Turf research is taking golf into the future

By MICHAEL KENNA

If you have not heard about the gene gun or biotech, you'd better brace yourself! Custom-ordered turf for the year 2000 may not be an impossible dream. The USGA Turfgrass Research Program has supported projects at Rutgers University, Virginia Tech and Michigan State University which are demonstrating some exciting breakthroughs.

In addition to the USGA's support of traditional plant-breeding efforts, new biotech or molecular genetics projects were initiated four years ago. Drs. Lisa Lee and Christina Hartman at Rutgers University have genetically engineered a strain of creeping bentgrass that is resistant to Finale herbicide (glufosinate-ammonium). The herbicide-resistant lines were developed in the laboratory and successfully tested under field conditions last summer. (Finale is a non-selective herbicide which breaks down quickly after application.)

The laboratory procedure transforms existing bentgrasses by combining foreign DNA with turfgrass through the use of a "gene gun." Called microprojectile bombardment, the process shoots DNA-coated particles into tissue cultures of popular bentgrass varieties. The transformed, or transgenic, cultures are grown on a tissue culture medium which contains the Finale herbicide. Those cells in which the herbicide-resistant gene has been successfully incorporated into the bentgrass DNA thrive and eventually produce roots and shoots.

In greenhouse trials, hundreds of survivors are further screened, receiving a lethal dose of the herbicide. From the first five experiments, 55 transgenic plants survived the greenhouse tests at five times the labeled field rate of application. Transgenic bentgrass plants established in field trials were sprayed at label spot-treat rates of 1.5 to 4 ounces per gallon of water. All 55 transgenic bentgrasses survived while the control group died.

At Virginia Tech, Dr. Sam Haas successfully inserted a disease-resistant gene into bentgrass. The chitinase gene, which has been used in agricultural crops, helps prevent fungal pathogens from infecting plant tissues. Most of the success has been achieved using the gene gun and techniques similar to those used at Rutgers University.

Another genetic engineering technique, called electroporation, has also been tested. Electroporation differs from the gene gun in several ways. The cell walls of bentgrass grown in tissue culture are digested using special enzymes. The bentgrass protoplasts, or cells without walls, are grown in solution with the chitinase gene DNA. This biotech soup is then zapped with 750 volts of electricity, which creates openings that allow the chitinase gene to enter the bentgrass cells. The transformed cells are then induced to regenerate their cell walls, and eventually produce whole plants with roots and shoots.

Researchers at Michigan State University are also pursuing the production of bentgrass plants which contain the chitinase gene. Dr. Miriam Sticklen has successfully transformed bentgrass plants by inserting a gene that made the leaves turn blue.

The GUS gene, which causes the blue color, has no commercial significance but demonstrated that the genetic engineering technique could introduce foreign DNA and have it expressed in bentgrass plants. In 1994, the USGA started to fund Sticklen's research program when she teamed with turfgrass scientists Dr. Joe Vargas and Dr. Bruce Branham.

The future looks promising, with less than four years of USGA-sponsored research completed on new biotech projects. If there are any dark clouds on the horizon, they appear due to legal and political considerations of how and where transgenic plants will be used.

There also are proprietary issues to work out between universities, chemical companies and commercial seed producers. The genetically engineered "Flavr-Savr" tomato and "Glyphosate-Ready" soybean varieties have pioneered the way, but it has been an expensive proposition. Golf could benefit greatly from the combination of conventional and biotech plant-improvement techniques. I hope the impossible dream comes true.

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