Breeding and Evaluation of Turf Bermudagrass Varieties

Oklahoma State University
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Start Date: 1998
Number of Years: 5
Total Funding: $124,978

Objectives:

1. *Assemble and evaluate cynodon germplasm accessions for important descriptors. Incorporate descriptor information and accessions into the National Plant Germplasm System. Maintain a working collection of germplasm accessions with breeding value and utilize in turf bermudagrass breeding program.*
2. *Improve bermudagrass breeding populations for seed production potential, cold tolerance, and other traits conditioning turf performance.*
3. *Identify bermudagrass parental plants with superior combining ability for use in producing inter- and intra-specific F1 hybrid.*
4. *Develop, evaluate and release seed- and vegetatively propagated turf bermudagrass varieties.*

The principal objective of the turf bermudagrass breeding program at Oklahoma State University is to develop improved seed- and vegetatively propagated cultivars for the transition zone. The development of seeded turf bermudagrass cultivars for the transition zone requires combining into breeding populations cold hardiness, economic seed yield potential and acceptable turf quality. Recurrent selection (RS) for these traits in broad genetic base *C. dactylon* population has resulted in incremental improvement with each cycle of selection.

The cold tolerant, seeded, synthetic variety OKS 91-11, was released in January 1997. Current synthetic varieties under evaluation as candidates for commercial release are OKS 91-3 and OKS 95-1. Additional plants were selected from recurrent breeding nurseries over the past year to generate new populations. The most elite of the selected plants will also serve as parents in narrow genetic base synthetic varieties. Breeding improvement in the broad base populations has now reached threshold levels that will allow more rapid progress in seeded turf bermudagrass cultivar development.

Intra- and inter-specific crosses were made to generate F_1 progeny populations for evaluation as potential vegetatively-propagated, hybrid bermudagrass cultivars. One thousand F_1 hybrid progeny from crosses made in 1997 were transplanted into field nurseries in spring 1998 for initial screening Approximately 50 select hybrid plants selected over the past 3 years are now in advanced stages of evaluation. Potentially valuable fertile hybrid plants from *C. dactylon* (2n = 6x = 54 chromosome) x *C. transvaalensis* (2n = 2x = 18 chromosome) crosses have been obtained. These tetraploid (2n = 4x = 36 chromosome) plants have one full genome (9 chromosomes) from *C. transvaalensis* and three full genomes (27 chromosomes) from *C. dactylon*. Open-pollinated and hybrid progeny from these plants have shown desirable turf characteristics.

Breeding and Evaluation of Kentucky Bluegrass, Perennial Ryegrass, Tall Fescue, Fine Fescues, and Bentgrass for Turf

Rutgers University
Dr. Reed Funk

Start Date: 1998
Number of Years: 5
Total Funding: $40,000

Objectives:

1. *Collect and evaluate potentially useful turfgrass germplasm.*
2. *Collect and evaluate endophytes associated with cool-season turfgrass species.*
3. *Continue the breeding and development of new cool-season turfgrasses.*
4. *Develop and apply several new tools designed to improve the ability to discriminate among endophyte isolates from nature and to synthesize new grass-endophyte combinations for experimental testing and possible commercial use.*

Promising germplasm of turfgrasses and *Neotyphodium* endophytes were collected from Bulgaria, Poland, the Slovic Republic, Inner Mongolia, Uzbekistan, and the United States. This included a number of endophyte-containing bentgrasses with a very small percentage of panicles showing choke stroma.

Germplasm collections and current turf trials indicate opportunities for substantial genetic improvements in a number of grass species which have received limited attention in turfgrass breeding programs in the United States. These include velvet bentgrass, colonial bentgrass, dryland bentgrass, *Koelaria* spp., *Deschampsia* spp. and interspecific hybrids between Texas bluegrass and Kentucky bluegrass. We are also seeing continued genetic improvement in perennial ryegrass, turf-type tall fescue, fine fescues, creeping bentgrass, and Kentucky bluegrass.

Broad sense heritability of dollar spot resistance in creeping bentgrass is being studied through the evaluation of 500 creeping bentgrass clones replicated six times in two environments. This study was initiated in May of 1998 at the Horticultural Farm 11 located on Ryders Lane in North Brunswick, NJ. The clones were heavily inoculated with the dollar spot pathogen (*Sclerotinia homoeocarpa*) using infested Kentucky bluegrass seed in July of 1998. These clones were evaluated for resistance to dollar spot throughout the summer and into the fall of 1998. Initial results indicate that only 8 out of 500 clones show high levels of resistance to dollar spot disease.

Nearly 11,000 new turfgrass evaluation plots were seeded in field trials at Adelphia, North Brunswick, and Pittstown New Jersey. They included 4,500 plots of Kentucky bluegrass; 1,890 plots of fine fescues; 1,750 plots of tall fescue; 1,700 plots of perennial ryegrass; and 1,040 plots of bentgrass. These tests will be evaluated for a number of years for establishment vigor, turf quality, pest resistance, stress tolerance, texture, density, vertical growth rate, and persistence.

Approximately 100,000 plants were added to our spaced-plant nurseries for selection of promising clones, evaluation of seed yield, disease resistance, growth characteristics, stress tolerance, and breeding behavior. An additional 25,000 seedlings were established in mowed, clonal evaluation trials. These came from promising breeding lines of perennial ryegrasses, fine fescues, *Deschampsia spp.* and *Koelaria spp.*

Research is currently underway to identify and characterize microsatellites in perennial ryegrass. These molecular markers are short DNA sequences that contain short di- or tri-nucleotide repeats that are randomly dispersed throughout the genome in most organisms. Their abundance makes them particularly useful for DNA fingerprinting which can aid in cultivar identification and ultimately cultivar protection. Microsatellites can also be useful for population genetics studies and for marker assisted breeding. Twelve polymorphic or variable microsatellite loci have been identified and used to study ryegrass cultivars, clones and other species within the genus *Lolium*. We find these markers provide reasonable insights into genetic relationships and are excellent for cultivar identification in perennial ryegrass. Seventy-five more potentially useful microsatellite loci that have been identified but need to be investigated further to determine if they are polymorphic. Since 20 to 30 polymorphic or variable loci are ideal for precise cultivar identification and chromosome mapping, future studies will concentrate on identifying more of these loci in perennial ryegrass.

We participated in the development of a number of new turfgrass cultivars. These included Jefferson, *CHAMPAGNE, CACHE, MOONLIGHT, DRAGON, BLACKSTONE, H94-301, SR-2100* and *SR-2109* Kentucky bluegrasses; *BRIGHTSTAR 11, CALYPSO 11, MONTEREY, PANTHER, PRELUDE III, PRIZIN, CATALINA, WINDSTAR, EXACTA, CHURCHILL*, and *PARAGON* perennial ryegrasses; *SHADOW II, AMBASSADOR, VICTORY 11*, and *TIFFANY* Chewings fescues; *OXFORD* and *NORDIC* hard fescues; *FLYER II, TRAPEZE, PATHFINDER, FENWAY* and *AUDUBON* strong creeping red fescues; and *REMBRANDT, RENEGADE, PICASSO, MASTERPIECE, WOLFPACK, PLANTATION, MILLENNIUM*, and *SHENANDOAH II* tall fescues.

Field trials of transgenic creeping bentgrass have been established to evaluate promising transformed genes for herbicide resistance, stress tolerance, and pest resistance. Crosses have been made to initiate population backcrossing and recurrent selection programs to incorporate these genes into elite varieties and breeding synthetics. Work is progressing on the transformation of other turfgrass species.

We continue to make crosses of elite Kentucky bluegrass parents and screen large numbers of seedlings for promising hybrids under greenhouse conditions and in spaced-plant field nurseries. I

Seashore Paspalum Ecotype Tolerance to Root Limiting Soil Stresses and Traffic Stresses

University of Georgia

Robert N. Carrow

Start Date: 1998
Number of Years: 3
Total Funding: $75,000

Objectives:

1. *Develop and implement a salinity tolerance screening procedure that a) provides salinity tolerance of seashore paspalum ecotypes under well-watered and drought stress, b) allows 3 salinity tolerance screening protocols to be assessed for efficiency in separating seashore paspalum ecotypes and for establishing a "standard" protocol, and c) provides detailed data on seashore paspalum ecotype root tolerance data on the edaphic (soil) stresses of salinity, drought, and drought+salinty.*
2. *Determine seashore paspalum ecotype tolerance to the multiple root stresses in the acid soil complex (soil strength, drought, nutrient deficiencies, element toxicities, high soil/air temperatures) that strongly influence drought resistance via drought avoidance from deep rooting.*
3. *For nine seashore paspalum ecotypes with the greatest potential for release, to determine relative to TIFWAY bermudagrass overall drought resistance, rooting, shoot performance, and water use (ET)/soil extraction patterns under close-cut fairway conditions.*

The breeding/genetics paradigm of Dr. R. R. Duncan's program for seashore paspalum (*Paspalum vaginatum*) is to systematically determine ecotype tolerance to important stresses. Of particular interest is genetic-based resistance to soil chemical and physical factors that limit root development and longevity. For grasses, these are: 1) high soil strength, 2) soil drought where soil drying causes death of roots that varies considerably with ecotype, 3) high soil salinity limiting root growth through physiological drought and specific ion toxicity, 4) acid soil complex which is common on kaolinitic and Fe/Al oxide soils, 5) low soil oxygen, and 6) high air and soil temperatures, especially for cool-season species.

In this project, seashore paspalum ecotypes are screened for root responses to 4 of the 6 edaphic factors that limit rooting. This *multiple stress approach* provides important