Development of Improved Bentgrass Cultivars with Herbicide Resistance, Enhanced Disease Resistance and Abiotic Stress Tolerance Through Biotechnology

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Objectives:

1. To produce creeping bentgrass cultivars through a combination of genetic engineering and breeding.
2. Provide golf course managers with more effective and selective weed control by developing herbicide-resistant cultivars.
3. To produce creeping bentgrass cultivars with improved disease resistance and abiotic stress tolerance that can be maintained in a more environmentally sound and cost-effective manner.

Start Date: 1998
Project Duration: 5 years
Total Funding: $250,000

The maintenance of creeping bentgrass typically requires extensive irrigation. Golf courses throughout the country are under pressure to reduce the amount of water used for irrigation. The development of creeping bentgrass cultivars that require less irigation, or which could tolerate irrigation with brackish water, would be of great benefit.

The protection of plants from damage incurred by drought stress is being explored in many laboratories and some successful strategies have been reported. One strategy that has shown promising results is the engineering of transgenic plants to accumulate osmotically active metabolites. Several genes have been identified which confer drought or salt tolerance when transformed into other plant species.

Since both salt and drought results in cellular osmotic stress, genes which confer salt tolerance are candidates for also conferring drought tolerance and *vice versa*.

We have obtained a number of such genes from other researchers including those for the synthesis and control of various enzymes important for both salt and drought tolerance. These include betaine aldehyde dehydrogenase, mannitol-1-phosphate dehydrogenase, myo-inositol O-methyl transferase and others.

Creating transgenic bentgrasses with not only resistance to abiotic stresses, but resistance to various hebicides and disease presssure could lead to improved cultivars valuable to the turf industry.

Novel genes improving disease resistance in other crops have been inserted into bentgrass genotypes. Resistance to some common turfgrass diseases has been observed.

The goals of this project are to produce improved creeping bentgrass cultivars through a combination of genetic engineering and breeding. Our aim is to provide golf course managers with more effective and selective weed control with herbicides by developing herbicide-resistant cultivars.

We are also attempting to produce cultivars with improved disease resistance and abiotic stress tolerance which can be maintained in a more environmentally sound and cost-effective manner. Through the Rutgers-Scotts-Monsanto partnership the development of a herbicide-resistant commercial cultivar is actively underway.

The 2000 field test of creeping bentgrass transformants expressing potential disease resistance genes was successful. Some transgenic lines expressing the bacterio-opsin gene or the PR5K gene had delays of 2-6 weeks in development of dollar spot symptoms. These results are encouraging regarding the potential of biotechnology to contribute to development of improved cultivars of creeping bentgrass.

We have established a field test of transgenic plants expressing the barley HVAI gene, a potential drought and salinity tolerance gene. The plants will be evaluated during the summer of 2001 for drought resistance.

Summary Points

- Developed herbicide resistant commercial cultivar in cooperation with Scotts and Monsanto.
- Transgenic lines with bacterio-opsin or the PR5K genes delayed development of dollar spot for 2 to 6 weeks.
- Produced transgenic plants with the barley HVA-1 gene that increases potential drought and salinity tolerance.