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PREFACE

Proceedings of the 21st Annual North Carolina Turfgrass Conference are being provided to those who attended as a permanent reference of the conference. The 1983 conference was held at the Pinehurst Hotel in Pinehurst, N. C., on January 4, 5 and 6. Sessions with general turf topics and concurrent sessions for golf course, lawn care and general turf topics were scheduled. The attendance at the conference was 566 people.

Special thanks are extended to everyone who helped make this conference successful. Each speaker is to be commended for his excellent presentation and for providing a written summary for the proceedings. The Annual Turfgrass Conference was 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 following committee members contributed to the success of the conference.

CONFERENCE CHAIRMAN - Dr. W. B. Gilbert

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The 1984 North Carolina Turfgrass Conference will be held again in Pinehurst, N. C., in January.

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Additional copies of the proceedings are available at $5.00 each from Dr. L. T. Lucas, Department of Plant Pathology, N. C. State University, Raleigh, N. C. 27650. Make checks payable to The Turfgrass Council of North Carolina.

TABLE OF CONTENTS

THE 1980'S - A DECADE OF CHALLENGE FOR THE TURFGRASS INDUSTRY

by
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It is appropriate at the start of a new decade to pause and reflect on our past before projecting into the future. In 1980 we celebrated the historic 150th anniversary of a major event in the evolution of turfgrass culture. Mr. Edwin Budding invented the first lawn mower in 1830. It was a reel design, with catcher, which was built in a shed and tested on a nearby grassy area at night in order to maintain secrecy before patenting. The manufacturing rights were obtained by Ransomes Manufacturing, which sold 1,000 units by 1850. The next benchmark was 50 years later in 1880, when the first powered mower was developed. It cut a very narrow swath and was steam-driven, but unfortunately weighed 1-1/2 tons. Then in 1900, the internal combustion engine was introduced in a powered mower. The electric mower was introduced in 1925. During this period in the development of the turfgrass industry, most approaches to turfgrass culture evolved as an art through trial-and-error methods.

The year 1950 marked the start of our greatest advances in the science of turfgrass culture. Both land grant universities and private industry devoted major research efforts toward solving the problems of turfgrass culture and developing a set of scientifically based principles. As a result, the 1960's and 1970's have been a Golden Era in the use of quality turfs, the development of professional turf managers, and the generation of research information concerning the science of turfgrass culture. We can be proud of these accomplishments. However, many of these advances in turfgrass culture were based on cheap, abundant resource inputs. This is a trend which cannot continue.

What can we anticipate in the 1980's? Projecting into the future is a risky occupation, but, it can serve as a useful guide so that we can prepare for the future - even if the projections are not entirely correct. The remainder of this paper will address the six major areas of concern for the 1980's: energy, water, pesticides, nutrients, equipment and manpower.

ENERGY

The news media bombard us daily with the energy problems of our country. They are real, but I am confident that man has the capability, through the ingenuity of the human mind, to develop alternate energy sources which will replace many of the roles now fulfilled by oil. However, these future energy sources will be available at a higher cost. As a result, energy conservation will be a high priority for the turfgrass industry in the 1980's. What are the trends?

1. Mowing - Increased use of reel mowers as they are cheaper to power than rotary units. A trend towards larger, more mobile mowing equipment.

2. Fertilization - Lower rates of nitrogen application, coupled with an acceptance of a less green color.

3. Irrigation - Increased pumping costs could lead to a trend towards more efficient, lower pressure heads.

4. Equipment - There is also the impact of higher energy costs on the basic purchase price of equipment, pesticides, and fertilizers, which is further amplified by our current high inflation rate. A partial solution is continuing emphasis on increased efficiency, which translates to cost control.

WATER

I believe that water is the greatest problem facing the turfgrass industry. Energy will be available at a price. Water availability problems will not be limited to the more arid regions, but will also be a problem facing the urban areas in the more humid, high rainfall regions during periods of extended drought. There is also concern for water quality as well as actual availability. Salinity is an increasing problem where effluent water is used, in arid regions, and along coastal areas such as Florida and Texas where salt water encroachment is occurring as ground water supplies are pumped out.

Far too many intensively maintained, high quality turfs are now over-watered. Studies have indicated that as much as a 50% savings in water use could be achieved by simply applying the cultural practices now known. Over-watering not only wastes water, but also leads to increased disease, soil compaction, weed, and nutrient leaching problems. The good turf manager of the future will have the capability of making the very difficult decisions involved in proper irrigation practices. The turf manager who maintains a green, high quality turf by a philosophy of maintaining constant water supplies in the soil through over-watering will become obsolete. In summary, what are the trends that can be anticipated?

1. Less water available for turf use.

2. Higher costs both for water and for pumping.

3. Increased use of effluent water.

4. Declining water quality.

5. Water allocation, as has already occurred in certain areas of California, even with landowners who possess private wells.

Again, the solution is conservation. It involves better designed and installed irrigation systems as well as the implementaion of more efficient watering practices by the turfgrass manager. In the future, research will hopefully be able to develop improved turfgrass cultivars which will have lower water use rates, improved drought tolerance, and a better ability to grow in saline soils.

PESTICIDES

Some individuals have been guilty of misuse of pesticides in the past. There was a need for use restrictions and educational programs to avoid potential problems in the future. This resulted in formation of the Environmental Protection Agency whose primary emphasis to date has been on environmental impacts. We have seen the elimination of many pesticides which are not rapidly biodegradable. The lack of persistent soil active insecticides, such as the chlorinated hydrocarbons, has led to a substantial increase in white grub problems across the United States. Now, more costly control programs and diagnostic procedures must be developed through integrated pest management programs to alleviate this and similar pest problems in the future.

Governmental controls have also greatly increased the cost of developing and registering a new pesticide. Knowledgeable specialists in this field indicate that there may be no new pesticides developed specifically for turf use in the future. Most pesticides that do become available for turf use will be spinoffs from the agricultural industries. Thus, during the 1980's we may have only two to four prominent new turf pesticides developed. At the same time, the EPA may remove registration approval for more turf pesticides than that. There is also the problem of escalating costs for pesticides.

What are the trends?

1. Few pesticides available to the turf industry.
2. Costs increasing substantially.
3. Tighter controls on pesticide use.
4. Emphasis on selective control rather than broad spectrum applications.
5. Increasing employee awareness regarding safe handling of pesticides through training programs.

In summary, we will need increased efficiency when applying pesticides, yet retaining adequate safety standards. Pesticide usage will be practiced only as needed to control a serious, threatening problem pest.

NUTRIENTS

For the most part, fertilizers will be subjected to the same trends as pesticides. That includes increased cost, more restrictions on use, and reduced application rates. Lower nitrogen levels will be used along with increasing rates of iron and potassium application relative to the nitrogen application rate. This translates to a more controlled shoot growth rate. Through research, there will be further improvements in the development of slow release nutrient carriers to extend the longevity of release and thus reduce nutrient leaching losses. Emphasis on maximizing the efficiency of nutrient utilization will also be acheived through other techniques such as the use of mulching mowers for recycling of nutrients. Research will also

emphasize the development of cultivars with lower nutrient requirements, yet at the same time retaining their important functional characteristics.

EQUIPMENT

Information from leaders in the equipment field indicate no major innovative breakthroughs in mowing equipment can be anticipated in the 1980's. Such statements may be dictated by the need to maintain secrecy even if there were some innovative concepts in the formative stages. Trends that are indicated include increased use of mulching mowers, better equipment for improved efficiency in pesticide and nutrient application, and increased use of diesel engines. All turfgrass equipment will experience a substantial increase in cost throughout the 1980's. Thus, there will be even greater emphasis on extending the operating life of this equipment through good preventive maintenance. Such programs translate to the hiring of a well trained mechanic and the development of training programs for employees to insure proper equipment operation and maintenance procedures that will maximize the operating life of each unit.

MANPOWER

The previous five areas of concern have all focused on the need for better trained professional turf managers. They must possess the needed formal knowledge followed by adequate experience to implement the previously mentioned operating efficiences and conservation of resources. The job opportunities and salaries for such individuals will be better in the 1980's than ever before. Prospective turf managers also will be better educated than before in terms of formal degree programs. Adult educational activities such as state and regional turfgrass conferences will also play an ever increasing role. Finally, individual turf managers must increase their efforts in developing on-the-job training programs for their employees.

SUMMARY

The key theme throughout the paper is efficiency. This focuses on management, and more specifically, the turf manager. There must be a constant vigil to seek efficiencies in the use of energy, water, pesticides, and labor. Through these efforts, the turf manager will be able to exercise cost controls that will provide a functional, adequate quality turf for the user at the most economical cost and investment in non-renewable terms.

There is also a second key - research. Research will develop new cultivars that will possess a slow vertical shoot growth rate, low water use rate, minimum nutrient requirement, drought hardiness, wear tolerance, disease and insect resistance, and green color retention at low fertility levels. This research will be critically needed by the turfgrass industry during the 1980's and 1990's. All professional turf managers should do their part by articulating and working for the support of research programs around the country.

Some might interpret this paper as being a doom-and-gloom position. It is not intended to be that at all. It is intended as a realistic

assessment of the situation which will stimulate thought on what adjustments need to be made to meet the needs for our changing times. We cannot continue to do things the same way we have for the past 20 or 30 years. We can continue to provide functional, quality turfs for the user which contribute so much to our quality of life in the United States. Achieving this will require more well trained, motivated turfgrass managers than ever before. Thus, from an employment perspective, the demand for good turf managers rather than just "grass cutters" will be greater than ever before. The challenge will be great, but achievable. The future offers excellent opportunities for the well trained, conscientious turf manager.

TURF AND THE QUALITY OF LIFE

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What value do we place on turfgrasses? As turf managers, can we justify the many dollars and hours of labor expended for turf maintenance? How many of us can list and explain the many attributes of turfgrasses and their importance in our lives? It should be common knowledge among turf professionals that North Carolinians spend an estimated $400 million dollars a year for turf maintenance. Turfgrass managers and those in related industries must be capable of justifying the cost of turf. Turf professionals cannot afford to be complacent and assume a common understanding on the part of the public, particularly politicians, of the many varied contributions of turfs in our daily lives.

Grasses, including turfgrasses, have long been associated with man. Given man's dependence on grasses, particularly as a food source, it is surprising that these plants are so poorly appreciated by the general public. The ubiquitous nature of turf has contributed to the public's tendency to take it for granted. A. S. Hitchcock (1931) stated that "the grasses are the least noticed of flowering plants. They seem to be taken for granted, like air and sunlight, and the general run of people never give them a thought." In the United States, turf is probably the most widely grown, talked about, and least appreciated commodity (ASA Mon. 14. 1969).

Dr. Coleman Ward perceptively noted that turfs are the canvas on which the landscape and associated buildings are placed. How often have we commented on the attractiveness of ornamentals or the architecture of buildings without noting the value and importance of the surrounding turf? Most of us have probably heard someone commenting that they were going to replace the lawn with green cement. When tried, this alternative is usually a short lived solution. The resulting heat, glare, cracking cement, peeling paint, and dying trees clearly evidence the previously unappreciated values of a turf.

Turfgrasses contribute significantly to the quality of our lives through aesthetics, recreation, safety, environmental quality, and economics. The aesthetic value of turf is expressed through their use in and around airstrips, cemeteries, churches, commercial buildings, fairgrounds, residential landscapes, gardens, orchards, parks, public buildings, roadsides, sports fields and complexes, and zoos. Psychologically, turfs and ornamentals provide an environment conducive to mental relaxation and therapeutic diversion. A 1971 Life magazine survey reported that 95% of respondents indicated one of the things they wanted most was "green grass and trees around me." Most of us can agree with A. S. Hitchcock (1931) that the love of a green sward is born in

us. Many grasses, including turfgrasses, are utilized as ornamentals directly (Table 1). One example of this are the dried arrangements of grasses often used to decorate homes and offices.

Table 1. Genera of the ornamental grasses.

Acorus	Chusquea	Lagurus	Sasa
Aegilops	Coix	Lamarckia	Schizachyrium
Agrostis	Cortadera	Leersia	Sesleria
Aira	Cymbopogon	Melica	Setaria
Alopecurus	Cynodon	Mibora	Shibataea
Ampelodesmos	Dactylis	Milium	Sisyrinchium
Andropogon	Deschampsia	Miscanthus	Sitanion
Apera	Echinaria	Molinia	Sorghastrum
Aristida	Elymus	Nadina	Sorghum
Arrhenatherum	Eragrostis	Oplismenus	Spartina
Arundinaria	Erianthus	Oryza	Stenotaphrum
Arundo	Festuca	Oryzopsis	Stipa
Avena	Glycera	Panicum	Tripsacum
Beckmannia	Gynerium	Pennisetum	Triticum
Bothriochloa	Hakonechloa	Phalaris	Uniola
Bouteloua	Helictotrichon	Phragmites	Zea
Briza	Holcus	Phyllostachys	Zizania
Bromus	Hordeum	Poa	
Calamagrostis	Hystrix	Polypogon	
Chasmanthium	Imperata	Rhynchelytrum	

The recreational utility of turf is often readily acknowledged by many. The resiliency and durability of turfgrasses adds much to the quality of play and safety of many sporting events. Some of the various sports which utilize turf are listed in Table 2. Recently, many artificial turf facilities have been replaced with natural turf for safety, economic, and environmental considerations.

Table 2. Sporting events that utilize turf as a playing surface.

Archery	Football	Lawn bowling	Soccer
Badminton	Frisbee	Lawn darts	Softball
Baseball	Golf	Playgrounds	Steeple chase
Cricket	Horse racing	Polo	Tennis
Croquet	Horseshoes	Rugby	Tetherball
Field hockey	Lacrosse	Skiing, lawn	Track and field
		Skiing, snow	Volleyball

Though not often considered, turfgrasses often enhance the safe utility of landscapes. Glare reduction near buildings, and along roadsides and airstrips through the use of turf and ornamentals will reduce eye strain. Turfs provide stable and uniform emergency stopping areas around roadsides, race tracks, and airstrips. The use of turf in this manner helps to protect both people and their property. Turf plays a unique landscape role in the design of sites where security considerations are of particular importance. Prison grounds and military facilities are good examples of such an application. Vandals and unauthorized personnel are more easily spotted on open turf than in wooded or ornamentally landscaped grounds. Healthy lawns are not likely to support a fire. As already noted, natural turfs can help reduce the number and severity of injuries compared to artificial turf.

The quality of the environment has been of much concern to many around the world. Turfgrasses do improve the quality of the environment in several ways. Turf and ornamentals help moderate temperatures near buildings and other urban settings. Temperatures above a turf can typically be 15 to 20 °F lower than that above paved surfaces because plants absorb radiation and convert it to food through photosynthesis, turfs scatter radiation due to their rough surface, and evapotranspiration is a cooling process.

Grasses have long been recognized for their ability to minimize soil erosion due to the action of air and water. Dust and mud control around homes and businesses is not only a convenience, but can lengthen the life of certain equipment. The proper placement of turf and ornamentals can do much in the way of reducing the noise of many urban sites.

Sanitary landfills have been successfully converted to useful landscapes using turfgrasses. Industry Hills and the Mountain Gates Country Club, both in California, are two excellent examples of such land reclamation.

As plants, turf uses CO_2 and release oxygen. One estimate noted that 25 square feet of turf yields enough oxygen to meet the needs of an average person for a day. Additionally, turfgrasses absorb toxic emissions, particularly along roadsides. Many pests such as snakes and rodents do not prefer turf as a habitat, while mowing reduces the pressure of certain objectionable weeds such as pokeweed and poison ivy.

The economic value of turf is not always easily documented. Turfgrasses provide an inexpensive, durable cover, and improve soil productivity for later use. Turf is typically easier and less costly to maintain than flowers and other ornamentals. A high quality, well maintained turf can significantly increase the resale value of homes and businesses. Sales are also often accomplished more quickly with a properly landscaped site.

Turf professionals have many options in terms of occupational choices (Table 3). Many industries are involved in turfgrass management. Some of these such as journalism, irrigation design, and equipment sales and manufacture are not often remembered.

Table 3. A listing of selected turf and turf related occupations.

Consultants	Lawn care
Equipment manufacturers	Lawn service firms
Fertilizer manufacturers	Lime production
Garden stores	Pesticide manufacturers
Golf course operations	Research
Irrigation installation and design	Seed firms
Journalism, newsletters, etc.,	Sod production
Landscaping/construction	Turf management, parks, etc.

Undoubtedly other turfgrass contributions to the quality of our lives can be added to those already discussed. Let us not be guilty of taking turf for granted. More importantly, let us work towards enlightening the general public of the importance of turf in their daily lives.

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WEATHER, CLIMATE AND THE NORTH CAROLINA TURFGRASS INDUSTRY

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There are few elements that have as large an impact upon the growth and quality of turfgrasses as day to day weather does. The amount and distribution of rainfall, the extremes of temperatures, the amount of evaporation, and the duration of sunshine are but a few of the critical weather parameters that affect the life of grasses. Accurately predicting these pieces of weather information is the job of the meteorologist.

Today it is very difficult for the man on the street to discern which forecasts come from which source. On one radio station he hears the ACCU-Weather forecast, on another he hears the forecast from the National Weather Service. Hopefully the two will be closely alike, and most of the time they are. Whatever the source, a standard weather forecast contains certain pieces of information that are important to the turfgrass owner. For purposes of simplification, we will deal with the forecast issued by the National Weather Service (NWS) whose products we use in the Agricultural Weather Office, and whose forecast most of you hear daily.

First, and probably of greatest interest to most people is the probability of precipitation. Some think of this as the percentage of the day it will rain, or the percentage of a particular area that will receive precipitation. Actually, it refers to the probability that any given spot within the region forecasted for will receive measurable (.01" or more) precipitation. It is derived from statistics generated by computer models at the National Meteorological Center in Washington, D.C., and by the judgment of the meteorologist.

Another important element in forecasts that affects everyone is the temperature. Weather forecasts are made for various zones in the state, with projected maximum and minimum temperatures given for the coming 36 to 48 hours. Important to note here is the large variation in low temperatures which is possible over just a few miles, depending on terrain. Temperatures may vary by as much as 15 degrees from adjacent urban and rural settings, and this is particularly noticeable on clear, calm nights.

Other elements in forecasts include wind speed and direction and the amount of cloudiness expected. While important, this information along with precipitation probabilities and expected temperatures is insufficient to meet the needs of most agriculturalists, including those in the turfgrass business. Recognizing this need, the North Carolina Agricultural Weather Program was started in 1979.

The Ag. Weather Program consists of two agricultural meteorologists, one secretary, and several pieces of weather equipment. We are housed in the Horticulture Department at N. C. State in Raleigh, providing easy access to other commodity specialists at the university.

Our primary mission is to produce twice daily agricultural weather advisories, which include information such as soil temperatures, spraying conditions, drying conditions, and pest forecasts that are not contained in a standard weather forecast. The advisory can be heard over any of the nine NOAA Weather Radio stations in the state and over many commercial radio and TV stations. It is produced Monday through Saturday. For a more complete listing of weather radio stations and a description of weather radios available, please pick up one of the brochures entitled "North Carolina Agricultural Weather Program" that are available here today.

I hope that this has been helpful in obtaining a better understanding of what a regular weather forecast is and how our agricultural weather advisories can be a great aid in deciding whether it is a good time to plant, or fumigate, or spray, for example. Weather forecasting is still far from an exact science but great progress has been made the last few years. The current national average for correct two day NWS forecasts is about 84%, which is certainly better than flipping a coin. The three to five day forecasts are also becoming increasingly more accurate, containing valuable information about any expected precipitation during the period and forecast high and low temperatures. This can be a great aid in planning your operations, and we attempt to incorporate this longer range information into the agricultural advisory, as well.

With this forecast information in mind, what I would like to do now is to take a somewhat general look at North Carolina's climate and some of the special weather situations that frequently affect our state.

North Carolina has several unique topographic features which make our climate what it is. First, is the proximity to the warm waters of the Atlantic Ocean. Second is a north-south mountain range on our western border. Third is our latitude, and fourth is our position on the North American continent. These are not necessarily in order of importance, with each playing a key role in our weather.

North Carolina sits at approximately the same latitude as south central California, and yet our weather is decidely different. Because we are on the east coast rather than the west, and weather systems most frequently move west to east across the continent, we feel the effects of cold, arctic air masses moving southeast out of Canada in the winter, as well as the hot, humid flow of air out of the Gulf of Mexico and off the Atlantic in the summer. This makes our weather much more extreme than California locations at our same latitude.

We do see modification of air as it moves east over the mountains, though. Frequently, moisture is deposited on western or southern flanks of the mountains, making some mountain and all Piedmont locations relatively dry in comparison. Also, cold air from the midwest is often times modified by the time it crosses the mountains, making our absolute lowest temperatures somewhat milder than places in Tennessee or Kentucky. Here we also see the influence of the Atlantic, with warm ocean water keeping coastal sections, in particular, from dropping to very low levels.

Weather systems tend to develop where there is energy available and where there is a contrast in temperature. Thus, the east coast of the U.S. is one of the primary areas where storm development occurs. The warm waters of the Gulf Stream and the colder air to the west over land combine to produce some very strong low pressure systems just offshore of the Carolinas at least several times each year. These storms are characterized by strong northeast winds over the state, considerable precipitation (especially along the coast), and frequent beach erosion. If the air to our north is cold enough, this often results in moderate to heavy snows over the eastern counties, as was the case in the winter storm on March 2, 1980.

Western sections of the state receive most of their precipitation from storm systems that track eastward over Georgia and South Carolina, often producing heavy rains during the winter and spring months over the southern mountains. With southerly to southeasterly winds ahead of a low pressure system, it brings copious amounts of moisture northward out of the Gulf of Mexico which is deposited over the southern mountains, leaving little moisture for locations on the north side of the mountains. As a result, Highlands in the southern mountains receives over 80 inches of precipitation annually, making it the wettest spot in the U.S. outside of the Northwest coast, while just to the north near Asheville less than 40 inches per year is normal--making the wettest and driest spots in North Carolina only 80 miles apart!

The variability in climate as one goes west to east across the state shows up very well in a map of the length of the freeze-free season. While northern mountain locations such as Banner Elk have less than 150 days between frosts normally each year, Cape Hatteras averages over 280 in its subtropical climate.

A map of average January temperatures also shows great variability. While the mean (average of maximum and minimum) temperature is barely above freezing in the northern mountains, southeastern coastal areas are near 50 degrees. Summer temperatures show the same range, with a difference of nearly 15 degrees between higher mountain and Coastal Plain locations. This directly affects what types of turf can be grown in any given area, as you are well aware.

While North Carolina generally enjoys adequate precipitation for turf growth, you are all aware that this is not always true. 1980 was a good example of an extremely dry summer, which was compounded with extremely hot temperatures. And even in years when rainfall is at or even slightly above normal there are almost always periods of dry weather. It is the distribution of precipitation, then, which is often a more important factor.

A graph showing precipitation and evaporation through the year shows: 1) Precipitation is fairly uniform throughout the year, with a slight peak in the summer and a minimum in October and November, 2) Evaporation varies with the sun, being a minimum around the first of the year and reaching a maximum in early July, and 3) That most of the year moisture is in excess, but normally in the spring and again, to a lesser extent in the fall, evaporation tends to exceed precipitation. These times of the year are when forest fire danger is normally the greatest and when soil moisture is most lacking.

However, one can see that if precipitation was reduced even slightly during the hot summer months, evaporation would be significantly higher than precipitation, leading to severe moisture stress. This is indeed what we see during rain-free periods in the summer--soils dry out very quickly and irrigation becomes necessary. We attempt to provide some general long range weather information for irrigation scheduling pruposes in our ag. weather advisories, but specific weather data for the site in question is necessary to make an accurate determination.

This has hopefully provided an overview of North Carolina's weather and climate and the North Carolina Agricultural Weather Program. We are here to serve you and value your questions, suggestions, and support.

DIAGNOSING AND REPAIRING WINTERKILL

by
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Now is the time to start considering a strategy should turfgrass damage occur during the winter. Winterkill encompasses all types of damage that occur to turfgrasses during the winter period. It can occur on both warm and cool season turfgrasses, primarily in the norther portions of the warm season and cool season climatic regions for each group of species, respectively. The major types of witner injury are (1) desiccation, (2) direct low temperature, (3) low temperature diseases, and (4) traffic effects. Note that ice sheet damage caused by the hypothetical oxygen suffocation or toxic gas accumulation underneath an ice sheet is not listed. Winter injury associated with an extended period of ice coverage more commonly occurs during the freezing or the thawing period when standing water increases the crown tissue hydration level. Subsequent injury of the turfgrass plant results if temperatures drop rapidly to below 20^{o} F.

Winter injury of turfs is difficult to interpret because it results from interaction of a number of different environmental, soil, and cultural factors. If winter injury is suspected, the turfgrass manager should first determine (1) that actual injury has occurred to the turf, (2) the specific cause of injury, and (3) the specific turfgrass species, soil condition, or cultural practices which need to be adjusted to minimize the chance that injury will occur again in the future. Guidelines in making these assessments are presented in the accompanying tables.

ASSESSING THE EXTENT OF WINTER INJURY

As more favorable temperature and moisture conditions occur signaling the initiation of spring greenup one needs to assess whether winter injury has occurred. This is necessary so that the appropriate renovation and replanting steps can be initiated as soon as possible. In this regard, lead time is required to plan and purchase the appropriate planting materials and to prepare the needed equipment. Two diagnostic approaches can be utilized.

There is one diagnostic technique which can be done well in advance of greenup. It involves collecting 5 to 8 turf plugs from areas where winter injury is suspected and placing them in a greenhouse or under similar conditions of favorable light, temperature, and moisture so that greenup of the surviving turf can be initiated artificially. This gives an indication of the potential turf survival of the area, assuming a representative set of turf plugs have been collected. This approach is an ideal biological indicator which the turf manager can utilize to obtain an early assessment of the degree of turfgrass injury that has occurred.

A second approach is to collect individual plants from the turf being assessed for winter injury. The diagnostic procedure involves removal of the outer dead leaf sheaths surrounding the plant crown, cutting a

longitudinal section or slice through the crown using a razor blade or sharp knife, and then examining the crown area under a magnifying lens. Firm white crown tissue with turgid cells indicates a healthy crown meristematic area that has survived the winter. Crowns which have turned brownish or dark colored with a mush appearance (flaccid cells) have experienced extensive injury. The crown tissue is the critical area to examine for winter injury. A turf can lose all the leaves and roots from winter injury and still recover as long as the meristemstic area in the basal crown of shoots and in the nodes of lateral stems, either rhizomes or stolons, survive the stress. These meristematic zones are capable of reinitiating both shoot and root growth once favorable spring growing conditions occur.

REPAIRING WINTER DAMAGED TURFS

The first priority of a turfgrass manager is to provide the best possible conditions for reestablishment of the damaged turf areas. For example, dry soils will warm up earlier in the spring than wet, perfectly drained soils. Thus, proper drainage is an important consideration. Further, the dead vegetative cover over the soil has an insulating effect which impairs the rate of soil warming. Thus, partial removal of the dead grass is desirable, keeping in mind to leave a portion on the surface to act as a mulch which enhances seed germination and seedling growth of the area once it is overseeded.

Injured areas smaller than 6 inches in diameter will normally recover without reestablishment if the adjacent desirable turfgrass species possesses creeping lateral stems, such as rhizomes or stolons. Small areas on greens are best repaired by plugging with a cup cutter. On larger more extensive areas of damage, reseeding, sprigging, or sodding is used to repair the area.

Complete reestablishment of the area usually involves removal of the existing dead turf plus any allied thatch and soil layering problems. Deep cultivation and sometimes recontouring of larger areas are needed to correct drainage problems. The application of the appropriate material is made to adjust the pH into the desired range followed by incorporation of a fertilizer at the proper rate and ratio based on a soil test. Subsequently planting may be done by sodding, vegetative sprigging, plugging, or seeding.

Small to intermediate sized areas in high quality, intensively maintained turfs such as greens are usually reestablished by sodding. This involves removal of the dead turf and underlying soil to a sufficient depth so that the sod can be transplanted level with the existing area. It is important that the sod selected possesses a species composition and character similar to that of the area being resodded.

In contrast to reestablishment, renovation of winter damaged turfs involves reseeding or replanting into an existing area which has only been partially damaged. That is to say, there is a sufficient stand of desirable turfgrass species remaining so that it is appropriate to salvage. Also the

surviving plants fuction in stabilizing the soil against wind and water erosion.

The key steps in turfgrass renovation are as follows:

(1) Eradication of undesirable weedy species. This usually will not be significant in the case of winter injured turfs, except for winter annual weeds such as annual bluegrass in a dormant winter season turfgrass.

(2) Removal of any excessive thatch accumulation. Thatch removal usually can be accomplished by vertical cutting in two directions followed by the use of a mechanical vacuum/sweeper for removal of the dead debris. In the case of seeding, it is critical that the seed be brought into contact with the soil to ensure the most favorable conditions for seed germination and seedling establishment. The presence of an excessive thatch layer can interfere with this objective and is an additional reason for thatch removal.

(3) Turf cultivation by coring, grooving, or slicing. Turf cultivation usually requires 2 to 5 passes in opposite directions.

(4) Correcting any undesirable soil pH condition by use of the appropriate lime or acidifying material.

(5) Application of fertilizer at the proper rate and ratio based on soil test results.

(6) A final coring or slicing to assist in incorporation of the fertilizer.

(7) Planting by seeding with a renovation overseeder that inserts the seed into the soil, by mechanical sprigging, or by plugging.

(8) Finally, the renovated area should be irrigated deeply the first day and subsequently on a daily basis as needed to prevent visual water stress until the new planting becomes sufficiently established to stabilize the area.

In the case of small, intensively maintained areas such as greens, which need to be reestablished as rapidly as possible in the spring, a polyethylene cover can be utilized. The clear polyethylene cover functions similar to a greenhouse in that it traps heat underneath, thereby accelerating warmup of the soil and thus stimulate earler spring reestablishment.

Table 1. Types, symptoms, and causes of winter injury that most commonly occur on turfs.

Type of winter injury	Symptoms	Cause of injury	
		External	Internal plant effects
A. Desiccation			
(1) Atmospheric	Leaves turn distinctly white but remain erect; occurs most commonly on higher locations that are more exposed to drying winds; can range from small irregular patches to extensive kill of large areas.	A drying atmospheric environment including high winds and low humidity; in addition, soil water absorption is reduced at low temperatures or may be inoperative because the soil is frozen.	Desiccation of the plant causes shrinkage and collapse of the protoplasm that results in mechanical damage and death.
(2) Soil	Leaves turn distinctly white and are semi-erect; the tissues including the crown are very dry; commonly occurs in a more extensive pattern over the turf than does atomspheric desiccation.	Extended periods of soil drought due to a drying atmospheric environment and lack of precipitation or irrigation.	(Same as above)
B. Direct low temperature kill	Leaves initially appear water-soaked, turning whitish-brown and progressing to a dark brown; the leaves are limp and tend to lay as a mat over the soil; a distinct, putrid odor is frequently evident; occurs most commonly in poorly drained areas such as soil depressions; frequently appear as large, irregular patches.	A rapid decrease in temperature particularly the adjacent soil temperature; kill most commonly occurs during late winter freezing and thawing periods; may be associated with thawing of an ice cover that occurs from underneath.	Large ice crystals form within the plant tissues causing mechanical destruction of the frozen, brittle protoplasm; the higher the water content of the tissue, the larger the ice crystals and more severe the kill.
C. Low temperature diseases:			
(1) Fusarium patch (pink snow mold)	Pink mycelium on leaves; 1 to 2 inch, tan, circular patches (in fall); or white mycelial mass on leaves, white to pink circular patches up to 2 feet in diameter (in winter/spring)	Fusarium nivale; favored by turfgrass temperatures of 32 to 40° F and moist conditions.	Parasitic action of fungus.
(2) Spring dead spot	Appears in the spring as irregular, circular dead spots of up to 3 feet in in diameter;	Causal organism has not been identified; favored by turfgrass temperatures below 50°	Unknown

(3) Typhula blight (gray snow mold)	Light gray mycelium on leaves, especially at the margins of the advancing ring; whitish-gray, slimy, circular patches of up to 2 feet in diameter; brown sclerotia are embedded in the leaves and crowns, ranging up to 1/8 inch in diameter.	Typhula itoana, T. idahoenis, or T. ishikariensis; favored by turfgrass temperatures of 32 to 40° F, usually under a snow or ice cover, especially during thaws.	Parasitic action of fungus.
(4) Winter crown rot (LTB)	Light gray, matted mycelial growth may be evident on the leaves; irregular shaped patches initially appear yellow and gradually deteriorate to a straw color; individual patches up to 1 foot in diameter may coalesce causing damage over a large area.	Unidentified low temperature Basidiomycte; favored by turfgrass temperatures of 28 to 32° F, especially under a snow cover.	Injury results from hydrogen cyanide gas produced by the saprophytic fungus; subsequently the fungus invades the host plant.
D. Traffic			
(1) On frozen turfgrass leaves	Erect, white to light tan dead leaves appearing in the shape of the footprints or wheels where they have been impressed onto the turf.	Pressure of traffic (shoes or wheels) on the rigid, frozen tissues; problem most commonly occurs during the early morning hours.	Disruption of the frozen, brittle protoplasm by ice crystals surrounding and extending into the plant cells.
(2) On wet, slush covered	Leaves initially appear water-soaked turning whitish-brown and progressing to a dark browh; the leaves are limp and tend to lay as a mat over the soil; appears in irregular shapes associated with previous patterns of concentrated traffic; soil rutting may also be evident.	Snow cover thaws to a slushy condition causing increased hydration of the turfgrass crowns; traffic, including snowmobiles, force the wet slush into intimate contact with the turfgrass crowns; kill most commonly occurs if this event is followed by a decrease in temperature to below 20° F.	Not completely understood, but related to the direct low temperature kill mechanism.

Table 2. Practices available to minimize winter injury on turfs.

Type of winter injury	Cultural practices that minimize injury: Turfgrass	Cultural practices that minimize injury: Soil	Specific protectants	Turfgrass species most commonly affected
A. Desiccation: (1) Atmosphere	Moderate nitrogen nutritional levels. Elimination of any thatch problem.	Do not core in late fall and leave the holes open	Conwed Winter Protection Blanket® Polyethylene (4-6 mil) Saran Shade Cloth® (94%) Topdressing (0.4 yd^3 / 1,000 sq ft.) Windbreaks such as snow fence, brush, or ornamental tree and shrub plantings. Natural organic mulches.	All species
(2) Soil	Moderate nitrogen nutritional levels. Irrigation or hauling of water to critical sites.	(Same as above)	(Same as above)	All species
B. Direct low temperature kill	Moderate nitrogen nutritional levels. High potassium nutritional levels. Higher cutting heights. Elimination of any thatch problem. Avoidance of excessive irrigation.	Rapid surface drainage by proper contours, open catch basins, and ditches. Adequate subsurface Drainage by drain lines, soil modification with coarse textured materials, slit trenches,	Conwet Winter Protection Cover® Soil Retention Mat® Enhancing snow cover with snow fence or brush. Natural organic mulches such as straw. Soil warming by electricity.	Bermudagrass Annual bluegrass Fescues Ryegrass
C. Low temperature diseases: (1) Fusarium patch	Moderate nitrogen nutritional level. High potassium and iron nutritional level. Moderate to low cutting height. Elimination of any thatch problem.	Avoiding neutral to alkaline soil pH's.	Benomyl, Maneb+zinc, PCNB, and Thiophanate-methyl (Mercury chlorides are labeled for putting green use only).	Annual bluegrass Bentgrass Fescues Kentucky bluegrass Ryegrass

(2) Spring dead spot	Avoid excessive winter irrigation. Moderate nitrogen nutritional level. Elimination of any thatch problem.	Provide good surface and subsurface drainage. Cultivate when compaction is a problem.	None; very slow recovery.	Bermudagrass
(3) Typhula blight	Moderate nitrogen nutritional level. Moderate to low cutting height. Elimination of any thatch problem.	Provide good surface and subsurface drainage. Cultivate when compaction is a problem.	Anilazine, Cadmium compounds, and Chloroneb. (For golf greens only; mercurous-mercuric chloride, PCNB, or PMA).	Annual bluegrass Bentgrass
(4) Winter crown rot	Elimination of any thatch problem. Moderate, late summer-fall nitrogen nutritional level.	Provide good surface and subsurface drainage.	None in United States. Mercury chlorides and PCNB labeled for use in Canada.	Annual bluegrass Bentgrass Fine fescues Kentucky bluegrass
D. Traffic:				
(1) On frozen turfgrass leaves	Apply a light application of water in early morning; this is most effective when the soil is not frozen and the air temperatures are above freezing.		Withhold or divert traffic from turfgrass areas during periods when the leaf and stem tissues are frozen.	All species
(2) On wet, slush covered turf			Withhold traffic on turfgrass areas during wet, slushy conditions, especially if a drastic freeze is anticipated.	All species in regions where freezing occurs.

OPERATIONAL PROCEDURES FOR "LOW-MAINTENANCE" LANDSCAPING

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The prime objective of the landscape industry should be to create landscapes which are functional and aesthetically pleasing. Landscape architects, nurserymen and contractors combine their efforts to achieve this goal, but often the finished product, after a few years of establishment, does not represent the designer's original intent. An influencing factor in the success or failure of any landscape is maintenance.

Landscape maintenance programs involve more than just "push-mowing." Trees, shrubs, and groundcovers require insect, disease and weed control, fertilization, irrigation systems, and a multiplicity of technical data on the culture of woody ornamentals and turf.

Landscape maintenance is an on-going project. Weeds can be eradicated one time but what about future weed problems - or what about shrubs that require pruning - generally this becomes a never-ending job. This is where maintenance becomes management. The management of landscapes implies practices which address not only present problems but future situations also.

Landscape management begins on the drawing board. Low maintenance projects can be designed if the following procedures are considered and incorporated into the project.

1. Plant trees and shrubs which are tolerant of adverse conditions. Plant ornamentals which will tolerate the "micro-climate" on which they are located. This includes the site characteristics of minimum and maximum temperatures, soil compaction, type, pH, and drainage, sun exposure and pollutants. Choose plants which are not "tempermental."

2. Plant trees and shrubs which are native to the area. When planting native plants the landscape environment should simulate the native environment. Don't assume that just because a plant is indigenous to the area that it will grow in the same general area.

3. Plant small to medium size ornamental trees. Generally the trees in this group will mature to a height of 35' or less and are quite "well-behaved." These trees can be planted in parking lots, under power lines, near buildings or clubhouses, or be used to define the entrance to a facility.

4. Incorporate slow-growing or dwarf type plants. Pruning can become a time consuming and expensive maintenance chore. Therefore, remove old overgrown plants and then plant the dwarf types. There are many varieties of hollies, and junipers which make excellent foundation plants or large bed area plants.

5. Use groundcovers in areas that would be difficult to grow grass such as under shade trees or on areas that would generally be difficult to maintain such as on steep slopes or in very small areas. Any number of groundcovers are adaptable to a wide range of soils, exposures and other environmental conditions.

6. Create natural areas to decrease the amount of turf being maintained. Since it is difficult to grow a high-quality stand of turfgrass in shaded areas, the popular trend of natural areas should be considered. Eradicate the turf and weeds and incorporate a 3-4" layer of organic matter. It is not recommended to put down black plastic under the organic matter as this creates very shallow rooted plants because of the decreased depth of oxygen and moisture. When creating these areas be sure to make them plenty large. Encompass the drop-line of the trees with mulch and create a definite boundary between the turf and the mulch.

Again, management is the key to sustaining a functional and aesthetically pleasing landscape. Consideration should be give to one and all of the preceeding suggestions to help make the landscape more manageable.

HERBICIDE USE IN AQUATICS

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Current Status

Algacides - Filamentous, Planktonic and Chara:

The use of chelated-copper complexes have essentially become the copper formulation of choice based on the lack of restrictions placed on the use of treated waters. Several of these complexed coppers are combined with Diquat for hydrilla control in Florida.

The old standby copper sulfate is still being used in specific areas and newer control release copper formulations are being introduced. Aquazine is still available for the farm pone and small lake market.

SUBMERSED SPECIES

General Phenoxy Compounds - 2,4-D Esters and Amine Salts:

These materials are used primarily for the control of water milfoil species. Several other species are listed on the labels. The critical submersed species such as hydrilla, elodia and the potamogeton group are normally not affected.

Other Compounds - Diquat, Endothal Formulations, Sonar Casaron and Fenatrol:

All of these compounds have full or limited label clearance for recreational water use either as a total water treatment or drawn down treatment-trestrictions vary as to the use in potable or irrigation waters. New data suggest clearnace for both Diquat and Endothal in potable waters. Certain dyes such as Aqua Shade are being used in golf courses and small ponds.

EMERSED SPECIES
Water Hyacinth, Water Lettuce and Water Primrose

Phenoxy Herbicides:

Dimethylamine salt of 2,4-D as well as limited use of ester forms are the primary control agents for these species. State labels also exist for oil soluble formulations.

Diquat is used in phenoxy sensitive crop areas to control water hyacinth. Banvel 720 and a mixture of Dicamba Plus 2,4-D has state label usage for the control of the above species as well as alligator weed and arrowhead and many other marginal species.

MARGINAL AND DITCH BANK WEEDS

General Herbaceous and Brush Species, Phenoxy Compounds, Amines, Esters, and Oil Soluble Amines:

These may be state or federal labels. Cattails and Phragmites; Amitrol, Dalapon, Diquat, Roundup, Phenoxy Mixtures: All have limited or full label clearnace for use in drainage ditches or marshes. Other multiple use waters have restrictions for treated waters.

SOURCES OF INFORMATION ON HERBICIDES USED FOR AQUATIC WEED CONTROL

1. State and Federal publication containing specific recommendations.
2. Special publications such as the Meister Annual Herbicide Guide.
3. Company Product Label Books from Firms with Herbicides Used in Aquatic Sites.

SUMMARY STATEMENT

There are many products available that have either limited or broad spectrum use as control agents for aquatic weed problems. These products will have restrictions which vary from very rigid and limited water site use to essentially no restrictions as with the copper complexes. The label must list all restrictions and is the final word in the choice of whether a product may be used in a particular site. Many other input factors will determine the actual use but the label must be registered for the use.

INTEGRATED PEST MANAGEMENT PROGRAMS FOR TURFGRASSES

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Rising chemical costs, unavailability of long term residual pesticides, increased resistance to pesticides and environmental concerns have reemphasized the importance of efficient turf management and a reduction in a dependency on pesticides. For these reasons, knowledgable turf specialists are looking at and developing systems of integrated pest management.

Integrated pest management (IPM) can be defined as the use of all available management practices to keep pests at acceptable levels while minimizing the effects on man, the enivronment, and his turf. What constitutes an acceptable level of pest activity will vary with each situation. For example, several broadleaf weeds may not prove objectionable in a park-like setting but would be totally unacceptable on a putting green. Defining an acceptable level of pest activity must be determined by the individual most familiar with the situation, you, the knowledgable turf manager.

Practicing IPM Concepts

A logical sequence to follow in an integrated approach to pest control is as follows: 1) Monitoring pest activity; 2) Implementation of necessary preventative measures; 3) Determining if control is warranted; and 4) Choosing and employing appropriate control measures.

Early pest detection, through frequent turf inspections, will help minimize pest damage and save time, effort and money. This can only be accomplished if you are knowledgable in pest identification, life cycle characteristics, weaknesses and strengths of the grasses being grown and the effect of the environment and management regime on both. You must also be alert for the unexpected and any changes that will favor a given pest over the desirable turf.

A good pest control program uses all available measures to prevent pests from reaching damaging levels. This is best accomplished by employing measures that favor the turf over the potential pest. Such measures are not new and have been used by conscientious turf managers for years. Some of the measures include use of:1) adapted grasses; 2) appropriate cultural practices; 3) chemicals; and 4) sanitary practices. (Integrated pest management is not a substitute for chemical control but considers chemicals as one of many management tools available to the turf manager for the prevention and control of pests.) Priorities must be set so that risk to man, the environment, and the turf are minimized.

Should a problem occur, determine the true cause and if control measures are warranted. Choose the safest, most effective control measures available and make sure precautionary measures are taken to prevent reoccurrence of pest damage.

When chemical control is warranted, select the proper pesticide, follow label directions and insure precise applications rates and timing for best effectiveness. Treat only necessary areas and measure cost effectiveness whenever possible.

Remember, the intent of IPM is to prevent unacceptable levels of pest damage using the safest, most effective means available. Conscientious turf managers will continue to treat the problems, not just the symptoms by using all available pest prevention and control measures at their disposal. This should result in more efficient turf management and a reduction in pesticide dependency.

NEW HERBICIDES FOR TURFGRASSES

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There are several recently labelled herbicides which should be mentioned to emphasize their proper use.

Prograss may be used for preemergence and/or postemergence control of annual bluegrass in bermudagrass which has been overseeded to perennial ryegrass. The use of Prograss is thoroughly discussed in another section of this proceedings.

Princep 4G Granular Herbicide (simazine) was recently labelled for use on bermudagrass, centipedegrass, St. Augstinegrass and zoysiagrass. It is applied in the early fall for preemergence control of winter annual weeds such as annual bluegrass, chickweed, corn speedwell, spurweed, henbit, hopclover, and knawel, or it may be applied in the spring for preemergence control of crabgrass and goosegrass.

Chipco RONSTAR G (oxadiazon) has been available for a few years for preemergence control of annual bluegrass, crabgrass, goosegrass, oxalis, carpetgrass and pigweed in perennial bluegrass, bermudagrass, perennial ryegrass, and St. Augustinegrass. It is a particularly effective preemergence herbicide for goosegrass control.

Scotts Goosegrass/Crabgrass Control may be used on common or hybrid bermudagrass. It is applied preemergence for control of crabgrass and goosegrass. This product contains both bensulide and oxadiazon.

Combinations of Buctril (bromoxynil) with other herbicides have been recently labelled. They include Buctril + MCPP, Buctril + Banvel, Buctril + MCPP + Banvel, and Buctril + 2,4-D + MCPP. These combinations may be used on established bentgrass, Kentucky bluegrass, fescues, ryegrass, bermudagrass and St. Augustinegrass. It is applied as postemergence spray to control many broadleaf weeds.

Asulox (asulam) is applied postemergence to control crabgrass, goosegrass and sandbur in St. Augustinegrass and Tifway 419 bermudagrass. On golf courses it should be only on fairways and roughs.

Sencor 75 Turf Herbicide (metribuzin) is a special formulation of Sencor for the turf trade. It may be used on common bermudagrass fairways. It is applied postemergence in dormant bermudagrass fairways for the control of winter annuals such as common chickweed, corn speedwell, henbit, parsley-piert, and spurweed. In the summer applied postemergence it will control crabgrass and goosegrass.

The most recently approved use of a herbicide is for Roundup to control Poa annua in dormant bermudagrass. The label rate is 12 fluid ounces of Roundup plus 0.5% by volume with a non-ionic surfactant in 5 to 20 gallons of water per acre. Application to actively growing annual bluegrass and dormant bermudagrass turf must be made prior to initiation of bermudagrass greenup in the spring. This is not recommended for domestic application except by professional applicators.

New Insecticides Labelled for Turf in North Carolina

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Two new insecticides have recently been labelled in North Carolina for the control of insect pests of turf. They are isofenphos (Oftanol 5G) and bendiocarb (Turcam).

Isofenphos (Oftanol) is a moderately toxic organophosphate insecticide. Most organophosphates are fast acting, short residual materials that kill insects quickly but last a very short time. Oftanol, by comparison, is slow acting and has a fairly long residual.

Control of the Japanese beetle grub has been excellent with Oftanol. However, do not expect to find dead insects for at least two weeks after application. Oftanol appears to give fair to good control of the green June beetle grub and good control of the masked chafer. It is also promising for control of mole crickets, cutworms and fall armyworms. For grubs Oftanol should be applied at the rate of two pounds of active ingredient per acre (40 pounds of 5G). Good, even distribution of the granules is essential for effective control. Granules may be applied in the spring, summer or early fall. Oftanol is registered for use only by licensed pesticide applicators.

Bendiocarb (Turcam 76%) wettable powder is a moderately toxic carbamate insecticide. Turcam is a fast acting insecticide that is moderately residual. In addition to turf pests, it is registered as Ficam for control of several household pests, fire ants and insect pests of flowers and ornamentals.

Turcam is effective for control of grubs of the Japanese beetle, European chafer, Northern mashed chafer, black turf grass Ataenius, green June beetle, and annual white grubs. It also controls mole crickets, chinch bugs, sod webworms, ants, bees and several other miscellaneous pests associated with turf. Turcam should be used at 1 to 2 ounces per 1000 square feet for grubs and at one-half that rate for the other insects. Turcam is registered for use only by licensed pesticide applicators.

NEW FUNGICIDES AND A NEMATICIDE LABELLED FOR TURF IN NORTH CAROLINA

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A number of new chemicals have been registered recently for controlling diseases and one for nematodes on turfgrasses in North Carolina. The new fungicides can be divided into chemicals for controlling several fungal diseases and chemicals for controlling Pythium blight.

Banol (Tuco) and Subdue (Ciba Geigy) have given excellent control of diseases caused by Pythium species for up to 3 weeks. Banol was available for use in 1982. Banol is formulated as a liquid with 66.5% active ingredient (propamocarb hydrochloride). Control of Pythium blight for up to 21 days is indicated on the label. Subdue 2E is a liquid formulation of metalaxyl that will give control of Pythium blight for up to 21 days. These new chemicals should be used judiciously in a disease management program. Continuous use of one of these chemicals is likely to encourage the development of resistant strains. Resistance in fungi closely related to Pythium species to the active ingredient in Subdue, has already occurred in Europe on other crops. Resistant strains of Pythium species, or closely related fungi, have not been reported to the active ingredient in Banol. Intermittent use of Subdue or Banol with each other, and with other fungicides, that will control Pythium species on turfgrasses is suggested.

The new broad spectrum fungicides for turfgrasses include Bayleton (Mobay), Chipco 26019 (Rhone-Poulenc), Duosan (Mallinckrodt), Rubigan (Elanco), and Vorlan (Mallinckrodt). Bayleton is formulated as a wettable powder with 25% triadimefon as the active ingredient with recommended rates of 1 to 8 oz for the control of ten different turfgrass diseases. It has up to 21 days activity against some diseases indicated on the label with longer effects observed in some experiment. Chipco 26019 is formulated as a wettable powder with 50% iprodione as the active ingredient. It has given excellent control for up to 28 days for some diseases and has given good control of resistant strains of dollar spot. Duosan is a 75% wettable powder with 50% mancozeb and 15% thiophanate-methyl as active ingredients. It is recommended for the control of severn different diseases. A synergistic effect of the combination of these older chemicals in this fungicide has been suggested. Rubigan is a 50% wettable powder with fenarimol as the active ingredient. It has six diseases listed on the label. Vorlan is a new chemical that has been labelled for the control of dollar spot and Fusarium patch, and is formulated as a 50% wettable powder. Other diseases are expected to be added to the label soon. Iprodione and triadimefon have also been formulated as granules as Fungicide VI and Fungicide VII, respectively, by O. M. Scott & Sons. These new broad spectrum fungicides should be used intermittently with each other and with some of the older fungicides for a good disease management program.

Soilbrom 90 (Great Lakes) has been labelled for the control of sting nematodes on bermudagrasses in North Carolina. It has 92.8% ethylene dibromide as the active ingredient. It must be injected into the soil with specialized equipment followed immediately by irrigation with 1/2 - 1 inch of water.

Turfgrass managers are fortunate to have these new chemicals to aid in controlling the many different diseases and nematodes that occur on turfgrasses in North Carolina. Some of the new fungicides are rather expensive per pound. However, the cost per 1000 sq. ft. and the length of control between applications should be considered. The cost of these new fungicides are often similar to some of the older fungicides when these calculations are made. Wise and careful use of these and older products along with correct disease diagnoses should ensure the availability of effective chemicals for many years.

WINTER OVERSEEDING PREPARATION AND SPRING TRANSITION

by
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Preparation for winter overseeding of cool season grasses on bermudagrass greens does not simply begin in the fall prior to overseeding time. It is a continuing process on a year-round basis which entails the proper preparation of the bermudagrass to withstand the winter stress of dormant play as well as preparing the proper seedbed for the cool season overseeded grasses themselves. In actuality, preparation for the upcoming overseeding season begins in the spring as the bermudagrass begins its green-up and rejuvenation for the summer growing season. At this time, a heavy potash application of one to one and one-half lbs./1000 sq. ft. should be applied to give the root system of the bermudagrass a good nutritional base from which to rejuvenate. Phosphorus is applied at this same time and liming applications have been made earlier in the winter according to annual soil test reports. As long as these proper nutritional levels and a proper pH range is maintained, then a strong bermudagrass will quickly rejuvenate itself into a good healthy turf. As growing begins, proper nitrogen fertilizations are applied in conjunction with other elements such as phosphorus and potassium, but these nitrogen levels should be kept low so that a strong disease and drought resistant turf, as well as a turf having a good wear tolerance, is developed in the fairways, tees and greens.

Cultural programs such as aerifications, topdressings and vertical mowings are also very important not only to keep the bermudagrass in a good upright growth habit and encourage stronger and deeper rooting, but also to provide a good seedbed for overseeding in the fall. If these cultural programs are maintained throughout the summer, then rigorous vertical mowing is not needed in the fall prior to overseeding. This is a bad mistake many people make when overseeding, as this heavy vertical mowing at the time of overseeding is very detrimental to the overall health of the bermudagrass. It can result in significant setback of the bermudagrass in the spring and in the presence of a harsh winter, death can occur through winter kill. Other fall management aspects include another potash application, as in the spring, to improve winter hardiness of the bermudagrass, as well as rapid root establishment of the overseeded grass.

The next step in proper preparation of winter overseeding is application of cool season grasses at proper rates. The most commonly used overseeding cover is a single perennial ryegrass or a blend of several perennial ryegrass cultivars. When ryegrasses are used, application

should be kept at 25 lbs./1000 sq. ft. or less for greens to provide not only the best playing conditions on a year-round basis for the overseeding, but also the least damaging conditions for the bermudagrass. When heavier rates of 30-45 lbs./1000 sq. ft. of ryegrasses are used, then significant damage can result to the bermudagrass next spring due to the shading out that can occur from these high density populations. Seeding rates for tees should consist of 10-12 lbs./1000 sq. ft., while fairways do not need more than 4-8 lbs./1000 sq. ft.

During the winter, the overseeding is maintained at proper cutting heights along with other programs to provide good putting surfaces and good health to the overseeding cover. Traffic must be kept off the winter overseeding grasses when frost or frozen ground is present due to the damage that can result to the overseeding grass as well as the underlying bermudagrass. As early spring approaches, a cultural program is initiated for the overseeding grasses which entails the use of vertical mowers, brushes, topdressings and the use of other reel implements such as grooved rollers. Light, weekly vertical mowings should be done during the spring on overseeded grasses to help maintain the ryegrass in a very upright growing habit which allows increased sunlight and warmth to penetrate through to the soil and thus encourage an earlier and more rapid regrowth of the bermudagrass. It also eliminates the ryegrass tendancy to become very grainy during this growing period and greatly reduce the putting qualities of the putting surfaces. Light topdressings done on a 2-3 week basis at about 1/8 yard/1000 sq. ft. are also very beneficial in assisting the above-mentioned qualities. The use of grooved rollers and brushes have also been very significant in improving playing conditions on the overseeded green during the spring and also helps maintain a very upright growth habit of the ryegrass, which increases the overall health of the bermudagrass during this critical period in the life cycle of the bermudagrass.

Oftentimes, these cultural programs are neglected in the spring for the ryegrass. If these are neglected, in conjunction with a heavy overseeding rate, then the overseeding cover can remain on the putting surfaces well into the summer and in some cases, such as in the summer of 1982, the ryegrasses may never totally leave throughout the summer months. This is very detrimental to the permanent bermudagrass cover, as it is important to remember that the bermudagrass turf is the primary turf grown on that putting surface - not the overseeding cover. Unfortunately, many people manage the greens in the reverse situation without realizing that they are managing the green for a predominately cool season cover. Spring transition is a very important element of good turf management for bermudagrass golf courses that must overseed in the winter with cool season grasses, but it is an aspect of turf management that can be successfully controlled a majority of the time if proper steps are taken throughout the year in preparation for overseeding and proper care of the overseeding itself. Unfortunately, it is often assumed that the quality of spring transition will be directly related to the present weather conditions for that particular year. This is true to a great

extent, but more times than not, a turf manager can determine the quality of his spring transition through proper management more than actual weather conditions themselves.

PROGRASS FOR POA ANNUA CONTROL IN GOLF GREENS

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Scattered clumps of yellow-green to light-green annual bluegrass (Poa annua) disrupt the uniform color of bluegrass, bentgrass or bermudagrass. Cultural practices such as fertility, irrigation and mowing have influenced its persistence as a weedy pest. Common vegetative characteristics of annual bluegrass are: a blade folded in the bud with parallel edges and a boat shaped leaf tip; a membraneous ligule, medium long (1 to 3 mm) and slightly pointed; and a greenish white panicle (seedhead).

Annual bluegrass is a highly variable species. It may be a tufted bunch type annual with an upright growth habit. Annual types are prolific seed producers having strong seed dormancy. At the other extreme is a creeping perennial type which roots at the nodes of prostrate stolons and tillers. Perennials are restricted seed producers with minimal seed dormancy.

Annual bluegrass is a low growing small plant possessing rooting depths comparable to Kentucky bluegrass and bentgrass when grown in the same soil media. With lower cutting, leaves increase in fineness. It is capable of producing seed heads when mowed at 1/4-inch. In North Carolina and to the south of us it behaves as a winter annual while in the northern part of the United States it exists as a summer annual. It is felt that perennial subspecies exist in bentgrass greens in North Carolina particularly in the central and western portions of the state.

Prograss (ethofumesate) may be used for preemergence and/or postemergence control of annual bluegrass in dormant bermudagrass which has been overseeded with perennial ryegrass. The herbicide Prograss is primarily root-absorbed. Common bermudagrass is tolerant to Prograss as well as the cultivars 'Tifway', 'Tifgreen' and 'Tifdwarf'. Based on our studies the initial application of Prograss should be 30 to 45 days after overseeding with perennial ryegrass. The rate is 2 pts/A (1 lb active/A) or 0.75 fl oz per 1,000 sq ft. This should be followed with one supplemental application 30 days later at the same rate. The use precautions appearing on the Prograss label may be summarized as follows: Prograss may cause premature onset of dormancy or injury to bermudagrass which is not fully dormant. Do not apply after February 1 or Prograss may temporarily delay spring greenup of bermudagrass. Do not apply more than a total of 8 pts/A. Do not mix with liquid fertilizer or other pesticides. Do not use activated sludge fertilizers in Prograss treated areas. Avoid overlapping when spraying.

Percent control of annual bluegrass by Prograss applied in common bermudagrass is given in table 1. Both rates, 1.0 and 1.5 lb active/A, at all dates of application gave excellent control with the exception of 1 lb ai/A applied 0 and 60 days after overseeding. Reduced control from

applications 60 days apart has also been observed in other tests. The following discussion will emphasize reasons for applying Prograss 30 and 60 days after overseeding perennial ryegrass and for not applying it after February 1, which is represented in the table by 120 days after overseeding.

In another study we examined the tolerance of 'Tifgreen' bermudagrass and overseeded grasses to Prograss. The overseeded grasses included CBS, Legend, and Legend + Sabre (Poa trivialis). The rates of Prograss and the treatment days were the same as those listed in table 1.

Early applications of Prograss can cause "onset of dormancy" according to the label. I prefer to say the appearance of winter dormancy for we do not know yet what is happening physiologically within the bermudagrass plant. As indicated in table 2 Prograss applied early reduces the green color of 'Tifgreen' bermudagrass. From the standpoint of causing bermudagrass to go off color, it is advisable to delay the initial Prograss application until 30 days after overseeding. This also enables the overseeded grass to become better established. In areas where bermudagrass does not naturally go into winter dormancy Prograss should not be applied. Also, it would be advisable to delay Prograss application in unseasonably warm falls until periods of cool weather which encouraged bermudagrass to go into winter dormancy. In tables 3 and 4 the influence of Prograss on the turf quality of the overseeded grasses and the percent greenup of the bermudagrass are given. The turf quality rating for overseeded grasses was generally better for the 1 lb active/A rate than for the 1.5 lb active/A rate. Prograss applied at the date of overseeding and 120 days after overseeding, which was early February, reduced bermudagrass greenup. The percent greenup of the bermudagrass was the greatest from applications applied 30 and 60 days after overseeding.

Prograss reduced the percent cover of the three overseeded grass mixtures (table 5). The 'Highlight' chewing fescue component of the Legend mixture was susceptible to Prograss. Also, Sabre showed susceptibility to Prograss. This was more evident in the 1982 test. However, by March and April differences among the overseeded grass mixtures were not noticeable.

Another aspect of Prograss is its influence on cold hardiness of 'Tifgreen' bermudagrass. This was measured by the regrowth of the 'Tifgreen' bermudagrass 4 weeks after removal from the field and subjected to artificial low temperature stress treatment in February of 1982. Results are presented in table 6. All Prograss treatments affected regrowth of the 'Tifgreen' bermudagrass. Applications 0 and 30 days after overseeding and 0 and 60 days after overseeding caused more reduction in regrowth than applications applied 30 and 60 days after overseeding. Greater growth reduction was caused by 1.5 lb active/A rate when applied at the date of overseeding. This again is another reason for not applying Prograss early and also emphasizes to carefully apply the proper rate and not overlap when spraying.

During the past two years we have investigated Prograss for the control of Poa annua in 'Penncross' bentgrass greens. This season tests are being conducted at Charlotte Country Club, Quail Hollow County Club, Greensboro Country Club and Country Club of North Carolina. Demonstrations are also located at Pine Needles County Club, Etowah Valley Golf Club and Forest

Oaks Country Club.

To date the results of these tests and demonstrations conducted in several areas of North Carolina indicate that Prograss (ethofumesate) has favorable potential for the control of annual bluegrass (Poa annua) in 'Penncross' bentgrass greens. The most favorable control was obtained with three applications of Prograss spaced at 30-day intervals applied at 0.75 or 1 lb active per acre per application (1 lb active per acre equals 1 quart per acre or 0.75 fluid ounce per 1000 sq ft of Prograss Flowable Herbicide, 0.75 lb active per acre equals 0.54 fluid ounce of Prograss 4F per 1000 sq ft). Initial application should begin in mid October. Slight discoloration of the bentgrass turf may result from each application, however, no permanent injury has been noted.

Applications spaced 60 days apart have not given favorable control. Two applications at 30-day intervals generally give less control than three. Observations indicate that bentgrass having a shallow root system is more susceptible to injury from Prograss and therefore should not be treated. Prograss application should not be made in late January or into February, as injury to the bentgrass may result. The control of heavy (or dense) infestations of annual bluegrass may result in bare areas. If this condition cannot be tolerated the turgrass should not be treated.

In bentgrass greens three applications of Prograss have given the most favorable annual bluegrass control while two applications give good control in bermudagrass greens overseeded to perennial ryegrass. In the case of many bentgrass greens annual bluegrass remains year round, therefore, well established annual bluegrass plants are present when treatment is initiated. On the other hand, in bermudagrass greens seedbed preparation for seeding perennial ryegrass tends to remove any recently germinated plants or existing annual bluegrass plants, if they have survived summer stress conditions. Therefore, in bermudagrass greens and also fairways initial treatments are being applied either preemergence or early postemergence to the annual bluegrass. Hence, less applications are required for control.

Table 1. Percent control of Poa annua by Prograss in common bermudagrass

Prograss lb active/A per appl	Days applied after overseeding	% P. annua Control Feb 8 1982	Apr 15 1982
1.0	0,30	100	99
1.5	0,30	100	100
1.0	0,60	84	55
1.5	0,60	99	95
1.0	30,60	97	98
1.5	30,60	99	96
1.0	30,60,120	98	99
0	-	0	0

0=Date overseeded, October 7, 1981

Table 2. Influence of Prograss on green color of 'Tifgreen' bermudagrass

Prograss lb active/A	% green Oct 21	Oct 30
0	66	68
1	28	28
1.5	23	24

Applied: October 7, 1981, date of overseeding
DiPaola, Lewis, Gilbert: NCSU 1982

Table 3. Influence of Prograss on overseeded grasses and percent greenup of 'Tifgreen' bermudagrass, March 1982

Prograss lb active/A per appl	Days applied after overseeding	Turf quality overseeded grasses	% green bermuda-grass
1.0	0,30	6.7	2
1.5	0,30	6.2	1
1.0	30,60	6.7	19
1.5	30,60	6.1	15
1.0	30,60,120	6.5	1
0	-	7.3	38

Overseeding date: October 7, 1981
Turf quality: 9=best, 6=acceptable
DiPaola, Lewis, Gilbert: NCSU 1982

Table 4. Influence of Prograss on overseeded grasses and percent greenup of 'Tifgreen' bermudagrass, April 1982

Prograss lb active/A per appl	Days applied after overseeding	Turf quality overseeded grasses	% green bermuda-grass
1.0	0,30	5.7	35
1.5	0,30	5.4	25
1.0	30,60	7.0	63
1.5	30,60	6.4	55
1.0	30,60,120	5.8	17
0	-	7.6	75

Overseeding date: October 7, 1981
Turf quality: 9=best, 6=acceptable
DiPaola, Lewis, Gilbert: NCSU 1982

Table 5. Influence of Prograss on percent cover of overseeded grasses on October 21, 1981

Overseeded Grass	Prograss lb active/A	% Cover
CBS	0	43
CBS	1	31
CBS	1.5	24
Legend	0	39
Legend	1	14
Legend	1.5	8
Legend+Sabre	0	34
Legend+Sabre	1	20
Legend+Sabre	1.5	16

Applied: October 7, 1981
DiPaola, Lewis, Gilbert: NCSU 1982

Table 6. Influence of Prograss on cold hardiness of 'Tifgreen' bermudagrass measured by regrowth of 'Tifgreen' four weeks after removal from the field and subjected to an artificial low temperature stress treatment in February 1982

Prograss lb active/A per appl	Days applied after overseeding	Prograss Total lb active/A	mg clipping dry weight
1.0	0,30	2	186
1.5	0,30	3	30
1.0	0,60	2	186
1.5	0,60	3	30
1.0	30,60	2	242
1.5	30,60	3	275
0	-	0	1143

DiPaola, Lewis, Gilbert: NCSU 1982

New Approaches to Spring Transition for Bermudagrass Greens

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To begin with, I would like to give you a little background on my club and our current situation. I am the Assistant Golf Course Superintendent at Carmel Country Club in Charlotte, NC. Carmel is a private, 36-hole country club. We have 18 holes with bentgrass greens and 18 holes with 328 bermuda greens.

We in the transition zone always speak of having either bent or bermuda greens when in actuality we should speak of either bent or rye greens. After all, we only play on bermuda for four to five months of the year, while we play on rye the remaining seven to eight months. This short growing season for bermuda means that we need to encourage as smooth and rapid a transition as possible in the spring of the year.

At Carmel for several years in the mid and late 1970's, we experienced problems with our spring transition from overseeded ryegrass to bermudagrass greens. Some of the problems we encountered include: 1) Cold temperature winter kill; 2) Late spring warm up; 3) Severe compaction and wear due to heavier winter traffic on dormant greens; 4) Severe competition from improved varieties of perennial ryegrasses.

The method that we have used to encourage the transition for the last several years has been quite successful. We employ a good basic cultural practices with the added help of the herbicide, Kerb, to do the job. These cultural practices include: 1) Aerification - around mid-April; 2) Top-dressing-frequent, light applications throughout the spring; 3) Frequent applications of soluable Nitrogen - usually in ¼ lb. increments; 5) Application of a Potassium fertilizer - according to soil tests; 6) Raise height cut to ½ in. - to encourage growth of bermuda until transition is complete; 7) Provide adequate moisture.

Of course, the key ingredient in our transition program is the use of Kerb. We spray Kerb at the rate of 2 lbs. Kerb/acre, or 1 lb/ active ingredient/acre. Since Kerb is absorbed through the root system, it should be watered in after spraying. We usually spray in mid-May, but this may vary a week or so in either direction year to year. We don't overseed our fringes around the greens, so we use these areas to help us decide when to spray. When our fringes have greened up and begun to fill in weak areas, we feel it is time to spray the greens. When spraying this material, extra precaution should be taken to avoid skips, as these areas will become quite obvious as the transition occurs.

Now, what does the Kerb do to help the transition? First, it takes out the ryegrass with no negative effects on the bermuda. This process can take from two to four weeks depending on the temperatures. Kerb is a very slow acting herbicide. It never appears to kill anything...the ryegrass just gradually disappears. Second, it lets you know early just weak or strong your bermuda is. Natural transitions without herbicides can drag on even into July of some years, giving you very little time to take the necessary actions should re-sprigging or sodding be required. Third, Kerb removes the competition and helps what bermuda you do have (hopefully full coverage) to come on faster. Fourth, we like Kerb better than Paraquat because we can allow the bermuda to start to green up before spraying, and then not worry about injuring the bermuda when we do spray. Finally, Kerb also helps to control foreign weeds and grasses such as Poa Annua on and around the greens.

In summary, we feel that this procedure puts the spring transition back where it needs to be, in the Spring, not in the middle of the summer. We feel this helps to make bermuda the dominant grass much earlier in the season, saving approximately four weeks of transition time eadh year. One problem can present itself, however, If you spray too early, or if the weather does not cooperate at all, you may have weak greens for a short time in June, but we feel you will be better off in July and August because of this practice.

One last thought...In a "perfect" year, this chemical help in the transition period may not be necessary, but how many "perfect" years can you remember?

SYRINGING OF BENTGRASS GOLF GREENS

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Syringing of golf greens during the summer months occurs throughout the United States. As a cultural practice, syringing remains a controversial topic for at least two reasons. First, syringing is not a single purpose cultural practice. Second, only limited research has thus far been conducted on the benefits of this procedure.

Syringing is the application of a small volume of water to a turf canopy for the purpose of a) removing dew, frost, exudates and/or foreign matter from turf leaves, b) dissipating accumulated canopy energy through the evaporation of water from the leaf surfaces, and/or c) preventing or correcting a leaf water deficit, particularly wilt. In other words, syringing is the application of a light irrigation to wash, cool, or minimize the water stress of a turf. The amount of water applied for syringing should not be enough to wet the soil under the turf.

As a turfgrass management tool, syringing is not equivalent to a midday application of "irrigation quantities" of water. Understanding the definition of syringing is critical if one expects to maximize the benefits of this practice and minimize any undesirable results.

The removal of dew, frost, exudates, or other foreign matter from turf leaves is readily apparent following syringing. Similarly, the relief of water stress and alleviation of wilt can often be observed as a result of syringing hot spots on a golf green. The remainder of this discussion will deal with the question of turf canopy temperature moderation through syringing.

The potential value of syringing for the purpose of cooling a turf has been discussed for many years. Syringing is of particular concern in the transition zone and southeastern United States where climatic conditions are not ideally suited for the growth and durability of bentgrass greens. Characteristically high humidities and temperatures of the southeastern United States' summers impose direct and indirect stresses on bentgrass golf greens. However, summer humidites and temperatures often reach stress levels for bentgrass throughout the United States.

In exploring the body of knowledge concerning syringing turf for leaf temperature moderation, one finds that very little research has been conducted. Duff and Beard (Agronomy Journal 58:495-497) reported on a syringing investigation in 1966. Their study involved Toronto creeping bentgrass greens under Michigan's growing conditions. Syringing at noon with 0.25 inches of water resulted in a 1 to 4° F drop in canopy temperatures, while presyringing canopy temperatures were not reached for 2 hours.

Ward (personal communcation) investigated the syringing of a turf under Virginia conditions in 1959. This study was conducted on a bluegrass sod and noted an approximate 20° F reduction in temperature near the soil surface following syringing.

Hawes in 1965 (Cornell MS thesis) applied 0.1 inches of water to Astoria bentgrass, (Agrostis tenuis Sibth.) between 11:30 and 3 p.m. He observed the turf canopy to be 8° F cooler 2 minutes after syringing and 1.5° F cooler after 10 minutes. Pre-syringing canopy temperatures were reached within 15 to 30 minutes after a syringing treatment.

Clearly, there is a need for the study of syringing bentgrass golf greens under the environmental conditions prevailing in the transition zone and the southeastern United States. At this point, it would do well to briefly review the relationship between the turf canopy temperature, syringing, and various environmental parameters.

Reducing canopy temperatures by syringing is dependent upon the evaporation of water from the surface of the turf leaves. Therefore, environmental conditions that favor the evaporation of water should enhance canopy temperature moderation following syringing. The air temperature, canopy temperature of the turf, relative humidity, wind speed, irradiance, amount of water applied, timing of water application, and the temperature of the water applied, are all factors which can potentially influence syringing efficiency.

High air temperatures impose a stress on the bentgrass turf and increases its water use. Canopy and air temperatures are not always the same. Canopy temperatures are typically lower than that of air in the morning, and higher by midday. However, this relationship is affected by other conditions such as wind speed and cloud cover. Afternoon canopy temperatures are likely to be lower than that of the air under windy and/or overcast days. Clear days typically result in afternoon canopy temperatures some 10 to 15° F above that of the air.

Relative humidity is a measure of the amount of water held in the air. The relative humidity is typically highest during the early morning hours and then declines during the day. Although not always the case, increasing relative humidity decreases the potential for water to evaporate from the surface of turf leaves. Increasing air temperature increases the water holding capacity of the air for a given relative humidity.

The evaporation of water from a turf surface is also influenced by wind speed. Wind speed is usually greatest at midday, and can have a marked effect on canopy temperature. A 3 or 4 mph wind can lower the canopy temperature 10 to 15° F in a few seconds. The impairment of air movement over a green by surrounding vegetation results in increased humidity of the entrapped air and reduces the potential evaporation of water from the surfaces of the turf leaves. Bentgrass greens enclosed by vegetation can not fully benefit from cooling by the wind. Air flow across a bentgrass green should be considered and maximized for bentgrass greens likely to experience summer stress conditions.

Passing cloud cover can result in a lowering of the turf canopy temperature some 10 to 15° F. While shaded turf is usually cooler, this must be balanced against increased disease problems and the inherent shade tolerance of the turf. Too much shade is a more typical problem for turf.

Syringing studies were initiated at N. C. State University during 1981. These investigations were supported, in part, by the Carolinas Golf Foundation and sought to determine the influence of syringing on the canopy temperature moderation of bentgrass golf greens. A 'Penncross' creeping bentgrass golf green located in Raleigh and constructed in 1979 according to USGA specifications was utilized. Irrigation was maintained at a rate of 1/3 inch of water every 1.5 to 2 days. The turf was clipped every other day at a cutting height of 0.25 inches during the summer months. Treatments included water application rates ranging from 0 to 0.22 inches of water, applied between 11 am and 5 pm during 1981 and 1982. The syringing treatments investigated included single hourly and repetitive hourly application times between 12 noon and 5 pm.

Observations show a slight drop in the turfgrass canopy temperature on the order of 1 to 3° F can be obtained for a brief period (up to 1 hour) following syringing. These observations are consistent with the previously noted studies which were conducted in the northeastern United States. Environmental conditions at the time of syringing do appear to have a noticeable influence on canopy temperature moderation. As expected, the chance of achieving a significant leaf temperature reduction via syringing on very humid, overcast days appears to be negligible.

Under the conditions of these studies, bentgrass canopy temperatures were not markedly affected by the volume or timing of syringing applications. In particular, temperature moderation of the bentgrass canopy for longer than one hour following treatment was not observed.

Syringing treatments did not result in deleterious effects to the turf during the course of these investigations. However, disease problems, particularly from Pythium would be expected as water application rates were increased, later syringing times during the day were utilized, and if syringing was practiced for a long series of warm, humid days.

In the absence of wilt, the routine syringing of bentgrass golf greens for canopy temperature moderation must be reevaluated considering the substantial economic cost of syringing from the standpoint of water and labor investment alone. Syringing for canopy temperature moderation is distinctly different than syringing to prevent or correct wilt. The canopy temperature of turf is elevated as it wilts under water stress. Syringing can relieve wilt and result in a measurable lowering of the turf canopy temperature. As in the case of temperature moderation, little research has been conducted on the influence of syringing on the water status of the turfgrass plant.

MAINTENANCE OF BENT GRASS GREENS IN EASTERN NORTH CAROLINA

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WATER PROGRAM

To begin with I would like to emphasize that this water program is designed for Walnut Creek course, and agree that other courses may very well require different schedules. Another fact to remember is that at Walnut Creek the greens were not built to USGA specifications. Instead, we have "push-up" greens with no internal drainage; therefore, watering must be determined on an "individual green" basis. Usually the soil of each green and its coutour, will dictate the watering schedule. At Walnut Creek, depending upon the weather, we water every other day, behind the greens mowers, and for as long as each individual green needs it.

AERATION

Aeration goes hand-in-hand with the water program. The practice is needed to get air and water to the grass roots. Among the first signs of the need to aerate is compaction and the green's inability to accept its proper amount of water. Another sign aeration is needed is an "off-color" appearance of the grass in high traffic areas. Aeration is also needed to stimulate spring growth, and is usually done at Walnut Creek between March 1 and 15. Again, at Walnut Creek, aeration might be needed in July or August to relieve "hot spots" on greens. We carefully observe the greens in the afternoons during this time, and note all hot spots. Next morning we aerate these spots with five-eighths tynes. The plugs are removed and a calcimide clay, such as Turface, is used to fill the plug holes. We hand water these spots that day, and the following day normal watering for that green is resumed. Fall aeration is used for each green to relieve compaction and stress caused by heavy summer play.

FERTILIZER PROGRAM

The majority of our fertilizer applications are in the fall of the year. This helps to develop a good root system that will support our greens during the next summer's stress times. At Walnut Creek we do not encourage top growth in the summer months. The natural top growth is usually sufficient.

FUNGUS PROGRAM

At Walnut Creek we spray each Thursday during the growth months of March through October. Chemicals used normally provide seven to fourteen days of protection. By spraying on Thursdays we are protected during the heavy weekend play, and if any fungus is developing we're spraying again before any real trouble begins. Approximately five different chemicals are used to keep the fungus growths from developing resistance.

INSECT CONTROL

During the insect problem period of each year we use three different kinds of insecticide chemicals for control, again to prevent the pests from developing immunity. Spraying is planned and carried out on a preventive basis, and usually occurs every 20 to 30 days, depending upon the weather. (Birds?)

WEED CONTROL

Problem weeds at Walnut Creek are Poa anna, goosegrass (or crow's foot) and crabgrass. For control of these weeds we use spring and fall applications of appropriate chemicals. In the spring the first application is prior to aerating, with the second following aeration by about two weeks. We have a fall application for Poa annua only, as near August 15 as possible. Our second fall application is after fall aeration.

DAILY PROGRAM

As with every course, our daily program at Walnut Creek is mostly controlled by the weather. When possible, Mondays are usually an off-day for the greens. Watering is carried out if needed. Tuesdays through Sundays all greens are cut, to a year-round height of three-sixteenths of an inch. Cups are changed every other day, except in tournaments. And, of course, water is applied if needed.

Thank you.

"GROWING BENTGRASS IN EASTERN NORTH CAROLINA"

Tommy Davis
Wilson Country Club, Inc.
Post Office Box 2145
Wilson, North Carolina 27893

The growing of bentgrass in Eastern North Carolina requires several different programs to be successful. Some of the different programs we try to follow at Wilson Country Club are as follows:

1. A good water management system that requires quite a bit of hand watering especially during windy weather with low humidity. We try not to over water and usually never water the greens any longer than ten minutes a station. Watering longer than this just causes run off. If we develop "hot spots" or isolated dry spots we hand water and if necessary aerify these areas with one quarter inch tines on aerifier.

2. A good aerification program is essential to producing a good bentgrass putting surface. This helps water percolation, thatch control and develops good root structure. The system we use consist of aerifing three times a year which consist of once in the fall, once in early spring or April and the last of May or early June. This year we have been chosen to host the North Carolina Amateau June 16th - 19th so we will aerify after this tournament.

   The procedure we use in aerifing and topdressing is as follows: We close the front nine on Monday and the back nine on Tuesday, trying to complete nine holes each day. We mow the green, then aerify with windrow attachment. After that, we use large coal shovels and pick up plugs. We follow this with the drag to work any excess soil back in the holes and brush up any wide blades. Then we mow two ways with Greensmower with Wiehle rollers. Follow this with topdresser and topsoil and drag green again. We have found that the late of May or early June aerification, after which we do not topdress, has helped on water percolation and dry spots during summer. We will aerify our greens whenever they need it at Wilson Country Club especially during the summer.

3. A good spray program must be followed to keep your greens in tip top shape the year round. We use the preventive maintenance program and spray weekly during the stress times and peak disease periods. We always try to spray on Thursday which gives us a day to work with before the weekend if we develop a problem. We try to lime our greens at least once a year and run regular soil tests annually on them.

4. Fertility - We try to put about five to six pounds of N per year on our greens. This is something you just have to develop a feel for. You can not treat each green the same all the time. Some greens may need more than others.

5. Mowing Practice - We try to mow our greens as frequently as possible. We do not mow the cleanup lap every time we mow. This will produce that fine putting quality desired by todays golfers. During very hot weather, we will skip days of mowing but we never change our height, we always mow 3/16".

Hopefully some of these items will help you in the growing of bentgrass. We have tried to follow this method for five years at Wilson Country Club.

If any of you are ever in Wilson, you are always welcome to come by Wilson Country Club and play our course.

PROBLEMS WITH MANAGING OLD AND NEW GOLF GREENS WITH DIFFERENT SOIL MIXTURES

George B. Thompson
The Country Club of N. C.
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Managing Penncross putting greens with different soil texture is one challenging aspect of our business. Many of us have a combination of "old and new" style greens with old meaning soil-greens, or mud-greens as some of my friends call them, and new, which I"m calling sand-greens. I'm only back tracking about 80 years. If I went back to the late 1800's, I would be going back to all sand composition again.

We have two 18 hole courses at the Country Club of North Carolina. The original Dogwood course was opened for play in 1963. Greens mix looks like native, dirty sand with 5-10% clay mixed in. A third nine (Cardinal) was opened in 1970, this nine has, what appears to be an 80-20 mix with very little soil. I have not been able to find any specifications for the soil-mixes so what I am describing are my own observations. A fourth nine was added to complete the Cardinal course in 1981. These greens were constructed entirely of sand with a little ground pine-bark topping to facilitate seed germination.

The original course had adequate size greens with beautiful contours, and many challenging pin positions to choose from. Their size averages 5,800 sq. ft. They were deep tine aerified and sand topdressed for 4 years, prior to my coming on board. Only three greens hold water puddles for any length of time after a heavy rain. They perk about 1-2"/hr. and have good moisture retention. Poa annua is present with percentages varying from 10-60%. The greens were not difficult to manage in 1982, even with the high percent of Poa. The greens held up very well in June-September. We deep watered them about every 5th night. Some supplemental hose water was required, usually the second or third day following night watering. Greens were syringed by hand as needed. I was pleasantly surprised in the way these 20-year-old greens responded to our maintenance programs.

The third nine greens also have been sand topdressed and deep tine aerified for four years. Their average size is 6,500 sq. ft. They also perk well, and have beautiful contours. Poa annua has invaded these thirteen-year-old greens, but the maximum percentage is only 20%. The greens irrigation system was not automated until this fall. Our irrigation schedule consisted of one man turning on a manual valve after mowing, every second or third day. The few snap valves we had on that nine were nearly inaccessible. It was difficult to hand water or syringe with hoses. This system was automated this past September. Snap valves were installed next to right rear pop-up sprinklers. In spite of a faulty irrigation system these greens held up very well in 1982. Our main problem was goosegrass.

The fourth nine greens have been the most difficult to manage because of the high percolation rate, 20"/hr. and the lack of available water in

the root zone. I probed these greens in December last year and suspected problems. They started wilting in March, which confirmed my suspicions. We took a collective sand sample from these nine greens, and sent them to Dr. Gilbert for a mechanical analysis. His comments were many, but briefly, he said the greens should be reconstructed to improve the poor materials used. An alternate procedure would be to alter the mix by frequent aerification, removal of plugs, and filling the aerifier holes, with a mix or material that would retain moisture. Since the greens were only 1-1/2 years old, and our membership expected things were done properly, and the greens would improve with age, we decided to aerate, and incorporate a medium sand, with some fine material, and some water holding capacity.

Comparison of Soil Separates

Greens	Topdressing sand
Fine gravel 8.3%	0
Very coarse sand 20.6%	0
Coarse sand 37.1%	15.1%
Medium sand 26.7%	71.6%
Fine sand 6.1%	13.1%
Very fine sand 1.2%	2.%
Silt)	
) Trace	0
Clay)	

If in the future these two sands could reorient,an equal mixture would pass USGA specifications.

Other Observations in March

1. Short root system, turf lost seedling vigor after one year, low phosphorus, low C.E.C. (1.5).

2. Thin turf with algae present.

3. 1/2" of thatch.

4. Difficult to extract plugs with Ryan aerator, entire green would heave up and, only 1/2 the plugs would come out of holes. We had to roll greens immediately after aeration counteracting some of the benefits.

5. We could not puddle greens with irrigation, bunkers would fill with water before green had standing water.

6. Very easy to change cups, and surprisingly plugs would hold together.

7. Greens always firm, but would hold a shot.

To hold turf on these greens in the summer we irrigated heavily, every third night, we applied 1/2" to 3/4" each irrigation, generally with three,

thirty minute sets. We also hand watered about 12 hours a week and syringed nearly every day. The greens were difficult to keep, but not impossible. Our fertility program consisted of 5 lbs. of N; 2 lbs. of P_2O_5, and 4 lbs. of K_2O. The progam on the other 27 holes, was 4 lbs. of N; .5 P, and 3 lbs. of K. The most significant growth response came from 18-46-0, Di-Amonium-Phosphate. The phosphate promoted root growth, and in general acted as a catalyst. Elemental phosphorus was applied in one spring application at the rate of 1.5 lbs.

In conclusion, I believe we have the tools to manage almost every putting green, regardless of how it was constructed. I think the most critical limiting factor, other than budget, is Positive Surface Drainage. If the soil is heavy, excess rainfall must move off quickly. One of the best greens I had in the D.C. area, had less than .1"/hr. infiltration. The green was also 65% sand, 24% silt, and 9.5% clay. Only 20% of the sand was in the medium fraction. By the book this green was an accident, ready to happen. The accident didn't happen during my 19-year tenure, mainly because of good surface drainage. At times we need to apply more art than science in this business. We may need to perform some radical treatments such as aerating in July, and irrigating in January. That is part of the challenge, and if it was too easy it wouldn't be fun.

Topdressing Materials for Golf Greens

W. B. Gilbert, NCSU

Topdressing is the distribution of a thin layer of a sandy soil to a turf. The primary functions of topdressing are for thatch control and/or to improve the smoothness of a putting green. It should not be used as a routine practice in the general cultural system.

Other uses for topdressing include covering of sprigs of vegetative plantings; when overseeding to provide a medium for seed germination; and for winter protection of turf.

In general, material used for topdressing should be similar to the soil materials in the putting green. The exception is when the soil in the green is unsuitable and susceptible to compaction. Under these circumstances a more desirable material should be used. The topdressing is matted into the holes following coring and provide vertical columns of soil having improved texture and structure.

Topdressing is one of the most effective biological controls of thatch. The following table is from work done by Thompson and Ward at Mississippi State University.

THATCH ACCUMULATIONS ON TIFGREEN BERMUDAGRASS GOLF GREEN TURF AS INFLUENCED BY MANAGEMENT PRACTICES.

Topdressings Interval	Aerifications Per Summer	Vertical Mowing Interval			
		None	Every 2 Wks.	Every 4 Wks.	Every 6 Wks.
		Millimeters of Thatch			
None	None	27	25	25	25
	Two	28	21	21	25
	Three	25	21	28	24
Bimonthly	None	11	12	10	11
	Two	13	11	12	11
	Three	9	13	11	10
Monthly	None	4	4	6	7
	Two	5	5	7	7
	Three	6	7	6	7

Thompson and Ward MSU

Using a combination of topdressing (none, every two months, and monthly), aerification (none, 2, and 3 per summer), and vertical mowing intervals (none, every 2, 4, and 6 weeks), Thompson and Ward conclusively showed no decrease in thatch on Tifgreen bermudagrass by either aerification or vertical mowing. Without topdressing, the thatch remained at 21-28 millimeters (1 inch = 25.4 mm) even when aerified three times and verticut every two weeks. Topdressing every two months reduced the thatch from 10-12 millimeters, while monthly topdressing reduced the level to 4-7. However, their conclusions stated that the quality of the putting surface was improved with the three aerifications and vertical mowing every two weeks plus monthly topdressing.

The topdressing rates for thatch control (and smoothness) should not be over 0.3 cubic yards per 1000 square feet at any one application. The topdressing should be applied when the turf is actively growing. This would apply for bentgrass in the spring and fall, and for bermudagrass during the summer.

For surface smoothness and firmness, and to produce a fine texture without grain, light, frequent topdressings are the answer. Rates of 0.05-0.10 cubic yards per 1000 square feet generally are applied to bentgrass biweekly or monthly in the spring and fall, and to bermudagrass biweekly or monthly in the summer. The rate and frequency of topdressing is determined by the thatch accumulation rate and the extent of irregularities in the playing surface.

The following table shows the rates and depth in inches:

TOPDRESSING RATES

Rate cm Yd/M	Depth/Inches
0.05	0.015
0.10	0.03
0.30	0.09
0.60	0.19
0.80	0.26

One of the most important concerns in topdressing is the use of a soil mixture that is similar to the soil present. The use of mixes containing textures different from the underlying soil may result in a layering that impairs water and air movement and results in overall reduction in turf quality.

The following table gives the specifications for a putting green mix as recommended by the U. S. Golf Association. A good topdressing material should be comparable.

USGA SPECIFICATIONS FOR PUTTING GREEN MIX

Textural Name	Diameter Limits - MM	Top Soil Mix Limits
Gravel	> 3	0
Fine Gravel	3-2	3%
Very Coarse Sand	2-1	10% Maximum
Coarse Sand	1-0.5	45% Maximum
Medium Sand	0.5-0.25	35% Min. - 75% Ideal
Fine Sand	0.25-0.10	15% Maximum
Very Fine Sand	0.10-0.05	5% Maximum 25%
Silt	0.05-0.002	5% Maximum Max.
Clay	<0.002	3% Maximum

Generally, 10-20 percent organic matter is incorporated with putting green mixes and topdressing materials. The following table gives quantative comparisons between peat humus, bark, and sawdust. The peat humus is the preferred amendment since it does not separate and float as does bark. Sawdust is a poor choice due to its very short durability.

QUANTATIVE COMPARISON OF SOIL AMENDMENTS

	Cost	Resist Compaction Wet	Resist Compaction Dry	Water Holding	Dura-bility	CEC
Peat Humus	Med.	Fair	Good	Good	5 yr	Good
Bark	Med.	Fair	Good	Good	5 yr	Good
Sawdust	Low	Fair	Good	Fair	1 yr	Fair
Calcined Clay	High	Good	Good	Good	10 yr	Poor
Sand	V. low	Fair	Good	Poor	Infinite	None

Also included in Table 4 is a comparison of calcined clay and sand. When attempting to modify a soil following aerification, both are excellent materials if worked into the aerifier holes to provide vertical columns and not as horizontal layers.

The use of sand as the only source of topdressing has many pros and cons, and generally is not recommended. Unfortunately, the original work with sand for topdressing used sand of volcanic origin and not the silica sand used in this area. New materials are becoming available for use and it would be advisable to keep abreast of developments. A recent report on "Zeolite" for topdressing use was made at the 1982 Agronomy meetings. This is a natural silicate material that is being mined in the Southwest. It is reported to have a high cation exchange capacity, increases the water-holding capacity of sandy mixes, delays nitrification, and increases the top growth of the turf.

PUBLIC RELATIONS AND PESTICIDE PROBLEMS ON ROADSIDES

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The Landscape Unit in the Division of Highways as a part of the Department of Transportation is responsible for highway roadside vegetation management. A part of that responsibility is the development and implementation of an extensive herbicide program.

Department of Transportation Herbicide Program

1. Growth Regulators - Our usage of plant growth regulators to retard the growth of grass incompassed 30,000 acres during the 1982 season with an approximate savings of $30 per acre over what would have been normal mowing costs.

2. Weed Control

   - Ornamental _ Plant bed weed control consists of both pre-emergence and post emergence treatment.

   - Broadleaf _ Full scale broadleaf control is concentrated along the growth regulator treated sections.

   - Stationary Objects _ Treatment for weeds are placed around sign post, guardrails, etc.

   - Paved Shoulders _ Treatments are placed to eradicate Bermudagrass from paved shoulders.

   - Capped Islands _ Treatments are placed to prevent weeds from growing in cracks.

3. Plant Pests

   - Johnsongrass _ Johnsongrass control has been, up to this point, from a spot spraying type operation.

   - Kudzu _ Kudzu control is undertaken when agreements with private property owners can be reached.

   - Nutgrass and Multiflora Rose control programs also are undertaken.

4. Brush Control - Our brush control program has expanded significantly with a usage of approximately 18,000 gallons of Krenite during the fall of 1982.

5. Bermuda/Bahia Release - This program has been undertaken to help in the establishment of these warm season grasses in Eastern North Carolina.

With such an extensive herbicide program we in the Department of Transportation are of course at times confronted with public complaints on pesticide use. The source of public complaints may come from:

1. Environmental Groups _ Please refer to "Environmentalism, Pesticide Use, and Rights-of-Way" by Ron Arnold presented to the Transportation Research Broard - Roadside Maintenance Committee. This particular publication goes in depth into the different types of environmental groups that may be organized to protest against pesticide use. As most of this activity is now limited to the West Coast we will not get into a further discussion of this particular area.

2. Individual Complaints - These complaints may be one of the following types: on site, telephone, letter, news media, or legal. Certainly by far the most serious are the news media and legal types. Our recent tobacco injury claims resulted in both news media and legal exposures.

How might we respond to complaints?

1. On-site response _ This is, of course, by far the best method. That is to have printed material available (manuals, labels, etc.) _ and personnel who can answer the parties questions on the application site.

2. Written response _ This may be a followup to an on-site complaint or a response to a letter or a telephone call. We should again use all available resources and answering this type of complaint. (Manuals, labels, University publications, etc.)

3. Use of Technical Resources - Private companies have available resource people who can respond to individual complaints. As an example, Dow Chemical helped us in a Garlon spraying incident adjacent to a pasture on a secondary road in Johnston County where an individual had some pregnant cows grazing. The Dow Veterinarian was able to explain the safety information concerning Garlon and convince the individual that there was no danger to his cows. Another example was our spraying of MH-30 adjacent to a pasture in McDowell County where thoroughbred horses were grazing. The owner of these horses was concerned that the sprayed roadside grass might be eaten by the horses with a resulting injury to them. We took soil samples and vegetation samples and Uniroyal tested these for us which showed no residue of MH-30. This satisfied the individual that no

harm would come to her livestock. University extension people are also an excellent source of resource information. You should definitely keep your County Extension people informed of what your program is, your aims and precautions, and products being used so that they might be able to help you when a problem arises.

We have developed, as a resource document, a Herbicide Manual for the Division of Highways entire program including sections on safety, treatments, calibrations, records, and an inclusion of a copy of all labels of products currently in use by the Department. Included in this manual is a LD_{50} toxicity listing of many of the herbicides we use with table salt and aspirin toxicity levels for comparison. It is interesting to note, for instance, that Roundup has a lower toxicity as far as oral intake than does table salt or aspirin.

Another excellent resource document to use in response to complaints is "Practical Considerations of Herbicide Toxicity" a Dupont publication which gives in one section the LD_{50} of various herbicide dilutions. For instance, a normal roadside dilution is 160 times that as listed in a normal LD50 chart as far as toxicity. An example might be Bromocil with a normal LD_{50} of 5200 miligrams per kilogram times the 160 dilution factor equals an effective dilution LD_{50} of 832,000. Thus a 132 lb. person would have to injest 100 lbs. of the solution for it to be lethal. An individual certainly could relate to this kind of practical information.

Another tool that can be used is "Herbicides: Practical Tools for Better Vegetation Management". This is also a Dupont publication that explains the action and purpose of herbicides and also some toxicity information. This would be a good general purpose publication to give out to interested individuals or groups.

A part of our Herbicide Manual and required records is the Daily Herbicide Spraying Report which is filled out by a licensed Landscape Specialist III (herbicide crew foremen). These are required to be filled out each day that any herbicide application is made indicating the applicators name, date, time, location, weather conditions, products used, etc. We certainly would have been in very serious trouble without this kind of documentation in the tobacco injury claims that we recently went through.

Several major complaints that we have been involved in have been damage to trees adjacent to our guardrail sections by Spike 80W where the tree roots were growing under the guardrail and also tobacco damage last season by the use of Banvel 4WS. In the tobacco injury situation we utilized many of the resource documents and technical resource people from North Carolina State University previously referred to.

How might we prevent complaints?

Certainly one of the best ways is the use of training. We have some 41 Department of Transportation licensed pesticide public operators in the areas of aquatics, right-of-way, ornamentals and turf, demonstration and research, and ag. pest. We are not required to have this many, but encourage everyone involved in these type operations to become licensed if at all possible. We also hold regular in-house training sessions each winter on our herbicide program.

A second consideration in complaint prevention is the use of a daily herbicide spraying report which will point out the conditions under which the spraying operations are made and possibly when we should cease operations because of, for instance, weather conditions. Also, a complaint record form which we are working on now might point out a particular history of complaints and how we might prevent them in the future.

The availability of a good Herbicide Manual containing labels and other aids to describe what to use and how to use pesticide products certainly should be a good resource in complaint prevention. Another good resource document is the North Carolina Agricultural Chemicals Manual; which, of course, describes what products to use for various treatments needed.

We also might use technical advances to aid in complaint prevention. This might involve the use of low drift nozzles or what we call the "great complaint preventor" - Nalcotrol. Nalcotrol is a polyvinyl polymer which is used to change the specific gravity of the spray solution and thus reduce drift. Another example of new technology for sensitive areas may be the use of granular materials such as our usage of a granular growth regulator (Eptam) through the North Carolina State Research Farm near Clayton.

Probably one of the best methods of complaint prevention is public relations. You may need to go on the offensive and go to the public and explain the benefits of the program you are undertaking and safety considerations, etc. We undertook this type of public relations campaign in the beginning stages of our growth regulator program. Articles appeared on this program in the Charlotte Observer and the News and Observer, and many daily newspapers.

Our aim in the Department of Transportation is to provide North Carolina with well managed, low maintenance, asthetically pleasing roadsides which we feel that a viable herbicide program is an essential part of. We all must protect our pesticide programs from complaints and consider public relations if we are to accomplish our vegetation management aims.

COOL SEASON TURFGRASS CULTIVAR EVALUATIONS FOR NORTH CAROLINA - 1982 RESULTS

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The turf type tall fescues have been heavily advertised and promoted for use in the transition zone of the United States. Tall fescue is utilized throughout the Carolinas for many general turfgrass applications including roadsides, parks, institutional grounds, and home lawns. Evaluation of these turf type tall fescues, including many experimental cultivars, have been conducted at NCSU since 1978.

Rebel, one of the first turf type tall fescues released, has continued to perform well under both full sun and shaded conditions. Rebel has ranked best among the cultivars examined in the Turf Type tall fescue trial (Table 1) and the Southern Regional tall fescue trial (Tables 2 and 3).

The turf type tall fescue trial was established from seed on October 9, 1981 at the NCSU turf field plots in Raleigh, North Carolina. Plots were seeded at a rate of 5 pounds per 1000 square feet, except for Glade and Kenblue Kentucky bluegrass. Glade and Kenblue plots were seeded at individual rates of 0.5 pounds per 1000 square feet when seeded together, and at 1.0 pounds per 1000 square feet when seeded alone. These plots have been mowed at a height of 2 inches and were fertilized at a rate of 2 pounds of nitrogen per 1000 square feet annually.

Mixtures of Kentucky 31 tall fescue with Kenblue and Glade Kentucky bluegrasses have also performed well in both sun and shade trial locations. This mixture's performance exceeded that of Ky-31+Kenblue and Ky-31 alone during 1982 (Table 1). Under shaded conditions, the Ky-31/Kenblue mixture consistently had better turf quality than either Ky-31 or Kenblue alone (Table 4). The addition of Glade to the Ky-31/Kenblue mixture significantly improved turf quality observed during 1982.

All entries in the turf type tall fescue trial provided acceptable turf quality during 1982, with the exception of TF 55B and NK81453 in July. In comparison to the other cultivars, Olympic tall fescue performed better under shaded conditions (Table 4) than under full sun (Table 1).

Table 1. Turf type tall fescue cultivar turf quality* evaluations during 1982.

Cultivar	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	MEAN
Rebel	6.3	6.2	6.2	6.3	7.2	7.8	8.0	7.0	8.2	8.2	8.5	8.5	7.5
Ky31+Kb+Gl**	6.6	6.5	6.7	7.0	6.8	7.8	7.2	7.0	7.0	7.3	8.5	8.3	7.3
Falcon	5.7	6.2	6.2	6.5	7.2	7.8	7.8	6.7	7.2	7.0	8.2	7.8	7.1
SynGA	6.8	6.2	5.8	6.3	6.5	7.7	7.7	7.0	7.2	7.5	8.0	8.0	7.1
Houndog	6.2	5.8	6.0	6.2	6.8	7.3	7.5	7.0	7.3	7.3	8.0	7.7	7.0
KS-76-703-2	6.4	6.2	5.8	6.0	6.5	7.8	7.5	6.7	7.2	7.2	8.0	8.0	7.0
Mustang	5.8	5.3	6.0	6.2	6.7	7.3	7.2	6.0	7.3	7.8	8.2	8.0	6.9
TF 5LL	5.8	5.7	5.7	6.5	6.3	6.8	7.3	6.0	7.3	7.8	8.7	7.8	6.9
Ky-31	6.0	5.8	6.2	6.7	6.7	7.3	6.7	6.0	6.3	6.8	7.7	7.3	6.7
KS-78-4-1	6.0	5.2	6.0	6.3	6.5	7.0	7.2	6.3	6.8	7.2	7.8	7.5	6.7
Galway-NK	6.0	6.0	5.8	6.0	5.8	7.7	6.8	5.7	6.3	7.2	7.8	7.7	6.6
KS-78-347-1	6.1	5.5	5.7	6.2	6.2	7.3	7.7	5.7	6.8	6.8	7.7	7.2	6.6
TF 805	6.2	5.5	5.7	6.2	6.3	6.7	7.5	6.3	6.7	6.8	7.2	7.3	6.6
TF 521	5.8	5.5	5.5	5.8	6.0	6.7	6.7	6.3	7.5	7.3	8.0	7.7	6.6
TF 579	6.1	5.8	5.5	5.8	6.2	7.7	7.5	5.7	6.7	7.2	7.5	7.3	6.6
Ky31+Kenblue	6.2	5.7	5.8	6.2	6.3	6.8	6.7	5.7	6.5	6.8	7.8	7.2	6.5
KS-76-701-2	5.9	5.7	5.3	5.8	6.2	7.3	7.3	6.0	6.3	7.0	7.7	7.7	6.5
NK81452	5.8	5.3	5.5	5.8	6.0	6.7	7.2	6.0	6.7	7.2	7.5	7.5	6.5
Brookston	5.8	5.7	5.7	5.7	6.0	6.2	6.8	5.0	6.7	7.5	7.7	7.7	6.4
TF LS9	5.8	5.7	5.8	6.0	5.5	6.7	6.8	5.3	6.2	6.8	7.7	7.5	6.4
TF 55B	5.6	5.5	5.3	5.5	6.0	7.3	7.7	4.7	6.3	7.0	7.8	7.2	6.4
Clemfine	5.7	5.0	5.2	5.5	5.7	7.2	6.8	5.7	6.0	6.7	7.3	7.2	6.2
NK 81453	6.2	5.8	6.0	6.0	5.8	6.7	6.2	4.7	5.7	6.5	7.2	7.2	6.2
Olympic	5.6	5.0	5.0	5.3	5.7	6.0	7.2	5.0	6.5	7.0	7.7	7.2	6.1
LSD	1.5	2.1	1.8	2.5	1.9	1.7	0.9	3.0	1.4	1.4	1.6	1.9	0.3

* Turf quality on a 1 to 9 scale, 9 = best, 5 = acceptable.
** Kb= Kenblue and Gl= Glade Kentucky bluegrasses.

The Southern Regional tall fescue trial was established at the NCSU turf field plots during October of 1978. Plots were seeded at a rate of 4.5 pounds per 1000 square feet and fertilized at a rate of 2 pounds of nitrogen per 1000 square feet per year. Irrigation was provided to prevent wilt and the turf was clipped at a height of 2.5 inches.

Since the start of this study, several new turf type tall fescues have been developed. Some of these have been included in the turf type tall fescue trial which began in 1981. The Southern Regional tall fescue trial has demonstrated the long term performance of both Rebel and Falcon relative to Ky-31 (Table 3.). Goar, Monaco, and Fawn provide poor turf quality relative to Ky-31 and the improved turf type tall fescue cultivars (Tables 2 and 3).

Table 2. Turf quality* scores for the 1982 Southern Regional tall fescue trial data.

Cultivar	Jan	Feb	Mar	Apr	May	Jun	Jul	Mean
Rebel	5.7	5.7	7.7	7.7	7.0	7.7	8.0	6.9
Clemfine	5.3	6.0	6.7	6.7	7.0	7.3	5.3	6.5
Belt KPH 1	5.7	5.7	7.0	7.0	6.7	7.0	5.7	6.5
Falcon	5.0	4.3	7.0	7.7	6.7	7.7	5.0	6.4
PHB-1-5	5.0	4.3	6.7	7.0	7.0	7.7	6.0	6.3
Kenwell	5.3	5.3	6.0	6.3	7.0	7.0	6.0	6.2
Belt Syn 16	5.3	4.3	6.7	7.3	6.3	6.7	5.0	6.1
AG125	4.3	4.0	6.7	7.3	6.7	7.0	4.7	6.0
Galway	4.7	4.3	6.0	6.7	6.7	7.3	7.0	5.9
Ky-31	5.3	5.0	6.3	6.3	6.3	6.3	5.3	5.9
Blend	5.0	4.3	5.0	7.0	7.0	6.7	5.3	5.8
Belt TF25	5.0	5.0	6.3	6.3	6.0	6.3	4.7	5.8
Kenmont	5.3	4.3	6.0	6.0	6.0	6.7	6.3	5.7
Belt TF 11	5.3	4.7	6.3	6.0	6.0	6.0	6.0	5.7
Kenhy	4.7	4.0	5.0	6.0	6.0	6.0	4.7	5.3
Alta	4.3	4.3	5.7	5.7	5.3	5.7	5.3	5.2
Monaco	3.3	3.3	5.3	6.7	6.0	6.0	3.3	5.1
Goar	3.3	5.3	5.0	4.7	5.0	5.3	4.0	4.8
Fawn	3.3	3.7	5.0	4.7	5.0	5.7	4.3	4.6
LSD	0.8	1.5	1.5	1.0	1.7	1.0	3.4	0.4

* Turf quality ratings on a scale of 1 to 9, 9=best, and 5= acceptable.

Table 3. Turf quality* summary for the Southern Regional tall fescue evaluation from 1979-1982.

Cultivar	Date of Evaluation 1979	1980	1981	1982	Mean
Rebel	7.7 ab**	7.2 a	6.5 a	6.9 a	7.1
Falcon	7.7 ab	6.7 abc	5.8 bc	6.4 bc	6.6
Ky-31	7.5 a-d	6.4 bc	5.7 bc	5.9 def	6.4
Clemfine	6.9 ef	6.5 bc	5.6 bcd	6.5 ab	6.3
Galway	7.8 a	6.8 ab	5.5 b-e	5.9 def	6.6
Kenwell	7.3 b-e	6.3 cd	5.4 b-e	6.2 b-e	6.3
Kenmont	7.4 a-d	6.3 cd	5.4 b-e	5.7 f	6.2
Kenhy	7.5 a-d	5.8 e	5.1 ef	5.2 g	5.9
Alta	7.2 de	5.2 fg	4.6 fg	5.3 gh	5.6
Goar	6.2 g	4.8 g	4.5 g	4.8 hi	5.1
Monaco	7.2 de	4.7 g	4.4 g	5.1 gh	5.3
Fawn	6.7 f	4.9 g	4.3 g	4.6 i	5.1

* Turf quality ratings on a scale of 1 to 9, 9=best, 5= acceptable.

** Means with like letters within columns are not significantly different at the 0.05 level, DMRT.

The cool season turfgrass evaluation trial under shaded conditions was seeded on November 10, 1980 and included tall fescues, hard fescues, red fescues, Kentucky bluegrasses, rough bluegrass, and perennial ryegrass entries. Seeding rates were as follows: tall fescues and perennial ryegrasses at 6 pounds per 1000 square feet, Kentucky bluegrasses at 2 pounds per 1000 square feet, and red fescues, hard fescues, and chewings fescues at 3 pounds per 1000 square feet. Cultural procedures for this study were similar to that for the turf type tall fescue trial.

Glade Kentucky bluegrass was the top performing entry during 1982, and was equivalent to Ky-31+Kenblue, Falcon, Houndog, and Fylking. Rebel's intermediate performance along with Olympic, Clemfine, Biljart, Reliant, and Galway is noteworthy since all three Rebel plots had significant tree root competition which the other test entries were not subjected to. Unacceptable performance was obtained from the red fescues, including Pennlawn, Fortress, Highlight, Banner, Jamestown, and Ensylva. Ensylva's turf quality was acceptable during 1981, but declined significantly during this study. The hard fescue entries, Reliant and Biljart had better turf quality than the red fescue during 1982, but not during the first year of investigation.

Table 4. Turf quality evaluations* for cool season turf cultivars under shaded conditions.

Cultivar	1981 September	1981 Mean	1982 September	1982 Mean
Glade KB	6.9	4.4	6.8	6.6
Ky-31+Kenblue	6.5	5.6	6.5	6.5
Falcon TF	5.7	5.3	7.2	6.4
Houndog TF	5.8	5.0	6.8	6.3
Fylking KB	5.8	4.4	6.3	6.3
Olympic TF	6.0	4.4	6.2	6.1
Clemfine TF	4.8	4.6	5.8	5.8
Rebel TF**	3.5	3.6	6.5	5.6
Biljart HF	4.0	3.7	5.2	5.6
Reliant HF	5.0	4.6	4.2	5.6
Galway TF	4.1	3.9	5.7	5.4
Ram I	5.5	4.4	4.2	5.0
Ensylva RF	6.3	5.1	3.3	4.9
Kenblue KB	4.8	3.2	4.0	4.9
Jamestown ChF	4.0	4.7	2.7	4.5
Highlight ChF	5.0	4.2	2.0	4.2
Banner ChF	3.5	4.0	2.5	4.0
Sabre RB	4.7	4.7	1.0	3.9
Derby PR	2.8	5.4	1.3	3.8
Baron KB	5.3	3.8	2.8	3.7
Fortress RF	4.7	3.1	1.5	3.6
Ky-31 TF	3.2	4.0	4.5	3.5
Pennlawn Rf	3.5	3.0	2.2	3.5
LSD	---	---	1.2	0.4

* Turf quality on a scale of 1 to 9, 9=best, 5=acceptable.
** Tree root competition present.

During the fall of 1980, 85 cultivars of Kentucky bluegrass were established for the purpose of determining their potential under North Carolina conditions. This trial was located at the NCSU turf field plots in Raleigh, North Carolina. Individual plots were established from seed at a rate of 1.7 pounds per 1000 square feet. Fertilization has been maintained at a rate of 2 pounds of nitrogen per 1000 square feet per year (1 lb/M in September and 1 lb/M in October).

The top ten performers for the first two years of this evaluation are shown in Table 5. Glade Kentucky bluegrass was the only named cultivar that remained in the top ten for both years of study. The experimental cultivars CEBVB-3965, 225, MLM-18011, AND PSU-173 also ranked in the top ten for the first two years of this evaluation. Continued performance by one or more of these four experimental cultivars may lead to a Kentucky bluegrass release with much improved turf quality under North Carolina conditions compared to existing varieties. The turf quality scores for all entries during 1982 are shown in Table 6.

Barblue, Glade, Parade, H-7, Cheri, Baron, and I-13 ranked the best of the commercially available cultivars (Table 6), while South Dakota common, Merion, Kenblue, and Mystic ranked as the poorest of this group. It is important to note Baron's poor performance in the shade evaluation trial (Table 4). Under shade conditions disease investations have severely injury Baron Kentucky bluegrass. The turf quality of Kenblue monostands has been poor under both shaded (Table 4) and full sun conditions (Table 6). However, the turf quality resulting from mixtures of Kenblue with tall fescue has been good to excellent under either sun (Table 1) and shade(Table 4).

Table 5. The ten top cultivars turf quality scores from the National Kentucky Bluegrass trial during 1981 and 1982.

1981		1982	
Cultivar	TQ*	Cultivar	TQ*
CEBVB 3965	7.4	Admiral	7.1
225	7.3	225	6.9
MLM 18011	7.3	CEBVB 3965	6.7
WWAG 463	7.2	Barblue	6.6
Fylking	7.2	PSU 173	6.6
Glade	7.2	MLM 18011	6.6
Monopoly	7.1	Wabash	6.6
PSU 173	7.1	K3-179	6.6
Mosa	7.0	Glade	6.5
Victa	7.1	H-7	6.5

* Mean turf quality measured on a scale of 1 to 9, 9= best.

Table 6. Mean turf quality* scores for the National Kentucky bluegrass evaluation trial during 1982.

Entry	June	Mean	Entry	June	Mean
Admiral	6.7	7.1	Charlotte	5.7	6.0
225	7.0	6.9	Challenger™	5.3	6.0
CEBVB 3965	6.7	6.7	Columbia™	6.3	6.0
239	6.0	6.6	BA 6191	5.3	6.0
PSU 173	6.3	6.6	Ram I™	5.0	5.9
MLM 18011	6.0	6.6	Cello	6.0	5.9
K3-179	6.7	6.6	WWAG 478	6.0	5.9
Barblue™	6.7	6.6	A20-6A	5.7	5.9
Glade™	5.7	6.5	Apart	6.3	5.9
Parade™	7.0	6.5	Mona	5.3	5.9
H-7™	5.7	6.5	Adelphi™	5.7	5.8
NJ 735	7.0	6.5	Rugby™	5.0	5.8
Cheri™	5.7	6.4	Piedmont	5.3	5.8
PSU 150	6.3	6.4	Enoble™	5.7	5.8
Baron™	6.3	6.4	Nugget™	5.0	5.7
WWAG 463	5.3	6.4	PSU 190	4.7	5.7
I-13™	5.3	6.4	Majestic™	7.0	5.7
SH-2	6.7	6.4	A-34™	5.7	5.7
Enmundi™	6.7	6.3	Welcome	4.7	5.6
Aspen™	6.0	6.3	Vantage™	5.7	5.6
Bayside	6.3	6.3	Merit™	6.0	5.6
K3-178	6.3	6.3	Sydsport™	5.7	5.6
Fylking™	5.3	6.2	Wabash™	4.3	5.5
A20-6™	6.3	6.2	SV-01617	5.3	5.5
Midnight™	7.0	6.2	WWAG 480	4.3	5.5
Mer PP300	5.3	6.2	A20™	4.7	5.5
Bristol™	7.3	6.2	Escort	4.3	5.5
Victa™	5.3	6.2	Kimono™	5.0	5.4
Eclipse™	6.7	6.2	Harmony	4.7	5.4
K1-152	6.3	6.2	Bonnieblue™	4.7	5.4
TPI-963	5.7	6.2	Mer PP43	6.0	5.4
America™	5.7	6.1	Lovegreen	4.7	5.4
Vanessa	5.3	6.1	S-21™	4.7	5.3
Shasta™	6.7	6.1	Trenton™	5.3	5.3
Birka™	6.3	6.0	Dormie™	5.7	5.3
Monopoly	6.0	6.0	Touchdown™	5.0	5.3
243	6.7	6.0	Argyle	5.0	5.2
Plush™	7.0	6.0	Mystic™	4.3	5.2
Banff™	5.0	6.0	KB-162	6.7	5.2
Holiday™	5.7	6.0	Kenblue™	5.7	5.0
Geronimo™	5.3	6.0	Merion™	5.0	5.0
Bono	6.3	6.0	S.D. Common™	4.3	4.6
Mosa	5.7	6.0			
LSD	1.8	0.5	LSD	1.8	0.5

* Mean turf quality determined on a scale of 1 to 9, 9=best.
™ Commercially available cultivar.

SOD PRODUCTION AND ITS USES IN NORTH CAROLINA

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Louisburg, North Carolina

In researching sod production in North Carolina, I was amazed to find no information compiled on varieties or acreage in production. I have attempted to assemble some facts and figures with reasonable accuracy. Hopefully this information will be of some value to producers and consumers alike.

New and improved equipment and technology have provided sod producers with a means of producing a low cost, high quality product. New seeding techniques, irrigation improvements, harvesting and material handling equipment have all provided producers and consumers alike with technology needed in todays cost efficient operations.

ESTIMATED SOD PRODUCTION FOR 1983

Variety	Acres in Production
Tifdwarf	11
Tifgreen	177
Tifway	149
Tifway II	3/4
Vamont	12
Centipede	151 1/2
Zoysia	10
St. Augustine	1/2
Fescue-Bluegrass	40
	551 3/4

Sod production in the transition zone has the advantage of being able to produce both warm and cool season grasses. This benefits the producer because he has the ability to harvest sod the year round. The consumer also has advantages in the transition zone because he has the choice of both grasses. Warm season grasses that grow well in this area are Hybird Bermudas, Zoysia, St. Augustine and Centipede. Cool season are more or less limited to Fescue, Bluegrass and Fescue-Bluegrass blends.

All producers of sod fall under the "Nursery Inspection" program of the North Carolina Department of Agriculture. This inspection is performed annually and is directed towards controlling the

movement of disease and harmful plant pests. Any sod shipped out of the state is required to be accompanied by a copy of this certificate from the producer. Likewise, shipments from out of state being used in North Carolina should be shipped with a copy of a similar certificate from the state where the sod was produced.

Certification of turfgrasses in North Carolina is performed by the North Carolina Crop Improvement Association. This is also done by an annual inspection which is made by officials of the association. Certification is the only means we have of being sure that grass being purchased is true to variety. Inspection also provides us with information on noxious weeds contained in sod and sprigs. There are four grades which may be applied to turfgrasses, they are BREEDER STOCK, FOUNDATION SEED, REGISTERED SEED and CERTIFIED SEED. In the certification program, the term "SEED" applies to sod and sprigs as well as seed. All sales of sod, sprigs or seed sold under the certification program must be accompanied by a tag which states the grade of this material.

1982 CERTIFIED & REGISTERED VARIETIES

Variety	Certified	Registered
Tifdwarf	4.0	0
Tifgreen	11.0	.8
Tifway	42.0	.6
Tifway II	0	.3
Vamont	1.1	.5
St. Augustine	.5	.5
Ky-31/Kenblue	24.0	0
Total	82.6 Acres	2.7 Acres

Source: N. C. Crop Improvement Association

Sod provides us with a fast, efficient and often cost effective alternative to seeding. Cool season grasses not available in this area before have provided the landscape industry with a useful tool in establishing the high quality lawns expected by their customers.

There are four main residential applications of sod in North Carolina. All of them apply to both warm and cool season grasses.

NEW LAWNS
RENOVATIONS
REPAIRS
EROSION CONTROL

Commercial applications are often the same as the residential uses, but warm season grasses are more widely used. Some examples of commercial uses are:

NEW CONSTRUCTION
RENOVATIONS
REPAIRS
GOLF COURSES
ATHLETIC FIELDS
EROSION CONTROL

North Carolina sod producers can supply grass in a variety of ways. The most common of these are sprigs, rolls and slabs, and are sold by the square yard. Consumers should be sure when purchasing sod that size and quantity are accurate. Grasses purchased from local suppliers assures consumers of fresh cut material grown under similar soil and climate conditions. Local producers can also provide customer services when needed.

The following is a list of North Carolina sod producers.

Burgaw Creek Nursery
Burgaw, N. C.

Carolina Turf
Raeford, N. C.

Oakland Plantation
Council, N. C.

Raleigh Turfgrass
Raleigh, N. C.

Tarheel Turf
Princeton, N. C.

United Turf
Louisburg - Powells Pt., N. C.

MAINTENANCE OF INSTITUTIONAL GROUNDS

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Let's dispense with the usual formality of definition of the topics. Everyone here should know it refers to care taking, upkeep, infinite gradations of gardening and landscape gardening.

Institutional grounds fit into a broad category. My own experience has been with a university campus for 23 years plus. Industrial parks are one of the newer institutions. Schools and parks of municipalities, hospitals and health care centers, retirement communities, shopping centers, corporate headquarters, "clean" manufacturing facilities with campus-like grounds, condominium complexes and rental apartment complexes are all institutions requiring maintenance in one form or another.

In November I visited still another institution requiring the highest degree of landscape maintenance. Longwood Gardens, Kennet Square, PA, could be an example of a highly intensive maintenance program with continual program changes to attract more paying guests. At the time of my visit the conservatories were filled with the annual chrysanthemum show which required months of preparation. Mums were grown as single stem standards, as blanket type cascades, as large balls suspended from conservatory ceilings -- all to decorate the conservatory for a few weeks. The highest horticultural skills are required for the garden area; high management skills are needed for overall care of the educational and other aspects of the enterprise.

I'm sure we all pass by another extreme of institutional care many times. I'm thinking of the small apartment building or condominiums (possibly converted from rental apartments). Typically there is a strip of grass in front and on two sides with parking in back. There will be bushes on all sides and there may be a tree or two. How is this cared for? A "yard man" who mows the grass, shears the bushes into round blobs, advises that the trees be topped and cut back, who may throw some fertilizer on the grass at the wrong time of the year; and that's the limit of his knowledge and ability. The owners are satisfied with the work because they know no more about proper care of landscape plants than the "yard man" and the place looks neat and tidy.

The point is sometimes a point of contention. The owner or manager or woever is in control of the property should be the one to be satisfied with work that is done. If work directives are issued contrary to the grounds manager's best judgement that manager may (and should) consult with those giving orders trying to persuade them to his judgement and way of work. Sometimes this is not possible.

In a former position I was once told of a directive issued to the grounds crew. There was considerable Celastrus scandens, Bittersweet, trained on walls of the institution. Those of us familiar with that plant know it is like American Holly in producing berries -- only female plants of Bittersweet have the bright orange fruit in fall and male plants are bare. In that institution, one of the most prestigious institutions of higher education in this country, the grounds crew was told that all bittersweet vines on campus must bear fruit. The task of educating the business office types who issued the order was not an easy one.

The functions of a grounds manager or superintendent may be many and varied depending upon the institution and its chain of command. At our university a salesman called on me some time ago after being told by someone that I was the person in charge of the garbage truck and its work. He wanted to sell me a deodorizer. Not being successful he tried other products trying to find one somewhere that fitted some crew on campus. "You pick up all the garbage" he said. "All except the kitchen swill which a prison camp picks up to fatten its hogs." "Who takes care of your trees?" "They're my responsibility." "Who sweeps your streets and parking lots?" "The grounds crew does it whenever it gets done." "Your crew mows the lawns?" "Certainly." "Do they also fertilize and lime it?" "It wouldn't get done otherwise." "Who takes care of the shrubs--pruning, fertilizing, spraying for insects and diseases? We have some good products for that use." "Those are our responsibilities and fertilizer must be ordered on state contract orders. Insecticides, fungicides and herbicides of a generic nature, rather than a brand name are preferred."

"Who is responsible for moving jobs on campus?" "The grounds crew, of course. This is the crew with the moving trucks and guys with big lifting muscles. Very large moves may be contracted to movers. Sometimes we just have to drop everything else and move furniture of some faculty member to another building."

"Who is the landscape designer? Who says what trees and shrubs and grass varieties are planted and where they are to go?" "That is my responsibility." "You also have a golf course, don't you?" "Yes, we have a small course--short--nine holes." "What crew takes care of that?" "Our grounds crew under my supervision." What do you do in your spare time?" "I write a weekly garden column for the local newspaper."

In addition, we must clear walks, drives, parking lots of ice and snow. We must have the campus neat and clean for Commencement and we must gather Christmas holly and greenery for office decorations. We dig ditches and help plumbers and steam fitters repair their underground lines. At times it seems that grounds crews are called on to do anything that other trades don't want to do. And ground crews are traditionally the lowest paid crews in institutional work.

I read with interest an article in November, 1982, Weeds, Trees and Turf about the superintendent of General Electric's corporate headquarters in Fairfield, CT. It seems that he is the sole crew member for a 45-acre facility with all work being done by contractors. His comment that the "lowest bidder might not be the best choice" is a comment that many of us can understand. And those of us working for public institutions know that we must always get the lowest bidder who sometimes acts as though he does not know what he is doing when his people get on the job. If we could only do what I've read is standard practice in Europe--automatically exclude the lowest bid for jobs or contracts. We know also that contract maintenance, while it might be desirable for us, could not work out very well because of so many extra tasks that must be done. Can you imagine the reaction of a lawn care contractor when told he must stop mowing long enough to move a faculty office? Or have one of his personnel work on the garbage truck until the regular person returns from vacation?

Contractors can be helpful in grounds maintenance. They may be highly specialized as in the many lawn care firms that have become established in recent years. With the equipment and supplies and personnel they have, they may very well give excellent lawn care leaving only the mowing to be done in house unless this task is also contracted. Specifications must be carefully written for contracted work unless a highly trusted, reliable and competent contractor can be found who in turn trusts the institution for which he works. Perhaps there are contractors who can be found to care for shrubs. There are reliable contractractos for tree care who know more about "tree topping". Members of the National Arborists Association and/or International Society of Arboriculture may be more reliable than non-members. They are exposed to more information and persuasion about good work.

Tree contractors should be fully covered by liability insurance and workmen's compensation. I've been told that some who advertise themselves as "licensed, insured and bonded" have been licenses by the city to do business, their vehicles are insured as required by law, and their bond covers possible damage to public property. One of our faculty members once asked me how to subtly ascertain this information. I told her there was no need to be subtle; contractors should be willing to furnish certificates of insurance and names of insuring companies so such information can be verified. I've heard a number of times about home-owners being sued for workmen's compensation for injuries suffered on the job. Trees have accidentally been felled on houses and automobiles. These possibilities should be covered by insurance paid for by the contractor which cost will be reflected in prices quoted for work. The cheapest may not be the best in tree work as in other work.

Grounds maintenance work is highly varied. I don't know how an unvarying routine can be set up for maintenance of all plants and related work in the landscape. The plants must be taken into account for some are more or less susceptible to pests than others. Seasons will vary with some being wetter than average and some dryer than average. Severe cold will characterize one winter and severe heat spells may occur in summer.

Turf is affected by weather as well. Diseases may occur: dollar spot in spring, brown patch in summer, Pythium perhaps anytime. Dollar spot may be reduced with additional fertilizer but this may cause soft growth susceptible to brown patch or Pythium as warmer weather arrives and turf stays moist.

Our beautiful azaleas may have their flowers infected with petal blight just when they should be at their most beautiful. The problem may be less in dry weather and may be aggravated in periods of rain. How can you schedule a preventive program on a basis other than "prepare for the worst but hope for the best." Then in summer we find the foliage is turning gray and find that lace bugs are sucking all the green color from leaves.

Colorful camellias may not be so colorful when tea scale and petal blight attack these popular plants. Again--expect the worst.

And then we do begin our protective program and find that well-intentioned people object to our tender, loving care. A dislike for pesticides has pervaded much of our society. In a segment of our population there is a distrust of all pesticides and those who apply them. From some of the news stories I've seen on TV the distrust is earned. We must conduct ourselves in such a manner as to inspire trust in our profession; we must properly diagnose problems requiring pesticides and we must then apply the correct pesticide efficiently and correctly.

We can no longer take the scattergun approach to pesticide use. If people are passing by where pesticides are being applied we must stop until the way is clear. On campus it is sometimes possible to spray pesticides during class periods and stop during change time. Around office buildings perhaps spraying can be done before office personnel arrives or delayed until after most personnel is safely in their offices.

If there is a choice of pesticide to use I prefer the ecologically safer one that will degrade rapidly, is safe for personnel to use, and is safe for nearby people. I have never used parathion, for example, for it is a "skull and crossbones" insecticide and we have managed very well with others. To control azalea lace bugs (also pyracantha, pieris, and cotoneaster) we have used Di-Syston 15G which does not require spraying; applied to the soil and absorbed through roots it does not give perfect control but we don't strive for perfection.

Grounds Maintenance supervisors must keep themselves informed on chemicals. Perhaps a new chemical will do a better job on pest control than an older one. A newer one's high cost may be offset by its better performane or lesser amounts to use to achieve equal control. Price also is an important consideration in pesticide usage as in other areas. I've been offered a chemical under different brand names at widely varying prices--a conspicuous example was one a few years ago which had 58 per cent active ingredient at $8.00 per gallon and its competitor containing 29 per cent active ingredient at $12.00 per gallon.

We advocate, and mostly practice, natural pruning or trees and shrubs. These look more like they fit into the landscape rather than being superimposed upon it. This is a struggle for supervisors--to get workmen to practice natural pruning. I have asked many job applicants what they can tell me about pruning; I have been told many time "I can cut 'em round or square--whichever way you like." When I tell these people I don't like either way they look dumbfounded as though wondering what other way there is to prune.

This practice has been praised by many faculty and visitors to our campus. However, not all people like it. Our grounds foreman told me that some faculty person spoke critically of it saying that people used to know when to prune shrubs by seeing when it was done on campus. But with the natural pruning effect nobody ever knows that pruning has been done. I told the foreman to regard this as a very high compliment because it was the effect we wanted to achieve.

I do not like "topped" trees and prefer tree pruning in its natural form. "Drop crotch pruning" is one term used to describe it but a tree service salesman lost a job because he knew nothing of this term or effect. We have had ice storms that caused severe damage to trees but the tree services we had to work for us pruned in such a way that the damage was hardly noticeable after a couple of years. Trees simply rounded over or topped take a very long time to recover from butchery, if indeed they ever do. Topping is not good for the health of the tree according to our scientists who investigate such matters.

One good thing I can say about topped trees and sheared shrubs is that the workman's mind is not overworked. No decisions as to which branches need be removed, how far to cut back, nothing--except cut, clip and shear. Make 'em round or make 'em square! An additional thought I have on the subject: if all plants in the landscape must look alike--must be round or square--why bother about planting anything except the cheapest; perhaps privet would be the most suitable because it is tolerant of soil conditions and grows rapidly. Forget about hollies and other plants of quality because they can be ruined by continued shearing.

We have found that John Baumgardt's "How to Prune Almost Everything" and the Sunset book on pruning are effective teaching aids and reference books for those who want to learn. These two books are inexpensive. Nothing is effective for those who do not want to learn.

There is little point in my talking about institutional turf care. This entire conference is about turf care in general and succeeding speakers will cover the topic in more detail. Our problems are complicated by heavy soil; heavy shade in places and full sun in others; compaction by the feet of many of our 10,000 students and I know of no way to grow turf under constant foot traffic. Our fertilizer is bought under state division of purchase and contract and no turf fertilizers are on contract so our choice of fertilizer is limited.

Our grasses are mixed--from Bermudagrass to Kentucky 31 fescue to some bluegrass and creeping fescue. We try to fertilize these types

individually as required but must necesarily compromise at times. Chickweed, henbit, clover and other broadleaf cool season weeds help provide green color in winter.

Just last fall contractors completed work on a new athletic field complex. We have not yet become involved in maintenance so I'm looking forward to hearing the next speaker on our program, Mike Harrison, from Wake County Public Schools.

I hope he can tell us how to maintain fields without adding more personnel, buying more equipment or buying supplies for growth, weed disease and insect control on those fields. Our economic recession has curtailed state income and we are required to cut back on personnel and equipment. I expect many others are similarly affected and all we can do in these circumstances is to do the best we can with what we've got to do with. If that is not good enough for our superiors then a system of priorities must be instituted so that to do a superior job in one place requires neglect in another. Department heads, business offices, or whoever is in charge of such policies in your institution, should become involved in these decisions, perhaps with the advice and guidance of the grounds manager.

Personnel and personnel management are perennial problems. Maintenance personnel are different from those who prefer construction type jobs. I've found construction workers want to get a job finished and move on some place else. Maintenance is never finished; mowing the same piece of ground week after week or pruning the same shrub year after year can be boring to someone who wants to travel. It can be interesting, rewarding and fulfilling to the person who wants to continually improve the landscape. The maintenance person can see the institutional grounds in all seasons and see it develop over the years--trees growing from 6-foot whips to 40 feet mature trees, for example.

The maintenance person can be of any color and of either sex. A few years ago it was unthinkable to hire women for grounds work, but after a few pioneers showed the rest of us they could do the work--and in some cases do it much better than men--women are now accepted for gounds work.

Our Community College system has several institutions offering curricula in horticulture and some of these graduates want to do grounds maintenance, though some want to do more glamourous jobs--contracting, selling, designing, growing poinsettias, and such work.

My advice to grounds managemers is to treat those wanting to do grounds maintenance, and to improve their skills in the work, with respect. Encourage them. Let them make mistakes (in places where it won't hurt too much) and learn from these mistakes. If these people are as good as they think they are, and you teach them everything you know, then you can go on vacation without worry and can occasionally get out to attend such meetings.

As a final thought I want to tell a story I heard years ago and have repeated several times. A farmer took over an abandoned unproductive farm and after some years of hard labor restored it to good productivity. Someoen then told him "You and the Lord have certainly done wonders for this farm." The farmer's reply was "You should have seen it when the Lord had it all to himself!"

We are all a part of Creation and are helpers in maintaining our own bit.

MAINTENANCE OF ATHLETIC FIELDS IN WAKE COUNTY

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Wake County Public Schools' athletic fields are used for the purposes of football, baseball, soccer, softball and physical education. In addition to the student population, many outside organizations use these same fields. In order to provide top quality, safe athletic fields for all people, a strong maintenance program for the school system needed to be developed.

In January, 1982, each school received a copy of the new maintenance program that is provided by our department. This program consists of aeration, complete fertilization, seeding and weed control. Watering and mowing are the responsibilities of each individual school.

A maintenance schedule is in effect to help us cover all eighty-four (84) athletic fields. Each principal has a copy of this schedule so that he or she is aware of when and where we will be on campus.

Booster club members assist with maintenance on a few fields. We have had excellent help from Dr. Jerry Weekman and George Coats at Sanderson High School, Chuck Norman at Cary Senior High School and Mike Hoffsetler at Athens Drive High School.

Complete maintenance could not be achieved, however, without the cooperation of the coaches who spend countless hours on their fields.

Most of our fields are common Bermuda, but some are Tifton 419. Last year we began our maintenance program by taking a soil sample from each field. Bulk lime was applied at the rate the analysis indicated. Most of the football fields had very little sand incorporated when they were constructed; therefore, sand is being added to the crown areas to help relieve some of the compaction.

Two weeks after the Bermuda greens up, we begin our fertilizer application with seven hundred and fifty (750) pounds of 6-12-36 agricultural fertilizer. After aerification the fields are seeded with common Bermuda at two (2) pounds per one thousand (1,000) square feet. Bare areas are firmed up with a Brillion cultipack seeder.

Ten (10) fields have pop-up irrigation systems. Coaches are instructed to water their fields every day for thirty (30) minutes until germination occurs. At this point we apply two hundred and fifty (250) pounds of ammonium nitrate. The fields are watered after this application. Now the coaches are responsible for watering every three (3) days for approximately thirty (30) minutes each time.

An application of four hundred and sixty-two (462) pounds of IBDU fertilizer is made the middle of June and again the end of July. By using this slow release fertilizer, we realize good, steady growth and color. In the event that the fields do not fill in as fast as they should, additional applications of ammonium nitrate are made.

The third week in August we apply one thousand (1,000) pounds of 6-12-36 to carry the turf through the football season and winter months. A minimum of six (6) pounds actual nitrogen per one thousand (1,000) square feet is applied to all fields. However, some fields receive ten (10) pounds actual nitrogen per one thousand (1,000) square feet.

Crabgrass, goosegrass and nutsedge are controlled with a mixture of three (3) pounds MSMA and two (2) ounces Sencor per acre. Two (2) applications are made ten (10) to fourteen (14) days apart. Knotweed, clover and wild garlic or wild onion are controlled with a mixture of three (3) pounds 2,4-D Amine and one-half (.5) pound Dicamba per acre. One (1) application was all that was needed for control. Reference was made to the North Carolina Agricultural Chemical Manual for proper rates.

During July and August herbicides are used to control unwanted vegetation on dirt infields, fence lines, tracks and under bleachers. Round-up is used in most cases; but where soil sterilization is needed, a combination of Hyvar XL and 2,4-D Amine is applied. With safety in mind, we avoid using restricted chemicals.

In the fall we overseed our Bermuda baseball fields with annual rye. During the off season, base lines are built up with a clay and sand mixture or granite screenings.

In summary I would like to say that the fields we maintain are definitely a challenge for our department. The transition zone, soil variations, drainage problems and traffic patterns reflect different results on each field. With this in mind it is important for us to continue our training in turf management. By attending seminars we review well-known techniques and gain exposure to new principles all of which helps us upgrade our turf program.

WEED CONTROL IN ATHLETIC FIELDS

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Weed Management in turfgrasses on athletic fields is influenced by the type of grass, the intensity of its use and the season of the year in which it is being used. On North Carolina athletic fields the most popular turgrasses are common bermudagrass, "Tifway" bermudagrass and a mixture of Kentucky bluegrass and Kentucky 31 tall fescue. A football field may have only a short season of use but a major portion of the growing season is required to maintain it and get it in playing condition. A soccer field may be used both in the spring and in the fall while a baseball field may receive intensive use in the spring and summer months.

Intensive use and wear of turgrass in athletic fields greatly reduces the factor of competition by the turfgrass, thus increasing the possibility of weed invasion. For example, bermudagrass in an athletic field is usually dormant in the fall before football season is over. Being dormant and subject to intensive foot traffic and wear the grass affords little or no competition to winter annual weeds, especially down the center of the field and around player benches.

Herbicides are just one part of the weed control program. Careful and faithful applications of fertilizer, lime and irrigation along with aerification and the addition of seed or sprigs are a part of the total weed management program. Both the type of the turfgrass and management practices will influence selection of herbicides used. For example, when seeding or sprigging bermudagrass, preemergence herbicides should not be applied.

Winter annual weeds

Common winter annual weeds include annual bluegrass, chickweed, henbit, knotweed, spurweed, hairy bittercress and hopclover. Rapid growth of these weeds in the early spring produces masses of growth that shade bermudagrass and delay its emergence and green-up for several weeks. To control winter annual weeds including ryegrass apply Paraquat at rates of 0.25 to 0.5 lbs active/A (1 to 2 pints/A) applied in 20 to 30 gallons of water per acre during late February or early March. The bermudagrass must be dormant with no indication of spring green-up. Add a nonionic surfactant to the spray mixture. Paraquat is restricted use herbicide and all label precautions should be followed carefully. Paraquat does not provide residual control of weeds.

Roundup has just received a label for the control of annual weeds in dormant bermudagrass turf. The label states apply 3/4 pint (12 fl. oz.) of Roundup plus 0.5% by volume of nonionic surfactant in 5 to 20

gallons of water per acre. Application to actively growing annual bluegrass in dormant bermudagrass turf must be made prior to initiation of bermudagrass green-up in the spring.

In bluegrass-fescue mixtures, these winter annual weeds should be controlled with a mixture of 2,4-D + MCPP or a 3-way combination of 2,4-D + MCPP + Banvel. In most areas of the state these should be applied in March or before active resumption of spring growth of these cool season grasses. More favorable control is obtained when temperatures exceed 50° F for 8-10 hours following an application.

Summer weeds

Grasses and sedges are the major summer weed problems. They may be annuals, for example, crabgrass, goosegrass, sedges and sandbur; or perennials which include dallisgrass, bahiagrass and nutsedges.

In a bermudagrass athletic field using preemergence materials is not advisable if there are thin or badly worn spots. Effective preemergence herbicides for crabgrass control such as DCPA (Dacthal), benefin (Balan) or bensulide (Betasan, Presan, Lescosan) effect the development of roots at the nodes of the bermudagrass stolons. Another preemergence herbicide that may be used in bermudagrass is oxadiazon (Ronstar). Also, these materials cannot be used if any reseeding or sprigging is done as they will reduce the germination and establishment of the bermudagrass. On the other hand, in fields with adequate grass cover these preemergence herbicides may be an effective way to approach annual grass weed control.

In a bluegrass-fescue mixture, DCPA, benefin or bensulide may be used for preemergence crabgrass control providing no spring seeding is done. Oxadiazon (Ronstar) may be used on bluegrass and tall fescue but not red fescue. If spring seeding is done annual grass control may be provided with an application of siduron (Tupersan). In North Carolina these preemergence herbicides should be applied when the dogwoods are in full bloom.

For postemergence control of annual and perennial grassy weeds DSMA and MSMA may be used in bermudagrass and fescues and bluegrasses. 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 DSMA and MSMA have no residual toxicity, treatment may be repeated as new seedlings appear. In the case of nutsedge and sandbur, 3 to 4 applications may be necessary. Rates are 2 to 3 lbs active per acre per application applied in 30 to 40 gallons of water per acre.

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° to 90° F. For temperatures below 80° F increase application rates according to recommendations on the product label.

Do not water or mow turf for at least 24 hours after application. Do not treat newly seeded areas until the third mowing. In newly sprigged areas a single appliation of 1 lb active/A may effectively control emerged seedlings with only 2 or 3 leaves.

Weed control in base lines

Weeds, particularly annual grassy weeds, may be controlled in base lines in baseball fields by shallowly incorporating into the soil pre-emergence herbicies which are used for crabgrass control. The rate can be increased by 50%. Applied properly these materials would not injure the desired turfgrasses when tracked onto turf areas. Herbicides normally used for lasting (residual) total vegetation control should not be used for they would be potentially harmful to the desired turfgrass. Edging can be done with Roundup. Use a 1 to 2% solution of Roundup, applied carefully with a shielded spray to prevent any spray drift onto the turf. Any soil sprayed with Roundup should not be harmful when tracked onto desired turfgrasses.

Identification of Insects and Insect Damage on Turf

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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. Insects, as well as the type of injury, and where the insects are found may be used to help identify the insect causing the damage. Detailed descriptions may be found in Insects and Other Pests Associated With Turf, N. C. Agricultural Extension Service Publication AG-268.

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 three 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, ciciada killer wasps and scollids.

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 are small (1/2 to 3/4"), long, grayish-white worms with brown spots and a dark brown head. They feed at night while living in a protected silken web formed about their bodies. The larvae cut off blades of grass at the soil level and eat them. Silk webbing and green droppings lead to silk lined tunnels in the ground. Damage often occcurs 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. Hot, dry weather is favorable for the development of this pest which is most troublesome in summer and early fall. The burrowing sod webworm is considerably larger than the sod webworm and may injure fescue lawns during extremely hot, dry weather. Holes are 12 to 18" deep and about the size of a pencil.

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" 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 of "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, dicussed 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 becomeing 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 distrubed. They do not damage lawns, however, they occasionally congreate 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 in lawns are 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 appear occasionally on lawns and about the yard. Control measures on lawns are seldom necessary.

IDENTIFICATION AND CONTROL OF TURF DISEASES

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A number of diseases can cause serious damage on general turf areas throughout North Carolina. Many of the problems are caused by fungi and nematodes, and other problems are caused by nutrient 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 ryegrasses) and warm season turfgrasses (centipedegrass, bermudagrass, St. Augustinegrass, zoysiagrass, and Bahiagrass) used in North Carolina are described.

Cool Season Grasses

Tall fescue

Brown patch is the most serious disease of tall fescue. The early symptoms of this disease are small circular brown patches that develop during hot-wet weather. The disease may spread throughout an area during the summer giving the turf an uniform brown appearance without distinct patches. Lesions develop rapidly on young leaves. As the tissue dries the lesions become 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. Tall fescue established less than one year can be completed 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 grass is dry, and fall fertilization) the grass will usually recover during the fall. Some fungicides can be used to control brown patch but are rather expensive and may not be needed if tall fescue is managed properly.

Helminthosporium net blotch occurs on tall fescue but usually does not cause severe damage. The symptoms of this disease are dark

brown areas on leaves with irregular margins and sometimes lighter colored "net" patterns in the affected areas. Sometime 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 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) often 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 cover the affected spots. Good management and particularly proper soil pH in new lawns helps to overcome this disease.

Rust occurs on tall fescue but is seen more often in late summer on plants that have not been mowed along fences or around shrubs. The symptoms of rust are small yellow spots on leaves that may have masses of yellow to rust colored spores in the center of the spots. The turf will recover from rust during favorable growing conditions.

Drought and heat during the summer can damage tall fescue. Seedlings that are less than one year old may be killed by drought 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 seedlings need irrigating during hot-dry weather. Tall fescue 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.

Animal urine and excess fertilizer can cause serious damage to tall fescue. Damage from animal urine is seen as circular dead areas of grass .5 to 1 foot in diameter. These spots develop quickly in hot, dry weather. The dead grass has a characteristic "bronze-like" color for a few days after the symptoms first appear. A ring of dark green grass will develop around the spots after a few days due to the extra nitrogen from the urine. A high soluble salts level can be detected in soil from the affected areas. Similar symptoms may occur in large areas if too much fertilizer is applied during dry weather. Suggested treatment would be to irrigate the affected areas heavily and reseed if needed. Irrigation or an extended rainy period will dilute and leach the salts into the soil so that the plants can survive.

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

Bluegrass

Helminthosporium diseases frequently occur on bluegrass. The leafspot symptoms are small dark spots on the leaves that increase in number and size. Many may be killed. Leafspots may cause bluegrass to have a brown color and will reduce the vigor of the turf. Root and crown rots often develop in the summer months resulting in the symptoms of melting-out or fading-out. Control of the leafspot in the spring will reduce the severity of summer leafspot, crown rot, and root rot symptoms. Good management programs that avoid excessive rates of nitrogen and use of irrigation to prevent excess water stress will help prevent damage from 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 that develop during wet weather in the summer. Red thread can be identified by the presence of a small "red thread" of the fungus that causes the disease at the tip of many of the dead leaves. Small amounts of nitrogen fertilizer can be used to stimulate bluegrass to grow enough to overcome the disease. Broad spectrum fungicides 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. Affected leaves may be yellow and die slowly. The turf usually becomes weak and may be more susceptible to other diseases and weed invasion. 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 on the leaves of the affected plants, usually in the spring and fall. During the summer the leaves of infected plants split and curl and many of the plants die during periods of drought stress. 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 disease that has occurred in recent years on bluegrass in the mountains of North Carolina. The symptoms of this disease are 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-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.

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

Other problems that occur on bluegrass such as fairy rings, slime molds, too much shade, and low soil pH are discussed later. Symptoms of damage from animal urine and excess soluble salts are similar to symptoms on tall fescue.

Warm Season Grasses

Bermudagrass

Spring dead spot is a serious disease of bermudagrass. 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. Bermudagrass grows over the spots slowly 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 the factors associated with its development are the use of high rates of nitrogen fertilizer and accumulation of excess thatch. 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. The symptoms of damage by the sting nematode are poor turf that does not respond quickly to nitrogen fertilizer, wilts quickly, and does not grow during

dry weather. The roots are stunted and are very shallow. Nematicides will control these nematodes; however, none of the nematicides have a label for use in residential areas in North Carolina. A good management program will help the bermudagrass overcome the effect of nematodes.

Dollar spot is sometimes a problem on bermudagrass. Symptoms of this disease are small brown spots 1 to 3 inches in diameter. The spots may become very numerous and give the turf a general brown appearance. 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.

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 soil pH (5.5 is best) have been associated with the problem. Soil test results should be used to correct these problems. Sting nematodes have been associated with decline in some cases. This 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. Nematicides are not labelled for use on this grass in home lawns. 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 green rings (3 to 20 feet in diameter) that enlarge for several years. Mushrooms may be present sometimes at the edge of the rings or throughout the circles. Effective treatments are not known for fairy rings, but 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. All of the centipedegrass in affected areas 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. 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 been associated with the problem since more centipede decline occurred in summers following unusually cold winters. Certain herbicides have 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.

St. Augustinegrass

Gray leafspot is the most serious disease of St. Augustinegrass in North Carolina. Symptoms are numerous gray spots on the leaves that may continue to develop in warm-wet weather until the turf has a light brown color. If the disease continues to develop, the turf may become thin.

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 may 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 most often seen on zoysiagrass in partially shaded lawns. Leaves of zoysiagrass will be covered with rust colored masses of spores 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.

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.

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. Thatch can be removed by mowing the turf as short as possible (1/2 inch) or by using a vertical mower in the spring as zoysia resumes growth from winter dormancy. Mowing frequently at 1 inch and removal of clippings during the summer will help prevent thatch from accumulating.

Nematodes can be a problem on zoysia in sandy soils as described on bermudagrass.

Bahiagrass

Bahiagrass is used in some lawns in eastern North Carolina. 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. The rings may be a few to many feet in diameter. Mushrooms may be associated with the rings at certain times of the year. The rings occur in the same area for a number of years and usually enlarge 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. Grass may be killed by toxins in the soil or by a lack of water in 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. Renovation by rototilling and replanting affected areas has controlled fairy rings in some cases. Loosening the soil and watering the area frequently may eliminate some fairy rings. Grasses that spread rapidly such as bermudagrass often will spread into the affected areas.

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 do not cause serious damage. The fungi can be removed by brushing, washing, or mowing the fungus off the affected leaves.

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 turfgrasses 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. The algae may form crusts that crack and curl when the soil becomes dry. It is usually a problem in shady areas that do not drain properly. Algae can be controlled by correcting soil drainage problems and eliminating shade and soil nutrition problems.

Animal urine kills turfgrasses because of high soluble salts in the spots. Grasses that do not spread such as tall fescue and ryegrass may be killed in small circular spots. Turfgrasses that spread by stolons and rhizomes may be killed in spots, but these grasses will usually survive or spread into the affected areas quickly. Dark green spots of turf may be present for weeks. The greening is caused by nitrogen-containing compounds in the urine. The effects can be prevented 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, to prevent weeds from invading 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 shaded 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. To allow enough sunlight for growth of turfgrasses, lower limbs or whole trees should 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 associated with trees and shade. Areas near trees will often wilt during dry weather. 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. 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. Soil samples should be assayed to identify nutritional and nematode problems.

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. When diseases do occur, identify the diseases correctly and then select proper management practices or chemicals for control.

PROBLEM SOLVING ANALYSES FOR LAWN CARE

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Problem solving analyses are the various means by which one looks at a problem in seeking a solution. A diagnostic service is just one area in which an individual can seek help in solving a plant problem. The diagnostic service can aid the lawn care industry in solving plant problems and will be the subject of the discussion here.

What is a diagnostic service? Who should use such a service and why? How does one get the most out of a diagnostic service? Is there a limitation on what these services can provide? These are a few of the questions one may ask about a diagnostic service. An attempt will be made to answer these questions in this discussion.

Diagnostic Service

A diagnostic service is a service that analyzes samples and/or information to solve plant problems. These services go by many names: Soil and Analysis Laboratories; Plant and Soil Laboratories; Plant Disease Clinics; Plant Disease and Insect Clinics; and etc.

Many of these services are offered by the State through the State Extension Service or the University system. Private services are also becoming more available for lawn care.

The type of samples analyzed by diagnostic services include; soil, plants and combinations of soil and plants. Certain services will handle soil, others plants, while still others will handle both types. Some services will also identify plants (weeds) and insects.

Samples

Soil samples can be analyzed for pH, plant nutrients, soluble salts, pesticide residues, and nematodes. Types of problems solved with analyzing plant samples include; problems caused by disease, insects, cultural practices, environmental conditions and pesticides. Plants such as weeds can also be identified. In some cases, both the plant and soil are required to solve problems related to pesticide injury, nematodes and plant nutrition.

Information

Information concerning the problem is needed with the various types of samples. However, there are situations where information alone is used to solve the problem. This may involve interpreting soil testing results or analyzing information concerning a problem received via the telephone.

Why Use A Diagnostic Service?

There are many reasons why a lawn care service may use a diagnostic service. Perhaps the first reason would be when an unknown problem is encountered. The problem may involve the plant (such as a disease or insect problem) or may also involve the soil (such as a nutritional or herbicide problem). In such instances, the diagnostic service would be used to help solve an unknown problem. Another situation would be soil test results used in planning a fertility program in a new area.

The second reason one may use a diagnostic service is to build good customer relations. Often times a customer will not believe the person making the application to their lawn. By taking a sample to solve a problem, you demonstrate your concern for their lawn. You may even tell the customer what you think the problem is, but just to make sure you are taking a sample for laboratory analysis. Do not tell them this if you do not intend to send the sample to a laboratory. Sending a sample for verification often increases your professional image in the eyes of the customer.

The last reason for sending a sample to a laboratory is for training purposes. A new person often has difficulty in learning all that is required, especially problems not encountered on a daily basis. This new person can send in samples and learn from the answer. This is also true of a lawn care service entering a new market where new problems may exist.

How To Use A Diagnostic Service

There are many cases where individuals use a diagnostic service and are dissatisfied. Often claiming that they did not get the type of service needed or the proper answer. Most of the time these problems exist because; the diagnostic service is not used properly, the diagnostic service received a poor sample and/or information, or the individual using the services does not understand their limitation.

The first step in using a diagnostic service is to find out something about the services available. You need to know something about these services to determine if they actually can help you. Know the people who are involved and what they can and can not do. Know what they require, in the form of samples or information, in order to help you.

The two most important aspects of sending samples to a diagnostic service are the samples themselves and the information accompanying the samples. First, the sample must be one representing the problem or problem area. Take the sample where the problem is occurring. Many times it is best to send a sample from a good area as well as from the problem area. Next, the sample should be large enough to work with. A good size for turf is approximately a 3" x 6" strip of sod (including roots with soil attached). Take the sample on the border of the problem area. Several branches with leaves should be taken from trees and shrubs. Again, try to include a sample from a healthy or unaffected plant.

Soil samples should be taken to root depth. In turf this is generally to the 3" level (majority of roots are in the top 3 inches). Depending upon the type of problem, soil samples should be taken from various areas (10 to 20 cores) and then mixed together (do not mix good and bad area).

How one sends the sample is also very important. Improperly packaged samples are often impossible to diagnose. Most samples should be placed into a plastic bag, packed tightly into a box and sent, immediately, to the laboratory. The fresher the sample upon arrival to the laboratory the better the answer. Do not add water to sample. If sample is wet when taken, allow sample to dry (no water on foliage) before placing into plastic bag.

Supply as much information as possible with the sample. Information that is helpful includes; plant indentification (if known), past cultural practices (including pesticides used), current practices (fertility, irrigation and etc.), unusual practices or events taken place (construction, and etc.), and weather conditions (past and present). Also needed is a description of the problem, its development and location.

Generally, each diagnostic service has its own form to be included with the sample. The purpose of this form is to get the type of information presented above. It is best, then, to check with the service before sending a sample. Most locations have literature or material available that not only describes the service but indicates the information and sample needed.

Limitations

It is important to remember that the quality of answers are dependent upon a representative sample, a fresh sample and sufficient information pertaining to the problem. There is nothing magical about a diagnostic service. A diagnostic service generally reports what they find (or do not find) on a sample. In some cases, they may also speculate on the problem or indicate what other information is needed.

In selecting a diagnostic service, make sure they can help you. Often this is dependent upon the training and/or experience of the diagnostic service. What you are seeking is a practical, useable, solution to your customers' problem. The service needs to be somewhat familiar with your type of operation, lawn care. You do not need a fertilizer recommendation for tons of manure per acre.

Again, there are many services available, some free of charge, to you. Learn what they can and can not do for you as an additional tool to use in servicing your customers.

Conclusion

Problem solving analyses are available to help you perform your job more efficiently. A diagnostic service can help you solve many of your problems. Learn what these services can do and use them to your benefit.

The answer received from those services is dependent upon the sample and information received from you.

LANDSCAPE MAINTENANCE INDUSTRY OF NORTH CAROLINA

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North Carolina with the help of Governor James Hunt is very industry conscious. In talking with plant managers and so on I have been told that North Carolina is a prime location for any industry. Inexpensive labor and property, and virtually no union involvement, makes North Carolina attractive to new industries. This in turn helps the lawn care industry. Industries coming to North Carolina from New Jersey, New York, Pennsylvania, Ohio, and so on, are used to the lawn care services. Most of these big corporations are using a great deal of capital investment for landscaping to enhance themselves in the public eye, one trying to outdo the other. Their capital investment is of such magnitude they are forced to contract their outside means, this is where the lawn care industry plays a big part. The landscape and outside appearance must be maintained at a high level so their capital investments will not deteriorate.

Ethical practices in our industry has become a big problem. The influx of industries to North Carolina at such a rapid pace has put a lot of people in the lawn care business. It first started with companies buying farm land and hiring the people who were farming the property to maintain the grounds. There was a need for this service and it has grown to such a degree that two and four year colleges are adding such classes as Turf Management, Recreation Turf Management, and so on into their curriculums.

From 1965 until 1975 the landscape maintenance industry, as far as qualified technical turf managers are concerned had few or none. Through the help of the North Carolina Turfgrass Council and North Carolina State University there has been good technically oriented turf contractors spawned in North Carolina. However, one of the main problems that landscape maintenance contractors have is the development of "overnight" maintenance contractors. They talk a good game, but do not deliver what they promise. They cut prices, do not follow contract procedures, and do not fulfill proposals. It's people and companies like yourselves who are interested in the landscape industry who attend conferences, seminars, classes and join professional organizations that separate you from the rest. A landscape maintenance contractor using poor ethics, in time will harm himself, but it reminds me of a weed once you eradicate one another one springs up.

There are a lot of companies in the United States and North Carolina that are trying to provide a good service, quality work, and a good company image. These companies will no doubt flourish in our industry. The need to join professional national and state organizations is imperative. This will provide to you a means of contact with the rest of the industry, educational programs, newsletters, updated materials, and the latest in equipment and service ideas. Also, this will provide the latest in state and federal regulations to stay ahead of the field.

A professional company often displays logos on equipment, accepts speaking engagements at garden clubs and other organizations, and serves

serves on some type of state or local beautification committee. Brochures are another way of separating a professional company from a non-professional company. We understand some professional companies can not afford a brochure at this time, but should be given consideration in the future. Fitting employees with uniforms and clean, well maintained equipment also helps your company image. There are also programs that can certify you as a certified grounds manager, for example, the Professional Grounds Management Society of America. One sure way of being a professional is not to bad mouth your competition and to ensure the lasting effectiveness of landscapes you are now maintaining.

I imagine you who are here today care about our industry and will do all within your power to make it a lasting relationship with the lawn care industry. If landscape maintenance contractors will keep these suggestions in mind, business referrals from satisfied customers will be very rewarding. As you know the landscape maintenance industry has many problems. One being soil conditions which from the coast to the mountains are completely different. This is a problem for all of us. The companies large enough to work in different areas of the state know what I'm referring to. From the mountains to the coast the soil changes from rock to sand, this poses problems in growing the different grasses. First and foremost know your soil conditions.

As we said earlier, bad competitors do the whole industry harm as well as themselves. We all need to go in the right direction to make ourselves professionals, this will leave the bad competitors behind. Equipment, as you know is only as good as the operators and preventive maintenance schedules. Our company, BOYCO, knows this first hand through experience, and we learned the hard way, but if your business can afford it, hire a mechanic who knows turf equipment and the equipment will respond for you.

Like the President of Duke Power said, "I don't know a damn thing about electricity, but I sure can hire people that do." It's always good practice to hire people with experience and technical knowledge. These types of people usually have an interest in your company and can greatly enhance and help the growth of your company.

SAFE AND PROPER USE OF PESTICIDES

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Always read and follow labeling directions when using pesticides. Directions for use are found on the label attached to the container or on separate labeling instructions.

It pays to know pesticide common names as well as trade or brand names of pesticides. Two pesticide products may have the same active ingredient but be manufactured by different companies and have different trade names. On the other hand, you may need a certain formulation as one may be phytotoxic (harmful) to plants or animals being treated.

The EPA Registration Number and the Lot Number on a pesticide label are important if you ever need to check on the pesticide's legality or its place and date of manufacture. The safety signal words on pesticide labels are very important. DANGER means highly hazardous, WARNING means moderately hazardous, and CAUTION means slightly hazardous. Homeowners should always use CAUTION labeled pesticides.

Most pesticide labels have a first aid treatment for accidently exposure. Hazardous pesticides will have a "NOTE TO PHYSICIAN" which is extremely important if poisoning occurs. Always take the pesticide label to your doctor if someone is poisoned so he/she will have the valuable (sometimes life saving) information.

Wear the protective clothing called for on the label when handling, mixing and applying pesticides. Such clothing may include rubber or neoprene gloves, water proof coveralls, water proof shoes, respirator or other clothing and equipment. You should always have full body covering to keep pesticides off your skin when using pesticides.

Pay close attention to "special" warnings on pesticide labels-for example, bee toxicity, flammability or other instructions. The law requires you to use pesticides only on the crops, animals, or sites specified on the label. Never use pesticides at lower or higher rates, or on pests not covered on the label unless you seek an expert's advice. Before mixing two or more pesticides, mixing pesticides with fertilizer, or employing an application method not covered by the label, you should consult an expert's advice.

If you use a RESTRICTED USE PESTICIDE you must be certified or licensed. Consult your local pesticide experts (County Extension Service, etc.) for these requirements. Never use restricted use pesticides unless they are necessary.

WEED CONTROL IN ORNAMENTALS AND HERBICIDE APPLICATION EQUIPMENT FOR ORNAMENTALS

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Scale is the major determining factor in efficiency in landscape weed control. Equipment purchasing must be matched to efficient utilization. There are few, if any, landscape maintenance firms that can afford large power equipment for herbicide applications on shrubbery. Tractor mounted equipment is very good for spraying open fairways and lawns but are frequently a source of problems in non-turf area maintenance.

Low pressure, low gallonage sprayers and small granular applicators will save enough herbicide to pay the extra labor and reduce overhead cost of owning large sprayers. Most hand sprayers can be rigged to apply less than one gallon of liquid per 2000 square feet which is equivalent to spraying 4000 feet of a six inch trim band. You don't have to drag hoses or be concerned that a worker drain 10 gallons in the wrong place. The biggest disadvantage with small equipment for herbicide applications is the manager must learn to work with weighing, measuring, and calibrating smaller quantities. The potential for errors increases because "eye-balling" small quantities needed to make correct mixes is nearly impossible. On the other hand small quantity measuring devices are readily available and very inexpensive. Make a measuring cup that matches your use. Take a commercially made measuring cup and cut it to hold the maximum amount of chemical you desire in a small tank. For example, if you have a two-gallon sprayer and you want to apply 1% Roundup, then cut the cup to measure 2.5 ounces. This allows you to mark the cup as a "Roundup" cup and attach it to the jug with instructions to use one container per tankful. The same can be done with wettable powder where quantities need to be weighed first then a measuring cup made to the desired size.

Granules can be handled the same way. That is, make a measuring device to measure the chemical being used in terms of 100 or 1000 square feet increments. In many operations a shaker type container marked with the amount per 100 square feet can be carried from place to place and utilized on small areas as needed. This plan can save many problems as the applicator has a constant check on his use rate.

The biggest mistake made on most shrubbery planting is the lack of preplant planning. Eradication and cleanup of difficult-to-control weeds is imperative. Cleanup can best be accomplished by pre-plant fumigation with methyl bromide. Many times a little pre-plant planning will save many problems later.

Broadspectrum fumigation (methyl bromide) will control most weeds, disease, insects, and nematodes if properly applied. Proper application means optimum conditions, that is soil temperatures at least 55 F, six inches deep, moisture near field capacity, and no clods in excess of one inch in diameter. For most new or renovated plant beds, a good fumigation job will probably be the most economical way to get a good clean start.

After the beds are planted and mulched, a maintenance program for weed control is started. The first year after planting most of the problems will be annual weed encroachment from surrounding turf, roads, or neglected areas. A band of herbicide protection is often all that is needed. Treating the fringe areas of the shrub beds plus several feet into the turf area with a suitable pre-emergent can eliminate hand labor and keep your landscape looking good.

Application timing and identifying your problem is very important. I like to separate weeds into groups to develop a control strategy. The annuals which can be broadleaves or grasses are further divided into winter or cool season and summer annuals. Cool season weeds include henbit, chickweed, annual bluegrass, ryegrass, while warm season include crabgrass, goosegrass, pigweed, and ragweed. These can often best be controlled by a preemergence herbicide application before they germinate. This means fall or early winter applications plus spring applications for summer annual weed control.

The other group is the perennials which are herbaceous such as nutsedge, bermudagrass, kudzu, horsenettle and the woody perennials like honeysuckle, poison ivy, trumpet creeper, and blackberries.

Glyphosate is an excellent material for controlling perennial weeds. The chart below gives the optimum application timing for controlling some perennial weeds in the landscape with glypohosate (Roundup). CAUTION: Roundup will damage landscape plants if it contacts them.

Weed Problem	Amount of Glyphosate Needed to Obtain 90% or Better Control	Time of Application For Optimal Weed Control
Blackberry	2-5 lb/A or 1% solution applied to wetting	Sept. 1-late Oct.
Trumpet creeper	2-5 lb/A	late Aug.-mid Oct.
Honeysuckle	2-5 lb/A	May-July
Poison Ivy	2-5 lb/A	May-July
Bermudagrass	2-5 lb/A or 1% solution applied to wetting	After seed head development of Fall
Johnsongrass	1-3 lb/A	Early boot stage or later
Virginia creeper	1% solution applied to wetting	August
Clematis Vine	1% solution applied to wetting	August
Greenbriar	3-5 lb/A	August
Maypop	3-5 lb/A	July or August
Annual weeds/grasses		
under 6 inches	1 lb/A	As needed
over 6 inches	1-1/2 lb/A	As needed
Wisteria	1%	Aug-Sept.
Kudzu	2-5 lb/A or 1%	June-Aug.
Horsenettle	1%	Within a month after full bloom

For controlling the annuals, materials, like Dacthal, Betasan, and Ronstar have a wide label spectrum on shrubbery and turf. They can be used in many landscape situations where turf, flower beds, and shrubbery interface.

SUMMARY OF LAWN CARE ASSOCIATIONS, PANEL DISCUSSION

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Thw time and money invested in a professional association will yield the turfgrass manager a handsome reward. We all must strive to increase the level of our professionalism. Lawn care and landscape persons in North Carolina have three associations they should consider. These associations are: N.C. Turfgrass Council, PLCAA, and the PGMS.

The purposes of the PLCAA are:

1. To provide and disseminate information to the industry regarding laws and regulations affecting the industry and to promote the enforcement of same.

2. To provide industry statistics.

3. To exchange knowledge among the members for the improvement of the industry.

4. To collect and disseminate information regarding lawn care for the betterment of public interest.

5. To recommend standards of nomenclature for the improvement of the industry.

6. To sponsor and propagate research related to lawn care among other persons or institutions.

7. To provide information to the public regarding lawn care by sponsoring or participating in seminars, conferences and congresses related to education in the lawn care fields.

8. To promote the lawn care industry in all other lawful ways.

We have formed a local Triad Professional Grounds Management Association. The Triad PGMA began as a North Carolina Chapter of the Professional Grounds Management Society in November 1980. Our goal is the same as the national organization. It was formed as "a professional society of managers of grounds of all types who have joined together for the purpose of educational and economic advancement."

In the Triad area, as well as across the state, we will endeavor to aid in improving the management skills and educational development of members and associates to better serve the public. This will encompass grounds management programming for any organization, agency, department, firm or employer as well as seeking to upgrade the level of professionalism. Monthly meetings

allow the membership to take part in workshops, presentations and informal meetings offering opprotunities to keep up-to-date on the latest management techniques and technical information.

We seek to become a professional vehicle to grounds managers in all settings: managers of parks, private maintenance firms, recreation areas, golf courses, cemeteries, botanical gardens, arboretums, military installations, hospitals, universities, institutions, estates, commercial and industrial parks and similar grounds. Included are head and assistant managers and others who may be horticulturally qualified, as well as those engaged in related work such as teaching, research and extension services.

NCSU TURF PROGRAM UPDATE

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North Carolina's turfgrass industry is a multi-facted enterprise including many turf interest areas from the intensive culture of golf course greens to the minimum maintenance goals of many roadside turf sites. Turfgrass managers currently spend in excess of 400 million dollars per year in the maintenance of almost one million acres of North Carolina turf. The diverse needs of our state's turf industry are served through several departments within North Carolina State University, including Crop Science, Plant Pathology, Entomology, Horticulture, and Soil Science. The NCSU Turfgrass work group is composed of six faculty members from three departments, each with direct turfgrass research, extension, or teaching responsibilities. Members of the turf work group are Drs. DiPaola, Gilbert, Lewis, Lucas, and Robertson. We look forward to Art Bruneau joining the group in April to assume the Extension management position formerly held by Dr. Blake. Turfgrass work group meetings are held monthly for the purpose of ensuring program direction and to facilitate cooperation and assistance within the turf program. Members of the NCSU turf work group also serve as advisors to the Turfgrass Council of North Carolina Board of Directors.

Program

Turfgrass research and extension programs are underway in a) the control of disease, insect, nematode, and weed pests of turf; b) varietal performance evaluations; c) environmental stress tolerance, i.e., cold hardiness, shade tolerance, and water stress; d) root growth and development, e) low maintenance turf management; and f) turfgrass fertilization. All of the major turfgrass species utilized in North Carolina are currently maintained within the 8.5 acres of the turfgrass field plots. A detailed listing of projects is given at the end of this report. The academic programs continue in the training of turfgrass professionals at the two-year, four-year and graduate levels.

Facilities

The turfgrass Research and Demonstration area at Raleigh includes over 50,000 square feet of experimental putting greens, roadside evaluation trials, pesticide phytotoxicity test areas, cultivar evaluations, and shade tolerance trials. The turfgrass field plots are supported from a small service area located nearby. During the past several years an extensive effort has gone into the expansion and development of this facility. The turf work group and especially Bill Gilbert, Joe DiPaola, and their technicians should be recognized for their dedication to the project. The contribution of the Toro Company through E. J. Smith and Sons for assistance with the irrigation system is recognized.

The turfgrass field plots and campus laboratory facilities are essential tools needed by the NCSU turfgrass work group in its effort to

seek new information and improved ways of managing turf. Extension Service turf newsletters, leaflets, circulars, and Teletips are ready sources of turf information. Ine intensive activity of the Raleigh location is supported and extended by demonstration and research plots located throughout North Carolina.

The annual Turfgrass Conference, Field Day, and workshops are additional opportunities for communication between NCSU turfgrass personnel and the turfgrass industry. Our activities at Raleigh and throughout North Carolina are open to the public and you are encouraged to visit them.

Support

Development and operation of the research and extension programs requires a large outlay of labor and equipment. We were fortunate to obtain additional state funds several years ago to expand our staff and increase the operational support. This increased activity was complemented by loans and gifts of equipment and supplies. Porter Brothers donated a Smithco rotary mower and also loaned a Jacobsen Turfcat rotary mower. E. J. Smith and Sons has continued their loan of a Toro Greensmaster III mower and irrigation parts at a discount. The seed industry, including Lofts Seed, International Seed, Turf Seed, Burlingham,Byrum Seed, E. J. Smith and Sons, Northrup King, and Pickseed have provided seed for our research and extension activities. Also, the support through grants from the Carolinas Golf Association (cold tolerance, syringing, and Poa annua control) and the Federal and State Department of Transportation (highway right of way management) funds have been provided to intensify and expand our program. The Turfgrass Foundation is a new venture and has a potential of contributing to the success of our overall program. Its contributions to our academic program through scholarships help to attract and retain top quality students. It is through this joint effort we have been able to rapidly expand and intensify our program.

Future

I indicated last year that we have come a long way, and that I was pleased with the progress. We have made more progress this year, but we still have not reached our goal. We have an excellent staff who are moving forward. To reach our final goal will require the commitment of the total industry. The following are a few of the priority items.

--Construction of a field laboratory and service facility
--Additional support of all our research and extension programs
--Additional field and laboratory equipment

Projects Now Underway

1. The influence of syringing on the leaf temperature of bentgrass golf greens (Carolinas Golf Association Supported). DiPaola.

2. Seasonal changes in the cold tolerance of bermudagrass turf. (Carolinas Golf Association Supported. DiPaola.

3. Shade tolerance of selected cool season turfgrass. DiPaola-Gilbert.

4. The utilization of wetting agents and cultural practices in the treatment and prevention of localized dry spots on fine turf. DiPaola-Gilbert-Lucas.

5. Evaluation of winter overseeding cultivars for golf greens, tees, collars, and home lawns. DiPaola-Gilbert.

6. The adaptation of selected plant species along North Carolina's roadsides. Gilbert-DiPaola.

7. Physiographic zoning of North Carolina. Gilbert-DiPaola.

8. Low maintenance turf establishment. Gilbert-DiPaola.

9. The influence of cultural practices and fertilization on the spring rooting of bermudagrass turf. DiPaola.

10. The tolerance of bermudagrass and overseeded turf to varying rates and dates of application of ethofumesate. Lewis-DiPaola-Gilbert.

11. Influence of fertilizer type and rate on the utilization of selected growth retardants on tall fescue. DiPaola-Lewis-Gilbert.

12. Evaluation of selected growth retardants for use on tall fescue and bahiagrass roadside turf. Gilbert-Lewis-DiPaola.

13. The influence of selected plant growth regulators on the growth, quality, recuperative potential, root growth, and cold tolerance of common bermudagrass. DiPaola-Lewis-Gilbert.

14. The evaluation of maleic hydrazide effectiveness following application at various stages of seedhead development. DiPaola-Gilbert-Lewis.

15. The influence of selected pesticides on the cold tolerance of Tifgreen bermudagrass. DiPaola-Lewis-Gilbert-Lucas.

16. The efficacy of dormant seeding of warm season turfgrasses. Gilbert-DiPaola.

17. The use of glyphosate as an aid in reducing the costs and soil erosion potential of vegetative turfgrass establishment. Gilbert-DiPaola.

18. The evaluation of tall fescue/Kentucky bluegrass mixtures under shaded conditions. DiPaola-Gilbert.

19. Evaluation of 85 Kentucky bluegrasses, 53 perennial ryegrasses, and 25 tall fescue cultivars under North Carolina conditions. DiPaola-Gilbert.

20. Spring deadspot control with benomyl and triadimefon. Lucas.

21. Rhizoctonia brown patch - species, distribution, damage and control. Lucas.

22. Southern Blight or bluegrass control in western North Carolina. Lucas.

23. Nematode management, species distribution and control strategies. Lucas.

24. Field demonstrations on disease control - 5 locations. Lucas.

25. June beetle control. Robertson.

26. Japanese beetle control. Robertson.

27. Black cutworm and fall armyworm control. Robertson.

28. Evaluation of Prograss herbicide and Rubigan, a fungicide, for the control of Poa annua in bentgrass greens. Includes different rates and dates of application on 5 golf courses. Lewis.

29. Determination of the tolerance of Penncross bentgrass to Prograss applied at 1x, 2x, and 4x. Lewis-DiPaola.

30. Evaluation of Prograss and Rubigan for P. annua control in a common bermudagrass fairway overseeded to annual ryegrass and not overseeded. In the non-overseeded areas preemergence herbicides and growth regulators also are being observed for P. annua control. Lewis.

31. Determination of the tolerance of 64 winter overseeding grasses or mixtures of these to Prograss. Lewis-DiPaola-Gilbert.

32. The use of herbicides in converting a Tifgreen bermudagrass green to a bentgrass. Lewis-DiPaola-Gilbert.

33. Evaluation of Sencor and Sencor + MSMA for goosegrass control in common bermudagrass. Lewis.

34. Carolinas turfgrass pest manual. Lewis-Bruneau-DiPaola-Gilbert-Lucas-Robertson (Carolinas Golf Assoc. Supported).

35. Carolinas Lawn Update. Bruneau-Gilbert-DiPaola.

36. Evaluation of herbicides for broadleaf control and grassy weed control. Lewis.

37. Overseeding Update. Bruneau-Gilbert-DiPaola.

NCSU DISEASE CONTROL UPDATE

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Fungicides and nematicides were evaluated at several locations in North Carolina. Fungicides were evaluated for the control of dollar spot and nematicides were evaluaed for nematode control on bermudagrass and on centipedegrass.

Fungicides were evaluated more for the length of control of dollar spot on bentgrass after application rather than just for control. Control with all fungicides except Actidione-Thiram was good and was not significantly different from each other one or two weeks following applications. However, only Tersan 1991 and Chipco 26019 at the 2 oz rates and Bayleton gave satisfactory control on June 14 which was 3 weeks after the last fungicide treatment. Tersan 1991 gave the best control in this test, but probably would not have been as effective if resiatant strains had been present. The weather was very wet during the evaluation period. These conditions were very favorable for disease development and reduced the length of time that some of the fungicides were effective. Actidione-Thiram alone did not give good control in this test which was probably due to the longer than reommended periods between treatments (Table 1)..

Table 1: DOLLAR SPOT CONTROL WITH FUNGICIDES ON BENTGRASS*

TREATMENT (Rate/1000 sq ft)	% AREA WITH DOLLAR SPOT ON			
	5/10	5/14	5/28	6/14
Tersan 1991 (2 oz)	1.0a	0.5 c	0.0 b	0.0 e
Bayleton (1 oz)	1.5a	2.8 bc	1.0 b	2.5 e
Chipco 26019 (2 oz)	1.0a	3.3 bc	1.0 b	2.0 e
HOE 00703 (2 oz)	1.3a	2.3 bc	2.0 b	6.8 de
Chipco 26019 (1 oz)	2.8a	5.5abc	3.8 b	13.8 cde
HOE 00703 (1 oz)	1.3a	4.5abc	3.8 b	19.5 bcd
Daconil 2787 (6 oz)	1.8a	5.8abc	2.8 b	26.5 bc
Actidione-Thiram (2 oz) + Daconil 2787 (3 oz)	2.0a	7.8ab	4.5 b	31.3 b
Actidione-Thiram (4 oz)	1.8a	11.3a	16.3a	56.3a
Check	2.5a	9.5ab	16.3a	65.0a

* NCSU Faculty Club research plots. Fungicides were applied on 4/27/82 and 5/21/82 in a randomized block design with 4 reps.

Nematicides were evaluated on common bermudagrass and on centipedegrass where sting nematodes were found at high densities. Nemacur and Soilbrom gave good control of the sting nematode and good turf quality on bermudagrass in Wilmington (Table 2). Soilbrom was not as effective in the Fayetteville test for some reason. The weather was hotter (95 F) when treatments were applied in Fayetteville than in Wilmington (85 F) which could have caused the Soilbrom to volatilize too quickly. It could have been lost in the air before irrigation was applied at the hotter temperature. Counter which is not labelled for use on turf gave good control of the sting nematode and needs additional evaluations. Furadan and Vydate are nematicides that are used in field crops and gave good turf quality but did not reduce the number of sting nematodes to low levels. The reason for imporovement of turf quality in these tests needs additional investigation. Nemacur is labelled for use on golf courses and would be the nematicide suggested for use on greens and even larger areas. Soilbrom has received a label in North Carolina for use on bermudagrass and would less expensive than Nemacur to use on large areas in fairways. This chemical must be injected into the soil with specilized equipment and irrigated soon after application. Mocap gave good control of the sting nematode but did not result in imporved turf quality. This result was unusual since better turf quality would have been expected with the low level of this nematode. Oftanol and Subdue did not control the nematode and did not improve turf quality.

Table 2: NEMATICIDES EVALUATED FOR CONTROL OF STING NEMATODES ON COMMON BERMUDAGRASS, 1982*

	Sting nema/500 cc of soil			Turf Quality**
TREATMENT (/1000 sq ft)	6/21/82	7/27/82	8/27/82	10/13/82
Nemacur 15G (2.7 lb)	136abc	5 b	2 d	7.8a
Counter 15G (2.5 lb)	156ab	15 b	4 d	7.8a
Soilbrom 90 (8.8 oz)	80 bc	5 b	12 d	7.2a
Vydate 10G (2.7 lb)	216a	23 b	52 bcd	7.2a
Furadan 10G (2.7 lb)	122abc	60 b	72abcd	7.2a
Mocap 10G (5 lb)	26 c	5 b	28 cd	3.8 b
Check	176ab	161a	140abc	3.6 b
Oftanol 5G (2.5 lb)	114abc	73 b	164ab	3.6 b
Subdue 2E (6 oz)	148abc	182a	182a	3.0 b

* Wilmington. Chemicals were applied on 6/21/82.
** Turf quality ratings were 1 - 9 with 9 = best.

Nemoticides were evaluated for the control of sting nematodes on centipedegrass in an institutional lawn in Fayetteville. The lawn was rotatilled and sprigged with healthy centipede since the stand of centipede was not uniform and was very thin. Sting nematodes were distributed uniformly throughout the test area. Nematicides were applied on June 10 and washed into the soil immmediately after application with 1/2 inch of water. All nematicides tested except Oftanol reduced the nember of nematodes significantly 6 weeks after application. Differences in turf quality were difficult to observe during the summer because of the slow growth of the sprigs and weeds. However, differences in rate of spread of stolons and percent cover with centipedegrass were observed in October. Treatment with Nemacur resulted in the best coverage with Furadan and Vydate be the next best. Mocap, Counter and Oftanol did not give significantly better coverage than the check. Counter gave excellent control of the sting nematode but did not significantly increase the coverage of centipedegrass over the check (Table 3). Ring nematodes that occurred uniformly throughout the plots were not controlled by any of the nematicides.

Table 3: STING NEMATODE CONTROL AND PERCENT COVERAGE OF CENTIPEDEGRASS FOLLOWING TREATMENT WITH NEMATICIDES, 1982*

	Nema/500 cc of soil		% Cover
TREATMENT (/1000 sq ft)	6/10/82	7/21/82	10/13/82
Nemacur 15G (2.7 lb)	70a	13 b	82a
Furadan 10G (2.7 lb)	93a	10 b	75ab
Vydate 10G (2.7 lb)	56a	3 b	72ab
Mocap 10G (5 lb)	58a	20 b	62abc
Counter 15G (2.5 lb)	75a	3 b	55 bc
Check	63a	52ab	47 c
Oftanol 5G (2.5 lb)	72a	85a	45 c

* Chemcials were applied on 6/10/82.

Extension acticities on turfgrasses included identification on many diseases throughout the state, the program committee of the annual turf conference, landscape workshops, working with county agents, speaking at many turf association meetings and coordination of the pesticide training and recertification program in ornamentals and turf for North Carolina.

Update of North Carolina State University Turf Insect Project for 1982

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During 1982, several promising insecticides in a variety of formulations were evaluated for control of Japanese beetle grubs, green June beetle brugs, fall armyworms, black cutworms and granulate cutworms on turf. Details are as follows:

Granulate Cutworms and Fall Armyworms

Golf greens and fringes of Tifton 328 Bermudagrass were treated on Septermber 7, 1982 with various rates of four different insecticides for the control of granulate cutworm and fall armyworm. Treatment consisted of 1,000 square feet and was replicated four times.

Insecticide application was made with a self-propelled sprayer designed for use on golf courses. The sprayer was operated at approximately two miles per hour with 30 psi with whirl chamber nozzles spaced 20 inches apart on a boom. Sprays were applied at the rate of 4.5 gallons per 1,000 square feet.

Insects were counted in a square foot area in each of the four replications by flooding with water containing a synergized pyrethrum diagnostic aid. The number of live worms are given in Tables 1 and 2.

Black Cutworms

Insecticides were applied on July 10, 1982, with a Hahn self propelled turf sprayer with Teejet 8020 flat fan nozzles spaced every 20 inches on the boom. The sprayer was operated at 30 psi at 4 miles per hour. Three gallons of spray per 1,000 square feet were applied.

Plots were replicated twice and consisted of one half of a Penncross bentgrass green. Greens varied in size from 8,000 to 10,000 square feet.

Counts of live worms were made on one-square-foot areas at 5 locations in each plot on August 2 and August 5, 1982, by flooding the area with a synergized pyrethrum diagnostic aid in water. Treatment rate and results are given in Table 3.

Green June Beetle Grubs

Insecticides were applied to Tifton 328 hybrid Bermudagrass fairways on September 8, 1982. Plots consisted of approximately 1/4 acre (100 ft x 100 ft).

Sprays were applied with a 150 gallon Hahn self-propelled turf sprayer equipped with a boom with 8015 Tee Jet flat fan nozzles spaced 20 inches apart. Sprays were applied at 30 pounds of pressure at four miles per hour. A total of 97 gallons of spray per acre was used. Granules were applied with a push type drop spreader.

The number of live grubs per square yard were taken on November 9, 1982. A total of three samples were counted in each replicate. Results are shown in Table 4.

Japanese Beetle Grubs

Insecticides were applied to golf course fairways at Sapphire Valley County Club on May 10, 1982. Sprays were applied with a 150 gallon Cushman mounted sprayer with 8020 teejet flat fan nozzles spaced every 20 inches on the boom. The sprayer was operated at 30 psi at 4 miles per hour and applied 3 gallons of spray per 1,000 square feet. Granules applied with a drop spreader. Plots were 1,000 square feet in area and replicated three times.

Evaluations and counts were made June 8 and October 13, 1982, by taking two 8" samples per plot. The number of live grubs are given in Table 5.

Table 1. Total number of live granulate cutworms[1], 1982.

Treatment and Rate/1000 sq. ft.[2]	9/8	9/10	9/20	9/28
Dursban 2E, 2 oz.	3	6	2	1
CGA 12223 1E, 3 oz.	0	2	1	1
CGA 12223 1E, 4 1/2 oz.	1	2	1	0
CGA 12223 2E, 3 oz.	0	1	0	0
CGA 12223 2E, 4 1/2 oz.	0	0	0	0
Oftanol 2F, .36 oz.	3	6	1	1
Oftanol 2F, .72 oz.	2	4	0	0
Deltic 2.4EC, 1.6 oz.	6	12	12	0
Deltic 2.4EC, 3.2 oz.	5	11	11	1
Untreated check	9	15	26	5

[1]Total number per 12" x 12" samples in 4 replicates
[2]Treated September 7, 1982

Table 2. Total number of live fall armyworms[1], 1982.

Treatment and Rate/1000 sq. ft.[2]	9/8	9/10	9/20	9/28
Dursban 2E, 2 oz.	3	7	3	0
CGA 12223 1E, 3 oz.	5	2	0	0
CGA 12223 1E, 4 1/2 oz.	3	0	0	0
CGA 12223 2E, 3 oz.	3	2	0	0
CGA 12223 2E, 4 1/2 oz.	3	0	0	0
Oftanol 2F, .36 oz.	5	5	4	0
Oftanol 2F, .72 oz.	3	4	2	0
Deltic 2.4EC, 1.6 oz.	15	22	11	0
Deltic 2.4EC, 3.2 oz.	10	17	9	2
Untreated check	18	37	17	3

[1]Total number per 12" x 12" samples in 4 replicates
[2]Treated September 7, 1982

Table 3. Black cutworm control, 1982.

Treatment & Rate/1000 sq. ft.[1]	8/2	8/5
CGA 12223 1E, 3 oz.	2	1
CGA 12223 1E, 6 oz.	0	1
Oftanol 2F, 0.18 oz.	12	5
Oftanol 2F, 0.36 oz.	7	2
Oftanol 2F, 0.72 oz.	4	2
Deltic 2.4EC, 1.6 oz.	11	10
Deltic 2.4EC, 3.2 oz.	8	9
Sevin 80W, 4 oz.	5	6
Untreated check	11	10

[1]Insecticide applied July 20, 1982

Table 4. Green June Beetle Control Test

Treatment and Rate/Acre[1]	No. of live grubs[2] Average of 4 replicates
Oftanol 2E, 2 lb. ai	9.0
Oftanol 5G, 2 lb. ai	6.5
CGA 12223 2G, 1.6 lb. ai	3.0
CGA 12223 1E, 1.5 lb. ai	2.8
Dursban 4E, 5 lb. ai	13.3
Untreated check	20.3

[1]Treated September 8, 1982
[2]Counts made November 9, 1982 on three areas 3 ft x 3 ft in each of four replicates.

Table 5. Japanese beetle grub control, 1982.

Insecticide[1] and Rate/Acre	No. live grubs in two 8" samples[2] 6/28	10/13
Check	68	17
Oftanol 6E (2 lb. ai)	3	0
Oftanol 5G (2 lb. ai)	3	0
Diazinon 2G ((5 lb. ai)	14	5
CGA 12223 2E (1 lb.)	2	0
Turcam 76W (2 lb.)	7	9
U56295 (7 lb.)	9	3
Dursban 4E (5 lb.)	16	8

[1]Applied May 10, 1982
[2]Total in three replicates

THE TURFGRASS COUNCIL OF NORTH CAROLINA, INC.

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

PURPOSES AND OBJECTIVES

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

ACTIVITIES

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

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Individuals interested in turfgrasses, representatives of turf related organizations and sales representatives of turf products are encouraged to become members. Dues for individuals are $10 per year.

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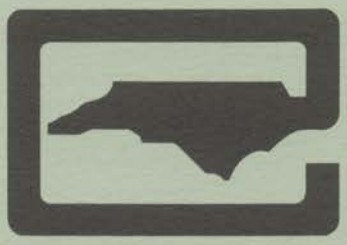

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