Jim Beard

UNIVERSITY OF ILLINOIS
DIVISION OF UNIVERSITY EXTENSION

# ILLINOIS

# TURFGRASS CONFERENCE

# PROCEEDINGS

College of Law
Auditorium

December 6 and 7, 1962

arranged and conducted by the

COLLEGE OF AGRICULTURE

with the cooperation of the

ILLINOIS TURFGRASS FOUNDATION

This conference is presented specifically for persons interested in turf management by the University of Illinois College of Agriculture. Abstracts in this manual bring to you up-to-date information required by those who wish to maintain high quality turf-grass areas but do not constitute positive recommendations unless so stated. Statements made herein are the responsibility of either the speaker or the institution he represents. Reproduction and publication are permitted only with the approval of each author.

University of Illinois
Division of University Extension

Announces the

# THIRD ILLINOIS TURFGRASS CONFERENCE

December 6 and 7, 1962
Auditorium, Law Building
Urbana, Illinois

arranged and conducted by the
College of Agriculture

with the cooperation of the
Illinois Turfgrass Foundation

## PROGRAM

### Thursday, December 6 -- First Session

| | |
|---|---|
| 9:00 - 12:00 Noon | Registration |
| 10:30 - 11:30 a.m. | Illinois Turfgrass Foundation Business Meeting<br>Mr. J. W. Brandt, President |
| 11:30 - 1:10 p.m. | Lunch |

### Thursday, December 6 -- Second Session

Moderator - Mr. B. O. Warren, Palos Park, Illinois

| | |
|---|---|
| 1:10 - 1:15 p.m. | Welcome |
| 1:15 - 1:35 p.m. | Insect Control<br>Dr. S. Moore, Univ. of Ill. |
| 1:35 - 2:20 p.m. | Microclimate and Grass Adaptation<br>Dr. L. C. Bliss<br>University of Illinois |
| 2:20 - 2:40 p.m. | Nematodes in Grasses<br>Dr. D. P. Taylor<br>University of Illinois |
| 2:40 - 3:00 p.m. | Establishing Spring Lawns<br>Mr. H. R. Kemmerer<br>University of Illinois |
| 3:00 - 3:15 p.m. | Break |

Moderator - Mr. J. W. Brandt, Danville, Illinois

| | |
|---|---|
| 3:15 - 3:35 p.m. | Turfgrass Disease Control<br>Dr. M. C. Shurtleff<br>University of Illinois |

Thursday, December 6 -- Second Session (continued)

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|---|---|
| 3:35 - 4:20 p.m. | Irrigation<br>Mr. P. A. Boving<br>University of Illinois |
| 4:20 - 4:40 p.m. | Shade<br>Mr. J. D. Butler<br>University of Illinois |
| 6:30 p.m. | Banquet |

Friday, December 7 -- Third Session

Moderator - Mr. Oscar Borgemeier, Chicago, Illinois

| | |
|---|---|
| 8:30 - 8:40 a.m. | Briefs<br>Dr. M. P. Britton<br>University of Illinois |
| 8:40 - 9:00 a.m. | Weed Control<br>Dr. F. W. Slife<br>University of Illinois |
| 9:00 - 9:45 a.m. | Weather Forecasting<br>Mr. W. L. Denmark<br>University of Illinois |
| 9:45 - 10:05 a.m. | Sod Webworm Research<br>Dr. L. L. English<br>University of Illinois |
| 10:05 - 10:20 a.m. | Break |

Friday, December 7 -- Fourth Session

Moderator, Dr. F. F. Weinard, Urbana, Illinois

| | |
|---|---|
| 10:20 - 10:40 a.m. | Disease Research<br>Dr. M. P. Britton<br>University of Illinois |
| 10:40 - 11:00 a.m. | Seeding vs. Sodding<br>Mr. R. A. Miller<br>University of Illinois |
| 11:00 - 11:45 a.m. | Ice Sheet Damage<br>Dr. J. B. Beard<br>Michigan State University |
| 11:45 a.m. | Adjourn |

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# TURF INSECTS AND THEIR CONTROL

Steve Moore III

## WHITE GRUBS

Several species attack turf.

1. Annual white grub, false June beetle or masked chafer, Cyclocephala spp., is probably the most common. It has a one-year life cycle.

2. True white grub or June beetle, Phyllophaga spp. is also common. It spends 2 to 3 years in the soil before completing its life cycle.

3. Japanese beetle, Popillia japonica, confined to quarantine areas presently in Illinois, but continues to spread. It has a one-year life cycle.

4. Green June beetle, Cotinus nitida, feed mainly on decaying vegetable matter. Often the primary species in new seedings, especially in dry years. It has a one-year life cycle.

GENERAL LIFE CYCLE - In general the habits are similar in that they feed just below the sod on the grass roots. They overwinter deeper in the soil. The main period of feeding is between May and October.

DAMAGE - The damaged turf turns brown as the grass blades wilt and dry. In the case of serious damage the turf can be rolled back like a carpet exposing the grubs beneath. Damaged turf is usually killed; replanting is necessary. Normally the infestations are spotty.

CONTROL - See condensed recommendations for turf insects, NHE 105.

Discussion on other turf insects such as armyworms, cutworms and leafhoppers will be presented.

References: Vance, A. M., Lawn Insects: How to Control Them. U.S.D.A. Home and Garden Bul. 53, 1956. Write to Superintendent of Documents, Washington 25, D.C. Price 15 cents.

CONDENSED INSECTICIDE RECOMMENDATIONS FOR

INSECT PESTS OF TURF



| Insects | NHE No. | Approximate time of attack | Insecticides: Name | Lb. actual per 10,000 sq. ft. | Lb. actual per acre | Placement | Timing of application |
|---|---|---|---|---|---|---|---|
| True white grubs | 23 | May-Oct. | Aldrin | 0.75 | 3.0 | On soil surface | Established sod: if used as a spray, water in thoroughly. Apply preferably in early spring or late fall. New seeding: Mix in soil prior to seeding. |
| Annual " " | 23 | May, Aug.-Oct. | Chlordane | 2.5 | 10.0 | | |
| Japanese beetle larvae | 32 | " " " | Dieldrin | 0.5 | 2.0 | | |
| Green June beetle larvae | | " " " | Heptachlor | 0.75 | 3.0 | | |
| Ants | | May-Oct. | | | | | |
| Cicada killer wasp | 79 | June-Aug. | ......as for grubs...... | | | On soil surface | As for grubs. For individual nests, pour 3% chlordane in nest after dark. Seal in with dirt. |
| Earthworms | | April-July | Chlordane | 2.5 | 10.0 | On soil | As for grubs. |
| Sod webworms | 42 | July-Oct. | DDT | 0.5 | 2.0 | On grass | As a spray. Using about 100 gallons of water per acre. Do not water for 72 hours after treatment. |
| | | | Dieldrin | 0.125 | 0.5 | | |
| Armyworms and cutworms | 21<br>77 | May-June &<br>Sept.-Oct. | Dieldrin | 0.125 | 0.5 | On grass | As spray or granules. |
| | | | Toxaphene | 0.50 | 2.0 | | |
| Chinch bugs | 35 | June-Aug. | Dieldrin | 0.125 | 0.5 | On grass | Sprays or granules. Use plenty of water as a spray. |
| Leafhoppers | 22 | July-Aug. | DDT | 0.25 | 1.0 | On grass | As a spray. |
| Mites | 58 | July-Sept. | Kelthane | 0.125 | 0.5 | On grass | Thorough coverage needed. 75 to 100 gal. water per acre. |
| | | | Malathion | 0.4 | 1.5 | | |
| Chiggers | | May-July | Chlordane | 0.6 | 2.5 | On grass | Good coverage required. Use minimum 20-25 gal. water per acre. |
| | | | Dieldrin | 0.2 | 0.8 | | |
| | | | Lindane | 0.125 | 0.5 | | |
| | | | Toxaphene | 0.5 | 2.0 | | |

| | | | Insecticides | | | | |
|---|---|---|---|---|---|---|---|
| Insects | NHE No. | Approximate time of attack | Name | Lb. actual per 10,000 sq. ft. | Lb. actual per acre | Placement | Timing of application |
| Thrips | | July-Sept. | DDT | 0.5 | 2.0 | On grass | Control rarely needed. |
| Slugs | 84 | June-Oct. | ......Slug baits...... | | | Scatter in grass | Where slugs are numerous. |
| Sowbugs | | June-Oct. | DDT | 0.5 | 2.0 | On grass | As a spray. Lots of water needed. Control rarely required. |

PRECAUTIONS: Most insecticides are poisonous. Be sure insecticides are clearly labeled. Keep them away from children and pets. After applying an insecticide, do not allow children and pets on the lawn until the insecticide has been washed into the soil by sprinkling, and the grass has dried completely. To protect fish and wildlife, do not contaminate streams, lakes, or ponds with insecticides.

One gallon of insecticide contains the following amounts of active ingredient: 25% DDT, aldrin, or heptachlor, 2 lb.; 45% chlordane, 4 lb.; 15% dieldrin, 1.5 lb.; 55-57% malathion, 5 lb.; 18½% kelthane, 1.5 lb.; 60% toxaphene, 6 lb.; 20% lindane, 1.6 lb.

Prepared by entomologists of the Illinois Agricultural Extension Service and Illinois Natural History Survey.
For additional copies see your county farm adviser.

Cooperative Extension Work in Agriculture and Home Economics, University of Illinois
College of Agriculture and the United States Department of Agriculture cooperating.
Louis B. Howard, Director. Acts approved by Congress May 8 and June 30, 1914.

# MICROENVIRONMENT AND GRASS ADAPTATION

L. C. Bliss

Climate near the ground or microclimate typically includes that environment within 4.5 feet of the soil surface. However, the soil environment should also be measured, thus microenvironment rather than microclimate will be considered here. The importance of microenvironment in relation to plant growth and distribution of species centers around the recognition that within this layer of environment at and near the soil surface, environmental conditions are often very extreme such as daily changes in temperature, humidity, light, and the longer term changes in available soil moisture. Since these environmental extremes are more pronounced near the soil surface and since this is the area in which all plants must become established, a knowledge of microenvironment is essential, especially in the establishment and maintenance of plant cover as in turf management.

Our orientation will consider microenvironmental factors as they affect plant growth and development. The first to be considered will be seed germination. Grass seeds in general germinate best at relatively cool temperatures, bluegrass for example at about $60^{\circ}$ to $70^{\circ}$ F. Such soil temperatures prevail most consistantly in spring or fall and not in the heat of summer. Associated with mild soil surface temperatures is the need for quite constant soil moisture, a balance which is often difficult to maintain. Attempts to counteract soil moisture deficiencies usually center around ways of reducing evaporation losses as through straw mulches as well as by frequent watering.

Data gathered a year ago by Mr. Atsatt on field and greenhouse turf plots hold some promise for the use of fatty alcohols, such as hexaoctadecanol, in the reduction of evaporation when applied as an emulsion to the soil surface. This material reduces evaporation by forming a thin film over the surface, which effectively aids in maintaining a better water balance around the seeds during and after germination. The material does not seem to interfere with normal $O_2$ and $CO_2$ exchange. Mr. Atsatt found significantly higher rates of seed germination, a more rapid rate of grass sod establishment, and subsequent greater dry weight yields of plants on field plots treated with 300 to 500 lbs/acre of the fatty alcohol. These findings warrant further investigation but they point toward an economically feasible means of ensuring more rapid and more uniform establishment of a turf.

Once plants become established, growth of shoots and roots is greatly influenced by available soil moisture. Kentucky bluegrass is generally considered to be shallow-rooted with most of the roots in the upper 3 to 18 inches of soil. Under natural prairie conditions bluegrass roots frequently extend to depths of 3 to 4 feet. Certainly depths of root penetration depend upon soil aeration, soil structure, available soil moisture, and available nutrients. The rather common observation that most turf roots are found in the upper 3 to 6 inches reflects in part the pattern of watering, for in general lawn watering is for rather short durations but at frequent intervals. This maintains a favorable moisture supply only near the surface and thus root proliferation is greatest in this zone. Such rooting habits are less favored during periods of drought if irrigation is not continued. In general more soil moisture is potentially available to those plants that have a well developed root system which penetrates to some depth. Drought studies on prairie grasses during the 1930's showed that shallowly rooted grasses were killed much sooner than were the ones with deeper root systems.

Kentucky bluegrass produces tillers and rhizomes which are quite effective in increasing turf development. Apparently tillering is stimulated in the spring and fall when photoperiods are shorter than in summer. Tillering also seems to increase with additions of nitrogen fertilizer and high levels of soil moisture.

Photoperiod while not a microenvironmental factor is worthy of consideration because of its effects on plant growth. The literature on photoperiodic response of bluegrass points to the production of decumbent leaves and shoots under short photoperiods (8 to 9 hrs) with the development of upright shoots during long photoperiods (15 to 18 hrs). This production of a decumbent form in fall might have some survival value during winter for it would reduce frost heaving and soil freezing in environments where winter snow cover is of short duration. Under shortening days in the fall there is a proliferation of new rhizomes and tillers, and rapid accumulation of carbohydrate reserves.

Dr. Lee Taylor working with Delta bluegrass here at Illinois found that as photoperiod increased (8.5 to 15 hrs) there was a considerable increase in clipping yields of tops with a corresponding reduction in root yields. These data and those of others indicate that summer shoot and leaf growth is in part at the expense of roots and that this inbalance is corrected under the shorter photoperiods of spring and fall; times when soil moisture and temperatures are more favorable in many climates. Light intensity studies showed that clipping yields were greater under 50% full sinlight than at higher or lower light levels. Root growth was reduced with higher light levels in association with longer photoperiods; results which agree with the findings of some other investigators.

Related to clipping yields is the balance of carbohydrated food reserves. In general, with frequent cutting of tops there is a reduction in root and rhizome food reserves for new shoot growth is in part dependent upon movement of sugars from rhizomes and roots into the shoots since the leafy photosynthetic surface has been freatly reduced. Carbohydrate reserves can be partially maintained in mid-summer when temperatures are high if drought occurs as long as it is not severe or too long in duration, for watering under these conditions promotes some root and shoot growth when the photosynthetic surface is not large and when high temperatures may increase respiration more than photosynthetic rates. Thus summer lawn dormancy induced by water deficits as related to long days and high temperatures can actually be beneficial for better lawn growth and appearance in the fall. With a drop in autumn temperatures and a greater availability of soil moisture, growth of roots, rhizomes, and shoots will increase, but so will the accumulation of food reserves indicating a much more favorable photosynthesis-respiration balance than with summer heat.

Numerous studies have been made on the effect of temperature on bluegrass shoot and root growth. In general shoot growth is greatest at medium temperatures (60° to 80° F.) with considerable reduction in plant vigor at temperatures above 90° F. Roots, as might be expected, respond to somewhat different temperature levels with root growth most vigorous at soil temperatures between 40° and 65° F. and a reduction in shoot and root growth when soil temperatures reach 70° to 85° F., soil temperatures that are not uncommon in mid-summer. Roots of some grass species continue to grow at temperatures only a little above freezing while the roots of other species do quite well at high soil temperatures. Thus certain species are better adapted for turf uses in the central and northern states, while others are better adapted to temperature conditions in the south. Hiesey, working with various ecological races of _Poa pratensis_ found that shoot growth responses of the various races under differnet controlled temperature regimes corresponded quite well to the temperature regime of the native habitat. Thus the races from the arctic or high mountains typically grew better at lower temperatures than did races from warmer climates, though in general growth of all races was better at medium temperatures (73° day and 43°, 50°, 57°, 63° F. night).

This introduces the final point that the set of microenvironmental factors operating in an area greatly influences the survival and growth of a species and that with time the environment selects out those races which are physiologically preadapted, by their genetic complement, to grow in such a site (habitat). Natural selection by environments of races adapted to certain microenvironmental conditions as well as selection and hybridization by man can be a useful tool in enabling horticulturalists to provide those plants best suited for growth in diverse environments such as prevail on different soils and exposures within one metropolitan area as well as over larger geographical areas. Certainly Kentucky bluegrass and its varieties including Delta and Merion have wide ecological amplitudes and can thus be grown successfully under a wide diversity of micro-environmental conditions. This is undoubtedly the best adaptive feature of bluegrass, a feature so desired in plants of economical value.

# NEMATODES IN GRASSES

Donald P. Taylor

## Introduction

Plant-parasitic nematodes are commonly associated with the roots of turfgrasses. Most written and verbal claims of extensive damage to turfgrasses are not supported by experimental evidence. In fact, I know of no other agricultural industry in which nematodes are claimed to cause such sweeping devastation based upon such a paucity of scientific data. In a recent book (1) on turfgrass diseases a chapter is entitled, "Diseases caused by pathogenic nematodes". About fifty species of nematodes are mentioned as turf parasites, and yet when the references cited are critically examined an entirely different picture appears. Acceptable proof of nematode parasitism, i.e. observation of nematodes feeding, or population increases in experimentally inoculated tests, could be found for only sixteen species. For very few of these is more than one grass species known to be a host, and in some cases the grass species is not a turfgrass, eg. Sudan grass for Tylenchorhynchus claytoni. Of these 16 species, only 7 have been shown to cause detectible damage to grasses (pathogenicity).

1. Paratylenchus projectus was proven to be pathogenic to Kentucky 31 Tall Fescue, but nothing has been reported concerning its pathogenicity to other turfgrasses.

2. Anguina agrostis reduces seed production on bentgrasses in the Pacific northwest, but Courtney and Howell (2) stated, "Nematode infection in closely trimmed bent grass turf scarcely interferes with plant growth and disappears if the lawn is not permitted to produce inflorescence."

3. Anguina graminis causes leaf galls on Festuca capillata (7) and perhaps some related species, but it has not been reported from this country.

4. Ditylenchus graminophila causes galls on leaves of Agrostis tenuis, but is also known only from Europe.

5. Hoplolaimus tylenchiformis causes damage to St. Augustine grass in Florida. The paper (3) in which pathogenicity is claimed was not cited in the chapter in question as a reference for this species.

6. Helicotylenchus digonicus was proven pathogenic to bluegrass in Wisconsin in a work (5) which probably constituted the most important contribution to a knowledge of nematode-turf relations up to that time.

7. An undescribed species of root-knot nematode (Meloidogyne spp.) was described as a pathogen of St. Augustine grass in Florida.

Thus, at the time of the writing of the book, about 43 of the 50 nematodes were not even known to damage any turfgrass and for 34 species no evidence even existed for their being able to parasitize turfgrasses. In June, 1962, the following statement was published by a nematologist working on the problem of nematodes and turf (6), "Although plant parasitic nematodes have been frequently associated with turf injury, very little experimental evidence has been published on damage caused by specific nematode species parasitizing specific grasses."

The vast majority of nematode species claimed to damage grasses have been incriminated on circumstantial evidence or "guilt by association" and these incriminations have absolutely no scientific validity unless documented by scientific data! In the original papers in which nematodes were associated with grasses, the authors only reported occurrence or distribution of the nematodes. Claims were not made by these scientists that their data constituted proof of either parasitism or pathogenicity. Nematode surveys are made to learn of associations of nematodes and plants occurring frequently enough in nature to warrant research on the significance of the relationship. No criticism is due these workers. They reported only their results. Criticism is due those who have taken these data and used them to support the hypothesis that nematodes are known to cause widespread damage to turf. Too many diseases of turf need investigation, too many important nematode problems have not been touched, and too few research workers exist, to encourage or even tolerate such abuse of the scientific method!

## Recent Advances

Ditylenchus radicicola, a known pathogen of certain grasses since 1864, has been reported for the first time from this country (7) attacking beach grasses. This is of only minor interest to turf specialists. In Europe, this species has been reported to produce abundant root galls on Poa annua and a moderate number of galls on P. pratensis (4). Another population of this species was not as pathogenic to these grasses, suggesting that "biological races" may exist within this species.

Sledge (8) has reported that the unidentified root-knot nematode already mentioned as a pathogen of St. Augustine grass also attacks crabgrass, Tiflawn (T-57) Bermuda, Tiffine (T-127) Bermuda, Tifgreen (T-328) Bermuda, Meyer (Z-52) zoysia, and Pensacola Bahia. However, it does not reproduce on Ormond Bermuda, Emerald Zoysia, or Floratine St. Augustine. As to the importance of this form, he said, "The grass root-knot nematode is an extremely interesting parasite, and its role as a plant pathogen may be established upon completion of further studies. This Meloidogyne sp. may well become an important economic pest of lawn and pasture grasses."

Rhoades (6) presented evidence based on root weight data that the stubby-root nematode (Trichodorus christiei) and a sting nematode (Belonolaimus longicaudatus) are pathogenic on St. Augustine grass in Florida.

Riggs, et al. (9) tested Bermuda grass varieties against five root-knot nematodes and found the Meloidogyne incognita incognita and M. incognita acrita caused as many as 36-65% galled roots on some varieties. One variety, Uganda, was resistant or immune to all five nematodes.

In summary, recent reports have added a few more species that are known to attack turfgrasses; however, relatively little more has been learned about the importance of the vast majority of nematodes commonly associated with most turfgrasses.

## Research on Nematodes and turf at Illinois

Survey: Many samples from turf, largely from golf courses, have been examined. A report was made at this meeting last year. This phase of the project has served its primary usefulness and we know that many species of plant parasitic nematodes occur associated with the roots of turfgrasses. Of particular interest was the occurrence of species of _Tylenchorhynchus_ in all turf samples from putting greens.

Parasitism and pathogenicity studies: In view of the frequent occurrence of _Tylenchorhynchus_ spp. in turf samples, greenhouse studies are now in progress to determine the role of these nematodes. Conclusive results have not yet been obtained, but we know that one species will reproduce on Merion bluegrass and that _T. maximus_ feeds on bentgrass seedlings. Additional results will be forthcoming.

## Conclusions

1. The high frequency of occurrence of plant-parasitic nematodes in association with grass roots indicates that these forms may be inflicting damage to the grass plants.

2. Insufficient data exists to support the hypothesis that nematodes are an important factor in turf production and management.

3. Until such time as this hypothesis has been supported or refuted, the turf industry should support research in this area in every way possible.

## Literature Cited


1. Couch, H. B. 1962. "Diseases of Turfgrasses". Reinhold: New York. 289 p.

2. Courtney, W. D., and H. B. Howell. 1952. Investigations on the bent grass nematode, Anguina agrostis (Steinbuch 1799) Filipjev 1936. U.S.D.A. Plant Dis. Reptr. 36: 75-83.

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4. s'Jacob, J. J. 1962. Beobachtungen an Ditylenchus radicicola (Greef). Nematologica 7:231-234.

5. Perry, V. G., H. M. Darling, and G. Thorne. 1959. Anatomy, taxonomy, and control of certain spiral nematodes attacking blue grass in Wisconsin. Univ. Wis. Agr. Exp. Sta. Res. Bul. 207. 24 p.

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7. Stessel, G. J., and A. M. Golden. 1961. Occurrence of Ditylenchus radicicola (Nematoda:Tylenchidae) in the United States and on a new host. U.S.D.A. Plant Dis. Reptr. 45: 26-28.

8. Sledge, E. B. 1962. Preliminary report of a Meloidogyne sp. parasite of grass in Florida. U.S.D.A. Plant Dis. Reptr. 46: 52-54.

9. Riggs, R. D., J. L. Dale, and M. L. Hamblen. 1962. Reaction of Bermuda grass varieties and lines to root-knot nematodes. Phytopathology 52:587-588.

# EFFECTS OF POST-EMERGENCE HERBICIDES ON ESTABLISHMENT OF SPRING SEEDED KENTUCKY BLUEGRASS

H. R. Kemmerer

Crabgrass and other grassy weeds are a serious hindrance in the development of spring-seeded lawns. Their competition for light, moisture, and nutrients have been responsible for the recommendation that lawns should not be seeded in the spring.

Some attempts have been made to reduce competition caused by the weeds. Soil fumigation and vertical mowing have been used with some degree of success. Also post-emergence herbicides, recommended for use on established grass, have been suggested as a possible way of eliminating the weeds before they become large enough to compete seriously with the grass.

Little information is available on the use of post-emergence herbicides on new seedings. Therefore, an experiment was conducted with several post-emergence herbicides on young bluegrass. Answers were sought to these questions: Which herbicides would best control the weeds without damaging the grass? How soon after seeding could the effective chemicals be safely applied?

## Six Post-Emergence Herbicides Used

The Kentucky bluegrass seeding for this study was made on May 4, 1962 at the rate of two pounds per 1000 square feet. Twenty pounds of 10-6-4 (inorganic nitrogen) were applied per 1000 square feet at the time of seeding.

The chemicals used were as follows:

| Material | Trade name | Active Ingredient |
|---|---|---|
| PMAS | PMAS | Phenyl mercuric acetate |
| AMA | Super Methar | Octyl and Dodecyl ammonium methyl arsonate |
| CAMA | Turf-sel CAMA | Calcium acid methyl arsonate |
| bar C | bar C | n-Butyl 2-n-propoxybenzoate and Disodium methyl arsonate Hexahydrate |
| DSMA | Sodar | Disodium monomethyl arsonate pentahydrate |
| A-12 | "ANSAR" A-12 | Ammonium salts of methane arsonic acid |

Reports indicate that they all have given good control of certain grassy weeds in established lawns.

The materials were used at the recommended rates. If recommendations varied according to temperature and maturity of the crabgrass the higher rates were used.

Three applications of each material were made at weekly intervals, starting 5,7,9, and 11 weeks after seeding. Grass and weed coverage resulting from each treatment was determined three weeks after the last application of the chemical.

All plots were irrigated as needed during the summer and the grass was mowed to a height of two inches.

## 50 Percent Grass Cover

Best coverage of grass occurred when the herbicide treatment was made 7 and 9 weeks after seeding. Table 1 parts B and C. Approximately 50 percent of the treated areas were covered with grass and about 10 percent by weeds. The check plots had 7 percent grass cover and a 91 percent weed cover.

Beginning the treatment 11 weeks after seeding did not result in any more grass cover than the 7 and 9 week treatments and the weed cover increased.

An extensive weed cover developed on plots where treatment was begun five weeks after seeding. Table 1 part A. Plots treated with A-12 had 44 percent grass coverage. With the other chemicals grass coverage was less.

## Treatments Compared

Use of the herbicide A-12 resulted in a 51 percent grass cover and a 11 percent weed cover when the data of treatments made at different time intervals were combined. PMAS treated plots produced 31 percent grass and 36 percent weed coverage.

## Post-Emergence Materials Effective

The results show that grass cover increases and weed cover decreases when post-emergence herbicides are applied to young grass. The greatest amount of grass (approx. 50%) and least amount of weeds (approx. 10%) occurred when treatments were started 7 and 9 weeks after planting.

When all treatments were combined the treated plots had as high as 44 percent more grass cover and 82 percent less weed cover than the check plot. Likewise, all the herbicides were effective with a difference of 20 percent grass coverage between the most and least effective.

Table 1

The effect of several different post-emergent herbicides on the coverage of Kentucky bluegrass and weedy grasses when treated at different times following seeding.

| PART | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| | Weeks before treatment started | | | | | | | |
| | 5 weeks | | 7 weeks | | 9 weeks | | 11 weeks | |
| Post-emergence Material | ----------------Per cent coverage------------ | | | | | | | |
| | Grass | Weeds | Grass | Weeds | Grass | Weeds | Grass | Weeds |
| PMAS | 15% | 65% | 29% | 45% | 46% | 8% | 35% | 27% |
| AMA | 34 | 54 | 57 | 8 | 52 | 1 | 47 | 11 |
| CAMA | 32 | 56 | 62 | 5 | 49 | 1 | 39 | 17 |
| bar C | 36 | 51 | 53 | 17 | 46 | 6 | 44 | 6 |
| DSMA | 27 | 61 | 49 | 4 | 47 | 3 | 40 | 11 |
| A-12 | 44 | 39 | 60 | 3 | 51 | 0 | 48 | 2 |
| Check | 6 | 94 | 6 | 93 | 7 | 91 | 8 | 92 |

* Determined 5 weeks after first treatment.

The difference between the % grass plus the % weeds and 100 was base space.

Table 2

The effect of several different post-emergent herbicides on the coverage of Kentucky bluegrass and weedy grasses when four different times are considered together.

| Post-emergence material | Per cent Coverage | | |
|---|---|---|---|
| | Grass | Weeds | Bare |
| PMAS | 31 | 36 | 33 |
| AMA | 48 | 19 | 33 |
| CAMA | 45 | 20 | 35 |
| bar C | 45 | 20 | 35 |
| DSMA | 40 | 20 | 40 |
| A-12 | 51 | 11 | 38 |
| Check | 7 | 93 | 0 |

# TURFGRASS DISEASE CONTROL

Malcolm C. Shurtleff

Turfgrass diseases vary in severity from year to year and from one locality to another depending on the environment (principally moisture, temperature, humidity, and grass nutrition), the relative resistance or susceptibility of the grass host, and the causal organism. All three factors must be present in "balance" for disease to develop. For example, if the environment is favorable for a disease and the disease-producing organism is present but the host plant is highly resistant, little or no disease will develop. Similarly, if the causal organism is present and the host is susceptible, but the environment is unfavorable, the disease usually does not appear.

We can put this in the form of a simple equation:

| | | | | |
|---|---|---|---|---|
| Susceptible grass | + | Disease Organism | | |
| + | | + | = | DISEASE |
| Proper environment | + | Method of distribution | | |

No disease will develop if <u>any one</u> of the above ingredients is lacking. Effective disease control measures are aimed at "breaking" this equation in one of three basic ways: (1) the susceptible plant is made more resistant or immune; (2) the environment is made less favorable for the causal organism and more favorable for the grass plant; and (3) the disease organism is killed or prevented from reaching the plant, penetrating it, and producing disease.

Let's discuss these three basic methods of control:

1. <u>Making the grass plant more resistant or immune</u> - This is the ideal method of control. All grass breeders, and everyone else concerned with turf, are hoping to develop more resistant grasses. Some progress has been made. We now have grass varieties somewhat resistant to dollar spot, snow mold, leaf spot, rust, powdery mildew, and other diseases. But this important control measure is still in its infancy. For some diseases like brown patch, where the causal fungus is composed of an infinite number of biotypes or strains, the development of highly resistant or immune grass varieties is remote and may never come about. Before such grasses can be developed and released, sources of resistance in wild or cultivated grasses must be found. Then comes the long, time-consuming process of working this resistance into otherwise desirable grasses. We will probably never have a lawn or fine turf grass which is resistant to all common diseases.

Another way to make the grass more resistant is through proper nutrition. Dollar spot, pink snow mold or Fusarium patch, powdery mildew, brown patch, and other diseases are less serious where a uniform level of soil nutrients is maintained in the root zone. This may mean fewer and lighter applications of fertilizer plus keeping the three major nutrients, N, P, and K in balance. When nitrogen is high in relation to potash and phosphorus you may be heading for trouble, especially in hot weather!

Grass cut at the proper height also has more resistance than turf which is scalped. Without sufficient green leaves to manufacture food to produce new leaves, roots, and stolons, the grass is definitely weakened. Remember that the grasses in a lawn, park, fairway, or golf green are growing under artificial conditions and are more subject to attack by disease organisms than they would be in their natural environment. Healthy, vigorously growing, adapted turf grasses that are properly managed can best ward off disease attacks.

2. The environment is made less favorable for the causal organism and more favorable for the grass plant. Fungi which cause all turf diseases (except those produced by nematodes) require much the same sort of environment that turfgrass requires: food, moisture, oxygen, and a favorable temperature. The basic concept here is to grow grass in an environment which will be unfavorable to the growth, multiplication, and spread of disease-producing fungi. This we can do by:

a. Keep the grass blades as dry as possible for as long as possible. Fungi, with the exception of the powdery mildews, require free moisture on the grass plant for three to 12 hours or more to infect a plant. Poling, brushing, or hosing are means of removing dew and guttated water in which these organisms thrive. There are reports of superintendents applying non-toxic, surface-active detergents to grass which prevented dew from clinging to the grass blades. The fungi couldn't penetrate without moisture and no disease developed. Poor surface and subsoil drainage result in compaction and soil aeration problems. Roots are suffocated from lack of oxygen or are "drowned." The result, too frequently, is disease. "Dead," humid air over a pocketed turf area results in disease problems. There is no wind to dry off the grass blades. If we could keep grass dry, and this includes the thatch, we would have no disease problems aboveground. Root rots which result in "wilt" in July and August are commonly the direct result of overwatering the root zone to keep the turf soft. Keeping the soil near saturation prevents normal root growth and favors the growth of organisms like Pythium, a common water mold, to take over. Proper water control is the single, biggest environmental factor in keeping disease in check.

b. Eliminate the dead grass (mat or thatch) in which disease-organisms thrive. This helps "starve out" these fungi and forces them to compete unfavorably with the multitude of bacteria and fungi in the soil, many of which are antagonistic or even parasitic on the disease-producing organisms which attack grass. The thatch also acts like a sponge in holding excess moisture. Elimination of thatch has cut many a fungicide budget in half!

c. Keep large trees away from greens or install root barriers.

d. Don't injure the grass by careless use of pesticides, using a mower out of adjustment, leaving the cup too long in one spot, walking or riding on turf which is soggy, removing ½ or more of a grass blade at one mowing, etc. Remember that anything you do to grass to weaken it, may lower its natural resistance, allowing a disease organism to "take over."

3. The disease organism is killed or prevented from reaching the plant and producing disease. We have talked about removing moisture thus preventing a fungus from penetrating. We could also mention the use of sand or other sharp particles to provide for superior surface and subsurface drainage and aeration. You can probably think of other ways to prevent distribution of the organism. But the principal means of control here is chemical. We can apply a soil fumigant to the turf area before planting and kill fungi, nematodes, insects, and weed seeds -- all at once, using a single chemical like methyl bromide, chloropicrin, Vorlex, Vapam, or V.P.M. Soil Fumigant. The expense is fairly high but more and more of this is being done before the seeding or soding of greens, tees, stadium turf, even home lawns. Generally a polyethylene cover is placed over the treated area to retain the fumes of the fumigant. The only problem is that disease and nematode problems may become more severe later because of the lack of competitive fungi, bacteria, and nematodes in the treated area. Once a disease-producing organism is introduced (blown, washed, or tracked) into such a treated area there is no "biological check and balance."

This gets us down to the use of turf fungicides on preventive schedule, applied before the disease strikes. We recommend that you follow the manufacturer's directions on the package label as regards rates to use, interval between applications, compatibility with other chemicals, grasses to be used on, etc.

The method of application is very important. We suggest you use at least 5 to 10 gallons of spray per 1,000 square feet to adequately wet the grass blades, thatch, and top quarter inch or more of soil. I would use five gallons of spray against such diseases as powdery mildew and rust which attack only the grass blades. Other diseases such as dollar spot, brown patch, Pythium, melting-out, and snow molds attack the crown and root area before growing on and over the grass surface. Here 10 gallons per 1,000 square feet is barely adequate. For diseases like brown patch, where the causal fungus is known to survive in the form of sclerotia buried in the soil, 15 gallons would probably do a better job.

High pressures are not necessary! It is much more important that the fungicide be applied evenly. This can best be done in most cases by using a multi-nozzle boom and applying the chemical equally in two directions. The time interval between spray applications should vary with the temperature, disease expected, grass condition, chemicals used, and the amount of rainfall or artificial watering. The spray interval may be as short as two or three days in hot, wet weather or be stretched out to two weeks if the weather is cool and dry. Some fungicides give some protection for a week or 10 days even when four to six inches of water has fallen as rain or been applied by sprinkler. Another chemical may only last two or three days under similar conditions. The problem is complex and one that you have to "feel out" for yourself, based on your knowledge of the chemical and its past performance, the problem turf area involved, past fungicide and other records, plus knowledge of the factors involved which cause a particular disease to flare up. It is only through the keeping of records that you can hope to determine why a certain fungicide failed -- or did the job. All the fungicides in the world cannot replace a poor management program.

The equipment you use is also important. How fast can you get around and complete a spray application? If Pythium strikes is this fast enough? These are questions you have to answer for yourself. The important thing to get uniform coverage of the grass. This may mean putting in a commercial spreader-sticker or wetting agent to insure wetting of the grass blades plus better penetration of the thatch and soil surface.

Below is a chart (Table 1) giving a summary of turfgrass diseases and fungicides which have been reported by various research workers as giving some degree of control. The success (or possible failure) you get with these fungicides, however, depends on how well you have put the pieces of the overall turfgrass disease control picture together, as previously outlined.

Table 1. Summary of turfgrass diseases reported as being controlled by various fungicides.

| Fungicide | Diseases | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Melting-out; leaf spot | Brown Patch | Rust | Powdery Mildew | Fairy Ring, Toadstools, Mushrooms, Puffballs | Dollar Spot | Snow Mold | Pythium |
| Acti-dione-thiram3/ | yes | yes | yes | yes | | yes | | |
| Caddy | | | | | | yes | yes | |
| Cadminate | | | | | | yes | | |
| Cad-trete | | | | | | yes | | |
| Calo-clor | | yes | | | yes | yes | yes | |
| Calocure | | yes | | | yes | yes | yes | |
| Captan | yes | | | | | | | |
| Dyrene | yes | yes | yes | | | yes | yes | |
| Karathane | | | | yes | | | | |
| Kromad | yes | yes1/ | yes | yes | | yes | yes2/ | |
| Maneb | | yes | yes | | | | | |
| Ortho Lawn and Turf | yes | yes | | yes | | yes | yes | |
| Panogen Turf Spray | yes | yes | | | yes | yes | yes | |
| Phenyl mercury2/ | yes | yes | | | yes | yes | yes | |
| Sulfur | | | yes | yes | | | | |
| Tersan | yes | yes | yes | | | yes | | |
| Tersan OM | yes | yes | yes | | yes | yes | yes | |
| Thimer | yes | yes | yes | | yes | yes | yes | |
| Zineb | yes | | yes | | | | | yes |
| Dexon | | | | | | | | yes |

1/ Calo-clor or Calocure(1-1½ ounces per 1,000 square feet should be added to Kromad to control brown patch and snow mold.)

2/ Trade names of phenyl mercury: PMAS, Puratized, Tag, Liquiphene Turfgrass Fungicide, Merbam 10, Puraturf, etc.

3/ Only Acti-dione-thiram is suggested for use on bentgrasses. Acti-dione RZ may cause injury.

# IRRIGATION

P. A. Boving

I. What are you trying to do?

You are trying to provide the best moisture condition for the growth of plants in soil. This includes both water and air. But the question then arises what is the best moisture condition?

## Saturation

This occurs when the soil is full of water. Flooding of low lands, intensive rain storms with runoff, all lead to conditions of saturation. We are all familiar with saturated soil.

## Field Capacity

This is defined by soil scientists and irrigationists as the moisture retained in a soil 48 hours after wetting when drainage has been allowed to take place. In other words, we are at a point something less than saturation, but that there is still the maximum amount of water present that the soil will hold.

## Wilting Point

This point is evidenced by the curling of many plant leaves and the cessation of growth. This is a danger point in that plants often times do not immediately recover when the soil has been allowed to dry to this point.

Thus it can be seen that the best moisture condition is not one specific point, but a range between the two points called field capacity and wilting point. We are very fortunate to have a range to contend with when we consider the dynamic situation of growth of plant material in the field.

These points have been determined in the laboratory and have been identified with amazing uniformity in the field, using special soils. In practice, however, soil texture and soil structure have a great influence on these points. Their net effect is to change the moisture level at which these criteria exist, and also they change the band width of optimum moisture condition. The lack of uniformity of soils for a given acreage also will create the difficulty of determining optimum moisture conditions for the total area as compared to any one part of the area.

In Illinois with our excess of rainfall over moisture used by plants, drainage becomes an absolute necessity to reduce the moisture content from saturation, at which point the plants will be drowned; to field capacity, which is the wet end of the optimum range. Drainage, however, forms a separate topic by itself and will not be discussed during this talk. Suffice it to say that drainage is an obvious necessity for good growth conditions.

So far we have considered the soil and ability to hold moisture. Now let us consider the plant and its need for moisture. Many researchers have gone to great lengths in extremely delicate experiments to determine how much water a growing plant needs per day. Their experiments ranged from Raleigh, North Carolina, to Pullman, Washington. The summation of their results lead us to believe that in the height of the growing season, i.e. in the hot summer months, we can expect plants to use between 0.3 and 0.5 inches of moisture per day. Young plants or mature growth in the early spring and late fall will use somewhat less than this figure. It should be noted though, that the use of fertilizers in the off-peak season will tend to increase their need for water.

II. How are you going to do it?

There are three methods of irrigation available to us. The first is sub-surface irrigation, which has to date proven rather unsuccessful for general use. The next two methods, surface irrigation and overhead or sprinkler irrigation, have proved successful over many years. Surface methods would consist of general flooding or furrow and soaking-type irrigations. Overhead or sprinkler irrigation is what its name implies.

Surface irrigation is not common for golf greens and fairways, graveyards, and other such horticultural uses, they are preferred for agricultural purposes. Therefore they have no place in this talk.

Sprinkler irrigation then or hose coupled-sprinklers will therefore be our means of spreading water. Sprinklers require portable pipe, hoses, and sprinkler heads. The portable pipe itself can extend from the source to the sprinkler head; it can connect from underground main pipes to hose risers with sprinklers on the ends of the hoses, or can be replaced by complete underground piping systems where sprinklers are attached to the couplers of the underground pipe.

Solid systems, i.e. systems that operate all sprinklers or outlets at once; or selected sequence sprinkling will have an important part in determining the type sizes to be used.

III. What is a logical sequence for developing an irrigation system?

The size of the reservoir or the water flow rate through a meter from the city are allowed for in a stream will set the maximum amount of water flow that can be used in the system. The next item to consider is the rate at which the soil will accept moisture. This should be determined for the worst conditions of mean irrigation. From the soil intake rate, a selection is made of a suitable sprinkler head which will match this rate. At the same time that the sprinkler is selected, a determination can be made of desirable sprinkler spacings. Sprinkler spacings and sprinkler sizes will control the uniformity of water application and the rate at which it is applied on the surface of the ground.

From these determinations, a simple sum will determine the number of sprinklers that can be run at any one time. This sum is: capacity divided by the sprinkler rate = the number of sprinklers to be run.

Having the selected sprinkler system and the number of sprinklers to be running at any one time, the piping layout can be developed and pump and pipe sizes determined. In this way, the system can be designed for present operation, and such designs include facilities for future improvement at a later date. Such improvements would be the use of underground main lines, increased water availability, and so on.

IV. When do we irrigate?

This question has given researchers trouble for a long time. All research and all practical irrigators know that irrigation must take place before the soil reaches the wilting point. Scientists have been developing accurate, simple, rugged water or moisture measuring devices. To date, they have found to be too delicate, and they tend to incomplete coverage of the desirable moisture range. It is felt, however, that sometime in the future they will have a desirable moisture measuring device.

The logical use of this proposed device will be the complete automation of irrigation. At present, we can automate irrigation by using time switches and time-sequence controls for automated water application. These operate successfully in the more arid areas of the continent. With the inclusion of a moisture measuring device and a time clock, we can then automate our irrigation completely in that when the plants require more moisture, and the area to be irrigated is in a non-use period; such as night time or after dark, the sprinklers will pop up from underground containers and the area will be irrigated to the desired level and the systems disappear underground again. It would then be the responsibility of the grounds keeper to maintain and correct the sprinklers and the control mechanism to adjust flow rates and keeps the system in operation in the same fashion as a modern automated factory.

# SOME EFFECTS OF DIFFERENT LEVELS OF SHADE ON SEVERAL GRASSES AND WEEDS

Jack Butler

Soil moisture, fertility, temperature, and light are important factors influencing plant growth. Since lawns are often seeded in areas having a reduced light intensity, this study was started to ascertain some of the effects of various amounts of shade on seeded lawns.

In this study six different lawn grasses were seeded on May 3, 1962 at 2 pounds per 1000 square feet. These grasses were fertilized with 20 pounds of 10-6-4 (inorganic) per 1000 square feet. Into four 6' x 12' areas with different levels of shade, the six grasses were seeded into 2' x 2' plots. A randomized complete block design with 3 reps was used. The plots were separated with lathe set into the soil to prevent the grasses from becoming mixed. The areas were irrigated throughout the summer as needed. The grasses were cut at a height of two inches once a week. The weed seed was present in the soil as a contaminant.

Three "shade houses" were covered with saran cloth of varying densities providing shade percentages of 30, 63, and 92. An area similar to those in the houses was planted in full sun (zero percent shade).

On May 26, 1962 a count was taken to determine the effect of shade upon the kind and number of weed seedlings present (Table 1). Also, at that time the influence of the various grasses under different levels of shade upon the weed population was determined (Table 2). The number of weeds recorded in Table 2 are a count of those present in five 100-square centimeter blocks, taken at random from each grass in each rep. The figures in Table 1 are all broadleaf weeds occurring in samples from one shade area.

Table 1 lists the fourteen different broadleaf weeds which were present. The four different weeds making up the greatest part of the total count occurred in all four shade areas.

The total number of weeds decreased as the light decreased. However, the amount of curly dock increased as the amount of light decreased, and yellow wood sorrel was present only in the area with the highest shade percentage.

In Table 2 there is a general decline in number of weeds occurring in each grass from minimum to maximum shade. Generally the smallest numbers of grassy weeds were present in the ryegrass, and the lowest numbers of broadleaf weeds generally were present in Highland bentgrass, Perennial ryegrass, and *Poa trivialis*.

Table 3 gives the green weights of both grass and grassy weeds. In each case the grass was cut one week before sampling. Five plugs 2" in diameter were taken at random from each grass plot in each rep in the four areas. The grass and grassy weeds, which were mostly crabgrass, were separated and weighed. Samples were taken on July 17 and October 10. Generally *Poa trivialis* had the greatest weight and the least amount of weeds present. Creeping red fescue had the least weight and the greatest amount of weeds present. The weight of the weeds decreased as the shade increased. When all grass weights in each shade area are considered together maximum weight on 7/17/62 occurred with 63% shade, on 10/10/62 it occurred with 30% shade.

Next year an increased amount of work with shade is planned. This includes a continuation of the study of seeded grass establishment in the shade, plus the effect of shade on established grass.

Table 1. Sample number of weed seedling under different shade levels - seeded grasses considered together

| Broadleaf Weeds | Percent Shade 92% | 63% | 30% | 0% |
|---|---|---|---|---|
| Rough pigweed | 1 | 38 | 58 | 44 |
| Smartweed | 0 | 2 | 2 | 2 |
| Henbit | 78 | 17 | 119 | 424 |
| Lambsquarters | 22 | 36 | 102 | 319 |
| Carpetweed | 11 | 39 | 188 | 140 |
| Velvet leaf | 0 | 0 | 1 | 7 |
| Prostrate spurge | 0 | 1 | 2 | 2 |
| Curly dock | 10 | 9 | 2 | 1 |
| Purslane | 0 | 1 | 2 | 1 |
| Common chickweed | 2 | 1 | 0 | 0 |
| Field bindweed | 0 | 0 | 1 | 0 |
| Mouse-ear chickweed | 0 | 0 | 1 | 0 |
| Wild lettuce | 0 | 0 | 4 | 0 |
| Yellow wood sorrel | 29 | 0 | 0 | 0 |
| Total | 153 | 144 | 482 | 940 |

Table 2. Sample number of weed seedlings under different shade levels when seeded grasses are considered separately.

| | Percent Shade 92% | | 63% | | 30% | | 0% | |
|---|---|---|---|---|---|---|---|---|
| | Broadleaf | Grassy | Broadleaf | Grassy | Broadleaf | Grassy | Broadleaf | Grassy |
| Creeping red fescue | 35 | 22 | 41 | 16 | 127 | 43 | 166 | 129 |
| Poa trivialis | 30 | 4 | 12 | 6 | 51 | 12 | 140 | 120 |
| Merion bluegrass | 30 | 13 | 29 | 13 | 101 | 37 | 176 | 145 |
| Kentucky bluegrass | 25 | 15 | 27 | 17 | 96 | 26 | 190 | 120 |
| Highland bentgrass | 21 | 14 | 15 | 9 | 47 | 15 | 129 | 130 |
| Perennial ryegrass | 12 | 1 | 20 | 2 | 60 | 10 | 139 | 89 |
| Total | 153 | 69 | 144 | 63 | 482 | 143 | 940 | 733 |

Table 3. Sample green weights in centigrams of grassy weeds and spring seeded grass under different shade levels. 7/17/62*

| | Per cent Shade | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 92% | | 63% | | 30% | | 0% | | Total | |
| | Grass | Weeds | Grass | Weeds | Grass | Weeds | Grass | Weeds | Grass | Weeds |
| Creeping red fescue | 87 cg. | 0 cg. | 542 cg. | 65 cg. | 286 cg. | 1191 cg. | 144 cg. | 1930 cg. | 1059 | 3186 |
| Poa trivialis | 361 | 0 | 771 | 11 | 862 | 362 | 706 | 1671 | 2700 | 2044 |
| Merion bluegrass | 123 | 0 | 802 | 18 | 780 | 475 | 122 | 2123 | 1827 | 2616 |
| Kentucky bluegrass | 86 | 58 | 782 | 75 | 617 | 593 | 246 | 2080 | 1731 | 2806 |
| Highland bentgrass | 135 | 34 | 733 | 0 | 675 | 524 | 253 | 2166 | 1796 | 2724 |
| Perennial ryegrass | 139 | 52 | 679 | 57 | 367 | 1008 | 385 | 2678 | 1570 | 3795 |
| Total | 931 | 144 | 4309 | 226 | 3587 | 4153 | 1856 | 12648 | 10683 | 17171 |
| | 10/10/62* | | | | | | | | | |
| Creeping red fescue | 90 cg. | 4 cg. | 711 cg. | 37 | 365 cg. | 1360 cg. | 89 cg. | 2303 cg. | 1255 | 3704 |
| Poa trivialis | 398 | 0 | 1212 | 0 | 2219 | 311 | 490 | 1730 | 4319 | 2041 |
| Merion bluegrass | 119 | 0 | 915 | 2 | 1040 | 441 | 174 | 2900 | 2248 | 3343 |
| Kentucky bluegrass | 111 | 0 | 860 | 86 | 750 | 935 | 319 | 1742 | 2040 | 2763 |
| Highland bentgrass | 92 | 0 | 906 | 0 | 1192 | 792 | 215 | 2135 | 2405 | 2927 |
| Perennial ryegrass | 126 | 0 | 668 | 19 | 570 | 442 | 351 | 1493 | 1715 | 1954 |
| Total | 936 | 4 | 5272 | 144 | 6136 | 4281 | 1638 | 12303 | 13982 | 16732 |

* Dates of sampling.

# WEED CONTROL IN TURF

F. W. Slife

The demand for chemical weed control in turf continues to expand. It is unfortunate that many homewoners believe that all their lawn weeds can be cured with weed chemicals while the basic problem is simply poor turf. Many lawn owners should invest their money in fertilizer instead of weed chemicals and the result would be a more desirable turf, which indirectly would give them good weed control.

This does not mean that there is not a place for good herbicides. Weed problems do exist in medium to high quality turf and the demand for chemical weed control will undoubtedly increase in these areas.

New weed chemicals have become available faster than the improvement in our methods of application or the realization on the part of the turf owner that the materials must be applied properly. A considerable number of complaints of turf injury were reported in 1962 from the use of new preemergence crabgrass chemicals. Most of this was caused by faulty application and a low turf tolerance with some of the new compounds. If the chemical companies are going to manufacture and sell compounds that have low turf tolerance, then they must accept the responsibility of improving methods of application and alerting the public to the possibility of turf damage.

## Broadleaf Weed Control

A new compound - banvel D - was evaluated in 1962. Bluegrass tolerance appears to be good. This compound gave better control of knotweed than did 2,4-D. Indications are that it could be used for chickweed control as well as for other broadleaf weeds that are not well controlled by 2,4-D.

Unfortunately, the soil residue from banvel D has not been fully determined. Since it is a benzoic acid, it may leach and cause damage to sensitive shrubs and trees. It will not be suggested for use until the soil residue is more fully determined.

## Pre-emergence Crabgrass Control

Several new compounds were evaluated for crabgrass control in 1962. These were: Chipman 12161A and 12161B, Penn Salt 1475, Niagria 6370, Bandane and Scotts 131, 128, 132, and 139. None of these materials appeared to have outstanding crabgrass control properties but, on the other hand, no turf injury resulted from their use.

Excellent crabgrass control resulted from the use of Dacthal, Zytron, Trifluralin, and Calcium Arsenate. Injury to turf was not apparent from the use of these materials in our plots in 1962 at recommended rates.

Dacthal, Zytron, Trifluralin, Calcium Arsenate, and Chlordane were widely sold in 1962 for pre-emergence crabgrass control. The advantages and disadvantages of these compounds are given below.

Dacthal. This material seems to have excellent bluegrass tolerance and can be used at least two times the recommended rate with little difficulty. Its toxicity to crabgrass is excellent. Some lawn owners report some crabgrass invasion in late August or September, indicating this material has largely disappeared. This allows fall seeding of bluegrass if necessary. Very few complaints were received from this material in 1962. Because of its high bluegrass tolerance and its good crabgrass toxicity, this seems to be the best material for the average home owner to apply.

Zytron. This material appears to have less than a 2X safety factor on bluegrass. Injury from applying more than recommended rates has been variable. Crabgrass control has been excellent. Zytron appears to last all season and possibly into the next season. A full rate of Zytron may not be needed the second year for full season control.

A few complaints from home owners were received in 1962. These complaints were that the grass appeared to be thinner.

Trifluralin. Trifluralin appears to have much less than a 2X safety factor on bluegrass turf. This material was sold at 1½ lbs per acre active ingredient in 1962 and in some trials injury has resulted with as low as 2 pounds. Its toxicity to crabgrass is excellent and full season control usually results. Many complaints resulted from the use of this material in 1962. Although this compound is excellent for crabgrass control, our research indicates that it does not have enough turf tolerance to be used by the average lawn owner.

Calcium Arsenate. This material has less than a 2X safety factor on turf. When applied properly it gives excellent crabgrass control. No more than 1/3 the original rate should be applied the second year.

After the second year, no more Calcium Arsenate should be applied until crabgrass begins to invade the area. This may be as long as five years. Calcium Arsenate has the most residue of all of our pre-emergence crabgrass killers. Once the level of arsenic is built up, it will last for a number of years. For this reason, Calcium Arsenate is best adapted to large turf areas such as fairways. A few complaints were received from the use of this material in 1962. Most of these appear to be an overdosage in the original application or a full rate application the second year. The home owner should be certain to understand that once the level of arsenic is built up to prevent crabgrass, it will largely stop the germination of new turf grass seedlings.

Chlordane. Bluegrass has good tolerance to Chlordane applications. Toxicity to crab grass is not extremely high and, in general, crabgrass control does not reach the level of the previous materials. Results seem to be best when applications are applied to healthy vigorous turf. The advantages of Chlordane are good turf safety and little or no problem in seeding turf grass before or after application. The majority of complaints with this material in 1962 were lack of crabgrass control.

Calcium propyl Arsonate. Bluegrass tolerance appears to be good with this material. Toxicity to crabgrass is good if applied properly. CPA must be applied just before, during or just after crabgrass germination to be effective. Its soil residues are relatively short and, if used in the spring, are usually gone by midsummer.

The advantages of CPA are that both established and seedling turf are highly tolerant. The disadvantages are that the time of application is very narrow and it has short soil residue.

Nimble will Control. Repeated applications of both Zytron and Endothal were made for the control of nimble will in 1962. Where three applications were made spaced at two-week intervals, good control has resulted but not complete elimination. This many applications have markedly reduced the vigor of the bluegrass turf.

It seems clear that we do not have a good selective compound to eliminate nimble will but repeated applications of either Zytron or Endothal do reduce the infestation.

# WEATHER FORECASTING

W. L. Denmark

While many meteorologists of the U.S. Department of Commerce Weather Bureau are members of the American Meteorological Society, the Society itself is an organization entirely independent of the U. S. Weather Bureau. The following is a "Statement on Weather Forecasting" released by the American Meteorological Society to the general public on March 21, 1962.

"One of the important activities in the field of meteorology is the preparation of weather forecasts as a vital public service. Weather forecasts are used by individuals to guide their daily living, and by industry, agriculture, forestry, commerce, and government to guide their operations. The widespread need for accurate advance weather information and the critical dependence of public safety and welfare upon the quality of such information make it desirable to describe the present weather forecasting capability of the meteorological profession. This statement on weather forecasting is issued to the general public by the American Meteorological Society as a revision to and replacement for that issued in July 1957.

"The usefulness of weather forecasts depends both on their accuracy and the manner in which the forecast information is used. Although the accuracy of all weather predictions deteriorates with time, forecasts of low accuracy can be useful and economically beneficial when properly applied. The forecast accuracy attained by such procedures as predicting that the weather will remain unchanged (persistence) or by predicting normal weather occurrences based upon past weather records (climatology) or simple variations on these procedures serve as scientific bases for measuring forecasting skill. Unless forecast accuracy exceeds the levels achieved by basic methods such as these, forecasting skill cannot be said to exist. Statements of high levels of forecast accuracy do not necessarily imply skill, since similar accuracy may be achieved by proper use of simple climatology or persistence. The skill factor in weather forecasts can be expected to vary depending upon the meteorological situation, geographical area, and season.

"The American Meteorological Society feels that the preparation of acceptable forecasts requires professionally trained personnel. Forecasts prepared by people so qualified can be expected to achieve the following levels of skill and usefulness:

"For periods up to 24 hours, skillful weather forecasts of considerable usefulness are possible. Within this interval detailed weather and weather changes can be predicted. Hour-to-hour variations can be predicted during the early part of the period.

"For periods extending to about 72 hours, weather forecasts of moderate skill and usefulness are possible. Within this interval, useful predictions of general trends and weather changes can be made.

"Average weather conditions for periods of about a week can be predicted with reasonable skill. Beyond 3 days, skill in day-to-day predictions is small.

"Average temperature conditions for periods up to a month can be predicted with some skill. Day-to-day or week-to-week forecasts within this time period have not demonstrated skill.

"Forecasts for periods of more than one month in advance must be considered as experimental. Although promising research is in progress, skill has not yet been demonstrated. Until such weather outlooks are of proven value, useful climatological information can be provided in their stead.

"Active research is in progress to improve forecasting skill for all time scales and for all altitudes in the atmosphere.

"The American Meteorological Society would like to point out that weather forecasting requires the rapid accumulation of observations from all over the world and is, therefore, one of the prime examples of successful international co-operation."

I wish to amplify this statement issued by a national scientific organization of professional meteorologists with examples of a number of ways in which the Weather Bureau is meeting the challenge at the present time. I believe your interest will center on the forecasts for 48 to 72 hours, the five-day forecast and the 30-day outlook. Each of these performs a valuable service but is also subject to certain limitations. A correct understanding of their content and purpose will enable you to adapt them more efficiently to your own personal problems.

Weather forecasting to be effective must be the connecting step between two associated operations. Weather observations are the starting point for weather forecasts. The weather for tomorrow or the day after cannot be efficiently foretold without a knowledge of the weather today. The Weather Bureau, in cooperation with interested parties both in the United States and around the world, maintains an ever expanding observational network. Observations of weather manifestations and effects are of international concern whether they be below the surface of the ocean or earth or through the various layers of the earth's atmosphere and beyond.

The third vital factor is communication. There must be high speed communication between the observer and the forecaster and between the forecaster and the ultimate consumer. Even a perfect weather forecast is wasted unless it reaches the potential user in time.

There is another field of meteorology which is likely to be just as important to you as the weather forecast. This is climatology. Do you, or did you ever, have ambitions to be a weather forecaster? With a little study of climatological records you should be able to adapt a method such as the "Schaal Hat Forecast" so as to compete successfully with "almanac weather" and other long range predictions.

Meteorology and weather forecasting are on the move. Observations are world wide and sky high. More than three and a half million aviation weather reports are collected each year from stations in the United States alone. AMOS, the Automatic Meteorological Observing System, reads his own instruments, writes down the information and transmits it by tele-typewriter from remote land and sea areas. Radiosondes twice daily climb through the atmosphere to heights of some twenty miles above the surface of the earth as they radio back their messages of air pressure, temperature, humidity and wind. Rockets probe to even greater heights while nearly one hundred weather-surveillance radar stations track severe storms from birth to death. And now the Tiros satellites enable the weatherman to get his first view of the weather from the other side, high above the earth bound atmosphere. Men not only talk about the weather, they are doing something about it.

# SOD WEBWORMS

L. L. English

Damage to lawns in Illinois by sod webworms in 1962 was probably the most extensive in a score of years. People away on vacations in August returned to find their lawns devastated. Before speculating about the reasons for this outbreak of sod webworms it might be well to outline briefly the life history of these insects.

Although there are some 60 species of sod webworms in the United States, less than one-third of these are economic, and of these, most of the damage in 1962 was caused by the larger sod webworms, *Crambus trisectus* Walker. Therefore, our life history sketch will have to do with this species although the life histories of several other species of *Crambus* are somewhat similar. *C. trisectus* is widely distributed in the northern two-thirds of the United States and southern Canada. The larvae feed on blue grass, orchard grass, crabgrass, timothy, oats, wheat, rye, barley, and corn.

The insect passes the winter in the larval stage, tightly coiled in a closely-woven silk case covered with particles of soil. Larvae of most any size seem to be able to go through the winter. Upon resumption of feeding in the spring, the larvae grow rapidly and pupate in a cell about the size and shape of a peanut meat. In about 10 days the moth emerges from the mahogany-colored pupa. Ordinarily this is about June 1.

The pale yellow moth has a wing spread of about an inch. At rest, the insect has a tubular shape because of the manner in which the wings are wrapped around the abdomen.

The eggs, elongate-oval in shape and about 0.5 mm long, are dropped at random by the female moth as she darts here and there a few inches above the lawn in the early evening. Several hundred eggs may be dropped by a single female moth. The eggs are dry and very difficult to find in the lawn. The moths hide in the shade and in the protection of shrubs and weeds during the day.

Under favorable conditions the eggs hatch in about 6 days; development requires 33 to 46 days; and there is a pre-oviposition period of 3 days, making a total of 42 to 55 days for the life cycle. Under ordinary circumstances with moths beginning to emerge in the latter part of May and the first part of June, we might expect two broods of larvae and a partial third. This brings us to speculate a bit about the circumstances contributing to the severe damage by sod webworms in 1962.

In the first place, there was more damage by sod webworms in 1961 than in several previous years. This would indicate a high carry-over through the winter. Secondly, May 1962 was unusually warm. The mean temperature for the month was $69.4^{o}$ F., the highest since the warmest May on record in 1888. Since that time the warmest May was in 1896 with a mean of 68.2. May 12 and 23, 1962 were $14^{o}$ above normal. These abnormal temperatures may well have given us a complete brood of larvae by the middle or latter part of June, with a second brood approaching maximum size and numbers in the first part of August, about the time people became alarmed about their lawns.

## Detecting Damage

The most obvious sign of a heavy infestation is the presence of an unusual number of birds attracted to the lawn to feed on the webworms. The birds are expert at finding and removing the worms. In the process of extricating the worms, the birds make small conical depressions in the sod.

By the time the birds invade the lawns, there may be brown areas because of extensive webworm feeding, necessitating heroic control measures. Less obvious signs of a webworm infestation should be learned. When numerous moths are seen flying in a zig-zag fashion just above the grass just at dusk and on door and window screens just after dark, the caution sign is up. This does not necessarily call for immediate insecticidal treatment. A well-kept lawn, fertilized and watered, may support a considerable population of webworms without serious damage. On the other hand, a shortly-mowed, dry lawn may be quickly injured. Careful inspection is required to detect the larvae, but if water from the garden hose is allowed to run on an infested spot of lawn, some of the larvae can be flushed out. Whereas grubs, by feeding on the roots of grass, cause all of the upper blade-growth to die, webworms clip the blades of grass just above the sod, leaving grass stubble. The brown areas caused by grubs do not recover, but those caused by webworms will recover following control measures and the application of fertilizer and water.

## Control of Webworms

In treating lawns, it should be kept in mind that the approach for webworm control is different from that for the control of white grubs. For grub control it is necessary to treat the soil at a given dosage per unit of area. The insecticide can be applied in any form, granules, spray or powder. For webworms it is necessary to apply the insecticide to the blades of grass. Hence, granular formulations are not recommended. Sprays take priority over dusts. They can be applied to the maximum deposit, they are inconspicuous and, in general, more durable than dust formulations.

## When to Spray

To answer this question requires considerable judgment. If there is a heavy flight of moths around the first of August, then it may be advisable to spray 10 days later even though damage to the lawn does not show. In any case, spraying should be done promptly when examination of a damaged spot indicates the presence of sod webworms.

## What to Spray With

DDT and dieldrin were among the most reliable materials used during the past season. DDT should be used at the rate of 2 lbs. per acre. This amounts to one gallon of the 25 percent emulsifiable concentrate for an acre or 1 quart for about 10,000 sq. ft. Dieldrin at rates of ¼ to ½ lb. per acre should do the job. Since a gallon of dieldrin concentrate contains 1.5 lbs. of dieldrin, 1/3 gallon of concentrate would be required for ½ lb. of chemical. Enough water should be used to thoroughly wet the grass, up to 100 gallons per acre.

Sevin, a relatively new material, has shown promise against webworms, but the residual effectiveness is shorter than DDT or dieldrin. In case the lawn has been seriously damaged, with little green grass left to spray, malathion might be used to obtain contact effectiveness, or DDT and malathion combined would provide both contact and residual effectiveness.

# A SUMMARY OF FUNGICIDE TESTING CONDUCTED IN 1962

M. P. Britton

## I. Experimental fungicides.

Nineteen chemicals were evaluated in this test conducted at Savoy, Illinois. Each chemical was applied to 3' x 8' plots replicated three times on Seaside creeping bentgrass mowed at 5/16 of an inch. Ten applications were made at approximately 7-day intervals beginning on June 26 and ending August 27, 1962.

The only disease that occurred was melting-out caused by *Helminthosporium spp*. (Table 1)

Table 1. Performance of experimental fungicides against melting-out, Savoy, Illinois. July 17, 1962.

| Chemicals | Rate/1000 sq. ft. | Estimated % Disease<br>Average of 3 reps |
|---|---|---|
| Dyrene | 8 oz | 0 - 10 % |
| Dithane M22 | 4 oz | |
| Dithane M45 | 4 oz | |
| Dithane S31 | 4 oz | |
| MV 271 | 2/3 oz | |
| Chipman Spectrum | 2 oz | |
| Folcid | 4 oz | |
| Thimer | 3 oz | |
| Kromad + Caloclor | 2 oz + 3/4 oz | |
| Thiram + PMA + Zineb | 2 oz + ½ oz + 2 oz | 11 - 20 % |
| Thiram + PMA + Maneb | 2 oz + ½ oz + 2 oz | |
| MV 272 | 2/3 oz | |
| Stauffer Turf Fungicide | 4 oz | |
| Chipman Liquid | 1½ oz | |
| DAC 1200 | 6 oz | |
| Dyrene + Dexon | 12 oz | |
| Check Plots | none | |
| Chemagro 2635 | 3 oz | Over 20% |
| Ortho Lawn & Turf Fungicide | 4 oz | |
| Cyprex | 12 oz | Phytotoxic |

Conclusions drawn from data in Table 1.

1. No fungicide gave complete control of this disease under the ideal conditions for disease development present during the first two weeks of July when applied every 7 days. More frequent applications may have given better control.

2. Dyrene was clearly more effective against this disease than other fungicides tested.

II. <u>Test on length of interval between spray applications</u>.

Three fungicide combinations presently in use by greens keepers were tested to determine the residual effect of applications made at intervals of approximately 7 days, 14 days and 21 days. The fungicide mixtures were applied on 3' x 8' plots replicated 6 times. The first application of fungicide was made on June 26, the last on August 27, 1962. The test was conducted on Washington bentgrass mowed 5/16 inch. Melting out data were taken on August 30, 1962 (Table 2); Brown patch occurred during the first half of July, data were taken on July 17 (Table 3).

Table 2. Melting out incidence. August 30, 1962. Savoy, Illinois

| | | Average disease incidence in 6 plots | | |
|---|---|---|---|---|
| Fungicide Mixture | Ounces per 1000 sq. ft | 7 day interval 10 applications 1/ | 14 day interval 5 applications | 21 day interval 4 applications 1/ |
| Ortho Lawn & Turf Fungicide | 4 | 5.0% | 10.5% | 12.5% |
| Tersan + PMAS + Parzate | 2 + ½ + 2 | 5.8% | 9.1% | 12.5% |
| Thimer | 3 | 9.1% | 8.3% | 15.0% |
| Check | None | 21.6% | 14.1% | 15.0% |

1/ Last application three days before taking data.

<u>Conclusions drawn from Table 2</u>.

1. No fungicide mixture gave complete control of melting out, even when applied at 7 day intervals during the period favorable for disease development.

2. The addition of Parzate to thiram and PMA gave better control than thiram and PMA alone (Thimer).

Table 3. Brown patch incidence. July 17, 1962. Savoy, Illinois

| Fungicide Mixture | Ounces per 1000 sq.ft | Total Diameter in inches of brown patch in 6 plots | | |
|---|---|---|---|---|
| | | 7 day interval 3 applications | 14 day interval 2 applications1/ | 21 day interval 1 application |
| Ortho Lawn & Turf Fungicide | 4 | 6.5 | 18 | 20 |
| Tersan + PMAS + Parzate | 2 + ½ + 2 | 23.0 | 52 | 155 |
| Thimer | 3 | 6.5 | 25 | 109 |
| Check | None | 60.0 | 95 | 76 |

1/ Second application was made 7 days prior to taking data.

Conclusions drawn from data in Table 3.

1. Under ideal conditions for brown patch development, no fungicide mixture gave complete control in all plots.

2. The addition of Parzate to Tersan and PMAS reduced the effectiveness of Tersan and PMAS in the control of brown patch.

III. Snow Mold Control Test.

The fungicides tested were applied on November 9, 1961 at Palos Park, Illinois at the rates recommended by the manufacturer. The applications were not repeated during the winter nor early spring. The data presented in Table 4 were taken on March 30, 1962.

Pink snow mold was present on all plots, no gray snow mold was observed in the two replications on Washington bentgrass.

The south replication was covered with snow from December 23, 1961 to March 10, 1962. The snow cover melted off of the north replication once in January, again in February and was completely gone by March 3, 1962. Depth of snow on the south replication was as deep as 18" for much of the winter, depth on the north replication averaged about 6" when present. The difference in depth was due to drifting. One inch of snow fall occurred on March 21, 1962 but had melted before evening.

The following data were taken by measuring the diameter of each diseased area in each plot. Two types of diseased areas were readily apparent (1) areas in which the grass was completely dead and (2) areas in which only leaf damage occurred. Measurements of each type of diseased area were taken and recorded separately. Since all diseased areas were nearly circular, the area of each was computed using the measured diameter and the formula for finding the area of a circle. Data presented are in terms of the total square inches of disease per plot. Also, the number of spots present per plot, and the average size of each diseased area.

Table 4. Incidences of Pink Snow Mold (Fusarium nivale) at Palos Park, Illinois, March 30, 1962.

| Fungicide | No. of spots | Ave. diameter spots | Total area of dead grass | Total area leaf damage | Total diseased area |
|---|---|---|---|---|---|
| NORTH REP I | | | | | |
| Actidione Thiram | 9 | 3.3 | None | 95.84 | 95.84 |
| Check | 37 | 1.1 | 29.6 | 15.66 | 45.26 |
| Tersan OM | 8 | 1.7 | .78 | 19.84 | 20.62 |
| Caloclor | 4 | 1.7 | None | 10.20 | 10.20 |
| Calocure | 8 | 1.2 | 8.62 | 2.34 | 10.96 |
| Check | 47 | 1.4 | 70.76 | 15.66 | 86.42 |
| MF 114 | 16 | 1.4 | 26.10 | 4.10 | 30.20 |
| Ortho Lawn & Turf Fungicide | 2 | 1.0 | None | 1.56 | 1.56 |
| Panogen | 3 | 1.6 | None | 7.06 | 7.06 |
| MF 119 | 9 | 2.2 | 23.62 | 14.16 | 37.78 |
| SOUTH REP II | | | | | |
| Panogen | 19 | 1.0 | 3.14 | 14.2 | 17.34 |
| Ortho Lawn & Turf Fungicide | 10 | 1.3 | 8.86 | 6.2 | 15.06 |
| Check | 88 | 1.6 | 269.34 | 16.22 | 285.56 |
| Actidione Thiram | 19 | 1.5 | 24.3 | 18.42 | 42.72 |
| Tersan OM | 17 | 1.2 | 20.74 | 1.56 | 22.30 |
| Caloclor | 18 | 1.0 | 17.08 | .78 | 17.86 |
| MF 119 | 37 | 1.5 | 18.24 | 62.36 | 80.60 |
| Calocure | 67 | 1.5 | 118.18 | 38.04 | 156.22 |
| Check | 77 | 2.0 | 305.76 | 26.68 | 332.44 |
| MF 114 | 45 | 1.7 | 78.52 | 35.56 | 114.08 |

# SEED SOD STUDY

R. A. Miller

The decision to use seed or sod of Kentucky Bluegrass (*Poa pratensis*) to establish new turf areas will depend upon a number of factors including economic considerations, the need for a quick cover, available equipment and time of the year etc. Interest in the above problem prompted a direct comparison of the problems involved in establishment of Kentucky bluegrass from seed and sod at periodic intervals throughout the growing season.

The above study was begun on April 29, 1960 at the Drug and Horticulture Experiment Station located at Downers Grove, Illinois. The turf and weather data presented should be appropriate for Northern Illinois.

Seed and sod of the Merion selection of Kentucky bluegrass and Common Kentucky bluegrass was planted every two weeks during the growing season with the last date of planting being September 30, 1960. Each planting treatment was replicated two times.

The method of planting seed and laying sod was conducted in a typical manner which the turfman or homeowner might use. A desirable seed bed was prepared. Seed was sown at two pounds per 1000 sq. ft. The seed was raked in, rolled lightly and mulched with straw using 100 pounds per 1000 sq. ft. The sod was laid, watered and rolled down firmly. Both treatments were watered when necessary with a perforated plastic hose to keep the seed and sod moist for two weeks.

Turf and weed cover data was taken April 21, 1961 which was one year from the first treatment date. The data sampling was taken by a modified point-transect method.[1] This consisted of a board with ten finishing nails located one inch apart. This board was dropped at random 20 times in each three by six foot treatment and the type of plant touching each nail was recorded separately, i.e. desirable turf, broadleaf or grass weeds.

The fact was soon noted that no data other than 100 percent density of desirable turf species would be found in the sod treatments. Successful establishment and growth was maintained by both species of sod with indifference to the establishment date.

Establishment from seed however showed differences to both specie and date of establishment upon density of desired turf and occurrence of weeds. The following tables reveal this difference in percent of soil covered.

Since temperature and rainfall were variables in this study, tables 5 and 6 are offered for consideration in evaluating the data in tables 1 through 4.

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1. Clarke, S. E., J. A. Campbell and J. B. Campbell. 1942. An ecological and grazing capacity study of the native grass pastures in southern Alberta, Saskatchewan and Manitoba. Dom. Can. Dept. Agr. Tech. Bul. 54. 31pp.

TABLE I.
PERCENT COVER OF DESIRABLE SPECIES

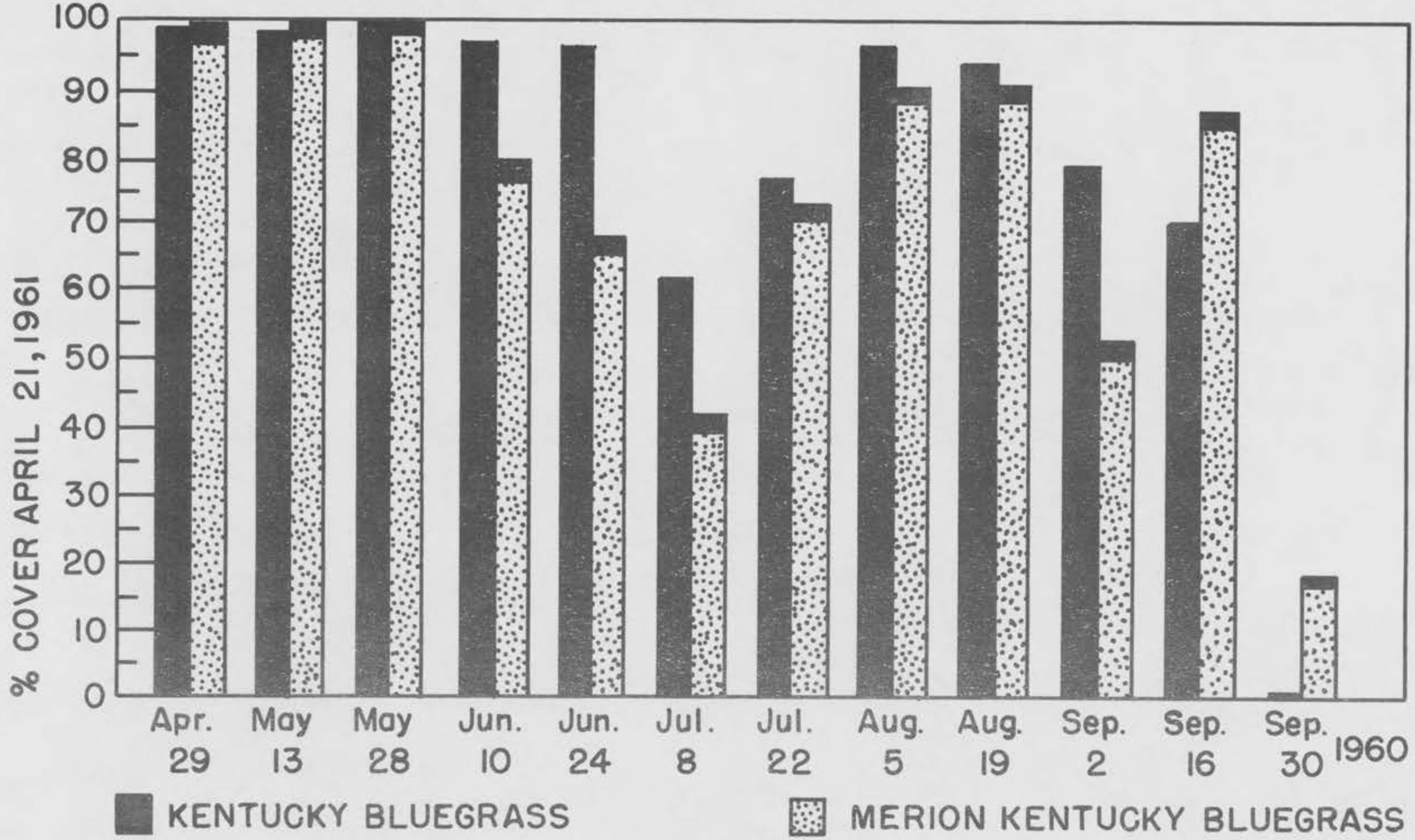


TABLE 2.

PERCENT COVER OF BROADLEAF WEEDS

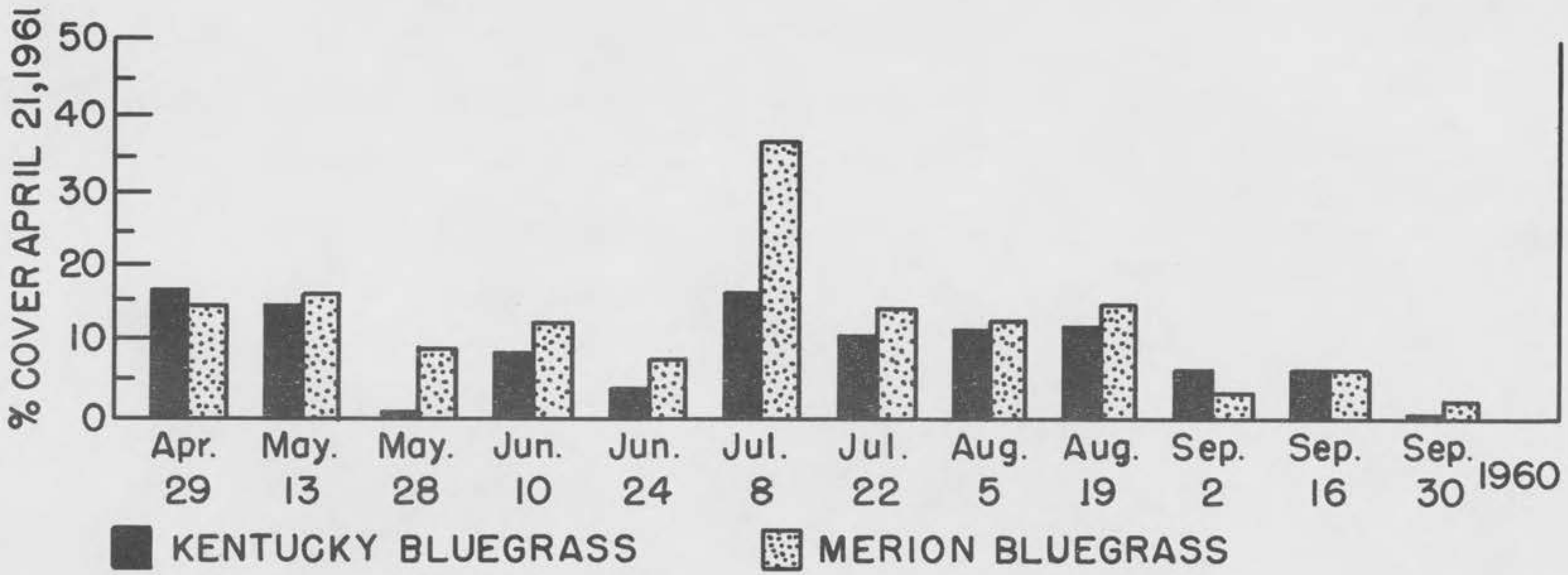


TABLE 3.
PERCENT COVER OF GRASS WEEDS

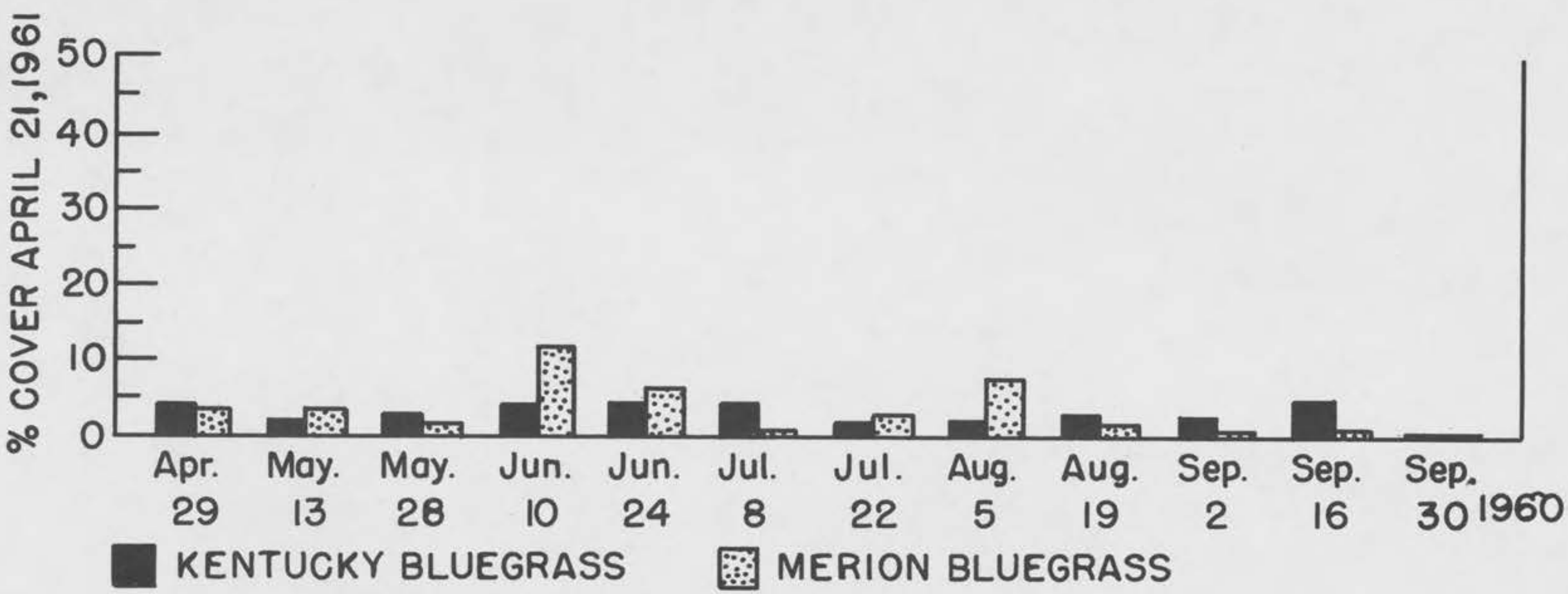


TABLE 4.

PERCENT SOIL NOT COVERED

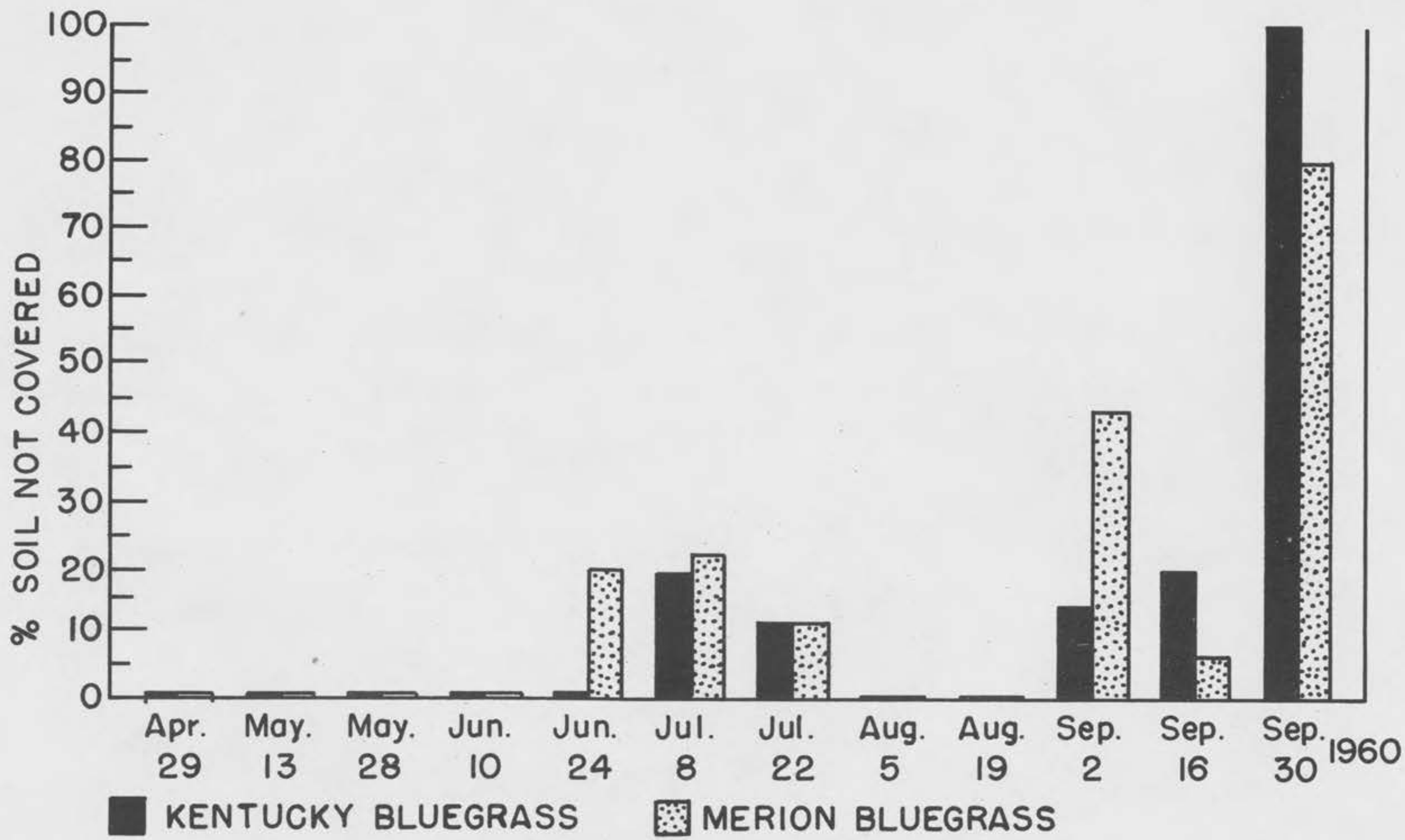
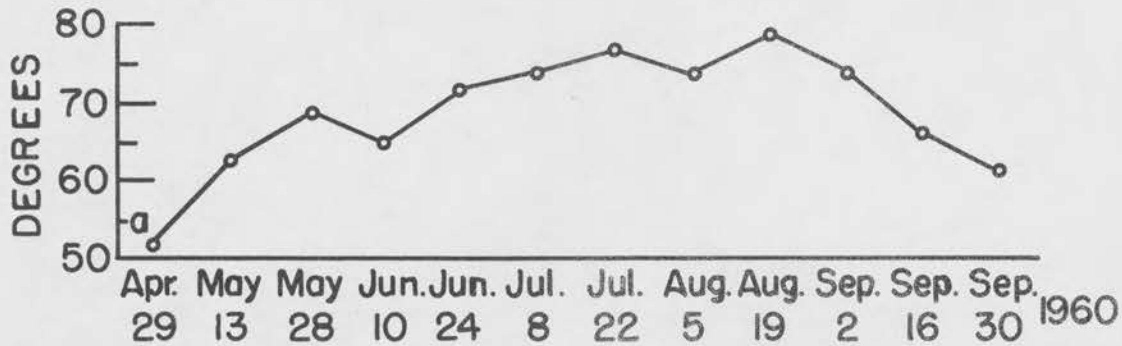


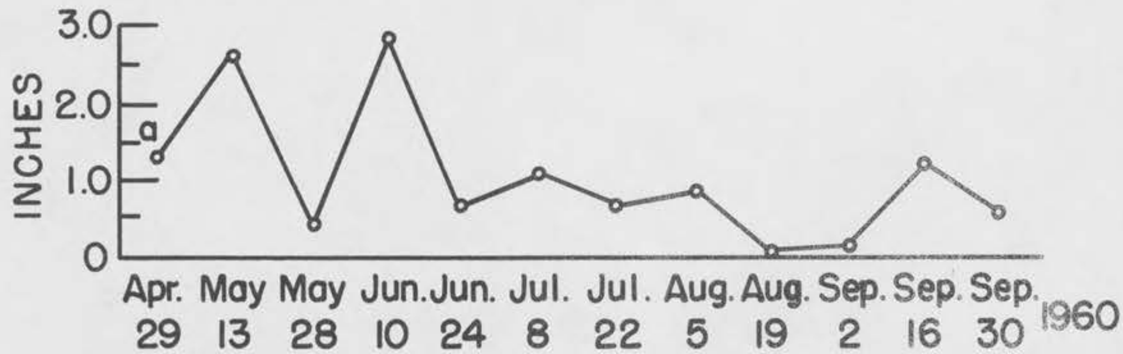
TABLE 5.
WEATHER DATA
14 DAYS FOLLOWING TREATMENT

TEMPERATURE




a. AVERAGE DAILY TEMPERATURES 14 DAYS AFTER TREATMENT

TABLE 6.
RAINFALL




a. TOTAL RAINFALL 14 DAYS AFTER TREATMENT

The data in the above tables indicates that Merion Kentucky bluegrass will establish itself slightly better than Common Kentucky at lower temperatures. The reverse is true for higher temperatures. In general, Common has slightly greater seedling vigor. Temperature and plant competition are important to broadleaf weed establishment. Neither temperature nor density of new turf appears to greatly affect the occurrence of grass weeds. June, July and after the middle of September are poor dates to seed bluegrass in Northern Illinois. Sod can be laid anytime good contact can be made with the soil.

Sincere appreciation is expressed to the Sod Growers Association for providing and delivering sod to the Downers Grove Station. Encouragement and suggestions from Dr. M. P. Britton are also appreciated.

# ICE SHEET DAMAGE

James B. Beard

Winterkill is a term encompassing a large number of types and causes of injury. It is loosely used to include any type of injury that occurs during the fall, winter and spring period. A detailed understanding of the climatic and soil conditions at the time of injury is needed to ascertain the actual cause. Winterkill due to ice coverings is common in areas where sleet storms predominate and in undrained low spots. Even under these two conditions the cause of injury varies considerably depending on the environmental situation.

## Cause

Two general groups of kill include (a) grass which was dead at the time of spring thaw and (b) grass which appeared green and healthy following the spring thaw but which subsequently began to gradually die.

Grass which was dead at the time of spring thaw may have been killed in one of four ways. (1) Severe hydration of the leaf tissue causing leaching of the cell contents and protoplasm. This type of injury will occur in late winter or early spring when temperatures are above 32° F. It commonly occurs in low spots and poorly drained areas, but may also occur under well drained conditions as follows. On sunshinny days the light waves will pass through the ice and be absorbed at the opaque grass surface. This absorbing of light rays will heat the grass sufficiently to melt the ice surrounding them, thus resulting in the leaves being encased in water with a heavy ice sheet cover still existing around them. At 40° F. leaf temperatures the plant may be killed by leaching within 1 to 2 days. Reducing this type of injury can be accomplished by providing optimum surface and internal drainage through surface drainage channels, tile, and aerification. However, water leaching may even occur on well drained locations on above freezing, sunshiny days, due to water encasement under ice sheets. This situation can be eliminated only by breaking and removing the ice sheet. This is feasible only on limited areas such as putting greens.

(2) Accumulation of toxic levels of carbon dioxide under the ice sheet. Carbon dioxide is a by-product of plant respiration processes. Even at below freezing temperatures a minimum respiration rate exists. Thus it is possible, in time, for killing concentrations of carbon dioxide to accumulate. However, it is quite possible that other types of injury may occur prior to this carbon dioxide accumulation. Reduction of $CO_2$ injury is obtained by removal of the ice and snow layers where feasible as described in Type I injury.

(3) Total destruction of the protoplasm within the hydrated growing tissue of the plant due to severe ice crystal formation at low temperatures. This type of injury will not occur in plants that are permitted to properly harden through dehydration or reduction in water content. If plants are improperly managed, through over watering, late fall fertilization, or any process which stimulates growth in the late fall, then the chance of direct kill by low temperatures is much greater.

(4) Deficient supplies of oxygen under the ice sheet. The respiring plant requires oxygen. The ice sheet impairs oxygen exchange thus limiting

the gas supply. Much winterkill by ice sheets has, in the past, been attributed to oxygen suffocation. However, experimental information currently indicates that winterkill by oxygen suffocation is probably of little importance under field conditions.

Winterkill in which the grass appeared green and healthy following the spring thaw but which subsequently began to die may be injured in one of two ways. (5) Injury of the lower crown tissue and root. The original cause of winterkill is the destruction of the cellular protoplasm in the lower crown tissue due to ice crystal formation. This in turn results in death of the root system even though the above ground leaves and shoots appear normal. If a cross section of the grass crown is made, a browning of the lower crown and roots can be observed in injured plants. With the advent of spring thaws, the grass plant will appear on the surface to be normal. However, warmer temperatures will initiate growth and transpiration of the above ground tissue. Those plants with severely injured lower crowns may not be capable of producing a new root system fast enough to meet the water uptake requirements of transpiration. Under these conditions the plant will die of desication resulting from the severe crown injury. Winterkill of this type occurred widely in the Detroit area in 1962. Fairways, greens and tees were completely killed. Through detailed microscopic analysis at Michigan State University the above cause has recently been proven. Again, as in Type 3 injury this crown damage can be reduced through proper fall management practices. Work in this area is currently being conducted at Michigan State University.

(6) Total destruction of cellular protoplasm within the hydrated growing tissue of plants which have prematurely initiated spring growth. The grass may survive the winter in excellent condition. The weather may turn extremely warm for 2 or 3 days, resulting in a premature loss of hardiness due to an increase in hydration within the plant. If this is followed immediately by a severe drop to below freezing temperatures, then direct low temperature injury may occur. The chance of this occurring can be reduced by avoiding any practices which encourage early spring growth. An additional factor which complicates the winterkill situation is the apparent variability between grass species in susceptibility to winterkill injury. For example, in Michigan annual bluegrass is more susceptible to Type 5 injury than either Kentucky bluegrass or bentgrass.

## EVALUATING INJURY

The conditions under which each of these six types of injury occur are quite different. The turf specialist must be capable of recognizing both the type of winter injury and the causal conditions. This involves observations of types of ice and snow cover; duration of coverage; time of occurrence, degree, and duration of low temperature; occurrence of water encasement in ice; and physiological condition of the grass plant at the time of low temperature occurrence. Samples of grass should be taken throughout the winter and placed under higher growing temperatures to observe if injury has occurred. Cross sections of the grass crown can be taken with a knife to check for lower crown injury which will typically appear as a browning of the lower crown and root. By this means, the turfman can ascertain if and when winterkill has occurred.

In time, the turfman will become experienced with the conditions under which injury occurs, as well as, in what locations injury is most likely. With this knowledge proper precautionary measures can be taken. Hasty evaluations regarding winterkill causes based on superficial information can lead to erroneous conclusions. On the spot, detailed observations are needed to arrive at the correct causal factors.

It should also be pointed out that these six types of injury are not completely understood, as yet. Extensive work is underway at Michigan State to further clarify the conditions resulting in each type of injury as well as the relative importance of each under field conditions.