Proceedings
Of The Joint
Western Canada
And
Northwest Turfgrass
Association Conference
And
Proceedings
Of The
27th Northwest Turfgrass
Conference

October 2-5, 1973
Harrison Hot Springs
British Columbia

Proceedings

Of The Joint

Western Canada

And

Northwest Turfgrass Association Conference

And

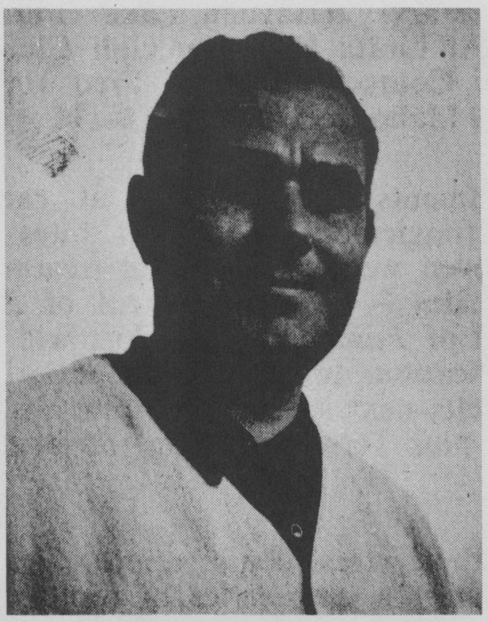
Proceedings

Of The

27th Northwest Turfgrass Conference

October 2-5, 1973
Harrison Hot Springs
British Columbia

PRESIDENT'S MESSAGE



It has been a pleasure to have served the Northwest Turfgrass Association this past year as its president. I am certain that strong regional organizations such as this serve an important role in providing benefits to its members. To most of us the Conference in the fall is the climax to the turf season and we anticipate that this year's Conference in cooperation with our Canadian neighbors will be outstanding.

I want to thank the Board of Directors for their support and cooperation, and in particular to single out Dick Haskell and Roy Goss for their continuing contributions to this Association. They are the ones who really make it go.

NORTHWEST TURFGRASS ASSOCIATION

1973 Officers

John Zoller	President
Milt Bauman	Vice President
Dick Haskell	Treasurer
Roy L. Goss	Exec. Secretary

Board of Directors

Bud Ashworth	Hangman Valley Golf Club 1029 S. Garry Liberty Lake, Wa 99019
Milt Bauman	Seattle Golf Club 210 N. E. 145th St. Seattle, WA 98177
Wayne Dean	City Parks & Rec. Dept. 129 North 2nd Street Yakima, WA 98901
Cliff Everhart	Manito Golf & Country Club Box 8025 Manito Station Spokane, WA 99203
Dick Fluter	Oswego Lake Country Club 20 Iron Mountain Blvd. Lake Oswego, OR 97034
Carl H. Kuhn	Irrigation Consultant Box 443 Mercer Island, WA 98040
Ron Proctor	Rainier Golf & Country Club 1856 S. 112th Street Seattle, WA 98168

Rich Schwabauer	Waverly Country Club Box 1100 S.E. Waverly Dr. Portland, OR 97222
John Zoller	Eugene Golf & Country Club 255 Country Club Road Eugene, OR 97401

WESTERN CANADA TURFGRASS ASSOCIATION

PRESIDENT'S MESSAGE

As host of the first Joint Turfgrass Conference (Western Canada Turfgrass Association and Northwest Turfgrass Association), I welcome you to Harrison.

Our committees have worked hard to make this first Joint Conference a successful one, and hopefully this will mark the beginning of a period of meaningful co-operation between the two associations.

The WCTGA has truly come of age. However, we must now guard ourselves against becoming complacent about having realized some of our objectives. This Conference should provide us with the necessary momentum to continue in our efforts to build a better organization.

WESTERN CANADA TURFGRASS ASSOCIATION

1973 Officers

Heinz Knoedler	President
Ruby Aston	Secretary-Treasurer

Board of Directors

Bob Bailey	Walt Spelay
Peter Dotto	Bob Symonds
Owen Hamilton	Doug Taylor
Eric Hughes	Ben Viersen
Richard Krahn	
George Pfieffer	

TABLE OF CONTENTS

PHYSIOLOGY AND CLIMATIC EFFECTS OF TURF[1]

James B. Beard[2]

This is a rather broad title that could be developed in many ways under the time limitations for this talk. The three major areas of emphasis include (a) an actual description of the individual climatic factors and how they are controlled, (b) the physiological reactions occurring in the turfgrass plant as affected by climate, and (c) climatic stresses, especially their physiological cause, and methods to minimize or prevent damaging effects. I have chosen to emphasize the third aspect.

First, I should define some of the key terminology involved. Three terms that are sometimes used interchangeably and can be confused are climate, weather, and environment. Climate is the composite state of the atmosphere for a particular region over a period of many years and encompasses the weather variations. This contrasts with weather which is a condition of the atmosphere at a specific time and place. It involves a description of the conditions at a specific time and place. It involves a description of the conditions at a particular point in time in contrast to climate which involves an overall description of the long term environmental characteristics of the area. Finally, the environment is the aggregate of all surrounding conditions influencing the turf. Turfgrass culture involves manipulation of the environment in order to favor growth and development of the turfgrasses.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Professor of Turfgrass Science, Michigan State University, East Lansing, Michigan.

Over the period of a year turf is subjected to numerous environmental stresses which we attempt to modify, minimize, or even prevent through our turfgrass cultural practices. Environmental stresses can be divided into three types: (1) atmospheric; (2) edaphic (soil); (3) biotic (man-traffic). This paper will be concerned primarily with the atmospheric types of environmental stress. The major environmental stresses that turf may be subjected to include (a) heat, (b) scald, (c) low temperature, (d) drought (summer dormancy), (e) winter desiccation, (f) flooding, (g) shading, and (h) atmospheric pollutants.

* * *

The first seven types of stress were then discussed in detail based on research conducted at Michigan State University.

* * *

The professional turfman should become as knowledgeable as possible concerning environmental stresses. There are five major aspects with which he should be concerned.

A. First, are the specific symptoms associated with turfgrass damage caused by each of the major types of environmental stress. Recognition is a very important prerequisite to determining the specific cause of damage so that the appropriate steps can be taken to correct it or to prevent it in the future. The specific criteria that can be utilized in recognizing a particular type of environmental stress include (a) the time of year, (b) associated environmental conditions, (c) soil conditions including topography and drainage, and (d) particular turfgrass species or cultivar that has been affected.

B. Second, he should have a clear understanding of the conditions that favor the eventual development of a specific type of stress. By knowing the conditions that favor a particular type of stress, he can be prepared in advance to take steps to enhance recovery through overseeding or reestablishment. He can also forwarn his membership or employers that conditions are favorable for a particular type of stress and can outline to them ahead of time the particular steps that he is taking to minimize damage from these stresses. In this way, he will assure his employers that he is on top of the situation. One should keep in mind that no matter how good the professional turfman or how well he exercises his options in preventing environmental stress, there is still the potential under certain situations for a severe loss of turf to occur in spite of his efforts. This is due to the fact that we do not have turfgrass cultivars available which tolerate all types of environmental stress that may occur over a period of time.

C. Third, is an understanding of species and cultivar tolerances to each type of stress. One can then assess the particular stresses most likely to occur in a given situation and select the particular turfgrass species and cultivar most likely to survive in this situation.

D. Fourth, he should have an understanding of the cultural practices that can be utilized to minimize environmental stress. Basically, this involves manipulation of (a) the environment surrounding the turf, or (b) adjusting the physiological condition of the turfgrass plant so that it is more hardy and able to survive the environmental stress. Quite frequently this involves a reduction in the hydration level (water content) within the plant tissues and a reduction in the growth rate.

E. Finally, the fifth involves an understanding of the cultural practices that can be utilized to enhance recovery of the turf from each particular type of environmental stress. Depending on which type of stress has caused the damage, there are certain steps that can be taken to reduce the chance of further damage and enhance recovery of the surviving turfgrass plants.

CONTINUING EDUCATION FOR GOLF[1] COURSE SUPERINTENDENTS

Nick Geannopulos[2]

Have you ever had one of those days when you were able to sit down and relax for a few minutes without interruption? If so, perhaps you may have silently asked yourself some very penetrating questions like: "Why did I select this profession as my life-long career?"; "Am I a good superintendent?"; "Why am I not as highly respected as my neighboring superintendents, even though my members freely admit that my turf is 100 percent better?" and "What can I do to improve my situation?"

These are questions that every professional person asks himself sooner or later. Unfortunately, not all of these people will take the step that is so important--making a firm decision to do something positive about the situation. They simply shrug their shoulders and say, "Well, the other fellows just get the lucky breaks," or "My members will never appreciate me regardless of what I do." If this is your attitude, then there is little need for you to read further.

However, for those of you who are genuinely interested in becoming better golf course superintendents, the remainder of this article should prove useful.

The Golf Course Superintendents Association of America has steadily improved on, and added to, its basic precept of providing meaningful educational services to its members, as well as to the turf industry in general. Since the organization of this association on September 13, 1926, every effort has been made to live up to the objectives adopted at that time.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Golf Course Superintendents Association of America, Des Plaines, Illinois.

Dedication to better turf and better golf, specifically:

1. To promote research and the interchange of scientific and practical knowledge pertaining to the care of golf courses and turfgrass operations.

2. To emphasize more efficient and economical golf course operations and increase prestige for GCSAA and its individual members as well as the profession of golf course superintendency, which encompasses the production, maintenance, and improvement of turfgrass.

3. To encourage cooperation with other associations and organizations whose interests parallel or complement those of GCSAA, and to stress justice, benevolence, and education to and for its members.

Conference and Show

The most widely known of GCSAA's programs is undoubtedly its annual International Turfgrass Conference and Show. The 45th such Conference and Show will be held February 10-15, 1974, in Anaheim, California.

It is fairly certain that this will be another record-breaker for GCSAA. More than 4,500 persons are expected to attend and the Show will have nearly 150 exhibitors in more than 400 booths. This, in itself, is an educational experience of a practical nature which no progressive superintendent can afford to miss.

The educational sessions, spread over 4-1/2 days and utilizing the knowledge and experience of nearly 50 well-known speakers (including more than 30 golf course superintendents), represent a value that cannot be turly measured. How can anyone place a monetary value on knowledge acquired; knowledge which may mean that a superintendent can drastically improve the playing conditions at his course or make more efficient use of available men, equipment or material?

Certification Program

This relatively new program, established on September 1, 1971, is beginning to gain momentum and popularity throughout both the association and other turf-oriented organizations.

Perhaps a few figures will corroborate this. At the end of 15 months of operation, the program has:

1. received over 240 prepaid applications, which represents more than 10 percent of the eligible membership;

2. recognized 145 members as Certified Golf Course Superintendents;

3. earned the reputation of offering a comprehensive and difficult, but fair, written examination (approximately 50 percent of all certified members have failed one or more sections of the examination and of these, approximately 50 percent have been successfully re-examined);

4. sold 40 Certification Manuals to non-superintendent GCSAA members who wished to use the manual as a reference source;

5. received over 20 inquiries from both turf and non-turf associations with respect to design, scope, and operation of the certification program (for consideration of certification within their organizations);

6. generated enough interest that more than 15 articles have been written by other groups about our efforts.

Seminar Program

The most recent GCSAA educational effort, a series of intensive, short-term seminars, became operational in April, 1972. This program, too, is rapidly gaining wide-spread acceptance among the membership because of its direct educational benefits. Before this fiscal year is over, six two-day seminars will have been offered to GCSAA members. The seminars are scheduled for Chicago, Columbus (Ohio), Hartford (Connecticut), Los Angeles, Tampa, and Washington, D.C.

This initial seminar, entitled "GCSAA Management Seminar-I", offers intensive training in basic accounting procedures.

It includes simulation exercises in budget analysis, cost analysis, and fixed and variable ratios as related to a hypothetical golf club operation. Based on past, current, and future enrollment figures, nearly 200 members will have attended this first seminar, and the executive committee has instructed the director of education to develop at least two additional seminar topics for implementation in 1973. Priority is to be given to pesticides, the Occupational Safety and Health Act, and "people relations."

The seminar program fulfills the prime objectives of the association by providing for an interchange of practical knowledge, emphasizing more efficient and economical golf course operations, and providing educational benefits to and for members.

Successful completion of a seminar, which is contingent upon passing a nonmandatory written examination, also benefits each participant in that he receives an achievement certificate, transmission of a congratulatory letter from GCSAA's President to a club official (selected by the participant and accreditation toward certification re-examination requirements if the participant is in the Certification program.

Of course, the greatest benefit of attending a seminar lies in the fact that the participant acquires more knowledge and experience in his profession--he has done something positive about upgrading his professional status.

Scholarship and Research Fund

This agency, founded in 1956 and dedicated to providing financial aid for turfgrass students and research projects and to the dissemination of turfgrass knowledge, has functioned admirably during its years of existence. As of this year, nearly a quarter of a million dollars has been awarded to 469 students and 72 research projects at more than 50 colleges and universities throughout the U. S. and Canada.

A record number of scholarship applications (163) and fourteen research grant applications were received this year. These requests amounted to more than $88,000.00 and created severe selection problems since the fund had only $36,760.07 available for distribution. After very careful consideration, fifty-three students were awarded scholarships totalling $23,450.00, and nine research grant applications were approved totalling $13,170.00.

The GCSAA firmly believes that the Scholarship and Research Fund program is of value to its members and the entire turfgrass industry. Over thirty percent of the scholarship recipients have become superintendents and it is obvious that all members benefit from turfgrass research endeavors. In addition, the very fact that GCSAA makes such awards ensures that our colleges and universities are made aware of the existence of the profession and this, in turn, encourages them to recognize turf management programs.

Slide and Film Library Program

A further indication of the association's desire to provide up-to-date technical information to its members lies in this area. During the past 2-1/2 years, several hundred color slides and five color and sound films have been obtained. The films are available to any GCSAA member, chapter, or bonafide educational institution on a cost-free loan basis; and as soon as the slides are properly catalogued, they, too, will be available on the same basis.

The five films, with approximate running times, are:

1. "The ABC's of Putting Green Construction" (23 minutes)
2. "Courtesy on the Course" (18 minutes)
3. "Water Movement in Soil" (27 minutes)
4. "Drainage System for a Difficult Green" (15 minutes)
5. "Your Experimental Green" (20 minutes)

Summary

The principal function of GCSAA is membership service, and high on our list of priorities is providing a wide array of educational material and opportunities. With more than 3,500 members in 90 chapters, our obligation is to assist each superintendent in keeping pace with new developments and methods which will make his work more effective, more efficient, and more economical.

SULPHUR-COATED UREA[1]

J. D. Beaton[2]

Introduction

Most of the conventional, water-soluble nitrogen fertilizers commonly used in agriculture are not ideal for application to turfgrass. One of their most serious shortcomings is rapid release resulting in excessive growth shortly after fertilization followed by inadequate N supply later in the growing season. Rapid flushes of growth are undesirable because they may reduce the quality of playing surfaces and interrupt scheduled uses of turfgrass areas. In addition, heavy growth will result in higher mowing costs.

More uniform turfgrass production can of course be obtained by frequent small dressings of the quickly soluble N sources. However, such repeated applications are an inconvenience and they tend to be expensive where labour costs are high. Also, it may be physically impossible to apply the fertilizer when it is needed most.

Other disadvantages in the general use of fast-acting sources of N include: (a) massive applications in excess of recommended rates may be harmful, especially to sensitive species and varieties; (b) soluble nitrates not taken up by the crop or held in the soil can be lost through leaching and run-off and may eventually contaminate ground waters and surface streams; (c) nitrogen from some fertilizer products may be lost through volatilization and decomposition; and (d) poor efficiency in terms of plant growth per unit of applied N.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Chief Agronomist, Cominco Ltd., Calgary, Alberta.

Much effort has been directed to the development of slowly available fertilizers which release N at rates more nearly matching the requirements of plants for this nutrient. The most important slow release N containing products now commercially available in North America for turfgrass fertilization include ureaforms, methylene urea - urea, isobutylidene diurea (IBDU), polymeric semipermeable coatings on soluble N sources, and activated sewage sludge.

Current annual consumption of the ureaforms and the methylene urea - urea products is estimated to be between 60,000 to 80,000 and 200,000 to 230,000 tons, respectively (J. A. Long, 1973, personal communication). Use of isobutylidene diurea is believed to be approximately 5,000 to 7,000 tons yearly (John T. Hays, 1973, personal communication; J. A. Long, 1973, personal communication). Total N supplied by all of the various slow-release fertilizers now sold in the U. S. is probably about 50,000 tons annually. (John T. Hays, 1973, personal communication).

Acceptance of slow-release nitrogen products will likely become much greater when their high cost is substantially reduced. One promising approach for production of reasonably priced slow-release N fertilizer is to coat common N fertilizer materials with relatively insoluble, inexpensive materials such as elemental S (Beaton & Fox, 1971). The remainder of this paper will be devoted to discussions of the production, properties, uses, and effectiveness of sulphur-coated urea (SCU).

Production

A. Manufacturing Facilities

Processes for the production of SCU have been studied by the Tennessee Valley Authority for over 16 years. This work has progressed from early bench-scale trials to the use in 1967 of a small pilot plant with an output of 150 pounds per hour (The Sulphur Institute, 1972 a). A new pilot plant was built in 1971 with a design production capacity of one ton per hour (The Sulphur Institute, 1972 b). Plans are now proceeding for construction of a ten ton per hour plant at TVA, representing a scale-up by a factor of 10 (The Sulphur Institute, 1972 a).

Pilot-scale SCU plants have been built within the last 4 or 5 years in England, Germany, Switzerland, and possibly in other countries (The Sulphur Institute, 1972 a). One fertilizer manufacturer (Imperial Chemical Industries Limited) in England is currently producing SCU in a plant with a capacity of 10,000 tons per year (Carpentier, 1973). There are also very recent reports of SCU pilot plants being built in Korea and Taiwan (Nelson, L. B., 1973, personal communication).

B. Manufacturing Process

The basic process involves formation of a S shell around each urea particle by spraying atomized molten S on a rolling bed of preheated urea particles (Beaton & Fox, 1971; The Sulphur Institute, 1972 a). A light coating of petroleum wax is applied on top of the S coating to seal pinholes and cracks, which would affect the controlled release properties. The wax may contain small amounts, usually less than 0.5% by weight, of microbiocides such as coal tar to prevent its being attacked by soil microorganisms. Finally, a small amount of conditioner is added to give good product handling characteristics. Greater details of this pilot plant process have been reported previously (Beaton & Fox, 1971; Bixby & Beaton, 1971; Rindt et al., 1968; The Sulphur Institute, 1972 b).

It is possible to manufacture SCU with coatings composed of only elemental S (The Sulphur Institute, 1972 a). In the absence of wax or other additives, approximately 40% more S is needed. A typical analysis of this newer type of SCU is 35-0-0-22 with a 22% dissolution rate. The significance of dissolution rates will be discussed later in this paper.

One of the most important considerations in the S coating of urea is the size and physical surface characteristics of the urea being treated (The Sulphur Institute, 1972 b). The urea should be spherical, smooth and closely sized. Granular urea is preferred to air-prilled urea because the larger particles of the former are easier to coat and require less S to obtain a given controlled dissolution rate (Tennessee Valley Authority, 1972). One fertilizer producer in western Canada makes a urea fertilizer by a spray drum granulation process (Phillips, 1971) which is especially well-suited for production of SCU. TVA has developed on pilot-scale a pan-granulation process for producing urea suitable for sulphur coating (The Sulphur Institute, 1972 b; Tennessee Valley Authority, 1972).

C. Cost of SCU Fertilizers

The N supplied in SCU is estimated to be about 30% more expensive than it is in uncoated urea (Tennessee Valley Authority, 1972). Transportation and handling costs of the N in SCU are expected to be about 15% higher than they are for N in conventional urea fertilizer. Costs of producing, marketing, and applying SCU are probably about the same as for ammonium nitrate. There are reports, however, of the ICI produced SCU selling in England at prices comparable to those charged for ureaforms (L. B. Nelson, 1973, personal communication).

According to TVA estimates, a total capital investment of approximately $2,700,000 is required to construct a SCU plant with an economical production capacity of 500 tons per day or 150,000 tons per year (Tennessee Valley Authority, 1972). Most any modern ammonia plant can produce urea or SCU and urea plants can be readily converted to the production of SCU.

Properties

A. Typical Analysis of SCU materials

Products from the early TVA pilot plant had a typical analysis of 35-0-0-19 (S). Improvements in operating procedures in the new pilot plant at TVA have made it possible to reduce coating thickness and to produce SCU materials containing more N, e.g., 39-0-0-10 (S) with total coating weights of about 14% and dissolution rates of around 20% (The Sulphur Institute, 1972 a).

B. Rate of Release of N from SCU Products

The controlled release property of SCU is expressed as the percentage of urea which dissolves following immersion of the product in water under controlled conditions for 7 days. Dissolution rates of 20 - 30% in 7 days, followed by 1% or less daily thereafter, are usually considered suitable for most agronomic situations.

Varying small amounts of urea are usually released soon after SCU products are applied to soil due to imperfections in the S coating of some granules. However, the mechanism of controlled release of N involves gradual seepage of water into granules followed by diffusion of dissolved urea solution through pores in the sulphur coating.

C. Factors Influencing Release of N from SCU

Release of N from SCU is influenced by several other factors including amount of coating, soil temperature, and flooding conditions. Small increases of only a few percent in coating weight will greatly delay the liberation of N from SCU granules (Terman & Allen, 1970; Tennessee Valley Authority, 1972). Increases in soil temperature between 50 and 86°F accelerated the dissolution of SCU (Allen et al., 1971). Under flooded conditions, formation of insoluble coatings of substances such as iron sulphide on the S coatings may retard the movement of urea out of SCU granules (Giordano & Mortvedt, 1970).

D. Favorable Physical Properties of SCU

Although SCU was developed primarily as a controlled-release N fertilizer, it has several other favorable properties which should increase its usefulness (The Sulphur Institute, 1972 a; Tennessee Valley Authority, 1972). Less dustiness and breakage during handling and transport of SCU are anticipated since it is more resistant to abrasion and about twice as hard to crush as air-prilled urea.

The coating reduces hygroscopicity and caking of SCU, even in locations with high humidity. Greater ease in storing and spreading of SCU will be of particular importance in developing countries which may lack adequate handling and storage facilities.

Because granules of SCU are considerably larger than air-prilled urea, less segregation will likely occur during the formulation, transportation and application of bulk blends containing this slow release N source.

The coating on SCU prevents undesirable chemical reactions with other fertilizer materials such as triple superphosphate.

If slow-release N characteristics are not required, coatings of only 3 - 4% by weight of S followed by a 0.5% by weight coating of oil and microbicide are sufficient to substantially increase resistance of urea to wetting and breakdown when exposed to humid conditions. Sulphur coatings of about 10% by weight without a further coating of wax and microbicide will also result in high quality granules. Both regular, controlled-release SCU and the products with thin S coatings appear promising for widespread use by bulk blenders.

E. Plant Nutrient Sulphur Supplied in SCU

Substantial quantities of sulphur, which is an important plant nutrient, will be supplied through fertilization with SCU. Sulphur is becoming increasingly deficient in North America (Beaton et al., 1971) and this nutrient is known to have a number of beneficial effects on the growth and quality of turfgrasses (Beaton, 1970; Grau, 1972 a, 1972 b).

During the degradation of SCU granules, sulphur in the coating will gradually oxidize to sulphate and become available for plant uptake (Mays & Terman, 1969). The amount of S provided by breakdown of SCU coatings should be sufficient to meet needs of most turfgrasses. However, in severely sulphur-deficient areas, the S may not be converted rapidly enough to satisfy plant requirements during the first growing season after application. Under these conditions it will probably be necessary to provide some soluble sulphate to meet the initial S needs of turfgrass.

Effectiveness of SCU for Turfgrass

The economics of using SCU products on various crops were reviewed several years ago by Diamond and Mays (1970). Their summary showed that definite savings could be realized, particularly in situations where split applications of water-soluble N sources are normally used.

Another review of crop responses and related benefits from SCU was made in 1972 (Diamond & Myers, 1972). This review indicated that one of the greatest potential uses of SCU is on warm season forages harvested several times each season. Also, SCU was reported to be an excellent fertilizer for turfgrasses in several trials. When compared with a single application of soluble fertilizer, SCU gave less growth immediately after fertilization, but better growth toward the end of the season. Less clipping removal and a longer lasting improved turf colour were two other important benefits of SCU dressings.

Results of studies in Alabama, Indiana, New York, Ohio, Pennsylvania, and Texas showed that SCU has excellent properties as a lawn turf fertilizer (Tennessee Valley Authority, 1972, Unpublished Report on Sulphur-Coated Urea). The important advantages of SCU were relatively small clipping removal, good colour during the growing season, and excellent fall growth. In addition, turf fertilized with SCU maintained its healthy appearance longer in the fall than did treatments with certain commercially available, slow-release fertilizers costing several times as much. Moreover, single applications of SCU were as effective as monthly additions of soluble fertilizers for the production of both total and uniform growth. Other suggested uses for which SCU seems well suited are grasses in parks, recreation areas, golf courses, highway rights-of-way, roadcuts, and newly completed construction projects.

Response of Tifway bermudagrass to several SCU products, ammonium nitrate, and ureaformaldehyde was studied by Mays (1972). He found that early season growth and appearance of the grass were slightly better with single applications of SCU, with dissolution rates of from 15 to 30% in 7 days, than similar quantities of N supplied as ammonium nitrate in 5 monthly increments. Total grass growth was comparable for these two N sources. Twice as much ureaformaldehyde was required to reach the same level of growth and appearance as was obtained with additions of either SCU or ammonium nitrate. Mays concluded that SCU was a promising material for fertilization of most turf areas except golf greens.

There is general agreement that SCU is unsatisfactory for golf greens. A study conducted at Agassiz, B.C., in 1970 showed that much more SCU, 2 to 4 times as much, than sewage sludge or ureaform was removed from closely mowed (1/4") bentgrass (Taylor, D.K., 1973, personal communication). Mowing was done three days after application and irrigation.

Sensitivity of SCU granules to fracture may also restrict use of this fertilizer on golf greens (Hays, J.T., 1973, personal communication). During periods of hot weather, breakage of SCU by mowing operations will result in release of excessive amounts of N and cause burning unless the greens are watered immediately (Ensign, R.D., 1973, personal communication). However, late season additions or applications during off-season, non-use periods may be satisfactory in cool season areas. In Idaho, late winter applications of SCU to greens have improved turf colour (Ensign, R.D., 1973, personal communication). This beneficial effect on colour persisted until the following spring.

The suitability of SCU for golf greens is also being questioned in Florida (Volk, G.M., 1973, personal communication). The major concern is that SCU granules, as now supplied, are too large for efficient use on close cut turf. Special procedures such as brushing, verticutting, etc., which are necessary to get this N source down into the turf for research purposes are considered impractical for routine management of closely mowed turf.

None of these difficulties is expected to be serious when SCU is applied to fairways where cutting heights are usually considerably higher than on greens.

Summary

One promising approach for production of reasonably priced slow-release N fertilizer is to coat common N fertilizer materials such as urea with relatively insoluble, inexpensive elemental S. The basic process developed at the Tennessee Valley Authority for producing sulphur-coated urea (SCU) involves formation of a shell around each urea particle by spraying atomized molten S on a rolling bed of preheated urea particles. A typical analysis of TVA's present SCU fertilizer is 39-0-0-10 (S) with total coating weights of about 14% and dissolution rates of around 20%. Manufacture of SCU with coatings composed of only elemental S is possible.

A pilot plant with a design production capacity of one ton per hour of SCU is currently being operated by the Tennessee Valley Authority. Construction of a larger plant at

TVA with a capacity of 10 tons per hour is being planned. Pilot-scale plants have been built or are being built in England, Germany, Switzerland, Korea, and Taiwan. One fertilizer manufacturer in England is currently producing a SCU product in a plant with a capacity of 10,000 tons per year.

The N supplied in SCU is estimated to be about 30% more expensive than it is in uncoated urea. Transportation and handling costs of the N in SCU are expected to be about 15% higher than they are for N in conventional urea fertilizer. However, an English produced SCU material is reported to cost about the same as ureaform.

In addition to its slow release characteristics, SCU has several other important advantages including resistance to moisture and caking, increased compatability with other fertilizer materials, and supplying S which is another essential plant nutrient.

Considerable savings have been predicted from using SCU on agronomic crops, especially in situations where split or repeated applications of water-soluble N sources are normally used. One of the greatest potential uses of SCU is on warm season forages harvested several times each season.

There are strong indications that SCU has excellent properties as a lawn turf fertilizer. The important advantages of SCU are relatively small increases in clipping removal, improved growth and appearance of grasses throughout the growing season, and excellent fall growth. Moreover, the beneficial effects of SCU applied late in the growing season may persist into the following spring. Also, single applications of SCU are as effective as monthly additions of soluble fertilizers for the production of both total and uniform growth. Other suggested uses for which SCU seems well suited include grasses in parks, recreation areas, highway rights-of way, roadcuts, and newly completed construction projects.

Current forms of SCU are unsuitable for golf greens because of the sensitivity of granules to fracture. In addition, substantial quantities of SCU are mechanically removed during mowing of closely cut turf. On fairways where mowing heights are usually higher, SCU is expected to be a very satisfactory source of slow-release N.

REFERENCES

Allen, S.E., C.M. Hunt, and G. L. Terman. 1971. Nitrogen release from sulphur-coated urea, as affected by coating weight, placement, and temperature. Agron. J. 63 (4):529-533.

Beaton, J.D. 1970. Role of sulphur in turfgrass fertilization. Proc. 8th B. C. Turfgrass Conf., Victoria, B.C. April 23-24, 1970. pp. 33-52.

Beaton, J.D. and R.L. Fox. 1971. Production, Marketing and Use of Sulphur Products. Chapt. 11 In. FERTILIZER TECHNOLOGY AND USE (2nd. ed.) (R.A. Olson et al, eds.). Soil Science Society of America, Inc., Madison, Wis. pp. 335-379.

Beaton, J.D., S.L. Tisdale, and J. Platou. 1971. Crop responses to sulphur fertilization in North America. Tech. Bull. 18, The Sulphur Inst., Washington, D.C.

Bixby, D.W. and J. D. Beaton. 1970. Sulphur-containing fertilizers: Properties and applications. Tech. Bul. 17, The Sulphur Inst., Washington D.C.

Carpentier, A. 1973. Visit report No. 643, The Sulphur Inst., London, England.

Diamond, R.B. and D.A. Mays. 1970. Agro-economics of sulphur-coated urea. Proc. Assoc. Southern Agr. Workers 67th Annual Convention, Memphis, Tenn., Feb. 1 - 4, 1970.

Diamond, R.B. and F.J. Myers. 1972. Crop responses and related benefits from SCU. Sulphur Inst. J. 8 (4): 9-11.

Giordano, P.M. and J.J. Mortvedt. 1970. Release of nitrogen from sulphur-coated urea in flooded soil. Agron. J. 62 (5): 612-614.

Grau, F.V. 1972 a. Sulphur for turfgrass. Weeds, Trees and Turf. 11 (2): 22, 48, 54, 60, 64.

Grau, F.V. 1972 b. Does your turf need sulphur? Better Crops with Plant Food. 56 (1): 22-25.

Mays, D.A. 1972. Response of Tifway bermudagrass to soluble and slow-release N sources. Agronomy Abstracts of 1972 Annual Meeting, America Society of Agronomy. Miami Beach, Fla., October 29 to November 2, 1972. P. 146.

Mays, D.A. and G.L. Terman. 1969. Response of coastal bermudagrass to nitrogen in sulphur-coated urea, urea, and ammonium nitrate. Sulphur Inst. J. 5 (3): 7-10.

Phillips, A.B. 1971. Impact of new technology on marketing. In. Searching the Seventies, Proc. Fertilizer Production and Marketing Conf., Memphis, Tenn., Sept. 15-17, 1971. pp. 43-48.

Rindt, D.W., G.M. Blouin, and J.G. Getsinger. 1968. Sulphur coating on nitrogen fertilizer to reduce dissolution rate. J. Agr. Food Chem. 16 (5): 773-778.

Tennessee Valley Authority Staff. 1972. Tailoring of Fertilizers for Rice. Bulletin Y-52, Tennessee Valley Authority, Muscle Shoals, Ala. pp. 38-42.

Terman, G.L. and S.E. Allen. 1970. Leaching of soluble and slow-release N and K fertilizers from Lakeland sand under grass and fallow. Soil Crop Sci. Soc. Fla. Proc. 30: 130-140.

The Sulphur Institute Staff. 1972 a. SCU - A progress report. Sulphur Inst. J. 8 (4): 2-5.

The Sulphur Institute Staff. 1972 b. Sulphur coated urea - TVA's new pilot plant. Sulphur Inst. J. 8 (4): 6-8.

NITROFORM, ITS CHARACTERISTICS AND PERFORMANCE[1] IN GROWING AND ESTABLISHING TURFGRASS

C. Robert Staib[2]

There have been tremendous advancements in turfgrass culture as you have witnessed and practiced in just the past decade. Refinements have been made in practically every segment of the industry.

One of the leading headliners in the new age of turf culture is the vastly improved fertilizer technology. Until recently a turfgrass fertilizer could only be defined as one having a distinctive odor of organic origin that would grow green grass. In fact, there really were no valid criteria for quality fertilizers. There were only two choices: natural organics, available at one price, and manufactured agricultural nitrogen fertilizers, available at another price. Differences existed primarily in their analyses and safety. The organics had low nutrient contents, but were relatively safe to use on grass. Synthetics had higher analyses and had to be used with care.

The trend, starting in the sixties and continuing ever onward, is toward high analyses fertilizers which can be used with complete safety, at a reasonable cost, as infrequently as possible. These are indeed quality plant foods, and VIVA LA DIFFERENSE!

Nitroform, being one of the first of the new breeds to appear on the scene, continues to offer turf managers and landscapers the means to establish and maintain quality plant materials with built-in safety and longevity at an

---

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Turf Products, Synthetics Department, Hercules Inc., San Francisco, California.

economical cost. In addition, its high analysis (38% N), and in particular, its high level of water-insoluble nitrogen (71% of total N) enables fertilizer formulators to build a wide variety of quality turf foods with high W.I.N. contents, more so than from all other nitrogen sources.

Nitroform® is Hercules' trade name for ureaform, a reaction product resulting from combining urea with formaldehyde at a ratio approaching two to one under carefully controlled prescribed conditions. Under these conditions, a chain-reaction occurs, referred to as polymerization, whereby a series of low molecular-weight polymers of methylene ureas are formed (condensed) on a belt passing through a drier. The reaction is complete when three fractions of methylene ureas are condensed in the desired apportionment and before any additional reaction would form products from which nitrogen would be completely unavailable. The finished product contains no free formaldehyde and but a trace of free urea.

$$\underset{\text{UREA}}{NH_2 - \overset{\overset{\displaystyle O}{\|}}{C} - NH_2} \quad + \quad \underset{\text{FORMALDEHYDE}}{H - \overset{\overset{\displaystyle O}{\|}}{C} - H} \quad =$$

$$\boxed{\text{UREA}} - CH_2 - \boxed{\text{UREA}} - CH_2 - \boxed{\text{UREA}} - CH_2 - \boxed{\text{UREA}} - CH_2 - \boxed{\text{UREA}}$$

UREAFORM

Desired specifications for the manufacturer of ureaform are based on the proportions of water-soluble, cold water-insoluble, and hot water-insoluble methylene ureas existing in the final product. The lightest molecular-weight methylene urea is water-soluble while the next two polymers in the chain containing more urea and - CH_2 - radicals are considered water-insoluble. These three fractions exist in Nitroform in nearly equal proportions. The higher molecular-weight methylene ureas contribute 27 units of the 38 total units of nitrogen in Nitroform as water-insoluble nitrogen.

Though the first fraction of methylene urea is considered to be water-soluble, it is soluble only to the extent of about one-gram soluble in 250-cc of water. Compare this to urea at one-gram soluble in one-cc water.

You may ask the question, how does this relate to nitrogen availability for growing turf? Let us make an interesting comparison. Nitroform is like a well-seasoned old oak log ready for the fireplace on a cold winter's night. It takes a while to get kindled, but once it does, just one good-sized log will provide comforting warmth all evening long.

All the nitrogen in ureaform is made available by the action of soil microorganisms. The more water-soluble fraction can be likened to fresh green organic residue. It is easily nitrified. The cold water-insoluble fraction is intermediate in its resistance to micro-biological attack, and gives up its nitrogen correspondingly. The hot water-insoluble fraction is the most resistant, yet the bugs stubbornly, over a longer period, chew it up.

In controlled laboratory nitrification studies where there exists an optimum environment for soil microorganisms at a constant temperature of 83°F., nitrification of these fractions proceeds thus:

Fraction I (water-soluble)	4 to 6 weeks
Fraction II (cold water-insoluble)	5 to 6 months
Fraction III (hot water-insoluble)	2 to 3 years

It is important to bear in mind that nitrification of all fractions commences immediately following application, and continues concurrently, all fractions releasing nitrogen together but at varying rates.

We suspect that many different kinds of organisms react on ureaform, and that resistant polymers of methylene urea actually influence the propagation of micro-biological species capable of doing the job. This may be why one finds the longer you use ureaform, the better the observed response. Speaking of these organisms, it is well to note that ureaform actually nourishes these fine creatures of the earth just as effectively as any natural organic medium. All the carbon goes to provide energy while they carry on their work and reproduce themselves.

Nitroform then, reacts in the soil in a "natural organic manner", and as such, contributes to the well being of the soil as well as feeding the vegetation growing upon it.

Knowing how ureaform works in the soil teaches us how to use it for feeding turf and other good plants. Remember the little bugs first! Also, remember the oak log on a cold winter night! It must be properly kindled to get the most out of it. It is advisable to apply a reasonably good quantity of Nitroform the first time you use it. For fine turf and ground covers, I recommend 20 pounds of product per 1,000 sq. ft. - equivalent to 7.6 pounds of actual nitrogen. This may seem like a lot of N to apply at one time. If you are about to embark on a Nitroform program, forget old concepts for just that one initial application. Nitroform will not burn, even at double that rate! You want to establish a reserve of nitrogen in the soil as quickly as possible. This amount influences the build-up of the microbial population necessary to do a fine job of making nitrogen available to the plant. Following that, only nominal increments are periodically applied at rates of N according to that recommended for particular varieties and climates. Now, you can go back to the old concepts. You just don't have to be as careful as you used to be. Another way to look at it .... The bigger the deposit, the greater the interest! You don't lose any of the principal; it just keeps right on working.

Now, regarding these new quality fertilizers. How do you define them? The Penn State University College of Agriculture Extension Service set up a criterion that is being widely accepted. Penn State is recognized as having an excellent turf program.

In a report, Turfgrass Fertilization, prepared by John C. Harper, II, Extension Agronomist, is defined a turf-grade fertilizer as a complete fertilizer having an approximate 2-1-1 ratio, containing 10% or more nitrogen and having 35-percent or more of the total nitrogen as water-insoluble, W.I.N. It is this nitrogen which is the key to quality. Any nitrogen fertilizer containing one-half the nitrogen from Nitroform will have 35-percent of the total nitrogen as W.I.N. If all the nitrogen is from Nitroform, then 71-percent of total nitrogen will be W.I.N. One of Sears most successful fertilizers is a 30-3-6 with 71-percent of total nitrogen as W.I.N.

Formulator-suppliers in this area have more capability of providing quality fertilizers at reasonable prices because no other organic nitrogen available anywhere has this high W.I.N. content. Economy is important! Nitroform nitrogen by itself or in mixed fertilizers is more economical than most commonly used organic or other slow-release nitrogen sources.

Nitroform can be blended in any desirable amount according to your own local needs. You can buy it straight for direct application or blend it onsite with natural organics for top-dressing or for general maintenance. Combining Nitroform with natural organics is often a fine idea. The synergistic effect on the microorganisms is soon obvious.

Probably the most dramatic response you will see from Nitroform is when it is incorporated in the seedbed when establishing new turf. Twenty pounds of Nitroform plus adequate levels of phosphorus and potassium per 1,000 sq. ft. will produce a solid uniform stand of turf possibly sooner than from other nitrogen sources. This slide comparing this rate of Nitroform to the highest level of ammonium sulfate which could be safely tolerated in establishing turf sod in Puyallup in November illustrates this point. The picture was taken the following February. No additional N was applied to either side. Note that this occurred during the winter months.

What about Nitroform during the winter months? In areas west of the Cascades, it will continue to respond to microbial activity, though at reduced rates. As long as there is sufficient warmth in the soil for micro-biological activity, Nitroform is releasing nitrogen. When temperatures drop, the plant's demand for nitrogen is decreased or eliminated. Nitroform will be available when temperatures again favor plant growth. In turf during the winter months in the warmer areas of the Northwest, Nitroform continues to influence green color and texture even though growth may have slowed considerably.

UREA-FORMALDEHYDE REACTION PRODUCTS[1] ARE NOT ALL ALIKE

Jim Chapman[2]

In 1948, Dr. Clark (1) reported that a solid, slowly available nitrogen product could be made by reacting urea with formaldehyde. The nitrogen availability from urea-formaldehyde was shown to be dependent upon the ratio of urea and formaldehyde and the chemical and physical properties of the reaction mixture. The nitrogen release characteristics can be estimated chemically by identifying the percent nitrogen which is insoluble in cold water and hot water. In addition to a chemical analysis, the nitrogen release characteristics of urea-formaldehyde reaction products can be determined by using grass as an indicator plant.

The water soluble nitrogen fraction of most commercially available urea-formaldehyde formulations is approximately one-third of the total nitrogen. Scott's ProTurf Fertilizer is a urea and formaldehyde reaction product which contains approximately two-thirds water soluble nitrogen. The reaction product is identified as methylene ureas. The analysis is shown below.

1/ To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/ O. M. Scott Company, Bellevue, Washington.

Total Nitrogen (N) 32%
1.3% ammoniacal from ammoniated phosphate
20.0% water soluble from urea and methylene ureas
10.7% water insoluble from methylene ureas
Available phosphoric acid P_2O_5 from ammoniated phosphate 5%
Soluble Potash (K_2O) from potassium sulfate. . . . 3%

The 1.3% ammoniacal and the 20% water soluble nitrogen make up the cold water soluble which is the more readily available fraction. The 10.7% water insoluble nitrogen consists of cold and hot water insoluble fractions with approximately half of the nitrogen soluble in hot water. Added together, the three total the 32% guaranteed nitrogen analysis. The analysis panel is a helpful tool in evaluating the nitrogen characteristics of a product.

The cold water soluble (CWSN) fraction is essential for initial response since it is more readily available to the plant. The cold water insoluble nitrogen (CWIN) of which 45-60% is soluble in hot water consists of larger methylene urea molecules that must be biodegraded by microorganisms before it is available to the plant. This fraction extends the turf response well beyond that which is provided by the cold water fraction. The hot water insoluble nitrogen fraction (HWIN) consists of even larger molecules and requires a longer time to become available as shown in Figure 1.

Figure 1 - The Approximate Turf Response from Various Nitrogen Fractions in a Methylene Urea Product*

Days After Treating

0 7 14 21 28 35

Cold Water Soluble N (CWSN)

Cold Water Insoluble N (CWIN)

Hot Water Insoluble N (HWIN)

*Methylene urea fertilizer used in this study was Scotts ProTurf Fertilizer 32-5-3.

The response period can be extended by applying heavier rates of nitrogen but the same general relationship exists as shown above.

The relative amounts of the three nitrogen fractions (CWSN, CWIN and HWIN) are controlled primarily by the U/F mole ratio (the ratio of the molecular weight of urea to the molecular weight of formaldehyde), and the reaction conditions. Examples of U/F ratios are as follows:

1.3:1 = moles urea to 1 mole formaldehyde. This ratio will often result in approximately 33% Cold Water Soluble Nitrogen.

2.0:1 = 2.0 moles urea to 1 mole formaldehyde. This ratio will often result in approximately 66% Cold Water Soluble Nitrogen.

The 2.0:1 ratio will often result in a product which contains more soluble nitrogen and therefore releases nitrogen at a reasonably fast rate.

It is technically possible, although not practical, to make a urea-formaldehyde fertilizer in which the nitrogen is completely unavailable to the plant. These type products could contain equal molar amounts of urea and formaldehyde (U/F 1.0: 1.0). The other extreme would be a fertilizer with a nitrogen release rate similar to that of urea. This material would contain a large quantity of urea and a small quantity of formaldehyde. Release rates between these extremes that support different levels of response are possible.

Scotts research personnel have been conducting laboratory and field experiments with methylene ureas and ureaform fertilizers spanning a twenty year period. Fertilizers with U/F ratios ranging from 1.3:1 to 3:1 have been tested on many grasses and under different climatic conditions. Products that are made with ratios of urea to formaldehyde as low as 1.3:1 are often slower to green the turf and have a short residual at rates of 1 - 4 lbs. of Nitrogen/1,000 sq. ft. Products with higher ratios of urea to formaldehyde

(1.5:1 to 2.0:1) produce a more rapid greening and longer residual response when applied at 1-2 lbs. Nitrogen/1,000 sq. ft.

Figure 2 demonstrates a typical turfgrass response for a low (1.3:1) and a higher U/F mole ratio (1.5:1 - 2.0:1).

All urea-formaldehyde reaction fertilizers are not alike. The graph shows that the initial response in the first 9-23 days was greater for the 1.5:1-2.0:1 U/F mole ratio treatment. The residual response based on the clipping yield between the fifty-fourth and the sixty-fourth day was greatest for the turf treated with the 1.5:1-2.0:1 U/F ratio as compared to the 1.3:1 ratio (39 grams vs. 25 grams, respectively). These data show that the lower U/F mole ratio at equivalent rates of nitrogen result in initial greening and a lower level of response during the growth period than the higher U/F ratio fertilizer.

Fertilizers with U/F ratios from 1.5:1 to 2.0:1 are considerably safer to use than soluble sources of nitrogen. This is especially true at heavier rates and under conditions which are conducive to turf phytotoxicity.

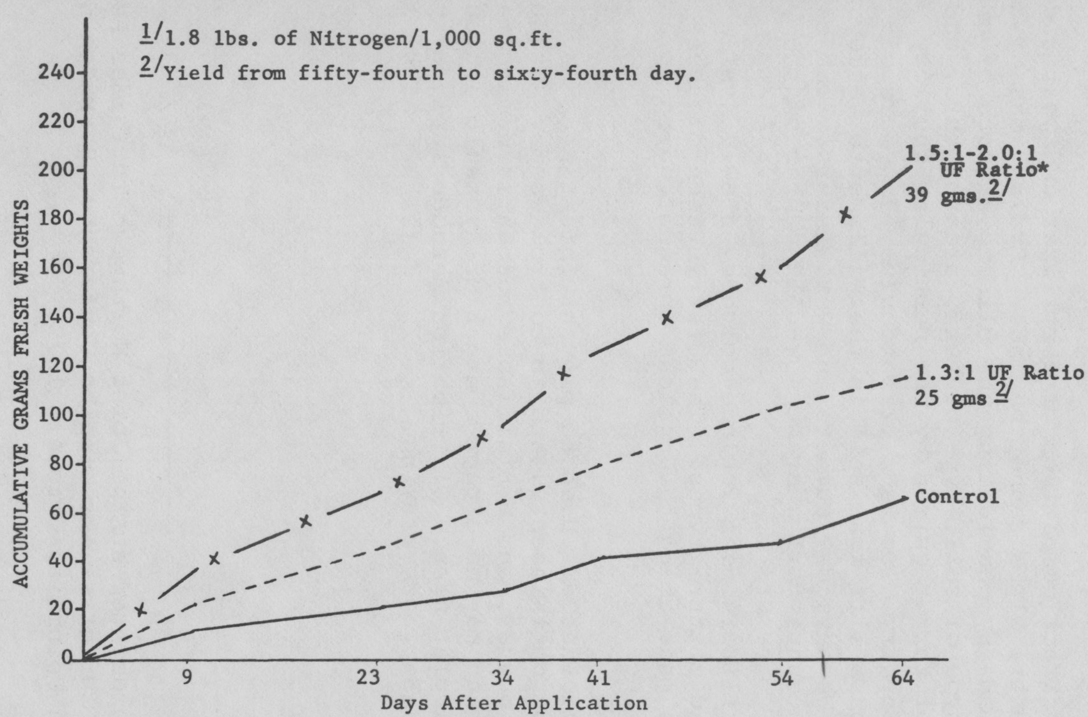
In conclusion, extensive testing of fertilizers with various U/F mole ratios have shown in our program that ratios as low as 1.3:1 U/F provide slow response and do not achieve the same level of total or residual response as higher ratios evaluated under the same conditions. The fast release rate of soluble nitrogen sources cause excessive initial growth and increase the likelihood of turf injury.

The nitrogen release rates of U/F ratios in the 1.5:1 to 2.0:1 range support early and adequate levels of initial greening plus a sustained growth response at light rates of nitrogen. These are fertilizer benefits that are most useful in any professional turfgrass maintenance program.

REFERENCE

(1) Clark, K. F., J. Y. Yee and K. S. Love, Ind. Eng. Chem., 40, p. 1178, 1948.

Figure 2 - Response of Merion Kentucky Bluegrass to Various Urea-Formaldehyde Mole Ratios[1]



* The O. M. Scott ProTurf Fertilizer used in this experiment is in the range of 1.5:1 - 2.0:1 U/F ratio.

ANNUAL FERTILIZER[1] AND PESTICIDE COST

Richard Schwabauer[2]

The direct comparison of fertilizer and pesticide costs among country clubs cannot be made. Evaluations of costs must be made by considering the climate, length of growing season, type of soil, type of turf, area of turf, and quality of turf required by the particular facility. Waverly Country Club is a private club, 75 years old, and located on a silt loam soil in the Willamette Valley of Oregon. We have dry summers and wet winters. The bent-grass-*Poa annua* turf must be mowed 12 months of the year.

Fertilizers used include soluble, slowly available, simple and mixture types. The distribution of these materials is made using the cyclone spreader, drop spreader, and spraying.

Pesticides are used to prevent infestation by fungi, to control soil insects, and to control weeds. Granular, wettable powder, and emulsifiable concentrate materials are used and may be either contact or systemic action on the particular pest. Distribution methods include cyclone, drop spreader, or spraying.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Superintendent, Waverly Golf and Country Club, Portland, Oregon.

ANNUAL FERTILIZER COSTS *

	Greens	Tees	Fairways	
Material				$3,700.00
Labor				
Applications	18	8	9	
Hours	125	80	72	
Cost	$420	$275	$256	951.00
Total Material and Labor Cost				$4,650.00

ANNUAL PESTICIDE COSTS *

	Fungicide	Herbicide	Insecticide	
Material	$1,700	$180	$275	$2,155.00

Labor	Greens	Tees	Fairways	
Applications	16	4	2	
Hours	250	36	70	
Cost	$835	$124	$227	1,186.00
Total Material and Labor Cost				$3,341.00

* Three Year Average

PROS AND CONS OF FERTILIZER[1] PESTICIDE COMBINATIONS

E. C. Hughes[2]

At the outset let me state that this report is a combined presentation. Dr. Gerber, Entomologist, and Dr. D. Ormrod, Plant Pathologist, B.C.D.A., Cloverdale, have added their inputs to mine for their respective fields.

The use of fertilizer combinations have generally not been advocated by the B. C. Department of Agriculture. In fact the B. C. Committee on Pesticide Use several years ago went on record as being opposed to their use generally. The reasons primarily centered about the opinions that:

1) Many of the pesticides in such mixtures may not be specific for use for specific problems

2) Such mixtures may be subject to overuse, being applied
   a) at times when not being needed, or
   b) being applied in excess by successive periodic applications as specified for fertilizer needs along with danger of injury

3) Fertilizer pesticide mixtures may be applied to/on other crops resulting either in injury or creating residue problems in crops for which such pesticides may not be approved.

Reaction from the trade at that time was actually quite critical. Generally, it was felt such statements were unjustified with reference to the use of pesticides.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Field Crops Specialist, Canada Department of Agriculture, Surrey, British Columbia.

Relative to more specific reactions is the availability and use of specific pesticides. Insecticides such as chlordane, aldrin and other chlorinated hydrocarbons are not allowable in B. C. In special instances such as for earthworm control in golf greens special use permits for chlordane are granted by the Chief Pesticide officer, but generally these long term residual insecticides are not available. Another factor is timeliness and retention of adequate active ingredients during the period of need. Many treatments, i.e. sod webworm or leather-jacket treatments are required in early spring and/or late fall for best results. At these times heavy fertilizer applications, especially of nitrogenous forms may cause excessive growth and increase turf winter injury. Untimely applications may result in loss of insecticide and lack of control. Conversely, insects because of their mobility usually will move to zones of toxic chemical and can be controlled probably better than other pests.

Fungicides have somewhat the same problem. Mercurial fungicides though still registered for turf use have been withdrawn from B.C.D.A. recommendations because of their toxicity and possible hazard to the environment. Other fungicides such as benomyl are quite unstable and may degrade if retained for too long a period in storage prior to use. Timeliness in use is probably more cirtical than with insecticides. Proper combinations applied in the spring can give maximum fertilizer response and some control of spring diseases. In all fairness however, it should be noted many of these diseases (i.e. Fusarium patch) are best controlled by several successive applications of the fungicides spaced one to two weeks apart. Such treatments, of course, are too often for most fertilizer treatments; hence fertilizer/fungicide treatments would require supplemental fungicide treatments especially for curative treatments.

Herbicides are similar to fungicides in that their use depends usually upon specific treatments dependent upon weed species and may require successive treatments. Proper use of fertilizer alone will give a good measure of control of most easy to kill weed species. Herbicidally, most plants are affected more by foliar application than by granular treatments. In trials in 1964 in New Westminster, 2,4-D granules at rates up to 5 lbs. a.i. per acre alone caused grass injury with only 40% clover control and 70% /

broadleaf weed control, whereas 300 lbs. 20-10-5 plus 2-1/2 lbs. 2,4-D applied every 4 weeks provided 90% control for both clover and weeds. Other trials have shown the need for more specific treatments such as mecoprop for clover and chickweed control, dicamba for knotweed; but these same trials indicated more of the specific herbicide is needed for specific weed problems than is usually available in combined mixtures.

Generally, sprays were more effective than granules and the specific spray was required at the proper rate for weed control of the specific hard to eradicate species. Fertilizers improved the weed control by their ability to improve grass growth and "crowd out" the weedy species.

In summary, to me the "pros" of fertilizer pesticide combinations indicate fair measure control of the disease, insect or weed problem, partially because of pesticide, but largely because of grass response to the fertilizer treatment. The "cons" actually indicate for best control, we require use of the pesticide in the manner most necessary for the particular problem. This is particularly noticed in severe problem cases of disease or in other instances where repetitive treatments are necessary for these severe infections or infestations.

PESTICIDE LEGISLATION[1]
CANADA AND BRITISH COLUMBIA

C. L. Neilson[2]

Mr. Chairman, Members of the Joint Conference, Northwest Turfgrass Association and Western Turfgrass Association, I would like to thank you for this opportunity of participating in your Conference.

While I can't lay claim to any great knowledge of how to produce and maintain the best turf, I can assure you that I have over twenty-five years experience in destroying turf with a collection of tools called golfclubs.

But before launching into specifics, as they concern pesticides and pesticide use in British Columbia, I think it might be useful to you to know that in Canada all pesticide registration comes under Federal jurisdiction. In other words, there are no Provincial requirements in so far as pesticide registration is concerned. They are registered once federally and such registration or registered use applies across Canada. However, there are four or five provinces in Canada who do have their own individual pesticide regulations--but these are aimed at how and where pesticides are sold and insuring proper pesticide use. In British Columbia all pesticide regulations are administered by the Department of Agriculture--under my direction.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Provincial Entomologist, Canada Department of Agriculture, Victoria, British Columbia.

In respect to our Federal scheme, new Pest Control Products regulations were passed on October 25, 1972, which updates former regulations and introduces several new concepts. The Federal or Canada Department of Agriculture, Plant Products Division continues to administer these regulations. There may be some lapse of time before these new regulations are implemented.

A few of the major new points in these regulations are:

A. Control products are classified for labelling and pest registration purposes into three (3) categories in order to direct marketing and limit the availability of certain products to persons authorized to use them from the point of view of occupational or environmental risk. (This will compliment Provincial regulations.)

Category 1 - Restricted Products: the sale of these are dependent upon the purchaser (e.g. Pest Control Applicators) showing proof of having obtained a permit from the Minister or his designate, or a permit or other official concurrence from a Provincial regulatory authority. Restricted products will be so labelled and the conditions of the restriction set forth on the label.

Category 2 - Commercial Products: These products would constitute the major proportion of control products. The label directions and limitations are sufficient to ensure safe use in commercial activities such as agriculture, forestry, institutional and industrial activities. Some of these products may also qualify for the domestic category.

Category 3 - Domestic Products: These products intended to be sold to the home owner for non-commercial activities. They must meet safety criteria in respect to occupational and environmental risks (e. g. container disposal in regular garbage). To be sold in food outlets both the oral and dermal LD 50 must be above 5000 mg./kg.

Superimposed on certain products in Categories 1 and 2, there will be some restrictive measures imposed on the purchaser and user.

1. <u>Signable Product</u> - This procedure is the least onerous and simplest restrictive measure which may be imposed on the sale of a pesticide and it provides for several valuable functions. By documenting the sale of certain pesticides, statistics reflecting intensity of use on a relatively specific regional basis may be accumulated. The record of the purchaser's name and address facilitates a follow-up on the use of the pesticide, if required, to assure that its use continues to satisfy the conditions under which it was registered. In the event of any incident involving the product, a record of the purchase is available to the regulatory agency. The designation of a pesticide as a signable product facilitates the control of its sale through dealers. The control of sale by this simple means allows the dealer to become more than a casual participant in the regulatory process, and at the time of the sale he can verbally reinforce the label precautions which are necessary to the safe use of the product, whether they relate to occupational or to environmental risk. Finally, the psychological effect on the purchaser is beneficial in that the special precautions attendant on the safe use of the product are emphasized. Misuse or use contrary to the terms of label under these circumstances is a responsibility which rests clearly with the user, and implies a flagrant disregard of instructions. The precautionary measures to be taken in respect to the safe use of a signable product should not be difficult, and they should be well within the capability of the average user to whom the product is made available. If there is any doubt of this, consideration should be given to subjecting the product to a more severe restrictive measure.

2. <u>User Permit</u> - This procedure imposes a more severe restriction than that of merely signing for the product. The requirement to obtain a "user permit" derives all of the advantages expressed in (1) but additionally requires the purchaser to document the purpose and location of the use. Further, the issuance of the permit, its cancellation, or its denial is at the discretion of the regulating agency designed as the appropriate authority.

Depending upon the reason for imposing the restriction, such as a concern for water quality, occupational risk, or wildlife hazard, the authority to issue such permits may be delegated to any appropriate agency. A well informed dealer system may be able to function to some degree in this respect, but local capability and policy would determine how this regulatory measure is best implemented.

It is conceivable that a "user permit" could be issued on a seasonal basis, where the time to obtain a permit in each case would unduly impair the capability of a knowledgable user to control a pest. Seasonal permits for certain pesticides could be issued at the discretion of the regional authority to persons considered to be sufficiently qualified, such as bona fide farmers, or licensed pest control operators.

3. Project Permit - When a pesticide application such as for certain aquatic, forest or vector control programs has special environmental significance, a "project permit" may be required. This form of restrictive measure imposes a more rigorous restriction on the use of a pesticide than the "user permit", and at the same time imposes an increased responsibility on the issuing governmental agency.

Application made for a project permit should be accompanied by detailed information on the product to be used, the project to be performed, the persons in charge and the equipment and conditions under which the project is to be carried out. The issuance of the permit is dependent upon an on-site inspection and approval of the project by the issuing agency, and the permit shall also set forth the conditions under which the project may be carried out.

B. Control devices will now require registration, e.g. electric dispenser plug in.

C. Packing standards will come under the new regulations.

D. Import into Canada for the importer's own use will require:

1. Authorization from the District Supervisor.

a) Products must have been accepted for registration under the regulations for the use stated on the importer's declaration.

2. The laws in force in the place where the product is to be used are not inconsistent with the proposed importation and use.

3. The amount that can be imported for private use is drastically cut and can be only of a stated weight or volume.

In British Columbia we do have pesticide regulations which will be affected by the new Federal regulations. However, we have been the leaders in pesticide regulation in Canada and their new regulations reflect some of our philosophy and practical experience. We do not expect to have to make any drastic change in our present regulations.

In respect to Pesticide Regulations in British Columbia, we entered the field of pesticide management through regulations in the early 1900's when some pesticides could only be obtained by signing a poison register. However, it was not until 1965 that we really became actively involved in Pesticide Management Regulations, for in that year "An Act to Amend the Pharmacy Act in B. C." was passed. This act gave the Minister of Agriculture much broader powers to regulate the sale of pesticides, pesticide applicators and the sale of veterinary drugs.

Why are provincial regulations needed? The Canada Pest Control Products Act certainly provides parameters under which the public is assured that registered pesticides will perform as stated on label claims. Similarly, pesticide tolerances established and monitored by the Food and Drug Directorate give further assurance that our food or health is not being unduly endangered by pesticide. This simply means that pesticides are no problem when used according to directions.

However, we all know that there are pesticide problems, most of which result from improper handling either during actual application or during transport or sale, and it is here that Provincial regulations are important.

In retrospect, I believe many of the present pesticide problems are the result of an oversell in past years by industry and government on the advantages of pesticides without sufficient effort being devoted to the problems associated with pesticide misuse. Coupled with this, of course, has been the upsurge in environment concern which has resulted in considerable inquiry of the necessity for pesticides as opposed to alternate methods of pest control.

In July of 1966 B. C. Regulations Providing for the Sale, Distribution and Keeping of Agricultural Pesticides in Open Shops became effective. These are administered by the B. C. Dept. of Agriculture and are aimed at keeping pesticides away from food, having more knowledgable people selling pesticides, having certain pesticides available only on signature and from this combination acquaint the user with better pesticide practices. The Regulations established two classes of pesticide sales licenses based on the degree of toxicity of products being sold, and one of the conditions of licensing is that one or more of the staff be certified, by examination, that he has a certain knowledge of pesticides.

At the present time we have 523 Licensed Pesticide Dealers (See Below) and 823 Certified Pesticide Dispensers (i.e. persons who have taken and passed our examination and who work in the licensed stores). In addition, many of our Pharmacies sell a limited number of pesticides.

LICENSED PESTICIDE DEALERS FOR 19

District	License Class	Number
Fraser Valley	A	202
	B	68
Vancouver Island	A	69
	B	15
Cariboo	A	24
	B	9

District	License Class	Number
Peace River	A	17
	B	1
Coast	A	5
	B	2
Kootenays	A	33
	B	2
Okanogan	A	61
	B	15

Despite the upgrading, which has occurred in these stores, we have not been satisfied for some time with the state of knowledge of many of our Certified Pesticide Dispensers. However, it did allow sales to continue and was an improvement over what we had prior to the instigation of the Regulations in 1966.

In 1972, we instituted a new approach to upgrade these Pesticide Dispensers. As old certificates expired re-qualification by examination was held. Those who obtain a mark of 50 - 65% are issued a one year certificate, but if the mark is above 65% a four year certificate is granted.

As a method of encouraging Pesticide Dispenser candidates to become more knowledgable and thus obtain a 4 year certificate, we are holding tutorial sessions with groups of 10 - 12 candidates wherever and whenever possible. In addition to these tutorial sessions, large courses are held as the need arises.

I would suggest that chemical companies in the past have not put sufficient effort into informing and training their dealers, and in particular the staffs of such dealers, about their various products.

I appreciate there are problems involved with such training, but I suggest that they have a responsibility in this area which needs considerable attention.

To date, under our present regulations certification is not necessary for everyone who sells pesticides--only one of the staff need be qualified as a Certified Pesticide Dispenser. However, it is our belief, based on experience, that change should be made in the Regulations to make such qualification mandatory.

I mentioned earlier that these Regulations also regulated how pesticides were stored within licensed stores. In this regard, we also believe after over five years experience that certain changes are needed. We are not happy with certain aspects of how pesticides are handled in some large department stores and supermarkets--particularly as they relate to shopping cart buying and to check-out procedures. Similarly, we are not happy when we find certain extremely toxic pesticides stored on low shelves in some stores and being handled by children. It would seem that some changes to remedy such practices are justified in the near future.

We are now trying to accommodate pet shops and stores which handle only wood preservatives in respect to Pesticides. Our examinations in the past have been too demanding for these groups, but we have recently revised and changed examination standards whereby it is now possible to obtain a Revised Pesticide Certificate limited to the dispensing of pesticides that are labeled for use on pets or for wood preservatives only.

Under these Regulations we have also greatly restricted the use of the insecticides aldrin, dieldrin, endrin, DDT, heptachlor and chlordane. We have not banned their use as they are available under permit for very restricted use, and we have issued some 75 such permits. As a further means of implementing the intent of the Regulations to restrict and reduce the use of these six insecticides, the B. C. Government announced they would accept unwanted pesticides. Over the past two years, we have accumulated approximately 50 tons of pesticides of every description. We know from this exercise alone, that a high percentage of householders who returned these pesticides did not know anything about them and they were a potential danger in the hands of such people. It's still far too easy for the uninformed to buy highly toxic products in almost any quantity.

A way must be found to restrict the availability of such toxic products to the uninformed user and thus preserve their use for the more knowledgable commercial users, and it appears that our new Federal regulations will attempt to do some of this.

In May, 1969, our Regulations Providing for the Sale or Provision of Services Involving the Use or Application of Pesticides came into effect. These are also administered by the Department of Agriculture.

Basically, these Regulations cover only the commercial applicator, but they have also provided a strong persuasive tool for other pesticide applications on private and crown land.

There are several ways of regulating pesticide applicators. One province does it by licensing for a certain group of chemicals, we chose to do it by "area of work" as we thought it suited B. C. better. Consequently, we established seven classes of Certified Pesticide Applicators.

We now have licensed firms in these categories shown below. One firm may be licensed in more than one category. It is also interesting that 85% of the 277 licensed firms (many of which are one man operations) are in the Lower Mainland and about 70% of these are in the landscape and garden business.

	Licensed Firms	Certified Applicators
Agriculture & Crop Pest Abatement	49	158
Forest or Forest Product Pest Abatement	8	604
Non-Ag & Non-Forestry Veg. Control	49	379
Landscape & Garden Pest Abatement	155	740
Mosquito & Biting Fly Pest Abatement	9	107
Structural Pest & Product Fumigation	30	173
Fish, Bird & Wildlife Management	0	18

Perhaps an even more interesting point is that approximately 2,179 persons have taken courses and passed as Certified Pesticide Applicators. We have also encouraged public officials from Parks Boards, School Boards, Department of Highways, Railways, Hydro and Telephone, Forestry firms and others to take these courses and become more knowledgable. The response has been excellent.

We have had only three years experience, but we now know who is applying pesticides on a fee for service basis and also what pesticides are being applied to Forests and Crown Lands. We also know that the knowledge of Pesticide Application in many cases is very limited. Many of them had not been previously aware that there were sources for consultation and advice, and obviously they were not always following label directions. With the experience we have gained, it is now our intention to intensify the education and training in pesticides and pesticide use for certified applicators in each of these seven categories of work.

Yet another forward step in pesticide management has been built into these Regulations. While there is provision to allow pesticide use on private land by the owner or lessee, there is also a clause requiring that where a licensee or permit holder proposes to apply any pesticide over a large tract of land or to any body of water, that plans and maps of the operation must be submitted for approval prior to treatment. Through this clause, and with the co-operation of our B. C. Government Interdepartmental Pesticide Committee (Agriculture, Forestry, Fish & Game Branch, Health and Highways) we are now reviewing and approving applications from Forestry firms, Federal Dept. of Transport (airports), U. S. & Canada Border Commission, B. C. Hydro, B. C. Highways, B. C. Forestry, B. C. Dept. of Recreation & Conservation, U. S. Corps of Army Engineers (pipelines) and others. See Appendix I.

Despite this, some changes are needed to insure that all pesticide legislation is under Provincial and not regional, municipal or city statute and also that all treatment on Crown Land is only done under permit. We expect to make these changes in 1973.

The net result of this program has been a re-examination of pesticide policies of the various firms and agencies, instigation or upgrading of training programs by those applying pesticides, upgrading of application equipment and techniques and above all, a better appreciation of both the good and bad that can result from pesticide use. I believe it has also been a means of educating many of those violently opposed to pesticide use. As stated earlier, we intend to step up this education process and believe industry should do likewise.

It has been our experience that Provincial Regulations are a necessary adjunct to Federal Regulations. In British Columbia we have been able to manage pesticide use to a degree which was previously impossible, and we hope to such a degree in the future that problems associated with their use will be on an ever reducing scale. Our Regulations do not, nor should not replace grower meetings, calendar recommendations, forums or other forms of education used in promoting proper pesticide use. However, Pesticide Regulations when properly written and administered will alleviate or prevent many of the problems caused by improper use of pesticides, thereby allowing continued use of these valuable chemical tools.

In conclusion, I should mention that in British Columbia there is presently a Royal Commission holding hearings respecting pesticides, and it is likely their report will suggest some changes in our present pesticide regulations.

WASHINGTON STATE AND EPA[1] PESTICIDE LAWS

Art Losey[2]

In 1901, when agricultural chemicals consisted of a few fertilizers and pesticides, the first Washington state pesticide law was passed to provide against the adulteration of "Paris Green" which was at that time one of the few chemicals for the control of insects on horticultural crops. This made Washington one of the first states to enact pesticide legislation and since that time we have remained progressive in this area.

<u>Pesticide Laws</u>

1901 - Chapter 22 - Providing against adulteration of Paris Green.

1915 - Chapter 166 - Set up Insecticide and Fungicide Board of laws on the correct labeling of pesticides.

1941 - Chapter 230 - Began the registration of pesticides by the Department of Agriculture.

1954 - 15.56 RCW - Economic Poisons Act

1961 - 15.57 RCW - Washington Pesticide Act

1971 - 15.58 RCW - Washington Pesticide Control Act

<u>Pesticide Application Act</u>

1945 - Chapter 120 - Protection of pollinating insects and licensing of commercial applicators.

1/ To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs British Columbia, October, 1973.

2/ Washington State Laws and Regulations, Olympia, Washington.

1951 - 17.20 - Regulating use of insecticides and herbicides.

1961 - 17.21 - Pesticide Application Act

1967 - 17.21 - Amended Pesticide Application Act

Federal Laws

1910 - First Federal Insecticide, Fungicide, Rodenticide Act (Required the registration of pesticides.)

1938 - Federal Food, Drug and Cosmetic Act

1947 - Amended Federal Insecticide, Fungicide, Rodenticide Act.

1954 - Miller Amendment to Federal Food, Drug and Cosmetic Act.

1959 - Amendment to Federal Insecticide, Fungicide, Rodenticide Act to include nematocides, defoliants, desiccants, and plant regulators.

1972 - Federal Environmental Pesticide Control Act

At the present time, the Washington State Department of Agriculture enforces two pesticide laws to protect the health and welfare of the people of the state. Some of the requirements of these laws are as follows:

The Washington Pesticide Control Act RCW 15.58 concerns the distribution, storage, and disposal of pesticides --

1. All pesticides distributed in the state must be registered with the department.

2. All pesticide dealers must be licensed.

3. Each licensed dealer outlet must have a licensed dealer manager who has passed the state examination.

4. Any person giving technical advice or recommendation of certain pesticides to the user must pass a state examination and become a licensed pest control consultant.

The Pesticide Application Act RCW 17.21 concerns the use and application of pesticides --

1. Any person applying pesticides to the lands of another must pass a state examination, be insured and obtain a commercial applicator's license.

2. Any person employed by an applicator to apply pesticides must pass an examination and obtain a commercial operator's license.

3. Employees of government agencies that apply pesticides must pass an examination and obtain a public operator's license.

The department has adopted many regulations under these laws to provide for the safe distribution, transportation, use, application and disposal of pesticides.

In the short time I have left, I will outline the areas of the Environmental Protection Agency's new Pesticide Control Act that may effect your industry.

The new federal act became law on October 21, 1972, and by the time all provisions of the act are implemented in 4 years, most users of pesticides, all producers of pesticides, and state pesticide control officials will be aware of the broad powers of this act. At this time EPA, industry and state officials are working on regulations providing for, to name a few, certification of states to issue "state registrations" reclassifying all pesticide formulations into general and restricted use categories, and standards for certifying commercial applicators and private applicators (the grower).

EPA is faced with a large task of registering all intrastate pesticides where in the past they were involved only with pesticides shipped interstate.

Was there a need for new federal legislation?

The best method for regulating the distribution of pesticides to the user, and to his application of pesticides, was control at the state level. Regulation of the storage and sale of pesticides; of those individuals giving pesticide recommendations to the user; and of those applying pesticides commercially was a responsibility of the states. However, at least 20 states were not effectively restricting pesticide usage and some of these states used pesticides extensively. In the past few years, a number of states have stepped up their pesticide programs. But too many reacted with too little, too late. It is interesting to speculate whether or not Congress would have taken all of the pre-emptive steps in the federal Act if all states had established pesticide programs. But this is only speculation. The fact is, the states did not get the job done, and Congress acted.

OK! We have a new federal Act. What now?

Although EPA has the "big club", there are a number of provisions in the Act and in the Congressional Records which give EPA some flexibility and an opportunity to work with the states. State agencies are closer to, and can be more responsive to, problems within their own state, whether they be pest control, health, or environmental problems. As a state control official, with an understanding of agricultural problems, I have been encouraged by the indicated desire of EPA officials to work with state officials and others in establishing standards, developing regulations, and implementing enforcement of the Act.

Sec. 24 of this Act gives authority to the states to regulate the sale or use of any pesticide. It does not permit the state to pre-emptively allow any sale or use prohibited by EPA. A state is pre-empted from placing any requirements on labeling or packaging that differ from those of EPA. This is not a conflict. States can limit sale or use without changing the label; for example, through regulations, as Washington restricts the use of 2,4-D and Carbaryl. This section also provides for states, certified by the Administrator, to register intrastate products to meet special local needs if such use has not previously been denied, disapproved, or cancelled by the Administrator. The registration to be reviewed by EPA will be deemed registered under the Act unless disapproved. Under this provision, states can accept a request for a registration from a registrant; determine the need for local pest control; determine the efficacy of formulations to control the pests with the detailed directions for use; and determine any need for additional restrictions by evaluating local use patterns. EPA retains the responsibility to approve or disapprove on the basis of hazard to the public or the environment. This provision will eliminate the unnecessary funneling of local information from 50 states into Washington, D.C. for study by persons who would find it difficult to evaluate and give timely approval for local or minor uses.

At the present time our state law already covers most areas required by the EPA act, however, the certification of private applicators (the grower) proposes a new problem. The law states in general that a restricted use pesticide can be used only by or under the supervision of a certified applicator. We have certified commercial applicators for many years, but have never been faced with the job of certifying growers (private applicators). It would be difficult to require a grower to pass a written examination before he could apply restricted use pesticides, which under some proposed regulations may include most pesticides used commercially. Fortunately, in the federal Act, there is provision for separate and differing requirements for commercial applicators and the private applicator or grower. One means of certifying private applicators has been proposed which could be acceptable to EPA.....that the private applicator be required to obtain a user permit prior to purchase and use of the pesticide. To obtain this permit, the user would have to document the crops, location, and acreage on the permit which would be either seasonal or for a temporary period of need. Some requirements of competency could be included as a requirement for obtaining a user permit. Washington state has required user permit for several years and this system has worked well.

A few comments on EPA's classification of general use and restricted use pesticides. The Act states that a pesticide shall be classified for restricted use if the acute dermal or inhalation toxicity of the pesticide presents a hazard to the applicator or other persons; also, a pesticide shall be classified for restricted use if its use without additional regulatory restrictions may cause unreasonable adverse effects on the environment. In establishing criteria on the first, you can use some numbers as a guideline. Keep in mind current thinking that classification will be by specific formulations and uses and not technical materials or chemicals. Figures such as a dermal LD_{50} of less than 200 mg/kg have been discussed. For inhalation hazard, the requirement of a respirator and specialized knowledge---possibly an LD_{50} of less than 20 mg/l. or 200 ppm for gases or vapors have been considered.

Regardless of numbers, the patterns of use, field experience and many other factors should be considered.

A few states have considered two categories---home and garden use chemicals as general use; and commercial agricultural pesticides as restricted use pesticides. This is a serious mistake. This would make the restricted use classification about as effective as the skull and crossbones insignia would be if it were placed on all pesticides. There should be three groups of pesticides: the home and garden use formulations on the one end; the most hazardous pesticides on the other end...those of national significance; and in the middle---the large group of commercially used pesticides, used by people whom we continually alert to stop, read the label and follow directions. We must continue to simplify and improve our labels.

I feel that as long as the pesticide control official can be responsive to local problems and needs, then the new law will be workable. If we lose this local contact, then the law is useless.

BEAUTIFICATION AROUND TURFGRASS AREAS[1]

Herbert E. Jones[2]

Much of the older plantings, as planted in earlier years, do not fit into the required pattern of necessity today. Since World War II the populative use of many of the general public areas has changed. Areas geared to handle hundreds, now must handle thousands, and with this increase we get wear and tear, an enormous difference in compaction.

We have had to utilize new methods, new soil compositions, new watering techniques, new feeding programs, new work formulaes. But by and large little use has been made of the technological availability of plant uses and information regarding the total balance between plant growth and plant nutrient requirements in respect to these general areas.

Let's look at one or two facets of plant use in the beautification around our turf areas - plant growth in size and shape, leaf-flower-fruit color - in looking at all these latter points of plant growth, we must use a common factor of tollerance, we can't have one without the other.

For example, if we want to use larger growing trees for one or more reasons, we must be prepared to tolerate within our budgets the cost of pickup of leaves. These same points would apply to the flower and fruit problems of such as the Prunus, Malus, or Sorbus trees.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Horticulturalist, Grosvenor International Holdings, Ltd., New Westminster, British Columbia.

So very simply, the basics are to what use do we need our support plants toward our turfgrass areas - windbreaks, people guides, golf hazards, ground barriers, or just for the general purpose of beautification.

Many the mistake has been made by developers of whatever - of doing your own (as we say today). Why? If you are not qualified in this knowledge, get help, someone to tell you what and how. So it costs extra bucks. Sound knowledge, wise expenditures, proper plantings and balanced maintenance will mean smooth flowing operations, balanced budgets and the loss of many unnecessary headaches.

Plant wisely in tree-shrub support, forgetting not - that these are the plants that supply oxygen for you and those who follow.

FACE-LIFTING TIRED GREENS[1]

W. H. Bengeyfield[2]

There are all sorts of reasons and justifications for renovating and 'working over' old greens. The golf course superintendent continually strives to improve his turfgrass picture by intelligent fertilizing, aerating, top-dressing, watering, and all the many other routine practices. However, there are times when further improvement can only be achieved through renovation or more drastic action. Among these situations one would include:

1. The need for improved drainage.

2. The need to improve the original soil or correct soil layering.

3. The need to correct compaction.

4. The need to check thatch accumulation.

5. The need to change the turf cover; i.e., from *Poa annua* to bentgrass.

6. The need for architectural changes.

7. The need to improve traffic flow or wear patterns.

You can probably think of several more.

Although the above "needs" may seem obvious, it is surprising to find most clubs and green committees willing to spend additional money for extra fungicides, aerations, hand watering, sodding and all the extra costly manhours in

---

1/ To be presented at the Joint Northwest Turfgrass Association/Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/ Western Director, United States Golf Association Green Section, Garden Grove, California.

trying to "keep" a poor green going through each summer even though it has a history of annual failure. It would seem some clubs would rather do this than get to the source of the problem and solve it once and for all. Apparently, they prefer to spend more money on a green which annually produces poorer turf quality than any of the others on the course. "Spending more and getting less" is not a good business practice. A good superintendent (and his records) will soon point this out to his committee.

On the other hand, and in so many cases, we traveling agronomists are prone to recommend complete rebuilding of greens rather than trying to accommodate or solve a problem in some less drastic manner. I'm afraid the country is filled with greens that "should be rebuilt" but are actually doing quite well because the superintendent has managed them well and kept them going. But really, there are times when complete rebuilding <u>is</u> the proper answer. And anything short of it an expensive substitute. We have all heard the expression:

"Dear is sometimes cheap, and Cheap is sometimes dear."

I believe it!

But what about methods of face-lifting greens, short of rebuilding, that under particular circumstances will help us produce better turf? Here are some ideas we have come across in visiting with superintendents throughout the West:

Problem - Poor surface and internal drainage of greens.

One Answer: Because of poor original construction, El Macero Country Club, El Macero, California had excessively wet greens with very poor surface and internal drainage characteristics. Fortunately, the Green Chairman was Dr. Del Henderson of the Department of Water Science, University of California, Davis, and he developed a series of tests intended to improve drainage without rebuilding the greens. These tests included:

1. A series of 2-inch diameter holes on a 4-foot triangular spacing. The holes were made deep enough to reach a sand strata about 4 feet deep in the subsoil.

2. Perforated 1-1/4 inch plastic pipe was placed in a 2-inch wide by 8-inch deep trench on 6-foot spacings. The perforated pipe was surrounded with pea gravel top-dressed with sand.

3. On another green, slots (8-inches deep by 3/4-inch wide) were made with a modified commercial trencher on 6-foot spacing, backfilled with gravel and top-dressed with sand. Individual slots were drained by 1-1/4 inch diameter dry wells extending into sandy subsoil at a depth of 4 to 5 feet at intervals of 12 to 15 feet.

4. On other greens, a 3-inch perforated plastic pipe mainline with 1-inch perforated laterals in herringbone pattern at 18-foot intervals were installed. All pipe was placed in 4-inch wide by 20-inch deep trenches.

All drain lines were installed on a 2-inch gravel base, then tile covered with 1/4-inch gravel to within a few inches of the surface and finished with coarse sand. All mainlines were constructed with outlets into lakes or long, gravel-filled trenches permitting seepage into the subsoil.

Tests showed that all types of drainage were effective. However, test Number 4 produced the best, long range results. Where drainage problems persisted in certain areas, it was supplemented with test Number 3; i.e., narrow, gravel-filled slots on 6-foot spacings.

Occasionally, we will visit a course having very wet approaches and greens during the summer months when little or no rainfall occurs! The wet areas are the result of a poor irrigation pattern or poor irrigation management. Although drain lines may help the situation, a more likely solution lies in correcting the irrigation problem before the wet areas can occur.

Problem - To correct compaction, soil layering or to improve the original soil.

One answer: A heavy aerification program (4 to 6 times annually) will surely help. The following schedule might be considered as a model one:

Late May	Aerify with 1/2-inch spoons, remove the soil cores and apply 2 cubic yards of a moderate to coarse sand per green. This should be boarded or worked into the open aeration holes until at least 90% of them are full. Remove excess sand and allow as little as possible to remain on the surface.
Late June	Same as late May.
Mid-July	Aerify with 1/4-inch spoons and remove the soil cores. Do not top-dress.
Early August	Same as July
Early September	Same as late May

Problem - To check heavy thatch accumulation

One answer: Follow a program similar to the one outlined above for compaction. In addition, schedule a minimum of five (5) mowings weekly for such greens and at least 2 or 3 very light vertical mowings monthly during the active growing season. An application of hydrated lime at the rate of 2 pounds per 1,000 square feet in the spring and again in the fall will help increase biological thatch degradation.

Localized dry spots may frequently appear on greens even though a heavy thatch condition does not exist. This is usually due to a poor irrigation pattern on the green and some sprinkler head relocation or additions will solve it.

Problem - Desire to change turf cover.

One Answer: A long range program of aerification and/or slicing in three directions followed with overseeding in late June and early August will produce results. It usually takes from 3 to 5 years. Each overseeding should be accomplished with 20 pounds of Seaside bentgrass or 10 pounds of Penncross bentgrass per average green. When over to 50% to 60% of the green is in bentgrass, instigate a bensulide program of 8 ounces per 1000 square feet in early September and early February.

Resodding of greens is quite acceptable if the sod is grown on a soil very similar to that found in the greens. If the soil is different however, trouble lies ahead. Further, the practice of laying sod is an art. It must be carefully and properly done.

Problem - Making architectural changes or correcting problems caused by traffic.

One Answer: It is difficult if not impossible to successfully "add on" to an established green. If this is necessary, the entire green should be redone and recontoured. However, if a green is in good condition but there is a need for better contouring of the surrounding area, the work can be successfully accomplished in many cases. A considerable amount of fill material will be needed.

Sand bunkers directly affect traffic flow and patterns. Through redesign and relocation of bunkers, traffic patterns or wear areas can be corrected.

Problem - "Dressing up" greens.

Some possible answers: One of the simplest and most effective face-liftings of all for greens is to improve its overall appearance. For example, appearance is always improved if a fresh, clean flag and pole is used along with a clean, white cup liner. You would be surprised what this can do even for a 'brown' green.

The opportunity to reshape or reoutline greens simply by using the putting green height of cut should not be overlooked. Interesting shapes and designs are possible without costing any money.

The procedures described above have been generally successful in improving greens. By using these techniques, a superintendent can sometimes avoid a crisis without spending very much money. Under very careful management, such greens can, if necessary, last indefinitely. Face-lifting greens can work, can improve the golf course and can give the superintendent time to proceed with future reconstruction on an orderly basis if it is needed.

METHODS OF ESTABLISHING TURF ON PUTTING GREENS[1]

Milt Bauman[2]

There are three methods to be discussed in the establishment of turf on putting greens. Seeding, Sodding and Stolonizing. Regardless of which method is used, the following standard procedures should be adhered to:

Proper drainage, both internal and surface, and a properly mixed putting green soil mix. There are several mixes available today that are successful, and I will dwell but very little in this area. The U.S.G.A. Greens-Section has a putting green mix that has been and is very successful. Our own Western Washington Research and Extension Center has been very successful in this area of soils for putting greens. I know that throughout the land today there are many universities that have excellent soil mixes for putting greens. Whichever mix that you choose, follow the directions to the letter. Do not add or take away from what is recommended, for if you do, it will definitely change the end results.

After the green is shaped and contoured and the top mix has been put on, fertilizer and lime should be added. The top six inches should have 100 lbs. of dolomitic lime, 20 lbs. of single super phosphate, and 25 lbs. of potash per 1,000 sq. ft. This material should be rototilled or disced into the top six inches. The top two inches should have 15 lbs. of urea-formaldehyde per 1,000 sq. ft. Assuming that we have the proper drainage, soil mixture and fertility level, we will dwell on this subject no more.

The methods I am going to talk about are not from any book or any area of higher learning, but from experience that I have had down through the years.

1/ To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/ Superintendent, Seattle Golf Club, Seattle, Washington

The first method I will discuss is the one we know the most about and the one that is the most widely practiced, at least here in the Northwest. That is seeding.

The time of year most conducive to seeding, in my opinion, is from May 1 to September 15. I have mixed emotions upon which is the best time. August and September seedings have their advantages and disadvantages. The advantages are as follows:

> At this time of the year it is easier to keep the surface of the ground wet while the seed is germinating and getting established. You have the whole winter for the green to establish sod without the golfer demanding to play on it.

Some of the disadvantages are: During the seedling stage the grass is very susceptible to "damping-off", and if conditions become right, you can lose enough seedlings that you will have to do some over-seeding. Also, at this time of the year, the grass is susceptible to Fusarium. Probably with the new systemic fungicides, this might not be the problem it used to be. However, I don't know anyone that has used them under these conditions. I do know with mercuries you have to cut the rate way down on bentgrass seedlings.

May, June and July seedings have the advantage of a little more breeze to stop "damping-off". At this time of the year, as a rule, Fusarium is not very active. The days are long and the nights are warm. Some of the disadvantages are an almost constant watering of the seedlings, and as a rule, the golfer demands to play the green before it is ready.

The next subject is <u>seed</u> .... This is a very controversial subject. There are many that will disagree with the choice that I would make. East of the Cascades, I would seed Penncross. West of the Cascades, I would seed Colonial; and if I had my choice of the Colonials, it would be Astoria. However, there are many new varieties (at least new to the Northwest that might be better) but, as yet, are not proven.

Rate of Seeding

For Penncross greens I would seed two lbs. per 1,000 sq. ft. if the budget could afford it. For Astoria, I would seed 3 lbs. per 1,000 sq. ft. Too much seed will cause the thicker stand to be more susceptible to "damping-off".

When seeding putting greens I have always used a hand spike disc to set the seed. I generally apply half the seed, then spike disc it two ways, and then apply the rest of the seed. The green then should be rolled and a slight top-dressing can be applied, less than 1/16 of an inch.

After the seed has germinated and the stand begins to grow, it should be mowed as soon as there is anything to mow with a greens-mower set at 3/8". This is a good height to cut the green until three or four weeks before it is ready for play. The green should be mowed as soon as there is a basket of grass to be mowed from it. At this time it would be well to start a permanent mowing schedule (weather permitting). Also, at this time light applications of nitrogen should be applied, or again, urea-formaldehyde (whichever the man doing the job prefers). If you are using inorganic nitrogen, no more than 1/2 lb. of actual "N" per 1,000 sq. ft. should be applied at one time. Urea-formaldehyde should be used at manufacturer's recommendation; however, at this time of the year it should be watered as I have seen it burn severely under certain conditions.

When it is time to set the mower down for play, it should be done in stages. For instance, if you are cutting at 3/8", set the mower at 5/16", mow at that height three or four times, then set it down to 1/4". Repeat this process until you have the desired cutting height.

Sodding Putting Green Turf

The second method discussed in this paper is the sodding of putting greens.

Going back to the start of the paper, the greens should be prepared for planting as we discussed earlier. The putting surface should be worked, firmed, and smoothed to the same degree as you would want your finished putting surface, for once the sod is layed it will conform to the base it is layed on. If you have a rough, poorly prepared base, your green will also be rough and will require many top-dressings to overcome the roughness. So it cannot be emphasized enough the importance of a firm, smooth bed to lay the sod on.

The sod should be grown on the same soil mix that you use in building your greens. This is very important. If you put one type of soil on top of another, you will have two problems. The most important being if the soil on top is finer than your putting green mix, you will build a false water table in the sod layer on top. This will keep the water in the surface, and will slow up root development below. There is a rule of thumb in water movement in soils. Coarse material will let the water drain into finer material, but fine material will not let water drain into coarse material until the soil reaches total saturation. With this in mind, it is very important to grow the sod on the same type of soil that it will be used on.

For sodding greens I would lay the sod as in any other sodding operation. We always place a chalk line down the center of the area to be sodded, lay the first row on the edge of the chalk line and proceed from there. The sod should be placed tightly together. If the weather is warm, the surface of the green should be wet down before the sod is placed on it.

After the sod is down in dry weather it should be watered and should be kept wet until the sod has knit. Some people prefer to use a light roller after the sod is down which is fine. From my own experience, the sod will conform to the base it is place on. Irrigation and mowing will do the firming as good as the roller.

The sod may be mowed as soon as it has grown enough to cut grass from it. Again, I would cut this grass at 3/8".

After it has knit, we like to aerify and top-dress lightly to true the surface up. The aerification will also help to establish roots below the sod level. At this time I would apply 1/2 lb. of actual nitrogen per 1,000 sq. ft. If urea-formaldehyde is used, it may be applied when you have finished laying the sod.

Again, as soon as the sod is knit and top-dressed, you may start lowering your cutting height. Do not lower the height too fast. Lower a little at a time.

Some of the advantages of a sodded green are: You start playing on a mature grass; The waiting time to get on it to play is very short. I have sodded greens where play has started on the 16th day. This is way too fast, of course, but it is possible. In a month after sodding in growing season, a green should be in pretty good shape. You can sod a green any time of the year except when the ground is frozen.

Some of the disadvantages are: You have to have a nursery to grow the sod on. It has to be established just like planting a green, so this route is more expensive. It does not inconvenience the golfer as much as seeding or stolonizing. It is harder to establish a root system with sod. In the dry season it has to be kept wet constantly or the sod will shrivel and pull apart at the seams. If this happens, we always fill the cracks with top-dressing and the grass will spread and fill the cracks providing you don't let it dry out.

Stolonizing Putting Green Turf

The third method of establishing turf on putting green is stolonizing. Again, the surface of the putting green should be prepared in the same manner as for seeding or sodding, as again, the putting surface will conform to the base the stolons are placed on.

The stolons should be purchased from a reputable firm and should be free of weeds, especially *Poa annua*. There are many varieties of creeping bents to choose from. Here again, it is a matter of personal choice. Most varieties will grow where any other bentgrass will grow. My own personal choice for our Northwest area, either on the east side or the west side, is Toronto. It is proven on both sides of the Cascades. It has good color and an excellent putting texture. There are many new varieties being tested at this time, and no doubt some of these will be outstanding; but until such time as they are proven, I will stay with Toronto.

If you cannot afford a good maint@nance program, I would advise you not to use a creeping bent. Creeping bents require much more maintenance than the Colonial type bents. If you are not prepared to top-dress frequently and do considerable thatching, you should not use creeping bentgrass. With proper maintenance creeping bents will give you a tremendous putting surface. If they do not get the proper maintenance, your putting surface will be stringy and grainy and the green will develop a tremendous thatch problem.

The rate of application should be ten to twelve bushels of stolons per 1,000 sq. ft. If you skimp on the stolons, the green will not cover as quickly as it should and will leave open ground that will be susceptible to weed invasion. There is an amount that seems about right. Too many stolons piled on top of each other isn't good either, as it will leave an air space for the stolons to dry out. The right amount is the covering of the surface.

Some contractors have mechanical innovations to apply the stolons with, and they do a pretty good job. Personally, I like to use about four men with five gallon buckets. I think they do a better job.

After the stolons are down they should be top-dressed with the same material that is in the greens mix. The top dressing should be applied heavy enough to cover most of the joints of the stolon. The stolons should not be completely covered as the top-dressing will cause a smothering action and slow down the time of getting a grass cover on the surface. I would say, as a rule of thumb, to cover about two-thirds of the stolons with top-dressing. This would leave a few stolons showing.

There will be many who disagree with what I like to do after the stolons are top-dressed. I like to overseed with 1-1/2 lbs of Highland bentgrass per 1,000 sq. ft. This will germinate in four or five days, and it will help keep your stolons from moving with irrigation. It will give you a solid cover much quicker than just the stolons. I have done this many times and in three months, I have never been able to find a Highland bentgrass plant. The creeping bent crowds out the Highland unbelievably fast.

After the over-seeding, the main job until you have a solid stand is to never let the surface dry out.

I feel the best time to stolonize greens in the Northwest is from May 1 until September 1. The warmer the temperature the faster the stolons spread.

With stolons, the same as seeding and sodding, they should be mowed as soon as there is anything to mow. Again, 3/8" is a good height to start mowing. After the first mowing apply 15 lbs. of urea-formaldehyde and 25 lbs. of Milorganite per 1,000 sq. ft. This will force the grass into a quick cover, especially so at the time of year indicated above.

After the stolons have a good cover, bring the cutting height down to playing conditions in the same manner as suggested for seeded and sodded greens.

At the beginning of this paper I did not mention soil fumigation before planting. With most of our soil mixtures today we use washed sand and soil amendments such as spagnum peat, sawdust, vermiculite, loamite, dialoam and others. With a mixture such as this, I don't feel it is worth the cost and effort of fumigation. If, however, soil that might have weed seeds, especially Poa annua, is used, the greens should be fumigated. I feel the best and quickest job can be done with methyl bromide at manufacturer's recommendation.

This concludes what I have to say on establishing turf on putting greens. I feel the best putting surface comes from a well-kept, stolonized green.

MANAGING CONTRASTING SOIL AREAS ON GOLF COURSES[1]

Roy L. Goss[2]

Modern trends for golf course putting green construction specifies sand and some form of organic material for the top mixture. The base material is usually of some highly permeable material such as pea gravel or pitrun (a conglomerate of sand and gravel with little or no silt and clay). This is designed for rapid surface drainage to provide stable putting surfaces for both player traffic and machine maintenance in most seasons of the year. In the Pacific Northwest where golf is played essentially 12 months a year west of the Cascades and perhaps for 7 months east of the Cascades, it is essential that putting greens be constructed along these lines. The cost of building greens has steadily risen due to increased costs in materials and labor. Due to tight budgets at the time of building, the selected, well-graded materials are used only on the putting surfaces with little budget left for sand or other materials on the aprons, collars and mounds.

Fairways are usually constructed only from the materials on-site. If the soils are extremely rocky, surface layers of more suitable material are sometimes used to cover the rocks, particularly on the approaches to the putting greens. Usually, this material is of minimal depth only to accomodate golf shots and perhaps some aerification. For the most part, however, no additional material is added to these areas. This is where the problem begins and what this paper is about.

To understand the management of contrasting soil areas, we must understand the soil characteristics sufficiently well to know why grasses respond to irrigation and other

---

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Agronomist/Extension Turfgrass Specialist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington 98371.

management the way they do. It is a well-documented fact that sands retain much less water than sandy loam or soils of heavier texture. Sands drain very rapidly whereas heavier textures drain more slowly. The greater the degree of compaction or disarranged textural properties, the slower the resulting drainage.

There are two major problems regarding the management of contrasting areas. The first is excessive accumulation of water in front of putting greens resulting in standing water, mushy ground, or mud holes left from maintenance equipment. The second problem, which is of lesser importance, is fertility maintenance. Obviously, sands will leach readily and fertilizers must be added in smaller increments more frequently to those areas. Soils of heavier texture retain more nutrients and can be fertilized less frequently, perhaps with higher amounts per application. Since fertilizer is a controllable variable and can be easily managed, this paper will deal specifically with problems relating to wet areas at the junction of contrasting soils. A suitable method for approaching this problem can be outlined in three steps, as follows:

1. First investigate the sprinkler system to determine if the pattern is correct. The greens must be uniformly covered by sprinklers placed around their perimeter to insure proper irrigation of these sand areas. If the sprinklers are adequately covering the green and proper irrigation practices are carried out on the green, then we can move to step number two. A detailed explanation of what can be done with regards to specific equipment for irrigating greens and fairways will be covered by Mr. Carl Kuhn in a separate discussion, hence no reference will be made here to types of sprinklers to help overcome these problems.

2. Old Greens. In general, problems do not develop with time but are more often created at the time of construction. There are many exceptions to this rule, however, such as problems with increased traffic, heavier maintenance equipment and other factors which cause a sealing, puddling, or compacting action on soils that normally drain adequately. Due to this incessant activity, soils lose their infiltration and

permeability rates. Infiltration is defined as the rate at which the soil will accept water whether it be from irrigation or rainfall. Permeability refers to the rate at which the water will move through the soil once it has entered the surface. Compaction or puddling is generally restricted to the surface 2 to 4 inches of soil. If we could prevent the compaction factor, we would probably have no trouble with contrasting soil areas provided the irrigation system was adequately designed and operated. The writer has observed golf courses that experienced no problem with contrasting soil areas for a number of years, but with time, the soils on the aprons and approaches lost their infiltration rates, presenting problems to the golfer and the golf course superintendent. Frequent aerifying is one possible solution to improve infiltration rates. Hollow tined aerifiers, slicing attachments, or continuous vertical slicing to a depth of 2 to 4 inches are the tools available to the turfgrass manager. If these practices fail, then we must procede to the second step. Sub soil investigations will reveal whether or not the soil has adequate permeability for either rainfall or irrigation. If it is determined that the subsoils are not adequately permeable, then drainage tile in addition to the mechanical treatment may solve the problem; but, there is one important consideration. Although an adequate tile system is installed, surface infiltration may be so low that water will not actually reach the tile. All of these factors must be known before spending money needlessly on tile drainage.

If it is determined that both the surface infiltration and the subsoil permeability are too low to accomodate adequate drainage, then it may be necessary to remove the sod and several inches of the soil in these affected areas. After removal of the sod and soil, the area should have tile drainage installed and adequately backfilled with permeable materials. A minimum of 6 inches of gravel or pitrun plus 6 inches of sand should be placed in these areas. The tile lines should be installed to a minimum depth of 16" to the bottom of the tile to insure adequate drainage. The sod removed from these wet areas should not be replaced. It should be discarded and the area seeded with a proper type of grass or sodded with sod grown on similar material to that which was replaced. Sand with organic additives would be the most suitable material for the surface topping of these repaired areas since sand is a single grain structure and will rapidly transmit water unless the surface becomes sealed with decomposing organic material or algal scum. Mechanical treatments or certain chemical treatments will help to rectify these surface conditions.

It is reasonable to extend this repaired area to a distance of 40 to 50 yards in front of putting greens. The farther the distance from the green, the more the soil can be tapered or feathered so that the resulting depth of sand may be only 3 to 4 inches deep.

One important factor in dealing with soils is to remember that many soils have suitable infiltration and permeability rates if compaction or puddling or the destruction of structure can be prevented. Since most compaction occurs only to a depth of 2 to 4 inches, a layer of highly permeable material can be placed over these soils as a protection against compaction, hence should permanently retain good drainage characteristics.

3. <u>New Putting Greens</u>. During the construction of new putting greens, the same type of investigation should be performed as described in point No. 2 above. If the soils are too heavy, or if there are hard pans or layers, or if the area is generally swampy, these soils should be graded out during construction. After grading, tile lines should be installed and replace soil as described above. New courses are usually seeded rather than sodded, hence there should be no incompatibilities between sod and soil. It is extremely important not to place a sod with fine textured soil over coarser textured soils because water tables will become perched and infiltration rates will be so low that these areas will often be wet.

With proper construction there is some leeway for poorly operated or designed irrigation systems. We should not have to design soils to compensate for something that can be controlled accurately, but we still have to deal with the human factor or with mechanical failur hence proper soil construction will help to compensate some for these errors.

In conclusion, through proper construction, adequate routing of traffic, proper management of irrigation systems and close attention to the fundamentals of grass growing, we can probably avoid many of the pitfalls of soggy approaches to putting greens.

Drew Smith

Bob Moore

CONFERENCE SPEAKERS

Eric Hughes

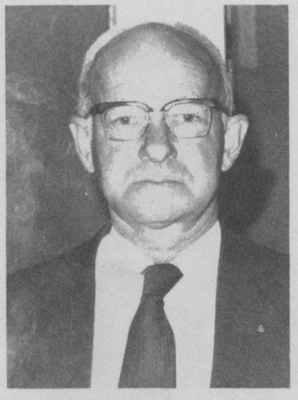
J. D. Meredith

Doug Taylor—Angus Richardson

Mr. Grey

Gary Perks

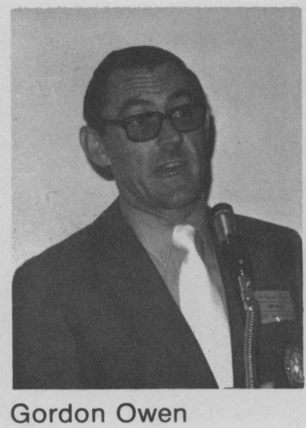
Dr. Thomps



Herb Jones

CONFERENC

Dick Schmidt



Gordon Owen

Clive Justic

son

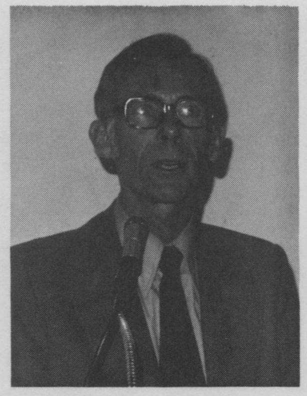
Mayor North

Art Losey

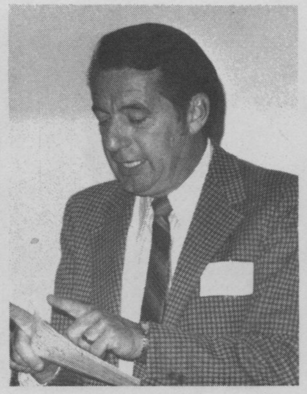
E SPEAKERS

Jim Beaton

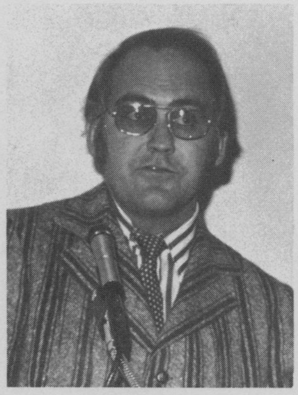
ce



Graham Drew



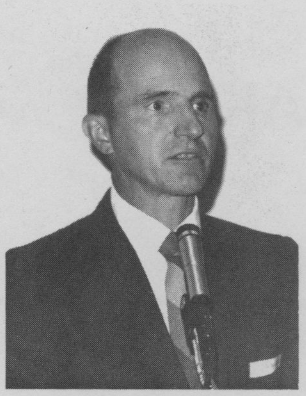
Bill Bengeyfield


Jim Chapman


C. L. Neilson

CONFERENCE SPEAKERS


Bob Staib


Rich Schwabauer


Bob Symonds


Carl Kuhn

SAND-SAWDUST GREENS V.S. IRRIGATION[1]

C. H. Kuhn[2]

How many years have we in the Coastal Range waited for a solution to the age-old problem of unplayable greens in the winter season? We tried many methods of greens construction, all giving relief to the drainage problem in some form, but none ever providing a total solution. Now, with sand-sawdust greens, properly underdrained, it appears that we have finally found a means to remove excess water and thereby provide firm, playable year-around putting surfaces. Why then am I, an irrigation engineer, addressing you on a subject which seems to have been solved? Like so many of the advances by mankind, in spite of their beneficial effect, side effects seem to crop up. We need not be reminded about vital advances such as DDT and the recent ecological trend based on "side effects". Am I telling you that sand-sawdust greens have latent problems? Let us pursue the matter of sand-sawdust greens in answer of that question.

It is no secret that sand-sawdust greens have superlative percolation capability, if properly designed and constructed. This capability is necessary to carry away water which would otherwise surface-flood green surfaces and render them objectionable to golfers in winter play (or, in some instances, during the summer when poor irrigation practices are involved). All too often during the course of greens construction, the greens are masterfully built to handle drainage and then surrounded on all sides by whatever glacial droppings exist nearby. Aprons and approaches are frequently constructed with soils of high clay or silt bases, excellent for retaining water but hardly known for their percolation capabilities. In effect,

---

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/C. H. Kuhn and Associates, Mercer Island, Washington.

we end up with an interface of high percolation material against material of unknown percolation at the edge of the green. This dissimilarity creates monumental problems for the irrigation engineer. Invariably, we place sprinkler heads around the periphery of the green ... full circle in pattern ... and irrigate both green and apron with the same heads. With improper precipitation rates or duration, either artificially or by natural rainfall, we quickly see that a given amount of water, which would breeze through the greens drainage mix, concurrently over-precipitates on the aprons. The results are frequently soft and unplayable aprons. How do we minimize the problem?

1. Construct aprons with pit-run material for a distance limited only by the construction budget of the course. Depths of this surfacing can be held down to 4 to 6 inches with an acceptable top soil overlay. This would provide a draining layer which would drain to the green drainage system on the inside faces of the aprons and away from the slopes to an intercepting tile on the outside of the aprons. Obviously, this form of construction would give some form of year-around drainage on the aprons.

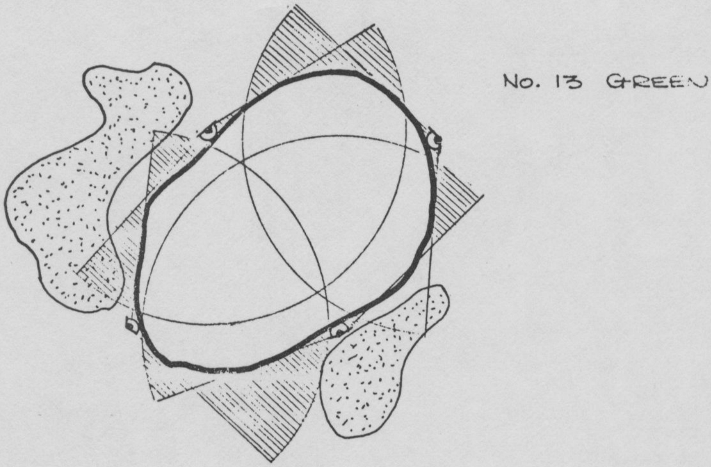
2. Since we find poor irrigation practices often affecting aprons as noted previously, effort must be taken to insure that the irrigation system is properly designed. A proper system is one that permits short cycles of precipitation with the option of numerous repetitions to insure that the precipitation rate and duration does not exceed the slowest percolation rate of the green/apron complex. Depending upon the amount of silts or clays in the apron construction, irrigation cycles may get as low as 3 to 5 minutes each. Additionally, sprinkler heads must be of a type which do not permit back-drainage, the draining of lateral piping each time an automatic valve is closed. This may be accomplished by various check-valves designed specifically for the purpose or by utilizing individual valves under each head. The system must be automatic, for no water man could hope to run fast enough to cycle green heads for the short period of time required here.

3. Dual greens irrigation systems have been considered as a partial solution. It would be the intention of such a system to provide part circle heads, one phase of which

irrigated the greens and one phase of which irrigated aprons only. The attached sketch shows the difficulties with such a proposal since greens tend to have oval peripheries and sprinklers throw in straight lines. Additionally, this type of system would be very costly. Each head would require individual timing since their arcs all differ.

In summary, the many benefits of sand-sawdust greens can be enjoyed without disasterous side effects on aprons or approaches if we follow good practices in selection of materials for these areas and provide irrigation systems which permit low and frequent application rates tailored to the green-apron-approach soil with the least percolation capability.

EXHIBIT 1




APRON AREA OVERLAPPED BY PART CIRCLE GREENS SPRINKLERS (PROPOSED SYSTEM)

PLAYFIELD PROBLEMS[1]
CONSTRUCTION AND MAINTENANCE

Roy L. Goss[2]

The principle problem relating to playfields and their management can be enumerated under seven major categories:

1. The use of materials at hand.

2. The use of fill material of unknown origin.

3. Inadequate drainage.

4. Improper selection of turf.

5. Low fertility program including micronutrients.

6. Other maintenance including aerification, mowing, watering and repair.

7. Over use.

Selection of Materials

The playfield site should be carefully examined before any construction begins. Investigation should be conducted in regard to subsoil drainage characteristics to determine the need for tile drainage. If subsoils are highly permeable, the placement of drain tile is unnecessary and will not function. The movement of water under conditions of unrestricted downward flow is vertical and will not enter a tile line. If, however, the permeability rate of subsoils is so slow that surface wetness occurs under normal rainfall or irrigation practices, then tile lines should be used by all means.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Agronomist/Extension Turfgrass Specialist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington.

Occasionally, subsoils are of adequate quality that no extraneous material will need to be added with the exception of the surface layer.

During construction of school sites and other turfgrass facilities, the athletic fields or playgrounds are situated in sites unsuitable for building construction. Most of these sites are filled from excavations for buildings or from other borrowed material in the vicinity. The quality of these materials is difficult to determine due to depth of placement and extreme variability. Unless the architect or contractor is well-informed on soil problems, the athletic fields or playgrounds are frequently graded out and planted regardless of the soil type. Obviously, most of these fields fail to perform satisfactorily.

Selecting the Proper Turfgrass

Grasses for play and athletic areas should be selected from a list of species known to be agressive, withstand extreme wear and respond to general management conditions. The only grasses that suitably fill these requirements today are the improved Kentucky type bluegrasses such as Merion, Fylking, Baron, Pennstar and a few others plus suitable varieties of the fine-leafed turf type ryegrasses. Perhaps the two most popular turf type ryegrasses today are Manhattan and Pennfine. Both of these varieties of perennial ryegrass blend well with bluegrass or respond favorably when seeded alone. Other selected varieties include NK100, NK200, Pelo and Norlea.

Bluegrass has the ability to spread by underground rhizomes and will fill in bare spots due to thin stands or damage from play. The ryegrasses do not creep or fill in but do withstand considerable trampling and a certain amount of compaction. A combination seeding of bluegrass and ryegrass has produced some of our best playing fields.

One of the problems that result from combination plantings of bluegrass and ryegrass is the extreme dominating vigor of ryegrass. The best fields have been developed by planting bluegrass first at rates of 50 to 80 pounds per acre and after this has germinated and emerged, the area is overseeded with ryegrass at the rate of 75 to 100 pounds per acre. In this manner, the bluegrass is off to a start and will compete successfully with the ryegrass. In case that ryegrass and bluegrass are planted together, the rate of ryegrass should be held to 30 to 35 pounds per acre with 70 to 75 pounds of bluegrass per acre.

Bentgrasses and fine-leafed fescues do not form suitable playfields intended for heavy traffic. They should not be used. The pasture type fescues such as Alta or similar varieties have not proven highly successful on playfields in many of our areas. The writer feels that the best choice is bluegrass and fine-leafed ryegrass.

Fertility Programs

On modern constructed playfields composed chiefly of sand and organic material, close attention must be paid to fertility programs. Most of the plant nutrients regularly leach from sandy soils from both irrigation and excessive rainfall. For this reason it is important to conduct soil tests annually at least for the first three or four years to determine levels of potassium, phosphorus and calcium. These tests serve as excellent guides to determine fertilizer needs.

It has been determined previously that fertilizers with an approximate 3-1-2 ratio of nitrogen, phosphorus and potassium serves a playfield turf best in the Pacific Northwest. Nitrogen levels from such a ratio should be maintained at 6 to 8 lbs. of available nitrogen per 1,000 sq. ft. per season regardless of whether this nitrogen is from soluble or insoluble sources. Soluble sources should be applied at the rate of 1 to 1-1/2 lbs. of nitrogen per 1,000 sq. ft. per application after the turf is well established. Insoluble sources can be applied at higher rates provided there is no danger of burn from potassium.

Burning of grass is a common phenononum from the use of soluble fertilizers. There is no danger of burning if the fertilizer is distributed from broadcast applicators with water following immediately behind the fertilizer or if it is applied when the grass leaves are dry.

Liming should be carried out as an annual practice on sand fields in order to maintain good stands of bluegrass. The pH should be kept as near 6 to 6.5 as possible and your soil test will determine the amount of lime to apply. The soil test will further identify whether you should use dolomitic limestone which also supplies magnesium or whether to use standard agricultural ground limestone.

Maintenance Programs

After the field is established it is very important to maintain regular mowing programs. Turf that is to be maintained at 1-1/2" high should be mowed first when it is no more than 2" tall. Do not allow excessive growth at any time. The more frequent the mowing the better the grass will respond in developing density and a good turf.

Watering should be maintained during the dry season to replenish the moisture in the root zone lost from evapotranspiration. This can be determined by examining soil cores removed from the area. Automatic irrigation with buried underground lines simplifies playfield and athletic field irrigation.

There are a few situations where a permanent turf can be maintained on athletic fields without a reseeding program. Goal mouths on soccer fields and scrimmage areas on other fields receive considerable use and wear. These areas should be overseeded annually with the same grass mixture that was planted in the field at a suitable time to improve the density and stand. If this is not practiced, *Poa annua*, a shallow rooted weed grass, will fill in all thin or bare areas.

Aerification or some form of spiking and slicing should be practiced frequently on athletic fields to reduce or eliminate surface compaction. This practice will increase oxygen supplies to the roots and allow rapid water infiltration. Although a field may have been constructed from sand, the accumulation of organic debris at the surface may reduce the infiltration rate of water by producing a thin seal at the soil/grass interface. These mechanical treatments will help to eliminate this problem and induce much faster drainage.

A Summary of Construction Methods

In summary, form the following methods of construction have proved highly successful in the higher rainfall areas of the Pacific Northwest:

1. Grade the base to the desired field grade. It is not necessary to provide a large crown on a football field. Flat fields respond equally as well as steeply crowned fields, if they are properly built.

2. Install drainage lines if subsoils indicate the need.

3. Place approximately one (1) foot of highly permeable material such as clean pitrun (sand and gravel) with little or no silt and clay. If inexpensive sources of sand are available, sand can be used for the same purpose.

4. Sand mix - Sand particle size is the most important factor in the top mix. Essentially, the sand particles should vary between 16 and 60 mesh - standard screens (1/4 to 1 mm). It usually is not possible to obtain a sand that fits this exact classification, therefore, it is reasonable to allow 15% of the sand particles to be finer than the 60 mesh and 15 to 20% to be coarser than 16 mesh. Organic materials such as ground bark products or sawdust with particle sizes not exceeding 3/8 inch maximum are suitable additions to sand. Twenty-five to thirty percent organic material should be mixed with sand off-site and placed to a uniform depth of 6 inches or more over the base material.

After the sand-organic mix has been placed and graded and all other irrigation installations have been completed, the following fertilizer applications have proven successful. Incorporate 25 to 30 pounds of single super phosphate (20% P_2O_5), 20 pounds of potassium sulfate (50% K_2O), and 100 pounds of dolomitic limestone per 1,000 sq. ft. This material should be rotovated to a depth of 4 inches. Smooth the field surface without excessive movement of the soil to prevent fertilizer displacement. Finally, an addition of a ureaformaldehyde (slow release) fertilizer applied to the surface at the rate of 3 to 4 pounds of available N per 1,000 sq. ft. lightly incorporated into the surface inch of soil will provide a reserve of nitrogen. The field should be planted with a suitable landscape seeder or Brillion drill to insure proper placement of seed and to provide some surface compaction. After seeding, an additional light application (1/2 to 3/4 pound of nitrogen per 1,000 sq. ft. from a soluble source can be broadcast over the surface to provide soluble nitrogen for germinating seedlings.

Sands usually contain very small amounts of micronutrients; therefore, a complete trace mineral mixture should be applied at the manufacturer's recommended rate to the entire area either at the time of planting or subsequent to the germination of the seed. Micronutrients should also be applied once or twice annually as a maintenance program.

In conclusion, there is one factor yet to be discussed, and only briefly. That is excessive use of the playfield area. There is no amount of good management that will compensate for excessive use. The best management practices will provide greater use of the facility, but when the grass is simply worn out from overuse, there is little that can be done except to restrict the use or provide alternate fields. Athletic fields and playgrounds can also be designed to allow rotation of goal posts or reversing direction of play.

The above suggestions and discussion in this paper have proven highly successful on many athletic and playfield installations throughout the Northwest, and if they are followed accurately and diligently, we can vastly improve our playing conditions.

IRRIGATION FOR LANDSCAPED AREAS[1]
PANEL DISCUSSION

Panel Moderator: .... C. H. Kuhn[2]

Panel Members: .... Owen Hamilton[3]
Vince Helton[4]
Alf Hiebert[5]
Bob Symonds[6]

The panel represents the engineering, sales and contracting aspects of irrigation. This panel will approach problems peculiar to landscaped areas, schools, parks, athletic areas; golf course irrigation will not be considered by this panel.

1/ To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/ C. H. Kuhn & Associates, Consulting Civil and Irrigation Engineers, Mercer Island, Washington.

3/ Irrigation representative for Taylor Pearson, Ltd., Vancouver, British Columbia.

4/ Sales Manager for Pacific Lawn Sprinklers, Ltd., Vancouver, British Columbia.

5/ Construction Supervisor, Terra Irrigation, Ltd., Vancouver, British Columbia.

6/ Owner, Pro-Turf, Ltd., Irrigation Contractors, Burnaby, British Columbia.

Summary

Mr. Kuhn addressed questions to each of the panel members aiming to reach the expertise of each member. Questions were asked which reflected upon the following areas:

a. Need for accuracy in obtaining plot measurements, static pressure, service make-up, etc.

b. Specific design criteria for athletic areas, cemeteries, recreational areas.

c. Contractor problems encountered through improper designs or specifications.

d. Use of rotors or sprays and desirable static pressure needed for each type of sprinkler (generalized).

e. Use of booster pumps on low pressure services.

f. Reasons for not mixing rotors and sprays on same battery.

g. General rule of thumb for sprinkler spacings.

h. Wind compensation; concern for winds over 5 mph.

i. Automatic vs. manual system costs.

j. Vandalism protection during construction and after construction.

k. Planning for future systems; installation of sleeves and pipes for future lines.

l. Shrub riser configuration (pipe coupling at grade).

CONCEPTS AND DESIGN OF OPEN SPACE[1]

Clive L. Justice[2]

Open space, that is green open space, is an essential part of man's environment. From the beginning it has been woven into the fabric of our western civilization and culture. Green space had its beginnings as a representation or interpretation of the Garden of Eden. Through the course of Western history, it has also had attached to it and has come to represent many other concepts: paradise, moral goodness, romantic love, the simple life, escape, and natural beauty. When you mention open space, it conjures up or brings to mind some or all of these things to each of us. I think though, that the concept that has come along with our culture as a physical object, and perhaps the strongest common theme is the idea that open space is natural and consists of green closely cropped grass on flat or gently rolling land, with groups of free-standing, high headed trees and a lake set in a low area or stream meandering through - 'Nature preserved as Nature laid it out'. What we imagine today to be natural open space is, in fact, man-made and emerged from 2500 years of pastoral agriculture - the raising of livestock in Western and Northwestern Europe. Grazing animals (the sheep, the cow and the goat) were the agencies which formed this kind of Landscape. The open spaces, meadows, pastures and fields were created out of the forest. It is, perhaps, interesting to note in passing that our cultures, concept and imagery of the forest is in direct contrast, representing evil, darkness, unnaturalness, wilderness, to our concept and imagery of open space. One has only to read some of the old European fairy tales to realize this.

1/ To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/ Justice and Webb Landscape Architects Ltd., Vancouver, B.C.

The pattern of village growth that emerged was a cluster of buildings separated from the forest by these meadows, pastures and croplands. Part of the meadow near the vilalge became, over time, common ground. Villages that expanded into towns incorporated commons within the settlement. By the 18th century, this had become so imprinted into the culture that planned villages in colonial America oftentimes included a built-in common or public open space. Although originally pastoral in nature, the common lost its agricultural uses and became a place for many group and social activities: lawn games using a ball, archery, horsemanship, military and athletic events, social dancing and other public celebrations, religious ceremonies and children's games.

The coming of the industrial revolution, and with it the tremendous growth of cities, changed all of this. Towns and urban areas were established with no direct connection to pastoral agriculture. The city and the countryside became two distinct and separate entities. While in the past public or common open space in towns had been a natural outgrowth of the way of life associated with pastoral agriculture, the new industrial towns and cities had no carry-over from the past of open space, and the emergence of a new philosophy of exploitation and subduing nature, along with the work ethic, gave little rationale for the provision of open space as a necessary part of the man-made environment of urban areas. Because the development of the west in North America was coincident with the industrial revolution, we copied the new industrial cities of Europe and the East in our urban development. In any event, there was so much open space about, why save it? Better to fill it up with development and people.

In North America, the movement to reintroduce public open space into our cities and urban areas in the main had its beginnings in the 1830's and 40's, largely through the efforts of two men - Andrew Jackson Downing, whose book the "Theory and Tretise on the Practise of Landscape Design" became the bible for the layout of private grounds and country estates throughout North America, and Frederick Law Olmstead, the first Landscape Architect in America, who did the design and layout for Central Park in the then largest new world city - New York. Incidentally, Olmstead also did the design for Montreal's Mont Royal Park. It is interesting to note that both these men took their model for open space from the private estates and gardens of England and northern Europe where the pastoral landscape had been developed, refined and modified into an art form taken from the work of the landscape paintings of Claude Lorrain and Salvator. The landscapes of the great English estates were developed on a formula of unbroken turf, sinuous streams, vistas amid clumps of trees and a surrounding ring of woodland. The lawn became the essence of symbol of beauty. Edmund burke wrote 'Most people must have observed the sort of sense they have had of being swiftly drawn in an easy coach on a smooth turf with gradual ascents and declivities. This" he continues, "will give a better idea of beautiful than almost anything else." Samuel Johnson defined the sensation of happiness as "Being swiftly drawn in a chaise over undulating turf in the company of a beautiful and witty woman".

In 1858, ten years after Olmstead had prepared the plans for Central Park, construction finally got underway. The Chief Engineer reported to Council the new pragmatic rationale for the Park: "Within the last few years public opinion has been awakened to a sense of the importance of open spaces for air and exercise as a necessary sanitary provision for the inhabitants in all large towns, and the extension of rational enjoyment is now regarded as a great preventative of crime and vice." Central Park became the model for all parks and urban open spaces in North America. It had, at last, a real down-to-earth rationale which fitted in the age of reason and pragmatism and the protestant ethic. It is interesting, as another side, to note that the naturalness of the English pastoral landscape was directed into the actual wilderness in America. When the first national parks were selected, Yellowstone and Yosemite, both Alpine Parks, it was primarily because the great areas of these two wonders of nature conformed to and looked like the English pastoral landscape.

Today we still carry with us the idea or myth of the pastoral landscape, but we find that the needs and purposes of open space in today's highly specialized urban society are refined and compartmentalized. Open areas now must have specialized functions and practical uses. Recreation and outdoor activities are now formalized, organized and programmed, requiring specialized types and forms of open spaces.

Golf requires a very specialized form of open space, but is the only known example where the reverse occurred. The game was invented solely to find a practical and justifiable use for all the sheep pasture land left in Scotland after the crofters immigrated to England and North America.

This demand for specialized and special purpose open spaces in our environment has left the Landscape Architect, who considered himself the last of the generalists, hard pressed to gather the technical knowledge and to encompass in his designs the requirements of these specialized open space functions. I know, in my own firm over the first six or so years of the twenty we have been in practice, we designed every conceivable type of landscape and open space - from cemeteries to university campuses, golf courses, sewage treatment plants and private residences. Gradually, while we would tackle anything that came along, we began to specialize in schools, parks, and large institutional grounds. In part, I believe, because of a fault or attribute common to many Landscape Architects in possessing a missionary zeal, that landscape (grass and trees) will somehow save the world and cure all its ills. Not surprising, as it is directly traceable back to our culture's concepts of open space mentioned previously.

We encountered many problems. We found, as an example, that we had to design and plan open spaces, sports grounds and playing fields, in canyons, on steep wooded hillsides, and in swamps. This was land not considered suitable or valued for any other type of development and had been piously designated for parks. Today, however, canyons and steep treed slopes and swamps are now becoming valued and preserved as a part of our environment. When we suggested, in order to retain these features, that the residents take up skiing, hiking and nature study, we were told that soccer, football and baseball were the activities required and the only true functions of parks.

We also found that there was a decided lack of technical information on the construction and maintenance of grass playing fields which had, we observed, to withstand a morning practice and two games of soccer on a rainy November Saturday. This technical information was slow in coming and even slower in acceptance by Parks and School Boards. In part, this was due to lack of funds, but more often due in a large part to the reluctance of these Boards (and all of us for that matter) to abandon the romantic concept of open space and realize or accept that open spaces, like grassed playing fields, must be designed, engineered, constructed and maintained to withstand the intensity of use we have today. We would not and did not long put up with or think of accepting a highway designed for the horse and buggy to meet the needs of today's transportation. Yet, it has taken us much longer to abandon the horse and buggy design and concepts for our open spaces. Luckily, through the work and efforts of organizations like the Turfgrass Conference, there is emerging a solid body of experience and research findings that is now enabling the Landscape Architect to design open space that is functional, beautiful and maintainable. Together we may yet save the world!

OVERWINTERING DISEASES OF TURFGRASSES[1] IN WESTERN CANADA

J. Drew Smith[2]

Introduction

It has been considered (9) (14) that the distribution of snow mold pathogens on grasses and cereals in Western Canada was similar to the Scandinavian situation with Sclerotinia borealis Bub. & Vleug. in the extreme north and Typhula spp. and Fusarium nivale (Fr.) Ces. further south. These pathogens were thought to be of minor or local importance compared with a sterile, non-sclerotial low temperature basidiomycete - LTB (1) not reported from other countries. While the latter is widespread and seriously damages a wide range of crops, there are anomalies in the distribution of the psychrophilic pathogens on turfgrasses. For example, S. borealis, and the LTB are found in Alaska and T. ishikariensis Imai in the Yukon (10). The latter fungus was reported to be the most prevalent snow mold on turfgrasses in the Peace River region of Alberta and adjacent British Columbia with S. borealis, F. nivale, and T. incarnata Lasch ex Fr. in successively decreasing frequency in spring 1968 (18). Lebeau (8) reported epidemics of F. nivale in 1967 and 1968 in southern Alberta, probably in complex with the LTB. In southern Manitoba Platford et al. (11) reported that the LTB was the cause of the most serious turfgrass snow mold but an unidentified Typhula sp. and F. nivale caused damage to bentgrass (Agrostis spp.) golf greens. In coastal regions in the Pacific Northwest F. nivale is the dominant turfgrass snow mold (5) while farther in the interior, in Washington, Oregon and Idaho Typhula spp. (T. ishikariensis and T. incarnata) and F. nivale occur as complexes (17).

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Research Scientist, Canada Department of Agriculture, Research Station, Saskatoon, Saskatchewan, S7N 0X2.

There is a great lack of recent precise diagnostic evidence on the causes and distribution of turfgrass snow molds, particularly from the interior of British Columbia, southern Saskatchewan, Montana, and Idaho and from all except the coastal regions of British Columbia, Washington, and Oregon. From some locations there are only isolated observations. Surveys in Saskatchewan since 1969 have yielded new records of *F. nivale*, *S. borealis*, 2 *Typhula* spp. a sclerotial low-temperature basidiomycete, 2 other unnamed sclerotial snow molds as possible pathogens or antagonists (15, 16). This points to the need for increased distribution and taxonomic studies in the Pacific Northwest as the groundwork for improving the efficiency of breeding and plant protection research programs. This paper summarizes the results of surveys since 1969 on the distribution of snow molds in western Canada, considers new information on the taxonomy and epidemiology and presents recent information on control of disease on turf inoculated with specific organisms or on natural infections where one pathogen was dominant.

The Unidentified Low-Temperature Basidiomycete - LTB

In the prairies this was probably the most common pathogen (or group of pathogens) on domestic Kentucky bluegrass/creeping red fescue, *Poa pratensis* and *Festuca rubra* turf often in complexes with *F. nivale*, the sclerotial low temperature basidiomycete - SLTB and *Typhula spp*. The LTB was found also on finer turfs of golf and bowling greens. Typical symptoms were also seen on domestic turf in the Peace River region of northern Alberta and British Columbia. Its distribution in western British Columbia is very uncertain; Vaartnou and Elliott (18) did not find it in their 1969 survey in northern British Columbia. Fair reliance for routine diagnosis of the LTB can be placed on the appearance of patches at snow melt when an abundant white fringe of mycelium is present. Damage may, however, occur when little mycelium is obvious and sometimes difficult to isolate in culture. Most isolates produce hydrocyanic acid which can be used for confirmation. Merion bluegrass seems particularly susceptible which is probably the main reason why this cultivar is less frequently recommended for prarie lawns.

In tests with artificially inoculated Kentucky bluegrass/red fescue turf in 1971/72 and 1972/73 with one fall fungicide application, mixtures of mercurous and mercuric chlorides, chlorneb, quintozene and daconil were most reliable in significantly reducing infection. For dosages in these tests see (16). Benomyl, cadmium chloride, topsin, phenyl mercuric acetate, TCMTB, BAS 3460F and CA 72003 were less reliable or ineffective. Some materials were associated with significantly increased damage. On a very heavy natural infection on 'Merion' bluegrass (82% av. on check plots) only mercurous/mercuric chloride of 15 materials gave significant control (7.4% infection).

Fusarium nivale

This pathogen is now known to be widespread on all common turf species although it was first officially recorded for Saskatchewan in 1971 (15). It was also found from the Peace River region to southern British Columbia in 1973 often in complex with *Typhula* spp. In the colder areas it is common on bluegrass and fescue turf receiving some heat from water pipes, sewers and basements but it also develops in these regions under heavy drifts. It is an important factor in the winter killing of *Poa annua* greens in Saskatchewan and I have often isolated it from such cases. It is usual to think of *F. nivale* as causing pink snow mold which develops after snow melt in colder regions. However, in such areas (in southern and central B. C. as well as Saskatchewan) typical fusarium patch symptoms were apparent on golf greens prior to the development of a permanent snow cover in late fall 1972. In Saskatchewan this was probably favored by the melting of an early snow fall in October. All common turf species seem to be susceptible but in Saskatchewan bluegrass/fescue turf generally recovers more rapidly from *F. nivale* attacks than those of the LTB. In 1971/72, using artificially induced infections, one late fall application of quintozene, mercurous/mercuric chloride, phenyl mercuric acetate or chloroneb significantly reduced the disease. On a light infection which appeared on *P. annua* following snowfall which melted in October 1972, phenyl mercuric acetate, quintozene and chloroneb were outstanding in preventing further disease development under a winter snow cover (16). Under these conditions neither daconil, thiobendazole benomyl topsin, BAS 3460F nor CA 70205 gave significant control.

Sclerotinia borealis

On every Saskatchewan golf course visited in spring 1972 and 1973 this snow mold pathogen was found on one or more *Agrostis* green. It was also found on creeping red fescue and Kentucky bluegrass turf of lawns, golf courses, and roadsides in Saskatchewan to Edmonton, Alberta, Beaverlodge and Dawson Creek in the Peace River region of Alberta and British Columbia. It was found on *F. rubra* at the turf plots at Agassiz. Diagnosis is simple and reliable, based on locating black sclerotia 0.5-7 mm in length in leaf axils and shoot bases.

From 1971 to 1973 the most severe outbreaks were associated with heavy snowdrifts resulting from snow fences or branches placed on or around greens to prevent desiccation damage. 'Penncross' bent seemed more susceptible than 'Seaside' or 'Colonial'. In several tests since 1971 on bentgrass greens from northern to southern Saskatchewan on late fall application of quintozene chloroneb, benomyl or phenyl mercuric acetate fungicide was generally effective in reducing infection but other materials gave significant reduction on occasion against naturally or artificially induced infections (16).

Typhula spp.

Several *Typhula* spp. are associated with snow mold diseases of turfgrasses in western Canada (16). *T. incarnata* Lasch. ex Fr. (syn. *T. itoana* Imai) (3, 22) which is also implicated in turfgrass snow mold in eastern Canada and the U.S.A. and in parts of the mid-west of the U.S.A. (19) has not yet been found in Saskatchewan. It was isolated from several golf green turfs during the 1973 spring survey in central and southern British Columbia. A fungus with sclerotia resembling those of T. ishikariensis Imai (7) [syn. *T. idahoensis* Remsberg (12) and *T. borealis* Ekstrand (4)] was isolated in central and northern Saskatchewan and a similar one collected at several points in Alberta and southern British Columbia in 1973. Another undescribed *Typhula* sp. was found at many places in these three provinces in 1972 and 1973.

Results from fungicide tests in Western Canada where _Typhula_ spp. were implicated are confusing. This may result from the interference by _F. nivale_, found at several locations in British Columbia and in Saskatchewan in spring 1973 associated with either _T. incarnata_, _T. ishikariensis_ or _Typhula_ sp. Dr. D. K. Taylor's results indicate that Mercuric chloride mixtures, quintozene, and chloroneb often give good control of snow mold where _Typhula_ spp. are involved.

Sclerotial Low-temperature Basidiomycete - SLTB

This unidentified pathogen was found on snow mold patches throughout Saskatchewan and in the Peace River region of Alberta and British Columbia from 1971 to 1973. Often it was dominant and it has been shown to be pathogenic. Although it is a typical basidiomycete I have been unable to induce spore production or to germinate the dark brown small sclerotia which is one means of distinguishing it from the LTB. It is effectively controlled by phenyl mercuric acetate, chloroneb, quintozene, and 5,6 dihydro 2 methyl-1, 4 oxathiin-3-carboxanilide fungicides (15).

Fungus with Orange Rindless Sclerotia - ORS

This unidentified snow mold fungus was collected from many survey points in Saskatchewan and the Peace River region. Although apparently absent in central and southern British Columbia, it has also been collected from turf in Ottawa, Ontario, by Dr. L. Werersub. The orange-colored rindless sclerotia develop under the snow and are produced abundantly on overwintered grasses and legumes of many species particularly where the snow is deep. Sporulation has been induced and the apparently unnamed fungus is probably a _Gliocladium_ or _Tubercularia_. Its significance is not in disease production but in its possible antagonism to snow mold pathogens (16).

Discussion

It is probable that local variations in microclimate are of greater importance in determining the prevalence and the dominance of snow mold pathogens than the overall climate. On the present evidence, the geographic or climatic distribution of the main snow molds is acceptable as a very broad general principle. The range of some pathogens is obviously greater than others - F. nivale is an example of one with a very wide range and the LTB one with a more restricted one. I have suggested previously (14) that it is not possible to correlate the distribution of these pathogens to their cardinal temperatures. Nearly all will grow (in culture at least) at freezing point or below. When suitable microclimatic or cultural conditions are presented they are capable of causing epidemics.

It is apparent that we have much to find out about the identity and distribution of snow mold pathogens. As new areas are populated new amenity turf is established often using management techniques and plant material adapted from a different environment. As an example, there are now 35 golf courses with grass greens in Saskatchewan where a few years ago only the main cities and towns had such facilities, mostly with sand greens. Many of the greens on the new courses are sown with Penncross bent since it produces an excellent putting surface in milder climates but which is quite susceptible to S. borealis. Traditionally inorganic mercurials have been used for overwintering diseases but these are generally ineffective against S. borealis although effective in preventing F. nivale or the LTB. In the colder areas of the northwest it has been usual to make one application of fungicide in late fall before a snow cover develops, the premise being that this would prevent the inoculum of snow molds dormant in the turf base from developing under the snow cover. However, this procedure is probably shortsighted in view of the events of fall 1972, when conditions were favorable for an attack of fusarium patch to develop on turf in many parts of Western Canada. It is axiomatic that it is more difficult to cure disease than to prevent it once established, and this proved to be so in this instance. Even where fungicides were applied post-attack, severe pink snow mold appeared on many golf courses in Saskatchewan in spring 1973.

The presence of more than one pathogen or possible pathogen can cause difficulty in prescribing control measures. A Typhula attack may be superimposed on fusarium patch as was the case in a course in northern Saskatchewan in the winter of 1972/73, or fusarium patch may be concurrent with disease caused by S. borealis and the SLTB and S. borealis may codominant. Turf pathologists have sought for wide-spectrum fungicides, universal systemic fungicides, have almost abandoned mercurials and we are now running into problems with the development of resistance of turfgrass pathogens to particular fungicides (2). There is some evidence that some fungicides inactivate competitive turf fungi (16) thereby favoring the disease to be controlled. That such antagonists are present is shown in the case of the ORS fungus. Our exploratory studies have shown that although little antagonism exists between F. nivale, LTB, S. borealis and Typhula spp. in pure culture, some isolates or ORS have shown antagonism towards all these pathogens at low temperature. Since the ORS fungus is widely distributed its role in snow mold development requires further investigation.

LITERATURE CITED

1. Broadfoot, W. C., and M. W. Cormack. 1941. A low-temperature basidiomycete causing early spring killing of grasses and legumes in Alberta. Phytopathology 31:1058-1059.

2. Cole, H., and C. W. Goldberg. 1973. Fungicide tolerance, a rapidly emerging problem in turfgrass control. 2nd Int. Turfgrass Res. Conf. Blacksburg (Abstract) 26.

3. Corner, E.J.H. 1950. A monograph of Clavaria and allied genera. 740 p.

4. Ekstrand, H. 1955. Hostsadens och vallgrasens overvintring. Statens Vaxtskyddsanstallt. 67:1-125.

5. Gould, C. J. 1964. Turfgrass disease problems in North America. Golf Course Reporter. May 1-9.

6. Imai, S. 1931. Nisan Nosakumotsu no - Typhula - byo ni tsuite (On some Typhula-deseases of agricultural plants) Nihon Shokubutsu byorigakki - no (Ann. Phytopath. Soc. Japan). 2:386.

7. _________. 1936. On the causal fungus of the Typhula blight of gramineous plants. Jap. J. Bot. 8:5.

8. Lebeau, J. B. 1968. Pink snow mould in southern Alberta. Can. Plant Dis. Surv. 48:130-131.

9. ________, and M. W. Cormack. 1959. Development and nature of snow mold damage in Western Canada. IX International Botanical Congress. Montreal 1:544-549.

10. ________, and C. E. Logsdon. 1955. Snow mold of forage crops in Alaska and Yukon. Phytopathology 48:148-150.

11. Platford, R. G., C. C. Bernier, and A. C. Ferguson. 1972. Lawn and turf diseases in the vicinity of Winnipeg, Manitoba. Can. Plant Dis. Surv. 52:108-109.

12. Remsberg, R. E. 1940. Studies in the genus <u>Typhula</u>. Mycologia 30:52-96.

13. Røed, H. 1969. Et Bidrag til appklaring av forholdet Mellom <u>Typhula</u> <u>graminum</u> Karst. og <u>Typhula</u> <u>incarnata</u> Lasch ex Fr. Freesia 9:219-225.

14. Smith, J. Drew. 1969. Overwintering diseases of turfgrasses. Proc. 23rd N.W. Turfgrass Conf. Hayden Lake, Idaho. Sept. 24-26, 65-78.

15. ________. 1972. Snow mold on turfgrass in Saskatchewan in 1971. Can. Plant Dis. Surv. 52:25-29.

16. ________. Snow moulds of turfgrasses in Saskatchewan. Proceedings 2nd Int. Turfgrass Res. Conf. Blacksburg, VA. 18-21 June 1973 (In press).

17. Sprague, R. 1959. Epidemiology and control of snow mold of winter wheat and grasses in the Pacific Northwest of the United States. IX International Botanical Congress. Montreal 1:540-544.

18. Vaartnou. H., and C. R. Elliott. 1969. Snow molds on lawns and lawn grasses in Northwest Canada. Plant Dis. Reptr. 53:891-894.

19. Vargas, J. M., and J. B. Beard. 1971. Comparison of application dates for the control of Typhula blight. Plant Dis. Reptr. 55:1118-1119.

MINIMIZING TURFGRASS WINTER INJURY[1]

James B. Beard[2]

Winter injury of turf is difficult to understand because it results from the interaction of a number of environmental, soil, and cultural factors. Before a turfman can initiate the appropriate cultural program to prevent winter injury, he must determine the particular type or types of winter injury that occur most frequently at various locations on the golf course. This involves a study of the particular symptoms, including time of occurrence, soil type, topography, drainage characteristics, traffic patterns, and the probability of environmental stress. Such information is assembled over a period of years, and a specific program is established in order to minimize the probability of winter injury.

Causes of Winter Injury

The major types of winter injury are:

Desiccation
Direct low temperature kill
Low temperature diseases
Traffic effects.

This article has been excerpted from an earlier original paper entitled "Ten Years of Research on Winter Injury on Golf Courses: Causes and Prevention" Green Section Record. Vol. 10, No. 6. pp. 3-8. Nov., 1972.

1/ To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/ Professor of Turfgrass Science, Michigan State University, East Lansing, Michigan.

Note that ice sheet damage caused by oxygen suffocation or toxic gas accumulations underneath an ice cover are not listed. Detailed investigations at Michigan State University over 10 years indicate that this type of winter injury rarely occurs. This is in contrast to the many articles by individuals indicating that this is a serious problem. Unfortunately, these earlier writers had essentially no information on which to base their comments other than data from research with alfalfa. The winter injury most commonly associated with extended periods of ice coverage occurs during freezing or thawing periods when standing water increases the crown tissue hydration and subsequent injury of the turfgrass plants when temperatures drop rapidly below 20° F.

Preventing Winter Injury

Cultural steps can be taken to minimize the potential for injury in the future once the cause or causes of winter injury on specific turfgrass areas have been established. The first prerequisite in minimizing all types of winter injury is a healthy turf with adequate carbohydrate reserves and recuperative potential. This phase of winter injury prevention is accomplished during the normal growing season, particularly in the late summer-early fall period. Practices to prevent or at least minimize the potential for turfgrass winter injury can be divided into cultural practices, soil management, and specific winter protectants.

The specific practices utilized in each of these categories are summarized in Table 1. It should be noted that a number of them apply to more than one type of winter injury. In some cases, the practice that is effective in preventing one type of winter injury will actually increase the probability of damage from another type. For example, snow covers or winter protection covers used to prevent winter desiccation will also maintain temperatures near 32° F which will enhance the probability of snow mold disease activity. This means that when such a practice is in use, steps should also be taken to apply a preventive snow mold fungicide application to the turfgrass area prior to installing the winter protection cover.

TABLE 1. PRACTICES AVAILABLE TO MINIMIZE WINTER INJURY ON TURFGRASS AREAS

Type of Winter injury	Practices that minimize injury: Turfgrass Cultural	Soil Management	Specific protectants	Turfgrass species most commonly affected
A. Desiccation				
(1) Atmosphere	Moderate nitrogen nutritional levels	Do not core in late fall and leave the holes open	Conwed Winter Protection Cover	Annual bluegrass
	Elimination of any thatch problem		Polyethylene (4-6 mil)	
			Saran Shade Cloth (94%)	
			Topdressing (0.4 yd^3/ 1,000 sq. ft)	
			Windbreaks such as snow fence, brush, or ornamental tree and shrub plantings	
			Natural organic mulches	
(2) Soil	Moderate nitrogen Nutritional levels	(Same as above)	(Same as above)	Annual bluegrass
	Irrigation or hauling of water to critical turfgrass areas.			
B. Direct Low Temperature Kill	Moderate nitrogen nutritional levels	Rapid surface drainage by proper contours, open catch basins, and ditches	Conwed Winter Protection Cover	Bermudagrass
			Soil Retention Mat	Annual bluegrass
	High potassium nutritional levels	Adequate subsurface drainage by drain tile, soil modification with coarse textured materials, slit trenches, and dry wells.	Enhancing a snow cover with snow fence or brush.	Red Fescue
	Higher cutting heights		Natural organic mulches such as straw.	

106

TABLE 1. Practices available to minimize winter injury on turfgrass areas (continued)

Type of Winter Injury	Practices that minimize injury: Turfgrass Cultural	Soil Management	Specific Protectants	Turfgrass species most commonly affected
	Elimination of any thatch problem Avoidance of excessive irrigation	Cultivation, especially coring and slicing, when compaction is a problem	Soil warming by electricity.	
C. Low Temperature diseases:				
(1) <u>Fusarium</u> patch	Moderate nitrogen nutritional levels High potassium and iron nutritional levels. Moderate to low cutting heights Elimination of any thatch problem.	Avoiding neutral to alkaline soil pH's	Cadmiums Benomyl Daconil Mercuries	Annual bluegrass Bentgrass
(2) Spring dead spot	Avoid excessive winter irrigation Elimination of any thatch problem	Provide good surface and subsurface drainage. Cultivate when compaction is a problem.	Nabam, time the applications to be present when soil temperatures are below 50° F and the soil is water saturated	Bermudagrass
(3) <u>Typhula</u> blight	Moderate nitrogen nutritional levels Moderate to low cutting heights Elimination of any thatch problem.	Provide good surface and subsurface drainage. Cultivate when compaction is a problem	Cadmiums Chloroneb Mercuries	Annual bluegrass Bentgrass

TABLE 1. Practices available to minimize winter injury on turfgrass areas (continued)

Type of Winter Injury	Practices that minimize injury: Turfgrass Cultural	Soil Management	Specific Protectants	Turfgrass species most commonly affected
(4) Winter Crown Rot	Elimination of any thatch problem.		Mercuric chloride (2 applications)	Annual bluegrass Bentgrass
D. Traffic				
(1) On frozen turfgrass leaves	Apply a light application of water in early morning; this is most effective when the soil is not frozen and the air temperatures are above freezing.		Withhold or divert traffic from turfgrass areas during periods when the leaf and stem tissues are frozen.	
(2) On wet, slush covered turf.			Withhold traffic on turfgrass areas during wet, slushy conditions, especially if a drastic freeze is anticipated.	Annual bluegrass

From a cultural standpoint, the proper control of plant and soil water relations is the most critical factor affecting all phases of turfgrass winter injury. Techniques to adjust the soil-water status must be achieved during the summer period.

Finally, it is quite obvious that selection and planting of the appropriate turfgrass species and cultivar can be critical in minimizing the degree of turfgrass injury that may occur. Annual bluegrass is very prone to all types of winter injury. The bentgrasses are considerably less susceptible to injury, and also have a greater recuperative potential from existing vegetative plant parts.

REFERENCE

Turfgrass: Science and Culture. by James B. Beard. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. pp. 1-658.

COMPATABILITY OF TREES,[1] SHRUBS AND GRASSES

W. H. Bengeyfield[2]

Anyone who has been charged with the growing of grass on an area heavily populated with trees knows the headaches, problems and inevitably the power of the "tree lobby". Joyce Kilmer surely could not have known the problems he would create for the turfgrass manager when in 1917 he wrote, "I think that I shall never see - a poem lovely as a tree".

Let it be hastily recorded that turfgrass managers are not necessarily anti tree. But, since our job is to grow turf for sports and aesthetic reasons, we recognize the fact that there are situations where trees and shrubs are simply not compatible with grass. Especially if the grass is expected to withstand any kind of traffic or use. That's the crux of the problem:

A) Is a solid, tight turf the requirement or

B) Is the presence and beauty of a tree or trees the requirement?

It seems that's the choice, the final decision one must make.

Trees and shrubs can cause turfgrass problems in at least four or five ways:

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Western Director, United States Golf Association Green Section, Garden Grove, California.

SHADE

1. Avoid the planting of those trees having notorious shade problems. A Norway maple is an example.

2. When planting trees, use them sparingly and in strategic locations. Don't overplant. Remember, what is a small tree today will be a giant awning tomorrow.

3. Whenever possible, remove excess trees during construction to avoid tree and people problems later.

4. Practice judicious pruning. Don't denude an area but don't be timid either.

5. Research is needed on the degree of light intensity required for different turfgrasses; especially during the winter months.

TREE ROOTS

1. Shallow tree feeder roots do the damage not the heavier, thicker tree roots.

2. Tree roots vigorously compete with the grass plant for both moisture and nutrients. Tree roots invariably win.

3. Barriers are not the best means of tree root control. A tree root pruner (capable of approximately a 15-inch deep cut) or small ditch digger is best. Repeat as needed.

AIR DRAINAGE

1. Poor air circulation means higher humidities in the summertime and frost pockets in the fall, winter and spring. The grass plant is the loser.

2. Through pruning or actual tree removal, open channels for air movement across the turfgrass area. Keep the prevailing wind direction in mind.

LEAVES, NEEDLES AND DEBRIS

1. Certain tree types directly affect the turf under the tree by smothering with leaves, debris and in some cases with toxic exudates from the leaves, needles, etc.

2. Avoid planting of such trees and remove them completely if they are already present and causing a turf management problem.

COMMON TREE TYPES TO BE AVOIDED

The trees we find causing the most problems for the turf manager include:

Scientific Name	Common Name	Problem
Acer platanoides	Norway maple	roots and leaves
Populus spp.	Poplars	roots
Populus fremontii	Cottonwoods	roots, leaves & cotton
Salix spp.	Willows	roots and leaves
Sorbus spp.	Mountain Ash	roots
Eucalyptus	Eucalyptus	roots and trash

Check with your County Extension Agent for the names of other "problem" trees for your particular area. Write to the USGA Green Section for the publication "Planting the Golf Course" for additional information on desirable and non-desirable trees.

GRASSES

There are a few grasses that will do reasonable well under shade conditions if given sufficient water and fertilization from time to time.

The fine-leaf fescues sown at 5 pounds per 1,000 square feet will do reasonably well in shady fairly dry situations.

<u>Poa trivialis</u> or rough stalk bluegrass will do well in shady or wet situations.

Poa annua seems to survive rather well under shade.

Bentgrasses, especially Velvet bent tolerates shade rather well.

PROPER PLANTING OF TREES AND SHRUBS

The characteristics most desirable for trees to be used in turfgrass areas include deep rooting, light of filtered shade, absence of litter, strong branching and a lack of insects and diseases. By carefully selecting and placing trees, the designer may produce beautiful vistas, enclosed spaces, provide beauty, color, privacy and protection and make man's environment that much more enjoyable.

Trees should be planted in groups or clusters rather than in straight row plantings. The placement of any tree should be thoroughly and thoughtfully considered before the actual planting takes place. The occasional use of single specimen trees (in the right location) is desirable but there is no need to make every tree or shrub a "specimen planting." Further, when planting trees or shrubs, keep in mind the mowing requirements of today as well as into the future.

A park, golf course or any turfgrass area provides unlimited possibilities for the use of plant materials. However, if the primary goal is to provide a strong stand of turfgrass for sports or aesthetic purposes, grass plant requirements must come first and those of trees and shrubs placed on a secondary level.

GOLF COURSE DESIGN— ITS FRUSTRATIONS AND REWARDS[1]

Norman H. Woods[2]

It has been said that every man is an expert --- or believes he is an expert --- at three things. He can, hopefully, do his own job well. He knows he could run a pub with great success. And he is damn certain he could design and build the perfect golf course.

I am, God help me, a golf course architect, and a member of the American Society of Golf Course Architects. I have been an architect for a long time, having designed 250 courses, re-shaped many others, and am still building them.

Who needs a golf course architect? Many people have asked, particularly when they find their favorite hole has been changed around. Why can't old Smithers, who knows a thing or two about growing grass, lay out a course for us? After all, Smithers says, the old Scottish courses were laid out sometimes by accident. They just looked around the terrain, at the gradients and the places where a green could sort of nestle into the contours, and the thing was done.

There is a lot of tradition behind the game of golf, and a great deal of mythology. A favorite myth is that a golf course is 18 holes long for the following reason: four men with a bottle of the dew of the glen would finish half the bottle in ninety minutes --- by which time they would have played nine holes. Time to get back to the clubhouse, so they turned around and played nine holes back. That accounted for the bottle.

1/ To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/ American Society of Golf Course Architects, Penticton, British Columbia.

You don't have to believe that story, though I have to report that many courses in Scotland, especially the seaside links, run nine holes one way and nine holes back to the clubhouse. So maybe there was something in the story!

Nowadays, of course, it is not necessary to find the ideal contours for the good golf hole. The bulldozer will do the work that Nature used to do. So the architect has machinery on his side, but I am going to suggest that the modern-day architect has a great many other troubles on his shoulders, undreamt of by the designer of long ago.

Not only must he know the game inside out, but he must be something of an expert on agronomy and agriculture --- not so important, this, because any university will help with experts on the subject. But he must certainly be an accountant, and know the finances of the club he is working for, the state of the equipment, and what plans there are in the future for new equipment. He must know the cost of land, and its not bad at all to know the average age of the members, and whether they want a course that will test the pros if they plan to stage a tournament, or whether they want a "members' course", a pleasant place where they can score well if they hit the tee shot 175 yards.

I remember talking to one chap who said he would like to build the perfect "resort course". When I asked him what he meant he told me: "My resort course would aim to please, even if a little subterfuge was necessary at times. If I were to bank up the sides of the fairway in the right places, the ball would tend to jump back into the straight and narrow from a slice or a pull. The greens would be ever so slightly like saucers, without being too obvious, and the pins would be in the center of the saucer more often than not. The traps would be there alright, but in locations only found by the very worst of shots."

I expressed some horror at this theory, but my friend went on to an even more shocking suggestion. "I might even do a little tinkering with the yardage," he said. "Imagine the delight of the tourist as he reported to his friends: A great course! Why, I was hitting those par four greens at 420 yards, according to the card."

Well, that's not in the category of golf course architecture, but I had to admit that my friend had one point that I applauded. For he had put the love of sport into the game. You remember, when golf was a game?

I would ask you to look around at the faces of the golfers these days. Dour, and solemn, their brows creased in concentration, as if the fate of the world --- their world at any rate --- depended on that approach shot to the green, on that four foot putt. Are they really indulging in sport when they stalk around the green, looking at the coming putt from every conceivable angle? Are they happy golfers?

I suggest they have all been looking at too much television. For sport has gone out of the competitive golf. As a rule the pros don't play for love of the game, but for money. And this attitude must affect the golf course architect in his decisions.

What is a good golf hole? What are we trying to give the members who play the shot?

There must be the challenge. For many reasons. The main one, the mistaken one, that a course without many obstacles means faster golf --- many public courses now have holes like freeways. As long as it's 500 yards from tee to green, the distance factor on the course is satisfied, and the long handicap man has his troubles in getting there with three shots and getting his par. That's the theory. Don't let him waste time in traps, or in the rough when his shots go off the line.

But there's no reward there for careful placing of each shot, the circumvention of obstacles, the strategy necessary in the approach to the green. Hit the ball far enough, and you're there. That's not golf.

I try to build a golf hole which demands a planned and carefully executed tee shot, with the thought of the second shot ever present. If the tee shot is off-line, then the second shot must be masterly or the penalty paid. If I had my way --- and I have never been able to build a course that is entirely to my way of thinking --- I would place a hazard right there in front of the tee. Too often, even on our best courses, I have seen the golfer miss - hit his tee shot, top it, and go unpunished. The ball bounds away for a hundred yards or so up the fairway, and if the golfer makes a good second shot, he's laughing. He should be crying.

My idea to make him cry is a very simple one, and an old one. And although it has many advantages, I am never able to put it into effect. I would simply forget to put the mowers over the turf for the 75 yards ahead of the tee. Better still, I would plant some cheap ground cover over that area, the finest being heather. For the ladies, perhaps, the distance would be 50 yards, not 75 yards.

That would put a crimp in the topper, who now gets away scot free. And, of course, it was the Scots who believed in this theory, and still do. Not for them the expense of mowing that area of 75 yards --- equivalent to many hours of work through 18 holes. Let the heather grow, and the golfer who has topped the ball will have to hack it out with a wedge, painfully aware that he must pay for his transgressions. But he will not squeal. He will know that crime does not pay.

But what do I find when I suggest leaving a hazard in front of the tees? I am Torquemada. I am a sadist, particularly in the view of the ladies, who insist they should be permitted to top the ball to their heart's content, bless 'em. And I find this mistaken view is especially prevalent with our neighbours and visitors. They seem to think that even if the tee shot is wildly hooked, they should be able to play off shaven turf, from perfect lies. Happy Hookers, all of them. So I am permitted from punishing them to the full extent of the law. They plead a new kind of Amendment, somewhat similar to the Fifth we hear so much about. It reads "I decline to be penalized for my error on the grounds that it might tend to bump up my score to an astronomical total."

The main objection to any proposal to present such a hazard in front of the tee is that it would tend to slow up play. But anyone who has studied the funeral pace of golf in this day and age knows very well that the golfer, in his snail's pace from tee to green, has all the time in the world for hacking out of the heather, exploding out of traps, and indulging in all kinds of time-consuming endeavors. In the five and six hour game of golf, a man could read War and Peace while waiting on the tees in one season, and a woman could knit a few sweaters. It's not the hazards that slow the game.

I never know why club managers and pros fail to see how the game can be speeded up. Obviously, its on the 18th green, and when that's taken care of with a few choice words, the 17th green and the 16th green, and so on. One marshall, with the tact and firmness of a diplomat, could get the game going splendidly. The only players who can move rapidly are the ones on the 18th green. Get them off, and get the foursome on the 18th fairway on the move. Then see that the foursome on the 18th tee is hard on their heels. One man in a golf cart with a marshall's band on his arm could take an hour off a weekend's round of golf. It would help, though it's a long way still from the old saying that "Golf is a three hour game over 18 holes."

Not that I envy that marshall. I'd rather be a golf course architect.

There must be a basic reason why golf is so slow. The blame lies with the pros seen on T.V. I know that there's a lot of money on a putt, and pros play for money, not for sport. But can any pro tell me why it's necessary to stalk round the green, studying the line of the putt not only from the front and rear, but from both sides? Whatever can they learn from this inspection? What clues are to be found? I am baffled.

But the hacker, watching his idol on the boob tube, believes he has to do the same. He looks into the hole as if to make certain that it is really there. He paces off the putt, and inspects every inch to make sure that it is indeed covered with turf all they way, free of traps, burrowing animals, snakes, and unexpected crevasses. The blame partly lies with pros seen on T.V.

Then at last he putts.

Meanwhile a foursome waits on the 18th fairway. A foursome waits on the 18th tee. On the course, upwards of 140 golfers are waiting for that memorable putt, and there's more in the clubhouse.

I try to build a golf course which will please both the titian of the game and the 18-handicap golfer. The latter play the shot, for there are more of them. I could make mention of many fine holes I have created, pars 3, 4 and 5. A lot of them are risky but only for the low handicapper who wants to gamble for his eagle or birdie, but in all cases there is an entrance for the fellow, young or old, who gives a whoop and a holler if he even bogies the hole. He is, after all, the majority who keep the course going.

But I wonder how many golfers get their minds off the figures and look around them to enjoy the beauty of a golf hole? I believe the aesthetics of the hole to be very important. At Shaughnessy in Vancouver, B.C., and on many other courses, I have insisted on quite a lot of money being spent in a direction that has nothing to do with the score on your score card. Blue spruce, wonderful Japanese maples, even plum trees, bushes, flower plants and flowers, of all kinds, round the tees and around the greens. This is part of the reward, but more rewarding is when you come back a few years later and see a beautifully maintained course and all those trees, plants, flowers, etc. have eventually grown to their full extent. I talked to many players, more or less strangers, on their particular course and have asked them a plain question, "Who designed this course?" None of them seem to know, but in my conscience I am satisfied that a monument has been left behind and many people will enjoy it and, of course, curse it from time to time.

There's more to golf than writing down the par figures. To some, a beautiful hole is one of the most splendid sights in the world.

Though I have said I believe golfers should be penalized for their sins, I do think they have one incontrovertible right --- they should be able to see the green and the bottom of the flagstick with full clarity. That is why I believe in making the green a target, even "propped up", if I can put it that way. So I have often re-shaped greens with large amounts of fill, raising the level so that the golfer can play INTO the target. Blind holes are for fortune tellers.

A word about money. It is inevitable that the golf course of the future must be linked with development of homes. How else can they survive? They lose on the food. They make money on the bar. But costs are so astronomical they must have land that can be developed. Otherwise, they must be 80 or 100 miles outside of a big city with its high taxes. Palm Springs, and other places where golf courses are ringed with homes and swimming pools, shows the way.

Spare pity for the golf course architect. He is surrounded by self-appointed experts. When young men write to me (as they do about once a month) they ask how they should go about becoming a golf course architect. I tell them they should apprentice themselves with a qualified registered architect for a least five years. There's so much to learn. They won't learn it out of books, for every terrain, every circumstance of a club, is different. They will only learn from bitter experience.

Spare pity. I've been called many things as well as "The man who came to dinner." When Sir Cantankerous is in a trap, it's a badly located trap. When young Curmudgeon finds the rough with his drive, the architect was out of his skull. When Mrs. Topper loses a ball in the water hazard, the golf course architect is the one who should drown.

Her husband, Mr. Topper, should design the course. For, quote, "anyone can design a golf course", unquote.

<u>And Finally</u>.....

Rod Gibson writes in The Miami Herald: "These golf course Designers remain rugged Individuals who seem to have only one common point of agreement among them --- not to agree with each other about their respective Design Philosophies. One Golf Course Architect's praising another is about as common as a public appearance by Howard Hughes.

"What does all this mean to the average golfer? Not a Hell of a lot really. The average golfer is a Duffer, slicing his ball into a lake here and forrest there; sometimes barely dribbling the ball beyond the Woman's Tees. All the different subtleties of design which the Golf Course Architects bicker seem lost on them." Sobering thoughts, those!

AGRONOMIC RESEARCH REPORT[1]

Roy L. Goss[2]

The following is a summary of agronomic research activity at the Western Washington Research and Extension Center, Puyallup, Washington, during 1973.

Nutritional

The putting green nutritional program is nearing the end of the fourteenth year of management and the following conclusions can be drawn:

Nitrogen

Rates as high as 20 pounds of available nitrogen per 1,000 sq. ft. per season can be used if close attention is paid to nutrient levels of phosphorus, potassium, sulphur and minor elements. In plots at Puyallup the important element seems to be sulphur. Without sulphur applications, plots receiving the highest level of nitrogen do not respond to nitrogen treatments. We do not recommend this level of nitrogen, but we are only looking at it for experimental purposes.

Nitrogen applied at 12 pounds per 1,000 sq. ft. per season continues to produce the best quality turf. The best quality turf at this nitrogen range is produced with very low levels of phosphorus with 8 pounds of K_2O and 3 pounds of sulphur per 1,000 sq. ft. per season.

The 6-pound nitrogen application per 1,000 sq. ft. does not produce turf with satisfactory color through all seasons of the year without applications of sulphur. Sulphur tends

---

1/To be presented at the Joint Northwest Turfgrass Association/Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Agronomist/Extension Turfgrass Specialist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington.

to increase the color of the turf and compensates somewhat for the low levels of nitrogen. Soil test values at the end of 1972 indicate that phosphorus is remaining at high levels while potassium is barely hanging on at acceptable levels even at 8 pounds of K_2O per 1,000 sq. ft. per season. It is, therefore, concluded that we must continue to apply potassium or run the risk of potassium deficiencies.

In regard to sulphur, all plots receiving this element are of superior quality regardless of the nitrogen, phosphorus or potassium treatments. Plot evaluations immediately following the cold, desiccating periods of December and January of last year indicate that plots receiving sulphur were less injured than those not receiving sulphur. Likewise, the sulphur plots retained a higher degree of color during the hot summer months than others.

Slow release fertilizer experiments conducted since early May, 1973, indicate that two (2) applications per year of most of these materials were maintaining adequate color and growth on bluegrass turf. The level of nitrogen applied was 4 and 8 pounds per 1,000 sq. ft. per season. The rank of quality is as follows: Sulphur-coated urea; Agriform; IBDU; Blue Chip Nitroform, with others rating below these. There were little differences in quality between sulphur-coated urea and the agriform product while IBDU and nitroform were only slightly less in quality and of about equal value. Any one of the first four (4) listed slow release products would serve very well in any turfgrass program at two applications per year. Other sources need more than two applications.

Poa Annua Control

Three years' data have been collected on preemergence control of *Poa annua*. Out of the materials tested, only bensulide and tricalcium arsenate have produced Poa free turf. Bensulide applied in one single application at the rate of 15 pounds of active ingredient per acre per year has not controlled *Poa annua*. Bensulide applied at 12 pounds active ingredient per acre every 3 months, has produced *Poa annua* free turf. This can be attributed to maintaining a level of toxicity throughout the entire year in the germinating zone and rooting zone of Poa annua. Tricalcium arsenate has consistently produced Poa free turf, but some learning experiences must be recognized. The area must be well drained and the arsenic level adjusted according to soil texture. Eighteen pounds of tricalcium arsenate per 1,000 sq. ft. was applied to these plots the first year, and maintenance rates of 4 pounds per 1,000 sq. ft. divided into equal applications of early spring and early fall, have been practiced. Sands require much less arsenic to maintain a level of toxicity. The exact level is not clearly known, but somewhere in the range of 6 to 8 pounds of tricalcium arsenate per 1,000 sq. ft. will possibly produce enough toxicity if maintenance applications are practiced.

Other Poa annua preemergence materials are being tested including Emblem, a product of Mallinckrodt Chemical Company.

Moss Control

Two separate experiments at three different sites were established to test products produced by Ortho and O. M. Scott Company in the spring of 1973. The Ortho products are essentially ferrous or iron compounds while the O. M. Scott products are other chemicals and for reasons of proprietary rights materials will not be mentioned in this report. One or two of the Scott products may be released in the near future for moss control. Both the ferrous applications and the Scott applications produced excellent control of moss with no phytotoxicity to mixed bentgrass turf. An interesting comment on the Ortho material is the extremely well-formulated pellets which lends itself to ease of application. This is a great improvement over the usual formulation of ferrous sulfate or ferrous ammonium sulfate.

Agrostis - Poa Pratensis - Festuca - Lolium Variety Trials

Considerable effort was given this year to the establishment and rating of over 2,000 plots of bent, bluegrass, fescue and ryegrasses. Since detailed reports of these will be presented by C. J. Gould and S. E. Brauen, no further comment will be made in this report.

Cooperative Disease Research

Evaluations were made in regard to turf response to fungicidal treatments for *Fusarium* Patch disease and *Typhula* snow mold disease. Efforts were made to determine which products were phytotoxic and others that may stimulate better color, growth or density. In general, all products containing sulphur produced turf with better color, density and growth characteristics. Other quality ratings are being reported by C. J. Gould.

Advanced Management Studies on Agrostis Cultivars

Four replications each of the following bentgrasses have been established at Farm 5 for advanced management studies to determine their response to mowing, fertilization and disease control: Arlington, Nimisila, Northland, Waukanda, Yale, Keen's 36, Arrowwood, (Keen's 53), MCC-3, Wayne Huffine Oklahoma, Smith's 721, 732, 736 (Saskatchewan), UCR 30 (Youngner), Penn No. 5, Hayden Lake, Kingstown, Novobent, Emerald, Prominent, Tracenta, Bardot, Highland, Penncross, A-75 (Scott's), and Boral.

These plots were established on methyl bromide fumigated ground on September 6, hence, they are just being established. More information will be reported on this in 1974.

RYEGRASS, BLUEGRASS AND FESCUE EVALUATIONS IN WASHINGTON

Stanton E. Brauen[2]

A new variety evaluation program was undertaken at Puyallup this past year for the purpose of evaluating the adaptability of presently available varieties of ryegrass, bluegrass and fescues for turf in this area. The program is a cooperative one involving Drs. Goss and Gould.

The collection of these selections started in the fall of 1972. Through numerous contacts with plant breeders, seed companies, and their representatives in many countries throughout the northern hemisphere, we have assembled and now established 271 varieties or selections of these three grasses. An additional 134 introductions of fescues and bluegrasses were obtained.

The grasses were seeded in July, 1973, at Farm 5 of the Western Washington Research and Extension Center. Bluegrasses and fescues were seeded in four replicates and ryegrasses in two replicates. Individual plot sizes are 4-1/2 x 5 feet. Introductions were seeded in smaller 2 x 2 foot plots.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Assistant Agronomist/Extension Agronomist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington.

There are a total of 115 bluegrasses now established. All are being managed at the 1-1/2 inch cutting height. In addition, 56 varieties or selections of bluegrasses were selected from the 115 varieties and are being managed at the 3/4 inch cutting height. There are a total of 91 selections of red, chewings, hard, and sheep fescues in these trials. These are cut at 3/4 inch. There are 55 ryegrasses being cut at 1-1/2 inches.

Data has been obtained at this time on emergence, general vigor, density of stand and color. Ratings will continue to be made with regard to dormancy, color, general appearance, leaf texture, spring recovery, and perhaps thatch accumulation. Tentative evaluations have been made with regard to disease infection. These have included observations on rust and Helminthsporium on the bluegrasses, Fusarium and Helminthsporium on the fescues, and general disease infection on the ryegrasses. Observations on the appropriate grasses are expected to be made with regard to pythium, red thread, powdery mildew, and perhaps other diseases as they occur. The evaluations should continue for several years.

TURFGRASS DISEASE RESEARCH—PROGRESS REPORT[1]

Charles J. Gould[2]

One hundred and thirty-six cultivars and selections are now being tested in cooperation with Drs. Roy Goss and Stan Brauen, and with partial financial support from the Green Section Research and Education Fund of the U.S.G.A. The goal is to find one or more varieties or selections with suitable color and texture that are more resistant to *Fusarium nivale* than are the varieties now being used.

Both seeded and stolonized types of *Agrostis* were obtained from 46 sources in nine different countries from Poland to New Zealand. Forty varieties were planted in 1971, 63 in 1972, and 32 in the spring of 1973.

An 8-foot burlap fence was placed around the plots in 1972. This, combined with unusually favorable weather for the fungus, resulted in two heavy outbreaks of *Fusarium* during the winter and enabled us to select 19 promising varieties to be planted this year in large-scale tests on management and disease resistance - a full year ahead of schedule. These varieties are: Kingstown, Emerald (Smaragd), Penncross, Prominent, Tracenta, Arlington, Nimisila, Northland, Novobent, Waukanda, and selections from Yale C. C., Keen (#36 and #53-Arrowwood), Huffine (MCC-3), Youngner (UCR-30), Duich (Penn. State #5), Scott's (A74 or A75) and Smith's (#721, 732, and 736). Bardot will be included because of its apparent ability to recover rapidly from a severe attack and the Hayden Lake selection and Highland will also be planted for comparison.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Plant Pathologist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington.

Fusarium Patch - Fungicidal Tests

Twenty-eight treatments were applied in the 1972/73 tests in cooperation with Dr. Roy Goss. The goals were: to evaluate the effectiveness of certain new fungicides; to compare frequent low rates of certain types with occasional high rates; and to determine the value of alternating different types of fungicides. Unfortunately, so little *Fusarium nivale* appeared last year that the experiment will have to be repeated.

Although disease development was inadequate, we did observe some differences between treatments in turf color and texture. In general, the best looking turf was obtained where a dithiocarbamate fungicide (such as thiram or maneb) was mixed with a benzimidazole or where applications of Fore were alternated with a benzimidazole (such as Tersan 1991, Fungo, 3336). In view of these results, and the knowledge that certain other fungi have developed resistance to the benzimidazoles, we recommend against the continuous use of only benzimidazole fungicides on turf in the Pacific Northwest.

The new thiophanate compounds appeared quite promising. Also promising were certain treatments involving occasional high rates of fungicides, but the latter cannot be recommended until disease control data are obtained.

We appreciate the support for these tests from Mallinckrodt, Cleary, Upjohn, Chemagro and American Hoechst.

Control of Ophiobolus Patch

The main purpose of this experiment, conducted in cooperation with Dr. Goss, was to determine the possible inhibition of the strain of *Ophiobolus*, which attacks bentgrasses in western Washington, by adding soil from a field in eastern Washington which had been found capable of inhibiting infection of wheat by a similar fungus by Dr. James Cook. Other treatments included lime, sulfur, certain fungicides, and different sources of nitrogen. *Ophiobolus* has not yet developed in the plots. The best turf at present is showing in the plots fertilized either with Milorganite or those with ammonium sulfate, both with and without chlordane.

Typhula and Fusarium Snow Molds - Resistance Studies

In response to a request from the Inland Empire Golf Superintendents' Association, a planting will be made this fall at Spokane of the same bentgrass varieties that we now have in the plots at Puyallup. We will not only be observing their possible resistance to *Typhula* and *Fusarium*, but also their cultural response under eastern Washington conditions. It is entirely possible that the varieties found best for western Washington conditions will differ from those looking best in eastern Washington.

Two 5' x 5' plots of each of the 136 cultivars and selections will be planted at the Hangman Valley Golf Course in an area specially prepared for this project by Superintendent Bud Ashworth, to whom we express our appreciation. Dr. Stan Brauen and Professor Al Law will be cooperating with Dr. Goss and me on this work.

TYPHULA AND FUSARIUM SNOW MOLD - Control with Fungicide

Dr. Goss and I are cooperating with Dr. Ron Ensign (University of Idaho), Professor Al Law (Washington State University), Bud Ashworth (Hangman Valley Golf and Country Club), Vern Harvey (Hayden Lake Golf & Country Club), Al Liotta (Pullman), and the Superintendents at the Elks and University golf courses in Moscow to determine the best control measures for both *Typhula* and *Fusarium* in the above locations. Nineteen different single and combination treatments were applied early in November of 1972, and six more were put on early in March of 1973. Snowfall was lighter and did not last as long as normal, so typical snow mold attacks were below average. However, enough disease did occur to indicate that PMAS (2 oz. in Nov.) and Borax (30 oz. in Nov.) were much less effective than Tersan SP, Caloclor, Terraclor, Proturf Fung. II, Daconil and Actidione + thiram in controlling snow mold. Both *Typhula* sp. and *Fusarium nivale* were present at one or more locations but the *Typhula* was somewhat more abundant.

Tersan SP was used at several rates and in various combinations with other fungicides. Turf treated in November of 1972 with Tersan SP (8 oz) plus Tersan 1991

(6 oz. in Nov. or 3 oz. in Nov. and 3 oz. in March) showed considerable injury by April of 1973. Some other combinations were also somewhat phytotoxic.

Most of the treatments used in 1972/73 will be repeated in 1973/74 and certain new ones will be added.

We are very grateful to the respective superintendents for their cooperation and to the Northwest Turfgrass Association and O. M. Scott & Sons for their financial support of this project.

FUSARIUM PATCH - CONTROL WITH FUNGICIDES (Farm 5) - Exp. 5A

Chuck Gould & Roy Goss

Purpose: To evaluate the effectiveness of some new fungicides; to compare frequent low rates with occasional high rates of certain types; and to determine the value of alternating different types.

Turf: Predominantly *Poa annua* with some Highland Bent.

Applications: In 10 gallons of water (except #12 & 17) per 1000 sq ft at approximately 3 week intervals for #1-17 and varying intervals for the others. The schedule was interrupted during the winter by freezing weather and snow. Alternating applications: Two different fungicides were used, FORE (labelled F) was one and some type of benzimidazole was the other, at various rates and schedules in plots numbered from 16 to 28.

	MATERIALS	Interval	APPLICATIONS												COLOR				DENSITY			% HEALTHY
			Sept 11	Oct 2	Oct 23	Nov 13	Dec 21	Jan 16	Feb 6	Feb 28	Mar 22	Apr 10	May 1	May 21	Jan 19	Apr 3	May 21	July 5	Jan 19	Apr 3	May 21	June 10
1	Check	-	-	-	-	-	-	-	-	-	-	-	-	-	7.2	6.0	7.6	6.8	7.4	6.2	8.2	6.0
2	MOL 17411 (60%)	3 wks	2	2	2	2	2	2	2	2	2	2	2	2	7.2	6.8	7.6	8.4	7.2	6.4	8.8	6.8
3	"	"	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.6	5.6	6.6	8.2	6.6	4.6	7.8	6.8
4	Acti-thiram (4)+1991 (2)	"	6	6	6	6	6	-	-	-	-	-	-	-	5.2	7.2	9.4	7.2	7.0	6.0	9.6	8.0
5	" (4) (4)	"	8	8	8	8	8	-	-	-	-	-	-	-	5.0	7.0	9.2	6.4	7.0	4.6	9.6	6.8
6	BAY 18654	"	2	2	2	2	2	2	2	2	2	2	2	2	7.0	5.2	7.4	7.4	6.4	6.0	8.6	6.8
7	"	"	4	4	4	4	4	4	4	4	4	4	4	4	7.2	6.0	7.6	6.0	6.4	4.8	8.4	5.8
8	Cleary's 3336	"	2	2	2	2	2	2	2	2	2	2	2	2	7.4	7.2	8.0	6.8	7.8	7.2	9.0	7.2
9	BROMOSAN	"	4	4	4	4	4	4	4	4	4	4	4	4	8.0	8.6	9.0	6.4	8.2	8.4	9.8	7.2
10	Mallin. MF-565	"	5	5	5	5	5	5	5	5	5	5	5	5	7.4	9.0	8.8	7.2	8.8	8.4	9.8	6.6
11	FUNGO (50%)	"	2	2	2	2	2	2	2	2	2	2	2	2	7.4	7.8	8.2	7.2	7.6	7.4	9.4	7.8
12	Mallin. MF-571-Dry+1 gal water	"	68	68	68	68	68	68	68	68	68	68	68	68	8.0	7.2	8.0	7.8	7.4	6.8	9.6	6.2
13	TERSAN SP	"	8	8	8	6	6	6	6	-	-	-	-	-	3.4	5.4	5.4	6.4	4.2	4.2	6.8	4.6
14	TERSAN 1991	"	2	2	2	2	2	2	2	2	2	2	2	2	6.8	5.4	7.2	7.0	6.0	4.4	8.2	6.0
15	FORE	"	F	F	F	F	F	F	F	F	F	F	F	F	7.8	9.2	10.0	6.8	8.0	8.2	10.0	8.2
16	1991/FORE - Alt	"	2	F	2	F	2	F	2	F	2	F	2	F	7.0	8.4	10.0	5.8	7.2	7.4	10.0	7.2
17	" (in 2 gal)	"	2	F	2	F	2	F	2	F	2	F	2	F	6.6	7.6	10.0	7.0	7.6	7.2	9.8	7.8
18	"	6 wks	8	-	F	-	2	-	F	-	2	-	F	-	7.2	8.2	9.6	6.8	7.2	7.2	9.8	7.6
19	Cleary's 3336/FORE	"	8	-	F	-	2	-	F	-	2	-	F	-	7.4	9.0	9.4	6.6	7.6	8.0	9.8	7.2
20	FUNGO/FORE	"	8	-	F	-	2	-	F	-	2	-	F	-	7.8	8.8	9.4	5.8	8.0	8.6	9.8	6.8
21	BAY 18654/FORE	"	8	-	F	-	2	-	F	-	2	-	F	-	7.0	8.2	9.0	6.4	6.6	7.2	9.8	7.2
22	TERSAN 1991/FORE	9 wks	8	-	-	F	-	-	6	-	-	F	-	-	6.8	8.4	8.6	7.4	8.2	7.8	10.0	6.8
23	"	12 "	8	-	-	-	F	-	-	-	F	-	-	-	6.4	7.6	8.4	7.0	6.4	6.8	9.0	7.2
24	"	"	14	-	-	-	F	-	-	-	F	-	-	-	7.6	7.8	8.2	6.2	6.4	6.4	9.4	6.6
25	"	"	20	-	-	-	F	-	-	-	F	-	-	-	6.4	8.6	8.8	6.6	6.6	6.2	9.0	6.8
26	Cleary's 3336/FORE	"	14	-	-	-	F	-	-	-	F	-	-	-	7.0	8.2	8.8	7.0	7.2	6.8	9.6	6.6
27	FUNGO (50%)/FORE	"	14	-	-	-	F	-	-	-	F	-	-	-	7.0	9.4	8.8	6.4	7.6	8.4	9.8	7.0
28	BAY 18654/FORE	"	14	-	-	-	F	-	-	-	F	-	-	--	6.8	8.2	8.2	6.2	7.2	7.0	9.4	6.6

F = FORE at 8 oz/10 gal/1000 ft^2

FUSARIUM PATCH - CONTROL WITH FUNGICIDES (Farm 3) - Exp. 5B

<u>Purpose</u>: To evaluate the effectiveness of some new fungicides and compare frequent low rates with occasional high rates of certain types.

<u>Applications</u>: In 10 gallons of water (except #12 & 17) per 1000 sq ft at approximately 3 week intervals (interrupted by freezing weather). Treatments 1-21 were started Nov. 13, #29 and 30 on Nov. 21, and #31, 32 and 33 on Dec. 21, 1972.

	Material	Applications Dates and Rates (oz.)									Color Ratings				Density Ratings			Percentage of Healthy Grass
		11-13-72	12-21-72	1-16-73	2-6-73	2-28-73	3-22-73	4-10-73	5-1-73	5-21-73	1-19-73	4-3-73	5-21-73	7-5-73	1-19-73	4-3-73	5-21-73	6-10-73
1	Check	-	-	-	-	-	-	-	-	-	6.6	6.8	7.2	6.0	6.4	5.4	7.4	40
2	HOE 17411 (60%)	2	2	2	2	2	2	2	2	2	6.0	5.4	9.4	8.0	6.2	4.4	7.4	62
3	" (20%)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	5.8	6.2	8.0	8.2	6.6	4.4	7.2	64
4	Acti-thiram(4)+1991(2)	6	6	-	-	-	-	-	-	-	5.4	7.0	9.6	9.0	6.4	5.0	7.6	74
5	" (4) " (4)	8	8	-	-	-	-	-	-	-	4.8	6.2	9.6	9.0	6.2	4.2	7.4	74
6	BAY 18654	2	2	2	2	2	2	2	2	2	6.8	7.6	8.8	7.6	6.0	4.8	7.2	60
7	"	4	4	4	4	4	4	4	4	4	6.6	6.6	8.4	8.0	6.2	4.4	6.8	56
8	Cleary's 3336	2	2	2	2	2	2	2	2	2	6.8	8.0	9.2	8.0	6.2	4.8	8.4	58
9	BROMOSAN	4	4	4	4	4	4	4	4	4	6.2	8.0	9.8	8.2	6.0	4.6	8.2	78
10	Mallin. MF-565	5	5	5	5	5	5	5	5	5	6.0	8.2	10.0	8.4	5.8	5.0	8.0	74
11	FUNGO	2	2	2	2	2	2	2	2	2	6.8	8.0	9.0	8.0	5.6	4.6	7.4	68
12	Mallin MF-571	68	68	68	68	68	68	68	68	68	6.6	8.4	8.8	7.8	6.0	4.8	7.8	66
13	TERSAN SP	6	6	6	6	-	-	-	-	-	5.8	6.2	8.4	6.4	6.2	5.2	7.0	54
14	TERSAN 1991	2	2	2	2	2	2	2	2	2	6.8	7.0	8.0	8.0	6.4	5.0	7.8	62
15	FORE	8	8	8	8	8	8	8	8	8	6.6	9.0	10.0	8.4	6.4	6.0	8.4	74
16	1991/FORE [a]	F	2	F	2	F	2	F	2	F	6.6	8.6	10.0	8.2	6.4	5.8	8.6	82
17	" " in 2 gal[a]	F	2	F	2	F	2	F	2	F	6.4	8.4	9.8	7.8	6.8	5.2	8.6	78
18	" " [a]	-	2	-	F	-	2	-	F	-	5.8	8.0	9.0	7.2	5.8	5.0	8.0	66
29	18654(1)+Dyrene(4)	5	5	5	5	5	5	5	5	5	7.0	7.8	8.8	8.0	6.6	6.2	9.2	80
30	" (1.5) " (6)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	6.6	7.0	8.8	8.4	6.2	5.6	8.8	72
31	Cleary's 3336/FORE[a]	-	2	F	2	F	2	F	2	F	6.6	8.6	9.8	8.2	6.0	5.6	7.6	72
32	FUNGO/FORE[a]	-	2	F	2	F	2	F	2	F	7.6	9.0	10.0	7.8	5.8	6.0	8.4	74
33	18654/FORE[a]	-	2	F	2	F	2	F	2	F	7.0	8.4	9.6	7.6	6.4	5.6	8.8	78

a = Alternating Schedule

FUSARIUM PATCH - CONTROL WITH FUNGICIDES

On putting green at Fircrest Golf & Country Club, Tacoma, Wash. in cooperation with Dick Gettle, Supt.

Purpose: To evaluate the effectiveness of new fungicides in comparison with certain standard types.

Applications: In 10 gallons of water (except #12-dry) per 1000 sq. ft. at approximately 3 week intervals, starting Sept. 13 during an outbreak of Fusarium which quickly subsided and never redeveloped.

	Applications										Color			Density
Materials	9-13-72	10-3	10-23	11-14	12-22	2-6-73	2-27	3-19	4-9	5-1	10-13-72	12-5-72	4-2-73	4-2-73
1 Check	-	-	-	-	-	-	-	-	-	-	7.4	9.4	10.0	9.6
2 HOE 17411 (60%)	2	2	2	2	2	2	2	2	2	2	8.2	8.0	10.0	10.0
3 " (20%)	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	7.4	10.0	10.0	9.8
4 Acti-thiram(4)+1991(2)	6	-	-	-	-	-	-	-	-	-	6.2	9.8	10.0	9.8
5 " (4) " (4)	8	-	-	-	-	-	-	-	-	-	6.0	10.0	9.8	9.8
6 BAY 18654 (2)	2	2	2	2	2	2	2	2	2	2	7.4	9.2	9.8	9.8
7 " (4)	4	4	4	4	4	4	4	4	4	4	7.6	9.4	10.0	9.8
8 Cleary's 3336	2	2	2	2	2	2	2	2	2	2	8.2	9.8	9.8	9.8
9 BROMOSAN	4	4	4	4	4	4	4	4	4	4	7.8	9.0	9.6	9.6
10 MF-565	5	5	5	5	5	5	5	5	5	5	7.8	9.8	10.0	9.6
11 FUNGO (50%)	2	2	2	2	2	2	2	2	2	2	7.6	9.6	10.0	10.0
12 MF-571-Dry + 1 gal water	68	68	68	68	68	68	68	68	68	68	7.4	10.0	9.6	9.4
13 TERSAN SP	8	8	4	4	-	-	-	-	-	-	7.0	7.8	9.0	7.0
14 TERSAN 1991	2	2	2	2	2	2	2	2	2	2	7.6	9.4	10.0	9.2
15 FORE	8	8	8	8	8	8	8	8	8	8	7.8	10.0	10.0	10.0
16 1991/FORE - Alt	2	8	2	8	2	8	2	8	2	8	8.0	10.0	10.0	10.0
18 " "	8	-	F	-	2	-	F	-	2	F	6.6	10.0	9.8	9.8

F = FORE at 8 oz/10 gal/1000 ft^2

EFFECT OF PLANT GROWTH REGULATORS ON POA[1]

Alvin G. Law[2]

Plant growth regulators, if effective, could greatly reduce the cost of maintenance of turf on city parks, cemeteries, and general use turf areas. To this end we applied a chemical (3-trifluoromethylsulfonomide-P-acetotoluidide) to ten varieties of Poa pratensis, and one variety of Lolium. Applications were made on May 18, May 29, and June 18, 1973. All plots were fertilized and irrigated to maintain optimum growth and color on the check plots. Each area was mowed three days prior to the application of the chemical. Following treatment the plots were not mowed for as long as 30 days. Height measurements were taken prior to mowing. Data are shown in Tables I and II.

While the height measurements do not give the best indication of the possible effects of the growth retardant, it is clear that various bluegrass species respond differently. For example, Cougar, Nugget, and Fylking, all low-growing dwarf types, showed greatest response to the growth retardant. Also, the effect of treating in May on growth in July was very small (see % reduction Table II). As a general observation there was no undesirable discoloration of the turf by any of the treatments applied. It is probable that repeat treatments may be needed to accomplish the desired effect. However, if we look at the detailed data in Table I for the May 18 treatment, we can conclude that for Cougar, Fylking, Lolium, and perhaps

---

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Professor of Agronomy, Washington State University, Pullman, Washington.

Sodco, and Merion, a two pound per acre treatment would eliminate the need for mowing for nearly 30 days. Treatments on May 29, and June 18 were much less effective on all varieties.

Detailed data on the wear studies will appear in an early issue of the Golf Superintendent.

Data are being accumulated on the effect of N-serve on controlling the release of nitrogen in ammonium sulfate as part of an effort to reduce costs of repeated fertilizer applications.

TABLE I. Turf Height in Centimeters on June 26, 1973 after Indicated Number of Days Growth

	Treated May 18 30 da. regrowth			Treated May 29 20 da. regrowth			Treated June 18 5 da. regrowth			
Variety	1#/a	2#/a	Ck.	1#/a	2#/a	Ck.	1#/a	2#/a	2#/a*	Ck.
Cougar	4.3	3.3	9.3	4.0	4.3	9.3	4.3	4.3	5.6	5.0
Fylking	6.6	4.3	13.3	6.3	7.3	13.3	5.3	5.0	5.3	4.3
S. Dak. Cert.	12.5	11.0	16.0	9.2	10.6	16.0	5.6	4.3	5.3	4.6
Newport	10.8	12.3	15.0	6.8	8.0	15.0	7.0	5.0	5.0	5.0
Delta	13.0	12.2	17.0	8.4	8.3	17.0	6.0	6.0	4.6	7.3
Windsor	13.1	5.7	11.5	6.0	6.3	11.5	4.3	4.6	4.3	5.6
Sodco	12.9	6.3	11.6	6.7	5.0	11.6	5.6	4.6	4.6	5.0
Pennstar	13.6	11.0	15.0	6.7	7.7	15.0	4.6	4.3	4.0	5.0
Merion	10.8	6.0	9.3	6.4	6.3	9.3	5.6	4.3	4.3	6.3
Nugget	7.8	4.6	5.3	6.3	6.6	5.3	5.0	4.6	4.3	6.6
Lolium	6.1	4.6	12.0	9.3	9.3	12.0	6.6	5.3	6.3	5.0
Average	10.1	7.4	12.3	6.9	7.2	12.3	5.4	4.3	4.8	5.4
% Reduction	18	39		44	41		0	20	12	

* Maleic hydrazide

Table II. Turf height in centimeters on July 23, 1973, with indicated days regrowth.

Variety	Treated May 29 5 days regrowth[1/] 1#/a	2#/a	Ck.	Treated June 18 5 days regrowth[1/] 1#/a	2#/a	2#/a[2/]	Ck.
Cougar	2.6	2.0	3.3	4.0	3.0	3.3	4.0
Fylking	2.9	2.6	3.6	3.0	3.0	3.0	3.0
S. Dak. Cert.	3.1	4.0	3.0	3.0	2.3	2.0	2.3
Newport	3.1	3.6	3.0	2.6	2.3	3.0	3.0
Delta	3.1	3.3	3.6	3.0	3.3	3.0	3.0
Windsor	2.6	3.6	3.3	2.3	2.0	2.6	2.6
Sodco	3.3	3.3	2.6	3.0	3.3	2.3	3.0
Pennstar	2.4	2.6	3.6	3.3	2.3	2.3	2.6
Merion	2.6	3.0	3.3	3.0	2.6	2.3	3.3
Nugget	2.9	3.6	3.0	2.3	3.0	3.0	3.0
Lolium	2.6	2.3	2.6	3.0	3.6	4.3	4.6
Average	2.8	2.9	3.1	2.9	2.8	2.8	3.1
% Reduction	09	06		06	09	09	

[1/] All plots mowed July 18. These data represent recovery rates.

[2/] Maleic hydrazide.

AGRONOMIC RESEARCH REPORT[1]

D. K. Taylor[2]

Turfgrass Variety Trials

Several varieties have been promising in trials conducted at the Agassiz Research Station over the period 1969-1972. These results are based on monthly observations over the growing season and averaged over a 2-3 year period. The trials were mowed twice weekly, at 3/4" and 1-1/2" for lawn turf and 1/4" for bentgrass, clippings removed. Adequate fertility and moisture levels were maintained for good growth, while broadleafed weeds were controlled by herbicides as required. The following is a list of the more promising varieties in each species, arranged in descending order of attractiveness rating.

Fescue -

Chewings - Koket, Wintergreen, Highlight, Jamestown, Rolax, Erika, Golfrood, Encota.

Creeping red - SAI 67, S59, Dawson, Wilton, Pennlawn, Rasengold, Leo.

Hard - C 26.

Kentucky bluegrass - Nugget, K412, Birka, B101, Pennstar, Fylking, Sodco, Baron, Golf, Merion, Sydsport, Monopoly.

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Turf Research and Forest Breeding, Research Station, Canada Department of Agriculture, Agassiz, British Columbia.

Bentgrass -

Colonial - Tracenta, Bardot, Enate, GS 2

Creeping - Penncross

Velvet - Kingstown

Perennial ryegrass - Manhattan, Pelo, Norlea

Seed Mixture for Lawn Turf

A three year study of mixtures of Boreal and Pennlawn fescue, Merion and Park Kentucky bluegrass and Highland bentgrass has confirmed the agressiveness of Highland bentgrass in lawn mixtures; and also, that the choice of variety is very important to the success of a certain species in a lawn mixture even when the bentgrass component was as little as 6 to 8% by weight of the seeding mixture. Highland dominates some mixtures after one year and constituted 90% of the turf after the second year. Although differences were recognizable among seeding ratios of most mixtures studied at the end of the third year, only with combinations of Pennlawn-Merion did they appear to have any practical significance; for in all other mixtures one variety dominated, outweighing any long term seeding ratio effect.

Pennlawn and Merion were much more competitive than Boreal and Park respectively, indicating that choice of variety is important to the success of a species in a mixture. Pennlawn and Merion appeared compatible in a mixture and gave a reasonable balance in composition at the end of the third year when seeded at 3:1 or 1:1 ratios by weight.

Grasses for Sportsturf

An assessment of turfgrass species and varieties for sportsturf is underway at Agassiz. A total of 58 treatments in a replicated study receive simulated wear treatments from a spiked roller. Results over one winter indicate that perennial ryegrass-Kentucky bluegrass mixtures were most resistant to wear. With fall seeding establishment was excellent with perennial ryegrass, but less successful with Kentucky bluegrass. Seeding ratios of perennial ryegrass-Kentucky bluegrass varying from 1:2 to 4:1 by weight have all resulted in stands dominated by perennial ryegrass in June of the following year. The ratio (1:2) @ 3#/1000 sq. ft. resulted in a stand of 58% Manhattan perennial ryegrass: 42% Merion Kentucky bluegrass.

Among the perennial ryegrass varieties, Manhattan, Pennfine and Sprinter had excellent density, while NK 200, Z9050, Stadion and Norlea were the easiest varieties to cut. Sydsport Kentucky bluegrass was superior to Fylking, Baron, Merion, and Nugget in speed of establishment and density of cover.

Of the miscellaneous species under trial only _Poa trivialis_ and diploid timothy show some promise to date. Fine fescues, crested dogstail, Canada bluegrass, and colonial bentgrass gave poor performances under wear, while Alta fescue failed to establish a good stand.

Snow Mold Control in the B. C. Interior

Winter damage to fine turf may be caused by _Typhula_ spp., _Fusarium nivale_ and other organisms which are presently under study by plant pathologists. In the past, repeated dosages of mercury products have helped to keep damage caused by these fungi to a minimum. Now with the use of mercury being curtailed other fungicides are sought which will do this job.

The results of two years of trials indicate that Tersan SP (chloroneb) at 9 oz. and Terraclor (PCNB) at 5 oz./1000 sq. ft. were most promising in the control of the _Typhula_ type of snow mold. Mixtures of these two fungicides at full and half rates were very effective in disease control but resulted in some turf burn when growth commenced. Neither chloroneb or PCNB were effective in _Fusarium_ control, and where this disease is a problem in late fall or over winter, fall applications of benomyl and maneb are recommended.

TURF GRASS OBSERVATIONAL TRIALS[1]

Ron Ensign[2]

In 1972, a turf grass observational trial was established on the Plant Science Farm at the University of Idaho, Moscow. This trial included 22 bluegrass varieties or breeding lines, two perennial rye varieties, six fescue turf varieties, and three bentgrass varieties. Each entry was planted in a 4' x 15' block which was duplicated. The first block has been mowed weekly during the 1973 growing period; one-half of the mowed block was rotary mowed at a 1-1/2 to 1-3/4 inch height, and the other half rotary mowed at 1 to 1-1/4 inch level. The other 4' x 15' block was allowed to grow and produce seed which has been harvested. During mid-August these seed production blocks will be burned. All plots were fertilized with an annual application of 4 lbs. of N, 2 lbs. of P, and 2 lbs. of K_2O per 1000 ft^2 each year. The plots were irrigated with portable sprinklers.

Emergence notes were recorded, but due to generally warm weather at the time of planting, these records do not adequately describe emergence differences of some varieties. Additional seedings were necessary for some. Notes on texture in the fall of 1972, 1973 spring regrowth, regrowth after April 13 (first) clipping, turf color during May, 1973, and the heading dates for each variety are recorded on the attached tables.

Texture

Bluegrass varieties which exhibited fine texture were Adelphi, Arboretum, Cougar and P-164. Course textured bluegrass varieties include Garfield, Kenblue 74-34, Newport, Prato, Sydsport, Belturf, and P-142. The other bluegrasses

---

1/To be presented at the Joint Northwest Turfgrass Association/ Canada Turfgrass Association Conference, Harrison Hot Springs, British Columbia, October, 1973.

2/Agronomist and Plant Breeder, University of Idaho, Moscow, Idaho.

varied from medium to coarse texture. Pennfine perennial rye has a finer texture in these plots than does Manhattan. The fescues all produced relatively fine textured leaves with Jamestown and C-26 showing excellent texture.

Spring Regrowth

Of considerable interest was the 1973 spring regrowth. The early regrowth varieties were Delta, Kenblue P-29, Pennstar, P-142, P-164, and Ram #1. Pennlawn, Aberystwyth and Barfalla were early spring growth fescues. The late spring growth varieties were Baron, Fylking, Nugget (very late), Manhattan rye, and Jamestown creeping fescue.

Varieties outstanding for regrowth after early spring clippings were Arboretum, Delta, Garfield, Kenblue, Park, P-142, P-164, Ram #1, Manhattan rye, and all of the fescue varieties.

Regrowth patterns may change as the turf ages.

Color

Color differences of the turf were most noticeable during May of 1973. These differences are recorded in the table. Varieties which show dark green color are: Adelphi, Baron, Kenblue P-29, Nugget, Victa, Belturf, P-164 and Ram #1. The C-26 hard fescue also exhibited a dark color. Light green varieties were Arboretum, Delta, Garfield, Kenblue, Park, and the ryegrasses.

Maturity

The early maturity varieties include: Kenblue, Pack, Arboretum, Sydsport, and Newport. Late varieties were: Kenblue P-29, Victa, P-164, Ram #1, Manhattan rye, and the bentgrasses.

Future

Additional turf quality ratings are being recorded during the 1973 growth periods. Color, regrowth and texture during hot periods are being noted. Fall dormancy and color will also be recorded. To date no significant disease developments have been observed, but will be observed during subsequent months.

Approximately 40 additional varieties are being planted adjacent to the same plots. These will complete most named varieties of bluegrasses, fescues, and ryegrasses grown for seed production in the Northwest. New varieties or potential varieties are being solicited.

FIELD DAY

Turf Grass Observational Trials
Plant Science Farm

University of Idaho
Moscow, Idaho

Planted: 22 June, 1972
Rate: 1 lb./1000 sq. ft.
Plot size: 4'x 15' duplicated; 2' alley between plots
Fertility: 4 lbs. N and P/1000 ft^2 at planting
4 lbs. N plus 4 lbs. K_2O Spring 1973
Clipping: Weekly beginning 13 April 1973
Irrigation: When needed

Plot Number	Variety	Kind	Source	Emergence	Texture 8-9-72, 10-10-72	Spring regrowth 27-3-73	Regrowth after first clipping 10=best 1=poor (13-4)	Turf color 10=dark 1=light 5-1-73	Turf color 10=dark 1=light 29-5-73	Full heading date 1973
1	Adelphi	Bluegrass	Jacklin Seed Company	7-25	Fine, F	Medium	5	8	9	12-6
2	Aboretum	"	Nez Perce Processing Co.	7-25	Fine, M	"	7	4	5	24-5
3	Baron	"	Palouse Seed Company	7-21	Med, C	Late	4	8	7	1-6
4	Cougar	"	Washington State University	7-21	Fine, M	"	4	6	6	16-6
5	Delta	"	Jacklin Seed Company	7-21	Med, C	Early	8	4	5	25-5
6	Fylking	"	" " "	7-21	F-M, M	Late	6	6	5	7-6
7	Garfield	"	Dye Seed Company	7-17	M-C, C	Medium	7	4	5	23-5
8	Kenblue 74-34	"	Jacklin Seed Company	7-15	M-C, C	"	5	6	6	28-5
9	Kenblue P-29	"	" " "	7-11	F-M, C	E - M	3	8	8	20-6
10	Newport	"	" " "	7-17	M, C	Medium	5	6	7	24-5
11	Kenblue	"	Western Farmers Association	7-12	M, M	Early	9	4	4	17-5
12	Nugget	"	Inst. Ag. Sci., U. of Alaska	7-12	M (Short), F	Very late	2	8	9	1-6
13	Merion	"	Chas. H. Lilly Company	7-13	M-C, C	Medium	5	6	6	7-6
14	Park	"	" " " "	7-17	F-M, C	"	8	4	4	22-5
15	Pennstar	"	Northrup King Company	7-17	F, M	E - M	5	6	6	7-6
16	Prato	"	" " "	7-12	C, M	M - L	5	6	6	26-5
17	Sydsport	" (1)	Nez Perce Processing Co.	7-17 (1)	C, C	M - L	5	6	7	24-5
18	Victa (Windsor II)	"	O. M. Scott	7-12	M, M	M-- L	4	8	7	10-6
19	Belt Turf	" (2)	Juska, USDA, Beltsville	8-15 (2)	C, C	Medium	3	8	8	7-6
20	P-142	" (3)	Funk, N.J. Ag. Expt. Sta.	8-20 (3)	C, C	E - M	9	4	7	25-5
21	P-164	" (3)	" " " " "	8-20 (3)	F (Short), F	E - M	7	6	8	12-6
22	Ram #1	" (3)	" " " " "	8-20 (3)	M, F	E - M	7	6	9	8-6
23	Manhattan	Perennial Rye	Turf Seed, Inc., Hubbard, Ore.	7-10	F, F	Late	7	6	4	24-6
24	Pennfine	" "	Rudy Patrick Company	7-20	F, F	"	6	4	3	16-6
25	Aberystwyth 3-59	Chewings Fescue	Nez Perce Processing Company	7-12	F, M	Early	9	4	5	25-5
26	Barfalla	" "	" " " "	7-17	F, M	"	9	6	5	27-5
27	Koket	Ch. F. (Fallax)	" " " "	7-12	F, F	E - M	9	6	5	29-5
28	Pennlawn	Cr. Fescue *	" " " "	7-13	F, F	Very early	9	6	5	30-5
29	Jamestown	" " *	Turf Seed, Incorporated	7-12	F, F	Late	9	8	6	1-6
30	C-26	Hard Fescue	O. M. Scotts	8-1	F, F	Medium	7	8	5	18-5
31	Kingston	Velvet Bent (4)	Great Western Seed Company	-	-, Ex. F	Very late	1	4	5	-
32	Exeter	Colonial Bent	Turf Seed, Incorporated	7-26	-, F	Late	7	6	3	22-6
33	Seaside	Creeping Bent (1)	Dessert Seed Company	7-30	-, M	Late	3	4	3	24-6

[1] Reseeded 14 August '72
[2] Seeded 21 July '72
[3] " 26 July '72
[4] " 21 Sept. '72
*Intermediate between Creeping and Chewings Fescue

ACKNOWLEDGEMENTS

Photography - Heinz Knoedler

Coffee Breaks and Hospitality Hour

A.B.C. Landscaping Ltd.
2511 W. Broadway
Vancouver, B.C.

A I M Steel
Annacis Industrial Estate
Delta, B. C.

Agrico Sales Ltd.
2233 Quebec St.
Vancouver, B. C.

Big Toys of Canada
18697 - 96th Ave.
Surrey, B. C.

Dial Contracting
3183 Norland
Burnaby, B. C.

Harry Sharpe & Son
620 Malkin Ave.
Vancouver, B. C.

Holland Landscapers
6969 Greenwood St.
Burnaby 2, B. C.

Harley Development
8719 Crest
Burnaby, B. C.

Imperial Paving
1307 W. Georgia St.
Vancouver, B. C.

Instant Lawns Ltd.
1055 Bayview Drive
Delta, B. C.

Jack Cewe Const.
1850 Hillside
Coquitlam, B. C.

Massot Nurseries
1606 Westminster Hwy.
Richmond, B. C.

Northern Ind. Ltd.
245 No. 8 Road
Richmond, B. C.

Pacific Coast Nurseries
12993 Harris
Pitt Meadows
Port Coquitlam, B. C.

Pacific Irrigation
405 Industrial Ave.
Vancouver, B. C.

Taylor Pearson & Carson Ltd.
5334 Lougheed Highway
Burnaby, B. C.

Golf Tournament Sponsored By

Pro Turf Limited
3215 Norland
Burnaby 2, B. C.

NORTHWEST TURFGRASS ASSOCIATION ATTENDANCE

Maurice A. Aasland
Oak Harbor, WA

Chet Allbee
Spokane, WA

Bud Ashworth
Liberty Lake, WA

Jerry M. Bacon
Vancouver, WA

Stan Bailey
Orting, WA

Milton Bauman
Seattle, WA

Clayton Bauman
Kent, WA

James B. Beard
Okemos, Michigan

Norris R. Beardsley
Spokane, WA

William Bengyfield
Garden Grove, CA

Tim Berg
Portland, OR

J. L. Bishop
Tacoma, WA

Al Blair
Seattle, WA

David A. Bobillot
Burton, WA

Norb Boyle
Seaside, OR

Jim Bromley
Orting, WA

Dave Brown
LaGrande, OR

Herb Brown
Spokane, WA

C. M. Brownell
Albany, OR

Sy Byle
Eastsound, WA

James Chapman
Bellevue, WA

Sam Clarke
Bainbridge, WA

Ray Coleman
Maple Valley, WA

R. E. Collard
Friday Harbor, WA

A. Wayne Cooley
Albany, OR

Gary L. Cooper
Hubbard, OR

Lloyd G. Brown
Everett, WA

Wayne Dean
Yakima, WA

Arthur P. Dome
Seattle, WA

Peter Dotto
Vancouver, WA

Ralph Evans
San Jose, CA

Cliff Everhart
Spokane, WA

Dick Fluter
Lake Oswego, OR

Edward Fluter
Portland, OR

Ellington Forsyth
Penticton, B. C.

Larry C. Franks
Redmond, WA

Ronald W. Fream
Los Gatos, CA

Richard Gettle
Tacoma, WA

Neville G. Gladding
Seattle, WA

Murl Goddard
Yakima, WA

Dr. Roy L. Goss
Puyallup, WA

Dr. C. J. Gould
Puyallup, WA

Monty C. Gravatt
Pocatello, ID

Gary Gunderson
Seaside, OR

Bond Harman
Warm Springs, OR

Dick Haskell
Seattle, WA

Vern Harvey
Hayden Lake, ID

Omer Henderson
Lynnwood, WA

Bernard Higgins
Anderson, WA

Donald A. Hogan
Seattle, WA

Charles C. Hoke
Puyallup, WA

Harold J. Huffman
Burnaby, B. C.

Robert V. Hughes
Glendora, CA

Frank H. Ingraham
Port Angeles, WA

Van Jackson
Washougal, WA

Walt Jefferson
Wenatchee, WA

Wesley M. Johnson
Union, WA

Bill Johnston
Camas, WA

Harvey Junor
Portland, OR

Art Kain
Seattle, WA

Alexander Kazai
Victoria, B. C.

Bill Keene
Mount Vernon, WA

Gardner Keith
Bellevue, WA

Donald Kolassa
Spokane, WA

Carl H. Kuhn
Mercer Island, WA

Henry W. Land, Jr.
Seattle, WA

Robert Larson
Bellingham, WA

Alvin G. Law
Pullman, WA

Owen Leathary
Pocatello, ID

Dick Lovell
Bend, OR

Joe Lymp
Sunriver, OR

Tim Manion
Portland, OR

Ben Malikowski
Redmond, WA

Richard Malpass
Vancouver, WA

Norman W. Marshall, Jr.
Tacoma, WA

Arthur G. Marston
Seattle, WA

Royce McCarley
Tracy, CA

Douglass McDonald
Longview, WA

Ken McKenzie
Renton, WA

John V. Messmer
Kent, WA

Robert L. Metre
Seattle, WA

Randy Meyers
Spokane, WA

Leo Moen
Eugene, OR

John Monson
Redmond, WA

Joe Much
Monmouth, OR

Steve Nord
Seattle, WA

Gary H. Perks
Vancouver, B. C.

Dr. T. E. Pocklington
Fresno, CA

Joe Pttenger
Yakima, WA

Ron Proctor
Seattle, WA

Kenneth L. Putnam
Sequim, WA

Warwick O'Hara
Surrey, B. C.

Marvin Oiness
Bellingham, WA

Thomas Opstad
Seattle, WA

Duane Orullian
Pocatello, ID

R. J. Rickabaugh
Sisters, OR

Henry Richert
Portland, OR

John S. Rogers
Vancouver, WA

Robert J. Root
Tacoma, WA

George Saunders
Leavenworth, WA

Dick Schmidt
Port Ludlow, WA

Ray Schmidt
Bellingham, WA

Bob Schoessler
Sequim, WA

Richard A. Schwabauer
Portland, OR

Dr. Robert C. Shearman
Gervais, OR

Jack Shults
Cornelias, OR

Clarence Sowers
Vancouver, WA

Wally Staatz
Orting, WA

Bob Staib
San Francisco, CA

Rich Stipe
Portland, OR

Paul Stokke
Everett, WA

Junior Stovall
Spokane, WA

Frank Trocinio
Eugene, OR

Vern Turgeon
Seattle, WA

Daniel F. Volimer
Hayden Lake, ID

D. H. Walker
Kennewick, WA

Doug Weddle
Olympia, WA

Melvin West
Union, WA

John Zoller
Eugene, OR

Sam Zook
Medina, WA

C. A. Schmidt
Deer Park, WA

Dr. Stanton E. Brauen
Puyallup, WA

Dr. K. J. Morrison
Pullman, WA

Mr. Ben Korsten
Sumner, WA

Mr. Rick Hoverson
Seattle, WA

Mr. Earl Morgan
Anacortes, WA

Mr. A. Quentin White
Spokane, WA

Mr. G. Schmitt
Spokane, WA

Dr. T. E. Pocklington
Fresno, CA

Mr. Hugh Burbank
Kelona, B. C.

WESTERN CANADA TURFGRASS ASSOCIATION
ATTENDANCE

Mr. G. Domich
Fallis Turf Equip. Ltd.
581 No. 3 Road
Richmond, B. C.

Mr. B. Mullins
11418 - 74 A Ave.
Delta, B. C.

Mr. A. Smith
Qualicum Beach Golf Course
Box 138
Qualicum Beach, B. C.

Mr. Hoffler
Northern Ind. Ltd.
245 No. 8 Road
Richmond, B. C.

Mr. Hans Molholm
School Dist. No. 63
6875 Saanich Cross Road
Victoria, B. C.

Mr. D. Millar
641 Thompson Ave. N.E.
Salem, OR

Mr. C. Gallant
Instant Lawns Ltd
1055 Bayview Drive
Delta, B. C.

Mr. Art Lindstrom
Prince George City Parks
Prince George, B. C.

Mr. N. Sheristobitoff
Site 19, Comp. 12, SS #2
Castlegar, B. C.

Mr. H. Knoedler
66 - 48th Street
Delta, B. C.

Mr. M. Hart
Burnaby Mtn Golf Course
Corporation of Burnaby
4949 Canada Way
Burnaby, 2, B. C.

Mr. D. Hartman
Corp. of Burnaby Parks
and Recreation
4949 Canada Way
Burnaby, B. C.

Mr. Art Goodwin
Prince Rupert Parks & Rec.
550 East 11th Ave.
Prince Rupert, B. C.

Mr. J. Crooks
Vancouver City Parks
2099 Beach
Vancouver, B. C.

Mr. F. Harris
Supt. of Physical Plant
School Dist. No. 57
1891 Sixth Avenue
Prince George, B. C.

Mr. E. Johnston
School Dist. No. 57
1891 Sixth Avenue
Prince George, B. C.

Mr. J. McNicol
Supervisor of Grnd. Serv.
School Dist. No. 57
1891 Sixth Avenue
Prince George, B.C.

Mr. C. N. Miller
Agrico Sales
2233 Quebec St.
Vancouver, B. C.

Mr. G. C. Hart
Buckerfields
P. O. Box 7000
Vancouver, B. C.

Mr. Pat Mead-Robins
Butchart Gardens
Box 4010, Station A
Victoria, B. C.

Mr. J. Kampen
Mission Golf & C. C.
Mission, B. C

Mr. R. Broome
Surrey Parks Board
2826 - 240th St.
Langley, B. C.

Mr. D. Mitchell
Surrey Parks Board
765 West 66th Ave.
Vancouver, B. C.

Mr. V. Johnson
Surrey Parks Board
14245 - 56th Ave.
Surrey, B. C.

Mr. Percy Criddle
Glen Meadows Golf & C. C.
1050 McTavish Road
Sidney, B. C.

Mr. Perry Criddle
Glen Meadows Golf & C. C.
1050 McTavish Road
Sidney, B. C.

Mr. Ron Criddle
Glen Meadows Golf & C. C.
1050 McTavish Road
Sidney, B. C.

Mr. K. Warner
Vancouver School Board
5150 Barker Crescent
Burnaby, B. C.

Mr. Jim Dennison
School Dist. No. 24
1383 - 9th Ave.
Kamloops, B. C.

Mr. Steve Delawski
Burnaby Mtn. Golf Course
611 Ascot Street
Coquitlam, B. C.

Mr. Keith Barwick
Corp. of Saanich
1400 Derby Road
Victoria, B. C.

Mr. W. Shvetz
Uplands Golf Course
24 Gorge Road East
Victoria, B. C.

Mr. W. Felix
Univ. of B. C.
Physical Plant
Vancouver, B. C.

Mr. G. Haie
University of B. C.
Physical Plant
Vancouver, B. C.

Mr. Hans Ganss
Dept. of Public Works
4570 Canada Way
Burnaby, B. C.

Mr. N. Jacobson
Dept. of Public Works
4570 Canada Way
Burnaby, B. C.

Mr. Vern Burnell
Burnell's Turf & Irrig. Ltd.
Box 2032
Rutland, B. C.

Mr. Ken Russell
c/o Hazelmere Golf Course, Ltd
18150 Campbell River Road
Surrey, B. C.

Mr. R. Krahn
12927 - 87 A. Avenue
Surrey, B. C.

Mr. Martin Moore
Dist. of N. Vancouver
123 East 23rd
N. Vancouver, B. C.

Mr. Frank Townsend
B. C. Provincial Govt.
Dept. of Public Works
Essondale, B. C.

Mr. A. Kazai
Victoria Golf & C. C.
1110 Beach Drive
Victoria, B. C.

Mr. J. Hancock
B. C. Provincial Govt.
Dept. of Public Works
Essondale, B. C.

Mr. John Anderson
Simon Fraser University
Burnaby Mountain
Burnaby, B. C.

Mr. Bob Murphy
Chilliwack Golf Club
Chilliwack, B. C.

Mr. Angus Richardson
Buckerfields
P. O. Box 7000
Vancouver, B. C.

Mr. Ralph Charlton
Peace Portal Golf Club
P. O. Box 130
White Rock, B. C.

Mr. John Bull
Peace Portal Golf Club
P. O. Box 130
White Rock, B. C.

Mr. G. Chaster
B.C.I.T.
3700 Willingdon
Burnaby, B. C.

Mr. R. Selig
Beach Grove Golf Course
Beach Grove, B. C.

Mr. Hugh Crawford
Tswassen Golf Club
Tswassen, B. C.

Mr. C. Lewis
Surrey Parks
14245 - 56th Avenue
Surrey, B. C.

Mr. B. Laing
School Dist. No. 14
Oliver, B. C.

Mr. Gunter Edel
340 First Street
New Westminster, B. C.

Mr. Jack Martin
Cherry Grove Golf & C. C.
Oliver, B. C.

Mr. A. Vanidour
School Dist. No. 68
395 Wakesiah Avenue
Nanaimo, B. C.

Mr. Larry Burnett
School Dist. No. 68
395 Wakesiah Avenue
Nanaimo, B. C.

Mr. Zoltan Szy
School Dist. No. 37
Delta, B. C.

Mr. A. Saenger
Park Superintendent
28325 McTavish Road
Mount Lehman, B. C.

Mr. Klaus Fischer
Dept. of Public Works
4570 Canada Way
Burnaby, B. C.

Mr. Doug Griffith
City of Penticton
171 Main Street
Penticton, B. C.

Mr. Fred Moss
City of Powell River
6910 Duncan Street
Powell River, B. C.

Mr. Melvin Gunn
Lawn A Mat of Vancouver
7680 Winston Street
Burnaby, B. C.

Mr. Jack Hoekstra
City of Prince Rupert
960 - 11th Ave. East
Prince Rupert, B. C.

Mr. Jim Dickie
Richmond Golf & Country Club
910 Steveston Highway
Richmond, B. C.

Marjorie L. Todd
5815 Yew Street
Vancouver 13, B. C.

Mr. Andy Esterle
Vancouver Golf Club
771 Austin
Coquitlam, B. C.

Mr. George Martin
Box 623
Invermere, B. C.

Mr. John Lindsay
108 Mile Golf Course
108 Mile House, B. C.

Mr. R. Krueger
The Toro Co.
3200 Portage Avenue
Winnipeg, Manitoba

Mr. M. Brooks
Capilano Golf Club
420 Southborough
West Vancouver, B. C.

Mr. Don Palmeter
Glacier Greens Golf Course
P. O. Box 138
Lazo, B. C.

Mr. D. Bacon
Corvallis Country Club
Corvallis, OR

Mr. George Karst
Hope Golf & C. C.
Hope, B. C.

Mr. J. Negraeff
2159 York Place
Port Coquitlam, B. C.

Mr. Karl A. Kolb
#2 Old Town
Los Gatos, CA

Mr. K. Watley
c/o School Dist. No. 70
1100 Redford St.
Port Alberni, B. C.

Mr. W. Campbell
Calgary Public School Board
3610 - 9th St. S.E.
Calgary, Alberta

Mr. E. Forsyth
Totem Par 4 Golf
Kelowna, B. C.

Mr. J. G. Aston
Fallis Turf Equip. Ltd.
581 No. 3 Road
Richmond, B. C.

Mr. M. Davies
Parks & Recreation Dept.
City of Vernon
City Hall
Vernon, B. C.

Mr. F. Enlow
Hirsh Creek Golf & C. C.
Kitimat, B. C.

Mr. Ashley LeGeyt
Kelowna Golf & C. C.
1297 Glenmore Drive
Kelowna, B. C.

Mr. Owen Hamilton
Taylor, Pearson & Carson
5334 Lougheed Highway
Burnaby, 2, B. C.

Mr. Tom Culbert
Taylor, Pearson & Carson
5334 Lougheed Highway
Burnaby 2, B. C.

Mr. N. H. Fallis
Fallis Turf Equip. Ltd.
581 N. 3 Road
Richmond, B. C.

Mr. G. Sweda
O. M. Scott & Sons
17012 N. E. 21st St.
Bellevue, WA

Mr. Gordon Westover
Green Valley Fertilizer
12816 - 80th Avenue
Surrey, B. C.

Mr. N. Woods
P. O. Box 195
Penticton, B. C.

Mr. T. L. Griffin
Sea-Born Inc.
2000 Rockford Road
Charles City, IA

Mr. Taja Singh Banns
17011 Windsor Road
Pitt Meadows, B. C.

Mr. Warren McDonald
Willard Equipment
2099 West 11th Avenue
Vancouver 9, B. C.

Mr. Fred L. McDonald
Willard Equipment
2099 West 11th Avenue
Vancouver, B. C.

Mr. Chris Johnsen
Johnson Landscaping Ltd.
5249 Regent St.
North Burnaby, B. C.

Mr. Richard Chapman
Pine Hills Golf Club
Penticton, B. C.

Mr. Bob Bailey
Corp. of the Dist. of Burnaby
4949 Canada Way
Burnaby, B. C.

Mr. G. Pheifer
Corp. of Burnaby
4949 Canada Way
Burnaby, B. C.

Mr. W. Spelay
Corp. of Burnaby
4949 Canada Way
Burnaby, B. C.

Mr. Bob Symonds
302 - 125 W. Keith Road
N. Vancouver, B. C.

Mr. Burt Andrews
International N.E.M. Co.
5815 Yew Street
Vancouver, B. C.

Mr. Ed Carl
Terra Irrigation
5954 Greenwood
Burnaby, B. C.

20