improvement work. Bentgrass germplasm from the improvement program under the direction of Dr. Engelke (Texas A&M) and buffalograss germplasm from Dr. Riordan (University of Nebraska) also were screened using this technique to evaluate salt resistance. Promising bentgrass lines were identified, while less satisfactory results were reported for buffalograss.

University of Illinois - Dr. M.A.L. Smith

Whole Plant Microculture Selection System

A novel, highly uniform *in vivo* screening method for monitoring mature turfgrass plant response to increasing salinity levels over time was developed. Video image analysis was utilized to quantify and validate turfgrass responses, and permitted larger sample sizes and a more thorough screening of plants.

A strong linear relationship for shoot and osmotic adjustment occured between solution culture and whole plant microculture. Root growth, as measured by root length and area, was more variable in both solution and microculture. Whole plant microculture conferred additional advantages as a highly-controlled test system in terms of scale, timing, maintenance, and repeatability.

Salt tolerant lines were regenerated, adapted to the greenhouse, and reestablished in whole plant microculture. In whole plant microculture, the grass plants again were subjected to salinity stress, and the whole plant responses were non-evasively monitored over time using video image analysis. Approximately one third of the lines selected for salt tolerance at the cell level retained salt tolerance traits at the whole plant level.

Water Use

University of Georgia - Dr. Robert N. Carrow

Influence of Soil Moisture Level on Turfgrass Water Use and Growth

Reducing irrigation frequency is one means of conserving water. Of concern to the turfgrass manager is the quantity of water conserved and any adverse effects on turf quality. Evapotranspiration (ET) data obtained in arid regions is not necessarily valid for estimating turf water use in humid regions. A scale was developed to include ET and overall drought resistance criteria to rank grasses for water conservation in humid regions.

The ET ranges for 'Tifway' bermudagrass, 'Meyer' zoysiagrass, and common centipedegrass were determined under moderate stress irrigation in large field plots. The three warm-season grasses were irrigated under three irrigation regimes, i.e., well irrigated, moderate stress, and severe stress.

For the well watered irrigation regime, common for golf course tees or very high quality fairways, bermudagrass used the least water in summer and fall. Relative to Tifway bermudagrass, Meyer zoysiagrass used 10, 30, and 5% more water for July, August, and October, respectively. Common centipedegrass used 4, 23 and 13% more water than bermudagrass in July, August, and October, respectively.

In the moderate stress irrigation program, typical for many fairways, water use rates were 39 and 11% greater than bermudagrass in August for zoysiagrass and centipedegrass, respectively. Just prior to an irrigation, zoysiagrass showed slight wilt, while the other grasses did not.

Under severe moisture stress, such as for rough areas, water use rates in August were 4% lower and 43% higher than bermudagrass for zoysiagrass and centipedegrass, respectively. The zoysiagrass exhibited severe wilt and bermudagrass no symptoms. The semi-dormant state for zoysiagrass accounted for its lower water use. Zoysiagrass did not appear to develop many roots into the heavy B soil horizon and could not effectively use subsoil moisture.

A second means of reducing water use is to utilize atmospheric, soil or plant based criteria to schedule irrigation in contrast to guessing when to water. Comparative data on these methods were developed to allow turfgrass managers to select the best means of scheduling irrigation.

Entomology

Rutgers University - Dr. Peter R. Day and Dr. C. Reed Funk

Endophytes of Turfgrasses: New Tools and Approaches

The purpose of this project was to find naturally occurring endophytes within the *Poa* and *Agrostis* genera that would improve insect resistance. Endophytes are fungi which grow within the turf plant and produce chemical compounds, (i.e., Alkaloids) which make the plant less desirable to some insect pests. If naturally occurring endophytes could not be found within *Poa* and *Agrostis* species, particularly creeping bentgrass and

Kentucky bluegrass, then biotechnology techniques were to be employed to help produce new endophytes that would work in these important turfgrass species.

The research project acquired a large turfgrass germplasm and endophyte culture collection from throughout the United States and other parts of the world. After extensive screening of more than 700 collections, some 14 fungal endophyte-infected species of *Poa* and *Agrostis* were obtained. A collection of 30 fungal endophyte cultures was established on agar medium and contains representative isolates from a variety of turfgrass genera.

Fungal endophyte-specific DNA probes were produced by the polymerase chain reaction (PCR). Ribosomal RNA internally transcribed spacer sequences (ITS-A) were isolated from *A. typhinum, A. starrii,* and *A. coenophiallum* using PCR primers. These are of similar size and their DNA sequences are being compared. The RAPD (randomly assigned primer DNA) method of using PCR with single ten-base DNA primers was tested with DNA extracts of eleven endophytes using different primers with varying guanine/cytosine contents. The technique is excepted to be useful for developing probes for detecting the presence of endophytes in grasses.

Callus cultures were obtained from six cultivars of Kentucky bluegrass (*Poa pratensis*) and four of creeping bentgrasses (*Agrostis palustris*) tested in tissue culture using mature seeds germinated on a callus induction medium. Several embryogenic callus lines were selected from 'Emerald' and 'Putter' bentgrass and 'Baron' Kentucky bluegrass. The usefulness of embryogenic callus as a target to create new endophyte-turfgrass combinations is under evaluation. The possibility of introducing foreign genes into turfgrass cells by DNA particle bombardment techniques also was investigated.

Sea Island, Georgia - Dr. A. Leon Stacy

Mole Cricket Pheromones and IPM

This project evaluated scouting methods to monitor population dynamics and the potential use of pheromones to reduce pesticide applications for the control of mole crickets on golf courses. Biologically active materials were discovered and, with further refinements, could be produced for commercial marketing. No previous research had been done with mole cricket pheromones when this study was initiated.

Various glands and body parts were dissected from both male and female crickets. During the cricket flight season, acetone homogenate of the spermatheca (♀ crickets) and an unknown gland (♂ crickets) were biologically active and appeared to act as attractants (sex or aggregating pheromones). An alarm substance from the rectum (♀ and ♂) significantly reduced "fly-in" crickets. Additional tests are still needed to improve on the pheromone dispensing system and to further refine optimum rates of activity.

Results from the study were extremely encouraging. The attractants and the alarm substance could eventually fit well into a pest management system by influencing the population dynamics of crickets, i.e. concentrating crickets into one area while repelling them from others. This use possibly could reduce the turf area requiring treatments.

Although no previous work had been done with mole cricket pheromones, the concept was used successfully in eradication programs for several insect pests of agronomic importance and millions of dollars were saved. This project successfully identified biologically active materials; however, cooperation with a qualified pheromone chemist will be needed before efficient testing of the effects of these compounds on the population dynamics can proceed.

Mycorrhizae

University of Rhode Island - Dr. Noel Jackson

Use of Mycorrhizae in the Establishment and Maintenance of Greens Turf

This research project took yet another approach to improve turfgrass water use in sandy soils. Mycorrhizal fungi grow in close association with plant roots and increase the surface area for nutrient and water uptake. Dominant species of mycorrhizal fungi associated with creeping bentgrass and *Poa annua* were isolated from old putting greens receiving routine fungicide applications. The dominant species of mycorrhizal fungi occurring in sand dune soils in New England also were collected. In fact, mycorrhizal fungi isolated from sand dunes were superior to non-dune fungi in stimulating growth of turfgrasses grown in the sand putting green medium.

Responses of creeping bentgrass to mycorrhizal fungi and growth mixes continue to be evaluated. Two methods for producing inoculum were developed for greenhouse conditions. A method to inoculate bentgrass plants with mycorrhizal fungi