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

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Goals:

- *Collect and evaluate potentially useful turfgrass germplasm.*
- *Collect and evaluate endophytes associated with cool-season turfgrass species.*
- *Continue the breeding and development of new cool-season turfgrasses.*

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The USGA has enjoyed a very long and productive relationship with Dr. Reed Funk at Rutgers University. Today, the financial contribution of the USGA to his breeding program is small compared to the progress made each year. A total of over 50,000 plots of turfgrass cultivars, experimental selections, and germplasm sources are under observation and evaluation in field trials at Adelphia, North Brunswick, and Pittstown, New Jersey.

More than 7,000 new turfgrass evaluation plots and eight acres of spaced-plant nurseries were established during 1995. Turfgrass evaluation tests included 3,305 plots of Kentucky bluegrass, 1,470 plots of perennial ryegrass, 1,500 plots of tall fescue, 850 plots of fine fescues, and 305 plots of creeping, colonial, dryland, and velvet bentgrasses.

Intraspecific and interspecific hybridization programs are being expanded in *Poa.* Many of the interspecific crosses are directed to transfer a useful endophyte into *Poa pratensis,* as well as increasing the pool of genetic diversity. Intraspecific crosses are directed to develop improved mid-Atlantic type bluegrasses with enhanced tolerance of heat and drought, deep roots and rhizomes, improved disease and insect resistance, and economical seed production. Current mid-Atlantic type Kentucky bluegrasses such as WABASH, BEL 21, VANTAGE, and EAGLETON are not widely used because of low seed yields.

Improved resistance or tolerance to billbugs is of vital importance to the summer performance and survival of many nonirrigated, medium-to-low maintenance turfs. Thinning of turf by billbugs creates conditions favorable to additional damage by chinch bugs and grubs. Weed invasion follows, restricting recovery of the Kentucky bluegrass turf.

Significant differences in damage by, tolerance of, and recovery from white grubs were observed in an older Kentucky bluegrass test. This test was growing under conditions of reduced air circulation which resulted in periods of severe heat stress. Kentucky bluegrasses showed striking differences in their ability to maintain an active, deep root system and to regenerate roots severed by grubs under these conditions.

One partial explanation for the differences observed among the Kentucky bluegrasses was the varying rate of net photosynthesis. Tolerance of high soil temperatures also could be involved. Mid-Atlantic ecotypes generally showed the best performance.

Germplasm developed at the New Jersey Agricultural Experiment Station contributed to a number of new turfgrass cultivars, including CALYPSO II, CITATION III, MANHATTAN III, WINDSTAR and RPBD perennial ryegrasses; TITAN II, CORONADO, FINELAWN PETITE, and COYOTE tall fescues; SOUTHPORT Chewings Fescue; WARWICK hard fescue; PRINCETON 105 and EAGLETON Kentucky bluegrasses; and L-93 creeping bentgrass.

Improved cultivars of *Koelaria macrantha* show promise as an attractive, fine-leaved, low-growing turfgrass for low-maintenance turfs. The cultivar Barkoel has performed well in turf trials receiving little or no fertilizer. However, it becomes excessively dense and is damaged by *Rhizoctonia* brown patch and other diseases when given too much fertilizer.

Hard fescues and blue fescues also perform best in lower maintenance trials receiving limited fertilizer. Hard and blue fescues frequently show serious damage from summer patch and subsequent chinch bug feeding when over fertilized, mowed close, and subjected to soil compaction. *Acremonium* endophytes frequently enhance performance of all fine fescues in New Jersey turf trials. This includes improved resistance to the dollar spot disease and perhaps summer patch.

Most improved turf-type cultivars of perennial ryegrass were developed from a very limited genetic base. For more than thirty years, extensive population improvement programs using phenotypic and genotypic recurrent selection, and occasional backcrossing, has been very effective in developing improved perennial ryegrasses.

Dramatic progress has been made developing ryegrasses with a darker color, greater density, finer leaves, a lower growth profile, improved mowing quality, and endophyte-enhanced insect resistance. Significant advances also have been made in seed yield potential as well as in seed production technology. Moderate progress has been made in improving tolerance of heat, cold, drought, shade, and wear. However, only limited progress has been made in developing stable resistance to crown rust, red thread and dollarspot. Turfgrass breeders have a great challenge and opportunity to find new sources of genetic resistance and better selection techniques to make improvements in these characteristics.

Most improved turf-type tall fescues were developed from a very narrow genetic base. Recurrent phenotypic assortive mating, combined with clonal and/or progeny trials conducted under frequent close mowing, has been used for a 34-year period. A few dozen plants surviving in old turfs in the United States were the primary parental germplasm. Substantial improvements have been made in developing tall fescues with darker color, finer leaves, greater density, a lower growth profile, greater persistence under close mowing, and high seed yields.

Kentucky 31 and most improved turf-type tall fescues show much better resistance to the *Rhizoctonia* brown patch disease compared to unadapted accessions from the cool-moist or hot-dry summer climates of Europe. However, genetic improvements in turf-type varieties for resistance to *Rhizoctonia* brown patch have not been sufficient to adequately overcome the more favorable conditions for this disease. A dense, lush turf that develops under high fertility and frequent close mowing remains very susceptible to *Rhizoctonia* brown patch in warm humid environments. *Pythium* blight also can be severe in turf-type tall fescues maintained in this manner.

Most of our major cool-season turfgrasses evolved in the cool-moist or hot-dry regions of Europe. This is the major reason why these cool-season species are not naturally well-adapted to warm-humid environments of much of the United States. It also helps explain reason why most of the germplasm used in the improved turf-type perennial ryegrassses and tall fescues originated from a few plants which had survived in old naturalized turfs in warm humid areas of the United States.

Much of the germplasm used in the development of the best performing Chewings fescues, strong creeping red fescues, blue fescues, Kentucky bluegrass, creeping bentgrasses, and rough bluegrasses also was collected from old turfs surviving in stressful environments of the United States. There is an urgent need for additional collection efforts in the United States, as well as in the regions of origin for all these species.

Among the extensive cool-season germplasm collections at Rutgers University, Kentucky bluegrass has the greatest amount of genetic diversity. Most of the characteristics desired in a cool-season, lawn-type turfgrass occur within this pool of Kentucky bluegrass germplasm. Unfortunately, recurrent selection and backcross breeding techniques to concentrate all of these useful characteristics into a single cultivar or interbreeding population cannot be used because of the apomictic reproductive behavior of Kentucky bluegrass. Efforts are underway to develop successful and efficient methods of population improvement in Kentucky bluegrass that will lead to faster progress in developing better turfgrasses.