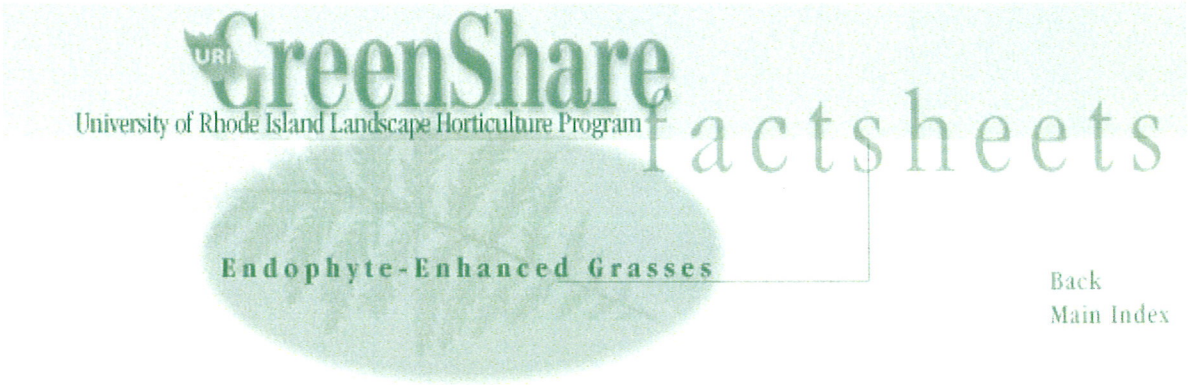

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Turfgrass infected with nonpathogenic fungal endophytes may meet demands for reduced pesticide use and for lower inputs for maintenance of turf and production of sod. Discovery of the symbiotic relationship between these fungi and turfgrasses occurred when cattle grazing on infected grass developed symptoms such as delirium and "livestock staggers." At the same time, infection with endophytic fungi, which occurs naturally on over 15 million acres of grassland throughout the U.S., results in turfgrasses with higher overall vigor and insect resistance compared with non-endophytic varieties. As such, endophyte-enhanced turfgrasses may be used for a low-input, biological control option for sustainable turf care programs.

Life Cycle/History:

The term "endophytic" refers to a situation where one organism lives inside another. In this case, a fungus and grass form a relationship that is mutually beneficial and enhances the reproductive success of each. The fungal endophytes *Acremonium coenophialum* and *A. lolii* manifest no visible signs on their fescue and perennial ryegrass hosts. These endophytes are transferred from plant to plant via seed. The mycelium of the fungus then grows into the sheath, stem, and leaf tissues of the developing grass seedling and maturing plant. Finally, the fungal endophyte enters the flowering stem and seed. The endophyte is passed to the next generation of turfgrass plants through the seed.

Plant Growth, Persistance, and Stress Tolerance

Endophyte-infected grasses tend to be comparatively vigorous, especially under conditions of minimal fertilization and irrigation. Infected plants produce greater numbers of tillers and roots, making them more drought-tolerant, more competitive with weed species, able to recover more rapidly from injury and generally more persistent in the field. The higher performance is particularly notable under stressful conditions such as high temperature, as well as nutrient and water deficiency. The result is a grass that is highly suitable for medium to low input situations.

Resistance to Insects and Other Pests:

Endophytic grasses have shown high resistance to foliar-feeding insects such as billbugs, chinch bugs, sod webworms, fall army-worms and argentine stem weevils. Biologically active alkaloids are found only in infected grasses. The insecticidal effects produced by these compounds deter insect infestations, resulting in a population decline. Alkaloid levels in the roots are low, however, and endophytes are thus not effective against root feeders such as white grubs.

Endophyte-Infected Cultivars:

The number of endophyte-infected, improved cultivars of tall fescue, perennial ryegrass and fine fescues is increasing. A combination of these endophyte-infected varieties is often marketed as a low-maintenance

mixture. Despite attempts to incorporate endophytic fungi into Kentucky bluegrass and bentgrasses, these high quality grasses are still endophyte-free. In order to maintain the viability of the endophyte, seeds must be stored at cool temperatures (approx. 40 degrees F) and under dry conditions. Even under excellent storage conditions, the percentage of viable endophytes in a seed lot will decline over time. In contrast, however, endophytes last indefinitely in plants; the endophytic content of a lawn typically increases over time as endophytic tillers outcompete non-endophytic ones.

Endophyte-Infected Grasses for Use in IPM of Turf:

Use of endophytic grasses provides a self-sustaining biological control option for turf. Outbreaks of insect and other pests may be prevented as a result of the insecticidal effects resulting from the interaction as well as from the vigorous nature of turf growth. The enhanced tolerance to stresses, as compared with non-endophytic varieties, makes endophyte-infected grasses particularly suitable for low-budget, low-input, low-maintenance situations. Endophytic grasses may form an integral part of an IPM strategy for turf in that they can withstand a range of mowing, fertilization, and irrigation practices. They are also compatible with the use of most insecticides and herbicides, and are only temporarily affected by fungicides. Endophytic grass seed is available at better garden centers and seed stores. It is only slightly more expensive than other seed and well worth the investment. Use only fresh seed to maximize endophyte content.

Adapted from the University of Massachusetts Extension, 1999