TURF CONFERENCE PROCEEDINGS

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MIDWEST REGIONAL TURF FOUNDATION

and

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1980

PROCEEDINGS OF THE

1980

MIDWEST REGIONAL TURF CONFERENCE

(Continued)

The 34 talks included in these Proceedings are condensations of talks by speakers before sections and divisions of the 1980 M.R.T.F. Conference. We appreciated the willinghess of the speakers to participate and prepare materials for your reading.

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W. H. Daniel, Executive Secretary
Midwest Regional Turf Foundation
Department of Agronomy, Purdue University
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A copy of these Proceedings has been mailed to:

- All those attending the 1980 Midwest Turf Conference
- One person of each member organization within the Midwest Regional Turf Foundation not represented at the Conference
- A list of those in educational activities

For lawns - first see articles beginning on pages:

2, 5, 8, 9, 14, 15, 20, 24, 26

For Golf Courses -

28, 35, 39, 42, 50, 51, 53, 54, 56, 66, 71, 73, 74

MIDWEST REGIONAL TURF FOUNDATION MEMBERSHIP

The Midwest Regional Turf Foundation was formed in 1945 and first dues were for 1946. It began serving a seven state area. Its peak membership was 385 in 1960. The figure beside the name in the listing following indicates the years of support by members. We are thankful for that support; many have been continuous since the first year. Members are listed by state for ease of identification. Increases in memberships by turf organizations within Indiana are necessary for other states have developed strong state programs.

ILLINOIS:

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Bryn Mawr Country Club, Chicago 19
Carmi Country Club 26
Central Illinois GCSA 15
Champaign Co. Forest Pres. Dist, Mahomet 23
Chicago Heights Country Club 21
Chicagoland GCSA 2
City of Danville, Harrison Park 4
Country Club of Peoria 25
Crystal Lake Country Club 9
Danville Country Club 30
Edgebrook Country Club, Sandwich 8
Edgewood Valley Country Club, LaGrange 33
Exmoor Country Club, Highland Park 33
Flossmoor Country Club 33
Geneva Country Club 9
Glen Oak Country Club, Glen Ellyn 1
H & E Sod Nursery, Markham 27
George Haddad, Peotone 7
Hinsdale Golf Club 5
Idlewild Country Club, Flossmoor 8
Illinois Lawn Equpment, Orland Park 21
Inverness Country Club, Palatine 6
C. W. Jennings, Western Springs 2
Lansing Sportsman Club 6
LaGrange Country Club 33
Lockhaven Country Club, Alton 27
Charles McKeown, Pekin 5
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James D. Mello, Downers Grove 2
Midlothian Country Club 33
Midwest Assoc. of Golf Course Supt. 25
Mueller Sod Nursery, Ontarioville 20
Northmoor Country Club, Highland Park 33
North Shore Country Club, Glenview 33
Onwentsia Club, Lake Forest 22
Robert Parmley, Wheeling 8
Pontiac Elks Country Club 14
Prestwick Country Club, Frankfort 13
Rockford Country Club 2
Roseman Mower Co., Glenview 26
Seaboard Seed Co., Bristol 9
Shoreacres, Lake Bluff 33
Silver Lake Country Club, Orland Park 33
Eugene Strasma, Decatur 4
Sunset Ridge Country Club, Northbrook 32
Thornton's Turf Nursery, Elgin 13
Timber Trails Country Club, LaGrange 31
Velsicol Chemical Co., Chicago 21
Wadsworth Co., Plainfield 20
Warren's Turf Nursery, Palos Park 21
Westmoreland Country Club, Wilmette 34
Woodward Governor Co., Rockford 26

INDIANA:

Anderson Country Club 26
Ball State University, Muncie 12
Randy A. Ballinger, Upland 7
Beeson Park Golf Course, Winchester 10
Bd. of Park Commissioners, Fort Wayne 30
B.P.O.E. # 649, Richmond 17
Broadmoor Country Club, Indianapolis 34
Burke Mem. Golf Course, Notre Dame 21
Calumet Golf Club, Gary 3
Christmas Lake Golf Course, Santa Claus 4
Clearcrest Country Club, Evansville 29
Connersville Country Club, 33
Country Club of Indianapolis 34
Country Club of Terre Haute 34
Crooked Stick Golf Club, Carmel 10
Donald A. Cross, Hobart 1
Culver Military Academy 17
Duane Danmeyer, Greenwood 1
Delaware Country Club, Muncie 34
Randy A. Denney, Warsaw 4
Desco Chemical Co., Nappanee 14
Elanco Products Co., Indianapolis 14
Elcona Country Club, Elkhart 3
Evansville Country Club 34
E-Z Lawn Corp., Richmond 2
Donald J. Fassnacht, Lafayette 1
Forest Hills Country Club, Richmond 12
Forest Park Golf Course, Valparaiso 13
Dale C. Foster, Fort Wayne 1
Fort Wayne Country Club 34
Frankfort Country Club 30
French Lick Springs Hotel & C. C. 11
Friendswood Golf Course, Camby 13

Midwest Regional Turf Foundation Membership

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Greenhurst Country Club, Auburn 19
Greensburg Country Club 17
Gritt Fields, Inc., Brooklyn 3
Harrison Lake Country Club, Columbus 17
Hickory Hills Golf Club, Brownstown 3
Highland Golf & C. C., Indianapolis 32
Hillcrest Country Club, Indianapolis 32
Hillview Country Club, Franklin 1
Honeywell Public G. C., Wabash 2
Hoosier Turfgrass Association 1
Indiana Farm Bureau, Mt. Vernon, 19
Indiana G.C.S.A. 24
Undiana University B.C., Bloomington 20
Indiana Turf Equip. Co., Indianapolis 28
Jansen Landscape Co., Elkhart 8
Dennis M. Keefe, Muncie 2
Kenney Machinery Co., Indianapolis 28
Killbuck Rec. Assoc., Anderson 15
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Kokomo Country Club 31
Lake James Country Club, Angola 1
Lafayette Country Club 33
LaGrange Country Club 6
L. C. Lane, Lafayette 6
Lawn Life, Carmel 5
Maplecrest Country Club, Goshen 19
Martinsville Country Club 19
Mead Johnson Co., Evnasville 16
Meridian Hills C. C., Indianapolis 34
Meshingomesia Country Club, Marion 34
Michigan City Municipal Golf Course 28
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New Albany Country Club 34
Northill Management, Fort Wayne 2
Oak Knoww Golf Course, Crown Point 4
Old Oakland Golf Club, Indianapolis 12
Old Orchard Golf Club, Elkhart 14
Orchard Ridge Country Club, Ft. Wayne 4
Otter Creek Golf Club, Columbus 15
Lloyd A. Paul, Roanoke 1
Pine Woods Golf Club, Spencer 6
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Seymour Elks 5
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South Bend Country Club 23
Sullair Corp., Michigan City 3
Summertree Golf Course, Crown Point 4
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Sycamore Springs G. C., Indianapolis 12
Tippecanoe Country Club, Monticello 19
Tippecanoe Lake C. C., Leesburg 3
Tri-State G.C.S.A. 6
USS Agri-Chemicals, Jeffersonville 22
Valparaiso Golf Club 33
Washington Country Club 19
Allen Wehr, Jasper 3
Western Hills C. C., Mt. Vernon 17
Woodland Country Club, Carmel 25
Woodmar Country Club, Hammond 20
Youche Country Club, Crown Point 20
Zollner Golf Course, Angola 2

KENTUCKY:

Audubon Country Club, Louisville 33
Big Springs Country Club, Louisville 32
Bunton Seed Co., Louisville 24
Harmony Landing Country Club, Goshen 24
G. W. Hill & Co., Florence 18
Irrigation Supply Co., Louisville 11
Kentuckiana G.C.S.A. 20
Met. Park & Rec. Bd., Louisville 11
Owensboro Country Club 18
Steve Phillips, Ashland 1
Standard Country Club, Louisville 31

MICHIGAN:

Bay City Country Club 18
Country Club of Detroit 33
Detroit Golf Club 21
Down River Lawn Service, Trenton 20
Eugene Johanningsmeier, S. Lyon 10
McKay Golf & C.C. Properties, Lansing 2
Maple Lane G. C., Sterling Heights 33
A. J. Miller, Inc., Royal Oak 25
The Moors Golf Club, Portage 1
Oakland Hills C. C., Birmingham 13
TUCO Div., The Upjohn Co., Kalamazoo 30
Wilkie Turf Equipment, Pontiac 8

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Bellerive C.C., Creve Coeur 19
Bogey Hills G. & C.C., St. Charles 9
City of St. Louis Parks Division 26
Forest Hills C. C., Chesterfield 2
Glen Echo C. C., Normandy 33
Lakewood Golf Club, Genton 8
Mallinckrodt Chemical Co.,St. Louis 19
Old Warson C. C., St. Louis 23
St. Andrews Golf Club, St. Charles 6
St. Ann's Golf Club 8
Westborough Country Club, St. Louis 26
Westwood Country Club, St. Louis 29

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Columbus Country Club 34
Country Club, Inc., Pepper Pike 31
Crest Hills Country Club, Cincinnati 30
Dayton Power & Light 26
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Edgecreek Golf Course, Van Wert 16
Edgewood Golf Club, N. Canton 24
Elyria Country Club 20
Findlay Country Club 23
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Gate of Heaven Cemetery, Cincinnati 30
Steve Gipson, Chesterland 10
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Kenwood Country Club, Cincinnati 33
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Little Turtle Club, Westerville 5
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Maketweah Country Club, Cincinnati 26
Mayfield Country Club, S. Euclid 19
Miami Valley G.C.S.A. 7
Moraine Country Club, Dayton 32
NCR Emp. Benefit Assoc., Dayton 24
Jack Nicklaus Sports Center, Mason 5
Northern Ohio G.C.S.A. 30
Oakwood Club, Cleveland Heights 32
Ohio State Univ. G. C., Columbus 32
Piqua Country Club 25
Rawiga Country Club, Seville 6
O. M. Scott & Sons, Marysville 28
Shawnee Country Club, Lima 26
Springfield Country Club 10
R. Stone's Landscaping, Willoughby 16
Tamaron Country club, Toledo 2
Tri-County Turf, Maineville 10
Valley Turf, Valley City 1
Valleywood Golf Club, Swanton 8
Walnut Grove Country Club, Dayton 23
Western Hills C. C., Cincinnati 18
Floyd M. Wiget, New Lebanon 1
Wildwood G. C., Middletown 10

WISCONSIN:

Brynewood Country Club, Milwaukee 4
Loft-Kellogg Seed Co., Milwuakee 7
Met. Sewage Comm., Milorganite Div. 26
Milwaukeek Country Club 18
North Hills C. C., Menomonee Falls 18
Ozaukee C. C., Mequon 3
Racine Country Club 4
Somers Landscaping, Stevens Point 6
Stevens Point Country Club 21
Tuckaway Country Club, Franklin 4
Wisconsin G.C.S.A. 24

OUTSIDE MIDWEST REGION:

Aquatrols Corp. of America, Delair, NJ 13
Barbara Emerson, Ambler, PA 2
Harold W. Glissmann, Omaha, NB 22
Jacklin Seed Co., Post Falls, ID 13
Lebanon Chemical Co., Lebanon, PA 23
Mock Corp., Pittsburg, PA 16
John Souter, Stirling, Scotland 2
The Toro Co., Minneapolis, MN 30

PRESIDENT'S REPORT

Bud Camp, Lebanon Chemical Corporation
Fort Wayne, Indiana

As President of the Midwest Regional Turf Foundation, I extend you a hearty welcome to our 45th Conference. We trust the time spent with us will benefit you as you pursue your position in the turf industry.

May we receive the various reports on Research and Its Applications with an open mind - ready and eager to evaluate - and incorporate them into our plans for tomorrow.

The turf industry is blessed with an era of unlimited new opportunities, and those who research best will prevail.

We express our appreciation to Dr. Bill Daniel, his staff, our board of directors, and the full executive committee. Without the complete cooperation and enthusiasm of these people the progress achieved in our transition program would have been impossible.

We thank all of you for your confidence and support of our projects.

You will note that your ballot contains names for new positions on the board. This is part of our transition program to seek representation and input from all areas of the turf industry to maintain our cosmopolitan, multi-state image.

In closing, we would remind you that further membership participation and input is needed to complete our revisionary process. Now is the time to get involved!

RESEARCH NEEDS OF THE LAWN CARE INDUSTRY

James F. Wilkinson, Ph.D., Director of Research
ChemLawn Corporation, Columbus, Ohio

The lawn care industry today is expanding at a tremendous rate. Few people, even as recently as three to four years ago, would have anticipated the growth the industry is now experiencing. Most people would now agree that lawn care is becoming a vital part of the total turfgrass industry.

Lawn care services have been available to homeowners for many years, however, few professionally trained turfgrass managers have become involved in the lawn care industry until recently. Many operations in the past consisted of one man, a pick-up truck and fertilizer spreader. The recent surge in the lawn care industry has been backed in most cases by professionally trained turfgrass personnel. The purpose of this article is to demonstrate that the lawn care industry has many research needs which have not been totally met or have been ignored by turfgrass research in the past.

Although turfgrass research began as early as the 1880's, major strides were not made until the late 1940's with the introduction of new pesticides and improved cultivars. Both university and industry research have contributed strongly to turfgrass science. University research has contributed most heavily in the areas of turfgrass breeding, fertility, nutrition, and management, whereas industry has made the major advances in the development of new pesticides for weed, insect and disease control.

Despite many major achievements in turfgrass science, numerous areas remain a concern to the turf industry as a whole: breeding challenges remain in the development of disease resistant cultivars and cultivars tolerant to low fertility and drought stress; fertility problems relating to more efficient use of N, P, and K coupled with improved diagnostic methods (soil and tissue) to evaluate nutrient cycles, and control; new or recently recognized disease problems such as Fusarium, Anthracnose and Red leaf spot, and insect problems such as the Ataneous grub will require a continuing research effort; and finally need for more thorough investigation of problems relating to management - mowing and thatch, establishment, renovation, and cultivation.

The Lawn Care Industry Has Special Research Problems. In addition to the research areas outlined above which are a concern to the total turfgrass industry, the lawn care industry has many unique research needs. These unique needs are the result of several factors:

1. Most lawn care companies schedule visits to a lawn on anywhere from a six to twelve week basis. This situation creates the need to insure adequate material residual of both fertilizers and pesticides to last through this six to twelve week interval. In addition, working on such a schedule often means a company representative is not on a lawn frequently enough to spot developing problems. As a result, a lawn care service most frequently gets called back to a lawn by the homeowner after a particular weed, insect or disease problem has gone beyond the point of easy control.

2. Lawn care companies must maintain a multitude of homelawn situations. Many different microenvironments, soils, species, and cultivars are encountered. Turfgrass management is made easier in many ways when the manager, for example a golf course superintendent, has a limited number of species, soils, etc. to work with. Many lawn care companies are modifying programs to fit sun vs. shade conditions, or species differences and utilizing soil tests to make supplemental

applications of lime, P and K when needed. However, there is a great need to improve programs to meet the special requirements of individual lawns.

3. Because of several distinct operational advantages, many companies are successfully utilizing liquid systems to deliver soluble and insoluble fertilizers and pesticides. This is a relatively new practice in the realm of turf management, although liquid fertilizers are being used extensively throughout agriculture in general. Use of the liquid fertility tecnhique has not been researched to the same extent as dry programs.

4. Most companies today, whether utilizing liquid or dry programs, are applying a number of different fertilizers and pesticides in one pass over a lawn. This leads to two situations which can create problems: (a) chemical incompatibility, where materials are not compatible within the same spray tank, and (b) placement incompatibility where different materials frequently are applied together whose targets are at different locations within the turf microenvironment. For example, the combined use of a broadleaf herbicide and an insecticide for grub control, whether applied liquid or dry, would present placement problems. The herbicide should remain on the foliage to achieve maximum control, whereas an insecticide should be watered into the thatch and soil.

Specific Challenges for Lawn Care Research. A very limited number of lawn care companies today support active research programs, and few if any university research programs are aimed directly at the problems unique to the lawn care industry. However, as many companies grow within the rapidly expanding lawn care market, more and more will recognize the research needs of the industry which must be met. If the industry is going to successfully reach its full potential, the following areas I believe will require research attention:

1. How can we more closely adjust programs to meet the specific problems of different locations, soil types, microenvironments, species and cultivars, present pest problems, etc.? To do this, we will require a highly trained applicator who can adjust programs as the different situations from lawn to lawn dictate. Specialized application equipment must be developed to accomplish this. Delivery systems which would enable the applicator to adjust programs as he moves from one lawn to the next would be a boon to the industry.

2. Liquid fertility programs require a substantial research effort. Fertility research has traditionally been based on dry programs. Much research conducted utilizing dry fertilizers and pesticides is not completely valid and many established ideas must be reevaluated.

3. Coupled with liquid fertility research, the mechanism of physiological burn and materials which produce burn will be a continuing problem. New materials and old materials in new combinations will have to be constantly evaluated for burn potential. One serious problem that exists in this area is that we often recognize the problems leading to burn, however, we are not always able to adjust our production schedule or materials rapidly enough to totally avoid burn.

4. Understanding tank mix compatibilty is an area which has been given little attention in the past. More and more lawn care companies are utilizing liquid programs, combining several different fertilizer and pesticide materials in one spray tank. Several articles have recently appeared in trade magazines regarding tank mixing, however, these have often contained old, erroneous information leading to confusion within the industry. Most lawn care companies up to now unfortunately

have taken a try it and see attitude. Especially as new products become available, much more knowledge needs to be gained regarding tank mixes and their chemical and physical compatibilities. In addition, companies utilizing dry programs often utilize fertilizer and pesticide combinations which have not been thoroughly evaluated with respect to pesticide efficiency.

5. New and improved fertilizer materials need to be found. This is esepcially true in the utilization of fertilizer materials in liquid programs. A liquid slow-release nitrogen source would find wide acceptance in the lawn care industry. Another important area would be the development of slow-release nitrogen sources with improved release properties which would better fit into production schedules. Questions relating to efficient fertilizer utilization must also be answered.

6. Weed and insect control programs will need continual improvement. Many hard to kill weeds are special problems. In addition, applying herbicides and insecticides on a six to twelve week production schedule presents several unique problems for the lawn care industry. For example, applying an insecticide which has a critical timing requirement becomes difficult. Other examples of problems include the application of a preemergent herbicide to every lawn in the spring prior to annual grass germination, short insecticide residual, and movement of insecticides through thatch for grub control where irrigation generally is not available. Alternative pest control measures, such as controlled release of encapsulated pesticides may provide part of the answer.

7. Few people within the lawn care industry have given sufficient attention to the long term effects of fertilizer and pesticide programs. Although some recognition is now given to the possible detrimental effects of continual preemergent herbicide usage, more research is required. Alternative approaches to annual grass control may be needed. Other pesticides as well may be causing long term detrimental effects. Also, continual use of improper fertility programs which initially appear suitable could also lead to the long term degradation of a lawn.

8. New products will continue to become available which will require evaluation. Despite the availability of many excellent pesticides, the pesticide industry recognizes the tremendous potential for sales within the lawn care industry. Alternative products, often economically attractive compared to older materials, will become available on a continuing basis. Also, newer type materials such as spray adjuvants, wetting agents, and antidrift agents will be introduced to the industry, all requiring substantial testing and evaluation.

In summary, it is true that the lawn care industry has a huge expansion potential, however, the industry as a whole must provide high quality services and programs to the homeowner. Only through research to answer some of the questions above can the lawn care industry be continuously evaluated and upgraded.

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PROMOTING, ADVERTISING AND MARKETING

Bob Earley, Editor/Associate Publisher, Lawn Care Industry
Cleveland, Ohio

We asked the readers of LAWN CARE INDUSTRY magazine the simple question: "Do you advertise?" 76 percent of chemical lawn care companies said, "yes" and 24 percent said, "no". For mowing/maintenance companies, 68 percent said "yes" and 32 percent "no".

As to how much they spent on advertising and promotion, we received answers all the way from $1,000 a year to $105,000, but two-thirds of the answers were $3,000 or less. It proved out that companies were spending anywhere from 1 to 5 percent of their annual gross on advertising, usually in the vicinity of 3 percent.

Here is how the advertising broke down:

Medium	Companies using %	Amount spent $
Yellow Pages	78	993
Newspaper	42	1,762
Personal solicitation	27	1,112
Direct mail	19	9,864
Phone	18	391
Radio	16	1,288
Door hanger	12	2,111
Television	6	6,197

We asked a cross-sample of consumers in the Midwest the question, "If a lawn care company was trying to reach you, which form of advertising do you feel would be best?" The answers:

44% - direct mail
27% - personal solicitation
15% - door hanger
12% - newspaper
8% - Yellow Pages
8% - home & garden show display
1% - radio
0% - phone solicitation

We asked the same consumers the question, "On what basis do you rate lawn care companies?" Their answers:

1 - reputation
2 - recommendation
3 - price
4 - worker/equipment appearance
5 - advertising

A real case can be made for advertising by asking, "How are you going to get the customers in the first place to gain a reputation or get recommendations if you don't advertise?"

Many companies offer rebates to existing customers if they provide a name of a potential customer. If the new customer signs up, the lawn care company provides a $5 rebate to the existing customer.

Do you need an ad agency? Probably not, unless you are really big. But when creating a company logo, a lawn care businessman should probably hire a professional graphics designer who also produces the design. A combination graphics designer and producer will keep an eye on dollars when asked for an idea. A cost of developing a logo can be anywhere between $100 and $500, probably an average of $300.

The design of the logo does not have to be anything elaborate, just use it constantly. A company logo has a wide variety of uses. It can be displayed on uniforms, vehicles, outdoor signs, Yellow Pages ads, television commercials, stationery, invoices, and novelty items like matchbooks and pencils. The most important thing is to use it over and over again. Repetition of the image - even if it is bad - is the key. All too often, companies develop a logo which they don't use constantly. If you have one logo on the truck and another on the invoices, then you have no image. Once you've done the work of investing in a logo, it doesn't cost anything extra to use it.

Many companies spend about 60% of their ad budget in the first ten weeks of the season, and then space the rest of it out from there. Many companies also pick up with a little more advertising in the fall.

Space out your mailings so that you can handle the requests when they come in.

Define your market, and concentrate your efforts to get the best results. Metro newspapers reach a large audience, weeklies are often more likely to reach your prospective customers. Build customer lists where you already have customers. Have your technicians drop off literature to next-door and across-the-street neighbors when they handle a servicing. This is called "cloverleafing".

Although his basic philosophy is to try to keep his customers as concentrated as possible, one lawn care businessman we spoke to is not afraid to break in a new area if he feels it has potential. He will take on customers 30 or 40 minutes away from his office, then he puts on the push to build business in that good-potential area. Once he gets a few customers he advertises heavily to get more as soon as possible.

Most serious lawn care companies have printed brochures that explain the problems a lawn will encounter and how to deal with these problems. Many also have brochures that explain the common practices a customer must employ, like watering and mowing properly, to keep his lawn in top shape and to complement the lawn care program the company is providing.

Yellow Pages advertising is the mainstay of lawn care companies and others in the service industry. Ma Bell does a good job of promoting "let your fingers do the walking". Put some thought into shaping your Yellow Pages ad; make the space count.

Many options are open to you in putting together your ad, with possibilities varying according to the size of the ad. Larger display ads permit use of more copy, illustrative material, etc. But even those who invest in larger space often prefer to keep copy brief, surrounding it with lots of space, feeling it results in more impact.

Build your ad carefully. Be specific. Concentrate on the essentials. Avoid tricky phrases. Generalizing in ads only leads to unwanted calls. People look for guidance and information in ads. One lawn care businessman told us he writes his ad copy as he would a telegram.

Suggestion: don't be bashful about seeking the counsel of the telephone ad reps. They can offer help on elements such as typefaces, borders, even illustrations. But don't be too quick to accept all of their recommendations. Above all, avoid turning the entire matter of putting the ad together over to the reps, or your ad may end up looking like all of the others in your classification. If you have a service or two that makes you unique, include this information. It is also vital that you check advertising proofs for errors or omissions like a wrong number in your address or phone. Remember, you have to live with these mistakes for an entire year.

Instead of splashing the name of the firm in big letters at the top of your ad, many companies display their service in large type. It is more meaningful to stress what you do rather than your name.

Newspaper advertising is a shotgun; direct mail is a rifle shot. Most lawn care companies expect anywhere from 1.5 to 3% response on their direct mailings, and close between 65 and 80% of the requests and leads they get. In a new market you might expect a bit larger response.

Many lawn care businessmen question if radio advertising is cost-efficient, but it has worked well for many other companies. On a small suburban station, ads will cost you about $10 a minute, perhaps $12. In major markets, radio ads will cost you about $30 a minute, $22 low and $50 high. Half-minute spots will cost you about half of the minute charge on small stations, and about 80% of the minute charge on large stations.

Billboard ads are being used by more companies because they have to be displayed only at certain times of the year, thus saving money, and they go a long way toward giving you a national image. It is going to cost you about $200 a month to run the ad. A large truck with your name on it is also a billboard ad. Keep that in mind when you design your truck logo.

A lawn care businessman must be covered by adequate liability insurance, but you should probably not advertise it. You can reduce the number of potential claims simply by eliminating the word "insurance" from advertising and contracts. If a customer asks if you are insured and wants proof, provide it, but don't invite trouble in this suit-conscious environment so prevalent today. Don't boast, "we are fully insured" or "we carry a million dollars worth of liability insurance".

When selling commercial maintenance, develop a brief letter of introduction. This letter should whet the prospect's appetite. Don't wait for him to respond. Call him two days after he has received the letter and set up an appointment. If you have a brochure, send it to him with a one-page cover letter. A brochure portrays a professional image, stability in the industry, and can be a very effective tool in promoting company image. You can produce a black and white brochure for $500. Carry a bidding kit with you at all times, including brochure, job references, background information sheet, a standard maintenance contract, and pictures of your crews in action, and a list of the jobs you have performed.

The best advertisement is, of course, a happy customer. He will sell your program for you. If you lose sight of the fact that you are in a service industry, you are in the wrong business.

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AN INDUSTRY GROWS

Steve Derrick, Professional Turf Specialties
Normal, Illinois

An industry grows in many ways. Most people measure industrial growth in relation to size or dollar volume. It's true that the lawn care industry has grown from 5500 companies in 1975 to 9400 companies in 1980. Also, total dollar volume in 1975 was about 960 million, and 1980 estimated volume is 1.4 billion. However, there are other ways to measure an industry's growth. I believe more important yardsticks such as knowledge, performance, integrity, customer acceptance, and satisfaction are also important measuring criteria.

Certainly a great deal of the lawn care industry's growth has to be attributed to increased knowledge. Ten years ago only a few of the large companies were familiar with fertilizer break down, disease problems, and herbicidal half life. Today most firms blend slow release fertilizers with water soluable to attain an even nitrogen release. They can do this with confidence and full understanding of their length of release. The knowledge doesn't stop there. Through university and individual efforts, the entire industry is now better informed on cultural and chemical methods to maintain better turf.

Performance grows out of knowledge. Every lawn care company strives to offer the best lawns economically possible. And once that knowledge was available, the lawn care industry has provided thousands of neighborhoods across the country with weed free healthy turf. In addition, the cost is less than that at which the homeowner could buy equal material at retail cost.

The reputation of any industry lies in its integrity. A few who have not understood lawn care applications have accused the industry of spraying water, cutting rates, etc. The customers knew better. Through a constant effort to provide good service, answer turf problems, and provide the customer with mailers and informative brochures, this industry has grown in integrity also. You can spend $700 for a television or $8,000 for a car, but you can't get the company to come out to your house to examine those products when something goes wrong without paying a high service call. The lawn care industry does come out, and at no cost. That's integrity!

Increased knowledge, high performance, and a continued level of integrity have given the lawn care industry a high level of customer satisfaction. It's this acceptance by the customer that has made our industry the 1.4 billion dollar industry it is today. And now that the Professional Lawn Care Association of America has been established, that level of integrity will increase even more.

Now let's look at the traditional measurement of growth. In 1976 the size comparison of lawn care companies looked like this:

Number of accounts	% of the companies (1976)
1-99	52.2
100-199	14.6
200-499	16.3
500-999	7.3
1000-4999	6.2
5000 or more	3.4

On the average, these companies have grown 20% per year since 1976. Is there anything left? According to Lawn Care Industry and Forbes magazines, there are 50 million homes that are located in areas that could receive lawn care. Only 5 million do. However, in Dayton, Ohio, 60% of the home lawns are treated. This leaves a potential market of 5-6 billion dollars, of which only 1.4 billion will be obtained in 1980.

What does this day? Our industry is made up of small business men, located in every size marketplace, with a great potential for growth. The industry is young and exciting. We are growing. Not only in size, not only in dollars, but also in product quality - where it counts most.

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TIMING AND SCHEDULES

Doug Halterman, Leisure Lawn, Inc.
West Carrollton, Ohio

Everything we do in the lawn care business involves timing and schedules. There are schedules for production, advertising, equipment maintenance, and for timing of preemergents and insecticides as well as for herbicides and fertilizers.

First we will explore timing, since we must acquire a feel for when the best time is to accomplish a series of tasks before we can arrive at a schedule for those tasks. We will look basically at the timing of chemical and fertilizer applications, but also take a brief look at aeration, dethatching and seeding.

If we look up the definition of timing we find it is the moment of occurance of something so as to produce the most effective results. Two common examples of timing are the timing of an engine and the timing of a golfer's swing.

In turf, we need to apply the correct materials at the proper time to obtain the desired results. We need to operate to favor turfgrass and to weaken its competitors. Often in the past we have operated for our own convenience - that is, taken the easy way out. We need to readjust our thinking in several key areas to start looking at things that are best for turf over the long run; take time to stop and think of what long range implications may follow actions that may have been though of as basic to the lawn care industry. Don't look at making any dramatic short term moves, but look for systematic methods that develop programs and techniques to provide a healthy, long term lawn maintenance program.

First, let's take a look at some considerations for timing of chemical and fertilizer applications.

With preemergent herbicides look for an ideal starting date based on the chemical you decide to use, its longevity, its effectiveness, your local conditions and program goals. Obviously, cost is a major consideration which makes this decision progressively more difficult each year. The familiar chemicals which are available are:

Betasan: long lasting, best used in those areas where heavy annual grass pressure exists.

Dacthal: has exhibited some post-emergent control when applied as a liquid and therefore can prolong the pre-emergence application. Dacthal can also provide control of broadleaf speedwells.

Benefin: applied only as dry material; however it is the most economical.

Consideration must then be given to the time the preemergent application should end. Heavy pressure usually exists here to prolong the spring application to allow for more treatments to be applied to newly acquired accounts. However, if the pre-emergent application ending date is delayed, it risks customer dissatisfaction from annual grass invasion. We have problems anyway because we extend pre-emergent applications beyond the published average crabgrass germination date when spring is cool and late results may be satisfactory.

The future will bring more flexibility in pre-emergent usage. Most thought will be given to alternating chemicals from year to year to avoid excessive accumulations, and to take advantage of the different attributes of each chemical.

We should realize that those lawns which provide a dense turf may not require the use of pre-emergents every year.

In using broadleaf herbicide applications, we all know what conditions are most favorable for weed control. However, our customers seem to have different ideas about when herbicides should be applied. This has come about for two reasons:

1. We have programmed the customer to expect an absolutely weed-free lawn by the literature we send him.
2. Lawn care companies have reinforced these expectations by trying to provide these results.

Broadleaf weed killers have been applied three, four and even five times per year in attempts to satisfy and reinforce our customers' wants. We must make applications when the weeds are most susceptible. We need cool temperatures, adequate soil moisture, and actively growing weeds. Let's begin to look more closely at species germination dates and chemical ineffectiveness during early spring and summer applications.

We have to get away from mid-summer applications of herbicides when conditions are not favorable. However, it's going to take a uniform effort to educate the customer. Make him aware of why a weed is present and the complications involved in trying to treat for it in less than ideal conditions. We know what the effects of herbicide applications are on turf in stress conditions. Now it's time to put this knowledge to work and make some long overdue decisions on timing of herbicide applications.

When we look at insecticide applications we should investigate the Target System of controlling insects. Past thinking in lawn care has been that with the large numbers of customers to be serviced and the limited number of visits to a single lawn each year, this type of approach was totally impractical. New information available on insect life cycles has shown that there are overlapping

periods when turf insects are susceptible to control. It may be entirely possible to apply insecticides with limited residuals at times when the chances of controlling a large spectrum of turf damaging insects is very high.

In looking at the Target Systems usage on common insect problems we find:

Bluegrass Billbug: Control is best achieved when the target is the adult. Insecticide should be applied before eggs are laid. The optimum time for this control would be mid to late spring. Larvae are difficult to control because they are located in the stem, crown, or thatch where contact from chemicals is less than ideal. Also, in most cases, larvae damage has already occurred before detection is made. Timing also influences the choice of chemicals since insecticides best for adult control may not always be best for larvae.

Chinch Bug: The chinch bug overwinters as an adult and begins feeding as soon as daytime temperatures raise to 70° F. At this point, control can be achieved by targeting applications to this active adult.

Sod Webworm: This insect overwinters as a larvae. As soil temperatures increase, the larvae pupates in the soil to form an adult moth. Since we have no control over this winged form we must wait until eggs are laid and these eggs hatch to form small larvae. Therefore, control is targeted to young larvae that occur later in the season than chinch bugs or billbugs.

Knowing the life cycles of these three insects, can we expect a single, well timed application of the proper amount of insecticide to provide control for all three? Recent research indicates this may be a solution in some areas. Other areas may not be plagued by all three insects; one or two may dominate. We have had a tendency to overreact to small infestations and assume an entire service area requires the same treatment. We should look for isolated areas of insect populations and if possible, time applications targeted toward these areas.

With most insects we are concerned with early season applications for control. The White Grub (European Chafer & Japanese Beetle) poses a different problem with timing.

Spring is not a desirable time to control grubs. Fall applications tend to be more effective because the grub is more actively feeding. Also, since the target area for grubs is below the thatch layer, insecticides commonly used for spring insect control must be used at a higher rate, or an alternative material must be selected.

The best approach here may be a curative application when the grubs are found to be actively feeding. Control at this time is easily achieved without unnecessarily applying large amounts of insecticide targeted for early preventative control.

We have been creating virtual deserts in the lawns we are servicing by the overuse of insecticides. The natural insect populations have been destroyed leaving lawns open to invasion by insects with well developed resistance to insecticides. Therefore, we have to begin placing more emphasis on insecticide timing.

An obvious side benefit of a properly timed application can be a reduction in material usage and therefore cost. We might be well advised then to put more effort into looking rather than applying.

Fertilizer applications offer another look at proper timing. Timing of nutrient applications involves much more than just programming an amount of fertilizer to be applied over a period of time. We need to look at: when to apply the largest quantities, the seasonal effects of poorly timed amounts of fertilizer, how much water insoluble nitrogen to apply, and when to apply it.

The source of water insoluble nitrogen infleunces the correct timing of its application. Some sources (urea formaldehyde) require microbial activity, which is directly related to soil temperature for release. Others like IBDU require moisture for release. The fertilizer response desired should be related to the time of application and the conditions expected afterward. We have a unique situation in that we don't know if a customer will be returning the following year. What kind of timing considerations are we then faced with to produce a quality turf without building an expensive reserve of water insoluble nitrogen from which we may never gain benefit?

Rather than use large amounts of water insoluble nitrogen we can use soluble fertilizers in our fertility programs if we are careful in our timing not to create conditions favorable to disease in the spring or produce a stress susceptible plant that will have used its energy reserves before summer. Maybe our best timed usage of larger amounts of water soluble nutrients can be applied as a late fall fertilization to optimize the relationship between photosynthesis, respiration, and carbohydrate storage.

Improved varieties of grasses, plus a customer insistance on a emerald green lawn year round present a case for larger amounts of fertilizer in a lawn program. Larger amounts, however, may not be the best solution to this problem. Better timing of the current amounts of fertilizer, plus an educational program that encourages customers to recycle grass clippings may provide a more agronomically sound approach.

Most of the diseases we are routinely confronted with (leaf spot, dollar spot, Fusarium, stripe smuth, Pythium and brown patch) require proper timing for acceptable control. We can provide control through the use of either preventative or curative measures. With the use of preventative measures a history of past infestations has provided a feeling that a recurring problem may exist. In cases where such a recurring problem exists, fungicides must be applied at a time when adequate concentrations of the chemical are present when environmental conditions favoring disease occur. In these cases, a systemic type fungicide may be best.

However, it may be a waste of time and energy to provide such controls. If the disease is so predictable that a preventative is advised, probably the <u>best long-run solution</u> may be to <u>change</u> varieties of grass in the lawn.

Curative applications of contact type fungicides require precise timing when reapplications are required. Such timing is generally difficult with the demands of keeping up with day to day operations. Systemic fungicides may be used for curative purposes. These systemics may be a solution to the timing requirements needed with contacts. Granted, they are more expensive, work more slowly, and there may be a few instances of resistance, but consider the time required for reapplications.

When we look at aeration and dethatching, we also have timing considerations to evaluate. In the spring we have to contend with a preemergence barrier, but also we should consider the amount of weed invasion that is likely to occur from a thinned turf, especially after dethatching.

Soil moisture is very high in the spring and may make if difficult to maintain clean, properly adjusted equipment. Excessive moisture present during core aeration can cause glazing of the core walls resulting in poor water penetration. Therefore, fall aeration and dethatching are encouraged. Just be sure the turf refills before winter dormancy.

As with aeration and dethatching, proper timing for seeding also must be considered. Spring seedings generally conflict with preemergent controls, except when Tupersan is used. Summers are usually too hot and dry for seeding. Weed invasion in properly cultivated seed beds can present considerable problems during the summer.

If seeding is to be done in conjunction with either aeration or dethatching, the fall presents an excellent opportunity. Flexibility to apply fertilizers is best achieved then, along with more favorable conditions of water and temperature. Weed invasion is less in the fall and conditions for turf recovery are excellent. If weeds are a problem, controls can be delayed in the fall until the grass has matured.

Put together all the considerations you feel important into a projected operation or procedure to follow. This schedule involves a sequence of events timed not only to produce your desired results, but also to accommodate the manpower, equipment and growing season available. This schedule should provide a program to eliminate problems,not just deal with the symptoms of a problem.

Fertilization schedules should provide application dates that enhance timing considerations. Applications should be timed to: reduce disease, increase stress tolerance, build carbohydrate reserves, and enhance root and rhizome development over leaf growth.

Herbicide applications should be scheduled to be applied when control is most easily achieved, and at times when the least harm will be inflicted on desirable grasses.

Insecticides should be scheduled to target more effectively on a period when the greatest spectrum of control can be expected.

Schedules should set day, week and round quotas for each truck. This allows each operator an opportunity to see at a glance where he stands. Well conceived and planned schedules tend to eliminate confusion, keep customer application sequences the same from application to application, and year to year, overlap application periods to accommodate new sales, allow the placement of newly acquired accounts into the same sequence as the neighbors, and dictates the production requirements required per truck.

Any program you put together for a mass production approach to lawn care has to contain some compromises. The most profitable, efficient companies have been able to come up with valid compromises to both timing and scheduling. They have also become deeply involved in fertilizer and pesticide management.

All lawn companies should take a closer look at what they are trying to accomplish with their programs. In the long run it appears as though companies who educate and retain the lawn technicians and applicators, inform their customers what they are trying to accomplish and the problems involved, work for the year round betterment of turf, and present a clean, efficient image will continue to grow and prosper.

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LAWN INSECTS - 1980

Jeff Lefton, Agronomist
ChemLawn Corporation, Indianapolis, Indiana

Insects can be a competing factor in developing a satisfactory turf for our customers. It is important to consider the following factors in order to properly treat a problem:

- Identify the insect
- Establish the life cycle
- Determine the damaging stage
- Determine the controllable stage

To help you consider each of the above factors, several common lawn insects are investigated below:

Winter Grain Mite - Recently a few lawns have shown damage as large areas of turf remain brown after the early spring green-up. Individual grass blades have a streaked appearance due to the feeding habit of the mite. The mite itself is olive black with eight red legs.

The mite oversummers as eggs which hatch in October. The new mites apparently feed throughout late fall and winter whenever the temperature permits. Beginning in March, the mites lay bright orange eggs in the thatch and soil. By late April the egg laying mites die and no further mites are seen until the following October.

Aphid or Greenbug - Aphid or Greenbug damage on lawns is an increasing problem. The damaged areas usually show a distinct orange-brown coloration. Many times the damage area first appears under trees. However, lawn damage can appear in the full sun areas as well. The Greenbug is a sucking insect damaging the plant by injecting a toxin into the plant and sucking plant juices from the phloem. The Greenbug is green and pear shaped, about 1/8 inch long. Lawn damage can be apparent from late spring to late fall depending on temperatures.

Chinch Bug - When temperatures warm to 70-75° F., Chinch Bugs emerge from hibernation and begin extracting plant juices from the grass plants. During hot, dry weather gradual yellowing of the turf resembling drought could be due to Chinch Bug. The adult Chinch Bug is about 1/8 inch long, black with white wings. The wings have two black triangles in the middle of the outer edge of each wing on the adults. The younger Chinch Bugs are red with white bands across the back. In general, it takes twenty or more Chich Bugs per square foot to cause a problem. With warm, moist weather the Chinch Bug is naturally controlled by a fungus, Beavueria, sp.

Sod Webworm - Brown areas that appear in the turf during hot, dry weather could be due to sod webworms. These worm-like larvae are brownish to grayish black, having several black spots on their caterpillar bodies. The larvae hide during the day in silken tunnels. They feed at night or during cloudy, rainy weather. To find the sod webworms look at the edge of the dead areas. A large number of starlings or black birds is an indicator of potential sod webworm activity. Thatch favors the presence of sod webworms.

Billbug - The bluegrass billbug overwinters as an adult. In early April, the adults emerge from hibernation and become active. They lay eggs in the stem of the grass plant in late April to mid May. Upon emerging from the egg, the larvae feed within the stem moving down to the crown area. The larvae are white with a reddish brown head and humpback bodies measuing 1/2 to 3/4 inches long. The larvae are legless. The larvae exit the grass plant and begin chewing on the root system. This damage will show in July. It can be confused with the disease Dollarspot without close observation. The larvae pupate and adults emerge for the fall season.

Grubs - The main grub problems in the central part of the state are due to the Northern Masked Chafer and Japanese Beetle grubs. The overwintering stage of these beetles is the older (late instar) grub stage. The grub is "c" shaped with a grayish white body and brown head. The grub has six legs. After becoming active in the spring the grub will pupate. From mid-June to mid-July the adult emerges and begins depositing eggs across the lawns. With the young (early instar) grubs chewing on the roots severe damage can show up in a lawn between mid-August and mid-September.

When selecting an insecticide to reduce the intensity of a lawn insect problem consider the following factors:

1. Identify the target pest.
2. Establish a list of potential insecticides based on university recommendations.
3. Consider the toxicity, hazard potential, precautionary measures and safety equipment needs of each insecticide.
4. In addition, consider the phytotoxicity, compatability, available formulations and the residual of each insecticide.
5. To select the insecticide look at the cost of the products in relationship to their effectiveness.

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NITROGEN: NEW AND OLD

John H. Detrick, Manager, Specialty Fertilizer Dept.
Ashland Chemical Company, Columbus, Ohio

The manufacturing facilities for producing urea-formaldehyde products are relatively simple, as are the ingredients. However, a preciseness in processing procedure and catalysts control is imperative for the solution stability and clarity desired. Basically a large quantity of urea is reacted with a small quantity of formaldehyde at moderately high temperatures in the presence of catalysts for a

precise time period to form various urea formaldehyde compounds which as "short chain" methylol ureas, methylene diureas, and dimethylol ureas remain in water solution when kept fairly alkaline - at about a 9 pH.

These new fertilizers, such as Formolene^{tm}, are shipped as bulk or as drummed liquid concentrates. It might be more instructive to compare their properties with a concentrated urea solution and to focus our attention on the significant differences.

There are both water solutions - very clear and very fluid. But that's where the similarity stops. Urea dissolved in water will reach a concentration point of about 20% N at room temperature. To increase urea concentration and hence raise the nitrogen concentration requires heat. A 20% N urea solution contains 57% water and 43% urea and has a plus 40° F salt out temperature, that is the temperature below which urea crystals will begin to form or salt out.

On the other hand, Formolene methylol urea solution exhibits entirely different solution properties. It contains only 15% water, yet the "short chain" polymers in that water solution remain very fluid, permitting a nitrogen concentration of 30%. What a difference. These two solutions are obviously not the same.

The importance of these differences means an economical shipment of Formolene liquid nitrogen in concentrated form without the use of heated or insulated tank trucks or railcars. And Formolene can be stored outdoors in low cost unheated carbon steel or poly tanks.

Finally, the pH difference. Urea solutions are about neutral - pH7 - but Formolene, methylol urea solutions, must be kept at a pH above 8 (usually about 9) for it to remain in solution. At lower pH, polymerization continues and gradually forms some water insoluble nitrogen.

Formolene organic nitrogen solution can be employed in a fertilizer system for both foliar and root feeding liquid nitrogen. This increases the opportunity for nitrogen uptake by the turfgrasses resulting in improved turf performance after application.

Generally, Formolene solutions are blended with other nutrients and applied as a water diluted spray onto the turfgrass with several factors affecting the performance of this organic nitrogen solution. Among these are pH, temperature, moisture, soil properties, and microbiological activity, namely the same factors which also affect other organic nitrogen ammonification and subsequent nitrification.

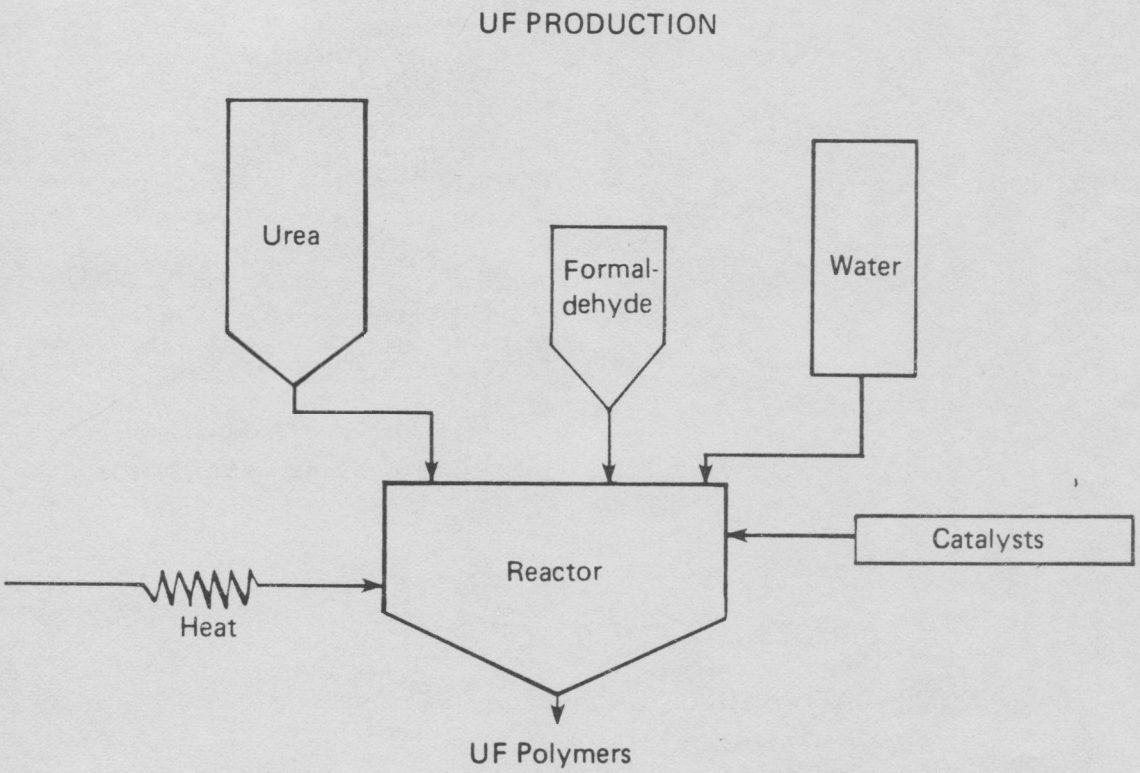
While it's possible to burn grass with Formolene, its nitrogen phytotoxicity potential is significantly lower than with urea solution, and when it is applied at rates of one to two pounds of nitrogen per 1,000 square feet, even in the hot summer months, burn has not been a factor when used with normal water dilutions. It is believed that the burn potential is related in part to the salt index per unit of nitrogen which for urea is 1.6 but less than 0.5 for Formolene fertilizer.

The more moderated initial response of Formolene compared with other water soluble nitrogen reduces the tendency for disease problems associated with the excessive burst of growth frequently experienced with urea or urea/ammonium nitrate solution applications, particularly in the spring.

As previously discussed, the factors which affect polymerization and ammonification affect Formolene nitrogen release rates which, cupled with its foliar feeding capability, bear on the efficiency of the grass plant's use of the nitrogen which is released. Nominally it appears that the nitrogen in Formolene will be available for about eight weeks at 1 lb. N per 1,000 sq. ft. Field and university tests on this subject are currently underway. Improved efficiency would permit a reduction in total applied nitrogen to get the desired results and reduce the cost.

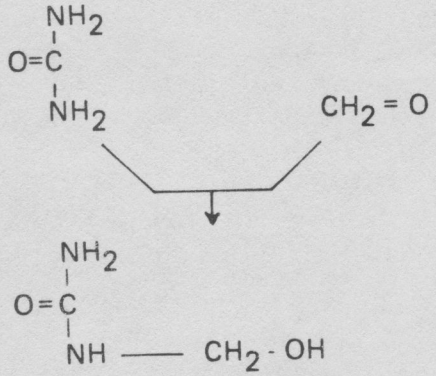
This, along with the reduction in handling costs (pumping and storing liquids is more economical than bag handling), and, last but certainly not least, the essential elimination of the cost of a burned lawn make the consideration of the use of these new organic nitrogen solutions such as Formolene compelling.

Freedom from customer complaint and high customer satisfaction! That becomes the real economics of Formolene organic nitrogen solution fertilizer.



UF PROCESS CHEMISTRY

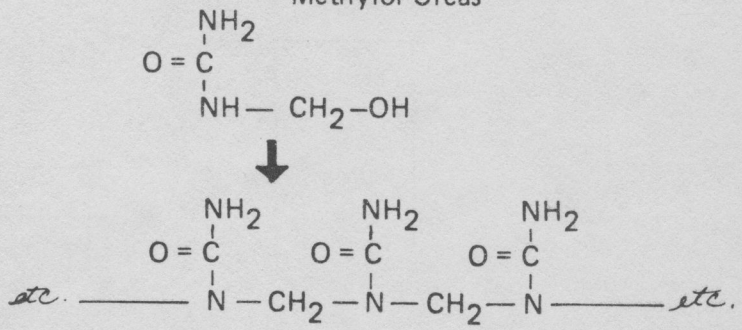
UREA + FORMALDEHYDE



SOLUBLE METHYLOL UREAS
("Short chains" in water solution)

FORMATION OF UF POLYMERS

Soluble "Short Chain" Methylol Ureas



Insoluble UF Polymers
"Long Chain"

FORMOLENE^{tm} FERTILIZER

COMPARATIVE SOLUTION PROPERTIES

Property	Formolene 30 Solution	Urea 20 Solution
N Content	30%	20%*
Water Content	15%	57%
pH	9-10	7+
Salt out Temp.	-20°F	+40°F
Appearance	Clear Lt. Amber	Clear Colorless

*Maximum concentration at ambient temperature

COMPARATIVE ECONOMICS
Cost of N as used
$/lb N

Cost	Formolene(tm) Fertilizer Solution	UF Powder Suspension	Urea Solution
Contained N	2.5X	3.0X	X
Plant Utilized N Efficiency Factor*	80-90%	60-70%	40-80%

*Estimates pending verification in continuing university and field tests.

FORMOLENE(tm) FERTILIZER
COMPARATIVE PERFORMANCE PROPERTIES

(After Application)

Property	Formolene Solution	UF Powder Suspension	Urea Solution
Burn Potential	Low	None	Med-Hi
Initial Response	Moderate	None-Low	High
N-Release Period*	8-12 Weeks	2-3 Years	4-8 Weeks
N-Utilization* (by the plant)	85-95%	70-80%	50-85%

*Estimates pending verification in continuing university and field tests.

FERTILIZER NITROGEN SOURCES FOR THE LAWN CARE INDUSTRY

R. P. Freeborg, Research Agronomist
Purdue University, West Lafayette, Indiana

The expansion of the lawn care industry has resulted in an urgent need for a better understanding of the availability of nitrogen in fertilizer. The basic chemical forms in which nitrogen may be present are ammonium or nitrate. The physical forms are dry granule, suspended particle, dissolved pellet, liquid in suspension or in solution.

Although there is a continuing controversy over the relative advantages of liquid as opposed to granular (dry) application, each of these physical forms has merit. First, let us consider the concept of using liquid application as a foliage treatment. An important factor here is the volume of water to be used as the physical carrier. If, for example, one were applying a pesticide in this way, the volume of water would be less because the pesticide must remain on the leaf to be effective. An application of nitrogen becomes more efficient as it reaches the thatch-soil surface, and so requires a greater volume of water. Generally, 4 to 5 gallons per 1000 sq. ft. are used. This may more accurately be termed a compromise between foliage and thatch-soil application.

Granular (dry) application, on the other hand, may be considered primarily a thatch-soil surface application. This method may have some disadvantages, particularly if dust-like particles are used. These may adhere to moist leaf surfaces or become lodged in the plant canopy and thereby result in undesirable plant responses.

If adequate irrigation or rainfall follows either liquid or dry granular applications and all nutrients are washed into the rootzone, there is no difference in root uptake of the nutrients or in plant growth response. Once the nutrients including ammonium (NH_4), nitrate (NO_3), phosphorus (P), potash (K), sulfur (S), iron (Fe), and the necessary minor elements are in the soil solution surrounding the plant roots, whether the original source was in liquid or dry granule form, the availability of these nutrients is controlled by the soil environment.

There are several factors attributable to liquid application that are often overlooked. One is relative to the loss of nitrogen from the soil surface as an ammonia gas. In his research, Volk in Florida, stated that losses from surface applied ammoniacal materials such as ammonium nitrate or ammonium sulfate may be high from soils with a pH above 7.5, and negligible from acid soils.

The degree to which nitrogen may be lost as ammonia gas following surface application of urea to sods had not, according to Volk, been fully appreciated. Urea, a physiologically alkaline form of ammonia, is converted to ammonium carbonate by urease, an enzyme which usually is abundant wherever microbial activity is taking place. Ammonium carbonate is unstable and releases ammonia which escapes to the atmosphere unless an efficient ammonia absorbing mechanism such as organic thatch layer or soil cation exchange is present to bind with it.

Ammonium losses from 100 pounds of urea-nitrogen averaged 20.6% and 29.3% of the application for pelleted and crystal urea, respectively, while only 0.3% was lost where an equivalent amount of ammonium nitrate was applied. The higher losses from crystal urea probably resulted from a greater tendency for the crystals to cling to the leaf rather than penetrate to the thatch layer where the possibility of efficient cation absorption was greater.

Data in the last column of Table 1 were obtained by the use of a solution containing 32% nitrogen with 16.5% from urea and 15.5% from ammonium nitrate. If all the loss is attributed to the urea fraction, it averages 22.3% pf the urea applied. This is similar to losses observed for the dry materials applied to the St. Augustine sod.

Table 1 - Gaseous loss of ammonia during 6 to 8 days following application of urea and ammonium nitrate to grass sods in field tests.

Sod type	Nitrogen applied per acre as: Pelleted Urea 25 lb.	Pelleted Urea 50 lb.	Pelleted Urea 100 lb.	Crystal urea 100 lb.	Pelleted $NH_4 NO_3$ 100 lb.	Urea-$NH_4 NO_3$ solution 100 lb.
	Percentage loss of nitrogen					
Coastal bermuda	13.9	15.2	16.9	30.5	0.2	14.4
Pensacola bahia	13.1	18.5	21.3	28.5	0.2	10.2
St. Augustine	14.1	21.7	20.8	29.8	6.7	10.8
Centipede	13.2	16.4	23.2	28.5	0.3	10.4
Average	13.6	18.0	20.6	29.3	0.3	11.5

Variations between tests conducted 6, 7, or 8 days were so small that these data were combined for simplicity.

Volk also observes that unreported data on tests kept in place to measure gas losses indicated that volatile loss of ammonia was about 95% complete in seven days.

Additional laboratory work completed by Simpson et al was further support of this observation of gaseous ammonia loss from a sod surface. His work showed that following low volume spray applications of a urea-N solution to a bluegrass sod there was a significant loss of gaseous ammonia. Application rates were 50, 100, and 150 lbs. per acre. It was observed that on a bluegrass sod losses of ammonia measured over a period of 8 to 10 days increased with increasing rates of application.

Table 2 - Gaseous ammonia lost into the atmosphere in 8 to 10 days after urea applications of 50, 100, and 150 lbs./acre of urea applied to a bluegrass sod.

Sod type	Amount of urea-N applied in lbs./acre: 50 Nitrogen as ammonia lost in 8 to 10 days		100		150	
	lbs. N/A	%	lbs. N/A	%	lbs. N/A	%
Bluegrass (mature sod)	15.9	32	31.1	31.1	44.5	30

At present there are ways to reduce nitrogen loss. This may be achieved either by irrigation after application, or by the use of other forms of nitrogen such as ammonium nitrate, solid or liquid ureaforms, IBDU, or coated fertilizers.

Another problem to be confronted relates to nitrogen loss from clipping removal. Research now in progress at Purdue University has compared the amount of nitrogen in plant tissue following liquid and granule (dry) applications on both irrigated and non-irrigated plots. An increase in the percentage of nitrogen in or on the leaf tissue was observed in the non-irrigated plots. This increase may be explained by either nitrogen adhering to the leaf surface or nitrogen within the leaf tissue.

Table 3 - Percent nitrogen in leaf tissue after nitrogen applications to *Poa pratensis* L. cv. Wabash. Applications on 14 August 1979.

Product	Analysis	1 day 15 AU 79		2 days 16 AU 79		3 days 17 AU 79	7 days 21 AU 79	14 days 28 AU 79
		IRR	(-IRR)	IRR	(-IRR)	IRR	IRR	IRR
Folian	12-4-4-0.5(liq)	4.6	5.5	4.9	5.6	4.6	4.9	4.5
Formolene	26-0-0 (liq)	4.0	4.9	4.3	5.0	4.3	4.7	4.4
Powder Blue	38-0-0 (dry)	3.7	4.2	4.2	4.4	4.0	4.5	4.4
IBDU	31-0-0 (dry)	3.4	3.3	3.6	3.4	3.6	4.3	4.0
Lebanon	18-4-10 (dry)	3.7	3.9	3.8	4.2	3.9	4.9	4.5
Shaw	16-4-8 (dry)	3.5	3.6	4.0	3.9	4.1	4.8	4.5
Urea	45-0-0 (dry)	3.5	3.9	4.0	4.4	4.2	4.8	4.6
Control		3.4	3.6	3.6	3.5	3.8	4.4	4.0
	average	3.7	4.1	4.1	4.3	4.0	4.7	4.4

It was evident that clippings should not be collected but returned following liquid suspension or solution applications of nitrogen. Research conducted by ChemLawn also emphasizes the need for clipping return after fertilization. This resport states that from unfertilized plots as much as 3 to 4 lbs. of nitrogen per 1000 sq. ft. could be removed in one year (25 mowings). Where clippings were collected after nitrogen application but before rainfall or irrigation, as much as 47% of the applied nitrogen was taken off with mowing. This was true in the case of both liquid and dry granular applications.

Table 4 - Salt indexes of fertilizers

Fertilizer	Analysis N % K	Tendency to cause plant injury	Partial salt index
Potassium nitrate	12 + 33	High	5.34
Ammonium sulfate	21		3.25
Ammonium nitrate	33		2.99
Monoammonium phosphate	12		2.45
Potassium chloride	50	Medium	2.19
Potassium chloride	60		1.94
Urea	46		1.62
Diammonium phosphate	21		1.61
Potassium sulfate	54	Low	0.85

With the partial salt indexes as a guideline, the formulator is able to predict the burn potential of a fertilizer and either change the rate, application procedure, or form of fertilizer to be used.

Physiological drought is caused by the presence of water soluble salts on the surface of turfgrass leaves and stems. This is often called "foliar burn". It can occur during the active growing season or during winter dormancy. The higher osmotic pressure of the salt particles in contact with leaves and stems causes the movement of water out of the leaf surface to the salt particles. Wilt and eventually death of the tissue adjacent to the salt particles occurs. Leaves are most frequently damaged, the injured tissue showing a whitish, bleached appearance. The use of fertilizers with a low partial salt index would be recommended where foliar burn is a problem.

Several presently available sources of nitrogen have eliminated some of the foliar burn difficulty. Among these are the urea formaldehydes in granular, powder, flowable or liquid formulations; the granular form of IBDU; and coated fertilizers such as the sulfur coated ureas and those with plastic coatings such as Osmocote; and finally, the natural organics.

Fertilizer	Release type	Critical variables
Coated	Diffusion	Temperature
IBDU	Chemical hydrolysis	Moisture Particle size pH
Ureaform & natural organics	Microbial	Temperature pH Aeration

There is a considerable amount of information on the performance of most of these fertilizers. Much remains to be learned, however, about the newer liquid ureaform fertilizer sources. These are usually identified as controlled release organic nitrogen sources. Whereas, in the standard ureaforms the urea and formaldehyde form various combinations of the methylene urea in the liquid formulation, the urea and formaldehyde combine to form methylol ureas. The behavior patterns of the latter formulations appear to differ from those of the methylene ureas. In addition, the precentage of nitrogen is lower than that of the granular UF formulations, and may vary from 21-0-0 to 30-0-0. Nevertheless, the liquid ureaform fertilizers apparently have potential for those lawn care firms where liquid application techniques are used. Work at Purdue has shown them to be relatively safe to use. Also, as seen in the folowing table, a minimum of burn potential was observed.

Table 5 - Plant foliar burn ratings of several liquid nitrogen and liquid urea formaldehyde fertilizers applied to a 'Wabash' bluegrass sod.

Fertilizer	Analysis	Lbs. / 1000 sq. ft.*	Foliar burn**
Formolene	26-0-0	1.5	8
"	"	3.0	6
Folian	12-4-4-0.5	1.5	7
"	"	3.0	5
GAPA	30-0-0	1.5	8
"	"	3.0	6
Amm. nitrate	33-0-0	1.5	5
"	"	3.0	3
Urea	45-0-0	1.5	7
"	"	3.0	5
Control	no treatment	-	10

*Applications made on 17 July 1979. Applied with a water volume of 4 gals./ 1000 sq. ft. No irrigation after application.

**Foliar burn rated on the basis of 10 = no burn and 1 = total surface vegetation dead

There is a need now for the study and solution of problems that are unique to the lawn care industry. To support this industry in its early years of development, research should be directed toward the evaluation of new products and toward the possibility of different application methods for existing formulations. Soon we should see interesting and effective work on the solution of the unusual problems faced by the lawn care industry.

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HOW THE INDIANA COMMERCIAL FERTILIZER LAW MAY APPLY TO YOUR BUSINESS

Robert C. Rund, Fertilizer Administrator
Office of the Indiana State Chemist, Department of Biochemistry
Purdue University, West Lafayette, Indiana

It seems most appropriate to review with you some of the questions raised during the first year of regulation over fertilizer distribution in Indiana by lawn care companies. Following are some of the most frequently asked questions followed by brief responses. There are other provisions of the law which apply but which are not considered pertinent at this point.

When am I subject to provisions of the fertilizer law? Any time you offer for sale, sell, barter, or otherwise supply commercial fertilizer not labeled and registered by another person.

Does this mean that I may take packaged fertilizer of another firm to the job site and use and not be subject to the fertilizer law? Yes, if the other firm has registered the product with the State Chemist and the product is properly labeled.

But I manipulate fertilizer materials purchased from fertilizer companies into tank mixes or dry blends. Doesn't that fertilizer company have the fertilizer material registered? Probably. However, the manipulation created a new fertilizer product, and responsibility for this new product must be assumed by you. Responsibility is assumed through labeling and registration.

My company registers tank mixes from the corporate office. If there need for duplicate registration from each branch? No, if all products distributed by the branches are included in the corporate office registration application.

How is registration accomplished? Application is made on forms provided by the Office of the Indiana State Chemist.

What is the cost? $5.00 per product distributed in packages greater than 5 pounds in bulk.

What is the registration period? July 1 through June 30 of each year. The registration of each product must be renewed each year.

Suppose I must make last minute changes not anticipated in nutrient and pesticide content to compensate for developing conditions? We will consider these as "custom mixes" and not subject to prior registration. However, all materials used in the mixtures must have received registration approval. Further, "custom mixes" are subject to the same labeling requirements.

What are the labeling requirements? The fertilizer law provides that fertilizer may be distributed only when labeled with (a) the brand name and grade, (b) guaranteed analysis, (c) net weight, and (d) name and address of registrant. Such information is the minimum required and may appear upon the invoice or a separate delivery statement provided the customer.

What is an example of proper labeling? An example of proper labeling for a tank mix is as follows:

2-1-1

Guaranteed Analysis

Total Nitrogen (N)----------2.0%
Available Phosphoric Acid (P_2O_5)----------1.0%
Soluble Potash (K_2O)----------1.0%
Iron (Fe)----------0.1%

Active Pesticidal Ingredient

Dimethylamine Salt of 2,4-D----------0.02%
Diazinon----------0.5%

*Precaution - Do not permit children or pets to go onto sprayed grass until spray has dried completely.

Net weight delivered _____ pounds

ABC Lawn Service
Anywhere, Indiana

*Applicable precautionary statement from pesticide label must be given.

May I note pounds of nitrogen and other nutrients applied per thousand square feet or in total? Certainly, but this may not substitute for any of the labeling requirements previously noted.

What else am I required to do as a fertilizer registrant? You must file quarterly report on forms furnished by the State Chemist noting tonnages of fertilizer distributed. Lawn care service companies using water in tank mixes solely for ease and uniformity of application need only report tonnages of fertilizer materials used in the tank mixes.

Is there a fee for tonnage reported? Yes, twenty-five cents per ton of fertilizer reported must accompany the quarterly report. An exemption is allowed for fees paid through a supplier, but the report must be filed and the supplier identified.

What should I expect in the way of enforcement activities? You may expect inspection of product being applied or stored for application. Samples will be obtained by inspectors of the Office of the State Chemist who carry proper identification. They will interfere with your application activity as little as possible. All product so sampled will need to be identified with labeling information noted above.

On very rare occasions you may be asked to provide access to sales and transportation records of fertilizer transactions for auditing purposes.

Will product sampled be subject to analysis? Yes, the product sampled will be subject to analysis to verify guarantees.

Are there penalties for failure to meet guarantees? The commercial value of any deficiency found will be required to be reimbursed to the customer.

Is the record of inspections made public? Yes, an annual publication of inspections and results is made and is available upon request.

Do I have recourse to proper hearing procedures? Yes. Any questions of finding by the Office of the State Chemist may be brought to his attention for review.

Who do I contact regarding questions about compliance with the fertilizer law?

The Fertilizer Administrator, Office of the Indiana State Chemist, Biochemistry Department, Purdue University, West Lafayette, IN 47907. Telephone 317/749-2391.

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THATCH, DETHATCHING, AND SERVICES

Randal C. Bellinger, Bellinger's Professional Grounds Maintenance
Lafayette, Indiana

The problem of thatch is an ever-prevelant concern in lawn maintenance today. Whether it be on residential, commercial, or industrial property, dethatching is becoming more important and a more popular part of our services. We hope that

this popularity has come about as a result of an effort to educate the customer as to what thatch is, where it comes from, what its effects are, and how to get rid of it.

What is thatch? For many years there has been a misconception as to what thatch really is. Many articles were published describing thatch as a build up of grass clippings. The cure - bag your grass.

Thatch is made up primarily of two things - roots and stems. Roots and stems take a long time to degrade or decompose because they contain a large amount of cellulose fiber. Cellulose gives the stem and roots a woody tissue, and therefore may take months to decompose. The grass plant is continuously producing more and more roots and stems and result in a build up of thatch. Grass clippings, on the other hand, do not really add much in the way of thatch build up. Grass clippings are made up of 90% water by weight. This leaves only 10% which is material which must be decomposed. Since grass clippings do not contain a large amount of cellulose and fiberous material, their degredation rate is very rapid. The only time in which clippings may contribute to a thatch build up is if the turf is allowed to grow tall and a large amount of leaf surface is removed - a hay field affect.

What are the effects of thatch? If you walk out across someone's lawn and it feels like you're walking on a sponge, that lawn most likely has a thatch problem. The best way to check for thatch is to use a soil probe or to cut a wedge out with a knife. The thatch layer is a very porous layer which allows great amounts of air to pass through. One of the most recognizable symptoms of a thatch lawn is its susceptability to drought. The roots and stems will be growing within the thatch layer rather than in the soil. The soil is where the greatest amount of water holding capacity is located. However, a crust can sometimes form on the soil just below the thatch layer which will not permit water to penetrate. The result of this condition is drought.

Disease and insects are more prevelant in lawns with heavy thatch build up. The thatch layer makes a perfect place for insects and diseases to overwinter and multiply. Thatch will build up a considerable amount of heat which triggers disease earlier and supplies diseases with a longer optimum range in which to produce and sporulate. Temperature and moisture are two key items which diseases and insects require to become active. By eliminating thatch we can help to reduce chances of survival.

Another item of service in which thatch can have effect is weed control. We've heard it time and time again - organic matter can tie up the chemicals we use for weed control.

When we dethatch an area we first have to determine the degree of severity the lawn will have to encounter in order to get it back into shape. We do this by taking core samples of different areas ot the lawn. If the thatch is one inch or less we will put the lawn on a fall dethatching program. We feel that a lawn should be dethatched once a year, and the best time is in the cool of the fall. Dethatching is a stress to the grass plants, so you want to time the dethatching for a period where minimal stress is occurring and which will allow the maximum amolunt of recovery time. Fall gives us this time; temperatures are getting cooler, rains are more frequent.

If a lawn has more than one inch of thatch we then recommend dethatching in the spring and fall until we can get it under control, and then keep it on a fall program.

The equipment we use for small areas such as home lawns and commercial accounts is a Ryan Ren-o-Thin, followed directly behind by two Toro vacuums. We like to have four people on a dethatching crew. One person is operating the Ren-o-Thin, one is operating each vacuum, and one person is working as a bag person. Extra bags are used so the machines don't have to stop while the bags are being emptied into large trailers. By using this method, we are able to dethatch a 15,000-20,000 sq. ft. lawn in less than one hour. We strive to dethatch about seven lawns a day.

For industrial areas where large acreages are concerned we prefer to reduce thatch by means of aerification. We will go over the acreage in two directions to insure adequate coverage. Aeration actually does two jobs in one. It pulls a core of soil out of the ground allowing the crust to be broken, and therefore opening new passages for water and air. This, of course, will help roots to make their way into the soil. The soil core which is thrown on top becomes broken up by mowing or rain and settles down into the thatch region. The microorganisms in the soil help to speed up the degradation process of the thatch.

We are also equipped with a machine this year which is large enough to dethatch industrial areas if we should need to do this. This machine will dethatch and pick up all in one motion. When the five cubic yard hopper is full it lifts hydraulically nine feet into the air and empties into our dump truck to be hauled away.

The equipment and knowledge are here today to do most everything, and so it is up to us as professionals to make use of every resource available to further upgrade our profession.

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PESTICIDE MONITORING AND SAFETY

Jeff McKenney, General Manager
CLC Labs, Columbus, Ohio

A cholinesterase monitoring program provides a safety check to ensure that: (1) Initially, susceptible individuals (unusually low cholinesterase levels) are not unduly exposed to pesticides which affect the nervous system (e.g. organophosphates); (2) Lawn spray operators are employing the necessary precautionary measures in handling these chemicals; (3) If these operators are indeed overexposed to these chemicals, the necessary steps are taken before clinically toxic symptoms occur.

Constant exposure to organophosphates at verying levels may lead to one of two situations. One is the well-known acute accidental poisoning accompanied by observable symptoms like headache, blurred vision, fatigue, nausea, and excessive perspiration. This is due to the organophosphate blocking an enzyme in the blood

called cholinesterase. This enzyme actively prevents the build-up of acetylcholine, a chemical responsible for transmitting electrical impulses from nerve to nerve or from nerve to muscle. Thus, excess acetylcholine overactivates the muscles controlling our voluntary and involuntary movements leading to the above symptoms, or in severe cases, convulsions, respiratory depression, and possibly death.

The second situation may occur even at low levels of exposure. Since the inhibitory effects of organophospates are cumulative, constant contact will lead to a progressive decline of the blood enzyme activity which may or may not be accompanied by clinical symptoms. However, the long range effects of this low level organophosphate exposure on the body are still unknown.

It is important that the test for cholinesterase activity be conducted prior to the use of any organophospate insecticide and periodically monitored throughout the spraying season. The reliability of the biomonitoring program will increase considerably with the frequency of blood sampling. The results of innumerable tests conducted over the last five years have been thoroughly evaluated and have provided a sound data base for estabishing the normal ranges of cholinesterase values. Cholinesterase activities vary over a wide range among individuals and not uncommonly from day to day in the same individual.

Before you initiate this program, the following steps must be carried out as soon as possible:

1. Discuss with your company or personal physician the appropriate sampling and testing program that is specific for your needs. This will depend on the extent and duration of exposure to the organophosphates. We suggest either Program I or Program II (following).

2. Have your physician submit an order for either testing program to a drawing agency or a clinic of his choice. CALL US FOR A LISTING OF A DRAWING AGENCY IN YOUR AREA, or write to Catherine Buttram PMI Marketing, P. O. Box 4081, Atlanta, GA 30302 Tel. 404/885-8154. If you opt not to contact a specific drawing agency, you will have to arrange for a qualified medical person to draw blood and separate the plasma from the red blood cells. (This will have to be done at your own risk).

3. Carefully follow the procedure listed following Program II to ensure a successful cholinesterase biomonitoring program.

Program I - Routine Plasma and Red Cell Cholinesterase

1. At the initiation of a cholinesterase testing program, a plasma and red blood cell cholinesterase will be drawn. This will be considered a baseline level for that person with which future test results can be compared. It is best if this value is determined at a time when the person has not been in contact with cholinesterase inhibitors for at least two months. The time lapse is not mandatory, however, if noted.

2. A plasma and red blood cell cholinesterase will be run after the initial exposure to organophosphate and then at every subsequent testing interval. For example, the accepted practice is biweekly sampling until assurance that subsequent exposure will not decrease cholinesterase levels below a safe threshold.

3. All low or below normal plasma results will be marked for the customer's attention on the report. Normal test values for plasma and red cell cholinesterase established at our labroatroy will be printed on all result sheets.

4. Under normal circumstances, results will be reported back to the physician or his designate by return mail, no later than two working days upon receipt of samples in our laboratory. Published literature from a major organophosphate manufacturer will be mailed with the first test results to provide some guidelines on evaluating the significance of test results. It will be up to you and your physician's discretion whether immediate action should be taken if either or both plasma and red cell cholinesterases are considerably below your baseline values.

Program II - Routine Plasma Cholinesterase With Reflex Red Blook Cell Cholinesterase

1. The procedure for baseline determination will be the same as in Program I.

2. Only a plasma cholinesterase will be run at every sampling interval.

3. Red blood cell cholinesterase will be automatically run on these samples whose plasma value is low or below the established normal range. Based on previous clinical studies conducted by a major insecticide manufacturer and current data compiled in our laboratory, a plasma cholinesterase value below 0.50 pH is considered low.

Protocol for Drawing and Shipping of Cholinestrase to CLC Laboratories

a. The customer or drawing agency can order adequate shipping containers and laboratory requisition slips.

b. It is necessary to fill out a laboratory requisition slip for each box of tubes mailed and also to properly identify the sample on a paper label attached to the tube with the following information: employee's full name, social security number and date drawn.

c. At the time of venipuncture, special care should be taken to ensure no contamination of the venipuncture site with cholinesterase-inhibiting insecticides. It is preferable to draw the sample before the employee has had contact that day with insecticides. If this is not possible, the venipuncture site should be washed thoroughly with soap and water.

d. Cholinesterase tests are to be drawn in a heparinized tube. This is a green stoppered vacuum tube containing sodium heparin as an anticoagulant. One, 5, 7, or 10 ml tube will assure an adequate sample.

e. The drawn sample should be centrifuged at 2500-3000 rpm (high speed) for 10-30 minutes and the plasma removed to a clean glass test tube. This tube should be labeled with the employee's full name, social security number and date drawn. At least 1 ml of plasma should be submitted to the laboratory for testing.

f. The plasma and red cells should be packed in CLC furnished mailers along with the completed laboratory requisition slip for those samples. The samples must be mailed the same day they are drawn to ensure immediate lab testing of the samples. Otherwise, delayed testing may compromise the validity of the test results.

Your samples will be processed within 24 hours upon arrival at CLC Labs. The final report will contain the acutal cholinesterase levels, the normal ranges established in our laboratory, and specific notations for abnormal values for your immediate attention.

Our Clinical Laboratory staff may discuss the significance of cholinesterase values outside the established normal range with your physician and suggest alternative methods to determine more specifically the source of this variance from the accepted normal range.

An additional benefit to this program is the storing of your results at our archives for seven years, which will provide a sound data base for your employees' cholinesterase biomonitoring program.

Cost per sample: $7.00 for plasma, $5.00 for red cells.

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GETTING YOUR WEATHER DATA - A DISCUSSION OF FARM AND HOME WEATHER INSTRUMENTS

James E. Newman, Professor of Agronomy Bioclimatology
Purdue University, West Lafayette, Indiana

Most of us know from experience that weather events vary from hour to hour, day to day, and from place to place here in mid-America. We often hear our favorite weather person referring to official weather data or statistics. Such data are collected at weather stations operated by the National Weather Service or some other place of business such as your golf course. Since weather events can vary greatly from time to time, as well as from place to place, making some weather measurements or observations on your own is often a wise activity.

Basically, there are two general types of observations:

The continuous elements in weather data which are:

1. temperature measurements
2. pressure measurements
3. humidity measurements

The discontinuous elements in weather data which are:

1. precipitation (all forms)
2. wind
3. sunshine or cloudiness

Normally, weather data from official weather stations miles away on continuous type weather elements are more likely to be of use to you in daily decisions than those of a discontinuous nature. Or, stated in a different way, official weather data on discontinuous elements are much less reliable for any given time and place than continuous elements. Therefore, every golf course should have at least one good rain gauge.

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KEEPING THE TURF IN SCOTLAND

John Leeper, Superintendent, Orchard Ridge Country Club
Fort Wayne, Indiana

It is indeed a pleasure to show you some slides of golf courses in Scotland and the way they are maintained in the old and traditional manner, as compared to U. S. courses.

Much to my surprise, in May of 1979 I was selected by the Golf Course Superintendents Association of America Board of Directors as one of four golf course superintendents to represent all the members of the GCSAA at the 4th British Turf Symposium organized by the British Golf Greenskeepers Association and held in Birmingham, England in October 1979. Following the Turf Symposium, the Ransome Company of Ipswich, England, sponsored the 3rd International Greenskeeper and Superintendent Golf Tournament in which nine countries participated. During the Turf Symposium, Charles Tadge, then GCSAA president and captain of the U. S. Golf Team, spoke on USGA green construction. Jim Wyllie, GCSAA director and Canadian golf course superintendent, spoke about the role of the Canadian superintendent. Jim Arthur, agronomist to the Royal and Ancient Golf Club, St. Andrews, Scotland, spoke on golf courses being over-managed. He believes in the old and traditional methods of golf course management. (I'll explain later, but he might be right). As at most turf conferences, everyone heads for the pub for a pint of beer afterwards, and do they like their beer!

The 36 hole golf tournament was held in a light rain, with the U. S. team holding a four point lead after the first round, but during the second round we could not get the putts to drop so tied the Belgian team for first place. We thought there would be a sudden death play off, but the organizers decided the Belgian team won using the back up system. After the tournament and symposium we decided to travel to different British open golf courses in Scotland and to talk to the superintendents, play golf, and have a beer at the local pubs.

My long-time dream, and probably yours too, is to visit and play the old course at St. Andrews, Scotland, the birthplace of golf in 1552, and the site of the 1978 British Open, which Jack Nicklaus won. Renting a righthanded car and driving on the lefthand side of the road, I took off for St. Andrews. If you think our gas is high, their gas is $2.50 per gallon. Upon arriving at St. Andrews, Walter Wood, the link supervisor of the old course, standing in the Valley of Sin on the 18th green, showed me around the golf course, and it didn't take me long to begin to feel the natural ruggedness of this 400 year old golf couse and to see the work of the first golf course architect, Mother Nature. There is not one tree on this golf course, just wild heather and bunkers galore. The bunkers, most of which are named, range from very large like the Hell Bunker on #14, to little ones, like the Road Bunker on #17, which allows room only for one angry man and his niblick. Some were made by the winds off the North Sea, while others were made by animals sheltering from the winds. Almost all of the bunkers which come constantly into play lie in the middle of the fairway, not, as in the U.S., along the sides of the fairways, like the 18th at Muirfield Village. While playing golf, trying to avoid these bunkers is one thing, but getting out of them is another, because they seem to be everywhere - 100, 150, 200 or 300 yards off the tee. Even over 400 years as the golf ball changed from the gutty percha to the present day ball, and even going a lot further, you can't escape Mother Nature's bunkers. Bunker design - U. S. or St. Andrews? I'll let you decide. However, if you compare the ruggedness and the difficulty of getting out of the St. Andrews bunkers to the eye pleasing, gentle slopes of some U. S. bunkers, such as the #13 at Augusta, it makes one wonder. Also, they would be harder to maintain. For example, some of the banks of these bunkers are hard to hold so layers and layers of sod are used. The roots and grass growth help hold the banks. Try using a Texas wedge out of this one.

While at St. Andrews, Mr. Wood showed me some of his interesting maintenance programs. One of these was his four year program on preparing topdressing for his greens and using a soil and seed mix for his tees and for new projects. Whenever they did any work that required removing soil, sod debris, or grass clippings they stockpiled it in compost piles. They have four compost piles, one for each year of work on the golf course. Each year Mr. Wood rotates each of his four year stockpiles, with the first one going into a building, which will later be hand shoveled into the small mixers as needed for that year. This gentleman is using some freshly prepared topsoil, plus seed, to overseed areas in the fairways. By the way, this is his only job, and would you believe, he has been doing it for fifteen years.

The most unusual thing I saw while at St. Andrews was the ladies putting green. Most ladies putting greens in the U.S. are located near the pro shop or close to the first tee. Right? At St. Andrews the putting green for ladies is located at the second tee. It has only one putting green marker, not a level spot on it, and it is loaded with weeds, and is hardly ever mowed. You have probably guessed by now that in the beginning of golf the men didn't want women on the golf course!

After St. Andrews we traveled to Turnberry, where the 1977 British Open was held, and where Jack Nicklaus and Tom Watson, in the last round, played some of the finest golf ever played at Turnberry. Yes, this is a fairway. I found some of the toughest fairways I have ever seen at Turnberry. Even if you are in the middle of the fairway, you have a tough lie and stance. The natural undulations were probably shaped by the tide and winds years ago, and naturally seeded with seaside type turf that was fertilized by animals and birds. Some holes at Turnberry have no fairways, while some have so many undulations that, again, it makes it makes it difficult to get a level stance to hit the ball. How would you like to mow this fairway? Probably most of the fairways at Turnberry were made by nature years ago with a lot of hidden bunkers, such as #11, with no contour mowing like we use in the U.S. A good example of contour mowing would be #10 at Muirfield Village. Sometimes at Turnberry, you just hit the ball and hope you land on any fairway!

Another unusual idea I ran across at Turnberry is the way of directing the players on the putting green. I could not figure out what they were trying to do - maybe help the golfers locate the next hole. If you want to cut down on maintenance costs, try this idea. Just make all your greens, tees, and fairways smaller in size. This is probably the smallest golf course I have ever seen. You can see they have very small greens, tees, traps, and even water hazards. (Probably a warm up golf course before tackling the tough Turnberry across the street).

On our way to Prestwick I found another way of cutting maintenance and fertilizer costs. This golf course still uses sheep as they did in the beginning of golf. However, I don't think this method of cutting costs would be good for modern golfers. Talking about cutting maintenance costs and making fairways small, at Prestick #13 the fairway is so narrow that Bob Hope, after playing the hole said, "That fairway is so narrow that if you are in the middle of the fairway, one half of your ball will be in the rough on the right and the other half in the rough on the left."

At Prestwick, where the British Open started in 1860 and was played on a 12 hole course, greenskeeper Mr. Lawson has a machine that slices into the turf six to seven inches. What a way to improve air exchange, and water and fertilizer penetration. Most all of the greenskeepers in Scotland seem to do a lot of this type of slicing or aerification on a regular schedule. Mr. Lawson does his greens every Monday morning, and I must say it does not bother the putting. Maybe we ought to ask one of our manufacturers to make a machine like this one.

The greenskeepers in Scotland are faced with the same problems as the U. S. superintendent in managing the putting greens for today's golfers - maintaining a near perfect putting surface which is fast and holds the ball well. However, they have a different way of maintaining their greens. Fertilizer is nil and they do not care about the color of the greens. Note the color and also the tee marker location here. This is the #17 at St. Andrews. In the beginning of golf, the golfers, after putting out, would be somewhere near the cup on the green and would tee up the ball to play to the next hole. So it is not uncommon to find the tee markers at St. Andrews almost on the green. Again, their fertilizer program on greens is nil; perhaps they fertilize only two or three times a year. For green color, for a special tournament such as the International Greenskeepers and the 1980 World Open at Wentworth Golf Club in London, they would spray or topdress their greens with sulphate or iron at a rate that would turn the greens black. However, after a few days the greens looked like this. This practice is as old as greenskeeping itself. According to Jim Arthur, agronomist to Royal and Ancient Golf Club at St. Andrews, "For better putting greens, one, reduce your fertilizer program; two, reduce your irrigation time; and three, aerate or slice more often; and four, apply sulphate or iron for color."

The greens in Scotland seem to have a lot more roll and undulation. A good example would be the Valley of Sin on the 18th at St. Andrews. Most use a walking type mower set 5/32, however, some are using the riding greensmower. In England, the cost of this rider is $12,000.

Well, we have been talking about bunkers at St. Andrews, fairways at Turnberry, and greens at Prestwick. Let's put together a green with a lot of roll and undulation, a fairway and some of Mother Nature's bunkers and see what we get. More thank likely you will see this type of hole in Scotland. This happens to be #5 at Gleneagle. Old tradition? Yes , some of it is still going on today, such as poling the greens, still done by a lot of the Scottish greenskeepers. This is the 18th at Prestwick. Or removing debris or leaves from the greens with a hand brush type sweeper. Can you imagine removing leaves in the fall this way?

Does anyone know where the term "postage stamp green" comes from? Well, it came from the par three, 123 yard 8th hole at Royal Troon, site of the 1973 British Open. It has only approximately 2000 square feet. The tees were made by leveling the wind blown sand dunes, and are they small. However, they use a soil and seed mix to keep the tees in shape, and they also pole the dew on the tees just like on the greens.

Throughout Scotland I noticed a lot of signs that were interesting, educational and some were even funny. This happens to be the greenskeeper's house at Royal Troon, and with a warning to the golfers. What an idea - a bag rack, information sign, ball washer and trash box all in one. Anyone know what a trolley is? Well, it is a hand pulled golf cart. I didn't see one electric cart at the seven golf courses I visited. However, I heard there are some in London. At St. Andrews, where the course is so narrow in width and shaped like shepherd crooks, and having seven double greens, you will find this sign located throughout. Its meaning is this - if, for example, you are playing #3, the player homeward on

#15, the sharing green, would have the right of way. Since most of the golf courses in Scotland do not have electric golf carts, they do not have to worry about cart traffic, cart wear or cart paths. However, they do have a lot of foot traffic. This foot traffic problem to the next tee gives you an idea. Note the two tracks, porbably one for the golfer and one for the caddy. One greenskeeper solves a similar problem by using railroad ties from a nearby railroad track.

In closing, I would like to say that maybe, just maybe, Jim Arthur, agronomist to the Royal and Ancient Golf Club at St. Andrews, is right. We over-manage or over-groom our golf courses. We seem to think this is so necessary. However, let's compare the maintenance and eye appeal of this par three Scottish golf hole to a U. S. golf hole such as the #8 at Muirfield Village. You be the judge. I don't know who is right, but I know what my members like, and that is an eye-pleasing golf hole, such as the #12 at Augusta National. Some day I hope you get the opportunity to visit and play some of the old sea links golf courses in Scotland and see the differences in turf maintenance.

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ENERGY CONSERVATION IN TURF MAINTENANCE

Roger J. Thomas, Jacobsen Division of Textron, Inc.
Racine, Wisconsin

As we enter the period of the 80's, energy conservation and inflation are two major problems for everyone, including turf managers. What will be presented is a series of practical approaches to cutting costs and conserving fuel.

Of utmost importance is the utilization of the right piece of equipment in terms of quality of cut and trimability. The application of the product may affect your purchase of reel or rotary mower; however, two machines with the same cutting width that produce the same amount of work will show that the rotary equipment will require more horsepower. More horsepower generally means more fuel consumption.

For the past fifteen years in our country and in our industry, the push was for more horsepower to do the job. We should all be taking a look now to determine whether we need all that horsepower. One thing is certain, and that is we would analyze our horsepower needs in a hurry if we were told or regulated to reduce our fuel consumption by 25 or 50%. That is not out of the realm of possibility in the 80's.

Planned replacement programs of your equipment should consider energy, operational cost reductions, life expectancy, usage, and horsepower requirements. A complete review should be made of your equipment inventory and followed carefully for "changing times". Better planning is going to be a solid requirement in the 80's.

It we are to consider reducing our costs of operation, then minimum maintenance practices will be necessary. Check carefully the need for such fine grooming. Be concerned about spraying weeds rather than attempting to cut them each week along fences and other hard to work areas.

If you are planting trees, leave enough space so that large equipment can get in and do the work and keep them away from buildings and obstacles so that one large piece of equipment can do the work rather than leaving areas for excessive work with smaller machines.

Decorate areas that are difficult to maintain with low maintenance bushes or ground covers. An eyesore could be converted to a beauty spot if good planning is done.

If you keep on doing what you have been doing, you'll keep on getting what you have been getting. If you are satisfied with the results, of course change is not necessary unless some outside influences such as costs or fuel shortages occur. Do some serious thinking about all your mowing patterns. Is there a different pattern that will do it better of more efficiently?

Have you considered the use of growth retardants? Use them carefully, not in the areas of normal play, but in areas that we still seem to have to cut for aesthetic purposes. A substantial number of man hours and fuel can be saved if these "outside" areas can be treated with a good growth retardant.

The whole area of managing men should be considered important with respect to producing an efficient operating team. Attempts should be made to repeat your present labor force as best you can. Training takes time and costs money, but mistakes that new people make can be even more costly. Develop, encourage, motivate, compliment, and even reward employees for jobs well done. "You did a good job" can be very meaningful for better cooperation of <u>your</u> team.

Stress the importance of fuel conservation. Impress upon your employess how costs of gas have risen and that your budgets are going to be strained unless conservation takes place. Your employees probably drive automobiles so the concepts of saving fuel should be nothing new to them, and they certainly understand increased fuel costs.

Give consideration to the purchase of diesel equipped machinery. While the fuel prices will rise rapidly, it is still a more efficient fuel to use for our day in and day out operations. Some manufacturers have indicated that diesels are as much as 40% more efficient!

What about service as a saver? Adjustment of blades, bedknives, carburetors, ignition points, and in general anything that will let the engine run more smoothly can contribute to a more efficient operation and fuel savings. Consider also the practice of regular lubrication, regular changing of filters, regular planned checks of radiators and screens, and checks of tire pressures, which also contributes to more efficient operating equipment. How about asking your workers what they think could be done to reduce fuel consumption? They just may come up with great ideas! Impress upon them the importance of eliminating long idling periods and have them shut off the engine if the idle period is more than two minutes.

Consider the number of mowings for fairways, roughs, greens and tees. Can you reduce one fairway mowing per week? On a local golf course, by doing so, there was an annual savings of $1600, and a fuel saving of approximately 240 gallons of gasoline for the year. Consider the rest of the areas that you mow and see if you can enter a skip-mow plan. It may not be optional if fuel shortages occur, so be prepared to take some positive actions regarding the reduction of fuel usage. It is obvious that if your total gasoline usage was 4000 gallons per year, and you reduce fairway mowing one time per week with a saving of 240 gallons, that you are going to have to look other places for fuel conservation.

In one study made, the skip-mow program amounted to only a 2% savings of the total maintenance budget for the course. One thing is certain - it is going to take many more ideas and actions than we have discussed here today to maek any appreciable dent in our fuel consumption and/or cost reductions. We may be forced into even more drastic situations than we can imagine.

Sample Mowing Schedule*

Months	Times per week Fairways	Tees	Greens	Comments
April-May	1-3	1-3	2-4	Data from one course.
June-August	5	4	7	Calculate your own
Sept.-Oct.	2-3	2-3	2-4	turf areas for
Other, as needed	0-1	0-1	0-1	comparison
Mowing/season	100	90	130	
Cost/mowing	$ 67	18	25	
Fuel & labor	$6700	1620	3120	

Reducing one mowing per week saves $110.00

*table adapted from data of R. J. Thomas, 10 Oc 79.

Greater exploration and development for sources of oil in the U. S., and for the U. S. are being made by our major oil producers. It is our heritage to overcome tremendous odds. Nealy every conflict this country has been in has involved uas as being the underdog, but we have won! The problems are clear. Actions are being taken now to solve them, and we may be unconfortable for some time during the 80's, but let's have confidence in America's ingenuity to overcome these problems!

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Analysis of Capital Equipment Requirements For
Meadowbrook Country Club Golf Course, 1980
Submitted by Al Vrana, Supt., and Roger J. Thomas, Greens Chairman

Qty.	Year Purch.	Machine	Mfgr.	Life Exp.	Repl. Date	Comments
1	62	Steam cleaner	Century			Possibly try new style washer when product wears out, possibly 2 yrs
1	63	Tamper	Racine Hyd.			Seldom used except for construction
1	66	Auger 24"	Danuser	25		Last a lifetime w/repair
2	69	Carts	Cushman			Converted golf carts (40% factor, replace with used)
5	67-70	Greens Mower	Jacobsen	8-9		Used only as part-time
2	77	Rotary Mowers	Jacobsen	6-8	83 (2)	

Analysis of Capital Equipment Requirements -

Qty.	Year Purch.	Machine	Mfgr.	Life Exp.	Repl. Date	Comments
*1	74	Fly rotary mower	Flymo	3-4	80 (1)	Rough use may necessitate
1					81	earlier replacement
*1	77	Triplex	Jacobsen	4	80	
1	79	Sod edger	Sod Master	20	99	
*1	75	Trap King	Jacobsen	4-6	80	May necessitate earlier replacement, works in sand every day.
1	70	Fairway F-10 Mower	Jacobsen	10-12	82	OK as outlined for repl.
1	75	Fairway F-10 Mower	Jacobsen	10-12	87	" " " " "
1	68	Tractor D-10	Jacobsen	12-15	84	Suggest not replacing, look to different unit
1	68	Sweeper, E series	Jacobsen	12-15	83	
1	76	Sod cutter	Sod Master	10	86	Needed for future patch-work & new construction
1	78	H. P. Sprayer	Siebring	10	88	Pump & hose only
*1	66	Fairway aerifier	Ryan	12-15	80	Normal replacement
1	74	Truckster	Cushman		81	
1	77	"	"	7	84	
1	79	"	"	7	86	
1	65	Spray unit	Broyhill	7	83	Dependent on tank (replaced 1976)
2	72-74	Triplex Greens-	Jacobsen	7	80 (1)	Natural wear, etc.,
*1		mower			82	depends on use
1	62	Trencher	Ditch Witch	20	85	Depends on use, drain tiles & irr., could be sooner
1	70	Roto-Tiller	Simplex	10-12	80	Amt. of construction determines accelerating purchase
1	70	Front end loader	Case	15	85	Normal replacement
1	79	Tractor	Case		94	
*1	73	3/4 ton pick-up	Dodge	6	80	Replaced only if major repair required
1	62	Dump truck	Internat.			Buy used when needed
1	75	Blower	Giant Vac	5-6	81	Replace or consider another
1	74	Turf King mower	Jacobsen	6	81	Normal replacement
1	66	Power roller	Ryan	15		Seldom used, constr. only
1	76	Hand fert. sprdr.	Scott	4	81	Replace on date
*1	75	" " "	"	4	79	" " "
1	68	Edge-R-Trim	Jacobsen	10		Used sparingly

Analysis of Capital Equipment Requirements -

Qty.	Year Purch.	Machine	Mfgr.	Life Exp.	Repl. Date	Comments
1	70	Seeder	Jacobsen	10-15	85	Normal replacement
*1	68	Top dresser	Ryan	10-12	80	Replace with Lely
1	78	Top dresser access.	Cushman			
1	79	Sprayer	Bean	10	80	Normal replacement depends on tank, etc.
1	78	Blower	Giant Vac		84	Consider new style if avail.
1	68	Shredder	Royer	15	83	Adequate w/repair, but slow & does not screen material
*1	68	Fert. spreader	Lely	12-13	80	Repair, but replace on schedule
1	76	Greensaire	Ryan	12	88	Only 1 needed unless program re sand greens stepped up
1	79	5-gang Blitzer mower	Jacobsen	12	91	Repl. when 40% factor occurs
1	68				81	" " " " "
1	78	Weed Eater	Green	4	82	

Note: Years of average life dependent on usage, upkeep, storage, etc.

* Needs replacement

Replacement equipment needed:

1 Flymo needed for replacement
1 Trap King needed for replacment
1 Green King
1 3/4 ton pick-up truck
1 Triplex
1 Roto-Tiller
1 Dedoes aerator
1 Hand fertilizer Scott spreader
1 Lely spreader to replace 2 units

Additional equipment required:

1 Weed Eater (gas)
1 Tractor mounted blower

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NITROGEN - RESEARCH AND RESULTS

Donald V. Waddington, Department of Agronomy
Pennsylvania State University, University Park, Pennsylvania

Research Approach - Our goal in nitrogen fertilizer research is to provide information that will benefit both the manufacturers and the users of various nitrogen sources. As new nitrogen sources are introduced they should be tested under a variety of conditions so that guidelines can be developed for their effective and efficient use.

At Penn State our nitrogen source research has been in the form of field research rather than laboratory or greenhouse studies. We also lean toward long-term studies rather than depending entirely on results from one or two years.

We collect and weigh clippings, not because yield is a primary goal in fertilization, but because yield reflects nitrogen availability and also indicates periods of excessive growth. Clippings are sometimes dried and analyzed for nitrogen so that the recovery of applied nitrogen can be calculated. Clipping yields correlate closely to nitrogen recovery, and usually the same conclusions can be drawn from yield or recovery results. Thus, we often omit the costly and time consuming chemical analyses.

All clippings are removed from the plots. Recycling of nutrients is an interesting and important subject, however nitrogen returned to plots in clippings could interefere with our interpretation of results when we are concerned primarily with nitrogen release from nitrogen sources.

Color also reflects nitrogen availability and uptake, and clipping yields and color ratings are usually taken each week during the growing season. Under normal conditions, color is the main component of turf quality on our research plots. Density may vary; however, the differences are not great if all plots receive about the same amount of nitrogen.

Because we are characterizing nitrogen sources, we try to minimize factors other than N treatments. We make sure that other nutrients are available in adequate amounts. We irrigate when initial signs of wilt appear because we do not want soil dryness to interfere with turf response to nitrogen treatments. When a weed, disease, or insect problem occurs, we use the appropriate pesticide. We usually use a monoculture, because shifts in species populations due to nitrogen fertility could conceivably cause differences in our evaluation criteria. If one wishes to obtain information on the effects of nitrogen fertility on species shifts, weeds, diseases, insects, or turf susceptibility to environmental stresses, I feel that these studies should be separate from studies designed to evaluate nitrogen sources. For instance, if a disease outbreak severely damages turf on plots receiving certain nitrogen treatments, then the value of the turf for nitrogen source evaluation is diminished.

In my fifteen years at Penn State, there were only three times when outside factors interefered with data collection. One year leafspot was severe on some of our plots. Once we had billbug damage and some plots had to be eliminated from data collection until they recovered. We also had heat damage from a plastic tarp that was placed on part of our experimental area. In this case, we ran the test with two replications until the turf on the third replication had recovered.

Research Results - Because considerable variation can occur among sulfur-coated urea products, we conducted a study to evaluate six formulations that were representative of different coating weights and coating methods. Five experimental formulations from Tennessee Valley Authority (TVA) and "Gold-N", a product of Imperial Chemical Industries, were applied to Merion Kentucky bluegrass as a rate of 4 lb N/1000 ft^2 in the spring of 1974, 1975, and 1976. Coating weights of sulfur on TVA materials had been varied to obtain laboratory /-day dissolution rates of 17, 26, and 35% from granular urea coated with sulfur only; and 16 and 26% from material coated with sulfur plus a wax sealant. Gold-N was made by coating prilled urea with sulfur plus a paraffin sealant and had a dissolution rate of 36%.

Clipping weights and turfgrass color were used to evaluate response. With sulfur-only coatings, turfgrass response increased as coating weight decreased (dissolution rate increased). Differences due to coating weight were greatest in the first year, and diminished in the following years. In yield and color

comparisons over three growing seasons, a low dissolution rate treatment never produced more response than a higher dissolution rate treatment. In comparisons of materials with similar dissolution rates but with different coating methods, release of N was more rapid with a sulfur plus wax coating than with a sulfur-only coating. Thus the 7-day dissolution rate was not dependable in predicting field response when coating method was varied.

Plots were sampled for residual sulfur-coated urea in 1976, 1977, and 19/8. After three growing seasons, residual pellets ranged from 3 to 37% of the total applied weight; and after two additional years in which no fertilizer was applied, 0 to 13% remained. The greatest residual (slowest release) occurred with the material having a sulfur-only coating and a 17% dissolution rate. Variations in sulfur-coated urea formulations caused significant differences in turfgrass response to fertilization and in the amount of residual material; thus, factors such as coating weight and method should be known and taken into consideration when developing a fertilization program based on sulfur-coated urea.

In work with IBDU, we have noticed a three to five week delay in turf response following application. Good release of N during cool weather has also been noted. Our spring applications often give growth and color peaks in the summer, and response from fall applications is often the greatest in the following spring when the grass begins growth. In early years of use, IBDU has been more efficient than ureaform. This advantage was lost with continued use of ureaform. Fewer and lower peaks of growth have occurred with ureaform applied at the same times.

Particle size has been found to have a greater effect on release of N from IBDU than from ureaform. Earlier response has been observed with the fine IBDU following application. A greater residual effect occurs with the coarser IBDU. Essentially no effect due to size has been observed with powdered and granular ureaform.

Comparisons of straight IBDU or ureaform with combinations also containing soluble sources have shown that with spring plus fall applications, the straight materials give better summer response but the combinations give greater response in the spring and fall.

Research Support and Publication - Except for faculty and technician salaries, our financial support for fertility research has come primarily from industrial grants. Other significant grants have come from the Tennessee Valley Authority, the O. J. Noer Research Foundation, and The Pennsylvania Turfgrass Council. We are grateful for the generous support that many companies and agencies have contributed over the years.

Results of research are usually published in scientific journals or in university research publications. The results may be used by manufacturers in decision making concerning the production of fertilizers, and by extension personnel in the development of recommendations concerning fertilizer use. Some of these reports are too technical for the average turf manager, and results are usually condensed and simplified for presentation in trade magazines, in advertising material, and in meetings for turf managers. Only when the results are put to good use, can we claim that the purpose of our research has been fulfilled.

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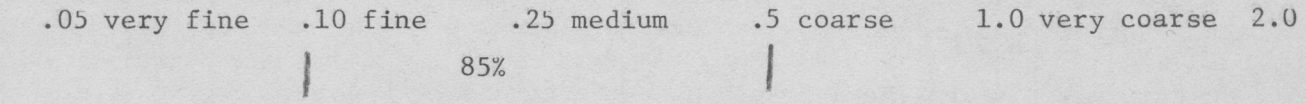
ROOTZONES - APPLYING RESEARCH

Donald V. Waddington, Department of Agronomy
Pennsylvania State University, University Park, Pennsylvania

Many of our turf maintenance problems are related to the type of soil utilized on a turf area. A wide range of factors, such as shallowness, stoniness, slope, and drainage, can limit the suitability of soil for various turf uses. On intensively used areas, soil texture is often the greatest limiting factor. Soil texture refers to the relative proportions of sand, silt, and clay in a soil, and texture is described using soil textural class names such as clay loam, loam, and loamy sand. A problem that occurs with fine and medium textured soils is that they contain very few large pores when compacted and thus have restricted permeability. The excess moisture that is often found on such areas is undesirable from the standpoints of play, maintenance, and turfgrass vigor.

Considerable research has been conducted that has enabled us to establish guidelines for selection of rootzones that will have acceptable physical properties even when compacted. Most noteworthy are the research results coming from Purdue, University of California, Texas A & M, and Penn State.

One of the first decisions to be made in planning to construct or renovate a rootzone is selection of a sand which could be used alone or to modify the existing soil. Five sand separates are used for sand classification:



In general, best results are obtained using sands with a narrow range of sizes. Some multi-component sands (often called "bank run" or "dirty" sands) can be used, but, as with all sands, some laboratory testing would be a good investment when performance data are not available on a given sand. Uniform sands with a large percentage (<85%) of particles in the medium and fine ranges have been shown to be excellent for soil-less rootzones. Uniform sands in the coarse and medium range usually are most effective for modifying a medium to fine textured soil. Very coarse sand and gravel are normally avoided in mixtures that will be used for topdressing because they will not work into the turf. Specific guidelines on sand have been suggested by the Green Section of the USGA, and Dr. Daniel at Purdue has developed a zone of acceptable limits for use with sand particle size accumulation curves. Following these guidelines should enable one to make a good choice of sand.

Peat choice can also influence the characteristics of a rootzone. Peat additions can increase cation exchange capacity, moisture retention, and resiliency in a sandy rootzone. We have found that finely divided organic sources, such as peat humus, tend to be more effective than fibrous peats for moderating the excessive water movement through sandy media. On the other hand, fibrous peats are usually more effective for increasing permeability when fine and medium textured soils are modified.

If a rootzone has been chosen to obtain acceptable infiltration and drainage of water, it will usually have a low water holding capacity. Water retention can be increased by placing the sandy soil over an impervious layer or a layer of very coarse sand, gravel, or crushed stone. Such practices are included in the "Purr-Wick" system that utilizes a plastic sheet to retain water, and in the USGA specifications which specify a layer of coarse sand beneath the top mix to create a false water table. The use of such barriers with fine and medium textured soils could create excessively wet soil conditions.

If a soil is selected for use and proves to be less permeable than desired, cultivation in the form of coring may prove beneficial if the coring machine penetrates below the compacted zone and if the soil beneath the compacted zone has physical properties that will allow good water movement. In our Penn State work, compacted field plots with mixes containing 60% sand, 20% silt loam and 20% peat were greatly benefited by coring; however, the properties of 40-40-20 mixes were such that poor infiltration occurred even with coring. Thus, the benefits to be received from a coring and topdressing program will be affected by the existing soil.

Watering and fertilization practices should be adjusted for sandy rootzones. Because of lower nutrient retention and greater leaching potential, more frequent fertilization may be required. Also the use of slow release fertilizers should help to minimize leaching losses. More frequent and lighter irrigation will be required on sandy rootzones, unless water is retained by a plastic barrier such as used in the Purr-Wick System. When soils are highly modified or when sand rootzones are used, adjustments need to be made in management practices normally used. Another observation made on sandy rootzones has been the decrease in permeability with time (over years). Thus an initially excessively drained soil may become easier to manage with time. On the other hand, a rootzone that is marginal to begin with may become too compact for easy management in later years of use.

Although research has not answered all the questions about rootzones, plenty of information is available and is being used by extension specialists, Green Section agronomists, and others to develop construction and maintenance methods. Research information on rootzones has been published in various ways. At Penn State, much of our work has been published in Progress Report 337, "Soil Modification for Turfgrass Areas", which is available from the Agriculture Mailing Room, Ag. Adm. Bldg., University Park, PA 16802.

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TURFGRASS ROOTS AND THEIR FUNCTIONS

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The importance of turfgrasses in our way of life can never be overemphasized. Primary uses include soil stabilization and providing a protective cushion of a living regenerative surface on home lawns, athletic fields, parks, playgrounds, and golf courses. Turfgrasses are required to resist wear and tear, diseases, insect attacks, weed invasion, injury from environmental stress and still retain an aesthetic appearance. However, management practices of turfgrasses tend to consider only the visible foliage, often overlooking the importance of the root system.

The root system of turfgrasses is fibrous and extensively branched. The function , longevity and health of the root system is directly affected by a multitude of natural and induced factors. Some soil conditions adversely affecting root growth are:

a. waterlogged soils
b. low soil oxygen
c. compacted soil and/or soil with high clay content
d. very high or low soil temperatures
e. very high or very low soil pH
f. toxicity of high salt concentrations
g. toxicity from pesticide residues

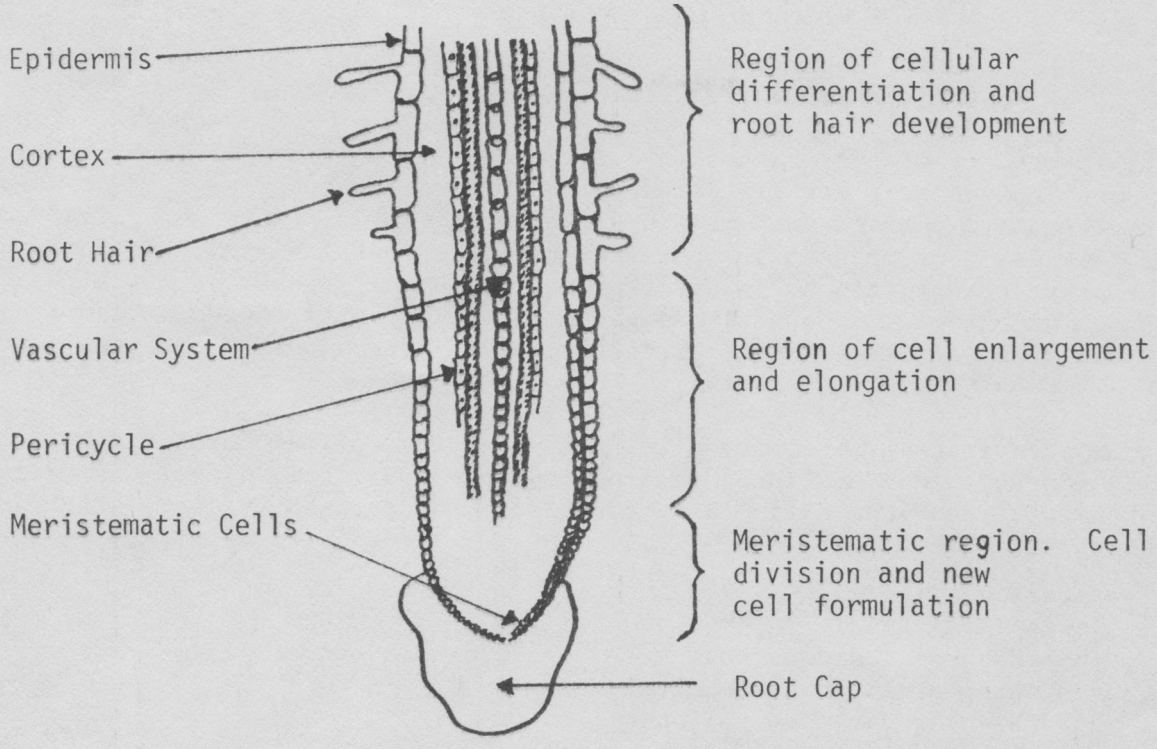
Biological and cultural factors influencing root growth and development include:

a. mowing too high or low
b. scalping
c. nutrient deficiencies or toxicities
d. excessive nitrogen
e. heavy thatch accumulation
f. excessive irrigation
g. excessive wear and traffic injury
h. injury from diseases, nematodes, and insects.

The root system in many ways can be considered the heart of the turfgrass plant. It takes up and supplies the life giving fluids and nutrients in accordance with the demands of the foliage. The greater the demands and needs of the foliage for water and nutrients the greater the stress and restrictions in growth placed on the roots.

Regeneration of the root system is a continuous process with the life of a root system varying from a few weeks to well over a year. A root can generally be divided into two functional areas: the "active" and the "passive" region. The active region is the root tip, which in turfgrasses varies from approximately 2 to 10 mm in length with most being from 2 to 4 mm in length. There are thousands of root tips distributed throughout a root system. However, the active region, as compared to the remaining passive region, comprises less than one-tenth of 1% by weight of the total root system. The following diagram generally illustrates the zones of cellular development and differentiation in a typical turfgrass root tip.

The Root Tip



Functions of the active region are varied and complex. New cells are continually formed in the meristematic tip as sufficient carbohydrates are available to support the generation of new cell growth. This region normally is from 1/2 to 1 mm in length. Cells in the active region can be considered elastic and flexible. The process of cellular enlargement and elongation is responsible for the movement of the root through the soil. With further maturation and differentiation, root hairs form as extension of epidermal cells and vascular tissues become fully developed. At least 95 percent of water and nutrient uptake by the plant occurs through root hairs. With nutrient movement through the vascular system, upward transport occurs to above ground plant parts (foliage). New lateral roots form from a cylinder of cells called the pericycle.

The passive region of the root also has important functions. Although cells in this segment of the root are much older, less elastic, and lack flexibility, they are quite strong. This is the root portion which serves to anchor the plant to the soil , stabilize the soil rootzone, and serves in transport of water and nutrients taken up by root tips to above ground plant parts. A small carbohydrate reserve can be stored in this region also.

Destruction of root tips without allowances for new tips to develop generally spells death for the entire root system, and sometimes for the above ground plant parts. In the normal life cycle of cool season grasses, death of roots is commonly associated with heat stress periods. Regeneration of new roots generally follows this stress period. Recent findings by DiPaola and Beard show that the root system of Tifgreen bermudagrass degenerates (sloughs off) during the flush of new foliage growth during the break of dormancy in the spring. Subsequently, a new root system begins developing a few days following the initiation of new leaf growth. During the spring new root growth period it would appear logical that Tifgreen bermudagrass would be very susceptible to damage and injury from close mowing, traffic, insects, diseases, high nitrogen, drought, and herbicides.

Roots are obviously important to the health and survival of the entire turfgrass plant. Management programs for turfgrasses should include the root system if the foliage is to have a chance to fulfill its physical and aesthetic functions.

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PREEMERGENCE AND POST-EMERGENCE HERBICIDES IN TURFGRASSES

Lloyd M. Callahan, Dept. of Ornamental Horticulture & Landscape Design
University of Tennessee, Knoxville, Tennessee

Herbicides have been of great benefit to mankind in all areas of plant culture. Many herbicides of different types have become commonplace in the management of turfgrasses under all manner of growing conditions.

Herbicides are available which will give very good control of the weedy grasses, crabgrass and goosegrass. Effective control of these weeds can be achieved by carefully following labeled directions for the use of the herbicides bensulide (Betasan), DCPA (Dacthal), benefin (Balan), and siduron (Tupersan). Most broadleaf weeds can be controlled with the proper use of 2,4-D, MCPA, MCPP, or dicamba. Tri-mixtures of 2,4-D + Dicamba + MCPP are readily available on the market. Again, careful adherence to labeled directions is important.

However, the use of herbicides alone does not solve the problem which allowed weed invasion in the first place. Occurrence of weeds usually can be associated with errors or failures in some aspect of turf management. Mistakes commonly made include mower scalping, improper fertilization, poor roctzone soil management, growing non-shade tolerant species in shady locations, injury with pesticides, and many more. Correcting these mistakes permits taking advantage of the competitive characteristics which allow a grass to succeed as a turfgrass.

Laymen often employ the simplest and most direct method, herbicides. However, many widespread misconceptions exist regarding herbicides. Turfgrass managers should remember that these chemicals are plant toxins and therefore are injurious to both the weed and the turfgrass plant.

During recent year the effects of herbicides have become of major concern in the health and survival of the root system of turfgrasses. The destructive effects on the root system of translocated, hormone-type chemicals such as 2,4-D, MCPP, and silvex have been well documented. Of increasing concern is the injury to the root system of turfgrasses by residues of preemergence herbicides. This group of chemicals has been associated with root degeneration and eventual loss of large areas of turfgrass.

Investigations by DiPaola and Beard recently help explain why preemergence herbicides have been implicated in extensive turfgrass sod loss. They showed that the root system of Tifgreen bermudagrass sloughs off during the flush of new foliage growth during the break from dormancy in the spring. A new root system begins forming a few days later following the initiation of new leaf growth. It then becomes understandable how root degeneration (root pruning) can easily occur since the recommended application of preemergence-type herbicides normally coincides with the root die-back and new root development period in the spring for turfgrasses.

A recent thesis by Seagle showed root tip cellular damage in Penncross bentgrass to be severe following treatment with the herbicides benefin and terbutol (Azak). The herbicides bandane, bensulide, DCPA, and siduron caused slight to moderate injury but root tips appeared to recover from this injury. When these same herbicides were exposed to roots of Tifgreen bermudagrass,cell damage was severe with DCPA, siduron, and terbutol. Moderate cell injury occurred with bandane and bensulide, and slight damage occurred with benefin, but injury did not result in death of the root tips.

A sensible weed control program should first involve developing a good cultural management program for the turfgrass. A balanced, full season fertilization program, coupled with proper mowing, irrigation, and rootzone management, can result in a strong and healthy turf capable of eliminating or reducing weed problems through competition. Then, if it becomes necessary to use herbicides, use them judiciously, follow label directions very carefully, and use them only as an aid to the cultural management program.

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SERVING THE TURF INDUSTRY

Bud Camp, Sales Manager, Lebanon Chemical Company
Fort Wayne, Indiana

Webster defines the word "serving" - "To promote the interests or welfare of".

When we serve the turf industry we promote the interests and welfare of everyone, directly or indirectly. There is no way to be selective, if we really serve, and there is no way to contain, or restrict, the benefits of our actions.

We started serving the turf industry in 1946, and there were few turf products available, or regulations to monitor them. This is where serving really separated a few devoted, energetic visionaries from the pack. Not many people grasped the potential of the infant turf industry; they just tolerated it.

We had fertilizer products of natural organics which were safe and moderate in cost. We had all mineral products which were soluble and "hot", and in 1939, DuPont had developed a process in which ureaformaldehyde was mixed with other materials, in ammoniation, using UAL-37 liquor, and this produced a slow release fertilizer with 20% W.I.N.

I will never forget how proud we were to offer a product with 10% N and 3% W.I.N. to our customers. That was serving!

We controlled weeds with a product known as "Wedo". It was a 10-3-7 analysis, and if you used it at the right time you grew the weeds to death before they could reproduce themselves. It still works!

We learned to burn clover out of a green with a strong solution of water and ammonium sulphate, diluting it with water when the clover turned black. Many such "tricks of the trade" were passed on by those who served.

It was a common thing to hear people state that a retired framer would make the best superintendent. Little did people realize the specialized nature of growing and understanding fine turf. They poured on the lime and phosphate, neglected potash levels, and thought the pH should be 7.

In 1946, two government scientists, Yee and Love, showed that by reacting urea with ureaformaldehyde, a superior product with exceptional controlled availability for plant growth could be made. The word ureaform was born, and this nitrogen product would yield a minimum of 40% W.I.N. compared to the top of 20% W.I.N. available from solutions. DuPont came out with Uramite in about 1950. This product was 38% nitrogen and 70% W.I.N. What a breakthrough!

The makers of Uramite did not serve themselves or the turf industry as other manufacturers would have to develop the range and scope of uses for this versatile product. This is where you crank up your company and serve, or others pass you by.

The turf schools and manufacturers went on a research boom, and the turf industry went into the finest era of improvement in turf history up to that time. If you were serving the turf industry around 1950-1960, you made lots of friends, learned fast, and built a base for future business.

Some interesting experiences along the way:

In the 60's all the fertilizer manufacturers went overboard on a new product, a manufacturing grade nitrogen solution which was supposed to solve all problems of storage and handling. Well - it made some of the most uniformly hard product you ever saw.

A supintendent spplied 12-4-8 W/HERBICIDE to his greens. They started to look bad so he made another application, and they really went out. He did not smell the 2,4-D either time, or see the 12-inch red square on the bad, which denoted a combination product.

We had a superintendent who said he could not figure out what happened after he applied our product to his greens and they started to go out. We found later that an applicator had made TWO passes with a Lely spreader and put down a double rate at 90° and 87% humidity!

Everyone has experienced his share of problems with sticks, bolts, paper, pop cans, etc. in the bag. We walked by a Cushman with a spreader on the back at Columbia, Tennessee, and sure enough, some work person had tossed a MacDonalds sack containing a plastic cup, a plate, a straw, and napkins into the hopper. When they fertilize greens the next time the fertilizer will go right in on top, and someone will complain about dirty fertilizer.

It is interesting to note that there are only two major plants in the U.S. which are devoted to exclusive manufacturing of TURF FERTILIZER AND CHEMICAL PRODUCTS. THE QUALITY CONTROL AT DANVILLE AND MARYSVILLE MUST BE BETTER.

The turf schools, manufacturers, and sales people met the challenge of modern technology with short courses, two and four year turf courses, spec. sheets, books, pamphlets, symposia, etc. Serving the turf industry was never so important. We had "old timers" who could not, or would not, grasp or understand W.I.N., controlled release, long feeding, carry-over, etc. You spent a lot of time serving these people.

There were some state and local superintendent associations. However, Indiana had only one, at Indianapolis, so we and four or five others formed The Hoosier Turfgrass Association in Fort Wayne in 1958. Thanks to many people serving, this association now leads the way with its own turf symposium and very efficient turf fund raising day each year. Thanks to serving members, we contribute more funds to the Midwest Regional Turf Foudnation, and award more scholarship money than the rest of the state combined.

There were many people in managment who could not or would not recognize the tremendous potential of the turf industy, and there were few people in sales spending over half of their time serving the industry. This fact kept me awake nights. I was golf course crazy, I guess. I wanted to serve this industry, but my boss thought golf was stupid, as well as everyone connected with it.

On March 1, 1963, I quit my job of 17 years, and told by wife I was going to build a golf course. We went $260,000 in debt, sold our home, and I built the golf course. In 1965 I became a class "A" Superintendent member of the NGCSAA and got a preferred players card. I still carry the originals and am proud of them. When you build a course yourself and manage it, you serve the industry in many ways.

We had a chance to serve in many new ways when we went to International Mineral and Chemicals in 1967 as Administrator, Lawn & Garden Division. We introduced combination products which are cheaper and more efficient - higher W.I.N. products, minor element mixtures, cleaner and more unfirom products, special sizing for greens products, reliable distribution and customer relations, to name a few.

We still serve by improving on these past innovations, striving to have the best products, fair prices, and reliable delivery. We constantly improve our product line, and recently added equipment to enable us to make our own urea-formaldehyde, resulting in a better product for the customer.

We serve with technical papers, help on site, put on seminars, advertise in local, state and national papers and magazines, make donations, participate in turf fund days, maintain close contact with all turf schools.

You can help us all serve better by realizing the cost of a call by your suppliers is over $50.00, and profit is not a dirty word. None of us would be here without it. Let's help each other and serve the turf industry better.

We have been involved with serving the home lawn industry the past few years and it is a new and different challenge and opportunity to serve. The policies, specs., and operation are unique to that industry. We are serving the smallest and the largest in the total turf industry, and they all get the same attention.

We trust you are doing your share of serving, but let's look at a few simple suggestions as to how we can best serve the turf industry:

- By giving, and expecting fair and just treatment.
- By wanting to be the best at what we do.
- By getting involved.
- By helping solve problems, not by creating them.
- By respecting yourself, your employer, and all people about you.

Well, we have rambled quite a bit and have not pushed any one big point, but serving is like that. You never know where it will take you!

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PENNEAGLE BENTGRASS

Warren Bidwell, Superintendent, Olympia Fields Country Club
Olympia Fields, Illinois

With the great performance Penncross bentgrass has provided us during the last twenty-five years, and still going strong, why a new variety from the same institution? Penneagle was selected for:

1. finer leaf structure that lends itself to greater density,
2. a broader based and carefully selected parentage that provides additional disease resistance, a necessary plus in a time of increasing costs for plant protectants,
3. a greater yield of seed per acre that should help hold the line against inflation at the customer level.

An example of disease resistance is noted in the 1965-1975 bent variety test at Penn State, where Penneagle rated #2 in a nineteen variety testing for dollar spot, and #1 in resistance to snowmold, and equally outstanding in natural resistance to red leaf spot. Of equal importance in a ten year testing period was the putting quality. Using the same nineteen varieties as indicated in the disease testing, Penneagle had a +9 average out of a +10 possible score.

Any testing of a new, untried bent would not be successful without stringent observation on a possible Poa annua invasion. It could be assumed that the track record indicated previously on natural resistance to the more troublesome diseases, there would be little fear of Poa invasion. Again, using the same nineteen bents, a five year test indicated that a maximum of 2% was observed while others allowed as much as 35% for the same period.

In reporting their observations to Dr. Joe Duich, superintendents from Canada to the Carolinas, and from Colorado and Arizona to the East Coast offer most favorable comments on Penneagle, a true backup fo the many favorable scientific observations.

Having had a close relationship with Dr. Duich since 1953 when he was my first turf student, it was only natural that my nursery at the Congressional Club in Washington should become one of the trial grounds for a period of six years for Penneagle. This area of 20,000 sq.ft. became a training ground for triplex greens mower operators, power sprayer chemical applicators, subair, deep soil, chemical application for nematodes, and new chemical trial applications.

Once the contract was signed for the 1976 PGA championship, we determined that the 12th green must be rebuilt and sodded with Penneagle, a very successful transplant from our nursery.

About the same time we were successful in securing another 85 acres for our fourth nine, and Dr. Joe offered sufficient seed of Penneagle for tees and greens that opened for play in June last year.

Although no longer associated with the Congressional Club, accolades continue to come my way for the choice made in the building of USGA specs, and in choosing Penneagle for this beautiful and very expensive nine hole addition. Membership satisfaction has been most gratifying.

It is my personal belief that this new bent has a great future for providing enjoyable, economic turf for years to come.

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ROUNDUP[R] AND FAIRWAY RESEEDING

James W. Brandt, Danville Country Club
Danville, Illinois

The Danville Country Club fairways were seeded to common Kentucky bluegrass in 1929. The fairways remained a relatively pure stand of bluegrass until a fairway watering system was installed in 1966. With moderate watering and applications of 3 pounds of nitrogen and 2 pounds of potash per 1000 square feet per year, there was a gradual invasion of Poa annua. In recent years there has been an increased incidence of Fuasrium roseum. Each time bluegrass was lost to disease, Poa annua was its ready replacement.

An overseeding program of introducing a mixture of improved blue and ryegrasses with the Rogers seeder has met with very limited success. The ryegrass was the sole survivor of the introduced species.

In 1973, Dr. Bill Meyer, who was with Warren's Turf Nursery, approached me with the idea of doing some experimental planting of some new cultivars of Kentucky bluegrass into the existing turf at a selected site at the Danville Country Club. Number 16 fairway was chosen because of the high incidence of disease and the greater infestation of Poa annua. Three replications of 9 cultivars were planted with 8 inch plugs on three foot centers. These included Baron and Fylking as checks. The plots were observed by a representative from Warren's, as well as being evaluated by the author.

1976, 1977, and 1978 were excellent years for the development of disease and stress on a mixed population of common Kentucky blue, improved rye, and Poa annua. In evaluating the cultivars on the 16th fairway those designated as H-7 and I-13 were outstanding in their ability to withstand disease and in their ability to spread into the existing fairway turf. By August of 1978 both Fylking and Baron were gone from the 1973 planting.

In the fall of 1978 it was decided to do a pilot program of fairway renovation. Sites were selected on numbers 1, 6, 14, and 16 fairways. The areas represented the best, average, and poorest turf on the fairways. At the selected sites, a swath of 16 feet running the width of the fairways was sprayed with Roundup at the rate of 2 quarts per acre. After one week, four foot strips were planted to the selected grasses with the Rogers seeder. The following diagram gives the plot layouts.

Width of Fairway

↑ 4 ft. ↓	Warren's cultivar H-7
↑ 4 ft ↓	Warren's cultivar I-13
↑ 4 ft ↓	Blend of equal parts of Adelphia, Baron, Glade, Nugget, Pennstar & Sydsport bluegrasses
↑ 4 ft ↓	Equal parts of Derby, Manhattan, and Pennfine ryegrasses

It was observed that germination on all four replicates was excellent. One cultivar designated as I-13 seemed to have outstanding seedling vigor. Very little growth past the seedling stage occurred in the fall of 1978. By mid-spring all but the rye plots appeared to have a predominance of Poa annua. By mid-summer the I-13 started to predominate over the Poa annua, and by August 15 the I-13 was an outstanding plot. The H-7 did somewhat better than the blend of six bluegrasses. By August 10, 1979, we were experiencing our usual loss of fairway turf in spite of what was considered to be an adequate spray program for disease prevention.

We had 9 inches of rainfall in July and were well on our way to 10 inches of rainfall for August. With the accompanying heat and humidity, the Poa annua was gone.

As a result of the pilot program, it was decided to embark on a complete fairway renovation program. This was to be accomplished in a two-year period with the front nine being selected for the first year. A detailed letter was sent to the membership explaining when and how the renovation was to be accomplished.

The following is a time table of the renovation work:

--	Aug. 27	Sprayed all fairways with 2 quarts Roundup per acre
--	30	Fairways off color, showing cart tracks
--	31	Fairway grass black in color, applied 375 lbs/acre of 13-25-12.
--	Sept. 3	Fairways completely brown
--	4	Started seeding equal parts of H-7 and I-13 with the Rogers seeder. Seeded two ways using 10 lbs. seed mixture each time.
--	7	Started watering first seeded area
--	11	Finished seeding all fairways
--	13	Seed germination started in early seeding
--	20	Germination started in all areas
--	21	Closed front nine to all play
--	Oct. 9	Mowed all seeded fairways; adequate stands in all fairways
--	Nov. 19	Applied 3 lbs of N (Nitroform source) and 1.25 lbs. of potash per 1000 sq.ft.

By March 1980 all new grass on fairways is much ahead of the pilot program in 1978. We believe that early seeding is imperative. The cost per acre was approximately $265 for seed, fertilizer and Roundup, and $44 for labor. Our plans are to renovate the back nine in the fall of 1980 using the seed mixture and procedures as used in 1979.

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TURF SEED SUPPLIES, 1980

Kent McFarland, Sales Manager, Indiana Seed Company
Noblesville, Indiana

Turf managers can be especially thankful this year for the many turfgrass cultivars they have to choose from, for without this number we would be left with a poor selection available for upgrading our turfs.

The Pacific Northwest experienced early rains in the fall of 1978 limiting the amount of seed field burning to about one-half the normal acreage. This was followed by a very cold winter which further reduced seed yields.

The bluegrasses were hit especially hard with some cultivars hardly yielding enough seed to fill existing orders. Turf type ryegrass enjoyed increased acreage so while yields were down, the total supply seems adequate. Note the word "seems". A short crop of common ryegrass has increased it price to a point where many consumers will switch to the better ryegrasses. The shortage of bluegrass will also increase the demand.

The fine fescues are in short supply, but not to a point of being unavailable. Most bentgrass varieties are in adequate supply.

The most serious aspect of all this is that it could take two good crop years to bring us back to a normal supply situation. There is seed readily available for sale this spring though a person may have to accept substitutions for certain cultivars. This fall could be another story. Even with a good seed harvest this summer, many cultivars will still have limited availability. Also, it will be difficult to get this new crop seed to the Midwest in time for fall planting.

Superintendents would be well advised to plan their turf seed needs as much as two years ahead. This is obviously important where major construction or renovation projects are being considered. Seed to be used this fall should be purchased as soon as possible to insure availability.

The price of some seed today is high compared to a year ago, but compared to other maintenance items, seed remains a true value. The price of turf type ryegrass has not changed in recent years, and bentgrass has gone down. Even at today's high interest rate it is impractical for a superintendent to be without a good quality of seed. This is especially true for the next two years.

Much is written today about the differences in cultivars, especially Kentucky bluegrass, with regard to appearance, i.e., color and texture. Growing side by side in test plots, it is obvious that variations do exist. However, very little difference could be found if those plots were separated by a few feet. No difference would be seen in a blend of cultivars. More difference could be found in a single cultivar growing under a different set of cultural conditions, i.e., soil types. We need to put these differences in their proper perspective when facing the possibility of deciding on a substitute cultivar. Consider factors such as disease resistance, fertility requirements, aggressiveness and drought tolerance. These traits will ultimately have a greater effect on the appearance of your turf.

Turf type ryegrass continues to gain popularity on golf courses throughout Indiana. Their vigorous seedling establishment and wear tolerance gets most of the credit for this.

Superintendents will be looking at the improved perennial ryegrass harder than ever this year because of the shortage of bluegrass. It has been demonstrated that the use of more than 30% by weight ryegrass in a seed mixture will produce a 90% ryegrass turf. Is this too much? Some say no, especially on hard use areas such as golf tees. There are superintendents using turf type ryegrass especially for overseeding. This increased use should take some of the pressure off the shortage of bluegrass.

It is improbable that good quality turf seed will become totally unavailable this year. But the superintendent who wants a quantity of a specific cultivar or mixture should order early.

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ZOYSIA - KOREA AND U.S.A.

Do Yi Yeam, Dept. of Horticultural Science
Seoul National University, Korea

Zoysiagrass is a very persistant, slow-growing turfgrass, and its superiority to Kentucky bluegrass in heat and drought tolerance and absence of disease make it a good choice for transition zone climate. Although it is dormant in winter, it enters dormancy later, greens up earlier, and is more cold-hardy than Bermudagrass. Zoysia is a very desirable grass for lawns and golf courses in the transition zone of the United States, but it has not been widely used. One of the primary reasons for this is slow establishment. Vegetative establishment other than sodding is very slow and seeds germinate poorly.

In Korea, the major gound cover plant is zoysiagrass. On all of the slopes of mountains, zoysia establishes excellent stands without any mowing, watering, or fertilization. There are many species of Poa, Festuca, and Agrostis, but they are little used as turfgrass. They think that they are all forage plants and it is impossible to use them as turfgrass because they grow too tall. According to Korean concepts of turfgrass, they must grow low without mowing. In the southern-most islands, Z.tenuifolia grows, while in southern Korea, Z japonia, and Z. matrella are mixed. In the central and northern parts, Z. japonia grows. In Korea, there are many mountains and valleys and many variations in zoysia. All turfgrass in Korea is zoysia except golf course greens. In the fall, zoysia turns to yellow. Koreans call it goldengrass, and love it. They usually don't mow, water, or fertilize, but they do annualy topdress. They call this topdressing a "diet" and use a mixture of sand and organic matter from ancient times.

In Korea, research on seed germination of zoysia was begun at Seoul National University in 1964, under the direction of Dr. Tal Young Yu. Researchers performed numerous studies on breaking dormancy by alkaline and acid scarification, low temperature treatment and light pretreatment, but seed propagation was not used until 1972. In 1973, they finally determined the physiological mechanism of seed dormancy of zoysia and thereafter the method has been used widely in covering roadside banks and establihsing golf courses by seeding.

The KOH scarification was effective in promoting the germination under light conditions whether the seeds were fresh or old. The intact fresh and old seeds did not germinate, but when they were scarified, they germinated to more 90% in light but less than 20% under dark conditions. These results suggest that during dry storage for one and a half years, slight changes of germination potential may occur, but the seed does not break dormancy. These results also strongly indicate

that the seed coat of zoysia may have certain protective action for dormancy but has nothing to do with dormancy itself. Thus zoysia seeds have a unique dormancy type quite different from those of many other grass seeds whose germination can be promptly induced or increased by decoating or scarification. Since decoating or scarification did not completely break dormancy the true dormancy factors which require light to trigger germination are likely to exist in the embryo. Seeds can be made ready to germinate by KOH scarification and subsequent light irradiation, but how to keep this germinability is a major problem. Thus, one of the primary concerns is a practical storage method for this germinable seed. Storage conditions should be dry for practical purposes. When the germinable seeds are dried and kept in a -10° freezer the germinability was kept unchanged for three years which was the maximum duration investigated in Korea. In this way we can get the germinable seeds whenever or wherever a freezer is available. But it is still a question how long the germinability will be kept at room temperature. In Korea, when the seeds were kept in a cool room in winter, there was no loss in germinability, but in summer there was rapid decrease after 30 days.

Table 1 - Effect of KOH scarification on germination of fresh zoysiagrass seeds. (% germination in 7 days)

KOH Concentration	scarification duration	35° constant temperature light	dark
15%	30 min.	75 %	2 %
	40	91	2
	50	80	6
	60	3	0
	70	0	0
20%	20	47	1
	30	94	3
	40	95	5
	50	86	
	60	8	0
25%	10	33	0
	20	73	2
	30	95	3
	40	96	8
	50	20	0
0	0	0	0

From 1975, Dr. H. L. Portz started research on vegetative propagation of zoysiagrass at SIU-C. Older methods of sodding and plugging are being compared to stolonizing. Hydrostolonizing was used by Jim Manka in 1970 to establish zoysiagrass fairways at Old Warson Country Club in St. Louis. Better weed control methods which include use of activated charcoal to reduce herbicide phytotoxicity are being tested. Further research on inducing more rapid rooting of stolons and in hydrostolonizing methods is underway.

Table 2. Effect of KOH scarification on germination of zoysiagrass seeds (1.5 year old) (% germination in 7 days)

KOH concentration	scarification duration	35° constant temperature light	dark
20%	20 min.	78	13
	40	90	26
	60	84	25
	80	76	13
	120	3	2
25%	15	63	6
	30	85	20
	45	90	24
	60	79	13
	90	78	2
30%	10	37	3
	20	62	11
	30	76	25
	40	88	28
	60	71	4
0	0	0	0

From 1979, research on seed propagation has been initiated at SIU-C with imported zoysia seed from Korea. Cooperators are H. L. Portz at Southern Illinois University, Do Yi Yeam from Seoul National University, Korea, and Jack Murray at the USDA, Beltsville, Maryland.

In Southern California, Dr. Vic Younger is developing evergreen zoysiagrass and these zoysias also may be evergreen in Florida. Recently, Disneyland in California has replaced bermudagrass with fine-leaved evergreen zoysia and they maintain these turf areas without any mowing.

Zoysia is a very desirable turfgrass for lawns and golf courses in the transition zone of the United States. And, also, there is the possibility of using fine-leaved evergreen zoysia in more southerly parts of the United States and of using coarse-leaved zoysias on roadside banks because of their low maintenance requirements. The newer establishment procedures of seeding and stolonizing as discussed in this presentation should greatly enhance the use of zoysiagrass in the United States.

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ESTABLISHING ZOYSIAGRASS BY SEED

Do Yi Yeam and H. L. Portz
Southern Illinois University, Carbondale, Illinois

1. Seed Treatment - Use mature zoysiagrass seed. It is not necessary to remove the hulls.

   Scarify - Treat with 30% potassium hydroxide (KOH) solution for 25 minutes.

   Rinse out KOH immediately
   Soak in clean water for one hour and decant (Pour off water)
   Repeat two to three more times; soak for one hour and decant.

Light Treatment - Treat imbibed (water-soaked) seed for 36 to 48 hours
Use florescent light (3000 to 15000 Lux)
Temperature 30 to 35c (86 to 95°F)
Plant immediately if practical

Dry - Dried seed can be stored overwinter at outside temperature and for shorter periods in the summer at higher temperatures. Seed can be stored three to five years at -10 to -20c (14 to -4°F) without significantly reducing viability.

Dried Seed - Sow at about 2 lbs per 1000 sq.ft. for home lawns using normal procedures, i.e., cyclone or drop seeder or by hand. Cover lightly with soil. A light straw mulch is optional.

Pre-Soak - Soak seed in water for 24 hours just prior to seeding.

Pre-Soaked Seed - Mix pre-soaked seed with fine sand and sow with normal seeder or by hand.

Pre-soaked seed can be transferred directly to a hydroseeder. Appropriate fertilizer and mulching materials can be added as desired.

2. Germination - 60% germination and emergence for the treated seed (KOH and light) can be expected in 10 days at ideal temperature of 35c (95°F).

60% germination and emergence of treated and pre-soaked seed is about 7 days.

Surface seeding or light soil coverage should be followed by frequent supplemental irrigation as needed.

3. Seed Source - Present improved zoysiagrasses such as 'Meyer' and 'Emerald' have been propagated by vegetative means and, therefore, seed production requirements and practices, seed yield and seed quality are not well known. Furthermore, segregation of various characters would be expected from most hybrids with off or parental types giving considerable heterogeneity.

Unimproved (common) Zoysia japonica does produce excellent seed in Korea and should do likewise in adapted areas in the United States. Approximately 300 tons of zoysiagrass seed are hand-harvested each year in Korea with most being used for hydroseeding of roadside and other disturbed areas. Importation of seed has been limited to date. The turf quality from the Korean seed would be somewhat inferior to that of 'Meyer' zoysiagrass especially in density.

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Editor's Note: The above report is most encouraging. Experiments on seed use in the 1950's were discouraging. No commercial seed is available in the USA, but major seed companies could procure seed. Anyone wishing to follow this technology should consult with Dr. Portz of Southern Illinois University and/or W. H. Daniel, Purdue University.

APPLYING RESEARCH FOR SALES

Lee Overpeck, O. M. Scott & Sons
Bolingbrook, Illinois

Let's begin with a little review. The Conference theme has been "Research and Its Application". The topic that Dr. Daniel has assigned to me is, "Applying Research for Sales, or "The Salesman As A Research Middleman". The salesman brings research to the superintendent and takes the superintendent's needs back to research. In my job as a Scott's Technical Representative, a large part of my duties concern using research to educate, inform and help solve problems that lead to sales for the company and results for the user. The salesman brings research to the superintendent. During this Conference, we have talked to research at an academic level, and we've talked about practical research applications.

As a Technical Sales Representative, I have a unique position regarding research. When I telephone Scott's daily, I have at my disposal the research capacity of the world's largest turf company. Literally dozens of research workers are available to answer questions and help solve technical problems. To be practical, research is what gives me the confidence to go about my job every day! In discussing a product - how much to use, when to apply, and what results to expect - I'm confident that research has tested the product thoroughly under a wide range of conditions. Application rates are a good example of research in action. Research allows me to make good recommendations, using good products that solve problems and fill your needs. The same applies to you. Research enables you to cut, water, nourish, and protect your turf. Without turf research, you would be grazing sheep, and I'd be selling shears.

I considered talking today about specific products, or following a product from an idea through the finished product sale and use. However, I feel I have a better topic. To apply directly to the golf course,the best bit of practical, applied research that I have to offer the superintendent is the soil test. The soil test is literally full of research, which allows meaningful, accurate data. Research has determined the optimum ranges for the various measurements. Imagine the research required to develop all the numerical data necessary to program a computer to many variables affecting plant growth when making a recommendation. That's research in action.

Many times a problem turf can be corrected, or a potential problem avoided by finding the source of the difficulty. Taking advantage of the research involved in the soil test is my suggestion for finding the problem. When the superintendent and the salesman double team the problem and work together, great things can happen.

I'd like to close with a specific example of how a superintendent, a salesman, a soil test and research solved a serious turf problem. Wellington Golf Club in West Palm Beach, Florida, was in pretty bad shape a few years ago when Mr. Norm Wyman took over as superintendent. Color, density, and root growth were very poor; routine maintenance and fertilizer applications gave virtually no response. Soluble nitrogen was tried, and still no response. Norm noticed that large piles of soil on the perimeter of the golf course were barren after three years. He assumed that if the soil would not even grow weeds after three years, there must be a serious soil problem. The superintendent called the local Scott's Technical Representative to assist with a soil test. The soil test results indicated some

serious problems, including a pH of about 8.6 to 9, and a serious micronutrient imbalance. The soil test had determined the problem, but a product did not exist that provided the solution. Scott's research began a full scale test project on the golf course to find a material that would give the needed results. One combination performed so well that it eventually became a new entry into the Scott's product line. Three years later the problem seems to be solved; the course is in super shape. Superintendent Wyman continues to work with his salesman to monitor any changes and continues his plan of attack based on scientific data presented by the research-developed soil test.

I feel that as long as companies and universities continue to generate good research information, and continue to provide outstanding examples of applied research such as the soil test, which the salesman has at his disposal, we will continue to have this type of success tory. Research is an important part of your turf management arsenal.

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MAINTAINING THE FIRST PAT FIELD

Richard Kercher
Goshen, Indiana

Maintaining the first PAT field at Goshen High School, Goshen, Indiana, has been an interesting and challenging task. For those of you who are not acquainted with the Goshen field, I would like to give you a brief history of the field.

This field was constructed in 1972 and was the pilot model for the PAT System. The field was designed and laid out by Dr. Daniel. In 1972 I was in the landscape construction business, and did the actual construction of the field under Dr. Daniel's supervision. That in itself was an experience I will always remember. Inasmuch as my home is in Goshen, and I have been deeply interested in the PAT System, it has been my privilege to continue to manage the maintenance of the field.

Our maintenance program is purposely designed to give us a quality athletic turf at a price that a local school system can afford. I am sure that if our funds were more plentiful and our maintenance personnel more turf experienced, our turf could easily be a show-place. However, Goshen is interested in an athletic field that can be used by as many students as possible from both junior and senior high schools, and this they are doing. In other words, they want to get as much mileage as possible from their investment.

It seems the school system custodial personnel is constantly changing, and I have a new custodian to train and work with every year. Since none has had previous turf experience, I have had to teach each custodian the principle of the PAT System and what we desire to accomplish. In a short time these new employees see the enthusiasm the community has for the field and soon acquire the the same enthusiasm and become very concerned about the field and how it is doing. This interest in the job goes a long way in maintaining a quality turf.

Our basic maintenance progras has been as follows:

1. In April, spring fertilization with a good complete turf fertilizer at 10# per 1000 sq. ft. Every two years soil tests are made to make certain our fertilizer program is satisfactory. In 1978 this topmix test showed the pH is 7.2, P is 86, High, and K is 182, Medium.

2. In April or May, replacement of any bare area larger than my hand with one or more turf plugs taken from the area of the field where wear was not great. Some special treatment, such as light fertilizer application, is given if necessary to improve appearance for such activities as outdoor graduation exercises.

3. In May our subsoil irrigation system is activated and winter drain closed. The moisture sensors operate the subsoil irriagation at points set by controller.

4. At the end of June we aerify thoroughly and topdress with mason sand - sand applied with Big A, with a total of 30-35 tons being used.

5. In the middle of August, application of 3# of IBDU per 1000 sq.ft.

6. In August, application of Tri-Mec and spot treatment of post emergence crabgrass control if needed.

7. During football season, if the color of the PAT becomes light, then a light application of urea - 1/2-3/4# of nitrogen per 1000 sq. ft.- is made, followed by surface irrigation.

Twice in the past seven years we have spot treated small areas of Poa annua with Round-up in November and seeded treated areas immediately. Although the field looks bad in early spring after this treatment,by July you cannot determine the treated areas.

Any time during the playing season if it rains before or during the game, the pump is started and the water pumped out of the field. I feel this goes a long way in keeping the field in excellent playing condition.

With anything you want nice, it seems you are invariably plagued with a problem when you least want it or expect it. We have had those problems, such as underground irrigation valves left open causing field flooding, underground irrigation lines breaking, and last but not least, vandalism, which consisted of a rival high school burning some initials in the field with fuel oil.

In summary, I would like to say we at Goshen are very pround of Foreman Field, the first PAT installation, and forsee no problems in the future, and I sure hope this includes no more blankety-blank vandalism.

If you are in Goshen, you are all more than welcome to visit our installation.

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OPERATING THE PURDUE PAT FIELD

Dan Weisenberger, supervisor of Turf, Athletic Dept.
Purdue University, West Lafayette, Indiana

Installation of the Purdue PAT field began in March 1974 and was completed in July of the same year. Heating cables were installed at the time of construction and moisture sensors added in the spring of 1979. Warren's A-20 sod was used as the first grass covering.

During the first two seasons, 1975 and 1976, the field held up very well. There were few divots and few problems as far as slippage or excess mud.

In 1976 it became evident that the Poa annua in the field was going to become a problem. The percent of annual bluegrass continued to increase, as did the number of divots. By the end of the 1977 season, the field was torn up beyond repair.

In the spring of 1978 the field was stripped and resodded from the Purdue Grounds Department sod field. This sod did not have the newer, more aggressive grass varieties in it. This situation, combined with poor grass growing conditions that summer, and a nutrient imbalance, resulted in the field divoting badly again that fall.

After spring practice, which ended in mid-April of 1979, we began preparations for redoing the field. On April 20, sod cutters were used to cut the sod loose. After this,we used Ford tractors with buckets to pick up the sod and load it into dump trucks. The tractor operators were able to slide the buckets under what the sod cutters had cut loose and take the sod but leave the topmix behind.

After the sod was removed, we noticed areas of the field that still had layers of soil. To prevent this from getting stirred into the topmix and having the small particles plug up the sand and slowing our drainage, they were removed also. Using a York rake the soil pieces were pulled into piles, then picked up with bucket loaders.

Next the electricians came in to fix the heating cables. There were seven breaks to be repaired. With over a mile of cable buried in the field, it took a few days to find all the breaks.

Twelve moisture sensors were then installed. There were six sets of wires with stainless steel probes on the ends. Three sets, one on either side of the field and one in the center, were placed partially sticking into the sod (1-2" deep). Two sets were placed in the top of the clean sand immediately below the topmix (3-4" deep). One was placed 12" deep near the plastic.

During the time the heating cables were being fixed and the moisture sensors were being installed, we checked the depth of the topmix over the area of the field. It varied from 1-3-1/2" except in two areas where it was as deep as 5". When the topmix was too deep we hauled out the material down to the clean sand. We then filled them with sand to within two inches of the top. After this, enough of the original topmix was brought back in to bring the area to level with the rest of the field.

Our next step was to apply IBDU 31-0-0 at the rate of 2 pounds of N per 1000 sq.ft., and Country Club 18-5-9 at the rate of 1 pound of N per 1000 sq.ft. This was followed by 200 pounds of Agri-Sul sulfur per acre. The surface was then loosened and stirred with a Roseman tillerake.

At this point we began to put down 22,000 sq.ft. of Enkamat. It was basically from 20 to 20 yard lines, and 12 feet outside the hash marks on either side of the field. The Enkamat was put down lengthwise with the field. Four inches of one end of a roll was buried in the topmix and then rolled out to length. As two men stretched the piece of Enkamat a Ryan roller was run over it to partly press it into the topmix and hold it in place. After the full length had been

rolled the four inches of the other end was also buried. After a few strips had been put down we began to fill the Enkamat with topmix.

On May 17 we began sodding with three year old sod from the Grounds Department sod field. The seeding mixture of the sod was Glade, Baron, Sydsport, and Touchdown. As sodding progressed, 40 pounds of Wabash was seeded over the surface.

The sod was brought in on pallets for the protion of the field covered by Enkamat. The pallets were taken out on the field with a fork truck and put down next to the Enkamat. After this the portions of the field driven over with the fork truck were lightly reworked and then sodded by hand carrying the sod from trucks or wagons parked at the edge of the field. It took four and one-half days to sod the field.

From this time until August when football season started, the field was aerified twice with the dedo and once with a greensaire. After each aerification the field was topdressed with sand for a total of 85 tons. This gave the field a covering of sand approximately 3/8" thick.

The grass was cut at 1-3/4 inches during the summer and gradually lowered to 1 inch by the first game. Every two weeks the clippings were collected to keep track of the nutrient level. Before fall practice started in August, 4 pounds of N per 1000 sq.ft. had been added.

The sulfur that was added before sodding had lowered the pH to 6.8 ny July. But in October the pH was back up to 7.9 so we added another 200 pounds of Agri-Sul this fall. We are continuing to monitor this situation.

Last fall the field held up very well. Moisture was monitored and less water was added as the season progressed. There was a minimal amount of divoting and no plugs were used. From all reports, the Purdue coaches and most of the visiting coaches were pleased with its condition.

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MAINTAINING A PRO FIELD

Anthony W. Burnett, Grounds Supervisor
Kennedy Stadium, Washington, D. C.

When entering a stadium, the first thing noticed by spectators and athletes, either professional or amateur, is the condition and appearance of the playing field. Success in our turf program can be attributed both to our maintenance program, Prescription Athletic Turf (PAT), and to the cooperation of our stadium managers to get the equipment and materials necessary to complete the job.

In 1979 we had 20 soccer practices, 20 soccer games, 75 bands for two days, 11 professional, 8 college, and 5 high school football games. Every year we are using the field more!

The maintenance crew at RFK Stadium consists of a full-time foreman, and four maintenance workers. The crew, although small (only five men), has over 130 years of professional groundskeeping experience. Additional help, when needed during the summer months, comes from part-time employees. In addition, we have access to a 15-man cleaning crew.

Due to RFK's not having a set schedule of events other than soccer and football, our maintenance schedule is set on a weekly basis. Damage to our bermudagrass field is mainly due to professional football where 75 percent of the play begins in the center of the field where the hash marks are only 18 feet apart. There is annual resodding done in some areas. This can be done only during bermudagrass growing season. In the Washington area, this is done in May during our soccer season within a ten day period. Due to RFK's having the PAT System and not being able to use heavy equipment on the sand base, it has to be done manually.

Aerification is extensive, usually at two week intervals from May to September, accomplished with an aerifier designed to punch 1/2 inch holes on 2 inch centers. During this time we topdress about four times with fine washed sand, using about 60 to 80 tons annually. This is done to insure maximum water penetration for our field has only a 2 inch crown.

Irrigation is done with a manual sprinkler system consisting of 20 foot sections of 4 inch aluminum pipe with 5/8 sprinkler heads. This takes two men approximately one hour. On the day of an event, light spraying is done by hand if necessary.

An annual soil test is used to check soil condition to determine fertilization or liming requirements. Lime is applied whenever necessary to maintain the soil pH between 6.0 and 6.5. Ground agricultural limestone is used at a rate of 3 tons per acre, working it unto the soil whenever possible. Fertilizing is usually done on a bi-weekly basis, using 18 pounds of nitrogen per year per 1000 square feet.

The mowing height is kept approximately one inch using a reel type mower during the growing months. The height is raised to 1-1/2 inches in September after overseeding with ryegrass is established.

Repairs to turf during football and soccer seasons include filling divots with topsoil to maintain a smooth playing surface. Often during football season ryegrass seed is used extensively in repairing divots, and is often broadcast before a game on the center of the field.

Due to the limited growing season in our area, we had heating cables installed in one field to help extend the growing season. Through use of the heat and a perforated tarp, we are able to keep the grass green, although not growing, until late November or early December.

Dyeing is done only after our bermudagrass turns brown. Although the playing surface remains in good condition, the color is desired by some spectators and for television coverage. The dye must be applied uniformly by an experienced operator to insure an appearance as close to natural as possible.

With new technology in grasses, athletic field construction, and equipment, along with good maintenance practices, we feel we can provide a natural playing field that meets optimum performance needs for players, whether professional or amateur.

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RESEARCH AND THE SOD INDUSTRY

Ben O. Warren, Warren's Turf Nursery
Palos Park, Illinois

In reviewing research related to the sod industry the major work relates to development of equipment for harvesting the crop. Prior to the late forties all sod was cut with a fixed blade. In the last few years of that decade, three companies, Ryan, Phillips, and Federal, introduced machines with powered reciprocating blades. These were a tremendous improvement in cutting under the grass, but cutting to length was done manually for several years. In the early fifties work sponsored by Warren's led to the development of an automatic device that cut a pre-determined length.

In the bluegrass, bent and fescue regions the square yard was, and is, the most common unit handled and the yard strips were formed into rolls manually. The next development was automation of this operation. Daymon, Giepel and Hadfield developed machines that did the job.

The latest development which brings this operation to its present state was the complete harvesters. These machines combined the above operations into one unit that cut under, cut to length, formed rolls or slabs and conveyed the product to one or two men who stacked the sod on pallets ready for delivery. Several machines were developed. The three that have found a place in the industry are: the Brouwer harvester developed by Gerry Brouwer, the Nunes harvester developed by John Nunes, and the Princeton harvester developed by Wiley Manor and Woodrow Wilson.

The use of pallets became widespread in the industry with the introduction of these harvesters and initially handling was done by conventional fork lift equipment. Contributions have been made by sod growers in this area. Light weight fork lifts which can be hauled by the delivery trucks to unload at the job site have been developed. The most popular to date is the Spyder by Carroll. A device that pushes the stack of sod off of the pallet at the delivery site greatly reduces the pallet requirements.

There has not been nearly as much work done in developing machines for installing sod. The Beck equipment that cuts and rolls a 50 sq. yd. roll and lays this unit with a conventional tractor with a simple attachment is most interesting and has been well accepted in some areas of the country. There has been a patent issued for a machine that lays 2' x 2' flat slabs mechanically. I am not aware of this equipment being on the market.

The trend in recent years to build athletic fields on sand fields such as the PAT System, led to investigation of the possibilities of handling sod without soil. Warren's has developed equipment that washes the soil from the sod.

Utilization of grass clippings has been the subject of several investigations. Work done at USDA Western Regional Lab., Albany, California, by Kohler and Livingston demonstrated the value of bluegrass clippings when dehydrated shortly after mowing. Conventional equipment used with alfalfa served the drying and pelletizing needs, but various types of mowers have been developed to do the job of gathering the clippings. Warren's has developed a seven gang reel mower for this purpose.

Research related to handling of sod has been done by various universities. One of the early research projects related to sod handling was done by the Illinois Sod Growers, with Dr. Daniel of Purdue giving valuable assistance and advice. Illinois Highway Department specifications at that time (1957), called for a 2 to 2-1/2 inche thickness of soil on sod. This experimental work was designed to establish the optimum thickness for cutting sod.

Sod heating has been the subject of research at Michigan State by Beard and King, and at Maryland University of Darrah and Powell. Vacuum cooling has been investigated by Warren.

Soil types - mineral vs. muck - has been the subject of work at Michigan State and Rutgers.

Vegetative propagation of bluegrass was studied by Turgeon and Solon at the University of Illinois.

Dehydrated bluegrass clippings - the nutritional value of this product was investigated by Turgeon, Hinds and Baker at the University of Illinois.

Transplanting of soilless sod was studied at various dates by Turgeon at the University of Illinois.

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SODDING AMERICA

Ben O. Warren, Warren's Turf Nursery
Palos Park, Illinois

Warren's Turf Nursery came into existence in the fall of 1938 on ten rented acres in Palos Township, Cook County, Illinois. To begin with we grew two grasses, Washington creeping bent and common Kentucky bluegrass. The only available herbicide was a sharp knife. Sod was cut with a fixed blade mounted between two rollers.

By the end of the 1940's, 2,4-D had become available, Ryan introduced the powered reciprocating blade, the U. S. Golf Association had released the C-strains of bent, Delta bluegrass was on the market, and small amounts of Merion bluegrass were available. Warren's had grown to about 100 acres.

The 1950's saw expansion of the Palos area and the opening of another nursery in McHenry County, Illinois, making a total of 800 acres devoted mostly to Merion. Some acreage was growing a blend of Merion, Delta, and Newport, and small areas of Meyer zoysia, and Arlington, Congressional, Toronto, and Washington were under cultivation.

In 1960 the original ten acres in Palos was taken out of sod production and varietal improvement work was started on that land. During that decade, nurseries were opened in Wisconsin, Indiana, New York, Ohio and California. The varietal work resulted in release of A-10, A-20, and A-34 bluegrasses. Seed production was contracted for A-34. By the end of that decade we had 3,880 acres in sod production and about 50 acres in seed production. During this period we began to merit the title of this talk. Through the use of vacuum cooling the hazards of long distance hauling were greatly reduced, and the geographical distribution of nurseries opened sizable areas of the bluegrass range to our market.

The 1970's have seen the introduction of some new varieties: H-7, H-6, and I-13.

There have been installations of dehydration plants in California and Wisconsin to utilize clippings as stock feed.

The first washed sod was used on the Denver Mile High Stadium, and most recently on Candlestick Park, San Francisco, and San Jose College, California.

Other major athletic fields sodded with conventional sod are those of the Cleveland Indians, Chicago White Sox., Washington, D.C., University of Wisconsin Milwaukee Campus, Oakland Coliseum, Purdue University, and Baltimore, Maryland.

Sod acreage has been increased by about ten percent in this decade, and seed production should go beyond 1,000 acres this year.

The general offices of this business are located at Palos Hills, Illinois, where a staff does the general bookkeeping for the company. Each nursery has a manager and assistant manager and one or two salesmen.

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VANDALISM AND WORK RETRIBUTION

Phil Bennett, Superintendent, Fort Wayne Parks & Recreation Dept.
Fort Wayne, Indiana

First let me explain that I do not get actively involved in the detailed day-to-day operation and maintenance of our golf courses. I have, however, attended the Midwest Regional Turf Conference several times, and have always felt it is an excellent conference, and am very happy to be part of it this year.

Obviously it is impossible to explore in depth all the facets of the complex subject of vandalism or to discuss fully all the dimensions of work retribution during a short period, and so I have put together a series of thoughts that reflect my personal views and our experiences in Fort Wayne regarding work retribution and the vandalism problem.

Now,I don't profess to be an expert in this area, and I'm sure I'm not going to reveal any great new "truths". Rather, I'm going to begin with a compendium of concepts and ideas presented randomly. For lack of a more scientific or literary term, I call these VANDAL-ISMS. I hope these will help spark some of your own thoughts regarding work retribution and maybe will spur you to some action when you return to your communities. Let's take a look at these VANDAL-ISMS:

1. In the game of Justice - OFFENDERS WIN, VICTIMS LOSE.

Historically the primary interest and focus of our justice system has been on the offender, not on the victim. There has been much more attention and concern for the perpetrator than for the victim of the crime. Although recently I think perhaps the pendulum has begun to swing back the other way.

2. In today's sociological math - DO GOODERS + DO BADDERS ARE GREATER THAN DO NOTHINGS.

Those who are always trying to 'do good' combined with those who 'do bad' (the criminals) exert more influence than the rest of us who 'do nothing' (silent masses). The social reformers, the rehabilitationists, the amateur social workers, the idealists, etc., have reinforced the criminals (especially juvenile offenders) in convincing the rest of society, the do nothings, that offenders should be slapped on the wrist, given aid and comfort, and sent on their way. After all, it's not Tommy's fault he broke into the golf clubhoue and stole $18.63, 82 Milky Ways, and a Bullseye putter.

3. HUMAN RIGHTS SYNDROME

Yes, every individual has his rights, and we have just completed the International Year of the Child where we emphasized and celebrated children's rights, including:

- right to affection, love and understanding
- right to education
- right to be free drom discrimination
- right to be a useful member of society
- right to develop individual abilities
- and others

I fully support and endorse all of these, as well as all of our rights and freedoms in this country. But many times we fail to recognize that rights carry with them responsibilties, and in our concern and advocacy for children's rights, we must also include being responsible for their own actions.

4. THE JUDGE ISN'T ALWAYS RIGHT, BUT HE'S ALWAYS THE JUDGE!

What does a 2,000 pound lion have for lunch? Anything he wants... Well, in our case the judge is King of the Jungle, and he can do anything he wants. Judges don't always make the right decisions or hand down the best sentences, but they do make the decisions and they do hand down the sentences. They have great latitude and leeway behind the bench, and we need to talk to these people and other court officials and staff, especially juvenile probation officers, about work retribution programs, other ideas, and other problems and concerns we have regarding the justice system. Talking to a judge can be a little awesome or intimidating to many of us, but they are not unapproachable. And, if work retribution is ever to get off the ground it must have the support and endorsement of the judge.

5. CRIME PAYS - CRIMINALS DO NOT.

Too often we see an offender sacrificing a small fine or a few days in detention in exchange for much greater personal rewards later on. Our punishment doesn't alwys fit the crime. All offenders should be made to repay the victim or society, even if they can't afford it or are unable to. Work retribution is one way in which this repayment can be accomplished, especially for the juvenile. We should be able to turn this around to read - Crime Doesn't Pay - Criminals Do!

6. WORK RETRIBUTION IS LIKE THE WEATHER - EVERYBODY TALKS ABOUT IT BUT NOBODY DOES ANYTHING ABOUT IT.

Work retribution is not a new concept; it has been around for years. A lot of people expound upon its virtues but very few every do anything to put it into practice. The concept is widely known but little used. Sometimes it takes the actions and efforts of some of us outside the justice system to get things moving.

7. THE WORLD IS NOT A JUST PLACE - IT IS JUST A PLACE.

No one ever promised you that everything was always going to be fair, just, and equal in this world, and work retribution certainly makes no promises either. It is not a panacea for our just system and will not bring instant justice to all offenders. The world will continue to be just a place for each of us to live out our days that we have in this lifetime - full of injustices and inequalities. However, I do believe that work retribution does have many potential benefits and should be examined closely as another alternative and tool to be used in our justice system.

Well, those represent some of my thoughts and philosophy relating to work retribution in particular and the juvenile justice system in general. Let's move on now and look at some key elements or ingredients that I believe must be present for work retribution to be successful.

1. Work retribution is a "natural" for parks and golf courses because of these elements:

- kids are interested in the out of doors
- a supervisory structure is already in place and much of the work can be one-on-one
- results are tangible and immediate
- work tasks are generally unskilled

2. Requires the willing cooperation and support and commitment of both the public agency and the court.

3. The offenders have a choice of work retribution vs. detention, fine, probation, restitution, etc. The alternatives must be stiff and unattractive.

4. The program must be viewed as a consequence for behavior, a penalty, a pay-back - and not as a social reform program!

5. Cannot create work! The tasks must be meaningful and necessary to the agency. No "busy work".

6. Work retribution works better with younger ages - juveniles 15 to 20. Older offenders (21-25+) are more threatening to the supervisors and the effectiveness of the program becomes less.

7. Must maintain two-way communications between the court and the agency at all times. Daily visits or telephone checks are recommended.

8. The court must screen the offenders. Some offenders are not suited for this type of program and must be weeded out by the court.

And, finally,I would like to share with you some of the results of our work retribution program in Fort Wayne after its first year of operation.

During the summer of 1979 a number of juvenile offenders were assigned to work in the Fort Wayne Parks as a dispositional alternative by the Allen Superior Court, Family Relations Division. The program was similar to a program used by the Misdemeanor Division of the Allen Superior Court for adult offenders.

The justification for ordering juveniles to perform physical labor is very simple. Since the juvenile's actions result in a cost to the community - either by damages to public property, or simply by the cost of processing through the criminal justice system - it is appropriate for certain juveniles to repay the cost to the community in some manner. Working for the Fort Wayne Parks and Recreation Department is one such way to perform a service which benefits the community directly.

The juveniles assigned to the parks worked with regular work crews, performing tasks such as picking up litter, weeding flower beds, and sweeping park buildings. Shirts, labeled Juvenile Court Work Project",were required to be worn by the juveniles involved in the program.

A total of eighty-two juveniles were assigned to the parks. One juvenile was assigned by the Juvenile Judge as a part of a formal court disposition. The remaining eighty-one were assigned by the Preliminary Hearing Referee. Seven of the juveniles were assigned in addition to being placed on either formal or informal probation.

Offenses for which juveniles were assigned:

Offenses	No. of Juveniles	Percentage
Possession or consumption/Alcohol	38	40.3
Criminal Mischief	18	22.0
Possession/Marijuana	9	11.0
Criminal Trespass	5	6.1
Possession/Alcohol & Marijuana	4	4.9
Other Drug Offenses	4	4.9
False Fire Alarms	2	2.4
Traffic Offenses	2	2.4
Burglary	1	1.2
Arson	1	1.2
Criminal Recklessness	1	1.2
Fleeing a Police Officer	1	1.2
Disorderly Conduct	1	1.2
Total	82	100.0

No. of Hours Assigned		No. of Juveniles	Total Hours
16		14	224
24		47	1128
32		6	192
40		14	560
80		1	80
	Total	82	2184

Five juveniles did not complete their work as assigned. Of these five, one could not complete the work due to health reasons. Problems with the other four included displaying poor attitude, arriving late, leaving early, not reporting at all, and found sleeping during work hours. These juveniles were required to return to the Courthouse with their parents to review the circumstances. Of the five, three were reprimanded with no further action, one was required to make up lost time, and one was placed in detention for six days.

Taking into consideration approximately eighteen hours for juveniles who did not satisfactorily complete the program, 2166 hours labor were provided for the community.

The park supervisors completed a check-off evaluation and returned it to the Court after each juvenile completed his/her work:

Comments	Number	Percent
Positive	67	81.8
None	5	6.1
Supervision needed all the time	2	2.4
Supervision needed at first	1	1.2
Mix-up as to the hours assigned	2	2.4
Unsatisfactory performance	5	6.1
	82	100.0

After the completion of the program, park supervisors were contacted for their comments. All those contacted were pleased with the work done by the juveniles.

In conclusion , it is felt that the Community Service Work Program for 1979 has been successful. The program has been a learning experience for the juveniles involved, and the community has benefitted by the hours worked. Out of the 82 juveniles involved in the program the first year there have been only two repeat offenders. And we have had several that have applied for full-time or part-time jobs with us following the completion of their sentences.

So, in conclusion , those of us connected with the program in Fort Wayne are very encouraged at this point. We feel that it is beneficial to the courts and the justice system, beneficial to the work-site (in our case, parks and golf courses), and beneficial to the offenders as well as to the community at large. Whether or not it eventually reduces or has some impact on the level or degree of vandalism in the parks and on the golf courses remains to be seen. But we are going to stick with the program and if any of you would like to come to Fort Wayne and see our program first hand please let me know and we will be more than happy to help you arrange a visit.

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AN ANALYSIS OF 170 SAND SAMPLES

W. H. Daniel, Turf Research, Department of Agronomy
Purdue University, West Lafayette, Indiana

Sands are being used extensively in the installation and management of rootzones for turf. Seven important characteristics of a rootzone sand include:

1. The finer fraction - 10%
2. The coarsest fraction - 10%
3. Uniformity - 26-48%
4. pH - less than 8.0
5. Less than 1% silt and clay when washed
6. Reasonable priced source
7. Continued availability

1. The finest 10% is all-important. The fine particles settle into openings between larger fractions. The author believes as little as 5%, if silt and clay, or as much as 25%, if very fine and fine sands, actually describes this predominance. These fine particles -

- determine the pore space
- control the rate and extent of capillary action
- permit increased rootzone moisture capacity
- increase surface stability
- improve ease of turf management

2. The coarsest 10% particles -

- form a filter for slits and narrow openings
- tend to reduce moisture retention
- tend to provide a less stable surface
- appear more obvious
- may collect and cause dry spots
- may adversely affect equipment and putting surface
- only occupy space - do little work

3. Uniform particle sand is preferred. Perfectly uniform particles can provide 48% pore space. Naturally occuring sands seldom provide uniform texture, but a "good" (refer to chart) dune (wind sorted) sand may provide 40-44% pore space. Many dune sands provide only 35-40%. Washed "pit" sands provide 26-32% since all particle sizes are often included. When all sizes of sand, plus silt and clay particles are mixed, the pore space is reduced to 18%.

Sand is processed primarily for use in concrete, mortar, and asphalt. For these a variety of particle sizes provides increased density and requires the addition of less cement or adhesive. The quality needed for cement production is the opposite of that best suited for turf production.

For evaluating sand particle sizes our turf laboratory uses a stack of graduated seives which divide dried sand into 14 fractions. The range of sand available has been documented in the 170 samples tested.

Table 1 - Particles at finer 10%

Size required to equal Finer 10%			
mm		%	
-.09		8	holds more
-.12		8	moisture
-.16		15	
-.18	.19 average	15	
-.20		13	
-.22		17	
-.24		15	hold less
+.24		8	drouthy
		100	

The average particle size for the finer 10% is 0.19 millimeters. The particle sizes range at 10% is from .08 to .27 mm. Of all sands tested, 61% measured 0.15 to .25 mm.

At the coarse end of all samples tested, 53% had less than 10% particles more than 0.5 mm in size. Another 17% had less than 20% coarser than 0.5 mm. Therefore, it is evident a rather adequate supply of good quality sands are available for rootzone use.

Table 2 - Percent of 170 sands below 0.5 mm

Quality	%	Less than .5 mm
Very good	40	100-95
	13	-90
Good	17	-80
Poor	11	-70
	9	-60
Very poor	7	-50
(sand trap	2	-40
maybe)	1	-30

Commonly turfgrass surfaces gradually develop an accumulation of thatch and dust which tends to predominate. A program of frequent, light sand applications as topdressing can result in a uniform predominance of sand.

4. pH of sands tested. Tests show dune sands generally are neutral, neither acid nor alkaline. Sand dug and crushed from pits formed by stream deposits in the Midwest tend to be calcareous. A pH of 7.6 to 8.6 has been measured in many samples. The addition of sulfur plus ample phosphorus, potassium and iron may be needed as an initial and annual nutrient program to encourage maximum turfgrass growth on sands with a high pH.

5. Washed sand usually contains less than 1% silt and clay. A simple test to determine the amount of silt and clay in a sand sample is as follows: dilute a 5" column of fresh sand with two parts water, shake vigorously, let settle for 24 hours. The amount of silt and clay present will form a surface crust which should be barely discernable. Pit or unwashed sands vary a great deal but may be suitable for use as a rootzone medium.

6. Availability. Check all sand sources before choosing the best uniform sand available at reasonable cost. Large sand companies are equipped to prepare in one day all the sand needed for the turf areas in a metropolitan district for one year. Turf managers are encouraged to work together to create bulk orders in order to obtain a preferred supply.

Plans for a sand topdressing program should provide adequate machinery for efficient use. The repeated procedure should be an efficient operation. The sand storage area should provide for an ample, dry supply. It should be arranged for easy drumping by trucks when delivered, and machine handling for spreading.

We at Purdue are encouraged by the availability of quality sands. Since 1972 we have records on 170 samples. Turf managers desiring to get an analysis of a sand may send one pint or one pound of sand for each sample to be tested. Ship to: Dr. W. H. Daniel, Turf Research, Dept. of Agronomy, Purdue University, West Lafayette, IN 47907.

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INCORPORATION OF SANDS IN ROOTZONES

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Rootzones can be divided into ten systems. All are described and specified in Chapter 16 of the Turf Managers' Handbook, by Daniel and Freeborg (Harvest Press 1979). Two of these utilize sand as a major part of a mix. Five of the ten use sand as the predominant material so that its characteristics determine the performance of the rootzone. A brief overview may be helpful.

We've researched many sands and sand-like products such as calcined aggregates to determine their potential to store and release water. The dialoams with more than 70% pore space transfer water well. The calcined clays (Turface, Terra-Green) have more than 60% pore space and more water readily available, but release little water to growing turf. These products were researched in the 50's and early 60's. They were widely used in the 60's to improve many greens, tees, and baseball paths and athletic fields.

A long-term trend, 1940-70, has been to use coarser sand particles to dilute silt and clay in topmix and thus reduce the water holding character of the silt and clay. Robert Dunning of Oklahoma, and others favored the coarse and very coarse sands for dilution. Sand also made the plugs from coring easier to crush. However, these combined sand-soil mixtures compact readily and harden as they dry due to the binding effect of the silt and clay. (Systems 4 and 5 of the Handbook).

Both laboratory and field research tests (USGA supported) have established that not more than 5% clay, or 8% silt and clay combined, should be included if the sand is to predominate, i.e., infiltration is rapid and compaction is reduced. Perched rootzones or 'a-mix-above-a-coarse-layer' utilize this principle. Many golf greens have been built in this fashion. (System 5).

Recently the challenge, or difficulty, in accurately controlling the 5-8% silt and clay in machine handling has prompted some architects and builders to omit silt and clay so just use organic matter (such as peat or decayed sawdust, rice hulls, etc.) with sand. Some advantages from using this combination include a reduction in weeds, time savings, and the fact that the area may be immediately compacted and seeded. (System 6).

Many have heard of the old practice of using only sand to topdress, level, and repair greens (or turf areas). Agronomists such as O. J. Noer observed and pointed out the disadvantages of a buried layer of sand. As a soil layer (about one-half inch thick) covers a layer of sand, the surface soil stays excessively wet much of the time, and conversely dries rapidly with a sudden loss of turf. The current wide use of sand topdressing is done in anticipation of a continued use of sand at the surface.

Research has also developed a sand layer rootzone. One version considers a clean layer of sand under an enriched (with organics) surface. This may provide infiltration and yet be economical to build. (System 7). A deeper pit-run bed of sand (10-12" deep) over soil has been tested and utilized in California. In both, drains in trenches are used to remove excess water. (System 7a).

Observations and research of Daniel, Bingaman, and Ralston at Purdue University, 1966-69, led to the development of Plastic Under Reservoir Rootzone with Wick action, labeled Purr-Wick. The first golf green utilizing a Purr-Wick System was built in 1968. Because the water moves readily in sand (at low tension) the compartments within a sloping green must be isolated by internal dividers to minimize siphoning. To improve the efficiency of greens built in 1968-75, internal plastic dividers should be exposed and extended to the surface. (System 9).

In the 80's turf managers face enough challenges without excessive rootzone problems. Understanding how sand can help improve individual turf areas can lead to better and healthier turf and greater turf use.

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TAKE THE GUESSWORK OUT OF GREENKEEPING

William E. Lyons, Lyons Den Golf
Canal Fulton, Ohio

Being a turf manager is sort of a guessing game, much like a golfer who has to guess on past experience which club to use to score.

The golfer has a score card to record his performance on each hole. The turf manager has never had a score card to record his daily estimations for each day's program. Every businessman has to make projections and calculations. A greenkeeper has the responsibility of "keeping the grass green and managing people".

We have developed a Daily Weather and Greens Report. With it we have what Al Radko, Chief Agronomist, USGA, calls a "burlap bag" of tools to take the guesswork out of greenkeeping.

The turf manager never hears his wife say, "Breakfast is ready." He is listening to that all-important weather forecast from his Instant Alert Weather Monitor, a radio (if he is not in a monitor area), or a TV. From experience he knows he must plan the day's work around weather. Even so, both he and the weather bureau sometimes miscalculate. But it is getting to be pretty accurate. Rely on it.

Arriving at the course ahead of the crew the turf manager begins with most difficult tool ever invented for a turf manager, a pencil.

First is to check off the five phases of weather that will govern the day's operation. Next, the three phases of the previous day's weather. For example, high and low temperature total, plus the high ahd low humidity total - "it just might be Pythium weather." Or was the rainfall enough to reduce irrigation? Did the (home made) William's Evaporator show the need for water?

Was there lots of dew (guttated water) this morning? Was it high in nitrates? Should this be washed down (recycled) before mowing? This color test is so simple that a child could use ut. If it is low should we fertilize today?

Are the greens too wet to take fertilizer (liquid)? A moisture meter will show the percent of saturation from 0" to 8" depth. At 25% water will be needed, at 40% watch closely, they may dry before a hot sun.

Grass roots function less well as the soil temperature goes up. Above 70 degrees we do not rely on the roots to transport food to the leaves.

For the past 35 years we have relied on clippings tests to determine the needs of the turf for N-P-K. For this we use the Bray's Plant Tissue Kit. It very quickly shows the lack of or excess of nutrients. If we are lacking in nitrogen? Put on "some", as the late George Hoffer would say. How much is some? Very little at first; experience will in time tell when "some" is too much. Basic rule is 1 lb. of N when soil temperature is 50° to 60°, 3/4 lb. at temperatures of 60° to 70°, and only 1/2 lb. at temperatures above 70° (per 1000 sq.ft.)

We have learned always to apply a few ounces of chelated iron with nitrogen. It makes for longer grass roots. Nitrogen without iron will shorten grass roots.

On greens we never apply nitrogen alone. Using the water soluble (hydroponic grades) of N-P-K, for each unit of N we like 1/2 unit of P and 1 unit of K. the K (potash) makes the turf tougher and will take more wear and also seems to give better disease control. Remember that nitrogen in some forms helps leach the potash away from the rootzone.

One of our tricks during hot weather is to tank mix Daconil, urea, iron and the insecticide Dursban in one application. Saves labor and does the job. We get sod webworm out of aerifier holes.

Before the days of golf course superintendents, greenkeepers like the late Jack Way (Scotchman) Canterbury Country Club, Cleveland, Ohio, did not have a "burlap bag" of good scientific instruments, but he had two "tools" always with him - his hand to test surface tem ratures, and a big pocketknife. Jack would stick that big knife down into a green and be able to tell if there was a dry zone developing. That takes years of experience.

Today we can rely on instruments to "speak out" when the turf will need help. For example, is the light green color of the turf due to lack of nitrogen (test will show) or is it lack of iron? (chlorosis). This is often the case with the high pH caused from the water supply. We saw the greens die at Ohio State University one summer because the water was pumped from a limestone quarry. The pH was so high we could not read it after diluting the sample four times. Applications of iron solved the problem.

In spite of all the TLC fertilizer (tender loving care) we gave some of our fairways, they died. Why? To learn why, when in trouble, ask the turf. Out of this came a Thatch Test Kit (included in our "burlap bag" and sold by the Soil Test Lab, Purdue University, as a Thatch Test Kit). When the thatch tested 4.6 pH we had too high a fungi population. It was living on both the thatch and the live grasses. Liming and aerifying, plus reseeding and fertilizing overcame the problem.

What will the "burlap bag" of instruments do for a golf course? The turf manager can fill out any part of the Daily Weather and Greens Report. It will assist in planning the day with less chance of error, and it will give him a record of successes and failures in his work. For the owner or operator of a golf course, this type of diary of operations should produce for him a superior turf that attracts play, as well as the reocrds. It could even help reduce costs, and is that not important to survival?

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DAILY WEATHER AND GREENS REPORT -- S M T W T F S Time _____ Date _____

Today's Forecast: Temperature: high _____ low _____ total _____
sunny _____ partly cloudy _____ cloudy _____
Chance of rain: morning _____% afternoon _____% evening _____%
Thunderstorms: morning _____ afternoon _____
Wind speed _____ direction _____ barometer _____ R F

Previous day's temperature: high _____ low _____ total _____
" " humidity high _____ low _____ total _____
" " rainfall inches _____ evaporator (William's) _____ inches
Dew guttation high _____ med _____ low _____ local dry spots _____
Nitrates dew test (Bray's powder) high _____ med _____ low _____
Irrigation: Automatic from _____ pm to _____ am minutes _____ inches _____
Manual start _____ pm minutes per green _____ inches _____
Soil temperature 1" _____ to 4" _____ Soil moisture% 0" to 1" to 4"
Mid-day surface temp: hand test: hot dry _____ hot moist _____ cool moist _____
Water supply temp. at green: _____ well _____ lake _____ stream _____ pH _____
Clipping test (Bray) Nitrates: high _____ med _____ low _____
Phos.: high _____ med _____ low _____
Potash: high _____ med _____ low _____
Chlorosis: none _____ slight _____ severe _____
Fertilizer to apply lbs./M sq.ft.: N _____ P _____ K _____ Iron _____
Thatch test (Purdue) Greens pH _____ Fairways #_____ pH _____
Diseases Present: _____
Fungicide to apply _____
Insects present: _____
Insecticides to apply _____
Notes on greens or fairways: _____
_____
_____

Form prepared by Lyons Den Golf, Inc., Canal Fulton, OH 44616
Revised by Dr. Wm. Daniel, Purdue University, Turf Specialist

Daily Weather and Greens Report Tools

1 carrying case (18" length)
200 Daily Weather and Greens Report Forms
1 soils thermometer — Step by step set
1 moisture indicator — of instructions
1 Bray N-P-K Leaf Test Kit
1 Bray Nitrate Test Powder
1 box Whatman filter paper
few sheets wax paper
Few sandwich bags for clippings
1 Purdue Thatch Test Kit

Not furnished but needed - can supply of requested

1 pocket knife with 3" blade
1 homemade golf shaft plugger
1 pliers, use with Bray kit (make sure blades mesh)
1 rain gauge
1 instant weather monitor (where applicable)
1 sun glasses
1 hand lens magnifier
1 William's evaporator gauge (homemade) See instructions

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Copies of these Proceedings are available from:

Midwest Regional Turf Foundation
Department of Agronomy
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West Lafayette, IN 4/907

FERTILIZER PROGRAMS -APPLYING THE IDEAS

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Fertilization research has provided turfgrass managers with several sources of nitrogen which are suitable for use in managing quality turf. In addition to the traditional fast-release fertilizers which were the backbone of the development of the turf industry, today's professional has the possibility of utilizing several slow release sources of nitrogen. Urea formaldehyde (UF), isobutyraldehyde (IBDU), methylene urea, sulfur-coated urea, methylol urea and several natural organic fertilizers are some of the more commonly available sources of nitrogen. A fair amount of research has been generated on these new fertilizers, but the difficult task of integrating these new nitrogen sources into complex existing management programs predominantly falls upon the shoulders of the professional turfgrass manager.

FACTORS TO CONSIDER IN SELECTING A NITROGEN SOURCE

Environmental, managerial and utilizational factors need to be considered in selecting a nitrogen source.

Environmental factors include soil texture, pH, moisture availability, type of grass, etc. Extremely sandy soils, with their high leachability, often necessitate the use of slow release sources of nitrogen. Soils with a high pH are conducive to volatilization and in these situations, urea is less desirable than ammonium nitrate because it tends to volatilize more readily. Slow release sources are less prone to volatilization than urea, however IBDU's rate of release can be excessively slowed by alkaline soil pH. Soil moisture conditions, if excessive, can lead to loss of nitrogen through the process of denitrification, which occurs most readily with nitrate sources of nitrogen in poorly drained soils. Heavily irrigated turf areas are very well suited to slow-release fertilizers such as IBDU since the rate of nitrogen release from IBDU is dependent upon moisture availability. The type of grass being grown and the geographic location are important. When cool-season grasses such as bluegrass are grown near their southern limit, excessive nitrogen release in the summer can mean death. Therefore, nitrogen sources such as UF that release nitrogen as a function of an uncontrollable factor such as temperature can be risky. Obviously many environmental factors must be considered in selecting the appropriate source of nitrogen.

Some of the managerial factors of importance include fertilizer cost, labor requirement, mowing height and levels of quality. Cost ranges are extremely wide for the available nitrogen sources, ranging from $.20 per pound of nitrogen for fast release sources to well over a dollar per pound of nitrogen for some of the new sources of nitrogen. The cost per pound of nitrogen must be tempered by the labor requirement for applying the various nitrogen sources. Fast-release sources require more total labor because of the need for more applications each year. Low mowing heights such as those used on golf greens, necessitate the use of small particle size fertilizers.

Sulfur-coated urea materials with a large particle size have been troublesome because of greens mowers cracking the particles and picking up the recently applied fertilizer in the catchers. If expense is not a major consideration, slow-release fertilizers have much to offer in the way of advantages. For low budget courses, however, the use of these materials has been pretty much limited to the greens with moderate use on tees.

Utilizational factors affecting choice include such things as the reason for fertilizing -- is it Agronomic or Economic? Lawn Maintenance companies frequently find themselves in situations where fertilization is needed at times that are not agronomically sound in order to keep customers happy. In these situations nitrogen source selection can be critical. Too soluble a source may be detrimental yet quick greenup and extended nitrogen release is desirable. Many Lawn Service companies are finding favor in blends continuing IBDU and soluble sources of nitrogen. In highway establishment, incorporation of high rates of UF (5 lb/1000 sq. ft.) are often deemed necessary to provide nitrogen over the two to three year period the new seedings require to reach maturity.

DEVELOPING PRACTICAL PROGRAMS

Different nitrogen sources obviously require different application rates and timing. Each area of the United States will have fertilization programs that are most appropriate.

In Virginia we currently have three basic nitrogen programs for bentgrass golf greens, depending upon the source of fertilizer desired.

NITROGEN PROGRAMS CURRENTLY RECOMMENDED IN VIRGINIA

Program A ---Intermediately available in both warm and cool weather. (IBDU, *Activated sewage sludge, and other natural organic sources*).

	lb. N/1000 sq. ft.
September	1
October	1 1/2 to 2
November -- December	1 to 1 1/2
Mid-December -- Mid-January	1 to 1 1/2
May	1 to 1 1/2
June	0 to 1
TOTAL	5 1/2 to 8 1/2

Program B -- Quickly available** (ANL, *ammonium nitrate, methylene urea, urea, etc.*)

September	1
October	1 to 1 1/2
November	3/4 to 1 1/2
December	3/4 to 1
Mid-January	1/2 to 1
May	1
June	1/2
TOTAL	5 1/2 to 7 1/2

Program C -- Slowly available in warm weather#, unavailable in winter.
Urea - formaldehyde -- 38% N (*Nitroform, Uramite, Borden's 38, Vertanite*).

September	3 to 4
November	1*
Mid-December -- Mid-January	1*
May	2 to 3
TOTAL	7 to 9

**From natural organic or quickly available sources.*

***Exercise caution in the use of quickly available nitrogen sources on established putting greens because of the danger of burning. Do not exceed the rate listed for the specific time of application, spread uniformly, and always water-in thoroughly immediately following application.*

#Program C: 1/4 to 1/2 lbs. of actual N from a quickly available source of nitrogen may be applied occasionally if needed to improve the color. Use the lower rate during hot weather and always water-in thoroughly immediately after application.

The nitrogen programs listed are basic programs using the nitrogen sources indicated. Although each is generally adequate to provide satisfactory response from bentgrass, an equally adequate nitrogen program may be developed using combinations of the three.

Research has provided many new materials which considerably expand the turfgrass professionals ability to produce quality turf. Obviously fertilization programs cannot be "cook booked" for the myriad of conditions that exist in nature. Each turf professional must consider the environmental, managerial and utilizational factors previously discussed and combine these considerations with recommendations of local turf specialists and past experiences of other turf professionals.

REFERENCES

Shoulders, J. F.; R. E. Schmidt and J. R. Hall, III, 1979;
Fertilizer Programs for Established Bentgrass Putting Greens,
Publication 155, VPI & SU

SELECTING BLENDS AND MIXTURES FOR TURF USE

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The production of quality turfgrass is complexed by variable climates, which include extremes of hot and cold weather, often in the presence of limited or excessive soil moisture. Insect and disease activity interact to increase the difficulty of selecting grasses that have a potential for producing the highest quality turfgrass at the lowest cost.

In selecting any turfgrass for a particular area one needs to consider climate, soil characteristics, light availability, irrigation facility, maintenance capability, use, season of planting, and personal preference. The cool-season turfgrasses are best adapted to climates similar to those found in the Northeastern and Norh Central United States. Kentucky bluegrass, perennial ryefrass, creeping red fescue and tall fescue are the more popular cool-season grasses in the cool-humid region. Tall fescue has its greatest use in the drought and heat-prone areas in the southern portion of the cool-humid region. Some of the cold tolerant hybrid bermudagrasses are working their way into turf use in the southern portions of the cool-humid region.

Managing turf in areas where soils are sandy and have low cation exchange capacity and moisture-holding ability necessitates the selection of a drought tolerant turf. The cool-season turfgrass most often recommended in dry shade areas is creeping red fescue or tall fescue. If a green turf is necessary for the entire season, summer irrigation will be necessary. It is important not to select a turf specie which requires higher maintenance than the budget can accomodate. Important in the selection of type of grass is the use to be made of the turf as well as the peak season of traffic. In many situations the time of planting is determined by factors outside the control of the individual responsible for the establishment. In these cases, it is important to consider when seeding is most likely to occur. Every individual has a personal preference with regard to the texture and color of turfgrass. Obviously this is an important determining factor in the final selection.

In order to have a good understanding of the competitive dynamics of any seed mixture it is important to understand the individual strengths and weaknesses of components of the mixture. Kentucky bluegrass has a pleasing texture and dark blue-green color. It has vigorous rhizome activity and a perennial root system. This extensive rhizome system provides it with maximum recuperative potential. Kentucky bluegrass exhibits greater low temperature hardiness than tall fescue or perennial ryegrass and will tolerate moderately wet soils. It reproduces apomictically, which means that the female parent can fertilize herself and produce genetically identical offspring. This reproductive process provides more uniformity in Kentucky bluegrass turf than is available in other grasses, such as tall fescue ryegrass and bentgrass.

Weaknesses of the Kentucky bluegrasses would have to include their slow germination and establishment rate. Successful germination of bluegrasses will normally require 14 to 28 days. Under limited summer moisture the Kentucky bluegrasses tend to go dormant and turn brown. In this condition they can withstand more severe droughts than perennial ryegrass or tall fescue and

regenerate from the crown and rhizomes. Under short term drought conditions better green color will be provided by perennial ryegrass and tall fescue because they do not tend to go into dormancy. Kentucky bluegrass will generally survive a long serious drought better than tall fescue or perennial ryegrass being maintained under similar turf management conditions. The Kentucky bluegrasses have a slower green up rate in the spring than perennial ryegrass and lack shade tolerance. Attempts to take Kentucky bluegrass below a 1 inch mowing height in the more southern portions of the cool-humid region requires additional management expertise to include the application of fungicides and extensive irrigation. The improved perennial ryegrasses appear to be better able to survive lower mowing heights than Kentucky bluegrass if disease pressure is reduced. Thatch buildup on some Kentucky bluegrass varieties under fertilization programs providing 3 to 5 lbs. N/1000 sq. ft. per year has been noticed. The removal of thatch is labor-consuming and expensive.

Kentucky bluegrasses are used in Virginia in the Northern Piedmont region and in all areas west of the Blue Ridge Mountains. The following varieties and percentages are currently recommended.

KENTUCKY BLUEGRASS RECOMMENDATIONS FOR VIRGINIA

Category I - Proven Cultivars

20 - 100%* Adelphi, Birka, Enmundi, Merion, Plush, Victa, Warren's A-34

Category II - Compatible Cultivars

0 - 70%* Baron, Cheri, Rugby, Sydsport, Touchdown, Vantage

*Each variety selected must make up 10 to 35% of the total mixture on a weight basis.

Tall fescue is a good turf if medium quality appearance is acceptable. It is strong in that it has a relatively quick germination rate of 10 to 14 days. It has an extensive, deep root system and can provide acceptable green color during short droughts. Tall fescue is adaptable to a wide range of soil types and does persist under low intensity management. It is popular on highways and on home lawns where a coarser texture is not objectionable. It has exhibited limited shade tolerance in situations where medium light levels are available and the microclimate is relatively dry. It will not provide good shade turf in poorly drained areas.

A primary weakness in tall fescue turf has been the difficulty of maintaining a fine textured leaf blade after seeding. The fine textured appearance is obtained with high seeding rates from up to 200 to 350 lbs./acre. However, after 3 to 5 years, the blades tend to broaden and become less desirable. Frequent mowing and periodic renovation by overseeding helps maintain the fine texture desired in Kentucky 31 tall fescue. Kentucky 31 and Rebel are two commercially available varieties of tall fescue that have performed well in Virginia trials. Several experimental tall fescues look promising and it appears that many new varieties will be commercially available in the next 5 to 10 years.

The improved perennial ryegrasses have made great strides in popularity in the last five years. The improved cultivars such as Manhattan, Pennfine, Derby and Citation have performed quite well. The strengths of the improved perennial ryegrasses include their medium texture and the fact that they blend well with the improved Kentucky bluegrasses. Their quick germination and strong seedling vigor has made them popular in athletic field repair. The perennial ryegrasses grow later into the fall than the Kentucky bluegrasses. This is seen by some as an advantage in that good green turf is provided over a longer period of time, however, others consider the extra five weeks of mowing a disadvantage.

Overall disease susceptibility is the major weakness of the perennial ryegrasses. They are extremely susceptible to the hot summer diseases such as Pythium and Rhizoctonia Brown Patch. Poor mowing quality in the months of June and July is characteristic of the perennial ryegrasses and is caused by the shredding vascular strands. Ryegrasses lack rhizomes and therefore have little healing potential where injury has occurred. The bright glossy underside of the improved perennial ryegrass blade does provide a color contrast which is noticeable in situations where bluegrass and ryegrass have been mixed. The ryegrasses as a group of grasses are considered to lack winter hardiness. Perennial ryegrasses appear to be more upright in growth habit than the majority of Kentucky bluegrasses and when mixed with Kentucky bluegrass this growth habit does necessitate more frequent mowing as the upright tendency produces an uneven appearance.

The fine fescues exhibit very high shoot density, extremely fibrous root systems and germinate in 7 to 14 days . The exceptional shade tolerance makes them the best cool-season grass for shade mixtures. Fine fescues also exhibit very good drought tolerance and can provide quality turf under relatively low soil pH conditions.

In combining the cool-season grasses such as Kentucky bluegrass, Tall fescue, Perennial ryegrass and Fine fescue it is important to use good judgement. In Virginia, we hestitate to mix more than 15% of any perennial ryegrass with Kentucky bluegrass, as the perennial ryegrass tends to dominate the stand. The general disease susceptibility of the ryegrass leaves a ryegrass-dominated turf with a good likelihood of contracting a severe summer disease infection unless fungicides are utilized.

In mixing Kentucky bluegrass with tall fescue we do not generally recommend more than 10% Kentucky bluegrass with Tall fescue as the bluegrass tends to dominate in our cooler and moister areas. This is less of a problem for us east of the Blue Ridge Mountains where heat and drought are more common. The Kentucky bluegrass domination is not considered desirable because it leaves the turf with clumps of tall fescue which are objectionable.

When mixing creeping red fescue with Kentucky bluegrass for full sun areas we never recommend more than 20% fine fescue in the mixture. Under droughty, low management conditions the fine fescue tends to dominate leaving a turf that is highly susceptible to Helminthosponium leaf spot and heavy thatch buildup. In shady areas we do recommend higher percentages of creeping red fescue.

In selecting the right components to include in a mixture it is important to be aware of the weaknesses and strengths of the individual components of the mixture. Understanding how the individual components will react to climatic, edaphic and biotic factors will help determine the proper amounts of each component to include to assure the highest turf quality possible.

THE PERENNIAL RYEGRASSES - UNDERSTANDING THEIR CAPABILITIES AND LIMITATIONS

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In the last five years there has been a tremendous increase in use of the improved perennial ryegrasses. Breeding programs at Rutgers and Pennsylvania State University have provided new improved cultivars of ryegrass. These new, medium textured, improved perennial ryegrasses have significantly expanded the capability of the professional turfgrass manager. They are being used more and more frequently on golf courses, athletic fields, and home lawns. As professional turfgrass managers consider using the perennial ryegrasses, it is extremely important that they be aware of their capabilities and limitations.

Some of the strengths of the perennial ryegrasses which have been noted include the fact that they are medium textured in blade width and blend well with Kentucky bluegrass. Their quick germination and establishment rate makes them extremely popular in situations where erosion is likely to occur or where quick customer satisfaction is necessary. They have exhibited good traffic bearing characteristics and show a strong recuperative potential especially during the cooler periods. They may grow 4 to 5 weeks longer in the fall and green-up 4 to 5 weeks earlier in the spring than the Kentucky bluegrasses. This can be either an advantage or a disadvantage. In situations where the extended growing season is needed, it certainly is an advantage to have this extra growing period, however, in situations where this simply means 8 to 10 more mowings a year, it certainly is an added cost. The improved perennial ryegrasses appear to be able to survive at lower mowing heights than the Kentucky bluegrasses. In test plots at Blacksburg, Virginia, we have observed Pennfine perennial ryegrass survival for 18 months under Bentgrass putting green management at 4/16" of a mowing height. This ability to withstand low mowing height would, of course, diminish as heat and disease stress increased.

The improved perennial ryegrasses have exhibited good short term drought color. During 20 to 40 day periods with limited water availability, they have maintained good green color in situations where Kentucky bluegrass has gone dormant. It is likely that they have less ability to withstand a long term drought, in that they lack rhizomes and the "early warning" dormancy capability of Kentucky bluegrass. The improved perennial ryegrasses have been very popular on athletic fields where they appear to develop a stronger root-soil bond than Kentucky bluegrass. There has been less flaking and shearing of the turf at the thatch-soil interface in situations where the perennial ryegrasses have been overseeded into Kentucky bluegrass athletic fields.

The vigor of the improved perennial ryegrasses has been an extreme advantage to the lawn maintenance industry in that it has made possible the successful overseeding of semi-thatchy areas. In the past, the limited seedling vigor of Kentucky bluegrass made it difficult, if not impossible, to successfully introduce new turf varieties into lawns where thatch depth exceeded one quarter of an inch.

The improved perennial ryegrasses have been excellent for overseeding bermudagrass tees, fairways, and home lawns. Their quick germination and desirable texture and color have provided excellent winter quality. Their ability to persist into the summer provides a smoother transition back to bermudagrass than has been possible with annual ryegrass.

Some of the weaknesses of perennial ryegrasses which have been observed in Virginia are disease susceptibility, non-uniform upright growth habit, lack of mowing quality, slow lateral growth habit, and a lack of seedling winter-hardiness.

The perennial ryegrasses appear to be extremely susceptible to pythium spp. and Rhizoctonia solani activity during hot weather. Unpublished data of Dr. H. B. Couch of Virginia Tech indicates there is a range of varietal resistance to these organisms. As a group of grasses, the perennial ryegrasses appear to exhibit less resistance to these hot weather diseases in the field than the improved Kentucky bluegrasses.

The ryegrasses are also susceptible to Helminthosporium sativum and Corticium fuciforme (Red Thread). Disease resistance is a major concern in breeding programs of improved perennial ryegrasses. At this point in time disease susceptibility is the major drawback in the use of the improved perennial ryegrasses.

In early spring and late fall the ryegrasses exhibit rapid and relatively upright leaf elongation rates which necessitate more mowing in bluegrass-ryegrass mixtures, than in straight bluegrass stands.

Mowing quality is still considered poor on the perennial ryegrasses. Citation and Diplomat have shown the best season-long mowing quality. However, the majority of the commercially available perennial ryegrasses do exhibit poor mowing quality at one time or another during the year (1).

Data from a study conducted at the University of Maryland in the summer of 1975 suggests that the perennial ryegrasses do not exhibit the lateral healing growth habit of the Kentucky bluegrasses (Table 1). In this study, cup-cutter size divots were removed and the soil replaced in such a manner as to allow normal healing of the divot. Fifty days after the cut had been made, the percent of the divot that was healed was recorded. In this study, you will note that the Kentucky bluegrasses exhibited much better healing potential than the perennial ryegrasses.

Table 1. The 50 day divot healing ability of 3 Kentucky bluegrasses and 3 perennial ryegrasses in the summer of 1975.

Cultivar	Portion of Divot Healed
	- - % - -
Merion	89
Baron	82
Kenblue	75
Derby	30
Manhattan	27
NK-200	13

In view of the fact that perennial ryegrasses are exhibiting extreme summer disease susceptibility in transition-zone climates, it is of major concern that they have shown a tendency to be extremely aggressive in certain situations when mixed with Kentucky bluegrass. The degree of aggressiveness is, of course, dependent on several factors including what variety of ryegrass is mixed with what variety of bluegrass. However, in studies seeded at Virginia Tech in April of 1972, containing 87.5 percent Merion Kentucky bluegrass and 12.5 percent Manhattan perennial ryegrass (bluegrass: ryegrass seed ratio of 69 to 1) the ryegrass made up 58 percent of the ground cover by April of 1977. This does not appear to be a serious problem where ryegrass is not exposed to hot weather disease. However, this could be a serious problem in areas where high temperatures and excess moisture and humidity are present. This aggressiveness would significantly increase the probability of

loosing the ryegrass dominated turf to summer disease.

The perennial ryegrasses as a group of grasses are not exhibiting good long term shade tolerance, however, their extremely fast germination and establishment rate does allow development of a turf in heavily shaded areas which will last 100 to 150 days. This certainly is an advantage over what we have been previously able to do with the existing slow establishing Kentucky bluegrasses.

In summary, as one considers using the perennial ryegrasses in a turfgrass management program, it is important to realize their strengths and weaknesses. Their disease susceptibility is a serious concern and is more serious in areas where hot weather disease activity is extreme. In areas where summer disease pressure is heavy, the perennial ryegrasses are going to be extremely limited in their ability to provide quality turfgrass over an entire growing season. At this point in time, the improved perennial ryegrasses are not, in my opinion, capable of providing the level of season-long quality we associate with a good Kentucky bluegrass mixture.

The perennial ryegrasses should be used primarily as a support or specialty grass in areas where summer disease potential is high. In these areas, they should be utilized with the realization that they will require a fungicide program and may require annual reseeding to thicken the turf.

When one compares Kentucky bluegrasses as a group of grasses with perennial ryegrasses as a group of grasses (Table 2), it is obvious that the perennial ryegrasses have provided us with improvements in establishment rate, spring green-up, low mowing tolerance, short term drought color and better root-soil bond. They have made a significant contribution to our ability to produce quality turf in the climatic transition zone. Hopefully, the breeding programs underway in several universities and companies will provide us with stronger perennial ryegrasses to use in our attempts to produce quality turf. Be prudent in your use of the improved perennial ryegrasses, realizing their strengths and weaknesses.

Table 2. A generalized comparison of the characteristics of the improved Kentucky bluegrasses and the improved perennial ryegrasses.

Characteristic	Kentucky bluegrass	Perennial Ryegrass
Establishment rate	poor	excellent
Heat tolerance	fair	poor
Spring green-up	fair	good
Shade tolerance	fair-poor	fair-poor
Disease resistance	fair	poor
Low mowing tolerance	fair	excellent
Thatch buildup potential	good	?
Mowing quality	good	poor
Short term drought color	poor	good
Long term drought survival	good	fair
Divot-healing potential	good	poor
Root to soil bond	fair	good

References

1) Funk, C. R. 1978 Proceedings of the 18th Annual Illinois Turfgrass Conference. University of Illinois.