

Optimizing Bermudagrass Athletic Field Winter Survival in the Transition Zone

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Bermudagrass is an excellent choice for use on athletic fields throughout the transition zone (which includes Virginia, Kentucky, southern Indiana, and Missouri) because of its tolerance to close (e.g. < 1") cutting heights, summer vigor, positive traction characteristics for athletes, resistance to divoting and ability to withstand and recover from significant traffic during active growth. The major limitation to successful bermudagrass persistence in transition zone locations is a general lack of cold tolerance and susceptibility to winterkill (Figure 1).

Although during most winters temperatures are sufficiently warm enough not to cause significant damage to bermudagrasses, winterkill is always a possibility in the uppermost region of the transition zone. While extreme cold is almost always the most important contributor to winterkill in the transition zone, it is also important to remember that winterkill severity can be further compounded by compacted soils, poor drainage, and sequential frosts during spring transition, and/or winter desiccation. Because winter survival can never be guaranteed in northern locations, the following Best Management Practices (BMPs) should be considered to maximize bermudagrass health and limit the threat of winterkill.

Cultivar Selection

To ensure a persistent bermudagrass turf in the unpredictable weather associated with the transition zone, cultivar selection is critically important. Cold tolerance levels vary tremendously among cultivars and there are many that should only be used in locations south of the transition zone (Figure 2). Over the past 20 years, numerous cultivars have been commercialized and specifically bred for improved cold tolerance. There are also many older cultivars with much



Figure 1. A bermudagrass football field in Kentucky damaged by low temperatures during winter. Healthy, non-damaged stolons are elastic and firm whereas winter-damaged stolons are typically not pliable and flaccid.

greater cold tolerance than common bermudagrass that are still available in the marketplace. Many of the older cultivars, however, do not have the improved turf quality characteristics such as increased shoot density, finer leaves, improved wear and recovery characteristics, and less susceptibility to scalping that are common in many newer cultivars. Bermudagrass cultivars commonly grown in the transition zone include Latitude 36, Northbridge, Patriot, Premier Pro, Quickstand, Riviera, VaMont, and Yukon. To view the list of the top performing bermudagrasses in the transition zone, see www.ntep.org.

Mowing

One of the most important considerations when determining whether or not bermudagrass is the best choice for an athletic field is a regular commitment to mowing during the warmest periods of the year. Of course, a maintenance advantage of a non-overseeded dormant bermudagrass turf is that no mowing is required during the four- to five-month



Figure 2. An overhead image of spring recovery of bermudagrass cultivars shows differences in winter survival.



Figure 3. Uneven growth causes slight differences in canopy heights. The initial frost of the fall collects in lower areas causing a loss of color while leaving the taller leaves untouched. This spectacle is commonly referred to as “leopard spotting.”

dormancy period. During active growth (May to early September), bermudagrass will require mowing two to three times per week, especially if it is maintained at heights of 0.5 to 1 inch. Mowing less than 1 inch will require a reel-type mower to achieve the highest quality of cut, appearance, and smooth-surface playing characteristics. Again, be careful when selecting a bermudagrass cultivar in terms of the ability and budget to provide the level of maintenance intensity it will require. Far too often, more money is spent on the maintenance of a reel mower than on the actual maintenance of the bermudagrass field. If a reel mower is not financially appropriate for your situation and maintenance capabilities, a rotary mower equipped with sharp blades and driven at the proper operating speed can provide an acceptable quality of cut. Rotary mowers, however, likely cannot duplicate the close cutting heights and mowing quality delivered by a properly adjusted and operated reel mower.

As day length decreases and cooler temperatures approach in early fall, mowing heights should be raised slightly

(e.g. 0.25-0.5 inches) to levels that still deliver acceptable playing conditions for fall sports, but also increase the amount of green leaf tissue available for photosynthesis. The theory behind this mowing adjustment is threefold. First, the taller mowing height will provide a slight benefit in terms of carbohydrate or plant food production and storage. Reserve carbohydrates are critical for winter survival as bermudagrasses slowly use them as food during the dormancy period. They also are essential for spring re-growth. Second, the taller mowing height will provide some insulation for crowns/stolons/rhizomes and potentially increase soil surface temperatures. Third, more leaf tissue provides a thicker canopy that can resist wear and in turn provides longer seasonal durability. Even if the “raised mowing height theory” only slightly benefits a bermudagrass turf, it is still a good insurance policy against potential winter injury, especially since this slightly higher mowing height does little to affect the playing characteristics (e.g. ball roll, footing, etc.) of the turf.

Traffic Management

The growth rate of bermudagrass slows dramatically during September and October, and plants eventually turn straw brown as they go into a winter resting state (dormancy). As a result of low light intensity and low temperatures, the rate at which chlorophyll breaks down is much greater than the rate at which the plant is capable of producing chlorophyll, thus leaves begin to lose color. The first frost of the season quickly causes growth to cease and leaf color to decrease. Due to differential growth rates across a turf, frost will collect on the shorter grass while leaving the taller areas untouched. This activity causes the shorter plants to quickly lose color while the taller grass remains green, a phenomenon known as “leopard spotting” (Figure 3). The slower growth experienced by bermudagrass in the fall also means the plant’s ability to recover during this time is greatly diminished. Excessive traffic during fall and winter will injure and thin the turf stand and areas of exposed soil can develop. If traffic is extreme, large bare areas likely will not recover the next spring due to a lack of turf growing points. Replanting will be necessary.

Additional traffic management considerations should include:

Do not traffic wet/saturated fields. One intense event on a wet field can destroy a season’s worth of maintenance efforts. Games played on wet fields, especially where standing water is observed, can cause catastrophic damage because wet soils are more easily displaced by human or vehicular traffic. In addition to poor footing, the turf can be torn/divoted and if this occurs during non-active growth the area will not recover, compromising field safety (Figure 4). Further, wet soils are more prone to soil compaction which results in poor drainage and restricted bermudagrass rooting depths. Compacted fields have less resiliency and harder surfaces, and may result in more athlete injuries. If possible, consider rescheduling or postponing events when fields are extremely wet. This benefits the turf while reducing the potential for athlete injury.



Figure 4. Do not traffic wet/saturated fields. These fields are prone to damage from soil displacement and divoting and increased soil compaction. Photo by Marcus Dean.



Figure 5. Portable goals extend the life of a field and are ideal for practice and warmup drills.



Figure 6. A highly modified, sand-based athletic field rootzone is designed to promote drainage.

Minimize use during dormancy. During slow growth and wet soil conditions do not allow practices or intense use on game fields (usually from September through May). Also, it is important to restrict incidental play by clubs or classes. It can be helpful to track field usage during the year to better estimate how much use a field can withstand.

Distribute traffic. As dormancy approaches and/or ensues, it is even more important to distribute traffic on the fields as much as possible to minimize localized turf thinning. Rotate repetitive drills throughout the field and utilize portable goals and field markings as much as possible to distribute traffic and wear more evenly (Figure 5).

Sand-caps and internal drainage. If a field is expected to be used outside of the bermudagrass active growth period, it may be prudent to consider modifying the soil by developing a sandy surface profile using a sand specifically recommended for turf rootzones (Figure 6). A sandy surface profile combined with a subsurface drainage system may allow for less chance for the negative effects associated with saturated soil conditions. This will not completely eliminate the cautions associated with dormant/wet field use listed above but may allow for slightly more use and better winter survival of bermudagrass.

Nutritional Inputs

Fertilizers applied during the summer are used for plant growth and development and will help prepare bermudagrasses for winter dormancy. When nutrients are limiting, plant vigor may be reduced, which can lead to reduced winter survival. All nutrient management plans should start with a soil test to determine existing nutrient levels and potential needs. Native soil athletic fields should be tested every two to three years and sand-based fields annually. The soil test should provide the status of essential macro- and micronutrients as well as the soil pH (e.g., need for lime) and organic matter levels.

Nitrogen (N)

This is the nutrient that plants need in the greatest quantity and is the focus of most nutritional programs as it is responsible for growth and greening. Most soil tests do not provide information related to N due to its tendency to change forms throughout the growing season. Each turf's N fertilizer needs are very site and use specific. In general, a well-established bermudagrass turf subject to moderate to intense use requires approximately $\frac{1}{2}$ to 1 lb. N/1,000 sq. ft./growing month, starting in May and usually ending at or around the first full week of September. While bermudagrass may have a high N requirement, it is important to note that extremely high summer N rates can be detrimental to winter survival, especially in extremely cold winters (Figure 7). Although research has shown that judicious N applications during autumn are not harmful to bermudagrass, the slight benefits in color and recovery during this time may not be worth the additional fertilizer cost and labor for application. Excessive late-season nitrogen fertilization can result in greater winter weed pressure as well as increase the susceptibility of the turf to spring dead spot (see Page 9).

Potassium (K)

Most turf managers are familiar with the suggestion of applying a "winterizer" fertilizer containing K to help grasses survive the winter. As the plant enters dormancy, K can increase in the cell sap acting as an "antifreeze" that helps prevent cell rupture and death during very cold weather. Research has shown that if the soil test level for K is adequate (36-60 ppm using the Mehlich-3 soil test), little if any benefit is gained by applying additional K during autumn. In fact, by overloading soil cation exchange sites with K⁺, the availability of other essential nutrient cations can be reduced, thus limiting uptake of the other necessary elements. The take-home point of this information is the importance of regular soil testing and making timely applications of any nutrients and/or lime that are recommended by the soil test results. Like N in some fertilizers, highly water-soluble K can leach out of the rootzone, especially on sandy soils or during wet



Figure 7. Spring green-up of bermudagrass in Kentucky following summer nitrogen application rates of 1 lb. N/1000 sq. ft./month (top), 2 lb. N/1,000 sq. ft./month (middle), and 4 lb. N/1,000 sq. ft./month (bottom). Nitrogen applications began in mid-July and ceased Sept. 1. Photo was taken in late-April of the following year.

years and where excessive supplemental irrigation is practiced. Regular monitoring of this nutrient in soil is important to turf survival.

Plant Growth Regulators

Plant growth regulators (PGRs) are often applied to high value turf areas in an effort to manage vertical shoot growth and improve mowing quality. Season-long use of PGRs like trinexapac-ethyl (e.g., Primo Maxx) will reduce clippings, reduce scalping, encourage lateral spread, and improve green color. PGR use also increases the carbohydrate content of stolons. Due to reduced top growth, carbohydrates are stored instead of being used for growth. This increased carbohydrate content results in stronger plants and has been shown to improve winter

survival in bermudagrass. See individual product labels for specific instructions on manufacturer suggested application rates and timings of PGRs.

It is wise to experiment with varying levels of PGRs on the particular bermudagrasses being managed as most improved vegetative bermudagrasses are more sensitive to PGR applications than seeded, common-type bermudagrasses. The varying sensitivity to the PGR by the different grasses will be reflected on the product application rates and intervals detailed on the manufacturer labels. In order to gain full benefit of the PGR response, regularly scheduled applications throughout the growing season and up to approximately one month prior to an anticipated hard frost date will provide the most desirable plant responses. This

strategy, however, may not fit all budgets or field use schedules. Whether or not a field is to be overseeded with ryegrass (*Lolium* spp.) can help determine how late a PGR application is made as it is likely that regulating the rate of growth of bermudagrass with the PGR can aid the establishment of ryegrass seedlings. However, other field managers might take advantage of the surge of late-season growth of the bermudagrass that accompanies the end of PGR treatments that can be beneficial for improving late-season traffic tolerance of bermudagrass. This strategy works when the PGR applications cease at least 3-4 weeks before the first frost date.

Winter Overseeding

Overseeding bermudagrass in the autumn with a cool-season grass like perennial ryegrass (*Lolium perenne*) for temporary cover improves the aesthetic appearance and playability of the turf during cool times of the year (Figure 8). This practice is generally considered to be an undesirable cultural necessity because although it improves winter appearance it essentially introduces thousands of what are potentially ‘weeds’ into the bermudagrass canopy. The actively growing cool-season grass must be mowed, and will absorb water from the soil. During spring green-up, the cool-season grass often becomes a strong competitor of bermudagrass and usually must be chemically removed to minimize plant competition and promote bermudagrass vigor. In addition to the aesthetic benefits, overseeding is thought to slightly increase canopy temperatures, and similar to increasing the mowing height prior to dormancy helps maximize winter survival.

While overseeding in general is considered to be detrimental to bermudagrass health due to the competition with bermudagrass each spring, if done properly, it can improve playability for late winter/early spring sports. If overseeding is to be done, it is important to establish a dense ryegrass canopy to ensure that playability and footing are optimized. For the transition zone, a typical overseeding rate is 200-400 lb. of pure live seed per acre (5-10 lb. per 1,000 sq. ft.).



Figure 8. A bermudagrass winter-overseeding trial in Kentucky. Note that the cool-season grass (in this case perennial ryegrass) is green and growing (and able to recover) from traffic/wear while the non-overseeded bermudagrass is brown, dormant, and unable to recover.



Figure 9. Clumpy ryegrass is both a safety and a playability hazard on dormant bermudagrass sports fields. The tall clumps create an uneven surface that negatively affect smooth ball roll and athlete footing.

Poor establishment and/or insufficient ryegrass seeding rates typically result in the loss of any enhancements related to insulation/traffic tolerance and may reduce field safety and playability due to ‘clumping’ of the low-density ryegrass plants (Figure 9).

Turf Covers and Blankets

Various types of covers and blankets are available depending on the specific objective and budget. Compared to covers, turf blankets are often thicker and have less light penetration (Figure 10). Both blankets and covers are very effective at reducing winter damage to warm-season grasses. At the very least, covers should be considered on high wear areas or on seeded bermudagrass during the first winter after establishment. Seeded bermudagrasses are often slow to cover the soil surface and lack a strong network of below-ground stems (rhizomes) during the first growing season. Covers reduce the length of the dormancy period and protect crowns/stolons/rhizomes from freezing temperatures and desiccating cold winds (Figure 11). Lightweight covers, often used for bermudagrass putting greens, can easily be removed as desired throughout the winter so that play can continue on warmer winter days. Lightweight covers offer protection to the turf but not to the extent of blankets or straw (Figure 12). By contrast, blankets are often placed on an athletic field at the end of the season and permanently left in place until spring.

An alternative to covers and blankets are straw materials (Figure 13). Wheat or pine straw can be broadcast over the turf in late fall and left untouched until spring. Straw can be spread by hand or with a straw blower at the rate of 300 to 400 bales per acre. Spring cleanup, blowing of straw during winter, introduction of weed seeds, rodents tunneling through the straw, removal of the straw in the spring, and potential turf thinning are several issues to be aware of with this type of cover.

If covers are used, the turf should be checked periodically during warmer weather due to the potential for winter diseases like *Microdochium* patch/pink snow mold to develop, especially if winter-overseeded ryegrass is present. Often a preventative fungicide application prior to cover installation is suggested to minimize disease severity.

Sideline covers are also frequently used to minimize wear on heavy wear areas like player's bench and cheerleader areas (Figure 14). These covers are only used during games and are removed to



Figure 10. Turf blankets protecting a bermudagrass field in north-central Indiana. This type of cover is typically placed in late fall and removed in mid-spring.



Figure 11. Covered (right) versus uncovered (left) bermudagrass in late winter. Covers protect warm-season grasses from extreme cold and reduce the length of dormancy.



Figure 12. Bermudagrass spring greenup differences between a lightweight cover (left) and a turf blanket (right). Turf blankets offer superior protection from winter temperatures but are very heavy and rather awkward to place and remove.

allow for maintenance and photosynthesis to occur. Although these covers can protect the underlying grass, some sideline covers can stretch or rip causing a tripping hazard to players or cheerleaders. Always thoroughly research the pros and cons of all products prior to purchasing to ensure they meet the needs of the facility and athletes.

Topdressing

Topdressing with sand, native soil, organic products, and other materials over bermudagrass turf may reduce thatch, modify soil physical properties, promote bermudagrass recovery, and smooth and firm the playing surface. Soil and mineral rootzone materials (e.g. sand) are an excellent temperature buffer. They take much longer to cool compared to air (e.g. the primary reason covers and blankets are effective). When topdressing is applied heavily enough to cover crowns/stolons/rhizomes it protects these plant parts from cool air temperatures. The concerns with this method of winter protection are the cost of materials, potential for turf injury during late-season application (e.g. compaction from equipment) and possible mechanical damage during spring cleanup as a drag mat or brush is used to move the material into the canopy.

Summer Management Factors that Will Impact Winter Survival

It has been emphasized repeatedly in this publication that a healthy bermudagrass turf is much more likely to survive an extreme winter. The optimum growing season for bermudagrass is summer. During this time bermudagrass turfs should be as healthy as possible. Proper agronomic practices such as reasonable mowing heights (e.g. not too short or tall), maximizing nutritional inputs and supplemental irrigation as needed to prevent severe drought stress are essential. Summer is also the ideal time to improve any problem areas that restrict turf growth and vigor like soil compaction, poor drainage, and excessive thatch. Make every effort to begin the sporting season with 100 percent turf coverage. The following are factors that should be considered during the growing season:



Figure 13. Straw being blown onto a bermudagrass football field in Virginia. Although straw is an excellent protectant from harsh temperatures, cleanup and other concerns exist when using straw. Photo by David Chalmers.

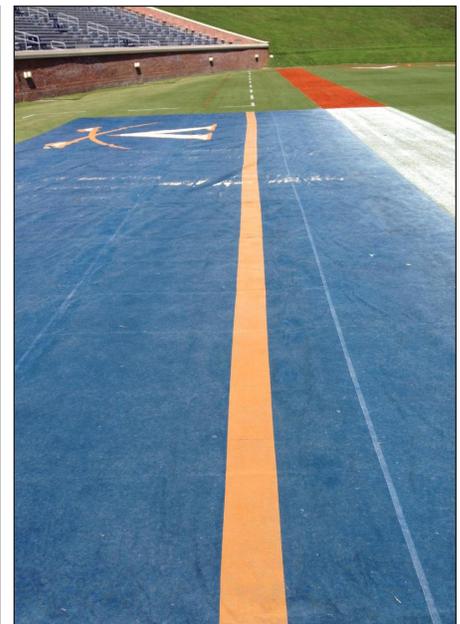


Figure 14. Damage to a player's bench area (left) from excessive wear without a tarp and a sideline tarp in place for a game (right). Photo by Jesse Pritchard.

Soil/rootzone management. The physical condition of the soil under heavily used athletic fields can be unfavorable for bermudagrass growth and survival. Foot and vehicle traffic can cause soil compaction. Severely compacted soils lack oxygen, drain poorly, and restrict root growth. To improve compacted soils, cultivation is necessary. Cultivation typically refers

to hollow tine aerification but can also include solid tine aerification, slicing, vertical mowing, etc. However, of all cultivation practices, only those that remove (e.g., hollow tine aerification) or fracture soil (deep tine quaking aerifiers) will reduce compaction. Cultivation practices that do not remove soil should be used for venting, thatch reduction,



Figure 15. Bermudagrass damaged by winter temperatures should be able to recover as long as surviving plants are found within 1 square foot of other surviving plants.

increasing lateral growth, etc. These cultural practices are less disruptive to the surface but do little to relieve severe compaction. The severity of compaction

should determine how many times each year cultivation occurs. It is very common to aerify bermudagrass athletic fields in early and mid-summer, leaving

plenty of time for the turf to heal prior to autumn usage.

Drainage. Wet soils lack oxygen and reduce root growth similar to compacted soils. Further, wet soils are more prone to soil displacement and compact more easily than dry soils and are slower to warm in the spring which delays spring green-up



Figure 16. The dense turf of the playing surface in this late August picture of a Patriot bermudagrass field in Virginia is much more prone to scalping than the sideline area where the turf had previously been worn away. The difference is in the number of leaves on the stems as shown in the inset photo, sideline stem (L) and playing surface stem (R).

and the resumption of active growth. To encourage proper drainage, fields should have crowns maintained to have at least a 1 to 1½ percent slope (18" crown). A properly maintained crown will encourage rapid water movement off the field, thus protecting the surface during the playing season. Underground drainage is also an option for removing excess water and may be required for flatter surfaces. (See "Traffic Management" on Page 2 for more information on wet soils).

Maximizing stand density. If the turf is thinned following cold winters, additional plant material may be necessary. Generally, if one live plant per square foot can be found in spring, the field surface should be fully covered by autumn (Figure 15). When planting is necessary, it should occur as early as possible in the late-spring (e.g. May) when daytime air temperatures stay consistently over 70°F. A major goal is to develop mature plants for use and promote maturation prior to autumn to limit winterkill. Cultivation to encourage lateral growth and moderate fertilization can encourage bermudagrass spreading into thin areas. Caution should be exercised with pre-emergent herbicide applications in spring as, in addition to controlling targeted summer annual grassy and broadleaf weeds, most of these chemicals will also prevent bermudagrass seed and sprigs from establishing. Oxadiazon (e.g., Ronstar®) may be used prior to sprig planting but not with seed.

While it seems paradoxical, one of the best ways to promote bermudagrass shoot density is to thin the canopy, a process traditionally done with a vertical mower (e.g., dethatcher) once active growth resumes in the spring. Mechanical thinning should be followed by aggressive irrigation and nitrogen applications to promote plant growth. Some of the more recently released cold tolerant, high density cultivars are prone to scalping in late summer due to their density and a change in their growth habit in response to shorter day lengths and 'shading' of the lower leaves in the turf canopy (Figure 16). One of the newest strategies in rejuvenating bermudagrass fields is an extreme version of vertical mowing called fraze mowing (Figure 17).



Figure 17. Fraze mowing is an excellent way to periodically rejuvenate extremely thick bermudagrass sports fields. It should be done only when there is ample time for grass recovery.



Figure 18. Spring dead spot disease of bermudagrass in Missouri. Although colonization from this fungal pathogen occurs during the early autumn and winter during slow growth, damage is visible in spring when the bermudagrass fails to green-up in affected areas.

Spring dead spot (SDS). This disease is active throughout the year but causes damage during autumn and winter when bermudagrass is not growing. It is first noticed in early spring when

softball to beach ball size spots fail to resume growth (Figure 18). It is always most severe after very cold winters. This disease often occurs three to four years post-establishment and is very difficult

and expensive to control. It is fairly short-lived in the soil, but it is likely new infection centers will emerge as previous dead spots disappear. Research at Virginia Tech and the University of Missouri in-

dicates that properly timed vertical/fraze mowing can help reduce spring dead spot severity by increasing turf juvenility, but these cultural programs will not eradicate SDS. If significant SDS has occurred

in the past and has adversely affected field playability, appearance and/or safety in spring, consider a fungicide application program per your university's current Extension recommendations.