PROCEEDINGS

of

1956 TURF CONFERENCE

Sponsored by the

Midwest Regional Turf Foundation

and

PURDUE UNIVERSITY

LAFAYETTE, INDIANA

March 5 to 7 1956

PROCEEDINGS OF THE

1956 MIDWEST REGIONAL TURF FOUNDATION

A copy of these Proceedings were mailed to -

1. The 485 attending the 1956 Midwest Regional Turf Conference
2. The Superintendents of member Clubs in the Midwest Regional Turf Foundation not attending the Conference.
3. List of those in educational turfgrass activities.

Additional copies are available at $1.00 each from -

W. H. Daniel, Executive Secretary
Midwest Regional Turf Foundation
Department of Agronomy
Purdue University
Lafayette, Indiana

Attendance divided by interest as judged by Registration card

Golf Courses	303
Cemeteries	10
Education	24
Landscape & lawn care	35
Nurseries	23
Roadsides	4
Turf material suppliers	86
Total	485

Attendance by area represented by the 13 Golf Course Supts. Ass'n.

Midwest	138
Canada	1
Central Illinois	35
Central Ohio	7
Cincinnati	26
Indiana	85
Kentuckiana	16
Miami Valley	16
Michiana	22
Michigan	22
Mississippi Valley	25
Northern Ohio	35
Outside Midwest	25
Purdue	9
Western Michigan	6
Wisconsin	17
Total	485

TABLE OF CONTENTS

		Page
President's Address	Ward Cornwell	1
Long Range Forecasting	James E. Newman	1
Weather Reporting & Forecasting	Bill Crawford	4
Observations on Eastern Turf Areas	W. Bidwell	7
Campus Maintenance	Jim Sinninger	9
Nutrient Insurance for Healthy Turf	C. G. Wilson	11
Healthy Turf Thru Fertilization & Irrigation	R. V. Mitchell	17
Irrigation & Fertilizing for Healthy Turf	Mal McLaren	18
Keeping Healthy Turf Thru Fertilization & Irrigation	R.M. Williams	19
Keeping Turf Healthy Thru Preparation with Irrigation	A. Bloch	22
Sod Nurseries - Keeping Turf Healthy Through Fertilization and Irrigation	B. Warren	23
Fertilizing for Sod Nurseries	W. H. C. Ruthven	24
Weed Control for Healthy Turf	P.Burdett	25
Healthy Turf Through Weed Control	J. E. Gallagher	28
The Use of Odorized Methyl Bromide for Turf Improvement	J. H. Davidson	30
Notre Dame Football Field Renovation	C. R. Keeley	34
Lead Arsenate and Poa annua	W. H. Daniel	36
Research on Poa annua control	N. Goetze	37
Fungicides for Disease Control	J.L. Holmes	38
Remarks by R. T. Miller		41
Fungicides for the Control of Turf Diseases	Geo. Swank	42
What They Ask About Grass?	F. V.Grau	44
Merchandising Meyer zoysia	L. H.Glissman	46
Commercial Zoysia Production	J. C.Harper	47
Zoysia Growing Problems in Certification	H. A.Inglis	51
Zoysia Needs for Tomorrow	W. H. Daniel	53
Questions Asked on Zoysia		55
Building Towards Better Grasses	R. C. Pickett	56
Advertising and Zoysia	J. C. Phillips	59

PRESIDENT'S ADDRESS

Annual Meeting, Midwest Regional Turf Foundation
Ward Cornwell, Detroit Golf Club

I want to extend a cordial welcome to the members and guests at this Tenth Anniversary meeting of the Midwest Regional Turf Foundation. I am making this report in the absence of your President, Frank Dunlap.

If I may reminisce just a minute, I would like to take you back eleven and ten years when this Foundation was being formed and our first meeting. There were probably twenty-five in the room - we were sitting up late hours of the night wondering how this could be accomplished. In time with a Charter, By-laws and Memorandum of Agreement this was arranged.

I believe we started our first year with about 100 members. At the present time we probably have over 260. It is true that this Foundation has shown growth. We are financially sound, but are limited to what we can do in the way of Turf Research. I do not believe that the increased membership from 100 to 260 has shown enough growth. With a larger membership Dr. Daniel and his staff can do more turf work for us. Last night you received material concerning the Foundation. I believe that every man attending this Conference should see to it that his club or firm is a member of the Midwest Regional Turf Foundation. The registration fee which you pay only covers the cost of this Conference that you are attending, whereby if you were all members of the Foundation we could do a great deal more in the Turf Research that we are so vitally interested in.

I would say that we have not reached complete success until 100% of the attendance of the Conference are members of the Midwest Regional Turf Foundation. We cannot thank the University and Dr. Daniel enough for the work he has put in. Again, all are welcome here. This is a state institution and our Foundation through it attempt to serve everyone possible.

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LONG-RANGE FORECASTING

James E. Newman
Dept. of Agronomy, Purdue University

Long-range forecasting of general trends over large areas has met with considerable success in the past ten years. By meteorological definition, any forecast greater than 36 to 48 hours is considered a long-range. In other words, statement concerning the expectance of weather events for a period greater than two days in advance is, in effect, a long-range forecast. Generally speaking, they interpret the weather in terms of expected deviations from the climatic normals for the given time, period and place. Short-range, or daily forecasts, rely almost completely on atmospheric conditions associated with migratory storm movements.

Methods of Long-range Forecasting

We have embedded in our folklore many sayings, signs and timely ob-

servations which lay claim to forecasting of coming events in weather. Most have little scientific basis; however, some folklore claims, when applying to certain areas, are based on the physical laws that generate large scale weather patterns. For example, an observed change in the winds during May and October in certain areas of the world forecasts "the bursting of the monsoons".

Many methods of extended forecasting based on scientific measurement have been used in various areas of the world. Perhaps the most noted of these is the Weather Typing Methods, several variations of which were used during World War II. May I explain in some detail how one can interpret the US Weather Bureau 30-day Outlook and perhaps give you some ideas of how you might make use of some extended weather outlook.

Interpreting the USWB 30-day Outlook

Starting in January 1947 the USWB began publishing bi-monthly long-range weather prognostications (a ten dollar word for something a little more accurate than a climatological guess). This publication, entitled "Average Monthly Weather Resume and Outlook", is based on established principles of atmospheric circulatory changes.

First of all the 30 day weather outlook attempts to predict only average weather conditions for any given place and period, and not specific day-to-day weather happenings. This point should always be kept in mind when interpreting "The Weather Outlook". Secondly, the Outlook is not intended to be used for predicting very unusual weather occurrences such as hail storms, tornadoes, etc. Such weather occurrences are fast developing meteorological freaks and are not predictable for any length of time ahead. Thirdly, when attempting to interpret the 30-day outlook for any given local area or community, one must always base his prediction in relation to what is normally expected during this period. In other words, the descriptive word classification for both temperature and precipitation are used in an attempt to describe the coming expected weather conditions in relation to what is normally expected for a certain period of time. For this reason it is very important to understand what the normal climatic conditions are for a given place and time.

How 30-day Interpretations are Made

As previously stated, all interpretations are given in relation to the normal of a particular climatic factor. Climatological normals are based on 30-year records (1920-1950) for any given area. In Indiana these are: northern - Fort Wayne; central - Indianapolis; southern - Evansville.

Verbal Classification of Predictions

The 30-day weather outlook reports: Precipitation - heavy, moderate, or light. Temperature: much above normal, above-normal, normal, below-normal, and much below-normal.

For precipitation the climatic normal for a given area is established from average amounts of precipitation recorded in the 30 year records. These averages, for each of 30 years during period predicted, are arranged in ascending order and divided into three groups -

1. Light precipitation - range of 10 driest
2. Medium " - range in middle
3. Heavy " - range of 10 wettest years

For example, if the prediction is for moderate precipitation for July at Ft. Wayne, Indiana, one can expect the July precipitation to fall between 2.8 and 4.5 inches of rainfall. For heavy precipitation 4.5 or more inches would be expected. Less than 2.8 inches for light precipitation would be expected.

Temperature predictions follow the same idea, except that five descriptive word classifications are used instead of three. This is accomplished by dividing an ascending 30 year climatic record of averages into five segments instead of three. In this case the 30-year climatic averages are again arranged in ascending order starting with the warmest six, followed by the next warmest six, followed by the Middle six, followed by the next six cooler than average, and finally the coolest six averages. If much above normal temperatures are predicted, it simply means that the temperature for a given time and place is expected to be as high as the temperatures recorded in the six warmest averages used to establish the classification.

Possible Use of 30-day Outlook Interpretations

Since 30-day outlooks only attempt to predict general weather trends, one should remember that applications must be confined to general overall planning of rather large operations. Examples of these operations are planting, reseeding or transplanting, harvesting, irrigation schedules, spraying for disease and insect control, as well as any other operation which cannot be completed in less than a week. Let us consider a predicted heavy precipitation and below normal temperature. For May, it will mean fewer days to complete any spring planting operation; for June, it will mean fewer days for hay-making, as well as a weed problem in summer crops; for July it will result in a moisture problem in the harvesting of small grains; for August and September, heavy rainfall and unseasonably cool temperatures will cause many diseases in summer crops. These same August and September conditions can afford an excellent opportunity for reseeding of legumes and grasses.

Perhaps the greatest application of the 30-day outlook in general management operations is seen during periods when unusual climatic deviations are foreseen - in other words, where weather predictions are vastly different than what is normally expected during the coming 30-day period. It is the extended periods of extreme weather that cause the most difficulty for management operations subject to weather hazards. In most cases weather risks which are economically sound can be minimumized by management if foreseen a week to 10 days in advance. For example, foreseen conditions which will lead to an early frost and the scheduling of the last tomato harvest in a large operation.

Summary

1. Long-range forecasting of general weather trends have had some success during the past 10 years.

2. Long-range forecasting is considered to be any forecast covering a period greater than 48 hours.

3. The US Weather Bureau publishes long-range weather prognostications twice monthly.

4. The USWB 30-day outlook attempts to predict only average weather conditions over broad areas and not specific day-to-day weather happenings.

5. Long-range forecasts never attempt to predict so-called meteorological freaks such as tornadoes and severe hailstorms, etc.

6. Most long-range forecasting is expressed in terms of expected deviations from the climatic normal.

7. When interpreting 30-day outlooks, an understanding of what is climatically normal is very important, since all predictions are based on climatic normals.

8. Many general management applications seem to be possible through proper interpreting the 30-day forecast.

9. Perhaps the greatest applicational use as found during the periods when unusual climatic deviations are foreseen.

10. Anyone can subscribe to the "30-day Weather Outlook" by writing the Supt. of Documents, Government Printing Office, Washington 25, D.C. Subscription price: $ 4.80 per year.

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WEATHER REPORTING AND FORECASTING

Bill Crawford, Weather Forecaster
WFBM-TV, Indianapolis, Indiana

Weather Reporting is:

1. World wide outside the iron curtain and from what balloons drift over the borders.

2. During the war, weather reports were ciphered but all ciphers were broken.

3. Major weather reporting elements in the U.S.A. are:

   a. Weather Bureau.
   b. Army, Navy, Air Force and Coast Guard.
   c. Volunteer reporters for the Weather Bureau with little or no compensation.
   d. CAA Stations.
   e. Commercial Airline Depots.
   f. All pilots while in flight.

4. Types of weather reports are:

a. Surface reports over land and sea consisting of:

1. Present temperature.
2. Dew Point.
3. Relative humidity.
4. Wind speed and direction.
5. Current pressure and amount and direction of change over a set period, usually three hours.
6. Cloud type, amounts, heights, and direction and speed of movement. The amount of sky covered by the clouds is estimated in tenths, or as scattered, broken or overcast skies.
7. Maximum and minimum temperatures for the twenty-four hour period, midnight to midnight.
8. Precipitation type and accumulated amounts for the last 3, 6, 12, or 24 hours.
9. Wave heights and direction.
10. Height of rivers and amount of flow.

b. Upper Air Reports

1. Radar detects position and movement of local storms. Located at airfields, these radar are used both as navigational and landing aids to airplanes as well as for storm detection purposes. C.A.A.

2. Pilot balloons are free drifting balloons rising at a constant rate of ascent and tracked by use of a theodolite (a surveyor's instrument). From this can be computed the direction and speed of the winds aloft up to the base of an overcast. Balloon is sometimes lost in hazy or dusty skies, or when tracked into the sun.

3. Radiosonde and Rawin free rising balloons are tracked by radar regardless of nature's obstruction to vision and also they radio back the temperature, pressure and relative humidity to a ground receiver from various altitudes.

4. Spherics is a long range storm detection device which basically pinpoints the storms by getting simultaneous radio bearings of the storm's electrical discharges or potential from three widely separated stations. By triangulation the storm is then pinpointed.

5. Hurricanes and other special phenomena are pinpointed and tracked by weather reconnaissance squadrons of the Air Force with some help from the Navy.

5. Collection and dissemination of Weather Reports

a. Mostly by U. S. Weather Bureau teletype network via Western Union and Bell Telephone channels.
b. By radio
c. By radio teletype

d. Each station encodes its own reports in number and/or symbols and transmits this information at proper second at each designated reporting time.
e. These reports are collected at major collection centers throughout U.S.A., edited and redistributed to other centers.

Forecasting

Types of Forecasts -

1. Spot forecasts - each station six hours.
2. Airways forecasts.
3. Forecasts for small grains.
4. Warnings affecting:
   a. Travel
   b. Boats
   c. Life, property and crop damage
      1. Tornadoes
      2. Winds
      3. Floods
      4. Droughts
      5. Ice - snow
      6. Freeze or frost
      7. Intense heat
5. 24 - 48 general forecast.

How Forecasts are Made

Generally speaking, all the various reports from North America and the Atlantic and Pacific are plotted on various charts at specified intervals each day. These charts are: surface weather maps, cross sections of the atmosphere along airways, local atmospheric conditions over selected individual stations, winds aloft charts and various types of upper air charts covering the whole U.S.A.

The basic method of making a forecast is to follow the movements of the weather conditions, the flow of moisture aloft, and the trend of the intensity of the storms from chart to chart and so forecast what the charts will look like in 24 hours.

Many variations of this general pattern are used. Theoretically, if all the tendencies could be correctly interpreted we could be right 100% of the time. Remember, the next time you hear a TV weather report that it combines a large background of data and experience. Weather is a dynamic changing relationship, therefore, forecasting never becomes a guarantee.

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OBSERVATIONS ON EASTERN TURF AREAS

Warren Bidwell, Supt., Seaview Country Club
Absecon, New Jersey

This is the two hundred and fiftieth anniversary of a very fine Quaker gentleman, Benjamin Franklin, who said: "Some people are weather-wise, but most are otherwise".

After the experiences of 1955, most golf course superintendents are weary of the weather. The weather patterns of July, and of August in particular, had a great influence on golf course maintenance, business and industry in general along the Atlantic Coast. You see, hurricanes Connie and Diane were very expensive girls. They cost the East coast over a billion dollars in damage.

Connie was very slow and erratic in her movement, and, while the wind damage was on the light side, rainfall from the Carolinas to New England was very heavy, especially in the Pocono Mountain area of Pennsylvania, where Stroudsburg received twelve inches in seven days, and in southeastern New York state, where La Guardia Field received twelve inches in thirty-eight hours. This soaking prepared the East for one of the most destructive situations in her history.

Diane soon followed and dumped billions of gallons of water along the same path Connie had pursued, making the total rainfall for August: fourteen inches at Richmond, Va., eighteen at Baltimore, fifteen at Stroudsburg, and thirty inches at Blandford, Mass. Diane cost the lives of one hundred and eighty-four people and a billion dollars in property damage. Some golf courses have not recovered yet.

In the East, as in most other places, a red sunrise is a sure indication of a heavy atmosphere above us. As the sun burns off the overcast, we find our golf courses laden with a heavy dew-almost rainlike at times--making ideal conditions for disease trouble on our turf.

After the excessive rains of Connie and Diane, it followed that we would experience trouble on our greens, for they were already weakened by the record-breaking heat of June and July. The high tides resulting from Connie and Diane covered our turf with salt water. Turf that had not been previously saturated from rainfall, or was not immediately washed off by rain or artificial means, suffered total destruction in the affected areas.

From these excessive rains, much turf was lost by simple suffocation. Fred Waring's course, Shawnee-on-the-Delaware, was flooded to a depth of ten feet. The Delaware River cut new channels right through the course.

In Florida, Gene Tift strains of Bermuda grass are making a name for themselves, but farther North we have had disappointments. During the last Field Day which the Greens Section sponsored at Beltsville, Md., we toured a golf course along the Potomac River, observing the blending of Bermudas and cool season grasses. In one instance we noted

the Cohansey strain of bentgrass crowding out Bermuda. At Colonial Williamsburg warm and cool season grasses were blended.

At Mt. Vernon where thousands of people make their pilgrimage at one time or another, cool season grasses predominated, being mostly bluegrass and fescue.

At the Woodmont and Princes George Clubs near Washington we noted the ability of U-3 Bermuda to grow in areas where literally nothing else would grow, and at Hercules near Wilmington, Supt. Frank Tull is successfully using U-3 Bermuda in normally troublesome areas.

A showing of Eastern golf courses would not be complete without presenting some of the famous holes at Pine Valley. Here, shot placement is a must. Like many of us, Eb Steiniger has struggled for years with the cool season grasses on his fairways. Many seasons his efforts have been successful, although I believe his feeling is that, too many times, the cool season grasses have failed to resist the onslaught of a difficult season.

In recent years, Eb has pioneered in the use of U-3 Bermuda in his most difficult areas. Many of his observations on the warm season grasses have been made on his own demonstration area, where he has planted many different combinations of warm and cool season grasses and as individual plantings. He has found that, while lack of color in warm season grasses is a deterrent factor, golfers will tolerate this situation so long as they are able to play from good turf, regardless of season.

The famous seventeenth hole was successfully converted to U-3 Bermuda. As the approach shot to the green always requires a niblick, formerly the area was quite full of divot holes. Now, with a firm close-clipped U-3 cover, the maintenance problem no longer exists. After experimenting with various vegetable dyes, Steiniger came up with a formula which is sprayed on his fairways during the non-growing season.

Unlike Pine Valley, we at Seaview strive to grow grass on every square inch. Native sand outcroppings in the rough areas require annual attention and heavy applicationsof fertilizer, lime and seed to accomplish this. Considerable progress has been made, but during the drier portions of the growing season the Poa annua grasses and other short-rooted grasses find the going rather difficult. At one time we attempted to rid ourselves of the Poa annua menace through the sodium arsenite method prior to and during the annual seeding period. However, we ran into opposition from the membership, primarily because they did not understand our aims, and furthermore, they wanted to see a green golf course, not one that was brown.

One successful venture in selective weed control was our elimination of clover through the use of 2,4,5-T, from a mixed turf of Poa annua, bent and bluegrass.

We have successfully used hemlock trees to screen and semi soundproof certain areas. We have added rhododendrons to our wooded sections, and, with only a slight amendment to our native soil, azaleas do very well for us. Also, American holly is a native plant in New Jersey.

One of the stumbling blocks which we encountered in setting up a cut-flower program was the presence of nematodes in our soil. Identification was made for us by the Rutgers University Experiment Station before we knew where to start in correcting the situation. Dow chemical MC 3 was used to treat our flower-growing area, also Virginia-Carolina Chemical Company's VC 13 was successfully used. Among the cut flower crops affected were hardy mums, gladiolus, lilies, and some of the more common annuals.

In the historic Valley Forge area of Pennsylvania turf is composed of the native bluegrasses and fescues which thrive under a high cut, which is done, in the most part, with the mowing machine type of cutter.

At Gettysburg, within sight of Little Round Top and the Peace Memorial Monument is the farm of our President. The sod on the President's putting green was grown by Leonard Strong of the Saucon Valley Country Club, Bethlehem, Pennsylvania.

In the heart of Pennsylvania, at the State University, Professor Burt Musser has initiated valuable turf experiments, being responsible for introducing many new grasses for use in the fine turf field. Research is being carried on at Penn State which may provide some answers to the problem of rust in Merion bluegrass, and to some of the mysteries associated with production of uniform Merion bluegrass seed. At Seaview, Merion was the best piece of cool season fairway grass in our thirty thousand square foot nursery.

In the mountains of Vermont and New Hampshire are many small golf courses that are dependent on the tourist business. Sometimes not even the greens are watered except by nature. Fairways are of hard fescue and greens mostly of seaside bent, but sometimes they, too, are of fescue.

We, as golf course superintendents, often feel that our profession is a precarious business. I can think of others that are more so, and as long as we in America have the freedom of making our choice, I would not care to select any other field.

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CAMPUS MAINTENANCE

Jim Sinninger, Supervisor
Purdue University

After looking over the technical material that you men have been exposed to today, I thought I would digress from that subject and give you a resume of our operations here at Purdue.

As you can see for yourself, this campus has been fairly well torn up. What the contractor hasn't bulldozed out, the students have tramped down. However, you are all familiar with this type of operation. As you grow and expand you must tear up and rebuild.

Back in 1943 the campus was composed of approximately 100 acres of lawn. The ground maintenance crew had 5 employees in the winter and 10 in the summer.

As for equipment we had:

6 Hand mowers
1 Toro Professional
2 Ideal triplex
1 Silver King tractor
1 dump truck (hired for $ 1.00 a day)
Also small hand tools

Today we have increased our lawns to about 300 acres and are spread out over the entire county. Our man power totals 45 men in the summer months and 24 men in the winter time.

As our lawns have increased in acreage, we have also increased our scope of work. Today we include maintenance of roads, parking lots, sidewalks, new area development, campus signs, fence construction and various other small jobs that are related to general maintenance.

As for equipment we now have:

5 tractors
5 trucks - 2 dump, 3 pick-up
7 triplex - 6 Toro, 1 Locke
2 gang mowers 1-3 unit 1-5 unit
7 small power mowers
25 hand mowers
3 power saws
2 portable generators
3 tree sprayers
4 trailers
Other small tools.

This gives you a fair idea of how we have expanded our operations of turf maintenance. With this expansion and diversification of work, we have been able to utilize some of our man power over a 12 month period. However, this has created labor problems such as, leadership of men, work lay-out and planning, ability of one man to do several classes of work, and straight labor supervision. In order to solve this problem we selected men from the crews and made them straw bosses, crew chiefs, or lead men. We then trained them to do various types of work. This training was done un-beknown to the men selected and was done over a period of 5 years.

Another labor problem we were confronted with was seasonal help. We first started out with younger men, but a temporary job at our rate of pay wasn't very attractive to them.

One year I sent in a request to our Personnel Department for 8 men to cut grass - age requirements: over 65. Gentlemen, I was amazed at what we hired: retired railroaders, business men, farmers and coal miners.

These men wanted something to do, yet industry wouldn't hire them because of their age. The pay wasn't what they were interested in - it's the fact that they were doing something that other people could admire.

When cold weather started blowing down their necks they were ready to quit and rest up for the next spring. Most of them take vacations to Florida or California. I started this system 4 years ago. Now I have 12 men part-time.

Another problem we have is schedule of work. This we have solved by making seasonal list, such as: spring, summer, fall, winter. With these lists we can do the job that the daily weather will permit. I try to bring the men in on the planning of operations for the day. It gives them a broader view and more interest in keeping themselves efficient. Thank you.

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NUTRIENT INSURANCE FOR HEALTHY TURF

C. G. Wilson, Agronomist
Milwaukee Sewerage Commission
Milwaukee, Wisconsin

I suppose I should confine my remarks to the actual role of nutrient elements in the plant. Through a U.S.G.A. Green Section grant of $ 2,000.00, Purdue is now studying nitrogen-carbohydrate relationship to healthy growth in bentgrass. Thus, anything I say on the subject may be disproved in the next few years.

Last season was a rough one - the roughest on record according to the old hands who also went through 1928. It was wet. It was dry. It was hot and humid. Often torrential rains were followed by temperatures in the high 90's. Thus, disease and iron chlorosis were the rule rather than the exception, and syringing came into its own.

The reason one had to baby the turf should be apparent. Shallow roots caused by waterlogged soils made it imperative to "treat the tops rather than the bottoms". Those who watched carefully for Don Likes "Wet Wilt", carried on disease prevention, and followed a light frequent fertilizing schedule came through in good shape. In fact, the reason why unprecedented turf loss did not occur can be chalked up to superintendent know-how.

Nevertheless, in the eyes of some, it now becomes necessary to revamp management programs in an effort to outwit the weatherman. We hear it said: "the grass wilts because it is over succulent. Carbohydrates are too low, thus nitrogen is too high. Starved turf is hardier." Only the second statement has any direct basis in fact for indeed there is a relationship between the amount of carbohydrate (sugar) and available nitrogenous compounds.

According to Meyer and Anderson, both carbohydrates and protein (nitrogen containing compounds) are necessary for the development of plants. Deficiency of either soon results in abnormalities. When carbohydrates are too high in relation to nitrogen, Kraus and Kraybill found plants were feebly vegetative and unfruitful. Where nitrogen was very high in relation to carbohydrates, the plants were still feebly vegetative and unfruitful.

Thus, one should avoid either extreme and try to hit a happy medium. Here one should remember that in turf we are primarily after healthy vegetative growth. The superintendent isn't especially anxious to produce a heavy crop of Poa annua, or to have his Bermuda flower. Neither is the golfer anxious to putt on stemmy turf. Either condition may occur when nitrogen is lacking and carbohydrates are high.

North of a line drawn from New York to Chicago we know pretty well how much nitrogen a good healthy creeping bent turf will utilize in a season. It is about 1-1/4 to 1-1/2 pounds per 1,000 sq.ft. per month of good growing weather. South of this line the turf can still utilize as much total nitrogen. Some superintendents favor loading the greens heavily in spring and early summer with no feeding from then on until cool weather comes in the fall. Others, like Dudley Day, Blue Hills Country Club, Kansas City, have the turf to prove their contention that weekly feeding with about 1/4 lb. of actual nitrogen per 1,000 sq.ft. is ideal.

By now some of you are, no doubt, wondering about the terms "carbohydrate" and "protein" that I have used. Carbohydrates are simple to complex sugars manufactured by a green plant in the presence of light. It is the most important process on the face of the earth. Neither you nor I would be here today were it not for this phenomena. To give you an idea of its magnitude, Dr. Postelthwaite of Purdue states, "It has been estimated that all the world's plants produce about 270 billion tons of sugar each year. In terms of trapped energy, this would be about one hundred times greater than the total energy released by burning all the coal mined on earth during a year".

The phenomena is called "Photosynthesis". In essence it means combining carbon dioxide of the air and water into sugar and oxygen. The carbohydrates are further converted into proteins and nitrogen, magnesium, and sulphur must be present for this to occur. Meyer and Anderson state: "Proteins and other related nitrogen-containing compounds are the principal constituents of protoplasm and hence are directly or indirectly involved in all the physiological processes occurring in living cells".

We are aware of serious nutritional disorders in humans - like anemia from a lack of iron, and rickets from lack of calcium, phorphorus, and vitamin D. Plants require many of the elements we need, and without them will show symptoms of hidden hunger. Much that remains in this talk is taken from the book, "Hunger Signs in Crops and Soils" published by the American Society of Agronomy. It is a worthwhile acquisition for any progressive superintendent's library.

When our forefathers first landed at Plymouth Rock they found the American Indian planting corn on burned-over land with a fish in each corn-hill. The Indian probably never thought he was adding nitrogen, phosphorus, and minor elements from the fish, and potash from the wood ashes. Yet, he had learned that this practice produced better yields, and since land was plentiful, he never thought to question why.

We are, of course, aware today that Meridian Hills, or Evansville Country Club can't "pick up stakes" and move on once the soil becomes depleted of its stored reservoir of plant food. For this reason it behooves one to understand the role of plant nutrients as the most important governable factor in what makes grass grow.

Forty or more elements have been determined by analysis. Fifteen are recognized as being essential to plant growth. They can be divided into the following groups:

1. Organic elements -- Carbon, oxygen and hydrogen
2. Major mineral elements -- Nitrogen, potassium, phosphorus, sulphur, calcium and magnesium
3. Trace elements -- Iron, manganese, boron, copper, zinc and molybdenum.

Water

Turf is a virtual pumping station, utilizing 300 to 500 pounds of water to produce one pound of dry matter.

Ninety percent of grass is water. It is in a water solution that nutrients are absorbed through roots. Roots give off carbon dioxide, which with water forms a weak carbonic acid that makes even more nutrients available to the plant. Roots pull in water and mineral elements through concentration gradient (higher salt concentration inside than out). This process is called "Osmosis". If salt in the soil is excessively high, it may result in loss of water from the roots back into the soil - plasmolysis (wilt for practical purposes - too much concentrated water soluble fertilizer applied, or salinity under some arid conditions). This often is termed "drought", yet could well be malnutrition since roots do not absorb nutrients unless in water solution.

Air

Fifty percent of the composition of dry matter in plants is air. Oxygen enters into the formation of compounds with all mineral elements. Absence of sufficient oxygen results in reduced manganese, sulfites, or nitrites, that can be toxic to grass. This should be reason enough for good drainage and physical soil structure that prevents waterlogging. It also is one of the major reasons for the use of aeration equipment, and should give a clue to the value of hydrated lime when soils are waterlogged during hot weather.

Carbon

Coal, graphite in lead pencil, diamond, flavor and even an element

in fragrance of a blossom is carbon. We are familiar with it in a gas form as carbon dioxide. This gives the fizz to scotch and soda. In order for life to exist, carbon has to be combined with other elements to form organic substances. This formation carried on by green plants is called "photosynthesis".

Nitrogen

Although the air we breathe is 80 percent gaseous nitrogen, in this form it is unavailable to plants. Certain bacteria living on the roots of legumes like clover, are able to fix atmospheric nitrogen in the form of ammonium and nitrate salts whence it becomes available to plants. This gives one a clue to clover control. Supplying adequate amounts of nitrogen fertilizer will keep it in check. The chemist can also fix nitrogen from the air in the form of fertilizer.

You have often heard O. J. Noer say, "Nitrogen is the key element in turf growth. It is the sales production engineer of the fertilizer industry. If you apply a fertilizer containing nitrogen on turf you are bound to think it is good". When ammonium and nitrate salts are absorbed into the roots, they are converted into amino acids and proteins. We see the results in increased vegetative growth, better color, and improved turf density.

Potassium

Potassium may be likened as the "middle man" of plant growth. As a farmer is unable to properly market his butter and eggs without an intermediary between production and consumption, so the plant is unable to grow properly without the intermediary element - potassium. Although this element is not built into the plant, it is vitally necessary to its resistance to adverse conditions like disease and cold. The greens clipping analysis at Brynwood and Memphis indicates that almost as much potassium as nitrogen is removed.

I recall during my first trip to Virginia Country Club in Long Beach, California, Rod Barker was having no end of trouble with large brownpatch disease. Good fungicides failed to keep it in check even though they were being applied three and four times a week. Rod was correct in suspecting a functional disorder rather than blaming the fungicides. Investigation showed that no potash had been used on the green in twenty years. Thus, it was a logical assumption to apply a test strip, using muriate of potash,while at the same time sending composite soil samples to Dr. Lunt, U.C.L.A. for testing. About six months later at a winter meeting Rod sought me out to explain the success of the potash treatment and show me the soil analysis from U.C.L.A. Rod told me the test strip took on better color and growth and the fungicides stopped the disease. I wouldn't have thought the improved color and growth possible, but Ray Lunt's analysis certainly brought out the fact that potassium was almost non-existent. This is probably one of the few instances where potash deficiency has been reported in California soils. It is understandable when one considers the mining of nutrients on putting green soils through continuous clipping removal.

PHOSPHORUS

Phosphorus is essential in the growth of any plant. Where the supply is too low, cell division is slowed down appreciably. This results in a stunted plant of intense dark green color due to the accumulation of sugars which still continue to be formed. Often this gives the plant a purplish color. Phosphorus also is essential in seed, flower, and fruit formation. It is for this reason that many all-purpose fertilizers stress phosphorus over nitrogen and potash. This results in fertilizer ratios of 1:2:1, like a 5-10-5, or 6-12-6.

Unfortunately, where such ratios are used to supply the proper quantity of nitrogen on turf, phosphates accumulate in the soil, and many of our turf areas become low grade phosphate mines. This intensifies other nutritional disorders like iron chlorosis, and intensifies our weed control failures with a good herbicide like lead arsenate. Under either acid or alkaline conditions, phosphorus can be tied-up with iron to form an insoluble compound and is termed lime induced or iron chlorosis. The condition can be corrected by applying iron sulfate in solution through the grass leaves. This last year the Soils Department of the University of California issued a warning to citrus orchards on the over-use of phosphorus. Such a warning is long overdue on turf areas where the problem is even more severe since we are interested only in good, healthy, vegetative growth.

Sulphur

Sulphur is in dire need of a good publicity manager. It seems to be the forgotten element of our time. This especially is the case with the advent of ever higher analysis fertilizers materially lacking in this important element. One should appreciate that grass requires as much sulphur as phosphorus to promote growth. The extra, not charged for dividend of sulphur contained in ammonium sulphate, 16, 20, or 24 percent superphosphate and natural organic fertilizers, may soon be regarded as yet another reason for their use.

In the plant sulphur is important in the formation of an amino acid and hence protein. Its lack shows up as symptoms similar to nitrogen starvation.

Magnesium

Not enough is known about the various functions of magnesium in the plant. It is believed to combine with phosphate in compounds that readily move through the plant. Also, we know that in plant life, green is green because of this wonderful element that is essential in the chlorophyll molecule. A deficiency is most common in acid soils and can be readily overcome by using a dolomitic limestone.

I remember a trip to Portland, Oregon, a few years ago, and the chlorotic appearance of one of Sam Zook's greens at Waverly Country Club. Iron was tried with partial success, but in this instance magnesium from Epsom salts was even more effective in improving the turf.

As Sam mentioned, "The purchase of Epsom salts was a good investment. If it didn't work on a test strip in the green, my wife was certain it would do wonders for me". I fear Sam never found the opportunity to test his wife's feelings on his own physical well being. The immediate and striking response of the turf caused the Epsom salts to be used on the rest of the green.

Calcium

Calcium is yet another essential element in what makes grass grow. Inside the plant it is a building block for rigid structure. In this respect it performs a function similar to its use in strengthening bones in animals. One of the main reasons milk is considered an excellent food for humans relates to its calcium content. It is further considered to be a great neutralizer in combining with certain organic acids that otherwise might be toxic to the plant.

Calcium deficiency in the plant is a problem in acid soils. When pH falls below 6.0 (7.0 is neutral) it is wise to add lime, not only from the standpoint of the need for the element within the plant, but its action in releasing other nutrients that may be tied-up in the soil.

Iron

A lack of iron in the plant is becoming more pronounced on acid as well as alkaline soils. Lack in the plant must be stressed because it is seldom that an actual iron deficiency exists in the soil. The overuse of high phosphorus fertilizers tie up iron in soluble compounds that are unavailable to the plant in either acid or alkaline soils. Overwatering, poor drainage, or excessive thatch accumulation that tends to hold water intensifies the problem.

The symptom of an off-color yellowish cast to the turf should be recognized immediately because even a short delay in treating the grass can result in loss of the turf. The yellow color tells us that iron is essential in the formation of chlorophyll. A deficiency in the plant is readily overcome by spraying iron sulphate on the leaves. Several fungicides now contain iron, so it is obvious that formulators appreciate its value.

Manganese, Boron zinc, Copper and Molybdenum

Little can be said about these minor elements because little is known about their actual function in the plant. Even though the quantity needed may seem minute, they are non-the-less essential in stimulating growth. They might be considered as the efficiency experts in the plant. They line up and direct the other nutrients to their proper positions in formulating compounds that we visualize as healthy growth.

The foregoing may help to answer in part the question posed as the theme of this Conference - Keeping Healthy Turf. Healthy turf is actively growing turf. This implies the need for a fertile, well-drained, well-aerated soil so the grass can absorb both moisture and nutrients. Our grasses won't fail us on the production of adequate carbohydrates if we

fertilize properly. And last, but far from least, there is more to promoting healthy growth than adding nitrogen alone. Eventually the plant will starve for other elements mined from the soil unless they, too, are replenished.

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HEALTHY TURF THROUGH FERTILIZATION AND IRRIGATION

Robert V. Mitchell, Supt.
Municipal Golf Course--Alton, Ill.

Alton's Municipal is a nine hole golf course having mixed German bent greens averaging 4,000 sq.ft., consisting of a gray brown loam soil and having no drain tiles.

Throughout the year I use approximately five pounds actual nitrogen per 1,000 sq.ft. Of this total N used, we use a little over four pounds of organics and the remainder of the N is of the soluble type. We do not have a set schedule or program to follow, but our general practice is this:

I start in the late winter along about January or February and apply 20 - 25 lbs. organic type fertilizer per 1,000. We do this to get the grass started growing as early in the spring as possible. We then start in about the middle of April with 5 - 10 lbs. organic per 1,000 and continue throughout the season at this rate approximately every month. In the early fall, about September, we apply another 20-25 lbs. organic per 1,000. Through the season we supplement the organic type feeding with light doses of soluble type fertilizer. We give each green a light shot usually before the week-end and before each tournament to give the greens an added boost and better color.

Due to the soil packing so quickly and causing hard greens and large amounts of water runoff, we find it necessary to aerify about once a month. We have a practice of following our aerifying with verti-cutting and mowing. Along with this operation, we usually apply our organic fertilizer. This practice has worked quite well. It allows us to:

1. Get water and fertilizer into the green.
2. Level up the surface somewhat by cutting the aerifier cores back on the green, and
3. Keeps the greens soft enough to hold a good shot--making our golfers happy.

Naturally we have to consider at all times the weather, temperature and humidity before carrying out any program. We find it is better not to fertilize when the humidity is high because of added possible disease attacks. But this is the program I try to carry out; however, it is altered many times due to unforeseen conditions.

Our water system was installed when the course was built, some 26 years ago, and needless to say it is very much inadequate. We have a 2" main line supplying the whole course, which is divided into two 1-1/4" lines to supply five greens apiece. Due to low pressure and volume, we find it necessary to water only five greens at a time and making two sets per green.

Even though our system is inefficient, the theory for keeping bent greens through the summer in the Midwest is still the same. Our desire is to keep our greens just moist enough to hold them each day and dry enough to discourage disease attacks. To do this, we have to water seven mornings per week, but we vary the length of the sets from day to day, depending on temperature, humidity and dryness of the soil. We have found that wet greens during high humidity weather are very susceptible to disease. Most every afternoon, depending on the weather, we have to syringe the greens off. In fact, ordinarily I have two men who do nothing from 12:30 to 4:30 but shower the greens. Once a week we water by hand the edges and the high spots--time permitting. We sometimes have to supplement our aerifying by slitting the edges and the high spots.

When asked to appear on this panel and make this short talk, I decided to scout around and talk to a few of the fellows in the St. Louis area and see how their practices compare with the ones I have presented.

As a whole, it is very similar--most of them use from four to five and one-half pounds of actual nitrogen per 1,000, depending on the season. Their watering practices differ; however, because most of them have a practice of watering by hand through the hot part of the season. I find it impractical to do this because of the unavailability of the water after seven in the morning, and because of lack of manpower. They all shower their greens in the heat of the afternoon.

It must be stressed, however, every season has to be dealt with differently--depending almost entirely on the weather.

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IRRIGATION AND FERTILIZING FOR HEALTHY TURF

Mal McLaren, Supt., Oakwood Golf Club
Cleveland, Ohio

There are many ways of watering turf. If you learn two of them you can come up with a healthy growth, greenness, turf that repels weed development and to some extent at least pests and diseases.

First, "let's call it watering to make turf grow". In this section of the country it is well to have your water system back in working order as soon as all danger of freezing is past. But, do not water turf any earlier than you have to. In other words, hold back water and let the grass roots go to work and find moisture themselves. Grass stands considerable dryness without harm in the early part of the season.

When you do decide to start out watering, soak the soil good. One good watering is much better than many light ones. Frequent, shallow sprinkling causes roots to be largely confined to the surface. Here they are most likely to suffer from heat and drying conditions. The amount of water necessary to soak the soil varies with the type of soil. More is needed on fine clays than coarse sands. Soils containing much organic matter take more than those with little.

Don't lay down water faster than the soil can take it. Run-off is wasteful and expensive. The speed at which water is absorbed can be determined by observation. Here again it differs with the character of the soil - its dryness, the slope of the land and other factors. On sloping ground slower application over a longer period may be necessary.

It is always well to test soil to see its moisture condition. This can be done with an old steel golf shaft made into a soil sampler, or one can be purchased for this purpose. Check the soil at least 6 inches deep. If it seems dry and a handful when squeezed crumbles rather than sticks together when the hand is opened, water is needed.

The second type of watering is "water to help prevent turf from dying". By that I mean during the hot humid weather when the grass remains pressed down and footmarks show clearly when walked across. The grass will wilt slightly and assumes a bluish color. This is one of the most critical times in fine turf maintenance and must be acted upon at once. The grass proper should be washed off with a fine spray so as not to get the soil too wet, or to have run-off water standing around where it will cause a sealed-in excessive heat. A fine spray nozzle works the best, and caution men to always keep on the move when doing the spraying. This is what you call making firemen of our golf course labor and put the fire out. It can be done any time of the day regardless of hot temperatures and without disturbing play.

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KEEPING HEALTHY TURF THROUGH FERTILIZATION AND IRRIGATION

Robert M. Williams, Supt., Beverly Country Club
Chicago, Illinois

The subject this panel is dealing with is that of the part played by fertilization and irrigation in the maintenance of healthy turf under adverse conditions of weather and usage.

My report is based primarily on my observations and experience at Beverly Country Club and may differ considerably from nearby clubs as well as distant ones. However, I believe many parellels can be drawn on this subject in a general way.

The part played by both fertilization and irrigation in keeping healthy turf is of such great proportion that my remarks are limited to more or less general conclusions and perhaps some of the details can be brought out in the discussion period to follow.

The objective of our fertilizer program for tees, greens and fairways is to stimulate the grass plants to a degree that will produce maximum limits of tolerance for the following factors:

1. Lengthen the golfing season as long as possible by extending the spring and fall growing periods.

2. Produce a turf that has a comparatively steady growth.

3. Maximum resistance to and recovery from damage of common enemies such as physical wear, disease, drouth, insects and the like.

4. Control over mat and thatch development.

5. Appearance through color and density of the turf.

6. Minimum risk from burning the turf at the time of application, or later.

7. Maintaining of desirable levels of plant nutrients within the soil.

8. Lastly, but most important of all, playability that affords satisfaction for the majority of our membership.

I believe that we would all agree that these objectives apply to your courses,as well as to mine, and to all areas on our courses.

The practices of fertilizer application vary considerably from area to area, course to course, and from year to year due to the changing of conditions. Conditions such as type of grass, soils, weather, equipment and many others.

Our green and tee fertilizer program consists of the total annual application of about 4 to 6 pounds of nitrogen per 1,000 sq.ft. approximately 1 pound of phosphorus per 1,000 sq.ft., and close to 2 pounds of potash per 1,000 sq.ft.

Our fairway program of fertilization was changed last year. We started out last March with an application of 200 pounds per acre of a half and half mixture of Synthetic Urea and white Muriate of Potash. The next application was activated Sewage Sludge at 600 pounds per acre during the latter part of August. This gave us an annual total per 1,000 sq.ft. of approximately 2 pounds of nitrogen, one-half pound of phosphorus and 1-1/2 pounds of potash. The application of Urea and Potash gave us a nice steady growth well up into July. The cost was about half of what we had been spending previously on ready mixed materials. The total bulk of the material was reduced from about 14 tons to 4 tons. The time of application was reduced from 24 hours to about 10 hours.

Now let us consider the closely related subject of irrigation. With irrigation, as other practices, first of all what are the objectives? What are we trying to accomplish? My opinion is that we want to maintain a degree of soil moisture that will be most effective in sustaining the grass plant at the most practical level of general health. Here again as with fertilizer, when we change the conditions of grass types, soil types, weather and many other factors, we must change our methods of practice in order to accomplish the same objectives.

In the Chicago area, during adverse weather periods, soil moisture is the number one consideration for the maintenance of mixed Poa annua and bent turf. The closer the degree of control over the soil moisture by the superintendent, the better results he will produce. By keeping a close watch over the soil moisture, we have practically eliminated the loss of Poa annua in putting greens. We still have had to sit by though, and watch Poa go out in fairway areas because of a lack of moisture control in this area anywhere near comparison to that of the greens. Our green watering program during mid-season generally calls for the watering of the greens about every other night, and sometimes every night, for periods varying from 15 minutes to one hour. One can readily see then that this sort of control has been out of the question on larger fairway areas because of the limitations of the water systems.

At Beverly we are meeting this problem by the installation of additional pumping facilities that will allow us to use approximately 1400 gallons per minute compared to the former 450 GPM that has been more or less standard in the past. This simply means that we will have the capacity to water all tees, greens and fairways during one night if we so desire. And many is the time when the Poa annua starts turning blue with wilt that we say, "If that turf doesn't get water tonight, or sooner, it will be gone by tomorrow". At the same time we know that our water system will only allow for watering of perhaps 6 fairways and the rest will have to wait for one or two days more.

After we achieve moisture control through irrigation, drainage and aerification, our last obstacle to maintenance of close cut bent and Poa annua fairways will be disease control of these larger areas.

To summarize, I believe that it may be simply put, THAT THROUGH CONTROLLED MODERATION IN FERTILITY AND MOISTURE WE CAN EXPECT TURFGRASS TO BE MORE RESISTANT, MORE TOLERANT, HEALTHIER, MORE USABLE AND MORE PLEASUREFUL THAN EVER BEFORE.

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KEEPING TURF HEALTHY
THROUGH PREPARATION WITHOUT IRRIGATION

Alfred Bloch, Supt., Gate of Heaven Cemetery
Cincinnati, Ohio

In order to produce worthwhile grass areas, or turf fields, it is of great importance that the fields be given sympathetic and intelligent management. We must know the texture of the soil and what to do with it at the proper time.

In Cincinnati the areas upon which we grow grass consist entirely of heavy, poorly drained yellow clay, with very little topsoil. Much of the land has been depleted, badly eroded and abused by its former owners.

This requires a "know how" treatment in order to create a condition that will enable grass to grow vigorously. It is not only more costly, but takes longer to get a neglected and starved grass area into a fair stand of well cared for lawn or playground, than it is to start from scratch and give the soil the physical treatment and plant food it requires for healthy and vigorous plant growth.

Whether we use green manure, mulch, or commercial fertilizer in granular, dust, or in liquid form, we still need to encourage a deep root system for the grasses we use to withstand traffic of one type or another at all times of the year.

In order to do this, we have put much emphasis on the breaking up of the hard pan and the lower sub-soil. This we accomplish by the use of a rooter, or sub-soil plow. We go not less than fifteen inches deep, and the rills three foot apart, or 30 to 36 inches deep, and the rills a possible six foot apart. This operation is preferably done in late summer or fall when the ground is dry and hard. We use a four or six inch diamater, oblong or egg-shaped iron mole, behind and at the bottom of the sub-soil chisel. This helps to crack and rip the soil by leaving a burrow at the lower level, which will act as a drainage canal, if and when there is a surplus of water in the soil. This breaking of the sub-soil also provides a large storage for moisture to be available at the dry season of the year.

We realize that a large percentage of the success in a future lawn area, sod or playfield, depends upon the fertility and physical condition of the soil in which it is to grow and thrive. It must be alive with organic matter, with plenty of bacterial activity for the best results from the fertilizer and seed which we apply.

To accomplish this, we apply the needed lime and fertilizer for growing a heavy and vigorous crop of deep rooting legumes with fast, tall growing grasses or grain. At the proper time we turn this green manure crop back into the soil by use of a Seaman Tiller. It chops all vegetative material into small fragments and mixes it with the churned up soil to an average depth of eight inches. This provides a loose, spongy seedbed which can absorb large quantities of water

without surface caking, and thereby eliminates washouts and erosion before the new grass takes hold. It also provides that springy feeling under foot. Experience has proven that when we have that kind of seedbed, which is warm, porous and full of life, we can expect fast germination and early growth.

Soil tests are essential whether we plant a cover crop or a permanent grass area. These determine the analysis and quantity of fertilizer which we must apply. We prefer to incorporate the plant food into the soil, or provide a condition with aerifying tools to get it to the grass roots at the earliest possible time.

Ifeel that we have had fair success with our operation of plantings in the past. When we planted Merion bluegrass at the rate of 25 pounds per acre, 11 months later we checked the area for root growth and found roots down to 18 inches. We also did not find it necessary to use weed control as the grass itself had done the job for us, not leaving room for weeds.

Another field of Delta bluegrass and Merion was seeded September 20 of last year and became strong enough to withstand the rigors of winter, freezing at night and thawing by day, which is so common in Cincinnati. Fertilizing was done with 10-6-4 at the time of seeding at the rate of 500 lbs. per acre and a similar amount in early spring.

On established areas we fertilizer in early fall.

We do not irrigate, but depend on the reserved moisture in the soil.

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SOD NURSERIES - KEEPING TURF HEALTHY THROUGH FERTILIZATION AND IRRIGATION

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

The job of keeping healthy turf through fertilization and irrigation can be summarized very briefly. Be generous with the fertilizer and miserly with the water.

A few qualifying remarks regarding my idea of generosity and parsimony will describe our efforts to raise and maintain healthy turf.

Most of our grass receives between 800 to 1000 lbs. of complete fertilizer annually. This is applied in two applications, late winter and August. These rates and timing are used on the bents, bluegrasses and fescue. Zoysia receives a complete food about the end of May.

We feel that this program maintains our phosphoric acid and

potassium at a fairly adequate level. Our concern for the balance of the season is Nitrogen. Beginning about May 1, Merion and bent receive monthly feeding of approximately 50 lbs. per acre of actual Nitrogen, excepting August and ending with an October application. Kentucky bluegrass gets the same except the May feeding is omitted unless certain conditions indicate it.

Our irrigation practices are not as simply described as our fertilizing. We have a schedule for irrigating which is seldom completely executed and never strictly adhered to. During extremely dry weather, our aim is to apply between 1 and 1-1/2 inches of water every 7 to 10 days.

This amount is subject to considerable variation. New plantings will receive considerably less than this, but possibly at more frequent intervals; while older grass quite often goes 2 weeks without water, and it is not uncommon to put on 2 inches of water during one irrigation. We have found a soil sampling tube very valuable in timing our irrigation setting.

In evaluating these two important functions of grass culture, I might make this statement. It is not uncommon to have an attractive appearing grass area after 2 weeks of no moisture where the various fertilizing elements were in adequate supply, but I have yet to see a pleasing piece of turf regardless of the amount of water applied where the plant food requirements had been neglected.

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FERTILIZING FOR SOD NURSERIES

W. H. C. Ruthven
Ontario, Canada

Gentlemen, I can assure you that I am very pleased to attend this Purdue meeting. This is my fifth consecutive winter turfgrass Conference to attend and I feel greatly indebted to you for the courteous welcome extended. The information received at these conferences has been very helpful to me and I hope to reciprocate in some way.

Soil tests indicate my sod land is deficient in phosphorus. Our first operation is to summer fallow the land and when the ground is in a good state of cultivation we apply 800 pounds per acre of superphosphate with a ten foot Gandy fertilizer spreader. Then a one-way disc is used to cover the fertilizer, cutting as deep as possible, approximately three to five inches.

Just previous to seeding we apply a balanced fertilizer of 400 lbs. of 10-10-10 (if we are seeding Merion bluegrass). The seeding is done during the latter part of August and first couple of weeks in September. In the spring when we are sure the ground is dry enough to carry on a regular mowing program with our Fairway or Blitzer mowers, we apply 200 lbs. of pelletized ammonia nitrate. About the first to tenth of

June we apply 400 lbs. of 10-6-4 fertilizer, and around August 15 or September 1, we make another application of 100 lbs. of ammonia nitrate. This is to brighten up the color and give the turf a good start when it is moved to the customer's lawn.

Seeding operations are often held up by the rain soaked soils, or days with high winds; consequently, we use two Brillion seeders so that the work can be done more quickly. The ground must be dry for seeding with a Brillion seeder. The tractor for drawing each seeder is equipped with dual wheels so as to keep the ground level. Each tractor is also equipped with good lights as we find our best seeding time is from 5 P.M. until 11 P.M. when there is no wind and dust nuisance. For working these odd hours, the operator gets overtime remuneration.

If the seedbed is in a good tilth and adequately fertilized, then 15 to 20 lbs. of Merion seed to the acre is sufficient.

Our 1954 Merion grass seeding was made about August 20, part of this acreage was lifted in September 1955. Had we irrigated two or three times and used a bit more fertilizer, we could have had the sod off in time for reseeding by August 1955.

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WEED CONTROL FOR HEALTHY TURF

Paul E. Burdett, Paul Burdett Co.,
Lombard, Illinois

I have been privileged to serve golf courses since 1929. During this time I have used some of the materials myself, but all of you will recognize that a salesman sees the results of his sales primarily through the eyes of his customers. So, the reports I present are actually the representation of reports as you have given them to me. As you have shared your varied experiences with me, I have gained a great deal. It is difficult for me to believe that any man could have a more interested, active, better qualified corps of co-workers than I have been permitted to serve, for this has been your life and I am proud to have played a little part in it.

It has not been many years ago that we had three major weed pests on fairways and roughs on our courses: dandelions, plantain and buckhorn plantain. Looking over the fairways now it is hardly possible to picture the severity of these pests. First yellow dandelions, then white dandelion seeds, then the broad-leaved plantain under which a ball could hide no matter how often the fairways were cut. Then later in the summer would come the narrow-leaved plantain with its seed pod sticking so boldly up on its tall stem, a stem that lays down in front of the mower and pops up after it has passed to wave triumphantly.

We still find it necessary to treat these pests separately; the dandelion in the spring before or during the blossom, and the broad and narrow-leaved plantain just about the time they go to seed. During the past several years we have used both the amine and the ester formulations of 2,4-D, but in each case we believe that the amine formulation is effective, and we have seen some tree injury almost every time the ester formulation has been used. If the plants are in good growth, 1 lb. of 2,4-D acid per acre in 50 gallons of water will usually give good control.

Clover does not seem to be too difficult to control in fairways. The most effective material we have used and sold has been the 4 lbs. per gallon Dow Ester 2,4,5-T at 1 quart in 50 gallons of water per acre. This has given excellent control and has usually resulted in freedom of clover for as much as three seasons. Where the two operations are to be done at one time, control of both clover and broad-leaved weeds, we have used 1 pint of Dow Formula 40 and 1 quart of Dow Ester of 2,4,5-T in 50 gallons of water per acre with excellent results. We have had few reports of injury to bents in fairways, but our chief complaint has been that we took out too many weeds and clover and left bare spots in the fairways.

Crabgrass is becoming increasingly important as a nuisance in fairways, and in some cases it has spread quite widely. I have watched it quite closely and sold a lot of material for its treatment. At this time, as far as I am concerned, we need an effective treatment for the control of crabgrass. Arsenate of lead at 300 lbs. per acre may not be heavy enough. Sodar was applied several times on one plot I saw every fourth day, but the results were far from satisfactory.

Repeated applications of Sodar seemed to be harder on the bent and fairway grasses than on the crabgrass last season. We know that the manufacturers are working on this problem. The fairways in the district I serve are heavily fertilized and well watered. While the weeds are soft and should be easily killed, the opposite seems to be true. They hang onto life with a tenacity that is unbelievable, and as long as there is power within the crown of the plant to send out one rootlet, that plant will re-establish itself and grow and set seed. It may be that early timing of the arsenate of lead application is a most important item in the control of crabgrass with this material. I know that it is on greens treatment.

At present sodium arsenite seems to offer the best control for chickweed and knotweed. I have seen 2,4,5-T applied to a fairway area in repeated applications to the end that the fairway was barren and all grass and weeds seemed to be dead, but it was back again the following year. The work was well planned and well executed, but it did not accomplish the job. Apparently knotweed can be controlled with very light applications of sodium arsenite applied when the plant is in the two leaf stage. The applications are at the rate of 1 lb. of sodium arsenite in 50 gallons of water per acre at weekly intervals. Once knotweed is controlled it is usually gone for a while. All the plants germinate in early spring and when they are killed there is usually little regrowth.

Frank Mastroleo of the Geneva Country Club worked out a method of treating chickweed in fairways that may offer definite advantages. Frank used 1 pint of 2,4-D and 1 lb. of sodium arsenite in 50 gallons of water per acre and repeated the treatment, I believe, at two week intervals. He accomplished a definite reduction in the chickweed population without noticeable discoloration. This work was done on unwatered fairways.

Poa annua has been treated as a weed to be disposed of for many years. I have watched the use of arsenate of lead on Poa annua, as well as the use of organic mercuries. I have decided that I will consider Poa annua as a problem in disease control rather than as a weed control problem. I am convinced that a healthy Poa annua plant is not a bad plant and that a healthy bent plant will crowd out a healthy Poa annua plant.

Observations made during the last several summers have convinced me that that factor which has caused the failure of Poa annua can be controlled, and that when controlled Poa annua ceases to be a problem because when Poa annua is right it is a good grass.

Trimming of grasses around trees has cost a lot of money and has taken a lot of the limited labor available, but when the job is not done the grounds present an unfinished appearance. Last year we tried a material called Dalapon. This material is a product of the Dow Chemical Co. and has been tried in orchards to remove the grass under pear and apple trees. This last summer we sold some for removal of grass around oak and other trees growing on course grounds. The material works on grasses like 2,4-D works on broad-leaved weeds - it takes a lot of time but does an excellent job. We used a weak strength about 5# in 100 gallons of water and wet the grass.

Our aim was to stun and hold back the grass during the season of active growth rather than to kill it out entirely. We hoped the grass would recover and cover the ground for fall and not leave it bare to wash away. The first reaction was not good - the grass turned yellow and unsightly and looked bad, but when trimmed it was all right and reacted as we figured.

This year we plan to suggest that our customers let the grass grow without trimming until the middle of May, then to spray and within the week to trim it with a mower. This will remove the unsightly grass and the job will not have to be done again. The same treatment under the fence line will control the grass and reduce fire hazard and make for less costly trimming. One field of 15 acres of quackgrass was sprayed early in May with Dalapon at 15 pounds per acre and when plowed three weeks later we found only a few plants with nodes that looked like they might be able to send out roots. This material can be used to great advantage in conjunction with 2,4-D in sand traps for grass and weed control.

Dow offers a material called Barron that they have used for the control of grass and weeds in sand traps. They found that sand blasted on the green by golfers did not carry the discoloration to the bent. I used this material only on roadways as a complete killer this year. It is extremely effective.

The September issue of the Golf Course Reporter carried a story of a material called Vapam, a soil fumigant. The story as published offers fascinating possibilities and I believe there will be some tried in this area this season. Vapam can be watered into the soil and with a light sealer of clear water following it, produces a gas that kills all weeds and grasses, weed seeds, nematodes, soil fungus and soil insects such as grubs. It will be first used in 1956 in the Midwest, but has been used in Florida, Texas and California. Thank you.

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HEALTHY TURF THROUGH WEED CONTROL

John E. Gallagher, American Chem. Paint Co.
Ambler, Pennsylvania

Developing healthy turf through weed control is contingent on the concept that weed control is not used as a substitute for the other cultural practices needed for the development and maintenance of good turf.

Today the overall concept of weed control is moving away from a haphazard application of a chemical which has shown a limited amount of selectivity. We are in the process of realizing that we must know more about the weeds we wish to control if we are to improve our chances of developing a control method which will assure us of an increased chance of success.

Since my subject is crabgrass, let us first consider the weed, then the control method. Crabgrass is a summer annual. The two terms, annual and summer, are themselves a key to why crabgrass has developed into a major turfgrass pest. The term annual describes a plant whose whole life cycle from seed germination to seed drop is completed in one short growing season. Annuals reproduce only by seed. Crabgrass has no vegetative reproductive parts, it assures specie survival only through the production of a large number of seed, mostly viable seed, which can remain dormant in the soil for a long time.

The term summer annual describes a plant which is most active during the summer, the period in which the cool season grasses are at their lowest ebb. Cultural malpractices such as over-watering, over-fertilization of cool season grasses, too close cutting and compaction, are harmful to the cool season grasses and favor the development of crabgrass.

From a crabgrass control point of view, if we work under the assumption that any control method which prevents crabgrass from producing seed is a logical one, we can better understand the concept of "pre" and "post" emergence control.

Pre-Emergence Control

Pre-emergence crabgrass control is based on the idea that the placement of material - toxic to the germinating seedling - in the germination zone will prevent crabgrass from ever reaching the problem stage. Over the past few years many chemicals have been tested as pre-emergence crabgrass control materials. In 1955 three materials were tested widely enough to warrant a brief discussion.

The first of the three chemicals was a new substituted urea compound 1-n-butyl (3,4-dichlorophenol)-1-methylurea. This material, a wettable powder, requires no specific preparations other than application at 4 lb/A. active ingredient, at a time period of 2 weeks before the expected date of germination and again one month later.

The second chemical Alanap 1-F is a combination of Alanap and a fertilizer, stabilized on vermiculite and is applied at a rate of 720# formulation per acre. Certain pre-treatment operations are necessary for effective control. The turfgrass area should be raked to remove matted turf and leaves, the material should be watered in after application - contact with the germinating seedling is necessary for effective control. Two or three treatments at 3 - 4 week intervals are needed, dependent on the anticipated crabgrass infestation. With this material certain precautions are suggested. Do not use on lawns less than one year old, do not use on putting greens, and avoid applications to wet turfgrass, or at midday.

The third material is a chemical which has had considerable test work in the past with varying results. A change of rate application, type of carrier and the addition of a soluble nitrogen has now produced effective results. The rate of application has been raised from 20 lb. to 60 lb. active ingredient and the carrier has been changed to vermiculite. As with Alanap 1-F the same pre-treatment operations are needed.

Post-Emergence

Post-emergence - control after germination - is based on the selective removal of one grass specie out of another. In 1955 most of the post-emergence crabgrass control work evolved around the continued evaluation of di-sodium methyl arsonate. This chemical was tested extensively throughout the country during the summer of 1955. In a year that was, weatherwise, very extreme, the results continued to show promise.

Test conducted at California, Iowa, Indiana, Missouri, Pennsylvania, Rhode Island and other locations show the following results:

1. Crabgrass control equal to, or better than existing post-emergence materials.

2. Turfgrass discoloration and injury (fine leaf fescue grasses excepted) was less severe.

3. Application at rates of 3-1/2 to 4# active ingredient per acre at 5 - 7 day intervals produced effective control with a minimum of discoloration.

4. Application with volumes of water ranging from 30 - 200 gallon per acre, showed no reduction in crabgrass kill, providing the reccommended amount of chemical was used. Turfgrass discoloration increased with the low volume applications.

5. Two and three applications were needed for effective control.

6. In general turfgrass discoloration increased with high temperatures (85° and above) and low soil moisture. So irrigate before treatments and spray in late afternoon.

7. Certain other annual grasses, such as common foxtail and barnyard grass, controlled at the same rate used for crabgrass control.

In summing up the results of the test work with di-sodium methyl arsonate, it should be dropped from the MIRACLE and classified as an improved crabgrass control material.

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THE USE OF ODORIZED METHYL BROMIDE FOR TURF IMPROVEMENT

J. H. Davidson - Dow Chem. Co.
Midland, Michigan

Most soils used for turf naturally contain many weed seeds along with roots, bulbs and rhizomes of undesirable plants. For new turf it would be ideal to start out with a soil free of all weeds, nematodes and harmful soil insects. This would permit the vigorous development of only the desired grass with no competition. Treating soil prior to planting with odorized methyl bromide* approaches this ideal.

It is only within recent years that the technique involved has become practical. The success of the treatment is dependent upon confining the gas in the soil to be treated for a sufficient time to effect complete kill of the pests. The availability of large polyethylene sheets at reasonable cost has now permitted the use of this treatment over fairly large areas.

A description of the methods used can be divided into three categories: 1) The treatment of cultivated soil prior to seeding, 2) Turf renovation without disturbing the soil, and 3) Treating of all topdressing soil prior to use. The following discussion assumes that soil of proper texture and good drainage is being used and that an ample supply of nutrients and water are available.

Pre-planting Treatments on Cultivated Soil

The best place to start a discussion on turf improvement is in the preparation of a new turf area. Many of the new desirable turfgrasses are slow growing and when planted in newly prepared soil are subjected

*Dowfume MC-2 (methyl bromide with 2% chloropicrin)

to considerable competition while they are young. In most cases weeds are faster growing than the grass and unless controlled may seriously reduce establishment of desirable grass. Control of this potentially competitive vegetation without injury to the desirable grasses is possible by a pre-planting treatment of odorized methyl bromide. This material is a gas at temperatures above 38° F. and must be confined under a gas-tight cover to produce its killing effect on soil pests. Large gas-tight polyethylene covers are available for this purpose. Their initial cost is low and they may be used several times if handled with reasonable care.

Methyl bromide as a gas has good penetrating properties and is capable of destroying weed seeds and other soil pests to a depth of 3 to 8 inches, depending upon the type of soil. The fact that it is a gas permits rapid escape from the soil after the cover is removed. This allows seeding within 24 or 48 hours after treatment.

The gas-tight covers should be held above the soil surface by straw filled sacks to permit diffusion of the methyl bromide under the cover. In cultivated soil the cover can be secured to the soil by placing the edge of the cover in an open furrow and covering with soil to form a gas-tight seal.

There should be sufficient moisture for weed seed germination, yet the soil dry enough to work. The best control of weed and grass seeds is obtained when the seeds have a high moisture content. Dry soil should be thoroughly watered and kept moist for three or four days prior to treatment to raise the moisture content of the seed. Hard coated seeds of certain plant species are not penetrated by methyl bromide unless the seed coats are quite moist and the seeds have started to germinate.

The methyl bromide is released from cylinders or cans through tubing to evaporation areas under the cover. The evaporation areas should be made in such a manner that as liquid methyl bromide comes through the tube, it will spread after evaporating. Any liquid methyl bromide which goes directly into the soil is lost and results in reduced concentration and consequently poor pest control. After fumigation and removal of covers, the regular procedure of seeding and watering should be followed.

Concentration of the gas, exposure period and aeration after the treatment, vary according to the situation. For average conditions, when soil and air temperatures are above 60°, 1 lb. of methyl bromide per 100 sq.ft. of area should be used. If the soil temperature is below 60°, the rate should be increased to 1.5 lbs. The exposure period at temperatures above 60° is 24 hours, at lower temperatures this time should be doubled.

Pre-planting Treatments on Undisturbed Sod

A similar procedure to that described above may be used to renovate established weedy turf without cultivation. This treatment kills all existing vegetation, including weed seeds. Grass seed is applied directly on the chemically killed sod 24 hours after treatment without

working up the soil. Gas penetration to greater depth in undisturbed soil may be obtained by aerifying the soil prior to fumigation.

The gastight covers may be secured to the soil by either removing strips of sod, or the use of metal strips. Strips of sod eight to ten inches wide and three inches thick can be cut by a sod cutter pulled by a tractor, or by the use of a spade. The sod is removed and the edge of the gastight cover inserted in the furrow and the cut sod replaced over the cover. The use of metal stripping does not require any disturbing of the old sod. The metal necessary for this procedure may be obtained from any sheet metal fabricator. Two kinds of metal strip are required. A six inch wide strip of 20 gauge galvanized iron eight feet long is inserted two or three inches deep in the sod and the soil packed in tight around the strip to prevent gas leakage. The ends of the strips are brought together and the joint taped with masking tape. The area to be covered is outlined with these metal strips placed in the turf. The margins of the cover are drawn tight and secured to the metal strip by S-cleats made from 24 gauge galvanized iron. When the covers are sealed to the soil in a gastight manner the methyl bromide is released and allowed to diffuse under the entire area enclosed by the cover.

Suitable preparation of the undisturbed sod is necessary to have a proper seedbed. If the area to be treated has a moderate cover of vegetation and the soil is not packed, very little further preparation is necessary. Uniform seeding followed by heavy watering will bring the seed in direct contact with the soil. Holes from the aerifying treatment and the killed vegetation will give sufficient cover to the new seedlings. If the area to be renovated has many spots devoid of vegetation and the soil is packed, additional preparation is desirable.

The soil in packed areas should be loosened to a six inch depth and vermiculite or horticultural grade peatmoss incorporated in the surface. After seeding, these areas should be lightly raked and rolled to prevent the seed from washing or drying out. An additional treatment which has greatly improved grass stand on areas of vegetation consists of going over the area both before and after seeding with a spiker. This loosens the soil surface prior to seeding and also affords a light covering after seeding.

There are several advantages to treating undisturbed sod for turf renewal. In many cases where only moderate traffic is encountered on the turf, it is possible to allow the traffic to continue over the new grass seeding. This is due to the protecting effect of the old grass and roots which hold the soil together and protects the new grass seedlings, until they become established. The old grass acts as a mulch to maintain a moist seedbed and the decaying roots from the old sod aid in aeration of the soil favoring good grass growth. No cultivation is necessary and for home lawns it reduces the amount of mud and soil that will be tracked into the house by children. This method of treatment also makes it possible to seed on slopes as the roots of the killed vegetation will hold the soil from eroding until the new grass becomes established.

The technique described above has proved useful in renovating athletic fields, golf green aprons or collars and tees.

Treating Topdressing Soil

In most cases topdressing contains many weed seeds, roots or other plant parts capable of growing whenever the right conditions occur. Treating this soil in bins or piles prior to use may be a very useful tool in controlling weeds.

The same conditions described above for effective use apply in this case also. Soil should be moist and in seedbed condition at time of treatment. If treated in piles or bins many holes should be made with a probe or shovel handle that will permit good gas penetration to all portions of the pile. For most purposes the methyl bromide is used at the rate of 1 pound per 2 cu. yds.

Precautions

Methyl bromide is a poisonous gas and should be used only after studying correct handling procedures. It is being used safely for tobacco seedbeds, grain fumigation and many other uses. During fumigation the area should be posted to warn children away and prevent their crawling under the covers.

There are many unanswered questions regarding how close methyl bromide may be used to growing trees and shrubs. In general, it may be stated that when working around shallow rooted plants in light soil the fumigation treatment should not come closer than two feet from the desired shrub. Deep rooted maple and apple trees have not been affected by surface fumigation treatments. Heavy irrigating prior to treatment may act as a barrier to deep gas penetration around desirable plants. Under or near trees, using a 4 hour covering may be ample to kill surface weeds and seeds, without deep penetration.

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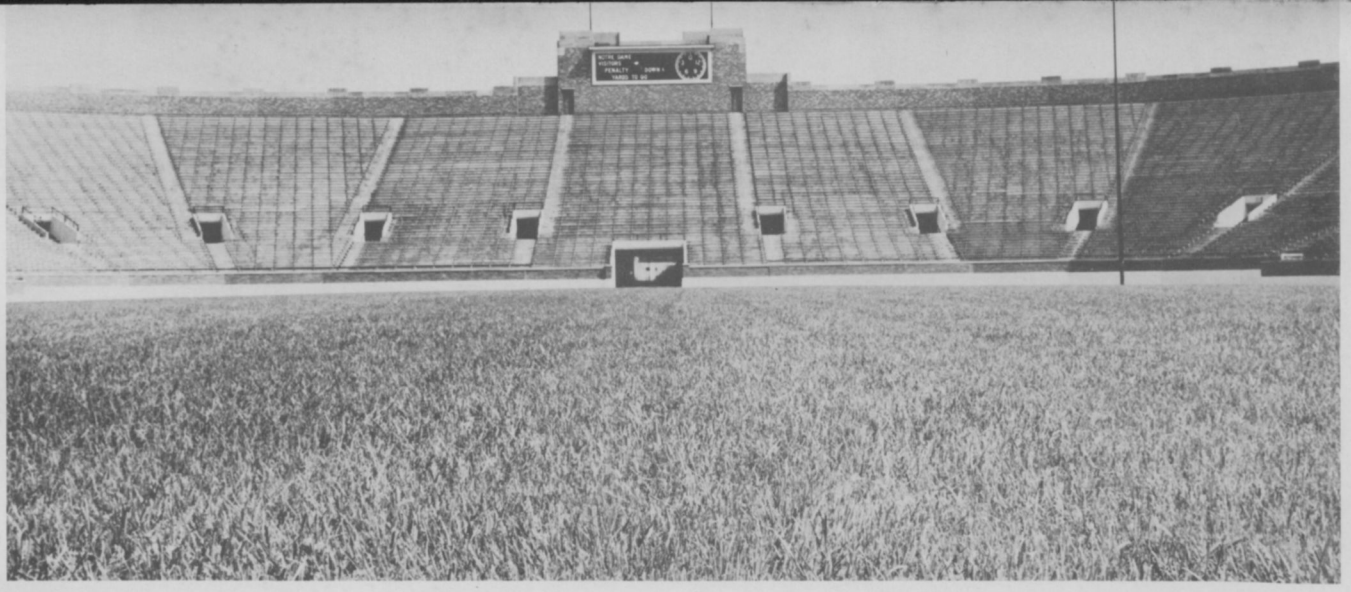
The following printed page is a reprint from "Down to Earth" which pictorially describes the renovation of the Notre Dame stadium.



Final results—This picture was taken on August 1, 1955. Turf was practically ready for play with the first game nearly two months away.

NOTRE DAME RENOVATES FOOTBALL FIELD with DOWFUME MC-2

By CHESTER R. KEELEY,
University of Notre Dame *Notre Dame, Indiana*

The very valuable 2.2 acres of turf of the football playing field within the stadium at the University of Notre Dame had shown increasing deterioration over the past several years. This was most noticeable in a central "aisle" more or less centered on the field which receives the heaviest traffic.

Efforts had been made over past years to restore the turf by fertilization and seeding but these measures had not resulted in any permanent improvement. The field was not satisfactory during the 1954 football season and University authorities decided to renovate the turf completely in time for the 1955 season.

Originally we were prepared to sod the area with established turf. This has the advantage that it gives a green surface immediately. For a football field it has the disadvantage that the sod does not always join tightly with the underlying soil. Football players have been known to lift a cleat-shod foot at the height of some exciting play only to have an entire sod come with it. In addition sodding is expensive. It was decided to seek an alternative if a satisfactory one could be found.

In view of the gratifying results of a technique used at Alabama Polytechnic Institute[1] and at Mississippi State College, we decided to work the area, add new soil, organic matter and sand, and then fumigate with Dowfume MC-2 under plastic covers. This latter treatment was to kill unwanted grass, weeds, and weed seeds as well as possible harmful soil nematodes and insects prior to newly seeding the area.

The Dowfume MC-2 fumigant was applied as shown in the photographs at the rate of one pound per 100 square feet. Following a short aeration period, the soil was leveled and planted with a mixture of 75 pounds each of Kentucky and Merion bluegrass seed which had been given a preplanting treatment to hasten germination and establishment. The seed was soaked in water for two days and then kept moist for eight days on a concrete floor. The one inch layer of seed was raked over several times. After this treatment the Kentucky bluegrass seed had begun to sprout. The entire 150 pounds of moist seed was then thoroughly mixed with 300 pounds of milorganite to facilitate handling and seeding with the usual equipment. Seeding was done on April 29 with spreaders adjusted to deliver approximately 400 seeds per square foot.

During dry weather, sprinkler irrigation was used in accordance with moisture requirements as determined by 12 strategically placed moisture blocks. First mowing was on the 34th day after which the grass was mowed twice a week for five weeks. Then the schedule was three mowings per week. In 15 weeks the grass was rooting to a depth of 9 inches and the field was practically ready for heavy football traffic. There are no undesirable grasses nor weeds in the entire area and the new turf has developed uniformly. We feel that we now have a turf that will stand up well and will present a satisfactory appearance during the entire football season beginning on September 24 and finishing up on November 19.

[1] DOWN TO EARTH, Vol. 10, No. 2, Fall, 1954.

1 Tractor follows a guide line in digging trench which will hold and seal edges of tarpaulin.

2 Fumigant was introduced through saran tubing into a bottle which in turn was placed in a saran film lined basin in the earth. The bottle stopped the fumigant from squirting out of evaporating basin when released.

3 Straw pillows in place to hold up plastic tarpaulin. The cases on the pillows were of closely woven cotton to protect the plastic cover from being punctured by stiff straws.

4 Placing plastic cover in position before covering edges with earth.

5 Four strips nearly ready for fumigation.

6 Workmen cleaned their shoes before walking on sterilized ground.

7 The author examining grass seed which was pre-soaked and spread out on cement floor.

FORM NO. IN517-955

Reprint from DOWN TO EARTH, *Fall, 1955*

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

LITHO IN U.S.A.

LEAD ARSENATE AND POA ANNUA

W. H. Daniel, Dept. of Agronomy
Purdue University

We would like to control Poa annua, yet, at the same time, carry on the normal maintenance and use operations, to avoid a sudden burst of control or failure of the existing grass.

For many years lead arsenate was widely used on golf courses, and in fact, some of the more "sot in their ways" superintendents may have continued to use lead arsenate after chlordane was introduced. As a result we find several golf courses scattered throughout the Midwest in which Poa annua is not a problem.

Our research begun in 1951 was to determine what the effect of the arsenic was and to attempt to evaluate whether there should be an increased use of arsenics. Since 1951 we have applied many plots, including lead, sodium and calcium arsenates. The sodium arsenites cause excessive burning and kill before arsenic toxicity can be accumulated if put on in large doses so they are not recommended unless it would be for light, repeated foliar burning application.

Where lead arsenite has been used on average phosphorus applied soils, lead arsenite continues to show Poa annua inhibition after three years. Rates of 20 - 30 and 40 lbs. per 1,000 sq.ft. are equally effective, while rates of 10 lbs. were not of sufficient toxicity. On putting greens, both old and new, the use of lead arsenate seems to be very slow acting inhibition. First, there has to be an accumulation of toxicity which may take one or more seasons. However, repeated testing shows that bentgrass is a low phosphorus requiring plant; therefore, if arsenic is used along with a definite reduction in the phosphorus supply, the gradual accumulation of the arsenic can inhibit the vigorous growth of Poa annua in spring and fall.

For superintendents that are interested, may I suggest that they use one-half of their three worst greens, or two or three of their worst greens, on which they use arsenics. Program -

A. Either early spring or early fall, before Poa annua growth begins, apply lead arsenate 20 lbs. per 1,000.

B. During the summer use lead arsenate to control cutworm and sodwebworm as needed.

C. About Labor Day, or early next spring, 10 lbs. lead arsenate per 1,000.

D. The following years use arsenic for insect control, probably equal to 5 lbs. lead arsenate per 1,000 per year.

We have done some work with calcium arsenate - a more soluble and cheaper source. Rates with this should be approximately two-thirds of that of lead arsenate. This is still considered a trial material. Rates

of 15 lbs. per 1,000 initially, with 5 lbs. applied ahead of the next vigorous growth period would be one program.

There are several problems in connection with lead arsenate use, one of the more important being its rather high cost for large areas. With that in mind the report by Mr. Goetze on continuing research at Purdue University is important to you in that it offers the possibility of reduced cost and more positive control than some of the newer selective herbicides.

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RESEARCH ON POA ANNUA CONTROL

Norman Goetze, Dept. of Agronomy
Purdue University

Poa annua or annual bluegrass is, in general an undesirable species in the Midwest. While it does make a fast regrowth in the early spring or during a mild winter, it quickly loses its desirable turf qualities during high temperature and low moisture conditions. Many cases of its persistence through more than one season have been known. However, its usual life cycle starts with germination in the fall or early spring, continues with lush vegetative growth during mid-spring and finishes with seed setting and death during early summer. Under artificial conditions of high moisture, Poa annua will germinate and produce seed heads most any time during the growing season. Whenever the turf cover is weakened by disease or mechanical damage, a new crop of annual bluegrass will emerge from dormant seeds in the soil.

The most practical control measure appears to be the application of a soil active herbicide to kill the seedlings as they emerge. The desired herbicide needs to have a long residual life so that one or two applications per year would give effective control of the germinating seedlings. The material should have no permanent effects on desirable turf and should be active at low acreage rates to reduce cost.

The present research program has been broadened to include most of the recent experimental herbicides that have indicated possibility of having selective activity on Poa annua. Twenty-two compounds are being applied at several rates at five different growth periods during the year. These materials are being applied to a Poa annua infested bluegrass fairway at the Lafayette Country Club. Visual ratings of Poa annua control and bluegrass turf damage are being taken at intervals during the season.

A more detailed greenhouse evaluation of the most promising chemicals is indicating the length of the residual activity and is determining the most susceptible stage of plant growth for each of the better compounds.

Complete results of these two trials will be used to design an intensive trial of only several of the most promising materials. These materials will be applied at many rates and dates on as many different turf conditions as possible. A concrete recommendation for Poa annua control can be made only after the completion of these trials.

The most promising material from the early tests has been "neburon" or 1-n-butyl-3-(3,4-dichlorophenyl)-1-methyl urea. Fall applications of 4 pounds of active ingredient per acre gave excellent control of annual bluegrass with no sustained injury to the desirable bluegrass turf. Greenhouse studies indicate that the material has a fairly long residual life. "Neburon" has not been effective when applied after the Poa annua emerges.

Another interesting compound has been "CDAA", or alpha-chloro-N, N-diallylacetamide. When applied at rates of six pounds or more per acre, it gave good annual bluegrass control with only slight damage to the bluegrass turf. This compound has very little residual activity, but was effective on annual bluegrass three weeks after germination.

These and other materials, including the arsenates, are being tested in an intensive project with the ultimate goal of classifying Poa annua with the other "easy-to-kill" turf weeds.

Research since 1950 at Purdue, has included several compounds. Of these lead arsenate has been most tested. Arsenates reduce Poa annua vigor by phosphorus metabolism interference. However, high pH, the excess phosphorus present in many turf soils and the high cost limits its adaptation.

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FUNGICIDES FOR DISEASE CONTROL

J. L. Holmes. Plant Pathologist,
Mallinckrodt Chem. Co., St. Louis,Mo.

Because I am the first one to appear on this panel, may I explain how this particular panel came about. Dr. Daniel asked four representatives of Fungicide Companies to bring to the group the results of our continuing opportunity to observe turf disease and protective attempts in turfgrass. Before the panel discussion actually begins, each of the panel members has been asked to give a five or ten minute resume of the products and their use which his respective Company offers.

Calo Clor

To my knowledge Calo Clor has been used as a turf fungicide longer than any other product. A balanced mixture of mercurous and mercuric chloride was recommended mainly through the efforts of Dr. Monteith for use on golf course greens for control of brownpatch, snow mold and dollarspot. The first container of Calo Clor was sold in 1926.

The lore of the product, such as amounts to be applied, how often to apply and other chemicals it can be mixed with, have been well worked out down through the years by golf course superintendents under actual field conditions. Calo Clor has been applied with various fertilizers. However, many golf course superintendents do not apply mercury fungicides and fertilizers at the same time. It is believed that the application of a complete fertilizer along with a mercury fungicide is on occasion a little too much for the grass. We have heard of very few failures to control the diseases for which this product is recommended.

Calocure

In 1952 Mallinckrodt introduced a new mercury fungicide, CALOCURE. The main purpose in introducing Calocure was to make available a mercury compound with maximum effectiveness and safety for use during periods of extremely high temperature and humidity. Mercury itself is toxic to every known living thing. If the fungus is to be destroyed, and the grass left unaffected, a controlled balance of mercury must be available. Mercuries are also more active as the temperature rises. Therefore, Calocure was developed so that a mercury fungicide could be used more safely during these periods of extreme heat with less precautions necessary to stay within the balanced limits for safety.

As you well know, Calocure will give generally as good control of brownpatch as will Calo-Clor. However, because of the greater mercury content, we recommend that Calo-Clor be used against snow mold at all times.

Application rates for Calo-Clor and Calocure vary depending upon the disease being treated. Five or six ounces of Calo-Clor is generally applied for snow mold and one to two ounces for dollar spot and brownpatch. One to four ounces of Calocure is usually applied for brownpatch and dollar spot at weekly intervals if a preventive schedule is followed. If a curative program is followed, it may be advisable to retreat the diseased area in two to four days if the disease attack has been especially severe.

Cadminate

Previous to 1950 when Cadminate was introduced, Mallinckrodt worked for a number of years toward developing a specific control for the diseases known as dollar spot, copper spot and pink patch. A large number of compounds were screened before it was definitely decided that cadmium succinate gave the most lasting and complete control of these diseases. Cadminate is somewhat unique, as far as turf fungicides go, in that under normal conditions 1/2 oz. per 1,000 sq.ft. will control these diseases for approximately 30 days. However, occasionally, if conditions are extremely severe, you men know as well as anyone else that it is to your benefit to increase application rates. I know of no cases where more than double the recommended rate has been required to achieve satisfactory protection.

KROMAD

For a number of years Mallinckrodt has been working toward filling the demand for a broad-spectrum turf fungicide. Last year, as most of

you know, we field tested such a product, - KROMAD. Results from the field tests were as follows: About 80% of the cooperators reported that KROMAD gave as good as or better control than any other products or mixtures of other products. About 15% said that the KROMAD appeared to be about the same as other products -- no better nor no worse. The remaining 5% reported that other products gave greater control of specific diseases than KROMAD. These results were very encouraging and we are now marketing KROMAD. KROMAD controls brownpatch, dollar spot, copper spot, pink patch, and various leaf spot diseases such as Helminthosporium and Curvularia.

Some of the things that we learned from our research last year which may be of interest to you men are as follows:

1. During periods of severe turf disease weather we found it necessary on occasion to increase the application, or to apply KROMAD more often than once per week. As you well know, each course (as far as disease control is concerned) is different. Not only is each course different, but susceptibility to disease will vary from green to green. Therefore, the exact application rate and frequency is up to you.

2. Most golf course superintendents testing KROMAD used their most disease-susceptible green, therefore KROMAD had an acid test. And 1955 was a most active year for turf diseases. It was gratifying to find that in most cases where KROMAD was tried a putting surface was maintained throughout the summer season. This does not mean that a lush, putting surface was in evidence, but it does mean that a putting surface was maintained and that the greens were not closed because of disease.

Mallinckrodt will continue to conduct research towards the development of even better turf fungicides. One of the objects we now have in mind is incorporating a compound in KROMAD which will give effective control of Pythium. Dr. Howard has discovered that the chemical Malachite green controls Pythium. Research is continuing along this line and we hope to have more complete information for you soon. Our combination turf fungicide-turf dye, AURAGREEN, contains approximately 60% Malachite green. We are now conducting research with AURAGREEN to determine its effect against Pythium.

I have heard Dr. Spencer Davis of Rutgers University remark that there is no better place in the world to develop and prove a turf fungicide than under actual playing conditions on a golf course. He said that with the co-operation of golf course superintendents effective turf fungicides would be developed in about half the time. I would like to say that we received exceptional cooperation from golf course superintendents last year in field testing.

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REMARKS BY ROBERT T. MILLER, TURF SPECIALIST
E. I. du Pont de Nemours and Co. (Inc.)

In our frequent contacts with the golf course superintendents, we are continually asked, "What is new?". By this, do they mean new chemicals or better ways of using existing products? We know that with agricultural chemicals, discovering new chemicals is a slow process. Equally important is to learn how to most effectively use a product and know its true value. This continuing study applies to all products, both new and old.

We, in the du Pont Company, are continually screening materials in the hope of being able to give the user a more suitable product. Coupled with this are studies on how products may more effectively be used. In this, recognition is given to the importance of a wide margin of safety needed with turf fungicides.

The use of "Tersan" 75 Thiram Fungicide has proven to be an effective fungicide. It has been used for years on golf courses with excellent results, both as a preventive and a cure for large brownpatch and control of snow mold. It has now been established that "Tersan" 75, when used in combination with a mercurial in a tank mix, will give better protection against more diseases than either material alone. Furthermore, in combination, we get the control advantages of both materials without the shocking or discoloring effect that frequently occurs when mercurials are used alone. In this combination the "Tersan" 75 appears to act as a safener for the mercurial and the two materials seem to compliment one another. Golf course superintendents have used "Tersan" 75 in combination with all the commercial mercury turf fungicides with very satisfactory results.

In 1956 we are introducing for sale a new organic mercury product, "Semesan" Turf Fungicide, especially formulated for use in combination with "Tersan" 75. This product wets readily, does not settle out, and is easily sprayable. It may be used alone with reasonable safety, if so desired. This product, "Semesan" Turf Fungicide, was tested last year in combination with "Tersan" 75 Fungicide in a number of different areas. The combination of "Tersan" 75 and "Semesan" Turf Fungicide in all cases gave excellent disease control.

Our recommendations will be to use two ounces of "Semesan" Turf Fungicide and three ounces of "Tersan" 75 in five gallons of water per 1,000 sq.ft. every seven to ten days. During periods of heavy rain and unusually favorable conditions for disease, it may be desirable to reduce the interval of treatment.

We are suggesting the use of the minimum amount of water necessary to get complete coverage of the turf area with a high pressure sprayer. This usually requires about five gallons of spray mixture per 1,000 sq.ft. A minimum of water permits retention of the fungicide on the foliage where it is needed and requires less time for the spray operation. Time and labor are the most costly parts of spraying. A reduction in spraying time of as little as one or two hours per spray means a big saving in time and money over a whole season.

We are often asked about the compatibility of different fungicides, fertilizers, herbicides and insecticides. This question cannot always be answered by a single "yes" or "no" because of the different types of compatibility. Materials may be physically incompatible in spray tank, due to the manner in which they are formulated to cause settling out, excessive foaming, etc. Materials may be chemically incompatible such as F531 and "Tersan" 75. Mercurials and "Tersan" 75 are presently incompatible when packaged together and stored for a period of time. They are compatible when used as a spray tank mix.

A third type of incompatibility is that of placement of the several materials. We want the fungicide on the leaves, and we may want the other product or products washed into the root zone. A rule of thumb could be that products which should be watered in are not compatible with fungicides that should remain on the foliage. Do not waste part of your fungicides to save time in applying an insecticide. This doesn't preclude applying fungicides, herbicides, insecticides, and soluble plant foods together if the fertilizer and insecticides are to be used at very light rates to hold a level and if there is no need for after-watering.

In a sound disease control program, we should not lose sight of the part fertilizer plays. High fertility levels and lush growth usually favor large brownpatch, while dollar spot is usually more in evidence at low fertility levels. Light, frequent applications usually permit better control.

Regular applications of an effective fungicide is only a part of good management. It is not the whole answer. The more factors we can control, such as fertility levels, pH, air and water drainage, insects, etc.,the better chance we have of keeping good healthy turf throughout a long, hard-playing summer season.

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FUNGICIDES FOR THE CONTROL OF TURF DISEASES

George Swank, Jr., The Upjohn Co.
Kalamazoo, Michigan

The Upjohn Company produces and markets Acti-dione* Ferrated as a turf fungicide.

A change in the preparation of Acti-dione Ferrated will no longer require that the antibiotic be added to the serrous sulfate in dry form and given a thorough mixing before use. The new package will contain two bottles of ingredients, one of which will be Acti-dione bulked with

*Reg. U.S.Pat.Off. Acti-dione is a registered trade-mark of The Upjohn Company for its brand of cycloheximide.

a diluent and the other ferrous sulfate. The contents of the two bottles may be added directly to the proper amount of water in preparing a spray mixture. This new feature will save the user the necessity of pre-mixing the contents of the package and will also provide a package which can be more readily divided into portions necessary to treat small areas.

The recommendations for disease control with Acti-dione Ferrated have been changed. The new label recommends Acti-dione Ferrated for the control of dollar spot, melting-out, and fading-out, but does not specify the control of large brown patch and snow mold. Those who obtained control of large brown patch and snow mold in the past should, however, obtain the same control from future use of Acti-dione Ferrated.

The rate of application of Acti-dione Ferrated will remain the same. One package containing approximately 14 ounces of material will treat 20,000 sq.ft. of turf area for the control of dollar spot and 15,000 sq.ft. for the control of melting-out and fading-out. The interval between applications will depend upon environmental conditions. It would be extremely difficult to specify a set number of days between applications since many factors must be taken into consideration; however, an interval of 7 to 14 days between applications is suggested when using Acti-dione Ferrated.

Soluble fertilizers may be combined with Acti-dione Ferrated with safety. No chemical or physical incompatibility has been observed to date.

Chlordane and materials of alkaline nature should not be applied with Acti-dione.

The Upjohn Company is also planning to introduce a new fungicidal composition for use on turfgrasses this year. The product, which will be sold under the trade name Acti-dione RZ*, is a mixture of two materials and will be packaged in two separate bottles within one carton container. No pre-mixing of the ingredients is necessary before they are used. The contents of the bottles may be emptied directly into the proper amount of water to obtain the spray mixture for the intended use.

Acti-dione RZ was widely tested during the past year for the control of large brown patch, dollar spot, melting-out, fading-out, and Pythium disease. Large brown patch was controlled in 95% of the tests conducted during the year. In no test was there a failure against melting-out, fading-out, or dollar spot. We did not expect to obtain control of Pythium-caused diseases, but to our surprise Pythium was controlled in three of four specific tests. The fourth cooperator listed the control of Pythium as improved. Acti-dione RZ proved to have excellent curative as well as preventive qualities.

Acti-dione RZ will be the first all-purpose fungicide to be marketed for the control of all major turf diseases.

The suggested rate of application of Acti-dione RZ for dollar spot

*Trade-mark, The Upjohn Company

is one package (30 ounces) in 100 gallons of water and applied to 20,000 sq.ft. of turfgrass. The same amount of material is suggested for 15,000 sq.ft. for the treatment of large brown patch, melting-out, and fading-out. The suggested rate of application for the control of Pythium is 1 to 1½ packages (30 to 45 ounces) per 100 gallons of water and applied to 15,000 sq.ft. of turfgrass.

Soluble fertilizers and insecticides of non-alkaline nature may be added to a tank mixture of Acti-dione RZ. Chlordane cannot be used with Acti-dione RZ.

Dr. Houston B. Couch has found Acti-dione to give excellent control of rust of Merion bluegrass caused by Puccinia graminis Pers. when applied at 15 day intervals. The rate he used would approximate one package of Acti-dione Ferrated in 50 to 60 gallons of water and applied to 25,000 sq.ft. It is easily seen that the cost for rust control will be reasonable. The phytotoxicity of the material will delay a general recommendation until the problem can be worked out.

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WHAT DO THEY ASK ABOUT GRASS?

Fred V. Grau, Agronomist
West Point Products Corporation
West Point, Pennsylvania

What do they ask about turf? It seems as though every question in the book has been asked, not once but many times over during the past 25 years. It was just 25 years ago that I started with the Green Section - first at the Lasker plots in Chicago and then at the Arlington Turf Gardens in Arlington, Virginia. During my ten years as Extension Agronomist in Pennsylvania, eight years with U.S.G.A., Green Section, and now with West Point Products Corporation and Grau Queries in GOLFDOM, the questions have come hot and heavy, and they are still coming in.

People ask questions because they want to know. It is rarely from idle curiosity. They want a simple, concise answer that they can use to solve a problem - right now. Occasionally a question is asked to settle an argument. Very often the question is asked by a superintendent who knows the answer, but wants confirmation for some purpose.

Q&A's are so popular because the information given is brief, usable and to the point. Space alloted to these columns is such that the reader is spared lengthy scientific background material, etc. He gets a suggested solution for HIS pressing and personal problem.

Q&A's are up to the minute. The A should come from the most recent data. A large volume of the Q's could be answered by anyone in

this room. Questions come from many, many clubs and superintendents who have not yet discovered conferences such as these. There are a lot of questions coming in that no one in this room or anywhere else can answer yet, questions that clearly indicate that the superintendent is well informed, is using the very best grasses and techniques, that he is working abreast of science (sometimes he is ahead of it), and that he is ready for science to show the way for the next improvement.

The many Q's that come from courses where the superintendent has not had the opportunity to attend conferences reveal to me that we, as teachers, have a big job ahead of us. I am always glad to participate in Q & A panels - they are so stimulating and so revealing.

Let's take a look now at the question that has been asked more than any other: "What is the best way to get rid of crabgrass?" Twenty-five years ago the answer had to be, "Get down on your knees. Prayer may help, but suggest a sharp knife. And set the mower as high as it will go." We were just starting to study other means of control - chemical and mechanical. Within a few years we were able to say,"Use sodium arsenite or sodium chlorate." Arsenate of lead had a place, too. Then the answer had potassium cyanate and phenyl mercury added to it. We also talked more cultural control - good grasses, adequately fertilized and properly maintained. During the last 3 years we've had added to our list of answers vertical mowing for mechanical control and di-sodium methyl arsonate for chemical control. There are others and there will be more.

Questions on lime continue to pop up. It is obvious that there still exists a lack of basic understanding of the different kinds of lime and the use to which each is best suited. Keep an open mind on this.

There are few questions on fungicides and insecticides. This seems to indicate that the questions are being answered well through other channels.

Only recently have questions started coming in on the proper operation of specialized equipment.

"What mixture should I use for the top of my new green?" The answer to this question has changed considerably over a quarter century. Today we would suggest much more sand and much less peat, based upon research results and upon practical performance.

"What grass should I plant?" What a train of thought this one starts! I probably spend more time pondering this one than any other before venturing to advise. The answer must, of course, be based upon sound (we hope) analysis of the total situation.

The use of stolon grasses presents new questions. "Where can I get seed of U-3 bermuda?" This illustrates that we, as teachers, have not been successful in teaching nearly enough people that this grass is NOT reproduced from seed.

Very few questions come in on, "How to Water?", yet many of the

Q's reveal clearly that water management, or mis-management rather, is the root of the trouble. It is something like a question on pearlwort. Any question on pearlwort tells us that the turf is weak - otherwise it wouldn't be there. The solution is to find out why the turf is weak.

One question that I have not handled satisfactorily as yet: "Tell me about Poa annua and how to keep it out of my greens". When we have the answer to that one I may not be writing Q & A's - I'll probably be out selling the stuff, whatever it may turn out to be. I'm joking of course, but here is a question that involves all the complex inter-relationships of soil, water, grasses, management - everything we do has its effect. Two chemicals hold top place in my book for now -lead arsenate and sodium arsenite. Water control and the use of a vigorous grass are just as important. So are feeding and the relief of compaction.

To tell the whole story of Poa annua would be to write a book covering nearly all fundamentals. So now what is happening? We have improved strains of Poa annua itself which look mighty good. A few years from now the Q's may change to, "How can I get it INTO my greens?"

Here is a Q - "I want to aerate my greens, but my chairman won't let me." It is obvious that the superintendent knows that this must be done to keep the greens in good shape. It is just as obvious that the chairman and members don't understand the principles of growing grass and that they are unfairly preventing the superintendent from giving them good greens. It is not really a question on growing grass. It is a question on how to educate the layman.

"I am a senior in high school and I would like to get into a college where I can learn about grass. Where would you suggest I go?" I love to get questions like this. You might be surprised how frequently they come in. It is a pleasure to be able to refer them to Purdue, Penn State and New Jersey. There are good courses at Texas A & M., at U.C.L.A., Rhode Island, Michigan and Wisconsin. Not all of them concentrate on turf. Not all of them have test plots. But a grass student today has more choice than ever before - and nonetoo soon. We are desperately in need of trained men. "Where can I learn about grass?" is frequently asked by men past college age who cannot take four years off for study. I believe that all of you will agree that Conferences such as this is the answer.

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MERCHANDISING - MEYER ZOYSIA

Lee H. Glissmann, Henry C. Glissmann & Son
Omaha, Nebraska

Our original source of Meyer (Z-52) zoysia was sent to us from the U. S. Department of Agriculture, Bureau of Plant Industry, Beltsville, Maryland in 1950. After a season of successful growth, my father was ready to start marketing the Meyer zoysia turf in 1951.

To the best of my knowledge, it was decided to sell in plug form, and West Point Products Company was asked to make up a plugging tool which would cut a two inch plug. The price of ten cents per plug was decided upon, and was sold in any amount desired by a customer. Later, a minimum order of $ 10.00 for 108 plugs was established, and a larger order of approximately 335 plugs packages in bushel baskets selling for $ 30.00 was also started.

The plugging tool which the purchaser used initially to plant the plugs, and could later be used for cutting plugs from his own nursery plot and transplanting them in other areas of his lawn, was included in about fifty percent of the orders. The original plugging tool retailed for $ 6.50. Through redesign and increased production, our manufacturer has substantially reduced the cost to us so that we can now retail our plugger for $ 3.85 each.

Since Meyer zoysia has proven so successful for the homeowner, and with the ever increasing publicity given it in magazine articles, television, etc., more homeowners wanted to try it. Many expressed their desire to try it if they could obtain a small number of plugs for "testing" in their lawns; so we introduced a trial order of 25 plugs in 1955. With the trial orders proving so successful in obtaining "reorders", we now have changed our number of packages to five, ranging in price from $ 2.50 for 25 plugs, to $ 27.50 for a carton of 324 plugs.

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COMMERCIAL ZOYSIA PRODUCTION

John C. Harper, Agronomist
Lawn Grass Development Co., Vienna, Virginia

In the commercial production of Zoysia there are two major production problems which I feel stand out above all others. The first is the method of planting or establishing the material, the second weed control. In small operations, where very limited areas are planted, neither of these problems are nearly as serious as they are in large scale production. Both of these problems become extremely expensive when large acreage is involved.

First, let's take a look at the planting problem. To begin with, the grower must decide whether he is going to plant plugs, sprigs or stolonize the area. All of these methods have a place, depending on the circumstances. The amount of planting material available, the size of the area to be planted, the labor and equipment available, and the time of planting are all important considerations in determining the method of planting. Each method has definite advantages and disadvantages.

Plugging - Plugging is the safest method of planting from the standpoint of survival. Plugs are less likely to dry out during dry periods and less likely to heave out of the ground during periods of freezing and thawing. Plugs are relatively easy to handle and plant. Machines are available for cutting plugs for planting material from existing sod. Several machines have been built for mechanical planting of plugs, but I have not seen a machine that really works satisfactorily. The use of solid strips of sod cut by the West Point strip cutter is a variation of the plugging method and has some merit, although the actual planting operation is again a hand labor job.

Plugging or setting solid strips does, of course, have some disadvantages. Either method requires large amounts of planting material in comparison with sprigging. Plugs in particular are extremely slow to initiate growth after transplanting because most of the growing points have been cut off when the plug was cut. Solid strips remove a considerable amount of the growing points but not as severely as plugs.

Sprigging - Sprigging is the most economical method of planting from the standpoint of the amount of planting material required. It does require more labor in preparing the planting material and in the actual planting operation. After planting, sprigs require more care for several weeks particularly in regard to watering. Sprigs planted on hot days must be watered immediately after planting.

With proper moisture conditions sprigs generally will begin to develop faster than plugs because most of the growing points are intact. I would not recommend the planting of sprigs in late fall because of the danger of heaving and desiccation. Plugs are much safer at this time of year.

Stolonizing - Stolonizing probably has no place in commercial production, but it may be useful in planting very small lawns where quick cover is desired and cost is no object.

Weed Control

To me, weed control is the most difficult single problem in the production of Zoysia. This is especially true if the area to be planted is a rundown pasture, or abandoned land. On such areas it sometimes pays to spray the area with Dalapon, or TCA before preparing the seedbed prior to planting. This will eliminate a considerable amount of the perennial grasses present in the area. In many cases it also pays to apply calcium cyanamid for partial seedbed sterilization prior to planting.

There are a great number of factors to be taken into consideration in any weed control program. Among these considerations are such things as the stage in development of the Zoysia, the tolerance of the Zoysia to various herbicides, the selectivity of a given herbicide, the weed species involved, and the climatic conditions, particularly soil moisture content and soil temperature.

I am not going to attempt to tell you how to set up a weed control program because each nursery will have to work out a program that is satisfactory for its conditions and needs. In fact, you will find

that your weed control program will vary from field to field. I would like to mention a few of the herbicides we have found useful and their general uses.

1. Calcium cyanamid - As previously mentioned, this material is useful for partial seedbed sterilization prior to planting. It also supplies nitrogen for initial growth and helps to neutralize excessive acidity.

2. TCA - TCA may be used for killing grassy vegetation prior to preparing the seedbed and may also be used as a spot treatment for grassy weeds in growing turf, realizing of course, that some Zoysia will also be killed.

3. Sodium arsenite - Sodium arsenite has a wide variety of uses on many types of weeds, but its use must be carefully understood and it must be used with caution. Soil moisture content and temperature have a great effect on the material, particularly when soil moisture is low. It is a contact killer and has no selectivity. Its greatest virtue is its low cost in comparison to most weed killers.

4. Dalapon - Dalapon also is useful for killing grassy weeds prior to seedbed preparation and for spot treatment of grassy weeds in growing turf.

5. Amino triazole - Amino triazole is one of our newer herbicides and needs further testing. There are indications that it may be used for spot treating quackgrass.

6. Phenyl mercuric acetate - PMA will give excellent control of crabgrass with little damage to the Zoysia if used properly. It is relatively expensive if used on a large acreage.

7. Di-sodium methyl arsonate - Newest of the many crabgrass control materials on the market it will, in most cases, do a satisfactory job. In addition it will control or partially control several other annual grasses. Like other arsenicals soil moisture and temperature are important considerations in its use.

8. 2,4-D and 2,4,5-T - Both these chemicals are satisfactory for broadleaf weed control. I mention both chemicals because some growers feel that 2,4,5-T does less damage to elongating runners than does 2,4-D. Either material will cause a slow down of growth in young turf when runners are developing. 2,4-D will control wild onion and garlic better than 2,4,5-T.

In any nursery operation, especially if fields are to be inspected for certification, a certain amount of handweeding will be required. I have found this true particularly where Poa annua is a problem.

Fertilization

Fertilization is another practice which must be fitted to the needs of the individual field or nursery. A complete fertilizer (N,P,K) should be applied at least once a season on mature or near mature sod and twice a year on immature sod. Supplementary feeding with a nitrogen fertilizer should be used throughout the growing season. No arbitrary time or number of such applications can be set up because of weather conditions, soil conditions, irrigation available and the actual growth of the sod. We try to use nitrogen in the same manner as the golf course superintendent uses it on his greens - when he feels it is needed.

In all cases we use a quickly available nitrogen carrier such as urea, ammonium nitrate, or sulfate, or sodium nitrate. Any of these materials may be applied dry with a spreader or cylone seeder, or they may be dissolved in water and applied as a foliage feed. In some instances it will pay to add fertilizer to the spray tank when making herbicide applications. Fertilizer materials may also be applied through the irrigation system.

Irrigation

Your irrigation practices will, of course, be dependent on your soil type and climatic conditions, particularly natural rainfall, temperature and drying winds. If your available water supply is limited you will have to adjust your irrigation practices to get the most out of the water you have. In our area it is our aim to supply one to two inches of water per week including natural rainfall.

The type of irrigation used will probably depend on the size of your growing operation. Even on relatively large acreages I do not believe permamently installed irrigation systems are needed, or are particularly desirable. Aluminum pipe equipped with quick couplers makes an excellent irrigation system, is much less expensive and highly maneuverable. Four inch mains from the water source with two inch pipe for the laterals is satisfactory. On small areas two inch plastic pipe is the most economical system.

Clipping

Frequent close clipping is necessary to develop a thick sod in the shortest possible time. The removal of clippings which are extremely resistant to decomposition is quite important. Failure to remove the clippings will result in the development of a thick mat, or thatch, and you will find that your mowers will be cutting 1/2 to 3/4" higher in the fall than they did in the spring even though the height of cutting adjustment on your mowers has not been changed. Thatch can, of course, be held to a minimum by aerating and supplying sufficient lime, fertilizer and moisture in addition to removing the clippings. Clipping removal is not an easy job particularly on areas which are not completely covered with sod because the clippings tend to accumulate in the bare areas and conventional brush types of sweepers ride over these low spots without picking up the clippings. Some type of vacuum equipped sweeper is much more satisfactory.

Insect Control

To date the only insect we have had to contend with in Zoysia turf is the grub of the Juno beetle and the Japanese beetle. These beetles can be controlled easily with applications of chlordane.

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ZOYSIA GROWING PROBLEMS IN CERTIFICATION

Hugh A. Inglis, University of Georgia
Athens, Georgia

Our Georgia Crop Improvement Association has 16 members growing certified Zoysia grass turf. We also have growers of three other turfgrasses, they are: Tiflawn, Tiffine and Tifgreen bermudas. We have had 34 applications to handle through our office with other states. Applicants from Maryland to Arizona who were obtaining their foundation Emerald zoysia turf from our Georgia Coastal Plain Experiment Station.

One of our largest problems is to find clean land free of noxious weeds and objectionable plants after we acquaint the applicant with our turfgrass certification standards and regulations. Our Experiment Station releases foundation Emerald zoysia turf to only members of State Seed certifying agencies. The I.C.I.A. plans to certify only one year from Foundation stock. The growers in the state and without the state are first required to pay their membership fees, have their land inspected two times at six weeks intervals, and if the land is found to be clean and qualified, we then notify the turfgrass specialist at Coastal Plain Experiment Station, giving him the name and address of the certified seed grower who has just qualified either in the state or outside the state. This foundation turfgrass is sold $ 15.00 per square yard, F.O.B. Tifton, Georgia. We allot two square yards per applicant.

Most all of our Georgia growers are fumigating their land with methyl bromide. This is done, as most of you know, by putting it under a plastic sheet. The sheets we use are 16 ft. wide and 100 ft. long. We have found when methyl bromide is used according to the manufacturer's instructions it will kill out about 98 percent of everything we find in our standards listed as objectionable. We have been rather strict in training our field inspectors because we know that with clean land in the beginning and planting pure sprigs we should have no trouble later. We believe that the only way to have satisfied customers is to give them the highest quality, pure living sprigs of Emerald zoysia grass. Most all of our growers take soil samples and get recommendations on what to use to fertilize in producing high quality Emerald zoysia.

We have found that by planting the sprigs on 6 inch centers and applying 1 inch of water each week that we can get good coverage of the

ground in one growing season. To plant on 12 inch centers we did not get this coverage. The person who looks after his turf carefully, fertilizes and applies the water is making the most satisfactory progress. It is necessary to go over the plots and rogue the fields carefully each week.

Many of the growers of certified Emerald zoysia turfgrass throughout the South expressed an interest in organizing themselves into an Association to promote the use of high quality certified Emerald zoysia turf. Several meetings were held in Atlanta during the fall and winter of 1955. Growers from Alabama, Florida and South Carolina attended this meeting with s ome of the Georgia growers of Emerald zoysia. They appointed a Constitution and By-laws Committee, and have adopted a Constitution.

The new Emerald Zoysia Growers Association now has 20 members representing eight states, namely: Arizona, Alabama, Florida, Georgia, Maryland, North Carolina, South Carolina and Virginia. There is an Instruction Sheet on how to plant and grow Emerald zoysia which was prepared from the data furnished by the Coastal Plain Experiment Station, Tifton, Georgia. I also have a special seal to show you which exhibits the trademark of this Emerald Zoysia Association. The front of this seal has green lithograph on white with the words "Certified Emerald Zoysia Turf Grass Growers Association" on it. The reverse of the seal is solid red. The only purpose of this seal is to promote the use of high quality certified Emerald zoysia.

Nothing disturbs a buyer any more than to have a mixture in his Zoysia nursery or lawn such as Bermuda grasses which will in the South grow much faster than Zoysia and cover it all up within a few weeks. It is amazing to listen to some of the "sales talks" that people will hand out when they have nothing to sell but a mixture. According to our standards all such grasses will be rejected and any growers who do not have the integrity to meet the standards they have agreed upon in becoming a member of this Association will be dropped from the membership. If we cannot enforce the standards on a member, we can at least return their application the next year and tell them so.

To maintain the high level of public confidence, we must meet and even exceed the minimum and maximum certification standards. Due to the widespread presence of perennial grasses such as Bermuda grass and the widespread presence of noxious weeds, such as wild onions, nutgrass and plantain, we find that our people more and more will not buy anything unless it is certified. We have plenty of people who will sell good quality seed stock without a Crop Improvement program, or a seed certification program, but we have found that even some certified seed growers would not meet these high standards if it were not for the official field inspector coming to his place unannounced. As time goes on we have fewer and fewer people who have their fields rejected because of low quality. We expect this Certified Emerald Zoysia Turf Grass Growers Association to spread to other turfgrasses and become more popular as time goes on, just as the person who built the better mouse trap had more people making a path to his door.

I was invited to come here and tell you our problems in growing certified Zoysia grass. Whether or not you decide to get into the cer-

tification of turfgrasses in the Midwest is for you to decide upon. We can tell you that in the South we recommend it and the buyers of these turfgrasses are profiting from such a program because later on they will have high quality lawns and golf courses not cluttered up with mixtures and noxious weeds that they will have to fight from now on.

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ZOYSIA NEEDS FOR TOMORROW

W. H. Daniel, Dept. of Agronomy
Purdue University

First, may I say a word about the reason for having the Zoysia section in our Turf Conference program. Zoysia today offers to the Midwest turf areas a new grass. However, there are many limitations in its adaptability and in its potential performance. Nevertheless, it is commanding considerable attention from nurserymen and for that reason a sharing and exchange of information should be mutually beneficial.

The needs for improvement in Zoysia may be classified into these headings:

Nursery Production

Much has been accomplished in procedures for nursery handling, and reports presented by Mr. Harper at this Conference show that considerable progress has been made. The use of methyl arsenates for crabgrass control, the recommended use of Dowfume to sterilize seedbeds prior to planting, plus pre-emergence weed control, offer a great deal of improvement in the ability to grow Zoysia without competition, thus much faster.

Shipping

In the shipping processes used today most of the effort has been either on the shipping of plugs of turf, washed sod, or sprigs. Shipping is expensive, therefore, any way to modify and reduce the weight offers considerable advantage. Some have proposed the use of vermiculite, or other light weight materials for growing media. Some have attempted to cut plugs quite shallow; others have attempted to use quite small plugs. Certainly the advantage lies with the lighter weight shipping unit. Beyond the weight and thus cost, Zoysia does package easily and it tolerates handling as well as any of our grasses. Excessive storage periods will reduce the carbohydrate supply, thus a slower regrowth.

Merchandising

In this area much remains to be accomplished. Consider the lawnowner - his needs are both to have something that will grow and multiply to produce the lawn he desires, and physiologically to have something that will look attractive and satisfactory to him very soon after planting. For this reason I believe much remains to be accomplished in the handling of plug units.

For example, power machinery will cut or dice sod while still rooted in the nursery with a later removal of the plug from the nursery may be of potential value. In some experiments we observed it took one month for the cut plugs to lose the brownness and loss of leaf caused by the cutting action. Cannot this one month of discoloration occur in the nursery much better than in the homeowners new planting? Also, such pre-cutting or pre-handling allows new runners to initiate in the nursery without cost to the nursery and of considerable early benefit to the lawnowner. Some day I visualize that most of the Zoysia will be sold at landscape and garden stores just as other homeowner vegetative materials, therefore, developments in the use of flats that are adapted to merchandising and shipping and handling methods adapted to flat use should be very advantageous.

Education

Education should serve the producer, the advertiser, merchandiser, plus the lawnowner. Advertising to date has been both educational and promotional. I have the feeling that there are so many places in the Midwest where the maintenance of the cool season grasses is difficult and where the sunlight and warmth favors Zoysia growth that the Zoysia should be sold in those areas rather than to attempt to sell it in many locations where other grasses normally grow quite well, and it may be the fringe area for Zoysia utilization.

Research

As pointed out by Mr. Inglis, Secretary, Georgia Crop Improvement Association, Athens, Georgia, the certification and production of Emerald Zoysia is well under way. In that grass they have much of what is needed for the southern belt of the United States. In the north, such as Indiana, we still need improvement in the Zoysias, something that will keep greener color during the winter, something that may spread faster in the early stage, something that stays a darker, more pleasant green at low nitrogen, something that will green up early in the spring even under cool spring conditions.

With this in mind we have collected 25 different viable seed sources and from these selected 1,000 seedlings. This will be planted the spring of 1956, will be mowed and maintained to observe vigor, fall color, spring greenup and general characteristics. I am certain there is good possibility of better selections than Meyer or Emerald for the Midwest. We have just begun to meet the needs presented by Zoysia.

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QUESTIONS ASKED ON ZOYSIA

Q. If you strip the sod 1" deep will it grow from rhizomes below?
A. Only if in planting some of the original rhizomes were placed so deep in the ground that they are below the sodcutter. Normally rhizomes grow within 1/4", or on the soil surface.

Q. How to keep a green lawn in winter with Zoysia?
A. Over-planting about mid-September with ryegrass, bluegrass, bentgrass, or redtop. It is difficult to get uniform stands. Top-dressing and intense aerification should help.

We at Purdue are testing a material, Poa bulbosa, which grows in winter from a corm which has the opposite growth periods of Zoysia.

Some work with dyes shows they can give greenness. It is difficult to match other adaptability to growing grasses, such as bluegrass, which varies in color. Has not been used widely.

Q. How may clippings be removed in large areas of nursery?
A. Some large vacuum cleaners are used by cities and airports. For small handling sweepers or catchers on mowers may be beneficial.

Q. What are some methods of planting?
A. 1. Stolonizing, placing the stems in shallow trenches, recommend rows 8" apart and 6" between tips of sprigs in each row.
2. Plugging. Usually 2-1/2" plugs placed on 1 ft. centers.
3. Pre-cut squares of sod, later undercut and placed at intervals.

Q. What depth should stolons be planted?
A. Just sufficient to cover the majority of the stem, 1/2".

Q. What height of cut favors Zoysia?
A. As low as the mower will go, about 1/2".

Q. What is the loss of color "effect" on customers?
A. You may suggest that they lose the leaves from their deciduous trees without dissatisfaction. What they wish is a summer, uniform green color and a uniform winter condition.

Q. What possible advantage from surface burning of browned leaves in spring?
A. The black residue will absorb more heat and enccurage slightly earlier greenup.

Q. Which is the most shade tolerant of the Zoysias?
A. The hybrid Emerald with its lower growing leaves should tolerate shade better than Meyer.

Q. Does fertilizing hasten early growth in spring?
A. It should increase the speed only to the extent that cool weather does not inhibit growth.

Q. What printed material is available on Zoysias from Experiment Stations?

A. 1. The U.S.D.A. Forage Crops Division, Beltsville, Maryland has a list of sources availble.

2. Purdue University has Midwest leaflet No. 1, April '56 - How Does Zoysia Look for Midwestern Lawns" available from W. H. Daniel, Department of Agronomy, Lafayette, Indiana.

3. Department of Agronomy, University of Maryland, College Park, Maryland has "Fact Sheet, No. 112, June '55 - Zoysia as a turfgrass".

4. National Better Business Bureau, Chrysler Building, New York 17, N.Y., has Service Bulletin No. 1543, Meyer zoysia grass.

5. Rutgers University, R. E. Engel, Farm Crops Department has mimeograph "Zoysias as Turfgrasses in New Jersey".

6. Coastal Plains Experiment Station, Tifton, Georgia should have material available on Emerald zoysia and its release.

Considerable material is available from nurseries producing zoysia.

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BUILDING TOWARDS BETTER GRASSES

R. C. Pickett, Dept. of Agronomy
Purdue University

Better turf is an objective of every member of this group, many homeowners, as well as club and public officials today. Striking improvements to date have been made in management, including mowing, watering and fertility, insecticides, fungicides, and soil preparation treatments. In general, this has been accomplished on a relatively few turfgrass varieties. There has been some progress in development and release of new varieties, but it is quite clear that further improved varieties, along with their increase and release, provides the greatest opportunity for turf improvement today.

The few new varieties that have been developed, usually by straight selection, have undoubtedly deserved much of the publicity and attention they have received. The conclusion can be quickly drawn, however, that the need for really superior new types is greater than ever and that more time and money should be devoted to turfgrass breeding programs.

To date work in other states has been under way with bermudagrass in Georgia, with Burton, Forbes and others engaged in the breeding program. Stephens from that Station made a collection of bermudagrass throughout Eastern Africa. This collection may be of much importance

for other areas as well.

Zoysia breeding has also been in progress at the Georgia Experiment Station in cooperation with the U.S.G.A. and U.S.D.A.

Work at Rhode Island has been concerned with turfgrass diseases and bentgrass breeding work.

The Pennsylvania Experiment Station has had an outstanding turfgrass program which has included breeding work in improved varieties of red fescue, bentgrasses and Kentucky bluegrasses.

Kentucky bluegrass breeding work was initiated during the 1930's at several state Agricultural Experiment Stations. Two of the biggest projects on breeding of this species were at Wisconsin and Minnesota. Much of that material remains at those Stations, but relatively little of it has been evaluated adequately for turf purposes. An experimental release, Minnesota 95, is one example of a new variety that has resulted for turf purposes from the original forage grass breeding program.

The Washington Agricultural Experiment Station has several experimental lines of Kentucky bluegrass entered in turf trials this year. Seed is limited to experimental rows only. The Montana Agricultural Experiment Station has released Troy with the stated purpose of being a forage selection. Such varieties may also have turf applications, however.

The turfgrass breeding work here at Purdue was begun in 1945. This original project was closed in March 1955 due to changes in personnel. This original turfgrass breeding project was concentrated on bentgrass breeding work and strain trials. Many self-pollinated selections were made and compared with open pollinated seed selections. Some of this seed is in cold storage at the present time and available for future testing. Zoysia breeding work was also engaged in with extensive crossing work, and there was revealed a wide variation in the Zoysia species. Many selections were made and compared for winter survival, rate of spread, small leaf size, and color retention during frost.

Bluegrass selection was engaged in to a limited degree, but this work was expanded in a joint program beginning in January 1955 with the Carnegie Institute of Washington at Stanford, California. A new project on turfgrass breeding is starting again in 1956.

This Poa, or bluegrass program at Purdue, had as its basic concept to do research on the nature and inheritance of the apomictic character (a sexual reproduction charcter of bluegrass) and the possible use of this unique method of reproduction in plant breeding. Crosses were made among various species, including Canada bluegrass, Kentucky bluegrass, Big bluegrass, Plains bluegrass and many other species well adapted on the Pacific Coast, but less well adapted here in the Midwest. The initial screening of these crosses and their parents revealed that a large proportion were not well adapted in the Midwest. For the rapid progress of this project here better adapted parents will need to be found and crosses made. There has been one

outstanding selection found from these Carnegie selections and that is the so-called Newport selection of Kentucky bluegrass which has shown outstanding adaptation, disease resistance and turf characteristics. It, along with several introductions of Kentucky bluegrass, has been found to be relatively resistant to the stem rust which has been so virulent on Merion bluegrass.

The present program at Purdue includes the pathological work by M. P. Britton under the supervision of Dr. G. B. Cummins. Their project includes the more complete identification of Poa diseases. Work will be concentrated on leaf rust, stem rusts, Helminthosporium and Curvularia as they affect bluegrass.

All of the present turfgrass species are introduced from abroad. There are no native grasses of major importance for turf in this area. The State Experiment Stations and U.S.D.A. are organized to introduce and evaluate new germ plasm of many economic plants. Turfgrass species are included in this program. The Regional Plant Introduction Station for this North Central Region is located at Ames, Iowa. New introductions from this and other regional stations form one of the most important bases for breeding work that we can have. Relatively large numbers of many new types are needed in order to produce new variability and then have a chance for the right combination of characters needed for a new turf variety.

Zoysia breeding work is in progress at Purdue at the present time with several hundred space plants from diverse sources being planted in 1956.

There is great need for retaining superiority of new varieties once they are obtained. In order for a new selection to be distributed as widely as needed, it must either be increased vegetatively, or by means of several generations of seed increase. There is a great deal of need for determination of high standards for both vegetative and seed increases to retain the superiority of any new variety that may be developed in breeding projects.

In cooperation with the U.S.D.A. a new position has been started at Purdue that is concerned with the retention of superiority of new forage varieties as affected by management and environmental factors. Basic information obtained on retention of varietal purity, the forage grasses and legumes will be of direct interest for the new varieties of turfgrass that will be produced.

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A Few Do's and Don't About Advertising

John Phillips
Family Gardens Zoysia Inc.
Downers Grove, Illinois

Do work with an advertising agency. Pick one as near your business as possible. If your business is small, you will do better to work with a small agency. An agency's services will save you money in the long run and cost you no more in the short run. If they recommend buying space in newspapers or time on a radio station, the costs they quote you are no higher than if you bought direct. The agency commission is paid by the station or the newspaper.

An agency is constantly ordering, engraving, printing, laying out art work,etc. As a result, they can usually buy better and cheaper than a business that doesn't have the same day to day contacts.

Their production services will save you time and your money. Once you have chosen an advertising agancy, educate them as completely as possible to every phase of your business. Give them all the information you have on whatever it is you want them to sell. For instance: if you intend to advertise Meyer Zoysia, it would be wise not only to explain in detail what the grass will do, but second, to explain your own growing methods. As Meyer Zoysia becomes more and more easily available, telling people that it is a good hot weather grass, resists drouth, etc. may no longer be enough. You will simply be saying what everyone else says. Try to find something unique in your business, the way you service customers, your packaging methods, your growth guarantee that make it possible for the agency to produce an attractive advertising story for your Meyer Zoysia.

Tell your agency what you expect your advertising to accomplish and then let them give you an estimate of how much it would cost to do the job. If the estimate is too high, ask them to trim it down, but remember, it is unrealistic to expect the same result from a smaller investment.

Advertising can be immediately successful, but it may not be immediately profitable. Make up your mind before you start an advertising program that you are going to give your agency and your advertising time to show they can do the job.