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PROCEEDINGS
OF THE
19TH ANNUAL NORTH CAROLINA TURFGRASS CONFERENCE

Volume II

January 14-15, 1981

Raleigh, N. C.

Sponsored by

Turfgrass Council of North Carolina

North Carolina State University

North Carolina Agricultural Extension Service

PREFACE

Proceedings of the 19th Annual North Carolina Turfgrass Conference are being provided to those who attended the conference to serve as a permanent reference of the many presentations. The 1981 conference was held at the Royal Villa Hotel in Raleigh, NC on January 13, 14 and 15. Concurrent sessions for golf courses, lawn care, and general turfgrass topics were part of the conference. The attendance of 350 persons resulted in a very successful conference.

Special thanks are extended to all persons whose efforts made this conference a great success. Each speaker is to be commended for his excellent presentation and for providing a written summary for these proceedings. The Annual Turfgrass Conference is sponsored by the Turfgrass Council of North Carolina, Inc., North Carolina State University, and the North Carolina Agricultural Extension Service in cooperation with the Turfgrass Associations. The efforts of the following committees contributed to the success of the Conference.

Conference Chairman - W. B. Gilbert

Program Co-Chairmen - Leon Lucas and John Rosser

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The 1982 Turfgrass Conference will be held in Raleigh, NC in January.

PROCEEDINGS EDITORS: L. T. Lucas and J. M. DiPaola

Printed April 1981

Additional copies of these proceedings are available from Dr. L. T. Lucas, Department of Plant Pathology, N. C. State University, Raleigh, NC 27650.

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NEW TREND IN TURFGRASS MANAGEMENT

Wayne W. Huffine
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Inflation, shortages of natural resources, advances in research, and technology, individually, and collectively have been the factors dictating trends in turfgrass management for the future. These trends for the entire turfgrass industry are directed toward the enhancement of our positions in the areas of conservation, communication, and productivity.

In plant breeding and management the trends are toward the development of turfgrass cultivars and cultural plactices that are better adapted, with a more simple, lower cost maintenance requirement, yet retains the vital functional role of providing a favorable environment for productive, harmonious human activities. Presently the search is on for more cold-hardy bermudagrasses, and heat and disease resistent bentgrasses. Bermudagrasses are definitely moving north, and the bents are moving farther south.

The trend in putting green construction is toward a greater use of sand, even to a mixture of just sand and organic matter. Infiltration rates of up to 10 inches per hour (compacted) are more desirable according to USGA Green Section specifications, than rates below 4 inches per hour. In topdressing materials the trend is toward the use of fine sands alone, and seemingly with good results to date.

Nitrogen is being applied in lesser amounts with no real decline in quality, and in some cases, as in Spring Deadspot, it has lessened the severity of occurrence. On mostly sand greens, there is a trend toward the use of slow release nitrogen, materials, such as IBDU, to as much as 50% of the total nitrogen applied.

The energy shortage and uncertainity as to availability, as well as cost has resulted in a shift from diesel fuel to electricity on many irrigation pumps. Likewise, we can anticipitate a shift to diesel engines on much of our maintenance equipment, as it has proved itself to be 20 to 25% more efficient than the gasoline engine. The making of alcohol from grass clippings and other bio-mass may become a reality on golf courses for use as gasohol when the price of gasoline reaches about $1.50 per gallon.

In the future we will find more use of low maintenance ground covers, such as weeping lovegrass, on our golf courses on areas that are out of play. Selective mowing will become more commonplace, giving our courses a more natural look.

Last, but not least, is the trend toward hiring of better qualified people in the field of turf management.

SOURCES FOR SOLVING TURFGRASS PROBLEMS IN NORTH CAROLINA

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This paper is an attempt to discuss the resources available in North Carolina for solving turfgrass problems. An attempt will be made to identify the characteristics of the basic resource, the turfgrass manager; to discuss various resources available to the manager; and to comment on management strategies and concepts of the future.

The basic resource for the turfgrass industry of North Carolina is the turfgrass manager. However, before this available resource can be utilized, individuals responsible for turfgrass management must decide whether they are caretakers or managers. The characteristics of a caretaker are (1) he is a follower--one who is dependent upon others to set the pace, (2) sees problems as stumbling blocks, (3) considers his work and his job as a chore--the nine to five type, (4) dependent upon others for ideas, wants to know only how not really concerned with why, (5) spends much of this time griping and grumbling, (6) looks for short cuts or quick solutions--masking effect is as good as the cure, and (7) establishes no goals for his organization or himself.

In contrast, the professional manager, and I emphasize professional because I believe that anyone who has a responsible position is a professional. A professional has the following characteristics--(1) he is a leader, not only in the job but in the profession, (2) sees problems as opportunities, (3) sees the work as a challenge--time is not a factor, (4) searches for new ideas--better and more efficient ways of doing things--wants to know the "why" in addition to the "how," (5) an innovator, (6) seeks long term solutions, the quick way is not always satisfactory, and (7) sets goals for his own professional growth and for the growth of the organization.

My challenge is to classify yourself into one of these categories. Are you a caretaker? If so, the conferences such as the turfgrass conference will be of little value to you. But if you are a manager, a professional, then the following will be of real value as you grow professionally. These resources can be used to enhance your professional growth and allow the operation

you manage to become one of the best. Resources available fall into the following categories--

A. Current--and formal resources

1. Textbooks

a. Turfgrass Science, A. A. Hanson and F. V. Juska. American Society of Agronomy, Madison, Wisconsin
b. Turfgrass Science and Culture by J. B. Beard, Prentice-Hall Co., Englewood Cliffs, N. J.
c. Turfgrass Management, by A. J. Turgeon (an excellent introductory text). Reston Publishing Co., Reston, Va.
d. Turf Managers Handbook by W. H. Daniel and R. P. Freeborg, Harvest Publishing Co., Cleveland, Ohio

2. Extension publications

a. Turfgrass memos
Overseeding Bermudagrass Golf Greens - Memo No. 1
Fertilizing Bermudagrass Golf Greens - Memo No. 2
Fertilizing Bentgrass Golf Greens - Memo No. 3
Managing Golf Course Fairways - Memo No. 4
Renovating Tall Fescue Turfgrass Areas - Memo No. 5
Maintenance of Tall Fescue Turfgrass Areas - Memo No. 6
Starting a New Lawn - Memo No. 7
Renovating Old Lawns - Memo No. 8
Tall Fescue Lawn Diseases - Memo No. 9
Zoysiagrass: A Warm-Season Turfgrass - Memo No. 10
Bermudagrass: For Warm-Season Turfgrass Areas - Memo No. 11
Turfgrasses and Shade - Memo No. 12
Watering Lawns - Memo No. 13
Thatch in Turfgrasses: Causes and Control - Memo No. 14
Problems in Turfgrasses - Memo No. 15
Centipedegrass: A Warm-Season Turfgrass - Memo No. 16.
Building (or Renovating) and Maintaining a Football Field - Memo No. 17
Kentucky Bluegrass: For Cool-Season Lawns - Memo No. 18
b. Newsletters
c. Circulars and Bulletins
d. Ag. Chem Manual
e. Teletips

3. Selected Popular Magazines

   a. American Nurserymen. 310 South Michigan Avenue Chicago, Ill. 60604
   b. Golf Course Management. 1617 St. Andrews Dr. Lawrence, Kan. 66044
   c. Green Section Record. Golf House, Fox Hills, N. J. 07931
   d. Grounds Maintenance. P. O. Box 1936. Appleton, WI 54913
   e. Landscape and Turf. P. O. Drawer 77, Elm Grove, WI 53122
   f. Lawn Care Industry. 757 Third Ave. New York, N. Y. 10017
   g. Parks and Recreation. 1601 North Kent St. Arlington, Va. 22029
   h. Park Maintenance. P. O. Box 1936, Appleton, WI 54913
   i. Seed World. 380 Northwest Highway, Des Plaines, Ill. 60016
   j. Seedsmen Digest. 3335 West Ave., San Antonio, TX 48213
   k. Southern Golf. P. O. Drawer 77, Elm Grove, WI 53122
   l. Weeds Today. Agron. Dept. Univ. of Wisc. Madison, WI 53706
   m. Weeds, Trees and Turf. 9800 Detroit Ave. Cleveland, OH 44102

B. Laboratory Analysis

   1. Soil Testing Lab
   2. Nematode Assay
   3. Plant Disease and Insect Clinic

C. Formal Education

   1. North Carolina State University (4-year and graduate)
   2. North Carolina State University (2-year Agricultural Institute)
   3. Catawba Valley Technical College

4. Other technical schools and specialized training schools

D. Personnel

1. Fellow Turfgrass Council of NC Members

2. Extension Agents

3. Turfgrass Specialist--NCSU

E. Education Programs

1. Annual Turfgrass Conference

2. Spring Field Day--Beginning May, 1981

3. Extension Workshops in the Winter

4. Turfgrass Association Meetings with Education Speakers

The resources cited above provide the turfgrass manager who is interested in opportunities to increase his capability and efficiency to do the tasks that are assigned him. It provides him an opportunity to be a professional and to grow. It is important that every professional, through reading and studying the information available, obtain an understanding of the basis of the growth, production and management of turf. Formal education may be difficult for many because of age and financial obligations, but it is imperative that young people be encouraged to enter the profession and be encouraged to pursue formal training. Everyone can benefit from short-term education. The time spent reaps rewards.

If one is to be a professional than a resource base must be developed at their fingertips. Some of the texts mentioned above should be procured and kept handy as a ready reference. By the proper accumulation and filing, in some logical sequence, of extension circulars and publications as well as articles from magazines the resource base can be enhanced. By being familiar with these resources, you can become an innovator and problem solver.

The extension personnel available to the manager in North Carolina are some of the best and available resources. These individuals strive to provide additional information to those who need it not only through educational media, but also through practical demonstration and research. But these personnel resources available to the manager can be most effective when the manager has done his homework and developed an understanding of his program.

In addition to being a professional and obtaining the resources, the turfgrass manager must look at the management of turfgrass as a total package. He must attempt to integrate all the inputs that go into managing turf into one program. Because of known and unknown interactions between insecticides, nematicides, herbicides, grass species and varieties, environment, soil type, and many other variables one cannot deal with single programs such as a weed control or a variety selection. The turfgrass manager who retains and enhances turf growth and development is one who plans a program of integrated turf management. He must put together and manage from a total program concept. Then adjustments that are made can be made with some logic and some insight.

In this presentation three points have been emphasized. One--is it necessary for the individual to be a professional of turfgrass management, two--resourses available to this professional have been identified and their utility and necessity to a management program discussed, and three--the professional with the resources available must manage turfgrass, production and maintenance based on an integrated program concept. Turfgrass will continue to be very important to North Carolina's economy and will continue to expand. The demand for turf whether it be for grass production, roadsides, in lawns, on golf courses, and industrial parks will increase. Therefore, it is imperative that a turfgrass manager prepare to meet the challenge.

MANAGEMENT OF TURFGRASS ROOT SYSTEMS

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Turfgrass root systems serve a critical role in the quality and performance of the entire turfgrass stand. The root system is responsible for water uptake, nutrient absorption, and the physical anchoring of the plant to the soil. In light of these functions it is easy to envision the result of poorly developed or injured turfgrass root systems. Many factors can influence the health of a turf's root system including fertilization, mowing, irrigation, herbicide application, soil compaction, and the use of growth retardants.

Adequate nutrient supply is essential if quality turfs are to be maintained, particularly if such turfs are subjected to high levels of traffic. Collecting soil samples for analysis by the North Carolina Department of Agriculture is an important step in determining the required levels of fertilization for a turfgrass site. Excess nitrogen has been demonstrated to increase the susceptibility of the turf to injury from disease pathogens and environmental stresses such as drought, cold, and heat. Surplus nitrogen supply also promotes shoot growth at the expense of the turfgrass root system. The result is a shallow rooted turf with excess top growth. This extra shoot growth increases the total leaf surface area and thus the demand placed on the root system for water uptake and translocation. Increased potassium fertilization increases the total root dry weight of a turf and enhances disease and cold tolerance.

Because the turf's roots function within the soil, the pH of the soil is a very important factor which affects the performance of the entire plant. Most turfgrasses, with the exception of centipedegrass do best when soil pH levels are between 6.0 and 7.0. Centipedegrass does best when the soil pH is between 4.5 and 5.5.

The effects of mowing on turfgrass root systems is a function of both cutting height and the frequency of cut. As the cutting height is lowered and the frequency of cut increased the turf's root system is reduced. Close clipping of turfs removes leaf tissue required to ensure adequate food production via photosynthesis. Cutting heights of cool season turfgrass are raised during the summer months in North Carolina. Raising the cutting height of warm season turfs during the fall is important for optimum cold hardiness of these turfs.

Turfgrasses should be watered deeply and as infrequently as possible. The soil should be wet to a depth of 6 to 8 inches with each watering. Frequent, light irrigations promote a turf with a shallow root system. Overwatering reduces the soil oxygen available for respiration by the roots. Subjecting turfs to moderate periods of water stress has been shown to result in increases in the total root dry matter.

Applications of certain herbicides also results in root system injury. Consecutive annual applications of benefin or bensulide were shown to cause injury in bermudagrass. DCPA has been reported as delaying early Spring growth of Tifgreen bermudagrass by Johnson (1976). Johnson also reported that oxadiazon applications resulted in slight reductions in the early Spring growth of Tifway, Tifdwarf and Ormond bermudagrasses. More recently, Johnson (1980) has reported that napropamide reduced the root growth of Emerald, Meyer, and Matrella Zoysia spp. as well as Tifway, Tifgreen, Tifdwarf, and Ormond bermudagrass following several consecutive annual applications. Prosulfalin retarded the root growth of Tifgreen and Tifdwarf bermudagrass. When applied at the 3x rate this compound also reduced the root growth of Tifway and Ormond bermudagrass, and the Zoysia spp.

Treatment of turfs with growth retardants will also result in root growth reductions. Schmidt and Bingham (1977) examined several growth retardants including Mefluidide and Maleic hydrazide, and found that all compounds studied with the exception of Metolachlor, reduced both shoot and root growth following application. These growth regulators also affected root growth for a greater length of time than shoot growth. While current economic considerations have resulted in a revived interest in growth retardant utilization on turfs, the effects of these compounds on the turfgrass root system should not be ignored.

A study investigating the influence of various cultural practices on the Spring root growth of Tifway and Tiflawn bermudagrass was initiated at NCSU in 1980. This test is examining the impact of mowing, soil coring and fertilizations at six treatment dates during the Spring. Clipping during the first week of this study removed only dormant bermudagrass leaf tissue (Table 1). Root growth of turfs mowed during this first week was significantly greater than that of comparable turfs which remained un-mowed. Clipping beginning at weeks thereafter did not alter the turf's root growth when compared to un-mowed swards.

Both bermudagrasses studied did not respond similarly, however. The root growth of Tifway was found to vary with each week's treatment while no effect was observed on Tiflawn turfs during the first year (Table 2).

This test is being repeated during the Spring of 1981. Results from the second year should better define the rooting response of these turfs to spring cultural practices.

Table 1. The influence of clipping during the Spring on the mean root dry weight (g) of Tifway bermudagrass sampled on May 27, 1980

Treatment	Week of Treatment*					
	1	2	3	4	5	6
Mowed	13.7d**	18.2a	16.9abc	15.3a-d	13.5de	14.0cd
Un-Mowed	10.0f	16.4a-d	17.2ab	17.3ab	14.7bcd	15.4a-d

* Week No. 1 was March 20, 1980; treatment was initiated the week indicated and continued weekly thereafter.
** Means with like letters do not differ significantly at the 0.05 level according to the DMR test.

Table 2. The mean root dry weight (g) of two bermudagrass cultivars following treatment by various cultural practices during the Spring.

Week*	Tifway	Tiflawn
1 (March 20, 1980)	11.8 d**	9.1 e
2 (March 27, 1980)	17.3 a	9.5 e
3 (April 3, 1980)	17.0 a	8.5 e
4 (April 10, 1980)	16.3 ab	9.3 e
5 (April 17, 1980	14.1 c	9.3 e
6 (April 24, 1980)	14.7 bc	8.7 e

* Turfs were subjected to mowing, soil coring, and fertility treatments during the Spring. Roots were sampled on 5/27/80.
** Means with like letters do not differ significantly at the 0.05 level according to the DMR test.

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2. Johnson, B. J. 1976. Bermudagrass tolerance to consecutive butralin and oxadiazon treatments. Weed Sci. 24:302-305.

3. _____ 1978. Response of Zoysia (Zoysia spp.) and bermudagrass (Cynodon dactylon) cultivars to herbicide treatments. Weed Sci. 26:493-497.

4. _____ 1980. Root growth of southern turf cultivars as affected by herbicides. Weed Sci. 28:526-528.

5. Schmidt, R. E. and S. W. Bingham. 1977. Chemical growth regulation of 'Baron' Kentucky bluegrass. Agron. J. 69:995-1000.

SULFUR COATED UREA FERTILIZERS

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The quality of turfgrass whether it is being grown, on a home lawn, a golf course or a park, is dependent upon the degree of management it receives. An important management practice in obtaining quality turf is nitrogen fertilization. Todays turf manager has a wide choice of available nitrogen fertilizers. However, there are basically two kinds of nitrogen for application to turfgrass.

QUICKLY AVAILABLE NITROGEN SOURCES

These materials produce a quick flush of growth which is of short duration and can be excessive. Examples of this source include ammonium nitrate and urea. Their advantages include:

A) They usually offer high N content.
B) They are relatively inexpensive.
C) They can be used in a dry or liquid form.
D) They are highly soluble.

Their disadvantages include:

A) High burn potential.
B) They are inefficient.
C) Attract moisture causing storage problems.

CONTROLLED RELEASE NITROGEN SOURCES

The second kind of available nitrogen sources are the controlled or slow release kinds, all of which are relative newcomers. These sources include natural organics, synthetic organics, and plastic or sulfur-coated materials.

Natural Organics

Before 1950 natural organics were the only slow release fertilizers available to turf managers. They include for the most part sewage sludge. The release of nitrogen from these materials is dependent upon microbial breakdown and therefore turf response is generally poor during the cooler months of spring and fall but good uniform growth does occur during warmer summer months. Unfortunately, they tend to be low in nitrogen content resulting in a high cost per unit of nitrogen.

Synthetic Organics and Coated Materials

Since the 1940's the fertilizer industry has been trying to increase the efficiency of fertilizers, ideally attempting to develop fertilizers which will release nitrogen at the same rate that a plant uses it, avoiding the terrible waste of nutrients to leaching or volitization.

The two ways that this is possible are by making new materials or by slowing down the release of existing materials by coating them.

One of the first new materials produced was ureaform in the early 1950's. Since its introduction it has gained acceptance particularly in the turf market. It is generally a 38% nitrogen product but because of its dependency on microbial activity for release of nitrogen to occur, ureaform performs best in warmer summer months and will not give up all its nitrogen in the season of application.

The next product to come along in the mid 1960's was I.B.D.U. which is dependent for its controlled nitrogen release on low solubility. Although initial response is slow, good longevity of nitrogen release is available from this product. The fact that it is imported all the way from Japan does, however, make it quite expensive.

From a chemical point of view, ureaform and I.B.D.U. were new products. The alternate approach that I mentioned was coatings. Plastic coated fertilizers refer to "Precise" a home owner house plant product and Osmocote made by Sierra Chemicals in California. Neither of these are used to any extent on turf.

Sulfur coated urea (SCU) fertilizer is a relatively new nitrogen source. Urea was chosen as the soluble nitrogen source since it is readily available and is high in nitrogen content at 46% N. Sulfur was chosen as the coating material because of its economic and agronomic advantages.

SCU Manufacture

The manufacture of SCU begins with urea. Both prilled urea and granular urea are manufactured. C-I-L uses only urea prills in SCU manufacture and is the only SCU manufacturer to use prills, the others use granular urea. The differences in the products can be readily seen. Urea prills are spherical and smaller than granules while urea granules are angular and irregular in shape. Urea prills are actually more difficult to coat but are preferred because they yield a more consistent and predictable release rate.

In its simplest form, the manufacture of SCU consists of five stages. Urea is heated in a fluid bed where hot air is blown through a bed of urea prills. This favors adhesion of the liquid sulfur.

The urea that enters the sulfur coating drum which continually revolves causing the urea to fall in a continuous curtain allowing sulfur to be sprayed evenly onto each prill. A wax coating is then applied to the product. After cooling the product is coated with a fine clay to ensure free flowing nature. The product is then screened to ensure that all the SCU particles fall within a uniform size range. The final product is then tested for release characteristics prior to blending or shipping.

In summary, urea prills are coated with sulfur, then wax, and finally a clay coating to obtain the final product.

The nitrogen percentage of the final product is dependent upon the amount of sulfur coating utilized. SCU made from prills by C-I-L and is a 32% nitrogen product, while T.V.A. or Ag. Industries SCU is made from granular urea and is 36% nitrogen. C-I-L applies a higher percentage of coating which means a slightly lower nitrogen content.

C-I-L has taken the manufacture of SCU a step further and is now making a miniprill. This is a fine grade product suitable for application to greens and other closely cut turf areas without having significant breakage or pickup occur.

Making sure that the product is consistent in its release rate is very important. Two tests are used to determine the release rate of SCU.

The most important is the seven-day dissolution test which consists of a 50-gram sample of SCU being immersed in 250 milliliters of water at 37.8^{o} C (100^{o} F) for seven days. At the end of the seven-day period the solution is measured for nitrogen content which indicates how much nitrogen has been released from the sample. To hold a product for a week before shipping is impractical, so a test, called the 45-minute test, is often employed.

This test is performed several times a day to insure that a good quality product is continually produced. This test is similar to the seven-day test except that a higher temperature is used and the product sample is ultrasonically vibrated. This more vigorous test gives us an approximation of the seven-day test. The seven-day test however, is continually done just to make sure that the product does meet specifications.

The analysis of C-I-L SCU is as follows:

A) Nitrogen cotent is 32%.
B) Coating of sulfur, wax and clay is 26 to 30% with min. 26%.
C) Release of nitrogen is 25 to 35% in seven days.
When bulk product leaves our plant, it is actually between 18 and 20% in 7 days.
D) Typical release after 8 days is 1% of the remaining nitrogen per day.

HOW DOES SCU WORK

Electron micrographs have revealed the surface characteristics of an individual SCU particle. The surface is not completely uniform and will not be identical to any other particle. This is an important feature indicating that the gross (or total) release of nitrogen from SCU products is an overall average of the behavior of many individual particles.

Two kinds of sulfur are formed during the cooling portion of the SCU production process. It is the formation of these two kinds of sulfur which ultimately control the release of nitrogen from the product. As viewed with the microscope, the darker plates of sulfur can be thought of as bricks and the lighter kind of sulfur around them as mortar.

It is the mortar portion of sulfur which breaks down allowing water to pass between the sulfur plates into the urea in the center. The urea solution which is formed then pushes its way out through the sulfur plates and to the surface of the prill becoming available to the turf.

Some initial release of nitrogen from SCU is more dramatic when the coating cracks under internal pressure from urea solution. This occurs in only a very small percentage of a good quality SCU and is responsible for an initial green-up immediately after application.

In summary, nitrogen is released from SCU in two important ways. Some nitrogen slowly diffuses through the sulfur coating. Also, faster release can occur in a small percentage of prills in response to internal pressure from absorbed water.

As SCU breaks down, both nitrogen and sulfur become available to the turfgrass plant. Both are major nutrients essential for sub-staining healthy turf. The coating on SCU is elemental sulfur, a form not available for crop use until it has been oxidized in the soil. Studies with SCU indicate that the sulfur becomes available very slowly, in some cases taking over a year to break down. You would expect the sulfur to have an effect on the pH of soils, but tests we have conducted at very high application rates have hardly changed the soil pH at all. However, the sulfur as it does become available is utilized by the grass plant. Turfgrass growth can be severely affected by sulfur deficiency.

As well as providing sulfur, SCU's controlled release characteristics offer better utilization of nitrogen. Comparing turfgrass responses to equal rates of nitrogen from urea and from SCU would show that the initial response from SCU is less dramatic but longer lasting than from urea. The growth response from SCU is more uniform than that of urea. SCU is also safer to use as its foliar burn potential is considerably less than could be expected from soluble sources of nitrogen that release very quickly after application.

The slow release characteristics of SCU also provides for a more efficient use of the applied nitrogen. Considerable quantities of soluble urea can be lost through leaching and volitization. The slow release characteristics of SCU substantially reduce these inefficiencies.

When a fertilizer company makes nitrogen, it combines hydrogen from natural gas with nitrogen from the air to make ammonia and from the ammonia urea is made. It takes 40,000 cubic feet of natural gas to make one ton of ammonia from which two tons of urea is produced. Therefore, it takes 20,000 cubic feet of natural gas to make a ton of urea. Consider that because of its high solubility only 80% usage of the soluble nitrogen applied is obtained, then 4,000 cubic feet of natural gas is wasted with each ton of fast-acting soluble urea applied.

Because of the fast reaction of soluble fertilizers, more applications are needed to keep the grass healthy. Each application costs extra labor, fuel and wear and tear on machinery, all of which can be reduced if a good quality slow-release nitrogen product is used.

Let's consider how SCU compares with U/F and with I.B.D.U. Unlike U/F, SCU is only mildy affected by temperature. It is primarily dependent upon moisture for nitrogen release to occur. Also, unlike U/F, good quality SCU will supply its nitrogen in the season that it is applied.

When we compare SCU and I.B.D.U., the differences are more difficult to find. In fact, the responses from SCU and I.B.D.U. are very similar. The major difference being that very little response can be seen from I.B.D.U. in the first three weeks after application. As explained earlier, 25% to 30% of SCU is available in the first week after application giving you an immediate response.

Sulfur coated urea like U/F or I.B.D.U. can be used on its own but is more usually seen in combination with phosphate and potash in complete fertilizers. Sulfur coated urea is not the panacea for the 1980's but you should consider it when you next buy fertilizer.

C-I-L, INC. SCU

If you are presently using a 12-4-8 with no slow-release nitrogen, consider a higher analysis like a 25-4-10 fairway blend. You would need less than half as much product because the 25-4-10 contains twice the nitrogen content. Fewer applications would be required because the slow-release nitrogen in the SCU product would last longer.

Another blend with SCU might be 32-4-8 40% SCU. This would be an alternative to 16-4-8, again half as much product would be needed. The savings made from buying fewer tons and making fewer applications will more than pay for the higher cost of a better quality product. The price per bag may be higher but the total annual cost of growing good grass may show quite a saving.

There are some fertilizer grades available that contain slow-release nitrogen but not enough to give any significant longevity. My personal feeling is that less than 40% of the nitrogen in a product being from slow-release nitrogen is not enough to have any marked effect.

The following products are SCU based products for application to greens.

1. 20-0-15 100% SCU
2. 20-5-10 90% SCU
3. SCU miniprills

These products have been used on greens in Canada for four years. In the western U.S. for two years and during the last 18 months in the southeastern U.S.A. All with good results. So, contrary to what some people say, SCU can be used on golf greens, as long as it's miniprilled SCU!

Slow release nitrogen products are from necessity going to be used more and more in the 1980's and although I'm slightly biased, I believe SCU to be one of the better sources. As I hope, I have explained, SCU based fertilizers offer a long-lasting, uniform release that is nonburning and usually less expensive than alternate slow-release N's.

SLOW RELEASE NITROGEN SOURCES

Mr. Art Wick
Lakeshore Equipment and Supply Co.
Elyria, Ohio

There are two general types of nitrogen sources, a) quickly available and b) slowly available types. Some of the undesirable characteristics of the quickly available sources can be overcome with the use of slow release nitrogen sources. The nitrogen solubility of the quickly available sources is high and results in a rapid consumption by the plant and excess growth. The nitrogen not absorbed by the plant is readily leached through the soil. The foliar burn potential of soluble N fertilizers is quite high when compared to that of slow release materials. Generally it is necessary to use low application rates and more frequent applications when using soluble nitrogen sources.

Slow release N sources were first developed during the late 1940's and early 1950's. Synthetic organic N sources were introduced at this time, whereas the natural organic materials were the only slow release fertilizers previously available. Basically there are three categories of slow release N fertilizers a) natural organics, b) synthetics, and c) coated materials.

Slowly available nitrogen sources have many key advantages including a) low solubility in water, b) nitrogen release over an extended period of time, c) minimal losses due to leaching or vaporization, d) low foliar burn potential, e) utility at higher application rates, and f) reduced frequency of application.

Natural Organics

These products are generally low analysis materials (e.g., 6% N for sewage sludge), therefore necessitating higher rates of applications to ensure adequate nutrient supply. Natural organic fertilizers have a wide margin of safety in terms of foliar burn. These sources can be objectionable due to the odor resulting from microbial decay. Additionally they can have poor storage stability in that they are hygroscopic and are subject to mold in the container.

Synthetic Slow Release Sources

Methylol ureas (formulene products) are soluble in water and generally shipped as a liquid. Fertilizer formulations are about 15% water, have a pH of 8.5 to 9.0 to ensure stability, and are approximately 30% nitrogen. These materials will not salt out in the tank at low temperatures. This is a distinct advantage over urea. Methylol ureas are stable to -20 F, while prilled urea will salt out in a tank at temperatures below 40 F. Nitrogen release of methylol ureas is not any longer than that of urea, therefore they do not quite fit the slow release characteristics. However, they do have a low foliar burn potential.

Methylene ureas have intermediate characteristics between the methylol ureas and urea fertilizer sources. These materials are short

chained ureas, but not as short chained as the methylol ureas and are generally 39 to 41 % N of which 25% of this N is in a slow release form. Methylene ureas result in a flush of growth and act like soluble nitrogen after one week after application. Natural organics cost about $1.50 to $4.00 per pound of N, methylene ureas cost approximately $1.00 per pound of N, methylol ureas cost about $0.58 per pound of N, and the ureas are about $0.20 per pound of nitrogen.

Synthetic Organics

Urea formaldehyde products such as uremite and nitroform are generally 38% nitrogen. Their characteristics are a) low solubility, b) long lasting N released during the season applied, c) nitrogen release via microbial decomposition (i.e., temperature and pH are important), d) slow release allows infrequent applications at high rates, and e) relative expensive fertilizers at $0.95 to $1.10 per pound of nitrogen. Seventy percent of the total N in urea formaldehyde is slow release. The remaining 30% of the total N will be released within the first few weeks after application.

Another synthetic organic N source is IBDU. Nitrogen is released by hydrolysis. These materials are about 20 to 30% N and are relatively expensive costing approximately $1.30 per pound of nitrogen. Seventy-five percent of the N present in these materials is in a slow release form.

Coated Fertilizer Sources

These fertilizers are generally high analysis, have a low foliar burn potential, and have good spreading and storage characteristics. The nitrogen release rate is dependent upon the type of coating utilized. Plastics, asphalt, latex, and sulfur coatings have all been developed. The sulfur coated materials are the only products of this type used to any extent in turf areas.

Sulfur Coated Ureas

Consistent N release from SCU materials can be expected to be between 12 to 16 weeks depending on the weather. These sources blend with other fertilizer sources well and are low cost at $0.57 to $0.67 per pound of nitrogen. Sulfur is also an essential element for plant growth.

Conclusion

There are many advantages and disadvantages of slow release nitrogen products. The selection of a slow release product should be based on the following criteria:

1. Nitrogen release speed and duration.
2. Application safety.
3. Application cost.
4. Product stability in handling and storage.
5. Product availability.
6. Ease of application.

IMPACT OF STRESS ON MOTIVATION

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At some point each of us contracts something called "stress". Its appearance takes various shapes. It fluctuates in degree of intensity and seems to affect each person differently. If stress is controlled, then the results are usually tolerable. When uncontrolled, intolerable results usually occur.

There are many ways to examine the impact of stress on motivation. One, is to examine stress signs and symptoms, to explore causes and results and to develop stress control techniques. It is good to remember that there is no cure for stress, only control. Three stages may be used for analysis.

1. Warning stage
2. Hazard stage
3. Relief stage

Some key points to remember are:

1. Stress is not an absolute, nor does it stand alone. It amounts to a parasitic state in which it rides along or attaches to something else. If you will, stress is a companion.

2. Stress is dangerous, it incapacitates and sometimes even kills its victim.

3. Human beings are the carriers.

4. Stress can only be controlled, not cured.

5. All people deal with stress.

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PESTICIDE DILEMMA - UPDATED PERSPECTIVE

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Today's pesticide situation is confusing, and for many farm and ornamental uses it borders on the state of calamity. Will we be able to cope with future regulations? The assault on pesticide manufacturing, distribution, and use appears in many forms. Briefly, lets take a look at adversarial approaches to discredit the use of pesticides.

First, chemicals are bad! Natural organic materials are preferred for growing and processing of food we eat, and for natural biological control of diseases and pests. Pesticides are worse because they are a poison, and poison in any amount should not be permitted. Create an atmosphere of uncertainty, suspicion, and fear. Make pesticide a dirty word in anyone's mind, like homicide, genocide. Sensationalize any alleged incident where a pesticide may have caused harm to an individual as being general, commonplace (e.g., Silvex exposure, DDT). Foster out of unknowing fear--the potential long run effects of exposure to chemicals and pesticides in particular. This is coined the "Time Bomb" effect. Brand all manufacturers as being concerned only with profits and having no regard for the environment. In the name of self professed righteousness, seek to eliminate pesticides through tighter and tighter government regulations and through constant litigation. Friends of the Earth, the Sierra Club and numerous others are constantly orchestrating "Political Action." What are the results of these concerted efforts of our adversaries? Time permits us to only review a few. The cost of developing new pest controls has been greatly increased. This has resulted in far fewer pest controls coming on stream for use. Ever increasing regulations forcing astronomically higher production costs and risks have greatly reduced the rewards for companies to stay in the pesticide business.

Bureaucracy at all levels of government has been greatly expanded. Poorly planned programs and their implementation are encouraging mountains of red tape and ever increasing millions of dollars in the cost of regulatory burdens. Registration for new uses of old products is a very time consuming process. The cost of insurance has risen too high for many small and large firms to be adequately covered. Claims have not covered this;--but scare journalism and constantly poor publicity have frightened insurance carriers. Also, it is harder to keep good employees under such adverse publicity. The "Scientific Inquiry" method of establishing relative merit, benefits and risks is being tossed out by the so called Environmentalists in favor of hearsay innuendo. Meanwhile the continued use of less efficient pesticides has resulted in pest resistance problems. Finally, the cost of food and fiber production has also been increased unnecessarily.

With the onslaught challenge from these professed "Keepers of the environment," let it first be understood we can not do without pest control and chemicals. In our own ornamental industry, aesthetic losses

would be unbelievable without insect and disease controls. The cost of food and fiber would sky rocket, forcing many persons to return to farming. Severe shortages of food and fiber would result in malnutrition, losses in the economic balance of payments from food exports, losses of foreign produced food dependent upon advances in American agricultural technology and supply, and finally, a period of forced business depression.

The battle is heating up and we must all do our part. What can we do? First, become familiar with pesticides and the controversies surrounding their use. Preach judicial, prudent use of pesticides, being fully aware that many pest controls do pose hazards, but when used properly, have great benefits with minimal risk. It is the same with aspirin, and many other medicines we take--too much will kill you. Don't blindly defend all pesticides. Show reasonableness, aware on occasion a pesticide will outlive its usefulness, or pose an unexceptable hazard versus its benefits, and thus be withdrawn from the market. Explain to others that pesticides are different, and just because one may not be suitable for use, it does not mean "all pesticides" are the same, and thus all pesticides are bad! This is the smear campaign "so called environmentalists" are using now. Take the time to train, indoctrinate yourselves and your employees on pesticide knowledge. Handle, store, and apply pesticides according to your local, state and federal laws, rules and regulations, although some of the laws and rules are ridiculous. Its the law, obey it to the best of your ability. In the future, applicators and their conduct will be challenged by the "so called environmentalists." Lets not have anyone of us "mess up" and give the "so called environmentalists" more ammunition then they deserve. They love to pick one isolated incident and brand that incidence as typical of the entire industry. The result, a clamor for more regulation, more red-tape, millions of dollars in more bureaucracy and thousands of more wide-eyed do-gooder bureaucrats. So take pains, lets not give them an excuse or help their cause.

Because the "so called environmentalists" have gone political in an attempt to gain their final exposed goal of no pesticides anywhere, we have no choice but to follow suit and go political too. They have chosen to throw out scientific fact; ridicule solid verifiable research; and belittle learned scholars views. They are no longer interested in truth obtained from pure unbiased scientific inquiry. They are seeking adherents and alliances in the political sphere. I suggest we do the same, but never losing sight of truth in presenting our argument. I suggest you form a government liaison committee, (better known as a watch dog committee) to keep in contact with state agencies and legislative bodies dealing with pesticide matters. Ask to be informed of impending new rules and legislation. Obviously we want to have some input into the forming of any new rules, regulations or laws! We also may want to change existing rules and legislation more to our benefit! Get to personally know your state regulators and legislative representatives.

Be on your toes and be aware of any local pesticide issues, and seek help if necessary in countering them. You may be shy, and not want to get involved, but at least inform others who can possibly carry the ball for you. Give aid and assistance to groups interested in our cause (e.g.,

ALCA or newly formed PLCAA). We most urgently need to be organized and speak with an effective voice.

FACT SHEET SUMMARY

Increase your knowledge about pesticides. Pesticide safety factors are largely determined through the use of test animals,--then recomputed to corresponding "live body weight of humans" to predict effects, behavior patterns, and problematic situations.

LD 50 Value = Lethal dose of a chemical. Usually expressed in terms of milligram weight of a chemical per kilogram of body weight needed to kill 50% of a test population (commonly mice, rats, dogs, etc.). The lower the numerical value, the greater the killing power. LD 50 of 750 mg/kg (table salt) is 3,320. LD 50 of human oral intake of paraquat = 150.

LC 50 Value = Lethal concentration of a chemical needed to kill 50% of organisms/animals in the test.

Modes of chemical entry into body and degree of toxic effect.

Oral - swallowing
Dermal - through skin
Inhalation - breathing

Residual effect = Toxicant remains effective for relatively long periods after application, but does not necessarily mean toxicant is a safety hazard. Duration of residual effect depends on degree of (1) volatility, (2) leaching, (3) chemical decomposition, (4) microorganism decomposition, (5) absorption on soil colloids, and (6) photodecomposition.

Tolerance = The amount of pesticide deemed safe/permissible, and permitted by law on an agricultural product.

Threshold level = That point at which a chemical produces a stimulus strong enough to be perceived, or produce a response or effect.

Teratogenic = A chemical that can cause abnormalities in an animal embryo or a fetus.

Mutagenic = A chemical that can cause genetic or somatic changes in subsequent generations.

Oncogenic = A chemical that can cause tumor formations.

Carcinogen = A chemical that can produce cancer in animals and humans.

Phytotoxic = A pesticide that is injurious or poisonous to plants.

Acute toxicity = A single or limited exposure to a pesticide that may result in injury or death.

Chronic toxicity = A prolonged exposure to a pesticide that may result in injury or death.

Crop tolerance = Ability of a crop to be treated with a pesticide, but not injured.

Pesticides are divided into a number of sub groups. The more common ones:

Insecticide = Chemical/pesticide use to prevent, destroy, repel, mitigate or attract insects and their relatives.

Fungicide = Pesticide used to control fungus/disease infections.

Herbicide = Used to prevent or destroy plants where they are not wanted to grow.

Nematocide = Chemical agents capable of killing nematodes. (Microscopic soil animals/organisms.)

Rodenticide = Used to prevent, destroy rodents.

Acaricide/Miticide = Chemical pesticide used to kill mites; (an insect relative.)

Avicide = Pesticide used to destroy, repel, or attract birds.

Ovicide = A pesticide used to kill eggs of insects.

Algicide = A pesticide used to control algae, particularly in water bodies.

Arguments you can use to help guide your community in to a sound, well reasoned, scientific and thorough approach to formulating pesticide application policy.

A few of my comments are as follows:

(a) We are all against any chemical that harms our environemnt;
(b) Lets establish just which materials are harmful. Notice the word materials, better not to talk about chemicals - it has a bad taste with many people (even though they are made up of chemicals). Talk materials;
(c) Ask your community leaders to consult with your Agricultural College Experiment Station, and United States Department of Agriculture for information and guidance;
(d) Determine what are natural pests in your area and the materials needed to correct them. Of the materials needed to correct a given situation, choose those that are safest to apply and have the least residual harm (there are many);
(e) Ask that an advisory council be established to assist in "making the rules" and in policing the situation. You, as part of industry would be on this council, as would interested lay people, etc.

Operate your business with careful respect to handling all pesticides--make every effort to fully comply with all existing rules and regulations. And the more you know about pesticides, better we all are!

GROWTH REGULATORS ON TURF

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Since the discovery of naturally occurring plant growth regulators in the 1920's, slow but sure progress has been made in the development of a means to chemically regulate the growth of turfgrasses. Maleic hydrazide (MH) was introduced to the market in 1950, then came chlorflurenol (Maintain(R) CF-125) and fluoridamid (SUSTAR(R) Plant Growth Regulator) and, in 1978, mefluidide (EMBARK(R) Plant Growth Regulator) was registerd for use on turfgrasses.

EMBARK Plant Growth Regulator (PGR) is recommended for use in public, commercial and industrial areas for regulating growth of various species of turfgrasses and broadleaf vegetation. Mowing requirements are reduced for up to 8 weeks following treatment through regulation of growth and suppression of seedhead formation. Spring applications, on cool season grasses before seedhead emergence, will give season-long suppression of seedheads.

EMBARK PGR may be applied to localized areas with small spray units, such as backpack sprayers, or to larger areas with conventional spray equipment. It is important that the sprayer be accurately calibrated and the spray uniformly applied. When used according to the label, EMBARK PGR represents no hazard to the user or the environment.

EMBARK PGR should be uniformly applied to green, actively growing turf. At the time of application or shortly thereafter, the turf should be at the height which is desired to be maintained during the period of growth regulation. Applications should not be made to closely mown areas where most of the green growth has been cut. Turf may be mown up to 1 day before or 3 to 7 days after application. Spray overlaps should be avoided because they may represent an overdose. EMBARK PGR may be applied twice per season on several species, however, an interval of at least 6 weeks should occur before the second application.

EMBARK PGR is especially useful in reducing both the frequency of mowing and the exposure to hazards in hard-to-mow areas near traffic, on slopes or around obstacles such as tanks, pipes, and fencing. It is also useful as a border or strip treatment in hard-to-mow areas such as along fencing, sidewalks and near buildings.

Several companies, including 3M, are developing new products for the turf growth regulation market. Possibly some of these chemicals will survive the gamut of performance trials, EPA regulations, and rising costs and become additional tools for vegetation management.

TURFGRASS SEED PRODUCTION

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How is turfgrass seed produced and where is the major area of production? The major production area in the United States is in the northwest states of Oregon, Washington, and Idaho. A combination of factors make these states ideal for seed production. These areas have a climate with a distinct rainy season during the winter months while having predictable dry months of June, July and August where minimal rainfall is anticipated. As the harvest takes place during these months, there is less chance of crop loss due to heavy rains and severe thunderstorms. When seed is produced in other climates with less predictable weather patterns, heavy rainstorms can dislodge and shatter the seed from the delicate panicles. Once on the ground the seed is lost and can't be harvested.

Low humidity is also important during harvesting as the crop is normally swathed first, set in wind rows and allowed to dry in the fields. High humidity and/or dampness from rain for extended periods can cause rotting of the seed, lower the germination, and increase the incidence of disease which can destroy the entire crop.

Seed production is not a complicated procedure in theory but in practice the demands are high due to potential weed contamination, insects, disease and other related problems. The seed utilized by the farmer when planting a field is provided by the breeder or more commonly by a seed company. Seed companies either develop their own proprietary varieties* through company breeding programs, or acquire marketing rights for varities developed by breeding programs which do not have facilities with which to market and promote a variety. This is usually the case with breeding programs conducted at state universities. For example, Lofts Pedigreed Seed, Inc. has the proprietary and/or co-marketing rights to the following varieties: Baron, RAM I, Majestic, and Touchdown Kentucky bluegrasses; Yorktown, Yorktown II, and Diplomat Perennial ryegrasses; Jamestown Chewings fescue and Beaumont Meadow fescue. The company or its agent will contract directly with the farmers to grow a set number of acres at a certain contract price for a predetermined number of years. The seed which is provided to the farmer would be either breeder's seed or very often foundation seed. Breeder's seed is produced under supervision of the breeder of a particular variety. Very strict standards are set with respect to isolation, contamination, and weed control for both breeder and foundation seed.

Breeder's seed is produced from plants or clones of the original seed source or plant. The purpose of the Breeder block is to have a basic source of seed which is genetically consistent and uniform according to the description of the variety. Foundation fields are planted from breeder's seed

*Varieties for which one individual, group of people or company have sole control over production, marketing and sales.

which will provide relatively large quantities of seed of desirable quality which is utilized to plant new or reestablished plowed out acres. For example, a breeder block of Kentucky bluegrass has 500 plants which will produce 10 pounds of seed. The ten pounds of breeder seed can plant five acres of foundation fields which will in turn produce 3,500 pounds of seed the following year. The 3,500 pounds of foundation seed could be utilized to plant 1,700 acres of production fields. From this 1,700 acres, a harvest of over 1,000,000 pounds of seed would be available for commercial sale. In a period of four to five years, a variety may be increased from a single plant or a few grams of seed to over a million pounds of seed to be sold commercially. The production fields are planted in spaced rows 12 to 18" wide, using extremely low seeding rates per acre, 2-3 pounds per acre for Kentucky bluegrass, 5-7 pounds for fine fescues, 1-2 pounds for bentgrasses, 15-20 pounds for tall fescues, and 5-7 pounds for fine leaf perennial ryegrasses. To insure genetic purity of a variety and minimize contamination, fields must be rotated every three to five years as every field planted has a seeding and plow-out schedule. Fields planted to sexual grass species are isolated far enough from other varieties of the same species so that pollen from a nearby field will not fertilize the desired crop.

After the field is seeded to "Baron" Kentucky bluegrass, for example, the field agronomist, employed by or acting as a representative for a seed company, must take special precautions to see that off types and aberrants (plants which are not characteristic of the variety being grown) are eliminated. The agronomist advises and works with the farmer to see that field hands walk every foot of the field looking for plants that are larger, smaller, have different color, textures, etc, than the desired variety. These plants are eliminated by spot spraying with a contact herbicide. The purpose of this procedure is to provide uniformity from plant to plant within a field. Weeds are selectively removed from the fields by using various herbicides. Fields which have extremely high weed infestations will be plowed up as directed by the field agronomist, thus resulting in a total loss with the crop in order to assure high seed quality.

There is one harvest per year. Harvest takes place between the months of late June through August. Each species matures and is ready for harvest at different time periods. Kentucky bluegrasses, tall fescues, and fine leaf fescues mature first during late June and early July. Next are the perennial ryegrasses in mid-July followed by bentgrasses in mid-August.

From seeding to harvest all fields are routinely visited by state seed inspectors whose responsibility is to verify records as to what variety and species was planted in a field. They also check for weed contamination, if any, and for off-types and aberrants, which may prevent a variety from being certified. The state inspectors, field agronomist and farmers do an excellent job in assuring the public a source of high quality turfgrass seed.

After harvest the seed is combined to separate the seed from the seed head while straw, dust and other inert debris are removed by cleaning machines. These cleaners utilize different size screens and air blowers to sift and separate the viable seed from weed seeds and undesirable elements. All seed is labeled by lot numbers designating the farmer and field in which the seed

originated. All seed is tested by licensed laboratories for percent purity, germination, inert matter, and weeds. Seed not meeting strict quality standards, as regulated by state and federal laws, cannot be sold as certified seed.

After harvest, preparation has already begun for next year. One of the most critical field procedures conducted in an established field after harvest, is to burn the field stubble with fires set and controlled by the farmers. The field burning is necessary to rejuvenate the plants, encourage new plant growth, kill weed seeds, and temporarily kill surface soil pathogens. If not burned, the yield generally will decline in succeeding years.

The procedures described above have been generalized in some cases, and only the most important grass species utilized for fine and sports turf have been mentioned. However, I feel that it is important for everyone interested in turfgrasses to have a basic understanding of seed production procedures.

The most widely utilized species and popular varieties for fine and sports turf use are:

SPECIES	VARIETIES	USE
KENTUCKY BLUEGRASS	BARON RAM I MAJESTIC TOUCHDOWN GLADE MYSTIC	Best adapted to areas receiving full sun. Extremely attractive species for general use on home lawns, parks, athletic fields and golf courses.
PERENNIAL RYEGRASS	YORKTOWN YORKTOWN II DIPLOMAT DERBY MANHATTAN PENNFINE	Quick germination, durable, wear resistant. Ten to fifteen percent should be included in most seed mixtures. Excellent for use on heavy traffic areas such as sports fields.
FINE LEAF FESCUES	JAMESTOWN HIGHLIGHT PENNLAWN BANNER REBEL CLEMFINE	Best adapted to dry shade conditions. Usually not seeded alone but included in mixtures for shade adaptability.
TALL FESCUE	K-31	Tough, wear resistant, coarse texture grass. Widely used on roadsides and in athletic field mixtures.
POA TRIVIALIS	SABRE	Poa trivialis is the only desirable turfgrass species recommended for damp shady conditions.
BENTGRASS		
Creeping	PENNCROSS PENNEAGLE EMERALD SEASIDE	High maintenance species usually reserved for golf course use.
Colonial	ASTORIA	

Major turfgrass seed production areas for cool season turfgrasses.

AREA	TURF SEEDS PRODUCED	COMMENTS
UNITED STATES		
Willamette Valley, OR	Bentgrass Kentucky bluegrass Perennial ryegrass Annual ryegrass Fine-leaf fescues	Poa annua and bentgrass contamination is constant concern for production in this area. Good climate for seed production with irrigation not as necessary as other production areas.
Madras, OR	Kentucky bluegrass Perennial ryegrass	Poa annua and bentgrass free area. Good yields depend on irrigation.
LaGrande Valley, OR	Kentucky bluegrass Fine-leaf fescues	Poa annua and bentgrass free area. Good yields depend on irrigation.
Spokane, WA Northern Idaho border areas	Kentucky bluegrass Perennial ryegrass	Poa annua and bentgrass free area. Ryegrasses and tall fescues may winterkill which limits extensive plantings. Good yields depend on irrigation.
Minnesota	Kentucky bluegrass	Big area for the production of the variety Park also common Kentucky bluegrass.
Arkansas, Missouri, Kansas, and adjacent states	Tall fescue	Seed typically harvested off of grazing fields to increase a farmer's income. Little effort put into seed production.
CANADA		
British Columbia Manitoba	Creeping Red Fescue Kentucky bluegrass	Big source of commons
NEW ZEALAND	Perennial ryegrass	Big source of commons or pasture types. Seed sold primarily in Europe and Australia.
EUROPE		
Holland, England, Denmark and Germany	Perennial ryegrass Bentgrass Fine-leaf fescues Kentucky bluegrass	Poa annua contamination severely limits United States import potential. Seed sold primarily in Europe.

BERMUDAGRASS OR BENTGRASS FOR GOLF GREENS

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In the upper south either bentgrass or bermudagrass in many cases can be successfully grown for golf course putting greens.

Comparative costs of maintaining bent and bermudagrass greens were obtained from Mr. Mike Davis, Assistant Superintendent, at the Callaway Gardens Golf Club in Pine Mountain, GA. Mr. Davis had compiled cost figures for the maintenance of two of the golf courses at Callaway Gardens.

The Lake View course has 100,000 sq. ft. of Tifgreen (Tifton 328) bermuda on the greens, whereas the Gardens View course has 105,000 sq. ft. of Penncross bent. During July, August, and September, the bentgrass course is not open for play in the afternoon.

The comparative costs as reported by Mr. Davis for the two kinds of putting greens in 1978 at the Callaway Gardens are as follows:

A. Chemicals

1. Fungicides (both curative and preventative)

Bermuda	$2,236	$22.36/1,000 sq. ft.
Bent	3,906	37.20/1,000 sq. ft.

Difference: The bent cost $14.84 more/1,000 sq. ft.

2. Insecticides (only major pest is armyworms)

Bermuda	$139	$ 1.39/1,000 sq. ft.
Bent	$162.20	$ 1.54/1,000 sq. ft.

Difference: The bent cost $0.15 more/1,000 sq. ft.

3. Herbicides (Preemergence)

Bermuda (one appl. in July)	$155	$1.55/$M^2$
Bent (two appl. Apr. and July)	$325	$3.10/$M^2$

Difference: The bent cost $1.55 more/1,000 sq. ft.

B. Overseeding (a major cost comparison)

Bermuda	$4,000	$40.00/1,000 sq. ft.
Bent	$ 00	$ 0.00/1,000 sq. ft.

Difference: Bermuda cost $40.00 more/1,000 sq. ft.

C. Fertilizer

Bermuda (total 23 lb N/M^2)	$2,450	$24.50/$M^2$
Bent (total 9 lb N/M^2)	$ 992	$ 9.59/M^2

Difference: The bermuda cost $38.87 more/1,000 sq. ft.

D. Overall comparison (costs for 1978)

Bermudagrass Greens	$89.80/1,000 sq. ft.
Bentgrass Greens	$51.43/1,000 sq. ft.

Difference: The bermuda costs $38.37 more/1,000 sq. ft.

In those areas where we have the option of either bent or bermudagrass greens, the decision probably should be based upon preference, facilities, and amount of play, as well as economics.

LANDSCAPING THE GOLF COURSE: FIVE EASY STEPS

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By stragetically locating and planting specimen trees, shrubs and flowers combined with construction materilas such as brick, railroad ties or treated lumber, landscaping can increase property values, create aesthetically pleasing focal points and functionally screen unsightly views around the golf course or country club. Granted, the philosophy for most superintendents is "the grass comes first" and landscaping only evolves with extra time, energy and money; items usually in short supply on most courses. But, with proper design and installation planting beds of flowering annuals and specimen ornamental trees and groundcovers can require a minimum of maintenance. The most important goal is to get the most mileage out of the landscape dollar. The following suggestions should be considered before any landscape project is begun.

The first step in the design process is to analyze the site. Consider the entire course or country club grounds, including tennis courts and swimming pool areas. Make notes as to the views, both good and bad. What about noise and distractions from cars in parking lots? Be certain to study environmental site conditions. Adverse conditions such as poor drainage, compacted soils, shallow roots or dense shade can create expensive problems. By critiqueing the existing conditions one can readily define areas which deserve attention and the amendments required.

What exactly are the landscape needs of the golf course? After analyzing the site and existing conditions you can define areas for future beautification projects and areas where landscaping can be very functional.

The next step is to develop a plan for the various areas. Since most of the projects will not include a professional landscape architect or consultant, this design step is very important. When choosing plant material consider the ultimate size which is desired. Consider plants which are low maintenance. These would include dwarf varities and native plants. Roses would certainly not be included on this list. Think about seasonal color and interest. Try to combine plants which have landscape character not only in the spring but on into the summer and fall. Before planting any tree or shrub ask a nurserymen or county agent how fast and how large the plant grows. Answers to these two questions will be quite helpful in the selection of plants.

After designing the various areas a priority list must be developed. Generally, not all landscape projects can be developed at one time. Set goals, list the priorities and complete the projects as time and money allow.

Around most courses the entrance to the club will be high on the list. Construct a sign and plant groundcovers and a specimen tree or shrub as a background. Pampas grass and crapemyrtles are favorites for Piedmont and Eastern areas, while Hemlock, Sourwood and Mountain laurel are recommended for Western North Carolina.

Create planted areas for high visibility. Don't design an azalea, rhododendron and bulb bed out behind #14 where golfers only see it from one direction. Choose an area which can be enjoyed from a couple of tees and greens. Popular areas would be near the clubhouse or practice green, or on many courses #1 tee, 9th green, #10 tee and 18th green are in sight of one another. Landscaping these areas maximize beauty and utility and make the most out of the "landscape dollar".

REESTABLISHING BERMUDAGRASS

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Winston-Salem, NC

Severe winter weather in 1976-1977 and 1977-78 caused much damage to bermudagrass on golf courses in North Carolina and surrounding states. Some courses were so severely damaged, they had to be closed and replanted entirely from tee to green. These courses recovered quickly, though at a large expense. Other courses like Forsyth Country Club in Winston-Salem, had only 25 to 30% of the bermudagrass killed. The course could only be closed on a day to day, hole by hole basis. Extensive tillage practices such as plowing could not be used. Renovation had to be accomplished with a minimum of disturbance to the golfers. These are the methods we used at Forsyth to restore the bermudagrass.

Sodding, seeding, and sprigging were all used to repair damaged areas. Because sodding is so expensive, its use was restricted to high maintenance areas such as tees and aprons. Bermudagrass sod was bought from a commercial grower by the trailer load. Delivery schedules were arranged early in the year so we would be adequately prepared when the sod arrived, In all, over a period of three summers, approximately 40,000 square feet of sod was purchased. Five tees plus the practice tee were sodded, half at a time, to keep them in play. Fertilizer was applied when the sod was laid, and topdressing started after the sod was mowed once. The only unsatisfactory results occurred when one load of sod was ordered too early in the year, and when one load of sod was cut too thick by the seller. It is imperative to have good sod to get satisfactory results.

Seeding the fairway areas in need of renovation was tried for two years. Seeding started in May following an application of KERB(R) in February for Poa annua control. Seeds were planted by both drilling and broadcasting, with incorporation by verti-cutting and/or aerification. Germination ranged from fair to poor, with bermudagrass seedlings equal to crabgrass and crowfoot. Germination was better when seeding was later in the year, and when thatch was removed from renovated areas before seeding.

Weed control in these areas was difficult the first year. Sencor(R) and MSMA were used to control crabgrass and crowfoot. Application rates were .125 a.i. Sencor(R) plus 2 lbs. MSMA per acre. No permanent damage to bermudagrass seedlings occurred if the grass was at least 6 weeks old and had been allowed to grow to a height of 2-3 inches before spraying. Sencor(R) at higher rates killed all new bermudagrass seedlings, but had no apparent effect on seedling germination at any time.

After two years of unsuccessful seeding in many areas, sprigging was tried. It gave the best results at the least expense. Areas to be repaired were aerified and verti-cut three times prior to sprigging. Sprigs were cut with a Rogers verti-cutter from stands of good bermudagrass adjacent to the renovated areas. Sprigs were hand raked, spread as evenly as possible, and top-dressed with sand. Water was applied as quickly as possible. Topdressing

with sand was expensive, but allowed the areas to be kept drier and interfered less with play. It was also a good indicator of when water needed to be applied. Sprigged areas were fertilized with starter fertilizer at planting and every three weeks with ammonium nitrate at 1.0 lb of N/M for two months. Areas had completely recovered in 30 to 40 days. If fairway water is available, sprigging will produce better, quicker results than seeding.

We are now on a program to prevent such damage again. In shaded areas, trees have been thinned where possible. Mowing patterns have been changed so that shaded areas are mowed as rough. An application of 5-10-30 fertilizer at 400 lbs/acre is applied in late August, and fairway mowers are raised from 5 to 12 notches in September. Lime is being applied annually to raise pH levels to 6.0. A Poa annua control was applied until this year. Fairways are now overseeded with ryegrass.

Reestablishment of Bermudagrass Fairways

William B. Gilbert
Turf Research and Teaching
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North Carolina State University

Common bermudagrass (Cynodon dactylon L.) is widely used for golf fairways throughout the southern region of the United States. However, susceptibility to winter injury the first winter after seeding has tended to limit its establishment from seed. This report is of a study by L. L. Hendrix, former graduate assistant at NCSU, on the effects of date of seeding, N and K fertilization, and height of cut on winterhardiness of common bermudagrass the first winter after seeding.

In mid-January, field hardened cores were removed from the field and exposed to a standard freezing test. Bermudagrass seeded the first three seeding dates was 15 to 20% more cold tolerant than that from the last seeding date (Table 1). Less damage from low temperature was obtained at the lower N rate and lower cutting height than with the higher N rate and cutting height. The K levels did not affect low temperature injury.

Field observations in the spring were similar to the standard freezing test (Table 2). Rhizomes were not produced until the second growing season, and were,therefore, not a factor in increasing winterhardiness the first winter after seeding.

Quality ratings seven weeks after regrowth had begun were higher for each earlier seeding date (Table 2). The quality of the turf cut at the lower height was much greater than the higher cut plots.

Root weights from field plots taken nine months after the first seeding decreased with date of seeding (Table 2). Root weights were lowest at the higher cutting height, and were reduced under the high N treatments.

This study indicated that management variables can be used to increase winterhardiness of common bermudagrass the year established since it is dependent largely on crown bud survival. Results indicate that earlier seeding dates, lower N rates and lower cutting heights can be used to increase the winterhardiness the first winter after seeding.

Table 1. Effects of management variables on regrowth and carbohydrate content of common bermudagrass after exposure to four temperatures.

Management variables	Dry wt of regrowth				Regrowth†	Total carbohydrates
	°C					
	0.6	-2.2	-5.0	-7.8		
	g				%	%
Date of Seeding						
June 5	.97	.84	.26	0.0	30.0	5.96
June 26	.82	.76	.28	0.0	33.0	5.91
June 17	.75	.59	.17	0.0	24.0	5.85
August 7	.91	.87	.10	0.0	11.0	6.26
$LSD_{.05}$	.11	.22	.10	--	13.6	NS
Cutting Height						
Low	.96	.88	.26	0.0	30.0	5.98
High	.76	.65	.14	0.0	19.0	6.01
$LSD_{.05}$	.06	.09	.09	--	11.0	NS
Nitrogen Level						
Low	.80	.74	.24	0.0	30.0	5.89
High	.93	.79	.17	0.0	18.0	6.10
$LSD_{.05}$	.08	NS	NS	--	8.6	NS
Potassium Level						
Low	.84	.73	.19	0.0	23.3	5.99
High	.89	.80	.22	0.0	25.2	6.00
$LSD_{.05}$	NS	NS	NS	--	NS	NS

† Divide regrowth at -5.0° C by that at 0.6° C.

Table 2. Effect of management variables on field determinations made for percent ground cover, quality, number of rhizomes produced and root weight of common bermudagrass.

Management variables	Ground cover	Quality † rating	Rhizomes produced			Root weight
	weeks after spring regrowth		months after June 5			
	3	7	4	9	14	9
	%	0-10	—— no. ——			g
Date of Seeding						
June 5	27.2	4.72	0	0	.25	2.01
June 26	25.3	4.03	0	0	.28	1.80
July 17	26.9	3.31	0	0	.44	1.38
August 7	15.3	1.75	0	0	.00	.91
$LSD_{.05}$	3.7	.55	--	--	.27	.16
Cutting Height						
Low	32.5	4.30	0	0	.23	1.63
High	14.8	2.61	0	0	.25	1.42
$LSD_{.05}$	3.0	.32	--	--	NS	.16
Nitrogen Level						
Low	22.3	3.53	0	0	.34	1.64
High	25.0	3.38	0	0	.14	1.42
$LSD_{.05}$	2.3	NS	--	--	.20	.11
Potassium Level						
Low	22.8	3.50	0	0	.23	1.54
High	24.5	3.40	0	0	.25	1.52
$LSD_{.05}$	NS	NS	--	--	NS	NS

† (0-10), 10= best

SOIL MODIFICATION OF TURFGRASS AREAS

John Moreland
President - Cambridge Soil Services of America
Glencoe, Alabama

YOU CAN'T MODIFY YOUR TOP MIX WITH SAND

You may know a superintendent who aerifies, removes the plugs and top-dresses with sand. If you asked him what he was doing, he would probably say something like, "I am increasing the sand content of the soil for better drainage."

The truth of the matter is that he is doing no such thing and it is a good thing for him that he is not increasing the sand content of the soil. His program is a good one and the greens will probably benefit greatly from it, but the benefit comes because the sand and soil are NOT mixed. Internal drainage is dependent on pore spaces and pore space is greatest when particle size is uniform. If you add a small amount of medium sand to a loamy soil you will make the drainage worse--not better. To better visualize this, consider a room full of BB's. You would hardly improve the drainage by pushing in half a room full of basketballs.

Although pure sand drains better than any other soil, adding a small percentage of sand to soil will usually make the drainage worse - not better.

Since you will probably need something like 80% sand in your mix, it is clearly impossible to successfully modify the existing mix without total reconstruction.

WHY IS CORING AND SAND TOP-DRESSING A GOOD PROGRAM?

When you core, you remove compacted soil and you create a space into which surrounding compacted soil can expand. In

addition to this you create pockets which will catch irrigation water. You also create a channel through the area of greatest compaction in the green allowing the water to quickly reach a 2-1/2-inch depth. Water is readily absorbed from this channel by capillary attraction and by the 2-1/2-inch hydraulic head which is developed. When you top-dress with a good quality sand, you provide a 2-way channel for the water to move through capillaries from the 2-1/2-inch level to the surface. More importantly, sand top-dressing prevents these holes becoming sealed over.

WHY ISN'T CORING AND SAND TOP-DRESSING MORE EFFECTIVE THAN IT IS?

A program of coring and top-dressing has several severe limiations.

1. It is seldom practical to go over 2-1/2 inches deep.
2. It is very difficult to fill the holes all the way to the bottom.
3. Some compaction is created at the bottom of the holes.
4. Since the holes are not connected, there is no improvement in the lateral movement of the water.

THE CAMBRIDE SYSTEM OF GREEN RENOVATION

The Cambridge System overcomes all of the above limitations.

1. We go a full 9 inches deep.
2. The slit is filled all the way with lightly tamped sand.
3. The vibratory action of our Sand Injector aerates the soil to a depth of 12 inches.
4. Our injection slits provide for lateral moevement as well as vertical movement.

The Cambridge System is a one time treatment. It need not be repeated, if you thereafter follow a program of coring, removing the cores, and sand top-dressing to keep the injection slits from becoming sealed over.

If no gravel blanket is present, or if the gravel blanket is not adequately drained, Cambridge can add a system of sub-surface perforated pipes in sand to take care of the deep drainage.

THE SUMMER OF 1980: How to get from July to September in 12 easy months

H. Eugene Maples
Golf Course Superintendent
Pine Needles Country Club
Southern Pines, NC

Bentgrass putting green turf must have everything going for it in order to survive the most adverse summers in good shape. Growing conditions can be quite different from one area to another as can weather conditions from summer to summer.

Individual managers must therefore tailor programs to suit their individual situations. Even though there cannot be one universal program for bentgrass management, it is often helpful to interpret the experience of others to see if any of their experiences and observations can be adapted to improve one's own chances for success.

Consequently, I have been asked to briefly list the main points of my bentgrass management program which proved quite successful this past summer.

It seems to me that if there is a starting point, it would be in September. Soil samples are taken the very first thing so that this information will be at hand early in the management year. I fertilize with a complete fertilizer to provide one pound of nitrogen just before Labor Day. This begins fall growth which allows rapid recovery from any summer damage and the first aeriation which follows immediately. The greens mowers are set down from the summer height of 1/4" to 7/32" just ahead of the aeriating with Ryan Greenaire machines equipped with 1/2" carbide tipped tines. Cores are removed and new F & S topdressing is applied at the rate of 1/8". If any reseeding of summer damage is necessary, it is done in conjunction with this topdressing.

Anytime this amount of sandy topdressing is present on the putting surface, the greens are mowed in the late afternoon when they are dry, since this provides a better quality of cut and is also much less abrasive on the grass and the mowers. Moderate combing with the greens mowers is begun about a week later.

The October schedule consists of another pound of nitrogen early in the month, weekly spiking, and slicing two ways around the end of the month. Another topdressing is provided at about one half the September rate. Monthly applications of iron sulfate at the two ounce rate are made throughout the fall and winter.

Aeriation in late November is performed with the now out-of-production R & R Deep Tine Aeriator and cores are removed. The holes are then swept full of USGA spec sand to aid in drainage the follow summer. This operation requires about 2.5 cubic yards of sand per green which is swept into the holes with a Ryan Greensweep machine with the rear door removed. The sweeper's use prevents the sand from bridging over the hole tops and also continuously lifts the sand out of the turf to prevent an unduely thick layer of sand from remaining on the surface.

The winter months of December, January and February find us simply maintaining acceptable growth and color with periodic spray applications of iron and ammonium nitrate which provide one quarter pound of nitrogen each. Any necessary nutrient adjustments and lime applications are made during the winter also. A pelletized lime product is used on greens as well as aprons and tees because of it's extreme convenience and ease of application.

We prepare to aeriate greens ahead of our spring season during the first warm spell forecast around the first of March. For this aeriation we use a Hahn - West Point fairway aerifier equipped with 3/8" or 1/2" open tines and tine springs. Walked over the greens very slowly, the West Point does a good job with minimum surface disturbance. The subsurface scooping action and unique tine design of this particular machine accomplishes hard-pan break-up at the four to six inch depth that results from continual coreing with one type of aeriator. This aerification is followed immediately by a 1/8" topdressing of E & S material.

As soon as the topdressing is out of the way, the greens mowers are lowered to 3/16" and heavier combing is resumed during the spring period of flush growth. A spiking schedule similiar to that of the fall season is resumed until the last aeriation before summer takes place.

Around mid- April the greens are sliced two ways and topdressed lightly. When soil temperatures approach 55 degrees, bensulide is applied to the greens at a rate of 0.37 pound active ingredient per thousand square feet for goosegrass control.

Also in April, all aprons receive a thorough aerification with a Hahn-West Point pull-behind aerifier equipped with 1/2" open tines and springs. This cultivation is followed by any needed lime application and Ronstar at the rate of 150 pounds per acre. This one application of Ronstar provides excellent four month goosegrass control in this critical area.

Usually by April, rainfall has deminished enough to allow us to dry the greens out as much as possible. Going into the summer, it is often possible to allow the greens to dry out sufficiently to kill poa annua without any adverse effect on the bentgrass.

In mid-May, when the spring flush of growth stops, an application of 1/2 pound slowly available nitrogen is made to encourage some growth into June.

By the end of May, we commence the final greens aeriation before summer. This is done with the Ryan Greensaire machines. Cores are removed and thoroughly cleaned up with the Ryan Greensweep to avoid as much goosegrass seed contamination as possible. If the weather is not too hot, a very light topdressing of E & S material is made.

Soon after this aeriation is completed, an application of Nemacur at the rate of three pounds per thousand square feet is made. Mowing height is raised to 1/4" and combing continues. Raising the mowers early-on allows better goosegrass control by thickening the turf cover.

Early in June we also make the first of two applications of hydrated lime and wetting agent. The rates are one pound and one pint per thousand square feet respectively. This treatment has shown some promise in minimizing localized dry spots that are bound to occur when the greens are irrigated as infrequently as possible.

July is when the sweat of one's brow begins to pay off. We step up the hand watering of drier areas since the greens are not irrigated all over more than three times a week. Sometime in July another hydrated lime and wetting agent application is made after the greens have been sliced two ways. Iron sulfate is applied early in the month along with 1/8 to 1/4 pound of nitrogen to aid in acceptable color retension. Combing with the greens mowers continues throughout the summer, but more lightly as temperatures increase.

Even during very hot summers, we don't find a great need for regular syringing until August. Often times even then, wilting appears more the result of inadequate soil moisture than actual desiccation. This phenomenon helps me gauge the adequacy of my root system in August. We don't take any chances with wilt during the final "tell all" month, however: we normally have two men patroling the course each afternoon prepared to hand syringe any areas that appear to need cooling off.

The exact balance and timing of all these practices is just as variable as the weather but there is no doubt in my mind that much more success can be expected if one can make bentgrass want to grow than simply trying to make it grow.

Naturally some disease and insect pressures will be too great for cultural practices alone to cope with. In such cases, chemical assistance must be used as is the case of the goosegrass problem.

My primary disease concern is the helminthosporium complex. Very little brown patch or dollar spot is ever observed. A spray program that works quite well consists of Chipco 26019 at two ounces followed 14 to 21 days later with Daconil 2787 followed in 7 to 10 days with the Chipco 26019 again.

Pythium prevention is accomplished during the summer with Tersan SP at four ounces with Exalt 800 extender added to the tank at a rate of one pint per 100 gallons of water. The extender appears to provide pythium protection for three to five days longer than the fungicide alone.

The first time the greens are mowed following any fungicide application, the grass catchers are not used on the mowers. The encapsulated leaf tissue is thus allowed to fall down into the turf to provide additional protection.

October to March disease control is accomplished with Acti-Dione/Thiram.

Good thirty day cutworm control in the spring and summer is observed with the granular dursban and diazinon materials.

These then are the primary tricks of the trade as I presently see them for bentgrass putting green management on my golf course. Through constant evaluation of the experiences and obervations of others, just as we are doing here at this conference, I naturally try imaginative new practices and products from time to time. I hope that I have sparked your imaginations with my viewpoint here today as much as you have sparked mine.

CREEK BANK STABILIZATION

Dale S. Blaser
Greensboro Country Club
Greensboro, NC

Creeks have an asthetic value for the golfer and to the golf course. Heavy rains, floods and the general maintenance of these areas are sometimes a difficult challenge to the Superintendent. Constant erosion and enlargement of the channel create problems such as lost balls, expensive trimming, wash around bridges and exposure of irrigation and control lines. When erosion is left unchecked, a creek can become more of a liability than an asset.

Several years ago we looked for solutions to solve our problems of creek bank erosion. Pipe was too expensive and enclosures of some of the creeks would reduce the integrity of the hole. Rip rap, railroad ties, and concrete did not seem appealing to our membership. Gabion baskets brought about a fresh approach to the problem. The word "Gabion" dates back to the Roman era. The Oxford dictionary gives a reference dated 1579 and indicates that "Gabion" is derived from the latin "cavea" meaning a cave.

The Gabion principle is much older than the Roman Era. The Pharohs of Egypt used gabion-like structures to build dikes along the Nile about 5000 B.C. The Chinese used similar structures along the Yellow River 1000 B.C. Military forces have used gabion-like structures since the late 1500's and our own war department describes them in their field manual as early as 1932. The early gabions were woven from plant fiber and were not very durable. They were satisfactory for military fortifications, but required frequent repair in river control programs. Because of their flexibility and ease of construction with locally available materials, the Gabion principle has persisted throughout the centuries.

Gabions are relative newcomers to American construction, but have been installed in their present form in Europe since the late 1800's. Metal Gabions used in modern construction are compartmented, rectangular containers made of hexagonal wire mesh filled with stone. They have portions which are laced together to add strength to the container and help retain its shape during the filling operation. The Gabion construction has been very effective in stabilizing the creek banks at Greensboro Country Club.

The installation of Gabions is simple. A backhoe clears the creek channel and shapes the sides. Workers unfold the metal fabric and shape it into baskets to form the Gabions. These baskets are then placed along the creekbanks and a front-end loader or backhoe is used to scoop up large slag rock and place it into the Gabion compartments. The baskets and compartments are then wired together.

Additional information including pictures and instructions may be obtained from Terra Conservation, 4930 Energy Way, Reno, Nevada 89510, or phone (702) 329-6262.

CLUB GROUNDS BEAUTIFICATION PROJECTS

Mr. John Rosser
Superintendent
Raleigh Country Club
Raleigh, North Carolina

Many superintendents have little experience and training in landscapeing, while their duties often encompass a wide variety of landscape projects. Limited training and experience need not be a significant stumbling block in completing necessary grounds beautification projects. Kim Powell from the Horticulture Department at North Carolina State University was instrumental in providing design ideas for two landscape problems at the Raleigh Country Club.

The first situation involved a steep sloping hill behind the Pro Shop at the Club. This area was difficult to maintain, particularly to mow. Crabgrass had established itself proving to be very unsightly. After discussions with Mr. Powell the decision was made to treat the area with glyphosate for complete plant kill. Approximately one week later a final plant bed was prepared by tilling and raking the area. Junipers, lirope, and various annuals were then planted on the hillside. This solution reduced the maint-requirements of the area while improving its appearance.

A second problem involved the front entrance of the club house. This area was in need of landscaping to increase its aesthetic appeal. Members of the club had expressed their desire to see this location filled with roses and benches. This approach would have been both very expensive and increased the maintenance requirements of the area. A compromised plan was proposed which included the use of river birches, lirope, and junipers. As in the previous example work began with the use of glyphosate followed by tilling and raking the soil. Kim Powell again provided tree placements and other design information. This compromise design cost about half that of the rose and bench proposal. Club members were pleased with the result and maintenance requirements were reduced.

Several similar landscape problem remain to be resolved at our club. However, obtaining ideas and assistance from NCSU and fellow superintendents will help in finding aceptable solutions. Communication with your club members on the details of what will be accomplished is very important in ensuring <u>successful</u> club grounds beatification.

NEMATODE PROBLEMS ON BERMUDAGRASS

Rodney Q. Harris, CGCS
Superintendent
Pine Valley Country Club
Wilmington, NC

Nematodes have been with us for a long time. However, they have been overlooked by some of the best turf managers in the business. The symptoms of a moderate to high population of nematodes would leave the turf in an apparent need for water and nutrients. These symptoms could easily be diagnosed as drought and if treated as such, could show some signs of recovery. However, as time passes the symptoms will probably reoccur. To understand the reason the wrong diagnosis occurs so often, it is imperative to understand the way nematodes attack the root system of turf plants.

Nematodes feed through stylets, sucking plant juices from the root system. This prevents the plant's root system from supplying enough water and nutrients for the plant to survive without showing extreme signs of stress. The higher the population and the longer the condition goes untreated the more severe the signs of stress. A condition that goes untreated will result in a barren soil that will support only certain weeds that are typically unaffected and which also could be an indicator of high nematode population. Spotted spurge has been an indicator for us at Pine Valley Country Club, finding it in most areas of low to moderate high nematode populations. In areas of higher nematode populations, however, we found only soft crabgrass and goosegrass, which are not good indicators.

In a nematode assay it is necessary to gather enough soil that would represent the infested area. The pattern of damage usually starts at a central point and works outward. The outside perimeter is the area that is the most indicative of the problem and should be the area where the samples are taken. As an experiment we took samples from the middle of an infested area and found the populations too low with no sting nematodes reported, while five feet away along the perimeter, another sample reported a population of more than sixty sting nematodes per pint of soil. Since the sting nematode has been determined to be the most damaging to turf, this was a serious infestation. It is also imperative to have a fresh sample that has been kept moist. Shipping such samples in plastic bags is a common practice.

When an area has been determined to have a population of sting nematodes it is advised to treat with a chemical labeled for turf. At Pine Valley we used Nemacur(R) with excellent results. This chemical is very toxic and should be handled with extreme care. Our applicators wore elbow length rubber gloves, rubber boots, disposable coveralls, goggles, and a cartridge type respirator. Even using these precautionary measures

we tried to keep the exposure time under three hours per operator per day. After the application the chemical was watered in for one to two hours. The irrigation man also wore rubber boots and a respirator as a safety precaution. The treated area was closed prior to the application and remained closed for eighteen to twenty-four hours.

The application was made using a Lely HR spreader. A center throw pattern was used, keeping the unit low to the ground and level. The Nemacur(R) application rate for turf is 2.66 lbs. of material per thousand square feet. We found that keeping the feed ring in a closed position would give us between 2.75 and 3 lbs. per thousand square feet. This method was introduced to us by Fred Meda, Superintendent of Myrtle Beach National Golf Club, and saved us a lot of time in the calibration process. Using the feed ring in a closed position meant that we had to control the flow using the PTO control lever (on to start flow and off to stop). This does result in some missed areas or wasted material until the operator learns to operate the spreader in this fashion.

The time of application is also critical and should be applied when populations are high, but in time to allow the grass to recover before the end of the growing season. This time has been determined to be in July and August, but we had good effects in late June and mid to late September as well.

In summary, it is imperative to make the proper diagnosis of the problem as soon as possible. Test the areas you suspect as soon as possible and make your diagnosis only after you have the test results in hand. Pick the most opportune time to treat, close the part of the course to be treated, and use every possible safety measure for the applicator. Water in the material sufficiently and watch the grass respond. Within weeks you should see a greater response to water and fertilizer. A follow-up assay will determine the effectiveness of your program.

SPRING TRANSITION OF OVERSEEDED BERMUDAGRASS GREENS

Paul Baker
NCSU Faculty Club
Raleigh, North Carolina

The greens of the nine hole Faculty Club course were overseeded in October, 1979 with nine blends or mixes. This overseeding was part of the winter overseeding studies conducted by the turfgrass research program at North Carolina State University. Each entry listed in Table 1 was generously supplied by the indicated source.

Table 1. Winter overseeding entries and suppliers for the NCSU Faculty Club Golf Course in 1979.

	Entry	Source
1.	Winter Turf I	O. M. Scott & Sons
2.	Marvelgreen Supreme	Lofts
3.	Marvelgreen Supreme 3 + 1	Lofts
4.	Marvelgreen Supreme + Sabre	Lofts
5.	Medalists 6	Northrup King
6.	Medalist 7	Northrup King
7.	Celebrity	North American Plant Breeders
8.	Celebrity Plus	North American Plant Breeders
9.	Annual Ryegrass	E. J. Smith & Sons

Prior to overseeding the Tifgreen bermudagrass was aerified in July and received an application of Pre-san™ approximately 55 days before seeding. All greens were verticut in two directions three days before seeding. Each of the nine entries were replicated three times and were sown at a rate of 40 pounds per 1000 square feet. The seed was then matted and the greens topdressed with a soil mix to a depth of 1/8 inch.

Mowing at a 1/2 inch cutting height was initiated when the seedlings reached a height of approximately one inch. The cutting height was lowered to 3/8 inch 7 to 14 days after the first mowing. The cutting was maintained at this level for two weeks and then lowered to a height of 1/4 inch until spring.

Fertilization began the last week of October. IBDU™ (20-0-16) was applied at a rate of 1/2 pound of actual nitrogen per 1000 sq ft. Additional fertilizer applications were made at the same rate every 3 to 4 weeks until March.

The first new bermudagrass leaf growth was evident on March 29, 1980. The cultural practices employed after this date so as to encourage bermudagrass growth are listed in Table 2. Once the cutting height was lowered to 5/32 inch it was maintained at that level throughout the summer. After the May 2 fertilization the greens received 1/2 pound of nitrogen (IBDU™) per 1000 sq. ft. every three weeks.

Table 2. Schedule of spring transition cultural practices employed at the NCSU Faculty Club Golf Course in 1980.

Date	Procedure
March 29	New bermudagrass leaf growth present
April 4	Cutting height lower to 7/32 inch
April 17	Verticut (one direction)
April 24	Aerification
April 29	Cutting height lowered to 5/32 inch
May 1	Verticut (two directions)
May 2	Fertilization 1/2 lb N/100 sq ft
May 28	Verticut (two directions)
June 19	Verticut (two directions)
June 20	Verticut (two directions)

The transition from overseeded to bermudagrass greens was nearly completed by the second week in June, with the exception of those areas that were seeded with Sabre Poa trivialis. By the middle of July, all overseeded grasses were gone. However, excellent bermudagrass coverage existed long before this time.

The schedule followed in Table 2 is not a strict time table. Each of these procedures is influenced by environmental conditions. There are as many methods to encourage bermudagrass growth through spring transition as there are superintendents that overseed golf greens each fall. The procedures outlined in this paper resulted in acceptable bermudagrass growth during the spring. While Sabre tended to have a slower transition, these plots also provided some of the best quality greens during the overseeded season.

MANAGEMENT OF A GOLF COURSE CREW

William Anderson
Golf Course Superintendent
Carmel Country Club
Charlotte, N. C.

Carmel is a private, thirty-six hole country club with a membership in excess of one thousand people. We own 360 acres and maintain approximately 250 acres. As golf course superintendent, I am responsible for the entire greens and grounds operation. This includes both golf courses, the clubhouse area, and the green areas around the tennis courts. My staff consists of: 1 assistant, 2 foremen (one for each course), 1 shop foreman, 1 mechanic, 4 crew chiefs, 5-10 laborers, 1 security guard, 1 clubhouse gardner, and 2 night watermen (during the summer months).

What is Management? The definition I like best is: "Getting the job done through others." This sounds extremely simple, but in fact it is the number one reason for success or failure among golf course superintendents and managers in general. Technical expertise is not as important for a manager as is being proficient at dealing with people. A manager's first responsibility is to supply all the necessary materials for employees to do their jobs. These materials may include training, information, direction and supervision, as well as tools, machines, and physical materials they will need. In order to efficiently supply these essential needs I follow five systematic functions of management.

I. Planning

Planning is performed on many levels. At Carmel, we have a five-year long range program which is brought up to date annually. This program is further broken down into yearly objectives, monthly goals, and weekly and daily "things to do" lists. Do you plan far enough ahead? One must plan ahead to be successful in these times of ever changing conditions.

II. Organizing

A well organized manager must first set his work standards, and then set an example of these standards for his employees. I personally write down everything of any importance. I use two clip boards to help me stay organized on a daily basis. The first clip board holds a "Things to do" list. This is merely a list of tasks that need to be accomplished during the day or week. The second clip board holds an assignment sheet with each employee's name on it. We have a rather large crew at Carmel and quite a varied work schedule from day to day. These two clip boards allow me to easily keep on top of all work being done and to effectively plan for future assignments.

Your office should be a very well organized work place. An up-to-date filing system with accurate and complete records on all aspects of your operation is essential for an efficient operation. All the work areas of your shop should have set standards for cleanliness and organization and a scheduled clean-up program. Employees should be encouraged

to become better organized through crew meetings, posted work schedules, and by providing the necessary tools, equipment, and materials for each work project.

I am fortunate to have a highly qualified crew. Most have prior golf course experience, and many have some type of post-high school education. This situation presents some special problems which must be dealt with. All of my employees are very competitive and highly motivated. They are also probably more expensive to keep on the job than the average golf course worker. I find it necessary to continuously provide opportunities for advancement within the organization. We provide regularly scheduled educational sessions for all employees, and when possible, we take them to professional seminars and turf conferences. We also try to follow a progressive management policy by encouraging participation in management, through expression of ideas and personal feed-back.

In order to find and retain good, high quality employees, we must provide a good benefits package. These benefits include:

Wages -- must be competitive with local market
-- must provide equal pay for equal positions
--provide for a pay review every six months

Insurance -- hospitalization and major medical plan
-- life insurance plan
-- pension plan

Holidays -- five paid holidays per year

Vacation -- one week's paid vacation after one year's service
-- two week's after two year's service

Sick Pay -- five paid sick days per year

Bonuses -- generous Christmas bonus plan

Uniforms -- clean uniform supplied daily

Parties -- crew parties given throughout year after major events

Golf Privileges and Outings -- golf privileges provided on Mondays and and several golf outings are provided throughout year

Recreation -- basketball, horseshoes, and ping-pong are provided for recreation during lunch and breaks

A good manager must know his employees. He must feel their pulse beat daily, and be available on an informal basis for them to discuss whatever problems, needs, or ideas they might have on their minds. When a problem does arise with an employee and a reprimand is in order, be sure it is done in private, after the heat of the disagreement has cooled. Avoid making rash decisions.

III. Coordinating

After you have planned your project, and organized your ideas, the next step is coordination. All of your ideas must be coordinated with your materials, your manpower, and the time available so that the finished product will be the same as the original goals. If everything is coordinated properly, your project and organization will operate smoothly. It is therefore a good idea to train your employees to work together as a team; to coordinate their efforts to achieve a common goal.

IV. Directing

I try to direct through delegation as much as possible. Direction is passed through the chain of command (i.e., Supt. -- Asst. Supt. --

Foreman -- Crew Chief -- Laborer, etc.). Make sure each task is UNDERSTOOD, SUPERVISED, ACCOMPLISHED.

V. Controlling

Controlling is a process of continuous evaluation. It is a constant comparison between what you have and what you want. Make use of deadlines, they encourage efficient work. Don't be afraid to make sound and timely decisions. Always have a "ready to go" back-up plan.

Summary

Good management practices are the key to success. It is not easy to be a good manager. Much work and thought are required. Indeed, personnel management can be the most frustrating, and yet the most rewarding part of our job as Golf Course Superintendents.

MANAGEMENT PROBLEMS FOR LAWNS IN THE TRANSITION ZONE

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The transition zone, as defined by turfgrass authorities, is that geographical area where warm season turfgrasses grow poorly due to cold winters and cool season grasses are poorly adapted to extreme summer heat. North Carolina is situated squarely in the transition zone and turf management decisions made on home lawns have dramatic effects here.

The effect of temperature extremes on grass types, whether warm season or cool season, is the same: the grass stops growing actively. Actively growing grass can tolerate comparatively higher levels of weed invasion, disease infection, insect infestation, and poor cultural procedures than dormant or semi-dormant turf. This is because grass blades affected by these problems are rapidly replaced by healthy new shoots, thus masking many problems from view. Examples of this phenomenon abound. Dollar-spot can disfigure a sward of bermudagrass turf after green-up but before it begins rapid growth. The arrival of warm weather accelerates growth and the plant frequently "grows out" of the disease. Similarly, a cool season turf can tolerate injury from scalping better in the fall than in the summer.

Since North Carolina lawns are predominantly cool season (tall fescue), no mention will be made here of warm season management problems. Because fescue is the principal lawngrass of the Piedmont area, disease and insect problems are, with a couple of exceptions, minor problems. This is true, however, only if the turf is fertilized, watered and mown properly. A proper fertility program heavily emphasizes fall nitrogen and de-emphasizes spring nitrogen. Nitrogen usage in summer is usually a waste of time. Lawns that receive heavy spring nitrogen applications almost certainly perform poorly in summer. The cause is twofold. First, the excessive top growth produced occurs at the expense of the roots and a deep root system is vital to summer survival. Second, homeowners can rarely keep their lawn mowed during the normal spring growth flush. With additional nitrogen, growth accelerates and "scalping" probability increases. Scalping weakens an already depleted root system.

Even with a proper fertility regime, problems arise usually in the hot summer. Tall fescue is remarkably free of serious pest problems compared to bluegrass, for example. Fall armyworms and brownpatch, however, are two mortal enemies. The way fescue is fertilized, watered and mown can play an important role in survival of these pest attacks, and can also determine whether the pests attack in the first place. Excessive spring nitrogen helps produce a plant very high in sugars that each pest thrives on. An abundance of free moisture and the right temperatures permit rapid build-up of the brownpatch fungus. Also, while brown lawns from drought may not be desirable, fall armyworms are not nearly as attracted to them as a nice, green, well-watered lawn. A balance must be struck

between supplying enough water for plant needs without creating problems. Follow two cardinal rules. First, water when the lawn needs it. Look for footprinting or probe the soil to determine soil moisture levels. If possible, morning watering which permits the turf to dry out with the morning sun, is best. Second, water heavily. In the clay soils of the Piedmont, two hours of watering is typically required to wet the soil to a depth of 6". Light frequent waterings do more harm than good since they encourage shallow rooting.

Finally, mowing frequency should be dictated by the turf needs. Two of the biggest problems encountered in home lawns are mowing too infrequently in the spring, thus scalping the turf, and mowing drought-stressed turf in summer, which can kill it. Both proper height (3" for tall fescue) and proper frequency (don't mow off more than one-third of the existing blade) are critical to good mowing.

In summary, extreme summer heat leads to inevitable problems for tall fescue in the transition zone. A proper fertility program combined with thoughtful mowing and watering can minimize many of these problems.

SELECTING AND PLANTING OF ORNAMENTAL PLANTS

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LOW MAINTENANCE PLANTS

The use of "low maintenance" plants is a popular trend among landscape architects, contractors and home gardeners. With increasing costs of labor and equipment and more stringent pesticide restrictions the use of plant material which demands less attention in order to grow and mature into a specimen planting is being emphasized. Practically all plants require some attention, so "No maintenance plants" is not a feasible goal. Superintendents should make it a top priority to choose plants which require little maintenance.

North Carolina offers a real challenge in choosing plants that adapt to the soils and climate and resist insects and diseases. Urban conditions and pollution pose obvious problems to plants. Street trees and plants grown in confined planting pits have to be extremely tolerant in order to survive. Low maintenance plants are also defined as ones which require minimum pruning and shaping.

An excellent example of the use of low maintenance plants is exhibited along our major highways and interstates where the use of wildflowers, native trees and shrubs are used in large areas. The planted areas are aesthetically pleasing and maintained with a minimum effort by maintenance crews.

Landscapes often include 'foundation' plantings which noramlly require pruning and shaping, mulching and applications of insecticides and fertilizers. These plantings are extremely high maintenance and when neglected become quickly overgrown and unsightly. The low maintenance approach to plantings is the use of native trees, small ornamental trees and groundcovers, and only a few shrubs grouped as a focal point.

The greatest diversity of low maintenance plants is offered by trees. Both native and exotic trees can be found in nursery and garden centers with numerous choices for any particular landscape situation. Excellent choices of native trees would be Redbud, Dogwood, Silverbell, Magnolia, Holly, Mountain Ash, Bald Cypress, and Sourwood. Numerous varieties of native oaks, pines and maples are also depended upon for shade trees. Bradford Pear, Zelkova, Leyland Cypress, Crape Myrtle, Japanese Maple, Ginko and Pistache are desirable exotic trees.

Many native woody ornamentals are used extensively in low maintenance plantings. These would include native Azaleas, Waxmyrtle, Hollies, and Mountain laurel. Other hardy landscape plants would include Abelia, Nandina, Cotoneaster, Cleyera, Osmanthus, and several Vibernum and Juniper cultivars.

NATURAL AREAS

Design elements for today's landscapes might include the use of small ornamental trees underplanted with groundcovers; raised beds and container plantings; a multiplicity of arrangements for railroad ties; decks, patios and terraces; and natural areas with free-flowing boundries.

These design elements satisfy the needs for focal points, functional living spaces, and low maintenance areas. Recently a popular project for the golf course superintendent is the reduction of turf area, and problem areas by incorporating the "natural area".

When designing this area, the existing trees should influence the design. Don't be stingy with the mulch and make the area too small, by cutting the boundries too close to the tree trunks. Incorporate at least half of the drip-line area on large trees and all of this space on smaller trees... After all, if you're naturalizing an area because of a poor stand of grass under the trees, its primarily because of too much shade... therefore, a general rule to remember is to include all areas that receive 50% shade at all times.

"Free flowing" curves can be easily overused in these projects. Try not to create boundries that project to abruptly, as these will not appear natural and also create hard to maintain areas.

Before spreading the mulch try to get rid of all bermudagrass, broadleaf weeds, fescue and nutgrass. It's true a 3-4" layer of mulch will control weeds -- but not by just piling it on top. Identify the weeds and eradicate physically or chemically. Several herbicides are labeled for home use for most weeds. Dowpon, Roundup, or Varsol (depending on the size area you are working with) are readily available without a pesticide license. Be sure to observe label directions and avoid drifts by applying at low pressure.

Now to decide on the type mulch to use. Again the trees are an influencing factor. Under pine trees mulch with a 2-3" layer of pine straw. Under hardwoods and small ornamentals you might consider a 2-4" layer of decayed bark. This is readily available at many landscape nurseries or large sawmill operations. Other recommended organic matter would be decayed sawdust, compost, leaves, grass clippings, etc. Again, the good part about these natural areas is that when the needles and leaves fall it adds to the mulch and compliments the area with little maintenance time.

BLACK PLASTIC

Black plastic is used as a mulch - usually in conjunction with some type organic matter. There are several advantages and disadvantages when using plastic. Most weeds will not come through the plastic. The plastic might be pushed up a bit, but the weeds will eventually die. Black plastic helps prevent crusting of soil and leaching of nutrients by rainfall. Plastic lasts from 3-5 years before needing to be replaced and also helps retain moisture in the soil.

The plastic is made in strips that can be rolled out and walked on with flat-heeled shoes. It should be weighed down with soil at about 5' intervals to keep from blowing. Don't try to plant trees and shrubs and pull the plastic up to the plants. The idea is to spread plastic then plant through it. The plants can be set through slits cut in the plastic.

There are a few disadvantages when mulching with plastic. If a slope is to be mulched the plastic is not recommended as the organic matter on top can be easily blown or washed off. If you are mulching over bermuda or nutgrass - get it out first. Otherwise the bermuda-grass will find its way to the planting slits and grow out and the nutgrass can puncture the plastic as it grows. Sometimes in hot weather the heat buildup near newly planted shrubs can be excessive. Plants with black plastic around them generally have a very shallow root system. There is not a good oxygen exchange and water does not penetrate to a normal root zone. Unless specifically desired, it is recommended not to use black plastic as a mulch.

BEDDING PLANTS

A favorite landscape idea for brilliant splashes of color is the use of bedding plants. As a rule, annuals are used for these areas and with careful planning and consideration they will go on a blooming spree from early May up until the first frost, a popular time at most golf courses.

Just as planning any landscape project, thought has to be given to size, texture, form and especially color. In deciding which plants you can use in the flowerbed, be sure all the plants share the same light requirements. This is probably the most important cultural factor. Group together those plants that require full sun at least 6 hours a day, and another list of plants for partial shade and full shade. Be sure to arrange plants in the beds where the tallest plants are in the background, and lower plants out front.

Often there is a problem of locating the flower bed to coincide with other landscape features. Instead of tilling up an area in the middle of the turf to plant flowers or just planting them in front of foundation plantings or around a tree, think in terms of a raised bed with a permanent border or even containers or planters to be placed on the deck or patio. A popular and rather simple design could include railroad crossties to construct a raised bed for your favorite annuals. The area will be more distinctive when it is separated from the lawn or other shrubs. Maintenance time should also be lowered as this edging will contain any vigorous, spreading plants, and facilitate mowing grass around the bed.

List of favorite bedding plants:

PLANT	EXPOSURE	PLANT	EXPOSURE
Wax Begonia	partial shade	Marigold	sun
Cockscomb	sun	Petunia	sun
Geranium	light shade	Scarlet Sage	sun
Impatiens	partial shade	Snapdragon	sun - part shade
Madagascar perwinkle	sun	Zinnias	sun

After you've designed the flower beds, decide on the varieties and construct the edging, the next step is the soil preparation. The soil mix should include loamy, porous soil with plenty of organic matter. To improve aeration and drainage add course sand. (Raised beds should not have any drainage problems.) The organic matter could be peat moss, leaf mold or compost, manure or decayed sawdust. Till the soil mix to a depth of 6-8 inches.

The general planting time is May 1. For a fast start purchase young plants and transplant them. Usually geraniums and petunias are transplanted. You can also plant seed about this time. Favorites started from seed are marigolds and zinnias.

Maintenance usually means watering weed control and fertilizing. When watering bedding plants during our typical summer dry spells, try to soak the soil about once every 6-8 days. A soaker hose comes in rather handy and is preferable to a sprinkler as soil and water are not splashed on the foliage and blooms. The general monthly recommendation for fertilizer during the growing season is 3 tablespoons of 10-10-10 per square yard of planting area. Weed control in the bed can be greatly achieved by a 3" layer of mulch, around the base of the plants. Usually bedding plants will cast a heavy shade on the soil and restrict many weeds. Insects and diseases of bedding plants are also possible and probable with the hot and humid growing conditions.

SPACING

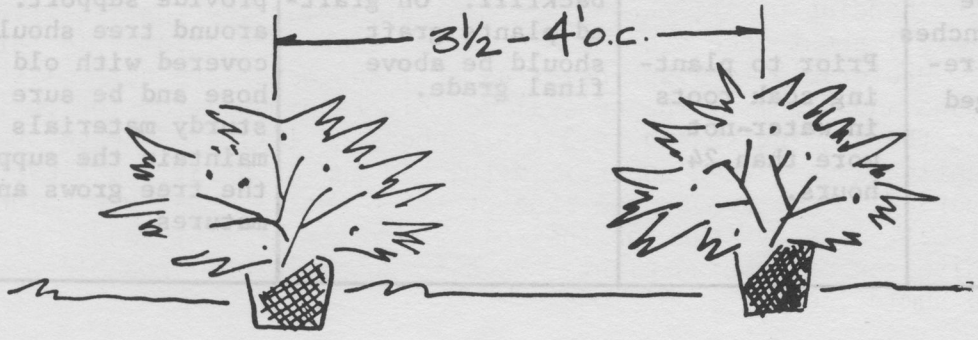
With the vast array of plant material now available to the gardener one often finds it difficult to know how far plants should be spaced from one another or the distances to plant from a wall or walk. With numerous plant varieties each having a specific natural form, size, and growth rate the problem is often compounded. The overall design should determine the type of plant needed and define the function of that plant. For example, if a hedge of photinia glabra were needed to screen an unsightly view the plants should be spaced 3-4' o.c.* If photinia glabra were used as accent plants the spacing could be 6-8' o.c. The same is true for the selection and spacing of all plants from shade trees to groundcovers.

When gardeners visit the nursery or garden center to buy plants, two questions should be asked -- 'How large does the plant grow and how fast does it grow?' Answers to these questions should aid in the choice of plant materials and save much time, effort and money in future maintenance costs.

Listed are popular landscape plants and spacing suggestions.

COMMON NAME	SPACING	COMMON NAME	SPACING
Dwarf Chinese holly	3½'-4' o.c.	Glossy abelia	5'-6' o.c.
Dwarf yaupon holly	"	Oakleaf hydrangea	"
Helleri holly	"	Photinia glabra	6'-8'
Nandina	"	Pittosporum	"
Azalea (Kurume)	"	Pfitzer juniper	"
Leather leaf mahonia	"	Podocarpus	"
Bar Harbor juniper	4'-5'	Camellia japonica	8'-10'
Andorra juniper	"	Burford Holly	"
Blue rug uniper	"	American Holly	"
Sasanqua	5'-6'	Crape Myrtle	"
Ligustrum	"	Saucer Magnolia	"
Cleyera	"	Cherry Laurel	"

*The overall design will have the most influence on the choice and spacing of certain plant material. O.C. "on-center" - measured from the center of one plant to the center of the next plant, or from the center of the plant to a walk, fence, or wall.

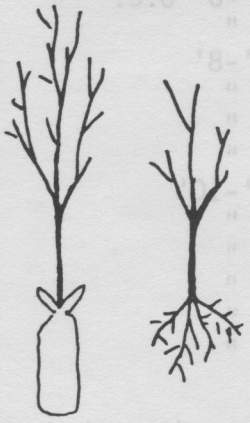


PLANTING

Early spring is an excellent time to plant and transplant trees and shrubs. One of the factors contributing to the survival and growth of the plant is to plant correctly. When buying plants from a nursery, garden center or ordering from catalogs there are several methods of root handing. Each requires the recommended treatment.

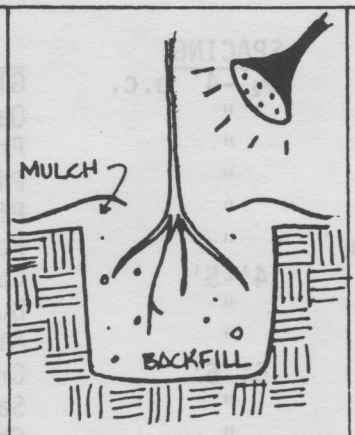
HOW TO PLANT...

bare root plants

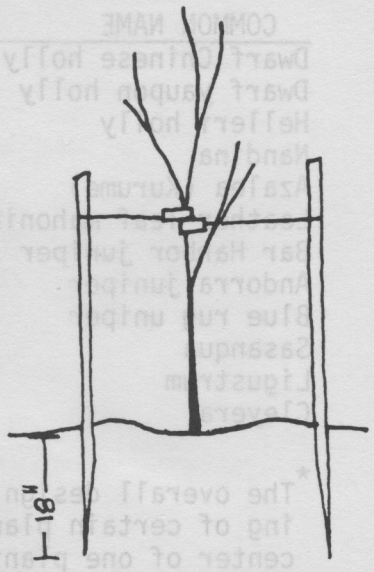


Remove all plastic bags, wires, strings and packing material. Prune to remove 1/3 of top branches Be certain to remove all damaged roots.

Prior to planting soak roots in water-not more than 24 hours.

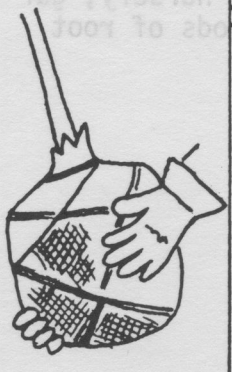


Prepare planting site before removing plant from water. When planting, spread roots well and plant on mound of good top soil. Water as you backfill. On grafted plants graft should be above final grade.

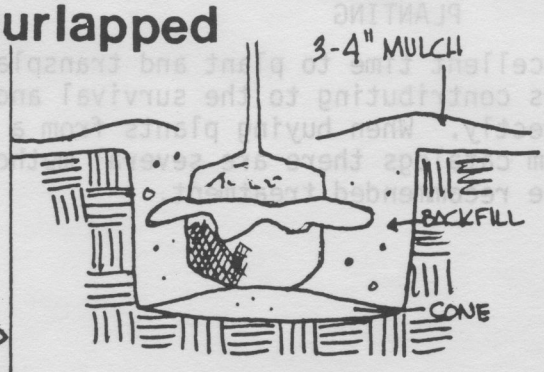


There are many ways to stake a tree in order to provide support. Wire around tree should be covered with old garden hose and be sure to use sturdy materials and maintain the supports as the tree grows and matures.

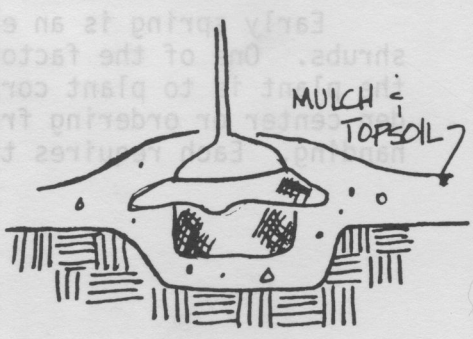
balled & burlapped



Handle carefully Do not carry by trunk.



Dig a hole twice the size of soil ball. If needed, add organic matter. Several inches of topsoil in base of hole. Remove strings, wire and fold burlap back. Cover with topsoil and mulch.



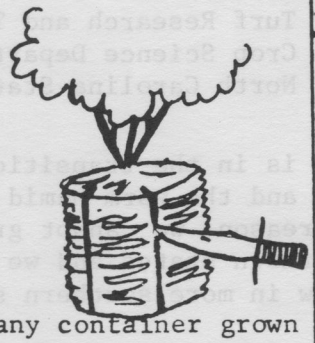
Many soils in NC have poor drainage and plants must be mounded up - above the original grade. Use topsoil and mulch as backfill around plants.

container grown plants

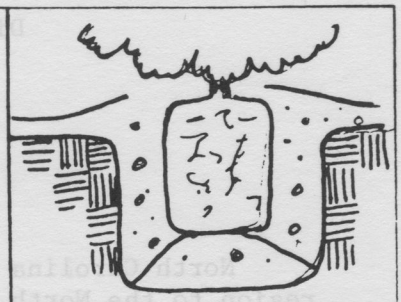
Handle plants carefully. Carry by container not by plant.

Metal containers need to be cut and folded back for easy removal of root system. Plastic containers are easy to remove

NOTE: Never plant the container with the plant!



Many container grown plants become pot-bound. USE A KNIFE TO CUT ON 3-4 sides to free tightly bound roots.



When soils are poorly drained-again mound up. This is especially true for azaleas, rhododendrons and camellias. Use plenty of mulch around plants AND THOROUGHLY WATER.

Diversity of Lawns in North Carolina

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North Carolina is in the transition zone (between the cool-humid region to the North and the warm-humid region to the South) for turfgrasses. For this reason, we cannot grow cool-season grasses as well as they grow in northern states and we cannot grow warm-season grasses as well as they grow in more southern states.

However, if we take a positive attitude to this situation, we realize we have the opportunity to select from both types of grasses and are not so limited in our choice. Warm-season grasses grow well in summer but are brown in winter, while cool-season grasses stay reasonably green in winter but usually go somewhat dormant during the summer.

Which grass you select depends mainly on where you live in the state. In the Mountains and western Piedmont, the cool-season grasses will give the best permanent, year-round lawn even though some of the warm-season grasses will grow in the area.

Most of the Piedmont is really the transition zone. Here the choice of warm-season versus cool-season grass depends more nearly on which side of the zone is involved, whether your site is sunny or shady, and your personal likes or dislikes.

In the Coastal Plain and Tidewater, a warm-season grass is most likely the best choice, especially on sandy soils which tend to dry out easily.

The question of the best turfgrass for a given purpose can be answered if we know the limitations of the grasses under consideration, where the turf is to be grown, and the desired appearance.

The perfect turfgrass has not been produced and all have good and bad features. We must understand the characteristics of each grass, decide what is required in the turf to be planted and then choose the variety that most nearly meets these requirements.

The following tables will be of aid in choosing the proper grass.

Table 1

HIGH TEMPERATURE TOLERANCE

ZOYSIA
BAHIA
IMPROVED BERMUDAS
COMMON BERMUDA
CENTIPEDE
ST. AUGUSTINE
CARPET
Tall fescue
Dichondra
Kentucky bluegrass
Red fescue
Ryegrass
Bentgrass

This is a measure of the ability of the grass to survive and make a good appearance under high temperature. Table 1 rates the grasses with respect to this ability.

We have to make one very great assumption at the beginning. Namely, that insects, diseases and nematodes are controlled and other management requirements are properly carried out.

The summer temperatures automatically put the southern grasses (large type) on top and northern cool season grasses (small type) on the bottom of this list. Hot weather and especially high humidity result in conditions favorable for diseases that are disastrous to the cool season grasses. Data are available that prove the warm-season grasses grow at a maximum rate when the temperatures are between 80 and 100 degrees F. In contrast, the cool-season grasses do best when temperatures are between 60 and 80 degrees F. A grass has maximum resistance to disease when temperatures are optimum for growth. This partially explains why our overseeded winter grasses begin to die in May and June.

The other extreme of temperature is equally as important, namely, cool temperature tolerance.

Table 2

COOL TEMPERATURE TOLERANCE

Kentucky bluegrass
Bentgrass
Red fescue
Tall fescue
Ryegrass
Dichondra
BAHIA
ST. AUGUSTINE
ZOYSIA
IMPROVED BERMUDAS
CARPET
COMMON BERMUDA
CENTIPEDE

Table 2 completes the weather picture as far as the warm and cool season grasses are concerned.

When we line up the grasses according to their cool temperature tolerance (winter color), we see a complete reversal of the previous table. Some of the grasses change order slightly but the warm- and cool-season grasses remain together. We know that we can successfully grow in any section of North Carolina all of the grasses listed at the top of Table 2 from September through June and year-round in the cooler areas. During part of this season, the warm-season grasses turn brown or have their leaves killed bo frost. In the middle and eastern part of the state, those who want a green turf all year take advantage of the difference between cool- and warm-season grasses and use a system of overseeding the warm-season grass with a cool-season grass, such as is done on bermudagrass golf greens.

Table 3

SHADE TOLERANCE

BAHIA
ST. AUGUSTINE
CARPET
Tall fescue
Kentucky bluegrass
Red fescue
ZOYSIA
CENTIPEDE
Dichondra
Bentgrass
Ryegrass
IMPROVED BERMUDAS
COMMON BERMUDA

The next most important consideration is shade tolerance. Table 3 ranks the grasses according to their relative shade tolerance. Many home owners, parks, and cemeteries are faced with trying to produce turf in sunny areas. In areas of heavy shade, selection of a grass tolerant to shade is a must. No level of maintenance can establish and produce a good bermuda turf under moderately heavy shade.

In dense shade, grass growth is limited and other plants for ground cover should be used. Many grasses can exist on a fraction of full sunlight. Usually it is a lack of fertility, or a combination of infertility and lack of moisture under trees, rather than shade, that limits growth of grass.

Table 4

SALINITY TOLERANCE

BAHIA
ST. AUGUSTINE
ZOYSIA
CARPET
CENTIPEDE
IMPROVED BERMUDAS
COMMON BERMUDA
Tall fescue
Creeping bent
Ryegrass
Red fescue
Kentucky bluegrass
Colonial bent
Dichondra

In many areas of North Carolina and other states having long coast lines, the problem of selecting a grass that is tolerant of high levels of salt becomes the most important consideration. Table 4 ranks the grasses in descending order of their salt tolerance. St. Augustine is quite salt tolerant and will grow very close to salt water providing ample fresh water is applied. This grass will tolerate a fair amount of salt in the irrigation water. The proper use of water containing dissolved salts is very important. It is a must to apply more salty water than would be required if fresh water were being used. Ample water must be applied at each irrigation to flush out accumulated salts in the upper profile of the soil. If light frequent watering is practiced, the movement is upward in the soil. As the moisture evaporates and is transpired through the leaves, the salts are left on or near the surface. In a short time, they accumulate to a level that is damaging to the turf. There is a tremendous difference between grasses in regard to salt tolerance. Tifgreen (328) bermudagrass planted on an airstrip on one of the Outer Banks has survived flooding with sea water for several years. The top growth is killed as if by frost, but the salt is leached out by rain before the roots and rhizomes are killed. Centipede and carept grass have a very low tolerance to salty irrigation water.

Table 5

DROUGHT TOLERANCE

BAHIA
ST. AUGUSTINE
IMPROVED BERMUDAS
COMMON BERMUDA
Tall fescue
Red fescue
CENTIPEDE
Kentucky bluegrass
Ryegrass
ST. AUGUSTINE
Colonial bentgrass
Dichondra
Creeping bentgrass
CARPET

The rating of the grasses according to drought tolerance is very difficult. So many other factors have to be considered, such as depth of rooting, type of soil, presence of nematodes that restrict roots, temperature, humidity and many others.

Table 5 is an attempt and is based on observations from plot work and larger areas. The bahiagrasses are in a class alone if left unmowed. However, when close mowing is maintained on the bahiagrasses, they begin to wilt within one day following the wilting of centipede and bermuda grasses. Close mowing restricts the root system and consequently the depth from which the grass can draw water.

Table 6

TOLERANCE OF CLOSE CLIPPING

IMPROVED BERMUDAS
COMMON BERMUDA
Creeping bentgrass
Colonial bentgrass
ZOYSIA
CENTIPEDE
ST. AUGUSTINE
CARPET
Dichondra
Tall fescue
Red fescue
Ryegrass
Kentucky bluegrass
BAHIA

We have established that close clipping restricts the root system and as a result, the performance of the grass is affected. Some grasses can withstand close clipping better than others. Table 6 ranks the grasses in order of their tolerance to close clipping.

Two important facts are tied in with the tolerance of a grass to close clipping. First, upright or bunch type grasses usually do not withstand close clippings. This type of grass is usually taller growing and the leaves and stems grow upright and repeated close clipping reduces the photosynthetic area drastically and the vigor accordingly. The creeping grasses, such as the bermudas, grow horizontally and send up mostly leaves vertically. Repeated mowing of the creeping grass removes parts of the blades each time and not main stems, consequently, the creeping grasses withstand closer, more frequent mowing.

Secondly, grasses with thin short blades withstand closer clipping because less of the blades are removed each time. Vigor of the grass is also important. A fast growing grass appears to be more tolerant to close clipping provided the frequency between mowing is short. Failure to mow grass frequently enough results in scalping and severe injury to grass.

Table 7

WEAR RESISTANCE

ZOYSIA
IMPROVED BERMUDAS
Tall fescue
COMMON BERMUDA
Bahia
Ryegrass
Kentucky bluegrass
Red fescue
ST. AUGUSTINE
CENTIPEDE
CARPET
Bentgrasses
Dichondra

Certain areas in play fields and parks receive an undue amount of wear and selection of a grass for wear tolerance is important. Zoysia-grass, once established, has a tremendous wear resistance. However, once this grass is worn thin, it is extremely slow to recover.

Table 8

DISEASE TOLERANCE

Tall fescue
ZOYSIA (Meyer)
BAHIA
IMPROVED BERMUDAS
COMMON BERMUDA
Ryegrass
CARPET
St. Augustine
CENTIPEDE
ZOYSIA (Emerald)
Kentucky bluegrass
Red fescue
Dichondra
Bentgrasses

Some grasses naturally have more disease resistance than others. Breeders are looking for strains that have greater disease resistance and look for this trait in selecting superior strains. Fortunately, most of our grasses were not given to us by breeders and survived naturally through natural selection. No grass is immune to all diseases; however, some are resistant or immune to one or more diseases.

The breeder may release a new variety of grass that is not immune to disease because other desirable traits more than make up for the lack of disease tolerance. Disease control methods and materials are much better now than a few years ago and we can better cope with disease problems.

When all of the other things have been taken into consideration, the last concern is the nitrogen fertility requirements. Table 9 lists the grasses.

Table 9

NITROGEN REQUIREMENTS

	Lbs/M^2
IMPROVED BERMUDAS	8-24
COMMON BERMUDA	8-16
Creeping bentgrass	4-12
Dichondra	2-6
Ryegrass	2-4
Kentucky bluegrass	2-4
Tall fescue	2-4
ST. AUGUSTINE	2-4
ZOYSIA	2-4
Red fescue	1-3
CARPET	1-3
CENTIPEDE	1-3
BAHIA	1-3

The nitrogen requirements should be a minor consideration because the cost of nitrogen under extremely high fertilization (20-25 pounds of N per 1000 sq. ft. as on T328 bermuda greens) is moderate to total maintenance costs. Requirements for lawns, parks, and playfields are much lower than this.

The grasses in the lists may change order slightly when more is learned about them. Their relative positions may change from one location in the state to another as the climate and other conditions vary. However, their general location is not likely to change in respect to high, low, or intermediate on the list. These conditions must be evalated before the best grass selection for a particular area can be made.

DIAGNOSING INSECT PROBLEMS IN HOME LAWNS

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Many insects and other small animals live in lawns and turf, but fortunately only a few cause enough damage to require control measures. The following are commonly found in North Carolina and may injure or disfigure home lawns or other turf areas.

I. Soil Pests - Those Infesting Soil and Attacking Below Surface Stems and Roots

A. Grubs - Grubs are the larvae of several species of beetles (green June beetle, May beetle, Japanese beetle, southern masked chafer, whitefringed beetle, etc.). Some grubs remain in the soil for as long as 3 years burrowing and feeding on the roots of grass. However, the most important grubs infesting turf in North Carolina have a one-year life cycle. Moles, skunks and birds feed on grubs and often damage turf searching for them. Heavy grub infestations can destroy grass roots, causing the area to become "springy" and allowing the mat of turf to be rolled back like a carpet. Certain species of grubs emerge from the soil and crawl on the surface of the ground. Larvae of the green June beetle may be identified by the unusual habit of crawling on their backs. Grubs may become numerous and cause severe damage to lawns and other turf areas.

B. Ants - Ants build nests in the ground. They are particularly troublesome in lawns and recreational areas. The anthills and mounds often smother the surrounding grass. If ants nest about the roots of grass, they may destroy it. They also destroy grass seeds in the ground, which may prevent good stands of reseeding grasses.

C. Mole Crickets - Mole crickets are light-brown crickets about 1 1/2 inches long with short, stout forelegs and shovel-like feet. They feed on the roots of grass. Their burrowing also uproots seedlings and causes soil to dry out quickly. One mole cricket can damage several yards of a newly seeded area in a single night.

D. Bees and Wasps - There are several species of bees and wasps that occasionally damage lawns by digging up the soil, making holes or forming mounds. Some of these are the wild bees, cicada killer wasps and scoliids.

E. Billbugs - The grubs of billbugs feed on the roots and burrow in stems of certain grasses, especially Meyer Zoysia. Adults feed on stems and leaves. Severe damage may occur if heavy populations of this pest are present.

F. Burrowing Sod Webworms - A burrowing sod webworm occasionally attacks lawns in North Carolina. This larva makes a hole about the size of a pencil a foot or more deep. The larva comes to the surface at night and forms a web while feeding. Heavy populations are very damaging to tall fescue during periods of extended drought.

G. Ground Pearls - These small scale insects resemble a miniature pearl. They attack the roots of grasses, especially centipede, causing an unhealthy, unthrifty condition. Good management practices are essential since effective chemical controls are unavailable.

II. Above-Ground Pests - Those Feeding on Leaves and Stems

A. Sod Webworms - There are several species of sod webworms, the larvae of "lawn moths" that attack grass in North Carolina. The adult moths fold their wings closely about their bodies while at rest and hide in shrubbery or other sheltered spots during the day. In early evening, they fly over the grass and the female scatters her eggs. The larvae feed at night living in a protected silken web formed about their bodies. The larvae cut off blades of grass and eat them. Damage often occurs in small patches. Sod webworms feed as soon as they hatch. As they grow larger, they build burrows or tunnels near the surface of the soil to hide in. Sod webworms prefer newly established, well-managed turfgrass. Insecticide treatments should be started immediately after damage is noticed. This pest is most troublesome in summer and early fall.

B. Armyworms and Cutworms - The armyworm, fall armyworm and several kinds of cutworms feed on lawn grasses. All common lawn grasses may be attacked and, if damage occurs during hot, dry periods, the grass may be killed. These insects hide in the soil, in thatch or at the base of plants during the day and feed at night. Fall armyworms usually attack grasses from early summer to fall.

C. Chinch Bugs - This small 1/6-inch long insect with black and white markings is a severe pest of St. Augustine grass in North Carolina. It will attack other grasses, including centipede in the absence of St. Augustine. Damage first appears as yellowish spots in lawns, which rapidly turn into brown, dead areas. Most damage is caused by the young, bright red nymphs.

D. Grasshoppers - Grasshoppers are usually not pests of well-kept lawns except when the insects are very numerous and other foliage is extremely scarce during a drought. Control measures are seldom necessary.

E. Leafhoppers and Spittlebugs - Many species of leafhoppers suck the sap from leaves and stems of grass. New lawns may be seriously damaged so that reseeding is necessary. Spittlebugs attack clovers and grasses. They suck juices from leaves and stems, especially in areas with dense growth and heavy mats of thatch. The spittlebug nymphs live within a mass of white froth or "spittle," which is found on the plants. Control measures are seldom necessary.

F. Scale Insects - Several different scale insects attack grasses. Some of these are Bermudagrass scale, Rhodesgrass scale, and ground pearls discussed earlier. Grass attacked by scales becomes yellow, then brown and finally dies. Damage is more severe in dry periods.

G. Mites - Little information is available on the mites infesting grass in North Carolina, but in other states, some species are pests on Bermudagrass.

III. Miscellaneous Pests - Those Inhabiting Lawns and Turf But Not Damaging Turfgrass

A. Earwigs - These insects are 3/4 inch long, reddish brown and have a prominent pair of forceps on their tail end. They are occasionally found on lawns especially in grass clippings. Earwigs sometimes invade homes, thus becoming household pests.

B. Slugs and Snails - These pests may move about on lawns and damage flowers and potted plants. They also leave mucous trails on plants and sidewalks.

C. Millipedes and Centipedes - Millipedes (thousand-legged worms) and centipedes (hundred-legged worms) are dark brown with many body segments. Most of them curl up when disturbed. They do not damage lawns, however, they occasionally congregate in yards after heavy rains and migrate into houses. Decaying vegetable matter is their main food.

D. Sowbugs and Pillbugs - Damp areas under stones, boards, dead leaves, or in basements are the favored "home" for sowbugs and pillbugs. They feed on organic matter in the soil and sometimes on grass and other plants. Control measures are in lawns seldom necessary. If they should be needed, apply one of the insecticides recommended for control of grubs.

E. Chiggers and Ticks - Several kinds of ticks, as well as chiggers, infest lawns. Although they do not damage grass, they are pests of man and animals. Ticks drop on lawns after feeding on dogs and rodents, while chiggers usually invade lawns from surrounding grassy and wooded areas.

F. Fleas - Fleas occasionally spread to lawns from infested dogs, cats, or nearby animal quarters. They may attack man or pets.

G. Spiders and Scorpions - Spiders are found about the lawn, on flowers, plants, and shrubbery. Most spiders are harmless to man and do not damage grass and other vegetation. Scorpions appear occasionally on lawns and about the yard. Control measures on lawns are seldom necessary.

DISEASES OF TURFGRASSES IN LAWNS IN NORTH CAROLINA

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A number of diseases can cause serious damage to turfgrasses in lawns through 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, red fescue, and reygrasses) and warm season turfgrasses (centipedegrass, bermudagrass, St. Augustinegrass, zoysiagrass, and Bahiagrass) used in North Carolina are described. The cool season grasses are used mostly in the piedmont and mountain regions of North Carolina except for some ryegrasses that are used to overseed bermudagrass in eastern and southern regions of the state. The warm season grasses are used mostly in the eastern and southern regions of the states and in some areas in the central and southern piedmont regions of the state.

Cool Season Grasses

Tall fescue

Brown patch is the most serious and frequently occurring disease of tall fescue. The early symptoms of this disease are small circular brown patches .5 to 1 foot in diameter that develop during hot-wet weather in early summer. More patches develop and the older patches may continue to enlarge up to 4-6 feet in diameter during hot-wet weather. The disease may spread throughout the lawn by the end of the summer giving the lawn a uniform brown appearance without distinct patches. 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 when dew is present 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 summer are more susceptible to the disease than properly managed turf. Also, tall fescue in partially shaded lawns are more susceptible to brown patch because of more succulent growth and increased humidity levels. 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 fertilizaton) the grass will usually recover during the fall. Fungicides such as Daconil 2787,

Dyrene, Teran 1991, Tersan LSR, or Fore applied once every 3 weeks during favorable weather conditions for disease development will give good control of brown patch. This treatment is rather expensive and may not be needed if the tall fescue is managed properly and shade problems are eliminated.

Helminthosporium net blotch occurs on tall fescue but usually does not cause severe damage. The symptoms of this disease are dark brown areas on leaves with irregular margins and sometimes lighter colored "net" patterns in the affected areas. Sometimes young seedlings will be killed by the fungus, but older plants will usually overcome the damage during favorable growing periods with good management.

White patch is a new disease that has been observed in 1- to 2-yr-old lawns but not in older lawns. Symptoms are circular white patches .5 to 1 foot in diameter in the summer. Small tan mushrooms (about 1/2 inch in diameter) develop on some of the dead leaves. The tall fescue may become thin in spots but usually enough plants survive and grow in the fall to fill in the affected spots. Good management and particularly proper soil pH in new lawns helps to overcome this disease. Broad spectrum fungicides may be useful if the disease affects large areas.

Rust occurs on tall fescue in lawns but is seen more often in late summer on older plants that have not been mowed along fences or around shrubs. The symptoms of rust on tall fescue leaves are small yellow spots on leaves that may have 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 the rust during favorable growing conditions.

Drought and heat during the summer can damage tall fescue lawns. Seedlings that are less than one year old may be killed by drought and heat. Old tall fescue plants may go dormant during dry weather in the summer and turn yellow or brown. Many of these plants will resume growth during cooler weather when adequate moisture is present. Young tall fescue lawns need irrigating during hot-dry weather. Older, well established lawns will remain greener with irrigation. In both cases, lawns should be irrigated infrequently (once every 1 to 2 weeks 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. A severe root decline occurs during the summer. Many different soil-borne fungi can be isolated but their role in the root decline is not known.

Animal urine can cause serious damage to a tall fescue lawn. Affected spots are first seen as circular dead areas of grass .5 to 1 foot in diameter that develop quickly, usually in warm to hot and dry weather. The dead grass has a characteristic "bronze-like" color for a few days after the symptoms first appear. More spots will continue to appear if animals are confined in the lawn or if animals use the area often. A ring of grass around the dead area will become greener and taller than the surrounding

grass after a few days due to the extra nitrogen from the urine. If a sample of the affected turf and soil is closed in a plastic bag, an ammonia smell can be detected. Also, a soluble salts assay of the soil will detect a high soluble salts level in the affected areas. The dead tall fescue plants in the spots leaves a bare area that causes the grass to become clumpy or weeds grow in the areas. Suggested treatment would be to irrigate the affected portions of the lawn heavily and reseed or remove the affected turf and replace with tall fescue sod. The irrigation or an extended rainy period will leach the salts deep into the soil so that seedlings or sod would grow in the area.

Other problems such as fairy rings, slime molds, moss, algae, too much shade, low soil pH, tree root competition, low soil pH, and traffic are often seen on tall fescue. These problems are discussed at the end of this paper.

Bluegrass

Helminthosporium diseases are the diseases seen most frequently on bluegrass in lawns. 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. These diseases may cause the bluegrass to have a brown color and will reduce the vigor of the turf. Root and crown rots that are caused by some of the fungi that cause leafspots often develop in the summer months resulting in the symptoms of melting-out or fading out. Broad spectrum fungicides to control these diseases should be used in the spring before leafspot symptoms become severe. Control of the leafspot in the spring will reduce the severity of the summer leafspot, crown rot and root rot symptoms. Good management programs that avoid excess rates of nitrogen and use of irrigation to prevent excess water stress will help prevent Helminthosporium diseases on bluegrass. Some of the newer bluegrass varieties have more resistance to these diseases and should be used.

Red thread is a common disease on bluegrass in the mountains of North Carolina during the summer. The symptoms of the disease are small circular brown areas .5 to 1 foot in diameter that develop during wet weather in the summer. The symptoms are very similar to brown patch that sometimes develops on bluegrass in the peidmont area of North Carolina. 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 in affected spots. Small amounts of nitrogen fertilizer can be used to stimulate bluegrass to grow enough to help overcome the disease. Broad spectrum fungicides such as Daconil 2787, Tersan LSR, Dyrene, Fore or Actidione-Thiram can be used to control the disease if needed.

Rust is a serious disease on some bluegrass varieties, particularly in lawns with partial shade. The symptoms of rust are first small yellow 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 weak and

may be more susceptible to other diseases and weed invasion. If a white handkerchief or 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.

Stripe smut is a serious disease of bluegrass when it is present. The symptoms of this disease are black stripes up and down the leaves of affected plants, usually in the spring and fall. During the summer the leaves of infected plants split and curl and many of the infected leaves die during periods of drought stress. Plants must be examined carefully to detect the black stripes on the leaves to identify this disease. Chemical control involves the use of heavy rates of certain systemic fungicides. Good management practices will help overcome the effects of this disease.

Southern blight is a new disease that has been recently discovered 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 (look like clover seeds) of the fungus are usually present near the soil surface at the advancing edge of the spots. Several fungicides applied as drenches have given some control of this disease. Bluegrass usually spreads back into the spots in the fall if weeds are controlled. The symptoms of this disease may have been confused with Fusarium blight which is a serious problem in the northern states but has not been observed in North Carolina.

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 amount of nitrogen will help overcome the effects of this disease.

Other problems that occur on bluegrass such as fairy rings, slime molds, too much shade, and low soil pH are discussed in a section at the end of this paper.

Ryegrasses and red fescue

Diseases discussed on tall fescue and bluegrass such as brown patch, red thread, Helminthosporium diseases, dollar spot, and rust occur on these grasses with similar symptoms.

Pythium blight and seedling diseases caused by several fungi are often problems on ryegrasses which are often overseeded in bermudagrass lawns in eastern and southern 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. Seedling diseases caused

by other fungi result in poor stands of overseeded grass. Planting cool season grasses in the fall when the weather is cooler will help prevent damage from these diseases. Also, treatment of seeds before or soon after planting with certain fungicides will give good control. Proper watering and mulching to avoid too much water and excess drying will help seedlings to survive.

Warm Season Grasses

Bermudagrass

Spring dead spot is a serious disease of bermudagrass in some lawns. 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 lawns that are 4 to 6 years old and have 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. The cause of this disease is not known, but factors associated with its development are the use of high rates of nitrogen fertilizer and accumulation of excess thatch. An application of the fungicide, benomyl, at 8 oz. per 1000 sq. ft. in October or November 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, 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 in most cases and with the stubby-root nematodes in some cases. High numbers of ring nematodes have been found in some cases, but damage to bermudagrass has not been associated with this nematode in lawns. The symptoms of damage by the sting nematode are poor turf that does not respond quickly to nitrogen fertilizer and it wilts quickly and does not grow during dry weather. The roots are stunted or dead and very shallow. Nematicides will control these nematodes resulting in good quality of bermudagrass; however, none of the nematicides have a label to use in home lawns in North Carolina. A good management program that includes a balanced fertilizer and lime to maintain the proper pH and irrigation to prevent drought stress will help the bermudagrass to overcome the effect of these nematodes.

Dollar spot is sometimes a problem on bermudgarass turf. Symptoms of this disease are small brown spots 1 to 3 inches in diameter. The spots may become so numerous as to give the turf a general brown appearance if it continues to develop for several weeks. The disease usually develops on bermudagrass turf that has not been fertilized adequately with nitrogen and in areas that may be exposed to drought stress. The use of good management practices including proper amounts of nitrogen and water will help the bermudagrass overcome this disease. Several different fungicides can be used to control dollar spot.

Other problems that often occur on bermudagrass include fairy rings and too much shade which are discussed later.

Centipedegrass

Centipede decline is a name used to describe the most common problem observed on centipedegrass. Recent research in North Carolina has shown that this problem can be caused by several different factors. Nutritional factors, including low potassium levels in sandy soils, the use of too much nitrogen fertilizer, and too low or high soil pH's (5.5 is best) have been associated with the problem in some cases. Use soil test results to correct these problems. Nematodes, sting and ring nematodes in particular, have been associated with decline in some cases. The sting nematode has been shown to cause very serious damage on centipedegrass in sandy soils in southeastern North Carolina. Centipedegrass affected by this nematode will become thin and even die during hot-dry weather. The sting nematode can be controlled with nematicides and the centipedegrass will recover but nematicides are not labelled for use in home lawns. The role of the ring nematode which occurs frequently in centipedegrass lawns in centipede decline is not known. A good management program can be used to overcome the effect of the ring nematode but not the sting nematode on centipedegrass. Another grass such as bermudagrass or bahiagrass may be an alternative to use in centipede lawns with high levels of sting nematodes until effective nematicides are labelled for use. Fairy rings have been shown to be the cause of some centipede decline problems. Fairy ring symptoms are large circular dead spots or rings or green rings (3 to 20 feet in diameter) that enlarge for several years. Sometimes mushrooms may be present at the edge of the rings or throughout the circles. Fairy rings are often seen in centipedegrass lawns near the base of large pine trees. Effective treatments are not known for fairy rings, but treating the soil in affected areas with methyl bromide or rototilling the soil and replanting healthy grass may eliminate a fairy ring. Ground pearls which are small scale insects that attack the roots of centipedegrass have been shown to cause some circular dead areas that resemble fairy ring. All of the centipedegrass in areas affected by ground pearls is usually dead and the outer edge may continue to die in the summer. Ground pearls are identified by the presence of small pearl-like bodies that are about 1/8 inch or less in diameter. Sometimes during the summer a small pink crawler stage and associated "cottony material" will be present around the roots. A control is not known for the ground pearls, therefore, another grass such as bermudagrass or bahiagrass that may be less susceptible could be planted in affected areas. Improper mowing has been indicated as a factor in experimental plots where centipede decline occurred when the grass was mowed at 2 inches rather than 1 inch. More thatch accumulated at the higher mowing height and probably was a major factor. Damage by cold weather has also been observed to be a factor since more centipede decline occurred in the summer following unusually cold winters. The use of herbicides has also been associated in some cases. Centipedegrass is very sensitive to most herbicides and recommended herbicides should be used at lower rates than on other grasses.

Herbicides that are in some turf fertilizers may cause damage. Dollar spot is a disease that is often seen on centipedegrass during the summer. The symptoms of this disease are light brown spots 2 to 4 inches in diameter. It does not appear to cause serious damage and can be overcome with the addition of small amounts of fertilizer and irrigation if soil is dry. Centipedegrass that is declining because of other factors may have more dollar spot than nearby healthy grass. In summary, centipede decline may be caused by a number of different factors.

St. Augustinegrass

Gray leafspot is the most serious foliage disease of St. Augustinegrass in North Carolina. Symptoms are numerous gray spots on the leaves that may occur in small circular areas when the disease first develops. The disease may continue to develop on adjacent plants in warm-wet or humid wet weather until the turf has a light brown color. If the disease continues to develop, the turf may become thin. Broad spectrum fungicides can be used to control this disease and prevent it from causing serious damage to St. Augustinegrass.

Nematodes, particularly the sting nematode, can damage St. Augustinegrass in sandy soil. Symptoms of nematode damage are poor turf that wilts rapidly during dry weather. Extra fertilizer and irrigation when needed will help overcome nematode damage.

Brown patch is a serious problem on St. Augustinegrass in the gulf coast area of the United States. Symptoms of this disease are large circular brown patches during wet weather in the spring and fall. This disease is not known to be a problem in North Carolina, but could occur in the southeastern portion of the state.

Zoysiagrass

Rust is the disease that is most often seen on zoysiagrass in partially shaded lawns. The symptoms of rust are a thin and weak turf after the disease has been a problem for several years. Leaves of zoysiagrass will have rust colored masses of microscopic spores on them and will die slowly. The zoysia usually grows well in open sun, but as trees in the lawn grow and shade increases, rust becomes more of a problem. A combination of good fertilization and liming to maintain a soil pH above 6.0 and removal of shade will help overcome rust. Broad spectrum fungicides can be used to control the disease, but zoysiagrass will not have the highest quality unless shade problems are removed and the grass is managed properly.

Dollar spot is sometimes a problem during the summer when zoysiagrass is maintained at very low nitrogen levels. Symptoms of dollar spot are brown circular spots 4 to 6 inches in diameter. Applications of nitrogen fertilizer during the summer will help overcome this disease. Broad spectrum fungicides such as Daconil 2787, Dyrene, Tersan LSR or Fore can be used if the disease is severe.

Brown patch can be a problem on zoysiagrass during cool-wet weather. Symptoms of this disease are circular brown patches 1 to 10 feet in diameter. This disease is usually not a problem in North Carolina, but if it does occur broad spectrum fungicides will give good control.

Excess thatch is often a problem in zoysia lawns because the leaves and stolons decompose very slowly. Zoysiagrass often grows poorly and the turf becomes thin and wilts quickly during dry weather if excess thatch is present. Thatch will often accumulate to more than 2 inches if zoysia is fertilized heavily with nitrogen and if thatch is not removed in the spring and several times during the summer. Thatch can be removed by mowing the turf as short as possible (1/2 inch) or using a vertical mower in the spring as zoysia resumes growth from winter dormancy. Mowing frequently at 1 inch high and removal of clippings during the summer will help prevent thatch from accumulating.

Nematodes can be a problem on zoysia in sandy soils. Symptoms of nematode damage are poor turf and rapid wilting during dry weather. Good management practices including proper fertilization and liming, thatch removal and irrigation will help overcome the effect of nematodes.

Other problems such as fairy rings and too much shade sometimes occur on zoysia. These problems are discussed at the end of this paper.

Bahiagrass

Bahiagrass is used in some lawns in eastern North Carolina and makes a good turf except for the unsightly seed heads that appear rapidly. However, diseases or nematodes are not known to cause serious problems on this grass. Bahiagrass may be an alternative to other warm season grasses in lawns in eastern North Carolina where diseases or nematodes are a serious problem.

Other problems that appear on all types of turfgrasses.

Fairy rings produce various symptoms including 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 usually enlarge a few inches or feet each year. The dead rings may remain bare or weeds often invade the affected rings. 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. Practical controls are not available for fairy rings in lawns. Removal of soil from affected rings and replacement with clean soil and replanting with healthy grass is recommended, but is usually not practical. Treatment of affected areas with methyl bromide and replanting with healthy grass may help control fairy

rings. Loosening of the soil and watering the area frequently is recommended for the control of some fairy rings. Grasses that spread rapidly such as bermudagrass often will spread into the affected areas and show little effect while grasses such as tall fescue or centipedegrass may be killed and areas remain bare or do not fill in with desirable grasses.

Slime molds appear as a grayish growth of certain fungi 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 damage turfgrasses by shading the leaves, but usually do not cause serious damage. The fungi can be removed by brushing, washing, or mowing the fungus off the affected leaves. Broad spectrum fungicides can be used to control slime molds if large areas are affected and the turf becomes unsightly.

Moss may be a problem in lawns with too much shade and a low soil pH. Mosses are short, light green to brownish plants that grow in shady areas where turfgrases cannot grow because of low light intensities. Removal of excess shade and application of fertilizer and lime as recommended from a soil test will help turfgrasses grow in areas affected with moss.

Algae are single celled plants that grow on the surface of wet soils or in water. 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 too much shade and a low soil pH. Algae can be controlled by correcting soil drainage problems and eliminating shade and soil pH problems.

Animal urine can damage turfgrasses in several ways. Grasses that do not spread such as tall fescue and ryegrass may be killed in small circular spots .5 to 1 foot in diameter. The surrounding grass becomes greener for a while and the turf becomes clumpy or weeds invade the dead areas. Turfgrasses that spread by stolons and rhizomes may be killed in spots and the surrounding grass becomes taller and greener for a while. These grasses will usually survive in the spots or spread into the affected areas quickly resulting in dark green spots of turf several weeks later. The damage to turfgrasses is caused by the high soluble salts from the urine in the soil and the greening is caused by nitrogen-containing compounds in the urine. The effects can be overcome by excess irrigation or long periods of rain that will leach the excess salts deep into the soil. Grasses such as tall fescue should be replanted or new sod placed in the spots.

Shade is probably the most common problem observed in lawns in North Carolina. Usually, lawns that had enough sunlight to grow good quality turfgrasses a few years ago become too shady because trees have enlarged over the years. Most turfgrasses will not grow well in areas that receive less than 50% sunlight. This amount of sunlight may filter through pine trees but not through the canopy of hardwood trees such as oaks and maples. To allow enough sunlight for growth of turfgrasses, lower limbs or whole trees may need to be removed. Ground covers that grow in shady areas, or

some type of mulch, may be used in areas with too much shade for growth of turfgrasses. Root competition is also a problem often associated with trees and shade. Areas near trees will often wilt during dry weather, and the turf may become thin. Additional fertilization and irrigation may be needed on turfgrasses around the base of trees.

Soil compaction from construction or traffic (walking, parking vehicles, playing, or animals) may cause poor growth of turfgrasses. Proper oxygen and water relations in the soil are disrupted by compaction. The soil should be loosened by renovating or coring to relieve the compaction for better growth of turfgrasses.

Diagnosis of diseases of turfgrasses

Diseases can be diagnosed by using the descriptions given in this and other publications on turfgrass diseases. Assistance can be obtained from your county agent who may wish to collect a sample and send it to the Plant Disease and Insect Clinic at North Carolina State University for examination and diagnosis.

Summary

There are many different diseases and problems that occur on turfgrasses in North Carolina because of the diverse climatic regions in the state. The selection of the proper turfgrass, proper soil preparation, proper establishment, and proper management will help prevent and overcome many of the diseases. Use soil test results regularly to determine the amounts of fertilizer and lime to apply to lawns. When diseases do occur, identify the diseases correctly and then select proper management practices and/or chemicals for control.

WEED CONTROL FOR PARKS, LAWNS AND ATHLETIC FACILITIES

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Weeds are unattractive in turf areas. In addition, they compete strongly with desired grass for space, water, nutrients and light. To begin with, the most effective weed control is a thriving turf - one that has been correctly fertilized, watered and mowed. Crabgrass is the predominant grassy weed of turf areas in North Carolina. We have both large (hairy) and smooth crabgrass. They are annuals and seed may germinate from April through the summer as long as the soil is warm and moist. All plants are killed by heavy frost in the fall.

PREEMERGENCE CRABGRASS CONTROL

Several satisfactory materials for preemergence control of crabgrass and certain other annual grasses are listed below. Generally goosegrass control is only fair from these herbicides. In addition, these chemicals may also control certain broadleaf weeds.

Benefin (Balan) is safe to apply on established lawns and golf courses of Kentucky bluegrass, perennial ryegrass, fescue, bahiagrass, bermudagrass, centipedegrass, St. Augustinegrass, and zoysiagrass. Established stands of fine-leaved fescues may be thinned. Do not apply in the spring to turfgrasses planted the previous fall. A spring application of Balan may thin over-seeded winter grasses in bermudagrass areas. Do not use on putting greens, dichondra, or newly sprigged areas of bermuda-grass, St. Augustinegrass or centipedegrass.

Bensulide (Betasan, Pre-San) can be applied to the following well established turfgrasses; bahia, bentgrass, bermudagrass, perennial bluegrass, centipedegrass, fescue, perennial ryegrass, St. Augustinegrass and zoysia. Can be applied in the spring to turfgrasses seeded the previous fall. It is not advisable to use bensulide on a bermudagrass golf green especially where the stand is thin for it affects rooting at the nodes of the stolons. The stolons (or runners) will not knit down tight to the soil. Balan, Dacthal and Tupersan will show similar effects. Do not apply to newly sprigged turfgrasses. Bensulide has been the most consistent performer for preemergence crabgrass control in the state.

DCPA (Dacthal) is applied on well established lawn grasses grown in North Carolina. However, certain bentgrasses are less tolerant. Consult the label. Stands of fine-leaved fescuses may be thinned. Can be applied in the spring to turfgrasses seeded the previous fall.

Oxadiazon (Ronstar) is for use in established perennial bluegrass, bermudagrass, perennial ryegrass and St. Augustine-grass turf; such as lawns, parks, fairways and golf courses. Red fescue and bentgrasses are not tolerant. Do not apply to zoysia-grass or centipedegrass, to putting greens or tees or to newly seeded areas.

Siduron (Tupersan) may be used in newly seeded or established plantings of the following turfgrasses only; perennial bluegrass, fescue, perennial ryegrass, zoysiagrass and certain bentgrasses (check label). Do not use on bermudagrass, carpetgrass, or centipedegrass. It is not recommended on golf greens. Tupersan is a unique product for it can be applied immediately following seeding of perennial bluegrass, fescue, perennial ryegrass, and certain bentgrasses and sprigging of zoysiagrass for selective control of crabgrass. Application at seeding is the primary utility of this product.

Time of Application

Apply these herbicides 10 to 14 days before crabgrass is expected to germinate in the spring. For North Carolina conditions, apply during the following dates:

Southern Coastal Plains	March 10 - March 25
Northern Coastal Plains and Piedmont	March 10 - April 1
Mountains	March 25 - April 10

Or another way to remember the application time is when the dogwoods are in fill bloom.

Methods of Application

Materials may be applied as a spray or granule. Wettable powders or liquid formulations are mixed with water and then applied with a pump-up sprayer or hose sprayer. Follow spray applications with at least 1/5 inch of water - irrigation or rain-fall - to wash the preemergence herbicide off the grass and down into the soil where the weed seeds are located.

Granules are applied with a lawn spreader. Research in North Carolina indicates generally more favorable results are obtained when a herbicide is applied as a granular product than

when the same herbicide is applied as a spray. Herbicides are also available on fertilizer carriers. Granular and fertilizer products are frequently marketed in a given size bag to cover 2500 or 5000 sq. ft. with settings listed for different spreaders.

POSTEMERGENCE CONTROL OF CRABGRASS, DALLISGRASS, GOOSEGRASS, FOXTAILS, BAHIAGRASS, SANDBUR, BARNYARDGRASS, AND NUTSEDGE

Postemergence control is the use of chemicals to kill growing crabgrass, dallisgrass, goosegrass or other weedy grasses present in the turf. These weedy grasses have a greater susceptibility to the chemicals than turfgrasses. More favorable control of goosegrass is obtained from postemergence treatment than preemergence.

Herbicides to Use

Chemicals known as arsonates; CMA, DSMA, MAMA, and MSMA are used for postemergence control. Do not use these materials on carpetgrass, centipedegrass, or St. Augustinegrass. Temporary discoloration of turf may be expected, especially in hot weather with low soil moisture. Rain or irrigation will revive the turf. Bentgrasses and fescues are generally more sensitive and may be temporarily discolored. Bermudagrass, bluegrass, and zoysiagrass are more tolerant. CMA is the safest of the arsonates to use on bentgrass. Treated areas may be seeded two weeks after the last application.

Time and Method of Application

Begin treatment when the grassy weeds are young (3 to 4 leaf stage) because control becomes more difficult as plants mature. One application may be sufficient if applied when seedlings are less than 2 inches tall. At least 2 applications are necessary, 7 to 10 days apart for medium to mature crabgrass. More mature plants may require additional applications. Since CMA, DSMA, MAMA, and MSMA have no residual toxicity, treatment must be repeated as new seedlings appear. In the case of nutsedge and sandbur, 3 to 4 applications may be necessary.

Uniformly spray infested area when soil moisture is adequate for rapid growth of turf and weeds. For effective results, treat when air temperature is 80^{0} to 90^{0} F. For temperatures below 80^{0} F increase application rates according to recommendations in the product label.

Do not water or mow turf for at least 24 hours after application. Apply in any type of sprayer, including hose-end sprayers. Do not treat new lawns until after the third mowing.

ANNUAL BLUEGRASS (*Poa annua*) CONTROL

Preemergence application of benefin (Balan), bensulide (Betasan or Pre-San), or DCPA (Dacthal) controls annual bluegrass. Certain winter annual broadleaf weeds are also controlled, for example, chickweed. Application time varies in the state with location and moisture and temperature conditions in late summer and fall. With good soil moisture and cool temperatures, annual bluegrass may germinate in late August in the Mountains and early September in the Piedmont or it can be as late as October or November. With fall herbicide applications it is not possible to fall seed turfgrasses. To extend annual bluegrass control and provide preemergence control of crabgrass in the spring, follow with another application at two-thirds the rate on March 1.

Pronamide (Kerb) provides preemergence and postemergence control of annual bluegrass (0.75 to 1 oz. per 1000 sq. ft. or 2 to 3 lbs per acre of Kerb 50W). Use only on bermudagrasses. Apply September 15 to February 1. Will also control annual ryegrass, common and mouseear chickweed, corn speedwell and henbit (preemergence only). Injury symptoms from postemergence applications are slow to develop. Weeds gradually turn yellow and die over a 3 to 5 week period. Do not use on areas to be overseeded with susceptible cool season grasses within 90 days after application.

BROADLEAF WEED CONTROL

The herbicides used for selective control of broadleaf weeds in turf are 2,4-D, dicamba and mecoprop (or MCPP). These are used primarily on growing weeds.

Time and Method of Application

In general the younger the weed the easier it is to control. Well established turfgrasses can be safely treated noting any precautions listed on the label and in the following section for each specific herbicide. Do not treat newly seeded turf until after the third mowing. Better results are obtained when the weeds are actively growing and daily temperature is expected to be 60^{o} F or higher. Do not spray during times of drought or when turfgrasses are under other stresses. Repeat treatments may be necessary especially on perennial weeds. Wait 4 weeks between treatments.

Winter annuals are preferably sprayed from February to April depending on location within the state and temperature and

growing conditions. Many summer annuals should be sprayed in April or May, while lespedeza and spurge should be sprayed in June or early July. Perennials are usually sprayed in April or May. They also may be treated in the fall, October or November.

Herbicides to Use

The susceptibility of important broadleaf weeds to herbicides is listed in the table. Many herbicide formulations are available at many different concentrations. Consult the product label for specific rate suggestions.

SUSCEPTIBILITY OF BROADLEAF WEEDS TO HERBICIDES

	Classification of weed	Response of Weed to Herbicides		
		2,4-D	Mecoprop (or MCPP)	Dicamba
Bittercress	WA	S	S-1	S
Black Medic	A	S	1	S
Buttercups	WA, B, & P	S-1	1	S
Buttonweed, Virginia	SA	S-1	1	-
Carpetweed	SA	S	1	S
Chickweed, Common	WA	R	S-1	S
Chickweed, Mouseear	WA	1-R	S-1	S
Clover, Hop	WA	1	S	S
Clover, White	P	1	S	S
Cranesbill	WA	S	S-1	S
Dandelion	P	S	S	S
Dichondria	P	S	1	S-1
Dock	P	1	1-R	S
Garlic, Wild	P	S-1	R	S-1
Ground Ivy	P	1-R	1	S-1
Hawkweed	P	S-1	R	S-1
Healall	P	S	R	S-1
Henbit	WA	1	1	S
Knawel	WA	R	1	S
Knotweed	A	R	1	S
Lespedeza	SA	1-R	S	S
Mugwort	P	1	1-R	S-1
Parsley-piert	WA	S-1	-	S-1
Plantains	P	S	1-R	1-R
Prostrate Spurge	SA	1	1	S
Red Sorrel	P	R	R	S
Speedwell, Corn	WA	1-R	1-R	1-R
Spotted Spurge	SA	1-R	S-1	S-1
Spurweed	WA	1	-	S
Violet, Wild	P	1-R	1-R	S-1
Wild Strawberry	P	R	R	S-1
Woodsorrel, Yellow	SA	R	R	1
Yarrow	P	1	1-R	S
Yellow Rocket	WA	S-1	1	S-1

A = annual WA = winter annual SA = summer annual B = biennial P = perennial
S = weed susceptible
I = Intermediate, good control sometimes with high rates, sometimes poor, usually require more than one treatment
R = resistant weed in most cases

Combination Products. There are many products on the market containing two or three herbicides to provide control of a broader spectrum of broadleaf turf weeds. Some examples are: 2,4-D + MCPP (Weed-B-Gon) Lawn Weed Killer M), 2,4-D + dicamba (Banvel + 2,4-D and Super-D Weedone) and 2,4-D + MCPP + dicamba (Trimec, Trex-san, Trex-San Bent, 33 Plus). Read the product label carefully for weeds controlled, recommended rates, application methods, safety to various turfgrasses, safety to nearby ornamentals, shrubs, trees, flowers, vegetables and other desirable plants and other precautionary statements.

Turfgrass and Ornamentals in the Raleigh Parks System

Frank E. Evans
Raleigh Parks and Recreation Director
Raleigh, NC

The Raleigh Parks System consists of 2,500 acres of park land and 1,000 acres of water. The broad responsibilities of this department as to ornamentals, turf, and shade trees match the responsibilities of the department for the maintenance and appearance of not only the park lands but the Downtown Fayetteville Street Mall, the grounds of the Civic Center, Memorial Auditorium, and City Hall. Nash Square and Moore Square, state-owned properties, are maintained by the Parks and Recreation Department. Additional special responsibility includes the horticultural and grounds maintenance of historic sites, the Rose Garden, the amphitheatre, a special day lily demonstration garden, and 40,000 shade trees that line the city streets. The department horticulturally maintains 128 miles of State Highway system and boulevards within the city limits.

The turfgrasses within the park system are varied. We have recently started a program of extensive soil improvements of athletic fields followed by the sprigging of Tifway bermudagrass. This is a slowly developing program, and the department plans to shift to more turf maintenance equipment to compliment the improved field situations. Irrigation is being added at approximately the same time as allowed by budget considerations.

At the newly constructed Marsh Creek Maintenance Headquarters the department has two greenhouses, 90' x 30', and a 25' x 40' propagation house. A lath house is attached and five acres of field storage is nearby. The capacity was recently tested when we were asked to force 10,000 narcissus bulbs in 2,500 one-gallon containers for the North Carolina Home and Garden Show.

The department has shifted away from Japanese holly in its landscaping efforts and has enjoyed success with Chinese holly and junipers of all types. The demands of a park system the size of Raleigh for beautification and stabilization are immense. Extensive plantings are required around the many buildings scattered throughout the park system. Ornamentals successfully used throughout the system consist of canna, day lilies, iris, lirope, 20,000 tulips purchased new every year, daffodils, and crocus. Annual plants used are pansies (16,000 a year), marigolds, petunias, begonias, geraniums, sultana, coleus, scarlet sage, chrysanthemums (6,000 to 7,000 annually of which 2,500 are placed on the Downtown Mall, alone), elephant ears, and caladiums. It is estimated some 65,000 annuals are put into the system each year for the citizens of Raleigh to enjoy.

The Raleigh Rose Garden is the only municipal rose garden in North Carolina certified by the American Rose Society. The plant materials there consist of some 1,800 bushes of some 60 different varieties. Test plants are sent to us by number and approximately July of each year they are named.

The plants are labeled so visitors can see, enjoy and perhaps order them the next year. New plants are required to be planted in an accredited garden so Raleigh is fortunate in that regard.

The system is fortunate in that it can accept ornamental trees such as flowering crab, flowering pear, and crepe myrtle. A special area in Pullen Park has a large planting of the Dawn redwood tree--Meta Sequoia.

Visitors to Raleigh are invited to stop by our award-winning office with a large interior garden and to tour parts of the parks system.

PLANT MATERIALS FOR SPECIAL USES

Foy Hendrix
USDA - Soil Conservation Service
Raleigh, North Carolina

Plant materials is one phase of the overall resource conservation program. There are 22 plant materials centers operated by SCS to develop new or improved plants to solve conservation problems. Three centers have responsibilities for problems in North Carolina.

The plant materials center at Cape May, New Jersey is working on plants for the coastal areas. Their number one priority problem is sand dune stabilization. Plants for erosion control of tidal river and sound banks are also a high priority problem. Americus, Georgia Plant Materials Center has the responsibility for developing plants for problems in the Coastal Plain and Piedmont major land resource areas. They are testing a tall fescue that is better adapted to sands than Ky 31. Summer legumes for forage plants for road bank stabilization and wildlife food are also being studied. Quicksand, Kentucky Plant Materials Center is responsible for developing plants for the Blue Ridge major land resource area. They are working on stream bank stabilization and improved forage plants for the Appalachian Highlands. North Carolina A&T University is cooperating with SCS in a plant materials and resource conservation laboratory. They are evaluating plants for adaptability to the Piedmont. This supplements the work being done at Americus, Georgia.

The first step in solving a problem is to clearly identify the problem and what part of the problem can't be solved with commercial plants. After the problem has been defined, plants are received from foreign countries through plant introduction stations, or are collected from native stands and sent to plant materials centers for testing.

The plants are assembled at the plant materials center and planted in rod rows or small blocks for initial testing in order to evaluate their performance and potential for solving a conservation problem. Superior plants are selected for advanced testing at the plant materials center.

After plants have been thoroughly tested at the plant materials center, they are taken off the center for testing on sites which are typical of the problem. Cultural and management techniques are also determined during this stage of testing.

Finally, seed is furnished to the soil and water conservation district which then locate a district cooperator who is willing to test the plant. Good seeding and establishment techniques and on-site assistance by the district conservationist is important. After the planting is made, frequent evaluations are necessary to determine if the seed germinated and seedlings emerged. Disease problems, weed invasions, and insect damage are noted. Proven plants are then released to seed growers or plant nurseries for commercial production. The plant is then included in the technical guide for use in the overall resource conservation program.

North Carolina plant material problems have been identified and a long-range program prepared. The most serious problems are given the highest priority by the SCS plant materials centers. Steep road banks with little or no vegetative cover are a serious erosion problem in North Carolina. There are a number of good plants that have either been developed or their use prompted through the SCS PM program. Ky 31 tall fescue is the most widely planted grass in North Carolina and was introduced in the 1940's. The use of sericea lespedeza has been demonstrated and it is the most widely planted legume for road banks. Wilmington bahiagrass is an excellent grass for road shoulders. It is more winter hardy than Pensacola, but has extremely limited seed supply. Some lower growing lespedezas such as Ambro and Appalow, are being worked on by the Americus PMC. Their low growth makes them attractive plants for road banks. Crownvetch is well adapted in the Mountains and Upper Piedmont. Prostrate sericea appears to have potential for road banks and is more compatible with tall fescue than common sericea.

Aquatic weeds often restrict flow in channels and are a serious problem in the Coastal Plain. Fully shaded channels have no aquatic weed problems, but they also have no fish. The channel bottoms are flat with no pools and little fish food. Partial shade appears to control the aquatic weeds but not eliminate them. The bottom channel is meandering and there are pools. The best plant for shade and where to plant them on the bank has not been determined yet.

Waterway stabilization on deep sands and poorly drained soils is also a problem. Tall fescue is the number one plant used for waterways and reed canarygrass is the best grass for poorly drained soils. Eroding banks of coastal sounds and river estuaries are a serious problem in eastern North Carolina. In many cases, banks are eroding at a rate of 4 to 8 feet per year. In some instances, sloping the bank and planting smooth cordgrass, marshhay cordgrass, and bermudagrass have been effective. Small grains have usually been successful but are usually considered too costly on cropland. Smooth cordgrass can be planted to protect sound fronts and canals where the exposure and/or boat wakes aren't too severe.

Sand dune stabilization has been emphasized in recent years. Cape American beachgrass developed by Cape May PMC and Hatteras beachgrass developed by NCSU are the primary plants for sand dune stabilization. The dominant native plant is sea oats but efforts to use sea oats for primary stabilization have not been very successful. Bitter panicgrass is another important dune plant that spreads only by rhizomes. A combination planting of American beachgrass, sea oats, and bitter panicgrass is the best mixture to use. It collects as much sand as American beachgrass alone but you have two species to rely on if Marasmius blight or the soft scale kills the beachgrass. False anil indigo is a good plant for stabilizing back dune areas. It is also promising for road banks in the Sandhills and Piedmont and may even have value for landscaping.

Surface mined areas cover a considerable acreage of land in North Carolina. These areas typically have excessive slopes and mixed horizons of parent materials, which are highly infertile making growing conditions for plants difficult. Arnot bristly locust has demonstrated its value on mica mine spoils. European black alder is a good tree species for spoil reclamation. Lathco flatpea also appears to be a promising new plant for mine spoil stabilization. Tioga deertongue was proven valuable for stabilizing acid spoils in the northeast and is being tested in the mountains of North Carolina. Autumn olive is a good plant for spoil areas. It is utilized by deer, wild turkey, bear, and songbirds.

Stream bank stabilization is also a high priority problem. Streamco willow, recently released from the Big Flats, New York PMC, has the potential to control erosion on small streams. Halifax maidencane, recently released by the Coffeeville, Mississippi PMC, is a good plant for water line protection. Reed canarygrass is a good plant for both stream bank stabilization and water line protection in the Mountains and Upper Piedmont.

SOIL MODIFICATION TECHNIQUES FOR TURFGRASS AREAS

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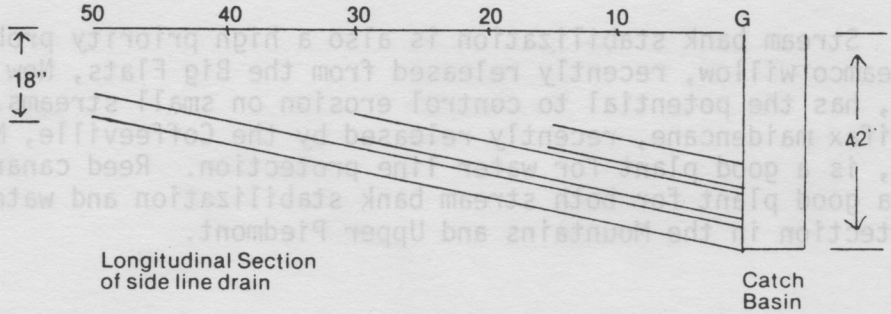
President - Cambridge Soil Services of America
Glencoe, Alabama

Below we have illustrated how a typical crowned football field could be modified to improve the quality of the turf through better drainage and aeration. The same principles would apply to any turfgrass area.

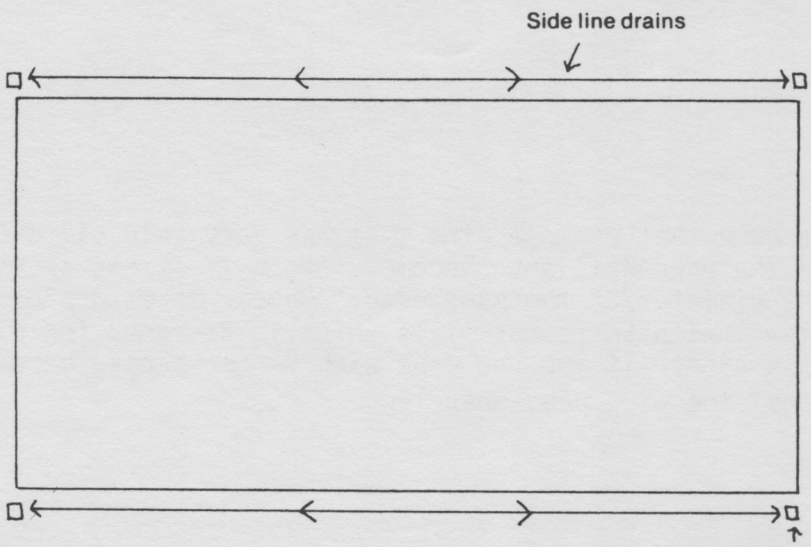
SIDE LINE DRAINS

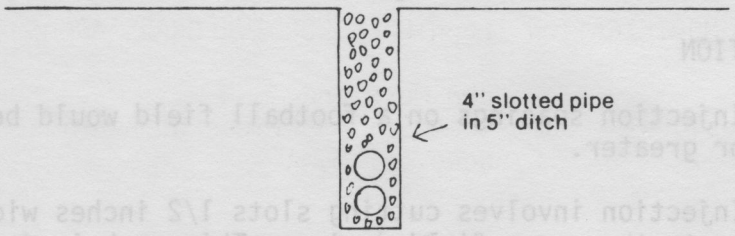
Side line drains should be several yards outside the playing field, should be 18 inches deep at the 50 yard line, and slope to 42 inches deep at the corner catch basis. Ideally the lines should be 4-inch slotted flexible corrugated pipe laid on pea gravel at the bottom of a 5 inch-wide trench. From the 50 yard line to the 30 yard line use 1 pipe. From the 30 yard line to the 15 yard line use 2 pipes. From the 15 yard line to the catch basin use 3 pipes. Where multiple pipes are used, they should be stacked as shown below.



Longitudinal Section of side line drain

Catch Basin



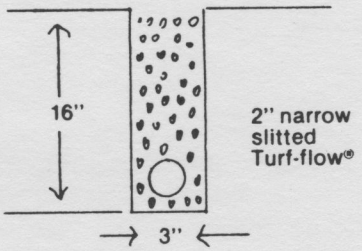


Cross Section of side line drain at 25 yd. line

Note that the pea gravel extends all the way to the surface. Do not cap it with sod or sand if you wish maximum efficiency. If you wish you may cap it with coarse Turface™ which will aid grass runners crossing the trenches without unduly restricting water flow.

CROSS FIELD DRAINS

A 2-inch drain should be installed at each 5-yard line. These should be 16 inches deep and 3 inches wide to carry narrow slitted 2-inch drain pipe. These trenches should now be back filled with grit or very coarse sand. The selection of the correct backfill material is of the utmost importance. If it is too coarse, grass will not cover the trench as readily; if it is too fine water will not infiltrate satisfactorily. Uniform material about 1/16 inch would be ideal. A small amount of coarse Turface™ at the surface will expedite grass coverage without inhibiting the flow of water.



Be sure that you use pipe that has very thin slits (knife cuts). The pipe will soon become clogged if it has slots larger than the diameter of the sand used. Hancor makes a pipe (2-inch Turf-flow™) with knife cut slits which is designed for direct burial in sand. If you use pipe with larger slots, be sure to cover the pipe with pea gravel.

For a first class drainage installation you must now add Sand Injection and Sand Grooving.

SAND INJECTION

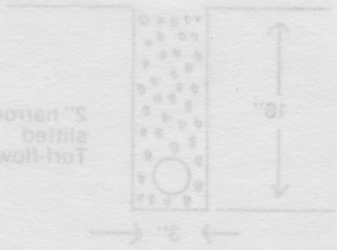
Sand Injection spacings on a football field would be at 19 inches or greater.

Sand Injection involves cutting slots 1/2 inches wide at right angles to the cross field drains. This work is done with a tractor powered Sand Injector which opens the slot and simultaneously backfills it with sand. Since the Injector works as a vibratory plow it loosens the soil to a depth of about 15 inches as it injects sand to a depth of 9 inches.

SAND GROOVING

Sand Grooving is most effective if done at right angles to Sand Injection. Its great virtue is that it provides an avenue for surface drainage such that no drop of water is over 4 inches from a sand drain anywhere on the field. A beneficial side effect is that the turf is loosened and aerated to a depth of about 6 inches.

A further advantage in Sand Grooving is that the Sand Groover can be adjusted to simultaneously top-dress the field with sand. This substantially reduces the likelihood that the Sand Injector slots or the Sand Grooves will become capped with soil.



ROADSIDE ESTABLISHMENT AND MAINTENANCE

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To establish vegetation along the roadsides of North Carolina's highways the Department of Transportation is faced with utilizing many types of grass and legume plants. I will briefly describe the turf and legume type plants that are now in use along our roadsides.

The predominate turf species in use along our roadsides continues to be Kentucky 31 or Alta Tall Fescue. As our state is centered in the transition zone between cool season and warm season grasses Fescue has done a good job for us over a number of years along the majority of our roadsides.

We have now begun an extensive use of Bahiagrass in the Eastern part of our state and also in some cases in the Southern Piedmont area. Pensacola Bahiagrass has been used exclusively because of the ample supply of seed. Bahiagrass being a warm season grass offers excellent drought tolerance and the ability to spread by stolons which is a definite advantage in providing more dense turf stands and less reseeding requirements. The fertility requirements for this grass species are also low.

We also use considerable amounts of Kobe or Korean Lespedeza as a nurse crop during the summer months mainly in Fescue-Bahia mixtures.

Sudangrass is used as a temporary type cover in areas that are not too final line and grade. We also use Rye grain for the same type of temporary cover during the winter months.

Common Bermudagrass cannot be planted along our roadsides in the vast majority of Eastern North Carolina because of a general statue. We have used this very excellent roadside turf in many of our coastal areas and in some cases urban areas where cultivated fields are not near. We have also made much use of Coastal Bermudagrass along our coastal areas. Coastal Bermuda of course must be sprigged and requires some watering during initial establishment but has proven to be very drought tolerant and an excellent turf species under adequate fertilization in these areas.

About the same time, 6 or 7 years ago, that we began to use Bahiagrass we also started using Weeping Lovegrass along many of our backslope sections in the Eastern part of our state and also Southern Piedmont portion. Weeping Lovegrass is a warm season bunch grass that provides a very quick cover on sandy soil types and is quite drought tolerant. Adequate fertilization must be provided to prevent clumping and the possibilities of erosion around these clumps.

We have made extensive use of American Beachgrass along our coastal area and in particular along the highway improvements on Bogue Banks. This bunch type grass must be sprigged and provided with adequate water and fertilization during establishment stages. The main usage has been on sandy back slope sections and we have enjoyed excellent results so far.

Two legumes are predominate along our highway back slopes, particularly on the huge cut and fill sections. Sericea Lespedeza has for years been the predominate legume used in these situations and has done an excellent job in controlling erosion and providing a very low maintenance type vegetative cover. We now also are using Crown Vetch in this same type situation where a more ornamental type cover is desired as the vetch will bloom profusely during the growing season.

Our use of sod has increased drastically over the last several years as we have used both Tifton 328 and 419 hybrid Bermuda for stabilization of sandy fill slopes and in some instances for its ornamental value in urban situations, such as planted median areas. We have also done some limited experimental work with hybrid Bermuda turf as a ditch liner. We also have used Centipede sod on several of our rest area projects with very good success.

One other phase of vegetation establishment that has presented itself in the last several years is the reestablishment of marsh grasses normally required by the Corp of Engineers on coastal bridge projects. This has been approached mainly from the standpoint of providing nursery areas for the existing marsh grasses and using these areas to provide stock to be sprigged along the new construction. The effectiveness of these reestablishment efforts remains unknown at present as only time might tell.

Two very important aspects of roadside vegetation maintenance of course are fertilization and mowing. We are now using as our main topdressing fertilizer a liquid waste material obtained from Mallinckrodt Chemical Works which contains 7% nitrogen. You might notice the use of this material along our roadsides as the turf will be colored a reddish brown. This comes from a pigment in the material. This material is fully approved by the NC Department of Agriculture and has provided us a means to increase the amount of roadside turf we can topdress. The mowing aspect has provided us with many complexities both from the standpoint of cost and from poor mowing practices. Many times the turf has been mowed much too low in a dry season with severe damage resulting. To combat the problem of reduced maintenance funds and sometimes very untimely mowing practices we have begun a very extensive effort in looking at growth regulators and herbicides for vegetation control.

The Department of Transportation began experimenting in conjunction with Uniroyal in the use of MH-30 for turf growth regulation during the early 1960's. Because of the cost benefits at that time broadscale use of growth regulators was deferred except in

one highway division until 1977. That particular highway division has treated one section of interstate highway for 18 consecutive years with MH-30 and continues to maintain a good Fescue cover. In 1977 we began to experiment with growth regulators - mainly MH-30 and Embark on a statewide basis. Our early equipment utilizing a makeshift boom operation with oc*nozzles presented rather sporadic results because of application techniques. We then made equipment modifications and incorporated the use of flood jet nozzles to drastically improve our application techniques. We are now extremely proud of the type applications we are able to make and of the results. In 1980 we treated 14,000 acres of highway roadside turf with a savings of a little over 1/2 million dollars in reduced mowing costs. The majority of these 14,000 acres only had to be mowed one time the entire year. We are very excited about this program and look for continued expansion during the coming years in an effort to save critically short maintenance funds.

Because of this intense look at the use of growth regulators we have also increased our efforts in broadleaf weed control. We have used both a MCPP, 2,4-D, Dicamba mix and in some cases a 2,4-D, Dicamba mix as an early summer treatment to control late germinating broadleaf weeds. Of course, we add 2,4-D in our early spring growth regulator treatments to control broadleaf weeds at that stage. The three-way mixture looks promising and works well even on hard to kill weed species.

Our herbicide program encompasses many other aspects as we strive to economically control the vegetation along our highway system. This is no small task as we maintain approximately 76,000 miles of highways, the largest state maintained highway system. Some of the different aspects of this herbicide program follow:

1. Guardrail - Roundup-Surflan or Roundup-Simazine mixtures to control unwanted weeds and grasses and prevent expensive mowing operations.

2. Capped Islands - Use of residual type herbicides underneath asphalt islands such as Pramitol or Spike. Also use of Pramitol 25E in conjunction with liquid asphalt in crack pouring operation for concrete islands.

3. Brush Control - Use mainly of Krenite to control unwanted brush around bridges and in some cases as a limb pruning type operation. Also use of Krenite and sometimes Garlon to prevent expensive extention arm mowing operation.

4. Control of Vegetation along Fences - Use of Krenite or in some cases Roundup to control vines along roadside fence lines.

*oc - off center

5. Ornamental Weed Control - Use of preemergence herbicides such as Treflan and Casoron to prevent weed emergence in ornamental beds and also treatments with Roundup for emerged weeds.

6. Bermudagrass Control - Use of Roundup to control Bermuda encroachment into paved shoulders and resulting deterioration of pavements.

7. Paved Shoulder Treatments - Use of Spike 80 W and sometimes other residual herbicides under paved shoulders.

8. Johnsongrass Control - Use of Roundup to control Johnsongrass and prevent spread along our roadsides.

9. Kudzu Control - Use of herbicides such as Krenite, Roundup and MCPP, 2,4-D, Dicamba mix to control this roadside pest.

10. Multiflora Rose Control - Use of Roundup and Krenite to control this plant which has been deemed a pest in Western North Carolina.

We continue to look for the means to expand our herbicide program to eliminate costly hand labor and/or expensive machine operations to control roadside vegetation. We believe these growth regulator and herbicide tools will allow us to satisfactorily maintain our roadside vegetation and in many cases improve highway aesthetics during this period of declining highway revenues.

RENOVATING ATHLETIC FIELDS

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A vast majority of our athletic fields have been constructed using native soil, in most cases whatever was available and plentiful and free. Too often it was grossly undesirable for this purpose, sub-soil high in clay and/or silt, discarded highway "soil" material fit only for making roads, or fill dirt so full of debris as to make it dangerous. I have come to the conclusion that if anyone has "free" soil for an athletic field, don't take it!

The use of most native soils in the state for this purpose results in such extreme soil compaction that we are unable to grow grass. Certainly, we are unable to maintain the desired condition and quality for safe, enjoyable athletic uses. The following discussion outlines the most effective, though not necessarily the least expensive, means of obtaining a rootzone in which turfgrasses can be established and maintained for a number of years, and keeping the cost as low as possible over the long run.

Soil compaction is the most serious and most common problem. Thus, physical amendment of the soil to the depth of the entire potential rootzone (6-8" deep) before planting is essential. A physical (particle size) analysis is the only certain way to find out what needs to be done. Once this is done, a determination can be made as to how much sand and/or organic matter should be mixed with the soil to resist compaction.

Then, test the soil chemically to find out how much lime, phosphorus, potash and other nutrients to mix into the rootzone. Generally, the pH should be 6.5 and the soil should contain 50 pounds of phosphorus and 100 pounds of potash per acre.

When the field is final-graded, the soil surface must be elevated from the center to the sidelines so as to insure, as nearly as possible, perfect surface drainage. Now, spread the physical amendments (sand and/or O.M) and the chemical amendments (lime, phosphorus, potash, etc.) evenly over the existing soil surface. Next, rotovate (second best, rototill) the sand, organic matter, lime and fertilizer into the entire potential rootzone. This is most important! If the rootzone is not modified, the roots of these grasses will not occupy this soil zone and poor turf will be the result. Rake or harrow the soil to smooth and level the surface. Roll or cultipack before seeding or planting.

Apply a starter ferilizer to insure available nutrients near the soil surface when seed germinate or sprigs or sod begin to grow. Normally, one pound each of available nitrogen, phosphorus and potash per 1,000 sq. ft. (450 to 500 lbs. 10-10-10/acre) is sufficient. Mix lightly into the top 2 to 3 inches of soil. Firm the soil with a cultipacker or roller.

Seeding or planting is the next step. Which grass you use depends on the location in the state. Cool-season grasses are used in the mountain area. Species and/or mixtures and seeding rates are in Table 1.

Table 1. Species, Mixtures and Seeding Rates of Cool-Season Grasses.

Species (percent)	Rate/1000 sq. ft.
Kentucky 31 tall fescue (100)	7 lbs.
K. 31 tall fescue (70) and *K. bluegrass (30)	6 lbs. of mixture
K. 31 tall fescue (40-50) and *K. bluegrass (20-30) and Pennlawn or common red fesue (20-30)	5 lbs. of mixture
*K. bluegrass (80) and Pennlawn red fescue (20)	3 lbs. of mixture

*A mixture of 2 or 3 varieties is suggested -- Merion, Flyking, Kenblue, Adelphi, Bonnieblue, etc. are complementary and adapted (use no less of any one variety than 10% of total mixture).

Piedmont and Coastal Plain locations should use one of the bermudagrasses since they are very resistant to wear and will recovery rapidly from damage by cleats and traffic. Seeding or planting rates by variety are given in Table 2.

Table 2. Varieties and Rates - Warm Season Grasses

Variety	Vegetative Rate	Seed Rate
Tifway	3-5*	--
Tufcote	3-5	--
Midiron	3-5	--
Tiflawn	3-5	--
Common	--	1-2 lbs.**

*Bushels of fresh stolons per 1000 sq. ft.
**lbs per 1000 sq. ft.

Further guidelines for seeding or planting are:

(1) Time of seeding or planting is critical. Seed cool-season species August 15 to September 10. Seed or plant warm-season species late April or early May (later plantings may survive, but should not be played on the first year).

(2) Broadcast seed evenly over soil surface. Roll or cultipack to press smaller seed (bermudagrass) 1/4" into the soil and larger seed (tall fescue, etc.) 1/2" into soil. Deeper plantings will not emerge.

(3) Shredded stolons should be broadcast and pressed into the top 1 to 2 inches of soil, then firmed with a roller or cultipacker.

(4) Mulch seeded areas with clean grain straw at 1 to 2 bales/1000 sq.ft. (light rates for bermudagrass).

(5) Irrigate directly following planting, rolling and mulching. Soak soil to the depth of the potential rootzone (6" deep). Following this deep watering, water during midday anytime the soil surface dries. In windy or hot-dry weather, this may be daily for four weeks.

Proper maintenance of athletic fields during establishments, and in later years, is part of the renovation process and is an absolute must if the desired results are expected. Begin maintenance early. Do not allow the grass to "grow up" before mowing, etc. Some maintenance suggestions are given below.

(1) Cool-season grasses - When 1-1/2 to 2" high, apply 1/2 lb. nitrogen/ 1000 sq. ft. When 4 to 5" high, begin mowing at 1-1/2 to 2-1/2" high. Never allow grass to get so high that over 50% of the top growth is removed at one mowing. See Table 3 for fertilizer suggestions.

Table 3. Suggested Maintenance Fertilization for Cool-Season Athletic turf.

September 1*	October 1	March 1	April 15
12 lbs. 12-4-8**	1-1/2 lbs. N	12 lbs. 12-4-8	1/2 lb. N
25 lbs. 0-10-20 + 1 lb. N	1-1/2 lbs. N	1-1/2 lbs. N	1/2 lb. N.
25 lbs. 10-10-10		25 lbs. 10-10-10	

* Dates suggested are based on central Piedmont to Mountains. If cool season grasses are used east of Piedmont, do not put on the April 15 nitrogen.

** All rates are lbs/1000 sq. ft. Multiply lbs. x 43.5 to convert to acre basis.

(2) Warm-season grasses - When 1 to 1-1/2" high, apply 1/2 lb. nitrogen/ 1000 sq. ft. When 1 to 2" high, begin mowing at 1/2 to 1" high. Never allow the grass to get over 2" high. See table 4 for fertilizer suggestions.

Table 4. Suggested Maintenance Fertilization for Warm-Season Athletic Turf.

April 15*	Each 6-8 weeks between	August 15
12 lbs. 3-9-18**	1 to 2 lbs. N	12 lbs. 3-9-18
3 lbs. 12-4-8	10 to 15 lbs. 12-4-8	3 lbs. 12-4-8
12 lbs. 0-10-20 + 1/2 lb. N	1 to 2 lbs. N	12 lbs. 0-10-20 1/2 lb. N
12 lbs. 10-10-10	1 to 2 lbs. N	12 lbs. 10-10-10

*Dates suggested are based on upper Coastal Plain and eastern Piedmont. May be 1-2 wks. earlier in spring and later in fall in south and/or southeast, 1-2 wks. later in spring and earlier in fall in west and north.

**All rates are lbs/1000 sq. ft. Multiply lbs. x 43.5 to convert to acre basis.

(3) Aerification is essential where concentrated and frequent traffic occurs. Compacted, impermeable soils do not allow oxygen circulation and roots cannot live. The better aeration machines will remove a soil core 3/4 to 1" in diameter. Fields of cool-season grasses should be aerated in the spring (March-April) and again in the fall (prior to play). Aerate the field lengthwise twice and crosswise once. Pulverize plugs and redistribute with a drag mat (or remove plugs and leave holes open every other time). Fields of warm-season grasses should be aerified in the spring just before fertilizing, then again in midsummer (when grass is growing best).

(4) Verticutting may be necessary on bermudagrass, especially the hybrids. Verticut to remove thatch (dead, undecayed plant residue). Set blades just to cut the soil surface (no more than 1/4" deep). Run two ways as grass begins to green up in spring. Sweep up thatch and remove. Verticut again in midsummer and remove thatch if there is danger of smothering or shading grass.

(5) Irrigation of established grasses is different than for newly seeded or planted stands. Once established, water the grass deeply and infrequently. Water once a week so as to wet the soil 6 to 8" deep. Let the soil dry out before watering again.

(6) Weed control measures should be used in accordance with the particular problem. Consult the latest Agricultural Chemicals Manual.

(7) Insect and/or disease control programs are usually on a specific problem basis. Consult the latest Agricultural Chemicals Manual.

If an athletic field is to be renovated, it should be treated essentially as a new field. It should be constructed properly all the way. A layer of topsoil, sand or other material over original soil without mixing is potentially worse than the original soil. The roots of grasses will not grow through layers which impede water and air movement. Replanting without correcting the basic problems is a futile exercise.

NCSU TURFGRASS PROGRAM EXPANSION UPDATE

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The past year has been one of much activity for the turfgrass program at N. C. State University. A turfgrass research and extension fund has been established within the N. C. Agricultural Foundation. Monies are currently being solicited from all quarters of the industry for expanded support of the NCSU turf program. A top priority of this fund is the construction of a service building at the NCSU turfgrass field plots.

Many new research plots have been established at the turfgrass field plots during the last year. Currently, there are 45,000 sq. ft. of simulated golf greens and 5.5 acres of additional plots within the 8.5 acre facility. The installation of automatic irrigation is approximately one third complete. Additional plots include shade evaluations, roadside vegetation trials, tall fescue and Kentucky bluegrass selections, fertilization trials, phytotoxicity test areas, growth retardant evaluations, winter overseeding trials, and fall seeding trials of warm season grasses.

The NCSU Turfgrass Work Group looks forward to the year ahead as the turfgrass program here at NCSU continues to grow and develop. Continued cooperation and support from the turfgrass industry of North Carolina will ensure the success of the NCSU turfgrass program.

Turfgrass Cultivar Evaluations

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Since the climate of North Carolina is so varied from the cool-humid mountains to the subtropical southern coast, all species of turfgrasses that grow in the humid zones can be grown in the various areas of the state. The project has developed a "Cultivar Evaluation" program to collect strains of warm- and cool-season turfgrasses that have superior characteristics to the cultivars currently available.

The evaluation of the grasses have included ratings for uniformity, density, texture, growth habit, smoothness, and color; these varying with the type of grass, time of year, and purpose of use. The effect of cutting intensity, diseases, insects, and weed competition on different grass species, mixtures, and genotypes as to their adaptation has been evaluated. Very large differences have been noted between cultivars of the same species, and through observation and selection of those with better adaptation to the various test conditions, strains can be obtained that will be more successful. Of interest was the release of the new St. Augustinegrass cultivar 'Raleigh' by the NCARS in 1980. This was tested as NCSA-21, and exhibits extreme coldhardiness and is highly resistant to St. Augustine Decline caused by the SAD strain of Panicum Mosaic Virus. 'Raleigh' is also quite tolerant of moderate to heavy shade. In tests at Texas A&M, nodes of 'Raleigh' survived lower temperatures than any other variety, indicating the nodes enter a low temperature dormancy which has not been previously reported in St. Augustinegrass.

The initial screening program has led to regional tests within the framework of the Southern Turfgrass Work Group (STWG) and included cultivar tests on Kentucky bluegrass and tall fescue selections. The first tests were seeded in the fall of 1972, with 14 cultivars of Kentucky bluegrass and 6 of tall fescue. These tests were terminated in 1977.

A second STWG regional test on 19 cultivars of tall fescue was seeded in the fall of 1978, and following two years of data collection on quality, density and percent green, cold, drought, and shade tolerance, disease and insect resistance, several of the entries have a higher overall rating than the standard Kentucky 31 tall fescue cultivar. It is planned to continue this test through 1983. A national Kentucky bluegrass test was seeded in the fall of 1980 with 85 entries. This is a cooperative effort with eight of the Southern Turf Work Group states involved along with 27 other states through the coordination of the USDA at Beltsville. The same type data as with the tall fescue test will be collected and analyzed both by states and overall. In addition, selected cultivars from both tests were seeded under heavy shade in 1980. Since tall fescue and Kentucky bluegrass are two of the major lawn species used in North Carolina, the tests will provide a sound basis for recommending varieties.

North Carolina has over 400 golf courses, of which approximately 150 have bermudagrass greens that must be overseeded with cool-season grasses for use when the bermudagrass is dormant. The major species used for this overseeding are perennial ryegrass and red fescue, with some bluegrass and bentgrass frequently added, giving a total of over 450,000 pounds of seed used each fall. Since there is a major market for these seed in the South, a breeding program has been underway with the resulting large numbers of new cultivars coming on the market. Through cooperative efforts with the seed industry, most of the varieties are planned to be under test at the research plots. Data will be collected and furnished to the turf industry.

Southern Turf Work Group Regional Tall Fescue Test #2

Mean Turfgrass Quality Ratings of Tall Fescue Cultivars

Entry	1979			1980
	NC	13 Loc	Shade	NC
Kenhy	7.5 ad	5.7 fg	5.5	5.8
Monoco	7.2 de	5.5 g	--	4.7
PHB-1-S	7.2 de	6.0 cd	6.1	6.3
L-FA-Syn	6.9 ef	6.1 bc	6.5	6.5
AG-125	7.8 a	6.3 b	7.1	6.0
NJ-78	7.7 abc	6.9 a	6.8	6.7
Kenwell	7.3 be	5.9 de	5.9	6.3
Blend 36-1	7.3 be	5.9 de	5.1	6.3
K5-27	7.8 a	6.3 b	6.2	6.8
T-5	7.7 ab	6.8 a	5.8	7.2
Fawn	6.7 f	5.2 h	1.1	4.9
Ky 31	7.5 ad	5.9 de	6.3	6.4
Kenmont	7.4 ad	5.8 ef	6.1	6.3
Alta	7.2 de	5.2 h	--	5.2
Goar	6.2 g	4.4 i	2.7	4.8
Syn 16-1	7.3 bc	6.1 bc	5.7	6.1
KPG-1	7.4 ad	6.0 cd	5.7	6.5
TF-11	7.6 ad	6.0 cd	5.9	6.1
TF-25	7.6 ad	5.8 ef	5.3	5.7

Values followed by the same letter are not significantly different (DMR 0.05).

General Evaluation Trial
Winter Overseeding Study
1980-81 NCSU

Seed Entries

No.	Name	Source	No.	Name	Source
1	Diplomat P.R.	Lofts	19	CBS+Shadow C.F.	Turf Seed
2	Yorktown VI P.R.	Lofts	20	Citation P.R.	Turf Seed
3	R-40 P.R.	Lofts	21	CBS	Turf Seed
4	Barry P.R.	Lofts	22	CBS + Oregreen	Turf Seed
5	PHD	Intern.	23	Eton P.R.	Northrup King
6	Dixiegreen + Sabre	Intern.	24	Medalist 6	Northrup King
7	Elka P.R.	Intern.	25	Medalist 7	Northrup King
8	Dixiegreen	Intern.	26	Delray P.R.	Northrup King
9	No. 7812 P.R.	Intern.	27.	No. 79309 P.R.	Northrup King
10	Showboat Mix	Intern.	28	Goalie P.R.	Northrup King
11	Derby P.R.	Intern.	29	Dawson R.F.	Northrup King
12	Loretta P.R.	Scott	30	No. 79308 P.R.	Northrup King
13	Winter Turf III	Scott	31	No. 79307 P.R.	Northrup King
14	Blend 906	Scott	32	Regal P.R.	NAPB
15	Caravelle P.R.	Scott	33	Celebrity	NAPB
16	Winter Turf I	Scott	34	Celebrity Plus	NAPB
17	Blend 709	Scott	35	Legend 3+1	E. J. Smith
18	Legend Econo Mix	EJS			

Turfgrass Shade Studies

Tall fescue	Ky. bluegrass	Red fescue
Ky 31	Baron	Pennlawn
Rebel	Fylking	Fortress
Houn-dog	Kenblue	Ensylva
Lf-A-Syn-1	Glade	
Ks-27	Ram-1	Chewings fescue
Olympic		Banner
Falcon	Poa trivialis	Highlight
	Sabre	Jamestown
Hard fescue		
Biljart	Mixture	Perennial rye
FL-1	Ky-31 Kenblue	Derby

Temporary Golf Greens Evaluation
Winter Overseeding Study 1980-81
Raleigh Country Club

	Entry	Source
1.	Marvelgreen Supreme	Lofts
2.	Marvelgreen 3 + 1	Lofts
3.	Winter Turf I	O. M. Scott
4.	Winter Turf III	O. M. Scott
5.	CBS Blend	Turf Seed
6.	Legend	E. J. Smith
7.	Legend 3 + 1	E. J. Smith
8.	Medalist 7	Northrup King
9.	Medalist PED Mix	Northrup King

Golf Greens Evaluation
Winter Overseeding Study 1980-81
NCSU Faculty Club

	ENTRY	SOURCE
1.	Marvelgreen Supreme	Lofts
2.	Marvelgreen Supreme + Sabre	Lofts
3.	Marvelgreen 3 + 1	Lofts
4.	Winter Turf I	O. M. Scott
5.	Winter Turf III	O. M. Scott
6.	Legend Perennial	E. J. Smith
7.	Legend + Sabre	E. J. Smith
8.	Legend	E. J. Smith
9.	CBS Blend	Turf Seed

NEW DISEASES OF TURFGRASSES IN NORTH CAROLINA

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Several new turfgrass diseases have been identified in North Carolina during the last two years. Five of the new diseases have been identified on bentgrass golf greens on a few courses. These diseases are yellow patch, Ophiobolus patch, white patch, Fusarium patch and southern blight. Brown patch has been identified on Tifton 419 bermudagrass on fairways of several golf courses in the Raleigh area. Southern blight has caused serious damage on bluegrass on some golf course fairways in the mountains. White patch has also been identified on many tall fescue lawns that are one to two years old.

Yellow patch is the name that has been given to the disease that was previously called cool weather brown patch. This disease has developed on bentgrass golf greens for several years in the piedmont region of North Carolina during cool-wet weather in the winter. The symptoms of yellow patch are circular yellow to tan spots .5 to 2 feet in diameter that usually have a brown ring 1 to 2 inches wide around the spots. Sometimes only the brown ring is present after grass in the center of the spots recovers from the disease. The affected leaves may be chlorotic and yellow and not killed by the fungus. Relatively little information is available on control of this disease, but fungicides such as Daconil 2787, Chipco 26019, Tersan 1991, Fungo 50, Actidione-Thiram and Fore have controlled the disease in the Raleigh area. The symptoms often remain for several weeks following the fungicide application, probably because the bentgrass does not grow fast enough during the cool weather for the affected leaves to be removed by mowing. If the spots do not enlarge during cool-wet weather after treatment, the fungus probably has been controlled. The effects of this disease disappear soon after the bentgrass begins growing rapidly in the spring.

The fungus that causes yellow patch resembles Rhizoctonia solani, that causes brown patch in the summer, under the microscope and in culture. However, this fungus has been identified by Dr. Lee Burpee in a recent publication to be Rhizoctonia cerealis. One of the main differences between the two is that R. cerealis has two nuclei per cell. A rather delicate nuclear staining procedure and careful microscopic examination are needed to detect this difference. Fungi of this type have been isolated from many different types of turfgrasses in North Carolina throughout the year. The importance of these Rhizoctonia-like fungi on other turfgrasses is not known, but are being investigated by Mr. Bruce Martin in his Ph.D. thesis research at N. C. State University.

Ophibolus patch was identifed on bentgrass golf greens and tees on a new course in the mountains of North Carolina in 1979. The symptoms of this disease are large circular spots 1 to 3 feet in diameter that resemble small fairy rings in some spots in the spring and fall. The spots may turn yellow in early summer and then die later in the summer. The symptoms in hot weather may look like brown patch, but all of the grass in the spots will be dead. Bentgrass will grow over many of the spots during the fall and spring and some of the spots may develop in the same place for two or three years. Bluegrass will fill in spots on taller cut bentgrass on tees and fairways. This disease has been a problem for years in western Washington and has been reported recently in the northeastern United States. The fungus could have been introduced on the seeds and developed rapidly in the soil mixture used on the greens. This disease probably will not be a problem on older golf greens in the mountains. The unusually wet summer of 1979 probably was a major factor in this disease becoming a problem.

There is not a practical control known for Ophiobolus patch. Fungicides are usually not effective. Applications of sulfur to lower the soil pH in Washington has given some control, but this treatment would be difficult to use on the soils in North Carolina that already have a low pH. The disease will usually disappear after two to three years because of microbiological changes in the soil that are antagonistic to the fungus that causes the disease. This disease is identified by the symptoms, the presence of large black hyphae on the stolons, and black sexual reproductive structures (perithecia) and spores that form on the dead stolons in the fall.

White patch is a new disease that was identifed for the first time on new bentgrass golf greens in the summer of 1980. This disease was observed earlier in new tall fescue lawns throughout central North Carolina. The symptoms of white patch are circular white patches .5 to 2 feet in diameter that develop during hot-wet weather. The grass leaves are covered with white masses of the fungus and sometimes small mushrooms (1/4 inch or less in diameter) are attached to some of the dead leaves. Some of the plants in the patches are killed, but the bentgrass or tall fescue in the affected spots usually recovers during cooler weather in the fall. Broad spectrum fungicides should control this disease. This disease has not been observed on older bentgrass greens or in older tall fescue lawns. Good management to maintain proper fertility and lime levels should help overcome this disease.

Southern blight is a new disease that was first described on bentgrass golf greens in Wilmington, NC, in 1976. This disease was severe on some bluegrass fairways in Asheville in 1980, and was also identified on several bentgrass golf greens in the Asheville area. Symptoms on bluegrass and bentgrass are completely dead circular spots .5 to 3 feet in diameter that usually have a tuft of green grass in the center. The disease develops during hot-wet weather. White masses of mycelium and small yellow to brown sclerotia of the fungus, Sclerotium rolfsii, that causes this disease are usually present near the soil surface at the edge of the spots. Some of the symptoms of this disease may have been called Fusarium blight until the causal fungus was identified.

Southern blight has become a serious problem on cool season grasses in California and has been identified in Maryland. It has been difficult to control this disease with fungicides. Correspondence with Dr. Endo in California indicates that several broad spectrum fungicides are effective if drenched into the soil of affected areas. Southern blight has the potential of becoming a serious problem on bentgrass golf greens throughout North Carolina and on blue grass in the mountains. Sclerotium rolfsii causes diseases on many crops and vegetables throughout the southern United States.

Fusarium patch or pink snow mold develops on bentgrass or overseeded grasses in small spots 3 to 6 inches in diameter during cool-wet weather in the winter. The disease will develop rapidly under leaves if left on the grass for several days. The spots will enlarge from 1 inch to several inches in a few days and will have a gray appearance at the edge where the grass is rapidly dying. These symptoms resemble Pythium blight that occurs in the summer, and Fusarium patch may have been incorrectly called cool-weather Pythium in the past. Sometimes the center of the spots will have a pink color which is from the masses of spores and mycelium that the fungus produces. Fungicides such as Tersan 1991, Chipco 26019, Fungo 50, Fore and Calo-Clor can be used to control Fusarium patch.

Brown patch occurred in Tifton 419 bermudagrass fairways on several golf courses in the Raleigh-Durham area during cool-wet weather in the spring of 1979 and 1980. Symptoms of brown patch on bermudagrass are large circular brown areas 3 to 25 feet in diameter. The new shoots rot at the base near the stolon and the upper portion of the shoot dies quickly and becomes light brown to tan. The affected shoots can be pulled away from the turf very easily. New shoots continue to be produced, therefore all the bermudagrass in spots is not usually killed. The disease is not active in hot weather, but the affected spots are evident into the summer because the grass remains thin. The bermudagrass usually grows well in the spots later in the summer in hot weather. The fungus that causes this disease appears to be Rhizoctonia solani which is the same fungus that causes brown patch on cool season grasses in hot-humid weather. Fungicides such as Daconil 2787, Tersan 1991, Fungo 50, Chipco 26019, Fore or Actidione-Thiram should control this disease. Treatment may be needed if the disease is present on tees. Treatment of affected areas in fairways should depend on how unsightly the areas are and if the bermudagrass is being damaged to the point of causing a problem with summer weeds.

A few new diseases identified recently on turfgrasses have been described. As with all diseases, an accurate identification is needed before proper and effective control methods can be selected. If you observe new diseases and need help in identification, contact a turfgrass pathologist for help in identifying the pathogen and control recommendations. We can expect to continue to see new diseases in the future as microorganisms mutate and/or adapt to turfgrasses and as new turfgrass species are introduced into new areas of the state.

Promising Insecticides for Turf in North Carolina

R. L. Robertson
Extension Entomologist
N. C. State University

During the past three years, 1978-80, fifteen different insecticide active ingredients in a variety of formulations have been evaluated for control of various insect pests of turf. Not all insecticides or formulations were evaluated for all insect species, but the more promising ones were used in replicated tests for control of green June beetle grubs, southern masked chafer grubs, Japanese beetle grubs, the southern mole cricket, fall armyworm, black cutworm and ground pearl.

Presently four of the insecticides tested are registered for use against the fall armyworm, four against cutworms, three against mole crickets and four against grubs.

Promising new materials or formulations for control of turfgrass insects in North Carolina are:

a. Green June beetle grubs
   1. Ficam
   2. Oftanol
   3. Dasanit
   4. Sevin baits and granules

b. Japanese beetle grubs
   1. Oftanol
   2. Dasanit
   3. Ficam

c. Southern masked chafer grubs
   1. Oftanol
   2. Dasanit
   3. Ficam

d. Southern mole cricket
   1. Sevin baits
   2. Dyfonate

e. Black cutworm
   1. Larvin
   2. Methomyl (Lannate/Nudrin)
   3. Synthetic pyrethroids

f. Fall armyworm
   1. Larvin
   2. Methomyl (Lannate/Nudrin)

g. Ground pearl
   1. None

With the presently registered insecticides, the professional turf manager has an adequate arsenal to control most of the important foliar feeding pests such as sod webworms, armyworms, cutworms and chinch bugs. Additional registrations for presently labeled insecticides or the development of new ones are needed to provide turf managers with the tools adequate for control of many soil pests such as mole crickets, Japanese beetle grubs, masked chafers and green June beetle grubs. If the aforementioned insecticides become available, most of these gaps will be filled. Unfortunately, no material available commercially or experimentally shows promise for control of ground pearls, a major pest of centipede grass.

NEW TURF HERBICIDES

METRIBUZIN FOR PREEMERGENCE AND POSTEMERGENCE CONTROL OF CRABGRASS AND GOOSEGRASS IN BERMUDAGRASS TURF

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Raleigh, N. C.

Studies with metribuzin (Sencor) in 1980 were designed to define minimum rates for effective preemergence control of smooth crabgrass [Digitaria ischaemum (Schreb.) Muhl.] and large crabgrass [Digitaria sanguinalis (L.) Scop.], postemergence control of smooth and large crabgrass and goosegrass [Eleusine indica (L.) Gaertn.] and for maximum safety to three bermudagrasses [Cynodon dactylon (L.) Pers.]. A preemergence application of metribuzin at the minimum rate of 0.75 lb active/A controlled large and smooth crabgrass throughout the season with minimum injury to common bermudagrass. Two postemergence applications, 7 to 10 days apart, of metribuzin at 0.38, 0.5 and 0.75 lb active/A resulted in 79 to 100% control of smooth and large crabgrass and goosegrass with goosegrass being the most sensitive. Metribuzin + MSMA (monosodium methanearsonate) at 0.125 + 2 lb active/A applied twice controlled 99 to 100% of the smooth and large crabgrass and goosegrass and was only slightly more effective than two applications of MSMA at 2 lb active/A or of metribuzin at 0.5 lb active/A. Common bermudagrass was the most tolerant to metribuzin, Tifgreen showed more discoloration and Tifway the most. Postemergence treatments causing minimum discoloration in common bermudagrass were two applications of metribuzin at 0.38 or 0.5 lb active/A and two applications of metribuzin + MSMA at 0.125 or 0.25 + 2 lb active/A, in Tifgreen two applications of metribuzin at 0.38 lb active/A or two applications of metribuzin at 0.125 + 2 lb active/A and in Tifway two applications of metribuzin + MSMA at 0.125 + 2 lb active/A.

TURFGRASS MANAGEMENT AND PHYSIOLOGY RESEARCH UPDATE

Joseph M. DiPaola
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Turfgrass management and physiology research efforts currently encompass several varied projects. Studies are underway into the low temperature tolerance of warm season turfgrasses. This investigation necessitated the construction of a low temperature stress simulator. The object of this project is to determine the influence of various cultural practices on the cold hardiness of the warm season turfs throughout the winter.

Tifway and Tiflawn bermudagrass are included in tests designed to determine the effects of cultural practices on the Spring rooting of these turfs. Treatments under investigation include mowing, soil coring, and nitrogen and potassium fertilization at six dates during the Spring.

The use of sulfur coated urea fertilizers and the treatment of localized dry spots are being studied on golf greens located at the NCSU Turfgrass Field Plots. Testing of SCU fertilizers includes five sources at three rates of application. Penncross creeping bentgrass and both Tifgreen and Tifdwarf bermudagrass greens are being evaluated in this test. Several wetting agents, as well as such cultural practices as soil coring and the use of hydrated lime are being examined for potential use in the treatment of localized dry spots.

Low maintenance plant species are being evaluated as to their suitability and adaptability along North Carolina's roadsides. Trial plantings are located in each NCDOT division. Growth retardant chemicals are also being tested for use along roadsides. This study includes both tall fescue and bahiagrass turfs. Treatments include chemical type, rate and application date.

These various investigations highlight the turfgrass management and physiology research efforts currently in progress at N. C. State University. Each of these studies seeks to provide the information needed for the better management of quality turfs in an efficient manner.

RECERTIFICATION OF COMMERCIAL PESTICIDE APPLICATORS

R. L. Robertson
Extension Entomologist
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Raleigh, N. C.

You may recall that five years have flown by since we went through the initial training and subsequent licensing of pesticide applicators. Both state and federal regulations require some type of retraining or recertification after five years. I will try to bring you up to date on this.

The N. C. Pesticide Board has recently approved a recertification plan for commercial pesticide applicators, public operators and consultants. The plan gives these ground applicators three options for renewing their certification during a 5-year period in order to be relicensed for the sixth year.

The three recertification options are (1) completion of approved Continuing Certification Credit (CCC) requirements in the pest control category in which the individual is certified and desires to retain certification (a CCC is one hour of approved training) or (2) participation in one or more training sessions during the recertification period and satisfactory passing of a comprehensive written examination or (3) passing of a comprehensive written examination. The credits required for option (1) in each pest control category for ground applicators are as follows:

Aquatic	6	Ag. Pest Animal	6
Public Health	6	Ag. Pest Plant	10
Forest	6	Ornamentals-Turf	10
Right of Way	4	Seed	3
Regulatory	6	Demonstration Research	10

Aerial applicators must complete 4 credits/2-year period in order to be licensed for the third year.

Persons desiring to retain certification in more than one pest control category must complete the credits for the category carrying the highest requirements plus 3 credits for each additional category. Persons certified in more than one category may complete any combination of the above options as long as one option is completed for each category. Individuals will not be allowed to carry over CCC's from one recertification period to another.

Credits must be approved by a Recertification Credit Committee consisting of 6 members - one member from the NCDA Pesticide and Plant Protection Division, two members from the N. C. Agricultural Extension Service, one member from an educational institution not otherwise represented and one member each from the Pesticide Board and Pesticide Advisory Committee that do not represent either NCDA or Extension.

The N. C. Agricultural Extension Service in cooperation with other pesticide related organizations is preparing training programs to meet the training requirements in options 1 and 2 and study materials needed for all three options.

THE TURFGRASS COUNCIL OF NORTH CAROLINA, INC.

The Turfgrass Council of North Carolina is a Non-Stock Association incorporated under the laws of the State of North Carolina as contained in Chapter 55A of the General Statues of North Carolina, and is tax-exempt under I.R. Code Section 501(c):(5).

PURPOSES AND OBJECTIVE

The purposes of the Turfgrass Council are: (1) to promote the Turfgrass industry in North Carolina; (2) to encourage further study and research in turfgrasses; (3) to analyze and disseminate information relating to turfgrasses in the State; (4) to represent the turfgrass industry in matters of polcy; (5) to do everything necessary to carry out the above activities. The objective of the Turfgrass Council is to help obtain the best turf possible for lawns, golf courses, athletic fields, parks, cemeteries, and roadsides throughout North Carolina.

ACTIVITIES

The annual North Carolina Turfgrass Conference is one of the major activities of the Turfgrass Council. The Conference is sponsored by the Turfgrass Council and North Carolina State University. The Conference seeks to provide all persons interested in turfgrasses the opportunity to keep up-to-date with the new trends and practices. A newsletter is published regularly by the Turfgrass Council to inform its membership of its activities and turf related programs in the state. Turfgrass research and scholarship programs in North Carolina receive financial commodity group support from the Turfgrass Council. A Turfgrass Research and Extension Fund has been established with the Agricultural Foundation at N. C. State University to obtain additional funds for research and extension programs on turfgrasses in the state.

MEMBERSHIP

Memberships are available to individuals interested in turfgrasses, representatives from turf-related organizations, and sales representatives from commercial companies for $10 per year. The Turfgrass Council encourages all persons engaged in any phase of the turfgrass industry in North Carolina to become members. A large membership from turf-related areas will help promote extension, research, and educational programs on turfgrasses throughout North Carolina. Write to: Turfgrass Council of N.C., Inc., P. O. Box 5155, Raleigh, NC 27650 for membership information.

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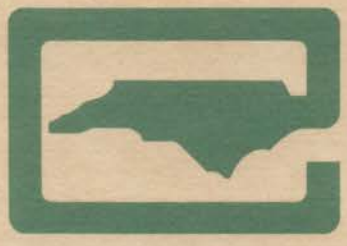

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Published by
THE NORTH CAROLINA AGRICULTURAL EXTENSION SERVICE

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