



LOOKING KINDLY AT KIKUYUGRASS

Long considered an invasive weed, this warm-season grass is managed by many courses as a desirable turf species.

BY PATRICK J. GROSS

Routine vertical mowing is a key management practice to control thatch and maintain good playing quality on kikuyugrass fairways.

Kikuyugrass is the Rodney Dangerfield of turf — it gets no respect. While many courses fought the invasion and spread of kikuyugrass for decades, others have learned to manage this grass to provide good playing quality on tees, fairways, and rough. Why the change of heart? Some courses had no choice but to learn to manage their former enemy as it gradually spread over most of the course. Other courses did not have the budget or resources to control infestations with multiple herbicide sprays, physical removal, and sodding. As superintendents learned more about the grass, they were able to adapt management practices to provide a dense, uniform turf with good playing quality. Although much of the literature to this point has focused on the control of kikuyugrass, this article will look at the culture and management of kikuyugrass as a fine turf for golf courses.

HISTORY AND BACKGROUND

Kikuyugrass (*Pennisetum clandestinum*) is a warm-season grass that is native to the Kenyan highlands of Africa. It is a course-textured grass with a rapid growth rate, and it is commonly used as a forage grass and turfgrass in mild coastal climates and sub-tropical regions. The spread of kikuyugrass was aided by the Dutch, who brought the grass from Kenya to South Africa and Australia during the Boer War. Kikuyugrass was eventually transported to other areas and is now cultivated in many mild climates throughout the world, including South Africa, Australia, New Zealand, Mexico, Spain, Central America, South America, and portions of the United States.

Improvement of kikuyugrass began in the 1950s when the Australian government awarded a grant to a plant breeder to develop a seeded forage type for livestock. The rapid growth rate, palatability,

and high protein content made kikuyugrass an ideal forage for cattle and livestock. The breeder, Dr. Whittet, developed the cultivar that bears his name and sold the first 22 lb. batch of seed to the Eykamp family for commercial seed production in New South Wales, Australia, where the *Whittet* variety is still grown today.

The establishment of kikuyugrass in the United States occurred in 1918 when it was imported to Pacific Palisades, California, as an erosion control for ditch banks, and it gradually spread to the coast and inland valley areas. Many golf course superintendents and homeowners misidentified the grass as St. Augustinegrass due to the similarities in leaf blade width, color, thick stolon, and dense canopy. From California, the grass was transported and spread to several states, including Hawaii, Arizona, and Texas.

Don Eykamp, son of the original grower, brought kikuyugrass seed to the United States in 1995 with the intention of producing seed and improving the species for the American forage and turf market. The main stumbling block was that kikuyugrass was listed as a noxious weed in most states due to concerns that it might be a host for an insect or a fungus that could devastate the United States millet crop. The host plant relationship was disproved, but the federal government continues to list kikuyugrass as a noxious weed, citing that it has an invasive growth habit. The status of kikuyugrass currently is under review, and a ruling by the governing agency, APHIS, is expected in the coming year.

In the meantime, seed production of *Whittet* went forward in Arizona under special permit. During this time, further improvement in kikuyugrass occurred in the seed fields of Arizona as a result of natural selection. A patch of kikuyugrass with a finer texture and improved density was observed in a field of *Whittet*. The seed from the unusual patch was replanted, and the progeny displayed the same desirable characteristics, resulting in the new variety *Arizona-1* (also called *AZ-1*).

Today, kikuyugrass is managed as the primary turf in fairways and rough at several golf courses, including prominent PGA Tour stops Riviera Country Club, Torrey Pines Golf Course, and La Costa Resort and Spa.

KIKUYUGRASS CHARACTERISTICS

Kikuyugrass has been described as “bermudagrass on steroids.” It is a coarse- to medium-texture

warm-season grass with a rapid growth rate. The leaf width ranges from $\frac{1}{8}$ " to $\frac{1}{4}$ ", comparable to Japanese lawngrass (*Zoysia japonica*) and St. Augustinegrass (*Stenotaphrum secundatum*). The wider leaf blade is typical of the native types, while the narrow leaf blade is typical of improved varieties under intensive management. The leaf blades are flat and pointed at the tip and typically grow in length from 1" to 10". Leaf color is a medium to lime-green that some golfers and superintendents find objectionable.



Kikuyugrass is often confused with St. Augustinegrass due to similarities in texture, color, growth habit, and the thick, fleshy stolons. Kikuyugrass is distinguished by the pointed leaf tip, flat leaf blade, and the long fringe of hairs that parallels the stem near the leaf collar. In contrast, St. Augustinegrass has sharply folded leaves and blunt leaf tips. Another distinguishing characteristic of kikuyugrass is the prominent anther and white filament that extends above the canopy on closely cut turf. The white filaments typically are visible in the spring and fall, but they can be seen throughout the year in some locations. The white filaments return within a day of mowing, giving the turf a silvery cast. The female part of the flower is near the base of the plant, and the seed is formed within the leaf sheath. The seeds are rounded and dark brown, approximately $\frac{1}{8}$ " in length.

The growth rate of kikuyugrass is very rapid under warm, moist conditions. Shoot extension can exceed 1" per day at the height of the grow-

Long considered a noxious weed, kikuyugrass is now considered a desirable turf by an increasing number of golf courses in temperate climates.

ing season. Active growth occurs at temperatures between 60° to 90°F, and it can survive well at temperatures near 100°F. Kikuyugrass sustains active growth and retains color at temperatures below 60°F, when most other warm-season grasses exhibit a loss of color and a slower growth pattern. In California, kikuyugrass may not go dormant during the winter along the coast, although it tends to enter dormancy from late November until February in colder inland valley locations. Kikuyugrass appears to have the best winter color retention of all the warm-season grasses and can tolerate light frost without a loss of color.

Kikuyugrass spreads by stolons, rhizomes, and seed. The thick, fleshy stolon and relatively wide leaf blade contribute to a somewhat open growth habit at mowing heights above 1½". Canopy density is significantly improved at mowing heights below ¾". Rooting occurs at the nodes of stolons under moist soil conditions. Rooting is

significantly restricted in dry soil, causing the turf to become puffy and more prone to mower scalping.

The rapid growth rate and thick mat layer associated with kikuyugrass contribute to excellent traffic tolerance and recovery from divot injury. The rapid growth rate is both a benefit and a challenge for maintenance. Excessive thatch contributes to spongy surface conditions, mower scalping, and diminished quality. If left unmowed, kikuyugrass has been observed growing over fences, up utility poles, and into trees and shrubs. Under routine mowing and maintenance, it can invade greens and tees unless a routine edging and hand-picking program are in place to control encroachment. Kikuyugrass provides good playing conditions and ball support when closely mowed, but the heavy thatch layer tends to limit ball roll on fairways and provides unpredictable bounces on the putting green approach. It can be especially treacherous in the rough, where the

Kikuyugrass responds well to applications of the growth regulator trinexapac-ethyl. A stolon from an untreated area (top) exhibits a wider leaf blade and greater internode length compared to a stolon from a treated area (bottom) that displays a finer leaf blade, darker green color, and shorter internode length.





thick stolons and wide leaf blades tend to grab the club and make it difficult to extract the ball.

Kikuyugrass tolerates a wide range of soil conditions. Optimum growth seems to occur in medium- to heavy-texture soils with a neutral to alkaline pH. Like many warm-season grasses, kikuyugrass has good tolerance to heat, drought, and salinity. It prefers adequate soil moisture but survives drought with a slight loss of color and a reduction in growth rate.

PROPAGATION AND ESTABLISHMENT

The irony of kikuyugrass is that it spreads rapidly where it is unwanted, but it can be slow to establish in existing turf or when efforts are made to actively cultivate and spread it. Control efforts are usually abandoned once kikuyugrass populations reach 30% to 40%. At this point, most superintendents begin active programs to cultivate and spread kikuyugrass to encourage a uniform stand.

The primary methods of propagation are sod, plugs, sprigs, and seed. The most successful method of establishment is transferring sod to provide a solid turf cover. Until recently, golf

courses in the United States had to propagate their own sod in a nursery area, but commercially grown sod is now available in Southern California at a cost of approximately 85¢ to \$1.00 per square foot.

Some courses have attempted to establish plugs of kikuyugrass in existing stands of bermudagrass using a specially modified aerifier that removes 2" to 3" diameter cores for transplanting. The plugs can be slow to establish even if planted in the fall when bermudagrass is less competitive. Plugs planted on 12" centers in the fall will provide reasonable coverage by the end of the next growing season.

Sprigs collected following vertical mowing can be used to establish kikuyugrass in bare or renovated areas. Stolons should be spread evenly over the soil, pressed or spiked into the surface, and topdressed with a light covering of compost to retain adequate moisture. Good establishment is usually evident within 4 to 6 weeks when temperatures are above 60°F.

Seed can be established on bare soil with relative ease. The recommended seeding rate is

A distinguishing characteristic of kikuyugrass is the prominent anther and white filament that extends above the canopy on closely cut turf, which can give the turf an objectionable silvery cast but does not affect playing quality.



$\frac{1}{2}$ lb. per 1,000 sq. ft. or 25 lbs. per acre. The germination percentage of the seed is approximately 85% to 90%, and germination is usually evident within 6 to 10 days when soil temperatures are 65°F or above. Seeding into existing turf has been a challenge for many superintendents. The recommended planting method is to lightly dimple the surface with a core aerifier, broadcast the seed at the rate of 1 lb. per 1,000 sq. ft., followed by a very light covering of compost. Ample moisture is critical during the germination and establishment period. Efforts to slit seed kikuyugrass into existing turf generally have been unsuccessful.

KIKUYUGRASS MANAGEMENT

While kikuyugrass can survive with only a moderate level of maintenance, a more intensive program is necessary to provide optimum playing conditions. Components of a successful management regime should include frequent mowing, thatch control, carefully controlling nitrogen applications, irrigation management, pest control, and other routine management practices.

● **Mowing.** Kikuyugrass tolerates a wide range of mowing heights from $\frac{1}{4}$ " on tees and collars to greater than 2" in the rough. Because of the rapid growth rate, frequent mowing with a motor-driven reel mower is necessary to provide good surface quality and minimize scalping. Heavier cutting units are preferred over lightweight mowers because the added weight pushes the reels further into the turf canopy to help control thatch and provide a better quality cut. Daily mowing is required when the cutting height is less than $\frac{1}{2}$ ", such as on tees and collars. Optimum cutting heights for fairways range from $\frac{1}{2}$ " to $\frac{5}{8}$ ", with a mowing frequency of four to five times per week during the active growing season. It is recommended to maintain kikuyugrass rough at a mowing height of 1 $\frac{1}{2}$ " and not more than 2" to avoid excessively difficult conditions for the average golfer. Mowing of the rough normally is required two times per week during the active growing season. Ignoring recommended mowing frequencies can contribute to mower scalping and an unsightly appearance throughout the course. Once kikuyugrass is scalped, it can be slow to recover. To reduce scalping injury, some superintendents begin fairway mowing in the early spring at $\frac{1}{2}$ " and gradually raise the cutting height to $\frac{3}{4}$ " by mid November, which also provides additional mat and wear tolerance during the

Advantages and Disadvantages of Kikuyugrass

Advantages

- Excellent traffic tolerance
- Rapid recovery from wear and divot injury
- Good heat, drought, and salinity tolerance
- Best winter color retention of the warm-season grasses
- Active growth and color retention at temperatures < 60°F
- Competes against weed invasion
- Tolerates a wide range of soil and water conditions
- Low nitrogen requirement (2-3 lbs. per 1,000 sq. ft. per year)

Disadvantages

- Medium to coarse texture
- Rapid thatch accumulation
- Medium to lime-green color
- Persistence of white filaments/anthems above the turf canopy
- Tendency for mower scalping
- Frequent mowing required to control rapid growth
- Sensitivity to herbicides

Opposite page:
Kikuyugrass has a
rapid growth rate and
can develop a dense
thatch layer as
observed on this
bunker lip.

winter. It is important to point out the accelerated wear on mowing equipment when maintaining kikuyugrass. The added wear typically reduces the expected life span of mowers by 10% or more.

- **Vertical mowing.** Vertical mowing is an important program for controlling rapid thatch accumulation during the active growing season. Studies at the University of California at Riverside showed that optimum quality was achieved with three vertical mowing treatments (April, July, September) at approximately the depth of the turf canopy ($\frac{1}{2}$ "). Because of the heavy yield of clippings that must be removed and swept following such a treatment, many superintendents prefer to vertical mow lightly, approximately $\frac{1}{4}$ " below the turf canopy, on a monthly schedule from April through September.

- **Aeration.** Core aeration should be performed a minimum of one time per year and preferably two to three times per year to aid in thatch control, encourage healthy root growth, and promote rhizome development. Additional treatments will be necessary where excessive thatch is a problem. Kikuyugrass also benefits from deep aeration (6" to 10") with a solid-tine aerifier in the spring. The deep aeration treatment does a better job of relieving soil compaction and also contributes to better air and water movement for healthy root growth and rhizome development going into summer.

- **Fertility.** Kikuyugrass is very sensitive to nitrogen applications, requiring only 2 to 3 lbs. of nitrogen per 1,000 sq. ft. annually. In some cases, the nitrogen supplied by effluent water is adequate to sustain active growth without the need for supplemental applications. Excessive levels of nitrogen further accelerate the already rapid growth rate and contribute to mower scalping.

Research at the University of California at Riverside showed that applications of 16-16-16 at the rate of 1 lb. actual nitrogen per 1,000 sq. ft. in April, June, and August produced the best visual quality while minimizing scalping injury. Many superintendents prefer to apply 2 lbs. actual nitrogen per 1,000 sq. ft. in the late spring using a slow-release carrier and supplement with monthly applications of $\frac{1}{8}$ lb. to $\frac{1}{4}$ lb. of nitrogen per 1,000 sq. ft. through the active growing season. Kikuyugrass responds well to applications of chelated iron and manganese to enhance green color without promoting excessive growth. Iron is often applied monthly with light rates of nitrogen as part of a spoon-feeding program. Applications of phosphorus, potassium, and other nutrients should be made based on the results of annual soil tests.

- **Water requirements.** Kikuyugrass will take as much water as you can give it, but it prefers evenly moist soil conditions for active root growth and development. Good irrigation coverage is important to prevent localized dry spots and loss of root growth that contributes to puffy surface conditions and mower scalping. Growth can be controlled to some degree by restricting irrigation as long as the soil does not become too dry. Kikuyugrass is drought tolerant but appears to require more water than other drought-tolerant species such as bermudagrass.

- **Pest control.** Kikuyugrass is sensitive to most commonly used broadleaf herbicides, which can result in discoloration and suppressed turf growth following application at recommended label rates. Many superintendents use a combination of 2,4-D, mecoprop, and dicamba at $\frac{1}{4}$ to $\frac{1}{2}$ the recommended label rates to control broadleaf weeds when the turf is actively growing. Kikuyugrass is very sensitive to triclopyr and MSMA, which

Key Points for the Successful Management of Kikuyugrass

- Mow frequently with a heavy, motor-driven reel mower
- Light vertical mowing three or more times during the active growing season
- Core aerate to control thatch and encourage root and rhizome growth
- Maintain even moisture
- Limit nitrogen to 2-3 lbs. per 1,000 sq. ft. per year
- Edge greens and remove stolons by hand to control encroachment
- Use trinexapac-ethyl to enhance color and density

are commonly recommended for control in unwanted areas. Applications of clopyralid do not appear to cause any damage and can be used to control certain broadleaf weeds without damaging the turf. Although kikuyugrass is reported to have no disease problems, many courses in California are experiencing significant damage from brown patch and take-all patch. Research by Stowell and Gelertner of PACE Research Institute indicates that applications of manganese sulfate at the rate of 1 lb. of material per 1,000 sq. ft. can suppress take-all patch and aid in turf recovery while reducing the need for fungicide sprays.

● **Use of plant growth regulators.** Kikuyugrass responds well to routine applications of trinexapac-ethyl during the active growing season. Research by Stowell and Gelertner of PACE Research Institute found that monthly applications of trinexapac-ethyl liquid from April through September at the rate of 0.2 oz. to 0.5 oz. per 1,000 sq. ft. dramatically enhanced color and density while reducing scalping injury and thatch formation. Rates of the WSB formulation of trinexapac-ethyl should be reduced by half to achieve the same results. Temporary yellowing can occur following the first application of trinexapac-ethyl, but turf color recovers within two weeks after the first application. Discoloration can be masked by the addition of nitrogen and chelated iron at light rates to the spray mixture.

● **Controlling encroachment.** Stolons of kikuyugrass can rapidly encroach into tees, collars, and putting greens if not actively controlled. Most superintendents find it necessary to edge the perimeter of greens every one to two weeks during the active growing season and remove any encroaching stolons by hand. Another method to

control encroachment near greens is to establish the collar with perennial ryegrass and treat encroaching stolons with recommended label rates of quinchlorac or a combination of MSMA and triclopyr.

CONCLUSION

Superintendents have learned to successfully manage kikuyugrass as a fine golfing turf for fairways, roughs, and even tees by embracing the strengths of the grass and overcoming the problems with creative maintenance practices. The same was done in the past with bermudagrass and seashore paspalum, which were considered by many to be invasive grassy weeds until plant breeders took the initiative to improve the turf characteristics of these grasses. With recent advances in biotechnology and plant breeding, there is ample opportunity to develop new varieties of kikuyugrass that capitalize on the positive attributes of winter color retention, wear tolerance, and low fertility requirement while working to improve the texture and winter hardiness and reduce rapid thatch accumulation. It is interesting to see the beginning of such advances with the recent release of AZ-1 kikuyugrass, and with luck and hard work, there will be more cultivars to follow. In the meantime, more and more courses are taking a kindly look at kikuyugrass and realizing that their former enemy can become their friend in an effort to provide good golfing conditions throughout the year.

REFERENCES

- Beard, J. B. 1973. *Turfgrass: Science and Culture*. Prentice-Hall, Inc. Englewood Cliffs, N.J.
- Cockerham, Stephen, R. Kahn, V. Gibeault. 1998. Kikuyugrass Cultural Practices. *California Turfgrass Culture*. Vol. 48, Nos. 3 & 4.
- Culley, James. Kikuyugrass — First by Force, Now by Choice. *California Fairways*. November/December 2002. pp. 16-17.
- Ormsby, David. Kikuyu: Is it always a weed? *New Zealand Turf Management Journal*. February 1996. pp. 9-10.
- Research Update: The Kikuyu Debate Continues. *Grounds Maintenance*. May 1998. p. 82.
- Cooley, Richard. Personal communication, March 15, 2002.

PATRICK GROSS is the director of the USGA Green Section Southwest Region, where an increasing number of courses successfully manage kikuyugrass on golf courses, including Torrey Pines, site of the 2008 U.S. Open Championship.