CORNELL UNIVERSITY TURFGRASS TIMES

# CUTT

2006 Issue 2 • Volume 17 • Number 2

# *Festuca*:

## Versatile, Weed-Suppressive Turfgrasses for Diverse Settings

The presence of a high quality turfgrass in a landscape influences our lives visually, functionally and recreationally. In the United States, there are currently more than 30 million acres of turfgrass including lawns, parks, golf courses, sod farms, industrial and institutional grounds, and highway rights-of way. In New York State alone, over 3.4 million acres have been established in turfgrass (NY State Turfgrass Survey, 2004), and over 18,000 miles of major highways. In all turf settings — especially lawn and roadside turf — weeds are a key pest problem.

A substantial pesticide market (over $2 billion dollars) currently exists for control of weeds, insects and diseases in private and commercial turfgrass settings. Although herbicides continue to be the predominant form of weed management in commercial turf settings, herbicide use in public and private landscapes is increasingly challenged by environmental and health concerns. Consequently, turfgrass managers, including homeowners, are seeking alternative weed management tools.

One preventive strategy to minimize weed infestation is the use of appropriate turf mixtures or cultivars that are well adapted to a given setting for optimal density and growth. Weeds are much less likely to invade a well-managed turf in good condition, maintained with appropriate cultural practices including timely mowing, fertilization and irrigation. In recent years, our research has focused on the selection and utilization of fine leaf fescues as low maintenance, stress tolerant and weed suppressive turfgrasses in landscape and roadside settings.

The genus *Festuca* or fescue represents one of the largest groups of grasses in the tribe *Poaceae*. Approximately 100 different fescue species are currently found in the United States and Europe. If one looks closely at a collection of fescues, it is easy to see that *Festuca* species vary greatly in morphology, cytology and growth habit. Generally, the fescues are divided by appearance and usage patterns into two specific types: fine or coarse leaf fescues.

*continued on page 4*

## This Times



CUTT, "Cornell University Turfgrass Times" is published four times per year by the Turfgrass Science Program at Cornell University, Ithaca, New York 14853. Address correspondence to: Cornell University Turfgrass Times, 134A Plant Science Building, Cornell University, Ithaca, NY 14853; phone: (607) 255-1629; email: fsr3@cornell.edu.

Editor: Frank S. Rossi, Ph.D.

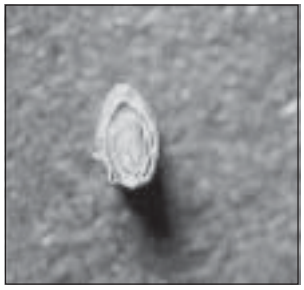
Design & Production: Ghostwriters, inc., Ithaca, NY

continued from page 1

## Fine Leaf Fescue

Fine leaf fescues are among the most common turfgrass species currently used in the Northeastern and Northcentral US and Europe for lawns and turf, especially in shaded areas or those with poor soils. The fine leaf fescues include slender and strong creeping red (*F. rubra* L.ssp. *rubra* and *F. rubra* L. ssp. *trichophylla* Gaud. or ssp. *littoralis* [Meyer] Auquiz), chewings fescues (*F. rubra* L. ssp. *commutata* Gaud.), hard fescues (*F. longifolia* Thuill.) and sheep fescues (*F. ovina* L.). These six cool season fine fescue species are commonly used not only as turfgrasses but also for forage, turf or conservation purposes.

The turf-type fine fescues — specifically red, chewings and hard fescues — have been recently selected for improved disease and heat resistance, as well as color and ease of establishment. These grasses prefer to be established in well-drained soils, and are tolerant of both full sun and shaded conditions. They prefer a non-alkaline soil, or lower soil pH. In general, the fine fescues require only limited fertilization and irrigation. The root systems tend to be shallow, and in heat and drought conditions of late summer, the fine fescues often go dormant and turn brown.

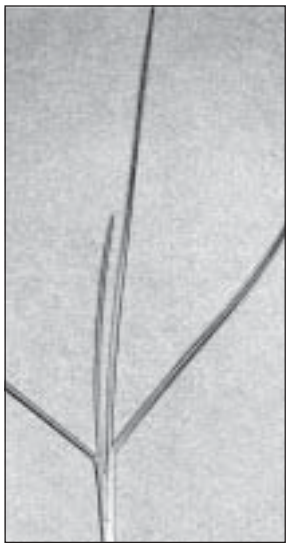


*Grasses prefer to be established in well-drained soils, and are tolerant of both full sun and shaded conditions. They prefer a non-alkaline soil, or lower soil pH.*

*The root systems tend to be shallow, and in heat and drought conditions of late summer, the fine fescues often go dormant and turn brown.*

## Coarse Fescues

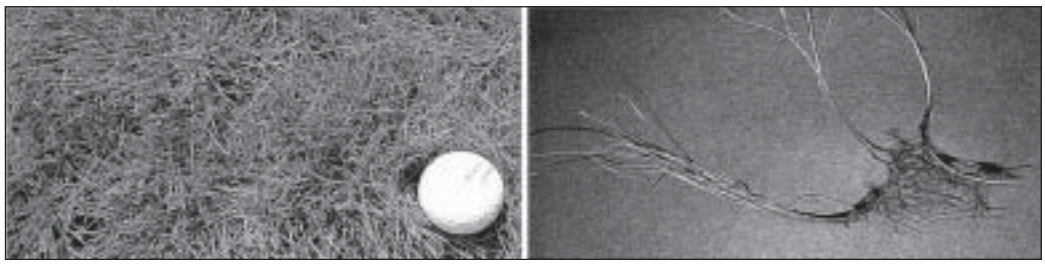
In contrast, coarse fescues or tall fescues (*Festuca arundinacea*) are relatively coarse-leaved, darker green grasses that are drought resistant and somewhat shade tolerant in more southern locations. They are well-adapted to heavy clay soils and perform well in the transition zone states with hot summers and cold winters. Endophyte-free tall fescues are used extensively as forage grasses in pastures and rangelands throughout the US. Other improved turf cultivars are utilized on roadsides and also more recently as attractive turfgrasses in transition zone areas.



The turf-type tall fescues were selected and extensively bred to improve heat and drought tolerance and to have narrower leaves than the pasture-type such as Kentucky-31. Although tall fescue has short rhizomes, it has a limited capacity to spread given its bunch-like growth habit, and can thin in the shade. Reseeding on a regular basis may be needed to retain desired density over time.

Compared to fine fescues, the leaf blades of coarse fescue are relatively tough and require a sharp blade while mowing to prevent ragged edges. It is recommended to mow tall fescue at a height of 3 inches to avoid scalping and maintain density, while fine fescue can be successfully mowed at a lower height. Like fine fescue, tall fescue tolerates periods of drought, but in high temperatures, tends to go dormant. Both fine and coarse fescues are susceptible to several diseases which may be enhanced by exposure to excessive irrigation and fertilization. Fine fescues are susceptible to red thread and dollar spot, while tall fescue is susceptible to brown patch and fescue leaf spot.

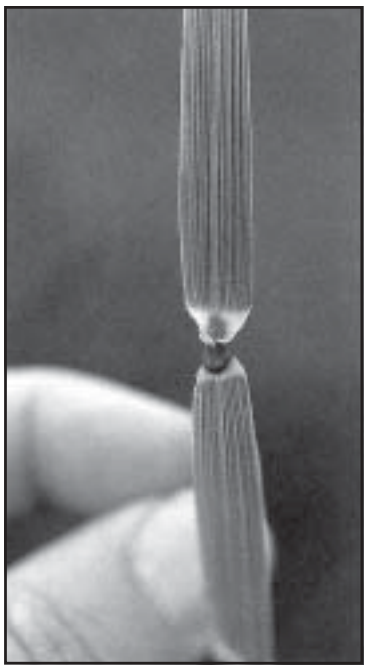
*Top: top of a fine fescue plant. Middle: leaf bud vernation of fine fescue. Bottom: turf habit and vegetative growth characteristics of fine fescue.*



## New & Improved!

Recently, fescue breeders have developed genetically improved cultivars that possess tolerance not only to acidic soils and those with low fertility, but also to a variety of sun exposures including substantial shade as well as full sun conditions. Although fescues are often slower to germinate and establish than other turfgrasses such as perennial ryegrass, newer cultivars have been selected for more rapid establishment and green-up.

Currently, there is increased interest by the US and European turfgrass industries in the utilization of fine leaf fescues for both lawn and golf turf as well as for low maintenance settings with exposure to stressful conditions, including cold temperatures, drought and saline soil conditions or roadside salt spray. Fine leaf fescues are viewed as especially useful for settings experiencing variable light conditions and poor soils.



## Allelopathy

Over the last decade, the study of plant-plant interactions and utilization of allelopathy and plant interference as a potential weed management tool has received increasing attention. The use of allelopathy for weed management relies upon the species-specific responses of a target weed to chronic or sublethal doses of an allelochemical (plant growth inhibitor), which can be exuded or leached from nearby living plants or decomposing residues. Weed suppressive cover crops that have been successfully used to suppress annual weeds have included economically important cereals such as wheat, oat, rye, barley, sorghum, and rice.

Although studies on allelopathic crops have focused on these key species, many other weedy and crop species show promise of allelopathic potential for suppression of surrounding vegetation, including several turfgrasses such as

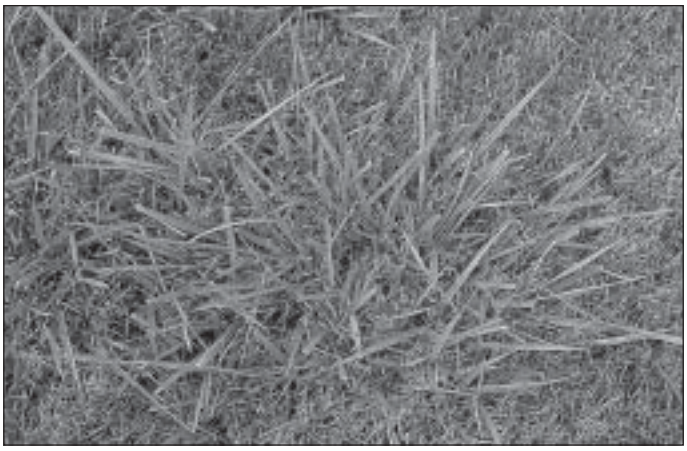
*continued on page 6*

*Top: tall fescue inflorescence. Middle: collar region of a tall fescue plant. Bottom: turf habit and vegetative growth characteristics of tall fescue.*

*There is increased interest by the US and European turfgrass industries in the utilization of fine leaf fescues for both lawn and golf turf as well as for low maintenance settings with exposure to stressful conditions, including cold temperatures, drought and saline soil conditions or roadside salt spray. Fine leaf fescues are viewed as especially useful for settings experiencing variable light conditions and poor soils.*

*Although studies on allelopathic crops have focused on economically important cereals such as wheat, oat, rye, barley, sorghum, and rice, many other weedy and crop species show promise of allelopathic potential for suppression of surrounding vegetation, including several turfgrasses such as buffalo grass, perennial ryegrass, bermudagrass, and both tall and fine fescues.*

continued from page 5



buffalo grass, perennial ryegrass, bermudagrass, and both tall and fine fescues. However, until now, few studies have been conducted to further evaluate the weed suppressive potential of these species. Our recent trials with weed suppressive ornamental groundcovers and turfgrasses for the New York State Department of Transportation have shown that the ability to establish rapidly, produce a dense turf or canopy thereby reducing light availability at the soil surface, and allelopathic properties can all influence weed suppressive ability.

*Prior studies have focused on the weed suppressive effects of tall fescue, which was shown to be potentially allelopathic by production of toxic root leachates.*

A review of the literature shows that *Festuca* spp. can be strongly weed suppressive when used for erosion control in agronomic, orchard and vineyard settings. Prior studies have focused on the weed suppressive effects of tall fescue, which was shown to be potentially allelopathic by production of toxic root leachates. In 1990 studies in Kentucky, we demonstrated that creeping red fescue (*F. rubra* L. spp. *rubra* and ssp. *tricolphylla*) was highly weed suppressive when established as a living mulch or as killed sod in no-tillage field experiments.

## Field Studies

Recently, we conducted a series of field studies in Ithaca, NY and in Riverhead NY, with Dr. Andy Senesac which show that certain cultivars of creeping red, chewings or hard fescue exhibit the ability to effectively suppress weeds over a multi-year period. An initial study was conducted in 1999-2002 as part of the National Turfgrass Evaluation Program (NTEP) to evaluate a collection of 78 fine leaf fescue cultivars for turfgrass quality, seedling vigor, and ability to suppress the establishment of common annual and perennial weeds.

*The fine fescue cultivars Intrigue, Columbra, and Sandpiper proved to be more weed suppressive (less than 5-8% weed infestations) over time than other fine leaf fescue cultivars. Reliant II, Wilma and Oxford were also good performers in terms of weed suppression, while Treasure, Boreal, Rebel II tall fescue, Sylvia High and several numbered selections were much less suppressive (greater than 15-30% infestations).*

Using these criteria, Dr. Frank Rossi evaluated the overall suitability of the cultivars for use in turfgrass settings, and we evaluated their potential to inhibit the establishment of common turf weeds, including large crabgrass, annual bluegrass, white clover and dandelion. Weed suppressive ability was visually evaluated, and several cultivars consistently produced dense stands of high quality turf and provided good to very good (greater than 70%) suppression of common turf weeds when established using the same planting density. Other cultivars provided moderate (between 35% - 70%) to (< 30%) little weed suppression.

In her M.S. work at Cornell, Cecile Bertin showed that greater weed suppression was likely associated with the differential ability of fescue cultivars to establish rapidly and maintain a dense turf as well as their potential to exhibit allelopathic interference. Laboratory studies indicated that certain fine leaf fescue cultivars exhibited greater ability to suppress weeds in agar or sand culture, through production of large quantities of inhibitory root exudates from fine fibrous fescue roots. Other cultivars which were less suppressive in field experiments, were also less suppressive to weed growth in the laboratory. Interestingly, fescue roots cultured under simulated drought conditions produced up to 3-fold greater levels of root exudates than did those cultured under non-stressed conditions.

*Top: a plot of tall fescue.*
*Bottom: seeds from tall fescue.*

In additional field studies conducted in Ithaca and Riverhead — with a selection of cultivars with variable weed suppressive performance and using a large number of replicates for statistical power — the fine fescue cultivars Intrigue, Columbra, and Sandpiper proved to be more weed suppressive (less than 5-8% weed infestations) over time than other fine leaf fescue cultivars. Reliant II, Wilma and Oxford were also good performers in terms of weed suppression, while Treasure, Boreal, Rebel II tall fescue, Sylvia High and several numbered selections were much less suppressive (greater than 15-30% infestations). All cultivars were established at a seeding rate of 4 lb/1000 sq. feet. Although our data suggest that certain cultivars possess differential ability to suppress weeds over time, further studies are required to improve our understanding of the factors influencing weed suppression over time, including the impact of root exudation by weed suppressive cultivars.

## What Makes It Work

With Dr. Frank Schroeder in the Chemistry Department at Cornell, we isolated and identified the main bioactive constituent in the inhibitory root exudates collected from the chewings fescue cv. Intrigue. This highly active inhibitor was identified as m-tyrosine, a simple derivative of p-tyrosine. M-Tyrosine was found in large quantities in root exudates of chewings fescue cultivars, strong red creeping cultivars and Arizona fescue. It suppressed weed seed germination and seedling growth in both soil and soilless assays, generally at concentrations of 100uM or less, which are in the range of application rates of several preemergent herbicides such as pendimethalin.

Similarly, m-tyrosine exposure at low concentrations resulted in stunted root growth, reduced cell division and likely impacts on cell elongation or cell wall formation in developing weed seedlings. The inhibitor is not highly selective in that it is active with every weed and crop species tested, but large crabgrass, barnyardgrass, dandelion, mustard, cress, and other small-seeded weeds are highly sensitive to its presence. Currently, we are attempting to further identify its mode(s) of action, and determine, with industry support, its potential to be developed as a soil-applied natural herbicide.

In ongoing studies with the NYSDOT and Dr. Senesac, we are evaluating a diverse collection of 25 turfgrass species and cultivars for their ability to establish across New York in a variety of field and roadside settings. Our better *Festuca* performers are part of this trial. The ultimate objective is to select a turfgrass cultivar or mixture that is tolerant of drought, salinity and low fertility, requires limited mowing, and establishes successfully such that it is weed suppressive.

A daunting task? Perhaps, but our collaboration with Dr. R. Brown, a turfgrass breeder, at the University of Rhode Island to select for enhanced weed suppression and stress tolerance among existing cultivars of creeping red, chewings and hard fescues as well as fescue/perennial ryegrass hybrids will help us to address this goal.

Although the selection of highly weed suppressive turfgrasses is novel from both a traditional and molecular perspective, the development of fescue turfgrasses with enhanced stress tolerance is not. The combination of these attributes will hopefully lead to the future development and release of value-added turfgrasses which have utility as weed suppressive turfs in low maintenance settings, including roadsides as well as landscapes. In addition, attempted crosses or hybridization with closely related species such as perennial ryegrass may lead to characteristics including more rapid establishment and growth as well as enhanced weed suppression and stress tolerance.

*Leslie A. Weston and Cecile Bertin*

*In ongoing studies with the NYSDOT and Dr. Senesac, we are evaluating a diverse collection of 25 turfgrass species and cultivars for their ability to establish across New York in a variety of field and roadside settings. Our better* Festuca *performers are part of this trial.*

*The combination of these attributes will hopefully lead to the future development and release of value-added turfgrasses which have utility as weed suppressive turfs in low maintenance settings, including roadsides as well as landscapes.*