Pennsylvania State University - Dr. Joseph M. Duich

Bentgrass Breeding

This research program has made a tremendous impact on golf through the development of 'Penncross', 'Penneagle', and 'Pennlinks' creeping bentgrass. The USGA/GCSAA research program has contributed a modest amount toward the continuing efforts of Dr. Duich to develop improved creeping and colonial bentgrass varieties.

In 1986, Pennlinks (PSU 126) was released and named. This cultivar featured an upright growth habit, finer leaves, minimal segregation, and improved seasonal turf quality and overall performance. A putting green evaluation trial with 38 varieties was established in 1989 and included 28 new PSU experimentals. Six of the experimentals were very promising, and resulting progeny continue to be evaluated under close clipping to develop close-cut tolerant creeping bentgrasses.

In addition, gel electrophoresis (finger printing) was evaluated to help develop methods which identify differences between bentgrass varieties. Fairway management studies with new and old bentgrass varieties also were conducted with growth regulators and clipping removal as methods to reduce *Poa annua* and disease reduction (i.e., leafspot, dollarspot, and brownpatch).

Studies were completed to enhance efforts to develop improved colonial bentgrasses. Early flowering response, improving rhizome production, tissue culture attempts to produce haploid plants from anthers, and refining somatic tissue culture media were some of the areas investigated.

University of Rhode Island - Dr. C. Richard Skogley

Selection and Breeding of Superior Bentgrasses

Since 1960, ongoing USGA research grants have been utilized to support an extensive effort in plant improvement at the University of Rhode Island. In 1989, 'Providence' creeping bentgrass was released and seed was sold to several New England golf courses and many others nationally. Through the years, the turfgrass breeding program conducted by Dr. Skogley has produced several other important turfgrass cultivars, including, 'Jamestown' and 'Jamestown II' Chewings fescues, 'Georgetown' Kentucky bluegrass, 'Kingstown' velvet bentgrass, and 'Exeter' colonial bentgrass.

Texas A&M University - Dr. Milton C. Engelke

Breeding and Development of Bentgrass

Even though creeping bentgrass provides a superior putting surface, its use is limited in the South due to its intolerance of high heat. Moisture stress can be relieved with good irrigation management; however, very little can be done to relieve the plant stresses caused by high temperatures. The major objective of this project was to develop bentgrass cultivars with superior heat tolerance for both high soil and air temperatures.

High ambient and soil temperatures impair the transpirational cooling process of bentgrass. Most bentgrasses also exhibit a definite degeneration of root tissue and shortening of roots under high soil temperatures, close frequent mowing, and heavy traffic.

Through the efforts of Dr. Engelke and his research staff, screening techniques were developed which examined leaf and shoot water content as it relates to bentgrass plants grown in high ambient and soil temperatures. In addition, a root screening procedure which identifies individual plants with superior root growth characteristics was developed. Numerous parental plants were identified with superior agronomic and biological characters.

The increased use of bentgrass on fairways, in addition to putting greens, and support of bentgrass breeding on the part of the USGA/GCSAA, renewed the interest of seed companies and universities to release or develop new varieties. Several new experimental varieties from Texas A&M University and new commercial varieties, including Providence, Pennlinks, Putter, SR-1020, Cobra and others will meet the future demands of golf course greens and fairways.

Department of Scientific and Industrial Research, New Zealand - Dr. William Rumball

Colonial Bentgrass Breeding

The original objective of this project was to breed a colonial bentgrass (*Agrostis castellana*) cultivar for U.S. golf courses using New Zealand breeding materials. Breeding work was conducted in New Zealand, and many selections were tested in the United States. The resulting cultivar would, hopefully, require much less water and maintenance than those currently available in the United States, but still be attractive and persistent.

The project took the pragmatic approach that breeding material meeting these characteristics would probably be found on sites such as non-irrigated, low-input fairways of golf courses in hot, dry regions of New Zealand.

Thus far, the colonial bentgrass breeding project has provided an experimental cultivar for evaluation in the United States. Results from the performance of colonial bentgrass in the National Turfgrass Evaluation Program Trials indicate that the species may be useful in our maritime climates. The entry in these trials was developed under low input conditions with virtually no irrigation, fertilizer, or pest control and has not performed well in the high maintenance putting green trials.

This selection also could be used as a component for blending with cultivars of *Agrostis capillaris* to extend their drought tolerance and cool-season color. Dr. Rumball provided 108 half-sib progenies of *A. capillaris* which were evaluated at Rutgers University by Dr. Reed Funk. The data collected from these materials was used to develop a selection for further testing in the United States.

Bermudagrass

Bermudagrass is a widely used turfgrass throughout the warm season climates of the world. Breeding work, supported by the USGA, was initiated with bermudagrass in 1946. A number of improved vegetative selections resulted from these efforts. These grasses have virtually revolutionized the turfgrass industry in the regions of their adaptation yet there is still need for continued improvement in this all-important turfgrass species.

U.S. Department of Agriculture and University of Georgia - Dr. Glenn W. Burton

Vegetative Bermudagrass Breeding

Turf research at Tifton, Georgia, began in 1946 with a $500 annual USGA Green Section grant to supplement the USDA-University of Georgia forage grass breeding program begun in 1936. Developing a better bermudagrass to replace sand greens or seeded bermudagrass greens became the first objective of the new research program.

During the period from 1950 to 1965, this research program developed 'Tiflawn', 'Tiffine', 'Tifgreen', 'Tifway', and 'Tifdwarf'. Tiflawn, like common bermudagrass (*Cynodon dactylon*), was a tetraploid with 36 chromosomes. The remaining cultivars were produced by crossing fine-leafed *Cynodon transvaalensis* with 18 chromosomes and *C. dactylon* to produce sterile 27 chromosome hybrids. In particular, Tifgreen and Tifdwarf provided a vast improvement for putting greens, while Tifway was a superior cultivar for tees, fairways, and athletic fields.

The sterile triploid hybrids cannot be improved by conventional plant breeding methods. They can be modified by exposing dormant sprigs of the triploids to 7,000 to 9,000 r of gamma radiation from a cobalt-60 source. This was done at Tifton in 1970 and resulted in 158 mutants of Tifway, Tifgreen, and Tifdwarf that were evaluated until 1981, when a mutant of Tifway was released as 'Tifway II'. Tifway II looks like Tifway but is more resistant to root knot, ring, and sting nematodes, is more frost tolerant and greens up a littler earlier in the spring.

In 1983, 'Tifgreen II', a mutant of Tifgreen that has a lighter green color, greater cold tolerance, lower maintenance requirements, and better spring recovery was released. It is a little coarser than Tifgreen and makes a less desirable putting surface.

The most recent release is Tifton 10, a clone found by Dr. Burton in a lawn in Shanghai, China, in 1974. It has 54 chromosomes instead of 27 or 36, sets few seeds, and must be propagated vegetatively, but spreads faster than the Tifton bermudas. It has dark bluish-green color, good winter-hardiness, salt tolerance, and ring nematode resistance. Tifton 10 is coarser than the other Tifton bermudas.

Recent research efforts attempted to cross the Kentucky Quicksand common with the best *Cynodon transvaalensis* clones to obtain a more winter hardy hybrid. When these efforts failed, the Kentucky Quicksand clone was crossed with Tifton 68, an excellent pollen producer. After many pollinations using Quicksand as the female, four plants finally were produced and were most certainly selfs. These plants were sterile and showed no promise in the first evaluation and no potential as parents for future breeding. Unfortunately, the winter hardy Kentucky Quicksand bermudagrass cannot be used in a breeding program designed to develop more winter hardy hybrids.

Winter survival in plants has been associated with carbohydrate reserves stored in their roots and underground parts. In 1962, "A Method for Measuring Sod Reserves," *Agronomy Journal* 54:53-55 was described. The method involved cutting 6-inch plugs of sod, putting them in large empty cans, letting them develop etiolated stems in the dark and measuring the dry matter produced. This method was modified for use in current greenhouse