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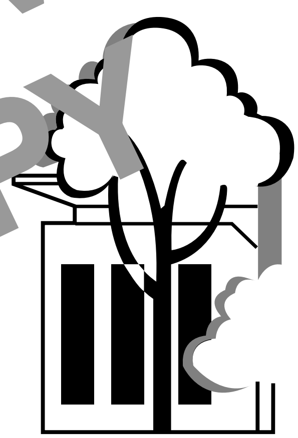
LANDSCAPING MAINTENANCE

Lesson One

Basic Plant Care



TPC Training Systems

37501

Lesson

1 Basic Plant Care

TOPICS

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OBJECTIVES

After studying this Lesson, you should be able to…

- Explain the importance of understanding and using a uniform plant identification system, and name the classifications into which plants are grouped.
- List six essentials of plant life.
- Describe the pH scale and tell how the acidity or alkalinity of a soil affects plant growth.
- Tell how to recognize the symptoms of overwatering and underwatering.
- Name at least four nutrients plants need, explain why each is needed, and tell how to recognize a lack or overabundance of each.

KEY TECHNICAL TERMS

Cultivar 1.04 plant grafted or grown from a cutting
Till 1.11 prepare for planting
Osmosis 1.23 process in which water passes through the walls of the root cells
Photosynthesis 1.24 process in which plants grow their own food
Respiration 1.24 release of energy used for growth and other life processes
Dormant 1.30 lack of growth
Leached 1.33 drained out of the soil by water
Footcandle 1.62 unit for measuring light quantity

More and more companies today are surrounding their headquarters and laboratories with a parklike atmosphere of growing plant life (Fig. 1-1 on the following page). More and more, the maintenance department is charged with the task of keeping up the grounds as well as the buildings.

When you consider that an oak tree grows from an acorn, and a huge vine from one small seed, you realize that plants are marvelous creations. They range in size from microscopic mold growths to tremendous 2500-year-old redwoods. Compared to the steel and concrete of buildings, plants are very soft and fragile. Because they are alive, they require special care.

This Unit explains the basics of maintaining trees, lawns, and other landscape plants. It describes the proper methods of caring for flowers and shrubs. It also tells how to control disease, weeds, and insect pests that can cripple or destroy plant life. This first Lesson acquaints you with the physical needs of healthy plants: soil, water, nutrients, air, light, and a suitable temperature.

The Need for Plant Identification

1.01 Groundskeepers and landscape maintenance people find it useful to classify plants on the basis of genus, species, and variety or cultivar. A plant *genus* (maple, for instance) is usually divided into several different *species* (sugar maple, silver maple, Japanese maple). Each of these species may be further divided into different *varieties* (threadleaf Japanese maple, red Japanese maple, etc.). If you use only the words “maple tree,” you could be talking about any one of 100 or more different trees. It is necessary to name or define clearly the plant you are talking about so that your supplier or your fellow worker understands what you have in mind.

1.02 Another problem is that the English names for different plants are sometimes confusingly alike. For example, if you are working in the north central United States, you may be planting a couple of “ash trees.” One is a green ash, and the other is a European mountain ash. The green ash is related to the olive, lilac, and forsythia. But the mountain ash is really a different genus, more closely related to the apple and cherry. Thus the two are totally unrelated, even though both are called ashes.

1.03 In order to identify plants more exactly, professional plantsmen and plant scientists use Latin names for genus, species, and variety. *Acer rubrum* is the scientific term for red maple, for example. You will begin to learn some of these Latin names as you work with the plants. For the purposes of this Unit, however, just remember always to use both the genus and species names to identify a plant—rather like giving a person’s first and last names.

1.04 A variety is a special form of a species that shows enough differences to set it apart from others of the same species. It may be capable of natural reproduction through seeds, or it may have to be artificially reproduced. If it must be grafted or grown from a cutting, it is a *cultivar*. A cultivar is any variety of plant that came into existence with the help of man. Most cultivars also need man’s assistance to continue in existence, because their seeds do not produce plants like the parent plants.

Structure of a Plant

1.05 Besides knowing something about plant names and classification, you should also know the basic parts of a plant, as shown in Fig. 1-2 on the following page. The underground portion, or root, consists of the primary (main) root, secondary roots, and root hairs. The root system anchors the plant in the soil and absorbs water and nutrients from the soil.

1.06 The above-ground portion, called the shoot, has leaves and buds. It may have flowers, and almost always has one or more stems. One function of the stem is to support the other plant parts. Another is to transport water and dissolved *nutrients* (food substances) to other parts of the shoot. Attached to the stem, the branches support the leaves, which are the plant’s food factory.

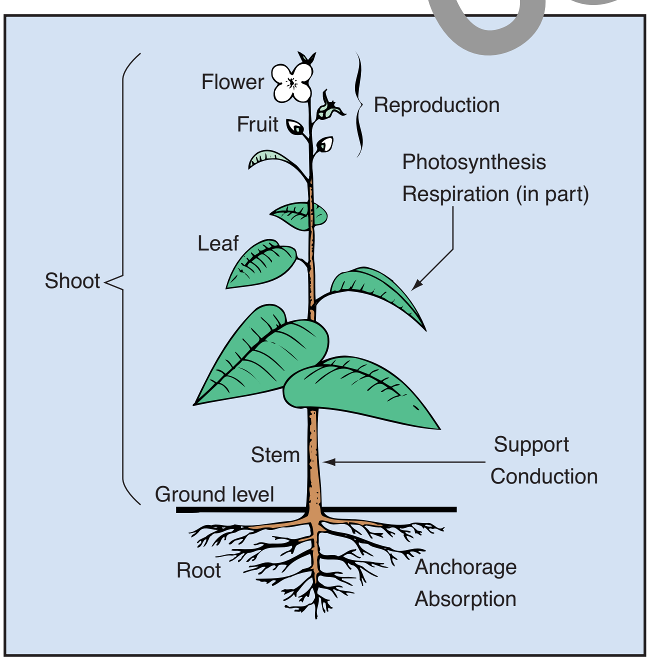
1.07 Plants are made up of cells, the building blocks of all life. Plants grow by increasing the number of cells through the process of cell division. Division takes place at the tips of roots and shoots, and in the buds. As the cells divide, the new cells form leaves,

Fig. 1-1. Landscape plantings such as this present new challenges for industrial maintenance departments

stems, roots, and other plant parts. Cells also divide along the length of the stems and beneath the root bark, causing the diameter of these plant parts to increase.

1.08 Plants are alive. They breathe air and use nutrients. They react to conditions such as cold and darkness.

Fig. 1-2. Structural parts of a plant



To grow and remain healthy, plants need an environment that gives them the following essentials of life:

- soil
- water
- nutrients
- suitable temperature
- air
- light

In landscape maintenance you will have direct control over the first three of these essentials. That is, you can prepare the soil to meet the plant's needs, and you can supply the water and nutrients they require for growth.

Plants Need Soil

1.09 Soil is the substance in which plants grow. It serves several purposes. It provides a place for roots to grow to anchor the plant, it acts as a reservoir to store nutrients and water, and it provides oxygen for the roots. It also insulates the root system from extremes in air temperature.

1.10 **Structure of soil**. Soil consists largely of mineral particles. They are classified according to their size as gravel, sand, silt, or clay. This classification is shown in Table 1-1. To understand this table, you should have some idea of the size of a millimeter. A millimeter is roughly 1/25 of an inch. It would take 25 grains of coarse sand, laid end-to-end in a line, to make an inch—but almost 25,000 clay particles to equal an inch. The symbol µm used in Table 1-1 means micromillimeter, which is a millionth of a millimeter.

1.11 Soils are classified according to the amounts of sand, silt, and clay that they contain. These amounts (expressed as ratios or percentages) tell much about the grade or texture of the soil. Soil with a high percentage of sand has a coarse texture and is said to be light. Light soil is easy to *till,* or prepare for planting. Soil that is mostly silt and clay has a fine texture and is said to be heavy. Heavy soil is made up of tiny particles which tend to stick together when moist. Because of this, heavy soil is often hard to till, and it tends to remain too wet.

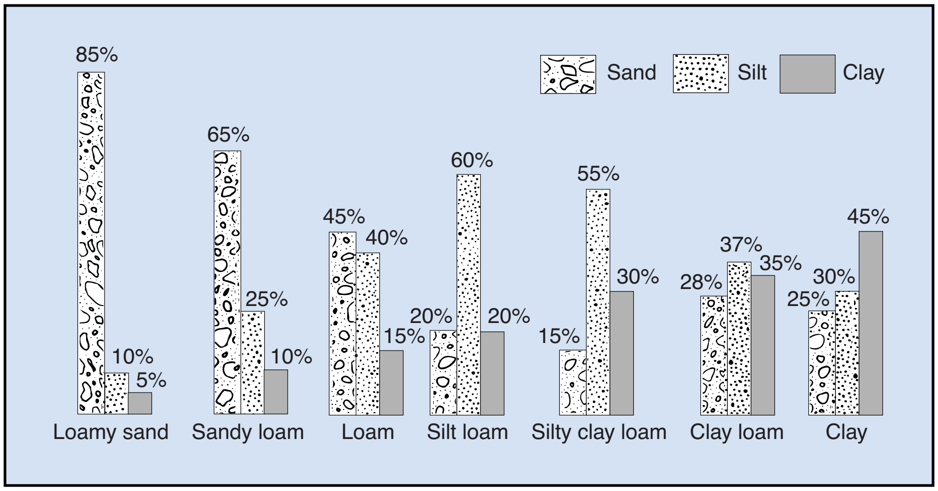
1.12 Sand particles are fairly large when compared with most other soil particles. A sand soil is very *porous* (full of holes). It holds very little water, because water passes through it quickly. Clay, with its fine particles, can absorb large volumes of water, and it remains soggy for a long time. Silt is finer than sand, but coarser than clay, so its water-holding capacity is intermediate between the two.

1.13 **Types of soil**. Soils are of four general types: sand, silt, clay, and loam. Sand soil is at least 70% sand by weight. Silt soils contain at least 80% silt and are rather uncommon. Clay soil has at least 40% clay by weight. Loam soil consists of about 45% sand,

Table 1-1. Identification and classification of soils

	Size and nature of particles				
	Principal soil types			Strength	
	Types		Field identification	Term	Field test
Coarse grained, non-cohesive	Boulders Cobbles		Larger than 200 mm in diameter. Mostly between 200 mm and 75 mm.	Loose	Can be excavated with spade.
	Gravels		Mostly between 75 mm and 2.36 mm.	Compact	
	Sands	Uniform	Particles mostly between 2.36 mm and 75 µm visible to the naked eye. Very little or no cohesion when dry.		Requires pick for excavation.
		Graded	May be classified as uniform or well graded. Uniform sands may be divided into coarse sands between 2.36 mm and 600 µm, medium sands between 600 µm and 212 µm and fine sands between 212 µm and 75 µm.	Slightly cemented	Pick removes soils in lumps that can be broken with thumb.
Fine grained, cohesive	Silts	Low plasticity	Particles mostly less than 75 µm. Particles mostly invisible or barely visible to the naked eye. Dries moderately quickly and can be dusted off the fingers.	Soft Firm	Easily molded in the fingers. Can be molded by strong pressure in the fingers.
	Clays	Medium plasticity High plasticity	Dry lumps can be broken but not powdered. They also disintegrate under water. Smooth touch and plastic. Sticks to the fingers and dries slowly. Shrinks on drying, usually showing cracks.	Very soft Soft Firm Stiff Hard	Oozes between fingers when squeezed in fist. Easily molded in fingers Can be molded by strong pressure in the fingers. Cannot be molded in fingers. Brittle or very tough.
Organic	Peats		Fibrous organic material, usually brown or black.	Firm Spongy	Fibers compressed together. Very compressible and open structure.

Fig. 1-3. Composition of sandy, clay, and loamy soils

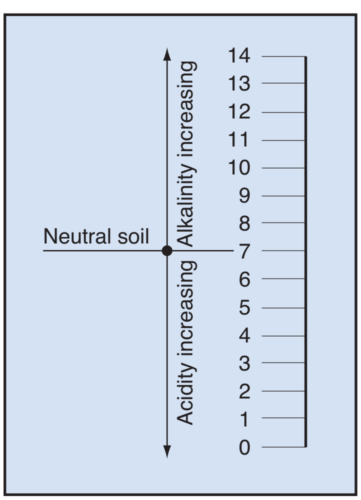


40% silt, and 15% clay. See Fig. 1-3 for a comparison of sand, clay, and loam soils. If you don't know the type of soil you will be working with, you can find out from the local office of the Soil Conservation Service, U.S. Department of Agriculture.

Organic Matter in Soils

1.14 Besides sand, silt, and clay, soils contain organic matter. As plants and animals die, their bodies fall and decay. These decaying plant and animal parts should make up about 3 to 5% of the soil by weight. They are constantly being broken down by *fungi* (mold growths) and soil bacteria into basic nutrients that living plants reuse for growth.

Fig. 1-4. pH scale for measuring acidity or alkalinity of soil



1.15 Organic matter provides important chemicals for plant growth—phosphorus, potassium, and nitrogen, to name a few. It also improves the quality of soils that are too light or too heavy. It increases the fertility and the water-holding capacity of light, sandy soils. Added to heavy, clay soils, organic matter makes it easier for plant roots to get air and makes the soils easier to till.

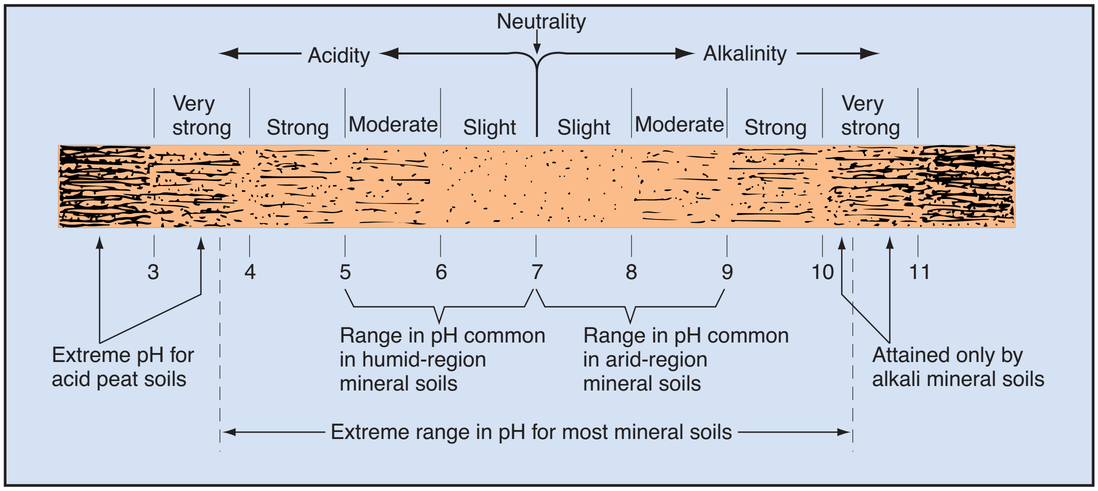
1.16 The small, dark brown or black particles you find in a good rich soil are the end product of plant and animal decay, called humus (HUE-muss). A small amount of humus, when added to a soil, greatly improves its ability to support plant life.

1.17 All soils benefit from the regular application of organic material. Composted manure and plant parts, such as leaves or grass clippings, are valuable for soil enrichment. So are peat moss and well-rotted wood chips and vegetable matter. However, farm manure in its raw form must not be used in the landscape. It is generally too rich, and it contains so much nitrogen that it burns roots. The usual method of adding organic material to a soil is to spread it over the surface and then work it into the soil with a spade or pitchfork.

Acidity and Alkalinity of Soils

1.18 Depending on the chemicals it contains, a soil may be acid, alkaline, or neutral. Acid soils are more common than alkaline or neutral ones. You can

Fig. 1-5. Variation of soil pH in humid and arid areas



express how acid or alkaline a soil is by stating its pH value. As shown in Fig. 1-4, the pH scale ranges from 0 to 14. Neutral compounds have a pH of 7, at the middle of the range.

1.19 As Fig. 1-5 shows, the lower the pH number (6, 5, 4, etc.), the more acid the soil is. The higher the number (8, 9, 10, etc.), the more alkaline it is. The pH of the soil is very important to successful growing. Most plants do well in the pH range of 6 to 7. If the pH goes below 6 or above 7, some plants can no longer remove basic nutrients from the soil. In strongly acid conditions (3, 2, 1), plants may show signs of being poisoned by aluminum, iron, or manganese.

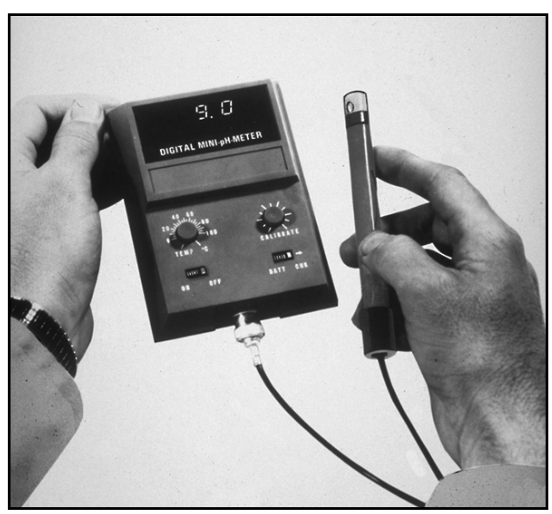
1.20 Testing a soil for its pH value is best done with a pH meter (see Fig. 1-6). This accurate and easy-to-use electrical instrument measures pH directly. You simply insert the instrument's glass probe into moist soil and read the pH value on the dial. A more common method of checking the pH requires the use of test tubes and indicating dyes, such as those found in field test kits. Instructions for using them are usually included in the kit.

1.21 If your tests show that the soil pH is not in the desired range, you have some work to do. Acid soils need lime to raise the pH. You may need as much as 100 lb of lime for 1000 ft^2 of soil if the soil is strongly acid. It is best to add a smaller amount, check the pH in 10 to 14 days, and add more if needed.

1.22 On the other hand, alkaline soils need sulfur, aluminum sulfate, or ferrous sulfate to lower the pH. Usually 1/2 to 1 cup of either type of sulfate per square yard will lower the pH by 1/2 point. Adding organic matter, such as certain kinds of pine needles, leaf mold, peat moss, or sawdust, may also lower the pH. Always test the soil before you attempt to adjust the pH.

The Programmed Exercises on the next page will tell you how well you understand the material you have just read. Before starting the exercises, remove the REVEAL KEY from the back of your Book. Read the instructions printed on the Reveal Key. Follow these instructions as you work through the Programmed Exercises.

Fig. 1-6. Common type of electronic pH meter



1 -1. A plant genus is usually divided into different __________, which may be further divided into __________.	1 -1. SPECIES; VARIETIES or CULTIVARS Ref: 1.01
1-2. A plant variety that came into existence with the help of man is called a(n) __________.	1-2. CULTIVAR Ref: 1.04
1-3. One function of a plant's stem is to transport __________ and __________ to other parts of the plant.	1-3. WATER; NUTRIENTS or FOOD Ref: 1.06
1-4. Soil that is mostly silt and clay has a(n) __________ texture and is said to be heavy	1-4. FINE Ref: 1.11
1-5. You add organic matter to light sandy soils to increase their __________ capacity.	1-5. WATER-HOLDING Ref: 1.15
1-6. The end product of plant and animal decay is called __________.	1-6. HUMUS Ref: 1.16
1-7. You can express how acid or alkaline a soil is by stating its __________ value.	1-7. pH Ref: 1.18
1-8. To raise the pH of soils that are too acid, you need to add __________.	1-8. LIME or CALCIUM Ref: 1.21

Plants Need Water

1.23 Water is vital to the life and growth of all living things, including plants. A plant is able to pick up life-giving nutrients and chemicals only if they are dissolved in water. The chemical-carrying water enters the plant through the millions of tiny root hairs along the tips of the growing roots. Actually, the water passes through the walls of the root cells. This process is called *osmosis* (oz-MO-sis). The roots take in a water and nutrient solution which is then delivered to the various parts of the shoot.

1.24 Plants use a process called *photosynthesis* to produce their own food. In this process (see Fig. 1-7), water and carbon dioxide—in the presence of sunlight—are changed into sugar. To accomplish this change, plants first split the water and carbon dioxide into separate atoms of hydrogen, carbon, and oxygen, then use the radiant energy of the sun to recombine the atoms into sugar molecules. Some oxygen is released into the air as a waste product. Both plants and animals need this oxygen for the process of *respiration*. In respiration, sugar is broken down, releasing energy that is used for growth and other life processes. Respiration, then, is essentially the reverse of photosynthesis—the process by which plants make sugar and a process that depends on a sufficient supply of water.

1.25 **Not enough water**. What happens when a plant doesn't get enough water? You've seen the typical signs—the leaves droop, flower stems become limp, and the whole plant may lie over on its side. In short, the plant begins to wilt. A plant may survive for only a matter of minutes in this condition, or it may last several days.

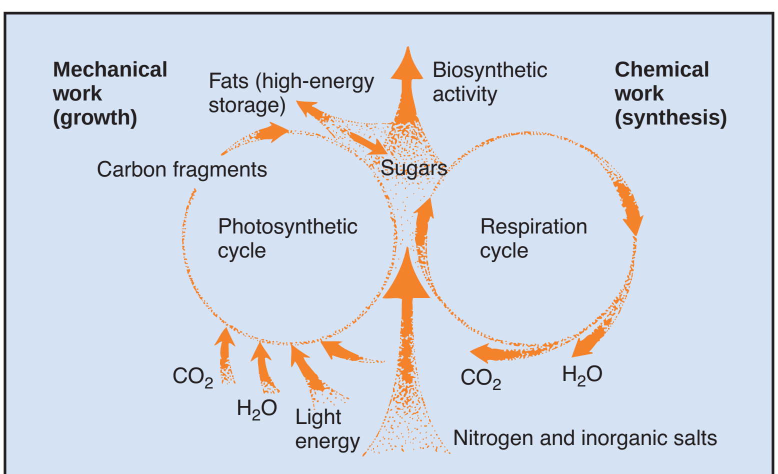
1.26 By adding water to the soil, you may save the plant—if the wilting has not gone too far. A condition known as permanent wilting occurs when the plant's cells cannot be restored to their original condition. Then adding water will be too late to prevent death.

1.27 **Too much water**. What happens when plants get too much water? Contrary to what many people believe, it is possible to overwater plants to the point where they die. When water fills all the spaces between soil particles for several hours, the root cells are unable to get oxygen, and they start to die.

1.28 Dying roots can no longer take in water and nutrients from the soil. When they no longer take in water, wilting starts. It may sound strange that an overwatered plant can die for lack of water. But it does happen, especially in heavy soils and in potted plants. One indication of too much water is a noticeable yellowing of the leaves.

1.29 **Erratic water supplies**. In many parts of the world, water supplies are very uneven, or erratic. In some regions, plants may adjust to occasional dry spells by shedding their leaves to slow their water

Fig. 1-7. Plant's photosynthesis and respiration cycles



loss. Or they may store unusually large amounts of water, as many cactus plants do.

1.30 In temperate regions, plants may have trouble adjusting to large changes in available water supplies. They may grow more slowly—or not at all. If growth stops altogether, the plant is said to have gone *dormant*. The fruit of certain plants hardens when the water supply is low. A sudden buildup of available water after a dry spell may then split the skin of the fruit. This often happens to tomatoes grown in areas of irregular or uneven rainfall.

1.31 You can reduce troubles caused by erratic water supplies in several ways. First, make sure you have good soil under your lawns and decorative plantings. Second, you can irrigate your grounds. Well-managed golf courses use this method. *Mulching*—spreading a 2- to 3-in. layer of coarse organic material on top of the soil—is one of the best ways to conserve soil moisture.

Plants Need Nutrients

1.32 Plants need various chemical substances from the soil. Those that plants take in in large amounts are called *macronutrients* (MAC-ro-new-tree-ents). Macronutrients include nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. Those that plants use in small quantities are known as *micronutrients* (MIKE-ro-new-tree-ents). Micronutrients include iron, manganese, copper, zinc, boron, molybdenum (mol-LIB-den-um), chlorine, and cobalt.

Macronutrients

1.33 **Nitrogen (N)**. Nitrogen is the chemical element that is most often lacking in soils. It is an essential part of protein, which is used by plants to build and repair cells. In certain forms, nitrogen is very soluble in soil water, and much of it is *leached* (drained) out of the soil by water. It is therefore necessary to add new nitrogen regularly. This is usually done by applying fresh organic material or fertilizer.

1.34 A lack of nitrogen stunts plant growth and weakens root systems. As the shortage of nitrogen gets worse, the older leaves begin to yellow. Plants may even remove nitrogen from older leaves so that newer ones can keep growing. Too much nitrogen tends to produce large, unhealthy leaves. Some plants, especially turf grasses, are readily attacked by insects and diseases if overfertilized with nitrogen.

1.35 In nature, nitrogen is added to the soil in many ways. Some plants (soybeans, for example) can take nitrogen out of the air in the soil and attach it to their roots. Nitrogen is present in plants that die and return to the soil. Fungi and soil bacteria add nitrogen when they die and become part of the soil humus. Even when it rains, it rains a little nitrogen on the soil.

1.36 But in cultivated landscapes, even with good soil management, fertilizers are needed for good plant growth. Some of the nitrogen in newer fertilizers is in the form of water-soluble nitrates (nitrogen salts) that are ready for plants to use. The rest is not immediately available to plants. It must be broken down over a period of time by soil bacteria.

1.37 **Phosphorus (P)**. Phosphorus (FOS-for-us) is also a vital element for plant growth. It helps plants to take in and to use other nutrients. You can often tell if a plant is short of phosphorus. It will have poor flowers and/or fruit, leaf margins streaked with purple, and leaves that are small and abnormally dark.

1.38 Phosphorus is present in small quantities in most soils, but it is often in a chemical form that plants can't absorb. To give your plants enough phosphorus, apply a commercial fertilizer to the soil before planting. Soluble fertilizers contain *phosphoric acid*, a chemical that plants can absorb readily. For best results, work the fertilizer into the soil to a depth of 6 in.

1.39 **Potassium (K)**. Potassium (po-TAS-see-um) is needed by plants to form chlorophyll. *Chlorophyll* (CLOR-o-fill) is the substance that allows photosynthesis to take place. It gives plants their green color. Scorched or dry margins on leaves may indicate a shortage of potassium. Potassium also promotes strong root systems and aids the distribution of sugars. The best source of potassium is a good fertilizer, which usually contains the potassium in compound form (called *potash*).

1.40 **Calcium (Ca)**. Calcium is an essential element that has the ability to sweeten soil by raising its pH value. The form of calcium fertilizer that you use depends on the soil pH and on what plants you wish to grow. Soils with a low pH do not support turf grasses and shrubs very well. On the other hand, some plants (azaleas and sugar maple trees, for example) thrive in soil with a low pH.

1.41 As mentioned in paragraph 1.19, most plants do well in a soil that has a pH of 6 to 7. If the pH is below this level, plants can benefit from yearly applications of calcium. Three different lime compounds can be applied to soil to add calcium and raise the pH: oxide of lime or quicklime, hydroxide of lime or lime hydrate, and carbonate of lime or ground limestone. Ground limestone is the most widely used compound.

1.42 **Magnesium (Mg)**. Magnesium is important for forming chlorophyll. If a soil lacks magnesium, plants growing in it have an unhealthy yellowish color. You can clear up this condition by applying dolomite. Dolomite (or dolomite limestone) contains varying amounts of magnesium combined with calcium. By adding ground-up dolomite limestone to raise the soil pH to the proper level, you automatically provide enough magnesium.

1.43 **Sulfur (S)**. Sulfur, found in plant proteins, helps plants "digest their food." Underdeveloped leaves and weak plants indicate a shortage of sulfur. In the past, much of the sulfur in soils came from the fallout of burning coal and other high-sulfur fuels. But, with the recent switch to clean-air standards, the sulfur in our soil is decreasing. For this reason, most commercial fertilizers now contain sulfur.

1.44 Bags of commercial fertilizer are marked with a series of three numbers (6-4-2, for example). These numbers show how much available nitrogen, phosphorus, and potassium (N, P, and K) the fertilizer contains. A 6-4-2 fertilizer has 6% N, 4% P, and 2% K. A 10-10-10 fertilizer contains 10% of each. The first number always refers to N, the second to P, and the third to K.

1.45 The percentages of N, P, and K never total 100. This is because the pure elements must be combined with other elements in some form that can be mixed, packaged, and applied easily. It would be impossible to use pure nitrogen in a fertilizer, for instance, because it is a gas under normal conditions.

Table 1-2. Natural forms of micronutrients

Micronutrient or trace element	Major forms of element in nature	Suggested analysis of a humid soil (ppm)*
1. Iron	Oxides, sulfides, and silicates	25,000
2. Manganese	Oxides, silicates, and sulfides	2500
3. Zinc	Sulfides, oxides, and silicates	100
4. Copper	Sulfides, hydroxy-carbonates	50
5. Boron	Boro silicates, borates	50
6. Molybdenum	Sulfides, molybdates	2
7. Chlorine	Chlorides	50
8. Cobalt	Silicates	8

*ppm = parts per million

1.46 Which of the different fertilizer ratios you use depends mostly on the kind of plant you want to fertilize. high-nitrogen fertilizers (10-6-4, for example) promote growth and rich green color in lawns. They stimulate growth of leaves and new shoots in shrubs and shade trees. But flowers and fruit trees require a high-phosphorus fertilizer (such as 8-24-8) to stimulate flower and fruit production.

Micronutrients

1.47 Micronutrients are present in soils in very small amounts. Sometimes they are referred to as *trace elements*, because the soil contains only traces of them. As shown in Table 1-2, micronutrients include:

Boron (B)	Copper (Cu)	Molybdenum (Mo)
Chlorine (Cl)	Iron (Fe)	Zinc (Zn)
Cobalt (Co)	Manganese (Mn)	

1.48 Iron and manganese are the most plentiful micronutrients. When soil becomes too alkaline (pH rises above 7), some trace elements become unavailable, such as cobalt, copper, iron, manganese, and zinc. If the pH drops below 6, the overabundance of some of these elements may actually poison the plants.

1.49 When the soil becomes too acid (pH below 6), other elements become unavailable for plant use. At a pH below 6, plants can't take in molybdenum. Below a pH of 5, boron becomes fixed in the soil. The relative availability of both micronutrients and macronutrients is shown by the varying band widths in Fig. 1-8. For example, boron availability increases rapidly as the pH increases from 4 to 5.

1.50 Soil additives containing trace elements are usually highly concentrated, so an overdose can easily poison plants. The best way to use these substances is to dissolve them in water and apply them with a sprayer. In extreme cases, it is possible to add powdered elements directly to the soil. Don't do this, however, without consulting a soil expert before you start the job.

Plants Need Proper Temperatures

1.51 The growth and development of plants depend on the proper temperature as much as they do on soil, food, and other factors. For example, air temperature greatly affects the rate of photosynthesis. The average daily temperature is probably the single most important factor governing the size and growth rate of ornamental plants.

1.52 The map in Fig. 1-9 shows how North America can be divided into climate zones according to average low temperature. Zone 1 is the coldest, zone 10 the warmest. These zones are important when selecting plants for new plantings. Plants guaranteed to grow in zone 6 may grow poorly or even die if exposed to the lowest temperatures in zone 5. On the other hand, certain plants thrive in cold climates and do rather poorly in the warmer zones.

1.53 **Low temperatures**. Frost damage (below 32°F or O°C) results from the formation of ice crystals in the plant's structure. You can't see the effects of freezing until the plant thaws out. As long as it is frozen, it appears to be healthy. Upon thawing, however, the ice-damaged structure turns black and appears to be wilted. Or the plant may look scorched or burned.

1.54 Temperatures do not need to drop all the way to the freezing point to damage plants. Sometimes temperatures slightly above freezing will take their toll—but you may not see the effects immediately. Tropical plants in the southern zones are subject to chilling injuries if exposed to low temperatures over a period of time. The symptoms may be dead or dying leaves or just slower growth. Plants in temperate regions sometimes suffer chilling injury when beginning their spring growth.

1.55 On cool autumn days, temperate plants develop a natural antifreeze system that lowers the

Fig. 1-8. Effects of soil pH on availability of nutrients

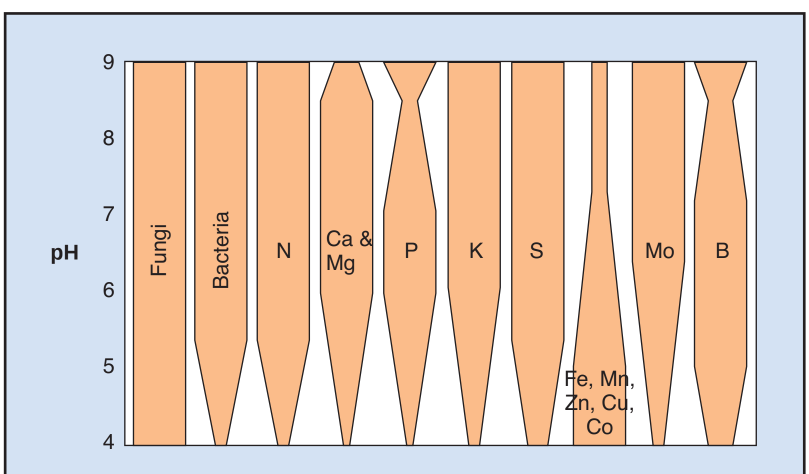
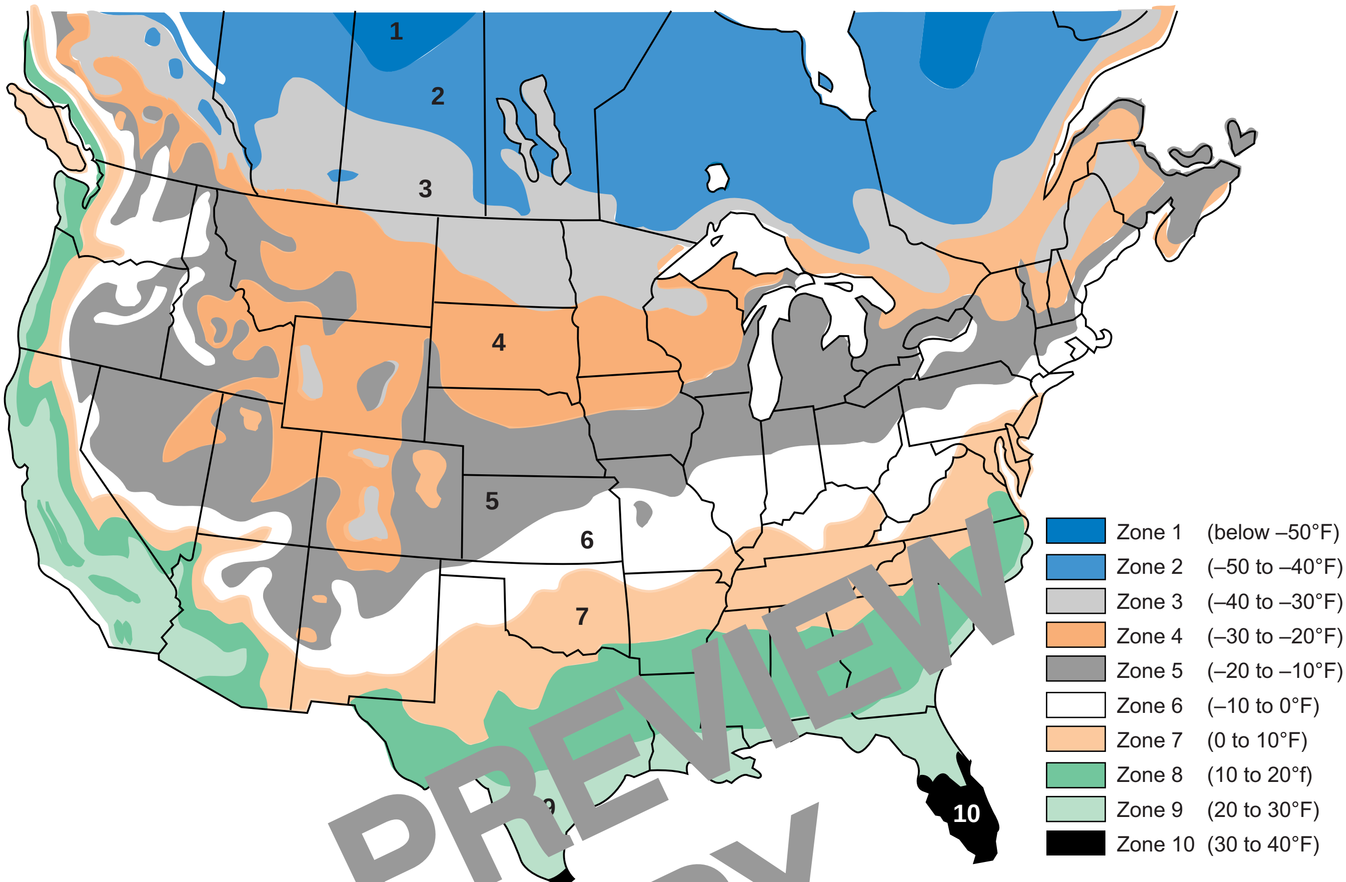


Fig. 1-9. Climate zones of North America



freezing point of the fluids within the cells. Hardy plants in zone 1 have a higher antifreeze concentration than those in zone 4. It is doubtful whether a plant from zone 4 would ever survive in the cold of zone 1.

1.56 **High temperatures.** High temperatures can also cause plant problems. At 85°F (29°C), certain plants use energy faster than they can supply it through photosynthesis. When a plant uses up its stored energy, growth stops. The plant begins to die back and then dies completely.

Soil Temperatures

1.57 Soil acts as a buffer or shield between a plant's roots and the atmosphere. Soil heats and cools more slowly than air. This allows the root system's temperature to change gradually. Even though the top 2 in. of soil may heat up as the air temperature rises, the temperature 6 to 18 in. below the surface remains amazingly even. Turf or ground cover and the shade from shrubs and trees result in even more uniform root system temperatures.

1.58 Soil temperature and moisture affect the growth of seeds and seedlings. Most seeds won't *germinate* (sprout) below 40°F (4°C). Cell growth increases as the soil warms up. Some fungi grow more readily as the temperature drops. Cool soil and abundant moisture can cause diseases (snow mold, for example).

Plants Need Air

1.59 To manufacture food, plants need air. Air consists mostly of nitrogen, oxygen, and carbon dioxide. There's usually plenty of air available for plants outdoors. However, poor soils and enclosed greenhouses may not have enough oxygen or carbon dioxide for good plant growth. Air pollution also tends to kill certain plants. Sulfur dioxide, a very common pollutant,

Table 1-3. Intensity Values of Natural Light

Light Condition	Footcandles
Starlight	0.0001
Moonlight	0.02
Indoors, near window (bright day)	100
Outdoors, overcast weather	1000
Maximum photosynthesis (individual leaf)	1200
Direct sunlight	10,000

forms sulfuric acid when it combines with moisture in the air. This weak acid can injure cells in leaves, thus reducing their food-making capacity and slowing their growth.

1.60 Frequently, however, plant problems that appear to be related to air are really soil related. For example, when you change the slope of the ground around a tree, you may raise the soil level a few inches or several feet. This added layer of soil severely limits the exchange of oxygen and carbon dioxide deeper down. A lack of oxygen damages the root system. This limits food and water intake and stunts the activity of the above-ground portion of the plant.

1.61 A similar condition can occur in soggy, saturated soils. Soils with too much water have too little oxygen. Some plants, like willows, cattails, and rushes, can live with their roots immersed in water—but most plants cannot do this.

Plants Need Light

1.62 Plants need light for photosynthesis. This process starts in plants at very low light levels—perhaps as low as 50 *footcandles* (footcandle is a unit for measuring light quantity, or intensity). The rate of photosynthesis varies with the amount of light the plant receives. In order to grow well in the landscape, a plant must get enough light to keep the correct ratio between its rate of photosynthesis and its respiration rate.

1.63 What is enough light for one plant may not be enough for another. Dwarf periwinkle, a ground-covering plant, grows well at 1,000 footcandles, but most turf grasses do best in full sunlight, which is about 10,000 footcandles. Table 1-3 lists the intensity values of natural light available for supporting plant life.

1.64 Plants that can maintain a satisfactory rate of photosynthesis at lower light levels are called *shade-tolerant* plants. These are very useful for planting in areas of the landscape that receive little or no direct sun, where other plants would not survive.

1-9. Water passes through root cells by a process called __________.	1-9. OSMOSIS Ref: 1.23
1-10. In the process of photosynthesis, plants produce simple __________ molecules and give off __________ as a waste product.	1-10. SUGAR;OXYGEN Ref: 1.24
1-11. If a plant stops growing, it is said to have gone __________.	1-11. DORMANT Ref: 1.30
1-12. One of the best ways to conserve soil moisture is by __________.	1-12. MULCHING Ref: 1.31
1-13. You can raise the pH of soil by adding some form of __________ to it.	1-13. CALCIUM or LIME Ref: 1.41
1-14. A fertilizer marked 10-6-4 contains 10% __________, 6% __________, and 4% __________ .	1-14. NITROGEN or N; PHOSPHORUS or P; POTASSIUM or K Ref: 1.44
1-15. The average daily __________ is probably the most important factor governing the size and growth rate of ornamental plants.	1-15. TEMPERATURE Ref: 1.51
1-16. Soils with too much water have too little __________ available to a plant's roots.	1-16. OXYGEN Ref: 1.61

Answer the following questions by marking an "X" in the box next to the best answer.

1-1. A variety of plant that came into existence with the help of man is called a(n)

- ☐ a. genus
- ☐ b. cultivar
- ☐ c. acer rubrum
- ☐ d. species

1-2. Which of the following is not a function of a plant's stem?

- ☐ a. To support the plant
- ☐ b. To transport water to the rest of the plant
- ☐ c. To transport nutrients to the rest of the plant
- ☐ d. To anchor the plant in the soil

1-3. Soil that is mostly silt and clay is

- ☐ a. coarse
- ☐ b. easy to till
- ☐ c. heavy
- ☐ d. all of the above

1-4. Decaying plant and animal parts should make up how much of a soil by weight?

- ☐ a. 3 to 5%
- ☐ b. 10 to 15%
- ☐ c. 20 to 25%
- ☐ d. 25 to 50%

1-5. Most plants do well in soil with a pH range of

- ☐ a. 3 to 4
- ☐ b. 6 to 7
- ☐ c. 9 to 10
- ☐ d. 12 to 13

1-6. One end product of the process of photosynthesis is

- ☐ a. simple sugar
- ☐ b. carbon dioxide
- ☐ c. sunlight
- ☐ d. water

1-7. You can reduce troubles caused by erratic water supplies by

- ☐ a. making sure you have good soil
- ☐ b. irrigating the grounds
- ☐ c. mulching
- ☐ d. all of the above

1-8. The chemical element most often lacking in soils is

- ☐ a. calcium
- ☐ b. sulfur
- ☐ c. nitrogen
- ☐ d. zinc

1-9. You can add magnesium to your soil by applying

- ☐ a. dolomite
- ☐ b. potash
- ☐ c. phosphoric acid
- ☐ d. humus

1-10. A lack of oxygen in soil has what effect on a plant?

- ☐ a. Damages the root system
- ☐ b. Limits food and water intake
- ☐ c. Stunts its growth
- ☐ d. All of the above

SUMMARY

Although plant structures vary, certain parts of the plant are always the same. Each plant has an underground portion, called a root, and an above-ground part called the shoot. All plants are made of cells. To grow and stay healthy, plants need a good balance of soil, water, nutrients, a suitable temperature, air and light.

Groundskeepers have a responsibility to keep plants healthy. Maintaining landscaping requires a special knowledge about plants. It is good to be familiar with the requirements of each type of plant. There are many varieties of plants, and each type requires different care. Some plants need certain types of soil, a particular pH (either acidic or alkaline), or a specific temperature in order to grow.

Answers to Self-Check Quiz

1-1. b. Cultivar. Ref: 1.04

1-2. d. To anchor the plant in the soil. Ref: 1.06

1-3. c. Heavy. Ref: 1. 11

1-4. a. 3 to 5%. Ref: 1. 14

1-5. b. 6 to 7. Ref: 1.19

1-6. a. Simple sugar. Ref: 1.24

1-7. d. All of the above. Ref: 1.31

1-8. c. Nitrogen. Ref: 1.33

1-9. a. Dolomite. Ref: 1.42

1-10. d. All of the above. Ref: 1.60

Contributions from the following sources are appreciated:

Figure 1-1. McMaster-Carr Supply Co.; landscape by Theodore Brickman Co.
Figure 1-6. Soiltest, Incorporated