# Breeding and Evaluation of Cold-tolerant Bermudagrass Varieties Golf Courses

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**Goals:**

- *Assemble, evaluate, and maintain Cynodon germplasm with potential for contributing to the genetic improvement of the species for turf.*
- *Improve bermudagrass germplasm populations for seed production potential, cold tolerance, and other traits conditioning turf performance.*
- *Develop, evaluate and release superior seed-propagated, cold-tolerant, fine-textured, turf bermudagrass varieties for the U.S. transition zone and similar climates.*
- *Develop, evaluate and release improved vegetatively propagated bermudagrass varieties with specific adaptations and uses in the southern U.S., e.g. varieties for golf course putting greens in the deep South.*

**Cooperators:**

*James Baird*
*Dennis Martin*
*Jeffery Anderson*
*Michael Anderson*

The turf bermudagrass breeding program was initiated in 1986 at Oklahoma State University. The initial broad objective was to develop fine-textured, winter hardy, seed-propagated varieties for the U.S. transition zone. The program was expanded in 1990 to include the development of superior vegetatively-propagated varieties.

Important ongoing activities supporting the breeding effort include: 1) the development, improvement and use of techniques to measure physiological and morphological parameters related to environmental stresses; 2) the procurement, evaluation, and use of new turf bermudagrass germplasm in the breeding effort; 3) the use of tissue culture in generating genetic variation and screening for desirable traits at the cellular level; and 4) the evaluation of bermudagrass varieties and breeding lines for turf performance.

Two broad genetic-base *C. dactylon* populations, one derived from cold-tolerant relatively infertile germplasm, the other from cold-sensitive highly fertile germplasm have been developed using phenotypic recurrent selection. Selection within the cold-tolerant population, $C_{3fer3tex}$, has been for increased seed production potential and finer texture. Selection within the cold-sensitive population ($C_{2ct}$) has been for increased freeze tolerance.

Cumulative performance data indicate synthetic varieties from the cold-hardy breeding population to be well-adapted to the U.S. transition zone with turf quality competitive with other seeded bermudagrasses. Commercial release of one or more synthetic varieties is planned for

1996. Field evaluations are underway to define optimum cultural management strategies for the varieties.

African bermudagrass, *C. transvaalensis*, has extensive phenotypic variation within the species for many traits influencing adaptation and turf quality. A population is now being studied that will permit estimation of genetic parameters for traits of interest.

Field evaluation of selected African genotypes indicate their major weaknesses to be instability of turf quality and light-green color. In tropical environments, the African selections maintain good to excellent putting-green turf in winter, but dramatically decline in quality during summer. Variation in summer performance of genotypes has been documented, indicating potential for improvement.

As a result of its weaknesses, African bermudagrass is now being evaluated for potential use on tees and/or fairways. Furthermore, African genotypes having demonstrated the best overall performance are being used extensively as parents in crosses with *C. dactylon* to produce large $F_1$ progeny populations. Several selections from these populations are performing well in field tests.

In 1995, African bermudagrass tolerance to herbicides and response to fertility were more clearly defined. The phenoxy class of herbicides caused some phytotoxicity. Most of the other herbicides commonly used for bermudagrass did not cause any problems. Generally, annual nitrogen fertilization rates of 6 to 12 lbs/1000 $ft^2$ provided the highest turfgrass quality.

Alterations in protein synthesis associated with cold acclimation have been documented in MIDIRON and TIFGREEN bermudagrasses. Acidic proteins were diminished in crowns of both varieties following cold acclimation. Both varieties synthesized cold-regulated (COR) proteins of several sizes in association with cold acclimation. MIDIRON crowns synthesized low molecular weight basic cold-regulated COR proteins in greater numbers and amounts, and intermediate molecular weight acidic COR proteins in greater amounts than TIFGREEN crowns. Peptide sequence analysis of a prominent low molecular weight protein from MIDIRON crowns indicates it to likely be a chitinase.

New germplasm from the Peoples Republic of China that has demonstrated good turf quality plus good seed production potential in initial evaluations and will be advanced to intensive replicated testing for adaptation, turf quality, and seed production capability. This germplasm is being used to formulate new breeding populations, create narrow-base synthetic varieties, and may be incorporated into the two existing breeding populations.

Mean Turfgrass Quality Ratings of Bermudagrass Cultivars for Each Month Grown at Twenty-Three Locations in the United States. 1994 Data.[2]

| | Turfgrass Quality Ratings 1 - 9; 9 = Ideal Turf: Months[1] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NAME** | **JAN** | **FEB** | **MAR** | **APR** | **MAY** | **JUN** | **JUL** | **AUG** | **SEP** | **OCT** | **NOV** | **DEC** | **MEAN** |
| TDS-BM1 | 5.0 | 4.4 | 5.5 | 5.6 | 6.1 | 6.0 | 6.4 | 6.3 | 6.5 | 6.6 | 6.3 | 4.1 | 6.0 |
| MIDLAWN | 4.9 | 4.6 | 4.9 | 5.0 | 6.0 | 5.6 | 5.9 | 6.2 | 5.9 | 5.8 | 5.5 | 3.4 | 5.9 |
| MIDFIELD | 5.0 | 4.4 | 5.1 | 4.7 | 6.1 | 5.8 | 5.9 | 6.0 | 6.0 | 5.8 | 5.4 | 3.6 | 5.8 |
| MIDIRON | 5.1 | 4.2 | 5.3 | 5.0 | 5.8 | 5.6 | 6.1 | 6.3 | 5.9 | 5.5 | 6.0 | 4.3 | 5.8 |
| TIFGREEN | 5.2 | 4.8 | 5.2 | 5.1 | 5.7 | 5.6 | 6.0 | 6.0 | 6.2 | 6.4 | 6.3 | 4.2 | 5.8 |
| TIFWAY | 5.4 | 4.3 | 5.4 | 5.0 | 5.6 | 5.7 | 6.2 | 6.2 | 6.2 | 6.4 | 6.4 | 4.4 | 5.7 |
| MIRAGE (90173) | 5.3 | 4.1 | 4.3 | 4.4 | 5.3 | 4.9 | 5.5 | 5.7 | 5.5 | 5.8 | 5.6 | 3.7 | 5.3 |
| TEXTURF 10 | 5.1 | 4.2 | 5.1 | 5.0 | 5.1 | 5.4 | 5.7 | 5.7 | 5.8 | 5.9 | 5.9 | 3.8 | 5.3 |
| OKS 91-11 | 5.1 | 4.4 | 4.5 | 4.5 | 5.5 | 5.0 | 5.4 | 5.7 | 5.3 | 5.5 | 5.3 | 3.7 | 5.3 |
| STF-1 | 4.9 | 4.3 | 5.0 | 4.7 | 5.2 | 5.1 | 5.5 | 5.6 | 5.5 | 5.6 | 5.5 | 4.1 | 5.3 |
| J-27 | 5.0 | 4.2 | 4.1 | 4.1 | 5.4 | 5.1 | 5.4 | 5.4 | 5.1 | 5.3 | 5.2 | 3.4 | 5.1 |
| GUYMON | 5.2 | 3.9 | 4.5 | 4.3 | 5.4 | 5.0 | 5.1 | 5.4 | 5.2 | 5.3 | 5.1 | 3.4 | 5.1 |
| JACKPOT (J-912) | 4.2 | 4.1 | 4.4 | 4.0 | 4.6 | 4.6 | 5.2 | 5.3 | 5.2 | 5.4 | 5.4 | 3.6 | 4.8 |
| SUNDEVIL | 4.9 | 3.7 | 3.9 | 3.7 | 4.5 | 4.2 | 4.8 | 5.0 | 5.0 | 5.4 | 5.4 | 3.7 | 4.7 |
| FMC 5-91 | 5.0 | 4.0 | 4.1 | 3.9 | 4.4 | 4.2 | 4.9 | 4.9 | 5.0 | 5.4 | 5.3 | 3.7 | 4.6 |
| FMC 6-91 | 5.1 | 4.1 | 4.0 | 3.9 | 4.3 | 4.2 | 4.8 | 5.0 | 4.9 | 5.4 | 5.5 | 3.7 | 4.5 |
| OKS 91-1 | 5.3 | 4.1 | 3.8 | 3.6 | 4.2 | 4.0 | 4.5 | 4.8 | 4.8 | 5.2 | 5.3 | 3.5 | 4.4 |
| FHB-135 | 4.6 | 3.9 | 4.7 | 4.2 | 4.1 | 4.4 | 4.7 | 4.5 | 4.5 | 5.1 | 6.1 | 4.2 | 4.3 |
| FMC 2-90 | 4.9 | 3.7 | 4.1 | 4.1 | 4.2 | 4.1 | 4.5 | 4.7 | 4.8 | 5.2 | 5.3 | 3.8 | 4.3 |
| FMC 3-91 | 4.9 | 4.1 | 4.1 | 3.9 | 4.1 | 4.0 | 4.4 | 4.7 | 4.7 | 5.2 | 5.5 | 3.7 | 4.3 |
| SAHARA | 5.1 | 4.1 | 4.3 | 4.0 | 4.2 | 4.0 | 4.5 | 4.7 | 4.8 | 5.2 | 5.3 | 3.5 | 4.3 |
| CHEYENNE | 5.0 | 3.7 | 3.9 | 3.8 | 4.0 | 4.0 | 4.4 | 4.7 | 4.5 | 5.0 | 5.1 | 3.6 | 4.2 |
| SONESTA | 5.3 | 4.1 | 4.1 | 3.9 | 4.1 | 3.8 | 4.3 | 4.4 | 4.3 | 5.0 | 5.4 | 3.4 | 4.1 |
| PRIMAVERA (FMC 1-90) | 5.0 | 3.6 | 3.9 | 3.7 | 3.9 | 3.7 | 4.1 | 4.3 | 4.3 | 5.0 | 5.3 | 3.5 | 3.9 |
| AZ. COMMON -SEED | 5.1 | 3.6 | 3.7 | 3.6 | 4.0 | 3.7 | 4.0 | 4.2 | 4.4 | 4.8 | 5.1 | 3.4 | 3.9 |
| AZ. COMMON-VEG. | 4.6 | 3.8 | 3.3 | 3.2 | 3.3 | 3.6 | 3.9 | 4.2 | 4.2 | 4.6 | 4.8 | 3.3 | 3.8 |
| LSD VALUE | 1.1 | 0.6 | 1.4 | 1.1 | 0.7 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 1.1 | 0.6 |

[1] To determine statistical differences among entries, subtract one entry's mean from another entry's mean. Statistical differences occur when this value is larger than the corresponding LSD Value (LSD 0.05).

[2] Source: National Turfgrass Evaluation Program. National Bermudagrass Test - 1993.