in varying models from one to 24 stations.

It is important to be far enough along in the design to know how many stations will be required before finalizing controller selection. Often, a single "clock" may be utilized; other times, multiple devices will be necessary. A large site, such as an athletic field complex or golf course, may lend itself to standardizing on a single type of controller, which is repeated at numerous locations around the site. If it's necessary or desirable to operate more than one valve on a station, select a clock that has this capability.

Another factor in determining the number of controllers is their desired location or locations. It is a good idea to have the controller fairly near to the valves, so trouble-shooting can be done quickly. Visual control is desirable, but not required. For example, there are times when controllers must be placed in secured locations, in lockable rooms or even in basement mechanical areas. All of these issues must be considered.

There are indoor-mount and outdoor-mount controllers available. For locations that will be sheltered (inside a room or separate enclosure away from rain and dust), there is no reason to employ expensive weather-stripped metal cabinetry. Indoor-mount controllers are made for this purpose.

Wall-mount and pedestal-mount controller cabinets are available. The least expensive method is usually to mount the controller on a nearby wall. Where no wall is to be found (or where required by regulation), a pedestal is placed under the controller as a base for mounting on a concrete pad. Pedestals today are manufactured from steel, stainless steel, and even high-impact plastic.

It is essential to know what types of irrigation will be running on the controller. The irrigation designer should have determined, in a park for example, whether there is turf that will be watered by turf sprays, flower bed areas that will receive shrub sprays, or trees and shrubs that will be irrigated using bubblers or drip irrigation. All of these require different sequencing and durations, and determine the number of "programs" necessary on the controller. If there is only turf, a simple, single-program clock is all that's needed. If all the functions listed previously are needed, it will require a four-program controller to properly segregate the irrigation needs. There are also controllers that have either two or three programs available.

Turf sprays need to run every day (or at least every other day) in summer, while trees and shrub irrigation operates only two to three times per week. Bubblers for annuals must run more frequently than for shrubs, and for shorter cycles. Also, drip irrigation cycles require hours of operation; it is essential that the designer select a controller that has the capability of long timing in a drip situation. The number of start times per day available is also a factor, since germination of seed for turf requires several starts to keep the seed moist.

Certain designs may require specialized functions such as pump-start or master valve capabilities. When low water pressure is available and a booster pump is necessary, a pump-start circuit and wiring and will allow a pump to energize whenever the controller starts its cycle. A master valve is usually used in the same way with the same circuit, allowing any individual station to operate only if the master valve

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Controllers

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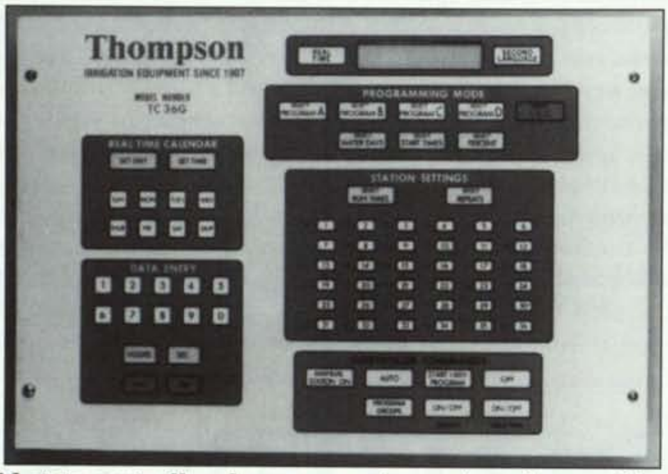

Solid-state controllers have no moving parts and cannot "wear out". Photo courtesy: Thompson Irrigation Equipment.

is energized. This concept is used in cold climates, and in certain instances with water-sensing controllers.

Holding the Power

All clocks require some type of power. While the most commonly used source is 120-volt electricity, there are controllers that operate on solar or battery power. These are available for use where no electric power exists or isn't planned. There are companies that manufacture solar panels that will operate any controller, and are reliable but still somewhat expensive.

In countries where 240-volt is prevalent, controllers that operate on 240-volt power are available. Where the power source is from a 220- or 440-volt power drop, transformers must be used if 120-volt is desired. This 240/120-volt conversion is usually specified by the electrical engineer, but the designer must be aware of the need. If part of a pump station, be sure the pump specification lists a stepdown transformer for power to the controllers

The most important safeguards for the control system, which are often forgotten, are lightning/surge protection and grounding. The irrigation designer must specify this equipment and can't assume the manufacturer or contractor will provide it. Most often, surge protection is an option, and in today's bidding wars can get bumped out of the price. Solid-state controllers are sensitive to power variations and lightning, and it can't be overemphasized how important it is to provide protection on the 120-volt side. Many high-end controllers contain this as standard equipment, and some even include protection on the 24-volt side.

Grounding is essential to dissipate extreme power surges such as lightning strikes to keep the controller from being damaged. Copper-clad rods (5/8 inch by 8 feet), driven into the ground and connected to the controller using bare copper wire, are the most common way of providing this protection. Ground resistance must be conducive to distributing the charge (10 ohms or less). One other way is to use a length of bare copper wire (about 100 to 200 feet) trenched into the turf, rather than using a rod.

Options to Consider

Water and time management have been considered in the development of several optional features in various controllers, and these may be helpful. Water management can be made easy with the adaptation of the "water budgeting" feature. Sometimes known as the "percent," this feature allows the user to increase or decrease a station, or the whole clock, in small or large percentages. Some controllers also allow for skipping a certain number of days between waterings. This is helpful since most controllers are either seven-, 14-, or 16-day cycles that repeat.

It's important to know that most high-end controllers include a built-in, fail-safe program that, if the power goes out and wipes out programmed information, operates a nominal time on each station. Some even have a non-volatile memory so they don't "forget." Clocks with fewer features may be reprogrammed in this condition. Electromechanical controllers just stop running for the duration of the power outage, and then resume when power is restored. They are behind by the length of the delay, so are not accurate on start times.

Some controllers today are capable of monitoring or being overridden by remote sensors. Moisture sensors, rain gauges, pressure switches and the like may be used in irrigation systems with certain controllers to attain the ultimate in efficiency and water conservation. Some of these controllers are computers in themselves, while others are satellites to more centralized master computers.

Sometimes the communication between the master central and the satellites is by telephone modem. It's also possible to control the satellites by the use of radio signals. Usually restricted to large, open areas where these signals aren't interrupted by mountains or buildings, this technology is most common today in the use of hand-held remote devices. These units can be used by maintenance personnel to energize individual valves from the field, without physical access to the controller.

Plan Prudently

Obviously, there are many choices involved in selecting irrigation controllers. In our experience, the irrigation designer must employ exact controller descriptions on the plans (legend), on the details, and in written specifications to wind up with what is desired. Generic or incomplete specifications may allow the contractor to supply something other than what is required for optimum efficiency and effectiveness.

Once a controller is selected, go to the catalog to be sure of the precise model number you want (or performance specification if required). Be sure to include all options in the description. If you have spent the time necessary to carefully tailor the controller to the needs of the system, it will be a tool that will help effectively manage water use for many years to come. ❑

Editor's Note: Gaylon Coates is the principal of Coates Irrigation Consultants, Inc., based in Scottsdale, AZ.

Central Control Pays Off in Milwaukee

By David Mellor

The late Harry Gill's dream, an automatic irrigation system, was installed at County Stadium — home of the Milwaukee Brewers — in Milwaukee, WI, in the fall of 1987. Before that, the field was irrigated with a network of quick couplers, impact sprinklers, water wheels, traveling tractor sprinklers, and hand-held hoses. A crew member frequently kept an all-night vigil, moving sprinklers every 20 to 30 minutes in an attempt to achieve consistent moisture across the field. A delay at one watering interval, or an interval cut short, resulted in uneven moisture levels that were revealed only as the turf showed signs of stress.

After years of troubleshooting the hard way and studying the reactions of the turf at County Stadium through all seasons and under a wide variety of conditions, Gill knew what he wanted an irrigation system to accomplish. He helped secure funds for the system installation. Then he teamed up with an irrigation system representative and Gary Vandenburg, current director of grounds. Together they came up with the irrigation system used today.

System Layout

The 2.6-acre site is watered by 57 Toro 640 heads operating from five separate stations. No station contains more than 12 heads. There are 22 heads on the warning track, 31 heads on the turf, and four heads for the infield skinned area. Heads are placed approximately 60 feet apart within triangular patterns for optimum coverage overlap. The spray pattern (180 degrees, 360 degrees), range (or "throw"), and arc of the heads vary to conform to the lines, curves, and angles of the field.

Each station is represented by a letter — A, B, C, D, and E. Each head is identified by an individual number within that station, such as A-1, D-6, and so on. In the grounds office, a display board shows the outline of the field, and the placement of each head is marked by LED lights. Whenever the head is used, the light indicating that head is lit. Personnel can tell at a glance, from inside the office, when a head is activated.

Before the automatic system was installed, just moving the sprinklers to cover the field took the entire night.

The irrigation system can be programmed up to 14 days in advance to set up the irrigation cycle, either manually by "pushing buttons" or through the grounds department's personal computer. Watering will then automatically begin when and where it's wanted for the intended duration. The Toro VT-3 Satellite (no longer manufactured by the company) contains two different set programs, which can be altered to fit conditions, such as moving the watering cycle ahead by 30 minutes when humid conditions slow turf surface dry-down.

The system is supported by 100 pounds of pressure per square inch. That's enough to operate the full range of heads and get consistent throws throughout the field.

Each head can be set individually from one minute to several hours. This gives the flexibility to adjust irrigation patterns to fit specific turf needs. For example, left field receives more sunlight than right field, which is shaded by the stands. To compensate for this, we can run the heads in left field for 25 minutes, and the heads in right field for 10 minutes.

Staying Flexible

Even the most efficient irrigation system can't compensate entirely for the alteration of spray patterns caused by winds swirling through the stadium. Because the winds are not a consistent force, and the system is designed for optimum coverage during "normal" conditions, the field has occasional isolated dry spots and edges that still must be watered by hand. When the team is in town, the infield grass is watered by hand to avoid any change to the baseline. The infield skinned area is watered by hand to achieve the precise effect the coaches and players want.

Because a sprinkler head could be activated unintentionally by a power surge or other problem in the system, more circuit breakers than required were added. Prior to games, we turn off the valve and supply and drain the rest of the system by quick coupler to prevent game interruption. An irrigation box is outside the left field gate, close enough to reach quickly if needed.

Added Benefits

There's a vast difference in field care with a central, automatic irrigation system than with a manual one. With the automatic system, we gained more complete control of our maintenance program. We're able to schedule watering on weekends, early in the morning, or whenever it will be best for the turf, rather than when the grounds crew can get the job done. Before the automatic system was installed, just moving the sprinklers to cover the field took the entire night. Now, we usually irrigate from 4 a.m. to 7 a.m. This timing reduces the water loss through evaporation we experienced with watering later in the day and cuts down on disease problems we had to contend with when the turf stayed wet during the night. Because it's no longer necessary

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Central Control
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for someone to physically set sprinklers or to be on hand to monitor the system during watering intervals, those valued labor hours can be used on other projects.

With the central control system, we can use irrigation to prevent problems. We use short watering intervals to knock the frost off the grass in the late fall, or the dew from the grass in the early spring. We can wash away the sugar-like substance the grass excretes from the cut end of the blade after mowing, which helps prevent disease problems. We can syringe the turf on a hot day, moving a short spray of water from station to station across the system to cool the grass and prevent heat stress.

Controlled irrigation give us more flexibility. We can adapt watering to increase the benefits of our fertilization and seeding programs. We can set up additional deep watering periods to counteract drought. We can supply 1/4- to 1/2-inch of water exactly where it's need to water in chemical applications.

The central system saves time and labor and enables us to use water more efficiently. It's money well spent. The field is safer and more playable because the grass is healthier and compaction isn't as great.

It's important to learn everything you can about any in-house irrigation system before it's installed. You'll want to be an "in-house" plumber who is able to work with solenoids and basic repair of heads, piping, and connecting hardware if necessary.

Gary Vandenburg and I do the troubleshooting on our system, and have had few problems. Sometimes, there will be grit in the collar of the heads that border the warning track. This grit must be removed to allow the head to function freely. A visual check of the heads will reveal any minor problems. If the throw from a head is erratic, the pattern inconsistent, or the arc improper, there could be a problem with the head itself or an obstruction that prevents it from retracting correctly.

In northern regions, it's important to winterize the system properly and early enough in the season to avoid damage. Use a compressor — rent one if necessary — to ensure the water is completely blown out of the system. Even a small amount of water can cause extensive damage during the freeze-and-thaw cycles of winter.

Irrigation technology is constantly changing and improving. It's even easier now to get excellent control of field water needs. Compare options and costs to current and projected field use when making sprinkler system decisions. Take into account the characteristics of your soil, turf, and weather conditions, as well as your budget and labor resources.

Central, automatic irrigation systems aren't the answer to every problem. However, they can be a vital, cost-effective tool in a high-quality turf management program. ❑

Editor's Note: David Mellor is assistant director of grounds at Milwaukee Brewers' County Stadium. He holds a bachelor's degree in agriculture from Ohio State University, and serves as professional team director on the board of the Midwest Chapter of the Sports Turf Managers Association, and on the two-year advisory board of Michigan State University's turfgrass program. He has teamed with George Toma in sports turf presentations across the U.S.

Choosing Traffic-Tolerant Turfgrass Varieties

Brinkman Machine used to evaluate wear tolerance of turfgrasses at University California Riverside. Photo courtesy: Stephen Cockerham.

By Roch E. Gaussoin

Outdoor recreation is one of America's favorite pastimes. Whether it is something as active as intramural or recreational soccer, baseball, softball and football leagues, or simply a walk in the park, there are many times when you need turfgrasses that can tolerate intense foot and mechanical traffic. Turf managers are challenged with selecting turfgrass species and cultivars that can tolerate the day-to-day abuse of an active American public.

Before you can make a specific selection of a turfgrass cultivar species to use in a site prone to traffic, you must understand some basic principles about what makes a grass more or less susceptible to the problems associated with heavy traffic.

The first criteria in selecting a turfgrass for a heavily trafficked site is its ability to withstand the wear or abrasion exhibited by sports cleats, foot traffic, and other mechanical traffic devices. Turfgrass species differ greatly in their ability to withstand the abrasion of traffic.

In general, the warm-season grasses, such as buffalograss, bermudagrass and zoysiagrass, are more wear-tolerant or wear-resistant than the cool-season grasses. Grasses that tolerate wear or have a high degree of wearability normally have tougher leaves and, in general, the leaf blade is wider than those grasses that are ranked or classed as being less wear-tolerant.

A second criteria in selecting a turfgrass with a high degree of traffic tolerance is its recuperative potential. Recuperative potential is the ability of the grass to recover and fill in voids and gaps traffic and other stresses leave. In general, grasses with rhizomes and/or stolons have a greater recuperative potential than grasses that spread by tillering, such as bunch grasses. The recuperative potential of Kentucky bluegrass, which possesses rhizomes, is much greater than that of perennial ryegrass, which spreads by tillering.

The generalization that warm-season grasses are more wear-tolerant than cool-season grasses does not hold true for recuperative potential. Bermudagrass and buffalograss are very aggressive and have the ability to spread rapidly into voids and gaps left by traffic damage. However, zoysiagrass is not very aggressive and its extension or growth into damaged areas is hampered by this slow growth potential. Even though zoysiagrass possesses both rhizomes and stolons, its slow growth rate limits its recuperative potential.

Many grasses that have a high degree of wearability do not have a high recuperative potential. It is not uncommon for grasses with a high wearability to be blended with those grasses with a high recuperative potential to get the best characteristics of both species. For example, blending ryegrass, which has excellent wearability, with the recuperative potential of Kentucky bluegrass is a very effective means of seeding sports fields and golf course fairways in the northern half of the United States.

Another approach is to use a grass, such as tall fescue, which has a high degree of wearability, and aggressively overseed on an annual or semi-annual basis those areas that are most prone to stand loss.

For example, many soccer fields and recreational installations in the transition zone of the United States use tall fescue. Tall fescue provides an excellent playing surface and is well-adapted to the northern U.S. The problem arises in front of the goal boxes and along sidelines where players congregate and stand, causing turf thinning and loss. By aggressively overseeding these areas in the off part of the season, recovery or recuperative potential is hastened by the new seedlings. Both the blending approach and the overseeding approach have proven to be effective.

Species Selection

Many times, geographic location will dictate your species selection. As a turf manager, you are faced with the decision within a species as to the cultivar that is most appropriate for high-traffic situations. In recent years, turfgrass plant breeders have aggressively developed new cultivars that are adaptable to specific situations.

Selecting a cultivar often can be confusing because of the number that are available and the attributes of each cultivar. The National Turfgrass Evaluation Program (NTEP) is designed to evaluate the suitability and appropriateness of these numerous cultivars within and across geographic regions in the United States. Briefly, this program is sponsored by the NTEP and companies wishing to have cultivars or

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Traffic-Tolerant Turf

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experimental lines evaluated submit seed and a small fee to have these products evaluated in the National Trials.

National turfgrass evaluation programs exist for most species of turfgrasses grown in the U.S. The majority of these evaluations include color and quality ratings, and in some instances, there will be multiple fertilizer and/or mowing heights imposed on the different cultivars. Unfortunately, extensive evaluation region-to-region on traffic tolerance is limited. Excellent programs exist at some institutions for evaluation of traffic tolerance of various cultivars. The University of California at Riverside has an excellent program that is currently evaluating many of the new cultivars for traffic tolerance. Other universities are also evaluating traffic tolerance.

When looking for a traffic-tolerant turfgrass cultivar, you have two options. First, consult with a local seed distributor. Second, obtain a copy of the NTEP reports and make assumptions about the information in these reports and their applicability in a high-traffic situation. Depending upon location, many of the evaluation sites will evaluate not only for quality and color, but also for other attributes that are of interest to people looking for traffic-tolerant turfgrasses. These attributes include rate of spread and establishment rate.

A grass with a high rate of spread would have a high recuperative potential and might be desirable in a given traffic situation. Cultivars that have a quick establishment time also may be applicable where overseeding is anticipated. Use this information to try to ascertain its applicability for the site you will be seeding.

Copies of NTEP reports or other cultivar evaluations are normally available from your state extension turfgrass specialist or from some county extension offices. If there is no such program in your state, check with neighboring states for available information. Pay attention to regional publications and newsletters.

Be active in your local professional organizations. Ask others who have evaluated or used different cultivars in your particular region what their impressions were of the turfgrass cultivars. Use the other experts in your region to critically evaluate grasses for traffic tolerance.

Cultural Modifications

Beyond selecting an appropriate turfgrass species and cultivar, there are other cultural modifications that you can do to improve the persistence of grasses in hostile, trafficked environments. Turfgrass grown under optimum conditions will be better able to withstand not only traffic stresses, but other stresses as well. This will ultimately result in good stand persistence and high quality.

The following are some cultural practices to examine.

Irrigation. Proper irrigation timing and frequency can facilitate the growth and subsequent traffic tolerance of many turfgrasses. Grasses that are shallow-rooted will not be able to withstand the wear and tear of sports cleats as well as turf that is deeply rooted and knitted. The proliferation of roots to deep depths within the limits of a species is hastened by proper irrigation and management.

Make sure to irrigate so that surface runoff does not occur and that percolation into the subsoil is adequate. The interval between irrigations often is dictated by the use of the particular facility. Modify the irrigation schedule to promote root production, which can greatly enhance the ability of the turfgrass to withstand stress conditions.

Fertility. Fertility also plays a key role in traffic tolerance. Grasses that are adequately fertilized have a greater potential to recuperate and spread into voids and/or damaged areas. Conversely, grasses that have a high degree of wearability that are overfertilized often exhibit lush, succulent growth from high nitrogen fertilization. This causes them to lose some of this wear potential, resulting in stand loss.

A balanced fertilization program is critical for traffic-tolerant turfgrasses. Potassium and phosphorus are also critical for traffic tolerance in turfgrasses. Work by Dr. Bob Shearman at the University of Nebraska has shown that high levels of potassium greatly enhance turfgrass' ability to withstand wear and traffic. Dr. Shearman's work shows that, although soils may not appear to be limited in potassium based on soil tests, the addition of potassium in excess of that dictated by soil tests resulted in grasses that were better able to withstand wear and tear. Consider an increase in your potassium fertilization program to enhance the wearability and stress tolerance of your turfgrass.

The condition of the soil is also critical to acceptable traffic-tolerant turfgrasses. An aggressive aerification program, including core aerification and soil modification with top dressing, can greatly facilitate turfgrass traffic tolerance. When the soil is compacted, roots are restricted. When roots are restricted, traffic tolerance also is restricted.

As was evident with adequate fertilization and irrigation, promoting deeper rooting helps the turf withstand traffic stresses. Unfortunately, the optimal time to cultivate or aerify most grasses coincides with peak playtime for most field sports. Scheduling these operations can be a turf manager's nightmare, but it is still critical to find an opportune window to aerify sports turf and highly trafficked sites to enhance their ability to withstand this stress.

The final step is managing traffic. Traffic control is the attempt to minimize the high degree of traffic, either vehicular or foot traffic, in recreational areas. If possible, use portable soccer goal nets or other field accessories that you can move to allow areas under heavy traffic to recuperate. For more permanent fields, this approach is obviously not appropriate. However, try to limit the amount of time spent on the field exclusive to game and/or peak recreation time. Work with your local park board or recreational department to facilitate field rotation and/or saving one or more field for use only for key events.

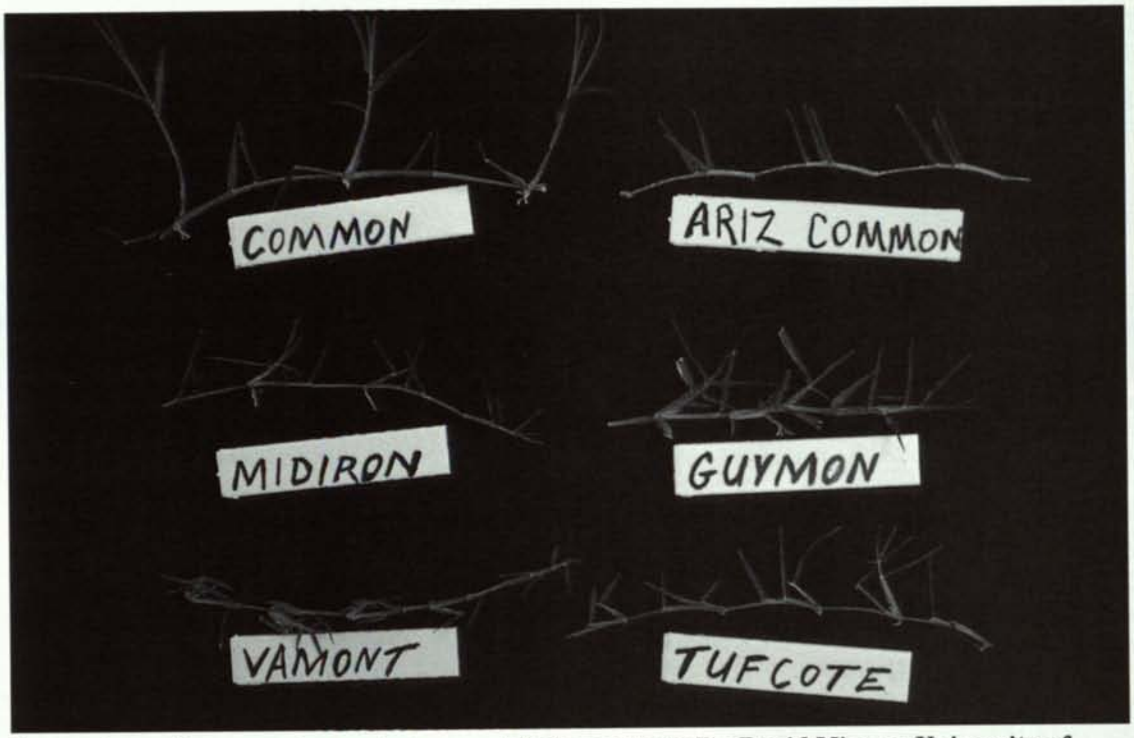
In park areas or recreational sites, individuals walking to and from events or using the park facilities will create footpaths. If these paths are recurrent from year to year, consider designating these as permanent paths and applying either a permanent covering, such as asphalt or concrete. If your budget is limited, a mulch path will work. Paths encourage people to walk in designated areas instead of across the turf.

If paths are not possible, consider using portable barriers that will route the traffic throughout the turfgrass area, dissipate the injury and allow for adequate recovery time in peak use areas.

The use of turfgrass in heavy traffic areas is a challenge. Selecting a traffic-tolerant turfgrass is just the first step. After the selection, you need to consider the existing management practices and establish methods to control traffic and maintain turfgrass health to retain both the aesthetics and useability of the site. ❑

Roch E. Gaussoin is an extension turfgrass specialist with the University of Nebraska, Lincoln, NE.

Curing the Bermudagrass Blues



Comparison of common bermudagrasses. Photo courtesy: Dr. David Minner, University of Missouri, Columbia, MO.

By Bob Milano

Bermudagrasses, particularly the hybrids, have proven valuable for turf managers in the sunbelt and even in some portions of the transition zone. But to many of us in the transition zone and farther north, bermudagrass is a troublesome weed in our cool-season turfs, such as Kentucky bluegrass, perennial ryegrass, and turf-type tall fescue.

Unwanted common bermuda can turn a smooth, uniform athletic field into an ugly, dot-to-dot matrix as it slowly turns brown and begins dormancy in the fall. In local parks, this may not be a major concern. But for high-use cool-season fields such as those for football, baseball, soccer and rugby, unsightly brown patches are not acceptable.

All the reasons that make bermudagrass the ideal turf for the sunbelt make it difficult to control when unwanted. It's an invasive perennial, tolerant of drought, and reproduces both vegetatively and by seed. Current control methods, which include mechanical removal, cultural practices, and non-selective herbicides have had limited success. Testing of a new selective herbicide is showing some promise.

Mechanical Control

The first control method, physical removal of invading bermudagrass plants, usually isn't the most practical choice. Physical removal can be extremely tedious, as ideally each stolon and rhizome needs to be identified and eliminated. In addition to complete removal of the above-ground portion of the bermudagrass, all below-ground segments need to be removed to keep the plant from generating new growth. This might require removing the soil to depths of 18 inches or more to ensure all below-ground bermudagrass parts are eliminated.

This approach is time-consuming, labor-intensive, and inefficient. Occasionally, it may be the preferred method for very small areas, such as patches in a baseball infield that will undergo renovation. Combined with immediate resodding, mechanical removal can be a quick and effective approach for certain highly-visible, key areas.

Non-Selective Herbicides

A second approach to post-emergence bermudagrass control is spot application of a non-selective herbicide such as glyphosate. This can be effective, particularly if a large block of time is available for eradication and subsequent repair activities.

If the facility schedule permits, non-selective herbicide applications should be made in late summer or early fall, while the bermuda is still actively growing. Once the bermudagrass has been killed, the areas can be either seeded or sodded immediately.

Eradicating the bermudagrass in early fall will not provide a long enough period of warm temperatures for it to reestablish into the repaired areas. The early fall window also offers an ideal time to reestablish cool-season turfs. By utilizing these two critical cultural facts, your success will be high.

Maintenance Practices

The third element to controlling bermudagrass, as well as other warm-season grasses, is the cultural

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