Scotts Turfgrass Research Seminar

June 24-25, 1968

Notes of Progress

from

Scotts Turfgrass Research Seminar

June 24-25, 1968

held at

Scotts . . . the grass people

Marysville, Ohio

PREFACE

The following informal papers summarize the discussions held during the Turfgrass Research Seminar at Scotts in Marysville, Ohio, June 24-25, 1968. Representation at this conference included 42 scientists from 36 states and Canada.

These reports show the direction and scope of turfgrass research in many of our land-grant universities. The authors point out particular problems facing turf culture in their localities and their particular area of specialization.

This compilation of reports is intended to furnish the often-requested, ready reference to current turfgrass research activities.

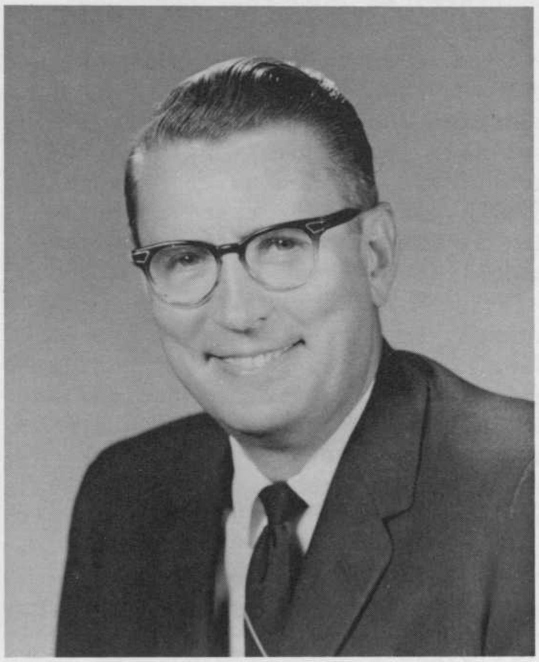
PREFACE

The following abstracted papers summarize the discussions held during the Turfgrass Research Seminar at Scotts in Marysville, Ohio, June 24-25, 1968. Representation at this Conference included 48 scientists from 21 states and Canada.

These reports show the direction and scope of turfgrass research in many of our leading universities. The authors point out particular problems facing turf culture in their localities and their particular area of specialization.

This compilation of reports is intended to furnish the often-requested, ready reference to current turfgrass research activities.

FOREWORD



Dr Roy M Kottman, Dean
College of Agriculture and
Home Economics, Ohio State University
Director, Ohio Agricultural Research
and Development Center

As man increases his knowledge of his environment, he strives harder for a more satisfying environment in which to work and live. Thus, new knowledge leads to a desire for more new knowledge. Each stage in the escalation process demands more sophisticated techniques and higher levels of complexity and cost. Research on turfgrass is no exception.

The recently completed Long Range Study[1] conducted jointly by personnel of the Experiment Stations of the National Association of State Universities and Land Grant Colleges and the Agricultural Research Service of the United States Department of Agriculture indicates that within these publicly supported institutions' laboratories there are 32 scientific-man-years devoted to research on turfgrass. This effort is principally at the state stations, where a total of 30 of these scientific-man-years of effort are to be found. The amount of research effort documented in these figures is, however, somewhat less than is actually being accomplished through expenditure of public funds.

Some effort involving use of both state and federal funds, but primarily federal funds, is being expended in private colleges and universities as well as in public educational institutions other than the Experiment Stations associated with the land grant universities. Many research projects conducted in departments of botany, microbiology, entomology, plant pathology, biochemistry, and various other disciplines located in institutions outside the Experiment Stations or the USDA, contribute directly or indirectly to the scientific advancement of the turfgrass industry.

The turfgrass industry itself, with its own research laboratories, through contract and grant research supported at private and public institutions and in private research organizations, is contributing substantially to the rapidly accumulating body of knowledge concerning turfgrass. However, even with generous estimates of the research effort bearing both directly and indirectly on problems of the turfgrass industry, there is considerably less research expenditure than expected when one considers the size of the turfgrass industry and its contribution to the economy of our nation.

1 "A National Program of Research for Agriculture." October 1966

It is unfortunate that such data as are available do not provide good estimates, let alone accurate data, on the total annual contribution of the turfgrass industry to our nation's economy. There is reason to believe, however, that this contribution to gross national product is approximately $4 billion annually. If we accept this figure as being reasonably accurate, we find that the total annual investment in research for the turfgrass industry (using this $4 billion annual contribution to gross national product) amounts to only 0.025 percent.

Even a substantial discounting of the annual contribution of the turfgrass industry to our gross national product makes it obvious that investment in turfgrass research, both public and private, is unrealistically low as compared with outlays for agricultural research generally or with outlays for research being expended on behalf of other industries where annual research investments often fall in the range of 3 to 10 percent or more annually.

These observations lead me to conclude that publicly supported research has an important and expanding role to play in providing new knowledge for the turfgrass industry. This expanding role of the State Agricultural Experiment Stations and the Agricultural Research Service was given recognition in the Long Range Study[2] to which previous reference has been made. It is quite likely that the Task Force on beautification, which is giving attention to research needs for ornamentals and turfgrass, will recommend that the present level of research support by the state stations and the USDA should be tripled within the next 10 years. Even so, the total annual investment in research still would be less than one-tenth of one percent, based on the present contribution of the turfgrass industry to our gross national product.

In view of the continuing rapid expansion of the turfgrass industry, it becomes apparent that more emphasis must be given to both undergraduate and graduate education of students preparing to enter the turfgrass industry on completion of their formal studies. This means that those universities preparing students for the turfgrass industry must greatly expand their basic and applied research efforts. It is not realistic for either a baccalaureate or an advanced degree student to enter the turfgrass industry without broad knowledge of the genetics, nutrition and management of turfgrass. This type of background can best be provided by an institution with a sizable research program encompassing both basic and applied studies.

The education of future employees for the turfgrass industry is perhaps the best reason for a university to conduct both basic and applied research in turfgrass. However, it is perhaps equally important that universities play a strong role in turfgrass research because of the continuity which a university can provide to those studies which require many years of data. This includes data taken in several locations throughout a geographical area without regard to whether or not there will be an immediate payoff in terms of consumer acceptance and sales.

As the turfgrass industry becomes of age--and certainly a $4 billion industry is beyond adolescence--there is urgent need for unbiased information. Such information protects both the industry and the public. The errors which could be made by a well-meaning firm become much larger as the size of the industry increases. State Experiment Station research or that done by other public institutions or agencies provides a most valuable service to the industry and secondary benefit to the public.

---

[2] "A National Program of Research for Agriculture." October 1966.

In summary, the need for increased levels of publicly supported research on turfgrass can be testified on the following counts:

1. The current low level of public support to the turfgrass industry in terms of its contribution to the gross national product (only 0.025 percent by the 51 State Agricultural Experiment Stations and the Agricultural Research Service of the U S Department of Agriculture).

2. The importance of research, both basic and applied, to the education of both undergraduate and graduate students.

3. A need to maintain unbiased sources of information for both the turfgrass industry and the public.

4. The high cost for a firm to undertake research in each of the states of the nation where their products are being sold and the tendency for unwarranted extrapolation of data when locally valid research is not available.

5. The long term stability of publicly supported research in the state stations and the Agricultural Research Service for providing data which would not be economically feasible for private industry to obtain.

There is good reason to believe that the state stations and the Agricultural Research Service will devote their efforts increasingly to the more basic aspects of turfgrass research, whether the research problems involve genetics, nutrition, physiology, pesticides or management.

It would be little short of catastrophic, however, if the State Agricultural Experiment Stations were to eliminate applied research on problems affecting the turfgrass industry. Graduate students particularly would enter employment without adequate background to undertake either the basic or applied studies for which they would have been hired. Similarly, undergraduate students would be deprived of obtaining that broad knowledge of the turfgrass industry, which they would need to make an intelligent choice of their area of concentration for graduate studies. Likewise, the undergraduate student desiring to enter turfgrass industry employment on receipt of his baccalaureate degree would be far less prepared for his employment. In fact, without this broad knowledge, he might never have become interested in employment in the turfgrass industry.

In summary, the need for increased [illegible] of publicly supported research on turfgrass can be justified on the following grounds:

1. The present low level of public support to the turfgrass industry, an [illegible] billion [illegible] of [illegible] to the gross national product [illegible] 0.2 percent by the 51 State Agricultural Experiment Stations and the Agricultural Research Service of the U S Department of Agriculture.

2. The inadequacy of research, both basic and applied, on the education of both undergraduate and graduate students.

3. A need to materially expand sources of information for both the turfgrass industry and the public.

4. The high cost, to many firms, of complete research in each of the states of the nation where their products are being sold, and the tendency for unrecognized [illegible] for [illegible] when locally valid research is not available.

5. The long-term stability of publicly supported research in the states [illegible] Research [illegible] data which would not be economically feasible for private industry to obtain.

There is good reason to believe that the State Stations and the Agricultural Research Service will devote their efforts increasingly to the more basic aspects of turfgrass research, whether the research problems involve genetics, nutrition, physiology, pesticides, or management.

It would be little short of catastrophic, however, if the State Agricultural Experiment Stations were to eliminate applied research or courses affecting the turfgrass industry. Graduate students [illegible] would enter employment without adequate background [illegible] which they would have been given. Similarly, undergraduate students would be deprived of obtaining that broad knowledge of the turfgrass industry which they would need to make an intelligent choice of their area of concentration for graduate studies. Likewise, the undergraduate student desiring to enter turfgrass industry employment on completion of his baccalaureate degree would be far less prepared for his employment. In fact, without this broad knowledge, he might never have become interested in employment in the turfgrass industry.

---

* "National Program of Research for Agriculture," October 1966.

ACKNOWLEDGMENTS

Our special thanks to Dr Jack Altman, Associate Professor of Botany and Plant Pathology, Colorado State University, for his help in compiling these reports, and to Dean Roy Kottman, Ohio State University, for preparing the Foreword.

We are grateful also to the authors for their contributions of ideas and knowledge...the roots of progress in the turfgrass industry.

CONTENTS

CONTRIBUTORS

Dr P M Alexander, Project Leader, Horticulture Department, Clemson University, Clemson, South Carolina

Dr Jack Altman, Associate Professor, Department of Botany and Plant Pathology, College of Agriculture, Colorado State University, Fort Collins, Colorado

Dr Jack Butler, Assistant Professor, Turfgrass Management, Department of Horticulture, College of Agriculture, University of Illinois, Urbana, Illinois

Dr Lloyd Callahan, Project Leader, Turfgrass Management, Department of Agronomy, University of Tennessee, Knoxville, Tennessee

Dr Ray Dickens, Assistant Professor, Department of Agronomy and Soils, School of Agriculture, Auburn University, Auburn, Alabama

Dr P N Drolsom, Professor of Agronomy, College of Agriculture, University of Wisconsin, Madison, Wisconsin

Dr A E Dudeck, Assistant Professor, Department of Horticulture and Forestry, College of Agriculture, The University of Nebraska, Lincoln, Nebraska

Dr Jack Eggens, Department of Botany, University of Guelph, Guelph, Ontario, Canada

Dr Lambert C Erickson, Professor, Department of Plant Sciences, College of Agriculture, University of Idaho, Moscow, Idaho

Dr C Reed Funk, Associate Professor, College of Agriculture and Environmental Science, Rutgers University, New Brunswick, New Jersey

Dr Roy L Goss, Associate Agronomist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington

Dr Philip Halisky, Associate Professor, College of Agriculture and Environmental Sciences, Rutgers University, New Brunswick, New Jersey

Dr Delbert Hemphill, Professor, Department of Horticulture, University of Missouri, Columbia, Missouri

Dr Paul Henderlong, Assistant Professor, Department of Agronomy and Genetics, College of Agriculture, Virginia University, Morgantown, West Virginia

Dr Dale E Herman, Assistant Professor, Horticulture and Forestry Department, College of Agriculture and Biological Sciences, South Dakota State University, Brookings, South Dakota

Dr Wayne W Huffine, Professor, Department of Agronomy, Oklahoma State University, Stillwater, Oklahoma

Dr Kenneth L Larson, Associate Professor, Department of Agronomy, North Dakota State University, Fargo, North Dakota

Dr W M Lewis, Agronomy Specialist, Agricultural Extension Service, North Carolina State University, Raleigh, North Carolina

Dr James Love, Professor of Soil Science, College of Agriculture, University of Wisconsin, Madison, Wisconsin

Dr John H Madison, Associate Professor, Department of Environmental Horticulture, University of California, Davis, California

Dr J W May, Weed Research Laboratory, Department of Botany and Plant Pathology, College of Agriculture, Colorado State University, Fort Collins, Colorado

Dr George McBee, Assistant Professor, Department of Soil and Crop Science, Texas A & M University, College Station, Texas

Mr Wallace Menn, Instructor, Department of Soil and Crop Science, Texas A & M University, College Station, Texas

Dr Robert W Miller, Associate Professor, Department of Agronomy, College of Agriculture, Ohio State University, Columbus, Ohio

Dr W H Mitchell, Extension Agronomist, College of Agricultural Sciences, University of Delaware, Newark, Delaware

Dr Charles L Murdoch, Research Associate, Department of Agronomy, Division of Agriculture, University of Arkansas, Fayetteville, Arkansas

Robert Newman, Horticulture Instructor, College of Agriculture, University of Wisconsin, Madison, Wisconsin

Dr Stanley Papanos, Turf Specialist, Cooperative Extension Service, Hartford, Connecticut

Dr L C Peirce, Chairman, Plant Science Department, College of Agriculture, University of New Hampshire, Durham, New Hampshire

Dr Eliot C Roberts, Chairman, Department of Ornamental Horticulture, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida

Dr A E Slinkard, Associate Professor, Department of Plant Sciences, College of Agriculture, University of Idaho, Moscow, Idaho

Dr C R Skogley, Associate Professor, Department of Agronomy and Mechanized Agriculture, College of Agriculture, University of Rhode Island, Kingston, Rhode Island

Dr Herbert Streu, Associate Professor, Department of Entomology and Economic Zoology, College of Agriculture, Rutgers University, New Brunswick, New Jersey

Dr Coleman Y Ward, Professor, Department of Agronomy Crops, Mississippi State University, State College, Mississippi

Dr Gayle Worf, Extension Plant Pathologist, College of Agriculture, University of Wisconsin, Madison, Wisconsin

Dr William A Young, Associate Professor, Department of Horticulture, Louisiana State University, Baton Rouge, Louisiana

Dr V B Youngner, Professor, Department of Agronomy, College of Biological and Agricultural Sciences, University of California Riverside, California

TURFGRASS RESEARCH IN ALABAMA

Dr Ray Dickens, Assistant Professor
Department of Agronomy and Soils
School of Agriculture
Auburn University, Auburn, Alabama

General Information

Research on various aspects of turfgrass culture was conducted by Dr D G Sturkie for many years prior to his retirement in July of 1968. The turfgrass research area at Auburn consists of about 3 acres of which various proportions are occupied by most all the established southern lawngrasses.

Research Projects

1. Weed Control: Extensive weed control studies on zoysia, bermuda, and centipedegrass have been conducted for several years and are continuing. Work has included, or now involves, both pre-emergence and postemergence control of annual grass and broadleaf weeds, and perennial weed problems such as nutsedge. Studies are now in progress and residual effects of herbicides, *Poa annua* control in golf greens, and interactions of pre-emergence herbicides and soil phosphorus.

2. Variety Improvement: Evaluation of strains and selections from various sources are being evaluated for their turfgrass potential. Zoysia, bermuda, St Augustine, and centipede are the principal species involved.

3. Nutrition: Considerable research has been conducted on the N, P, and K requirements of bermuda, zoysia, and centipedegrass. Rates and sources of nitrogen are currently being tested on bermuda and centipedegrass.

Educational Projects

Assistance and guidance is provided to the Alabama-Northwest Florida Turfgrass Association in the form of an annual shortcourse and speakers for other meetings.

Future Plans

Indications are that the present turfgrass research area will be lost to campus expansion within the next 3 or 4 years. Plans are to expand the area for turfgrass research at the new location in order to allow for research in insect and disease control and other aspects of turf culture. Plans also include the installation of modern irrigation facilities and other labor saving changes to reduce labor requirements and increase the amount of constructive research conducted.

TURF RESEARCH AT THE UNIVERSITY OF ARKANSAS

Dr Charles L Murdoch, Research Associate
Department of Agronomy, Division of Agriculture
University of Arkansas, Fayetteville, Arkansas

Turf research at the University of Arkansas is carried out at the Main Experiment Station, Fayetteville, and at golf courses in the state. The research presently under way may be divided into four categories; (1) Evaluation of new varieties, (2) Management studies, (3) Weed control studies and (4) Disease control studies.

Nursery plots are maintained at Fayetteville in which new varieties are evaluated for adaptation.

Present emphasis in management studies is placed on fertility practices for maintaining turf. Different sources, rates and application schedules of plant nutrients are being evaluated.

Herbicides are evaluated for weed control and phytotoxicity. Present tests include pre-emergence crabgrass control, pre-emergence Poa annua control and winter weed control.

Fungicides are evaluated for control of various turf diseases. Materials are presently being evaluated on bentgrass, bermudagrass and zoysia.

EVALUATING TURF STRESS FROM SELECTIVE HERBICIDES

Dr John H Madison, Associate Professor
Department of Environmental Horticulture
University of California
Davis, California

Selective turf herbicides often have an injurious effect on both weeds and turf, but while the weeds die the turf recovers.

Our work has been centered on developing a method for evaluating stress or injury to turf from selective herbicides. At some seasons turf has a limited ability to take additional stress, and chemical treatments causing stress should be avoided.

At its present stage of development, the procedure costs about $50 to $60 per test and gives an evaluation of effect of chemicals on growth (yield). It is being expanded to also evaluate effect of chemicals on stored reserves and on root development. As currently used turf is cut from uniform field grown sod using a 4" cup cutter. Plugs are cut to uniform length in a mitre box. Plugs are slid into #7 cans (soil must be moist and plastic). A 10% excess of plugs are cut. After a 10-day establishment period cans are selected for uniformity with the excess 10% being discarded. Nitrogen and herbicide treatments are applied and 4 weeks later yield is taken. The interaction between N and herbicide treatments is used to give an evaluation of the extent of herbicide stress or injury.

The modified method has not yet been fully tested. It is based on using a thin slice of sod placed in a #7 can on top of sterile sand. All nutrients are supplied except N is supplied in graduated increments. Following treatment and the four-week growing period, yield is harvested. Cans are placed into the dark and harvested 4 weeks later to get a measure of stored reserves. OM in the sand is measured as an indication of root growth.

As examples of the need for testing with multiple parameters we may cite Azak and chlordane which have no effect on stored reserves but severely restrict root growth and shoot spread. While MCPP and Bandane have little effect on rooting or tiller density but which greatly limit rhizome growth and stored reserves.

SUMMARY OF MAJOR AREAS OF TURFGRASS RESEARCH

AT THE

UNIVERSITY OF CALIFORNIA, RIVERSIDE

Dr V B Youngner, Professor
Department of Agronomy
College of Biological and Agricultural Sciences
University of California, Riverside, California

I. Breeding of Superior Turfgrasses for Western Conditions

Project Leader - V B Youngner, Department of Agronomy.

A. Bermudagrasses for heavy duty turf, with superior cool weather tolerance and less thatch accumulation.

B. Zoysiagrasses with less thatch accumulation, more rapid rate of cover and superior cool weather tolerance.

C. Bluegrasses better adapted to the California climates.

D. Tall fescues with fine texture, better color and vigorous rhizomes.

E. Creeping bentgrasses tolerant of diseases, high soil salinity and high temperature for putting and bowling greens.

F. Disease tolerant dichondra strains with uniform growth habit.

II. Weed Control in Turf with Particular Reference to Kikuyugrass and Annual Bluegrass.

Project Leader - V B Youngner, Department of Agronomy.

III. Turfgrass Pathology.

Project Leader - Robert Endo, Department of Plant Pathology.

IV. Insect Pests of Turf.

Project Leader - R N Jefferson, Department of Entomology.

V. Soil Amendments and Soil Mixes for Turf.

Project Leaders - John Letey, Department of Soils and Plant Nutrition and V B Youngner, Department of Agronomy.

VI. Turfgrass Irrigation.

Project Leaders - A W Marsh, Agricultural Extension Service and V B Youngner, Department of Agronomy.

VII. Cultural Practices as They Relate to Turf Density, Survival and Composition.

Project Leader - V B Youngner, Department of Agronomy.

VIII. Growth of Grass Leaves and Tillers Under Turf Conditions.

Project Leader - V B Youngner, Department of Agronomy.

IX. Effects of Soil Salinity on Turfgrasses.

Project Leader - V B Youngner, Department of Agronomy.

X. Nematodes of Turfgrasses and Their Control.

Project Leader - J D Radewald, Agricultural Extension Service.

XI. Effects of Wetting Agents on Turf and Soils.

Project Leader - John Letey, Department of Soils and Plant Nutrition.

XII. Effects of Climatic Factors on Turfgrass Growth and Quality.

Project Leader - V B Youngner, Department of Agronomy.

XIII. Nitrogen Efficiency and Metabolism in Grasses.

Project Leader - R E Young and V B Youngner, Department of Agronomy.

XIV. Effects of Growth Retardants on Turfgrasses.

Project Leader - V B Youngner, Department of Agronomy.

TURF DISEASE RESEARCH IN COLORADO

Dr Jack Altman, Associate Professor
Department of Botany and Plant Pathology
College of Agriculture
Colorado State University
Fort Collins, Colorado

Turf management and disease control, and a basic knowledge of disease development should result in a more effective disease control program.

Disease development is a complex which consists of three parts: fungus, host, and environment. The last part, environment, includes such factors as temperature, moisture, soil type, nutrition, etc. Sometimes, by modifying these factors, we can appreciably retard fungus development. Conversely, certain cultural or management practices may accelerate disease.

Helminthosporium leaf spot and foot rot, and Rhizoctonia brown patch are two perennial disease problems wherever turf is grown in Colorado. These diseases occur on golf courses, in parks, and on home lawns throughout the State and constitute the primary turf disease problems in Colorado.

With continued emphasis on recreation resulting in increased winter use of turf, snow mold and winter damage to turf have been observed increasingly in Colorado.

The increasing use of polyvinyl acrylic colorant on turf to maintain green color for year-round recreation also makes it mandatory to study turf disease etiology and physiology.

In the period 1957-1958, about 35% (245) of 700 inquiries that passed through the Plant Disease Clinic, Colorado State University, were concerned with turfgrass diseases. In recent years, these inquiries have dropped to about 15%, reflecting a better program of education for turf specialists on the part of the Extension Pathologist and better dissemination of information through the various county agents and horticultural clinics regarding disease control. There has been nc general reduction of turf disease outbreaks in the state although fewer problems have been referred to the clinic.

The increased urbanization in the State, and the increased use of rotary mowers has complicated the disease problem by providing more frequently damaged turf and an increase in thatch development, both of which help predispose grass plants to disease. A poor seed bed on heavy soil is another factor that might produce thatch formation.

The advent of new bluegrass varieties has further complicated the disease problem in that several of these newer varieties show varying degrees of susceptibility to turf diseases that occur in Colorado. For example, Merion Bluegrass is more susceptible to Helminthosporium leaf spot than Windsor Bluegrass. Prato, Newport, and Park Bluegrass are other selections that have not yet been completely evaluated for resistance or for susceptibility to disease in this State. In several isolated instances, the use of colorants or green turf pigments may have masked snow mold damage to bentgrass greens, although for the most part, these materials are used successfully.

Notice — This page (7) is out of sequence. It should follow page 58 as the second page of the So Carolina report.

Summary of 1968-69 Work:

A. Diseases:

1. Phythium Blight (Pythium aphanidermatum) was extremely severe during the period from June 26 - August 30, 1968, and was most prevalent on bentgrasses, bluegrass, and fescues. Results of fungicide trials during this period on two bentgrasses (Penncross and Cohansey) and two bermudagrasses (Tifdwarf and Tifgreen), all maintained at ¼" height, revealed that none of the "standard" turf fungicides afforded any reasonable degree of control. One experimental material, Mallinckrodt's MF-344, proved to be outstanding when applied at 4 oz per 1,000 sq ft in 3 gallons of water. This chemical is now being marketed under the trade name of Koban.

   Environmental data was recorded at these same plots during the period maintained above. It was learned that disease activity increased significantly when the minimum night temperature exceeded 68° F and relative humidity was 90% or greater (7 A M reading). Significant correlations were not observed with maximum day temperature, dewfall, maximum/minimum 4" soil temperature, or rainfall.

B. Weed Control:

1. A study on the effectiveness of summer applications of pre-emergence for Poa annua control on Tifdwarf and Tifgreen bermudagrasses (to be overseeded with cool season grasses 60 and 90 days following treatment) was initiated. This study will be continued for a minimum of 4 years to determine residuality of the chemicals used.

   Following both the July 16 and August 16 applications it was evident that temporary injury to both bermudagrasses was caused by Azak, Balan, and Dacthal, but not by Pre-San. With respect to the individually planted cool-season grasses (nine species and/or varieties used), none of the chemicals significantly retarded germination or subsequent growth. The effect on Poa annua germination and development has not yet been evaluated.

C. Planting Techniques:

1. A study on the feasibility of planting centipedegrass, St Augustinegrass, and 4 types of zoysiagrass by stolonization has been completed. Grasses responding favorably to this technique were centipedegrass and Meyer zoysia, whereas it was found that St Augustinegrass, Zoysia matrella, Z. japonica var. Emerald, and Z. japonica would not survive.

Currently, a better understanding of the etiology of disease, which encompasses not only the causal agent but also all the environmental factors and specialized factors cited above, is required in order to better control turf disease. There is still no complete study on the role of thatch in the turf disease complex in Colorado. The introduction of new varieties of bluegrass and new bentgrasses will make it mandatory to continue evaluating turf fungicides under Colorado conditions. In the past, chemicals such as the phenyl mercuries and compounds containing Actidione were recommended. These chemicals have been shown to be phytotoxic to both Merion and Common Kentucky bluegrass in Colorado during late spring and summer. It is conceivable that some of the newer selected turf fungicides currently recommended could be toxic to future bluegrass varieties.

With regards to thatch (clipping remains), under experimental conditions for the past four years, no difference in disease was observed, whether thatch was removed or whether it remained in the crowns. However, turf with clippings was a better quality turf and more drought resistant than turf from which the clippings were removed. The above plots were inoculated with Helminthosporium on several occasions. All soil in the plots was homogeneous.

Another facet of the turf disease complex that has been evaluated in the past is one involving iron deficiency. As a result of studies regarding this complex, the use of iron is a standard recommendation in Colorado turf.

During 1967, turf disease research involved the following: 1) An evaluation of turf fungicides for the control of turf disease in Colorado; 2) A comparison of turf varieties for disease resistance; 3) The development of new and improved methods for growing vigorous healthy turf in order to eliminate or reduce diseases in turf, particularly in bentgrasses and bluegrasses.

With regard to item #1 above, during winter-spring of 1966-1967, severe winter desiccation followed by snow mold occurred on several golf courses in Denver. The same type of injury occurred during the winter of 1967-68 but on a more moderate scale than previously. Along with this we have had conditions favorable for Helminthosporium leaf blight occurring in late spring and summer. Several fungicides were tested for control of these diseases during the past three years. Daconil 2787, Fore, and Tersan OM were three of the outstanding fungicides tested. These materials were compared on a 7-day, 10-day and 14-day application schedule. Best results were obtained with 7-10 day applications.

We also ran into a problem of Pythium on newly planted greens at elevations of 8500 ft and again Daconil and Fore were outstanding in controlling it. Scutl used at recommended rates for disease control was not effective.

Item # 2. We have evaluated two bentgrass varieties and 7 bluegrass varieties for disease resistance in this area. Our work to date with the bentgrasses showed no difference regarding disease between Seaside and Penncross in new plantings. In older greens which were predominantly Seaside, more disease was evident and here again, Daconil, Fore, and Tersan OM exhibited superior disease control during the growing season.

With regard to the bluegrass varieties, we have evaluated and are continuing to evaluate--Common, Newport, Park, Merion, Prato, RHR, and Windsor--and of these, Windsor has been one of the most disease resistant and most vigorous of the bluegrasses. Although Park germinated rapidly, it was unusually thin the second year after planting in our experimental plots.

A comparison of Helminthosporium leaf spot on the seven bluegrass varieties was made in June 1967. The results are given in Table I.

In greenhouse tests to evaluate powdery mildew resistance, Merion was the most susceptible to powdery mildew and Windsor was the least susceptible of the seven bluegrass varieties tested. Common and Park were somewhat less susceptible than Merion to Powdery mildew. The greenhouse conditions were ideal for mildew and other disease development and resulted in severe disease to the grasses. Since temperatures and moisture, especially relative humidities, were higher in the greenhouse than in the field, the disease may have been more severe than under field conditions.

Item # 3. With regard to maintaining good healthy turf, new field plots have been established in which various test greens mixtures evaluated in the greenhouse were able to produce grass with exceedingly long roots with as little as 25% soil plus other amendments and in some instances with no soil at all. (The greenhouse tests were carried out in tapered glass fronted boxes 18" high x 8" wide.)

One of the purposes of this test will be to compare Colorado peatmoss with Canadian peatmoss in the various greens mixes, and also to compare disease resistance of Penncross and Seaside bents seeded on the various greens mixes.

When the grass is well established, the plots will be inoculated with Helminthosporium and/or Rhizoctonia (brown patch) to evaluate their ability to withstand disease and also to compare turf vigor in relation to disease tolerance. Temperature and recording instruments with remote sensors will be buried in each of the greens. This test will continue for 3 or 4 years in an attempt to establish the relationship, if one exists, between environment, disease, and predisposing environmental factors.

A word about year-round play: Many golf courses are using green coloring materials in order to prolong the season for playing golf. One of these is a polyvinyl acrylic green colorant (Turfcoat*). We have used this material on actively growing bluegrass and have supplied upwards of 6 consecutive applications weekly on our grass plots without any visible retardation or damage to the turf. When these materials are used to prolong fall and early spring play on golf greens, these materials should be applied only if a turf fungicide has first been applied to the green. We have a winter test underway where one-half of one of the greens at the Fort Collins Municipal Golf Course has been sprayed with this polyvinyl acrylic. One-half of the painted area and one-half of the unpainted area were pretreated with Daconil 2787 fungicide at 8 oz/1000 ft^2.

*Turfcoat P O Box 16621, Denver, Colorado 80216

The results of the test indicate that the Daconil plus polyvinyl acrylic plots are best. Grass treated with the colorant was less desiccated than non-colored grass. Putting characteristics and ball holding capacity was also better. The treated green did not retain snow as long as the untreated green. Growth was initiated sooner (by about two weeks) on the PVA treated green compared to non-treated. Transpiration appeared to be reduced in the PVA treated section compared to the non-treated section of the green based on comparisons of dormant turf in the non-treated section of the green. The bentgrass on the PVA treated greens was not as brittle as the bent on the non-treated green. Examination of 30 greens in the Denver area point out that winter play and maintenance were improved where PVA was used. Again a note of caution for those of you who plan to use PVA; I would strongly recommend pretreatment of greens with a suitable fungicide to avoid possibilities of disease damage that might be overlooked. One such fungicide, Daconil, was effective in reducing disease when used as a pretreatment.

Each turf is unique because of its peculiar soil and environment. Sound turf management is often the major key to disease prevention, but quite often fungicides are necessary for preventative and curative control programs. Diseases for which cures are known should never be permitted to progress to the point where turf quality is reduced as this results in unnecessary losses. To accomplish this goal each turf manager must be a keen observer. The excellence of turf is therefore related to the ability of the manager to overcome or modify those factors in each particular locality, which are detrimental to turf quality, and provide the best management practices which favor optimum development of the turf.

Table I

HELMINTHOSPORIUM READINGS ON THE BAY FARM BLUEGRASS PLOTS 6/23/67

Fort Collins, Colorado

Plot	Infested Leaves/Sq Ft	Vigor in Order of Rank
Common	30	6
Windsor	2	1 (best)
Prato	3	5
Merion	1	2
Park	24	7 (poorest)
Newport	1	3
RHR	7	4

All grass plots inoculated with Helminthosporium 0.006 gm/1000 sq ft and applied in a 1-1-3 mixture of Idealite, soil, and Terragreen with a fertilizer spreader.

AN EVALUATION OF NINE PRE-EMERGENCE HERBICIDES FOR THE CONTROL OF ANNUAL GRASSES IN BLUEGRASS TURF

Dr J W May
Weed Research Laboratory
Department of Botany and Plant Pathology
College of Agriculture
Colorado State University, Fort Collins, Colorado

It is widely accepted that crabgrass can be easily controlled in established bluegrass turf. There are a number of chemical compounds which may be safely applied to accomplish this under prescribed conditions. A summary of data collected over 15 years of intensive research related to crabgrass control in Colorado lawns is available in a current bulletin, Crabgrass Control in Colorado Bluegrass Lawns, General Series 850, Agricultural Experiment Station, Colorado State University, Fort Collins, Colorado.

While conducting research specifically concentrating on the prevention of crabgrass it has always been apparent that the same compounds which effectively control crabgrass also in many instances reduce the occurrences of several other annual grasses. Among the predominant weedy annual grasses found in bluegrass lawns of Colorado beside smooth and hairy crabgrass (_Digitaria_ _ischaemum_ (Schreb) Muhl and _D_. _sanguinalis_ L Scop) are annual bluegrass (_Poa_ _annua_ L), both green and yellow bristlegrass (_Setaria_ _viridis_ (L) Beauv and _S_. _lutescens_ (Weigel) F T Hubb.), downy brome (_Bromus_ _tectorum_ L, and barnyard grass (_Echinochloa_ _crusgalli_ (L) Beauv). In newly established turf, the latter is one of the most frequent. Many questions arise every spring concerning this weed. Although there has been good evidence that crabgrass herbicides might be acceptable for the purpose of controlling barnyard grass, no specific experiments had been conducted in this area up until 1967.

Large plots of Windsor, Merion and common Kentucky bluegrass were planted on May 4, 1966, on land heavily infested with barnyard grass. This test provided an excellent opportunity for evaluating barnyard grass control with several annual grass herbicides. It also provided a good test of bluegrass variety differences with respect to pre-emergence annual grass herbicides in young turf. No herbicides were used during the first season. Weeds, consisting mainly of barnyard grass, were kept mowed but this did not prevent a heavy crop of barnyard grass seed. Establishment of the bluegrass varieties was only fair by the end of the 1966 season. In April, 1967, bluegrass seedlings were well established in remnants of the 1966 cover. The soil was uniformly covered with a dense distribution of barnyard grass seed with very little germination at that time.

Herbicide applications consisted of one rate each (the rate recommended) for crabgrass control) of nine annual grass herbicides. These were applied April 22, 1967. Evaluations were made at intervals during the summer and final plant-count data were recorded on August 2, 1967. At the same time the identical treatments were applied to an adjacent area of well established common Kentucky bluegrass which was heavily seeded with crabgrass. This was done in order to compare herbicide effects on new vs old common bluegrass and to allow a comparison of crabgrass vs barnyard grass control for each of the nine herbicides.

Quantitative data were obtained by using a 5 x 5 ft transect divided into nine equal 400 sq in subunits. Eight transects were read for each treatment on each turf variety. The following arbitrary scale was used in the evaluation: 0=no annual grasses; 1=1-2 plants; 2=3-10; 3=1-25; 4=26-50 and 5=over 50 weedy annual grasses per 400 sq. in.

CONTROL OF BARNYARD GRASS AND CRABGRASS WITH NINE ANNUAL

GRASS HERBICIDES. 1967. C S U, FORT COLLINS, COLORADO

	Treatment	Formulation	Rate	Weedy Grass Control Rating			
			lbs/A	Barnyard Grass In Year-Old Planting			Crabgrass In Well-Established
				Common	Windsor	Merion	Common Kentucky
1.	Dacthal	75% WP	12	0.01	0.01	0.00	0.00
2.	Betasan	5% Gran	15	0.18	0.06	0.00	0.00
3.	Sindone	4% on Verm	10	0.32	0.03	0.04	0.00
4.	Bandane	10% Gran	35	0.32	0.19	0.15	0.50
5.	Planavin	80% WP	3	0.07	0.17	0.01	2.80
6.	Azak	5% Gran	12	1.40	1.66	0.51	1.20
7.	Balan	2.5% Gran	2	0.72	1.67	0.28	2.20
8.	Tupersan	50% WP	12	2.26	3.61	3.38	2.80
9.	Sirmate	5% Gran	8	2.31	2.34	1.78	4.00
10.	Control	--	--	1.45	2.21	2.52	4.80

This data supports the general hypothesis that pre-emergence herbicides which satisfactorily control crabgrass are also effective in controlling barnyard grass. However, some differences between bluegrass varieties in their response to the nine herbicide compounds were observed. These varietal differences are summarized in the discussion of specific herbicides which follows:

1. Dactha1, or DCPA (dimethyl ester of 2,3,5,6-tetra-chloroterephthalic acid) has consistently given excellent crabgrass control. In the 1967 barnyard grass control tests, DCPA was outstanding. This product appears safe in all respects and no damage was evident on any of the three year-old turf varieties nor on established common Kentucky bluegrass. Its performance in controlling bristlegrasses, downy brome and annual bluegrass appears to be from good to excellent. DCPA also controls a wide range of annual dicot weeds, but its relatively short residual life prevents it from being extremely effective for the control of annual bluegrass since this species germinates readily over a long period during any one season.

2. Betasan, or bensulide S-(0-0-diisopropyl phosphorodithioate) of N-(2-mercaptoethyl)-benzenesulfonamide has resulted in extremely good control of both barnyard and crabgrass. The material has shown much promise for the control of other annual grasses and it is effective over a wide spectrum of common annual broadleaved weeds as a pre-emergence treatment. It remains active for a longer period of time than DCPA. Bensulide has proven safe for use in young turf of all three varieties as well as established Astoria bentgrass. Due to the prolonged residual activity, bensulide offers a relatively good control for annual bluegrass but reseeding with desirable grass seed should probably not be attempted before one year following treatment.

3. Sindone (1,1-dimethyl-4,6-diisopropyl-5-indanylethyl ketone), an experimental product, has shown great promise in Colorado turf weed control tests. However, it appears that the compound will not be available regardless of its record as an herbicide. Like another good annual grass herbicide, Zytron (DMPA), Sindone will not see wide use due to its high manufacturing cost and relatively narrow range of use.

4. Bandane (polychlorodicyclopentadiene isomers) has long been recognized as a good pre-emergence crabgrass herbicide. Its performance in controlling barnyard grass appears equally good. There has been no apparent adverse effect associated with the use of bandane on any of the turf varieties with one application at the recommended rate of 35 lbs ai/A. Bandane has caused chlorosis and thinning of bluegrass when applied in excess or if used repeatedly at recommended rates for more than two years in succession.

5. Planavin (4-methylsulfonyl)-2,6-dinitro-N, N-dipropyl-aniline has given adequate to excellent control of crabgrass. The capacity of this compound to prevent barnyard grass germination appears to be excellent and there is good evidence to support its use for controlling other annual grasses and common dicot weeds. Some thinning of bluegrass has been observed at the 3 lbs ai/A rate with this product. Under the conditions of tests in 1967, damage has been severe enough to make the treatment unacceptable especially in young Merion bluegrass. Common Kentucky bluegrass, both young and well-established, appeared to be intermediate in susceptibility. Windsor bluegrass was least susceptible of the bluegrass varieties and Astoria bentgrass demonstrated good tolerance.

6. Azak, or terbutol (2,6-di-tert-butyl-p-tolyl methylcarbamate) has given acceptable pre-emergence control of both barnyard and crabgrass without injury to bluegrass turf. No visual differences were observed between the three bluegrass varieties with respect to herbicidal response.

7. Balan, or benefin (N-butyl-N-ethyl-alpha, alpha, alpha-trifluoro-2,6-dinitro-p-toluidine) has given satisfactory to excellent control of both barnyard and crabgrass. In Colorado tests, benefin has on occasion resulted in slight thinning especially in young Merion bluegrass. Noticeable injury was also detected in year-old common Kentucky bluegrass, however, this damage was short lived. No damage has accompanied the use of benefin at 2 lbs ai/A on well established bluegrass. The compound appears to prevent emergence of most annual grasses and dicot weeds. The relatively long-lived activity of benefin makes it a likely prospect for the control of annual bluegrass.

8. Tupersan, or siduron (1-(2-methylcyclohexyl)-3-phenylurea) has fallen short for controlling both barnyard and crabgrass at the rate of 12 lbs ai/A in most Colorado tests. The product appears to be quite safe for use on all three bluegrass varieties but Astoria bentgrass was damaged with this treatment. Bluegrass, in fact, appears to have a high tolerance to siduron so that higher rates might well accomplish an acceptable degree of annual grass control. The safety factor with siduron is such that bluegrass seeding can be successfully carried out shortly following moderate herbicide application.

9. Sirmate (3,4-dichlorobenzyl methylcarbamate) was applied in 1967 as an experimental compound for the control of both barnyard and crabgrass. At the suggested rate of 8 lbs ai/A, chlorosis developed in all three varieties of year-old bluegrass and in well established common Kentucky. This condition was conspicuous, but relatively short term. Control of both annual grasses was poor.

TURF GRASS DEMONSTRATION PROJECTS

IN CONNECTICUT

Stanley Papanos, Turf Specialist
Cooperative Extension Service
Hartford, Connecticut

On August 19, 1965, the Southington High School Vocational Agricultural Department and the Hartford County Extension Service planted a series of turfgrass plots to be used for teaching purposes.

The primary purpose of the turf plot demonstration area is to provide the student with technical and practical information in the expanding field of turfgrasses. It is hoped that this program will prepare interested students for better jobs in garden and nursery centers, and also for those whose interest is in landscape maintenance or turf production.

A total of 71 plots covering an area of approximately 10,000 square feet has been planted to the various varieties of grasses used for lawns An assortment of commercial lawn seed mixtures have been planted for the purpose of showing the students the wide differences in commercial seed mixtures. One area has been planted to grasses for use on athletic fields and other areas that receive hard use.

A rate of superphosphate and potash for new lawns is included. On this area two grass mixtures will be studied. A fall pre-emergent crabgrass treatment is also included in this study.

Management practices such as height of cut, leaving clippings vs. picking up clippings and rates and kinds of maintenance fertilizer will also be observed by the students.

Students will also be allowed to try out some of their ideas as applied to turf.

As the area becomes established it is hoped that local garden clubs, professional landscapers, garden center operators and homeowners of the surrounding towns will use these plots to their advantage.

At present it is planned to hold demonstration meetings at the plots for interested groups.

Fertility Studies

Turf plots were established with Cougar, Windsor, Fylking, Merion and Common Kentucky bluegrass under high nitrogen and low nitrogen treatments (6 lbs and 2 lbs) Superimposed on these plots are phosphate rates of 2 and 5 lbs of P_2O_5. Cutting height for the first year was 1-3/4". No irrigation applied.

Athletic Field Turf Mixtures

With Kentucky 31 fescue as a base, bluegrasses and fine fescues were introduced into the mixture on a light sandy soil (Merrimac fine sandy loam). Cutting heights and fertilizer rates are other variables.

Turf Renovation Demonstration

Purpose: To demonstrate how a poor lawn can be upgraded by the use of limestone, fertilizer and proper cutting height.

Plot Plan: There are 40 plots each 10' X 15' in a randomized block. Treatments are replicated four times.

Treatment: Soil test of area: 4-26-67

Limestone applied at 50 and 100 pounds per 1000 sq ft.

Fertilizers used: 10-10-10 and 10-6-4 all mineral, 10-6-4, 50% organic nitrogen and 20-10-5 vermiculite base.

Fertilizers applied to furnish one pound of actual nitrogen per 1000 square feet per application.

One series of plots receives fertilizer in April and September.

Another series receives fertilizer in April, June, August and October.

A series of plots receives no limestone and fertilizer in September only.

Turf cut at two inches and clippings left on plot.

TURFGRASS RESEARCH IN DELAWARE

Dr W H Mitchell, Extension Agronomist
Delaware Cooperative Extension Service
College of Agricultural Sciences
University of Delaware, Newark, Delaware

Project Title: The Influence of Shade, Moisture and Nitrogen on the Growth and Persistence of Several Cultivars of Kentucky Bluegrass

Objectives:

(1) To compare subsurface and conventional sprinkler irrigation for turf production.

(2) To measure the influence of light intensity on the performance of several turf species.

(3) To study interactions that may exist between nitrogen fertilization, shading and irrigation as measured by the differential growth and development of several grasses.

Treatments:

Mixtures	(1)	Windsor Ky bluegrass
	(2)	Kenblue " "
	(3)	Merion " "
	(4)	Windsor + Pennlawn Red fescue
	(5)	Kenblue + " " "
	(6)	Merion + " " "
Shade Levels	(1)	full light
	(2)	75% full light (Saran shade cloth)
	(3)	25% full light " " "
Nitrogen	(1)	Control 1#/1000 (Source - NH_4NO_3)
	(2)	5#/1000
	(3)	10#/1000
Irrigation	(1)	Control (rainfall only)
	(2)	Rotating sprinklers
	(3)	Subsurface irrigation (24" spacing of laterals at 6" depth)

Design: Split plot, 3 replications.

Seeding date: September 1967

Data: Density, leaf area index, dry matter production, soil and air temperatures, occurrence of disease and persistence of seeded species.

Project Title: Evaluation of Fairway Mixtures

Objective: To measure the performance of several fairway mixtures maintained under differential cutting heights.

Treatments:

Mixtures:	(1)	Merion Ky Bluegrass	(2#)*	Astoria bentgrass	(½#)
	(2)	" "	(2#)	NK-100 ryegrass	(3#)
	(3)	" "	(2#)	Astoria (½#) NK-100	(3#)
	(4)	Windsor "	(2#)	Astoria bentgrass	(½#)
	(5)	" "	(2#)	NK-100 ryegrass	(3#)
	(6)	" "	(2#)	Astoria (½#) NK-100	(3#)
	(7)	Fylking "	(2#)	Astoria bentgrass	(½#)
	(8)	" "	(2#)	NK-100 ryegrass	(3#)
	(9)	" "	(2#)	Astoria (½#) NK-100	(3#)
	(10)	So Dakota "	(2#)	Astoria bentgrass	(½#)
	(11)	" "	(2#)	NK-100 ryegrass	(3#)
	(12)	" "	(2#)	Astoria (½#) NK-100	(3#)
	(13)	Merion "	(2#)	Ky 31 fescue	(4#)
	(14)	" "	(2#)	Pelo ryegrass	(3#)
	(15)	" "	(2#)	Exeter bentgrass	(½#)
	(16)	" "	(2#)	Holfoir bentgrass	(½#)
	(17)	Ky 31 tall fescue	(6#)		

*Seeding rate/1000 ft^2

Cutting heights (1) 1½"; 1"; 3/4".

Design: Split plot, 3 replications.

Seeding Date: September 1968

Data: Turf quality and changes in species components with time.

Project Title: Demonstration of Subsurface Irrigation of Several Turfgrasses

Objective: To demonstrate and further evaluate the use of subsurface irrigation for the production of utility and fine turf.

Treatments:

System design -

The irrigated area is 80' x 200'. Perforated tubing was placed on 24-inch centers at a depth of 7". Perforations of 0.025" diameter were located at 12-inch intervals in the tubing wall. City water is used and the pressure is regulated to provide 2-3 psi at the end of the 200' laterals. Water is applied, as needed, to maintain a good quality turf.

Turf mixtures -

(1) Merion Ky bluegrass and Pennlawn fescue
(2) Ky 31 fescue
(3) Seaside bentgrass
Penncross "
Holfoir "
Exeter "
Astoria "
Highland "

Design: Non-replicated.

Seeding date: September 1968

Data: Observations.

TURFGRASS RESEARCH IN FLORIDA

Dr Eliot C Roberts, Chairman
Department of Ornamental Horticulture
Institute of Food and Agricultural Sciences
University of Florida, Gainesville, Florida

Research in Ornamental Horticulture sponsored by the Institute of Food and Agricultural Sciences of the University of Florida may be classified in 4 categories:

I Floriculture	III Foliage and Ferns
II Woody Ornamentals	IV Turfgrass

Turfgrass research conducted at the University in Gainesville and at the Plantation Field Laboratory in Fort Lauderdale involves 15 scientists who devote about 7 SMY (scientific man years) of major effort in this area each year. At both research stations a team approach is featured, which involves -

I Ornamental Horticulturists and Agronomists (Turfgrass Specialists including Physiologists, Geneticists, and Weed Scientists)
II Entomologists
III Nematologists
IV Plant Pathologists
V Soil Scientists
VI Agricultural Economists

Cooperative effort between staff at different stations increases productivity and enhances the "Problem-solving" process even further.

The turfgrass research field day provides an opportunity for all individuals interested in golf courses, sod production, turf nurseries, garden equipment and supplies, cemeteries, athletic fields and school grounds, industrial turf, home lawns, parks and roadsides to inspect the work underway at the Horticulture Unit in Gainesville.

Later turfgrass research field days will also feature work at the Plantation Field Laboratory. At that time projects directed by Dr E O Burt, Ornamental Horticulturist (Turf), T L Stringfellow, Assistant Entomologist, H I Borders, Plant Pathologist, G H Snyder, Assistant Soils Chemist, and J A Winchester, Associate Nematologist will be reviewed.

SOIL AMENDMENT STUDY - PUTTING GREEN

This experiment is the oldest one at the Hort Unit and has been maintained as a green from the day it was planted.

10 years of research are summarized below.

1. There are no significant differences between the 6 and 12 inch depth of amendments.
2. Effects of amendments individually:
   A. Vermiculite:
      1 - Increased yield and quality.
      2 - Increased penetrability.
      3 - Increased capillary pore space.
      4 - Increase in water available to grass.
      5 - Increase in cation exchange capacity.
      6 - Increase in available magnesium.
      7 - 10% was equal or superior to the 20% rate.
   B. Colloidal Phosphate:
      1 - Increased amount and depth of roots.
      2 - Increase in capillary pore space.
      3 - Increase in cation exchange capacity.
      4 - Increase in available magnesium.
      5 - Decrease in noncapillary pore space.
      6 - Decrease in permeability.
      7 - 5% gave better average results in mixtures than 10%.
   C. Fired Clay:
      1 - Decreased yield and quality.
      2 - Decreased soil compaction.
      3 - Increased capillary and noncapillary pore space.
      4 - Increased permeability.
      5 - Decreased water available to the grass.
      6 - Increased available calcium, magnesium and potassium.
   D. Peat:
      1 - Increased permeability.
      2 - Increased capillary pore space.
      3 - Increased water available to grass.
      4 - Increased the organic matter content.
3. Yield and quality decreased as noncapillary pore space inc. from 7 to 12%.
4. Yield and quality increased as water availability increased.
5. Yield and quality increased as hydraulic conductivity increased from 3 to 12 inches per hour.
6. No amendment changed the penetrability of the upper inch of soil.
7. Use of organic matter to change O M content and exchange capacity is not practical.
8. Addition of several amendments was superior to any one amendment added alone - at any rate used in this experiment.
9. The most significant visual difference due to treatment is the improved turf on certain treatments because of the increased amount of water available to the turf.

SOME ECOLOGICAL ASPECTS OF CRABGRASS DIGITARIA SANGUINALIS

AND STITCHWORT STELLARIA GRAMINEA

AND THE

COMPARATIVE EFFECTIVENESS OF SEVERAL HERBICIDES

FOR

CRABGRASS CONTROL IN LAWNS

Dr Lambert C Erickson, Professor
Department of Plant Sciences
College of Agriculture
University of Idaho
Moscow, Idaho

Isley (2) suggested that crabgrass is a classic example of a universal weed. In a survey conducted by the Velsicol Company in 1964, crabgrass got more first place votes than any other species as the "most important" lawn weed. In 1914, Ada Georgia, (1) wrote, "in the southern states this (crabgrass) is regarded as a good thing, for the spontaneous growth of this grass in grain fields after harvest often yields a heavy crop of nutritious hay and good pasture after that."

Crabgrass does not prevail at Moscow, Idaho, where the elevation approximates 2500 feet but when man supplies the required water it grows profusely in lawns in Lewiston only 30 miles away at about 900 feet elevation. Idaho's variable environment in elevation, precipitation, and temperature provides a stimulating outdoor ecologic laboratory. This laboratory supplies the ecologic variants which I richly capitalize on in teaching "Biology of Weeds." Fortunately, for the students' benefit, the non-universal ecologic parameters of crabgrass can be demonstrated in nature laboratories early in the semester.

In Idaho, crabgrass is not a field weed. It is limited to lawns in situations where its thermal requirements are satisfied. Thus, it prevails primarily in four cities: Lewiston, Boise, Twin Falls and Pocatello; respectively, in decreasing order of luxuriance compatable with decreasing temperature.

We could, erroneously, correlate its ecologic parameters with elevation but this is not the determining factor. At Lewiston germination occurs between May 1 and May 15. Typically, germination is delayed a few days progressively for each of the four given locations, to 15 days at Pocatello.

Consequently, the typical mean monthly minimum temperatures required for a large crabgrass, continuum, can be illustrated in the following manner.

Month	May	June	July	August
Mean ^oF	57	64	72	69

The 20 or more acres of lawn at the Lewiston Normal (Teachers College) available for these studies was predominantly a complex of three species: Kentucky bluegrass, stitchwort and large crabgrass. The cyclic composition of these two weedy species in the lawn cover was influenced by the prevailing temperatures as illustrated in Table 1. The two weed species form an extremely compatible association because of their differing thermal requirements.

Table 1. Cyclic growth of stitchwort and crabgrass as evidenced by percentage of soil surface covered by each, per month, and the prevailing monthly mean temperatures at Lewiston, Idaho.

Species	April	May	June	July	August	Sept	Oct	Nov
^oF	48	52	65	74	72	63	53	40
Stitchwort	87	82	62	47	34	22	35	78
Crabgrass	0	1	31	62	78	82	30	0

Results and Discussion

With varying degrees of intensity numerous compounds were evaluated for both crabgrass and stitchwort control over a period of 8 years. It was resolved early, that fall is a more effective time that spring for dandelion control. Nitrogen as ammonium nitrate or ammonium sulfate was essential, and the only essential element, for lawn luxuriance. An April and July application each at 40 pounds of N per acre, as ammonium nitrate, was the most economical and desirable procedure. Numerous organic and inorganic fertilizer mixtures and expensive pelleted and plasticized formulations were included but failed to equate the performance of ammonium nitrate.

Silvex was significantly more effective than 2,4-D and numerous other phenoxy compounds for stitchwort and mouse ear chickweed control. A 1+1 lb/A (2,4-D + silvex) combination applied in a single application broadened the control spectrum and reduced the application costs.

Zytron at 20 lb/A provided complete control of both stitchwort and crabgrass. Residually, Zytron was more toxic to stitchwort than to crabgrass. In the year subsequent to complete control, crabgrass approximated 50 percent but stitchwort only 10.

Table 2 gives the average performance of herbicides which were acceptable for crabgrass control. Some of the herbicides were included annually for 5 or more years, some for only 2 years.

Table 2. Average performance of several herbicides for crabgrass control, applied pregermination prior to May 1, Lewiston, Idaho.

Product	Rates lbs ai/A	Avg % soil surface covered by crabgrass Sept 1 to 15 AVG	RANGE	Visible turf injury
Dacthal (WP)	8, 10, 12, 14	0.8	1.0-0.1	none
Zytron liq	8, 10, 12, 14	6.1	12-0.7	"
Tupersan liq	8, 10, 12, 14	36.7	57-14	"
Trifluralin liq	2, 2½, 3, 3½	10.3	19-3	"
Azak liq	8, 12, 16, 20	18.9	42-4	"
Betasan liq	14, 18, 22, 26	17.6	36-5	"
OCS21944 liq	5, 7, 9, 20	24.9	55-0.7	"
" " gran	5, 7, 9, 20	78.2	97-26	"
Bandane liq	30, 35, 40	2.5	4.5-0.1	"
" gran[a]	30, 35, 40	3.2	6.2-0.2	"
" " [b]	30, 35, 40	36.6	55-13	"
" " [c]		5.3	8.1-2.9	"
Sindone gran[d]	4, 8, 12, 16	21.5	67-0.1	"
Benefin gran	1, 1½, 2, 2½	21.2	48-1	"
Check	None	98.3	99-96	"

[a]Bandane in vermiculite
[b]Bandane on clay
[c]Bandane on NPK fertilizer
[d]has post germination activity

As the study progressed numerous questions and concerns developed. Among these were: (1) What were the most desirable microclimate environments of crabgrass? (2) What quantities of seed were produced under usual lawn care conditions? (3) Were there residual effects from the herbicides that continued into the following year? Did some herbicides have greater latitude with respect to application time or were all of them strictly pregermination herbicidal?

Results from efforts attempting to answer the above questions revealed that: (1) crabgrass was totally suppressed by bluegrass in continously shaded sites; (2) crabgrass could tolerate up to 50% shade; (3) any exclosure condition that increased the soil or air temperature above that prevailing in air movement enhanced crabgrass and depressed bluegrass growth.

The plot area was typically mowed every 5 to 7 days at a 1½ inch height. Table 3 shows the seed yields obtained in mid-September.

Table 3. Total air dry grass and seed weights obtained per 10 x 1.5 foot mower swath.

Treatment	% crabgrass present	height of clipping	Wt in grams grass	Wt in grams seed
Checks	87	above 1½"	636	20.7
"	"	1½ to 1"	658	17.5
"	"	1 to ½"	829	19.3
		Total	2123	57.5
Bandane 40 lb		above 1½"	462	1.0
on vermiculite		1½ to 1"	362	1.0
applied 1 year		1 to ½"	665	2.0
earlier		Total	1489	4.0

Dense stands of crabgrass in lawns produce seed yields perhaps approximating 500 pounds per acre. In this specific instance the checks yielded the equivalent of 355 pounds and the bandane second year residual yielded 23 pounds per acre.

Trials were conducted to determine the toxicity of the numerous herbicides used in these studies as postgermination toxicants. If both pre and postgermination toxicity prevailed the specific compounds effective spectrum would be greatly enhanced. The herbicides were applied one week after the first germinations were detected. Sixteen herbicides were included. The final results revealed crabgrass stands ranged from 78 percent for Glenbar and Tupersan to 3 percent for Sindone and benefin. Crabgrass stands resulting from twelve remaining materials ranged from 15 to 30 percent.

Grass yields following annual herbicide applications for 3 years were found to be as follows. Betasan 428, Bandane 334, Dacthal 318 and Zytron 306 grams. Only trifluralin, yielding 250 grams, significantly reduced the grass yield. Turf condition ratings each April indicated no detrimental herbicidal effects from any of the above herbicides. The ranks ranged insignificantly from 9.4 to 9.6 among the checks and treatments.

As additional crabgrass herbicides were produced and promoted the screening trails were enlarged. Table 4 gives additional information on some additional factors.

Table 4. Residual effects of several herbicides on major weed species and on turf conditions in mid-April one year following application.

Herbicide	Rate range per acre	Turf condition (rank) grass	Turf condition clover	% of plot area infected by indicated weed: stitchwort	Mouse ear chickweed	crabgrass cover Sept 15
Pax	1.0-2.5	8.9	good	2	2	20
Dacthal	8-14	9.5	"	13	4	--
UC22463	4-10	9.6	"	37	2	100
AC 64-269B	4-16	9.5	"	9	3	0
Glenbar	9-18	9.4	"	39	3	--
AC 65-27	4-16	9.5	"	29	6	0
Bandane NPK	30-40	9.3	"	1	3	75
Bandane + verm	30-40	9.3	"	5	2	75
Benefin 0.86 gran	1-2.5	9.6	"	4	3	--
Azak gran	8-20	9.4	"	6	11	95
Tok-3	8-20	9.5	"	5	7	100
Zytron gran	8-14	9.6	"	3	1	50
Bandane (liq)	30-40	9.5	"	6	2	65
Benefin 0.55 gran	1-25	9.6	"	8	2	1
Checks		9.2	"	7	3	98

The data in Table 4 indicated that the toxicity of the included herbicides were highly specific for crabgrass. In no instance was there evidence of clover injury nor significant reduction in the included weed species. The variations in distributions of stitchwort and mouse ear chickweed recorded for the herbicide treatments prevailed similarily in the paired checks.

Literature Cited

1. Georgia, Ada 1935, Manual of Weeds, The Macmillian Co New York, N Y

2. Isley, Duane 1960, Weed Identification and Control, University of Iowa Press Ames, Iowa

EVALUATION OF FESCUE SPECIES

Dr A E Slinkard, Associate Professor
Department of Plant Sciences
College of Agriculture
University of Idaho, Moscow, Idaho

This research is concerned primarily with Idaho fescue, *Festuca idahoensis*. Idaho fescue is a drought tolerant bunchgrass native to the Intermountain West. A special USDA grant in 1968 for domestic exploration of Idaho fescue resulted in the collection of 38 ecotypes in addition to the 17 ecotypes obtained from Dr Tisdale of the College of Forestry. These ecotypes are being increased and evaluated for seedling vigor, seed size, seed yield, fertility, growth habit and vegetative yield.

Variation in gross morphology of Idaho fescue ranges from types similar to ornamental blue fescue (*F. glauca*) to types approaching Chewings fescue (*F. commutatus*). More research is needed to determine if some of these types are suitable for ornamental or turf purposes.

TURFGRASS RESEARCH AT THE UNIVERSITY OF ILLINOIS

Dr Jack Butler, Assistant Professor
Turfgrass Management
Department of Horticulture
College of Agriculture
University of Illinois
Urbana, Illinois

At the University of Illinois an extensive turfgrass research program has been underway for the last few years. Both basic and applied work is being done in most phases of the plant sciences, as related to turf production.

The research and extension activities at the University are a cooperative program primarily within the Departments of Horticulture, Plant Pathology, Agriculture Entomology, and Agronomy. This work is done at Dixon Springs in southern Illinois (in cooperation with Southern Illinois University), and the Urbana campus of the University, with specific problems at other sites in Illinois.

General herbicide, insecticide, nematocide, and fungicide testing programs are carried out at Urbana. The phytotoxicity of many materials, as well as the effectiveness of control have been investigated. In some instances new or unique methods of application have been utilized. It would not be possible to enumerate in detail the various research projects concerned with turfgrass under way at the University of Illinois.

A short synopsis of a few of the more recent findings in various areas that might be of general interest are:

<u>Turf varieties</u>--The continued outstanding performance of Merion Kentucky bluegrass during five years in extreme southern Illinois and of Merion at Urbana when maintained at one-quarter inch is noteworthy. A generally higher quality turf from the more recently introduced Kentucky bluegrasses has been demonstrated. While only poor quality turf has resulted from red fescues in central and southern Illinois due to heavy incidence of leaf spot.

<u>Turf fertilization</u>--The necessity of adequate phosphorus in starter fertilizers for optimum turf establishment has been well demonstrated on the low P soils of southern Illinois.

<u>Weeds and weed control</u>--The necessity of weed control at time of seeding becomes increasingly important as one goes south in Illinois. Basic research with siduron indicates that this material has no effect upon photosynthesis. The major toxic effect of siduron appears to be a reduction in root growth. If the plant establishes a root system before coming into contact with siduron, then the crabgrass plant is in an excellent position to show no harmful effects.

Insects and insect control--Sod webworm appears to be the most destructive insect of Kentucky bluegrass lawns in Illinois. Much work has been done at Illinois on the environmental as well as the control aspects of this insect. Studies have shown that a square foot area of Kentucky bluegrass that is well watered and properly fertilized may carry 5-6 larvae to show 50% damage; whereas in a poorly watered and improperly fertilized lawn, 2 to 3 larvae may cause equivalent damage.

Diseases and disease control--Stripe smut, rarely flag smut, has been widely found as a problem on Kentucky bluegrass and on several bentgrasses in Illinois. However, Helminthosporium spp continue to be the most troublesome disease. The exudation of glutamine by annual bluegrass and creeping bentgrass in response to nitrogen fertilization can be an important factor contributing to the severity of disease outbreaks. There is no doubt that both glutamine and wounding fluids produced by mowing play an important role in increasing the infection of plants by fungi associated with diseased putting-green turf.

Research in turfgrass at Illinois in the immediate future will be directed primarily toward:

(1) Continued studies of the cultural and environmental requirements of turfgrasses.

(2) Fertilizer and pesticide applications and evaluation.

(3) A thorough investigation of pesticide activity, accumulation, and inactivation.

Much more emphasis on research in the various disciplines involved with turfgrass research has developed recently at Illinois. The future seems even more bright for in-depth studies in turfgrass science, especially with the availability of more refined equipment, new and better physical facilities, and increased staff time devoted to turf.

TURFGRASS RESEARCH AT LOUISIANA STATE UNIVERSITY

Dr William A Young, Associate Professor
and
Claude S Blackwell, Assistant Professor
Department of Horticulture
Louisiana State University
Baton Rouge, Louisiana

Turfgrass research presently being conducted at Louisiana State University was initiated during 1968. This work includes variety performance trials, method of establishment studies, and herbicide screening experiments.

Variety performance trials are being conducted to compare the entries under the rather variable environmental conditions of south Louisiana. These studies will be expanded to include any varieties which show potential in Louisiana. At present, five bermudagrass varieties, two zoysia varieties, common St Augustine and common centipede are under comparative study. In addition, cool season grasses for use as temporary overseeded cover are being evaluated.

Methods of establishment being compared are plugging, sprigging and stolonizing. These studies should provide immediate information concerning the most efficient and economical method of lawn establishment.

Herbicide screening experimentation is oriented toward the use of weed control in conjunction with turfgrass establishment. These studies are based on the use of a pre-emerge type material at or immediately following transplanting. Preliminary observations indicate that certain herbicides show promise from this standpoint. Data are being obtained on weed control, injury to the turfgrass, and the possible inhibition of spread and/or rooting of the turfgrass. These studies involve eight turfgrass varieties.

TURF RESEARCH IN MISSISSIPPI, 1968-1969

Dr Coleman Y Ward, Professor
Department of Agronomy Crops
College of Agriculture and Agriculture Experiment Station
Mississippi State University, State College, Mississippi

1. An Evaluation of the Shade Tolerance of F B 137 bermudagrass.

F B 137 bermudagrass stolonized at 8 bushels per 1000 sq ft on June 22, 1968, was subjected to variables shown at bottom of Table 1.

A split-split plot design was used in which nitrogen rate served as the subplot and light intensity as the sub-subplot.

All plots were mowed weekly at 3/4" and supplemental water applied at approximately 1" per week.

The shading was accomplished by placing an 8' x 12' piece of shade cloth over the plot at all times (except when mowing or fertilizing). The cloth was sewn to a galvanized pipe frame which rested on legs 15" in height.

Measurements were made for rate of spread as a function of percent ground covered. A modified belt transect 3" wide and 12' in length with 100 fixed observation points along its length was used to obtain the percent ground cover. In addition the plots were rated visually for density and appearance. All measurements were made at weekly intervals.

Results:

As shown in Table 1, F B 137 exhibited adaptation to shade. Total plot coverage was about as fast with moderate shade as in full sunlight.

When F B 137 was subjected to more than a 50% reduction in incident light, it became somewhat elongated in growth. Stolons were not as numerous, sod density was reduced and scalping was objectionable at a 3/4" cutting heights.

Seeds heads were more numerous on newly planted areas than established sod. Fewer seed heads occurred on shaded plots compared to those in open sun.

Table 1 The percent ground cover and density of F B 137 bermudagrass as influenced by shade and nitrogen fertilization.

Date of Sampling	Low Nitrogen* Light Intensity 1/ L0	L1	L2	L3	High Nitrogen Light Intensity L0	L1	L2	L3
3rd Week	52	54	53	61	61	55	51	49
4th Week	83	84	64	77	77	77	70	71
5th Week	92	94	83	91	90	93	86	78
6th Week	99	99	96	95	99	99	96	90
Density 2/ after 6 weeks	8.2	7.6	6.1	6.5	9.0	8.0	6.4	5.0

1/ L0 = Full sunlight
L1 = Saran shade calibrated to remove 50% incident light
L2 = Saran shade calibrated to remove 75% incident light
L3 = L1 + one layer of cotton muslin = 90% incident light

* Low N = 1/2 lb/1000 bi-weekly
High N = 1 lb/1000 bi-weekly

2/ On a scale 1 to 10 with 10 = most dense.

OTHER NEW RESEARCH

1. Phytotoxicity of simazine, dicamba, 2,4-D, silvex, MSMA and DSMA on centipedegrass, St Augustine, Meyer and Emerald zoysiagrass and Common, Tifway, Tiflawn, Tifgreen, Sunturf and F B 137 bermudagrass sod.

2. Effect of selected herbicides on the rate of establishment of stolonized F B 137 bermudagrass. Herbicides used were 2,4-D, MSMA, DSMA, simazine, Betasan, Balan, Bandane, and Zytron at manufacturer's recommended rate.

3. Effect of mowing height, nitrogen fertilization and vertical mowing on the quality of F B 137 and Tifgreen bermudagrass for home lawns.

4. The compatability of pre-emergence herbicides with overseeding Tifdwarf bermudagrass putting greens. Balan, Betasan, and Dacthal at recommended rates were applied 90, 75, 60, 45, and 30 days prior to overseeding Tifdwarf bermudagrass. The species used for overseeding were annual ryegrass, rough bluegrass and red fescue.

5. Influence of nitrogen fertilization rate and cultivation (spiking and vertical mowing) on the quality of winter putting green turf of NK-100 perennial ryegrass overseeded on 328-bermudagrass.

PRESENT RESEARCH IN FINE TURF:

I. Selection and Screening for Adapted Turfgrasses: (Cultivars are examined for color, texture, disease resistance, cold tolerance and growth habit, etc.)

   A. Bermudagrasses - observation plantings of isolated blocks of approximately 80 cultivars from numerous sources.

   B. Centipedegrasses - selections made from pastures and lawns throughout the state. Some progress is being made in getting more uniform color, absence of seed heads and more dense turf. Two selections are being increased for further evaluation.

II. Turf Nutrition Research Experiments:

   C. Potassium Nutrition of Tifgreen Bermudagrass. The influence of potassium fertilization and clipping heights on winter hardiness, growth, potassium uptake, and carbohydrate accumulation in storage tissue are being measured.

   D. Relationships of Nitrogen and Potassium Nutrition on the Ability of Tiflawn Bermudagrass and Meyer Zoysiagrass to Withstand Traffic. Variables: three levels of K across two rates of nitrogen; traffic simulated with golf shoe soles on motorized roller.

   E. Nitrogen Requirements of Established Meyer Zoysiagrass. Variables: 2, 4, 6, and 8 pounds of nitrogen per 1000 square feet under mowing heights of one-half and one inch.

III. Turf Establishment Experiments:

   A. A Comparison of Methods of Vegetative Establishment of Bermudagrass (Tiflawn), Zoysiagrass (Meyer), Centipedegrass (Common), and St Augustine (Common). Variables: grasses, methods (sprigging, plugging, and stolonizing).

   B. Influence of Shade (Reduced Light Intensity), Mowing Height and Nitrogen Fertilization on the Establishment of Meyer Zoysiagrass, When Plugged and Stolonized. Variables: shade (zero, 50 percent, and 75 percent), nitrogen (1, 2, 3, 4 pounds per month), mowing (one-half, one inch, and none).

IV. Tee Management:

   A. Divot Injury Recovery of Meyer Zoysiagrass and 419 Bermudagrass. Variables: species, mowing height (one-half and one inch), and nitrogen (4 versus 8 lbs per season).

V. Thatch Control Studies:

   A. Methods of Thatch Control in 328 Bermuda Putting Greens. Variables: vertical mowing (none, 2, 4, and 6 times annually) and aerification (none, bi-monthly, and monthly).

VI. Overseeding Studies:

A. Evaluation of Cool Season Species for Overseeding Putting Greens and Home Lawns. Some 25 cool season species are planted at 25,000,000 seeds per M under putting green conditions (328) and at 2,500,000 per M under lawn conditions.

B. Influence of Topdressing, Vertical Mowing and Spiking on NK-100 Perennial Ryegrass as a Grass for Overseeding Bermudagrass Putting Greens.

VII. Miscellaneous Studies:

A. An Evaluation of Four Bermudagrasses and Four Degrees of Soil Modification on an Athletic (Football) Field. Calcined clay versus sand as a physical amendment.

B. Turf Quality of Ormond and U-3 Bermuda as Influenced by Type of Mower (rotary versus reel) and Frequency of Mowing.

STUDIES DISCONTINUED IN 1968

A. Nitrogen Requirements of Tifgreen Bermudagrass for Putting Greens. Sources, rates, and intervals of applications are variables.

B. Nitrogen Requirements of Tifdwarf Bermudagrass for Putting Greens. Variables: sources and rates.

C. An Evaluation of Hydroplanting Bermudagrass and Zoysiagrass. Variables: grasses; method of stolonizing, a.) one step, b.) 2 step; pre and post firming of seed bed, a.) no rolling, b.) rolling prior to stolonization, c.) rolling after stolonization.

D. Response of Fourteen Southern Ornamentals to Herbicides Applied to Three Turfgrasses Grown as the Base Sod. (Cooperative with Horticulture and Weed Science Departments).

E. Thatch Control in Lawn Turf. Variable heights of cut and frequencies of vertical mowing were studied on Emerald zoysia and Sunturf bermudagrass.

F. The Response of Centipedegrass to Nitrogen, Iron and Mowing Heights. Variables: nitrogen at 3 and 6 pounds per 1000 square feet; mowing heights of 1 1/2 and 2 1/2 inches; across iron (chelated) at 1, 1/2, and 1 pound per 1000 square feet seasonally.

G. Curative and Preventative Control of Dollarspot (Sclerotinia homeocarpa). Some 10 fungicides (commercially available and experimental) were used at several rates on Sunturf, Tifton-57 and Tufcote bermudagrass at two levels of nitrogen fertilization.

TURFGRASS RESEARCH IN MISSOURI

Dr Delbert Hemphill, Professor
Department of Horticulture
University of Missouri
Columbia, Missouri

I. Field Research Area

A new area of approximately 20 acres three miles from the campus is presently under development. Most of the area is in common Kentucky Bluegrass, and weed control, fertility and growth regulator plots have been established. A reservoir has been constructed as a water source and an irrigation system is under design by our Agricultural Engineers.

Variety plots of the various turfgrass species will be established this fall and next spring.

The development of the new area was necessary because our turfgrass plots adjacent to the University Golf Course were taken for other purposes.

II. New Staff

John Dunn, presently completing the requirements for the doctorate at Rutgers under Dr Ralph Engel will join our department on September 1. He will assume the responsibility for the turf research and teaching program.

Dr Bill Lobenstein, after September 1, will devote one-half time to turf extension activities.

III. Research Projects

The loss of our established turf plots caused a serious interruption in our research activities. It has been possible to continue some work in the greenhouse and on other areas.

1. Weed Control - Extensive weed control studies on bent and bluegrasses have been conducted for several years. A study to determine the long-term effects of pre-emergent crabgrass control chemicals is now in its 11th year for arsenates and chlordane and a shorter period for other herbicides.

2. Improvement of Turfgrasses - Dr Lobenstein is evaluating a number of tall fescue and bermuda selections. The fescue selections came from many different countries. Fine-leaved selections with good rhizome development have been sought. Many selections are not cold hardy under central Missouri conditions.

3. Growth Regulator Studies - Two graduate students are studying the effects of plant growth regulators on turfgrasses.

4. Nutrition (a) The nitrogen nutrition of bentgrasses is being studied by a doctorate candidate in an effort to develop leaf analysis standards, (b) New forms of nitrogen fertilizers are being evaluated on bluegrass.

IV. Missouri Valley Turfgrass Association

This organization is now in its third year. It was formed to support turfgrass research in Missouri. Its current major effort is to have a turfgrass survey for the state.

TURFGRASS RESEARCH IN NEBRASKA

Dr A E Dudeck, Assistant Professor
Department of Horticulture and Forestry
College of Agriculture
University of Nebraska, Lincoln, Nebraska

Turfgrass research activities in Nebraska are primarily confined to the roadside environment. In 1964, a fifteen-year contract for roadside research was agreed upon between the University of Nebraska and the Nebraska Department of Roads. Financial support of this project is from the Nebraska Department of Roads using Federal Aid Highway Planning and Research funds. The over-all objectives are to study ground covers for stabilization of highway rights-of-way and to study methods of reducing maintenance costs.

Over the years, a number of studies were initiated and are currently in progress. Areas under study include species and varietal trials of cool and warm season grasses at selected locations throughout the state; nutritional and moisture requirements of saltgrass, *Distichlis stricta*; crownvetch varietal adaptation and performance; renovation of critical highway slopes with crownvetch, ecological effects of mowing on roadside vegetation; nitrogen fertilizers for sod maintenance; mulches for grass establishment and erosion control; evaluation of mulching practices and seeding methods for grass establishment; herbicide studies for controlling undesirable roadside vegetation; and studies of spray adjuvants for drift control.

A new field research area of approximately seven acres was recently developed at the University Field Laboratory, Mead, Nebraska. Irrigation facilities, equipment storage and laboratory space have all been provided. It is anticipated that varietal plots of the various turfgrass species can be established next spring.

TURFGRASS RESEARCH AT THE UNIVERSITY OF NEW HAMPSHIRE

Dr L C Peirce, Chairman
Plant Science Department
College of Agriculture
University of New Hampshire
Durham, New Hampshire

Research is applied with tests of varieties and mixtures of lawn and specialized use turfgrasses. Tests also include fertilizer materials and rates and herbicides over prolonged periods of time. This research project will likely undergo substantial change in 1970.

CHEMICAL CONTROL OF STRIPE SMUT IN MERION KENTUCKY BLUEGRASS[1,2]

Dr Philip Halisky, Dr C Reed Funk, Dr P L Babinski
Associate Professors
College of Agriculture and Environmental Sciences
Rutgers University, New Brunswick, New Jersey

ABSTRACT

Evaluation trials were conducted with Benlate, PCNB, and Bayer 33172 fungicides to determine their effectiveness against stripe smut (Ustilago striiformis). The chemicals were applied to replicated plots of heavily smutted 'Merion' Kentucky bluegrass turf. The data show that the systemic fungicide, Benlate, was highly effective against this disease. PCNB also was effective, however, the formulation used in these tests imparted a yellow discoloration to the turf. Bayer 33172, on the other hand, was generally ineffective in controlling stripe smut.

Stripe smut is a widespread and destructive disease of turf and forage grasses in North America (2,3,4,7). This disease, caused by Ustilago striiformis (West.) Niessl, has become a serious problem in Poa pratensis L, especially in cultivars grown widely for turf usage (4,6). In the past, the use of protective chemicals for suppressing stripe smut in perennial grasses has generally been unsatisfactory. Such chemicals either gave limited control of the disease or proved phytotoxic to turfgrasses. Recently Halisky, Funk and Babinski (5) reported the results of trials with protective and systemic fungicides for the control of stripe smut under turf maintenance conditions. Their data showed that a new systemic fungicide, Benlate, Methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate (Benomyl), was an effective control for this disease. The present paper reports new data confirming the effectiveness of Benlate and provides further information on chemical control of stripe smut in Kentucky bluegrass.

Materials and Methods

Sod of smutted Merion Kentucky bluegrass was established in the turfgrass research area at New Brunswick, New Jersey. The turf was clipped at 1½ inches and maintained at moderate fertility (4 lb N per 1,000 sq ft per yr). The experimental area consisted of 96 plots each measuring 5x5 feet as part

---

1/ Paper of the Journal Series, College of Agriculture and Environmental Science, Rutgers University, New Brunswick, New Jersey, 08903.

2/ Grateful acknowledgment is extended to the Merion Bluegrass Association, E I DuPont Company, and Chemagro Corporation for grants-in-aid contributed in support of this research.

of a randomized, complete-block design containing 6 replicates. Each replicate consisted of 16 randomized treatments. The chemicals used, their rates, and dates of application are given in Table 1. The method of application of each chemical varied with its formulation. Thus Bayer 33172 = 2-(2-furyl)-benzimidazole and Benlate, both wettable powders, were mixed with water and applied to the turf as drenches at the rate of 50 gallons per 1,000 square feet of turf per application. PCNB (pentachloronitrobenzene), on the other hand, was applied in combination with a granular (14-3-3) fertilizer containing 15.4 percent active fungicide. This combination was broadcast on each plot by hand and watered in at an equivalent rate (50 gal per 1,000 sq ft). The material was applied both in the fall of 1967 and in the spring of 1968, whereas the other chemicals were applied only in the spring of 1968 (Table 1). Disease counts were made on September 4-5, 1968, by determining the number of smutted tillers per square foot of sod. Two counts were made per plot, the data averaged, analyzed statistically, and presented in Table 1.

Results

The infection data in Table 1 show that the highest reduction of stripe smut was achieved with 5 applications of Benlate at the 6 ounce rate. At the 12 ounce rate, Benlate applied once or twice during the spring months also was highly effective. However, the use of Surfactant F in combination with 6 ounces of Benlate applied 1, 2 or 3 times did not enhance disease control appreciably when compared with similar applications without the surfactant. Thus, differences among data derived from plots treated with Benlate plus Surfactant F, and those treated with Benlate alone, were not statistically significant (Table 1). PCNB applied in combination with a granular (14-3-3) fertilizer containing 15.4 percent active fungicide also was effective in reducing stripe smut in Merion bluegrass. At the 32 ounce rate, PCNB applied during both the fall and spring seasons resulted in significant disease control. At the 16 ounce rate, similar applications were inadequate in controlling the disease. Bayer 33172, on the other hand, generally was ineffective against stripe smut at both the 8 and 12 ounce rates (Table 1).

To determine the phytotoxicity of Benlate and Bayer 33172 fungicides, the chemicals were applied at rates of 24 ounces active ingredient per 1,000 sq ft of turf to individual plots of Merion during April, May and June, respectively. Subsequent observations for evidences of phytotoxicity made at 7 day intervals revealed that neither chemical was injurious to the turf at these relatively high dosages. The granular fertilizer-PCNB combination, however, induced a yellow-greenish tinge in the foliage of treated plots. In general, these chlorotic symptoms did not appear until the onset of hot, dry weather. By August 8, 1968 it was possible to distinguish 21 of the 24 PCNB treated plots on the basis of foliar yellowing. With the return of cooler weather in September, the turf recovered from this discoloration.

Discussion

Stripe smut, as a disease of turfgrasses, has not been effectively controlled by protective chemicals (4,5). With the recent advent of systemic chemicals, however, the control of this perennial disease has become more promising. The present study confirmed an earlier report (5) that the systemic fungicide, Benlate, was effective as a control for stripe smut in Merion Kentucky bluegrass. The data (Table 1) indicate that either five applications at the 6 ounce rate, or fewer applications at the 12 ounce rate significantly reduced the incidence of this disease. The addition of Surfactant F to Benlate did not significantly increase fungicidal effectiveness and, therefore, its use is of questionable value.

PCNB generally is considered to be phytotoxic to bentgrasses and to fine fescues (1). In our trials with Kentucky bluegrass, the use of a PCNB-fertilizer combination, and its application at relatively high rates, may have contributed to the chlorotic response of the foliage. Since the plots in these trials were already maintained at a moderate level of fertility, the application of additional fertilizer may have rendered the turf excessively succulent, thereby predisposing it to injury from environmental hazards such as summer stress or toxic chemicals.

Literature Cited:

1. Couch, H B and H Cole. 1957. Chemical control of melting-out of Kentucky bluegrass. Plant Disease Reptr 41 : 205-208.

2. Fischer, G W 1940. Fundamental studies of the stripe smut of grasses (Ustilago striaeformis) in the Pacific Northwest. Phytopathology 30 : 93-118.

3. Govindu, H C and G W Fischer. 1962. Physiological variation in the stripe smut of grasses, Ustilago striiformis. Res Stud Washington State Univ 30 : 139-168.

4. Halisky, P M, C R Funk, and S Bachelder. 1966. Stripe smut of turf and forage grasses -- its prevalence, pathogenicity, and response to management practices. Plant Disease Reptr 50 : 294-298.

5. Halisky, P M, C R Funk, and P L Babinski. 1968. Control of stripe smut in Kentucky bluegrass turf with a systemic fungicide. Plant Disease Reptr 52 : 635-637.

6. Kreitlow, K W, and F V Juska. 1959. Susceptibility of Merion and other Kentucky bluegrass varieties to stripe smut (Ustilago striiformis). Agronomy Jour 51 : 596-597.

7. Osner, G A 1916. Leaf smut of timothy. Cornell Univ Agr Exp Sta Bull 381 : 189-230.

Table 1 Chemicals evaluated for stripe smut control, their rates, application dates, and comparative effectiveness.

Fungicide	#N/1000	Rate [a/]	Dates of application	Smut level [b/]
Benlate	4	6	15 Apr; 13,20 May; 17 June; 11 Jul	1 a
PCNB	10	32	2 Oct; 8 Apr; 10 Jun	10 ab
Benlate	4	12	13 May	14 bc
Benlate	4	12	15 Apr; 17 June	16 bc
Benlate	4	6F	15 Apr; 13 May; 17 June	23 bcde
PCNB	8	32	2 Oct; 8 Apr	23 bcde
Benlate	4	6	15 Apr; 13 May; 17 June	24 bcde
Benlate	4	6F	15 Apr; 13 May	29 def
PCNB	7	16	2 Oct; 8 Apr; 10 Jun	47 defg
Benlate	4	6	15 Apr; 13 May	48 efg
Benlate	4	6	15 Apr	52 fgh
Benlate	4	6F	15 Apr	74 gh
PCNB	6	16	2 Oct; 8 Apr	84 hi
B 33172	4	8	22 Apr; 20 May; 10 Jun	120 ij
B 33172	4	12	20 May; 10 Jun; 11 Jul	138 j
Control	4	0		132 j

a/ Ounces of active ingredient per 1,000 sq ft of turf per application. Treatments designated by "F" contained 4 fluid ounces of Surfactant F per 100 gallons of drench.

b/ Number of smutted tillers per square foot of turf on September 4-5, 1968. Values followed by the same letter do not differ significantly from each other at the 5 percent level according to Duncan's multiple range test.

SOME EFFECTS OF PESTICIDES IN THE

TURFGRASS ECOSYSTEM

Dr Herbert T Streu, Associate Professor
Department of Entomology & Economic Zoology
College of Agriculture
Rutgers University, New Brunswick, N J

Control recommendations for most arthropod and nematode pests of turfgrass include periodic applications of a variety of pesticides, including carbamate, chlorinated hydrocarbon and organic phosphorus type materials. Although much information is available concerning the pesticidal effectiveness of these materials, little is known concerning the long term effects of annual applications of these same materials in the same turfgrass area. It has been the objective of research being conducted at Rutgers University in the Department of Entomology and Economic Zoology to determine some of these effects in the turfgrass ecosystem. This research has been in progress since 1962 and includes studies on plant growth response, comparative effects on soil arthropod populations, effects on plant parasitic nematode populations and measurements of activity of surface inhabiting arthropods. Observations of earthworm surface activity as well as changes in plant community composition and succession are also being made.

Results of pesticide activity and growth response effects have shown that annual applications of pesticides to the same red fescue-Kentucky bluegrass utility-type turf after 4 years have resulted in large differences in the overall quality of that turf. Increased density and clipping yield were found to be related to chinch bug control and population suppression of the spiral nematode *Helicotylenchus pseudorobustus* (Steiner) and the stylet nematode *Tylenchorhynchus claytoni* (Steiner) and to some degree *Tylenchorhynchus maximus* (Allen). Large differences in percent crabgrass were also related to growth differences. Chinch bug *Blissus hirtus* (Montandon) populations in chlordane treated areas were more than two and one-half times greater than in control areas suggesting interference with some population limiting mechanism. Of greater ecological significance, however, was that red fescue succession occurred in ethion, carbophenothion and diazinon treatments. Plots treated with ethion were found to consist of almost 54% red fescue compared to 7% in control areas.

Summaries of population levels of plant parasitic nematodes in annually treated turfgrass showed that differences in numbers of nematodes affected were somewhat variable and that the various pesticides used may exert a possible selective action. The predominating species found was *Criconemoides mutabilis* (Taylor) and insecticide effects on population levels were quite variable with the exception of Dasanit[R] (Bayer 25141) which reduced populations initially, and when applied annually, exerted continued seasonal control.

Numbers of *Tylenchorhynchus claytoni* were reduced each season through annual applications of all pesticides including diazinon, ethion, Baygon, and Dasanit with the exception of carbaryl. Dasanit eradicated this nematode in all treatments. Cumulative effects of annual applications of the same pesticides to the same turf area on populations of *Helicotylenchus pseudorobustus* were similar.

Only small numbers of Hoplolaimus galeatus (Cobb) and Xiphinema americanum (Cobb), Tylenchorhynchus maximus (Allen), Tylenchus sp. and Paratylenchus sp. were found.

Estimates of surface inhabiting arthropods with Fichter-type pitfall traps has indicated some differences in Collembola and mite populations between treatments, although differences in quantitative estimates of soil inhabiting arthropods have shown larger differences. Organic phosphorus containing pesticides, ethion in particular, appear to exert the greatest initial as well as cumulative and residual effects.

Cumulative differences, therefore, in growth response due to annual treatments have been related to effects on populations of plant parasitic nematodes, differences in collembolan and mite populations in the soil and to a lesser degree have been reflected in activity of surface inhabiting arthropods.

References

Streu, Herbert T and Louis M Vasvary. 1966. Pesticide activity and growth response effects in turfgrass. Bull New Jersey Acad Sci 11:17-23.

Streu, H T and L M Vasvary. 1966. Control of the hairy chinch bug Blissus hirtus Mont in New Jersey. p 78-83 in 1966 Report on Turfgrass Research, New Jersey Agric Expt Sta Bull 816.

Streu, H T and L M Vasvary. 1966. Sod webworm control trials. p 83-85 in 1966 Report on Turfgrass Research, New Jersey Agric Expt Sta Bull 816.

Streu, H T and L M Vasvary. 1967. The nematocidal activity on some insecticides in turfgrass. p 77-93 in 1967 Report on Turfgrass Research, New Jersey Agric Expt Sta Bull 818.

SUMMARY OF TURF WEED CONTROL RESEARCH

IN NORTH CAROLINA 1964 - 1968

Dr W M Lewis, Agronomy Specialist
Agricultural Extension Service
North Carolina State University, Raleigh, N C

In the general evaluation of herbicides for pre-emergence crabgrass control in turf, spray and granular applications have been compared. In general, granular applications have given a higher percent crabgrass control than spray applications of the same herbicide in all tests, though differences were not significant in all cases. Delay in rain following application influenced the degree of effective control with spray applications being more adversely affected than granular applications. The more effective herbicides have been bensulide, benefin, DCPA, and terbutol which can be safely used on turfgrasses grown within the state and managed for lawns and general turf areas. Other tests have shown that herbicides tend to perform approximately the same or slightly better when in combination with a fertilizer carrier than a non-fertilizer carrier.

Time of application studies have revealed that pre-emergence crabgrass herbicides have given effective control when applied 4-6 weeks prior to expected crabgrass germination. Bensulide and DCPA have given very effective control when applied in the fall, approximately six months before germination. From one application of either of these compounds control of annual bluegrass in the fall and winter and crabgrass in the spring and summer has been obtained.

Studies on evaluating the effects of pre-emergence crabgrass herbicides on establishing and established turfgrasses have been conducted. Studies with siduron indicated that it cannot be safely used at the time of seeding carpetgrass, centipedgrass, and common bermudagrass nor sprigging Tifton 328 bermudagrass. Sprigged Meyer zoysia was not adversely affected by siduron. Siduron did not affect the germination and establishment of three cool season turfgrasses, Merion bluegrass, Kentucky 31 tall fescue and Pennlawn red fescue.

Merion bluegrass, Kentucky 31 tall fescue, and common bermudagrass were planted in soil samples collected from treated plots six months after the third consecutive year of treatment. Toxic levels of eleven pre-emergence crabgrass herbicides did not appear to remain in the Cecil sandy clay loam in quantities sufficient to adversely affect the germination and early growth of the three turfgrasses.

Studies have been initiated on the long term effects of pre-emergence crabgrass herbicides on established cool season turfgrasses and on the growth and development of plugged warm season turfgrasses. Preliminary results indicate that rooting at the nodes of the stolons is greatly reduced in the warm season turfgrasses.

Observations are currently being made on pre-emergence herbicides for annual bluegrass control and their effects on T-328 bermudagrass and four overseeded cool season turfgrasses. Herbicides were applied 30, 45, 60, 75 and 90 days before overseeding with and without a previous early spring treatment. The overseeded grasses were ryegrass, Pennlawn red fescue, Highland bentgrass, and *Poa trivialis*.

In postemergence control studies of crabgrass and dallisgrass, arsonates have been evaluated alone and in combination with pre-emergence crabgrass herbicides. The combination treatment has been more outstanding in seasons having considerable late summer rains favoring crabgrass germination. Control the following season has been variable from the various combinations. Bensulide in the combination has consistently given favorable crabgrass control the following season.

Benefin, bensulide, DCPA, and terbutol have given effective pre-emergence control of annual bluegrass, while atrazine, simazine, diuron, norea, paraquat, and terbacil have given effective postemergence control.

For broadleaf control, 2,4-D + silvex and 2,4-D + dicamba have been successful. Spray applications have been more reliable and effective than granular applications.

TURF RESEARCH

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Dr Kenneth L Larson, Associate Professor
Department of Agronomy
North Dakota State University
Fargo, North Dakota

No formal research project is in progress at the North Dakota Agricultural Experiment Station. Occasionally, demonstrations of various grass species have been established for observation. These demonstrations, experiences of station personnel, and research results from other stations with active research programs in turf provide the basis of North Dakota's recommendations.

The following recommendations have been established for North Dakota:

1. Six or more inches of black fertile topsoil should be present.

2. Weed-free seedbed should be smooth and firm prior to seeding.

3. One inch of well-rotted compost spread on the soil surface after seeding will prevent excess drying of the soil.

4. Kentucky bluegrass is the most popular species for lawns which will be adequately watered. For dryland, Fairway crested wheatgrass is a satisfactory species.

5. Three to five pounds of Kentucky bluegrass or/and creeping red fescue seed per 1000 square feet is an adequate seeding rate. Three pounds of Fairway per 1000 square feet is adequate.

6. Seedings should be made from mid-spring to early fall (May 15 - September 15).

7. First mowing should be delayed until grasses are 2-3 inches tall.

8. Mower should be set to cut at least 2 inches for the first cutting. Slightly lower cuts are permissible after the lawn is established.

9. Thorough watering is essential during periods of limited rainfall.

10. Two or four pounds of nitrogen per 1000 square feet after the lawn is established will help maintain dark green foliage. Need for phosphorus and potassium should be determined by soil tests.

11. Herbicides, such as 2,4-D, are available for broadleaf weed control. Specific herbicides are available for control of crabgrass, chickweed and other hard to control weeds.

TURFGRASS RESEARCH SPONSORED BY THE OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER AND THE OHIO STATE UNIVERSITY

Dr Robert W Miller, Associate Professor
Department of Agronomy, College of Agriculture
Ohio State University, Columbus, Ohio

Staff

Ohio has eight men associated to some extent with turfgrass research, teaching, or extension which totals about three and one-half full time equivalent positions. Drs Merle Niehaus, Ronald R Muse, and Gerald Musick are located at the Ohio Agricultural Research and Development Center at Wooster, Ohio. Niehaus is a plant breeder and his time is spent in Kentucky bluegrass variety development and with turfgrass management studies. Muse joined the staff in 1968 and spends all of his time in turfgrass pathology. Dr Musick joined the staff in 1969 and works part time with turfgrass entomology. Dr R R Davis has been associated with turfgrass research at the Ohio Agricultural Research and Development Center since 1950. As of July 1, 1969 he assumed the position of Assistant Director of the OARDC and will no longer be conducting turfgrass research.

Drs Robert W Miller, Lowell E Moser, Paul R Henderlong, Richard L Miller and Robert E Partyka are associated with turf at the Ohio State University. R W Miller is the only full time individual and his responsibilities encompass turfgrass research, teaching, and extension. Moser works part time in turfgrass physiology and management research. Henderlong joined the OSU staff in 1968 and part of his time is spent in basic physiology research, part of which deals with turfgrass. R L Miller and R E Partyka are associated with the extension service and spends some time on turf insect and turf pathology extension work respectively. Partyka is in charge of plant disease clinic where Ohio turfgrass samples can be sent for pathogen culture and identification.

Turfgrass Research Projects in Ohio

New Field Research Area

In 1968 the construction of a new turfgrass field research facility at Columbus was begun. By the end of 1969 its construction and establishment should be nearly complete. Present plans include research in the areas of weed control, fertilization, nutrition and tissue testing, seed mixtures and blends, mowing height and type, turf establishment, thatch accumulation, irrigation, and turfgrass ecology. In addition a rather extensive Kentucky bluegrass, fine leafed fescue, tall fescue, ryegrass, and bentgrass varietal evaluation program will be undertaken.

A rather elaborate bentgrass irrigation experiment is to be constructed in 1969. Plans include the construction of twenty-four USGA bentgrass greens on which six irrigation variables can be imposed. Provisions are to be made for measuring, collecting, and analyzing the leachate from these plots. The Ohio Turfgrass Foundation has made much of the construction of the new area possible through their support.

Present Field Research

At the present time Kentucky bluegrass variety evaluations are being conducted at Wooster and Ripley (Southern Ohio). Bentgrass variety evaluation plots are located at Wooster and the bermudagrass evaluation is conducted at Ripley. The bermudagrass work will probably be phased out in the future. Research in turfgrass mixtures and fertilization is underway at Wooster also. Field work has been phased out at Columbus until 1969 because the old field research area has been lost to construction.

Laboratory and Greenhouse Research

Rhizome and tiller initiation and development as affected by photoperiod, cold treatment, nitrogen level, growth regulators, soil mixtures and varieties has been investigated and further research is planned in this area. Future work on the physiological effect of morphactins and other growth regulators on Kentucky bluegrass is planned.

Research in mineral nutrition is underway and there are plans to expand it. The purpose of much of this research is to develop a practical and relatively accurate plant tissue analysis for turfgrass and correlate it with soil tests.

Tall fescue cold hardiness has been of interest and future research is planned concerning the environmental effects on tall fescue winterhardiness.

Turfgrass Breeding

A program to develop improved Kentucky bluegrass varieties and breeding procedures was initiated in 1965. Emphasis is being placed on looking at exotic material and the use of radiation and chemical mutagens to increase variability. Thus far the mutagen work appears to be very promising and will be pursued. Superior plants have been produced and studies are underway to determine their breeding behaviour and chromosome makeup. This work is being done at Wooster.

Turfgrass Entomology

Dr Gerald Musick is assigned responsibility for studying the biology, ecology and control of insects and other depredating animals which cause damage to turf. Departmental research has involved the biology and control of white grubs (*Phyllophaga spp.*), Japanese beetle, northern masked chafer, hairy chinch bug, sod webworms, cutworms, and moles. In Ohio the cutworms responsible for most turfgrass damage are the black cutworm, *Agrotis ypsilon*; the dusky cutworm, *Feltia venerabilis*; glassy cutworm, *Crymodes devastator*; and the shield-backed cutworm, *Sunira bicolorago*. More detailed studies have been concerned with the effect of insecticides on the growth of permanent grasses; the effect of soil aeration, various rates of irrigation, and different mowing heights on insect populations.

The following publications are available for distribution:

Polivka, J B and W F Lyon. 1967. Ohio insecticide recommendations for lawn insects. 7 pp.

Polivka, J B and W F Lyon. 1966. Learn where, when, how to control the Japanese beetle. Dept Ent Pub Series 25. 4 pp.

Polivka, J B 1959. The biology and control of turf grubs. Res Bull 829. 30 pp.

Polivka, J B 1963. Control of hairy chinch bug, <u>Blissus leucopterus hirtus</u>, Mont, in Ohio Res Circ 122. 7 pp.

Polivka, J B 1962. Results of area campaigns against Japanese beetles in Ohio. Res Circ 108. 16 pp.

Polivka, J B 1950. Distribution and control of the Japanese beetle in Ohio. Res Circ 4. 15 pp.

Polivka, J B 1965. Effectiveness of insecticides for the control of white grubs in turf. Res Circ 140. 7 pp.

Turfgrass Pathology

The turfgrass pathology research program is just getting started again with the addition of Dr Muse to the staff. A few of the aims for future research include the following.

1. Influence of the Environment on the Development of Turfgrass Diseases. Relationship between nutrition and soil moisture content and susceptibility of various turfgrasses to <u>Helminthosporium spp</u>.

2. Nature of the Differential Susceptibilities of Common Kentucky Bluegrass and Merion Bluegrass to <u>Helminthosporium spp</u>. Measurement of the extracellular enzyme capacity of <u>H. sativum</u> while colonizing each bluegrass variety.

3. Field Fungicide Trials. A field screening program is underway for chemical control of <u>Helminthosporium</u> incited diseases, stripe smut, <u>Fusarium</u> blight, and <u>Sclerotinia</u> dollar spot.

TURF RESEARCH PROGRAM

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Dr Wayne Huffine, Professor
Department of Agronomy
Oklahoma State University
Stillwater, Oklahoma

Research work on turfgrasses and their management was begun in 1948 under the supervision of Professor W C Elder. These investigations for the first three years, were supported by money furnished by the Tulsa Golfers Fund for War Wounded, Inc, through the USGA Green Section. Both basic and applied types of research are conducted in the turfgrass research program. These investigations involve genetics and plant breeding, plant nutrition and physiology, establishment and maintenance. Turf research that is now in progress includes:

1. Evaluation of introduced and domestic grasses and ground cover plants for turf purposes.
2. Selection and compatibility determinations of creeping red fescue seedlings.
3. Evaluation of bentgrass selections for disease resistance, heat tolerance and putting green qualities.
4. Investigation of thatch development in bermudagrass and its relation to the decline in turf quality.
5. Investigation of protective coatings on bermudagrass sprigs to extend the present planting period.
6. Herbicide evaluation for weed control in turf.
7. Roadside development and erosion control on Oklahoma highways.
8. Diseases of turfgrasses and their control.
9. Management practices for high quality turf production.
10. Investigation of herbicide longevity and its effect on germinating creeping bentgrass seed.

TURFGRASS RESEARCH REPORT

Dr C R Skogley, Associate Professor
Department of Agronomy & Mechanized Agriculture
College of Agriculture
University of Rhode Island
Kingston, Rhode Island

The responsibility of department researchers involve is as follows:

N Jackson - Diseases
J A Jagschitz - Turf weed control
D T Duff - Physiology
F B Ledeboer - Management
C R Skogley - Management

I. GRASSES AND MANAGEMENT - GOLF TURF

A. Bentgrass for Putting Greens

Seventy-two grass selections or mixtures, established vegetatively or from seed between 1963 and 1965 were evaluated in 10' x 10' plots. Data were obtained on turf quality, dollar spot and snow mold. Half of each plot receives annual applications of bensulide to check its effectiveness as a *Poa annua* herbicide and to check grass response to the chemical. Half of each plot, at right angles to the herbicide treatment, receives periodic fungicide treatments. The other half plot receives no fungicide through the year.

In general the velvet bents continued to receive the highest turf score ratings on a seasonal average. The highest rating was given to Vesper V B closely followed by Kingstown and R I selection A-9. Mixtures of Kingstown and Jamestown red fescue also rated high during 1968.

Evansville, four R I selections and the USDA selection 4(42)4 were the top rated creeping bent selections for the year.

Exeter and Exeter - Jamestown mixtures continued as the best colonial bentgrass in the trial.

Thirty-six additional grasses were established for putting green observation during 1968 and 20-30 bent selections were made from old golf greens in the state and are being vegetatively increased.

B. Plastic Screens for Winter Protection

Plastic screens providing shade densities from 9 to 88%, in color of white, green and black were evaluated as turf covers to provide winter protection to putting greens and newly seeded areas. Temperatures in the soil and turf were recorded and quality scores were given regularly. Black screens with shade densities from 50 to 65 appear to be optimium. Some information was obtained on temperatures under the covers, on fertilizer - cover relationship, and on management following cover removal in the spring.

C. Potassium and Soil Testing Studies

A fertilizer ratio study on velvet bentgrass, started in 1929, has been used during 1968 for small scale potash studies and for soil test correlation observations. Scheduled fertilizer ratio treatments were stopped in 1964 and only N has been supplied since that time. Potash deficient plots were subdivided and received ¼, ½, and 1 lb/1000 sq ft rates of K during the season. Excellent responses were obtained even at the lowest level.

Soil samples from all old ratio plots was sampled twice during the year in an attempt to relate grass response, levels of P and K in the soil as measured by the North Carolina Soil Testing System (newly adapted for R I), and fertilizer usage recommendations based on soil test results.

D. Management of Velvet Bent for Putting Turf

An area of Kingstown velvet bent was established during the year to provide space for a projected management study. Fertilization, soil topdressing and cultivation will be included. Treatments will commence in 1969.

II. GRASSES AND MANAGEMENT - LAWNS AND UTILITY TURF

A. Variety Evaluations for Turf Use

Biweekly turf scores were taken through the season on a trial started in 1966 which includes 54 strains and varieties of Kentucky bluegrass, red fescue and ryegrass. Plots were mown at 3/4 inch and received 3 lbs N/1000 sq ft during the season. A variety trial which included 12 of the most promising Kentucky bluegrass selections was established in the spring of 1967 and was maintained and evaluated as the above test during 1968.

As scoring continued into late November, the seasonal performance of the grasses in these trials has not yet been analyzed.

B. Lawn Seed Mixtures

A study of 20 experimental lawn grasses and mixtures was established in early 1967. The mixtures include promising varieties of Kentucky bluegrass, red fescue and colonial bentgrass. This study includes 2 cutting heights (1 1/2 and 3/4 inch) and three fertility levels (2, 4, 6 lbs N/1000 sq ft annually).

C. Grass Selection

Several Kentucky bluegrass, red fescue and colonial bentgrass selections were obtained throughout the Northeastern U S and Eastern Canada during the season. They are being increased for inclusion in evaluation studies.

D. Red Fescue Morphology

A study was initiated to gain knowledge of the morphological and genetic differences of several red fescue varieties. Jamestown, Highlight, Pennlawn, Chewings and common are included.

E. Kentucky Bluegrass and Red Fescue Variety Evaluation

Fifty-five bluegrass varieties or selections were seeded in the fall of 1968 as a part of the NE-57 regional project effort. Duplicate trials were established so that two fertility levels can be maintained. 24 red fescues were established in addition and will also be evaluated under 2 levels of fertility. Data have been obtained on rate of establishment.

F. Fertilizer Studies

1. Timing of applications: Ten grasses, alone and in mixtures, kept under a 3/4" cutting height are being subjected to different rates and variable timing of fertilizer applications to provide 1, 2 and 3 lbs of N/1000 sq ft a year as 10-6-4. Results over a 4 year period indicate considerably earlier spring green-up of red fescues and Kentucky bluegrasses, better winter color and acceptable summer performance where 1 lb of N is applied in Sept and 2 lbs in late November. While turf quality is equal or better with fall fertilization, average clipping yields are generally lower than with spring-summer applications.

2. Slow release N studies: Two trials are in progress to evaluate the performance of IBDU, mag amp, urea-form and activated sludge, with variables of rate and time of application. One study was initiated in the fall of 1967 and the second in the spring of 1968.

3. Potassium studies on Kentucky bluegrass: An M S thesis study on N:K relations was completed and a paper on the study has been accepted for publication in the Agronomy Journal. The study was entitled "Effects of N-K levels on the growth and chemical composition of Kentucky bluegrass." It was determined that the requirements for K was increased as N was increased.

G. Electric Soil Warming

Soil warming with electric cables to supply 10 watts/sq ft has been tested for three winters on seven different putting green and lawn grasses. All seven grasses were kept reasonably green on unfrozen soil all winter when the soil thermostat was at 50°F.

The heat was turned off suddenly during cold spells (below $0^oF.$) on two occasions during the winter of 1967-68 and the soil was permitted to freeze to a depth of 12 inches before again warming the soil. Grasses browned off but recovered 100% when heat was restored.

A larger scale study was installed in Dec of 1967. This included 3 cable types to supply 5, 10 and 15 watts/sq ft and soil thermostat settings were varied from 40^o to 60^oF during the winter. Thermocouples were installed to measure temperatures at the cables and at many locations from the base of the grass to depths of several feet. During the winter information was obtained on the use of various covers over the warmed soil, on seed germination and establishment with and without covers and on the rooting of sod.

H. Colonial Bentgrass Management for Lawn Turf

A study was started in the spring on 2-year old Exeter Colonial bentgrass to study the variables of mower type, fertilizer rate and application frequency and on cultivation or thatch control.

I. Thatch Control in Heavily Fertilized Merion Kentucky Bluegrass

This study is now 7 years old and the grass stand is 11 years old. The grass is fertilized at 4 and 8 lb/N/1000 sq ft annually and cultural treatments include: fall treatments - mowing 1/2 to 3/4 inch (maintained at 1 1/2 inch routinely) aeroblading, thin-cutting and combinations of these practices. Data are now being assembled for publication.

J. Late Fall Fertilization Effects on Cold Hardiness of Kentucky Bluegrass

A new project was initiated this season to investigate the level of cold hardiness in Kentucky bluegrass fertilized throughout the fall season at biweekly intervals. Plots receive 2 lbs N per 1000 sq ft in one fall application from ammonium nitrate. Additional N to total 5 lbs N per 1000 sq ft per year will be applied during the growing season. Laboratory determinations, of the polymerization of storage carbohydrates and the conductivity of tissue leachate will be used to indicate the inherent cold hardiness of tissues produced under the various treatments. No data are available from this study to date.

III. WEED CONTROL IN TURFGRASS

A. Bioassay for Bensulide, DCPA and Siduron in Turfgrass (1964-67)

Seedlings of 22 plant species were evaluated in aqueous suspensions of bensulide, DCPA and siduron to determine their value as indicator plants for bioassay in a week's time. The species showing the greatest sensitivity by reductions in root or shoot lengths were evaluated in soil mixtures to determine the level of sensitivity under soil conditions. Oat and brown-top millet were sensitive to bensulide at 1 ppm, wheat and intermediate wheatgrass to siduron at 1 ppm and browntop and foxtail millets to DCPA at 10 ppm. These indicator plants, in most cases, proved reliable in detecting the presence and movement of these herbicides in soils from field-treated plots. Downward movement of bensulide and siduron from surface field applications was detected in soil. The highest concentration of all three chemicals was found near the surface. There appeared to be no accummulation in soil treated with four annual applications of bensulide, DCPA or siduron. ("Weed Science" early 1969)

B. Effectiveness of Fall and Spring Applications of Chemicals for Pre-emergent Crabgrass Control (1967-68)

Eight chemicals were applied in the fall (October) and spring (April) for the selective control of crabgrass in a four-year-old stand of lawn-type turf containing bluegrass, fescue and bentgrass. Bandane (35 lb/A), bensulide (10 lb), DMPA (15 lb) and DCPA (10 lb) gave effective control when applied in either the fall or spring, but DCPA produced thinning of the fescue and bentgrass. Only the spring treatments of siduron (12 lb) and terbutol (10 lb) gave effective control. The fall use of terbutol resulted in severe turfgrass injury. Nitralin (2.4 lb) produced effective control when applied in the fall or spring, but fall use resulted in considerable turf injury. Poor crabgrass control was produced by benefin (2 lb) when applied in either the fall or spring. (Proc NEWCC 1969)

C. Evaluation of Spring Applied Pre-emergent Crabgrass Herbicides (1968)

New and standard herbicides, as well as various formulations and rates of these, were applied in May 1968 for the selective control of crabgrass in a two-year old stand of lawn-type turf containing bluegrass and fescue. The test area had been overseeded with crabgrass in 1967. To determine the control of late season crabgrass it was overseeded again in July. Treatments which showed a decrease in control from August to September chiefly due to the presence of new plants were as follows: benefin (2 and 3 lb/A), siduron (10, 12 and 15 lb), nitralin (1½ and 2 lb) and NC-5651 (8 lb). These herbicides evidently have a relatively short period of residual effectiveness. Four DCPA (10 lb) formulations gave excellent crabgrass control, but produced a severe reduction in fescue grass plants. Control with benefin at the 1½ lb rate was 69% and at the 2-3 lb rate ranged from 70-85%. Turf injury produced by the 3 lb rate was moderate. Crabgrass control was in the 80's at the 1½ lb rate of nitralin and in the 90's at the 3 lb rate. Some injury developed at the 3 lb rate. Granular formulations of nitralin produced less injury than sprays while both had comparable degrees of crabgrass control. Siduron at rates from 10 to 15 lbs produced control of 87-91% with good safety to the turf. NC-5651, an experimental herbicide (Fisons), at the rate of 8 lb gave 88% control with good turf tolerance. This herbicide should be investigated further. (Proc NEWCC 1969).

D. Residual Effectiveness of Pre-emergence Crabgrass Herbicides (1966-68)

To determine the residual effectiveness of herbicides which were applied in May 1966, crabgrass seed was sown over the test area in December 1966 and control ratings were made in September 1967. Results of the 1967 season were presented in the Proc NEWCC 1968. Bandane and bensulide gave better residual control the year after treatment than did benefin, DCPA, DMPA, nitralin, terbutol, siduron and Sindone. Control from Bandane and Betasan ranged from 75-83% at the standard rate and from 92-98% at the double rate. Crabgrass was seeded in the fall of 1967 and residual control was noted in the 2nd year (1968) after treatment. Bandane and Betasan treated plots in the 2nd year had less crabgrass than the other treated plots. At the standard rate control ranged from 44 to 49%. At the double rate bandane gave 91% control and bensulide gave 62% control.

The above procedure was applied to another test area where similar herbicides were initially applied in May 1967. The results of the 1967 season were presented in the Proc NEWCC 1968. Bandane and bensulide again gave the best residual control the year after treatment. At the standard rate control ranged from 76-80% while at the double rate from 97-98%. None of the other seven herbicides at the standard rate had better than 31% control, although in the season of use most of them had control above 90% as did bandane or bensulide.

E. Postemergent Control of Crabgrass (1968)

Several herbicides and combinations of herbicides were evaluated for the selective control of crabgrass in a two-year old stand of lawn-type turf containing bluegrass and fescue. Crabgrass at the time of the first treatment was in the 5-leaf stage of growth. At eight day intervals some plots were treated for a second and third time. Two applications of DSMA at 3 lb/A gave good crabgrass control as did one application of siduron plus DSMA (10 + 3 lb) or dicamba plus MSMA (.4 + 2.6 lb). All treatments caused turf injury. The siduron plus DSMA combination caused the least injury and the dicamba plus MSMA the most. An experimental chemical (ER-5661) failed to control crabgrass and/or caused considerable turf injury. Rates under study were 1/3, 2/3 and 1 lb/A with one, two and three applications.

TURF RESEARCH SUMMARY, 1968-69

Dr P M Alexander, Project Leader
Horticulture Department, Clemson University
Clemson, South Carolina

Project Title: Investigations of factors influencing the development, production, and management of turfgrasses utilized for utility, beautification, and recreational purposes. (SC-788)

Objectives:

1. To obtain and evaluate new strains, varieties, and/or species of turfgrasses for varied uses under South Carolina conditions. (continuing)

2. To develop methods and techniques for better utilization of turfgrasses with respect to production, establishment, and management practices. (5 year-renewable)

3. To determine, by state-wide survey and contacts with turf industry personnel, the nature and relative importance of major problems in all aspects of turfgrass usage for the purpose of enlarging the scope of research to include these problems as rapidly as possible. (continuing)

Cooperating Units:

1. Department of Horticulture
2. Department of Agricultural Chemical Services
3. Department of Agricultural Economics
4. Department of Agricultural Engineering
5. Department of Agronomy
6. Department of Botany and Bacteriology
7. Department of Entomology and Zoology
8. Department of Recreation and Parks Administration
9. Department of Seed Certification
10. S C Agricultural Experiment Stations
11. S C Extension Service
12. S C Crop Pest Commission

TURF STUDY IN SOUTH DAKOTA

Dr Dale E Herman, Assistant Professor
Horticulture & Forestry Department
College of Agriculture & Biological Sciences
South Dakota State University
Brookings, South Dakota

South Dakota State University does not have a definite turf program under funding but will have shortly. I presently have a turf varietal evaluation study underway.

Twenty-five named Kentucky bluegrass seed sources are being comparatively evaluated. This study also includes fourteen species and varieties of fine fescues, thirteen species and varieties of bentgrasses, buffalograss, four tall fescues, four ryegrasses and five coarse-textured western species.

Some of the factors to be considered are year-round color, including spring green-up and fall growth response, disease resistance, fertilizer response, vigor of spread, density, texture and mowing characteristics.

TURFGRASS RESEARCH AT THE UNIVERSITY OF TENNESSEE

Dr Lloyd Callahan, Project Leader
Turfgrass Management, Department of Agronomy
University of Tennessee, Knoxville, Tennessee

Research in Turfgrass Management at the University of Tennessee is conducted at three locations on the Main Station, at Knoxville, and at six Branch Experiment Stations strategically located throughout the state. The following is a summary of the work in progress.

I. Hatch 245: The Effects of Pesticides on Turf Pests and Turfgrasses.

A. Phytotoxicity of Selected Herbicides and Their Residual Effects in a Penncross Creeping Bentgrass Green.

Objectives: To determine the tolerance of Penncross to selected pre-emergence type herbicides; to determine the type of injury, duration of injury, and level of herbicide persistence in the soil.

Results: First year of a three-year test.

1. Bensulide (10, 15, 20 lb ai/A) caused no visible foliage injury in the field but did cause severe reduction in root regrowth in residue tests.

2. Siduron (8, 12, 16 lb ai/A) caused no visible foliage injury in the field and no significant reduction in root regrowth in residue tests.

3. Terbutol (10, 15, 20 lb ai/A) caused slight to moderate foliage injury in the field and severe root reduction in residue tests.

4. Benefin (2, 3, 4 lb ai/A) caused severe foliage burn in the field but no significant reduction in root regrowth in residue tests.

5. DCPA (10, 15, 20 lb ai/A) caused slight to moderate foliage injury in the field and slight to moderate reduction in root regrowth in residue tests. Foliage responses for the first 4 weeks in the field resembled dark greening similar to nitrogen responses.

6. Bandane (40, 60, 80 lb ai/A) caused slight foliage injury in the field and slight to moderate reduction in root regrowth in residue tests.

7. Tri-calcium arsenate (200, 300, 400 lb ai/A) caused an initial severe foliage burn in the field which recovered in two weeks showing no visible injury. Residue tests showed no significant reduction in root regrowth.

Summary: (of first years tests).

1. No treated plots in the field were lost.

2. The herbicides which tended to accumulate in the 0-2 inch soil zone were tri-calcium arsenate, bandane, bensulide, and terbutol.

3. The herbicides which tended to accumulate in higher concentration in the 2-4 inch soil zone were siduron, benefin, and DCPA.

4. Thus far, the safest herbicides as residues to root development appear to be tri-calcium arsenate and siduron. The most phytotoxic residues were terbutol and bensulide.

B. Phytotoxicity of Selected Herbicides and Their Residual Effects in a Tifton 328 Bermudagrass Green.

Objectives: To determine the tolerance of T-328 bermuda to selected herbicides; to determine the type of injury, duration of injury, and level of herbicide persistence in the soil; to determine herbicidal effectiveness in controlling *Poa annua*; and to determine the phytotoxicity of herbicide residues to cool season grass overseedings for winter cover.

Treatments: This study was just recently started. Treatments are as follows:

1. Bensulide (12.5 and 25 lb ai/A) and benefin (2 and 4 lb ai/A) applied in mid-July and early February.

2. Uracil (1/2 and 1 lb ai/A) applied in mid-July, late September, early February, and mid-March.

3. Siduron (8 and 16 lb), DCPA (10 and 20 lb), bandane (40 and 80 lb), terbutol (10 and 20 lb), and tri-calcium arsenate (200 and 400 lb), all ai/A, applied in mid-July.

4. *Poa annua* was seeded in a portion of each treated plot in mid-July.

5. A portion of each treated plot will be seeded to Seaside creeping bentgrass, Pennlawn creeping red fescue, annual ryegrass, and *Poa trivialis* in late September.

Results:

1. Siduron caused moderate (8 lb ai/A) and severe (16 lb ai/A) foliage injury (browning) within 7 days after application. By the end of the second week both rates were causing very severe foliage injury. By the fourth week the foliage still had not recovered.

2. Uracil (1/2 lb ai/A) caused slight and (1 lb ai/A) moderate foliage injury (yellowing) by the end of the first week after applications. By the fourth week the foliage injury had recovered.

C. Phytotoxicity of Selected Herbicides in Cool and Warm Season Turfgrass Varieties under Lawn Management.

Objectives: To determine the general safety of the more commonly used pre-emerge and postemerge type herbicides recommended for use in turf on selected cool and warm season turfgrass varieties maintained under lawn conditions at different locations throughout Tennessee.

Results: (general summary).

1. Siduron (12 lb ai/A) caused moderate turf thinning in most of the 14 bermuda varieties. Severe thinning occurred in Tifdwarf bermuda.

2. Bensulide (10 lb ai/A) and Benefin (3 lb ai/A) cause slight injury in *Zoysia matrella*.

3. DCPA (12 lb ai/A) induced a dark greening of the foliage of all the warm and cool season varieties similar to nitrogen response. During persistent hot weather some foliage burn resulted, particularly in the cool season grasses.

4. Benefin (3 lb ai/A) caused severe injury in 5 Kentucky bluegrass varieties, moderate injury in 5 red fescues varieties, severe to complete kill in 5 bentgrass varieties, severe injury in dichondra, and only slight injury in tall fescue and perennial ryegrass.

5. CMA-18%:CPA-6% granular (30 lb ai/A) caused slight injury in the bentgrass varieties and severe injury in centipedegrass.

6. DSMA (3 lb ai/A) caused slight foliage burn in common Kentucky bluegrass and *Zoysia matrella* and moderate foliage burn in Kentucky blue, zoysia, and T-328 bermuda at 6 lb ai/A.

D. Fungicidal Control of Large Brown Patch in a Penncross Creeping Bentgrass Green.

Objectives: To evaluate the effectiveness of several fungicides in controlling the Large Brown Patch disease in Penncross creeping bentgrass; to determine the effectiveness of these fungicides when applied in an infrequent preventive-type program.

Results: (Summary of 1967 and early summer 1968).

1967

1. Out of 16 formulations, 2 rates each, applied every 2 weeks for 9 treatment dates, the only fungicides providing complete control of Brown Patch were Dac 2787 and an experimental containing Daconil as one of its active ingredients.

2. Most of the remaining fungicides gave outstanding control.

1968

1. Treatment entries were reduced to 14 formulations, 2 rates each, applied every 3 weeks for 6 treatment dates. (All treatments are expressed as oz or lb commercial/1,000 sq ft.)

2. Treatments providing complete control of Brown Patch during early summer were: Dac 2787 (4 and 8 oz), CS-5623 (4 and 8 oz--contains Daconil), Dupont 1991 (2 and 4 oz), Tersan OM (3 and 6 oz), Kroma-clor (3 and 6 oz), Thiram (3 and 6 oz), Acti-dione + Thiram (2 and 4 oz), Dyrene (1/4 and 1/2 lb), and Ortho Lawn and Turf Fungicide (3 and 6 oz).

3. Treatments providing complete control of Brown Patch by mid summer were: Dac 2787 (4 and 8 oz), CS-5623 (4 and 8 oz), Dupont 1991 (2 and 4 oz), Tersan OM (6 oz), and Kroma-clor (6 oz).

E. Nematode Control and the Effects of Nematocides in a Bentgrass Green.

Objectives: To determine the effects of selected nematocides on nematode populations in a Penncross creeping bentgrass green and to evaluate the response of the turf to the nematocides.

Treatments: This study was just recently started. Treatments are as follows:

1. A Penncross creeping bentgrass green is being inoculated with the lance, stunt, and spiral nematodes and allowed to increase until sufficiently high to initiate damage before treatments are applied.

2. Planned treatments are with Dasanit, Sarolex, Zinophos, Nemagon, and two experimentals.

Cooperations: This study is being conducted as a joint project between Turf and Agricultural Biology (Nematology).

II. Hatch 47: Management and Evaluation of Turfgrasses.

A. The Evaluation of Selected Fertility Treatments on a Cool and Warm Season Turf.

Objectives: To evaluate the accumulated effects of various combinations of a complete fertilizer, nitrogen, and lime on turf color, density, disease susceptibility, and competition with weeds in common Kentucky bluegrass and Tifton 328 bermudagrass lawn-type turfs at different locations throughout Tennessee.

Treatments: We have a 2-1/2 years information on a 5-year program in plots located at 3 branch experiment stations and at the Knoxville station. All nitrogen was applied at 1 lb actual/M^2 with each topdress application and 4 lb/M^2 when incorporated in the top 8 inches of the soil. Seedbed preparation lime was at 100 lb/M^2 and topdress applications are at 25 lb/M^2.

Results: (General Summary)

1. In general, most treatments were better than none at all.

2. The less desirable treatments began showing their effects quickly as serious turf thinning, chlorosis, winter and summer weed invasion, and Helminthosporium leaf spot, rust, and dollar spot.

   (1) lime only, incorporated only at seedbed time or topdressed once/year;

   (2) complete fertilizer (10-10-10), incorporated only at seedbed time;

   (3) complete fertilizer (10-10-10), topdressed only once each year, regardless of whether lime was included or not;

   (4) nitrogen only, with or without lime;

   (5) thus for treatments producing the greater density and best disease tolerance are fertilizer treatments applied in the fall and spring only.

   (6) the more desirable treatments are segregating out at a slow rate.

B. Effects of Predormancy Phosphate and Potash Treatments on Winter Survival of Emerald Zoysia.

Objectives: To determine the effects of different rates of potash, ratios of P-K, and dormancy mowing heights on winter survival and leaf bud development in an Emerald zoysia turf.

Results: Summary of 1 year Special Problem Work.

1. The highest number of buds occurred in the plots treated with 0 lb N - 2 lb phosphate - 6 lb potash/M^2, which amounted to 121 buds/50 sq cm.

2. The lowest number of buds occurred in the plots treated with 0 lb N - 24 lb phosphate - 12 lb potash/M^2, amounting to 38 buds/50 sq cm.

3. Plots receiving no predormancy fertilization treatment produced 90 buds/50 sq cm.

C. Summer Fertilization of a Bentgrass Green.

Purpose: Bentgrass is generally favored as the permanent golf course putting green in most areas of Tennessee where it can be maintained. However, bentgrass greens are often lost in Tennessee most often due to a lack of knowledge of summer fertilization management.

Objectives: To determine the response of a Penncross creeping bentgrass green to different types and rates of selective nitrogen fertilizers during the summer. To develop information on the proper use of nitrogen fertilization as to type, source, and rate, for the safest means of maintaining bentgrass greens during summer stress periods.

Treatments: (M S Thesis just initiated).

1. Two natural organics, UF, ammonium nitrate, urea, and a sulfur coated urea each applied at 1/2, 1, and 2 lb N/M^2 at 4 week intervals throughout the summer.

D. Variety Evaluations.

Objectives: To determine the general responses of selected cool and warm season turfgrass varieties, and mixtures, under lawn-type conditions while maintained at different locations throughout Tennessee.

Results: (Progress summary).

1. Kentucky bluegrass in sunny locations in south central and west Tennessee areas tend to degenerate rapidly.

2. Rainier creeping red fescue at high elevations in east Tennessee retains its color much longer into late fall and winter than does Pennlawn, Illahee, or Chewings fescue.

3. Although Merion Kentucky bluegrass is highly susceptible to leaf rust this disease does not appear to be serious when several modest fertilizer treatments are made throughout the growing season to encourage continuous growth.

4. Winter-kill of the fine-leaved zoysias appear to be a problem in east Tennessee. Thus far, withholding water-soluble N from the zoysia until well after it has broken dormancy in the spring tends to reduce the seriousness of this problem.

E. A Correlation of Temperatures with Bud Formation in a Bermudagrass Green.

<u>Purpose</u>: In Tennessee where bermudagrass is the predominant golf greens grass, the problem exists of protecting the grass during winter dormancy. Straw has been used with varying success. However, the problem arises as to the proper time to remove the straw with the least danger to the newly developed bermudagrass buds.

<u>Objectives</u>: To correlate soil and air temperatures in the microclimate of winter dormant bermudagrass greens with periods of bud formation in late winter to early spring. To determine dates in early spring to remove mulch covers with the greatest safety to the bermudagrass buds prior to full dormancy breaking.

<u>Cooperations</u>: This study is to be conducted with the cooperation of the U S Weather Bureau at the Jackson Tennessee Experiment Station.

F. Effects of Shade on Stand, Vigor and Longevity of Selected Grasses.

<u>Objectives</u>: To determine the tolerance of selected turf and forage grasses to controlled levels of shading. To measure vigor, rate of spread, appearance and longevity of these grasses under 3 levels of shade as compared to growth in full sun.

<u>Treatments</u>:

1. Turfgrass selections are T-328 bermudagrass, Emerald zoysia, common Kentucky bluegrass, and Pennlawn creeping red fescue.

2. Forage type selections are Boone orchardgrass and Kentucky 31 tall fescue.

3. Shade levels are 30%, 50%, and 70% plastic mesh sheets and plots in full sun.

<u>Cooperations</u>: This study is being conducted as joint project between Turf and Forages.

TURF RESEARCH AT TEXAS A & M UNIVERSITY

Dr George McBee, Assistant Professor
Wallace Menn, Instructor
Department of Soil & Crop Science
Texas A & M University
College Station, Texas

The turf research program at Texas A & M University is generally divided into two categories which are basic and applied. A summary or outline of the program is as follows:

I. Basic

A. Tifgreen nutrition - Includes cation ratios among which interactions of K, Ca and Mg have been studied, P-K relationships, and Nitrogen.

B. Shade tolerance - Studies are and have been conducted on influence of light quality, certain influences by biochemical agents and variety responses.

C. Variety variations - Trials on chemical differences between various bermudagrasses are currently in progress.

D. Herbicides - Physiological condition of weeds at time of herbicide applications are being investigated.

E. Cold tolerance - The varieties of turfgrass under investigation are Tifgreen and St Augustine; both field and greenhouse trials are used to study the interactions of temperature and nutrition.

II. Adaptive type experiments

A. Edging trials - Residual plus desiccants and combinations of both have been used with the purpose of trying for fast desiccation plus residual or long lasting effects. For use on baseball diamonds, etc.

B. Soil amendment - These experiments have included Texturf 1F as the turfgrass for our experiments. Materials used have been calcined clay, organic material and decomposed bark. Variable fertilizer rates coupled with aerification <u>vs</u> no aerification have also been included.

C. Herbicide phytotoxicity on St Augustinegrass - Hormone type materials along with varying times of application are being studied on this grass.

D. Phytotoxicity trials on Tifgreen and Tifdwarf - Three groups of materials, herbicides, fungicides and insecticides were used at 1x and 2x rates on these two grasses. Hormone type herbicides were about all that produced some damage.

E. St Augustinegrass (chinch bugs) - We are studying possible tolerance or resistance of some strains to chinch bugs.

F. Establishment of Zoysia - Midwest and Meyer zoysia grass were used with St Augustine included for comparison---three methods of planting have been studied along with three rates of nitrogen.

G. Variety trials - Two areas are planted to bermudagrass selections. The usual ratings of color, density, aggressiveness, etc are being recorded.

H. Poa annua - Trials are being initiated on Tifgreen to study effects of certain pre-emerge materials and timing of application for best control of Poa annua.

I. Brownpatch control in St Augustinegrass - The program to date has largely been one of material evaluation. Practically all of the commonly used fungicides have been used over a period of years, but PCNB continues to consistently produce the best results.

J. Soil warming - Three sites in Texas have been used for soil warming studies on warm season grasses. They are College Station, Ft Worth and Houston. These results have been reported in two station type reports and one journal article. We have tentatively terminated these trials.

K. Virus in St Augustine - Cooperative studies are underway with one of the plant pathologists to study this virus. Present work consists mainly of studies to learn "characteristics" of the pathogen. Following this, we have plans for studies to try to limit its spread.

SUMMARY OF TURFGRASS RESEARCH ACTIVITIES

Dr Roy L Goss, Associate Agronomist
Western Washington Research and Extension Center
Washington State University, Puyallup, Washington

Turfgrass research at the Western Washington Research and Extension Center at Puyallup, Washington, has centered around the following major categories: 1) Turfgrass nutritional studies, 2) Turfgrass diseases common to the western slopes of the Cascade Mountains, 3) Turfgrass weed control studies, 4) Soil mixtures and compaction studies, and 5) Species and varietal adaptations.

Turfgrass nutrition studies have been carried out at this location since 1958. Three levels of nitrogen, namely, 20, 12, and 6 pounds per 1000 sq ft per season have been applied to putting green turfgrass plots in combinations with 4 and 8 pounds of K_2O from muriate of potash and 0 and 4 pounds of P_2O_5 from treble superphosphate. These various rates of nitrogen, phosphorus, and potassium were selected to cover the wide range of fertilizers being applied in the Pacific Northwest. Some results of these studies have been published in the various journals and presented at the American Society of Agronomy meetings from time to time.

Turfgrass disease studies have been conducted by Dr C J Gould, Plant Pathologist at this location, since about 1955. The major emphasis has been placed upon *Fusarium* patch disease and, more recently, with considerable emphasis on *Ophiobolus* patch disease. Prior to the study of these two diseases, considerable efforts were expended on measures to control fairy ring disease. The results of these investigations have led to good controls for *Fusarium* patch. At the present time controls are being investigated for *Ophiobolus*. As yet, no practical controls for fairy ring have been definitely determined.

Weed control investigations have led to control of such noxious pests as mouse eared chickweed, English lawn daisy, crabgrass, *Veronica filiformis*, and the other more common weeds. Considerable time has been spent on methods to control *Poa annua*, and some of these results have been published. Investigations are continuing on the control of some of these weeds. Of particular interest at present is the mode of action of Dacthal on the control of *Veronica*.

Other investigations have included the interaction of fertility levels on the control of turfgrass diseases, proper mowing heights for bentgrasses, and bentgrass/bluegrass fescue mixtures, and other methods of turfgrass management which include lawn renovation, compaction studies, and soil mixtures.

TURFGRASS RESEARCH PROGRAM AT

WEST VIRGINIA UNIVERSITY

Dr Paul Henderlong, Assistant Professor
Department of Agronomy and Genetics
College of Agriculture
West Virginia University
Morgantown, West Virginia
(Dr Henderlong has now joined the
faculty at Ohio State University)

Turf research has been conducted at West Virginia on an extremely limited basis since about 1930. A major turf research and teaching program, however, was not organized until 1966. A course in turfgrass management was first offered at West Virginia during the 1966-67 academic year and taught by Paul R Henderlong. In June of 1967, two research projects were approved for funding. The first Turfgrass Conference was held on August 2 and 3, 1967 and a second conference is scheduled for August 6 and 7, 1968. During the 1967 West Virginia Turfgrass Conference, the West Virginia Turfgrass Foundation was duly organized to financially support the turf research program and assist the University in the promotion and dissemination of turfgrass management information.

Staff

Currently, West Virginia has five men associated to some extent with the turfgrass Program. The general turfgrass teaching and research program is conducted by Dr P R Henderlong. Dr C D Porter and Mr Clifford Collier handle most of the general turfgrass extension programs. Dr E Elliott and Dr J Wilson conduct a limited amount of research on turf disease and insect problems, with Dr Wilson handling the extension program.

Research Program

At the present time the turf research program involves four major subareas; physiology and ecology, weed control, soil modification and highway roadside research.

Greenhouse and field studies have been conducted and will be continued with respect to turfgrass mixture ecology. This work involves both mixtures of different species and mixtures of the same specie, such as bluegrass "blends." Physiological studies will be initiated in the near future, with the major emphasis on basic metabolism and mineral nutrition.

Limited research is currently in progress in the area of weed control. At the present time a study on the possible interrelationships of nitrogen fertilization and herbicide effectiveness or efficiency is in progress. Some work has also been undertaken in the area of herbicide movement or leaching.

Most of the soil modification work has been directed to the feasibility of using the solid waste product, "fly ash," as a soil amendment or conditioner. The fly ash used for this research has been sintered to develop a stable light weight aggregate. The fly ash work is a cooperative project with the Morgantown Coal Research Center, Bureau of Mines, U. S. Department of Interior.

The highway research program was initiated in January 1968 in cooperation with the West Virginia State Road Commission and the Federal Bureau of Public Roads. The major emphasis of this work will most likely be directed towards highway roadside turf maintenance research.

<u>Recent Publications</u>

1. Parks, O C, Jr and P R Henderlong. 1967. Germination and Seedling Growth Rate of Ten Common Turfgrasses. Proc W Va Acad Sci 39:132-140.

2. Metcalf, J I and P R Henderlong. 1967. Establishment and Seedling Growth of Kentucky 31 Tall Fescue on an Exposed Clay as Influenced by Fertilization and Wood By-Products. Proc W Va Acad Sci 39:146-151.

3. Henderlong, P R. The Turf Industry in West Virginia. Proc W Va Turfgrass Conference. W Va Univ Agri Exp Sta Misc Pub #5, May 1968 pp 3-10.

4. Patterson, J C, Jr, P R Henderlong and L M Adams. 1968. Sintered Fly Ash as a Soil Modifier. Proc W Va Acad Sci (In Press).

5. Henderlong, P R, D E Brann and C Veatch. 1968. Preliminary Studies on the Differential Movement of the Granular and Emulsion Forms of Bensulide in Soils. Proc W Va Acad Sci (In Press).

6. Proceedings of the West Virginia Turfgrass Conference. W Va Univ Agr Exp Sta Misc Pub #5, May 1968.

TURF RESEARCH AT THE UNIVERSITY OF WISCONSIN

Dr Gayle Worf, Extension Plant Pathologist
Dr James Love, Professor of Soil Science
Dr P N Drolsom, Professor of Agronomy
Robert Newman, Horticulture Instructor
College of Agriculture
University of Wisconsin, Madison, Wisconsin

Survey of disease situations related to turf production and culture in Wisconsin; and evaluation of methods pertaining to their control or abatement, including cultural methods, chemical treatments and varietal reactions.

Turf research activity in the Soil Science Department is centered largely around the following areas:

1. Nutrient Deficiency Symptoms in Turfgrass
2. Nutrient Requirement of Merion Kentucky Bluegrass
3. Lateral and Vertical Root Development in Merion Kentucky Bluegrass
4. Characterization of Thatch in Merion Kentucky Bluegrass
5. Characterization of Sand Fraction in Soil Mixtures Subjected to Compaction
6. Soil Sampling of Turf Areas

Turf research activity in the Agronomy Department:

Attention is given to releases of new strains that are available for turf use. As necessary, seedings of strain plots are made and their performance is observed. A number of selections of red fescue are currently in plot trials. These originated through collections and introductions made earlier and evaluated by E L Nielsen and D C Smith.

Horticulture Department investigations include:

1. Weed control
   (a) evaluation of pre-emergence crabgrass herbicides.
   (b) screening and evaluation of selective herbicides for broadleaf weed control.
   (c) chemical and cultural methods to control perennial grasses prior to establishing turfgrass.
   (d) identification of weeds in Wisconsin turfgrass.
2. Turfgrass variety evaluations.
   (a) variety evaluation plots are currently established at the University of Wisconsin.

Experiment Stations at Ashland, Spooner, Sturgeon Bay, Marshfield, Lake Mills, Lancaster and Arlington, Wisconsin. Additional trials will be established at Hancock and Arlington in 1969. Turfgrasses are being evaluated for disease susceptibility, color, texture, density, winter hardiness and general desirability for turf purposes.

TURF RESEARCH AT UNIVERSITY OF GUELPH

ONTARIO, CANADA

Jack Eggens
Department of Botany
University of Guelph
Guelph, Ontario, Canada

The University of Guelph was established in 1964 and now includes Wellington College as well as the Ontario Agricultural College, Ontario Veterinary College and MacDonald Institute. In essence the turf management program was begun Spring 1968 and involves teaching, extension and research. The direction that the turf research program will take has not been firmly established but I hope will evolve to include some of the most pressing problems of the sod growers and golf course superintendents. Some of the work now underway is as follows:

1. Turf variety trials

During June 1968, 96 varieties and cultivars were established on the light sandy loam soil at the Horticultural Research Station at Preston, Ontario. They were established on one by two meter plots replicated four times. Evaluation included general appearance, vigour, colour, disease and general suitability for home lawns. At the time of evaluation each plot was assigned a value from 1-10 with 10 being best. This initial evaluation is supplied for interest sake only and because of the short period of evaluation, the results obtained may well change as more data becomes available and as the trial matures. One hundred additional cultivars will be planted spring 1969.

2. Miscellaneous programs

Standard run-of-the-mill projects on maintenance, fertilizer trials, some very good work on herbicides under Dr Clay Switzer, Chairman, Botany Department, some work on snowmold under Dr Steve Fushtey, Botany Department, sod growing on muck soils, and covering material for winter protection of putting greens.

BOTANIC NAME	CULTIVAR	12 JUL 68	9 SEP 68	23 OCT 68	AVERAGE
Poa pratensis	Park	5.0	6.5	5.8	5.8
	Newport	1.0	3.7	4.5	3.1
	Geary	1.0	6.0	5.0	4.0
	Windsor	5.0	5.5	5.3	5.3
	Delta	0.7	4.5	5.0	3.4
	Nugget	2.0	6.0	6.3	4.8
	Merion (Dutch Grown)	1.0	4.8	6.0	3.9
	Primo	2.3	7.0	7.5	5.6
	S 21	0.7	4.5	4.5	3.2
	Golf	4.0	8.0	8.8	6.9
	Cougar	0.7	4.5	5.0	3.4
	Merion (U S Grown)	1.3	6.8	7.3	5.1
	0217 Fylking	0.3	3.0	4.0	2.4
	Nike	5.0	7.3	5.5	5.9
	Hunsballe soma S 64	4.0	6.3	6.3	5.5
	Sydsport	4.3	7.3	9.0	6.9
	Captan	2.0	6.5	7.3	5.3
	Delft	2.0	6.5	6.5	5.0
	Fusa	4.3	6.8	5.3	5.5
	Skandia II	6.0	6.5	6.0	6.2
	Atlas	6.0	7.3	6.5	6.6
	Arista	3.7	8.0	8.0	6.6
	Baron	5.7	7.0	9.0	7.2
	Skrgeszowice SK-46	8.3	7.3	6.5	7.4
	Spaths	4.0	7.3	7.3	6.2
	Prato	6.3	9.0	7.5	7.6

BOTANIC NAME	CULTIVAR	12 JUL 68	9 SEP 68	23 OCT 68	AVERAGE
Festuca rubra	Bargena	4.7	5.3	5.0	5.0
	Turf	7.0	5.3	4.5	5.6
	Golfrood	2.0	5.8	5.8	4.5
	Arctared	2.7	5.8	5.8	4.7
	Olds	4.3	4.3	4.5	4.4
	Echo	5.0	4.8	4.3	4.7
	Duraturf	3.7	6.5	5.3	5.2
	Rubin	4.0	4.8	3.8	4.2
	Polar	2.7	5.5	5.0	4.4
	42-8	1.7	4.3	4.0	3.3
	Erika	1.3	5.5	5.0	3.9
	Sceempter	2.3	5.3	4.5	4.0
	Taca trifollium	5.0	4.8	4.5	4.8
	Elco	3.3	4.3	4.8	4.1
	Ruby	5.5	5.8	4.8	4.1
	N F G	6.7	5.3	4.8	5.6
	Polo	5.7	4.8	4.3	4.9
	Tjelvar	4.3	4.8	4.5	4.5
	Reptans	6.0	5.5	4.8	5.4
	Pennlawn	6.0	7.0	6.0	6.3
	S 59	1.0	4.3	4.3	3.2
	Bergere	2.7	4.3	4.5	3.8
Festuca rubra commutata	Barfalla	5.0	7.3	6.8	6.4
	Dawson	5.3	6.5	6.8	6.2
	Ruby	7.0	5.3	4.5	5.6
	New Zealand (Commercial)	4.7	6.8	6.3	5.9

BOTANIC NAME	CULTIVAR	12 JUL 68	9 SEP 68	23 OCT 68	AVERAGE
	Borial	5.3	5.8	5.0	5.4
	Cottage	1.7	3.5	4.3	3.2
	Illahee	3.0	6.5	5.8	5.1
	Oasis	2.7	6.3	5.5	4.8
	42-14	2.3	6.3	5.8	4.8
	Novorubra	2.7	4.8	4.8	4.1
	Highlight	3.7	7.0	5.8	5.5
	Oregon	3.7	7.0	6.8	5.8
	Golfrood	1.3	5.5	4.5	3.8
	Highlight	3.7	7.5	6.8	6.0
Poa trivialis	Ino	6.3	6.3	5.3	6.0
	Dasas 5 64	6.3	5.5	5.3	5.7
	Omega	7.3	6.0	5.8	6.4
	Commercial (Danish Grown)	6.0	5.8	5.0	5.6
Lolium perenne	Pelo	8.3	5.3	4.3	6.0
	NK 100	6.3	6.0	3.8	5.4
	Norlea	6.3	5.5	3.5	5.1
	Viris	5.7	4.5	4.0	4.8
	E 10	4.7	5.0	3.8	4.5
	R V P	5.7	5.0	4.0	4.9
	Kent	7.0	6.3	5.0	6.1
	Brabantia	4.7	6.3	4.3	5.1
Agrostis palustris	Penncross	7.7	7.0	7.3	7.3
	Smaragd	6.3	8.0	7.3	7.2
Agrostis tenuis	Highland	6.3	5.8	5.0	5.7
	Astoria	7.0	5.8	6.0	6.3

BOTANIC NAME	CULTIVAR	12 JUL 68	9 SEP 68	23 OCT 68	AVERAGE
Agrostis alba	Red top # 1	6.0	6.8	5.3	6.0
Festuca ovina duriuscula	Duran	4.7	5.5	5.5	5.2
Festuca rubra genuina	Steinacher	3.0	4.8	4.0	3.9
Festuca arundinacea					
	Backafall	5.7	5.0	4.0	4.9
	Manade	4.7	3.3	2.8	3.9
	Kentucky 31	4.3	4.3	4.0	4.2
	S 170	4.0	3.0	2.8	3.3
Phleum nodosum	Sport V 46	6.7	5.5	4.8	5.7
	S 50	4.3	6.3	4.8	5.1
	Evergreen	7.0	5.8	4.3	5.7
Poa compressa	Canon	3.0	6.5	4.5	4.7
	Commercial (U S Grown)	2.3	7.3	4.8	4.8
	Commercial (Ont Grown)	1.0	6.5	4.5	3.0
Poa glaucantha	Draylar	3.7	4.0	4.0	3.9

Turfgrass researchers attending this seminar recommended that it be repeated every 3 or 4 years. It was further suggested that seminars limited to specialized areas of turfgrass research be held during the intervening period. Thus, a Turfgrass Entomology Seminar was planned for May 19-20, 1969 and a Turfgrass Pathology Seminar for June 16-17, 1969. Proceedings would be prepared following these meetings.

Scotts THE GRASS PEOPLE . . . Marysville, Ohio

H6 83069