Cultivars, Cutting Heights Affect Black Cutworm Feeding

By Cale A. Bigelow and Douglas S. Richmond

Throughout much of the cool-humid region and upper-transition zone of the United States, the most widely planted species for golf course roughs and lawns has been Kentucky bluegrass (*Poa pratensis*). This is due to its pleasing dark-green color, wear tolerance and recuperative capacity.

The recuperative capacity of Kentucky bluegrass is attributed to its underground rhizomes that if not properly managed may form a dense, thick, thatch layer. Thatch provides an ideal habitat for various disease causing fungi and insect pests. Therefore, to ensure turf persistence in economically important areas, turf managers preventatively apply insecticides each year.

Although pesticides may be an important and periodically necessary tool to sustaining a perennial turf, ideally they are not the first line of defense in pest management.

Two other turfgrass species, perennial ryegrass (*Lolium perenne*) and tall fescue (*Festuca arundinacea*), are also well adapted and frequently used for lawns either in combination with Kentucky bluegrass or alone. Both of these species germinate and establish much more quickly than bluegrass, but because they are bunch-type grasses, they do not spread and recover as well as Kentucky bluegrass and are generally regarded as less desirable species where a uniformly dense, durable and persistent turf is wanted. During the past decade the fungal disease gray leaf spot (*Magnaporthe oryzae*) has devastated many perennial ryegrass stands, and this species has therefore lost favor with turf managers.

By comparison, tall fescue has been underutilized because of its association with pasture and forage use and the fact that early cultivars (e.g. Kentucky-31 and Alta) were deemed unattractive for high-quality turf areas. These early fescue cultivars have a light-green color, wide leaf blade, low shoot density, poor traffic recovery and do not tolerate relatively close mowing heights (under 2.5 inches) as well as Kentucky bluegrass.

Photo 1. Four TTTF cultivars with various endophyte infection levels were maintained at two mowing heights.

Recent advances in turf-type tall fescue breeding, however, have produced superior cultivars that are very dark green, fine-leaved and possess high shoot densities and wear tolerance comparable to many Kentucky bluegrass cultivars. Many of these improved turf-type cultivars have been popular for lawns throughout the transition zone and much of the southeastern United States. They are widely planted throughout this warmer climate because they perform well in a variety of growing environments, including full sun and moderate shade, are generally easy and inexpensive to establish from seed, tolerate prolonged heat, drought and low fertility soils. Most importantly, though, they do not turn brown because of winter dormancy like the warm-season species.

Another characteristic which makes tall fescue more desirable than Kentucky bluegrass or perennial ryegrass is a deeper and more extensive root system enabling it to extract water and nutrients from a larger soil volume. Thus, this species may require less supplemental irrigation and fertilizer to maintain an equivalent level of appearance. Lastly, tall fescue may be more desirable than Kentucky bluegrass because of its bunch-type growth habit, which does contribute to a thatch layer and some of the problems often found with thatch. In terms of resist-

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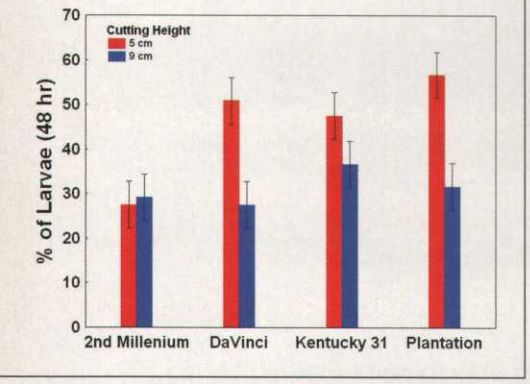
FIGURE 1



Higher cutting reduced larval settling response on three of four cultivars.

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ance to insect feeding damage, tall fescue is reputed to be highly tolerant, possibly because of its large, tough root and shoot tissue (Murray and Powell, 1979).

Another reason that tall fescue may be more resistant to insects is that fescue plants often harbor a fungal endophyte (*Neotyphodium coenophialum*) that forms a symbiotic relationship with the turf plant and enables the plant to produce several chemical compounds in the leaf and leaf sheath called alkaloids. It is these alkaloids that provide a chemical defense against surface-feeding insects (Prestidge et al, 1982; Siegel et al, 1987; Murphy et al, 1993).

Many other benefits of endophytes have also been observed. For example, increased seedling survival has been observed in endophyte-enhanced tall fescue where the soil was infested with the fungal organism *Rhizoctonia zeae* (Gwinn and Gavin, 1992). Mature endophyte-enhanced cultivars generally possess enhanced growth and recovery, greater drought tolerance (Arachevaleta et al, 1989; West et al, 1990), and superior deterrence to nematode and mammalian herbivory (Bacon and Siegel, 1988; Siegel, et al, 1985). Endophytes may also help in terms of fertilizer use, since endophyte-infected Chewings fescue was shown to have a higher nitrogen uptake capacity than non-endophyte fescue (Richardson et al, 1999). The relationship of endophytes with disease suppression is unclear. However, in a greenhouse experiment, endophyte-enhanced tall fescue recovered more quickly from brown patch (*Rhizoctonia solani*) than nonendophyte-enhanced tall fescue (Burpee, 1992).

Currently, there is very little scientific data regarding the effect of simply varying common management practices like mowing and nitrogen fertilization on endophyte expression and insect feeding habits. A previous greenhouse study demonstrated that tall fescue alkaloid concentrations increased when mowing height increased from 1 to 3 inches (Salminen, et al, 2003).

Several alkaloids are produced in the leaf and their relative amounts may also be influenced by nitrogen source. In solution culture, Chewings fescue (*Festuca rubra* L. ssp. cummutata Gaud.) produced two main alkaloids, ergovaline and peramine, with slightly higher ergovaline produced for ammonium fertilized plants (Richardson et al, 1999). It is unclear, however, how the concentrations of each of these compounds actually affect insect herbivory.

Additionally, previous research demonstrated that simply overseeding endophyte-enhanced perennial ryegrass into a Kentucky bluegrass turf significantly reduced bluegrass billbug populations and damage (Richmond et al, 2000). No information, however, is available regarding the effect of overseeding turf-type tall fescue on turf insects. It also is unclear what level of endophyte infection is actually required to reduce insect populations and damage in tall fescue.

In the recent 2001 National Turfgrass Evaluation Program tall fescue cultivar test, a tremendous variation in endophyte levels were observed among the 160 entries which ranged from 0 percent to 94 percent of the seeds infected (Mohr et al, 2002). Thus, if the overall goal in designing a turfgrass management system is to provide a persistent, high quality turf that requires the fewest cultural inputs, especially with respect to insecticide applications, more information regarding the effect of varying cultural practices on endophyte enhanced grasses would be helpful in making reliable management recommendations to turf managers.

Preliminary research

A greenhouse study at Purdue University investigated the effect of two typical lawn mowing heights (2 inches and 3.5 inches) on the feeding habits and survival of a common surface-feeding insect, black cutworm (*Agrotis ipsilom*, Hufnagel). This was studied using mature turf from four commercially available and widely planted tall fescue cultivars (DaVinci, Kentucky-31, 2nd Millennium and Plantation) which varied considerably in their level of endophyte infection (44 percent to 92 percent).

Initially, black cutworm neonates (newly hatched larvae) were fed freshly harvested leaf tissue in a non-choice petri dish experiment and 3rd instar larvae were caged in pots to assess sur-

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vival (Photo 1). In general, neonates showed a stronger preference for clippings harvested from turf maintained at 2 inches with fewer larvae settling on clippings from three of the four cultivars in a 48-hour larvae settling study (Fig. 1).

Furthermore, survival was also reduced by the higher cutting height on two of the four cultivars when larvae were subjected to a five-day feeding study. As expected, among cultivars, fewer larvae settled and fed on the cultivar with the highest endophyte infection level, 2nd Millennium. However, larval settling response was not well correlated with survival.

It is hypothesized that these mixed responses are most likely because of differences in leaf alkaloid concentrations which may vary with endophyte and plant genotype. The survival of 3rd instar larvae varied significantly with cultivar, but seemed to run contrary to our prediction that survival of these larger larvae would also be negatively correlated with endophyte-infection levels.

Further studies and evaluations are required before clear conclusions can be drawn, but biomass of 3rd instar larvae was less on higher-cut tall fescue.

Overall, the early results of these studies are very promising and reinforce the hypothesis that cultivar selection and simple management practices have the potential to provide safe non-chemical alternatives to managing lawn pests.

Currently for black cutworms and perhaps other surface feeding insects, it appears that in order to maximize the beneficial endophyte effects, the turf should be mowed as high as practical (e.g. 3.5 inches), which in turn will result in fewer neonates settling and surviving.

This result should cause an overall reduction in populations of black cutworms. Further studies will continue to evaluate cultivars, mowing height, nitrogen sources and field validation of these greenhouse experiments.

Cale Bigelow is an assistant professor of agronomy/turfgrass science at Purdue University in West Lafayette, Ind. He can be reached at cbigelow@purdue.edu. Doug Richmond is an assistant professor of entomology at Purdue. He can be reached at drichmond@purdue.edu.

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TURFGRASS TRENDS

SECTION STAFF

Managing Editor
Curt Harler
440-238-4556;
440-238-4116 (fax)
curt@curtharler.com

Graphic Designer
Tracie Martinez
216-706-3776;
216-706-3712 (fax)
tmartinez@questex.com

Golfdom Staff Contact
Thomas Skernivitz
216-706-3758;
216-706-3712 (fax)
tskernivitz@questex.com

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