tact with sufficiently moist surfaces where germination and establishment can take place. Nutrition also plays a role and nitrogen is the key nutrient. As shown below, the impact of nitrogen management on weed populations was evidenced in our plots.

Establishment method	Annual N rate	Crabgrass population	Broadleaf weed population
	lb/M	------------number/M------------	
Seed	1.0	1237	889
	2.0	1065	109
	3.0	897	104
	4.0	390	88
Sod	1.0	140	494
	2.0	11	109
	3.0	5	58
	4.0	0	42

The above weed populations are those averaged across all 3 mowing heights. This makes the lack of crabgrass in the sod fertilized with 4.0 lb N/M even more notable because at this N rate there was no invasion of the sod by crabgrass. Broadleaf weeds were absent in the sodded plot if the mowing height was 2.5 inches or higher and at least 3.0 lb of N were applied. In other words, by sodding and imposing the proper cultural practices, there was no need for herbicide applications in the first year after establishment. In contrast, no combination of cultural practices eliminated the need for herbicides in the seeded plot. If the sodded area continues virtually weed free for a number of years, the point could eventually be reached where the long term costs of sodding become equal to or may even decline below those of seeding. Only time will tell.

If you're establishing roughs, you may be interested in turfgrasses other than Kentucky bluegrass. One option often considered is the so-called "low input" fine fescues. Based on my observations in this study, that may be a misnomer and the term might better be applied to the turf-type tall fescues. The basis for this statement lies in the weed populations we found in the plots seeded to something other than Kentucky bluegrass. To simplify matters, I'm presenting only the average high and low weed populations and the cultural practices required to achieve the lowest populations.

Turfgrass established	Highest weed population	Lowest weed population	Lowest population practices
	-----------number/M-----------		
Creeping red fescue	2044	265	3.5 inches, 4.0 lb N/M
Turf-type tall fescue	109	0	> 1.5 inches, > 1.0 lb N/M
Perennial ryegrass	936	0	3.5 inches, 4.0 lb N/M
Madison Parks mix	842	0	3.5 inches, 4.0 lb N/M

Two things stand out in these weed populations. One is the fact that creeping red fescue was the most prone to weed invasion under any set of cultural practices. This prompts the question, "In the long run, is fine fescue really a low maintenance turfgrass?" The other thing to note is how well the turf-type tall fescue kept out weeds, even at an annual N rate of 2.0 lb/M. This I attribute to the fact that this grass germinated faster than any of the others, more quickly achieved 100% ground cover, and at the 6 lb/M seeding rate employed, has thus far maintained a higher stand density than any of the other grasses. This winter is providing a good test of differences in cold weather tolerance among the different species. How they fare will influence their susceptibility to weed invasion next summer.

There are few, if any studies on the long term costs of seeded versus sodded Kentucky bluegrass. The same holds true for seed establishment of different turfgrass species. Until such studies are conducted under different sets of conditions that have different demands as far as erosion control is concerned, a final answer to the question, "Sod or seed?" cannot be given. But I think you'll agree from the data presented here that we need to look beyond just installation costs.

The Future of Golf and its Superintendents

By Pat Norton, *Golf Course Superintendent, Nettle Creek Country Club*

So, where does the golf course superintendent go from here? After many years of progress, both personally and professionally, golf course superintendents everywhere should start asking themselves what the future might hold. Collectively and individually...what does the future have in store for us golf course agronomic types? Indeed...where does the great game of golf go from here? The golf industry, of which we are all a part, seems to be at a crossroads. Golf is not the hot sport that it was five or six years ago....rounds played at most public courses are flatlining, while private courses are finding it tough to fill the membership roster.

Worse yet, the golf headlines these days are just filled with negativity...courses going broke, being sold at a fraction of the initial investment. Hey!!! What a great time to jump in and buy a golf course!! Oops, almost forgot that nobody these days seems to want to offer financing to golf course investors. To look into the future, maybe we should review the past....

Those of us with some experience have seen and probably experienced firsthand the rise of golf over the last two decades. Those in my age group(mid-40's) broke into the superintendent ranks in the early 80's...as golf courses of all types were beginning to employ trained, professional superintendents.

Following the push to convert to the trained superintendent was the push to build golf courses anywhere and everywhere. This golf building boom paralleled the booming economy worldwide...and definitely led to lots of great employment opportunities for guys everywhere.

As we all now know...way too many golf courses were built during the 1990's...especially in the upscale public golf sector. This is news to absolutely nobody...but the deflation of the golf economy in the past three years has been hard news for many people.

Over the past twenty years, the value of the superintendent has continued to rise...as has his/her compensation. We all like to think that nowadays superintendents are as highly valued as our 'on property' colleagues of the PGA ranks. I think that some of that philosophy is simply window dressing.

Don't kid yourself, guys. Most PGA professionals still derive their income from various sources...which when totaled up blow right past a simple salary and benefits package. It's an economics term called diversification. This term can also be used to describe those savvy superintendents who copy their PGA buddies and in various ways diversify their incomes also!

What is the percentage of superintendents nationwide that outcompensate PGA professionals? Probably a very small number...maybe 20%. What is the percentage of PGA professionals that outcompensate their brothers in golf...the golf course superintendent? Probably about 80%...I'd guesstimate!

We can say that our profession has made enormous strides in twenty years...and we'd be stating the truth. But to think that the superintendent is considered the key man on the property is somewhat naive, I think. If we are so key, then we should be the guys pulling down six figure salaries and having the eight month contracts!

The art and science of being a golf course superintendent must expand its scope to include much more involvement in the business side of golf...especially these days. I am truly not sure of the details of the turfgrass cirriculum at the U of I, UW-Madison, Penn State, or any of the other Big 10 schools...but I'll bet it's still pretty heavily weighted towards ag classes. Ferris State over in Michigan has a major called **Golf Course Management.**..which on perception and promotion alone knocks the snot out of turfgrass graduates.

Who do you think is perceived to be more important in the eyes of golf course owners...a guy who has had lots of business training...which the PGA insists on before granting Class A status and knows how to make a golf operation profitable...or a guy who is really, really good at maintaining the course and keeping it beautiful and playable? The answer is definitely...in my twenty years of experience...the guy with all of that business training!

I really hope that today's turfgrass grads are getting a generous helping of business, accounting, and marketing classes tailored specifically towards the green industry. And I really applaud the GCSAA for starting down the road of having meaningful membership criteria through its PDI initiative. The day needs to arrive sooner rather than later when being a GCSAA Class A course manager carries the same weight or more than does the designation of PGA Class A golf professional.

And...by the way...each and every one of us is a golf course manager. We do not superintend...we manage...every day. Our national magazine is titled Golf Course Management...so obviously we should be Golf Course Managers...and part of the Golf Course Managers Association of America.

Golf is evolving and has been continually evolving over the years. Our involvement must evolve if we are to compete and take our proper place in the golf world. Maybe I am behind the times...but I think not. Superintendents are still perceived as ***superintendents***...the very name itself evoking an image of the guy wearing a tool belt...in which there is certainly no shame.

And although our professional organizations...MAGCS, GCSAA, ITF, WGCSA, and the USGA Green Section all do a fantastic job helping us...each and every golf course superintendent must still prove his professionalism on a daily basis. Like the game itself, the future of the golf course superintendent is somewhat in question.

Although we are simple superintendents, and will most likely never be partaking in any expert panels at any 'golf summits'...can we not offer up a few simple observations on the future of the game/sport/business that provides not only our livelihood...but is our personal and professional link to this international sport that traverses the world?

Yes, we can...yes, we should...and yes, we must.

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Molecular Approach to Solve Rust Disease on Turfgrass

By Sung-chur Sim and Dr. Geunhwa Jung, *Department of Plant Pathology, University of Wisconsin-Madison*

When I began to work with Dr. Jung, I knew a little about turfgrass as I had worked in fungal molecular genetics for my Masters degree. Over the past year of working with turfgrass, I have come to realize that turfgrasses are playing important role in our lives, even if they are not edible crops.

Can you imagine our life without turfgrass? How could you design beautiful outdoor architecture without it? Since I want to apply my knowledge and experience of molecular biology techniques to the study of turfgrass, my work in Dr. Jung's lab has started with genetic research of perennial ryegrass (Lolium perenne), which is one of the most widely grown cool-season turfgrasses and foliage crops in the world.

The DNA marker-based chromosome map is a useful tool for genetic analysis of important traits such as disease resistance. With the construction of a DNA marker-based chromosome map of perennial ryegrass, I can study the genetic mechanisms of disease resistance for my PhD research. Rust is one of the most important diseases on turfgrass, and the genetic study of its disease resistance in perennial ryegrass has been insufficiently explored.

In this article, I would like to tell you about the general knowledge of rust diseases on turfgrass and then discuss my research project.

Rusts occur on all commonly grown turfgrass species. Although many rusts have been documented over the years, they have generally been considered as a minor problem on turfgrass. However, rusts have recently become a major disease problem of both warm and cool season turfgrasses due to the more widespread use of susceptible species and cultivars.

The occurrence of rust diseases is favored by warm humid conditions. The optimal temperature range for the diseases is between 65 and 86°F, depending on the rust species. The diseases develop most frequently on plants stressed by drought conditions, low nitrogen fertility, and shade. Turfgrass with reduced growth rate due to a lack of nitrogen, insufficient watering, or other growth-limiting factor is susceptible to a more severe infection of rusts.

Causal agents of rust diseases include a variety of *Puccinia* and *Uromyces* species. The rust fungi are initially grouped according to uredinial characteristics: 1) presence or absence of paraphyses, which are sterile, hairlike appendages occurring within or at the periphery of the uredinia; 2) the ornamentation of the urediniospore wall, either echinulate or verrucose with flat or rounded warts; 3) the arrangement of germ pores in the urediniospore wall, either equatorial (aligned around the spore's equatorial) or scattered (not in a single line at the equator).

The rust fungi are specific to species within the grass subfamilies used as turfgrasses, chloridoid, panicoid, and pooid. On perennial ryegrass, which is one of the most susceptible cool-season turfgrasses, the common rusts can be readily separated into stem (*Puccinia graminis*) and crown (*P. coronata*) rusts. They both have rounded to oblong uredinia. On zoysiagrass (*Zoysia japonica*), which is often a target of severe rust damage among warm season turfgrasses, rust is caused by *Puccinia zoysiae*. Many rust fungi have complicated life cycles with multiple spore stages.

The appearance of light yellow flecks on leaves or stems is the initial sign of rust infection. The yellowish spots of the infected area enlarge and elongate parallel to the leaf or stem axis as the infection develops. Within several days, orange to reddish-brown pustules, which are known as uredinia, appear in the area of the yellow flecks, breaking through host epidermis. Urediniospores are exposed from uredinia. Urediniospores may be yellow, orange, brownish yellow, chestnut brown, or brick red and they appear as a powdery mass.

Although most rust fungi can also produce another spore type, called the teliospore, this spore is primarily produced on unmowed grasses. Therefore teliospores are rarely important for the occurrence of rusts on turfgrasses. As rust disease develops, infected plants become thin and weak and then die as excessive moisture from infected leaves is lost.

Rust diseases, like many other diseases of turfgrasses, are managed mostly by cultural practices, such as use of resistant cultivars and use of fungicides. The damage of rusts can be greatly reduced by maintaining recommended fertility, avoiding moisture stress or overwatering, and adjusting mowing heights according to turfgrass requirements. Adequate nitrogen levels that sustain a moderate growth rate are a critical factor in rust control on turfgrasses. Another effective control strategy is frequently mowing turfgrasses at recommended heights until symptoms disappear. However, low mowing heights must be avoided because they will stress the plants.

The use of a rust-resistant cultivar can be an effective control strategy. On perennial ryegrass, several cultivars such as Elka, Tara, Gator, Ovation, and Ranger have good rust resistance. However, Regal, Manhattan, Citation, Linn, and Dergy perennial ryegrass cultivars are highly susceptible to rust. The use of fungicides is recommended for rust control on golf courses and athletic fields but not home lawns.

Genetic analysis of rust resistance using DNA marker technology on perennial ryegrass allows us to understand host resistance and possibly develop a rust resistant cultivar more effectively than conventional methods. This is the ultimate goal of my research. My first effort will be to construct a DNA marker-based chromosome map of perennial ryegrass. I am using a mapping population derived from the crosses of annual and perennial ryegrass clones made at Oregon State University. The DNA marker-based chromosome map is being constructed with various DNA marker types. This map can be a useful tool with several applications for improving turfgrass: genetic analysis of important turf disease resistance, DNA-marker assisted transfer of agriculturally important genes, and molecular cloning of high-value genes.

In closing, I am very glad to be working on genetic analysis of disease resistance on perennial ryegrass for my PhD. Understanding how many genes control disease resistance and how they interact promises many interesting results, both for scientists and end-users of turfgrass.

"OK. REMIND ME. THIS IS **MARCH**, ISN'T IT? THIS IS **WISCONSIN**, ISN'T IT?"

Watch Out For Yet Another Potentially Destructive Insect Pest!

By Dr. R. Chris Williamson, Department of Entomology, University of Wisconsin-Madison

Sometimes it seems as if every time we turn around, yet another insect pest is discovered. The emerald ash borer, *Agrilus planipennis* Fairmaire, is no exception! In May and June of 2002, adults of the emerald ash borer (EAB) were collected from ash (*Fraxinus*) trees in the Detroit area of southeastern Michigan. This finding was quickly followed by the discovery of EAB in neighboring Ontario, Canada. It is suspected that the EAB entered into the United States and Canada via wood pallets from Asia. As a result, we are again faced with the challenge of managing yet another potentially destructive insect pest.

Origin and Native Range

The EAB is an exotic forest pest that is native to China, Japan, Korea, Mongolia, Russia, and Taiwan.

Identification

EAB is a Coleopteran (i.e., beetle) from the *Buprestidae* family (i.e., same as bronze birch borer). The adults are slender, elongate beetles approximately 1/4 - 9/16 inch long. They are metallic, emerald-green in color (Figure 1). Larvae are white, flat, slender, and have a pair of brown pincher-like appendages on the last abdominal segment. Fully-grown larvae reach approximately 1 - 11/4 inches in length. Compared to the thorax and abdomen, the head is relatively small, and retracted inside the thorax (Figure 2).

Hosts

It is understood that the only host of EAB is ash (*Fraxinus*). In Michigan and Ontario, EAB has only been discovered in ash trees including *F. americana*, *F. nigra*, and *F. pennsylvanica*.

Biology

Unfortunately, the biology (i.e., life cycle, behavior, habits, etc.) of this important insect pest is vague at best. Based on the nominal information that is available, EAB typically completes one generation per year in northeastern China; however, some individuals may require two years to complete development. Adult EAB activity has been reported from mid-May through July. The adults appear to lay their eggs on the bark surface, inside bark cracks and crevices, typically from early-June through late-July. EAB larvae actively feed in the cambial region of the trunk from mid-June through mid-October. Thereafter, they overwinter as fully developed larvae in pupal cells constructed in the outer sapwood or in the bark. The following spring, late-April and May, the larvae pupate within the tree, and adults begin emerging approximately two weeks later. In climates where the larvae do not fully mature by fall, they will overwinter in the cambial region and initiate feeding again in April, completing their life-cycle later in the summer.

Damage Patterns and Symptoms

It appears that the EAB does not discriminate between "healthy" and "unhealthy" trees, nor does it discriminate against tree size. In China, EAB most often attacks ash trees that are growing

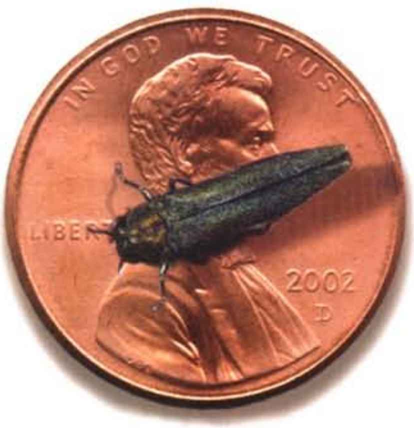


Figure 1. EAB Adult

Figure 2. EAB Larva

Figure 3. D-shaped adult exit

Figure 5. S-shaped larval feeding gallery

Figure 4. EAB damage

in the open or along the forest edge; however, entire tree stands can be killed during outbreaks. EAB appears to initiate attack along the upper trunk and lower portions of main branches, with succeeding years of attack being concentrated along the lower trunk. Generally, tree death typically occurs in 3 years; however trees can die within 1 - 2 years when EAB populations are at outbreak levels. In Michigan and Ontario, EAB has reportedly infested apparently "healthy" ash trees ranging in size from 11/2 inches - 3 feet in diameter. Like most boring insects, EAB infestations are difficult to diagnose the first year, since eggs are laid deep inside bark cracks and larval feeding occurs under the bark. It is not until the following year that D-shaped exit holes appear, providing the first positive evidence of an EAB infestation (Figure 3).

Typical damage symptoms occur over a three-year period. Year 1 shows a little crown dieback. Year 2 includes less development of foliage and crowns appear thinner (Figure 4), 2) the sapwood forms callus tissue around the larval galleries from the first year, which can result in longitudinal bark splits 2 - 4 inches in length, and 3) "sprout" development along the main trunk and on some branches. When EAB larval populations are high, branches typically turn brown prematurely in late summer and characteristic S-shaped larval galleries (Figure 5) can be seen through cracks in the bark. These galleries are most common along the upper trunk in the first year of attack; however, they can be found throughout the trunk in succeeding years. In Year 3, many branches are dead, little foliage is present, bark splits are common, and exit holes are present throughout the trunk.

Action

Because an outbreak population of EAB is less than 200 miles from Wisconsin, ash trees are commonly grown here, and numerous imported products are shipped into Wisconsin on wood pallets, it is essential that we be on the lookout for this important insect pest. Should you suspect an EAB infestation or discover EAB specimen (adult or larva), be sure to contact the USDA-APHIS regional office immediately (in Wisconsin 608-231-9545).

All photos are courtesy of Michigan State University (Drs. McCullough and Roberts)

A Cold Trip Down South

By Monroe S. Miller, *Golf Course Superintendent, Blackhawk Country Club*

I rubbed my hands together just before we left Wisconsin for the GCSAA conference in Atlanta, thinking about warm weather and green grass that could only be a couple of days away. Exciting thought.

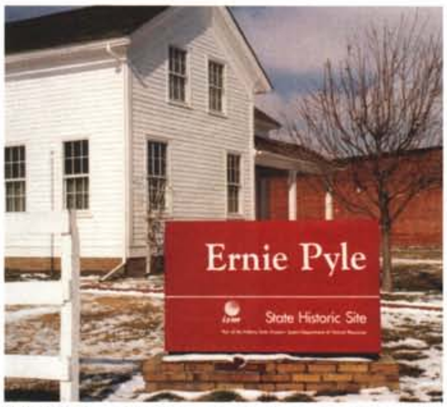
But false hope, as it turned out. Actually, the farther south we drove, the more snow we saw. Ponds were frozen south of Louisville, and on the Sunday before conference, snow and winter weather in the mid-south created treacherous driving conditions. We didn't know it, but it would be worse coming home. When we arrived in Atlanta, it was raining, the wind was blowing 20 - 30 mph and the raw weather depleted the anticipation of only a few days earlier.

In recent years GCSAA has settled on certain cities for the conference, and most of them are a reasonable drive from Madison. That has become my preferred mode of travel. Air travel is a hassle, made even worse by events of 9/11/01. It can be costly; it is inflexible, boring and aggravating. So again this year, we drove.

Driving is not without its own problems. Winter weather through the south can be dicey - they don't invest heavily in snow removal equipment - but since we give up two weekends we can let the weather forecasts determine our departure day. So far it has been great traveling.

Going by car gives the chance for some substantial conversation, nearly impossible by plane. The variety is nice, and by alternating routes, it is possible to see lots of sites on the way down or while at the conference city, from golf courses to historic sites.

Car travel at times would drive a certain kind of person crazy, though. There are the usual odd noises and aromas males are all too willing to share with one another, giving the driver a lot of power with the master window control switch. The radio causes irritations, too. The young guys want to listen to music that gives me a headache; I cannot understand why, on the other hand, they can't enjoy a beautiful Mahler concert on NPR. We nearly had a minor row on the first Sunday going down. I was driving and therefore had radio control. I was searching the dial for *The Lutheran Hour* since I was missing church. Grimm



World War II writer Ernie Pyle had humble beginnings near Dana, Indiana.


There is one big bat outside the Louisville Slugger factory!


President Zachary Taylor is buried in Louisville.


President Andrew Johnson is buried in Greenville, Tennessee.