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Research You Can Use

Evaluating the New England Velvet Bentgrass Collection

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More than 250 velvet bentgrass accessions have been collected from old golf courses throughout New England.

Objectives:

- Collect velvet bentgrass (*Agrostis canina* L.) germplasm accessions.
- Identify and group accessions based on their genetic similarities for analysis and breeding.
- Evaluate accessions for improved resistance to biotic and abiotic stresses.

Velvet bentgrass (*Agrostis canina* L.) has excellent tolerance to lower levels of sunlight, nitrogen, and water and is considered native to New England and coastal regions as far south as Maryland. The stress tolerance genes found in velvet bentgrass need to be preserved as potentially irreplaceable genetic resources.

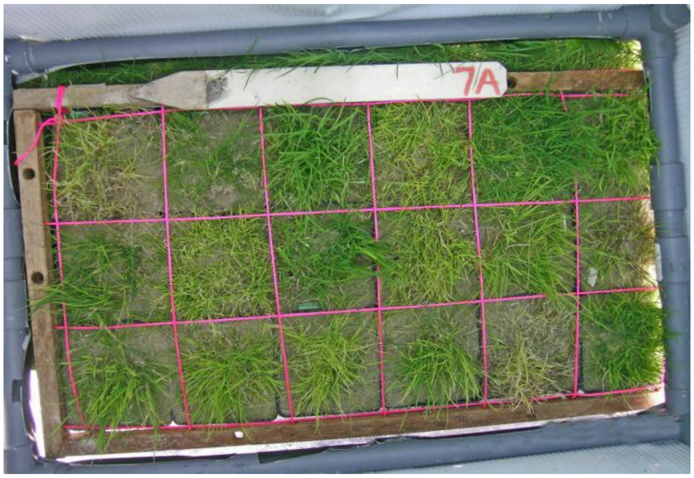
The New England velvet bentgrass germplasm collection is a collaborative effort by researchers at the University of Rhode Island (URI) and the University of Massachusetts. More than 250 accessions have been collected from old golf courses throughout New England. In 2008, more than 750 individuals were evaluated in the field at the University of Massachusetts for turf quality and resistance to brown patch and dollar spot. In 2009, the entire collection was evaluated for salt tolerance in the greenhouse at the University of Rhode Island, and for genetic color, growth rate, and dollar spot in the field. In addition, copper spot-resistant accessions identified in 2008 were re-screened to confirm resistance.

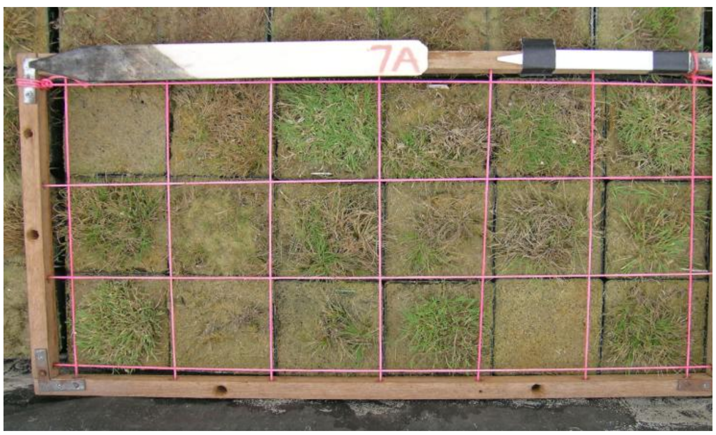
Velvet bentgrass has two ploidy levels, diploid (2n=14) and tetraploid (2n=28), referred to sub-species *canina* and sub-species *montana*, respectively. A flow cytometry analysis was carried out in the velvet bentgrass collection to clarify the ploidy level of the accessions. It was determined that 74% (159 individuals) of the accessions were diploid, and 26% (56 individuals) were found to be tetraploid.

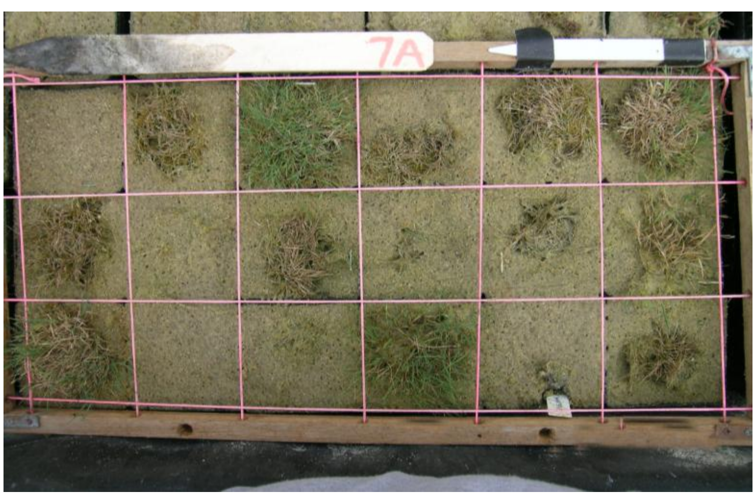
Screening for copper spot resistance was done in the greenhouse, using clones grown in a sand-peat mix, clipped to fairway height, and fertilized with an excess of nitrogen. The plants were inoculated using copper-spot (*Gloeocercospora sorghi*) isolates and maintained under appropriate conditions to promote disease. Disease severity was evaluated on a 0-10 scale where 0 indicated complete loss of foliage and 10 indicated no damage. The varieties 'SR7200' and 'Greenwich' were used as standards for comparison. Sixty-two percent of the accessions were effectively defoliated by copper spot. Both 'SR7200' and 'Greenwich' showed some resistance to copper spot, while 30% of the accessions tested were at least as resistant.

The entire collection also was evaluated for salt tolerance in the greenhouse at the University of Rhode Island from February until June 2009. Three clones of each accession were transferred to pots filled with sand and placed in an ebb-and-flow hydroponics system. The plants were irrigated with a nutrient solution amended with sodium chloride. The salt concentration was increased every two weeks from 1,000 ppm to 8,000 ppm.

At the end of each two-week period, all the plants were photographed using a digital camera and a portable light box. SigmaScan software was used to measure retention of green foliage by calculating the number of green pixels in each image. At 8,000 ppm salt, 'SR7200' retained 4% green cover, and 'Greenwich' retained 10%. The velvet bentgrass accessions ranged from 0% green cover to 80% cover. Thirty-nine accessions were significantly more salt tolerant than either 'Greenwich' or 'SR7200'. Thirty-one of these accessions retained more than 50% green cover.







Velvet bentgrass maintained with irrigation water containing 0 (top), 7000 (middle), and 14,000 (bottom) ppm of NaCl irrigation water for two weeks showed various levels of salt injury.

Three replications of the germplasm collection were established in the field at URI as spaced plants on 18-inch centers and mowed at fairway height. This field trial is used to evaluate genetic color, turf growth, and disease resistance. Each accession was photographed in September 2008 and July and November 2009 using a digital camera and controlled lighting. The digital green color index has been calculated for each accession, producing quantitative data for color comparisons. Velvet bentgrass has a tendency to be lighter green than other bentgrasses. The identification of velvet bentgrasses that are genetically darker green may make turfgrass managers more comfortable applying less nitrogen.

The collection was transplanted to the field in June 2008 as two-inch plugs. Holes were cut into an established Chewings fescue turf using a standard cup cutter, so each plug was surrounded by a one-inch-wide ring of bare soil. The diameter of each plant was measured in July 2009 and ranged from 2.4 to 9.1 inches, while four accessions failed to survive. Most of the accessions more than doubled in size, and 42 accessions more than tripled in size despite competition from the Chewings fescue.

The field trial was visually evaluated for dollar spot resistance in August 2009 following a severe natural disease outbreak. Accessions were rated from 1-9, with 9 indicating no disease. Eighty-seven out of 233 accessions (37%) showed no sign of disease.

<u>Summary Points</u>

- Collaborative studies continue with several researchers in New England.
- Significant progress has been made to identify germplasm that have enhanced resistance to biotic and abiotic stresses.

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Related Information

http://turf.lib.msu.edu/ressum/2009/31.pdf

http://turf.lib.msu.edu/ressum/2008/46.pdf

----- Connecting the Dots -----

An interview with Drs. Rebecca Nelson-Brown and Geunhwa Jung regarding the evaluation of the New England velvet bentgrass collection.

Q. *What is the historical and geographical significance of velvet bentgrass for use as putting greens?*

A. (Nelson-Brown) Velvet bentgrass was a component of the South German Bent mix used on the greens at nearly every golf course built before 1930. Velvet is best adapted to the Northeast and Pacific Northwest, and has probably been most widely used in the Northeast. Part of this adaptation is climate-based, and part is its preference to acid soils. Prior to the current interest in velvet, there were a number of vegetatively propagated varieties developed before 1945. For example, the variety 'Kingstown', which was released by the Rhode Island Agricultural Experiment Station, was planted at a number of courses in the 1970s.

Q. *What velvet bentgrass characteristics would make it especially desirable as putting green surface?*

A. (Nelson-Brown) Velvet bentgrass produces an extremely smooth surface at putting green height, superior to that produced by creeping bentgrass. This is the primary advantage for the golfer. For the superintendent, a major advantage is the dense growth and low mowing height tolerance of a velvet green suppresses annual bluegrass far more effectively than many creeping bentgrass.

Q. *Do you think that velvet bentgrass is more valuable as a putting green species or as a source of resistance genes that could be incorporated into other species such as creeping bentgrass? Which resistance genes are most important?*

A. (Nelson-Brown) In the near future, velvet bentgrass is probably more important as a source of abiotic and biotic resistance genes because superintendents and golfers are more accustomed to creeping bentgrass. However, as the available inputs for maintaining greens decrease, we expect velvet will become popular in its own right, as it has in Europe.

Velvet bentgrass uses nitrogen more efficiently than creeping bentgrass, which is likely to become important as the price of nitrogen fertilizers increases. Other potentially important resistance genes are ones for drought tolerance and dollar spot resistance.

Q. *What diseases affect velvet bentgrass?*

A. (Nelson-Brown) Pythium blight is probably the most serious disease of velvet bentgrass. It can be a severe problem during establishment of new velvet bentgrass stands. Pythium root dysfunction is common in the spring on established greens in New England, although it generally only causes purpling, which can be masked with fertilizer applications. Copper spot is the most serious foliar disease. Dollar spot, anthracnose, and brown patch can occur on velvet bentgrass, but are generally less serious than on creeping bentgrass.

Q. *How do the velvet bentgrass management requirements compare with other cool-season species, such as creeping bentgrass or annual bluegrass?*

A. (Nelson-Brown) Once established, velvet bentgrass needs significantly less fertilizer and water than creeping bentgrass on the same soil. The dense growth of velvet leads to high thatch production, especially if the velvet bentgrass is over-fertilized. Compared to creeping bentgrass, velvet needs less fertilizer and more regular verticutting and topdressing for thatch control.

Q. *Besides genetics, what is the significance of ploidy level in velvet bentgrass? Are there significant differences between diploid and tetraploid velvet bentgrasses in their inherent characteristics or management requirements?*

A. (Jung) Technically, the tetraploid types are *Agrostis vinealis*, not *A. canina*. Management needs of *A. vinealis* are largely unknown. The major advantage of tetraploid velvet bentgrass is that it is easier to cross with creeping and colonial bentgrasses than diploid velvet bentgrass. Polyploid velvet might have elite traits not present in diploid velvet. The tetraploid genotypes from the collection show wider leaves than the diploids. Other inherent characteristics, such as disease resistance and management requirements, are still under investigation.

Q. *Does chromosome number of velvet bentgrass favor it for interspecific hybridization?*

A. (Jung) We are not sure of that yet. However, interspecific hybridizations between diploid or tetraploid velvet genotypes and creeping or colonial bentgrass genotypes are under investigation.

Q. *Are you using molecular genetics approaches to improve this species, and does the long-term approach include the use of marker-assisted selection?*

A. (Jung) Clonal copies of the velvet collection were shipped to Dr. Leah Brilman at Seed Research of Oregon for incorporation into velvet breeding. Genetic-similarities-data of the genotypes generated from the current study will be very useful for choice of parental clones for polycrosses in breeding. The marker-assisted selection will be used for the long-term breeding approach. However, more research is required in order to develop functional/molecular markers linked to traits of interest in velvet before their implementation in marker-assisted selection.

Q. *How much salt tolerance variation do the velvet accessions demonstrate? Can the salt tolerance be significantly improved?*

A. (Nelson-Brown) In last year's trial, the maximum salt level was 14,000 ppm sodium chloride (NaCl). Some accessions were killed by less than 4,000 ppm NaCl. Fifty-six accessions survived this level, many with more than 25% green cover. There is definitely salt tolerance available in velvet bentgrass.

Q. *What progress has your project achieved regarding the biotic and abiotic stress resistance of velvet bentgrass?*

A. (Nelson-Brown) We have identified genotypes that are resistant to salt, copper spot, dollar spot, and brown patch, and genotypes that retain good green color even when nitrogen and iron are limited. We also have evaluated the collection for aggressiveness of lateral growth under mowing.

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