

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.

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#### *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-leaved *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

**Table 15. Summary of USGA/GCSAA Turfgrass Breeding Programs.**

Turfgrass	University	Status of Varieties
Creeping Bentgrass <i>Agrostis palustris</i>	Texas A&M University	88 Syn-3, and 88 Syn-4 released.
	University of Rhode Island	'Providence' released
Colonial Bentgrass <i>Agrostis castellana</i>	DSIR-New Zealand	A preliminary line, BR-1518, was entered in the NTEP trials.
Bermudagrass <i>Cynodon dactylon</i>	New Mexico State University	NuMex Sahara, Sonesta, and several other experimental seed propagated varieties were developed.
	Oklahoma State University	Two entered in 1992 NTEP Trials.
<i>C. transvaalensis</i>	Oklahoma State University	Thirty experimental cultivars in initial turfgrass evaluations.
<i>C. dactylon</i> X <i>C. transvaalensis</i>	University of Georgia	'Tifton 10' released, several 'Midiron' and 'Tifway' mutants are under evaluation.
Buffalograss <i>Buchloe dactyloides</i>	University of Nebraska	Several are entered in the 1991 NTEP Trial. Vegetative: NE 84-315, NE 84-378, NE 84-436, NE 84-453, and NE 84-609. Seeded: NTDG-1, NTDG-2, NTDG-3, NTDG-4, and NTDG-5
Alkaligrass <i>Puccinellia</i> spp.	Colorado State University	Ten improved families are under evaluation in preparation for release.
Blue grama <i>Bouteloua gracilis</i>	Colorado State University	'Elite', 'Nice', 'Plus' and 'Narrow' are under evaluation in preparation for release.
Fairway Crested Wheatgrass <i>Agropyron cristatum</i>	Colorado State University	Narrow leaved and rhizomatous populations are entering preliminary turfgrass trials and a second cycle of selection.
Curly Mesquitegrass <i>Hilaria belangeri</i>	University of Arizona	Seed increases of 'fine' and 'roadside' populations are underway in preparation of germplasm releases.
Annual bluegrass <i>Poa annua</i> var <i>reptans</i>	University of Minnesota	Selections #42, #117, #184, #208, and #234 under evaluation for seed production, naming and release.
Zoysiagrass <i>Zoysia japonica</i> and <i>Z. matrella</i>	Texas A&M University	Several are entered in 1991 NTEP Trial: DALZ8501, DALZ8502, DALZ-8507, DALZ8508, DALZ85012, DALZ85014, DALZ85016, DALZ8701, and DALZ9006.

and field trials to evaluate carbohydrate reserves in bermudagrass. With these methods, significant reserve differences were found among 16 genotypes

that involved the winter hardy Berlin bermuda as one parent. These had been mowed regularly and received low maintenance for 20 years.