is possible to develop a creeping bentgrass cultivar for golf course greens that does not require application of snow mold fungicides.

Objective 2: To develop fine fescues suitable for use in golf course fairway construction and/or overseeding.

As a group, these species tend to have extremely fine leaf texture, good drought tolerance, and excellent shade tolerance. They are generally used in low maintenance turfs or as mixture components in shady environments. There have been a number of recent attempts to utilize fine fescues under more intensive mowing managements, such as occur on golf courses. There are large differences among cultivars in tolerance to various intensive mowing managements, indicating that there may be considerable genetic variation for such tolerances. This indicates that there is potential to develop cultivars that are more adapted to golf course managements. Combining this with the excellent inherent drought and shade tolerance of most of the fine fescues would provide additional flexibility and options for golf course superintendents and possibly other turf managers.

We plan to rely heavily on both local and distant collections of fine fescues from stressful environments, including sandy soils, soils with clay pans, and closely mowed sites. Collections of fine fescue plants will be screened for turf quality and adaptation in collaboration with golf course superintendents. Initial survey of existing cultivars and fine fescue plants found in many Wisconsin turf sites indicates that there is greater potential for improvement.

Objective 3: To determine the potential of meadow fescue as a high-quality, traffic-tolerant turfgrass.

Meadow fescue is a close relative of tall fescue. It has a lower growth habit, with reduced above-ground biomass production, finer leaves, softer leaves, and greater tiller density than tall fescue. Clumpiness (unevenness of stand as the turf ages) and leaf coarseness are two of the major problems with the use of tall fescue in turf applications in the north central USA. As such, there is relatively little tall fescue used in the north central USA. It is primarily recommended on sandy, drought-prone soils. Because of its excellent traffic tolerance, a solution to these problems might be useful to turf managers.

My initial screening of the USDA collection of meadow fescue indicated that some lines have potential turf applications. I have found good-looking, narrow-leaf, low-growing plants with good ground cover. The next step will be to increase these collections and put them into turf plots for initial evaluation and additional selection and breeding. These trials will be done in collaboration with athletic field managers in the Madison vicinity to assist in creating a realistic stress that we can readily evaluate. They will also be evaluated in mixtures with Kentucky bluegrass and compared to dwarf-type tall fescues to determine their potential value.

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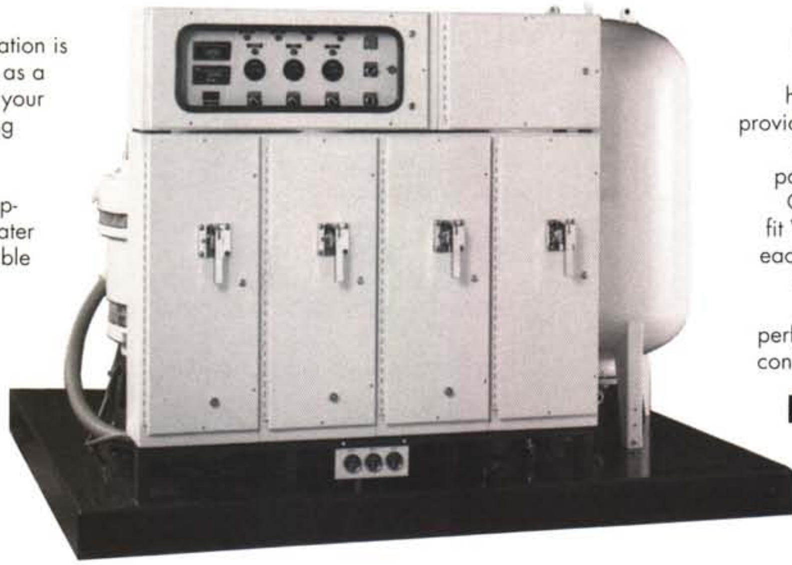

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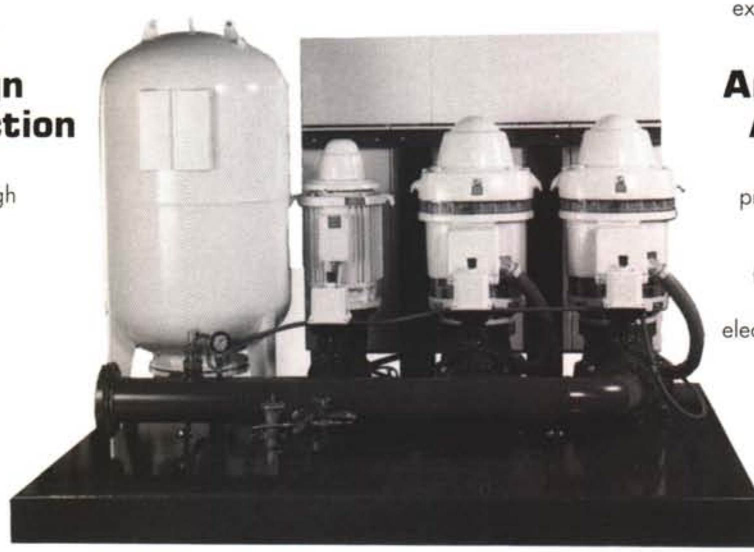

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The Chambers of Death

Jeffrey S. Gregos, Turfgrass Disease Diagnostic Lab, Department of Plant Pathology, University of Wisconsin-Madison

Recently, the TDDL became the premier testing facility for the evaluation of Pythium blight control products in the midwest with the help of a little technology that I was able to smuggle out of Penn State before I left. I like to call them the Chambers of Death because they are two Gothic arch greenhouses with very low-tech humidity and temperature controls designed for the sole purpose of Pythium development.

During the trial, temperatures were maintained around 100ºF during the day and 70ºF during the night. With humidity levels approaching 100% and artificial inoculation, these conditions result in the ultimate recipe for Phythium blight development.

This year's trial featured several standard products and some that I am not at liberty to discuss at this time. However, the trail was a success. We were even lucky enough not to have to inoculate the first greenhouse due to a natural outbreak this year.

I have to admit that I received quite a few questions why I left the plastic on the greenhouses for only a week.

But as many of you know, that is all it takes. This year I had three application timings. The first was a preventative application applied to both greenhouses prior to closing up the ends of the first house. The next was done on the day of inoculation. In the first house this was a day after the preventative application, and for the second house about ten days later. The final applications were applied curative, or when one mycelium development was noticed.

The trail is conducted in such a way that length of efficacy data is obtained. The length of the trial is determined by how quickly one of the untreated checks or treatments take to receive almost 100% damage. From this we were able to determine 7-day efficacy and 14-day efficacy. Below are some of the treatments tested this year along with their rates, application timing, and 7-and 14-day efficacy ratings. With data obtained from this trial I hope that you will remain Phythium free in the years to come. Also, with the data that I am unable to print at this time I feel that we will have other chemicals to add to our arsenal in the future battle this dreaded disease.

Treatment	Form.	Rate	Rate Unit	[1]Timing	[2]7 day Rating		[2]14 day Rating	
					% Damage		% Damage	
Chipco Signature	80 WDG	4.0	oz/1000 ft2	Prev.	13.3	bc	20.0	d-g
Chipco Signature	80 WDG	4.0	oz/1000 ft2	Day of Inc	20.0	bc	20.0	d-g
Subdue Maxx	1.0 EC	1.0	fl oz/1000 ft2	Prev.	15.0	bc	28.3	b-e
Subdue Maxx	1.0 EC	1.0	fl oz/1000 ft2	Day of Inc.	16.7	bc	3.3	h
Terrazole	35 WP	4.25	oz/1000 ft2	Day of Inc.	41.7	ab	20.0	d-g
Terrazole	35 WP	4.25	oz/1000 ft2	Cur.	30.0	bc	21.7	c-f
CGA 279202	50 WDG	0.3	oz/1000 ft2	Prev.	41.7	ab	88.3	a
CGA 279202	50 WDG	0.15	oz/1000 ft2	Prev.	20.0	bc	16.7	d-h
Subdue Maxx	1.0 EC	0.5	fl oz/1000 ft2					
Heritage	50 WDG	0.4	oz/1000 ft2	Prev.	50	c	41.7	b
Heritage	50 WDG	0.4	oz/1000 ft2	Cur.	8.3	c	6.7	fgh
Terraneb	65 WP	4.0	oz/1000 ft2	Prev. GH 1 Cur. GH 2	63.3	a	21.7	c-f
Check					65.0	a	78.3	a

[1]Prev. = Preventative treatments, Day of inc = day of inoculations treatments, and Cur = curative applications.

[2]% damage means followed by the same letter do not significantly differ (LSD 0.05)

Chamber 1

Chamber 2

Turfgrass Seed Production in the American West

By Dr. John C. Stier,
Department of Horticulture
University of Wisconsin-Madison

Carpe diem

This June I had an opportunity to take an all-expense paid trip to the seed production and research facilities at Jacklin Seed Company in Post Falls, Idaho. Known as the Discovery Tour, this annual event was open open to people from all over the turfgrass industry. This year there must have been close to 200 people who took advantage of the tour. Superintendents, sales representatives, and even a few of us university types were present.

The trip started on Friday, June 12 and finished the evening of June 13. For early arrivals, mule trips were offered. Having seen mules before, I purposely arrived after the mule ride. On Sunday June 14 golf was offered at Twin Lakes Village Golf Course; although it sounded like fun, duty called back in Wisconsin so I had to pass on the golf. Nonetheless I managed to squeeze in quite a fun and educational time between Friday afternoon and Saturday evening. Friday evening we spent touring seed production areas and discussing seed production with a grower. Since this coincided with the NBA playoffs between the Chicago Bulls and the Utah Jazz, the grower was thoughtful enough to have a TV in the equipment shed where dinner was served. Saturday we toured Jacklin Seed's research laboratories and field plots, capped by dinner at Coeur d'Alene golf club and a boat ride on beautiful Lake Coeur d'Alene.

Grass breeding plots.

Seed Production

Jacklin Seeds claims to be the largest producer of Kentucky bluegrass seed in the U.S. (and therefore the world). Typically, they contract for 60,000 acres of Kentucky bluegrass seed production annually, using approximately 120 growers. Some of the growers maintain close to 1000 acres of seed fields. They also produce some fescue and ryegrass.

Most Kentucky bluegrass seed is produced in eastern Washington, eastern Oregon, and Idaho. The Columbia basin in southern Washington and northern Oregon, which receives only 6 inches of rain annual, is typical of the desert-like region. To the north and east (eastern Washington and Idaho) is an area known as the Palouse. The dry climate in these areas inhibits *Poa annua* which precludes Kentucky bluegrass seed production in the western part of the Pacific Northwest: it is nearly impossible to separate *P. annua* seed from Kentucky bluegrass seed. At $300/acre, turfgrass seed production fields are expensive to establish. In the Palouse, which is dryland farming, the fields are planted in late spring/early summer and are not harvested until mid-July following year. This means each field only produces revenue once every two years. Some fields, especially those with common types of Kentucky bluegrass, may be left in perennial production, up to seven years before seed production declines or the field

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becomes too weedy to harvest. Fields in the Columbia basin are irrigated so can fields can be planted later (in August), allowing harvest of a crop earlier in the season (e.g., winter wheat), and earlier harvest of grass seed the following year, e.g., mid-June.

Thatch development is a tremendous problem on perennially-cropped seed farms as it reduced yield due to harboring of diseases and insects. Until 1998 this problem was controlled by burning. Starting in 1996, due to concerns over smoke causing health problems, WA law was initiated to phase out burning. Spread of the urban population into rural areas has really precipitated this and other issues (does this ring any bells for us in Wisconsin?). In 1996, growers had to reduce burning their acreage by one third. In 1997, the restriction was expanded to two thirds of the acreage, with a total ban beginning in 1998. Already growers are seeing reduced yields in areas not burned since 1996 and 1997. What will this mean for superintendents? Likely, increased prices. Burning is still allowed throughout Idaho and in rural areas of Oregon. In Idaho, burning is allowed due to the "Right to Farm" law. Public sentiment against the practice, though, is growing strong and may result in burning bans in Idaho as well.

Growers are struggling to develop new methods of reducing thatch. One option is to use flash burning. First the straw must be removed, a process which can cost $35 to $50 per acre. This is followed by driving propane burners over the closely mown land area to scorch the surface thatch. Unfortunately the practice is too slow and costly to be effective. Other practices include using sheep to graze the land following harvest and longer rotations with non-turf crops.

In the non-irrigated Palouse most seed production is limited to common types of Kentucky bluegrass (e.g., 'Park'). Seed production varies widely depending on the variety and of course the weather, ranging from 700-1000 lb/acre. The record-setter is 'Kelley', with a yield of close to 2,000 lb seed/acre once reported. Common seed sells, at best, for $0.60 to $0.70 per pound. Non-burned areas suffer at least 250 to 300 lb/acre of lost seed yield, and some of the older fields are already being taken out of production because seed yield losses have been so high.

Proprietary cultivars are grown almost exclusively in irrigated areas. In an effort to regain some of the margin lost due to burning bans, some growers are planning to begin producing proprietary varieties in the Palouse. Since most proprietary varieties mature later than common types, concern is great that drought may often coincide with the prime time for grain fill. Still, the growers must do something to maintain profit.

The Harvest Process

Seeing a production field for the first time usually sets most people aback, especially those used to managing fine turf on golf courses. The grass is allowed to grow to its maximum height, typically three to four feet. The fields usually look more like a monostand of a prairie species than a turfgrass.

Harvesting occurs between mid-June and mid-July. Once the seed has formed and matured, the crop swathed (cut) and windrowed. The seed is harvested once it dries to approximately 12% moisture. Rains generally do not increase seed moisture. Only in 1993, during an excessively wet harvest period, has the seed ever sprouted while still in the windrows. An ordinary grain combine, with a slightly modified header, is used to pick and sort the seed from the stalks.

Cleaning, packaging and selling

Once harvested the seed must be cleaned to remove chaff, weeds, and non-seed material. At Jacklin, the seed cleaning process begins in early July and continues through the following April. At peak processing, 120,000 lbs of seed per hour can be cleaned. The plant generally operates about 20 hr per day during peak season. Interestingly enough, some cultivars clean easier than others, so this is usually related to seed size, with the larger-sized varieties being easier to clean.

The seed is packaged and stored at room temperature. Extra high quality seed is tagged as "sod quality". This is largely to ensure against rough bluegrass (think about paying the extra money in the future if you want to avoid rough bluegrass in your fairways!). Loss of viability during storage is not too great as most of the seed is sold within a year. During the first year the seed typically loses about 1% viability although this is temperature-dependent.

Endophyte Enhancement of Bentgrass and Bluegrass

A major portion of the research labs at Jacklin are devoted to producing endophyte-enhanced turfgrasses. Endophytes are a unique group of fungi which inhabit the aboveground portions of grass plants without harming their hosts in a mutually symbiotic relationship. The hyphae grow between the cell walls and the fungi utilize some of the plant-produced sugars (carbohydrates) and possibly proteins for growth. The grass benefits as the endophytes appear to confer resistance to many insects and possibly some diseases. The fungus releases several types of alkaloids which the insects find distasteful. In some cases the alkaloids can disrupt the insects' growth stages, sometimes even killing the insect.

Perennial ryegrasses and fescues have traditionally been the only turfgrass species to contain endophytes. If endophytes could be found which infect bentgrass and bluegrasses, insect and some disease problems may require fewer pesticide applications in the future. Widespread searches for creeping bentgrasses and Kentucky bluegrasses which naturally contain endophytes have borne little fruit. However, related species have been found to contain endophyte (e.g., other *Agrostis* and *Poa* species). Introducing endophyte into a cultivar is a laborious process much of which is performed in the laboratory. First, endophytes from wild species are cultured on media which contains extracts from desirable bentgrass or bluegrass cultivars. Those endophytes which grow well are then used for attempted introductions into seed of those varieties. There are two initial problems with introducing endophyte into species or cultivars which don't normally contain the fungus: 1) The grass plant could inhibit growth of the fungus and 2) The fungus may harm the grass. Occasionally a successful introduction will be made–this material then will go on to field testing to check the viability of the "infection".

Endophyte enhanced turfgrasses have exciting potential for use on golf courses and other fine turf areas but may cause us to redevelop some of our management strategies. Consistent pesticide use, especially systemic fungicides, can harm endophytes and decrease their concentration in turf. Unless ways of application, new formulations, or other protective measures can be found, it may not be possible to use systemic fungicides regularly on endophyte-enhanced turfgrasses.

Also, we will need to establish what level, or percentage, of infection is needed to control insect pests in various turf species. Even under optimal conditions less than 100% of turfgrass plants in a sward contain endophyte anyway, but this does not necessarily result in poor control of insect damage. In fact, just the opposite may occur. For example, if a stand of turfgrass initially has 20% infection with endophyte, over time the percentage of endophyte-infected turf can increase as the insects feed on and remove endophyte-free turf. Since endophytes are only transmitted through seed, the endophyte cannot move from one plant

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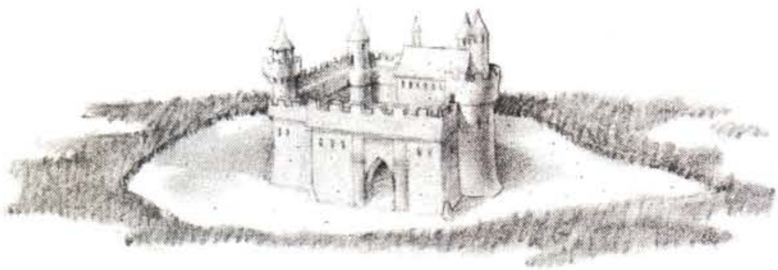
There Are A Few Things The Sand Pro Can't Do



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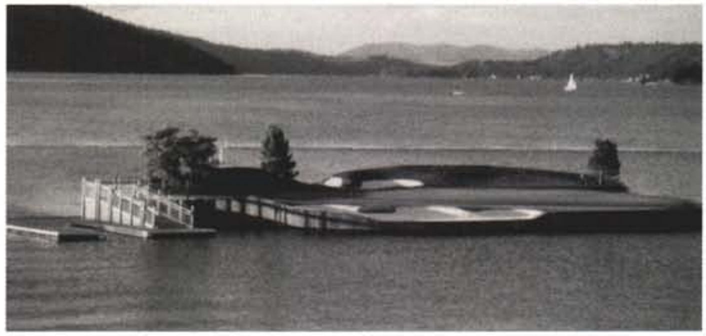
to another plant. One recent discovery, however, is that endophytes can grow through stolons but typically stay back about one inch from the tip. Endophytes do not grow in the roots. Roots are the realm of other symbiotic fungi, known as mychorrizae, but that's another story.

The shape of things to come

Several other tour stops were variety trials. By and large, the bermudagrass looked poor, but you have to admit the Idaho location is pushing the northern limit just a bit! Fescues, ryegrasses, and bentgrasses were all present. One interesting bentgrass was Idaho bentgrass (A. idahoensis), probably a naturalized ecotype of a colonial bentgrass. Idaho bentgrass is unique because it was found growing in an abandoned mine region up the Spokane River Valley. Two breeders found it on a boating trip up the river, and noticed it because it grew on soils contaminated with acid mine tailings and heavy metals where it was the only vegetation around. A bunch-type perennial, it is unlikely Idaho bentgrass will ever see much use on putting greens as long as we have creeping bentgrass. Still, it is able to be mowed close, and will maintain a decent turf: the most striking feature is it shows how well nature can adapt to toxic conditions if given enough time.

Bluegrasses comprised the largest of the variety trials. Over 7,000 cultivars were maintained at the farm. It was surprising to see yesterday's and today's top varieties paired against experimental cultivars. Varieties like Ram I, found on a putting green in Maine in the 1960's and still considered a decent cultivar, looked terrible compared to many of the new experimental varieties. These type of plots highlighted the idea of how much improvement has been, and continues to be, made with new cultivars.



Floating green at Coeur d'Alene.

End of the line

The tour officially ended Saturday evening with a wonderful boat ride on Lake Coeur d'Alene and dinner at Coeur d'Alene golf course, home of the famous floating golf hole. The hole is built on a small island, ringed with trees and bunkers. You have to take a boat to the island to putt in. For kicks, we all had a chance to tee off onto the hole; few of us made it. It didn't help knowing the island had an underground control system from which an operator could move the island closer to or away from shore! The whole trip was an exciting experience. If you ever get a chance to go to the seed production fields out west, seize the opportunity. Turfgrass seed production is a whole different game and the scenery is breathtaking!