



Maintaining Bermudagrass Athletic Fields

Athletic fields are among the most difficult turfgrass areas to manage. Good management is important, not only because an attractive sports field appeals to spectators and expresses community or school pride, but because the field's playing surface is critical to the sports played on it. The turf should provide a soft, resilient, wear-resistant surface that helps the athletes maintain even footing and protects against injuries. For the turfgrass to fulfill these functions satisfactorily, the field must be properly designed, established, and maintained. The investments in establishing, renovating, or reconstructing athletic field turf are wasted unless an adequate maintenance program is followed.

Surveys by proponents of artificial turf show that nearly half of the serious knee and ankle injuries occurring on natural turf are related to poor field conditions, such as hard or rough surfaces, poor grass cover, or slick or muddy conditions. On properly conditioned and maintained natural grass fields, fewer injuries occur.

Maintaining a safe, attractive playing field requires an adequate budget, a competent sports field manager, cooperation on limiting the use of the field, and a good maintenance program. It also requires cooperation and coordination among administrators, coaches, and grounds managers. Few schools have a large enough staff or budget to keep a field in top condition. Most have little problem growing grass when the field is not in use, but wear and tear on the turf and soil compaction under playing conditions make it difficult to keep a good turf cover through the season. Proper mowing, fertilization, irrigation, and aeration will produce a field that stands up to normal use.

Bermudagrass (*Cynodon dactylon*) is the most common and best-suited turfgrass for most sports fields in Hawaii. Bermudagrass is fast growing with aggressive creeping rhizomes and stolons that cover bare and worn areas. It produces a tough surface with good traction. Common bermudagrass and selections of it can be established from seed; bermudagrass hybrids must be established from sod, plugs, sprigs, or stolons. Bermuda-

grass tolerates hot weather and is the best choice for water conservation, because it can survive with limited irrigation. This publication describes maintenance practices suggested for managing bermudagrass athletic fields in Hawaii.

Mowing

Regular mowing at the proper height and with the right equipment is a must for sports fields. Proper mowing promotes rooting, surface density, and uniform growth. The best maintenance practice for bermudagrass is to mow frequently and low. Bermudagrass responds to close mowing by initiating new shoots and leaves. A thin, weak turf can be converted to a much thicker and more wear-resistant surface if mowed at the correct height (Table 1) and frequency. Mowing frequency is based on the general rule of removing no more than one-third of the leaf blade at any one mowing. Mowing at lower than recommended heights encourages thin, weak turf that is less wear and drought resistant. Waiting too long between mowings results in scalping, thin turf, and slower recovery from wear.

Use a rotary or fine-cut flail mower for mowing heights above 1 inch. Use a reel mower for heights of 1 inch or less. Reel mowers produce the finest cut because of their scissors-type cutting action. With regular mowing, clippings are normally not collected, which recycles nutrients. If mowing is delayed and clippings are excessive, they can block sunlight and increase incidence of disease, and they should be dispersed or removed.

For a striping effect, mow strips (such as between each 5-yard line) in the same direction every time. Otherwise, alternate the mower direction with each mowing.

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Table 1. Mowing heights for bermudagrass sports fields.

Grass	Use	Mowing height (inches)	Mow when grass reaches this height
Common bermudagrass	football, soccer, outfields	1–1½	1½–2¼
Seeded selections (‘Oasis’, ‘Sultan’, ‘Numex Sahara’, ‘Blue-muda’ and others)	football, soccer, outfields	1–1½	1½–2
	infields and higher maintenance fields	¾	1
Hybrid bermudagrasses (‘Tifway’, ‘Tifway II’, ‘MS-Choice’)	infields and higher maintenance fields	½–¾	¾–1

Fertilizer applications

Proper fertilizer rates and timing are essential for good bermudagrass color and appearance, turf health, wear resistance, and quick recovery from damage. A routine maintenance fertilizer for bermudagrass should have an N-P₂O₅-K₂O ratio of 4:1:2 or 3:1:2. Nitrogen should be available to the grass at low, continuous, uniform rates. Slow-release nitrogen fertilizers formulations are more expensive but can produce better results than soluble sources such as ammonium sulfate. They also require less frequent application, reducing labor. Each month approximately ½–1 pound of nitrogen (N) and ½ pound of potash (K₂O) is required per 1000 square feet. Phosphate (P₂O₅) needs should be determined based on a soil test. The soil should be tested every 3–5 years to assess soil pH and nutrient status.

Periodic applications of iron (Fe) can improve turf color without causing additional leaf growth. Granular and liquid iron fertilizers are available.

Soil pH

The optimum soil pH for bermudagrass is between 6.0 and 7.0. It tolerates a pH range from 5.5 to 8.0. Most Hawaii soils have pH within the acceptable range.

Irrigation

Supplemental and careful irrigation is necessary to maintain a safe and desirable playing surface. In the absence of rain (or in general for sandy soils), irrigation at least one to three times weekly is necessary to prevent the turf from undergoing moisture stress. Each irrigation should apply about ¾ inch of water. Do not irrigate daily with light rates of water, because this encourages shallow rooting and increased pest problems. Excessively wet conditions, however, contribute to rapid deteriora-

tion of sports turf. Coordinate irrigation with scheduled use and apply water at least 24 hours before the field is to be used. Many turf managers also irrigate immediately after athletic events and practices. This helps prevent worn areas from drying out and aids recovery.

The irrigation system can be calibrated to determine the specific amount being applied and to select the proper running times. Calibrate by randomly placing empty cans of identical diameter throughout the field. Run the system for ½ hour and measure the water in each can with a ruler. Calculate an average and determine the amount of time necessary to apply the desired amount.

Waiting until the turf first shows drought symptoms (wilting or turning a bluish-gray color) before irrigating allows maximum water use efficiency without sacrificing turf quality. Apply ¾ inch of water, and wait until water stress symptoms reappear before watering again. Drought tolerance of turfgrass can be promoted by mowing at heights near the upper end of the proper range and providing adequate potassium fertilizer.

A permanent and automatic irrigation system that evenly supplies water to the field is best. Professional-grade traveling gun-sprinklers can be used to irrigate athletic fields. They are portable for multi-field use but may require 8–10 hours to irrigate a single field. Home lawn sprinklers, even traveling models, are not adequate for large athletic fields.

Dethatching

Thatch is a layer of undecomposed living and dead organic matter intermingled with live plant stems at the soil surface. Periodic removal of thatch with a “vertical mower” is necessary for well maintained bermudagrass. Examine thatch buildup by pulling cores from different areas of the field. Consider action if the layer of thatch

is between $\frac{1}{2}$ and $\frac{3}{4}$ inch, and plan for thatch removal if the layer exceeds $\frac{3}{4}$ inch. The preferred method for mechanical thatch removal is vertical mowing. Dethatching should be done in early spring and again in midsummer if the thatch layer is excessive. Blade spacing for the vertical mower should be 1 inch apart for bermudagrass. Mow in two directions at right angles and deep enough to just scratch the soil surface. Scalp the area by low mowing ($\frac{1}{2}$ inch) before and after vertical mowing to remove debris. Any debris remaining can be raked, vacuumed, or blown off, but its removal is essential. Irrigate deeply after de-thatching to provide moisture to roots exposed during vertical mowing. Fertilize with 3 pounds of ammonium sulfate per 1000 square feet about one week after dethatching to stimulate growth. Irrigate immediately after fertilizing. Vertical mowing exposes weed seeds, and application of a preemergence herbicide within a week of dethatching should be considered.

Compaction

Compaction is a primary cause for decline of sports fields and occurs in direct proportion to the amount of use a playing field receives. Compaction reduces pore space in the soil, limiting root growth and penetration of air and water. Turf vigor gradually declines, and the grass will not respond to management practices. Weed invasion often follows. Compaction is usually most prevalent where traffic is concentrated, such as along player benches and sidelines, between hash marks (football), and in front of goals (soccer and football).

Core aeration, sometimes referred to as turf cultivation, is the practice of removing many small soil cores $\frac{3}{4}$ –1 inch in diameter and 3–4 inches deep. This is one of the most important management practices for competitive playing fields. Coring relieves compaction, allows better penetration of oxygen into the soil, encourages deeper rooting, and increases water infiltration. Core aeration also reduces thatch.

Intensively used fields should be core aerated three or four times a year, and fields for seasonal play should be aerated at least twice a year (after the last game, and in the spring). Core aerate the area in at least two directions. Allow the plugs to dry, pulverize them by mowing, and redistribute the material with a steel drag mat. Any debris remaining should be removed by raking, blowing, or vacuuming. Irrigate after the debris has been removed, and apply 1 pound of fertilizer nitrogen per

1000 square feet to encourage rapid recovery. If you cannot aerate the entire field, concentrate on the most heavily used areas. An alternative for severely compacted situations with little desirable turf is to till the soil, mix in amendments, and then reestablish the turf.

Do not confuse core aeration with spiking, which only pokes small holes in the soil. In clay soils, spiking can increase compaction around the points of penetration. Spiking is not a substitute for core aeration.

Core aeration should be done when the soil has sufficient moisture to allow the hollow coring tines to penetrate the soil, but not so much that they become clogged. If the tines clog, the aerator functions like a sheep's-foot soil compactor. Some weight may need to be added to the machine for adequate soil penetration, although with too much weight the tines may bend. Rocks also can damage tines.

Slicing or spiking tines are used during the playing season to increase water penetration without disrupting the playing surface. A machine that can be converted from coring to slicing tines provides the best equipment value. Slicing should be done just before irrigating.

Gypsum is sometimes recommended to improve the structure of soils under commercial turf. Gypsum is effective only on soils high in sodium (Na); it has no effect on soils with low or normal sodium levels. When gypsum is used to solve a problem of excess sodium, it is most effective when tilled into the soil. Surface applications of gypsum have limited value.

Wetting agents in liquid or granular form are sold under a variety of trade names. Their main use is to improve water penetration into the soil surface. They do not reduce soil compaction or increase pore space, but they may occasionally aid in alleviating dry spots.

Topdressing

Topdressing is the addition of a thin layer of material to the turf surface. Topdressing controls thatch, levels low spots, fills holes, and can be used to improve compacted fields. Topdressing is most effective following core aeration. In order to prevent layering, many turf managers topdress with a material similar to the field's soil type. On heavy soils, the holes can be filled with sand, soil, or compost, or combinations of these. Over time, these amendments can improve the physical qualities of the field soil. Table 2 lists volumes required to obtain specific levels of topdressing. Light, frequent topdressing applications to build up low areas are preferred over less

Table 2. Volume of material required per 1000 square feet to achieve various depths of topdressing.

Topdress depth, inches		Volume of material	
Fraction	decimal	Cubic feet	Cubic yards
1/32	0.03	2.6	0.1
1/16	0.06	5.2	0.2
1/8	0.125	10.4	0.4
1/4	0.25	21.0	0.8
1/2	0.5	42.0	1.5
3/4	0.75	62.4	2.3
	1.0	83.3	3.1

frequent, heavier applications.

Recent work has shown that topdressing with crumb-rubber products can assist in reducing compaction. The products are expensive but may prove to be useful materials for the sports turf manager.

Pest management

Weeds

Weeds often occur due to soil compaction or poor turf management. Dense, healthy turf usually keeps weeds out, but they can appear and thrive when turf density and competitiveness decrease. Weeds often become established in areas of an athletic turf subject to traffic and wear.

Weeds are classified as either grasses (e.g., goosegrass, crabgrass), broadleaves (spurge, pennywort), or sedges (purple nutsedge, kyllinga). Preemergence herbicides are applied before weed seed germination, and postemergence herbicides are applied to growing weeds.

In Hawaii, weeds are present year round and are not as seasonal as on the U.S. mainland. Many turf managers in Hawaii rely heavily on a program of postemergence weed control for bermudagrass sports fields. Preemergence herbicides might be a good choice to prevent weed seed germination following severe dethatching or aeration of thin or damaged turf. For thin or renovated bermudagrass, Ronstar® may be a good choice for preemergence weed control. Ronstar does not adversely affect bermudagrass rooting, as do some other products, which when used on thin bermudagrass turf should be applied at half the normal rate. When seeding, do not use preemergence herbicides within 16 weeks before or

4 weeks after applying seed (or at least until you are sure that all the seed has germinated). For further information on the use of preemergence herbicides to control weeds in bermudagrass, see CTAHR publication II-20, *Chemical weed control recommendations for turf-grasses in Hawaii*.

Wide-bladed grasses such as crabgrass, goosegrass, dallasgrass, hiloggrass, and St. Augustinegrass can be controlled in bermudagrass using postemergence herbicides containing methane arsenate (MSMA, DSMA, and CMA), sold under various trade names. Two or three applications may be necessary to eradicate some grassy weeds, such as dallasgrass. For best control, set up a schedule to apply the material on one particular day every two weeks for three consecutive applications. Failure to stick to a multiple-application program results in only temporary yellowing of the weeds, and they recover shortly. Repeated applications of methane arsenate herbicides can control sandbur and many sedges; three or four applications may be needed. A nonionic surfactant should be added to the spray mixture if one is not included in the product.

If goosegrass is well established, control will be improved by combining MSMA at the label rate with Sencor 75® or Lexone® at 4 oz per acre. Apply only when the temperature is less than 85°F, and do not mow or water the turf for 24 hours after the application. Temporary discoloration of the bermudagrass should be expected; adding a soluble iron fertilizer to the spray mix can reduce this yellowing. Most MSMA formulations contain a surfactant, and additional surfactant is not recommended. After two weeks, follow the combination application with a normal MSMA application.

Purple nutsedge, green and white kyllinga, and sandbur in bermudagrass may be controlled with Image® alone or in combination with MSMA. A nonionic surfactant is required for Image applications. Manage® also provides good control of nutsedge. Reapplications approximately every three months are necessary to prevent build-up of new sedge tubers. (See CTAHR publication L-9, *Nutgrass control in the lawn, landscape, and garden*.)

Broadleaf weeds can be controlled by using herbicide products combining two or three active ingredients, including 2,4-D, 2-DP, MCPP, MCPA (or dicamba, under several trade names) and Confront® (triclopyr + clopralid). Trimec Plus® also contains MSMA and can be used to control broadleaf weeds, wide-bladed grasses,

and sedges in bermudagrass. When the herbicides are applied, the bermudagrass should be actively growing and not under heat or drought stress, or damage can result. Some herbicides active on broadleaf weeds should be applied in a schedule of two or three applications, each two weeks apart, for best results.

Insects and mites

Monitoring. It is important to accurately identify insects found in sports fields because many of them are not pests, and the most effective treatment for one pest may not work on another. Insect samples can be identified by the CTAHR Agricultural Diagnostic Service Center via your local CTAHR Cooperative Extension Service office.

To detect cutworms, sod webworms, southern chinch bugs, fiery skipper larvae, and billbug adults, use the pyrethrum test. Mix 1 tablespoon of a commercial garden insecticide containing 1–2% pyrethrins in 1 gallon of water. If the insecticide has only 0.5% pyrethrins, use 2 tablespoons. Using a sprinkling can, apply the solution as evenly as possible to 1 square yard of recently mown turf. The insects will be irritated and move to the surface within 10 minutes. Collect and count the number of insect larvae to assess the seriousness of the infestation. Sample several locations across the playing field. If the problem is localized, spot treatment may be suitable.

Treatments. Insecticide registrations and labels change constantly. Check with the nearest office of the CTAHR Cooperative Extension Service or your agricultural supplier for the latest recommendations.

Before applying an insecticide against foliar or thatch-dwelling pests, irrigate the turf well, and treat as soon as the foliage is dry. Apply the insecticide as specified on the product label, and apply enough to thoroughly wet the grass down to the ground. In general, applications vary from about 2 to 25 gallons of spray per 1000 square foot for most pests except mites, which may require a greater volume because they hide within leaf folds. Do not irrigate following a pesticide application, unless or until it is necessary to prevent wilting. This allows the insecticide to remain on the plants for the longest possible time. Do not apply insecticides when temperatures exceed 90°F.

In general, liquid sprays work best for treating foliar turfgrass pests, but granular formulations are acceptable for controlling billbugs, cutworms, skipper larvae,

and sod webworms. Granules are good for controlling pests residing in or below a thatch layer, because they move past leaf blades and partially penetrate the thatch layer. Granular applications do not work as fast as other formulations, and the pesticide can be ingested by birds.

The valuable assistance provided by predators and parasites of turfgrass pests is disrupted by broad-spectrum insecticides such as pyrethrins, carbamates, and, to a lesser extent, organophosphates. Certain alternative pesticides such as *Bacillus thuringiensis* (B.t.) control a narrower range of organisms while preserving many naturally occurring beneficial insects. B.t. products are typically inexpensive, but application timing is critical to effective pest control.

Armyworms and sod webworms are the most serious problems in bermudagrass sports fields in Hawaii. Insect problems are encouraged by lush growth resulting from over-fertilizing with readily available nitrogen, mowing at irregular intervals, and allowing thatch build-up. Watch for browning areas and grass blades with a chewed appearance.

Rhodesgrass scale has been the most troublesome scale insect on bermudagrass in Hawaii. It is usually found near the base of the grass. This spherical insect is up to 1/8 inch in diameter, has piercing-sucking mouthparts, and is covered with a white, cottony secretion. The adult scale lays eggs within its secreted covering. After hatching, the crawlers spread throughout the grass before settling down to feed. The life cycle is about 6–8 weeks. Infested grass turns yellow, and the turf thins and may be killed if the pest is not controlled.

Bermudagrass mite is sometimes a serious pest. Its damage is most severe on common bermudagrass. These yellowish-white, somewhat worm-like mites are extremely small, only about 1/30 inch long. A microscope or strong hand-lens is needed to find them on infested grass. Mites multiply rapidly and require only about seven days to complete their life cycle. Because this pest is so small and hides beneath the leaf sheath, it is identified primarily by damage symptoms. The grass blades turn light green and cut abnormally. The internodes shorten, the tissues swell, and the grass becomes tufted so that small clumps are noticeable. The turf loses vigor, thins, and may be killed. Injury is more pronounced during dry weather, especially when the grass is stressed due to poor maintenance.

Diseases

Plant diseases are rarely a problem in sports fields in Hawaii that are under good management.

Repair

Many factors contribute to the decline of grass playing fields. Except when severe inherent problems require turf reconstruction, renovating critical or damaged sections of the field can often restore a suitable turf cover. Renovation may involve eliminating weed infestations, applying proper amounts of soil amendments and plant nutrients, intensive core aeration and verticrossing, followed by reseeding, sprigging, or stolonizing (as appropriate), and dragging to spread the mixture over and into the soil. Bermudagrass will reestablish rapidly if provided proper management. It is important to solve the problems resulting in the decline, if possible, or the work and expense will only have to be redone.

Limiting playing field use

A well established and maintained turf can withstand significant use without serious damage. However, no grass can withstand unlimited use. Abuse will result in permanent damage that cannot be overcome by even the best maintenance program. If a field is subjected to football practice, soccer practice, band practice, official games, practices for other sports, intramural games, physical education classes, and other activities, all in limited turf areas, the wear will result in decline of the turf. Moreover, the use of fields during inclement weather when the soil is wet is likely to result in permanent damage requiring extensive repair. Coaches and administrators must take an active interest in scheduling activities and preventing excessive wear.

Ideally, two or more practice fields should be provided for each main game field. Practice fields should be marked according to official regulations, reducing the need to practice on the main field. Many athletic programs lack the resources to provide additional practice areas or to overcome deficiencies in the original construction of the fields. Priorities for use of the field must be established and adhered to. Maintenance procedures and repair become even more important as use increases or cannot be reduced.

Main fields should be used only for official games, with the exception of one team practice and one band practice before each game. During football practices, as many scrimmage activities as possible should be con-

ducted on the sides of the field, rather than in the center.

Activities during the off-season should be limited, especially during the summer and wet seasons.

Maintenance of non-grass areas

The non-grass (skinned) areas of a baseball or softball infield are as important to play, safety, and appearance as the grass areas. Skinned areas require more time to maintain than grass areas. The skinned areas must meet the specification of the league for which the field is used.

The material for the skinned areas must provide firm footing while remaining resilient. The soil surface should be loose and firm and readily absorb moisture. Slope skinned areas toward the sidelines and outfield to provide surface drainage. Soils suitable for skinned areas range from clay to sandy clay loam. Work sand and calcined clay (Turface® or similar product) into skinned areas throughout the season to maintain the loose, firm, and resilient nature of the playing surface. Stockpile and cover the supply of topsoil, sand, and calcined clay before the season so it remains dry and available when needed.

Before the season, scarify the skinned area to loosen the soil several inches deep. Work sand or calcined clay into the top inch or two of soil by hand raking. Trim the grass edges of the infield with a mechanical edger and lift the sod by hand to keep the edges sharp. Repeat several times during the season to keep line sharp and to prevent soil buildup along the grass edge.

After a practice or game, routine maintenance is required. First, remove the bases and put in a plug to keep sand from entering the base hole. Sweep the grass edge of the infield with a stiff broom to remove soil along the edge of the turf. This procedure is essential to prevent soil buildup along the grass edge. Next, hand-rake the areas around the bases to replace the soil that was moved by the players. Then, drag the skinned area with a nail drag followed by a carpet drag or steel mat to smooth the surface. Regular maintenance of non-grass area keeps the field in top playing condition and helps avoid major reworking of the skinned areas during the season.

The pitcher's mound and home plate will require a few minutes of repair daily to keep them in good playing condition. Sweep the mound with a stiff broom after each use to remove any loose material. Then moisten the worn area and add moist clay to fill the hole. Tamp the fresh clay to pack the mound. Stockpile clay or clay

loam soil for the mound and keep it moist for regular repair of worn areas of the mound.

After repairing the mound, rake the entire area by hand and drag with a steel mat or carpet drag. If the clay sticks to the equipment or cleats, add sand or calcined clay to the surface to prevent sticking. Check the height and slope of the mound regularly to be sure they meet specifications.

Follow the same procedure for the batter's box and catcher's box at home plate. Sweep the boxes after each use, add fresh clay and tamp, rake the area by hand, drag it, topdress with sand or calcined clay, and smooth with a carpet drag. Tarp the entire infield to keep skinned areas dry if rain is forecast.

Lines and marking

Straight, sharp lines help define and dress the field. Cut lines $2\frac{3}{4}$ inches wide and mark them with latex paint or other approved marking paint. Avoid lime because it can cause eye injuries. Re-mark lines before each game day. A properly lined and marked field is essential to playability and appearance of the field.

Records are important in turf management

Document the turf management program and the results. Records serve as a basis for timely maintenance, a training aid, and a guide for future managers. Use positive results as an incentive to improve field conditions while you explore alternate sources of funding. Make sure parents' support groups and team boosters are aware of the efforts and the need. Maybe additional funds are not available, but volunteers to help with maintenance procedures or pre- and post-game operations may be.

Resources available to sports turf managers

CTAHR publications

Adaptation of turfgrasses in Hawaii. TM-4.

Bermudagrass. TM-5.

Chemical weed control recommendations for turfgrasses in Hawaii. II-20.

Nutgrass control in the lawn, landscape, and garden. L-9
CTAHR publications can be obtained from the college Web site, <www.ctahr.hawaii.edu/publications>; by sending e-mail to ctahrpub@hawaii.edu; by writing to CTAHR-PIO, 3050 Maile Way Gilmore 119, Honolulu, HI 96822; or by calling 808-956-7046.

Magazines

Trade magazines are an excellent way to learn about the latest technology in the field and to learn about products. Several magazines have free subscriptions to qualified athletic field managers. These include:

Athletic Turf Maintenance & Technology. Advanstar Communication, Inc. PO Box 950008, Pittsfield, MA 01203-9717 (no charge for qualified professionals).

SportsTurf. Adams Business Media, 68-860 Perez Rd., Cathedral City, CA 92234 (no charge for qualified professionals).

Grounds Maintenance. PO Box 12960, Overland Park, KS 66212-2215 (no charge for qualified professionals).

Professional associations for sports turf managers

Sports Turf Managers Association, 1375 Rolling Hills Loop, Council Bluffs, IA 51503, Sportstmgr@aol.com.

Hawaii Turfgrass Association, 1085 S. Beretania, Room 203, Honolulu, HI 96813.

Books of potential interest to sports turf managers

Playing fields and sports turf. Stewart and Gooch. 1994. Routledge, Chapman & Hall.

Sports turf handbook. Aldous. 1998. Butterworth.

Sports Turf: Science, construction and maintenance. Stewart. 1994. Chapman & Hall.

Turf management handbook: Good turf for lawns, playing fields and parks. Schroeder and Sprage. 1996. Interstate.

Turfgrasses; their management and use in the southern zone. 2nd edition. Duple. 1996. Texas A&M University Press, College Station, TX.

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