

MAY 1970

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association





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COVER PHOTO:

From another era. The Green Section Beltsville (Md.) Turf Gardens in 1951. Dr. Marvin Ferguson (left), past USGA Research Director and Alexander Radko, present Research Director examine threshed straw of Zoysia seed.

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A view of one portion of the Green Section's tests at the Arlington Turf Farms in 1940. Dr. John Montieth, whose brilliant direction of early research set the guidelines for present day maintenance and management practices on the golf course, addresses a group of turf workers at a Field Day sponsored cooperatively by the Green Section and the U. S. Department of Agriculture.

Review of the Green Section Research Program

by **ALEXANDER M. RADKO**, Eastern Director and National Research Director

Golfers are aware that the USGA has a stake in turfgrass research, but they are vague about what has resulted from it over the years. This article is an attempt to bring them up to date on the USGA's program, steadfastly directed by the Green Section, and what it has meant to the betterment of turfgrasses and specifically to golf throughout the world.

Golf is a relatively young game in the United States. It reportedly began with John Reid and his "Apple Tree Gang" in Yonkers, N.Y., a little over 80 years ago. Not until 1920, however, was direct research assistance first requested by a Green Committee Chairman. E. J. Marshall, of the Inverness Club in Toledo, brought the United States Department of Agriculture and the USGA together, and the result was the birth of golf turf research in the United States. On November

30, 1920, the following resolution was adopted by the USGA:

"That a Green Section of the United States Golf Association be and is hereby created for the purpose of collecting and distributing among members of the Section information of value respecting the proper maintenance and upkeep of golf courses."

Dr. C. V. Piper and Dr. R. A. Oakley, who were

then employed by the Department of Agriculture, Division of Forage Crop Investigation, became the first Chairman and Vice-Chairman respectively of the Green Section of the United States Golf Association. They and their committee lost no time in bringing together and disseminating the best available information of the day in a publication called "Bulletin of the United States Golf Association Green Section." It was first published in 1921. The Bulletins were distributed to anyone interested in golf course maintenance and management problems.

Putting Science To Work

In 1924 Dr. John Monteith, Jr., a brilliant young pathologist, joined the Department of Agriculture. Later he was persuaded to join the Green Section to direct research and all other activities. From then through 1933, the monumental work of Dr. Monteith and his associates is reported in the Bulletins, Turf Culture and other publications. As an indication of the magnitude of this work, 3,435 pages of pertinent information for golf course maintenance and management made up 13 volumes of the Bulletin of the USGA Green Section. This published research set the guidelines for golf course management, and to a large degree it is responsible for the programs followed today.

In Disease Control

Much of the information in the early Bulletins is still timely and applicable. The 1932 Bulletin on "Turf Diseases and Their Control," a classic document of 188 pages, described in detail the known diseases of the day and recommendations for their control.

From page 142:

As the susceptibility of any grass to injury from snowmold has been found to be increased by fertilization with excessive quantities of nitrogen in late fall, putting greens in the snowmold belt should be fertilized as little as possible after August. Since there is a decided difference in the susceptibility of grasses to this disease, the ability of a grass to withstand attacks of snowmold should be given consideration in the choice of grass for putting greens in the snowmold belt. On courses where the disease is likely to be particularly serious, the Columbia, Inverness, Seaside and similar strains of creeping bent, and also red fescue, should be avoided. It has been found also that a covering of straw, particularly when left on the turf late in the spring, tends to encourage the development of the disease. The use of any covering which keeps the grass wet after the snow

has melted and the grass has commenced growth should therefore be avoided. The removal of snow, the sweeping off of any debris or any mass of the fungus remaining on the putting greens, and any other treatment tending to hasten the drying of the surface after the spring thaws begin, will in many instances tend to reduce late damage by snowmold.

In spite of all these precautions, however, snowmold is likely to develop under other favorable conditions. It is therefore well to treat the greens with one of the mercury fungicides before winter begins in order to avoid entirely attacks on the greens or at least to greatly reduce the severity of the attacks. Corrosive sublimate and calomel have proved to be entirely satisfactory for the control of the disease. These should be applied in late fall or early winter at the rate of from 2 to 5 ounces to 1000 square feet.

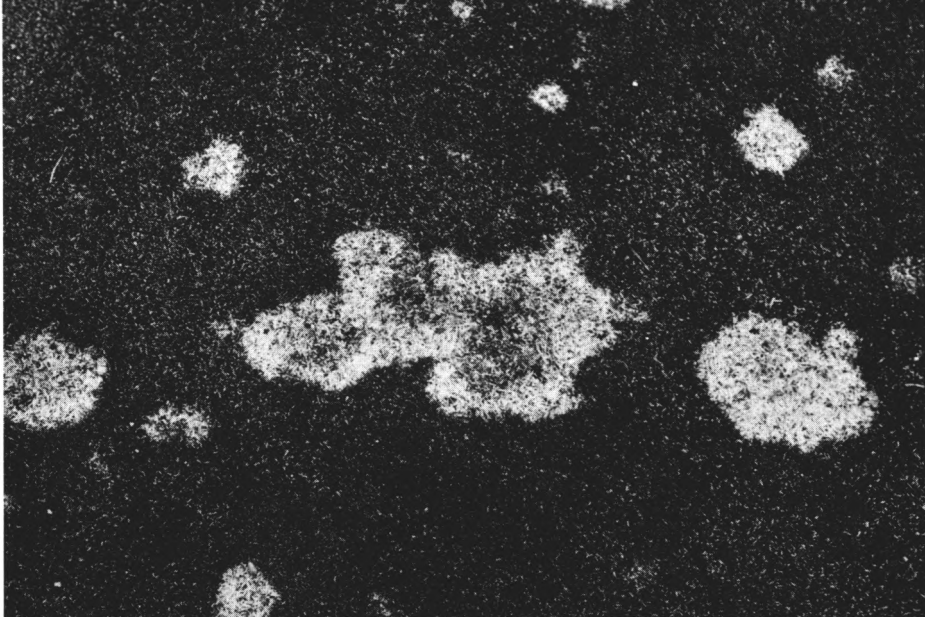
From page 116:

In 1917 experiments were first made on golf courses to test Bordeaux mixture as a fungicide for the control of brown patch. By 1919 its use was general on courses on which the disease was serious. Corrosive sublimate was used successfully as early as 1920 in the Chicago district. The disadvantages of Bordeaux mixture led to the testing of other fungicides in brownpatch control. In 1923 careful study of turf diseases and the organisms causing them was begun by the Green Section, in the laboratory and in the field, and the results of this work have been published in the Bulletin from time to time. Many chemicals are useful as fungicides, but it is not a simple matter to find one that will kill fungi and at the same time not injure the plant on which it is used. A great many chemicals have been tested at the Arlington turf garden for the control of turf diseases.

From page 123:

Since corrosive sublimate and calomel each had advantages not possessed by the other, it was apparent that a combination of the two could be used to advantage. This was particularly true for brown patch. Dollar spot can be effectively controlled with calomel alone, but in the Arlington experiments active brown patch was not immediately checked. Combinations of 1/3 corrosive sublimate and 2/3 calomel proved effective for brown patch. For extremely active cases of the disease 1/2 corrosive sublimate and 1/2 calomel has been more effective. This treatment has advantages in that it checks

Snow mold a cold weather disease. Green Section research discovered controls in the 1920's, for which no better controls have been discovered to-date.



the disease immediately, due to the corrosive sublimate, and gives a long period of control due to the calomel. Combinations of the two chemicals in various other proportions have also proved effective.

Such combinations were first suggested by the Green Section in the Bulletin in 1927 and since that time preparations containing mixtures of corrosive sublimate and calomel have appeared on the market with trade names.

From page 214, Vol. VII:

Since calomel acts slowly and for that reason is not desirable for control of active large brown patch, an attempt was made to combine it with a more quickly effective chemical to provide a combination treatment which would have the advantages both of the immediately active chemical and of the more lasting calomel. Since corrosive sublimate and the oxide of mercury check large brown patch almost immediately, these two appeared to be the most promising for such a mixture since they possessed certain other desirable features besides that of lowest cost. An application of one ounce of corrosive sublimate per 1000 square feet proved to be entirely satisfactory in checking active large brown patch. Therefore, a mixture of one ounce of corrosive sublimate with two ounces of calomel was applied to a number of plots and it was found to give the desired results. Other proportions were tested, but it appeared that the ratio of one-third corrosive sublimate and two-thirds calomel was best. The demonstration plots of the turf garden, which are cared for as putting greens

should be, were treated with such a mixture previous to the meeting of greenkeepers in August. When a mixture of these two chemicals is combined with a little fine clay, to add more bulk, it makes a very satisfactory brown patch remedy.

We found that the oxide of mercury was likewise effective in combination with calomel, used in the same proportion as was the corrosive sublimate and calomel. There are two common oxides on the market (red and yellow), which proved to be equally effective against these turf diseases. The oxide is less likely to burn than is corrosive sublimate and lasts a trifle longer. It should prove to be a valuable chemical for this work.

In Improved Grasses

Except for a brief period during the depression of the early 1930's, the Green Section has always identified with a publication and has published without interruption through today in Turf Culture, Timely Turf Topics, The Turf Management section of the USGA Journal, through Regional Turfletters, and now the USGA Green Section Record.

The program of selection and testing of hundreds of grasses began during the time when Dr. Monteith was associated with the Green Section. Promising grasses from all over the United States were brought to the Arlington (Va.) Turf Farm, near Washington, D. C., and tested for a period of several years before a decision was made whether any individual selection was worth further research. For every one selected, hundreds were discarded. Many of these selections were transferred to the Beltsville (Md.) Research Farm when the Department of Agriculture moved from Arlington to make



An important part of the Green Section program has always kept golf uppermost in turfgrass research studies. Here the C-1 Arlington strain of creeping bentgrass is being tested for putting quality. Dr. John Montieth (center) observes technique and stroke in 1940 at the Arlington Turf Farms.

way for new highways and construction of the Pentagon. The Pentagon now stands on the site of the old Green Section turf plots and oldtimers who religiously followed research there like to think of it as a fitting and lasting monument to the Green Section's program of research.

Dr. Fanny Fern Davis, the only woman to direct the Green Section, followed Dr. Monteith. She directed research work during World War II. She, in turn, was succeeded by Dr. Fred V. Grau, who was Director from 1945 to 1953. Under Dr. Grau's direction, zoysia, Merion bluegrass, and bermudagrass became prominent. Dr. Grau published extensively and travelled widely, promoting the cause of improved grasses while continuing to direct the Green Section's research program at Beltsville. Dr. Marvin H. Ferguson was responsible for the direction of research from 1953 to 1968. Today the author is National Research Director.

From its inception, the USGA has spent more than \$3 million on the Green Section. The U.S.G.A. Green Section Research and Education

Fund, Inc., has distributed approximately \$250,000 for research since 1953. Prior to 1953 the Green Section's activity was devoted to full time research.

Listed below is some Green Section work that greatly influenced the golf turfgrass world.

- Hundreds of creeping bentgrasses were tested in search of superior putting green selections, but only a few were chosen. Some that are still used widely include C-1 Arlington, C-7 Cohansey, C-15 Toronto, C-19 Congressional, Washington, and the Old Orchard selections. The Green Section also perfected methods of propagation and establishment of putting greens from vegetative strains.

- Green Section research discovered controls for dollar spot, brown patch and snow mold that are still used today. The mercury compounds have been standard disease control materials since the 1920's.

- Green Section research produced fungicidal green dyes which also were used widely to color weak or injured turf.

● Green Section research helped develop some of the zoysia grasses presently used on golf courses. Meyer zoysia was released jointly with the U. S. Department of Agriculture, which awarded the Green Section a special citation for this work.

In Weed Control

Green Section research helped develop techniques for the safe and selective use of weed control chemicals such as 2, 4-D and sodium arsenite. Excerpts of Dr. Fanny Fern Davis' thesis on "Turf Control with 2, 4-D" report the beginning of large scale turf and golf course weed control tests as follows:

Dr. E. J. Kraus first suggested that some of these growth regulating compounds, when applied at concentrations of a much higher order than those which were necessary for the production of typical growth responses, killed plants of certain species. From his early observation grew the general idea that some of the growth-regulating compounds might make good herbicides. In 1942, the investigators at the Boyce-Thompson Institute stated in one of their publications that 2, 4-dichlorophenoxyacetic acid was an extremely potent growth-regulating compound. In the course of investigations with the use of this new compound for the setting of seedless fruit, the prevention of apple drop, etc., Drs. John W. Mitchell and Paul C. Marth of the Bureau of Plant Industry, U.S.D.A., observed its lethal effect on certain weeds. In August 1944 they approached the present author, who was then acting Director of the U.S. Golf Association Green Section, concerning the testing of its potentialities in the control of turf weeds. Since that date, experimental work has been underway continuously, first under the auspices of the U.S. Golf Association Green Section in cooperation with Drs. Mitchell and Marth, and subsequently with Mr. Horace Wester of the Horticultural Division of the National Capital Parks. In addition, for more than a year a large-scale weed eradication program has been in progress in the National Capital Parks in which several hundred acres of turf have been quickly and strikingly improved by judicious applications of 2, 4-D accompanied by appropriate fertilizing and seeding programs.

With Merion Bluegrass

Green Section research resulted in the release of Merion bluegrass as an improved selection. Today it is still considered the standard by which all other bluegrasses are judged. It seems

incredible that of the millions of bluegrass selections, this one would come to the attention of researchers and be the one chosen from sixty that survived the tests imposed on it. An article by Charles G. Wilson and Fred V. Grau entitled "Merion (B-27) Bluegrass" in the April, 1950, USGA Journal and Turf Management stated:

The selection and testing program which has resulted in the release of Merion (B-27) Kentucky bluegrass for commercial production is one of the achievements of the cooperative research program being carried on by the USGA Green Section and the Department of Agriculture.

This grass was tested by the Green Section for several years before the war. With the curtailment of Green Section activities in 1942, the Division of Forage Crops and Diseases, Department of Agriculture, took over the work, carrying on the clonal stock and observing plantings which had been made. At the end of the war the Green Section resumed its field work and since that time the Department of Agriculture and the Green Section both have been interested in getting Merion into production.

Merion bluegrass was observed for a number of years by Joe Valentine, superintendent at Merion Golf Club, in Ardmore, Pa., and a plug of turf was given to the Green Section in 1936 along with two similar strains from a tee at Merion. The name Merion was chosen for B-27 bluegrass by reason of the origin of the original material. Merion was described as a dense, dark-green turf growing in partial shade, spreading over several feet and crowding out weeds with its vigorous growth.

Subsequently, this work was given over to Penn State University for detailed breeding and related studies.

Green Section research promoted studies in nutrition and in slow release nitrogen fertilizers (urea-formaldehyde) as a cooperative effort with the U. S. Department of Agriculture.

With Tifton Bermudas

Green Section support of the breeding work at The Georgia Coastal Plain Experiment Station resulted in the release of some outstanding bermudagrasses for greens. Specifically, Tifgreen and Tifdwarf, developed by Dr. Glen W. Burton, made golf far more enjoyable in the South. Prior to release of these selections, one English professional described putting on most bermudagrasses "like trying to putt over cables." Today, these select strains are being propagated wherever bermudagrasses can be grown.

Green Section research on traffic wear on putting greens influenced the kinds of spikes

now being used on golf shoes; its support of a study on cart tires influenced the size of tires now being used for golf carts.

In Green Construction

Early Green Section research pioneered the development of practices in course care that helped minimize practical maintenance and management problems. The USGA encouraged H. B. Musser to write the book *Turf Management*, which for years was the only comprehensive book available for golf course superintendents and managers of large-scale turf areas. This publication has been called the "Golf Turf Bible" by many golf course superintendents.

Green Section research and support of studies related to putting green construction resulted in a new and revolutionary method of green construction. It is now used throughout the United States and the world. While every research director of the Green Section contributed to the thoughts involved, Dr. Marvin H. Ferguson's singular and dogged pursuit of soil research studies culminated in the publication of *The Specifications* in 1961.

Research the Primary Mission

From 1920 to 1953, the Green Section's primary mission was research. In 1953 emphasis changed to extension activities centered around USGA Member Clubs with continued strong financial support of research activities. The U.S.G.A. Green Section Research and Education Fund, Inc., was developed, and today it receives support from the National Golf Fund, the Masters Tournament Committee, the New England Golf Association, various individuals and the USGA. The National Golf Fund raises its money through National Golf Day.

In this event the individual pays \$1 to play a round at his club during a period of about two weeks. On one day during this period, the United States Open Champion and the Champion of the PGA of America play a round together. The lower score of these Champions then becomes the "target score" that the club player is shooting against.

This event is a solid fund raiser for research. The National Golf Fund has contributed heavily to the support of research projects and we heartily endorse every golfer's annual participation.

And More

At the Green Section Educational Conference in New York City last January, club officials had the opportunity to listen to three prominent researchers who have been or are now working on projects supported by the U.S.G.A. Research and Education Fund. These projects include re-

search on *Poa annua* by Dr. James B. Beard of Michigan State University; a colonial bentgrass breeding program by Dr. Joseph M. Duich of Penn State University; and a bluegrass breeding program by Dr. C. Reed Funk of Rutgers University. It was an opportunity for USGA Member Club officials to learn how their research funds were being used. Many of those present expressed their unanimous praise of the calibre of research conducted by these young scientists.

In addition to the three projects listed above, other USGA Green Section Research and Education grants-in-aid totalling \$32,000 are being made in 1970 to the following institutions: Georgia Coastal Plain Experiment Station, University of Connecticut, University of Georgia, University of California (Davis), University of California (Riverside), Oklahoma State University, Kansas State University, University of Rhode Island, Texas A&M University, and Virginia Polytechnic Institute. Projects include work on spring dead spot, microbial degradation of thatch, renovation studies on green-fairway-tee turf, disease, weed and insect controls, bentgrass improvement studies for southern courses, bermudagrass breeding and creeping red fescue studies for southwestern golf courses, and the general support of work in progress at these institutions.

A Balanced Program: Research & Extension

Our program, integrated into the total university and experiment station program, is golf course oriented, designed to solve the problems as observed, discussed, and determined by the nationwide Green Section Staff.

Over the years the Green Section has supported numerous university research programs, many in support of advanced degrees in turfgrass culture. Several prominent authorities earned advanced degrees while working on projects supported by USGA funds. Dr. Fred V. Grau was perhaps the Green Section Director most responsible for encouraging this program of decentralization and the establishment of turfgrass research at state university levels.

Today, eight USGA agronomists are engaged in bringing the best of research and practical experience to Member Clubs. By way of its Green Section Visiting Service Program, on-the-site visits with the golf course superintendent and the Green Committee Chairman culminate in discussions of the total program. Findings from state university research programs, together with the rich background of Green Section research, play an important part in these discussions. As a USGA Member Club, this is your program, and we hope that you are as proud of its accomplishments as we are.

Biology and Control Of a Species of *Hyperodes*

by R. SCOTT CAMERON, Cornell University, Ithaca, New York

In recent years a species of *Hyperodes* has damaged turfgrass, particularly *Poa annua* L., on golf courses in the Long Island and Westchester County areas of New York State. Large patches of *Poa annua* are killed on greens, tees, and fairways (Fig. 1). Unlike grass damaged by fungi or wilt, many of the grass plants attacked by *Hyperodes* are severed at the base of the stems and lie flat soon after being damaged. This type of stem feeding is different from that of other common turf insects, such as chinch bugs which suck plant juices, and Japanese beetle grubs which chew on the roots of grasses. *Hyperodes* damage occurs in May and early June. Larvae, pupae, and young adults can be found beneath the damaged turfgrass in mid-June.

Biological and control studies of the insect reported here were initiated late in the summer of 1967.

CLASSIFICATION—The species of *Hyperodes* involved has not been determined. It has been identified as both *H. anthracinus* (Dietz) and *H. maculicollis* (Kirby), but counts of punctures

and hairs on specimens of Long Island *Hyperodes* indicate that they are significantly different from either species. Dr. Rose Ella Warner recently classified several *Hyperodes* collected on Long Island golf courses as *Hyperodes* sp. nr. *anthracinus* (Dietz). The common name of "turfgrass weevil" has been given to the species of *Hyperodes* causing damage to golf course turf on Long Island.

DESCRIPTIONS—The turfgrass weevil larva is crescent shaped, legless, creamy-white, and has a dark brown head capsule. A larva will vary in length from 1 mm (1/25 inch) when it first hatches to about 4.5 mm (1/6 inch) when fully grown. The pupa is about 4.5 mm (1/6 inch) long, creamy-white and exhibits many of the adult characteristics. The adult is oblong and about 3.5 mm (1/7 inch) long (Fig. 2). The front of the head is elongated to form a beak with elbowed antennae attached near the tip. Young adults are soft and orange-brown, but they gradually darken and harden. The mature adults are generally black and are clothed with fine hairs and yellow-brown to grayish-white

Fig. 1. *Hyperodes* damage on a fairway showing larval preference for annual bluegrass over bentgrass. The dark rectangular areas are patches of bentgrass which were sodded in the area 2 years before. The larvae killed the surrounding *Poa annua* leaving the bentgrass unharmed.



scales. As the adults grow older, many of the hairs and scales are worn off, leaving a shining black body.

BIOLOGY—Turfgrass weevil eggs are deposited between leaf sheaths in *Poa annua* stems, where the larvae hatch after about five days and begin feeding (Fig. 3). The small larvae emerge from the original stem and move about above the soil in the thatch and often tunnel in several other stems. The large larvae appear to be more sedentary. They feed externally on grass stems from a small burrow formed in the thatch and upper soil. Larvae prefer *Poa annua* to other grasses, particularly bentgrass and Kentucky bluegrass (Fig. 1). Larval feeding causes most of the damage to turf. Adult feeding is usually restricted to leaves and upper stems of grass plants and appears to cause little damage.

A turfgrass weevil larva passes through five instars in about 30 days before becoming fully developed. It then burrows about 1/4 inch deep in the soil where it transforms into a non-feeding pupa. The pupal cuticle is shed after five days, and the young adult remains in the pupal cell for several days before emerging to begin active feeding. In laboratory feeding trials, adults generally preferred *Poa annua* to other grasses. Except when they first emerge from the soil, adults are generally hard to find during the day. They hide in the thatch among the grass stems during the day and become active at dusk as they crawl to the tips of leaves to feed. No important natural enemies of the turfgrass weevil have been found.

Turfgrass weevils overwinter as adults in protected areas on or near golf courses. Many adults have been found in tufts of fescue and among leaves and debris under bushes and trees during the winter. Overwintering adults become active soon after thawing temperatures pre-

Fig. 2. Turfgrass weevil adult.

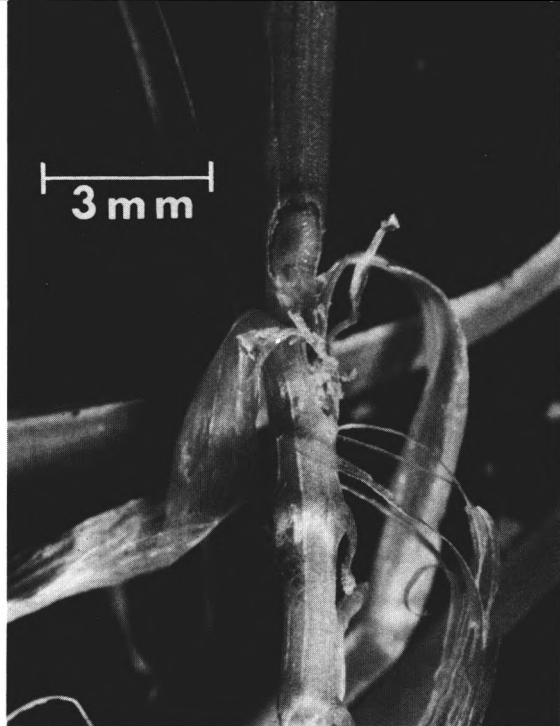
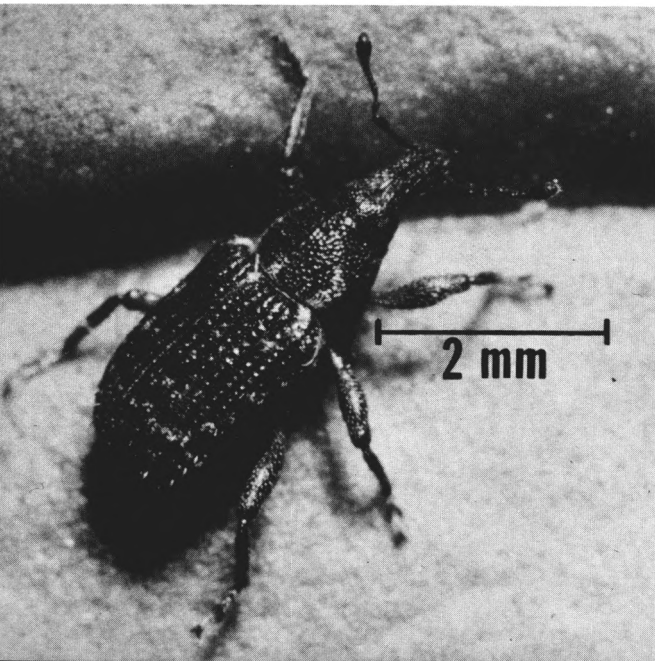


Fig. 3. Medium-sized turfgrass weevil larva feeding inside a *Poa annua* stem.

dominate in the spring. Some adults fly from the overwintering sites to more favorable breeding sites while others probably migrate on the ground.

On Long Island there is one complete spring generation and what appears to be a partial late summer generation. Eggs of the first generation are laid throughout April and May. Larvae are numerous from mid-May through early June and become relatively scarce in late June. Pupae and young adults are most numerous throughout June, with a peak in mid-June. The bulk of the spring generation develops from eggs to adults in about two months, from late April to late June.

Eggs of the second generation are laid during July and August. Larvae are found during August and early September. Pupae and young adults are found throughout September.

It appears that the spring generation may occur anywhere on golf courses, while the second generation has only been observed on greens and tennis courts which receive intensive care throughout the summer.

Some adults probably migrate to their overwintering sites as early as the beginning of September, while others do not leave the greens and tennis courts until October.

CONTROL—Twenty-five insecticides were tested on turfgrass weevil adults in laboratory experiments. Several organophosphate insecticides, including Guthion®, Supracide®, Baytex®, and Dursban®, were most effective, while sev-

eral chlorinated hydrocarbon insecticides, including heptachlor and chlordane, were least effective.

The materials which were most promising in the laboratory bioassay experiments were selected for field testing in 1969, along with Di-Syston®, which looked promising in 1968 field tests, and diazinon, an insecticide commonly used against soil dwelling insects. Diazinon was given more emphasis than the other materials because it had been used with apparent success on an operational scale by several golf course superintendents.

Nearly all the 1969 plots treated in both April and again in May were conspicuously healthier than their surrounding control plots. Dursban® applied at a rate of 2½ pounds active ingredient per acre in April and again in May gave the best control. Diazinon applied at a rate of five pounds active ingredient per acre in April and again in May consistently gave good control, while diazinon applied at a rate of two pounds active ingredient per acre in April and May gave only fair control. The diazinon plots treated only once in mid-April showed considerable weevil damage.

Applications were made with the intention of controlling the adults before they laid their eggs,

but it now appears that the small larvae can be controlled before they cause appreciable damage.

Results of the field plot tests and the operational field trials lead to the conclusion that the turfgrass weevil can be controlled by insecticides applied at the proper times. To control the turfgrass weevil, granular diazinon at a rate of from three to four pounds active ingredient per acre, or Dursban® emulsifiable concentrate at a rate of 1½ to two pounds active ingredient per acre, should be applied on suspected problem areas in mid-April and again in mid-May. Neither diazinon nor Dursban® are registered for use against the turfgrass weevil, but both are registered for use against other turf insects. More extensive field tests could prove that lower rates of application and one treatment per year would adequately control the turfgrass weevil.

In January, 1968, the New York State College of Agriculture at Cornell University received a grant from the Long Island-Metropolitan Golf Course Superintendents Research Foundation. The USGA Green Section was a major contributor. These funds have supported the research for the past two years.

How to Grow Grass Without Pain

by **FRANKLIN B. JARMON**, Superintendent, Facilities, The Du Pont Country Club,
Wilmington, Delaware

Superintendents who have spent sleepless nights worrying about disease, drought, and labor until their ulcers erupted or their heads seemed to split—will not find the answer to their problems here.

Let's face it, there is no panacea for growing grass. As always, nature will continue to challenge every successful superintendent to expect the unexpected. Just as soon as one adversity is overcome, another in the form of a more vigorous insect or a more virulent fungus is sure to appear. Certainly superintendents don't have to be convinced that growing grass can be quite a pain. This, however is the kind of pain that we all have to learn to accept and expect.

There is another and much more devastating kind of pain. It is the pain caused by accidents. Physical pain is all too often the result of some careless and/or unsafe act which exacts an intolerable toll of both physical and mental suffer-

ing. Fortunately, we can generally do something about it.

Of course, we don't run golfers down with a tractor, nor do we intentionally walk in front of their drives. These hazards to our safety are all too obvious. But what of the unnumbered subtle hazards we, our men and our members encounter on the golf course each day? Although safety is everyone's business, the fact remains we too are responsible for those using our facilities. In one way or another, whatever happens to an employee or a member also happens to us.

Accidents resulting from overlooked or inadequate safety practices are inexcusable, and pain cannot be removed by sharing it. The only thing we can and absolutely must do is to prevent accidents from happening in the first place. Those areas most vulnerable are the eyes, fingers, arms, feet and legs.



Mr. Charles Sylvester (left) and Mr. Carl Toth are both outfitted with safety clothing and are inspecting other items of safety equipment used in their work.

Let's consider these questions: Did you ever see a golf ball split a safety helmet on a man raking a sand bunker? Have you ever seen the toe of a safety shoe that had come too close to a rotary mower and realize what would have happened without the special shoe? Did you ever see safety glasses or goggles which had been struck by a flying object? Do your men wear respirators and rubber gloves when using harmful chemicals?

Consider the use of shin guards on rotary mower operators. Seeing a man suffer in a hospital operating room with a piece of rusty wire embedded in his instep is all the persuasion one would require.

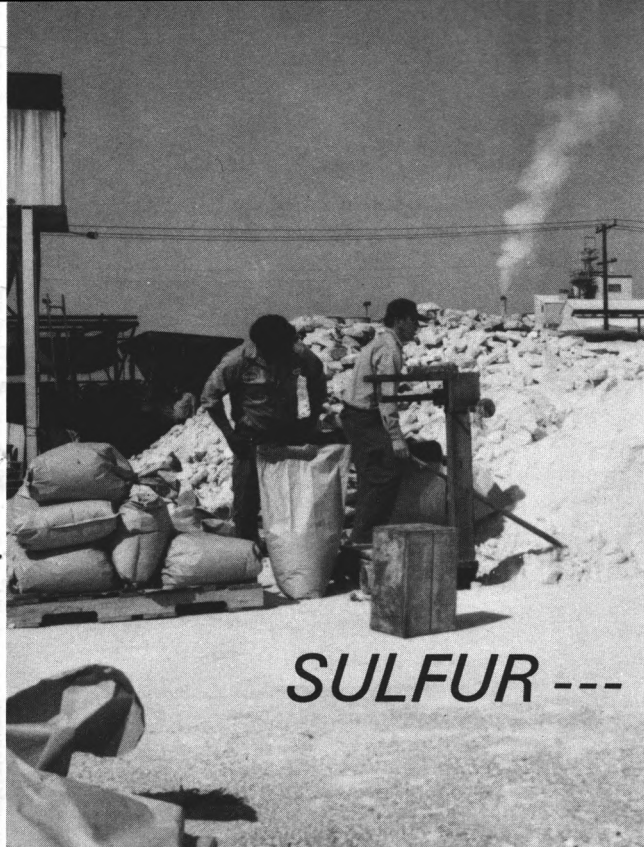
Place guards over all open gears and drive belts. Many fingers, arms and legs have been lost because the continuous whirring of an engine hypnotized a person into a false feeling of security, which led to a careless act.

All of these and other safety features cost money. But it is money well spent if only one major injury is prevented. We cannot afford to ignore the potential loss of an eye or a limb on our golf courses. Think of all the suffering, and even loss of earning power, which can result from an accident, and take immediate steps to eliminate any obvious hazard under your command.

We are constantly on the lookout for disease or things which would cause us to lose turf. Shouldn't we be more alert to the potential hazards which could lead to the loss or harm of human life? Let's do something now to improve the safety conditions of our employees and members.

It would probably be impractical to buy or place in use all of the safety equipment available. Your men would feel and look like Sir Lancelot in armor and trot out the nearest gate. But giving them the necessary instruction in the use of safety equipment and orienting the crew to "think safety" can be done. Indeed it must be done—today, tomorrow, constantly. The most vivid demonstration of all is when a "direct hit" occurs on a newly installed piece of equipment. The gratification in knowing a major accident has been averted is beyond description.

Grass can be grown without pain—unnecessary pain to those who are on the "firing line." A good safety record on any crew is "no accident." After all, aren't your own crew members the ones most responsible for your success as a golf course superintendent? With the heavy maintenance season just ahead, isn't this spring THE time to stress to them the importance of their safety to you!



SULFUR --- The Essential Element

by **G. DUANE ORULLIAN**, Western Agronomist, USGA Green Section

Yellow is a popular color on the golf course. Dandelions prefer it, golfers wear it, and golf course superintendents use it for tee markers and putting green flags.

Turfgrass also has a great preference for yellow. Sulfur plays an important role in turfgrass nutrition. Did you know that the need for sulfur in turfgrass parallels that of nitrogen? It is vital for tissue development, protein synthesis, chlorophyll production, root development and for stimulating the growth and increase of soil micro-organisms!

Recent information has shown that one ton of bluegrass clippings contains about 2.5 pounds of sulfur. Bermudagrass yields even more with 4.3 pounds of sulfur per ton of clippings.

Sulfur is a versatile element. It helps to improve the physical structure of certain soils, thus enabling a better moisture-holding capacity. Where soils are alkaline, it reduces the pH value to a neutral or acid level. This process in turn liberates other elements already present in the soil, such as phosphorus, potassium, calcium and magnesium. This is team work in

action because these elements are also important to good turfgrass development.

How Turfgrass Obtains Sulfur

Sulfur availability to plants, and in particular, to turfgrass, is accomplished by numerous means.

1. Through direct absorption from the air.
2. Decomposition of organic sulfur into the available sulfate form in the soil.
3. From water containing sulfur.
4. From fertilizer and chemical materials that contain sulfur.

Nature provides a cycle for conversion of sulfur into the various useable forms needed by plants. Basically, sulfur occurs naturally as a solid crystalline form and as gasses, such as hydrogen sulfide, and sulfur dioxide. These gasses are either carried into the soil by water or absorbed directly into the plant. In the soil, natural inorganic sulfur is converted (oxidized) to sulfurous acid which combines with some of the soil mineral elements to form sulfides of calcium, magnesium, sodium and potassium.

These sulfides are then further oxidized into sulfates such as sulfuric acid.

The importance of this process is appreciated when it is understood that higher plants take up sulfur in the sulfate form. When the plant dies, organic sulfur is released by combustion or putrefaction, and is given off as gasses, or as elemental sulfur, thus completing the cycle.

The sulfur available in the air is sulfur dioxide, which can be absorbed by plant leaves. Would you believe that there is a benefit from smog! Golf courses in metropolitan areas benefit from sulfur released into the atmosphere by industrial centers. In fact, reports indicate that air pollution contributes upwards of 40 pounds of sulfur per acre per year. This sulfur is carried into the waters, soils and vegetation! By contrast, golf courses in the desert and in semi-arid parts of the United States, may only receive as much as four pounds of sulfur per acre per year. In short, if you breathe fresh air, your soil may have a sulfur deficiency!

Most soils throughout the United States have an adequate supply of sulfur for plant needs. As a natural occurrence in the soil, sulfur content averages .05 per cent, or about 1,000 pounds per acre. In comparison, nitrogen averages .1 per cent, or 2,000 pounds per acre. The ratio of sulfur in the soil to sulfur in the plant is about 1 to 30. Since we are not always blessed with an ideal soil, sulfur deficiency may become a problem. Deficiencies arise in soils which exhibit the following: high leachability, low organic content, alkalinity, non-irrigated, and those soils located far from atmospheric pollution.

Sandy and alkaline soils frequently cannot supply sufficient quantities of sulfur for good turfgrass growth. If for instance, you live in a semi-arid climate, chances are you will encounter sulfur-deficient soils. For sandy soils, applications of 50 to 60 pounds of sulfur per acre per season may be necessary. Clay soils exhibit variability with respect to sulfur absorption into their particle surfaces. Soils containing illitic or kaolitic clays exhibit higher absorption rates than those composed of montmorillonite clays. Absorption increases with a decrease in pH.

Applications of calcium sulfate (gypsum) are helpful in reducing the alkaline reaction of clay soils. This process may, however, take from three to six months to accomplish, depending on the degree of good surface and subsurface drainage. As a guide, one pound of sulfur will neutralize three pounds of calcium carbonate. Therefore, only one-third as much sulfur is needed to reduce alkalinity as carbonate is used to reduce acidity. Where alkaline soils are encountered, the use of bermudagrass as a golfing

turf is desirable because of its ability to withstand alkaline conditions.

Have you often wondered why sandy soils do not respond well to repeated fertilizer applications? Obviously these nutrients are leached down through the soil profile. A supply of soil organic matter plays an important role in preventing this loss. From the sulfur cycle, we should not forget that organic matter has a direct bearing on the availability of sulfur, as well as many other elements. Elemental sulfur is not readily available to turfgrass where soils of low organic matter content are encountered. One method used to increase organic matter and also to supply needed sulfur is to mix a sulfur-bearing fertilizer with top-dressing. The bacteria present in good decomposed top-dressing will immediately begin to oxidize the sulfur. This method is valuable in regions where soils make it difficult to create acidity by the sole use of acid-forming fertilizers. Generally, most organic fertilizers already contain from five to ten pounds of sulfur per ton.

Have you ever drunk well water that had a very strong taste? It probably contained sulfur. In the western United States the content of sulfur in water supplies varies from three pounds to 2,000 pounds per acre foot. It is reassuring to know that most irrigation waters contain enough free sulfur to prevent deficiencies in turf. Unfortunately, water, while being a supplier, is also a robber of sulfur. Irrigation water constantly leaches large amounts of sulfate sulphur through the soil and into subsurface drainage areas. About one-half of the available sulfur is lost through this process, amounting to nearly 43 pounds per acre per year in highly porous soils.

In nature, sulfur must come from either decomposed organic matter, irrigation and rain water, air sources, or in soils as an element. Unfortunately, these sources cannot always be depended upon to provide an adequate supply of sulfur for turfgrass. The golf course superintendent should therefore supplement this need from time to time with fertilizers containing sulfur.

Sulfur Deficiency

Since we cannot speak to members of the plant world in our language, we must learn to know plant language. As O. J. Noer once said, "Let's ask the grass." Indeed, grass plants speak very loudly to us in the form of coloration and growth habits. A good rule of thumb in detecting sulfur deficiencies in turfgrass, is to watch for a general yellowing of young leaves and bud shoots. Sulfur does not readily move from the protein constituents of older leaves into newly developing leaf tissues. In severe deficiency cases however, older leaves may also

become pale green in color. These symptoms are similar to nitrogen deficiency with the main difference being that with nitrogen loss, the older leaves lose color and the entire plant may become chlorotic.

Caution: Avoid Extremes

Because sulfur is a strong acid-forming element, care should be used when applying it to turf. Avoidance of high temperatures (90° F. plus) and overfertilization are important. Closely clipped grasses can be severely injured when sulfur materials (including pesticides) are improperly used. Light and frequent applications of sulfur fertilizers are certainly more beneficial than large quantities applied all at once.

For example, ammonium sulfate can be very caustic if applied to creeping bent at 5 pounds per 1,000 square feet during the summer. When this rate is reduced to approximately two pounds per 1,000 square feet, chances of injury are greatly reduced. Remember always to water in this type of fertilizer immediately following application.

New Information

Research in the Northwest indicates that sulfur is very beneficial for cool season grasses. Applications of sulfur have greatly improved the vigor of bentgrass under these soil conditions. In addition, disease damage was minimized and invasion by *Poa annua* into good turf was reduced. Application of sulfur at the rate of 3.4 pounds per 1,000 square feet per year is recommended by Washington State University.

Work in Florida also indicates that warm season grasses exhibit greater resistance to dollar spot when sulfur is included as part of a regular fertilizer program. Sulfur-containing fungicides like Thiram contribute to the control of brown patch and dollar spot.

Obtaining a Supply

Commercially, sulfur is available in the fertilizer form either as a simple element, or in combination with other elements. The following fertilizer materials are listed as some of the more important sources of inorganic sulfur showing their percentage content:

DRY

Elemental sulfur (33-99S)
Ammonium sulfate (21-0-0-24S)
Ammonium phosphate-sulfate
(16-20-0-14S)
Ammonium sulfate-nitrate (26-0-0-12S)
Potassium sulfate (0-0-52-18S)
Potassium-magnesium sulfate (0-0-26-15S)
Calcium sulfate (gypsum, CA 21-S17)
Copper sulfate (CU 24-S12)
Zinc sulfate (ZN 45-S44)
Magnesium sulfate (MG 10-S14)
Manganese sulfate (MN 25-S14)
Iron sulfate (FE 19-S32-70) (Fe 19-S30 to 70)
Activated Sewerage Sludge

LIQUID

Sulfuric acid (23S)
Calcium polysulfide (lime-sulfur 32S)
Ammonium polysulfide (20-0-0-32S)
Ammonium thiosulfate (18-0-0-43S)

Sulfur is usually present in pesticides as part of the carrier for wettable powders and dusts. The most prominent pesticide group containing sulfur includes the dithiocarbamate fungicides such as Thiram, Ferbam, Ziram, Nabam and Zineb.

IN CONCLUSION: The benefits of sulfur in turfgrass management should be quite obvious. It is probably the one element that is most overlooked in turfgrass nutrition today.

Our society is becoming more conscious of the natural environment and its needs every day. Championship golf turf also demands that the turf grass manager "let the grass speak to him" and observe its changing needs in a dynamic environment. Do not take for granted that you have an ample supply of nutrients available to grow fine golf turf! Check your turf, have a soil test taken. It may tell you things that you hadn't realized before.

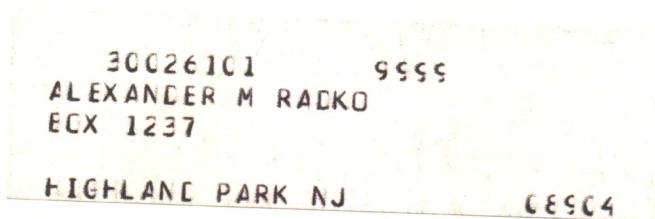
Let sulfur strengthen your hand in turfgrass management. Include it in your fertilization program. It is not as priceless as gold, but it fulfills a priceless need to fine golf turf.

The Triplex Putting Green Mower

In the January, 1970, issue of the Green Section Record, mention was made that a nationwide report on triplex putting green mowers by the Green Section Staff would appear in our May, 1970, issue. This created a great deal of interest. Then last February, two different manufacturers introduced two new triplex mowers at the Golf Course Superintendents Association

International Turfgrass Conference in Houston, Texas. Because three such mowers are now available, the Green Section Staff has decided to recaucus and review the matter once more. A report will be forthcoming this year, but we felt it in the best interest of all to put it off for another issue or two.

MAY 1970



TURF TWISTERS

REMOVE

Question: With the recent loss of DDT, will other related insecticides like chlordane be removed from commercial use? (Washington)

Answer: There is a definite possibility that within the next year or two, chlorinated hydrocarbon-types of insecticides will be severely curtailed for commercial use. These include aldrin, dieldrin, chlordane, heptachlor and endrin. The problem is that these materials persist too long in nature and are not easily broken down. They may eventually contaminate water supplies and endanger wild life.

Other chemicals that may be used in their place include toxaphene and lindane. The organic phosphates like diazinon, ethion and carbamate sevin, are not in danger because they break down sooner. In addition, newer chemicals like the systemics baygon and dasanit may offer a better approach to the problem.

POA ANNUA

Question: Our club is on a gradual program of conversion from *Poa annua* to bentgrass using light rates of calcium arsenate to suppress the *Poa*. Can an application of another herbicide in the spring to control weeds, further weaken the *Poa* so it will go out faster than anticipated? (Connecticut)

Answer: All herbicides adversely affect the metabolism of the turf plant to some extent, although how much is not known. If the *Poa* is sufficiently weakened by the arsenate, an application of another herbicide may disrupt the plant enough to cause quicker death in periods of moisture or temperature stress. We have seen this on occasions, especially in low, wet areas. If there is any doubt it would be best to postpone weed control until fall or prior to renovation and overseeding.

MISTAKES

Question: Is there anything that can be done after a misapplication of pesticides has been made? (Pennsylvania)

Answer: Very little if anything can be done to reduce the initial injury to turfgrasses from a misapplication of a pesticide. On the other hand, the long-term effects of misapplied chemicals can be reduced by an application of 150 to 200 pounds of activated charcoal per acre. An application of charcoal will permit the establishment of turf from seed where it may normally be prevented by phytotoxic levels of pesticide in the soil.