

A man with short brown hair, wearing a white polo shirt and khaki pants, is sitting on a wooden bench on a golf course. He is looking directly at the camera with a slight smile. The background shows a lush green golf course with sand traps and trees under a clear sky.

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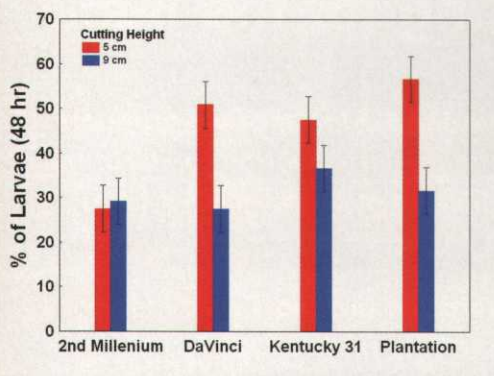
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FIGURE 1



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

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

Continued from page 48

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

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 ipsilon*, 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 3<sup>rd</sup> instar larvae were caged in pots to assess sur-

Continued on page 54



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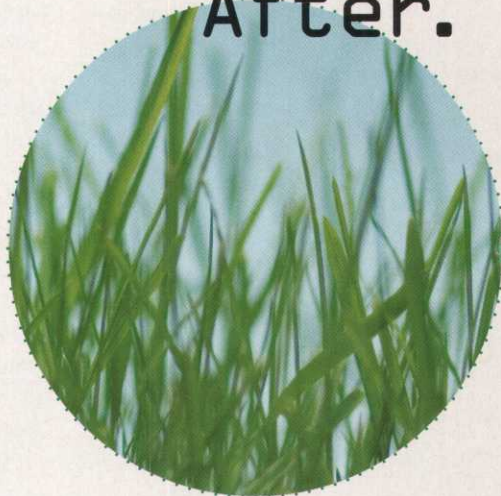
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Continued from page 52

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 concentra-

tions which may vary with endophyte and plant genotype. The survival of 3<sup>rd</sup> 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 3<sup>rd</sup> 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.

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AgraQuest Inc.	03	Otterbine Barebo Inc	29
Andersons, The	04	PBI/Gordon	13, 26, 28
Aqua Aid	21	Sam Williams	(reg) 32A-32D
BASF Corp	cv2, 16-17, 31	Scotts Seed	cv3
Bayer ES	Bellyband	SePro Corp	(reg) 05, 29
Bell Labs Inc	02, 07	Smithco	09
Chemtura Corp	37	Spindler Enterprises	55
Cleary Chemical Corp	cv4	Syngenta	22-23, 39
Drill & Fill Mfg.	55	Tech Sales	55
Eagle Golf & Landscape Products	56	Turf Merchants	11
Ewing Irrigation	34	TurfMaster Ind	04
FlexStake Inc	55	<b>TURFGRASS TRENDS</b>	
From Tee To Green	55	Bayer ES	53
Graden USA	02, 27	Floratine	51
Helena Chemical Company	05, 15	John Deere and Co	45
International Lawn & Garden Expo	35	Pursell Tech	47
Irrigation Association	56	This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.	
IVI Golf Sandtrapper	42		
Liquid Fence	30		
Markers, Inc	55		
Milorganite	36		
Montco Products	27		
Oregon Fine Fescue	19		

# Editorial Index

Company	Page No.	Company	Page No.
Arrowhead Golf Club	34	Fenway Golf Club	20
Augusta National Golf Club	12	Golf Club at Redlands Mesa	36
Bayer Environmental Science	10	Hazeltine National Golf Club	40
Bell Laboratories	10	Homestead (The)	33
Boston Hills Country Club	40	John's Island Club	12,40
Broken Arrow	8	Lafayette Municipal GC	14
Bryant Marketing Communications	12	PACE Turfgrass Research Institute	10
Chickasaw Point Resort	8	Pebble Beach Golf Links	26
Club Car	12	Quaker Ridge Golf Club	20
Colorado Chapter/GC Owners Assoc.	36	Rain Bird	10
Colorado Golf Association	36	Rocky Mountain GC Superintendents Assoc.	36
Colorado Section PGA	36	Saddle Rock GC	33
Colorado Women's Golf Association	36	Shinnecock Hills Golf Club	26
Country Club of Charleston	10	USGA	20,26
Deer Creek Village Golf Club	34	Westfield Group Country Club	40
		Winged Foot Golf Club	20,24

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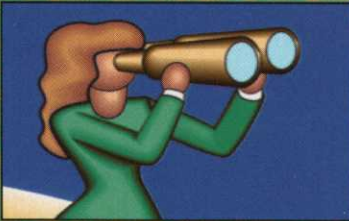


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## BLTs

**W**hen I was about 11, my grandfather got it into his noggin to raise pigs. Already with a farm full of cows, bees, cats, dogs, wheat, milo, alfalfa and even some corn, Grandpa claimed the pigs were just a commodity, another way to bring in a small stream of cash.

I know better. He tended pigs because he loved bacon.

Whether wrapped up in wax paper for a harvest lunch break or with chips for dinner, Grandma's BLTs — with each element coming straight from the farm — brought satisfaction every time.

Grandma's summer sandwiches created a BLT connoisseur — me. I have wolfed them down from coast to coast, from middle-of-nowhere mom 'n' pop diners, seemingly abandoned truck-stops, all variations of Denny's, and even once in a high-end restaurant more geared to *foie gras* and mixed grill.

These culinary expeditions, ranging from double-deckers on white, to an avocado addition on the West Coast, have led to firm (but sometimes supple) opinions on what makes the perfect BLT. Let us address them, part by juicy part.

**Bacon** — The heart of the concoction, which even the most maladroit short-order cook can't mangle too badly. Like most things in life, the more you spend on Mr. Piggy, the better he tastes. If there's a legitimate meat market in your

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BY MARK LUCE

area, the bacon there will be significantly thicker than the skinny store brands. Flavored bacons can be outstanding, especially applewood-smoked. Be wary of charring the stuff when frying it. Never, under any circumstances, nuke bacon for the microwave robs it of its soul.

**Tomato** — If you have access to heirloom tomatoes, use them on your sandwich. Sure, they're more expensive and often as strangely shaped as they are colored. For taste, though, no other type of tomato comes close. Their acidic sweet fluids complement the "B" and "L" beautifully. When cutting, slice 'em thick.

**Lettuce** — Romaine or red leaf lettuce only. Cut big leaves that will more than cover the bread.

**Bread** — Sourdough makes the best BLTs but never discount the cheaper wheat breads, which seem to do a workman-like job absorbing tomato juices whirled with bacon grease without getting too soggy.

**Accoutrements** — Not many folks

know that the devil himself first crafted mayonnaise. Its color, texture and ingredients have more in common with Crisco than the claims of "clouds of creamy goodness" that I sometimes hear. The plain BLT speaks to simplicity. The properly made sandwich renders any condiments unnecessary.

Hamlet never asked, "To Toast or Not to Toast?" But the spin on his famous soliloquy makes me feel like the indecisive Prince of Denmark, since for all the sandwich eating, I still don't have a preference on this final piece to the BLT puzzle. Straight toasting can make crunchy-good sandwiches on a winter's day, while no-toast seems better geared toward warmer weather. However, a variation may be the answer — butter one side of each piece of bread and pretend you're making a grilled cheese. The resulting mix between toasted and doughy mirrors the relationship between the bacon and tomato.

Remember, too, the proper order: lettuce layered on bottom, bacon packed in middle, tomatoes on top.

Enjoy your lunch.

*Mark Luce lives in Kansas City, Mo., where he's found a masterful BLT at a restaurant called The Cigar Box.*

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