turning over the soil. It is useful for digging and lifting clumps of bulbs or herbaceous perennials without damaging the bulbs, tubers, rhizomes, or roots. A **pitchfork** is a long-handled, lightweight fork for moving coarse, lightweight materials, such as straw. A **scoop fork** is a short-handled, broad fork for moving large volumes of lightweight materials, such as compost or wood chips.

Rakes

Rakes are implements with teeth, or tines, used for gathering material or smoothing the ground. Rakes are long handled. A **leaf rake** has long, flexible tines and is used for raking grass clippings and leaves. A metal **garden rake** has short, rigid teeth and is used for heavy-duty raking, leveling, and grading. A **landscape (grading) rake** is a lightweight magnesium rake up to 42 inches wide. It has short, rigid teeth and is used for smoothing and final grading before seeding a lawn and for lightly raking in the seed after it is sown. A **thatch rake** has short metal blades. It is used to remove thatch that has built up in a lawn.

Hoes

Long-handled tools used to break up the ground or control weeds are called hoes. A **garden hoe** is rectangular with only the bottom edge of the blade sharpened. It is used to break up the soil and to remove weeds in planted areas. A **weeding hoe** consists of two sharp prongs on top of a sharpened blade. The sharp prongs are effective for pulling weeds, while the bottom edge is used as a regular garden hoe. A **grading hoe** has a narrow, sharpened, flat end. It is particularly helpful in loosening hard or compacted soil. A **grubbing hoe** has two narrow, sharpened, flat ends. It is used to loosen compacted soil or dig up shrubs.

Spreaders and Sprayers

Spreaders and sprayers are used for seed, fertilizer, and pesticide application.

A **rotary (broadcast) spreader** is a type of spreader used for broadcast application of seed or fertilizer. The seed or fertilizer is held in a hopper. The material drops onto a propeller driven by the moving wheels. As the propeller turns, it propels the material out about 8 to 12 feet.

FIGURE 2. A rotary (broadcast) spreader for rapid application of fertilizer to small or medium-sized turf areas.

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A **drop spreader** also has a hopper that holds seed or fertilizer. As the wheels turn, a roller allows the material to be dropped directly below the spreader.

A **hand-crank spreader** is a relatively small device used for small-surface areas where other spreaders cannot be used. A hopper contains the seed or fertilizer, which is broadcast by turning the hand crank.

A **compression sprayer** is a 1- to 3-gallon sprayer that uses air pressure created by hand pumping. The air pressure forces the contents to spray from a hand-held hose and nozzle.

A **backpack sprayer** is similar to a compression sprayer. It is a bit larger, and pumping can be done while the sprayer is on your back and while you are spraying. Larger areas can be sprayed with this sprayer.

Miscellaneous Tools

Lawn/utility carts and wheelbarrows are used to move soil, mulch, plants, and other tools. A **lawn/utility cart** is a flat-bottom cart with two wheels. A **wheelbarrow** typically has one air-filled tire and a metal or plastic container with a 4- to 6-cubic-foot capacity. Some larger wheelbarrows have two wheels. This provides more stability for heavier loads.

A **lawn roller** is a round cylinder usually filled with water or sand that can be pulled over loose soil to firm it. Some rollers are concrete. Rollers are used after seeding a lawn to improve the contact between the soil and the seed.

A **measuring wheel** allows one person to measure distances. Areas need to be measured to estimate purchases of seed, fertilizer, mulch, etc. A wheel may measure feet, or it may require you to multiply the number of revolutions of the wheel times its diameter to figure the distance.

Common shop hand tools are required for many jobs in the turfgrass industry. They include hammers, wood chisels, cold chisels, files, pliers, standard screwdrivers, Phillips screwdrivers, adjustable wrenches, vise grips, channel locks, and tape measures. These tools may also be used to maintain and repair other tools.

POWER TOOLS

Power tools improve the efficiency of turfgrass industry workers. Power tools include tools operated by gasoline engines and electric motors.

Mowers

Lawn mowers come with gasoline engines or electric motors. Lawn mowers may be push, self-propelled, or riding. Also, different types of lawn mowers have different designs for cutting grass.

A **rotary mower** has one or more blades that rotate rapidly. The blades cut the grass as they strike the leaves. The blades must have sharp cutting edges to cut rather than tear the grass. Rotary mowers are best used where well-groomed turf is not essential, such as home lawns, roadsides, and golf course roughs. A rotary mower may have a mulch mower deck. The

Coon April 20-24 Chorus

mulch mower deck confines the cut material so the blades can cut it into small pieces before it is allowed to fall to the lawn surface. Returning mulch to the lawn recycles nutrients.

A **reel mower** is a precision tool used on turfgrass where a well-groomed appearance is desired, such as golf fairways and greens. A reel mower has a rotating reel with blades that cut or slice the grass leaves when they come into position against a stationary bed-knife. The reel may be **ground driven**, meaning the contact of the wheel with the ground serves as the power source to turn the reel. Or, the reel may be **hydraulic driven**, meaning the mower relies on a hydraulic motor mounted on the reel as the power source.

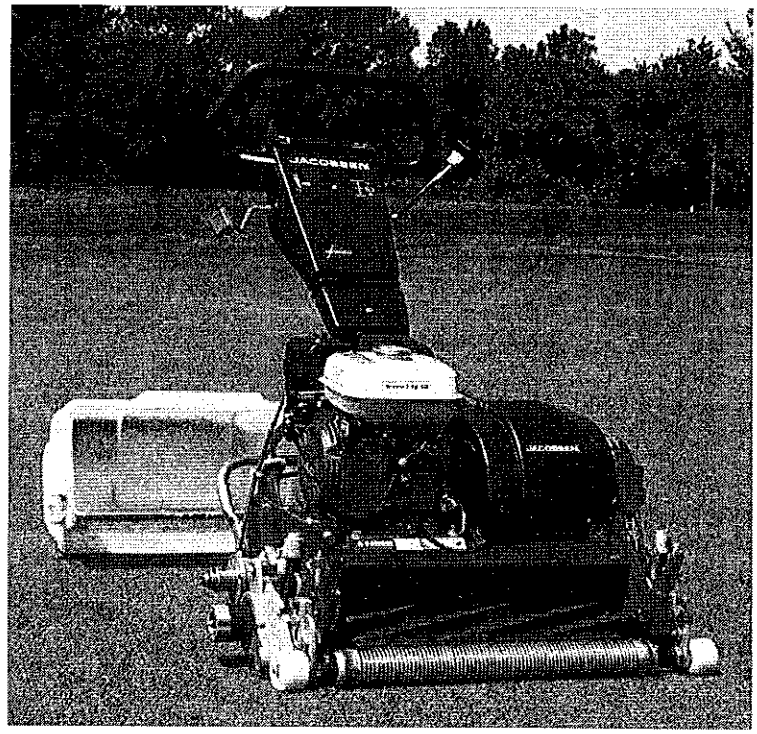

FIGURE 3. Reel mowers are commonly used on golf courses to cut the putting greens.

A **Hover® mower** is a mowing tool without wheels used in cutting grass on extreme locations, such as steep banks.

Trimmers, Edgers, and Blowers

Trimmers, edgers, and blowers are used to provide a neat and finished look to a property.

A **string trimmer** is a hand-held power tool with an engine or motor that spins nylon string rapidly to cut grass and other plants. It is used to cut turfgrass in areas not accessible to a mower.

An **edger** is used to trim the grass along the edge of sidewalks and driveways. An engine or motor powers the cutting wheel or blades.

A **blower** blows leaves, grass clippings, and other debris from landscape beds, sidewalks, and driveways.

FIGURE 4. A backpack blower uses air speed to move dust, dirt, leaves, and grass clippings.

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Other Power Tools

A **core cultivator**, or aerator, is a machine with hollow tines that are forced into the soil to remove $^1/_2$-inch-diameter plugs that are 2 to 4 inches long. Removal of the soil plugs then allows air, water, and nutrients to penetrate.

A mechanical dethatcher, or **power rake**, removes the excess thatch from the turf.

A **boom sprayer** is a mechanically driven device used for the application of pesticides. The design includes a 10- to 30-foot-wide boom equipped with spray nozzles, a holding tank for the chemicals, and an engine to apply a pressurized liquid evenly over the turf. It may be pulled by a tractor or mounted on a utility vehicle.

A **rototiller** is a gasoline-powered tool equipped with tines that break up and pulverize the soil. It is commonly used to prepare the soil in planting beds.

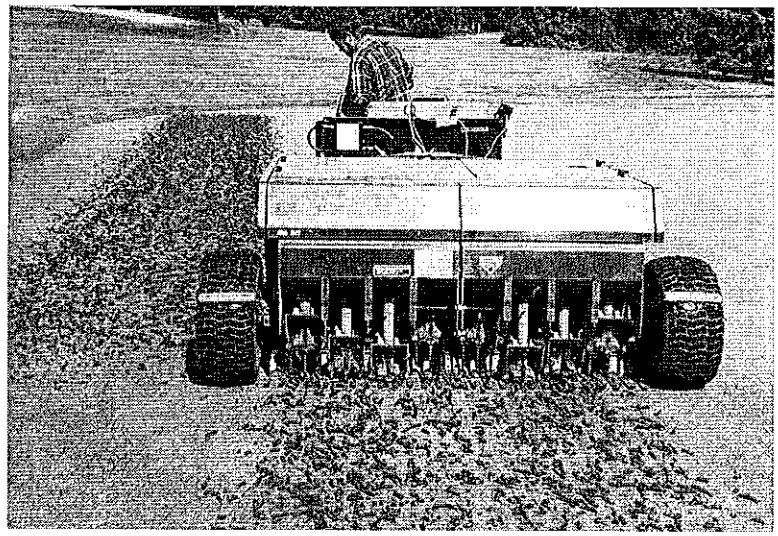


FIGURE 5. A core cultivator.

FIGURE 6. Rototilling peat moss into a planting bed.

HEAVY EQUIPMENT

Heavy jobs such as moving large volumes of soil, mowing acres of grass, and pulling other equipment require heavy equipment.

Tractors provide the heavy-equipment power for many jobs. Tractors come in many sizes with varying degrees of power. Large tractors usually operate on diesel engines. Smaller tractors are fueled by gasoline.

A tractor is the power source for pulling and operating large equipment. The **power take-off (PTO) shaft** is a shaft that drives or powers an implement, such as a large rotary mower, an auger, or a fertilizer spreader. **Hydraulic cylinders** can be used to lift and lower a **backhoe**, which is a bucket on the back of a tractor used to dig trenches and holes, and a

Coon April 20-24 Choice 2

front-end loader, which is a wide bucket on the front of a tractor. Tractors can also be used for pulling wagons, boom sprayers, and trailers.

Trucks are used to transport workers, materials, and equipment. Dump trucks are helpful in moving soil, gravel, sand, and mulch materials.

A **utility vehicle** is a small vehicle handy for moving small loads, tools, and people. Utility vehicles are widely used in the golf course industry and are valued for their relatively light weight and their broad tires, both of which limit soil compaction.

A **skid steer loader** is a versatile "mini" machine. Its compact size, low center of gravity, and maneuverability makes it useful. Skid steer loaders can be fitted with such attachments as loader buckets, trenchers, tillers, augers, and forks.

A **forklift** is a hydraulically operated, self-powered machine used to move, load, and unload sod or supplies stacked on pallets.

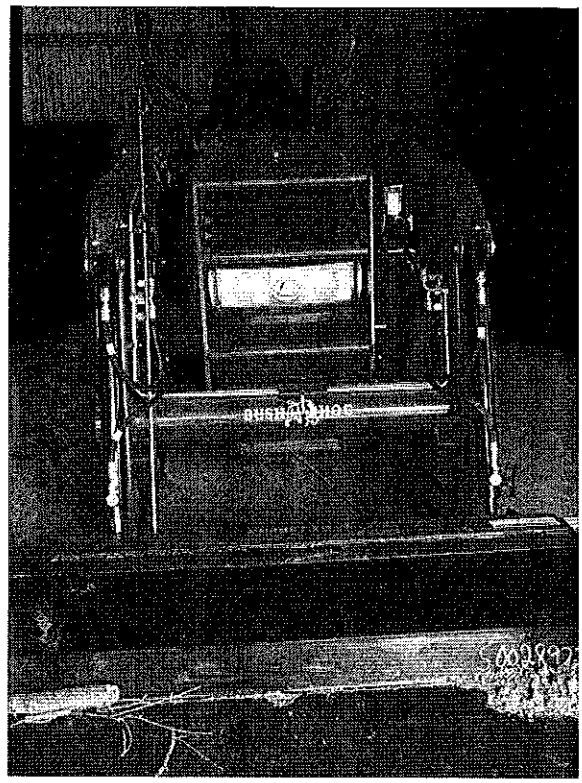


FIGURE 7. Hydraulic cylinders are used to lift and lower attachments for the front and back of tractors.

A **trencher** is a hydraulically driven rotating chain with blades that is commonly used to dig narrow channels for the placement of drainage tile or electric wiring.

Tillage and soil-moving equipment is used in preparing the grade for installation of turfgrasses. The implements are pulled behind a tractor. A **field cultivator** has blades that dig into the ground as it is pulled, loosening soil and killing weeds. A **disk** uses round blades to loosen and pulverize the soil. It is especially useful in seedbed preparation. A **harrow** has steel prongs, or teeth, and is used as a leveling device. It is often attached to, or pulled behind, a disk or field cultivator.

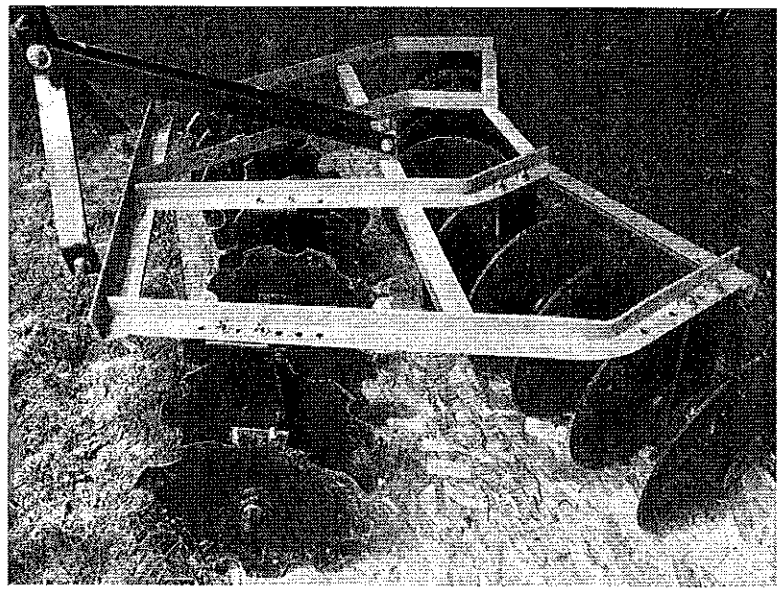


FIGURE 8. A disk uses round blades to loosen and pulverize the soil.

Coon April 20-24 Choice

Summary:

Tools are devices that give a mechanical advantage to the accomplishment of a physical task. Hand tools used in the turfgrass industry include a variety of shovels, forks, rakes, hoes, spreaders, sprayers, and other tools.

Power tools include tools operated by gasoline engines and electric motors. Rotary and reel mowers are widely used. Trimmers, edgers, and blowers are used to provide a neat and finished look to a property. Other power tools used in the turfgrass industry include core cultivators, power rakes, boom sprayers, and rototillers.

Heavy jobs such as moving large volumes of soil, mowing acres of grass, and pulling other equipment require heavy equipment. Tractors provide the heavy-equipment power for many jobs. Trucks are used to transport workers, materials, and equipment. Utility vehicles are small vehicles handy for moving small loads, tools, and people. Skid steer loaders, forklifts, trenchers, and tillage and soil-moving equipment are also used.

Checking Your Knowledge:

1. What are the common hand tools used in the turfgrass industry?
2. How do the different types of shovels and rakes compare?
3. What are the common power tools used in the turfgrass industry?
4. How do the different types of mowers compare?
5. What are the common pieces of heavy equipment used in the turfgrass industry?

Expanding Your Knowledge:

Visit a hardware store and take an inventory of the types of tools used to establish and maintain turfgrass. Also, from online catalogs, compile a list of tools and equipment used in grounds maintenance. Or, get permission to visit a golf course maintenance facility to learn about the tools and equipment.

Web Links:

Gardening Equipment
http://www.ext.vt.edu/pubs/envirohort/426-315/426-315.html

Equipment
http://www.ipm.ucdavis.edu/TOOLS/TURF/MAINTAIN/mowequip.html

Agricultural Career Profiles
http://www.mycaert.com/career-profiles

Choice 3

Landscaping Hort

Mr. Coon [redacted] IPM April 20 -24

Checking Your Knowledge:

1. What is integrated pest management?

2. What is a pest?

3. What is the significance of the disease triangle?

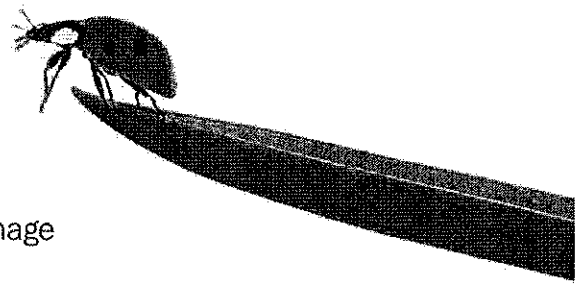
4. What are four broad areas of control in an IPM program?

5. What are five cultural/physical controls that can be applied in horticulture?

Coon April 20-24 Choice 3

Understanding Integrated Pest Management

SINCE humans first practiced agriculture, they have been faced with pest problems. In horticulture, pests disfigure ornamental plants and damage fruits and vegetables. Unlike our ancestors, though, we have a number of effective methods at our disposal to limit the damage caused by pests.



Objective:

Describe the elements of an integrated pest management program.

Key Terms:

annual weed
bacteria
best management practices
biennial weed
biological control
broadleaf weeds
causal agent
chemical control
cultural/physical control
disease triangle
economic injury level
economic threshold
fungi
grass weeds
infectious diseases
insect
integrated pest management
mite
nematodes
noninfectious diseases
parasitic plants
pathogens
perennial weed
pest
pesticides
plant disease
sanitation
scouting
viruses
weed

Integrated Pest Management

Integrated pest management (IPM) is a strategy that uses a combination of best management practices to reduce pest damage with the least disruption to the environment. **Best management practices** (BMPs) are those practices that optimize production and increase

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crop quality while maintaining environmental integrity. IPM provides protection against hazards to humans, domestic animals, plants, and the environment. Studies have shown that no single control measure works consistently over a long period. A reason for this is that pests can develop resistance to a particular control measure.

The goal of IPM is to keep pest populations below the economic injury level. **Economic injury level** is the point at which the cost of pest control equals the revenue loss caused by a pest. Economic injury level is determined by estimating the potential yield loss, the value of the crop, and the cost of treatment. It also clearly defines how much damage can be tolerated.

Economic threshold is the number of insects per plant or the amount of damage to a plant that economically justifies the use of control measures. If a control is applied when a pest population reaches the economic threshold, the population will be suppressed before it reaches the economic injury level.

The key to a successful IPM program is scouting. **Scouting** involves regularly monitoring pest populations and crop conditions. A scout collects data about which pests are causing damage, what stage of life each pest is in, and whether the pest population is increasing or decreasing. Knowing how to identify key pests and their biological characteristics is important. The weakest link in each pest's biology must be found if management of the pest is to be successful.

IPM BENEFITS

There are many benefits of IPM to horticulture and the environment. These benefits help sustain the ability of the earth to meet the needs of an increasing human population. The benefits to horticulture vary with the crop and the extent to which pests interfere with production. Through IPM, the environment is made more sustainable and friendly to people. The following are some specific benefits of IPM.

- The cost of using pesticides is reduced, and fewer pesticides are used. Also, less pesticide equipment is needed.
- Less cost is associated with time and labor for pesticide application.
- Less pesticide resistance develops within populations of insects, weeds, and diseases. This means that a pesticide is more effective when it is used.
- IPM results in reduced contamination and degradation of the environment. Pesticide residues do not build up in soil, water, and other natural resources.
- Cancer-causing residues are present in smaller amounts, or no residues are on food. Having fewer pesticide residues on food products means less chance of people ingesting pesticides.

PLANT PESTS

An understanding of the major pest groups and their biology is required to ensure success in reducing crop losses due to pests. A **pest** is a living organism that can cause injury or loss to a plant. Plant pests include insects, weeds, mites, nematodes, parasites, and animals. Disease-causing organisms are another major type of plant pest. Diseases and their causal agents will be discussed later in this unit.

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Insect Pests

An **insect** is an animal with an exoskeleton and three body parts. A typical insect has six legs and four wings. More than 800,000 kinds of insects have been identified. Insects are capable of producing large numbers of offspring in a short time. Insects can cause economic loss by feeding on horticultural crops.

Different insects have different kinds of mouthparts. In general, they have either chewing or sucking mouthparts. Damage symptoms caused by chewing insects are leaf defoliation, leaf mining, stem boring, and root feeding. Insects with sucking mouthparts produce distorted plant growth, leaf stippling, and leaf burn.

As an insect grows from an egg to an adult, it passes through several growth stages, called metamorphosis. There are two types of metamorphosis, incomplete and complete.

Incomplete metamorphosis consists of three life stages: egg, nymph, and adult. During the nymph stage, the insect grows and passes through several instars between molts. Each time the insect molts, or sheds its exoskeleton, it passes into another instar.

Complete metamorphosis consists of four life stages: egg, larva, pupa, and adult. The larva stage is the period when the insect grows. The pupa is a resting period during which a dramatic morphological change from larva to adult occurs.

Weeds

A **weed** is a plant that is undesirable and often considered out of place. Weeds compete for the space, nutrients, water, and light that the crop plants need to grow. They also harbor insect pests. Weeds are often classified based on their life cycles. Three life cycles are annuals, biennials, and perennials. Weeds are also classified as broadleaf or grass weeds.

An **annual weed** is an undesirable plant that completes its life cycle within one growing season.

A **biennial weed** is an undesirable plant that lives for two growing seasons. Vegetative growth occurs in the first year, when the plant produces leaf, stem, and root tissue. During the second year, the plant flowers and produces seeds.

A **perennial weed** is an undesirable plant that lives for more than two growing seasons and may reproduce by seed and/or vegetative growth.

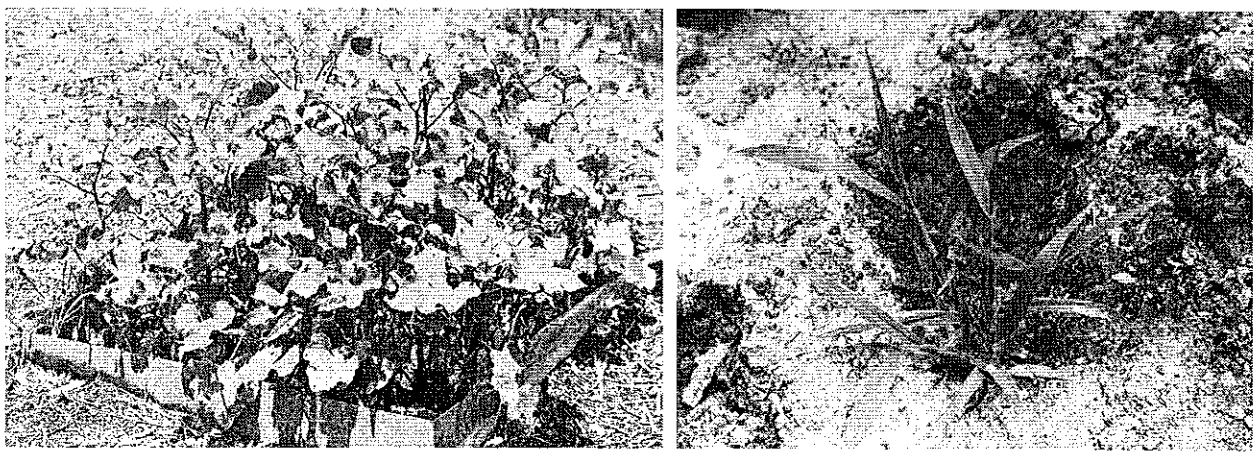

FIGURE 1. Two common annual weeds are cocklebur (left) and crabgrass (right).

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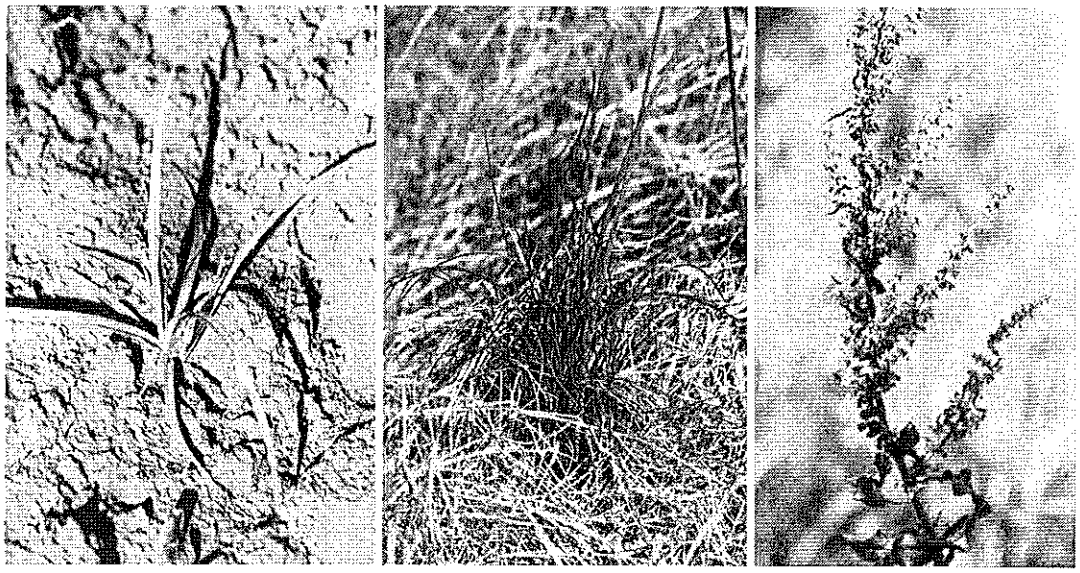

FIGURE 2. Three common perennial weeds are nutsedge (left), wild onion (center), and curly dock (right).

Broadleaf weeds have broad leaves and are usually associated with dicot plants. Examples are dandelions, ground ivy, plantain, and spurge.

Grass weeds include monocots, such as crabgrass, tall fescue, and quackgrass.

Other Pests

Plants suffer from a variety of other pests, including mites, nematodes, parasitic plants, and animals.

A **mite** is a small organism with an exoskeleton, two body parts, and eight legs. Mites suck sap from plants.

Nematodes are tiny, hairlike roundworms that feed on the roots of plants. They may live in the soil or water, within insects, or as parasites of plants or animals. Nematodes are small and produce damage to plants by feeding on roots, stems, or leaf tissue.

Some plants, such as dodder and mistletoe, are parasitic. **Parasitic plants** extract water and nutrients from other plants and give nothing in return.

Animals, including deer, mice, rabbits, and voles, cause severe physical damage by chewing or eating plants. Often, damaged plants are stunted or die.

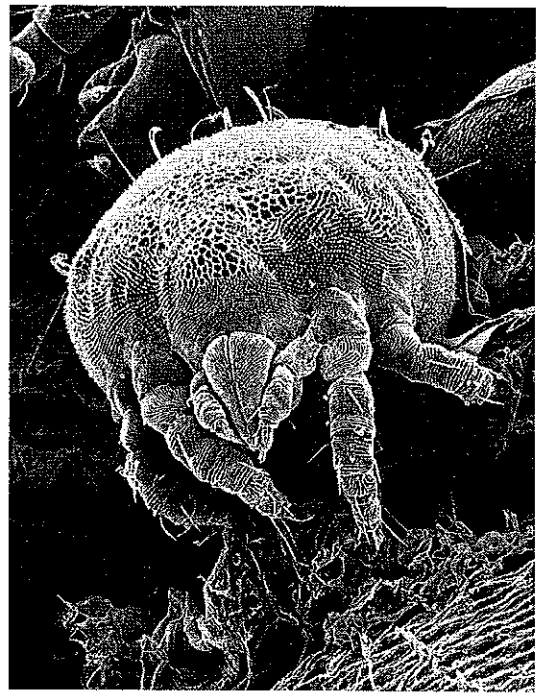

FIGURE 3. Mites are minute sap-sucking organisms. (Courtesy, Agricultural Research Service, USDA)

PLANT DISEASES

A **plant disease** is a disturbance to the normal growth and development of a plant. Diseases are generally classified as infectious or noninfectious.

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Infectious Diseases

Infectious diseases are caused by living organisms, such as bacteria, fungi, or viruses. These organisms are often referred to as disease **pathogens**. An infectious disease can be spread to other plants. The occurrence as well as the severity of an infectious plant disease is based on three factors. A susceptible plant or host must be present. The **causal agent**, or organism that produces the disease, must be present. Environmental conditions conducive to the causal agent must occur. The relationship between these three factors is known as the **disease triangle**. Disease control programs are designed to affect any or all of these factors.

Causal Agents

Fungi are a principal cause of plant disease. **Fungi** are organisms that lack chlorophyll. They absorb nutrients from living or dead organisms. Their bodies consist of threadlike vegetative structures known as hyphae. The mass created when the hyphae of a fungus are grouped together is called the mycelium. Fungi can reproduce and cause disease by producing spores. Fungi can produce spores asexually or sexually.

Bacteria are one-celled, or unicellular, microscopic organisms. Bacteria can enter a plant only through wounds or natural openings.

ON THE JOB...

CAREER CONNECTION: Plant Pathologist

A plant pathologist is a professional who specializes in plant health. Plant pathologists have knowledge of how plants grow and of agents that cause plant disease. They study a variety of pathogens, including fungi, bacteria, viruses, nematodes, protozoa, and parasitic plants. They also investigate how nonliving agents, such as air pollutants, nutrient deficiencies, moisture extremes, and salts, affect plant health.

A common route to becoming a plant pathologist begins with a bachelor's degree in biological, chemical, or mathematical science. Some universities offer bachelor's degrees in plant pathology. As a rule, graduate work in plant pathology is necessary to obtain most professional positions. Employment opportunities are found in research, product development, sales, teaching, extension, regulatory work, and private industry.

(Courtesy, Agricultural Research Service, USDA)

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Viruses are composed of nucleic acids surrounded by protein sheaths. They are capable of altering a plant's metabolism by affecting protein synthesis. Plant viruses are transmitted by seeds, insects, nematodes, fungi, and mechanical means. Viral diseases produce several symptoms, including ring spots, stunting, malformations, and mosaics. A mosaic symptom is a leaf pattern of light and dark green color.

Noninfectious Diseases

Noninfectious diseases are caused by environmental imbalances and cannot be spread to other plants. Examples of noninfectious diseases are nutrient deficiencies, air pollution damage, and the effects of overwatering.

Plants are most susceptible to disease when they are under some type of stress. The stress is usually associated with environmental factors. While an environmental condition itself may or may not cause a noninfectious disease, the stress it creates can reduce a plant's ability to fight off infectious diseases. For instance, overwatering alone can cause the death of root tissues, but it also weakens a plant's defenses against soilborne disease organisms.

PEST MANAGEMENT

Careful planning is required to make effective use of IPM. For successful management of pests, the IPM program must be a year-round program. Also, IPM control measures for a specific crop should begin as soon as plant growth begins. The strength of IPM is the combination of control measures used. Four broad areas of control are sanitation, cultural/physical control, biological control, and chemical control.

Sanitation

Many pest problems can be greatly reduced, if not eliminated, with sanitation. **Sanitation** is simply the efforts made to keep a greenhouse or garden clean. Many insects and diseases can be found in plant debris. Sanitation involves the removal of weeds from the immediate area around crops. Another important sanitation practice is the removal of plant debris and other debris from the ground around crops.

Cultural/Physical Control

Cultural/physical control involves methods that physically prevent activities of pests. Used alone, the methods probably will not provide complete control of pests. However, they can significantly reduce certain problems. Cultural/physical controls are also safe for humans and relatively easy to implement. Some cultural/physical controls are:

- Stop the introduction of pests to the greenhouse when possible.
- Remove and destroy heavily infested and diseased plants.
- Maintain optimal cultural requirements for each crop. Proper growing medium, watering, fertility, and temperatures promote healthy growth. Plants that are healthy are better able to fight disease organisms and pests.

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- Reduce fungal diseases by providing good air circulation around plants.
- Use yellow sticky traps. Often used as monitoring tools, these also serve as means of physical control. Flying insect pests attracted to sticky traps fly onto the traps and get stuck. In a short while, they die.

Biological Control

Biological control involves the use of living organisms to control pests. They may be microbial organisms, parasitic organisms, or predators. Biological control organisms are found in nature and considered environmentally safe.

A bacterium, *Bacillus thuringiensis,* effectively controls caterpillars. Aphids and whiteflies can be controlled to an extent by certain species of bacteria and fungi.

Parasitic organisms help to control some pests. The parasites are natural enemies of the pests and live off the pest organisms. An example is a tiny parasitic wasp that lays its eggs in immature whiteflies. The wasp's larvae hatch and slowly weaken and kill the developing whiteflies from within. Each female wasp lays eggs in up to 200 immature whiteflies. The wasps mature, emerge from what is left of the whiteflies, mate, and look for immature whiteflies in which to lay the next generation of eggs.

Predatory organisms can be released to devour certain plant pests. A beetle attacks whitefly larvae and adults. A mite is used to control thrips. Ladybugs eat aphids.

Predatory and parasitic organisms should be released when pest populations are small. Also, chemical pesticides should not be used when predatory and parasitic organisms are present.

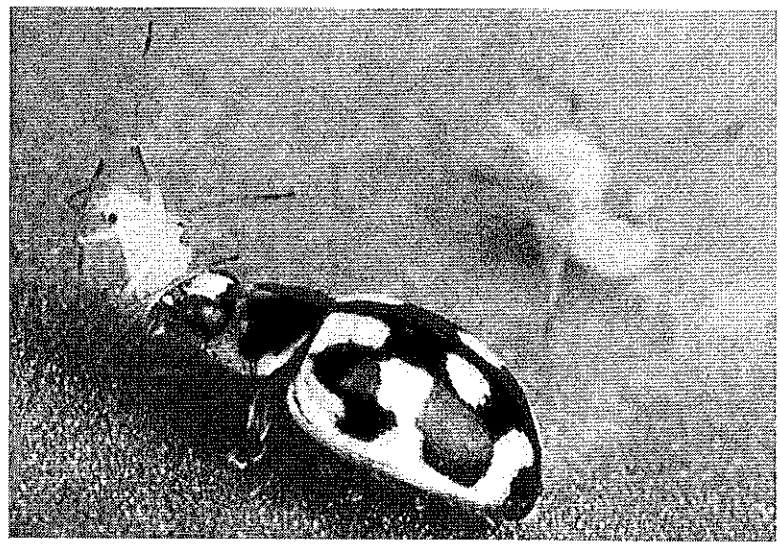

FIGURE 4. This ladybug is eating an aphid. (Courtesy, Agricultural Research Service, USDA)

Chemical Control

The use of chemicals to control pests and diseases is **chemical control**. The chemicals used are **pesticides**. Although control of pests with pesticides was once the method used almost exclusively, it is now viewed as only one component of an IPM program. In fact, chemical pesticides are currently used only when absolutely necessary. Application of pesticides must be done safely to reduce potential injury to people and the environment.

Summary:

Integrated pest management is a strategy that uses a combination of best management practices to reduce pest damage with the least disruption to the environment.

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The key to a successful IPM program is scouting, or regularly monitoring pest populations and crop conditions.

A pest is a living organism that can cause injury or loss to a plant. Pests include insects, weeds, mites, nematodes, parasites, and animals. Disease-causing organisms are another major type of plant pest. An insect is an animal with an exoskeleton and three body parts. A typical insect has six legs and four wings. A weed is a plant that is undesirable and often considered out of place. A mite is a small organism with an exoskeleton, two body parts, and eight legs. A nematode is a tiny, hairlike roundworm that feeds on the roots of plants.

A plant disease is a disturbance to the normal growth and development of a plant. Infectious diseases are caused by living organisms, such as bacteria, fungi, or viruses, and can be spread to other plants. Noninfectious diseases are caused by environmental imbalances and cannot be spread to other plants.

IPM involves a combination of control measures. Four broad areas of control are sanitation, cultural/physical control, biological control, and chemical control.

Checking Your Knowledge:

1. What is integrated pest management?
2. What is a pest?
3. What is the significance of the disease triangle?
4. What are four broad areas of control in an IPM program?
5. What are five cultural/physical controls that can be applied in horticulture?

Expanding Your Knowledge:

Scout the school greenhouse or school grounds for pest problems. Record your observations. Do the pests you have identified justify control measures? If so, what type of control methods would you recommend?

Web Links:

Integrated Pest Management
http://www.ipm.uiuc.edu/

Integrated Pest Management (IPM) and Food Production
http://www.epa.gov/pesticides/factsheets/ipm.htm#garden

Agricultural Career Profiles
http://www.mycaert.com/career-profiles