Turfgrass and Environmental Research Online

...Using Science to Benefit Golf

Since its inception in 1986, the bermudagrass breeding and development program at Oklahoma State University has released five cultivars with improved quality and winter hardiness. These cultivars have reduced the risk of winterkill when using bermudagrass in the transition zone. An extensive bermudagrass germplasm collection has been formed, breeding populations improved, and a steady stream of promising experimental lines has been developed. Dr. Yanqi Wu, Turf/Forage/Biofuels Breeder examines flowers of experimental bermudagrass lines in a field space planting.

Volume 6, Number 17
September 1, 2007

PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 350 projects at a cost of $29 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

Editor

Jeff Nus, Ph.D.
1032 Rogers Place
Lawrence, KS 66049
jnus@usga.org
(785) 832-2300
(785) 832-9265 (fax)

Research Director

Michael P. Kenna, Ph.D.
P.O. Box 2227
Stillwater, OK 74076
mkenna@usga.org
(405) 743-3900
(405) 743-3910 (fax)

Bermudagrass Cultivars with High Quality and Improved Cold Hardiness

Dennis L. Martin, Yanqi Wu, Jeff A. Anderson, Michael P. Anderson,
Gregory E. Bell, and Nathan R. Walker

SUMMARY

The turf bermudagrass breeding and development program at Oklahoma State University (OSU) began in the mid-1980s with the goal of developing high quality bermudagrasses with improved cold hardiness for the golf turf industry. In its first two decades, the effort has resulted in:

- Release of two seeded and three vegetative bermudagrass with improved quality, cold hardiness, and overall performance for the golf turf industry.
- Development of an extensive collection of bermudagrass germplasm for further breeding work.
- Substantially improved breeding populations for a more regular and continuous flow of bermudagrass cultivar releases.
- Advancements in genetic characterization of the bermudagrass species.
- Increased understanding of fundamental and applied aspects of stress tolerance.
- Generation of an increasing flow of royalties to the USGA and OSU enabling further turfgrass improvement.

Bermudagrasses (*Cynodon spp.*) are the most widely used turfgrasses for golf courses, athletic fields, and lawns in the southern United States. Tolerance to close mowing, as well as favorable heat, drought, and traffic tolerance and few serious pests makes bermudagrass an attractive choice in tropical and subtropical areas. Although widely adapted, bermudagrass susceptibility to freeze injury has been a continuing threat in many areas of its use. Several years of mild winters may occur between catastrophic winter events. When severe winter-kill does occur, considerable time and expense can be involved in repair of damage not to mention the potential for loss of revenues to severely damaged golf courses. Thus, there has been a long-term need for high quality bermudagrasses that have reduced risk of winterkill.

In 1986, Oklahoma State University (OSU), with support from the USGA, began a joint venture to improve the cold hardiness, as well as visual and performance qualities, of seeded turf bermudagrass. At that time, the only choice in seeded bermudagrasses was between the less winter hardy ‘Arizona Common’ (*C. dactylon* var. *dactylon*) or the more cold hardy but coarse-textured 'Guymon' (*C. dactylon* var. *dactylon* 'Guymon'). The bermuda breeding effort at OSU would eventually grow to encompass vegetatively propagated types. This article provides a brief overview of the OSU turf bermudagrass development effort.

An interspecific hybrid and an aggressive common bermudagrass “duke it out” during establishment phase. Inability to eradicate on-site aggressive common bermudagrass leads to mixtures with reduced playing surface quality. Work is underway at Oklahoma State University to determine if rapid-spreading improved types can better compete against "common" bermudagrass.

DENNIS L. MARTIN, Ph.D., Professor, Horticulture & Landscape Architecture Department; YANQI WU, Ph.D., Assistant Professor, Plant & Soil Sciences Department; JEFFREY A. ANDERSON Ph.D., Professor; MICHAEL P. ANDERSON, Ph.D., Professor; GREGORY E. BELL, Ph.D., Professor; Horticulture & Landscape Architecture Department, and NATHAN R. WALKER, Ph.D., Associate Professor, Entomology & Plant Pathology Department; Oklahoma State University, Stillwater, OK.

USGA Turfgrass and Environmental Research Online 6(17):1-8.
TGIF Record Number: 127725

Cultivar	Year Released	Propagation Method	Ploidy Level
Guymon	1982	Seed	Tetraploid
Midlawn†	1991	Vegetative	Triploid
Midfield†	1991	Vegetative	Triploid
Yukon	2000	Seed	Tetraploid
Riviera	2001	Seed	Tetraploid
Patriot	2002	Vegetative	Tetraploid

†Midlawn and Midfield developed by the Kansas State University (KSU) turf program and were jointly released with Oklahoma State University.

Table 1. Turfgrass cultivars released by the Oklahoma State University Bermudagrass Development program.

History of Bermudagrass Development at Oklahoma State University

Collection of *Cynodon* germplasm for culture and scientific use began around the start of the 20th century in South Africa and the US (16). Bermudagrass germplasm collection and taxonomic characterization at OSU was underway in the 1950s and 60s by Drs. Harlan, de Witt, and Huffine (4, 6, 7). Turf bermudagrass improvement at OSU, with support by the USGA, began in earnest in 1986 under the direction of Dr. Charles Taliaferro with assistance from Drs. Mike Kenna and Jeff Anderson. Dr. Joel Barber joined the development effort in 1987. The initial broad objective was to develop finer textured, seed-propagated, cold-tolerant bermudagrasses (*C. dactylon* var. *dactylon*) for the US transition zone. The initial efforts involved collecting additional germplasm, characterizing appearance and performance, improving the fertility and texture of breeding populations that were known to be cold-tolerant, and improving the cold hardiness in populations known to be highly fertile.

By 1990, the effort at OSU was expanded to include the development of high quality, cold-hardy vegetatively-propagated materials for golf course fairways/tees and to examine the possibility of generating improved African bermudagrasses (*C. transvaalensis)* for use on putting greens. Field plantings of improved African bermudagrasses in tropical areas of the US revealed the species performed well in fall, winter, and spring but declined substantially in the summer months in both tropical and the more southern subtropical planting sites. Many African bermudagrass selections also suffered substantially more nematode problems on the sandy gulf coastal plain soils compared with the interspecific hybrid 'Tifdwarf' and its derivatives. Although by early 1997 efforts to generate putting green types of African bermudagrass were discontinued, the breeding and selection effort in that species resulted in improved types that had value in generating improved interspecific hybrid crosses (*C. dactylon* X *C. transvaalensis*) for the golf turf industry.

Dr. Charles Taliaferro led the turf and forage bermudagrass breeding/development effort from its inception until his retirement in December 2005. 'Guymon', 'Yukon', 'Riviera', and 'Patriot' turf bermudagrasses (Table 1), as well as a number of promising experimental types (still under study), were developed under his leadership. Additionally, his familiarity with cultivar development helped facilitate cooperative releases of 'Midlawn' and 'Midfield' hybrid bermudagrasses between Kansas State University (KSU) and Oklahoma State University in 1991 (Table 1). 'Midlawn' and 'Midfield' were developed by Dr. Ray Keen of KSU with field testing assistance by Drs. John Pair and Dr. Jeff Nus of KSU, among other scientists. The successes of the OSU turf bermudagrass development program are not only due to USGA investment but can also be attrib-

Faculty Working Group Member	Area of Expertise
Charles Taliaferro	Team Coordinator (retired), Breeding & Genetics,
Yanqi Wu	New Coordinator, Breeding & Genetics
Dennis Martin	Cultural Management
Jeff Anderson	Physiology & Cold Tolerance
Mike Anderson	Molecular Biology &Genetics
Greg Bell	Cultural Management, Herbicide & Shade Tolerance
Nathan Walker	Plant Pathology, Entomology & Molecular Biology
Tom Royer	Entomology

Table 2. The Oklahoma State University Bermudagrass Breeding & Development Team has expertise in several crucial areas. Current team members and their areas of expertise are listed.

uted to the leadership of Dr. Charles Taliaferro in concert with a number of past and current faculty (Table 2), staff, graduate students, and cooperating industry scientists.

Following the retirement of Charles Taliaferro, an extensive search was conducted that resulted in the hiring of Dr. Yanqi Wu in July 2006 to head the OSU bermudagrass breeding and development effort. Dr. Wu completed his PhD under the tutelage of Dr. Charles Taliaferro in 2004. A substantial portion of the newer bermudagrass germplasm in our program was collected by and is in an ongoing state of characterization by Dr. Wu.

Bermudagrass Cultivars Developed at Oklahoma State University

Preceding the USGA-funded turf development effort at OSU, the forage/pasture effort resulted in the release of 'Guymon' bermudagrass (*C. dactylon* var. *dactylon* 'Guymon') in 1982 (17, Table 1). ‘Guymon’ was arguably the first seeded bermudagrass with improved cold hardiness compared to ‘Arizona Common’. ‘Guymon’ found favor in soil erosion control areas, roadsides, rangeland, and pastures. With only the non-cold hardy ‘Arizona Common’ bermudagrass seed being available during the 1980s, the coarse textured but cold hardy and vigorous ‘Guymon’ was often used on lower maintenance sports fields and lawns in the transition zone.

'Yukon' bermudagrass (*C. dactylon* var. *dactylon* 'Yukon'), tested as OKS 91-11, was released in 2000 (18). It was the first turf bermudagrass from OSU developed with grant funding from the USGA. ‘Yukon’ is a high quality seeded turf-type bermudagrass with improved cold hardiness (1) and improved spring dead spot disease tolerance (10, 13).

‘Yukon’ found favor on some golf courses, sports fields, and in the lawn/landscape industry. It performs well at the 0.5-inch mowing height typical of bermudagrass fairways. Divot recovery rate of ‘Yukon’ varies from intermediate (Martin, unpublished) to rapid (8). Although ‘Yukon’ seed availability has been limited in recent years, increased availability of seed is anticipated in the near future. ‘Yukon’ continues to provide excellent quality in transition zone climates (Table 3). ‘Yukon seed’ production rights are licensed to Seed Research of Oregon, a Division of Pick Seed USA.

'Riviera' bermudagrass (*C. dactylon* var. *dactylon* 'Riviera'), tested as OKS 95-1, was released in 2001. ‘Riviera’is a high quality (Table 4), medium-fine textured seeded bermudagrass. ‘Riviera’ seed production yields are typically higher than those of ‘Yukon’ (19). ‘Riviera’ has improved cold hardiness (2) and improved tolerance to spring dead spot disease (11, 13). ‘Riviera’ divot recovery rate varies from intermediate (8) to rapid (Martin, unpublished). ‘Riviera’ is now

Seeded Entry	Mean
Yukon	6.2
Riviera	5.8
Contessa	5.8
SWI-1046	5.7
SWI-1012	5.7
SWI-1044	5.6
CIS-CD6	5.4
Veracruz	5.4
SWI-1014	5.4
CIS-CD7	5.3
SWI-1003	5.2
Sunbird	5.1
SWI-1001	5.1
Princess 77	5.0
Tift No. 2	5.0
Transcontinental	5.0
CIS-CD5	4.9
Tift No. 1	4.8
SR 9554	4.8
Panama	4.7
LaPaloma	4.7
FMC-6	4.7
Arizona Common	4.7
Southern Star	4.7
NuMex Sahara	4.6
Mohawk	4.6
Sundevil II	4.5
Sunstar	4.5
B-14	4.5
LSD (0.05)	0.3
Coeff. of variation (%)	12.3

†Excerpted from Tables 3b, p. 14., of the 2006 NTEP Progress Report NTEP No. 07-6. Quality rated on a 1 - 9 scale where 1 is poor and 9 is excellent.

Table 3. Mean turfgrass quality ratings of seeded bermudagrasses during 2006 from 9 transition zone locations, 2002-2006 NTEP Bermudagrass Trial†.

Entry	Regime A††	Regime B
Arizona Common	4.7	4.5
Blackjack	5.3	5.4
Blue-Muda	5.1	5.0
Cardinal	5.4	5.7
CN 2-9	6.1	5.8
J-540	5.3	5.2
Jackpot	5.0	4.9
Majestic	5.3	5.3
Midlawn	5.8	6.5
Mini-Verde	5.6	5.1
Mirage	5.1	4.9
NuMex-Sahara	5.0	5.0
OKC 19-9	5.8	6.1
Patriot	6.1	6.6
Princess 77	6.5	6.1
Pyramid	5.2	5.0
Riviera	6.4	6.6
Savannah	5.4	5.3
Shanghai	5.6	6.1
Shangra La	5.2	5.1
Southern Star	5.4	5.4
Sundevil II	5.3	5.0
SWI-11	6.1	5.5
Sydney	5.2	5.2
Tifgreen	6.1	6.3
Tifsport	6.5	6.1
Tifway	6.4	6.2
Transcontinental	6.0	5.6
LSD (0.05)	0.2	0.2
Coeff. of variation	14.0	14.9

†Excerpted from Tables 1a and 2a of the 1997-2001 NTEP Bermudagrass trial Final Report NTEP No. 97-9. Quality rated on a 1 - 9 scale where 1 is poor and 9 is excellent.

††The 9 Regime A trials were mowed at 0.5 to 0.75 inches and fertilized with 0.75 - 1 lb of N per 1,000 sq. ft per growing month. The 11 Regime B trials were mowed at 0.75 to 1.0 inches and fertilized with 0.5 - 0.75 lb of N per 1,000 sq. ft per growing month. Both regimes included irrigation to prevent visual drought stress.

Table 4. Mean bermudagrass quality from multiple locations during the 1997-2001 National Turfgrass Evaluation Program Bermudagrass Trial†.

receiving increased use on fairways, tees, athletic fields, and lawns when a high quality seeded bermudagrass with improved cold hardiness is desired. Although originally created as a seed-propagated bermudagrass, arrangements have been made to allow for the production of 'Riviera' sod for use on sites where installation deadlines are too short for seeding or high erosion potential demands sodding. 'Riviera' seed production rights are licensed to Johnston Seed Company.

'Patriot' bermudagrass (*C. dactylon* X C. *transvaalensis* 'Patriot'), tested as OKC 18-4, was released in 2003. 'Patriot' is a vegetatively propagated hybrid characterized as having improved color, quality (Table 4), and cold hardiness (2). Divot recovery rate has been characterized as medium (8) to rapid (Martin, unpublished). Licensed producers have reported rapid sod production cycles from planting to harvest. Improved tolerance to spring dead spot disease (11, 13) has been documented in 'Patriot'. We believe 'Patriot' to be the first commercialized interspecific hybrid turf-type bermudagrass that is a tetraploid. It was created by the cross of the hexaploid 'Tifton 10' and an improved African bermudagrass (a diploid) from our collection.

'Patriot' is well adapted to golf course tee and fairway use and is currently experiencing increased use by the golf course industry. 'Patriot' has been widely accepted as a sports turf playing surface for football, baseball, and soccer in the transition zone and upper region of bermudagrass adaptation.

A Note of Caution - Improved Cold Hardiness But…

For those unfamiliar with bermudagrass, types with improved cold hardiness still experience canopy (leaf and aerial shoot) discoloration under short day length and chilling temperatures, as well as when death of leaves occurs from freeze injury. Although these bermudagrasses often perform suitably in full sun areas of USDA Hardiness zones 5a or 5b during summer, they can still experience significant winterkill during cold winters as seen in National Turfgrass Evaluation Program Trials (11). The USDA Cold Hardiness zone map it is located at: http://www.usna.usda.gov/Hardzone/ushzmap.html. Prospective bermudagrass users are urged to conduct a thorough risk/benefit analysis before making a decision to switch from one bermudagrass to another, or if switching from a cool-season grass to bermudagrass.

Experimental Oklahoma Selections with Promise

OKC 70-18 bermudagrass developed in part with funding from the USGA has recently undergone intensive internal as well as external testing (2002-2006 NTEP bermudagrass trial). This variety ranked first in overall quality at nine transition zone test sites during several years of the 2002-2006 NTEP trial. OKC 70-18 has several meritorious characteristics and a decision concerning possible release is forthcoming.

Three promising experimental bermudagrasses from our program were entered into the 2007-2011 NTEP bermudagrass trial. These included OKC 11-19 and OKC 11-34, vegetatively propagated types and a seeded type, OKS 2004-2. Sixteen NTEP testing sites are in place for the 2007 NTEP trial. Besides the traditional parameters of color, quality, texture, density, green-up, and living cover, additional parameters monitored

'Riviera' is a high quality seeded bermudagrass with improved cold hardiness and rapid divot recovery rate.

"Patriot is a high quality vegetatively propagated interspecific hybrid bermudagrass with improved cold hardiness and rapid divot recovery rate.

at selected sites will include sod tensile strength, as well as tolerance to spring dead spot disease, salinity, and traffic (14).

Current Breeding/Development Work in the Oklahoma State Bermudagrass Program

A new broad-based breeding population was recently formed using desirable Chinese *Cynodon* material selected from a collection by Dr. Wu made in 11 provincial regions of China. Selections were made based on extensive evaluation of chromosomal, morphological, seed yield potential, and DNA marker investigations completed in 2004 (21, 22, 23, 24). The population contains favorable traits for turf cultivar development, including darker green color, relatively fine texture, good winter hardiness, and good sod density. Study of genetic relatedness assists the turf breeder in elimination of possible duplication of breeding efforts due to close relatedness of parents. Additionally, this work may help in locating crosses that have increased likelihood of compatibility.

Complimentary to this work, Dr. Kevin Kenworthy (now of the University of Florida Turfgrass Program) recently completed an assessment of the variability in 21 performance traits of African bermudagrass while in our program (9). The work determined which traits can most easily be improved in the African bermudagrass parents that are subsequently used for developing interspecific crosses.

Applied field trials comparing later-stage promising experimental entries and industry standards are on-going for turf quality, divot recovery, spring dead spot disease resistance, and sod tensile strength. Due to inability to eradicate preexisting aggressive *C. dactylon* var. *dactylon* types from many installation sites, some superintendents choose not to renovate to improved bermudagrass cultivars. In order to address this issue, a preliminary study investigating the resistance of hybrid bermudagrasses to encroachment by common bermudagrass was initiated in 2006 by MS candidate Holly Han.

What Bermudagrass Performance Features Will the OSU Program Focus on in the Future?

Development of bermudagrasses with high turf quality and suitable cold hardiness will remain a key focus of our efforts, however pursuit of additional improvements has begun. Limited fresh water resources threaten the vitality of the golf turf and landscape industry. Work commenced in late summer 2007 by MS Candidate Santanu Thapa to evaluate the water use rate of several experimental OSU bermudagrasses. Evaluation of leaf firing resistance under drought will also be incorporated into our screening program in future years. Development of bermudagrasses with delayed leaf firing may help superintendents maintain quality turf during periods of limited natural rainfall and during irrigation restrictions.

Lack of suitable shade tolerance is a key limitation of bermudagrass (3). As the golf course landscape matures, increased shading of turf occurs. Breeding and selection for improved shade tolerance in bermudagrass has been successfully conducted by turfgrass scientists at the University of Georgia (5). Screening of bermudagrass germplasm for improved shade tolerance commenced in our program in summer of 2007 by Drs. Greg Bell and Yanqi Wu. The work incorpo-

rates the use of a combination of natural and artificial shade.

Conclusions

USGA support has been instrumental in the long-term turf bermudagrass development effort at Oklahoma State University. A comprehensive, interdisciplinary team of scientists has been assembled focusing on turf bermudagrass improvement. The effort has resulted in extensive collection, characterization, and improvement of breeding populations of bermudagrasses from the *Cynodon dactylon* and *C. transvaalensis* species. Studies aiding in the understanding of fundamental mechanisms of stress tolerance has occurred. Improvements in turf quality, cold hardiness, and spring dead spot tolerance has occurred. The improved turf bermudagrasses 'Yukon', 'Riviera', and 'Patriot' were direct results of the USGA investment.

Training of a number of graduate students has occurred. Two clonally propagated and one seed propagated selection with improved characteristics for the golf industry were entered into the 2007 NTEP bermudagrass trial. New germplasm from China has recently been introduced into our program. Incorporation of increased water use efficiency, leaf firing resistance under drought, and improved shade tolerance in bermudagrass are future goals of our development effort.

Acknowledgements

The authors wish to thank the USGA's Turfgrass and Environmental Research Program for support of this research program. Also, support of the Oklahoma State University Agricultural Experiment Station and the Oklahoma Turfgrass Research Foundation are gratefully acknowledged.

Literature Cited

1. Anderson, J.A., C.M. Taliaferro, and D.L. Martin. 2002. Freeze tolerance of bermudagrasses: vegetatively propagated cultivars intended for fairway and putting green use, and seed-propagated cultivars. *Crop Sci.* 42:975-977. (TGIF Record 79907)

2. Anderson, J.A., C.M. Taliaferro, Y.Q. Wu. 2007. Freeze tolerance of seed- and vegetatively-propagated bermudagrasses compared with standard cultivars. *Appl. Turfgrass. Sci.* May 8. p.1-7. (TGIF Record 124630)

3. Beard, J.B. 1973. The turfgrass environment: light. Pages 181-208. *In* Turfgrass Science and Culture. Prentice-Hall, Inc., Englewood Cliffs, N.J. (TGIF Record 294)

4. de Wet, J.M.J., and J.R. Harlan. 1970. Biosystematics of *Cynodon* L.C.Rich. (Gramineae). *Taxon.* 19:565-569. (TGIF Record 98495)

5. Hanna, W., and B. Maw. 2007. Shade resistant bermudagrass. *USGA Green Section Record* 45(2):9-11. Available on-line at: http://turf.lib.msu.edu/2000s/2007/070309.pdf (TGIF Record 122766)

6. Harlan, J.R., J.M.J. de Wet, W.W. Huffine, and J.R. Deakin. 1970. A guide to the species of *Cynodon* (Gramineae). *Okla. Agric. Exp. Stn. Bulletin* B-673. (TGIF Record 30696)

7. Harlan, J.R., J.M.J. de Wet, K.M. Rawal, M. R. Felder, and W. L. Richardson. 1970. Cytogenetic studies in *Cynodon* L. C. Rich (Gramineae). *Crop Sci.* 10:288-291. (TGIF Record 2821)

8. Karcher, D.E., M.D. Richardson, J.W. Landreth, J.H. McCalla, Jr. 2005. Recovery of bermudagrass varieties from divot injury. *Applied Turfgrass Science.* Jan. 17. p. 1-7. (TGIF Record 100540)

9. Kenworthy, K.E., C.M. Taliaferro, B.F. Carver, D.L. Martin, J.A. Anderson, and G.E. Bell. 2006. Genetic variation in *Cynodon transvaalensis* Burtt-Davy. *Crop Sci.* 46:2376-2381. (TGIF Record 119186)

10. Martin, D.L., G.E. Bell, J.H. Baird, C.M. Taliaferro, N.A. Tisserat, R.M. Kuzmic, D.D. Dobson, and J.A. Anderson. 2001. Spring dead spot resistance and quality of seeded bermudagrasses under different mowing heights. *Crop Sci.* 41:451-456. (TGIF Record 73367)

11. Morris, K.E. 1997. Table 14a. Percent winterkill ratings of bermudagrass cultivars 1992-1996. Page 41. *In* 1992-1996 National Bermudagrass Test Report. Final Report NTEP No. 97-9. Beltsville, MD. (TGIF Record 54866)

12. Morris, K.E. 2002. Table 56a. Spring dead spot measurements of bermudagrass cultivars at Stillwater, OK, 1997-2001 Data. Page 114. *In* Final Report NTEP No. 02-7. Beltsville, MD. (TGIF Record 81657)

13. Morris, K.E. 2004. Table 20a. Percent winter kill ratings of bermudagrass cultivars 2003 data. Page 62. *In* 2002 - 2004 National Bermudagrass Test Report. Progress Report NTEP No. 04-1. Beltsville, MD. (TGIF Record 107241)

14. Morris, K.E. 2005. Table 34a. Spring dead spot measurements of bermudagrass cultivars, 2004 data. Page 106. *In* 2002-2004 National Bermudagrass Test Report. Progress Report NTEP No. 05-4. Beltsville, MD. (TGIF Record 107242)

15. Morris, K.E. 2007. 2007 Approved NTEP bermudagrass trial locations. NTEP News Room. March 2007. Available on-line at: http://www.ntep.org/pdf/2007/2007%20NTEP%20Bermuda%20Trial%20selected%20locations.pdf

16.Taliaferro, C.M. 2003. Bermudagrass (*Cynodon* (L.) Rich). Pages 235-256. *In* M. D. Casler and R. Duncan (eds.) Turfgrass Biology, Genetics, and Cytotaxonomy. Sleeping Bear Press, Ann Arbor, MI. (TGIF Record 92152)

17. Taliaferro, C.M., R.M. Ahring, and W.L. Richardson. 1983. Registration of 'Guymon' bermudagrass. *Crop Sci.* 23:1219. (TGIF Record 1817)

18. Taliaferro, C.M., D.L. Martin, J.A. Anderson, M.P. Anderson, G.E. Bell, and A.C. Guenzi. 2003. Registration of 'Yukon' bermudagrass. *Crop Sci.* 43:1131-1132. (TGIF Record 86327)

19. Taliaferro, C.M., D.L. Martin, J.A. Anderson, M.P. Anderson, and A.C. Guenzi. 2004. Broadening the horizons of turf bermudagrass. *USGA Turfgrass and Environmental Research Online* 3(20):1-9. (TGIF Record 98496)

20. Wu, Y.Q., C.M. Taliaferro, and M.P. Anderson. 2004. AFLP analysis of *Cynodon dactylon* (L.) Pers. var. *dactylon* genetic variation. *Genome* 47: 689-696. (TGIF Record 125504)

21. Wu, Y.Q., C.M. Taliaferro, G.H. Bai, and M.P. Anderson. 2005. Genetic diversity of *Cynodon transvaalensis* Burtt-Davy and its relatedness to hexaploid *C. dactylon* (L.) Pers. as indicated by AFLP markers. *Crop Sci.* 45:848-853. (TGIF Record 104608)

22. Wu, Y.Q., C.M. Taliaferro, G.H. Bai, D.L. Martin, J.A. Anderson, M.P. Anderson, and R.M. Edwards. 2006. Genetic analyses of Chinese *Cynodon* accessions by flow cytometry and AFLP markers. *Crop Sci.* 46:917-926. (TGIF Record 110350)

23. Wu, Y.Q., C.M. Taliaferro, D.L. Martin, C.L. Goad, and J.A. Anderson. 2006. Genetic variability and relationships for seed yield and its components in Chinese *Cynodon* accessions. *Field Crops Res.* 98:245-252. (TGIF Record 127697)