was used in a bioassay. Herbicide effectiveness was measured as suppression of annual ryegrass seed germination. Oryzalin suppressed germination about as effectively (54.9% of the untreated control) as pendimethalin (55.7% of the untreated control). This will allow us to adjust the treatments to achieve similar *efficacy rates* for both herbicides.

Concurrently with the greenhouse experiment, we are using selected RFLP markers taken from maize (*Zea mays* L.) to check for appearance of DNA polymorphism that might stem from chronic exposure of the grasses to the herbicide. It is unknown if these compounds are mutagenic; however, many organic compounds, including some herbicides, have mutagenic activity at high rates and/or chronic exposure levels). RFLPs will allow us to monitor phenotypically silent mutations. Although these do not result in observable off-types, appearance of new RFLP band polymorphism due to the treatments will guide us in determining application rates that will enhance the odds in favor of producing an off-type.

To date, 71 maize cDNA clones have been tested in cross-species hybridizations against bermudagrass DNA to identify those that show an adequate signal in Southern blots of bermudagrass. Roughly 75 percent of those tested are usable, and there are three subclasses within this category: a) those showing strong signals on bermuda, b) those with moderate signals, and c) those that show a weak signal (these three subclasses are present in fairly equal proportions). These selected probes will be used to probe Southern blots of bermudagrass genomic DNA samples from flats subjected to the herbicide treatments.

Cytological examinations of the six varieties to this point have revealed only the expected number of chromosomes for triploid bermudagrass ($2n = 3x = 27$). I

Genetic Enhancement of Paspalum for Recreational Turf

University of Georgia

Ron R. Duncan

Start Date: 1998
Number of Years: 5
Total Funding: $125,000

Objectives:

1. *Ecotype evaluations off-site and industry collaboration.*
2. *Creation of additional genetic diversity within the species.*
3. *Genetic profiling of ecotypes.*

AP-10 (greens) and Fwy-1 (PI 509018-1: fairway/tees) ecotypes are slated for submission to the University of Georgia germplasm release committee during early 1999. Sufficient vegetative material will be available if the releases are successful. These seashore paspalums have exhibited excellent aggressiveness and performance on golf courses and under sod production. The darker green genetic color and turf quality traits are parallel to or better than most dwarf bermudagrasses. Genetic analysis research involving simple sequence repeats (SSRs or microsatellites) has progressed to the point of effectively profiling individual ecotypes for plant variety protection using trinucleotide repeats.

Wear tolerance mechanisms differ between paspalum and bermudagrass. Recoverability rates were identical between the two species. Wear tolerance in paspalum was attributed to leaf total cell wall contents (50% of the variability) while tolerance in bermuda was due to stem moisture (41%) and stem cellulose (32%).

Fertility studies have revealed that paspalum is more highly responsive to $CaNO_3$ than NH_4NO_3, NH_4SO_4, or urea. These highly soluble fertilizers appear to be critical for rapid establishment and recoverability, and may be important during long-term management in stressed environments. I

Long-Term Preservation of Clonally Propagated Turfgrass Species

Colorado State University

Harrison G. Hughes

Start Date: 1998
Number of Years: 2
Total Funding: $49,701

Objectives:

1. *Develop suitable micropropagation procedures for selected genotypes of bermudagrass, zoysiagrass, saltgrass and buffalograss.*
2. *Develop suitable shoot tip culture media (STCM) for the four species.*
3. *Examine cryopreservation of the four species using vitrification methodologies.*

Clones of saltgrass (6), buffalograss (3), bermudagrass (1), and zoysiagrass (1), were established in the greenhouse and grown for a source of materials to put into tissue culture. It is important to establish *in vitro* protocol for each clone because cryopreservation requires very small growing points which will need to be established *in vitro* after freezing. If the tissue contains bacteria or fungal contaminates, they will likely overgrow any plant tissue thus obscuring positive results.

Various techniques involving different bleach treatment times and *PPM* (a commercially patented compound with antibiotic activity) concentrations, were used to disinfect tissue samples of buffalograss, bermudagrass, and saltgrass. Basal medium used was half strength MS and Nitsch and Nitsch vitamins plus 5 mg L^{-1} thiamine, 2 mg L^{-1} glycine and 30 g L^{-1} sucrose. Best results were obtained when small sections (1 to 2 cm) were used. In addition, either a bleach soak for 20 minutes for buffalograss, or 10-minute soak in bleach containing 5 mg

L^{-1} of *PPM* in the medium for bermudagrass provided better results.

Clean cultures of clones of buffalograss, bermudagrass, and saltgrass have been established and are being propagated for use in the cryopreservation studies.

Germplasm Development for Buffalograss Varieties

University of Nebraska

Terrance Riordan

Start Date: 1998
Number of Years: 5
Total Funding: $125,000

Objectives:

1. *Acquire additional germplasm through collection and recombination of germplasm already in our collection.*
2. *Evaluate germplasm with superior turfgrass characteristics including mowing tolerance, color, length of growing season, insect resistance, establishment and recovery of vigor, sod strength, combining ability, and seed production.*
3. *Obtain inheritance data on important traits, conduct genome size and molecular marker analyses, and evaluate the impact of inbreeding and genetic diversity on variety development.*

Seeded Releases. Native Turf Group (NTG) is considering the possibility of selling *NTG-5*, which was included in the 1991 National Turfgrass Evaluation Trial, and they are looking at *NTG-7* and *FW-3* (a low mowing tolerant experimental) for future release and production.

Vegetative Releases. Patents were filed for new releases *NE 86-61, NE 86-120* and *NE 91-118*, but have not been granted. Official UNL release statements have been completed and these cultivars are included in the 1996 National Turfgrass Evaluation Program Buffalograss Trial. *NE 91-118* has been vegetatively increased at Crenshaw Turf (CT) located at Poteet, Texas. Todd Valley Farms located at Mead, NE, bought a new farm and planted 35 acres of *NE 86-61*.

Sod Production. Crenshaw Turf (CT) has purchased Ellsberry Sod in Florida and Milberger Sod in Bay City, Texas. They continue to grow and have positive growth plans for production of buffalograss and other southern turf species. Todd Valley Farms (TVF) continue to increase sales of *378*, but TVF now has a greater role in developing the buffalograss market in the Northern United States. UNL, CT and TVF are working cooperatively on the development of new releases.

Summary of Breeding Work. Overall, the levels of performance continue to improve with each generation of selection. Newly released cultivars continue to show their superiority over older varieties with improved sod strength, color, quality, and density. Accessions from fairway maintained areas look very promising and show continuing improvements towards a high quality, low maintenance fairway turf. The top performers in the Nebraska National Buffalograss trial were *91-118* and *86-61*, which are being commercialized. The seeded varieties *CODY* and *TATANKA* showed little differentiation during the first year of this study. However, in 1998 the advance-seeded types began to show better performance than the common types like *TEXOKA*.

Evaluation for Low-mowing and Wear tolerance. Under low mowing and no wear the female clone *92-135*, which outperformed all other entries in 1997, performed very well again in 1998 along with the female clone *92-31*. However, two male clones, *92-141* and *92-116*, had the best overall performance in 1998. All seed established experimentals exhibited average color and quality characteristics. The trial had a number of promising male and female clones. Wear results indicated that male and monoecious clones exhibited the most damage, while wear tolerance of female cultivars was significantly better than males, but not as good as for mixed seeded types.

Fertility and Mowing Effects on Buffalograss. At the Nebraska site, *NE 91-118* and *378* had the highest quality ratings at the 2.5 cm mowing heights for years 1996-1998. *CODY* and *TEXOKA* had poor quality ratings at the 2.5 cm mowing height for all years. In 1998, *NE 91-118*, *378*, and *CODY* had the highest quality ratings at the 5.1 cm mowing height. At the 7.6 cm mowing height, *CODY* and *TEXOKA* had the highest quality rating in 1997 but *CODY* and 378 had the highest quality ratings in 1998.

From 1997 to 1998, several trends were evident. First, turfgrass quality decreased from 1997 to 1998 for all cultivars at the 0, 2.4, and 5.0 g N m^{-2} rates. At 10 g N m^{-2}, *NE 91-118* and *378* had higher quality in 1998 than in 1997. All cultivars had improved quality ratings in 1998 at the 20 g N m^{-2} rate. Quality ratings in 1998 were poor (< 6) for all cultivars at 0, 2.4, and 5.0 g N m^{-2} rates. At 10 g N m^{-2} *NE 91-118, 378*, and *CODY* had good turfgrass quality. Management recommendations for 378 and *NE 91-118* are 2.5 or 5.1 cm mowing heights and a nitrogen rate of 10 g N m^{-2} $year^{-1}$. Recommendations for *CODY* and *TEXOKA* are 5.1 or 7.6 cm mowing heights and a nitrogen rate of 10 g N m^{-2} $year^{-1}$.

Nitrogen Partitioning in Turfgrasses. Field experiments to determine the fate of nitrogen fertilizer applied to three turfgrass species were initiated in 1997 at the John Seaton Anderson Turfgrass Research Facility near Mead, Nebraska. Fate of fertilizer nitrogen will be followed in buffalograss, Kentucky bluegrass, and tall fescue. Established turfgrass plots of two cultivars of buffalograss, *NE 91-118* and *NE 86-120*, a blend of Kentucky bluegrass, and a blend of tall fescue. The total amount of actual nitrogen that will be applied each year to a 9 m^2 plot is 0, 10, and 20 g N m^{-2}. For Kentucky bluegrass and tall fescue 80 percent of evapotranspiration will be returned every four days and for buffalograss 60 percent of evapotranspiration will be returned weekly. Plots will be randomly sampled prior to each fertilizer application to analyze for nitrogen content in plant and soil fractions. A Giddeon Soil Probe will be used to extract six cores (5 cm diameter) to a