A Short History of Creeping Bentgrass

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Mankind has long had an intimate association with grasses for survival and pleasure (Casler and Duncan, 2003). Over 500 years ago, at a time when the majority of people on the planet struggled daily for food and warmth, some Europeans took pleasure in hitting a small ball presumably into animal holes in the ground. These areas were naturally cropped by animals, both domestic and wild, causing the grasses to adapt to frequent defoliation and traffic. By the late 19th century, the simple game of golf had been developed as we know it, relying on regular-managed turf and skilled greenkeepers.

In the United Kingdom some of the grasses used for golf were bentgrasses though they were usually found in mixtures with fine fescues and sometimes ryegrass. A little over 100 years ago South German (Mixed) Bentgrass was introduced to the U.S for turf. Seed from pastures was harvested from what was then known as Austro-Hungary and later from other parts of Europe (Warnke, 2003). The seed, containing a mixture of creeping, colonial, velvet, and redtop bentgrasses was planted on U.S. golf courses and home lawns. Selections from some of the nicer-appearing patches were collected and maintained by the United States Golf Association Green Section at the Arlington Turf Gardens during the early 1900s (Duich, 1985). Some of the best turf patches were composed of creeping bentgrass (*Agrostis palustris* Huds.; possibly also *Agrostis stolonifera* L.) while others were velvet bentgrass (*Agrostis canina* L.). Since none of the creeping bentgrasses pro-

duced a consistently reliable seed source, cuttings of stolons (clones) were used to propagate the most desirable of the selections. These clones contained the exact same DNA as the "parents", including both desirable and undesirable characteristics. Continued propagation of the creeping bentgrasses resulted in what we now refer to as the "C-series" of "vegetative bentgrasses". Stolons were harvested from the turf using a type of vertical mower then collecting the stolons. Superintendents who wished to establish the vegetative varieties would purchase the stolons immediately after harvest then spread them on the ground, either covering them with sand or soil (stolonizing) or pocking them into the ground (sprigging). These practices are still used today in the southern U.S. for establishing vegetatively-propagated grasses such as hybrid bermudagrass. The vegetative bents became widely used on golf courses during the early half of the 20th century. The most popular variety was 'Toronto', sometimes called 'C-15'. Other varieties included Washington (C-50), Cohansey (C-7), Arlington (C-1), Congressional (C-19), Old Orchard (C-52), and Metropolitan (McCarty, 2001; Warnke, 2003). Although the release of 'Penncross' and other seeded varieties diminished the reliance on the C-series, they continued to be used until the early 1980s when they were discovered to be susceptible to bacterial wilt caused by *Xanthomonas campestris* (Roberts et al., 1983). Bacterial wilt appeared about the same time that sand topdressing began to be commonly employed: it is thought the abrasions from sand wounded bentgrass plants, allowing the bacterium (which had always been around) access to the turf (McCarty, 2001).

In 1954 Penncross became the first widely used seeded type of creeping bentgrass. Seeded varieties such as 'Seaside', 'Coos Bay', and 'Cocoos' bents were actually available prior to the 1950s (Hitchcock, 1951), but lacked the desirable characteristics of the vegetative bents and Penncross. Interestingly, Hitchcock (1951) listed these early seeded varieties as belonging to *Agrostis palustris* Huds., the same designation he applied to the vegetative bents. *A. stolonifera* was recognized as a different species and native to the U.S. Today the terms *A. stolonifera* and *A. palustris* are used interchangeably. Developed by Dr. Musser of Pennsylvania State University, Penncross remains unique among the bentgrasses because seed is developed by cross-pollination of three varieties. To produce Penncross seed, fields are planted with alternating rows of 'Pennlu', 9(38)5, and 11(38)4 (McCarty, 2001). Individual seeds of Penncross vary in the amount of DNA from each of the 3 parents resulting in good overall turf vigor but creating a tendency for turf to develop a patchy appearance over time known as "segregation". Segregation is especially prominent in older greens as individual plants develop into larger patches or distinguish themselves by differences in leaf texture, color, or other characteristics.

Occasionally segregating patches of turf yield substantial benefits. The A and G series of creeping bentgrass ('A-1', 'A-4', 'G-1', 'G-2', 'G-4', 'G-6') were developed from plants plucked from putting greens at Augusta National Golf Club in Georgia. The progenitors of the A and G series had a collection of genes that made for superior-quality turf compared to their brethren. These genes provided for the fine leaf texture, incredibly high density, and tolerance to short mowing height that have made the A and G series almost legendary.

While Penncross continues to be synonymous with creeping bentgrass for much of the interna-

tional golf world, U.S. turf managers have long realized its imperfections. Compared to other varieties, Penncross has a relatively shallow root system, a tendency to develop grain, and is prone to segregates into patches (McCarty, 2001). As with most bentgrass varieties, it lacks sufficient dollar spot resistance to obviate the need for fungicides, though it continues to have better resistance than some newer varieties.

As the U.S. economy began to boom following WWII, golf course development followed suit. Between 1950 and 1970 the number of golf courses nearly doubled from approximately 5,000 to 10,000, and has since nearly doubled again to approximately 17,000 (Beard, 2002). The U.S. turf seed market became the second largest in the country following only corn (maize). A growing realization that a single grass variety did not have suitable genes for all situations became evident. Long dominated by Pure Seed Testing, Inc., other companies and universities began breeding creeping bentgrass cultivars, often for specific niches. In the mid-1990's 'Crenshaw' was released by Texas A & M specifically for the high temperatures of the American Southeast (Engelke et al., 1995; McCarty, 2001). Crenshaw has since acquired an unfavorable reputation as being especially prone to dollar spot but this is because it was planted outside the region for which it was adapted. Other varieties such as Seaside and 'Mariner' (developed from a Seaside selection) were developed for improved salt tolerance. Salt tolerance will become more important in many parts of the country as increasing numbers of golf courses are forced to rely on effluent irrigation due to increasing demand for potable water to support a growing human population.

Today there are dozens of creeping bentgrass varieties on the market. The latest NTEP putting green test has 26 varieties including some velvet bentgrasses; the fairway NTEP has 25 varieties including some colonial bentgrasses. Some varieties such as 'L-93' are marketed for and often preferred for putting greens. Others are marketed for fairway use-these may have less tolerance to close mowing heights but better traffic tolerance than other varieties. In some cases it is difficult to distinguish useful differences on which to base selection for planting.

Dr. Geunhwa Jung and others

have developed various types of molecular markers used to fingerprint, or identify, bentgrass species as well as individual varieties (Caceres et al., 2000; Scheef et al., 2003). The ability to identify species and especially varieties within an existing turf stand allows us to determine the competitiveness of different bentgrasses when they are blended, something that was impossible to do just five years ago. The information can also be useful to determine the degree of genetic difference among varieties. Warnke et al. (1998) published the first data documenting the genetic distance among 19 creeping bentgrasses. Warnke's work showed two distinct groups of creeping bentgrass based on differences enzyme forms of phosphoglucomutase. Warnke later noted that the ability to develop resistance for certain bentgrass diseases such as dollar spot would depend on the exhaustive, time- and money-consuming processes of developing genetic linkage maps for resistance genes (Warnke, 2003). For the past several years Dr. Jung and his students have been doing just that, with the first data now starting to be published (Chakraborty et al., 2005). Breeders will soon be able to use the genetic information developed at the University of Wisconsin-Madison to incorporate known dollar spot resistance genes into new or existing creeping bentgrass cultivars.

Tremendous advances have been made in the quality and availability of creeping bentgrasses for golf courses in the past 50 years. Breeders and seed dealers can now offer high quality varieties with fairly consistent performance for various regions of the country. A growing awareness exists that best turf performance may depend on choosing a variety specifically suited to a certain region. To that end, the NTEP test results are becoming increasingly important as end-users base varietal selections on local data. The University of Wisconsin-Madison results can be located either in our annual Wisconsin Turf Reports or at www.ntep.org.

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