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North Carolina Agricultural Extension Service

PREFACE

Proceedings of the 27th Annual North Carolina Turfgrass Conference are being provided as a permanent reference to those who attended the Conference. The 1989 Conference was held at the Raleigh Civic and Convention Center, on January 4, 5, and 6. Sessions on general turf topics and concurrent sessions for golf course, lawn care, roadside and low maintenance turf, landscape maintenance, sod, and athletic field topics were scheduled. Workshops on Lawn Maintenance, Weed Identification, Landscape Design and Landscape Plant Selection were held the afternoon of January 4. The trade show used 40,000 square feet of space. Approximately 1400 people attended the Conference.

Special thanks are extended to everyone who helped make this Conference successful. Each speaker is to be commended for their excellent presentation. The following committee members contributed to the success of the Conference.

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The 1990 North Carolina Turfgrass Conference will be held in Raleigh, NC on January 10, 11 and 12.

Additional copies of the Proceedings are available at $5.00 each from Dr. L. T. Lucas, Department of Plant Pathology, Box 7616, North Carolina State University, Raleigh, NC 27695-7616. Make checks payable to the Turfgrass Council of North Carolina.

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UNDERSTANDING ENVIRONMENTAL STRESS

David J. Wehner
University of Illinois

The 1988 growing season was characterized by exceptionally hot, dry weather in much of the United States. In central Illinois, there was a 7.5 inch deficit in rainfall for the year. Watering restrictions, ranging from specific times during the day when lawns could be watered to a ban of all outside watering, were imposed in many communities. Certainly, turfgrass managers thoughts turned to environmental stress in 1988. Environmental stress on turfgrasses, however, has been around for a long time. The following quote reminds us of this.

> And don't fancy for a moment that you can have an English lawn in an American climate. As well recognise first as last the fact that the world famed lawns of Europe are impossible to the gardens this side of the Atlantic. Over there the grasses grow once they are established and reseed themselves with a facility that is surprising to the New World gardener. Here, with the problems of excessive and brilliant sunshine in summer, often coupled with prolonged spells of exhausting drought; and followed by the extreme cold of our often very rigorous winters, the grasses suffer strains which necessitate an entirely different method of lawn making.

This quote was taken from the book "Lawns, And How To Make Them," written by Leonard Barron in 1906. Environmental stress will continue to be a problem in the future. There are no magic solutions to environmental stress problems; the turfgrass manager cannot make it rain or change the air temperature. He can, however, evaluate the cultural regime being used on the turf and manage the plants to increase their ability to withstand environmental stress.

It is important to understand the definition of stress as well as know the optimum conditions for plant growth in order to determine when stress is a problem. Stress can be defined as any condition that makes the plant less healthy. When stress conditions occur, plants will reduce their growth rate and then, if the stress is severe, will be injured or killed. The ideal temperatures for the growth of cool season turfgrasses are 50 - 65 °F for the roots and 60 - 76 °F for the shoots. The optimum temperatures for warm season turfgrasses are 70 - 85 and 80 - 95 °F for the roots and shoots respectively. Turfgrasses require good soil conditions, moisture, and sunlight in addition to the proper temperatures to maintain growth.

If turfgrasses are provided with reasonably good growing conditions, and left alone, they will be very resistant to environmental stress when it does occur. However, if Kentucky bluegrass is left alone, the plants will produce seedheads that are several feet high in addition to having leaves that are 12 inches long. A desirable turfgrass stand is

differentiated from the above condition and from almost all other plants by one practice, mowing. Mowing turfgrasses results in a shallow root system and plants that are more susceptible to environmental stress. It is important for the turfgrass manager to realize the consequences of mowing on the plant. Mowing removes leaf surface area that is necessary to make food for the root system. As a result, the roots system is not as extensive on a mowed plant as it is with a plant that has not been mowed. Remember that only 1/3 of the leaf blade should be removed with each mowing so that the root system will not be drastically affected.

During the summer, plants are frequently exposed to high temperature. The actual temperature of a plant is affected by solar radiation (sunny versus cloudy conditions), evapotranspiration (evaporation of water from the soil surface and transpiration of water from the plant) soil properties (soil moisture, soil texture, slope etc.), and environmental conditions (presence of wind, high humidity etc.). The actual temperature experienced by the plant can be considerably cooler or warmer than the current air temperature. Where moisture is limiting, the temperature of the plant will usually be higher than air temperature because the plant is not able to transpire water. Transpiration is a cooling process where heat from the plant is used to evaporate water resulting in a lower plant temperature. As soil temperature rises, the root systems of the plants can also be restricted resulting in a shallower root system so that less water is available for transpiration.

The ability of the plant to survive high temperature stress is going to depend on how hot the plant gets and the ability of the species to resist high temperature injury. For example, annual bluegrass is much less heat tolerant than other turfgrass species. Unfortunately, the turfgrass manager has little control over the temperature that a plant is exposed to. The only thing he can do is to plant the most heat tolerant species that fits the ultimate use of the area and maintain good moisture conditions.

Moisture is required for plant growth in addition to its roll in transpiration. When moisture is limiting, the plant undergoes drought stress and heat stress. The water status of the plant is influenced by the available soil moisture, a function of rooting depth and soil type, and the climatic environment. The greatest transpirational demand occurs when high temperatures are accompanied by low humidity and high wind speeds.

No turfgrass manager can make it rain, but some managers have the facilities to irrigate. It will be extremely important in the future to be as efficient as possible when irrigating turfgrass stands. Water use efficiency depends on a knowledge of the moisture inputs and outputs from the system and understanding the quantity of water stored in the soil. The key to being efficient is to apply irrigation water only as fast as it can enter the soil, and to only apply as much as can be reasonably stored in the soil profile. Tools such as tensiometers and infrared thermometers can help the turfgrass manager evaluate the need to irrigate.

Man's activities can also influence the ability of plants to withstand environmental stress. Traffic on a turfgrass area causes the soil to become compacted which means that the soil particles are compressed into a smaller volume. This results in less pore space for root growth, less air and water storage and soil that is more susceptible to temperature extremes. The air in the soil pores helps insulate the soil from rapid changes in temperature. The best way to combat the process of compaction is to core cultivate. Core cultivation opens the soil for water infiltration, air exchange and provides space for the root system.

Much has be written lately on the importance of thatch control. The presence of an excessive thatch layer will make turfs more susceptible to drought and heat stress. Thatch is made up of undecomposed organic matter which has very large pores. The large pores cause the thatch to be a very droughty medium for plant growth. The thatch interrupts the resupplying of water from the soil below since water cannot cross from the fine pores in the soil to the large pores in the thatch. Core cultivation helps make the thatch a better media for plant growth because soil is incorporated into the thatch layer.

Fertilization programs also influence the ability of a plant to withstand stress. Nitrogen fertilization during stress periods can cause excessive shoot growth which is detrimental to the root system. Research being conducted in Nebraska indicates that a high level of potassium fertilization will help a plant withstand drought stress.

Application of pesticides can sometimes influence the turfgrasses stress tolerance. Improper applications where either high rates of chemical or inappropriate pesticides are used will result in injury to the turf. In general, broadleaf herbicides should only be spot sprayed when temperatures are above 85°F.

Finally, the presence of insect or disease organisms in a turfgrass stand can also reduce the ability of turfgrasses to survive stress situations. Various soil born insects can feed on the root system causing the plant to wilt. In 1980, a disease occurred in the Chicago area which plugged the water conducting vessels of creeping bentgrass resulting in a wilt condition. The plants died as a result of stress due to the inability to transpire water.

In Summary, turfgrass stands are subjected to numerous environmental conditions and receive various management inputs. The interaction of the environment and cultural programs will determine the overall health of the plant and its ability to withstand environmental stress. Successful turfgrass managers will strive to understand this interaction and optimize management to produce the best possible results.

WEED MANAGEMENT IN PONDS

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The presence of some vegetation in small ponds is desirable for aesthetic purposes and to enhance fisheries. The most critical factors in maintaining a good balance of aquatic vegetation in ponds are proper pond location and design and prevention of nutrient runoff. Ponds banks should be constructed with a minimum slope of 1:6 (ratio of depth to distance from bank) to minimize the areas having depths less than 2-3 feet. A healthy sod cover should be maintained around the pond. In heavily-fertilized systems (golf courses and residential yards), an unfertilized buffer zone should be maintained around the pond to minimize nutrient runoff. A small sedimentation pond on an inflowing stream above the main pond also will reduce sediment and nutrient deposition in the main pond. Proper pond construction and care to prevent accidental or intentional introductions of undesirable species (especially exotic weeds such as hydrilla) are critical to maintaining healthy pond systems.

When excessive growth of aquatic vegetation occurs, the first step is to obtain a proper identification of the specific weed problem. Knowledge of the weed species is necessary to insure that proper management procedures are used. Samples of the weeds of concern should be wrapped in a damp (not wet), absorbent paper towel, placed into a zip-lock bag, and be taken to your county extension agent for identification and recommendation of an appropriate management strategy.

Physical, mechanical, biological, and chemical techniques are available for weed management in ponds. Physical control techniques include drawdowns and the use of physical barriers, dyes, and fertilization. Drawdowns are effective mainly on submersed vegetation and generally are not recommended unless the pond is larger than one acre and has a control structure which freely allows water level manipulation. Drawdown is done during the winter months when the combination of drying and exposure to cold temperatures can be most effective. The use of drawdowns during the warmer months may enhance the spread of marginal species (e.g., cattails, rushes, and willows) and is not recommended. Physical screens such as Texel and Aquascreen are expensive, but may be useful for the control of submersed weeds around access areas and water intakes where other management procedures often cannot be used. These materials block all light from the pond bottom, thereby preventing photosynthesis and eliminating weed growth. Physical barriers are largely ineffective on floating and emergent species. Dyes (Aquashade) and pond fertilization may be effective if there is little water exchange in the pond and if the pond has been properly constructed. Fertilization is a fisheries management technique which enhances the bloom of microscopic planktonic algae. Fertilization should begin in the spring prior to the appearance of weed growth when the water temperature reaches approximately 60-65 degrees and must be continued monthly until water temperatures in the fall stabilize at 65 degrees. Do not fertilize when emergent (cattails, rushes, etc.) and floating weeds (duckweed, watermeal, etc.)

are present or when dense growths of aquatic weeds already exist in the pond, as these species will absorb the fertilizer and spread prolifically. The use of a non-toxic dye (Aquashade) provides similar weed control without the addition of fertilizer. Aquashade may persist in a pond up to a year and is safe for fisheries, irrigation, and all recreational uses. Both techniques reduce the penetration of light to the pond bottom and are effective mainly on submersed vegetation.

Mechanical removal by seining, raking, dredging, or the use of a backhoe is the most common and expensive form of pond weed management. Mechanical harvesters are available, but are expensive and usually are impractical in ponds because of shallow waters, the presence of obstructions, and limited access. The primary advantages of mechanical removal are that nutrients bound within the vegetation are removed completely from the pond (preventing possible fish kills due to oxygen depletion and subsequent algal blooms as nutrients are released by the decaying vegetation) and that herbicides which could kill irrigated crops and other desirable vegetation or which would require other water use restrictions are not present in the pond water. Disadvantages include the necessity of access to a disposal facility (landfill), physical disruption of the shoreline due to movement of machinery, ineffective removal of portions of the vegetation, and the dispersal of vegetative fragments which may take root elsewhere. If a serious weed problem exists and requires mechanical removal, a more viable option would be to consider draining the pond entirely and redesigning it by excavation of the shallow areas.

The most effective, most environmentally desirable, and least costly long-term management practice for pond weed control is the triploid sterile grass carp. Grass carp feed primarily on submersed plant species (e.g., pondweeds, naiads, watermilfoils, hydrilla, etc.) and may reach weights exceeding 20 lbs and live as long as 10 years. Although they also feed to a certain extent on floating and emergent weeds and algae, they often are not effective on these species and generally are not stocked for their control. Grass carp may be used in ponds and lakes which are closed systems (i.e., no major outflow through which the fish may readily escape). Grass carp usually are stocked in North Carolina ponds at approximately 10-12 fish per acre, depending upon the nature and extent of the weed problem, and usually are about 10 inches in length, to prevent predation by larger fishes, such as bass. It is necessary to obtain a permit from the North Carolina Wildlife Resources Commission to acquire grass carp. Stocking rates, issuance of permits, and the locations of suppliers are provided by the Wildlife Resources Commission. If the pond is larger than 10 acres, a regional fisheries biologist will visit the site prior to issuing the permit. For information and an application for this permit, call (919) 733-3633.

Several herbicides are available for use in ponds. Herbicides should not be used as a first choice if other more environmentally acceptable and equally effective management options are available, however. Herbicide application rates for ponds and lakes are expressed in three ways: as lbs or gallons per surface acre; on the basis of herbicide concentration in the water (parts per million or ppm); and as lbs or gallons per acre-foot of treated area. The latter two procedures require the calculation of pond volume. The timing of herbicide applications is critical both for herbicide efficacy and for prevention of fish kills. In most cases, herbicides should be applied early in the growing season after the water temperature is at least 65

degrees. At this time, the plants are actively growing and will absorb the herbicide more readily; fewer weeds are present; less herbicide is required; less plant material is present to decay; the water is cooler (and holds more oxygen); and fish kills due to oxygen depletion are less likely. About 99 % of all fish kills which occur following herbicide application are caused by oxygen depletion due to decomposition of the dead vegetation. Direct toxicity of aquatic herbicides is rare and occurs as the result of applicator error: overapplication or improper choice of herbicide. Proper choice, timing, and application of herbicides rarely results in undesirable consequences, such as fish kills due to oxygen depletion.

The choice of a herbicide depends upon the weed species present and the uses of the pond. In most cases, ponds have more than one intended use. The water use restrictions for particular herbicides determine which herbicides, if any, may be used in a particular situation. Water use restrictions depend upon the persistence of the compound, its toxicity to nontarget plants (crops, etc.) and aquatic species (fish, molluscs, etc.), and public health considerations. When herbicides are to be used, the first step is to identify the weed species to be managed, as herbicides effective on one species may not be effective on others. In many cases, more than one herbicide may be required for weed control in the same pond, particularly when several different species are present (e.g., cattails and filamentous algae).

Diquat, endothall, glyphosate, fluridone, simazine, 2,4-D, and various copper compounds are labelled by the EPA for use in ponds. Water use restrictions vary greatly for these compounds. Copper (copper sulfate and organic copper complexes) may be applied without restriction to essentially all inland waters. Simazine, on the other hand, may not be used at all in water which will be used for irrigation, livestock, or human consumption. Glyphosate may be used without restriction except in potable water supplies. Other compounds have restrictions for varying periods of time for different water uses including fishing, swimming, irrigation, livestock watering, and human consumption. The water use restrictions also vary with the specific formulation of a particular herbicide. Application rates of herbicides vary greatly depending upon the specific herbicide and formulation and the specific weed to be treated. Water use restrictions and efficacy for specific weeds must be considered before purchasing and using a herbicide. Information on application rates, weeds controlled, water use restrictions, and efficacy of specific herbicides and formulations may be found on the herbicide label or in the aquatic weed section of the North Carolina Agricultural Chemicals Manual (single copies are available at $ 10 each from The College of Agriculture and Life Sciences, North Carolina State University, Raleigh, NC 27695). Additional information and assistance may be obtained by calling your county extension agent.

THE PREEMERGENCE HERBICIDE BARRIER MYTH

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A uniform application of a preemergence herbicide creates a herbicidal barrier that kills weeds during germination. If this barrier is disturbed there is a decrease in weed control. The question is does turf aerification (i.e. coring, spiking) disturb this barrier sufficiently to cause a decrease in weed control?

Current information on this question is contradictory. B. E. Branham (1986) at the University of Michigan found no significant effects on preemergence herbicide control of crabgrass in annual bluegrass fairways from aerification. B. J. Johnson (1987) found similar results in common bermudagrass at the University of Georgia. In contrast many preemergence herbicide labels specifically direct the user not to perform soil disturbing practices (such as aerification) after herbicide application.

Research on the effects of aerification on the performance of preemergence herbicides began in the Spring of 1987 at the NCSU Turf Field Center. This research was for a Masters' Degree Thesis with Dr. W. M. Lewis and Dr. Joe M. DiPaola. Test plots were established in creeping bentgrass, Tifgreen hybrid bermuda and common bermudagrass (fairway conditions).

Preemergence herbicides were applied March 25 both years (1987 and 1988). Four weeks after herbicide application the plots were aerified using a Ryan GreensaireII with 1/2 inch diameter tines. Cores were removed or returned according to treatment designation.

Crabgrass counts were made at monthly intervals beginning in June. A one square meter frame was placed on each plot and the crabgrass plants in that area were counted.

The 1988 counts in bentgrass indicate no significant differences (for any herbicide) between non-aerified plots and plots that were aerified and the cores removed. Although aerifying disturbed the herbicide barrier, it did not create an environment favorable for crabgrass germination.

In contrast, however, when plots were aerified and the cores returned, there was a significant decrease in crabgrass control compared to aerifying and removing the cores. The process of returning cores diluted the herbicide with untreated soil from the

bottom of the core. Ungerminated seed in the cores were able to germinate in the soil returned to the holes.

Turfgrass managers who return cores following aerification can expect an increase in crabgrass populations. Split applications of preemergence herbicides made after aerification improves crabgrass control. Since topdressing after aerification creates a situation similar to returning cores, an increase in crabgrass can be expected unless topdressing material is sterilized.

SAND GREENS
PROS AND CONS

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One of the major problems in obtaining a good root zone mix is the variability of the sand. Many times I have seen the sand change from the lab tested sample to one that is completely different in the dredging or mining operation. A very close monitoring of the sand being delivered with refusal of any suspect load will aid in reducing the variability. This could be as simple as shaking a sample in a jar with a small amount of dispersing agent such as Calgon, and checking to see how much silt and clay are present. A dry sample screened through sieves and weighing each separate does a more thorough job. A good green mix is too vital to a golf course to take any chances with a poor sand, and any time, energy, and money is well worth spent to insure the proper mix.

The following table gives the proper sand sizes:

USGA PARTICLE SIZE CLASSIFICATION TABLE

Textural Name	Sieve Opening Millimeters	Top Soil Mix Limits	
Gravel	4.76	0	
Fine gravel	2.00	3% maximum, 0 over 3mm	
Very Coarse Sand	1.00	10% maximum	
Coarse Sand	0.50	45% maximum	
Medium sand	0.25	35% minimum, 75% ideal	
Fine Sand	0.10	15% maximum	
Very Fine Sand	0.05	5% maximum	25% maximum
Silt	0.002	5% maximum	
Clay	<0.002	3% maximum	

The ideal sand is a mixture of medium and coarse particles, with about 80% of the total in these sizes. Gravel contributes nothing to the mix except interference in coring operations. The very coarse sand makes the mix crunchy and a very hard non-resilient surface. This causes destruction of the stolons and crows of the turf, and also prevents the approach shot from holding. Some fine particles, including a minimum of silt and clay (in addition to the organic matter) are necessary for moisture retention and cation exchange capacity.

The best organic matter source probably is sphagnum peat. Most of the sphagnums are very consistent, with a high water-holding capacity, and very low in silt-clay content. There are quite a few peat bogs in the south-east that produce a high quality fibrous peat that is very similar to the Michigan-Canadian sphagnums. These local peats should be carefully checked to insure a minimum of silt and clay and that they are consistent.

To illustrate the above points, core samples were obtained from five greens from five different North Carolina golf courses. Golf green #1 was from a 50-year old course in the Raleigh area; #2 from a new course on the coast; #3 from a re-built green in Charlotte; #4 from a new green in Greensboro; and #5 from a new green in Charlotte.

PARTICLE SIZE ANALYSIS[1]
North Carolina Golf Greens

Golf Green	#1	#2	#3	#4	#5
Fine Gravel + 2mm	2.7	1.7	3.1	0	2.3
V. Coarse Sand 1-2mm	15.9	10.1	19.4	4.6	14.6
Coarse Sand .5-1mm	33.5	29.7	42.5	34.9	33.4
Medium Sand .25-.5mm	27.7	42.2	26.7	44.3	33.2
Fine Sand .1-.25mm	11.9	16.9	7.1	15.1	15.1
V. Fine Sand .05-.1mm	3.7	0.4	0.8	0.8	1.1
Silt-Clay	4.6	0.2	0.4	0.3	0.3

[1]Raleigh Physical Soil Testing Lab

Green #1 has a fair particle size distribution except the silt-clay content. Evidently the age of this green and the fine particles contribute to the very poor performance. Greens #2, #4, and #5 have very good particle sizes, while green #3 has a very high coarse sand content. The physical analyses of these greens are in the following table:

PHYSICAL ANALYSIS[1]
North Carolina Golf Greens

Golf Green	#1	#2	#3	#4	#5
Perk Rate inch/hr	Trace	17.6	28.1	12.5	12.1
Porosity Total	38.1	42.9	43.7	42.2	44.2
Aeration	8.3	28.2	33.4	29.1	26.9
Bulk Density g/cc^3	1.40	1.57	1.60	1.54	1.47
% Water 40cm	19.5	8.3	5.9	7.6	7.7
Organic Matter %	15.0	10.0	7.0	12.0	12.5

[1]Raleigh Physical Soil Testing Lab

The "Perk" rate of the five greens are a reflection of the particle size analyses. #1 had only a trace, with a very low aeration porosity and a high water retention at 40 cm tension. It is no wonder that the bentgrass was very shallow rooted, subjected to diseases and severe stress in the summer. Greens #2, #4, and #5 have excellent "perk" rates, high aeration porosity, and low water holding capacity. The water retention is somewhat lower than optimum, but it is much easier to add water than remove from the root zones. Green #3 had a very high "perk" rate and very low water retention. This green has had a problem in getting a good stand of bent, and with the high coarse sand, has been somewhat unstable on the surface.

The following data is from a golf course in the Raleigh area, and illustrates how a sand can change from the original sample to the material that was delivered:

	F.Gr	VCS	CS	MS	FS	VFS	S-Cl
Lab Mix	1.6	8.0	20.1	48.8	18.5	2.7	0.3
Actual Mix	6.6	11.0	20.9	31.4	17.4	5.5	7.2

	Perk Rate	Total Poro.	Aeration Porosity	Bulk Den.	Water Ret.	Organic Matter
Lab Mix	13.3	42.8	28.6	1.40	9.8	14.3
Actual Mix	1.3	40.7	15.1	1.49	18.5	16.3

During the mining of the sand, a layer of "blue" clay was encountered at the pit, and at no extra charge this was included with the sand. The results have been disastrous, for the greens don't drain, retain excess water, are hard even when wet, and have had every imaginable turf disease. This course has deep-tined the greens several times in the past few years with considerable improvement in the turf, but as a considerable cost and a lot of comments from the members.

The root zone soil mix must be based on research data, with close monitoring for quality control.

The moral (if any) of the above, is to be sure of your sand.

OPPORTUNITIES FOR GOLF COURSE SUPERINTENDENTS TO SERVE THEIR COMMUNITIES

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Southern Pines, NC 28387

The previous speaker has highlighted a number of areas of concern. I would like to tell you in more detail about some of the things that we have been doing in Moore County.

How many of you care about the overall appearance of your town? Have you done anything to promote beautification projects: landscaped areas of flowering shrubs and annuals around town? What about litter control, signs and outdoor advertising control or putting overhead utility lines underground? What about the quality of the turf on your school's athletic fields and playgrounds? The appearance of your county building's landscaping - the courthouse lawn, airport terminal area, county administration building and hospital all help make an impression on visitors to your community and home folks alike.

How about the highway entrances and corridors into your county and various towns? How many of you care about the quality of the water you and your family drink? How many of you care how much money is spent for turfgrass research and extension programs? Do you know where that money comes from? When is the last time you talked to your representative, senator and congressman about it?

Several years ago, I applied for and was appointed to the Southern Pines Appearance Commission. The spirit moved me after I met our town's newly hired horticulturist. Even though he and the Appearance Commission members had established a good base of community support, they were having a terrible time getting adequate backing from the town council and manager.

After we had several confrontational meetings with the town council, thanks to a chamber full of vocal allies, I was able to lead a two hour breakfast negotiation session with the town manager and a liaison councilman which resulted in a streamlining of the appearance commission and a renewed commitment from the town. As a result, the public support we received was stronger than ever.

We were able to dramatically increase the Appearance Commission's operating budget. In addition to strengthening our tree ordinance, council requested our input in drafting the landscape section of the Southern Pines zoning ordinance. We also established a better-than-ever working relationship with the town planning board.

We helped our horticulturist establish a tree cutting permit system through the Planning Department. We had the final word about the cutting of street trees when requested by developers. We built our Arbor Day observance into a major event. We helped our horticulturist establish an aggressive street tree replacement program co-sponsored by Carolina Power and Light Company that became a pilot/model for their entire distribution system.

During my tenure, I took advantage of getting to know and establish a positive relationship with our Planning and Zoning Department, PUblic Works Director, Town Manager and each and every councilman. The Mayor of Southern Pines became the Appearance Commission's greatest supporter. The Southern Pines Appearance Commission is alive and well today and continues to enjoy a very strong alliance with all of the area garden clubs and a very aggressive town beautification and ordinance enforcement effort.

My County Extension Director and I have been very active in assisting the Moore County School system in drastically improving the turf on their athletic fields. Several of our area golf courses have helped by letting them use machinery and donating sod and fertilizer. In addition to 'just getting rid of the weeds,' we have been pleased to see the administration, coaching staffs, booster clubs and the county school board spend money on worthwhile projects.

Using the high school in Southern Pines as an example, we have effectively shown how proper management techniques can pay big dividends in improved athletic safety, parent support and good old-fashioned school pride. Every year in April, our Moore County extension director coordinates a school campus beautification tour. He always includes a turf expert other than himself in the tour group. In addition to judging our 27 campuses on overall beautification efforts, this tour is an excellent opportunity to get to know and to give turf management tips directly to each school's staff either during or after the tour.

And, of course, we never pass up an opportunity to let people know that the extension service with all of it's publications and specialists is always ready, willing and able to help individuals to the full extent of their interest and desire. The advisory leadership system is the motor that makes the extension service go. Real people out in the real world serve on these committees. Their job is to recognize budding problems and forecast trends within their particular area of interest.

The specialized committee reports are then passed upward to the four mid-level consolidated committees representing the four program areas of the extension service: agriculture and natural resources, home economics, 4-H and community and rural development. After additional refinement and homogenization, the mid=level committees' reports are reviewed by the top level committee, the county advisory council, who with the county extension director and agents set priorities and staff time

allowances to create research based educational programs to address the priority issues out in the county.

There is also a similar advisory committee structure at the state and national levels so that broader and more far reaching problems can be more easily recognized. There is a constant flow of report information going both up and down within this advisory system. Our goal is to be as pro-active as possible rather tan reactive. Through this dynamic communication system, most potential problems can be solved before most people realize that there is a problems.

One real down home issue to illustrate this system is water quality. How about the quality of the water in this building? What about the well water down at grandma's house? Okay, you say? Well, you and I both know that we have the luxury of presuming that it's okay.

But some people around the country aren't so lucky and we aren't going to be so lucky much longer. Water quality was such a university concern of almost all committees all across the United States that water quality shot up through the committee structure and became a top priority.

Our extension staff was already doing some water quality programs for various population groups in Moore County. But when this thing jumped within our own committee structure, we realigned our priorities. Some people in our county were right on the verge of finger pointing when we moved in. Rather than just golf courses causing water quality problems, we focused their attention on all potential pollution sources - golf courses and farms for sure, but what about home and highway construction - and urban runoff - and septic tanks that are too close together - and solid waste management, our landfills. What about improper forestry management practices or overloading a municipal sewer system? Once the big picture was brought into focus, the finger pointers turned around and asked what they could do to help.

Right now, all of the golf courses in Moore County have received specialized training in risk assessment and have been told how to evaluate various chemicals and fertilizers to be sure they don't inadvertently create a problem. Over 450 members of Moore County's poultry industry recently received similar research based information regarding proper litter and dead bird disposal.

The beauty of the extension advisory leadership is that all of the people on the various specialized committees are like your eyes, ears and nose. That makes it a lot easier to jump right on top of the most productive educational opportunities right at home. That's sure a lot better than being a day late and a dollar short. If you aren't already helping, find out how you can become involved. A lot of problems are clear cut and are right in front of us. A lot more may come around and grab us from behind. By being involved, you're a lot more likely to be in the right place at the right time to help make a difference in your community.

OPPORTUNITIES FOR SUPERINTENDENTS TO SERVE THEIR COMMUNITIES

Charles E. Hammond
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Opportunity never seems to be where we are at the time. It always appears to be somewhere else. Yet the truth is that nine times out of ten, opportunity is right in your own backyard.

The opportunities available for each of us in the turfgrass industry to serve our community are numerous. The increase in construction, and the emphasis on the aesthetics of our state has created a real need for information on turfgrass management.

Your expertise as turfgrass specialists is needed to help provide information to local officials, homeowners and others on proper turf management. How many times have you observed a new shopping center or a new subdivision being developed and after a few months the turfgrass was on the decline. Have you thought what you could have done to improve these conditions. You have the technical knowledge and hand's on experience to be familiar with local problems in growing turfgrass. You have contact with a large number of people each year that need information on turfgrass management.

The need for the turf industry to be recognized by local officials is important. Many times elected officials vote for regulations and ordinances and are not aware of the effect these regulations or ordinances have on you as golf course superintendents. I can assure you that you can have a more effective impact on local issues if you have interaction with citizens, elected officials and regulatory agencies. There must be a cooperative effort and a trusting attitude of all parties involved in addressing issues of the turfgrass industry.

The Extension Service needs your help to identify and prioritize problems and challenges facing the turfgrass industry. Your assistance is needed in planning, implementing and evaluating educational programs. Your expertise is important in conducting educational programs for commercial turf managers, homeowners and others.

I feel there must be a cooperative and coordinated effort in addressing challenges and opportunities facing the turfgrass industry. In our county we are moving in the right direction to achieve these goals. For example, representatives of the turfgrass industries are on the county specialized committees and Gene Maples serves on the State Extension Agriculture Program Committee, Agricultural Foundation, has been to Washington to represent the Agricultural Extension and is currently serving as chairman of Dean Bateman's Advisory Committee. We appreciate the time and

support Gene has given to Extension.

One of the important issues affecting us in Moore County is Water Quality. We have a specialized committee addressing this issue. This committee has the responsibility to develop an educational program on water quality for the turfgrass industry. It is essential that these programs be proactive and provide opportunities for interaction with local officials and citizens. We must inform these groups of our concern with Water Quality and assure them we are following latest research based practices.

Athletic fields are an important area in which golf course superintendents can serve as resource persons. Coaches or Athletic Directors in most instances have little knowledge of turf management. Athletic supporters are well pleased with good turf for their football fields.

Appearance of the grounds around the county courthouse was a concern of our new County Manager and new Board of County Commissioners. Gene Maples and George Thompson were contacted and made recommendations on the type of grass to plant and have made recommendations on maintenance of the grass. The results have been better than expected. In fact the courthouse was selected as yard of the month by the local garden club. Activities of this type help to build trust between local officials and the turf industry. There are other groups such as appearance commissions and beautification committees which provide opportunities to serve.

There are many benefits to you as an individual and to the turfgrass industry when you are involved in community issues. Gene Maples will allude to some of these in his presentation.

In summary, there are many opportunities to become involved on the local level. It is important for you and the extension agent responsible for Agronomy or Turf to have a good professional relationship. There are resources on the local level that are beneficial to you. It is important for all parties to be aware of activities occurring in the county that have an impact on the turfgrass industry. Become involved to let others know about turfgrass and in the process you will learn more about activities in the community that could have a major impact on the turfgrass industry. You'll be surprised at the incorrect information that is circulating.

It is imperative for local officials, regulatory agencies, concerned citizens and others to understand the turfgrass industry is helping to improve the environment and make our communities a better place to live and work.

ZOYSIA AND TALL FESCUE AT THE HONORS CLUB

Mr. David Stone, Superintendent
Ooltewah, Tenn 37363

The Honors Course is a Pete Dye designed course located near Chattanooga, Tennessee. The elevation and climate of the course is similar to that normally found in the piedmont region.

Initially the faiways had Mid-Iron bermuda with Meyer zoysia sodded the last 20 yards to the greens. The below-zero temperature late December 1983 froze out much of the bermuda while the zoysia came back in perfect shape. As a result, all the fairways were sodded solid with Meyer zoysia. Whenever I mention zoysia in this talk, I will be referring to Meyer zoysia.

Compared to bermuda, zoysia greens up 2-3 weeks sooner and reaches full density at least 4 weeks sooner than bermuda. There is a 4 week period from mid-April to mid-May when zoysia has seedheads. This is somewhat objectionable, but not a serious problem. Zoysia is not nearly as drought-tolerant as the bermudas and can suffer serious damage if it is mowed short and gets no water for an extended time (3 or more weeks).

At The Honors Course we mow the fairways at ½ inch. It is not necessary to raise the cutting height in the fall for winter protection. Zoysia grows faster at low heights than many people may realize. For the best quality we find fairways need mowing every other day from May-September. We use light weight triplex type units to mow. The zoysia holds a much nicer mowing pattern than bermuda does and is a superb playing surface. Many times during each year we have guests tell us it is the best playing fairway grass they have ever played.

Our nitrogen applications on the fairways totals 2¼ lbs per 1000 square feet per year. Zoysia can be forced to spread much faster if needed by using up to 4½ lbs. of nitrogen per year, but I feel this makes it much more suceptible to brown patch in the fall. I feel zoysia should be aerated at least once per year in July when it is growing the best. We have only verta-cut our fairways one time in four seasons and I do not see a thatch problem.

Divots in zoysia heal slower than in bermuda, but they heal relatively fast in the summer. I know of a public course in Kansas that gets a lot of play. It has zoysia fairways, and divots are not a serious problem. In the cool weather of spring and fall, the divots heal very slowly just as bermuda heals slowly during the cool weather.

Brown patch (also called zoysia patch) can be a problem on zoysia in the fall and sometimes in the spring. The temp-

erature range most favorable to this disease is daytime highs of 75-82 with a lot of cloud cover and nighttime temperatures of 55-62. Efforts to control this disease with chemicals have seldom been effective. The disease seems to occur on recently sodded areas more than on well-established turf. High nitrogen also seems to make the disease much worse. My experience shows that even severly blighted areas usually recover without replanting by late July.

Under high nitrogen (4 lbs.) zoysia will remain green longer than bermudagrass in the fall. Under lower nitrogen (2¼ lbs.) there may be no difference and sometimes the zoysia can go dormant before the bermuda. In the winter the color of the dormant zoysia in my opinion looks nicer than dormant bermuda.

Zoysia tolerances to herbicides can often be quite different from bermudagrass. Zoysia seems quite tolerant of all the preemerge chemicals, the phenoxys, Simizine, Roundup (when dormant) and MSMA. On the other hand zoysia is very senesitive to Prograss (in early spring), Sencor and Diquat (even when dormant). Roundup is my choice of winter weed control. A rate of 24-32 ounces per acre using 30 gallons per acre of water in January will do a good job. Hand spraying bunker banks is tricky and too much Roundup or too much water by this method can result in severe damage to the zoysia.

Zoysia makes a great bunker bank. It requires about ½ the mowing of bermuda (unless mowed under 1"), it invades the sand at about one third the speed of bermuda and is easier to play out of than bermuda. When sodded it roots very slowly and will have to be watered almost daily for most of the first season. It is very slow to greenup in the spring when maintained at 1½ " and above. Closer mowing in late summer and fall will help it green up sooner in the spring, but scalping zoysia in the spring will severly injury it.

Zoysia on tees in the full sun does fine. Zoysia on tees in the shade is not much better than bermuda because it heals much more slowly in the shade.

I am very high on zoysia for fairways and bunker banks. I don't think any of the few drawbacks I have mentioned should scare anyone away from using this grass. A very serious problem, however, to growing zoysia is the existence of or the contamination with bermudagrass. When both grasses exist, the bermuda will completly take over even the very thickest zoysia weather under low mowing or higher cuts such as on bunker banks.

In the summer of 1988 we screened a lot of chemicals for possible bermuda control in zoysia. To make a long story short, we found Fusilade 2000 to show the most promise. We

think 24 ounces per acre of Fusilade 2000 about June 1 followed by 16 ounce applications July 1 and August 1 could be the answer. I think it will take more than one year's treatment to get rid of the bermuda. Another method that would be less damaging on the zoysia would be 6 ounces of Fusilade 2000 every 4 weeks May 1 through October 1. Of the more than 30 chemicals and combinationa I tried, the only other chemicals to show much promise were Poast and Acclaim. I will work more on this problem in 1989 and try to refine the amounts needed and the timing. Fusilade 2000 may kill all cool season grass with the possible exception of tall fescue.

Kentucky 31 Tall fescue is used in the roughs further than 40 feet from the fairway edges at The Honors Course. Some of this rough that comes into play a lot is mowed weekly at a 4" height. The rest of it is mowed about once every other year so it is quite tall most of the time.

As the fescue grows seedheads, it goes through many color changes as the seed matures. This makes the course change colors slightly from month to month, making it more interesting.

The fescue is used on tee banks, on mounds, on some out-of-play bunker banks as well as other areas generally out of play. Maintenance is very minimial in these areas. The tall fescue is good for hiding cart paths that might otherwise be unslightly, and it provides a better habitat for wildlife than manicured golf courses. The height and thickness controls most of the weeds so that no herbicides have been sprayed on these areas in three years. We will have to spray some of it in 1989 because of some tree and bush sprouts. Bermudagrass has started to take over some areas also so we will be using Fusilade 2000 to control it.

The way we use tall fescue at The Honors will not work for most golf courses. A lot of room is needed between holes. There is a danger of fire in the tall dense grass and many clubs would not like the looks or be able to tolerate it slowing down play. If you have a place for it at your golf course, it can provide many of the benefits I have mentioned.

It has been a pleasure being with you at your conference. I hope there may have been something I have said that will help you grow better grass on your course.

MOLE CRICKET CONTROL

Dr. R. L. Brandenburg
Extension Entomologist
N. C. State University

A new species of mole cricket was discovered along the North Carolina Coast in 1988. The Tawny mole cricket is even more destructive than the Southern mole cricket which we have been battling for years. The Tawny has eventually worked its way up from the South. The importance of this pest to the turf industry, especially the coastal golf industry cannot be overstated. In Georgia, damage was estimated to exceed 19 million dollars.

The adults begin flying and laying eggs in April through May. Most egg laying is finished by July 1 and nymphs appear as early as June. The adults can fly up to 3 miles, although most stay close to the area previously infested. The Tawny mole cricket, however, has a habit of dispersing more to new areas.

There is a strong temptation to control mole crickets in the spring before they lay eggs. However, they are very difficult to kill at this stage and others from adjacent untreated areas will fly in and repopulate the area. If spring control is attempted, I recommend a bait.

Most effective control is accomplished by marking damaged areas in the fall. Then begin treatments in late June and early July while nymphs are still very small. Since damage is not very visible it is imperitive to treat those areas marked the previous fall. A wide variety of pesticides are effective at this stage (see the 1989 Pest Control Recommendations for Turfgrass Managers).

After August, spot treatments should be made with Mocap or Orthene until damage declines in the fall. With Orthene it is critical to water before application.

Triumph 4E has a state label for golf course greens and tees, but has a federal label restricting its use on sandy soils. Therefore, its use for mole cricket control along the coast would be a violation of federal law. This product is extremely water soluble and represents a serious threat to aquatic organisms.

Future plans include work with nematodes that attack the mole crickets, sound traps to help time sprays, high pressure injection of Dursban and a new malathion bait.

A new publication "Mole Cricket Management on North Carolina Coastal Golf Courses" is in preparation and will be a pamphlet that outlines the best current approach to mole cricket control. Hopefully, it will be available this spring or summer.

Growth Regulators and *Poa annua* Suppression

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Over the past few decades, many cultural and chemical procedures have been employed in attempts to control or eradicate annual bluegrass (*Poa annua* L.) from putting greens and tees. Plant growth regulators (PGR's) have been used in utility turf settings since the 1950's. Unfortunately, most PGR's are not labelled for use on recreational turf areas. However, two PGR's have recently been marketed for seedhead and foliar suppression of annual bluegrass under golf course conditions.

Mefluidide, sold as Embark™, is labelled for suppression of annual bluegrass seedheads[1] on golf courses. However, mefluidide is *not* labelled for use on golf greens or on turf that is less than 4 months old. This growth regulator also suppresses foliar growth and enters through the leaves. Because of its mode of plant uptake, mefluidide activity will be reduced if irrigation or rainfall occurs within 8 hours of application. The label application rate is 0.5 pint of Embark™ 2-S per acre in 15 to 150 gallons of water. This is equivalent to 0.125 lb of active ingredient per acre.

Paclobutrazol, sold as Scotts TGR™-Poa Annua Control, for annual bluegrass suppression on bentgrass greens; and bentgrass, Kentucky bluegrass, Kentucky bluegrass/perennial ryegrass and zoysiagrass fairways, tees, and roughs. This PGR is formulated on a fertilizer carrier and works by reducing the competitive ability of the annual bluegrass relative to the more desirable turf species. Unlike mefluidide, paclobutrazol enters through the root, thus rainfall or irrigation is necessary to realize full activity. The manufacturer does not recommend the use of this product on areas that contain more than 70 % annual bluegrass. Depending on the specific product and soil type, paclobutrazol is 0.07, 0.4 or 0.7 % of the formulation. Application rate generally does not exceed 0.5 lb of paclobutrazol per acre with, along with nearly one pound of nitrogen per 1000 ft^2.

A study was initiate in 1988 at Raleigh, North Carolina, to evaluate these plant growth regulators with respect to their effects on bentgrass quality and annual bluegrass suppression. Applications of mefluidide (0.125 lb ai/A), paclobutrazol (sprayed at 0.5 lb ai/A), and paclobutrazol (TGR™ spread at 0.5 lb ai/A) were made in March and September to 11 bentgrass cultivars. Untreated control turf areas were included for each cultivar. All plots, regardless of growth regulator treatment and carrier, received identical levels of nitrogen fertilization. The bentgrass cultivars evaluated included Cobra, Emerald, NJ Mix, MSX-68, Penncross, Penneagle, Pennlinks, Seaside, SR1019 and SR1020.

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[1] Except in California.

All growth regulator treatments slightly depressed bentgrass turf quality at 22 and 33 days after treatment (DAT) on March 29 (Table 1). However, plots treated with paclobutrazol had improved bentgrass turf quality at 44 DAT (TGR™ only), 68 and 89 DAT (TGR™ and Spray). With the exception of paclobutrazol sprayed plots on May 3, bentgrass turf quality exceeded minimally acceptable levels throughout the course of this study. All eleven bentgrass cultivars responded similarly to the growth regulator treatments in this investigation.

In May, annual bluegrass encroachment of untreated plots was at 9 %, while that of plots treated with paclobutrazol was only 2 %. Mefluidide treatment apparently suppressed bentgrass growth as well as that of annual bluegrass. Plots previously treated with mefluidide were 15 % annual bluegrass in May. The level of annual bluegrass encroachment remained stable through June.

Bentgrass plugs were sampled in September to determine differences between cultivars and the influence of PGR treatment on root development. March applications of mefluidide or paclobutrazol (either formulation) did not adversely impact the root mass of any of the 11 bentgrass cultivars studied. This investigation is being continued to determine the long term effects of these treatments.

Table 1. Mean bentgrass turf quality and annual bluegrass suppression following growth regulator application on March 29, 1988 at Raleigh, NC.

Growth regulator treatment	Turf Quality*					Poa annua		Root** weight
	Apr	May3	May14	Jun	Jul	May	Jun	
	----- 9 = best -----					-- % --		mg/plug
Untreated	7.7	7.0	7.9	7.0	7.7	9	9	4470
Mefluidide	5.9	5.5	6.5	6.3	7.2	15	17	4790
Paclobutrazol								
TGR™	6.2	6.0	8.4	7.8	7.6	2	6	4810
Spray	6.6	4.5	7.3	7.8	7.7	2	5	4590
LSD	0.4	0.3	0.3	0.2	0.4	1.7	2.3	ns

* Turf quality on a 1 to 9 scale with 9 as best and 5 as minimally acceptable.

** Four inch diameter plugs, 8 inches deep, sampled in September.

Averaged over 11 bentgrass cultivars.

GREEN SPEED AND MANAGEMENT OF BENTGRASS PUTTING GREENS

Patrick M. O'Brien
Southeastern Director
USGA Green Section
Augusta, Georgia

Green speed receives much publicity in our golf business today. Speed is certainly an important factor of putting green quality. A smooth and firm bentgrass green with a stimpmeter speed between 7 1/2 ft. and 8 1/2 ft. will receive high praise from most golfers in the Carolinas for regular play.

Putting green speeds averaged 10 ft. 9 in. for the US Open at The Country Club, Brookline, Massachusetts last year. However, championship putting greens speeds are only maintained for these special events for only a short time. The speeds are usually reduced for membership play immediately after the championship.

The USGA will conduct two championships in North Carolina this summer during July. The USGA Girl's Junior will be held at Pine Needles Lodge & Country Club and the USGA Women's Amateur at the Pinehurst Country Club No. 2 course. Green speeds between 8 1/2 ft. and 9 ft. have been requested for these championships. Eugene Maples and Brad Kocher are golf superintendents respectively at these outstanding Donald Ross layouts.

A challenge for the Carolina's golf course superintendent is to maintain stimpmeter speeds between 7 1/2 ft. and 8 1/2 ft. not only in the spring and fall, but also during the busy summer play season. Obviously, the heat and humidity becomes very intense for the bentgrass plant in the Carolinas in the summer. Higher speed demands may pose a serious dilemma for the golf course superintendent, since the bentgrass is more likely to decline in this hot summer weather.

Fortunately, bentgrass is now grown in just about every climatic zone in the Carolinas. The bentgrass putting green southern boundary in the Southeast region extends from Georgetown to Columbia to Aiken, South Carolina. In the Carolinas only a small area in the southeastern corner of South Carolina is without bentgrass greens today. Poor water quality is the main factor limiting the bentgrass growth in that area. Tifdwarf hybrid bermudagrass is the best grass selection for these golf courses. Tifdwarf can be managed now to provide putting green quality and speed very similar to bentgrass for the regular membership play.

Many factors influence the speed of bentgrass greens in the Carolinas. A few important considerations are green construction, amount of play, budget limitations, climate, irrigation system, type of membership, and the golf course superintendent's ability. Limitation may be overcome in one or two areas, but grass failure is more likely without most factors in your favor.

The bentgrass plant has many environmental stresses to battle in the Carolinas. High temperature and high humidity are the main concerns at most golf courses during the summer. Less rainfall has not significantly deterred bentgrass greens since irrigation restrictions have been limited so far. Water will certainly become a bigger issue in future years with our predicted population growth. The USGA-GCSSA Research Project is now in its seventh year to develop better golf course grasses to meet these requirements of less water and lower maintenance. A total of $2.9 million will have been spent through 1989 on this project.

Bentgrass putting greens positioned near too many trees usually cause the most problems for the golf course superintendent. These greens will show stress from shade and poor air circulation or both. The best preventative measure is to prune the trees causing the problem. Most people resist cutting trees, but selective tree removal is the only way for better greens at many sites.

Bentgrass greens may decline for many other reasons. Besides opening up tree pocketed greens, preventative disease and nematode programs are essential. It is also important to be very careful with fertilizer, pesticides, or combinations of products that have the potential to burn the turf. If summer fertilization is necessary, keep rates in the light to ultra light spoon feeding range. In any event, aerification is a practical consideration for thinning or troubled bentgrass in the summer. This operation helps bentgrass revive with the oxygen supplied into the root zone.

The golf course superintendent can control many mechanical stress factors in the summer. It is helpful to raise mowing heights, avoid double mowing, skip a mowing, and monitor the grooved rollers. Walk behind mowers are less stressful on the bentgrass plant than triplex mowers. Many golf course superintendents are mowing greens with walk mowers, especially during the hot summer months. The routine grooming operations like topdressing and vertical mowing are best deferred until cooler weather.

The Carolinas golf course superintendent should typically seek the middle ground for putting green speeds especially during the summer. Stimpmeter speeds between 7 1/2 ft. and 8 1/2 ft. are very acceptable with our summer conditions. The gifted golf course superintendent is readily challenged to maintain bentgrass at higher speeds in this climate.

LATE SEASON FERTILIZATION OF TURFGRASSES

David J. Wehner
University of Illinois

Fertilization is one of the most important practices that a manager uses to promote a strong, healthy turf. Proper fertilization will help in weed control, stress tolerance, and provide an aesthetically pleasing appearance. There are 16 elements necessary for plant growth. Of the 16, managers routinely apply nitrogen, phosphorus, and potassium to turfgrass stands. These three elements are frequently limiting in the soil and have been shown to be important in turfgrass growth and response to environmental stress. In planning a fertilization program, managers must decide how much of the nutrients to apply, when to apply the fertilizer and what type of fertilizer to apply. It is also important to look at factors such as what species is being fertilized, soil conditions, if irrigation is available, and whether the area is under any environmental stress. The purpose of this presentation is to discuss the benefits of applying a portion of the total yearly fertilizer late in the growing season. For our purposes, on cool season grasses, late season will translate into sometime in November.

The use of a late season application of fertilizer has increased in popularity over the last several years. The benefits are an earlier spring greenup and increased rooting. The concept behind late season fertilization is to maintain color during late fall and into winter when low air temperature has reduced the growth of the shoot system. In research done at Ohio State, turf fertilized in the late fall had increased rooting in the spring. The researchers attributed this to the fact that they were able to reduce the amount of fertilizer applied in the early spring and favorable carbohydrate relationships for root growth due to early spring greenup. Early spring fertilization reduces root growth.

A research project was conducted at the University of Illinois to evaluate the use of late fall fertilization on Baron Kentucky bluegrass. Our goal was to document the benefits of this practice and to examine the use of several different fertilizer sources in late fall. The urea treatments used in our study are listed below:

	Pounds of Actual N per 1000 square feet				
Treatment no. and N source	26 APRIL	6 JUNE	15 JULY	6 SEPT	1 NOV
1 Urea (46-0-0)	1.25	1.0	0.75	1.0	
2 Urea		1.0	0.75	1.0	1.25
3 Urea		1.0	0.75	1.0	1.25(SCU)
4 Urea	0.50	1.0	0.75	1.25	

Color ratings were taken at weekly intervals during the growing season and the treatments were made for three consecutive years. Although the test was conducted on Kentucky bluegrass, which may not be widely utilized in North Carolina, the trends observed in this research should provide some useful information. Comparisons were made between treatments to determine which treatment resulted in the best color.

Comparing treatment #2 with a late fall application against treatment #1 which had a spring application indicated, as expected, that spring green up was better with treatment #2. However, turf color in May and June was better with the spring fertilization. Comparing treatments #2 and #3 indicated that there was no advantage to applying SCU (#3) in November versus the cheaper urea (#2). Comparing treatments #2 and #4 revealed once again that the November application of urea (#2) provided better spring greenup than the spring application of urea (#4). However, again, the application of urea in the spring (#4) resulted in better color during May and June. The results of these four treatments showed that late fall fertilization is beneficial for spring greenup but that the application of N in November does not eliminate the need for an early spring fertilization. It does indicate that the amount of N applied in early spring can be reduced.

Additional treatments were applied using sulfur coated urea (SCU) and isobutylidene diurea (IBDU). One set of treatments involved either SCU or IBDU applied at 2 pounds of N per 1000 square feet in June and September. These treatments were compared to applications of the same fertilizers in June and November.

We found that a June + September application of SCU resulted in better fall color but not as good spring color as the June + November application. With IBDU, we found better results in the fall and spring with the June + September application when compared to the June + November application. Apparently, there is not enough release of the IBDU from the November application prior to the onset of cold weather to give good spring results.

In summary, the main benefit of late fall application of N is improved spring color and increased rooting. A late fall application does not eliminate the need for spring fertilization, but it can allow a reduction in the amount of N applied in the early spring. I encourage turfgrass managers to experiment with an application of N in the late fall. Everyone must make their own judgement as to whether the results are worthwhile.

HOME LAWN INSECT CONTROL: CONCERNS FOR THE FUTURE

Dr. Rick L. Brandenburg
Extension Entomologist
N. C. State University

As more people demand higher quality turf as a part of their homes, recreation areas, and surroundings, more pressure is felt by lawn care operators to maintain this standard. At the same time more people are concerned with environmental hazards and the use of pesticides in close proximity to people. These new demands and concerns encourage us to more carefully consider the use of Integrated Pest Management in our lawn care operation. Scouting, treating only when necessary, and the use of all available control agents are steps in the right direction.

The white grub is our most common turf pest and is one that is frequently the object of pesticide abuse. Publication AG-366 "Controlling White Grubs in Turf" highlights the importance of timing for effective grub control. Too frequently we let the presence of moles dictate our need to treat for grubs rather than scouting and actually determining an infestation on a timely basis.

Many applicators and homeowners are concerned about the fate of pesticides applied to the soil. Do they rapidly travel through the soil and contaminate groundwater? Recent studies at Ohio State have shown that even with irrigation most of the insecticide remains at the soil surface. In fact, much of it remains on the foliage, thatch, and other organic matter. An equally important study at Cornell University has demonstrated that irrigation following pesticide application may be more responsible for bringing the grubs up near the soil surface than it is for moving the insecticide down into the soil. The concept of irrigating both before and after application is being put into wider practice. This pre-treatment irrigation dampens the organic matter and permits slightly better penetration into the soil while at the same time begins bringing the grubs near the soil surface. Regardless of the treatment and irrigation most insecticides remain very near the soil surface.

As environmental concerns increase we should naturally eliminate some of the pest problems of poor pesticide performance. Through scouting, proper timing, irrigation, adjusting spray water PH, using biological and cultural control practices we can most likely maintain high quality turf while keeping pesticide use at an appropriate and safe level. This can be done in light of the fact that several pests such as ground pearls, mole crickets, and two-lined spittlebugs seem to be on the increase.

A final note on pesticide concerns centers on the new interest in the use of biological control agents such as parasitic nematodes. Some of these are commercially available now, but many have had inconsistent results. New strains of milky spore are also available and new production techniques should result in a lower price for this product in the future.

ORNAMENTAL GRASSES FOR LANDSCAPE USE

Marie E. Pompei

LOFTS SEED, INC.
Bound Brook
New Jersey

Grass species commonly referred to as "Ornamental Grasses" can be utilized in landscape plantings to produce a dramatic visual effect. Ornamental grasses can provide interesting contrasts in texture and color when used in combination with traditional landscape plants on the golf course, park setting, or in residential designs. Because of the wide variety of plant types available, ornamental grasses can be utilized for borders, mass plantings for screening purposes or specimen plants. Their attractive flowers or inflorescence also provide late summer and fall interest when little else is in bloom.

One of the most attractive features of ornamental grasses is that they are virtually free of disease problems and insect pests and are extremely easy to establish. Most cultivars are available vegetatively and a few are available by seed.

The following is a partial listing of some of the more popular ornamental grasses that are available. Most of the ornamental grasses in this listing grow best in full sun, however, some will tolerate partial shade.

SPECIES	SCIENTIFIC NAME	MATURE HEIGHT	ZONES	COMMENTS
Japanese Silvergrass	Miscanthus sinensis (Eulalia japonica)	7' - 13'	5 - 9	Upright plant form, attractive pink or red fall plumes. Good screen plant. Tall, graceful appearance, propagated vegetatively.
Silver Banner Grass	Miscanthus saccariflorus	4' - 6'	5 - 9	Upright plant form, attractive silvery white fall plumes. Tall, graceful appearance. Good for massing along waters edge. Spreads by rhizomes. Propagated vegetatively.
Maiden Grass	Miscanthus sinensis 'Gracillimus'	3' - 6'	6 - 9	Upright arching plant form, fine texture, attractive reddish-pink-beige plumes. Long curly arching leaves, propagated vegetatively.
Red-Leaved Miscanthus	Miscanthus sinensis purpurascens	4' - 5'	7 - 9	Reddish foilage develops through the season. Entire plant is reddish in September and October. Used as specimen or in group plantings. Propagated vegetatively.

SPECIES	SCIENTIFIC NAME	MATURE HEIGHT	ZONES	COMMENTS
Variegated Cordgrass	Spartina pectinata aureo-marginata	4'	5 - 9	Adapted to wet or dry areas. Utilized for waters edge or massing. Can be invasive. Propagated vegetatively.
Feather Reed Grass	Calamagrostis acutiflora stricta	4'	5 - 9	Best overall medium grass. Attractive flower in the summer and fall. Good plant form. Used for group plantings. Propagated vegetatively.
Zebra Grass	Miscanthus sinensis zebrinus	6' - 7'	6 - 9	Striking plant for its horizontal banding on the leaves. Good near water. Propagated vegetatively.
Ornamental Oats	Helictotrichon sempervirens (syn. Avena)	2'	4 - 8	Attractive for its blue foliage. Flowers not of interest. Best used as space plantings in borders and rock gardens. Propagated vegetatively or by seed.

SPECIES	SCIENTIFIC NAME	MATURE HEIGHT	ZONES	COMMENTS
Plume Grass (Ravennae Grass)	Erianthus ravennae	7' - 15'	6 - 9	Upright open plant form, attractive. 12'-15' stalks with 2' plumes, large appearnace. Easy to grow, propagated vegetively. Specimen plant.
Pampas Grass	Cortaderia selloana	6' - 15'	8 - 10	Striking white plumes, attractive, upright plant form. Specimen plant. Propagated vegetatively or by seed.
Fountain Grass	Pennisetum alopecuroides	3' - 4½'	6 - 9	Excellent upright form, numerous coppery tan or reddish plumes. Showy fall color, propagated vegetatively or by seed.
Weeping Lovegrass	Eragrostis curvula	3' - 4'	6 - 9	Needs adequate room to develop. Open and arching form, fine texture. Requires full sun. Attractive form throughout summer. Propagated by seed. Great on slopes.
Sheep Fescue	Festuca ovina glauca	8" - 12"	4 - 8	Commonly called 'Blue Fescue'. Forms fine textured silver blue clumps. Best used as space plantings, in borders, and in rock gardens. Established by seed for use in sun or shaded sites.

SPECIES	SCIENTIFIC NAME	MATURE HEIGHT	ZONES	COMMENTS
Ribbon Grass	Phalaris arundinacea picta	2' - 3'	4 - 9	Varigated grass that spreads by rhizomes. Very hardy. Grows in sun or partial shade. Flowers not of interest. Vegetatively propagated.

Centipedegrass Problems and Solutions

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Centipedegrass has many attributes that makes it a desirable grass for low traffic areas which are subject to generally low to medium maintenance conditions such as park areas, church lawns, home lawns, and ornamental lawns around commercial buildings. Although centipedegrass is generally trouble-free, it does have certain conditions which must be met if it is to be grown successfully.

It was learned soon after its introduction into the United States that centipedegrass is not very winter hardy and tends to be chlorotic, especially in the spring when the leaves are growing rapidly and the root system is not well established.

Early work at Auburn University and at other institutions showed that this chlorosis could be alleviated by the application of a soluble iron source. Further, the work in the 1960's at Auburn University established the fact that high phosphorus in the soil tended to increase the chlorosis problems, although it did not appear to materially affect winter survival of the grass. On the other hand, high rates of nitrogen increased the severity of the chlorosis and also caused severe loss of stand during cold winters.

Another factor contributing to winter survival of centipedegrass turfs is mowing height. Work at Mississippi and at Auburn University during the 1960's showed conclusively that when centipedegrass is maintained at mowing height in excess of 1 to 1.5 inches, the survival will be materially reduced. This poor winter survival becomes even more noticeable as nitrogen rates increase.

A three-year study at Auburn University showed that soluble nitrogen applied in excess of 3.0 pounds per 1,000 square feet per year reduced survival (averaged over mowing heights of 1.0, 1.5, and 2.0 inches) of centipedegrass at Auburn, Alabama. More recent work at Griffin, Georgia, on turfs mowed at 2.0 inches, indicates that nitrogen rates in excess of 2.0 pounds of nitrogen per 1,000 square feet per year reduced survival and spring green-up materially.

Thus, it appears that for the general management of centipedegrass turfs, mowing heights should maintained at no higher than one and one-half inches and nitrogen applications should be held to 2.0 to 3.0 pounds of actual nitrogen per 1,000 square feet per season.

To reduce the severity of chlorosis, it is advisable to delay applications of nitrogen until the grass has become well established. Early spring applications of nitrogen are

detrimental in two ways. Obviously it will enhance the chlorosis problem, but it also stimulates new growth early in the spring and causing excess new soft tissue to be formed. Then, if a late frost or freeze occurs, severe damage to the centipede turf can result in large losses in density and possibly stand.

Soil phosphorus should be kept at a reasonable level, also. Excess phosphorus does not appear to affect winter survival, but it certainly does increase and prolong the chlorosis that may occur.

Centipede turf tends to resist weed invasion and tolerate most insect and diseases. Control of common weeds in centipede can be obtained by the use of atrazine or simazine. These materials give excellent preemergence and some postemergence control of annual broadleaf weeds and grasses. Sethoxydim, or Poast, is an excellent material for controlling most annual grasses in centipede. It has high selectivity and it will also discourage common bermudagrass infestations with repeated applications.

Bahiagrass has been the Number 1 weed problem in centipede over the years. Herbicides are now available which will control this weed in centipedegrass. Sulfometuron (sold under the tradename of Oust) and metsulfuron (sold as Ally) will control this weed in centipedegrass. Currently, these materials are not registered for fine turf situations, but we expect registration on one or both of the materials in the near future.

One other weed that is a significant problem in centipede turf is wild garlic. Herbicides are available to control this pest, also. Metsulfuron will give control, although as mentioned previously, it is not currently labeled for use. Image (imazaquin) gives excellent control of this species and is labeled for use in centipedegrass.

In summary we can say that centipedegrass is a versatile grass that thrives under low levels of maintenance when mowing heights are below 2.0 inches and nitrogen rates below 2 to 3 pounds of actual nitrogen per 1,000 square feet per season. Adequate herbicides are available, or soon will be, to solve the more serious weed problems in this grass.

HAVE YOU IRONED YOUR PLANTS LATELY?

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Growth within the turfgrass community is a summation of interactions of all the outside factors within the greater scope of the environment. Included in these are the primary cultural practices of mowing, fertilization, and irrigation, as well as any secondary cultivation practices or pest control. In developing a sound fertilization program the inclusion of primary nutrients is a given factor. The macronutrients are necessarily included in fertilizers because rarely does a soil inherently contain adequate levels to sustain growth at an optimum level. The micronutrients are handled differently. Of those which are essential for plant growth, iron is most likely to be limiting within the soil.

The role of iron in the plant in primarily in energy transformations. It is involved in enzyme systems linked to chlorophyll production, and as a catalyst in nitrate reduction to amines and subsequently proteins. Iron is immobile within the plant and deficiency symptoms are exhibited in the youngest leaves. Iron availability is affected by a number of factors including the following:

1) Overlimed or alkaline soils.
2) Wet or cold soils.
3) Compacted soils.

Anywhere there is restricted root growth or activity iron availability may be a problem.

Within the soil iron has very low solubility. It is much less soluble than the other elements. In fact, phosphorus may be 300 billion times more concentrated than iron in the soil solution. Within the plant available soil nutrient pool, iron may become limiting by being converted to unavailable forms.

Using iron in a fertility program is recommended in a number of instances. The actual amount of iron, manner of application and timing of the application is not well understood. Daniel and Freeborg (1983) recommend a standard foliage application of 2 to 3 lbs. of iron sulfate per acre or 1 oz. per 1000 sq.ft. to correct an iron deficiency. They further suggest that during stress periods a 3% solution be applied to the turf every 7 to 14 days. Determining the cause of this iron chlorosis can be useful in mapping iron fertilization strategy. High soil pH conditions which are the cause may be of two types. Either the soil has an inherent problem which must be continually dealt with or there was overapplication of lime which is a transient problem. There may be excess phosphorus in the soil, again inherently, or from an overapplication. Iron forms insoluble precipitates with phosphorus and other metal ions, especially under alkaline pH conditions. There may be a micronutrient imbalance and the competition for uptake may favor other minor elements more than iron. There may be root problems, not necessarily related to soil conditions, but

certainly influencing nutrient uptake to a great degree. A study in Arizona on bermudagrass found that simply irrigating the turf with a 3% sulfuric acid solution freed enough iron from the soil to be as effective as ferrous sulfate or chelated iron in correcting chlorosis on alkaline soils (Ryan et al., 1975). Iron deficiency may be magnified by high growth rates caused by nitrogen applications. If the iron availability in the soil is low, higher nitrogen rates without iron fertilization can lead to an iron chlorosis.

Plant tissue analysis can determine the nutrient condition of the plant. Normal plant tissue content is in the 60 to 300 ppm range. Deficient plants normally range from 10 to 50 ppm while toxicity can occur in the 400 to 1000 ppm range (Anderson, 1982).

Studies on iron nutrition of turfgrasses has not been extensive. Two studies did determine that there are differences in iron chlorosis among cultivars of Kentucky bluegrass and bermudagrass. In zoysiagrass there also are cultivars which are more efficient at iron uptake under field conditions. Kentucky bluegrass in a New Jersey study exhibited a rapid increase in color which lasted 4 to 5 weeks with a slight improvement for up to 16 weeks at very low application rates of iron salts, 1 lb. Fe/acre (Deal and Engel, 1965). There was also an increase in sod density and root weights at 25 weeks after application. Topgrowth was not stimulated by the iron application. In a Colorado study on Kentucky bluegrass growing under calcareous soil conditions, color was improved at iron application rates up to 44 lbs. Fe/acre (Minner and Butler, 1984). Initial production of acceptable color was achieved at lower rates with chelated materials (4 lbs. Fe/acre) compared to iron sulfate (21 lbs. Fe/acre). In an experiment in Illinois on Kentucky bluegrass, foliar iron applications of 1 to 4 lbs. Fe/acre improved color for several weeks to several months, depending on weather conditions (Yust et al. 1984). A longer response was noted under hot, dry conditions than under moderate, moist patterns. The best overall result was produced with iron chelates at 2 lbs. Fe/acre. A key point in this study was that iron + 22 lbs. N/acre gave equal turf color during the late spring and summer to 44 lbs. N/acre. The implication here is that color can be retained without stimulating topgrowth. Phytotoxicity can be a problem with high iron application rates. This research found that above 4 lbs. Fe/acre the turf developed a blackish green color. While no permanent damage resulted the turf quality was generally reduced to an unacceptable level.

Studies in Virginia (Schmidt and Snyder, 1984; Snyder and Schmidt, 1974) on bentgrass using a series of applications of iron sulfate and chelates from 1.0 to 7.0 lbs. Fe/acre extended over the fall and winter found that iron + nitrogen (220 lbs. N/acre) enhanced appearance, chlorophyll content and the chelated materials produced a better root system. The enhanced color persisted during the summer stress period and an increased rooting benefit was noted. On another bentgrass study in Texas iron sulfate and chelates were applied at rates of 2, 4, 8, 12, 16, and 24 oz./1000 sq.ft. and a better response was found with the chelates (Beard, 1984). It was found that up to the 6 oz. rate could be applied, regardless of the carrier, with no phytotoxicity noted. It was summarized from this work that part of the phytotoxicity which has been reported may be the result of mixing iron materials with other chemicals, particularly

pesticides, with resultant incompatibility problems.

Among the warm season turfgrasses a California study showed that zoysiagrass had better iron uptake at a soil pH of 5.5 than 7.5, probably related to iron solubility (Gibeault and Mueller, 1975). They also noted differences among cultivars in their ability to utilize iron. On calcareous soils in a Texas study as iron application rates increased from 13 to 53 lbs. Fe/acre, bermudagrass root and rhizome growth improved (Horst, 1984). Bermudagrass studies in Virginia found that iron applications as a chelate at 1 lb. Fe/acre in 2 applications increased photosynthesis but did not impart this after chilling stress (White and Schmidt, 1988). Turf color was better with iron applications, related to an increased amount of chlorophyll. One of the turfgrasses most prone to iron deficiency is centipedegrass. Iron + nitrogen combinations were tested in a Georgia study to enhance color (Carrow et al.,1988). No difference in color response was noted among the iron sources. All iron sources provided positive greening for up to 68 days. The study found that this was temperature dependent, with shorter responses noted during hotter weather. Phytotoxicity was observed 1 to 6 days after treatment at the highest N + Fe rates. With low N rates of 8.75 lbs/acre up to 1.8 lb. Fe/acre could be applied without problems. As the N rate increased, there had to be a concomitant decrease in Fe rates below 1.0 lb. Fe/acre. At higher air temperatures, above 82 °F, it was necessary to watch the iron and nitrogen rates very carefully, with the optimum being 0.65 lbs. Fe + 11 lbs. N/acre. This work concluded that centipedegrass is very sensitive to iron or iron + nitrogen applications.

A greening response can almost always be obtained with a foliar iron application. But correcting iron deficiency may have to be the summation of lowering the soil pH, applying iron fertilizers, and/or a hard look at turf selection for the given conditions. In most cases, a foliar application of iron at 2 to 4 lbs. Fe/acre (3/4 to 1.5 oz./1000 sq.ft.) will correct deficiency problems. If applying granular materials and the soil pH is above 6.5, there may be a need to up the rate to as much as 25 lbs. Fe/acre in order to get a response. Centipedegrass is especially sensitive to iron applications and rates may vary with the time of year. In general chelated forms are superior since they are more effective at lower rates, probably due to their stability. The major disadvantage is their cost. Iron fertilization may be a necessary part of a turf nutritional program. Long term effects and the interaction of iron applications on stress tolerance are poorly understood and warrant further research.

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CURRENT AND FUTURE REGULATORY CONCERNS FOR LAWN CARE APPLICATORS

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Pesticide applicators today are confronted with a rapidly changing (and generally adverse) environment. Public perception of pesticides and pesticide applicators is at an all time low. Federal, state and local regulation of pesticides increases almost daily. Environmental concerns from ground water contamination to endangered species will continue to generate regulations imposed on applicators for many ears to come. And the non-agricultural user of pesticides, those applicators using pesticides in the urban setting (trees, lawns) or for vegetation management (utilities, highways, right-of-ways, forestry) will face even stiffer rules and regulations due to a perceived lack of "benefits" from their use of pesticides and the availability of alternatives to the use of pesticides.

This paper first will present those legislative and regulatory concerns for lawn care applicators with which the Pesticide Public Policy Foundation (3PF) is currently involved. The issues facing lawn care applicators will undoubtedly have a major impact on the way in which pesticides are used in the future. Next, the paper will review the need for pesticide applicators to begin to help formulate reasoned pesticide public policy through cooperation with other pesticide applicator groups. Otherwise, future regulations may jeopardize the lawn care industry itself.

PERCEPTION OF PESTICIDES/MEDIA ATTENTION

The American public's perception of pesticides and toxic chemicals today, created generally by the media, environmental groups and a few, but highly effective anti-pesticide activist, is at an all time low. Here's just a few of the stories which the public hears almost on a daily basis:

pesticide residues on food
ground water contamination
farm workers exposed to pesticides
death of Navy Lt. Prior
2,4-6 and Kansas farmers
data gaps, chronic effects of pesticides unknown
allergies/sensitivities to pesticides
dioxins, agent orange, love canal

It's no wonder that the public feels the way they do about pesticides after a steady diet of these type stories filled, in many cases with half-truths, innuendos and misinformation. Anti-pesticide activists and environmental groups are presented as

experts. Environmental groups, including the National Coalition Against the Misuse of Pesticides, Sierra Club, Audubon Society, National Wildlife Federation, and Environmental Defense Fund, all recognize pesticides, especially when used in the urban setting, as a great issue to strike a nerve with the public.

All of this has created a number of broadly defined issues facing the pesticide user industries, including lawn care. It's beginning with the public demanding their right to know more about pesticide use, health and safety issues, and could end up with serious impairments to the applicator's ability to conduct his business.

RIGHT-TO-KNOW

The public's right-to-know has become an important buzz word among anti-pesticide groups. Communication of this right-to-know is taking many different forms as the issue arises in various locations around the country.

Prenotification of pesticide applications has been proposed in many areas, and has already been adopted in some areas. Proposals often include notification of not only the customer but neighbors or abutters as well. LCO's, of course, would be strongly opposed to notification of everyone in the immediate areas of an application.

Some states (RI, MA, MD, NY) have adopted regulations requiring prenotification of tree and lawn pesticide applications as requested. This system seems to be working well since only a small minority of people actually request prenotification and it's not overly burdensome to the applicator.

Posting after tree and lawn care applications is required in at least half a dozen states, and more are sure to follow. In this particular case, strong industry input into the drafting of the regulations has so far led to the use of signs only at the time of applications. Many groups are in favor of "pre" posting (putting up signs 1 -2 days before the application), and should this type of posting become law, applicator costs will significantly increase.

Central registries of pesticide sensitive or allergic individuals are gaining favor in some areas. Pennsylvania, Maryland and Connecticut now have registries for individuals with medical evidence of an allergy. The registry is then shared with applicators to allow them to prenotify allergic individuals of impending applications. Industry's reaction to this system has been positive thus far.

Health and safety information is frequently required to be passed along to customers. This information generally involves post application safety precautions, but in some cases labels and MSDS's must be made available.

The newly passed federal Community Right-to-Know Law will also require certain pesticide applicators to provide material information to local fire departments and other emergency personnel.

Local jurisdiction over pesticides is often an issue which arises out of local right-to-know concerns. Federal legislation as well as legislation in many states often prohibits political entities below the state level from regulating the use of pesticides. Numerous applicator alliances have challenged the right of local governments to regulate pesticides (Wauconda, IL; Prince George County, MD), and in most cases courts have upheld the right of only the federal and state government to regulate pesticides.

PUBLIC HEALTH AND SAFETY

Public concern over the health effects of exposure to pesticides will continue to generate future regulations. Chronic risks from low level of long term exposure, particularly in food residues and drinking water are a major concern. Dislodgeable residue and potential exposure after lawn care applications is receiving considerable attention and has been one supposed justification for requiring lawn care posting.

A recent GAO report alleging inadequate EPA testing of most pesticides will surely speed up the federal reregistration of many pesticides to bring them up to current registration standards. At the same time, many states have lost confidence in the EPA's ability to adequately regulate pesticides and protect the public. Thus, some states (CA, MA) will begin to require their own registration data. Both of these developments will surely lead to higher pesticide costs and product loss as manufacturers conclude that the economics of a product simply doesn't justify continued registration.

The public also is increasingly hearing the question of risk/benefit analysis on pesticides used non-agriculturally. Why, some ask, take any risk what-so-ever to simply have a green lawn or control vegetation which could be controlled mechanically? Non-agricultural users of pesticides have not done a good job communicating benefits of their use of pesticides.

EMPLOYEE HEALTH AND SAFETY

The health and safety of applicators regularly using pesticides is receiving increased attention. Proposed and enacted legislation/regulation in this area alone will add huge costs to applicators in the future. Consider the following examples:

OSHA'S Hazard Communication Standard requiring health and safety information to be shared with employees;

a newly proposed EPA worker protection standard requiring health monitoring and extensive personal protection equipment;

strengthened certification and training requirements in most states and the adoption of federal minimum standards for certification and training;

a narrowly defeated Senate bill which would have required extensive monitoring of the health of employees occupationally exposed to toxic chemicals;

a newly implemented regulation requiring drivers carrying hazardous substances to be trained and carry commercial driver's licenses;

proposed changes in pesticide labeling which should make them more readable for applicators, yet labels will contain more detailed information than ever.

Employee health issues will undoubtedly drive up the cost of doing business, and at the same time make it more difficult to find employees in an increasingly tight labor market.

ENVIRONMENTAL CONCERNS

Numerous concerns for the environment will place further scrutiny on the non-ag pesticide applicator. Concern for the impact of pesticides on endangered species is leading to areas where specific pesticides simply will not be allowed. Wildlife concerns have recently led to the banning of diazinon on golf courses and sod farms. Pesticide container and waste disposal (RCRA, Superfund) has led to volumes of regulation.

The granddaddy environmental concern, however, is ground water contamination. As the EPA concludes its current survey of wells around the country, and more trace amounts of pesticides are found in wells, more and more public misunderstanding, fear, regulation and product loss and restriction is bound to impact pesticide applicators.

LEGAL ISSUES

Several legal issues are currently being debated as well. While some of these wouldn't seem to have an immediate impact on the urban pesticide user, their long term impact could be immense:

User indemnification on cancelled or suspended products was upheld as part of a new FIFRA bill amendment passed by Congress in late 1988. Previously, the EPA was responsible for the cost of disposing of cancelled products. Under the new FIFRA Amendments, this changed, leaving registrants responsible for the disposal cost of cancelled products. At this time, users have no responsibility in this regard.

Applicator liability on issues such as ground water contamination is another issue debated as part of the new FIFRA amendments, but no action was taken on this matter. Farm groups proposed that their members be exempt from liability if ground water became contaminated should they be able to show they used a pesticide in accordance with all label directions. If this exemption is allowed as part of additional legislation, should it be extended to the non-ag user as well?

Private right of action, or the ability of a citizen to bring suite against an applicator for pesticide misuse, is yet another issue being debated at the federal level which could have serious impact of pesticide applicators liabilities.

Local regulation of pesticides continues to be debated at the federal level as well as within many states. Although applicators have won a few battles in this area, the war is far from over. With over 88,000 individual government entities in the U.S., all pesticide users should easily understand the chaos which would be created should local governments be given the authority to regulate pesticides.

INDUSTRY/APPLICATOR RESPONSE

Industry's response to many of these issues in the past has not been adequate. It's time industry, including lawn care applicators, becomes more proactive in terms of defending the legitimate use of pesticides. The public must be made more aware of pesticide's benefits, regulators and extension people must be better educated on the professionalism which already exists within our user industries, and all of us must work towards reasonable pesticide public policy.

At the same time, lawn care applicators need to do all they can to get their own house in order. Applicator training requires the highest priority, and operations must be run squeaky clean. Applicators also need to understand that they must adapt to many changes on the horizon such as IPM, new application equipment, and new products which will change forever the pesticide application business.

Alliances (local-state-national) of pesticide users need to be formed and become actively involved in pesticide policy formation. A few state alliances, as well as the Pesticide PUblic Policy Foundation, are already working toward this goal, but the job is immense and much more needs to be done. The opposition, the anti-pesticide forces, are well organized and funded, and network extremely well. Pesticide users need to rise up to face their challenge.

A major goal of the Pesticide Public Policy Foundation is to foster the formation and development of state wide pesticide user alliances. Applicator alliances must be formed rapidly and in as many states as possible to allow applicators to be heard on the many important issues facing them today.

For more information about these issues of pesticide user alliances in your state, feel free to call the Public Policy Foundation at 1-800-438-7773.

Weed Management for Roadsides

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Auburn University's Turfgrass Research Unit has worked closely with Alabama Highway Department for the past several decades. The Alabama Highway Department is responsible for the maintenance of some 106,000 acres of mowable turf on the roadsides. Some seven million dollars are spent each year to maintain this 106,000 acres of Alabama roadsides. The program has changed emphasis from the control of specific weeds to the management of the total vegetation complex.

The Alabama Highway Department has in its state office in Montgomery one full time person devoted to vegetation management and two part time equivalents. Each of the nine divisions within the state system has one part time individual for vegetation management. Each of the districts within the nine divisions has one or two persons assigned primarily to vegetation management activities. Therefore, it becomes quite obvious that Alabama has a "bare bones" approach to vegetation management. This does not mean, however, that a good job is not being done.

In the early to mid-1970's, we started switching our emphasis away from controlling specific weeds to a more generalized concept, that of managing the existing vegetation. In managing the vegetation, we include chemical treatment and mowing. Some of the advantages to using herbicide sprays versus mowing are that we tend to have longer and much more economical control. The first objective of Alabama's vegetation management program was to eliminate Johnsongrass from the rights-of-way. This tall growing perennial caused sight-distance problems and materially affected the safety at virtually every highway intersection in the state of Alabama.

The program had as a secondary objective, to release common bermudagrass and develop stands of this low growing perennial to replace the taller growing species, such as Johnsongrass, broomsedge and others, and to give a more uniform and attractive appearance to the roadside turf. Release of the bermudagrass was accomplished primarily by repeat applications of MSMA herbicide. As we developed 80, or 90 percent stands of bermudagrass, we were able to utilize another herbicide, Oust (or sulfometuron), to finish the transition and remove other weed problems.

The vegetation management program now being used in Alabama has some constraints. First of all we allow no restricted use pesticides in the program. Secondly, we insist that the people in charge of the operations be certified with the Department of Agriculture and Industries for pesticide application, and finally, we have developed an

extensive training program that is conducted annually by the Landscape Engineer and the Training Engineer for the Bureau of Maintenance.

The standard program consists of applications of Oust (sulfometuron) in January or February to the bermudagrass, or atrazine to turfs that are predominantly bahiagrass at this time. This gives control of the winter weeds and delays the necessity of mowing. Additional applications of MSMA or MSMA plus diuron are used during the summer months to control growth and to eliminate broadleaf weeds.

Currently the program calls for one mowing per year, usually in the fall of the year. In this way we can maintain the beneficial and attractive aspects of newly mowed turf over a considerable period of time; whereas, if we were to mow in the spring, the subsequent regrowth would limit the effectiveness of the mowing to a period of two to three weeks.

A major disadvantage of the use of herbicides in maintaining the rights-of-way is that we do tend to delay spring green-up. We have brown turf somewhat longer than if we did not make the mid-winter herbicide application. And, the other disadvantage is that we have discouraged many of the wildflowers that originally bloomed in these areas. We have just recently initiated a project to enhance the wildflowers on Alabama's roadsides.
Alabama has an effective vegetation management program and this program has resulted in substantial savings to the state's citizens. It has improved the appearance of the roadsides, and has increased the safety to the traveling public. We are very proud of our program, and we hope to continue to improve it in the future.

Plant Growth Regulators for Roadside Turf

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Plant growth regulators are currently receiving increased use in turfgrass management. Growth regulators are natural or synthetic organic compounds that affect the growth and development of the plant. These compounds are usually applied at very low applications rates to a target plant to change its life processes to improve quality, increase yield, or otherwise accomplish a desirable goal. In a turf setting, a desirable goal includes reductions in the mowing requirement. Turf quality enhancement would include changes in shoot density and color.

There are a number of plant growth regulators currently commercially available. Growth regulators are very selective and thus are not equally effective on all turfgrasses or at all possible application dates. Since applications rate are typically very low, it is critical for operators to take care and use properly calibrated spraying equipment. Turfgrass growth inhibition is usually accompanied by some degree of leaf discoloration. This leaf tip "burn" typically begins at about 3 to 4 weeks after treatment. This phytotoxicity is enhanced if the turf is under stress (drought, traffic, etc.) at the time of application. Fortunately, this growth regulator induced discoloration is of short duration and usually judged as acceptable for low maintenance turf settings like roadsides. Turf color at 8 to 9 weeks after growth regulator application often exceeds that of untreated areas.

Tall fescue and bahiagrass are important turfgrasses for use along North Carolina's roadside. Amidochlor, glyphosate, maleic hydrazide, mefluidide alone or in combination with chlorsulfuron, and sethoxydim were effective seedhead and foliar growth suppressants of tall fescue and safe treatments with regard to turf quality and stand density. Tall fescue response to glyphosate was somewhat rate dependent. Glyphosate at 0.5 lbs ai/acre provided the best seedhead and foliar growth suppression, but this treatment also reduced turf quality (one month after treatment) to a greater extent than treatment at 0.25 lbs ai/acre treatment. Growth regulator applications to Pensacola bahiagrass that adequately suppressed seedheads (July observation) and result in an acceptable turf quality (September) include glyphosate at 0.19 lb ai/A, Manage, Manage + chlorsulfuron, maleic hydrazide, and sulfometuron. Tables 1 and 2 lists the relative characteristics of a number of growth regulators on roadside tall fescue and bahiagrass.

Table 1. Turf performance summary for selected plant growth regulators applied to tall fescue under limited maintenance conditions at Raleigh, NC during 1985-1987.

	Year	Seedhead suppression		Foliar ht. suppression	Turf safety		Additional comments
		No.	Ht.		TQ	PC	
Amidochlor	1987	E	G	G	E	E	
	1986	S	U	U	E	E	
	1985	E	U	U	E	E	
EPTC	1985	S	U	U	E	E	
Glyphosate	1987	G	E	E	E	E	Initial Turf Quality reductions
	1986	S	G	U	E	E	and rate dependent response for
	1985	S	G	U	E	E	all three years.
Maleic hydrazide	1987	E	E	E	E	E	Initial Turf Quality reductions.
	1986	E	E	S	E	E	
	1985	E	G	U	E	E	
Mefluidide	1987	E	G	E	E	E	
	1986	-	-	-	-	-	
	1985	E	U	U	E	E	
Mefluidide + chlorsulfuron	1987	E	E	E	U	U	
	1986	E	E	U	E	E	
	1985	E	G	U	E	E	Initial Turf Quality reductions.
Metsulfuron	1985	S	U	U	E	E	Initial turf quality reductions.
Sethoxydim	1987	E	E	E	E	E	Initial turf quality reductions
	1986	E	E	G	U	U	and rate dependent response.
	1985	E	E	U	G	U	

June Evaluation Rating	Seedhead No.	Seedhead Ht.	Foliar Ht.	Turf Quality	Stand Density (PC)
E - Excellent Performance	> 90 % Supp.	> 50 % Supp.	> 50 % Supp.	= Untreated	= Untreated
G - Good Performance	> 75 % Supp.	> 30 % SUpp.	> 30 % SUpp.	> 6 but < CK	< 5 % Decrease
S - Slight Effect	< check	< check	< check	> 5 but < CK	< 10 % Decrease
U - Unacceptable Performance	= check	= check	= check	< 5	> 10 % Decrease
- - Not Evaluated					

Table 2.

Turf performance summary for selected plant growth regulators applied to bahiagrass under limited maintenance conditions at Raleigh, NC during 1985-1987.

	Year	Seedhead suppression				Foliar growth suppression		Turf quality		Stand density	Additional comments
		Number		Height							
		Jul	Aug	Jul	Aug	Jul	Aug	Jul	Aug	Aug	
Amidochlor	1985	S	S	U	U	-	-	E	E	E	
Ethephon	1987	S	U	G	U	S	U	E	E	-	
Glyphosate	1987	E	U	G	U	S	U	E	E	-	Initial turf quality
	1986	E	G	E	U	-	S	S	E	E	reduction and very
	1985	E	E	E	E	-	-	E	E	E	rate responsive.
Maleic hydrazide	1987	E	E	E	U	U	U	E	E	-	Initial turf quality
	1986	E	E	E	U	-	G	S	E	E	reduction.
	1985	E	G	E	U	-	-	S	E	E	
Mefluidide	1987	U	U	U	U	U	U	E	E	-	
	1985	U	U	U	U	-	-	E	E	E	
Sethoxydim	1987	S	U	U	U	U	U	E	E	-	
Sulfometuron	1987	E	E	E	U	G	U	U	E	-	Initial turf quality
	1986	E	E	E	U	-	S	S	E	E	reduction.
	1985	E	E	E	S	-	-	S	E	E	

Evaluation Rating	Seedhead No.	Seedhead Ht.	Foliar Ht.	Turf Quality	Stand Density
E - Excellent Performance	> 90 % Supp.	> 50 % Supp.	> 50 % Supp.	= Untreated	= Untreated
G - Good Performance	> 75 % Supp.	> 30 % SUpp.	> 30 % SUpp.	> 6 but < CK	< 5 % Decrease
S - Slight Effect	< check	< check	< check	> 5 but < CK	< 10 % Decrease
U - Unacceptable Performance	= check	= check	= check	< 5	> 10 % Decrease
- - Not Evaluated					

IRRIGATION FOR ATHLETIC FIELDS

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In the last few years, interest in irrigation of athletic fields has greatly increased. Many new athletic fields have been constructed, and older fields have been upgraded. Fields are receiving more intense activity. It is difficult to maintain an adequate turf without the ability to irrigate when needed. The types of equipment to use in irrigating athletic fields have increased, and the quality of this equipment has improved.

There are basically three reasons that athletic fields are irrigated. They are:

1) Germination of seed or establishments of sprigs,
2) Provide soil moisture, and
3) Maintain the field in a playing condition even with extensive traffic.

Irrigation systems can be divided into approximately six categories which are:

1) Hose and portable sprinkler,
2) Portable aluminum pipe system,
3) Self-propelled gun traveler,
4) Valve and key system,
5) Manual valve permanent system, and
6) Automatic valve permanent system.

As expected, there are costs associated with each of these systems. This includes initial cost, operating cost, labor and ability to do a good job of irrigating. The initial cost will generally increase and labor cost will decrease as one goes from system one to six. Operating costs will generally be a function of system pressure, with higher pressure systems having higher operating costs. This will be a function of sprinkler size, but generally the self-propelled gun traveler will have the highest system pressure, but all the other systems could use large sprinklers and require as high pressure as the gun traveler. The permanent systems will probably provide the highest uniformity of water application, but the gun traveler under calm conditions can also provide good water application uniformity.

The gun traveler and the automatic valve permanent system are the two systems that are most used. Each has advantages and disadvantages. The gun traveler requires more labor, but no pipe is installed in the playing field. The gun traveler can be used on more than one field and generally has a lower initial cost. The automatic valve permanent system is more expensive, requires pipe and sprinklers to be installed in the field, but irrigation can be scheduled for day or night with a minimum input of labor and generally a higher coefficient of water uniformity.

There are several companies that manufacture the self-propelled traveler. One company has manufactured a small cable-tow traveler for a number of years. It uses a 200-foot, 1 or 1.25-inch hose, follows a nylon cable, requires two pulls throughout the field to cover a football field and requires a water source of 15-25 gpm on each side of the field. Recently another company has introduced a small hose pull

traveler that uses a 0.9 inch hose of about 250 foot length and with a water source of 5 to 20 gpm at two valves near the 50 yard line of a football field, a field could be irrigated in two pulls. In the last couple of years, several manufacturers have introduced small hose pull travelers that use 1.25 up to 2-inch hoses in lengths up to 400 feet or more. With these systems, a water source of 20 to 50 gpm is only needed on one end of the field. Generally, two runs are required to cover the width of a football or soccer field.

Permanent systems, either manual valve operated or automatic valve operated uses either gear drive or rotary impact sprinklers. Most gear drive sprinklers have a plastic body and the top is less than one half the diameter of a rotary impact sprinkler. The rotary impact sprinkler can use a plastic or metal case and the cover can be equipped with a rubber cover to prevent injury if a player steps or falls on the sprinkler.

In some models of both gear drive and rotary impact sprinklers, stop-o-matic or check-o-matic valves are available to prevent sprinklers in low areas from draining when the pressure is shut-off. This could be important on a well crowned athletic field. Some of the gear drive sprinklers commonly called valve-in-head are available with automatic valves built into the sprinkler. Some people do not like or recommend this feature especially with hydraulic valves. The problem is that a hydraulic valve fails in the open position and water could continue to spray out of this sprinkler if a valve fails. However, this is sometimes used as a sales feature for other products and should not be considered as a negative for valve-in-head sprinklers.

For permanent systems on football and soccer fields, double or triple rows of full circle sprinklers normally provide the best coverage. Some users also desire a row of part circle sprinklers around the edge of a field. Where possible, supply line, valves and valve boxes should be located off the playing surface, except where valve-in-hand sprinklers are used.

Automatic control valves can be electric or hydraulic and selection of one or the other is generally personal preference. One needs to examine cost of wiring versus cost of control tubing, problems of freezing versus lightning damage and ease of winterizing and maintaining each system.

Controllers can be electro-mechanical, solid-state or hybrids. Solid-state controllers are generally less expensive and offer more flexibility in control, but are subject to lightning damage. Electro-mechanical controllers are generally more durable. Hybrids offer some of the advantages of both solid-state and electro-mechanical. All three types will perform satisfactorily.

Back flow prevention should be a part of any athletic field system. If the system is hooked to a city or county water supply, the supplier may specify what is required. There are four types of backflow prevention devices which are reduced pressure, double check valve, pressure vacuum breaker and atmospheric vacuum breaker. Why and how each of these is used should be determined either by local plumbing codes and/or by someone familiar with the operation of each system.

Reduced pressure backflow devices have a large pressure loss across them and this needs to be designed into the total system pressure requirements.

Booster pumps may be required when pressurized water systems are used and available pressure is not adequate to operate the system.

Maintenance of systems generally consist of insuring that there are no leaks, that sprinklers are operating properly and that periods of operation are adequate to provide adequate soil moisture. Where possible, provisions should be made to easily drain systems during the winter to prevent freeze damage.

RENOVATING ATHLETIC FIELDS

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BERMUDAGRASS

When to Plant

April and May are the preferred time to plant bermudagrass if you plan to schedule play in the fall. Plant as early as possible to insure that the field can withstand traffic. Table 1 provides the options available.

If large areas are dead, sprigging is the most reasonable method of reestablishment. If small areas are dead, plugging is the best method of reestablishment. Sodding may be the only option if time is of the essence.

Exposure of underground plant parts to soil temperatures of less than 27°F result in significant turf loss. Compacted areas and plants less than 12 months old are prone to injury. Determine the extent of injury before the growing season by removing several plugs of turf as soon as the soil allows, and place them in a greenhouse or south facing window that receives a lot of light. Healthy plants should green up in 2 to 3 weeks. Lack of green growth suggests the need to plan for renovation.

Method of Reestablishment

1. Plugging: Using a plugging device, remove plugs of soil from bare areas on either 6 inch or 12 inch centers depending on speed of reestablishment desired. Most bermudagrass plugged on 6 inch centers will provide 90% ground cover in 1 to 2 months. Plugs on 12 inch centers will provide 90% cover in 6 to 12 weeks. Insert bermudagrass plug collected from sideline areas. Put bare area plugs back in holes where bermudagrass plugs were removed. Fertilize area with starter type (high phosphorus) fertilizer such as 10 pounds of 5-10-10 per 1000 square feet.

2. Sprigging large areas (15,000 square feet or larger): Apply recommended amount of fertilizer and lime according to soil test. If test results are not available and field has not been limed in past 3 years apply 75 pounds of ag lime and 20 pounds of 10-10-10 to the area to be sprigged. Lightly disc or rotovate into soil surface being careful not to destroy the existing surface drainage or crown of the field. Spread sprigs on surface of disced area at the rate of 7 to 10 bushels per 1000 square feet. Lightly disc sprigs into the soil with disc set relatively straight to insure good sprig to soil contact. Some sprigs should be buried and some protruding. Those that remain on the surface will probably not survive. Roll the sprigged area to firm the soil and to insure sprig soil contact. Keep the area moist for 30 days or until the sprigs are rooted. Do not let them dry out! Fertilize with a complete (N-P-K) fertilizer such as 10 pounds of 5-10-10/1000 square feet every 4 weeks until coverage is complete. This can be supplemented with a weekly application of 1/2 pound of nitrogen per 1000 square feet (e.g., 1 1/2 pounds of 33-0-0) until

Table 1. BERMUDAGRASS RENOVATION OPTION

Traffic Level*	Use Urgency	Option Advisability		
		Bermuda		Perennial Rye**
Days		Sod	Sprig	Seed
LIGHT	0-45	yes	no	yes
	45-90	yes	yes	yes
MODERATE	0-45	yes	no	yes
	45-90	yes	no	yes
HEAVY	0-45	yes	no	yes
	45-90	yes	no	yes

* Light = less than 10 football games/year
Moderate = 10-20
Heavy = greater than 20

**Perennial ryegrass establishes quickly but is often a poor choice for permanent cover because of disease susceptibility and environmental stress problem.

establishment is complete. Begin mowing with a reel mower when the foliage reaches a 1-inch height.

3. Sprigging smaller areas: Use a core aerator with 3/4 inch diameter tines to disrupt the soil surface. Make a minimum of 6 to 8 passes over the affected area, allow the plugs to dry and pulverize them with a dragmat. Cut out any germinating weeds such as knotweed or crabgrass with a hoe and scatter sprigs (7 to 10 bushels per 1000 square feet) on the surface. Broadcast 1/4 to 1/2 inch of soil over the sprigged area to partially cover the sprigs. Make sure the soil used is similar to the existing soil to prevent layering. DO NOT TOPDRESS A NATURAL FIELD WITH SAND. Apply 15 pounds of 5-10-10 per 1000 square feet over the sprigged area. Roll the sprigged area to firm the soil and to insure sprig soil contact. Keep the area moist for 30 days or until the sprigs are rooted. Do not let them dry out! Fertilize with a complete (N-P-K) fertilizer such as 10 pounds of 5-10-10 per 1000 square feet every 4 weeks until coverage is complete. Weekly supplemental applications using an N-0-0 fertilizer (0.5 pounds of N per 1000 square feet) will enhance the filling in process. Begin mowing when the foliage reaches a 1-inch height.

TALL FESCUE/KENTUCKY BLUEGRASS FIELDS

When to Plant

Cool season grasses are best seeded from mid-August (Western Region) to mid-October (Piedmont and Coastal Plain Regions). However, this is not always possible. Renovation of football fields must often be postponed until after the season is complete so as not to disrupt play. Seeding of football fields in February (Coastal Plain and Piedmont Regions) and March (Western Region) is not uncommon. Seeding too early in the season can result in seed rot whereas seeding too late can result in seedling failure from weed competition and diseases.

When fields are used both spring and fall, very little can be done to establish new turf other than sodding. The best option in this instance is to insure that everything is being done to promote the existing turf. This involves proper mowing, watering, fertilization, coring, etc. Table 2 provides the options available.

Methods of Reestablishment

Renovate only those areas that have been worn extensively. Kentucky bluegrass fields do not have to be overseeded if the bare areas are less than 4 inches in diameter. The existing bluegrass should fill in on its own provided proper mowing, watering and fertilizing practices are followed. Bare areas in tall fescue and perennial ryegrass fields must be overseeded since they are both bunch type grasses.

Good seed to soil contact is essential. Broadcasting seed onto the surface of the field without attempting to insure seed to soil contact often leads to failure. Mow the area as short as possible without scalping and remove excessive debris. Fill in sunken areas with soil similar to the existing root zone moisture. Several methods can be used to insure good seed to soil contact.

Table 2. TALL FESCUE/KENTUCKY BLUEGRASS RENOVATION OPTION

Traffic Level*	Use Urgency	Option Advisability: Kentucky Bluegrass	Tall Fescue	Tall Fescue/ Kentucky Bluegrass
	Days	Sod		Seed
LIGHT	0-45	yes	yes	no
	45-90	yes	yes	yes
MODERATE	0-45	yes	yes	no
	45-90	yes	yes	no
HEAVY	0-45	yes	no	no
	45-90	yes	no	no

*Light = less than 10 football games/year
Moderate = 10-20
Heavy = greater than 20

1. Use of slit seeders (e.g., Olathe and Jacobson) are very effective in incorporating the seed and smoothing the soil surface with little disruption. these machines open a slit in the soil and place the seed at the desired depth. Less seed is required compared to other methods and seedling survival is excellent. Calibrate the machine to deliver 20 pounds per acre of Kentucky bluegrass and either 40 pounds of tall fescue or 20 pounds of perennial ryegrass and traverse the area twice in two different directions.

   Pasture renovators can also be used; however, fields much be traversed 4 to 6 times due to wide spacing between discs.

2. Traverse field 4-7 times with coring machine, using 3/4 inch tines that remove soil cores. Although less effective, the soil can be distributed/grooved with a vertical mower (power rake) or by discing lightly several times with the disc wheels running almost straight.

   Broadcast tall fescue at 7 pounds per 1000 square feet and/or Kentucky bluegrass at 2 pounds per 1000 square feet. Incorporate the seed and plugs with a dragmat.

3. Broadcast tall fescue at 7 pounds per 1000 square feet and/or Kentucky bluegrass at 2 pounds per 1000 square feet. Topdress the area with 1/4 inch of good topsoil similar to the existing root zone mix. This is only practical on small areas. This also helps to smooth the playing surface.

   No matter which method is used, fertilize the area with a starter-type (high phosphorus) fertilizer such as 10 pounds of 5-10-10 per 1000 square feet. Apply the herbicide Tupersan (siduron) to prevent crabgrass competition if seeding is done in the spring.

DISEASES OF TURFGRASSES ON ATHLETIC FIELDS IN NORTH CAROLINA

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A number of diseases can cause serious damage to turfgrasses on athletic fields in North Carolina. Many of the problems are caused by fungi and nematodes, but other problems are caused by management and/or environmental factors. An accurate diagnosis is the first and most important factor in the control of turfgrass diseases. Diseases of the commonly used cool season turfgrasses (tall fescue, bluegrass, and ryegrasses) and the warm season turfgrass (bermudagrass) used in North Carolina are described. The cool season grasses are used mostly as permanent turf in the mountain regions and ryegrasses are sometimes used to overseed bermudagrass in eastern and southern regions of the state. The more cold tolerant bermudagrass cultivars such as Vamont and Midiron are used in th northern and western regions of the Piedmont.

Tall fescue diseases

Brown patch is the most serious disease of tall fescue. The early symptoms of this disease are small circular brown patches about 1 foot in diameter that develop during hot-wet weather. More patches develop and the older patches may continue to enlarge up to 4-6 feet in diameter during hot weather. Lesions that are olive color in the morning when dew is present, or during rainy weather, develop rapidly on young leaves. As the tissue dries the lesions become very light tan. Lesions may girdle leaves and the portion above the lesion will die in a few days. Webby mycelium of the fungus may be seen on the lesions and the surrounding grass blades in the morning or during extended periods of humid and cloudy weather in the summer. Vigorously growing plants that have received higher than recommended rates of nitrogen fertilizer during the spring are more susceptible to the disease. Tall fescue established less than one year can be completely killed by this disease. Affected areas may need renovating to correct soil pH and fertility problems and replanting in September or October. Well-established lawns may be damaged during the summer months, but with proper maintenance (proper soil pH, low nitrogen levels in the summer, infrequent irrigation, regular mowing when the grass is dry, and fall fertilization) the grass will usually recover during the fall. Fungicides such as Daconil 2787, Dyrene, Tersan 1991, or Fore applied once every 3 weeks during favorable weather conditions for disease development will give good control of brown patch. This treatment is expensive and should not be needed on athletic field if the tall fescue is managed properly.

Helminthosporium net blotch occurs on tall fescue but usually does not cause severe damage. The symptoms of this disease are dark brown "net" patterns on the leaves. Sometimes young seedlings will be killed by the disease, but old plants will usually overcome the damage during favorable growing periods.

Rust occurs on tall fescue and is seen more often in late summer. The symptoms of rust on tall fescue are small yellow spots on leaves with masses of yellow to rust colored microscopic spores in the center of the spots. The number of spots may become so numerous that the entire leaf becomes yellow and dies slowly. The turf will recover from rust during favorable growing conditions.

Drought and heat during the summer can damage tall fescue. Seedlings that are less than one year old may be killed by drought. Old tall fescue plants may go dormant during dry weather in summer and turn yellow or brown. Many of these plants will resume growth during cooler weather when adequate moisture is present. Young tall fescue fields need irrigating during hot-dry weather. Older, well established fescue will remain greener with irrigation. In both cases, irrigate infrequently (once every week during dry weather) and enough water should be applied to wet the soil at least 6 inches deep. A good management program to encourage the development of a healthy root system in the fall and spring will help tall fescue tolerate hot and dry weather.

Bluegrass diseases

Helminthosporium leaf spot occurs frequently on bluegrass. The leafspot symptoms are small dark spots on the leaves that increase in number and size and cause the leaves to die. Leafspots develop in the spring and often continue to develop throughout the summer and fall. The disease will cause a brown color and will reduce the vigor of the turf. Root and crown rots are caused by some of the fungi that cause leafspots resulting in the the symptoms of melting-out or fading out in the summer. Broad spectrum fungicides to control these diseases should be used in the spring before leafspot symptoms become severe. Good management programs that avoid excess rates of nitrogen and use of irrigation to prevent water stress will help prevent Helminthosporium diseases on bluegrass. Some of the new bluegrass varieties have more resistance to these disease and should be used.

Red thread is a common disease on bluegrass in the mountains during the summer. The symptoms of the disease are small circular brown areas .5 to 1 foot in diameter that develop during wet weather. The symptoms are very similar to brown patch that sometime develops on bluegrass. Red thread can be identified by the presence of a small "red thread" of the fungus that causes the disease at the tip of many of the dead

leaves. Small amounts of nitrogen fertilizer can be used to stimulate bluegrass to overcome the disease. Broad spectrum fungicides can be used to control the disease.

Rust is a serious disease on some bluegrass varieties. The symptoms of rust are first small yellow or brown spots on leaves that enlarge and increase in number until entire leaves are affected. Masses of orange to rust colored microscopic spores develop on the lesions. Affected leaves die slowly giving the turf a uniform yellow to brown appearance. The turf will usually become thin and may be more susceptible to other diseases and weed invasion. If a white cloth is rubbed on the affected turf, a rusty color from the spores will be present on the cloth. Broad spectrum fungicides can be used, but the best control is the use of improved varieties and good management programs.

Southern blight is a disease that occurs on bluegrass in the mountains of North Carolina. The symptoms of this disease are completely dead circular areas .5 to 3 feet in diameter that usually have a tuft of green grass in the center. The disease develops rapidly during hot and wet weather. Even clover and other weeds in the affected spots are usually killed by the fungus. White masses of the fungus and small yellow sclerotia of the fungus are usually present near the soil surface at the advancing edge of the spots. Bluegrass usually spreads back into the spots with good management.

Dollar spot sometimes occurs on bluegrass and appears as a small circular spot 2-4 inches in diameter. A cottony growth may be present in the morning on leaves in affected spots. Good management practices and the use of small amounts of nitrogen will help overcome the effects of this disease.

Ryegrass diseases

Diseases discussed on tall fescue and bluegrass such as brown patch, red thread, Helminthosporium diseases, dollar spot, and rust occur on perennial ryegrasses with similar symptoms. Some ryegrass cultivars are very susceptible to rust.

Pythium blight and brown patch are often serious problems on ryegrasses used to overseed bermudagrass in eastern North Carolina. Symptoms of Pythium blight are rapid death of seedlings in circular to oblong areas during warm-wet weather. Sometimes gray masses of the fungus may be present in the affected areas giving the condition called cottony blight. Planting ryegrasses in the fall when the weather is cooler will help avoid damage from these diseases. Also, treatment of seeds before or soon after planting with certain fungicides will give good control. Proper watering will help prevent these diseases and improve seedling survival.

Bermudagrass diseases

Spring dead spot is a serious disease of bermudagrass on some athletic fields. Symptoms of this disease are small circular dead spots .5 to 2 feet in diameter in the spring as bermudagrass resumes growth from winter dormancy. This disease usually develops in 4 to 6 years old bermudagrass that has been managed at a high level. Bermudagrass grows over the spots slowly, or weeds invade the affected spots, during the summer. The spots may occur in the same place and enlarge for 2 or 3 years and then disappear. Factors associated with development of this disease are high rates of nitrogen fertilizer and accumulation of excess thatch. An application of the fungicide, Tersan 1991, at 8 oz. per 1000 sq. ft. in October or Rubigan at 6 oz/ 1000 sq. in September to turf that was affected in the spring has given good control of this disease the following spring. Management practices that use lower rates of nitrogen and thatch removal will help prevent spring dead spot.

Nematodes which are microscopic eel-like worms in the soil, can cause serious damage on bermudagrass, especially in sandy soils in southeastern North Carolina. Several nematodes including sting, ring, stunt, lance, stubby-root, and spiral nematodes are commonly found in soil from bermudagrass turf. Serious damage to bermudagrass has been associated with the sting nematode. The symptoms of damage by the sting nematode are poor turf that does not respond quickly to nitrogen fertilizer and wilts quickly during dry weather. The roots are stunted and very shallow. Nematicides will control the sting nematode however, nematicides are very toxic and must be applied by licensed applicators. A good management program that includes fertilizer and irrigation to prevent drought stress will help bermudagrass overcome the effect of these nematodes.

Dollar spot is sometimes a problem on bermudagrass turf. Symptoms of this disease are small brown spots 1 to 3 inches in diameter. The spots may become so numerous that the turf has a general brown appearance. The disease usually develops on bermudagrass turf that has not been fertilized adequately with nitrogen. The use of good management practices including proper amounts of nitrogen and water will help bermudagrass overcome this disease.

Other problems on all type of turfgrasses.

Fairy rings cause dead, green, or a combination of dead and green rings in turf from a few to many feet in diameter. Mushrooms may be present in the dead or green rings at certain times of the year. Sometimes fairy rings occur as rings of mushrooms without any apparent effects on the turfgrass. The rings occur in the same area for a number of years and enlarge

a few inches or feet each year. The fairy ring fungi grow in the soil and cause the green rings by releasing nitrogen from organic matter, or kill the grass by releasing toxins into the soil or preventing water from entering the soil. The fungi usually begin growing on some source of organic matter such as old stumps or wood buried in the soil. Removal of soil from affected rings and replacement with clean soil and replanting with healthy grass is recommended, but is usually not practical. Rototilling the soil in and several feet around the ring and replanting healthy grass has controlled fairy rings in some cases. Loosening of the soil and watering the area frequently may help control some fairy rings. Grasses that spread rapidly such as bermudagrass often will spread into the affected areas whereas grasses such as tall fescue may be killed and areas fill in with weeds.

Slime molds appear as a grayish growth on grass leaves in small circular spots. These fungi produce a slimy growth on the leaves in wet weather that develops into a powdery mass of spores. Slime molds can shade the leaves, but usually do not cause serious damage. The fungi can be removed by brushing or mowing the fungus off the affected leaves.

Algae are single celled plants that grow on the surface of wet soils. Algae may appear as a black slimy growth on the surface of a poorly drained soil in wet weather and may crack and curl when the soil becomes dry. It is usually a problem in an area that does not drain properly and may have a low soil pH. Algae can be controlled by correcting soil drainage and soil nutrients problems.

Soil compaction is probably the most serious problem on athletic fields and causes poor growth of turfgrasses. Compaction results from traffic from practicing, playing or marching on the fields. Proper oxygen and water relations in the soil for turfgrasses are disrupted by the soil particles being pressed together. The soil should be loosened by renovating or aerifying to relieve the compaction for better growth of turfgrasses. Limiting access for the use of athletic fields must be a part of a good turf management program.

Diagnosis and management of diseases

Diseases and other problems can be diagnosed by using the descriptions given in this and other publications. Assistance can be obtained from your local Agricultural Extension county agent. Soil samples should be taken regularly to identify nutritional and nematode problems. Many different diseases and problems occur on turfgrasses in North Carolina because of the diverse climatic regions in the state. The selection of the best turfgrass and proper management program will help prevent and overcome many of the diseases.

SOD PRODUCTION AND MANAGEMENT

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In the southern US the interest in sod production as an agricultural enterprise has risen dramatically in the past 10 years. This has partly been due to depressed farm commodity prices and the farmer has been looking for alternatives to maintain the land in agricultural use. But a large part of the interest is due to an increase in sod demand by landscapers and golf courses who recognize the value of an increased establishment cost compared to the decreased establishment time. Homeowners are particularly willing to add 1 to 2% to the price of the home for a sodded lawn and established landscape rather than deal with bare soil and muddy conditions for an extended period during establishment.

Good sod exhibits a number of desirable characteristics. Included in these are uniformity, high shoot density, adequate strength for harvest and handling, and an acceptable color. It should be reasonable mature from a turfgrass community viewpoint, be free from pest problems and have a minimum thatch layer. Production cycles for most species will range between 6 months to 2 years. This is entirely dependent on soil conditions, climate, previous harvest time and production cultural practices.

Sod production cultural practices include adequate site preparation and planting, fertilization, irrigation, mowing and harvest. Establishment usually demands extensive soil preparation including preliminary weed control, soil sampling for lime and nutrient analysis, and a variety of cultivation procedures. An example of the preplant site work which may need to be done would include discing, landplaning, rotovating, removing debris, liming, leveling and cultivating with a roterra, a starter fertilizer, additional leveling and cultivation and irrigation.

Establishment can be by a variety of methods. For centipedegrass and St. Augustinegrass they can be established vegetatively by plugs. Bermudagrass and zoysiagrass can be sprigged and the cool-season grasses can be seeded with tall fescue being grown with the use of plastic netting to shorten production times by adding tensile strength. Establishment rates for vegetative methods usually require a 10:1 expansion. Therefore the amount of vegetative material can be considerable if there is a large acreage to be planted. For seeding cool season grasses, rates will vary widely. Tall fescue may vary from 220 to 425 lbs/acre and Kentucky bluegrass from 25 to 50 lbs/acre.

Primary cultural practices during the grow-in period include paying critical attention to mowing, fertilization and especially irrigation. Fertilization must be concerned with the immaturity of the root system. There is a greater chance of nutrients being lost through leaching since the root system will not be extensive. Also, since there is a large amount of bare soil prior to the spread of the crop,

fertilization will also stimulate weed growth, so weed control is essential. Nitrogen fertilization is used to control growth. Cost is a major constraint. Soluble sources are cheaper but must be applied at lower rates to match turf growth. They should also be matched to soil pH. Phosphorus will ensure good root growth. The carriers used today are highly water soluble. They also will interact with the micronutrients especially Fe, Al, and Mn. Triple superphosphate and monoammonium phosphate have been shown to give better performance on high pH soils. Potassium added as potassium chloride is 100% water soluble. Better than 95% becomes immediately available to the plant. Fertilization strategies are important here as leaching can occur, especially on sandy soils. On clay soils it becomes exchangeable and is available for a longer period. Soil testing should be used as a guide, but any turf will require potassium at some rate on a yearly basis.

Growing sod is a production situation. Therefore irrigation is critical to producing a quality crop in a reasonable time period. Irrigation should be tailored to growth rates, especially rooting. It should also match soil conditions. Two factors will impact irrigation, water availability and quality. Using effluent water for sod irrigation has been used successful in a number of locations. Several factors must be considered for its use. Salinity or soluble salt content is important to prevent stress on the turf. This is usually not a problem on a sandy, well drained soil. The organic wastes in any effluent create a biological oxygen demand (BOD) which will use oxygen for microbial breakdown. This could compete with oxygen the root system requires resulting in a deficit in the soil. Another consideration is hydraulic loading, the physical amount of water which will be applied under a given set of conditions. Effluent availability on turf demand is the ideal situation. Effluent disposal on turf regardless of prior rainfall history or turf demand can create rooting problems due to the soil remaining between saturated and field capacity conditions for extended periods.

Sod is ready to harvest when density and tensile strength allow. This varies with the type of turf. Netting allows early harvest by adding tensile strength. Sod is normally cut as thin as possible therefore it is easier to handle, establishes faster, and is less expensive to transport. Most sod production figures quote an average of 4,000 sq. yds. (36,000 sq.ft.)/acre as a reasonable harvest. Techniques for harvest will vary with the kind of grass. Centipedegrass, St.Augustinegrass, and Zoysiagrass are harvested with ribbons left between harvest strips for vegetative regrowth. Bermudagrass is normally clear cut. The cool-season grasses are normally clear-cut and reseeded. Sod is a perishable item. Sod heating within the pallet can reach lethal temperatures due to respiration. Normally sod should be harvested, transported and laid in a 24 hour period to avoid a decline in viability.

Sod marketing has been extensively studied in Alabama. There are five main categories of buyers: golf courses, garden centers, homeowners, landscape contractors, and building contractors. The Alabama study found that approximately 2 cents per dollar of sales was

spent on advertising cost. It was noted that marketing was considered the most important aspect of sod production.

Initial sod farming considerations should include a look at a number of factors. These should include marketing potential, land suitability, water availability and quality, grass selection, labor and capital (sod production is labor intensive, but not labor demanding), business aspects, equipment (a variety of turf and farm equipment is needed), chemicals, advertisement, and miscellaneous considerations such as travel and organizational dues, etc. Sod production is a very specialized farming operation, that can be profitable if approached in the correct production and management situation.

INSTALLATION AND CARE OF SOD

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Sodding offers fast establishment, quicker use of high trafficked areas such as athletic fields and reduced chances of failure and erosion compared to the traditional method of seeding. Sod can be done when seeding is not possible thus extending the planting season. High cost and limited availability of plant material are the major disadvantages.

Purchase planting material free of objectionable broadleaf and grassy weeds. Planting certified sod is a good way of insuring that the material being purchased is true-to-type and free of objectionable weeds and crop species. Planting material containing hard-to-control perennial grassy weeds can reduce turf quality for years to come.

Plant only improved, adapted grasses. Proper grass selection in combination with correct establishment procedures will result in a durable turf with minimal maintenance and little need for pesticides.

WHEN TO SOD

Cool season grass sod is best installed in the fall, but can be installed any time the ground is not frozen and the means to irrigate are available. Warm season grasses are best sodded in the spring or early summer after soil temperatures reach 50°F. Preliminary results from research conducted at North Carolina State University suggest that bermudagrass can be successfully installed during the winter months provided the sod is not allowed to desiccate. Research is continuing to verify these initial findings.

INSTALLATION

Installation begins with proper site preparation. Remove debris and perennial grassy weeds using a non-selective herbicide such as glyphosate. Remove topsoil, if present, shape the underlying soil to the proper contour, grade and redistribute the topsoil evenly over the surface. Water or roll the area and fill in areas that settle to avoid standing water. If topsoil or amendments are not used, loosen the subsoil to a depth of 6 to 8 inches to reduce compaction and enhance root growth. Make sure the soil is not overly moist when preparing the site so that soil tilth is maintained.

Fertilizer and lime should be applied based on a soil test and thoroughly incorporated to a minimum of 4 inches using a rototiller or disk. Insure that the sample being submitted for analysis is representative of the site by taking 15 soil cores

preferably to a 4 inch depth and thoroughly mixing them in a plastic container or paper bag. Submit soil samples to your county Extension office for testing by the Agronomic Division of North Carolina Department of Agriculture. Contact your Extension office for recommendations if a soil test cannot be taken.

Rake or harrow the site to establish a smooth and level final grade. Soil particles should approach the size of pea gravel. Water thoroughly, roll or cultipack to allow settling and firm the soil. Hand rake to break up the crusty surface prior to sodding. The finished grade should be about 3/4 to 1 inch below walks and drives.

Stacked or rolled sod tends to build up heat that can be harmful to the grass plants that make up the sod. For this reason, every effort should be made to reduce the time that the sod is left in this condition. Plan to have the final grading done prior to the delivery of the sod and ensure that enough workers and appropriate equipment are on hand to quickly and effectively lay the sod. Check to insure that the sod is in good condition at time of arrival. Sod should be installed no later than 24 hours after delivery. Place sod in the shade to lessen the chance of heat buildup during the installation process. Plan to unstack and unroll sod if sod cannot be laid within 48 hours or the sod is showing signs of severe wilt. Moistening the sod after it is unrolled will help maintain viability.

The soil should be moist but not overly wet at time of installation. Avoid laying sod on dry soil. This can be accomplished by irrigating the area several days in advance of delivery. Start sodding from a straight edge and butt strips together, staggering them in a brick like pattern. Make sure the edges are not overlapping. Avoid stretching sod and use a knife or sharp spade for trimming to fit irregularly shaped areas. Lay sod lengthwise across the face of a slope and peg or stake sod pieces to prevent slippage. Have soil on hand to add between sod pieces that do not butt properly to prevent drying of edges. Roll the sod to ensure good soil-sod contact and begin watering.

CARE

Thoroughly water the sod immediately after rolling making sure the soil underneath is wet. Sod should be kept continually moist by daily watering until the sod starts to root. This can be determined by gently tugging on the sod and determining if their is any resistance. Resistance is an indication that rooting is occurring. Rooting normally requires 2 to 3 weeks. Watering can be reduced gradually to once a week after the sod is fully pegged down.

Begin mowing as the grass resumes growth and reaches 30 to 40 percent over the desired mowing height. Make sure that it is mowed just prior to scheduled irrigation to lessen the chance of increasing compaction and bogging down of equipment. Use a mower with a sharp blade.

After the sod is rooted, follow a fertilization schedule suggested for established turf. A high phosphorus (starter fertilizer) applied three to four weeks after installation; may assist in rooting.

Avoid the use of herbicides until the sod is fully established and the turf has been mowed 3 to 4 times. Cool season grasses may need to be treated with a fungicide if sod is transplanted during hot weather or with an insecticide if harmful insects are present at damaging levels.

Good management practices such as proper mowing, watering, and fertilization will be important in maintaining a high quality turf.

CERTIFICATION AND QUARANTINE REGULATIONS FOR SOD

Foil W. McLaughlin
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Before specifically discussing the sod certification program in North Carolina perhaps I should describe briefly the certification program and how it is carried out in this state. The North Carolina Crop Improvement Association is designated by state law as the official agency for the certification of seed and other plant materials in North Carolina. The Association had its origin in the crops and plant breeding department (now Crop Science) at North Carolina State University and was officially organized in 1929.

Membership in the Association is open to any person or firm who makes or desires to make seed growing a specific part of their farming operation. Any other person or organization interested in promoting the work of the Association may also become a member.

The Association, under the ledership of personnel of North Carolina State University establishes and administers standards for certification and inspects the production of certified seed (or sod) under those standards. The Association office, located on the University campus, is responsible for inspection, records, issuance of tags and for other administrative duties.

The purpose and objectives of the Association are three: (1) To encourage the production of high quality seed (including plants and sod) grown and distributed under certification standards to assure proper identity and purity; (2) To encourage the use of improved seed/sod; and (3) To certify only crops and varieties accepted by the Association.

The maintenance program of certification can best be described as a "seed chain" with four classes: Breeder, Foundation, Registered and Certified. The Breeder seed or sod is maintained or produced by the plant breeder who developed the variety. Once a variety is released it is the Breeder's responsibility to produce a small quantity on a continuing basis - Representative of the characteristic of the variety as released. Foundation seed or sod is the next increase from breeders. This is grown by the private seed company, or, if a public variety, by a Foundation seed stocks organization. Foundation is officially labeled with a white tag and used by the growers to produce Registered or Certified. The Registered class is the next generation increase from Foundation and is labeled with a purple tag. The last increase permitted in a certification program is the certified class labeled with the official blue tag.

Through this "seed chain" - Breeder, Foundation, Registered, Certified - is made available to cooperating growers and unbiased and rigid inspection service. All applications for certification are made voluntarily. The grower of seed or sod must accept an obligation to uphold the high standards for certification and agree to abide by the rules and regulations of the Association.

Procedures for the production of certified sod can be described as follows: (1) A grower must become familiar with the certification standards and procedures (See: North Carolina Certification Handbook); (2) Plant seed or sprigs that are eligible for certification on land that has proper rotation; (3) Make application for crop certification to the Crop Improvement Association whose personnel will make the inspections to see that all standards are met; if the field passes inspection an official label can be issued for use in marketing the crop.

The program for the certification of Turfgrasses and sod in North Carolina is relatively small - only a couple hundred acres. But we do have an excellent program developed jointly by University Personnel and the Crop Improvement Association.

The Turgrass certificaiton generally involves those species that are reproduced vegetatively. That is, the production of a pure stand of one species, such as Tifgreen Bermuda, involves the planting of either Foundation or Registered sprigs, Stolans or Rhizomes on land that is free of any other Bermudagrasses or objectionable weeds. The Turfgrass fields are then inspected during the growing season to determine variety purity and the presence of any objectionable weeds or other crop mixtures. If all certification standards are met then official blue certification tags may be used to market the Turfgrass.

Turfgrass Sod certification, on the other hand, involves the same procedures except that instead of the vegetatively reproduced species, these crops include only those reproduced by seed. Species involved include Bluegrass, the Fescues and mixtures of desirable Turfgrass species. Certified seed must be planted and the fields free of objectionable weeds and other crop species. Field inspections are required. As in the case of all certification, if all standards and requirements are met an official blue certified tag may be issued for use in the marketing of the sod.

Plant protection quarantine is administered by the N.C. Department of Agriculture's Plant Industry Division. This program is carried out as a nursery inspection and for sod is generally concerned with freedom of pest - fire ants and witchweed.

TURF ENTOMOLOGY UPDATE

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During 1988 we were successful in receiving Agricultural Foundation funding for an Agricultural Research Technician to assist with my extension program in turf, peanuts, small grains and forage crops. This provided great assistance to my program as well as freeing up other money for equipment and supplies. Work on white grub control has continued in the western portion of the state as well as studies on the problems of micobial degradation from continued use of insecticides for grub control.

Additional work has continued on ground pearls attacking centipedegrass in the coastal plain area. Although attempts at various insecticide control have been inconsistent, a new approach at cultural management shows some promise. Ground pearls prefer acidic environments so cultivating centipede under high PH with iron supplements may be an alternative to ground pearl control.

Extensive work has been conducted on mole crickets along the North Carolina coast. Many new findings have enabled us to more effectively manage this pest. A new species, the Tawny mole cricket, was found for the first time in North Carolina. This species is more destructive than past species. A publication on managing mole crickets in coastal North Carolina golf courses is currently in preparation.

Triumph 4E is labelled for home lawn use and has a state label for use on golf course greens and trees but cannot be used on sandy soils. Diazinon cannot be used on golf courses and sod farms. The twolined spittlebug appears to be causing more problems as does the Green June beetle grub. We plan to develop some information on these pests.

Numerous workshops are planned throughout the state which will include insect management. This past year a publication AG-366, "Controlling White Grubs in Turf" was made available as well as an insect note on Scoliid wasps. Scoliid wasps are the large ground dwelling wasps we often see hovering over the turf. Numerous articles were also published in various trade journals, the N. C. turfgrass magazine and newsletters.

TURF DISEASE CONTROL UPDATE

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Brown patch has been a serious problem on tall fescue in recent summers. The following experiment was conducted to determine the effectiveness of labelled fungicides in sod or lawn conditions for one month after application. The experiment was conducted in a 1-yr-old field of mixed tall fescue varieties and a Kentucky bluegrass variety on a commercial sod farm where brown patch had developed. The fungicides were applied with a CO_2 backpack sprayer in 2.5 gal of water/1000 ft^2. All treatments were applied on 29 Jun. Plots were 10 ft long by 10 ft wide. Treatments were arranged in a randomized complete block design with four replications. All cultural practices were carried out by the sod farm manager. The summer was hot and dry. Disease was severe at the site due to partial shade in the morning and poor air drainage in the area.

All fungicides tested except Cleary 3336 gave acceptable control of brown patch on tall fescue for 3 weeks. Dyrene 4F, Tersan 1991 and Daconil 2787 at 6 oz gave acceptable control for 4 weeks. Application of these fungicides on 3 to 4 week intervals would be useful and more economical for the control of brown patch in sod fields or home lawns. Better control would be expected from more frequent applications according to label directions. Similar results were obtained on bentgrass, however, more frequent applications are needed because the level of brown patch recorded below is not acceptable on golf greens. In other experiments, several new fungicides for brown patch gave better control than currently available fungicides. Some of these fungicides should be labelled soon for turfgrasses.

Treatment and rate/1000 sq ft	5 JUL		18 JUL		22 JUL		26 JUL	
	BP*	TQ**	BP	TQ	BP	TQ	BP	TQ
Chipco 26019 FLO 2 oz	3.0	7.3	6.5	6.5	11.3	6.5	22.3	6.0
Dyrene 4F 5 oz	7.3	7.0	3.3	7.3	4.0	8.3	7.5	7.3
Daconil 2787 500F 3 oz	5.0	6.8	7.8	7.0	8.8	6.8	16.3	6.3
Daconil 2787 500F 6 oz	3.5	7.0	5.0	6.3	3.3	8.3	4.0	7.5
Tersan 1991 50DF 2 oz	8.0	6.5	3.0	6.5	2.3	8.3	6.3	7.0
Fore 80W 4 oz	3.3	8.0	6.5	7.0	10.5	7.3	13.8	6.3
Banner 1.1E 2 oz	2.8	7.8	4.5	7.0	11.0	7.0	12.5	7.0
Cleary 3336 50W 2 oz	7.5	6.3	43.8	5.5	63.8	2.5	71.3	3.3
Control	18.8	6.0	55.0	5.3	72.5	2.0	70.0	3.3
LSD (P=0.05)	4.1	0.9	18.7	1.1	12.8	1.5	12.5	1.4

* % area with Brown Patch
** Turf Quality rating of 1-9 with 9 being highest quality

TURF WEED CONTROL UPDATE

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Splitting preemergence herbicide applications improved goosegrass control and extended the length of crabgrass control compared to a single application in tests conducted in 1987 and 1988. The single application was at label rates and each split application was at the minimum label rate or one-half the maximum label rate. The split applications were 8 weeks apart.

In studies involving the period of time during which preemergence herbicides can be applied for effective control in the Raleigh area, we found that Ronstar, Surflan, Pre-M, and XL provided effective smooth crabgrass control when applied from February 10 through March 25. Splitting the application, with a second 8 to 10 weeks after the initial application, improved the control slightly.

Balan 60DF (dry flowable) followed 8 weeks later by Surflan 4AS provided excellent smooth crabgrass control.

In 1988 we continued the study on the effects of Ronstar, Pre-M, Prodiamine, Surflan and Team on the root development of three tall fescue cultivars seeded the previous fall. This year, herbicides reduced root strength values 0 to 12%. In 1987 root strength values were 0 to 59% lower than the untreated tall fescue. In both years Ronstar had the least effect on root development.

Triamine (2,4-D + dichlorprop + mecoprop) performed similar to Trimec Classic (2,4-D + mecoprop + dicamba) in the control of common chickweed, henbit, hairy bittercress, ivyleaf speedwell, dandelion, and buckhorn plantain.

THE TURFGRASS COUNCIL OF NORTH CAROLINA, INC.

The Turfgrass Council of North Carolina is a Non-Stock Association incorporated under the laws of North Carolina, and is tax-exempt.

PURPOSES AND OBJECTIVES

The purposes of the Turfgrass Council are: (1) to promote the turfgrass industry; (2) to encourage study and research in turfgrasses; (3) to disseminate information relating to turfgrasses; (4) to represent the turfgrass industry in matters of policy. The objective of the Council is to help obtain the best turf possible for lawns, recreational areas, roadsides, and cemeteries throughout the state.

ACTIVITIES

The Annual North Carolina Turfgrass Conference and the NCSU Turf Field Day are co-sponsored by the Turfgrass Council and North Carolina State University. A newsletter is published to inform the membership of council activities and turf programs in the state. Turfgrass research, extension, and scholarship programs receive financial support from the Turfgrass Council. A Turfgrass Research and Extension Fund has been established at NC State University to provide additional funds for turf research and extension programs.

MEMBERSHIP

Individuals interested in turfgrasses, representatives of turf related organizations, and sales representatives of turf products are encouraged to become members. Dues for individuals are $30 per year. Sustaining memberships at $75 are also available. Membership application forms are printed in the North Carolina Turfgrass News. Additional information can be obtained from Mr. R. L. Robertson, Executive Director of the TCNC (P.O. Box 5395, Cary, NC 27511, phone 919/467-1162).