A USGA-SPONSORED RESEARCH PROJECT

Out of Africa — A New Look at "African" Bermudagrass

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SOME AFRICAN bermudagrasses now under study at Oklahoma State University offer new possibilities as improved varieties and for use in breeding, but bermudagrasses from Africa are not new. In fact, the African continent is generally considered as the center of diversity for bermudagrass and, consequently, its most likely place of origin. The first bermudas introduced to the New World probably came from Africa in the early to mid-1700s. Most past and present turf bermudagrass varieties used in the U.S. trace to Africa either as direct imports or through ancestry.

As a common name, "bermudagrass" generally refers to forms of *Cynodon dactylon*, which together with *C. transvaalensis* constitute the two most important *Cynodon* species used for turf. *C. transvaalensis* plants have been given the common name "African bermudagrasses." These very fine-textured plants have crossed naturally and have been artificially crossed with bermudagrass plants to produce fine-textured, high-quality turf hybrids. As examples, "Sunturf" (Magennis) and "Bayshore" are considered natural hybrids between African and common bermudagrasses. The widely used "Tifway" (419) and "Tifgreen" (328) varieties developed by Dr. Glenn Burton at Tifton, Georgia, had an African bermudagrass as one of their parents.

Although African bermudagrass has played a very important role in the development of many of the improved turf bermudagrass varieties, until recently there has not been a concerted effort to assess the improvement potential within the species. Thanks to USGA financial support, such an effort is now underway at Oklahoma State University. This effort is part of a comprehensive USGA-sponsored research project to breed improved seed- and vegetatively-propagated bermudagrass varieties for different environments and uses.

African bermudagrass differs in several respects from the usual type of bermudagrass grown as turf throughout the southern U.S. Its natural distribution is limited to a relatively small geographic area within South Africa consisting of the Transvaal and

Unmowed African bermudagrass, in a breeding plot at Oklahoma State University, is allowed to produce seed heads (inflorescences) which are used to produce crossed and open-pollinated progenies.

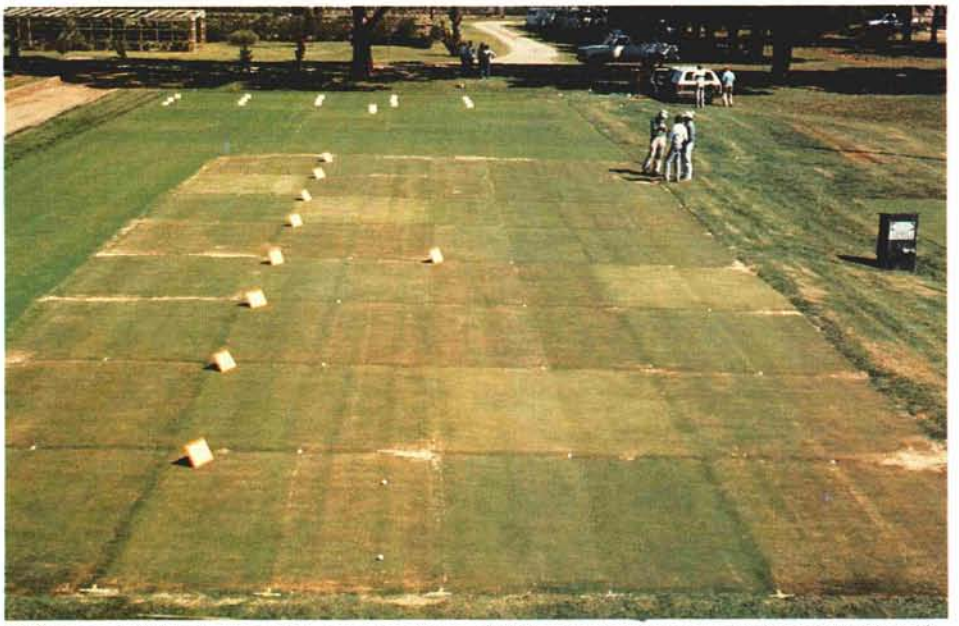
Of 100 African bermudagrass plants in the screening nursery at the High Ridge Country Club, Lantana, Florida, only a few survived and continued to perform well after one year. John Foy, USGA agronomist (left) and David Bailey, former superintendent, examine a plant that had performed well.

Orange Free State, whereas the more common form of bermudagrass is widely distributed throughout tropical and semi-tropical regions of the world. Even in its natural habitat, African bermudagrass is more sparsely distributed than other bermudagrasses, generally inhabiting damp sites. It has fine, linear, pale yellow leaves, small stems, and profuse shallow rhizomes, which contribute to its very fine texture and greater sod density compared to other bermudagrasses. It exists only as a diploid with 2n=2x=18 chromosomes. Other turf bermudagrasses generally are tetraploids with 2n=4x=36 chromosomes, although diploid and triploid (2n=3x=27) types occur naturally.

Only a few African bermudagrasses have been introduced into the U.S. Currently, 15 *C. transvaalensis* accessions are listed in the United States *Cynodon* germplasm collection at the Southern Regional Plant Introduction Station, Griffin, Georgia. A few have been lost from the collection over the years, and it is possible that a few others entered the U.S. without being included in the collection. A small number of African bermudagrasses were introduced into the U.S. during the first half of this century, primarily by the New Crops Research Branch, Crops Research Division, USDA/ARS. Some of these, such as PI (Plant Introduction) 213319 ("Florida) and PI 183551 ("Uganda") had limited use as turfgrasses in the southern U.S. before being supplanted by better-performing hybrid varieties. Major criticisms of the few African bermudagrasses tried as turf included one or more of the following: 1) high demand for water and nutrients, 2) propensity to thatch, 3) yellow-green color, 4) development of purple pigmentation in response to cool temperatures, and 5) overall decline in quality during late summer and fall. Their major assets, however, are a very fine texture and the ability to form a dense sod under good growing conditions. An important question, then, regarding the overall value of African bermudagrasses, relates to whether the deficiencies of the few varieties tried in past years are common to the species as a whole. Work is now underway to help answer this question.

In the summer of 1988, some of the African bermudagrass accessions in our germplasm nursery were found to have excellent fertility, ranging from 72% to 83% of florets producing a seed. These have provided large progeny populations for breeding and genetic study. Using open-pollinated seed harvested from the fertile plants in late June 1988, 816 progeny plants were started in the greenhouse and transplanted to a field nursery on August 1, a late planting date for Stillwater, Oklahoma. By the end of the growing season, differences were evident among these plants in rate of spread, growth habit, and other characteristics. Dramatic winter hardiness differences among the plants were revealed in the spring of 1989. Responses ranged from complete winterkill to early vigorous greenup. Selected plants from this nursery were included with their parents in isolated field crossing blocks to produce intermating populations. Since 1988, over 6,000 progeny have been grown as spaced plants in preliminary breeding evaluation nurseries.

A step-wise plan was effected in 1990 to screen large numbers of these progeny under different environments and uses and then intensively evaluate a small number



Differences in fall color retention and appearance of African bermudagrasses are being investigated by graduate student David Gerken at the Turf Research Center, Stillwater, Oklahoma.

(15-30) of the very best selections. In early June 1990, 3,300 progeny from the breeding nurseries were planted at the Stillwater Turf Research Center on 3-foot centers in nursery blocks mowed at putting green heights. In October 1990, 400 selected plants from these blocks were transplanted, in groups of 100, on each of four cooperating Florida golf courses. The cooperating courses were Country Club of Orlando, in Orlando; Fiddlesticks Country Club, in Ft. Myers; High Ridge Golf Club, in Lantana; and Palm Beach Country Club, in Palm Beach. An additional 189 selected plants were planted in early spring 1991 on the Sea Island Golf Club, Sea Island, Georgia. These plantings were designed to screen the 589 plants for adaptation and overall performance under the same management programs that the golf courses use for their putting greens. Performance criteria of special interest were maintenance of a uniform, dense sod under close mowing, quality of the putting surface, and consistency of performance across seasons, particularly plant response to high summer temperatures and low winter temperatures.

It was expected that one to three years would be required for the "sorting out" process to occur and for any truly superior plants to be identifiable. Experience has shown that many bermudagrasses may perform very well for one to three years after establishment, then quickly deteriorate in stand and quality. Truly superior golf course turf is best identified by thorough testing over several years under conditions that subject it to the various stresses imposed by actual golf course use. As in the Stillwater nurseries, substantial differences were noted among plants in rate of spread, texture, sod density, and color during the establishment phase. There also were differences among the Florida locations in overall rate of establishment, due primarily to imposed management. Two locations overseeded soon after planting in 1990 while two did not. Mowing heights at the different locations also were lowered at different rates during the establishment period.

By October 1991, one year after planting, the sorting process was progressing rapidly at some locations. At the High Ridge Country Club in Lantana, about half the plants had perished, and most of the others were obviously inferior. A few plants, however, were maintaining very high quality turf. Three of the 100 original plants were identified as having superior performance. At Palm Beach Country Club, all plants had survived, but there were substantial differences in texture, sod density, color, and overall turf quality. Five plants were identified as having superior performance. Four additional plants were selected from the Palm Beach site in February 1992, based on good color retention during the winter months. Only two plants at the Ft. Myers location were judged worthy of further evaluation. Stand establishment at the Orlando site was delayed by overseeding and no substantive differences were noted among plants in 1991. Changes in persistence and performance of plants at the different locations is expected to continue, and they will be closely monitored over the coming months. The results to date suggest, however, that this procedure is effective as a preliminary screen for desirable plants. Screening of even larger numbers of African bermuda progeny plants will be initiated in spring 1992.

In the spring of 1991, graduate student David Gerken began an intensive replicated experiment designed to test the putting green performance of six African bermudagrass selections in comparison to Tifgreen and Uganda. Plots 10 × 12 feet in size, replicated four times, were planted in April 1991 at the OSU Turfgrass Research Center. Each individual grass plot is subdivided into halves which are mowed at heights of either ⅛ or 3/16 inch. David collected data on rate of establishment, sod density, color, putting speed (Stimpmeter), yield of clippings, and overall turf quality. Although there were differences in rate of spread, all plots were fully covered by the end of August. First-year data supported previous observations and results indicating the existence of substantial variation among African bermudagrass progeny. Significant differences among strains were found for all response variables. Some of the African selections performed better than both Tifgreen and Uganda for overall turf quality, sod density, and putting speed. Tifgreen received the highest rating for color. The most impressive of the six African selections, however, maintained a dense, uniform turf only slightly lighter in color than Tifgreen.

While more testing is necessary to accurately characterize the performance of the African bermudagrasses now in trials, results to date are promising. If the performance of the elite plants selected in 1991-92 is maintained in intensive tests over the next three years, one or more could then be released as new varieties.

Cumulative results with African bermudagrasses indicate substantial variation within the species for the major traits affecting turf performance. The extent to which the observed variation is heritable will dictate its value in breeding for improved turf performance. Genetic studies are planned that will provide information on the magnitudes of heritable variation for important turf traits within the species.

African bermudagrass selections should be of value in the breeding of new triploid hybrid turf bermudagrasses by serving as elite parents in crosses with common bermudagrasses. African plants now being identified as having superior turf performance can be tested as parents in such crosses to determine their genetic value in producing superior progeny. A wealth of valuable turfgrass germplasm has come out of Africa, and this work with African bermudagrasses suggests that the supply is far from exhausted.