Evaluating Methods for Vegetative Propagation and Enhancement of Seed Production of Greens-type Poa annua *Cultivars*

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Objectives:

1. Establish efficient vegetative propagation methods of greens-type *Poa annua* for sod production and for establish ing/renovating golf course putting greens.
2. To scale-up our results for greens-type cultivar production to a larger commercial level by collaborating with sod producers.
3. To release a genetically stable, vegetative greens-type cultivar exhibiting superior putting green quality and stress tolerance.

Start Date: 2008
Project Duration: two years
Total Funding: $20,000

Poa annua L. has been part of the game of golf for over 130 years, however despite repeated attempts to breed improved strains, currently there are no commercial sources available of high quality greens-type *Poa annua*. Developing such commercial products would allow superintendents and architects an opportunity to immediately begin utilizing the perennial greens-types of *Poa annua* putting surfaces rather than having to wait for the natural evolution of high quality greens-types from the wild and weedy invasive annual types.

The greens-type phenotype in *Poa annua* L. is essentially a dwarf annual bluegrass plant where a number of traits (including shortened culms, shortened tillers, short leaves, reduced number of spikelets, and single-branched inflorescences) are linked together thus inherited as though they were a single trait. As a result, the greens-type phenotype is a reduction in plant stature as compared to the annual-type.

In previous studies, GA_3 and 1-naphthaleneacetic acid (NAA) were used in plant hormone bioassays while auxin signaling and GA biosynthetic genes were PCR-cloned and used for expression analysis on annual-type and greens-type *Poa annua*. The results indicated that the greens-type biotype is responsive to GA_3, resistant to NAA, and GA20 oxidase is up-regulated in comparison to the annual-type. Moreover, a 518 bp length fragment was cloned from *Poa annua* and shows high sequence homology to Auxin F-Box sequences from rice, maize, and *Arabidopsis*.

When left unmowed, perennial greens-type Poa annua *will revert back to wild, weedy annual bluegrass.*

RT-PCR and Real-Time analysis suggest that the greens-type phenotype is correlated to a reduction in the expression of this Auxin F-Box like gene which are known to regulate GA expression. These results suggest that the greens-type *Poa annua* dwarfism is the result of hormonal cross-talk between the auxin and gibberellin biosynthetic pathways.

Previous genetic research also suggests that regulation of the Auxin F-Box-like gene expression is potentially altered from environmental stimuli. Perennial greens-type phenotypes result from the action of mowing which causes an alteration in Auxin F-Box-like gene expression resulting in repression of the plant growth hormone gibberellic acid (GA) signaling pathway. In the absence of the mowing stimulus, the GA pathway progressively becomes unsilenced resulting in reversion of the greens-type plants back to the annual type. The annual type is undesirable as a putting surface and requires years of mowing in order to develop a perennial greens-type form.

We believe that the genetic stability of perennial greens-type *Poa annua* is capable of being maintained through vegetative propagation in combination with mowing. We have established vegetative plots using different source plant materials including aeration cores, solid sod, and shredded sod/plugs.

We also evaluated vegetative establishment in the greenhouse in combination with the exogenous applications of GA in an attempt to further reduce the time required to achieve full coverage. Mowing was deemed to be the most critical factor to maintaining the greens-type phenotype. Using these methods, we successfully propagated enough vegetative material to establish a series of replicated trials of greens-type *Poa annua* cultivars at five different universities.

This research project will now begin to extend these vegetative propagation techniques towards the commercial sod production of greens-type *Poa annua* to a larger scale approaching that of commercial sod production. Seed and vegetative materials produced in 2009 will provide the necessary planting material for us to work directly with interested sod producers for an evaluation of scaled-up production.

Summary Points

- Our research continues to indicate that the dwarf nature of perennial greens-type *Poa annua* results from an epigenetic inhibition of the biosynthetic pathway for the plant growth hormone gibberellic acid (GA).
- We demonstrated our ability to vegetatively propagate greens-type *Poa annua* to an extent of satisfying requests from five universities participating in the Northeast 1025 Project titled: "Biology, Ecology, and Management of Emerging Pests of Annual Bluegrass on Golf Courses".
- We have begun collaborating with commercial sod producers in Pennsylvania and Illinios to begin scaling up our vegetative propagation techniques of greens-type *Poa annua*.