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Greens

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Of all the playing areas on the golf course, the most significant is the green. Nearly 40 percent of all golf shots are played on and around the green. Golfers may tolerate mediocre fairways, inferior bunkers, and sparse tees, but they expect, and deserve, puttable, near-perfect greens. When a golf ball rolls onto the green toward the hole, nothing must impede it from its true path. The factor that most affects the roll of the ball is the smoothness of the putting surface. The final step of preparing a green for play is mowing and needs to be done with a sharp mower by a well-trained operator that will ensure that the surface allows the golf ball to roll accurately and effortlessly.

All other work that is done to a green – such as topdressing, aerating, fertilizing, spraying, rolling, and watering – are wasted unless the green is cut to perfection. No matter how healthy the green, its dark green color, its long root system, or the absence of disease, if the green is not cut perfectly, golfers will condemn it, and much work will have been in vain. Topdressing, aerating, fertilizing, spraying, rolling, and watering are all important, and then there is the icing on the cake – the cutting of the green to perfection, which is the glorious culmination of all the hard work that has been completed. That is why proper cutting is so vitally important in maintaining golf course greens in tiptop condition. Golf course superintendents are judged by the putting surfaces they produce, and the quality of ball roll should be the number one concern of a superintendent.

KEEPING THE MOWERS SHARP

Just as it is impossible to obtain a clean shave with a dull razor, it's not possible to mow a green successfully with a dull mower, so the putting green mowers must be kept sharp at all times. To check whether a mower

will cut grass, simply insert a strip of paper between the bed knife and the mowing cylinder, and watch the blades shear it off. If the paper is creased and not cleanly cut, more than likely the same will happen to the grass when the mower traverses a green.

If in doubt, get down on your hands and knees and examine the grass with a magnifying lens. Getting down on your hands and knees is a tried-and-true way of examining the turf for most situations. A grass blade that is poorly cut will look bruised, with the veins in the leaf blade sticking out like damaged protrusions or tiny hairs. The collective effect of the bruised hairs is the appearance of a light sheen over the entire surface of the grass. This phenomenon is not limited to greens alone, but may also occur on tees, fairways, and roughs. It is a common problem that can easily be corrected by adjusting the cutting edge of the mower and/or by sharpening the mower. It is well to remember that dull mowers usually are a major factor in reducing the speed of greens. This is particularly important on greens in southern locales that are overseeded for winter play.

There are two fundamentally different methods of sharpening mower reels: spin grinding and relief grinding. The first method, spin grinding, sharpens all the blades equally in a perfect cylinder with the entire width of the blade touching the cylinder and, subsequently, the bed knife. The second method, relief grinding, results when single blades of the mower are ground on an angle and only the front edge of a blade touches the bed knife. Both methods have their adherents, and both camps tend to believe in the superiority of their particular way.

Equally important to the cutting cylinder is the bed knife, which depending on one's school of thought, can be sharpened with or without a relief angle. One thing everyone agrees on is that the front edge or the face of the bed knife must also be kept sharp. When the front tip of the bed knife becomes rounded, it will once again result in bruised grass blades. The grinding of bed knives and cutting cylinders is usually done during the off-season, and is repeated often during the regular season. Once the grass is cut on a regular basis, the cutting cylinders need periodic attention and are occasionally back-lapped with a grinding compound to maintain their edge. The grinding compound is applied lightly with a brush as the reel turns backward. This process tones the cutting edges of both the reel blades and the bed knife and results in a superior quality of cut. The front edge or face of the bed knife may be touched up at this time with a specially designed facing tool for use between major sharpenings. Those who prefer spin grinding over relief grinding often do away with back-lapping, claiming that it is messy, bad for the mower bearings, and unnecessary.

CUTTING THE GREENS

Cutting the green is accomplished by well-trained, conscientious operators who understand the importance of the task at hand. Recognizing and

removing hazards such as stones from adjacent bunker shots or twigs and other debris is paramount to a consistent and uniform cut and ultimately a smooth ball roll. One small rock can nick a mower blade or knock the unit out of adjustment, causing and uneven surface wasting all other inputs and efforts to produce the best putting surfaces possible.

The Height of Cut

A cutting unit that traverses across a grass covered area is supported by a front and a rear roller. These two rollers touch the ground, and the cutting cylinder turns between the rollers at some distance above the ground. This distance, known as the height of cut, is expressed in parts of inches or millimeters, depending on the country in which the course is located. For repair or adjustment of a cutting unit, it is tilted backward or upside down on a workbench. A straightedge is placed across the front and rear rollers; the distance between the straightedge and the top or front edge of the bed knife represents the height of cut. Measuring the height of cut is made infinitely easier by using a solid steel bar and a micrometer attachment. Because the height of cut is measured on a workbench, the resulting measurement is known as the *bench setting,* which often differs from the actual, on the green, cutting height. Why is this so? Superintendents discovered long ago that a cutting height of 3⁄16 inch produced different results on different makes of mowers. Obviously, mowers made by different manufacturers are constructed differently and perform in their own peculiar ways, which are rarely similar. There is a device that makes it possible to measure the actual height of cut on the green. It consists of a triangular prism that is placed on the putting surface with the edge touching the soil. The height of the grass mat is projected against incremental graduations, thus revealing the actual in-the-field height of cut. During the same process, one can observe the quality of cut, which can be just as important.

Heights of Cut on Greens

Imperial	*Decimal*	*Metric*
$\frac{3''}{16}$	0.188″	4.76 mm
$\frac{1''}{8}$	0.125″	3.18 mm
$\frac{1''}{10}$	0.100″	2.54 mm
$\frac{1''}{16}$	0.063″	1.59 mm

At most golf courses, greens are cut at 3/16 inch or less. Above that height, the speed of the green slows dramatically and the enjoyment of golf, and particularly of putting, is reduced. A cutting height somewhere between 1/8 inch and 3/16 inch is acceptable to the vast majority of golfers. However, the recent introduction of dwarf species of bent and Bermuda grasses for putting greens has mandated the need to cut the grass at or below 1/8 inch.

Mowers and Cutting Patterns

Though robotic green mowers have been developed in recent years, their entry into to the golf course market has been met with many obstacles. There will come a time when science and technology will push forward and introduce an autonomous green mower that will free up employees to do other tasks. Until then, there are two basic types of green mowers used on putting greens worldwide: riders and walkers. The first reel-type mower was patented in England in 1830, and although many changes and improvements have been made since then, the basic principle of having a cutting cylinder with blades shearing off the grass above the bed knife remains the same.

At first, walk-behind greens mowers needed to be pushed. Later, engines were added, as well as many other refinements that made it possible to cut at lower heights. In spite of this progress, cutting greens with walkers remained a slow and laborious process. Not surprisingly, when the first riding triplex greens mower came on the scene in 1963, its introduction was an immediate success. Large numbers of golf courses discarded their walkers and switched over to the riders (Figure 1.1). Quickly it became evident that the riding mowers had certain drawbacks. The heavy machines caused compaction, which often created wear patterns. Serious hydraulic leaks occurred from time to time and left streaks of ugly dead grass in their wake. Today, the problems with hydraulic leaks have been minimized on new machines and eliminated when battery-operated triplex greens mowers are utilized.

The walk-behind greens mowers have made a comeback and are now widely used on traditional golf courses with small greens, even more so with the reintroduction of an efficient battery-operated version similar to ones used in the early 1960s. Golf courses with larger greens, 5,000 square feet and more, find the riders more economical. The quality of cut from both types of units is comparable. In fact, many superintendents use riders and walkers alongside each other. Occasionally, the main body of a green is cut with a rider, and a walker is used for the cleanup pass. When sufficient workers are not available during shoulder seasons or on weekends, riders are used and walkers the rest of the time.



Figure 1.1 *Triplex greens mower in operation.*

The distinctive checkerboard cutting pattern on putting greens is a desirable feature, very much appreciated by golfers. Although both riders and walkers are capable of producing these patterns, the use of walkers, because of their narrow tracks, produces a far more eye-catching design.

Cutting the Green: 10 Steps to a Perfect Putting Surface

1. *Check the mower's performance*. It is customary for the equipment manager or technician to check the mower for its ability to perform as expected. The first function of the greens mower operator is to double-check to make sure that everything is in order. While a gas-fueled mower is still in the maintenance area, the engine oil should be checked and the gas tank topped off. If using a battery-powered mower, it is important to check that the battery is fully charged.
2. *Before commencing cutting, inspect the green*. Walk and scan the putting surface, looking for stones and debris that need to be removed. In the process, fix ball marks and check the height of hole plugs that have been replaced by the cup changer, and make sure that the new plugs are level with the putting surface. Remove the flagstick and put it aside. Some fast operators believe that they can remove the stick as they pass by, but this is seldom a good idea and quite often leads to accidents.

3. *The direction of cut varies and is generally determined by the superintendent*. It is important that it be different from that of the previous day. The direction of cut is changed every day to help reduce the buildup of grain. The grain on a green is the direction in which the grass leans, much like the nap of a living-room rug. Change the cut every day, and, ideally, grain will be eliminated or at least reduced.
4. *Straight cutting lines are essential*. For the first pass, pick a tree on the horizon or some other feature in the landscape, and keep looking at it as you mow a strip across the green. A straight line will result. For subsequent passes, it is no longer necessary to look at the horizon. Instead, focus on the straight line that has been completed at the far end of the green.
5. *Novice cutters should overlap several inches*. Experienced cutters may reduce the overlap to a narrow strip. The markings on the baskets can be helpful in determining the degree of overlap. Missing a small strip of grass because of insufficient overlap is a cardinal sin against good greenkeeping. This results in golf balls jumping on the green and losing their direction, which becomes a golfer's nightmare.
6. *It is important to make long, wide turns*. Think of the shape of a light bulb or a teardrop while making the turn. Short, quick turns tear the turf on the apron. If a sand bunker or other obstruction is in the way of completing the turn, maneuver away from the hazard and turn in the adjacent rough. Operators should be cautious when making turns on wet aprons. Mowers may slip and slide on the damp turf. Some operators will use turning mats (Figure 1.2) where there is little room between the putting surface and an obstacle to make their turn and not damage the turf.
7. *Check the basket for clippings while the green is being cut*. Clippings tell a story: Uneven distribution within the basket means the cutting unit is set improperly. Unbalanced quantities between the baskets on a rider may indicate differing heights of cut. Likewise, when using a walking mower, the quantity and distribution of the clippings in the basket is a sign of how the mower is cutting. If you think the green has been cut perfectly and the mowers are truly sharp, come back in the evening to make an assessment. With the setting sun over your shoulder, every imperfection on the green is clearly visible, and suddenly what was the perfectly cut green does not look as perfect anymore.
8. *Always empty the baskets before they become too full*. Baskets laden with wet grass affect the quality of cut. If policy dictates that clippings be spread, learn the sweeping but coordinated motion of the upper body, arms, and hips that results in the perfect dispersal



Figure 1.2 *Walking greens mower utilizing turning mats to minimize the wear on the collar of the putting green.*

of the grass clippings. The clippings should be spread in the rough behind the green, *never* on the fairway in front of the green or in wildlife areas. At some golf courses, the clippings are collected and composted instead of being spread in the rough.

9. *At the completion of the back-and-forth cutting pattern, the outer edge of the green must now be cut*. This process is known as the *cleanup pass,* and it requires great diligence on the part of the operator. A cut into the adjacent apron will result in an ugly brown streak. Alternatively, to leave a few inches uncut can result in experiencing the superintendent's wrath. Instead, slow the mower down to a crawl and concentrate on the edge. Superintendents from time to time – and especially during the first mowings of the season – will mark the perimeter of the green with small dots of paint. This process will help to keep the shape of the green intact. The cleanup pass may be omitted from time to time to prevent the buildup of wear patterns along the edge of the green.
10. *Listen to the mower*. Although many operators now use earplugs to protect their ears from excessive noise, it is still important to listen to the sound of the mower, especially the purr of the reels touching the bed knives, which will give a hint if the reels are maladjusted or if an unseen object is struck.

When the green has been completely cut, replace the flagstick. Last but not least, take a whipping pole and brush away the clippings that may have fallen off the mower during cutting near the edge of the green and on the apron. Then, stand back for a few seconds and admire your work in the hope that your supervisor will, from time to time, praise you for your outstanding greens-cutting ability.

The Sequence of Cutting Greens

When golfers arrive at the club in the morning, they typically can tell whether the superintendent has the interests of the golfers in mind. It has been said, "If the putting green has been cut, it shows that the superintendent cares about the golfers." We agree, and we strongly recommend that the putting green be among the first greens that are cut in the morning, certainly before the golfers start arriving at the golf shop.

When using riding greens mowers, it is relatively easy to stay ahead of the players. Riding mowers cut faster than most golfers can play. Superintendents should be aware that some golfers may start play on the back nine, and the needs of those golfers should be taken into account when the superintendent schedules cutting. Checking the schedule with the pro shop is beneficial. When using walker-type greens mowers, three to four operators may be needed to cut all 18 greens, as well as the putting and pitching greens. This will keep green mowing ahead of the golfers. The cutting sequence is then determined based on the superintendent's familiarity, and the sequence will vary from course to course.

When greens are mowed (or any other hole-by-hole maintenance) after play has begun, it is best to change the sequence in which they are cut. Start with the 18th green and work backward so as to avoid bothering the same foursome more than once during the course of their game.

During the height of the golfing and growing season, the greens are frequently cut on a daily basis, but prudent greenkeepers know the beneficial effects of skipping a cut on occasion. Every mowing injures the turf. This practice can be compared to a man not shaving his face for a day after routinely doing so every morning. The skin on the jowls immediately improves after a day of rest. It feels softer and healthier. So it is with a green that has been given a rest from daily mowing. In lieu of mowing on a skip day, some greenkeepers will roll the putting surfaces before play, removing the morning dew and giving the turf an extra day to recover. Skipping a day during the busy golf season is not always conceivable, but a rainy day when cutting is not possible will provide the same result.

The First Cut of the Spring

Superintendents in northern regions look forward to the first cut of the spring. The harbinger of a new season brings with it anticipation and great expectations for the months ahead. Many superintendents enjoy making the first cut themselves. The thrill of trying new mowers, combined with the fragrance of the freshly cut grass, brings memories of past seasons and lost youth. At the same time, there is a wonderful opportunity to outline the greens.

During the previous season, the greens may have lost some of their shape because cautious operators made them smaller with each successive cutting. In the process, curves and shapes were unintentionally altered. Spring is a good time to cut into the apron and reoutline a green, returning it to its original configuration. Small adjustments can be made while using the mower, but if the green will be substantially enlarged, it is best to outline the change with a paint gun. It may be necessary to mark the new outline several times before it becomes established.

Cutting the apron or collar to greens height is a drastic measure that should be performed only during the spring when the grass plants have an inner drive to recreate themselves and are able to recover from the severe scalping. At any other time of year, such treatment could result in instant death of the grass plants, but in the spring the grass will manage to survive.

Many superintendents like to cut greens themselves from time to time during the season, even at large operations where there are plenty of staff, not only for exercise, but also to get a feel for the course. It is part of the mystique of being a golf course superintendent and having a love affair with one's golf course. Such a relationship needs constant nurturing on the part of the superintendent, and cutting greens from time to time is an important part of that process.

TAKING CARE OF WEAK GREENS

Not all greens are created equal. Certain greens may have been constructed from the same material and in the same manner, but there are other factors that cause greens to perform differently, not only during the growing season but also when the grass is dormant. Foremost among these factors is location. Greens exposed to the north tend to be colder and green up more slowly in the spring. The soil on greens that face the south tends to be much warmer, and the growth on such a green is more substantial. Another factor is shade. As a general rule, grasses don't grow well in the

shade, and Bermuda grass needs more sun than any other turf. Therefore, greens that are surrounded by trees often struggle for survival. Trees should not be planted near greens. If they have been so established by well-meaning but ill-informed committees, then the trees should be trimmed regularly to reduce shading and the roots pruned to keep the nutrients and moisture levels acceptable on the greens. The early morning sun is particularly important for the health of the green.

Greens that become weaker during the progression of the golfing season should be treated gingerly. There are several steps that can be taken to prevent the further decline of a weak green:

1. Use only walkers on weak greens; they are lighter and cause less mechanical damage and compaction (Figure 1.2).
2. Periodically, roll instead of cutting.
3. Remove the dew on weak greens as early in the morning as possible. Dry greens are less subject to fungal diseases.
4. Cutting weak greens when the grass is virtually dry is beneficial.
5. During extreme conditions of high temperature and humidity, consider cutting the green in late afternoon, early evening, or not at all.
6. Syringe lightly during the hottest part of day. This will help to cool the turf. Syringe refers to a light watering either by hose or a quick irrigation cycle.
7. Spread the wear by changing the hole daily, even twice daily if needed.
8. Choose hole locations that are easier for the golfer to make putts and minimize traffic on the green.
9. Raise the height of cut ever so slightly.
10. Cut with solid rollers instead of grooved rollers. Do not use groomers.
11. Go easy on fertilizer (organic sources of fertilizer are less phytotoxic) and pesticide applications. Stay away from cocktail mixes. A mixture of pesticides, wetting agents, and liquid fertilizer is known colloquially as a "cocktail mix."
12. Improve the internal and subsurface drainage of a weak green by removing water on an as-needed basis with a roller or squeegee. Other methods of draining the greens are included in a later chapter.

On which days should superintendents choose not to cut their greens? Usually a day or time is selected that is the least busy on the course. It may also be a rainy morning, or a cloudy day with no dew on the grass. Other factors enter into the decision as well. Clever superintendents who wish to survive the pitfalls of club politics should be aware of the playing

schedules of the owners and club officials and other VIPs. Communication with the pro shop on special events and play can also help dictate what days a superintendent may skip a mow.

SPIKE MARKS AND BALL MARKS (OR PITCH MARKS)

The introduction and the acceptance of nonmetal or soft spikes have improved the day-to-day condition of golf greens immeasurably. Gone are the days of spike-marked greens and putts deflected on the way to the hole as golfers are now permitted to tap down any imperfections on their putt line. Ball marks continue to scar and mar otherwise perfect greens. These marks are caused by high-flying golf balls leaving ugly indentations on a soft green. Ball marks are rarely a problem on firm greens; however, when greens are moist from rain or excessive irrigation, ball marks can become problematic.

Ball marks left unrepaired become the responsibility of the superintendent and the greens crew. On a daily basis, the task of repairing them falls to the greens cutter and/or the hole changer. Some superintendents assign special staff to fix ball marks with a mix of seed and green sand, or other various types of divot mix according to the composition of the green. In severe cases, periodic topdressing alleviates the problem. The ball marks on some of the newer cultivars of bentgrass don't heal as quickly and it is up to the superintendent to develop a course of action to address this putting green infliction. Of course, we can also appeal to the golfers to repair the damage resulting from their actions. All golf courses, without exception, encourage players to repair ball marks. In fact, the practice is a principal part of the codes of conduct and ethics everywhere.

DEW REMOVAL

On mornings when greens are not to be cut and there is dew on the turf, it should be removed for the benefit of the golfers as well as for the health of the grass. Wet turf provides an ideal breeding ground for disease development, and drying the grass early in the morning either by means of dew whipping or simply by cutting the green is an essential part of disease prevention.

Methods of Dew Removal

We know from experience that courses that religiously practice dew removal spend less on chemicals for disease prevention than those



Figure 1.3 *A fiberglass-tipped pole is used to wipe the dew off greens and to scatter grass clippings on the collars and can be used to mask a skipped cleanup pass.*

courses that never remove dew. Using one of these "green" methods of dew removal will more than likely result in long-term cost saving on the chemical budget:

1. Whipping with a fiberglass-tipped pole (Figure 1.3)
2. Using roller squeegees, like those used on tennis courts
3. Dragging a rubber hose, weighted rope, or similar device across the green
4. Running the syringe cycle on the irrigation system

THE TRIPLEX RING SYNDROME

When a riding greens mower cuts the same swath day after day along the outer edge of the green, the tires of the mower are on the same track each time. If, in addition, the green is small or has been designed with many exotic curves, the weight of the mower and the wrenching action of the tires making tight turns will quickly injure the grass. Ugly dead or brown concentric rings, the dreaded "triplex ring syndrome" (TRS), will result. This is not some mysterious disease related to fairy rings, but pure and simple mechanical damage caused by the overuse of a mower.

TRS Prevention

Most superintendents, at the first sign of TRS damage, will switch back to walk-behind greens mowers. This is not always possible, nor is it wholly necessary. Many superintendents have successfully eliminated the triplex ring by the simple expedient of skipping the cleanup pass every other day. Even for one day on a weekend, the cleanup pass can be conveniently forgotten. It is amazing how quickly the stressed-out grass responds to, and recovers after, a rest from the regimen of the daily routine. Removing groomers and replacing grooved rollers with smooth rollers on the greens mowers will help eliminate triplex ring damage.

Golfers generally don't notice that the grass has not been cut for the first 3 to 4 feet near the edge of the green, and if they do, they probably won't mind. Golf balls that are putted from this area are rarely deflected in the initial stages, when they are traveling at their greatest velocity on their way to the cup. Possibly the grass along the outer edge of the green may look shabby as a result of omitting the cut. This is especially true during times of heavy dew on the grass. Carrying a whipping pole and brushing the greens along the outside perimeter will address this shortcoming.

Another method simply involves disengaging the mower reels prior to turning, but not lifting the cutting units. This helps stop the clippings from falling off the rollers and leaving a mess along the outside of the green.

From time to time, a good practice is to move the cleanup pass in from the edge of the green between the extents of 1 to 2 feet. This method results in the tracks of the wheels being straddled and, thus, helps prevent the buildup of the triplex ring. Perhaps the best method of eliminating the triplex ring is to use walkers for the cleanup pass.

Architects wanting to break the monotony of round and oval greens continue to design fancy-shaped greens with many tight turns, much to the frustration of the superintendent. Superintendents, however, have many golf architect friends who are sympathetic to this hardship and refuse to make curves on greens that have a radius of less than 25 feet. That makes the development of a triplex ring virtually unlikely.

Strategies to Prevent Triplex Ring Damage

Any one or more of the following can be used to help prevent triplex ring damage:

1. Skip the cleanup pass on alternate days.
2. Use walkers for the cleanup pass.

3. Move the cleanup pass away from the outer edge periodically.
4. Disengage the outer reel when using a rider.
5. If necessary, engage a golf architect to redesign the perimeter of the green, thus reducing the severity of the curve.

Repairing Triplex Ring Syndrome Damage

In the initial stages, when a triplex ring is just starting to show, it is relatively easy to stop the damage from becoming serious. Simply using a walker on such greens will do the trick. Once the grass has become seriously injured, however, more drastic measures are needed. Aerating with minitines and overseeding (a process that is described in detail in Chapter 9) are probably sufficient to promote the recovery of the turf. In really serious cases, the affected part may actually have to be resodded. Whether seeding or sodding, the portion of the green that is being treated should be roped off and put out of play until recovery is complete.

HYDRAULIC SPILLS

A most unpleasant occurrence in using a riding triplex greens mower is the occasional bursting of the hydraulic hose. This usually happens when least expected and often goes unnoticed until it is too late. The results can be disastrous. A careless operator might not notice a hydraulic leak until the machine actually stops functioning. A perfect pattern of brown lines may result on several successive greens. Most often, the burn of the grass is limited to a single narrow strip across a green or on the apron.

There have been many miracle cures advocated by fast-talking salespersons to save the grass from hydraulic burns: activated charcoal, liquid soap, kitty litter, and strips of felt tissue, to name but a few. These do not work adequately. These quick fixes can make the superintendent or the greenkeepers feel better for a little while, because at least they are doing something, but there are no magic cures that can bring dead grass back to life. The hydraulic oil from the mower that is squirted onto the green because of a loose-fitting or broken hose is very hot. It is so hot, in fact, that the grass immediately singes and dies upon contact with the oil. It may still look green, and a bit shiny at that, but it will certainly be brown in just a few days. The damage can be mitigated, however, if the area is washed off with a powerful spray of water during the initial stages. Adding a wetting agent at this point may also help, but it also needs to

be washed off. Others use a peat product immediately after a spill, which absorbs much of the oil and lessens the damage.

Some superintendents now use vegetable oils in their hydraulic systems. These oils are biodegradable and less caustic to the grass. Battery-operated mowers in use at a number of courses have helped to alleviate the wrath of the hydraulic spills.

Prevention

It all starts at the "grounds maintenance facility" (see Chapter 20), the maintenance headquarters, with a good, well-qualified mechanic, the unsung hero in the golf course maintenance industry. A conscientious mechanic will regularly check and repair the hydraulic hoses on all machinery, but especially on the mowers. When a particular hose becomes worn or breaks, the mechanic should order one or even preferably two replacement hoses. Hence, it's important to have a supply of spare hoses is in the parts room.

In some instances, the mechanic and an assistant will work together to put out all machinery from the storage area in the morning. It is helpful to start the engines to warm up the machines before they are taken out onto the course. Each operator should be responsible for checking that his machine is in proper running condition, which includes looking for small drops of oil as well as gasoline leaks that are telltale danger signs before taking mowers out. A small drip can be an indicator of a loose fitting. Fixing it, then and there, can prevent a disaster on the greens later.

Mixing a dye into the hydraulic oil makes it somewhat easier to see a leak, and this can help to prevent running the hydraulic tank completely dry. Some superintendents and mechanics have installed elaborate alarm systems that will immediately detect a drop in hydraulic pressure and signal the operator. Such systems are very expensive, but the cost can be justified in terms of avoiding damage to a precious green, tee, or fairway.

As long as there are cars on our highways, there will be accidents. As long as we use mowers equipped with numerous hydraulic lines, there will be mishaps and damaged turf. It is inevitable. Operator training should cover all aspects of hydraulic leaks, starting from what to look for after each mowing pass to where to move the mower once a leak is detected, such as a cart path, rough, or even sand bunker in some cases. A printed, detailed plan of action should be conveniently available so that when a hydraulic spill does occur, immediate remedies can be executed.

Repairing Burnt Grass Caused by Hydraulic Spills

Quick action and clear thinking are necessary to cope with unexpected hydraulic spills. Several key members on the greens staff should be familiar with one or all of the following steps:

1. *Remove the excess oil by spreading Turface or kitty litter over the affected area or applying Peat-sorb*. Any one of these materials will soak up much of the oil and prevent the burn area from becoming a much wider strip than it needs to be. Applying a solution containing a wetting agent will further dilute the remaining oil. If a wetting agent is not available, use hand or dish soap and dilute with water.
2. *Use an aerator with pencil tines or minitines closely spaced, about 1 inch apart and no deeper than 1 inch*. A tine hole deeper than 1 inch will prevent the seedling from reaching the surface of the green once it has germinated. Make a double pass to ensure that there is plenty of seed bed. Hand-forking is an alternative method. Apply seed, making sure that some of it ends up in the tiny aerator holes. The seed that falls on the surface is mostly wasted, but the seed in the aerator holes has found a growth chamber. Below the surface, in a moist and warm environment, it will quickly germinate and sprout up. The small tufts of grass, firmly rooted below the surface, will withstand golfer and mower traffic and rapidly join together to make an acceptable turf. In four to six weeks, the ugly scar will disappear. Frequent topdressings will speed the process. Unfortunately, this practice is not an option on Bermuda grass greens.
3. *If you absolutely must, take a sod cutter and remove the affected area and replace it with new sod*. This is a drastic measure that will affect the putting surface much longer than seeding. Try to obtain a sod cutter with a narrow cutting blade. Make sure that the sod is cut thicker than normal, so that the sod won't shift under the golfers' feet or the greens mower. If there is no sod nursery from which to take the sod, consider taking it from the putting green or along the edge from the back of a regular green. Taking sod from the back of the damaged green will guarantee that you will have the same turf that is already on the green that is being repaired. This not only will be visually more appealing but will offer a more consistent playing surface. The sod should be carefully laid and tamped down just a fraction of an inch below the adjacent surface. After sodding has been completed, the strip must be topdressed and rubbed with the back of an aluminum rake or, better yet, with a Levelawn. This makes for a perfectly smooth surface that will quickly grow in and become part of the regular green. Although a mechanized

sod cutter can be used, hand-pushed, narrow-bladed sod cutters are available and are ideally suited for this type of repair.

The problem with the sodding process is that the sod needs regular watering until it becomes firmly rooted. This means that someone has to be available to water it, even on weekends and perhaps during late afternoons and evenings. If the sod were to die, it would be one mistake compounding another and a crisis difficult to survive, especially for novice superintendents.

4. *Repairing turf on damaged tees and fairways is slightly less cumbersome because these surfaces are not as critical as the green.* In many cases, when the scar is narrow, the adjacent turf will grow in quickly. It may still be necessary to either seed or sod or even use a divot mix to help promote growth. In any case, it is always better to repair the damage than to let the visual effects of the dead turf linger. Golfers will lose their patience with superintendents who are indecisive or procrastinate.

CLIPPINGS

Clippings can be spread in the rough behind the green or in the rough between two fairways as long as it is done properly. Leaving clumps of clippings in the playing areas interferes with the game and is not acceptable. As stated previously, many superintendents collect the clippings and compost them on-site or have them hauled away to a waste area.

We have already discussed the significance of constantly checking the grass clippings in the basket(s) of the mower when cutting greens. Important information can be gleaned from uneven distribution inside the basket. This may indicate that the mower is dull or out of adjustment, but there is more to be learned from the clippings.

Grass clippings have an odor all their own. When the grass is healthy, it releases a very pleasant fresh smell, but when the green is sick, the odor of the clippings is very pungent. Early warnings of a pending fungus disease outbreak can often be detected by simply sticking your nose into a handful of clippings. A foul odor is a sure giveaway that disease is trying to gain a foothold. Old-time greenkeepers knew this secret long ago and could often be seen on all fours, sniffing a green and trying to learn about pending problems. In the baskets, among the clippings, look for adults of the hyperodes weevil or the ataenius beetle insect species. Keeping track of the number of bugs found in the clippings may help to determine the need for spraying an insecticide.

Clippings can also reveal the succulence of the turf. Overfertilized greens produce an abundance of fat, juicy snippets of grass. Lean greens make for wiry, stringy leaf blades. If there are fertilizer granules mixed in with the

clippings, it probably means that the green should have been cut with the baskets off after applying fertilizer. Even the small-particle, homogenous fertilizers get caught in the reels and end up in the baskets. It makes no sense to pick up the expensive nutrients from the greens and spread them in the roughs. Better to remove the baskets for a couple of days and water in the fertilizer.

Emptying the baskets (Figure 1.4) is a common practice after cutting the green. If the baskets need emptying before the green is finished, it probably means that the green is overfertilized. If, however, the baskets still do not need to be emptied after four or five greens are cut, it indicates that the turf is lean and thin and possibly did not need cutting at all. A light rolling with a high-speed greens roller might have been a better method of creating a perfect putting surface.

Greens rollers were first used on lawn bowling greens in Australia. The original models were 6 feet across, much too wide to cope with undulations of putting greens but ideal for flat bowling greens. Their purpose was to speed up the green without cutting it. Lawn bowling greens are frequently maintained at the very edge of survival in order to be hard and fast. Cutting greens maintained under such stressed-out conditions would almost certainly mean instant death to the grass. A light rolling achieves the desired result without removing any of the grass growth.



Figure 1.4 *Grass clippings are mostly water and will decompose quickly when spread out properly in the rough or other out-of-play areas.*

Australian golf course superintendents, who often manage bowling greens as well, adopted the speed roller for putting greens by the simple expedient of making it narrower. Such rollers quickly became a hit in North America and are now widely accepted all over the world.

FAST GREENS

Television golf and the Stimpmeter have combined to put pressure on superintendents to provide faster greens – greens so fast that, according to some witty tour players, a dime left as a ball marker would slide off the green. That is an exaggeration, of course, but with an element of truth. Greens have been cut to the quick, rolled, and left to dry, all in a quest for speed. It is a miracle that the poor grass plants manage to survive, and all too often they do not.

The Stimpmeter is a device used to measure the speed of a green in feet and inches. A ball is rolled from a slotted steel bar at a predetermined height, and its progress is measured on the green. The direction is reversed, and the process repeated two to four times. Several measurements are averaged to arrive at a length to calculate the speed for a particular green. The Stimpmeter should be used on a flat portion of the green. That may present a problem, inasmuch as many greens have severe undulations and with only a few flat areas available to measure the speed.

It is becoming more common for greens to reach speeds of 12 to 13 feet. The stage is set every spring during the Masters at Augusta National, where quick greens are commonplace. Golfers from all parts of the world watch and then demand that their superintendents emulate the course conditions and also the lightning-fast greens. Those weak-willed souls who give in to the golfers and cut their greens to the root hairs usually lose their grass and their jobs at the same time.

Until the advent of the dwarf cultivars, no grass, whether it was Bermuda, bent, or *Poa annua,* could survive being cut at ⅛ inch for any length of time. Yet rookie superintendents kept on trying at their own peril. They accommodated the club champion and the captain, but completely forgot about the needs of the grass and perhaps the majority of the golfers. In the horribly hot and dry summer of 1995, when grass across the continent was dying by the acre on the golf courses, many greens could have been saved if they had just been cut a little higher. The introduction of high-density dwarf varieties of both bent and Bermuda grasses improved the situation. Cutting heights below ⅛ inch are commonplace for these grasses – indeed a necessity – and green speeds of 12 to 13 feet can be maintained for extended periods.

The major factors that affect the speed of a green are the height of cut and the rolling of the green. Superintendents should select mower settings

that will ensure the survival of the grass and produce a green speed that is acceptable to the majority of the golfers. A dry wind on a sunny afternoon can speed up the greens as much as 6 inches on the Stimpmeter, at the same time stressing the grass.

For special events, such as club competitions and tournaments, the green speed can be increased a trifle by the simple expedient of double cutting. This is an old trick that smart superintendents have known about for years. The double cut results in a smoother and faster putting surface. The entire green can be double cut, but this is not always necessary. Three or four cuts on either side of the cup could be adequate. Remember, the ball is most likely to deviate from its true path as it slows near the cup. This is all the more reason that the turf should be perfect near the hole, so that more putts will drop and golfers will applaud the greens staff.

There is one machine that helps speed up the greens without cutting the grass and is used by most golf course superintendents. As discussed earlier, the greens roller was first used on bowling greens in Australia and later adapted for more undulating golf greens. These fast-moving machines (Figure 1.5) can roll a green quickly and can appreciably increase the Stimpmeter readings (Figure 1.6). The greens rollers have been refined and



Figure 1.5 *Greens rollers are a great tool to even out putting surfaces and increase green speed.*



Figure 1.6 *The Stimpmeter is a tool that is used to measure green speed and helps golf course superintendents make sure all the greens on the course putt the same.*

are very user friendly. One crew member can roll a green quickly that will create a fast, smooth putting surface. After a rolling, the grass blades are still there, to breathe and keep the plant alive. The greens roller is a useful tool and can be used occasionally instead of cutting, or on a regular basis in addition to cutting. We know of superintendents double cutting and double rolling the greens daily for extended periods, but such practices are hazardous, particularly when both the temperature and the humidity are on the rise.

MEDIUM-SLOW GREENS

Amazingly, there are some golf clubs that don't want any part of fast greens. Such courses take pride in having slow greens. Using the United States Golf Association's (USGA) guidelines, a green that measures between 6 and 7 feet on the Stimpmeter is considered medium-slow. In terms of height of cut, this translates to 3⁄16 inch, or 4.76 mm.

The problem with slow greens is that they tend to develop thatch and grain. Superintendents who cut their greens at the 3⁄16-inch height should be vigilant about the potential formation of a heavy layer of mat or thatch. On such greens, the groomer attachments on the mowers should be used on a regular basis. Verticutting and topdressing frequently is important to prevent the buildup of thatch and encourage the grass to grow upright.

OVERSEEDED GREENS

Bermuda greens in the transition zone, south of the Mason-Dixon Line in the United States, experience a period of dormancy during the winter months. Golfers do not like to putt on brown grass, and turf managers respect their wishes by overseeding the greens with northern grasses such as rye grass, *Poa trivialis*, and bentgrass, or any combination of these three. During the overseeding period, grass is left to grow at a higher height of cut and greens are watered several times daily to promote seed establishment. Once the seed is actively growing, the height of cut is reduced to acceptable putting levels, but rarely low enough to satisfy all golfers. Overseeded greens have a reputation of being slow and inconsistent, but recent advances in plant breeding have resulted in superior species of grass for the purpose of overseeding. In addition, superintendents have become more adept at establishing and maintaining overseeded greens.

At the conclusion of the winter months the reverse transition from winter to summer grasses is encouraged by methods that favor Bermuda grass and are harmful to northern turf grasses. This involves reducing the height of cut, verticutting, and controlling nutrient intake.

TEMPORARY GREENS

There are times when the regular green cannot or should not be used. On such occasions, the ingenuity of the superintendent is called on to create a temporary green. If the temporary green is to be in use for only a few hours or perhaps even a day, it is simply a matter of moving the pin of the regular green and cutting a hole in the fairway. A sign explaining the reason for the temporary green is advisable, and the best place to put the sign is on the tee of the hole that is under repair.

Golfers will accept a temporary green far more readily if they know the reason. Another little trick that will put a smile on a golfer's face is to use a larger-than-normal cup on a temporary green:

1. Use an 8-inch hole auger for the initial cut.
2. Use a standard hole cutter to cut inside.
3. Place the cup inside the regular hole.
4. Place the flag inside the cup.

Even a square hole that can be made with the help of an Australian Turf Doctor, a handy turf repair tool invented by an Aussie greenkeeper, can be used to give an unusual twist to a temporary green.

When a temporary green is planned to be in use for an extended period, more care should be taken in its preparation – golfers deserve a decent

putting surface at all times. If possible prepare the temporary green several months in advance of its intended use. Select a level portion of the fairway and mark out the green with a paint gun. It is very important that even this temporary green be of sufficient size, as large as the space permits but at a minimum of 1,500 to 3,000 square feet. Double-cut the temporary green about ⅛ inch lower than the existing fairway. The new putting surface is then verticut in two different directions. In northern climates, the temporary green should also be seeded. In southern regions, a Bermuda turf will gradually adjust to the new cutting height. Fertilize moderately with a starter fertilizer and topdress heavily. For such a relatively small green, it is best to work the topdressing in with the backside of an aluminum rake or, better still, with a Levelawn. If there are old divot marks in the green, these should be repaired with a hole cutter or similar tool.

At this time, it is important that the green be soaked thoroughly. This can best be done with a hose attached to a roller-base sprinkler that is connected to a fairway outlet. Next, fence off the temporary green with stakes and ropes, and declare the area as "Ground Under Repair," or GUR for short. A sign placed on the green explaining to the golfers what you are trying to do is appreciated. The golfers will gladly take a free lift as long as they know its purpose.

Over the next six to eight weeks, institute a regular cutting regimen, lowering the height of cut gradually every week until the desired cutting height is reached. In the meantime, topdress and verticut at least two more times; also consider aerating at least once prior to opening up the green to golfers. Temporary greens have to be treated with loving care by the superintendent and greens staff. They should be inspected frequently to ensure their health and condition. If the reason for a temporary green is the rebuilding of an existing green, then a near-perfect putting surface on the temporary green is extremely important. There will be less pressure on the superintendent to open the new green prematurely if birdie putts are frequent on the temporary green.

Steps to Establish a Temporary Green

When a temporary green is necessary, the following steps should be taken to establish and maintain the green:

1. Select a suitable location that is reasonably flat and spacious.
2. Outline the green, rope it off, and declare it as GUR.
3. Double-cut the existing turf at a slightly lower height and remove clippings.
4. Double-aerate and then verticut the entire area.
5. Apply seed, starter fertilizer, and topdressing.

6. Keep the green moist by watering when necessary.
7. Gradually reduce the height of cut weekly.
8. Continue topdressing.
9. Fine-tune to putting green quality.
10. When the temporary green is in play, remind the players that it is in use so they are aware and can adjust their game or play.

DOUBLE GREENS

Ever since St. Andrews was established along the shores of the North Sea, double greens have been a part of golf. In North America, double greens are an occasional oddity that attracts attention but also presents potential injury liabilities. To prevent the danger of golfers hitting into each other, double greens tend to be of immense size. Double greens seem to take forever to cut. Although much of the grass is never used, double greens are visually spectacular and exciting to play. The perceived saving in maintenance is frequently not realized. Therefore, sometimes double greens are abandoned after just a few years and converted to separate greens.

SAND GREENS WITHOUT TURF

Years ago, sand greens without turf were quite prevalent. These greens were easy to maintain and cost effective. Now they are usually found in arid areas and extreme climate regions in the world where growing grass greens are just too difficult or too expensive. Until recently, sand greens were quite commonly found in the prairieland sections of the United States and the provinces of western Canada. There were even sand greens at some of the more exotic golf courses in the world, including the Royal Kathmandu Golf Course in Nepal, although many of these have since been converted to grass. The firm surface of a sand green is created by the addition of old engine oil or diesel fuel. When sand greens are used, local rule permits players to smooth the putting line to the hole by dragging a small mat over the intended line of play.

HIGH-SAND-CONTENT GREENS

The trend toward high-sand-content greens had its beginning in California, where it was believed that so-called dirty sand (containing small amounts of other soils, such as peat, clay, etc.) would make the ideal matrix for growing grass on putting greens. Dirty sand occurred naturally in many places and was an easy shortcut for the construction of golf greens. When

dirty sand was not available, superintendents used washed sand and added peat or similar organics to duplicate the dirty sand.

Initially, sand had been one of the three components of the ideal greens growing mix; it quickly became the major component, and in some cases, the only component of the growing medium. Sand has several advantages:

- It drains well and rarely becomes saturated.
- Sand is difficult to compact and needs little aeration.
- Sand greens hold golf shots, even when dry.

GREENS FOR HOMEOWNERS

Superintendents are often asked to build a putting green in someone's backyard. The temptation to accept the assignment can be flattering and often irresistible. Ardent and enthusiastic golfers have a way of making otherwise rational superintendents surrender to the homeowner's desires. We have constructed several backyard greens during our extensive greenkeeping careers, and the most successful ones are those that are located in the backyards of the golf superintendent's home. Greens are the pride of their owners, but rarely do they last beyond a few years. Over a period of time, the unkempt greens are usually inundated by an overabundance of *Poa annua* and other noxious weeds. They are frequently converted to flower beds, swimming pools, or outdoor living space around the home.

The Expense of Building a Backyard Putting Green

Obtaining cups and flagsticks is probably the least expensive and least important aspect of building a backyard putting green. Making sure that the maintenance work is done on a regular basis requires lots of time and funds:

1. When homeowners dream of a putting green for their backyards, they think in terms of one similar in size to their living room or master bed room, and that is just too small. The minimum size for a backyard green is 1,500 square feet. Twice as large would be better. Invariably, the existing soil needs to be modified, which means importing several truckloads of sand and topsoil.
2. Putting greens require a lot of sun, and most home yards are too heavily shaded, most often by trees that cannot be removed.
3. Keeping the green irrigated is a must. An automatic irrigation system is most desirable. It may be possible to modify an existing

sprinkler system, but undoubtedly several new irrigation heads, new pipe, and a new controller may be needed.

4. Although seeding the new green is initially less expensive than sodding, both methods require expertise and much can go wrong before a desired result is achieved.
5. Maintenance involves buying a new or used green mower and then cutting the green four to five times a week. Perhaps it is best to use a push-type mower for a small backyard green. Using such a mower would provide an opportunity for regular exercise. Maintenance also includes fertilizing, spraying with pesticides, and topdressing the green on a regular basis. Spraying for diseases should be postponed as long as possible.

Homeowners should analyze their reasons for wanting a backyard putting green. Some want to improve their putting and chipping skills, and others just want to live on a golf course. Most golf course superintendents discourage golfers from building backyard putting greens. In the case where a golfer has completely lost his or her senses and insists on proceeding, as a last resort, we advise our colleagues to inform them of the high maintenance costs, which include labor and chemicals, involved with a backyard putting green. Hopefully, this will bring the overenthusiastic golfer back to reality. Another option is now readily available and should be discussed with the homeowner – the installation of a synthetic or artificial putting green.

Artificial turf products have improved in quality. There are now many ready-made contoured greens completely made from artificial materials. Such greens are used as target greens on driving ranges and are ideally suited for backyard use. Like artificial Christmas trees, they have all the same advantages: they look just like the real thing, are much less expensive, and require very little upkeep.

SUMMARY

We must assume that the great majority of golfers will want to continue putting on grass greens and that these greens must be smooth and reasonably fast and consistent throughout the course. A superintendent's greatest accomplishment will be to provide such greens. In the process, the superintendent walks a fine line between ultimate success and utter failure in balancing the needs of the grass with those of the golfers.

Superintendents must remember that nearly 40 percent of all golf shots are played on and around the green. Therefore, to keep the golfers happy, the greens should be kept in as perfect condition as possible.