

Mowing

Objectives

After studying this chapter, the student should be able to

- Explain why correct mowing practices are important to the quality of the turf
- Explain the effects of mowing on turfgrass plants
- List the correct cutting height for turfgrass species and cultivars
- Identify the factors that influence the selection of the correct cutting height
- Describe the factors that determine how often turfgrass should be cut
- Describe the advantages and disadvantages of different types of mowers
- Compare the advantages and disadvantages of collecting grass clippings
- Distinguish between safe and unsafe mowing practices
- Discuss the use of plant growth regulators

Introduction

Turfgrass is mowed regularly for both aesthetic and functional reasons. Generally, the shorter grass is cut, the more attractive it appears. Regular mowing results in a more uniform turf surface and a finer leaf texture. Few people would prefer the appearance of a field to that of a closely mowed turf. Tall grass on golf courses and athletic fields interferes with sports activities. A lawn soon loses its usefulness if it is not cut.

As explained in Chapter 2, grass can be mowed regularly and survive because almost all of the meristematic tissue is located below the path of the mower blade. Leaf formation continues at the crown, which is found at the base of the plant near the soil surface. Cell division and elongation in mer-

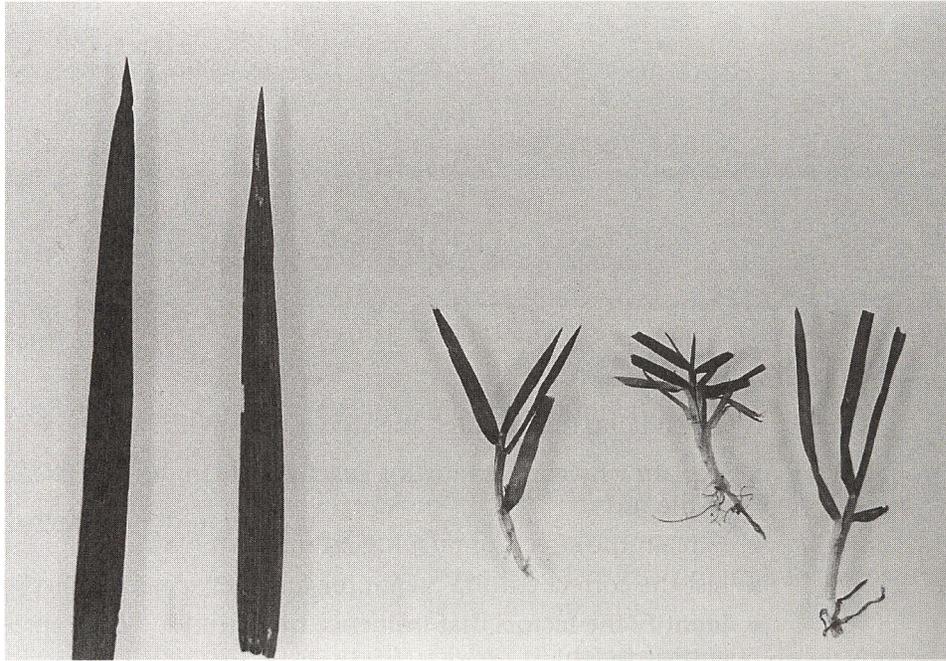


FIGURE 11-1

The wider leaves on the left are from a bentgrass plant that has not been mowed. The leaves on the right are on bentgrass plants mowed regularly at fairway height.

istematic regions causes leaves to extend in length and enables the grass plant to “grow back.”

Mowing has several effects on the growth habit of turfgrass plants. It results in increased shoot density because of greater tillering, but causes a decrease in root growth. Less food is available to support the growth of roots because it is needed for the production of new shoot tissue. Food storage is also reduced. Mowing causes a decrease in leaf width but increased leaf succulence (Figure 11-1).

Mowing has an influence on pest problems as well. Weed populations usually decrease because of increased turf density and the continual removal of the terminal growing point from broadleaf weeds. These dicots have meristematic tissue at the top of the stem. When a broadleaf weed has its growing point removed repeatedly, the plant is in a state of constant stress and is eliminated eventually.

However, if the grass is cut too low, it begins to thin out and weeds will become a problem. Disease problems often increase because of mowing. When shoot tissue is cut off, an open wound remains. Fungi that cause turfgrass diseases can gain entrance into the leaf through the wound before it heals.

Some effects of mowing, such as reductions in the root system and food reserves, are detrimental to the turf. Individual turfgrass plants would probably be healthier if they were allowed to grow to full height. However, overall

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**FIGURE 11-2**

The strip in the center has been scalped—cut too low.

turf quality suffers severely when the grass is not cut. If mowing is performed correctly, an attractive, functional, and healthy stand of turfgrass can be maintained. Improper mowing practices have an especially devastating impact on turf quality because grass is cut frequently. When errors are continually repeated once or twice a week, serious injury will occur. The major reason for the decline of many turf areas is poor mowing practices such as cutting the grass too low or too infrequently or using a dull blade (Figure 11-2).

Mowing Height

The *cutting height* or mowing height is the height of the topgrowth immediately after the grass is cut. The selection of the most appropriate mowing height is influenced by several factors. Each species has a recommended mowing height range (Table 11-1). This range is determined by the growth characteristics of the species or cultivar.

As will be explained in greater detail later in this chapter, no more than one-third of the leaf growth should be removed at each mowing. Grasses that produce leaves and stems that grow horizontally have a lower growth habit than grasses that produce more erect, upright leaves and stems. The more hori-

TABLE 11-1 Mowing Heights Normally Recommended for Turfgrass Species*

| Species | Mowing Height Range | |
|--------------------|---------------------|-----------|
| | (in) | (cm) |
| Bahiagrass | 2.0–4.0 | 5.0–10.2 |
| Bermudagrass | | |
| Common | 1.0–2.5 | 2.5–6.4 |
| Hybrids | 0.2–2.0 | 0.5–5.1 |
| Carpetgrass | 1.0–2.0 | 2.5–5.0 |
| Centipedegrass | 1.0–2.0 | 2.5–5.0 |
| St. Augustinegrass | 2.0–3.0 | 5.1–7.6 |
| Zoysiagrass | 0.5–2.0 | 1.3–5.0 |
| Creeping bentgrass | 0.1–0.5 | 0.25–1.3 |
| Colonial bentgrass | 0.3–1.0 | 0.8–2.5 |
| Fine fescue | 1.5–3.0 | 3.8–7.6 |
| Kentucky bluegrass | 1.5–3.0 | 3.8–7.6** |
| Perennial ryegrass | 1.5–3.0 | 3.8–7.6** |
| Tall fescue | 1.5–3.5 | 3.8–8.9 |
| Crested wheatgrass | 1.5–2.5 | 3.8–6.4 |
| Buffalo grass | 2.0–3.0 | 5.0–7.6 |
| Blue grama | 2.0–2.5 | 5.0–6.4 |

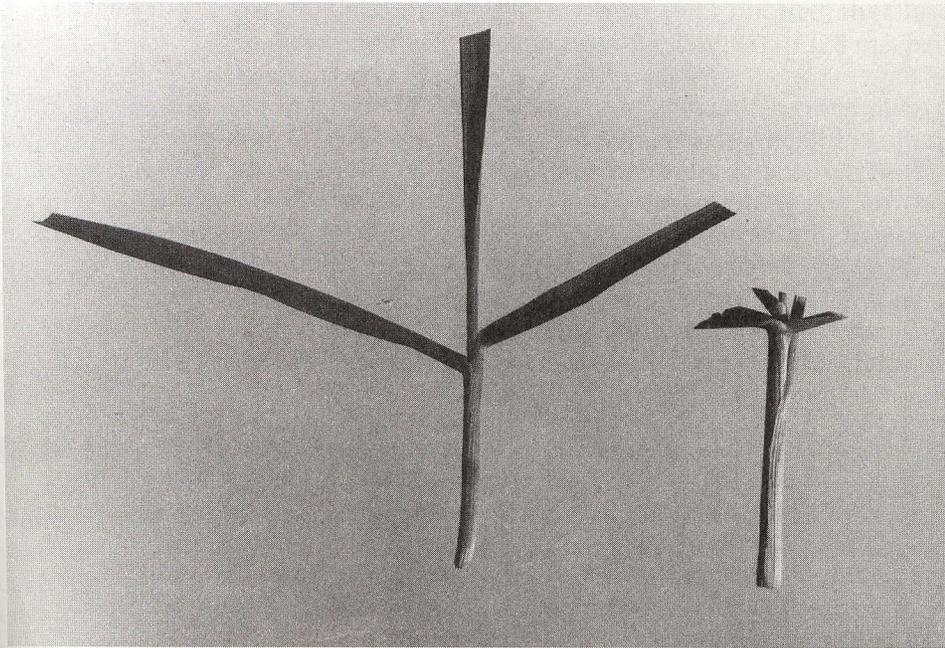
*Certain cultivars may be exceptions.

**Some cultivars will tolerate closer mowing.

zontal the direction of growth, the lower the plant can be cut without removing over one-third of the leaf tissue or injuring the crown. The height from the ground of the lower leaves also affects the mowing height (Figure 11-3).

If the grass is mowed too low, the crown can be damaged and too much topgrowth is removed. The ability of the plants to photosynthesize is severely limited when an excessive amount of leaf tissue is removed. The result is a reduction in the size of the root system, a partial depletion of stored foods, and a weakening of the turfgrass. Turf managers refer to this type of extreme defoliation as *scalping*. After a severe scalping, only brown stubble and bare soil may remain. Many people would like their turf to have the closely mowed appearance of a golf course putting green. Unfortunately, most turfgrass species will not tolerate such a short cutting height.

Cutting the grass too high also has detrimental effects. Tall grass has a shaggy, puffy look. Longer leaves have the potential to lose more water because of the greater leaf surface area. The thatch layer may increase in thick-

**FIGURE 11-3**

This tall fescue cultivar has an erect growth habit. The lower leaves occur relatively high above the ground. A 3-inch (7.6-centimeter) mowing height is ideal. A 2-inch (5-centimeter) mowing height (right) will seriously weaken the plants.

ness and cause problems. The shoots droop, and the tops may bend over. This results in higher humidity around the leaves and may lead to increased disease problems. Leaf texture becomes coarser when the grass is cut to tall heights. Density decreases, and the turf is more open. The turf is less satisfactory aesthetically if the mower blade is raised too high.

People generally prefer to mow grass to the lowest heights that the species or cultivar can tolerate because closer mowing results in a better looking turf. However, closer mowing also results in a turf that is less tolerant of environmental and disease stresses. When grass is cut at the lower limit of its mowing tolerance range, it requires a higher level of maintenance and a more expert management program. For example, because shorter grass has a less extensive root system than grass that is mowed to a taller height, it requires more frequent fertilization and irrigation (Figure 11-4). The shallower roots of the grass that is cut lower have a decreased ability to obtain nutrients and water from the soil.

If the turfgrass manager is willing to give turf the extra care it needs to be maintained successfully at closer mowing heights, the results can be very satisfying. Bermudagrass and creeping bentgrass growing on golf greens exhibit superior quality even though they are mowed at the lowest heights in their tolerance range. However, a tremendous amount of maintenance is required to keep a green in healthy condition. Unfortunately, many homeowners cut their lawn at the lowest limit of its tolerance without providing an adequate level of maintenance.

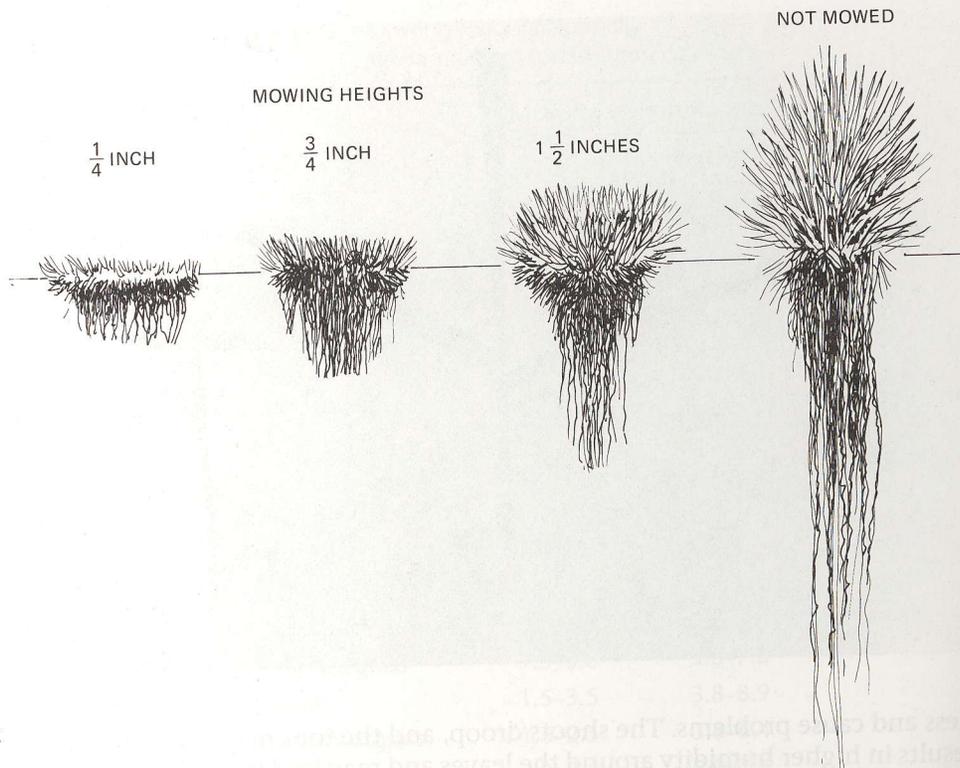


FIGURE 11-4

The root system becomes more extensive as the mowing height increases.

When the grass is experiencing stress, it is best to raise the mowing height. During summer months, it may be wise to cut cool season grasses higher to increase their heat and drought tolerance. Warm season grasses may be cut higher in the early and late parts of the growing season when colder temperatures occur. If the turf is recovering from injury due to insects, diseases, traffic, or other stresses, the mower blade should be raised. Turfgrass growing beneath trees is often in a weakened state because of the lack of sunlight and other problems. Mowing grass to a taller height enables it to adapt better to the shaded conditions.

Grass is occasionally mowed lower than its minimum height tolerance when it is dormant. Before the growing season begins, turf may be cut very short to remove dead leaf tissue and "clean up" the area. This close mowing also hastens spring greenup because shading of the soil surface is reduced following the removal of topgrowth. A greater amount of solar radiation reaches the soil surface, causing the soil to warm up more quickly. This can also lead to increased weed seed germination if turf density is unsatisfactory. A certain degree of scalping may be permissible before the growing season when the grass is still dormant. However, it is important not to cut so low that the grass is seriously injured.

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For each 0.125 inch (3.2 millimeters) the cutting height is raised, the photosynthetic area of the grass can be increased by as much as 300 ft² (28 m²) per 1,000 ft² (93 m²) of turf.

In many cases, the height to which the turfgrass is actually mowed differs from the height at which the mower blade is set. The mowing height is often adjusted and checked on a level surface such as a driveway or a bench in the equipment storage building. This is known as the *bench setting*. When the mower is operated on the turf, its wheels force down grass shoots and then ride on top of them. As a result, the mower is raised higher above the soil surface and the grass is cut at a taller height than the bench setting. In some cases, however, the mower cuts lower than the bench setting. This occurs when the wheels sink into the turf because of soft ground or a thick, spongy thatch layer.

Mowing Frequency

Mowing frequency should not be determined by mowing when it is most convenient or on a set date such as every Saturday. How often the grass should be cut is determined by the growth rate of the grass. The growth rate depends on environmental conditions, the degree of maintenance, and the species and cultivars that make up the turf.

Cool season lawn grasses may require mowing twice a week in the spring when temperatures are optimal and rainfall is abundant. However, in the summer, when weather conditions are unfavorable, mowing once every two weeks may be sufficient. Warm season grasses require frequent mowing in the summer, but the number of days between mowings increases at other times of the year because of cooler temperatures. Turf that is heavily fertilized and irrigated grows faster; it needs to be cut more often than turf that receives minimal maintenance. Some species such as centipedegrass or the fine fescues tend to have a slow growth rate and require less frequent mowing.

Turfgrass managers usually determine mowing frequency by using the one-third rule that was mentioned previously. The grass should be cut often enough so that not more than one-third of the topgrowth is removed at any one mowing (Figure 11-5). Cutting off more than one-third of the total leaf surface causes a drastic decrease in the plant's ability to photosynthesize because of the extensive loss of leaf area. The reduction in food production can result in the death of a large portion of the root system. All available carbohydrates are used to produce new shoot tissue, and there is not enough food remaining to sustain many of the roots. When one-third or less of the vertical shoot growth is removed per mowing, the impact on the root system is minimal.

To observe the one-third rule, the turfgrass manager should cut the grass when it is 50 percent higher than the desired mowing height (Figure 11-6). For example, if the blade is set at a 2-inch mowing height, the grass should be cut when it is 3 inches tall. The 1 inch of topgrowth that is removed is one-third of

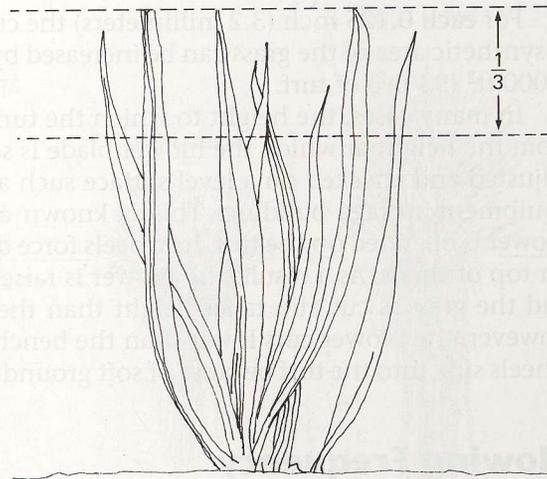


FIGURE 11-5

Approximately one-third of the topgrowth should be removed per mowing. Stated another way, leave twice as much leaf surface as you remove at any single mowing.

the total height. The lower a turf is cut, the more frequently it needs to be mowed. For example, if a certain species is cut to 1 inch, it is mowed when it reaches a height of 1.5 inches. If that species is maintained at a mowing height of 3 inches, it need not be cut until it is 4.5 inches tall. The plants, of course, will produce 0.5 inch of vertical growth much faster than they will increase in height 1.5 inches.

If the grass becomes excessively long, it should not be chopped down to the normal mowing height at one time. Such a severe scalping can stop root growth for a month or longer. Instead, the grass should be lowered to the desired height gradually by mowing at frequent intervals. For example, if the regular mowing height is 2 inches and the grass is 5 inches tall, it could be cut at 3 or 3.5 inches immediately, and then mowed at 2 inches after a few mowings. Reducing the mowing height 0.5 inch (1.3 centimeters) per week is best, but not usually a realistic choice. Even cutting the grass from 5 inches to 3.5 inches, and then cutting it a second time down to 2 inches the same day is better than chopping it all down at once. This gradual lowering requires more

THE EASIEST METHOD OF DETERMINING MOWING FREQUENCY IS TO MOW THE GRASS WHEN IT IS 50% TALLER THAN THE HEIGHT TO WHICH IT IS TO BE CUT. THIS IS CALCULATED BY DIVIDING THE MOWING HEIGHT BY 2 AND THEN ADDING THIS LENGTH TO THE MOWING HEIGHT. GRASS THAT IS CUT TO 2 INCHES SHOULD BE MOWED WHEN IT IS 3 INCHES HIGH.

FIGURE 11-6

How to determine when to mow by following the one-third rule.

$$\frac{2 \text{ in}}{2} = 1 \text{ in}$$

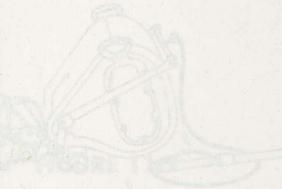
$$2 \text{ in} + 1 \text{ in} = 3 \text{ in}$$

time and labor than a single mowing, but is usually worth the extra effort, especially if the grass is suffering any type of serious stress.

How seriously turf is weakened by violations of the one-third rule depends on the health of the grass, the severity of the scalping, and the number of times that too much leaf tissue is removed. Significant injury is most likely when the grass is suffering from some type of stress. If the turf is healthy and not more than 100 percent higher than (double) the mowing height, the effect may be insignificant. Repeated failures to observe the one-third rule often result in a gradual thinning of the stand and a dramatic reduction in turf quality.

On sites where turf quality is relatively unimportant, there is less concern about mowing the grass frequently enough to avoid removing more than one-third of the leaf tissue. Turfgrass growing beside highways may be cut only a few times during the growing season. Money is saved by mowing low-maintenance, utility areas infrequently.

Removing considerably less than one-third of the topgrowth at each mowing also leads to problems. Cutting the grass before it reaches the proper height results in a greater mowing frequency. The adverse effects that may result from mowing the grass more often than is necessary include decreased root, rhizome, and shoot growth, reduced food reserves, and increased succulence. The wounds occurring at the cut leaf tips are ideal sites for fungi and other pathogens to enter the plant. Disease problems can be encouraged by frequent mowing because of the increased amount of wounding. These wounds also provide an opening through which water is readily lost. Mowing too often also results in unnecessary labor and expense.



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Types of Mowers

Mowing equipment has increased tremendously in sophistication since 1830, when the first mechanical grass mower was developed (Figure 11-7). Today there are two basic types of mowers used to cut turfgrass—reel and rotary mowers.

Reel Mowers

Reel-type mowers have blades attached to a cylinder, which is known as the reel. As the reel rotates, leaves are pushed against a sharp bedknife and cut off. The blades, as they turn, guide the leaves to the *bedknife*, which does the actual cutting (Figure 11-8). A basket is often attached to catch the clippings. When the cutting edge is sharp and the mower is properly adjusted, the reel mower exhibits better mowing quality than the rotary mower. It produces a sharp, clean cut because the blade and bedknife create a scissor-type cutting action.

Reel mowers are the most commonly used type of mower on higher quality turf areas because of the superiority of their cut. Golf course greens, tees, and fairways, better lawns, athletic fields, and sod farms are usually main-

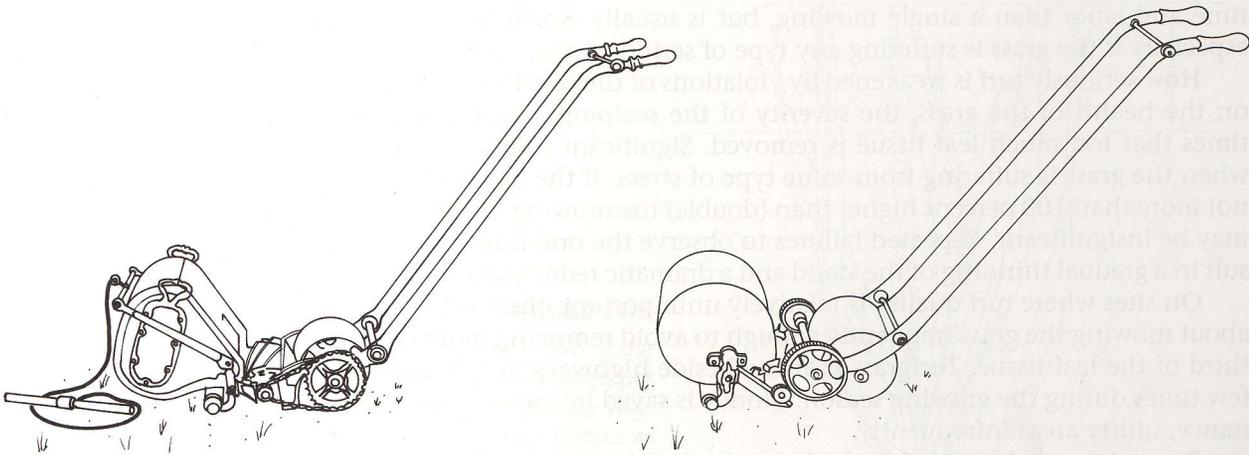


FIGURE 11-7 Two examples of early mowers. (Courtesy of Brooklyn Botanical Garden)

tained with reel mowers (Figure 11-9). Some reel mowers can be set to cut grass as low as 0.10 inch (2.5 millimeters). They also offer the advantages of being safer and more fuel efficient than rotary mowers.

There are some disadvantages associated with reel mowers. They have difficulty cutting through seed stalks and cannot be used to mow some warm season species that produce tough seed heads. Reels often cannot mow tall grass that is higher than 4 to 6 inches (10.2 to 15.2 centimeters). Best mowing quality is obtained when a reel-type mower is operated on a relatively smooth surface.

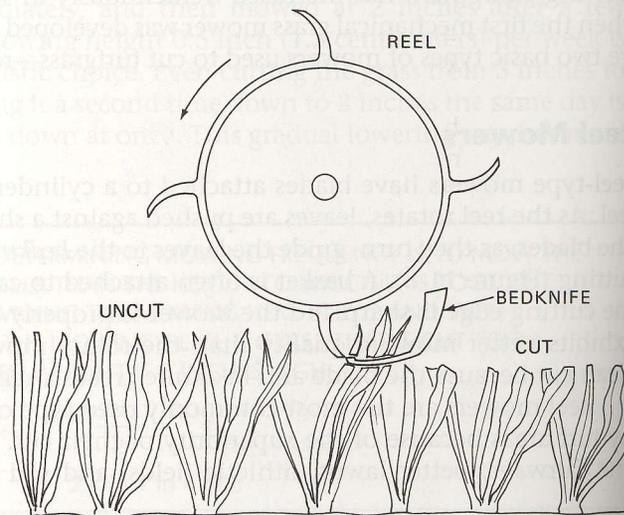


FIGURE 11-8
Cutting action of a reel mower.

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**FIGURE 11-9**

Reel mowers produce superior mowing quality. (Used with permission of The Toro Company. "Toro" is a registered trademark of the Toro Company, Minneapolis, Minnesota.)

Approximately 98 percent of all mowers sold are the rotary type. Homeowners generally prefer rotary mowers because reel mowers are often more expensive and require special maintenance. When reel blades and bedknives are nicked or worn, they must be ground and lapped. Professional turf managers use machines to perform the grinding and *lapping* operations (Figure 11-10). Most homeowners do not have access to this type of sharpening equipment or the skill to use it.

The reels should be disengaged whenever the mower is driven across surfaces that are not covered with grass. The liquids in the grass leaves act as a lubricant and prevent the metal from heating and expanding as the blades strike the bedknife. If the reel is allowed to rotate when it is not cutting grass, excessive wear can occur.

Rotary Mowers

Rotary mowers have blades that rotate horizontally at high speeds. The sharpened edges at the ends of the blades cut off leaf tissue by impact (Figure 11-11). A rotary mower is able to cut grass because the blade spins so rapidly. It does not produce the sharp, clean-cut characteristic of a reel mower. Rather than cutting like a pair of scissors, its cutting action is more like that of a machete or scythe.

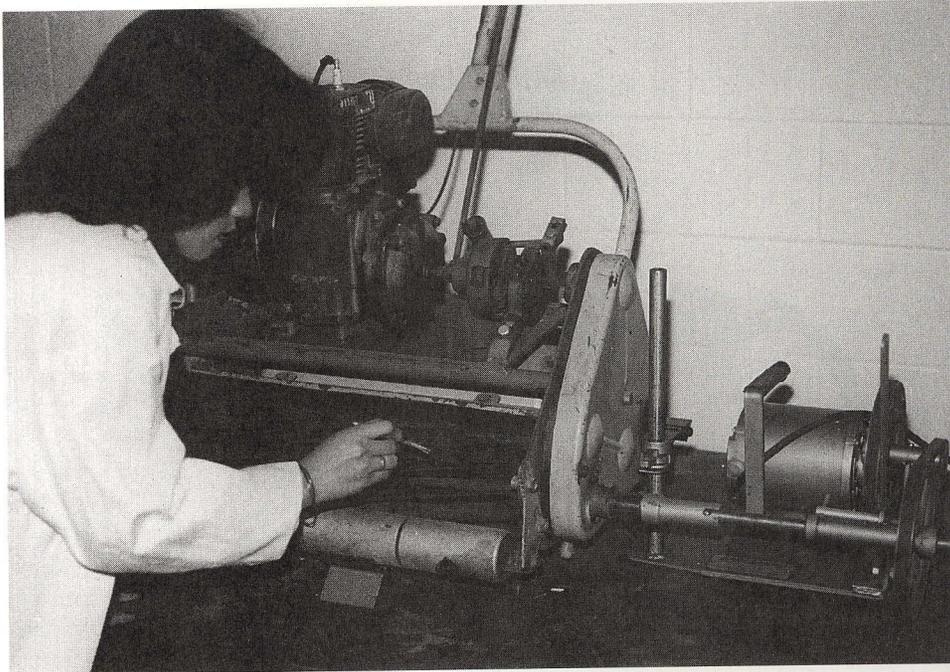


FIGURE 11-10
A lapping machine helps to keep the mower cutting properly between grindings.

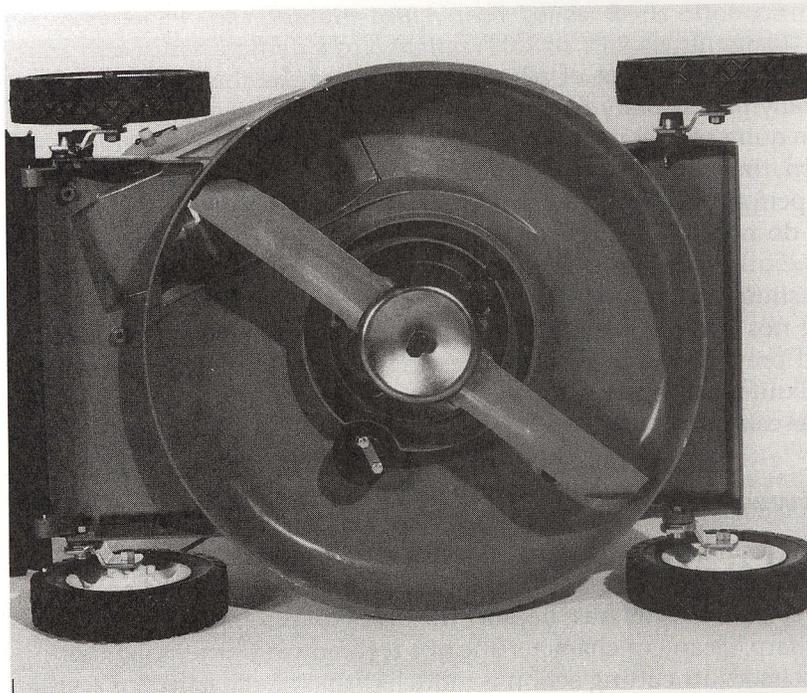
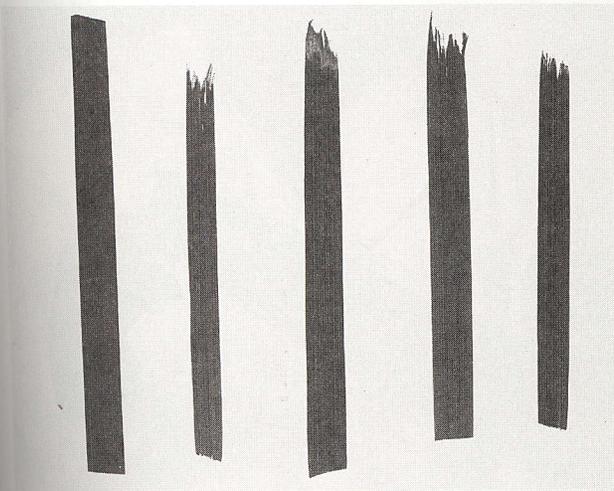


FIGURE 11-11
The rotary blade revolves at speeds as great as 200 miles per hour. (Used with permission of The Toro Company. "Toro" is a registered trademark of The Toro Company, Minneapolis, Minnesota.)

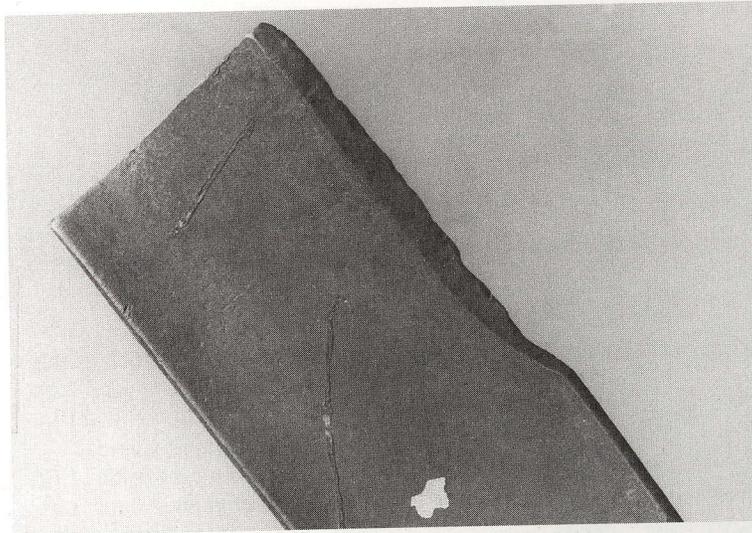
**FIGURE 11-12**

Rotary mowers such as this riding model are very popular for home lawns. A sharp blade is essential. (Used with permission of The Toro Company. "Toro" is a registered trademark of the Toro Company, Minneapolis, Minnesota.)

The mowing quality produced by a rotary mower is generally not good enough for higher maintenance areas. However, if the blade is kept sharp, a rotary is quite satisfactory for use on most lawns and lower maintenance areas (Figure 11-12). A sharp blade is essential. Grass cut with a dull blade is torn or shredded at the point of impact; the cut tip appears jagged and frayed (Figure 11-13). When the tissue is mutilated the wound heals more slowly. The result is greater water loss and an increased likelihood of disease problems. Repeated mowing with a dull blade seriously weakens the turf.

**FIGURE 11-13**

The leaf on the left was cut by a sharp blade. The others were cut by a dull blade.

**FIGURE 11-14**

The cutting edge of this blade is nicked and very dull.

When a rotary blade is dull or nicked it should be sharpened (Figure 11-14). A file or power grinder can be used. Excessively worn blades should be replaced; new blades are relatively inexpensive. The blade must be balanced before it is put back on the mower (Figure 11-15). The turf manager should examine the mower blade and cut leaf tips regularly to be sure that the blade is sharp.

**FIGURE 11-15**

Rotary blade on a balancer.

There are other advantages to the rotary mower in addition to its simple maintenance requirements. Rotaries are more versatile than reel mowers. They can mow very tall grass and cut through tough seed stalks and weeds. The rotary is preferred for species such as bahiagrass, centipedegrass, and St. Augustinegrass because of their extensive seed head formation. It is also easier to trim around trees and buildings with a rotary mower than with a reel mower.

Rotary mowers have disadvantages as well. A serious accident can occur if a hand or foot is placed under the mowing deck (housing) while the blade is rotating. It is important to buy machines that have the best safety features to help prevent these types of injuries. It is also very important not to disconnect or in any way circumvent the safety devices. Rotary mowers can also be dangerous if the blade strikes a rock or stone. The object can be thrown from beneath the mower at the speed of a bullet. Rotaries are not used on turf that is mowed to a height lower than 1 inch (2.5 centimeters) because the mowing quality would be unsatisfactory. Reel mowers generally have two wheels and follow the contour of the surface more exactly than a rotary mower, which travels on four wheels. At close mowing heights, the rotary is more likely to scalp as it moves over small mounds or ridges (Figure 11-16).

Flail Mower

A hammer knife or *flail mower* is occasionally used by turf managers. It has numerous, loose-hanging small knives, which are held out by centrifugal force as the shaft rotates at high speeds (Figure 11-17). The blades sever grass by

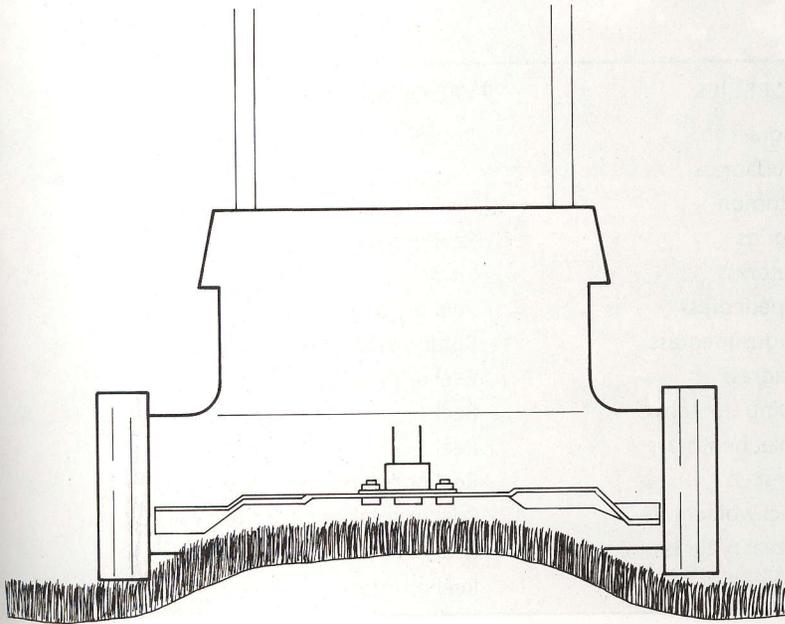


FIGURE 11-16

Scalping caused by high spots in the turf.

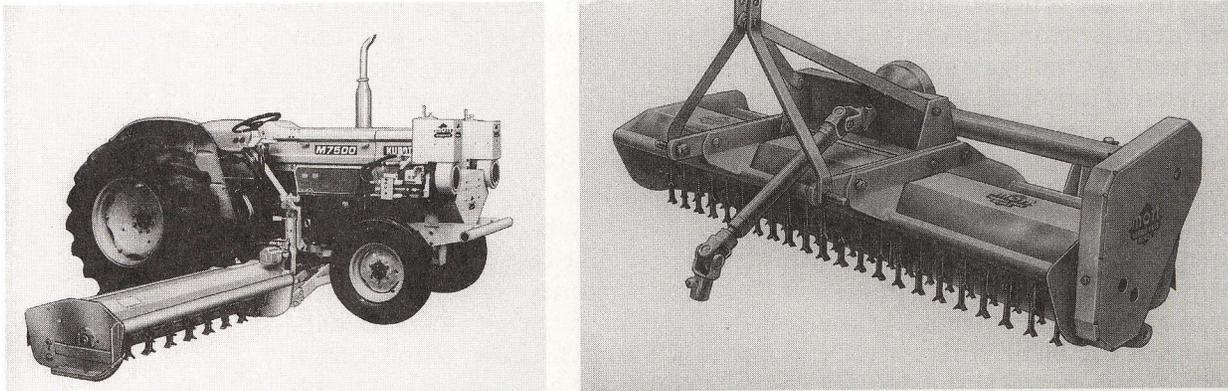


FIGURE 11-17 A flail or hammer knife mower. (Courtesy of Mott Corp.)

impact. Flail mowers are used on low-maintenance, utility sites that are cut infrequently. They can mow grass that is 12 inches (0.3 meter) high. One disadvantage is the amount of time it takes to sharpen the many small blades on the machine. Mowing quality is inferior compared to a reel or rotary mower. Flail mowers do not throw objects they hit as rotary mowers do.

Selecting a Mower

The best type of mower for a particular turf area (Figure 11-18) depends on many factors, including turf quality, mowing height, species and cultivar,

| SPECIES | TYPE OF MOWER |
|--------------------|-------------------|
| Bahiagrass | Rotary |
| Bermudagrass | |
| Common | Reel or rotary |
| Hybrids | Reel or rotary |
| Carpetgrass | Rotary |
| Centipedegrass | Reel or rotary |
| St. Augustinegrass | Rotary, primarily |
| Zoysiagrass | Reel or rotary |
| Creeping bentgrass | Reel |
| Colonial bentgrass | Reel |
| Fine fescue | Reel or rotary |
| Kentucky bluegrass | Reel or rotary |
| Perennial ryegrass | Reel or rotary |
| Tall fescue | Reel or rotary |

FIGURE 11-18
The type of mower recommended for various turfgrass species. Certain cultivars may be exceptions.

safety considerations, and the sharpening equipment available. The mowing width of the mower is also important. For an average-sized home lawn, a small mower with an 18- or 21-inch (0.46- or 0.53-meter) width is usually sufficient. Large areas such as golf courses, estates, parks, sod farms, athletic fields, school grounds, and cemeteries require large mowing machines. The mowing width of a rotary or reel mower is increased by cutting with several blades or reels (Figure 11-19). Some gang mowers have as many as nine reel units and can cut a swath over 20 feet (6.1 meters) wide (Figure 11-20).

The turf manager should purchase mowing equipment that is large enough for his or her needs. The initial amount of money saved by buying a smaller, cheaper machine may be small when compared to the cost in time and labor saved by purchasing a machine with a greater mowing capability. For example, it takes over two and a half hours to cut an acre (0.4 hectare) with a walk-behind mower that has an 18-inch (0.46-meter) cutting width. A 60-inch (1.5-meter) riding mower can mow the acre in approximately thirty minutes, while a gang mower with a 20-foot (6.1-meter) mowing width takes less than ten minutes.

Commercial-grade mowers, though more expensive than homeowner-type mowers, are better built and will last longer.



FIGURE 11-19

A rotary mower with three blades. (Used with permission of The Toro Company. "Toro" is a registered trademark of The Toro Company, Minneapolis, Minnesota.)

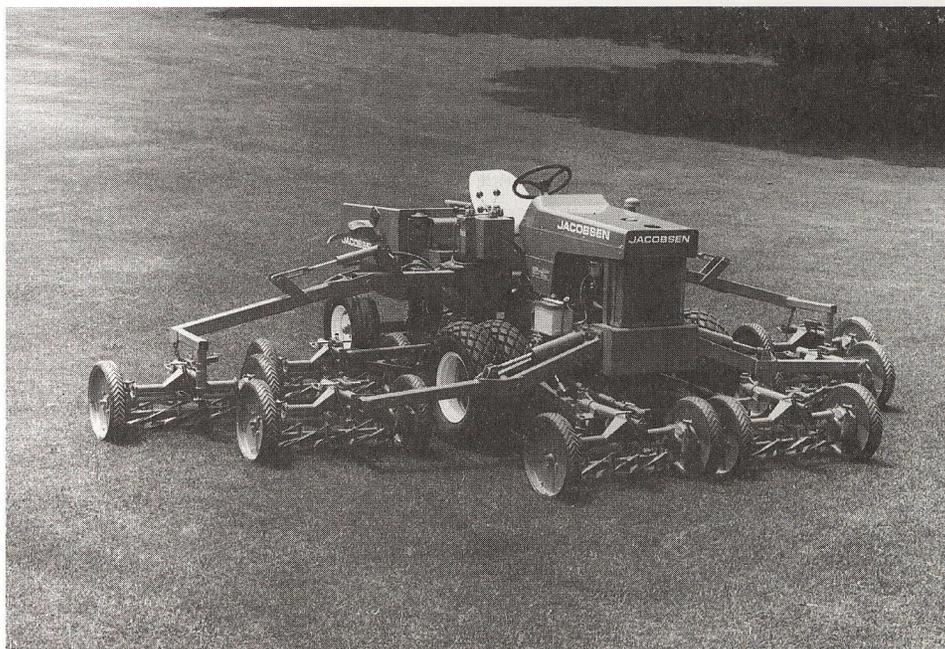


FIGURE 11-20
A nine-gang reel
mower. (Courtesy of
Jacobsen Division of
Textron, Inc.)

Mowing Pattern

It is advisable to vary the mowing pattern. The grass should not be mowed in the same direction each time it is cut. Grass tends to lean or grow in the direction in which it is mowed. The horizontal orientation of grass foliage in one direction is called *grain*. Grain results in a less even cut, a streaked appearance, and poorer putting quality on golf greens. Alternating mowing directions reduces grain. A brush or groomer can be attached to the front of the mower to help lift leaves and stems.

Varying the mowing pattern prevents continual scalping of the same high spots and reduces compaction and rutting by mower wheels, which can develop if the wheels run over the same ground each time. Repeatedly turning the mower at the same places results in damage to the turf.

The operator must be very careful when mowing around trees (Figure 11-21). If the mower hits the trunk, the vascular tissue of the tree may be injured. Disease-causing microorganisms can enter the tree through mower wounds. Placing a mulching material such as wood chips at the base of the tree helps to prevent mower damage because the operator does not have to mow close to the trunk. Monofilament trimmers are good tools for trimming around trees, but the line should not hit the bark (Figure 11-22).

**FIGURE 11-21A**

The mower must not bump into trees. (Used with permission of The Toro Company. "Toro" is a registered trademark of The Toro Company, Minneapolis, Minnesota.)

**FIGURE 11-21B**

Injury caused by a mower resulted in the death of this tree.

Clippings

The pieces of grass tissue cut off by the mower are called clippings. They can be collected in a catcher or bag that is attached to the mower. If the clippings are short it is best not to remove them. Clippings are a valuable source of fertilizer nutrient, and the need for fertilization is decreased when they are left on the turf to decompose. As they decompose, the clippings return substantial quantities of nutrients to the soil. Clippings are often composed of 3 to 5 percent nitrogen on a dry weight basis. They also contain significant amounts of phosphorus and potassium. Research has shown that grass plants can obtain 25 to 40 percent of the nitrogen they require from recycled clippings.

Observing the one-third rule is advantageous because the mower removes small pieces of leaf and stem tissue. These short clippings fall close to the soil surface and do not cause aesthetic problems. They are *succulent* and decompose rapidly, so their contribution to thatch accumulation is minimal.

Long clippings should be collected or raked up after mowing. These longer leaf pieces look unattractive on the surface of the turf. Large clumps can smother the grass, cause heat stress, or lead to disease problems because the grass beneath them remains damp. When turfgrass is diseased, clippings may be collected in an attempt to remove some of the disease-causing organisms



FIGURE 11-22

A nylon line or string trimmer. (Courtesy of Homelite Division of Textron, Inc.)

that are living in the leaves. Clippings are not allowed to remain on golf greens even though the leaf pieces are quite short. The clippings detract from the superior appearance of the green and interfere with putting.

Whenever possible, clippings should be left on the turf. Time is wasted emptying the catcher or raking when the cut tissue is collected unnecessarily. It is especially important to leave the clippings for a few mowings after a fertilization application. Approximately 60 to 70 percent of the nutrients that are immediately available to the plants are found in the clippings the first three times the grass is cut after fertilization.

Mulching mowers are rotary mowers that are designed to cut leaf tissue into very small pieces. These pieces are small enough to fall into the turf rather than remain on top of the grass, and they will decompose rapidly because of their small size. Mulching mowers either do not have a discharge chute or have a chute that can be closed. The clippings are trapped beneath the mowing deck in the cutting chamber and are recut until they are finely chopped (Figure 11-23).

A number of walk-behind and riding mulching mowers are available on the market. They are becoming very popular where the disposal of clippings is difficult because of local restrictions or lack of dumping sites. Grass clippings

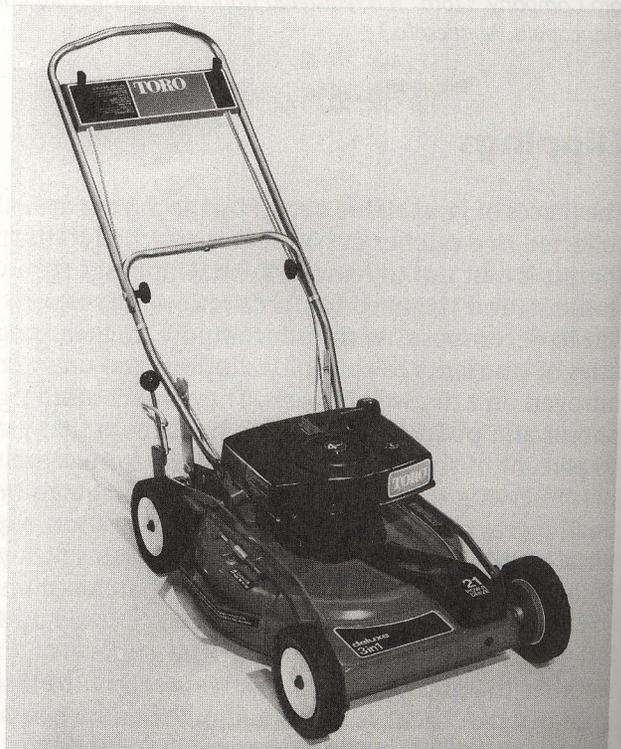


FIGURE 11-23

Clippings are trapped under the deck of a mulching mower because it does not have a discharge chute. (Used with permission of The Toro Company. "Toro" is a registered trademark of The Toro Company, Minneapolis, Minnesota.)

result in major waste disposal problems in some communities. A major problem with mulching mowers is that they have not performed satisfactorily when grass is wet or if long pieces of tissue have to be removed. However, improvements in design and in air flow in the cutting chamber are helping to overcome these problems.

Mower Safety

The Consumer Product Safety Commission reports that each year in the United States approximately 80,000 people are injured by mowers. Of these accidents, 10,000 result in the amputation of toes or fingers. One must always be very careful when operating a mower. Obeying the following safety rules is essential.

- Never allow children near the mower.
- Always stop the engine when you leave a mower. The engine should be shut off even if you are going away from the mower only for a minute.
- Pick up any stones, sticks, or debris lying on the area that is to be mowed.
- Remove the ignition wire from the spark plug before touching a rotary blade. If the wire is not disconnected, the engine could start accidentally.
- Be sure that feet and hands are away from the blade before the engine is started. Start the mower on a level spot. Before starting a walk-behind rotary mower, place one foot firmly on top of the mower deck and be sure that the other foot is on solid ground, a safe distance away from the mower. Never place any part of the body near the blade when the mower is operating.
- Do not remove the bag that catches the grass clippings while the mower is running.
- Make certain that you know how to operate the mower before starting the engine. Be sure that you know how to stop the engine quickly in case of an emergency.
- Always push a rotary mower forward—never pull it backward toward you. There is too great a chance that it could be pulled back over a foot.
- Wear heavy, protective work boots or shoes when mowing. The safety-tipped type of shoe is best. Shoes should also have good traction to help prevent slipping.
- When using a walk-behind mower, mow across slopes—not up and down. A riding mower is often driven up and down a slope to reduce the risk of tipping over. Never operate a mower on a steep slope.
- If possible, do not mow wet grass. The operator is more likely to slip when walking on damp turf. Wet clippings also tend to stick together and clog the mower. Large clumps of cut tissue may remain on the turf after mowing.
- Never attempt to pour gasoline into the tank when the engine is hot. Allow the engine to cool off before refueling.

- Do not add fuel or oil to the mower when it is on turf. Spills will result in injury to the grass.
- Always pay careful attention when mowing. Operating a mower can be boring, but the chance of an accident increases significantly if you daydream or let your mind wander.
- Read the instruction manual before operating a mower. Additional important safety rules are listed there.

Mowers manufactured today are required to have certain safety features. For example the blades must stop immediately if the operator releases his or her grip from the handle or leaves the seat. This is an excellent safety feature because it helps to prevent people from accidentally placing their hands in the path of a mowing blade.

When the turf manager is deciding which type or model of mower to buy, safety considerations should have an important bearing on the decision. Also, it is important to check constantly to make sure that safety devices are working properly.

Chemical Mowing

A large percentage of the turfgrass manager's maintenance budget is spent on mowing operations. Consequently, there is great interest in plant growth regulators (PGRs), chemicals that slow down the growth rate of grass and reduce the need for mowing. One type of PGR retards plant growth by inhibiting cell division, or cell elongation. A second type inhibits the production of gibberellic acid, a plant hormone. Treated plants have shortened cells and are more compact. The best PGRs reduce shoot growth without significantly affecting root growth.

Plant growth regulators have traditionally been sprayed on low-maintenance sites such as golf course roughs, roadsides, and difficult-to-mow areas such as steep banks and cemeteries, and around trees, fences, or ponds (Figure 11-24). Their use on fine turf has been limited because of their potential to reduce turfgrass quality. When growth is slowed, plants become more susceptible to stress and less able to recover from injury. PGRs should not be applied to areas that receive much traffic. They may initially discolor the turf, and mixed stands of grasses can have an uneven appearance if one species is inhibited more than another.

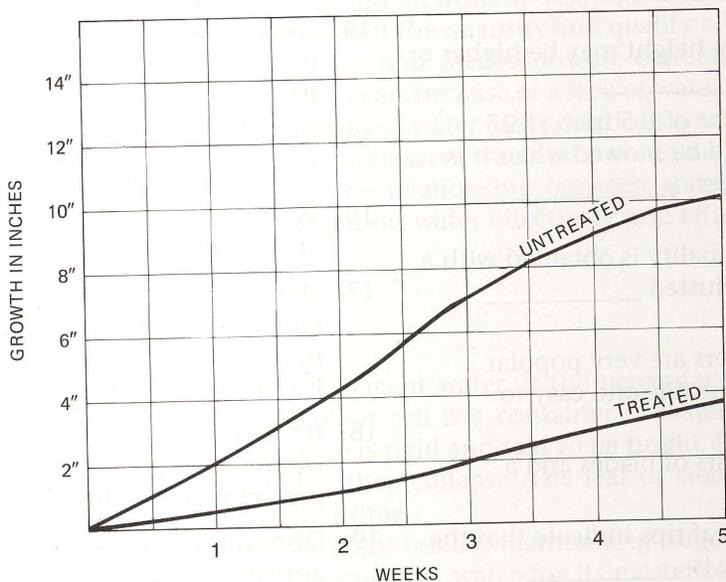
The characteristics of PGRs have improved significantly in recent years. Some of the newer materials are used on lawns and golf course fairways. One product, trinexapac-ethyl, actually produces a darker green, dense-appearing turf. However, turf managers must be very careful when treating better quality sites. It is important to experiment on small areas first and to start out using the lower recommended rates. An application of PGR generally slows growth for a four- to ten-week period. Its use may reduce the number of mowings that

**FIGURE 11-24**

The grass on the right was treated with Embark® growth regulator. The tall grass on the left is untreated. (Courtesy of Agricultural Products/3M Corp.)

are necessary by 50 percent (Figure 11-25). The result is a decrease in maintenance costs and a reduction in the likelihood of mower accidents when hazardous mowing sites such as slopes are treated.

Another significant advantage of PGRs is the reduction in the volume of clippings. This is very helpful where clippings need to be removed from the site and disposal is a problem.

**FIGURE 11-25**

Average growth rate on untreated turf and turf treated with a plant growth regulator.

Plant growth regulators are primarily used at times of the year when the grass is growing rapidly. In the North, for example, half of the yearly top-growth can occur in the spring. It is difficult to keep up with the mowing, especially if it rains a good deal. Turf quality can be greatly reduced if the grass gets too high and is scalped down or if heavy mowing equipment must be operated on wet turf and soils. A PGR can help to solve these problems.

There is also interest in using plant growth regulators to reduce water and fertilizer use. When its growth rate is slowed, a grass plant does not need as much irrigation or fertilization.

Many broadleaf weeds are not affected by PGRs used on turf. It may be necessary to apply a herbicide when a PGR is used to prevent the weeds from taking advantage of the grasses' lack of competitiveness.

Self-Evaluation

1. The size of the turfgrass root system becomes _____ if the mowing height is lowered.
2. Leaf width _____ if the mowing height is raised.
3. Not more than _____ of the vertical shoot growth should be removed at each mowing.
4. Extreme defoliation is referred to as _____.
5. The actual mowing height may be higher or lower than the _____.
6. Grass cut to a height of 0.5 inch (1.27 centimeters) should be mowed when it is _____ inch(es) (_____ centimeter [s]) tall.
7. The best mowing quality is obtained with a sharpened, well-adjusted _____ mower.
8. _____ mowers are very popular because they are versatile and easy to sharpen.
9. The reel unit consists of blades and a _____.
10. Ragged, shredded leaf tips indicate that the rotary mower blade is _____.
11. When the turf is stressed because of unfavorable environmental conditions, the mowing height should be _____.
12. Whenever possible, clippings should be left on the turf because they are a valuable source of _____.
13. The horizontal orientation of shoots resulting from repeatedly mowing in the same direction is called _____.
14. Remove the ignition wire from the _____ before touching a rotary mower blade.
15. Allow the engine of the mower to _____ before refueling.
16. When using a PGR, a _____ should also be applied.
17. What factors should the turfgrass manager consider when deciding what type of mowing equipment is most appropriate for his or her needs?
18. If you were a turf manager, describe the mower safety program you would use to protect your employees.
19. Discuss the advantages of using plant growth regulators.

Intro

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