UNIVERSITY OF RHODE ISLAND

THE USE OF MYCORRHIZAE IN ESTABLISHMENT AND MAINTENANCE OF GREENS TURF

1990 Research Grant: $40,000
(2nd year of support)

Drs. Noel Jackson
R. E. Koske & J. N. Gemma
Principal Investigators

The project consists of several interdependent studies: identifying the species of mycorrhizal fungi that are associated with velvet and creeping bentgrass and Poa annua in New England, culturing the dominant/most promising species of fungi, and testing the ability of the fungi to promote establishment of greens turf in a sand medium, minimize application of P fertilizers and water, and offer protection against root pathogens.

RESULTS:

A. Twenty-eight species of mycorrhizal fungi were isolated from turfgrasses. Two species were never isolated from root zones of Poa annua but were commonly recovered from beneath both bentgrass species. This information may be useful in reducing the competitive abilities of Poa in greens.

B. Nine species of mycorrhizal fungi have been established in pot culture. Some of the isolates are from sand dune soils (associated with beachgrass) and offer promise for use in sand greens (see below).

C. Numerous screening experiments have been conducted to identify the most effective fungi for sand green culture. We have tested 7 isolates/species of mycorrhizal fungi, 3 different levels of P fertilization, 2 kinds of peat (sphagnum and sedge), and 3 grass species. The most effective fungi were those isolated from sand dunes. Fungi isolated from turf soils often were ineffective in the USGA sand green medium (sand and peat).
   Preliminary observations also suggested that the dune fungi conferred tolerance to drought.

D. A field trial involving two kinds of peat, 4 levels of phosphorus fertilization, and 2 turfgrasses and mycorrhizal fungi is in progress.

E. An inexpensive method for producing highly infective inoculum of mycorrhizal fungi has been developed.

F. A method has been developed to grow bentgrass plants with mycorrhizal fungi under sterile laboratory conditions. This technique will facilitate study of the interaction between mycorrhizal roots and pathogenic fungi.

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This report covers research completed through Oct., 1991. The project consists of several interdependent studies: identifying the species of mycorrhizal fungi that are associated with velvet and creeping bentgrass and Poa annua in New England, culturing the dominant/most promising species of fungi, and testing the ability of the fungi to promote establishment of greens turf in a sand medium, minimize application of P fertilizers and water, and offer protection against root pathogens. The research combines laboratory, greenhouse, and field experimentation.

In addition to testing fungi isolated from turf, we also are investigating the potential benefits of species associated with naturally occurring sand media, i.e., beachgrass growing in a sand dune. Preliminary results suggest that these dune-species are more effective than are species isolated from turf soils.

MAJOR RESULTS

A. Identification of mycorrhizal associates:
Analysis of ca. 600 soil samples revealed 28 species of mycorrhizal fungi (including 14 new, undescribed species) that are associated with greens turf. The dominant species are indicated below.

Scutellospora calospora*	Glomus lamellatum*
S. erythropa*	G. mosseae*
S. pellucida*	G. 3347
Entrophospora infrequens	Acaulospora 3347
	A. 3382
	A. 3106

Different seasonal trends in spore abundance and species composition were identified in association with each species of turfgrass. Two species of fungi, Acaulospora 3106 and A. 3347, were commonly associated with both bentgrasses, but never were found with Poa annua. When single species cultures of these species are established, they will be tested in our competition studies to determine if they may limit the growth of Poa.

B. Culturing of mycorrhizal fungi:
Nine species of mycorrhizal fungi have been established in pot culture to be evaluated in trials with turfgrasses. We are presently getting other species into single-species pot cultures. Cultured species include:

Scutellospora erythropa*,**	Scutellospora calospora*
Scutellospora pellucida*	
Glomus lamellatum*	Glomus mosseae*
Glomus clarum**	Acaulospora scrobiculata**
Gigaspora gigantea	Gigaspora albida**

note: * indicates species isolated from turfgrasses.
** indicates species isolated from grasses growing in sand dune soils. These species also will be tested for their effect on greens turf because they are known to be effective in a sand medium.

C. Growth experiments using mycorrhizal fungi:
Numerous screening experiments have been conducted to identify the most effective fungi for sand green culture. We have tested 7 isolates/species of mycorrhizal fungi, 3 different levels of P fertilization, 2 kinds of peat (sphagnum and sedge), and 3 grass species.

1) Overall, fungal species isolated from turf plots and the commercially available fungus Glomus intraradix did not consistently improve yield of turfgrasses grown in the sand/peat mix specified for USGA sand greens. In contrast, isolates of mycorrhizal fungi from sand dunes always resulted in improved growth at the higher levels of P used, and one species (S. erythropa) stimulated growth at the low P concentration. These preliminary findings suggest that the most effective fungal isolates will be those that are adapted to the sandy environments, rather than to association with turfgrasses. The results are summarized on the next page. Each "+" or "-" represents the average response (dry matter production) of 5-15 pots (conetainers) of turfgrass. A "+" indicates a growth increase in comparison to the control, a "-" represents a growth depression.

Summary of responses of turfgrasses to inoculation with mycorrhizal fungi at two phosphorus concentarations

fungus	creeping bent P1	creeping bent P2	velvet bent P1	velvet bent P2	poa annua P1	poa annua P2
Gl. intraradix	- & +	- & +	-	-	-	-
S. erythropa*		-		-		
S. erythropa**	+	+				
S. pellucida*	-	-				
Gi. gigantea**	-	+				
dune mixture**	-	+	-	+		

P1 = 7.5 ppm P, P2 = 30 ppm P added biweekly
* = isolated from turf; ** = isolated from sand dunes
"dune mixture" used sand containing a variety of sand dune species (Gi. gigantea, S. erythropa, etc.) as the inoculum.

2) Glomus intraradix was found to be very sensitive to P concentrations in excess of 20 ppm and was ineffective if soil levels of P exceeded that level.

3) A sphagnum/sand mix is superior to a sedge peat/sand mix in terms of plant growth and response of plants to inoculation with mycorrhizal fungi, based upon results from greenhouse studies.

4) In general, increasing levels of P in the sphagnum/sand mix were correlated with decreased levels of colonization.

5) Preliminary observations also suggested that the dune fungi conferred tolerance to drought.

D. Field trial:
A field trial involving creeping and velvet bentgrass, Glomus intraradix, 4 different levels of P, and sedge and sphagnum peat was established and is still being monitored. The majority of the test plots contained sedge peat that has sufficient P to inhibit mycorrhiza formation.

E. Inoculum production:

Two methods of producing inoculum on a larger scale are being assessed. One involves culturing plants aeroponically and the other involves use of particles of calcined clay to which hyphae of mycorrhizal fungi have attached. This part of the project was planned to produce enough inoculum of fungi isolated from turfgrass and to supplement the commercially available fungus. The latter is no longer available (the technology was sold to Japan). The inoculum production methods that we are studying have been shown to be very efficient and inexpensive in trials in Germany and Florida. Trials in our greenhouses have been very encouraging, and the best growth response we have acheived so far occurred using inoculum that we produced in the U.R.I greenhouse. We are gearing up production for a large field trial in the Spring of 1992.

F. Laboratory experiments:

A method was developed to inoculate bentgrass plants with mycorrhizal fungi under sterile laboratory conditions. This technique will allow us to closely monitor the interaction between pathogenic fungi and mycorrhizal roots and enable us to select mycorrhizal fungal isolates that confer greatest resistance. Five species of mycorrhizal fungi are presently being tested in the system.

An exciting development has been the growth and sporulation of Glomus intraradix on roots grown in root-organ culture. At present, this has been achieved only with tomato roots, but we are attempting to obtain similar results with turf roots and other species/isolates of fungi. With such an in vitro system, we can readily produce pure inoculum that can then be multiplied in the processes described above in section D.

CURRENT RESEARCH

Work in progress is designed to determine which species or species mix of VAM fungi can provide optimal growth response in the sand green medium and can impart protection from pathogenic fungi, confer resistance to drought, and favor bentgrasses in competition with Poa annua.