Accurate Records Imperative

The first step in your maintenance program is to keep accurate and detailed records of each car's use. This enables you to monitor expenses aimed at extending service life and identify the nominal costs associated with good upkeep and its relationship to fleet longevity.

Maintenance charts should divide vehicle operational costs into two categories:

Operations—labor, fuel, and parts associated with operations.

Maintenance—labor and parts that contribute to vehicle longevity and long-term performance, including tire rotation, filter replacements, engine valve adjustments, and more.

In terms of general maintenance, both gas and electric cars should be rotated equally. Avoid the "last car in, first car out" trap, which unevenly distributes car work load. Well-designed storage facilities use a unidirectional flow of the cars, making rotation relatively simple. In addition, you may find it helpful to number each car and utilize schedule charts to document use and maintenance.

Other procedures include checking brake operation and pedal play, checking park brakes, and inspecting tires for pressure and uneven wear. Clean the cars regularly, since well-maintained vehicles encourage golfers to treat them more carefully. Also, clean battery terminals and inspect electrical wires for damage on a weekly basis.

Electric Car Maintenance Principles

Because electric cars have fewer parts, their maintenance is easier than that of gas cars. Several procedures can extend an electric car's service life and enhance its reliability. The service life of the battery pack will be significantly affected by how well your car personnel perform the maintenance required for maximum battery life. The following steps are vital.

- To ease batteries into service, break them in by running the cars a maximum of 18 holes between charges during a new car's initial break-in period. This period lasts for at least the first five cycles of the batteries, or about one week. The idea is to avoid deep discharges during the break-in period.
- Check water levels in electric car batteries at least once a week. Use only distilled, purified water since chemical contaminants and water hardness will "poison" battery fluid. Add water to fully charged batteries only.
- Measure and record the specific gravity of electrolyte in each cell periodically with a hydrometer or boost charge every three months. Recharge the battery when it reaches 1.220.
- To test the batteries, connect a 36-volt load tester to the battery set, discharge batteries at 75 amps and record the time that elapses until the terminal voltage reads 31.5 volts. If batteries run less than 40 minutes, they have either reached the end of their lives or a defective battery is in the circuit.
- Inspect batteries for corrosion, loose connectors, and broken or frayed cables. Wipe away any corrosion, dirt, or rust with a wire brush. Remove debris from the battery top with a cloth moistened with baking soda and water. The removal of corrosion is important since its presence can create a high-resistance coating, which can contribute to batteries overheating and possibly melting the lead connection.
- Check charger plugs and receptacles for damage daily, and inspect battery terminals weekly, washing and removing all corrosion with baking soda or another suitable substance.
- Use battery carriers that do not place undue strain on battery terminals. A recommended carrier for plastic-cased batteries is a clamp-type with rubber pads, which grip the side wall just below the lip of the cover. Gripping the flexible end walls of the battery's plastic container can cause electrolyte to spew from the cells. Never lift batteries by the terminals, since this can break the post sealant, potentially causing acid to leak.

Incidentally, safety dictates storing electric cars indoors or in some kind of covered facility. The storage space must be well-ventilated to release hydrogen gas, a natural by-product of battery charging.

By establishing regular intervals for in-depth gas car service, preventive maintenance will increase the chances of maximum uptime and contribute to vehicle longevity.

Gas Car Care

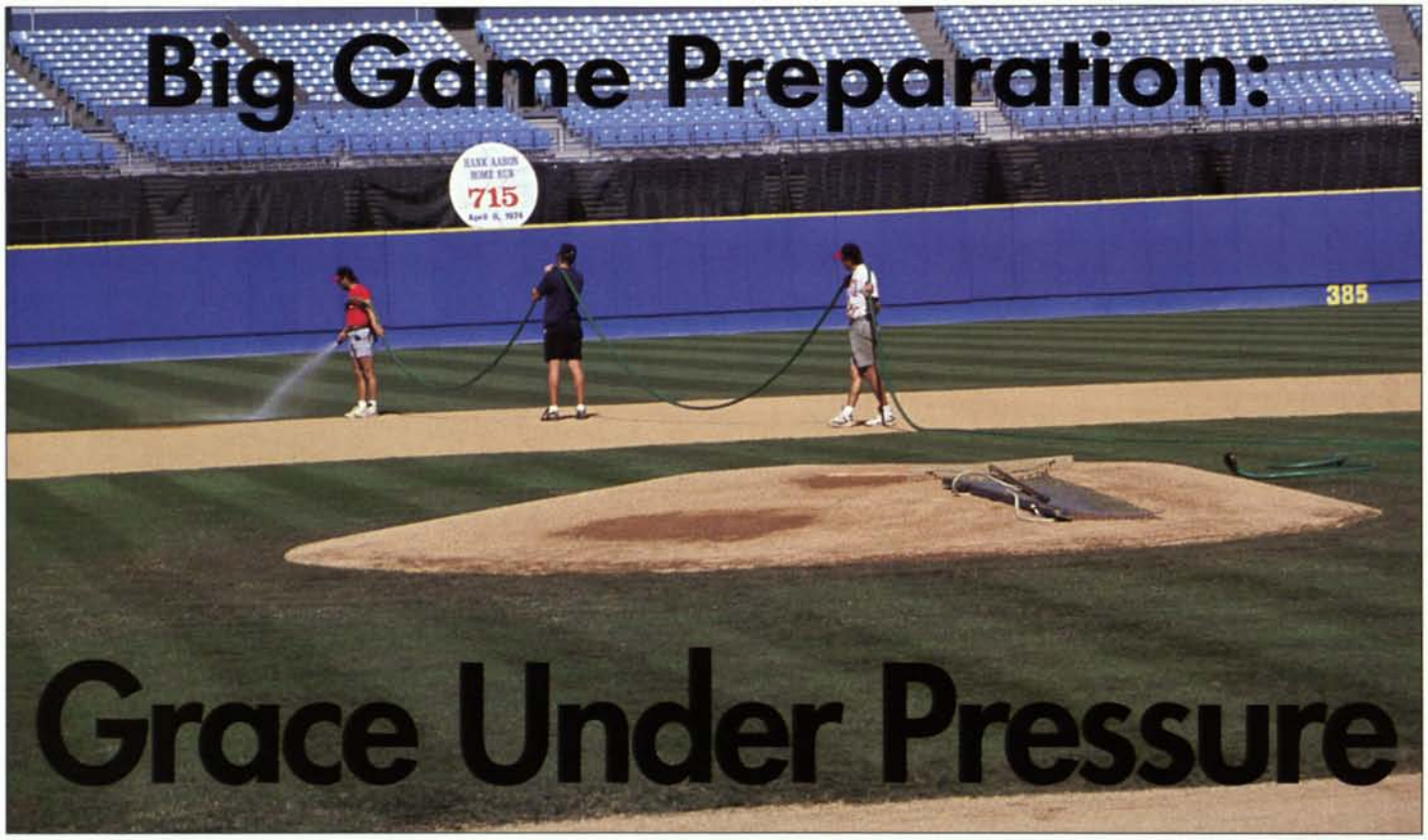
For gasoline engines, items like gas, oil, spark plugs, filters, and more must be added or replaced consistently. By establishing regular intervals for in-depth gas car service, preventive maintenance will increase the chances of maximum uptime and contribute to vehicle longevity. The manufacturer's reputation for reliability is also an important factor to consider when examining vehicle reliability and should be reviewed carefully prior to purchase. Adhering to the following procedures will maximize gas car life and operational efficiency—both of which have significant economic advantages.

- Change air filters and oil regularly (at least once a year, more often with frequent use and dusty conditions).
- If a car isn't being used regularly, keep the fuel tank full to prevent stale gas and condensation.
- Rinse torque converter with water weekly. Inspect exhaust system for leaks.
- Check oil level at least once a month, adding when necessary.
- Inspect fuel lines for leaks.

Keeping your golf car fleet running at its best ensures maximum revenue-generating performance. All these aforementioned procedures should be performed—and performed regularly—in addition to regular servicing by your dealer. With a little care, your fleet can go a long way toward increasing course revenues and customer satisfaction, while providing you with the highest value at trade-in time. ❑

Editor's note: Joe Stahl is the vice president of Yamaha Golf Cars, 1000 Highway 34 West, Newnan, GA 30265-1320, (800) 852-6544.

Big Game Preparation:



Grace Under Pressure

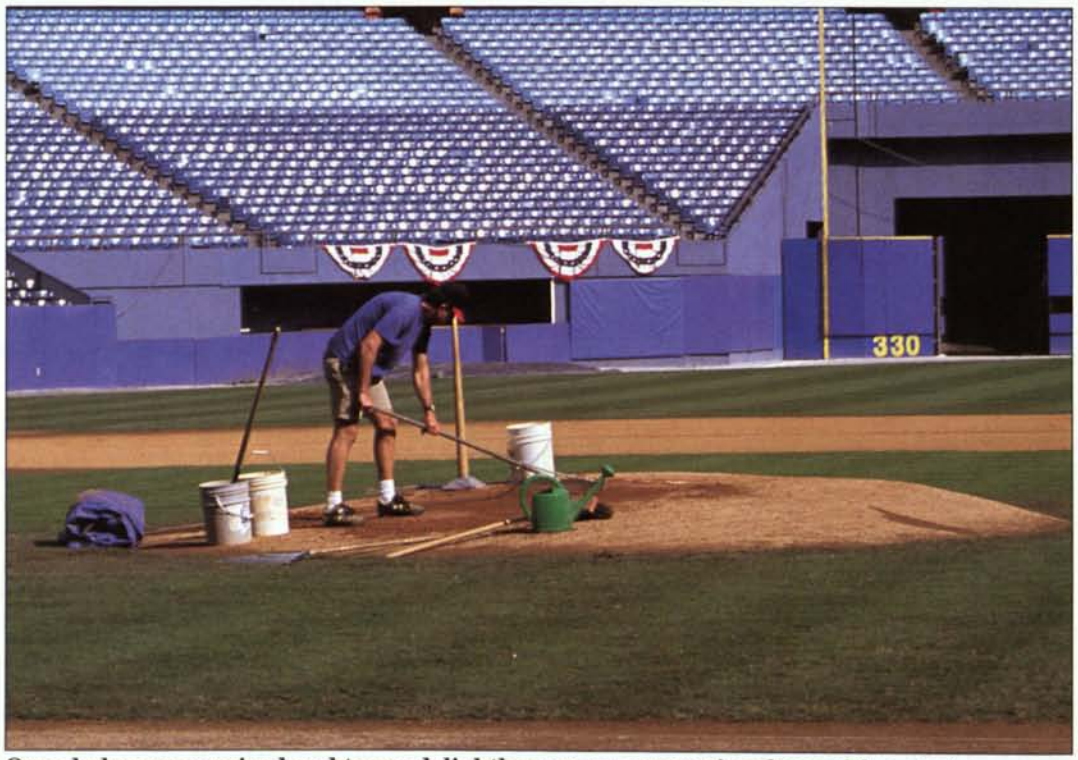
In warm weather conditions it may be necessary to prepare half of a diamond's skinned area at a time, adding more water as required. All photos of Atlanta-Fulton County Stadium, courtesy Aimcor.

By Ed Mangan

The Atlanta Braves have seen much success in the last two seasons, making it to the World Series both years. With that success comes pressure—on the players, the coaches, and even the grounds crew. The field conditions must be perfect to provide safe and consistent playing surfaces for the athletes. The field must also be aesthetically pleasing to thousands of fans in the stands, as well as millions of television viewers.

The pressure of preparation for a World Series game is intense. However, what may surprise you is that the job essentially remains the same. For the grounds crew, every game is "big." Home field advantage means more than having the fans on your side—it means knowing that for every practice and game the field will be in the fine condition the players have come to expect.

Meeting these expectations requires tremendous consistency, which can only be accomplished through a strict routine. At Atlanta-Fulton County Stadium, this routine begins after the previous game, in the early morning hours, when as many as 15 crew members hit the field.



Once holes are repaired and tamped, lightly go over your entire slope with a steel or aluminum landscape rake and repair and smooth any remaining areas that are not level.

Critical Areas

The first step is uncovering the pitcher's mound, bull pen mounds, and home

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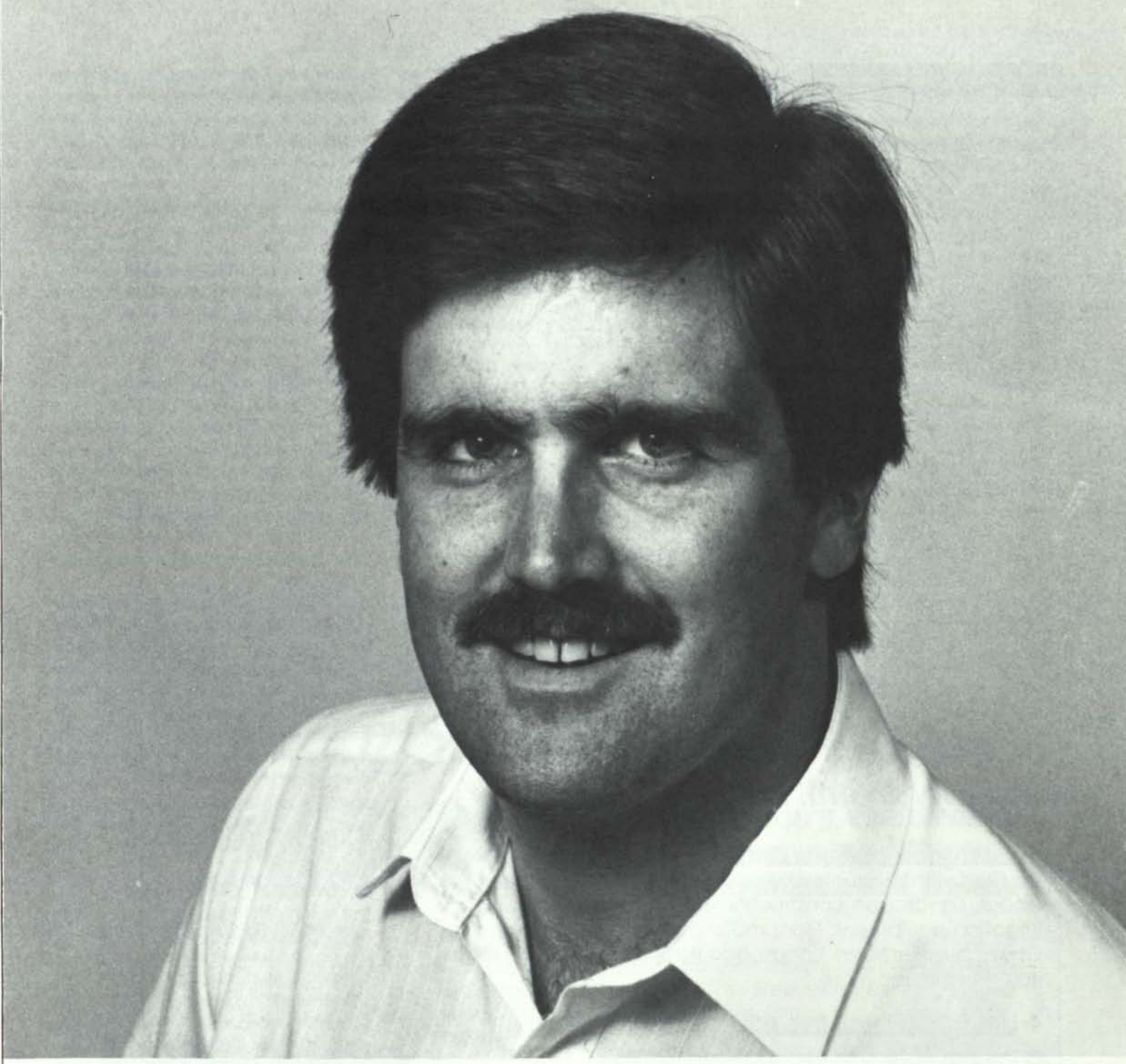

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BIG GAME PREPARATION
continued from page 12

plate, which are always covered after a game. It's vital to keep these areas covered when they're not in use. Covers prevent moisture from evaporating from the clay, as well as protecting it from heavy downpours. Moisture is critical when working with clay. Too much and you don't play—not enough and you must play cautiously in anticipation of that bad hop or loss of footing.

Setting up your mounds and plates should not be a time-consuming or strenuous task. If it is, then you're are not maintaining them properly. It takes just a few minutes after each game to repair any holes, apply the proper amount of moisture to the mounds, and then *cover* them. These few minutes will save you hours in the long run.

For repairing holes, it is essential to clean your entire slopes of all game debris, which includes grass, chewing gum, tobacco, sunflower seed shells, and even conditioners and drying agents you may use. These materials can dry and contaminate the clay on the mound surface or plate area. Once this clay is contaminated or dried out, it is unable to bond properly with the base clay, which can prevent firm footing and stability. That means debris must be removed, which can be accomplished by sweeping down your entire slope with a broom so you're left with a good, clean working area.

Next, evaluate your area to determine just what you need. If you need to regrade your slope, do it now. Do not try to repair holes first and then come back to make the slope fit your repairs. Remember that when grading your slope, for every one foot you travel, your elevation must drop one inch.

Once your area is swept clean, you should apply enough water to promote the binding of your clay, but not enough to make it muddy. With the clay moist, use a spade to chop into the existing holes. This chopping is what will give new packing clay the cracks and crevices to bind with the old clay making up the base. Be sure to chop or scarify the entire hole, including the sides and edges. If this isn't done, the clay packed into the hole will not bind with the old clay and can be kicked out.

If holes are more than a few inches deep, don't try to add all the clay at once. It will pack better if you add approximately one to two inches of clay. This must be followed, of course, by firm tamping.

When your holes are repaired and you're through tamping them, lightly go over your entire slope with a steel or aluminum landscape rake and repair any remaining areas that are not level. This will eliminate any unevenness left by your tamp. Now, with your hand drags, smooth off the finished product. Once again, before you move on, check the moisture of the clay. Pay particular attention to your plateau and the areas behind it.

The steps used to repair your mound are the same you will use for the plate area, minus the slope of course. Again, moisten the plate area well. Moisture is equally critical in the homeplate area and covers go a long way to controlling this moisture.

Skinned Areas

Preparing the skinned areas follows the same basic principles. First, get the proper moisture so the clay is workable. The infield must be moist, but not saturated. Begin with your nail board or

nail drag to get the good underlying clay to mix with the worn surface clay. The best results are achieved when you nail drag twice in opposite directions. If you are doing this on a hot, sunny day, the clay may dry out too quickly. You may have to prepare half of your skinned area at one time, adding more water as required.

Moisten the entire dragged area until the water has penetrated the clay. The wetted area must be slightly dry before floating. The area is ready for floating when the surface hazes over like the wax on your car. You want the top dry, but not the bottom. This will give you a loose, workable top surface, yet a moist sub-surface that will bind back together for firmness and stability.

After the top has hazed, float or level the entire skinned area with the back side of your nail board or some other leveling device. This will give you the opportunity to shave off high spots and fill low ones. Pay close attention to the edges where the turf meets the clay—the transitions should be as small as possible.

Once you've finished floating, you're "ready to roll." Yes, *roll*. This will get the subsurface to bind with the surface for a firm, yet soft playing area. The dry haze on top that you've been working with is your playing cushion, yet what lies underneath must be firm for good footing. It must allow for cleat penetration, without skidding.

When you're done rolling, you'll need to come back and screen the area with your nail drag. This will smooth out the roller marks and finish off your playing surface. Again, check the clay for moisture—it's often necessary to apply a light amount of water to keep the clay from drying out during the game. Of course, this all depends on the weather and how much Turface you have in your field. Turface helps control the moisture in your field.

Don't try to use exactly the same steps every day. Hot, dry days will require more water applications than overcast days. You've got to be flexible.

Making Turf Shine

On a daily maintenance basis, turf areas are less time consuming. In terms of game preparation, irrigation and mowing are the only necessities. At Fulton County Stadium, the infield and outfield turf areas are cut at 3/4-inch in a distinctive checkerboard pattern. The pattern is reversed during strings of Braves road games to prevent the grass blades from growing horizontally.

Preparing damaged turf for a game is no easy task. Prior to the 1992 National League Playoffs, a college football game and a marching band practice were held at the stadium in a heavy rain. The damage to the field was significant.

The top two inches of the skinned area had to be removed and replaced with new materials, while the ground crew could only attempt to repair the turf. The turf was topdressed with sand to help level the field, followed by a series of rollings to further level the turf areas. The turf was mowed frequently after drying. This kept the grass healthy, while getting it back in condition for a game.

Here again, flexibility is essential. A routine is vital for daily maintenance, but you never know what surprises you'll face between routines.

As in all things, it is critical to realize that you get out of your work exactly what you put into it. These tips are not cure-alls, and the easiest way may not always be the best. Pay attention to the details—they separate the exceptional from the mediocre. ❑

Editor's note: Ed Mangan is the field director for the Atlanta Braves.

Winter Weed Control In Warm-Season Athletic Fields

TOP: White Clover (*Trifolium repens*). BOTTOM: Virginia Pepperweed (*Lepridium virginicum*). Photos courtesy Burt McCarthy.

By Dr. Bert McCarty

Maintaining an aesthetically-pleasing and functional athletic field requires a planned year-round program. The challenge is to provide a dense, lush turf which decreases the chance of injury by providing a cushion for players. In addition to providing a cushion, thick, healthy turf also minimizes weed invasion. This article will review turf management practices and herbicide options available to athletic field superintendents who have to ensure a quality turf surface void of weeds.

Provide Healthy Turf

Athletic fields, unlike most commercial turf areas, are exposed to intense traffic pressure. Today's linemen can weigh more than 300 pounds. When this amount of force is placed on an area the size of a shoe, turf damage is bound to happen.

The first key to providing healthy

turf is to construct fields with an appropriate soil mixture, proper drainage, and adequate irrigation.

Using fundamentally sound agronomic practices is the second key for quality long-term athletic field surfaces. Bermudagrass is the turf species most often used for southern athletic fields. Zoysiagrass, and Florida bahiagrass are also used in athletic fields, but not to the degree of bermudagrass. Bermudagrass provides a dense, resistant, appealing turf surface when properly managed. However, thin, worn areas develop when the grass is mismanaged or when there is excessive concentrated traffic. These worn areas soon become weed patches and require an extensive amount of time to recover.

In order to maintain bermudagrass fields at the high activity level, the fields must be frequently mowed at the proper height (e.g., minimum of twice weekly at 3/4- to 1-1/4-inch). They must be watered deeply but infrequently to encourage rooting and regrowth. They also must be frequently fertilized to provide a dense cover. Aerification twice a year is needed to combat soil compaction. Local cooperative extension service offices can provide specific recommendations for athletic fields in select areas.

Weekly game traffic, along with team and band practices, should be limited. Concentrated stepping in the areas used by these groups causes extensive damage to the turf. Location of practice within a given athletic field should be rotated as much as possible to avoid excessive damage. Foot traffic also should be minimized when the field is excessively wet.

Identifying Weeds

Weed identification is the next step in its control. If the weed is unknown, it should be taken to the local extension service for identification. A recent publication, *Weeds of Southern Turfgrasses*, can also be quite helpful. Jointly released by turf and weed specialists at the University of Florida, the University of Georgia, and Auburn University, this 208-page book contains 437 color photographs of 193 weed species found in southern turfgrasses and nurseries.

Herbicides

Once the turf has been maintained with proper cultural practices and the weeds present have been identified, the next step is to create a control program. Knowledge about a given weed's most susceptible growth stage and chemical tolerance or susceptibility of the turf it has invaded are important. The economics of using a given chemical and the development of a treatment program also are aspects to consider. In addition to correctly choosing and using a specific herbicide, proper application techniques are needed.

Many variables influence successful herbicide application. They include proper equipment, environmental factors in action at the time of application, proper calibration of equipment, and adequate agitation of the chemical solution. Most herbicide failures involve using the wrong chemical at the wrong time, in an improper manner or rate.

Preemergence Herbicides

Preemergence herbicides are applied to the turfgrass site prior to weed seed germination because this group of herbicides controls weeds during seed germination. The mode of action for most preemergence herbicides (e.g., Betasan, Balan, Surflan, Dimension, pendimethalin) is the inhibition of certain phases of cell division (mitosis). As the weed seedling germinates, its root and shoots contacts the herbicide layer, which prevents cell division, resulting in the death of the seedling. These herbicides are most active on annual bluegrass and unwanted perennial ryegrass clumps during the winter.

Several problems with preemergence herbicides exist when they are used on athletic fields. Since these materials are inhibitors of plant cell division, they can prevent bermudagrass regrowth in worn areas. As bermudagrass grows across treated areas, rooting through the herbicide layer is prevented.

Another potential problem with weed control in athletic fields is that many fields are overseeded with ryegrass in the fall to maintain turf color after frost occurs. Used incorrectly, most preemergence herbicides will prevent ryegrass seed from germinating. Turf managers should therefore follow all label directions when overseeding is planned.

If clumps of perennial ryegrass are undesirable in areas adjacent to overseeded areas, a preemergence herbicide should be applied before overseeding. Surflan, Dimension, pendimethalin, or Barricade can be used to outline, or picture-frame, an overseeded area by preventing movement of ryegrass from the desired overseeded area to adjacent areas.

Grass weeds. The major winter grass weeds in warm season athletic fields are annual bluegrass (*Poa annua*) and clumps of escaped ryegrass. Annual bluegrass germinates in late summer or early fall when soil temperatures at the four-inch level reach the low 70s. A second germination flush typically occurs in mid-winter. Problems when controlling annual bluegrass include preemergence herbicide-delayed recovery of damaged turf areas, or the herbicide interfering with ryegrass germination on overseeded fields. Several preemergence materials are now available that do not have these problems when proper application timing is followed. Pronamide (Kerb) provides good to excellent control of annual bluegrass with minimum damage to germinating ryegrass. Minimal damage to the rooting of the permanent bermudagrass also is achieved with Kerb. It must, however, be applied 60 to 90 days *before* overseeding. Application of Kerb should occur in midsummer in most areas. If applied closer to the overseeding date, the Kerb application may delay or prevent desirable ryegrass establishment.

Activated charcoal has been used successfully to prevent injury to the desirable overseeded grass when Kerb was applied closer than 90 days to overseeding. High rates (e.g. 2-1/2 to four pounds per 1,000 square feet) of charcoal are necessary. A disadvantage of this method is the inability to re-establish the ryegrass in the event the charcoal treatment fails. Current formulations of activated charcoal also are messy to handle and apply and may reduce the effectiveness of the herbicide.

If the field is not to be overseeded, Kerb can be applied before, during, or shortly after annual bluegrass germination since it offers both pre- and post-emergence control of this weed. A second application probably will be needed in midwinter (late January through early February) to control additional germination.

Rubigan, a fungicide with selective herbicide activity, also provides preemergence annual bluegrass control without adverse effects to overseeded grasses or bermudagrass. Optimum weed control occurs when a series of two or three applications are made. The last application should be

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timed for two weeks prior to overseeding. Multiple applications provide best control but require appropriate timing.

Broadleaf weeds. Preemergence broadleaf weed control traditionally has not been used for overseeded athletic fields. The herbicide Gallery, has become available for this purpose. Gallery, at the low rate, must be applied at least 60 days prior to overseeding to prevent damage to the ryegrass. Higher rates require longer waiting periods. Although Gallery controls annual broadleaf weeds, it does not satisfactorily control annual bluegrass. It must be tank-mixed with one of the other herbicides for control of that weed.

Watering-in. Irrigation is an important management practice when preemergence herbicides are used. Preemergence herbicides require incorporation and activation by irrigation to be effective. One-quarter to 1/2-inch of water is required within seven to 10 days of application to optimize their activity. If irrigation is not done within this time frame, many herbicides will not be in position to control the germinating weed or may lose their effectiveness by being broken down by sunlight. They also may be volatilized.

Repeat applications. Repeat applications of preemergence herbicides generally are necessary for season-long control of weeds. Most herbicides, when exposed to the environment, begin to degrade soon after application—the level of degradation usually occurring six to 16 weeks post-application. The reduced herbicide level in the soil results in poor control of later germinating weed seeds. Repeat herbicide applications become necessary at this time for prolonged preemergence weed control.

Postemergence Herbicides

Postemergence herbicides generally are effective only on visible weeds. The timing of the application should be when weeds are young (two to four leaf stage) and actively growing. At this stage, herbicide uptake and translocation is favored, and turfgrasses are better able to fill in voids left by the dying weeds.

Weeds actively grow primarily when temperatures are between 40 and 80 degrees F. This is the time when postemergence herbicides are used. Applications outside this range either respond too slowly or result in excessive turf damage. The soil must be moist to prevent or minimize turf damage.

Broadleaf Weed Control. Broadleaf weeds such as chickweed, henbit, clover, and dandelion normally are controlled with 2,4-D or combinations of 2,4-D plus 2,4-DP, MCPP, MCPA, and dicamba. All are selective, systemic, and foliar-applied herbicides. Few broadleaf weeds, especially perennial ones, are controlled with just one of these materials. Usually two or three-way combinations of these and possible repeat applications of them are necessary for satisfactory control of older plants. Basagran T/O also controls many winter annual broadleaf weeds. Basagran T/O, however, is not as effective on biennial or perennial weeds. Sequential applications of all broadleaf weeds herbicides should be spaced 10 to 14 days apart, and should be considered only after the ryegrass has been mowed three or four times.

These various herbicide combinations were the main chemicals for broadleaf control until recently. New chemistry, such as Turflon and Confront, provides alternatives to these tradi-