There's no magic that creates this model football-soccer field. Bryan aerates, plants grass seed, and fertilizes with a starter fertilizer every spring. When the ground becomes dry, he uses a traveling sprinkler with a 1½-inch hose that extends across the field. In three passes it covers the field. "It's important to water," he says, "probably the most important thing."

Bryan's crew cuts the field every fourth or fifth day. If it grows very rapidly and they can't keep up with the mowing, his workers sweep up the clippings.

When dandelions start growing, the crew applies a 30-5-3 fertilizer and dicot weed control which kills the roots immediately. In July and August they spread a 31-3-10 high-density fairway fertilizer. A little overseeding is done in September, but it is not necessary to do anything else in the fall, according to Bryan.

Bryan and Sweitzer are now preparing a new field, which they have been building for two years and will make ready for play next fall. They have followed many of the construction procedures outlined previously: laid a rock bed underneath the soil for drainage through the clay soil; leveled, rowed and packed the land both years to get a firm, contoured slope; had the university do a soil test; and with those results, prepared the proper amounts of lime and conditioners.

They expect the new field to be as attractive and functional as Memorial Field. Yet now Memorial is the showpiece and their close maintenance has made it that way. "The biggest thing is steady watching," says Bryan. "You've got to get on the problems right away. It makes the job a lot easier."

Although Bryan's remarks may seem to simplify a rather precise operation, his and his boss's years of experience enter into the day-to-day work that is not verbally expressed. Research and results from Penn State University and O.M. Scott can add the fine points to the maintenance of an athletic field.

Mowing

Grass should be cut often and at a height adjusted to the predominating grass in the mixture. Kentucky bluegrass, fescue, and ryegrass or a mixture of these should be cut regularly at a height of 1½ to 2 inches. Prior to play, the height can be reduced to 1¼ inches. It should be taken down gradually and never more than one quarter inch at a time. Frequency of mowing is governed by the growth rate of the grass.

Cutting should be done whenever grass makes a growth of ¾ to 1 inch above the cutting height. If this practice is followed, it is not necessary or desirable to change the mowing height at any time. Bermudagrass should be kept ½ to ¾ of an inch by frequent mowing during the playing season and 1 inch during periods of limited use. When cut higher it becomes spongy and loose and does not provide a good footing or a dense turf. Zoysia should be cut at ¾ of an inch.

Watering

When dealing with mature turf, it is only necessary to irrigate when the grass shows signs of water stress, such as discoloration or wilting. When these signs appear, it becomes necessary to water the field to a depth of 4 to 6 inches, which is about 1½ inches applied in two or three applications a week. The sprinklers should be adjusted to apply water only as fast as the soil can absorb it. Since the type of soil dictates the amounts of water it can absorb, caution should be

Exceptional systems give extended life for turf

For the athletic field manager with the funds and support to construct a new field, a few modern options exist beyond the basic principles of construction and maintenance. These fields cost more but they also last much longer than superficial renovations. In the long run, the best system could also be the least expensive.

Dr. William Daniel, turf specialist at Purdue University, and Melvin Robey, who at the time was superintendent of athletic facilities at Purdue, coinvented the Prescription Athletic Turf or PAT system first installed in 1972. It is a replacement system which improves the playability of the field and extends its usage by countering the wet, dry, cold, and hot extremes of climate.

Briefly, it works like this: first, whenever it rains during a game, the suction pumps (below the surface), which are attached to the terminals of drain tubes, are turned on and they pull the moisture through the compacted sand, topmix, and turf; second, the flat subgrade is covered by a strong continuous plastic film which forms a waterproof barrier that conserves the overflow rainfall; and third, automatic subirrigation is achieved by back-watering through the drain tubes. Moisture sensors in the rootzone sand signal the need for rewatering whenever necessary. (For more information, write **901** on reader service card.)

Robey has since developed his own system and company for athletic fields, Sportsturf Systems, Inc. Basically, there are two types of fields which Robey's crew build and have built in various parts of the world: the Sportsturf All-Weather Field, which contains a 100 percent sand rootzone of 18 inches, and the Sportsturf Touchdown Field, with a 12- to 14-inch sand rootzone. Both types involve a plastic liner, which aids in the conservation of water and plant nutrients and also prevents contamination of the all-sand rootzone from external water in the surrounding subsoil; and a network of drain lines and sub-surface irrigation which controls the amount of moisture in the sand.

Robey points out that although the sand is the vital ingredient, his system involves a soil analysis to determine the right type of sand, amendments, and drainage. He also has a system called Sportsturf Mod Field, a modified version of the other two. (For more information, write **902** on reader service card.)

Another system of benefit to athletic fields is Enkamat, a turf reinforcement installed in the Rose Bowl, Orange Bowl, and other prestigious playing fields. This three-dimensional webbing made of nylon monofilament fused at the intersection is sold by Tom Mascaro of Turfibre Products in Miami.

Enkamat comes in 87-pound rolls that are 38 inches wide and 328 feet long. It rolls like a rug over an already-prepared soil mix and drain tile system. Once it has been laid, you can either sow seed or stolinize into it. Enkamat helps scarred turfgrass heal itself while protecting against compaction and wear, promoting a strong root system that will give resilient footing and may help reduce players' injuries. It also holds turf together, minimizing the damage from tearing and divots as athletes make their cuts and pivots. (For more information, write **903** on reader service card.)

Athletic Field

taken not to over-water. When run-off occurs, the water should be shut off. The soil should be checked with a soil probe to determine the depth of the water penetration.

Traveling types of sprinklers can provide more uniform water distribution than stationary kinds, unless the latter are checked often. Periodic aeration will speed up water penetration and usually results in more efficient water use.

Aeration

Constant trampling often produces a compact, impermeable surface layer of soil. Mowing, rolling, and use of other heavy equipment when soils are wet can aggravate this condition. When compaction develops, grass roots are injured because they can't receive sufficient moisture or air.

Various types of aerating tools have been devised to break through the compacted soil layer mechanically and remove a soil core. Size of openings made by these machines varies with the diameter of the hollow tines or spoons used. For athletic field use, such openings should be about ¾ to 1 inch diameter. Aerating equipment should be used over solid tine spikers, which do not remove a soil core.

Penn State recommends aerating heavily in the spring (six to eight times over the area) and lightly in late summer or early fall (one to three times). Scotts recommends heavy aerification during the fall. It should always be done before fertilization and overseeding. Aeration in the spring or late summer should be followed by dragging with a chain or chain link fence to break up the soil cores. Fields should not be dragged after aerification later in the season because freezing and thawing of moisture will help relieve compaction and improve soil structure with open holes.

Fertilization

The maintenance fertilizer program should be based on complete soil test results. Most athletic areas will require two complete fertilizer applications per year although some fields may require only one complete fertilizer application supplemented with one or more nitrogen application. Occasionally, fields having very high phosphate and potash levels will require only nitrogen applications.

The ideal fertilizer program provides uniform growth over the entire growing season. The type of nitrogen-carrying materials—quickly available or slowly available — in a fertilizer determine how such a program can be obtained.

In general, cool season grasses require a rate of 4 to 6 pounds of nitrogen, 1 pound of phosphorus, and 1 pound of potassium per thousand square feet each season. Southern grasses require 5 to 10 pounds of nitrogen with approximately the same amount of phosphorus and potassium per thousand square feet each season. These amounts should be evenly distributed in four to five separate applications. This will supply the necessary nutrients throughout the growing season.

Overseeding

An overseeding program to regenerate worn turf should be an integral part of any athletic field maintenance program. The same quality seed should be used in overseeding as used in original establishment. An

Continues on page 24

HONEYLOCUST GROWS RAPIDLY, PROVIDES OPEN SHADE FOR TURF

By Douglas Chapman, Horticulturist, Dow Gardens, Midland, MI

Thornless Honeylocust *(Gleditsia triacanthos* var. *inermis)* is a native tree that thrives in most urban conditions. Some have suggested it is over-used or a "weed tree," but if plantsmen and/or landscape architects keep in mind that no one species should comprise more than 5 percent of the trees in a landscape, then honeylocust is outstanding. It is native throughout much of the U.S. and exists as two specific types — one northern and another southern. This is of particular interest as the southern phenotypes will not harden off in the Northeast or Northern Midwest areas.

Gleditsia triacanthos var. *inermis* ranges in height from 30 to 70 feet with a spread of up to 80 feet in the landscape and 100 feet in the wild. The general habit is a broad oval. This tree has a fine texture and provides open shade under the canopy. This unique characteristic allows grass to thrive under it up to the trunk. The leaves are dark green throughout the summer and often develop an outstanding yellow fall color. The 7 to 8-inch reddish-brown seed pods develop with maturity. Some feel this is a problem, but I believe it is an aesthetic advantage. *Gleditsia t.i.* seed has been used as a cattle feed. Professor Joe McDaniels at the University of Illinois did some work in the '30's and '40's, developing outstanding high sugar varieties. In fact, one "tastes great." I am sure that interest again will develop in this plant as a source of cattle food.

Honeylocust is native to wet bottom lands or flood plains but is tolerant of droughty sites as well. It will grow in a wide range of soil pH, full sun and partial shade conditions, and is tolerant of chlorides (highway salts). In fact, it is so tolerant it has been grown quite successfully on Nantucket Island in Massachusetts. It is tolerant of many air pollutants but has a slight susceptibility to sulfur dioxide. Honeylocust transplants readily, which is of great interest to landscapers.

The insect problems of significance include Honeylocust Pod Gall, Mimosa Webworm, spider mites, Tarnished Plant Bugs, and borers. Mimosa Webworm is the most devastating in Illinois and southern Ohio while Tarnished Plant Bug and Honeylocust Pod Gall are major concerns in Michigan and the Northeast. Diseases include powdery mildew, rust, Witches Broom, and cankers. Heartwood rot has been reported a problem on honeylocust, but, in fact, it is more significant with *Robinia.* One significant advantage of Thornless Honeylocust is that many cultivars have been developed or tailored for almost any landscape situation.

'Moraine' Honeylocust (*Gleditsia t.i.* 'Moraine') is the standard that most honeylocust varieties should be measured against. Its habit of growth is broad oval, almost graceful, 45 to 50 feet in height at maturity. This plant was introduced in 1949 by the Siebenthaler Nursery Company of Dayton, Ohio. It has been grown for many years and should be continued. It is resistant to Mimosa Webworm attack. 'Moraine' Honeylocust is an aggresive grower and one of the tallest cultivars introduced. It needs staking in the nursery until it reaches 1 to 1½ inches in trunk diameter. 'Moraine' Honeylocust is an outstanding street or large area landscape specimen tree.

'Imperial' Honeylocust *(Gleditsia t.i.* 'Imperial') has an ultimate height of 35 feet with an upright oval habit at maturity. It has a good central leader considering the honeylocust's habit of growth, especially its good branch structure of 70 to 80° angles. It grows compactly and does exceptionally under power lines, in out lawns, and in small area landscapes.

'Majestic' Honeylocust *(Gleditsia t.i.* 'Majestic') reaches a mature height of 45 to 55 feet. Its summer foliage is a rich, dark green. 'Majestic' maintains a central leader and needs little or no staking in the nursery. In some areas the fruit can be undesirable, but it can be an asset in the landscape.

Moraine is the standard that most honeylocust varieties are measured against (left).
Sunburst's unique foliage contrasts the dark green of older leaves with the yellow of new foliage (above).

HoneyLocust *from page 23*

'Skyline' Honeylocust (*Gleditsia t.i.* 'Sunburst') has a somewhat ascending to upright oval crown, reaching 45 to 50 feet in height. Staking is not required in the nursery. It does develop a good straight central leader. The leaves are a rich, dark green during the summer and develop an attractive yellow each fall. It is a good specimen for large areas or home landscape sites. It certainly ranks with 'Moraine' Honeylocust as one of the outstanding cultivars.

'Sunburst' Honeylocust (*Gleditsia t.i.* 'Sunburst') has an upright habit, reaching 40 feet at maturity. 'Sunburst's' foliage is unique. It has rich, dark green leaves on year-old wood, contrasted with outstanding yellow foliage on the current season's growth. To develop this color, one must encourage vigor. This means annual pruning after 10 to 15 years in the landscape to stimulate new growth. This annual pruning should be vigorous, almost attacking the tree with a "machete." 'Sunburst' does seem to attract more than its share of insect problems, specifically Honeylocust Pod Gall and mites, but if used sparingly in the landscape, it can be a unique addition.

Honeylocust is an outstanding urban tree. It has been overused, leading to increased reports of insect and disease problems. If not overused (diversity — no more than 5 percent of the same tree specimen in the community), insect and disease problems will not be significant. If overused, borers and many other problems will crop up. This did happen with 'Moraine' Honeylocust in the '60's, but with a shift of emphasis and more knowledgeable urban foresters, landscape architects, and horticulturists, this plant is again becoming a desirable tree for city streets, large area landscapes, parks, and home landscapes. Its ability to compete with turf, providing open shade and the fine texture make it outstanding. Its rapid rate of growth is certainly another desirable characteristic. In fact, it is not uncommon to see this vigorous tree grow 2 to 3 feet annually the first 10 years planted in the landscape. There have been some pest problems, but if our rule of diversity in any landscape is maintained, this tree has a place in difficult sites for most urban landscapes. **WTT**

Athletic Field *from page 22*

acceptable program for overseeding permanent grasses might follow these steps:

1. Aerify heavily in late fall (four to six times) leaving holes open
2. Break up and drag in plugs next spring
3. Mow area close (¾ to 1 inch) and remove all debris
4. Scarify
5. Apply starter fertilizer at recommended rate
6. Seed at recommended rate
7. Apply light topdressing if possible
8. Drag lightly
9. Keep newly seeded area moist

These are general considerations. The methods should be adjusted to suit the level of maintenance desired, equipment available, and the present condition of the field. Program modifications for southern turf should include increases in fertilizer rates from 4 to 8 to 10 pounds of nitrogen per thousand square feet each growing season. Timing of the aerification and overseeding operations should be adjusted to the longer growing season. **WTT**

WEEDS TREES & TURF

TURF MANAGEMENT SERIES
PART 6

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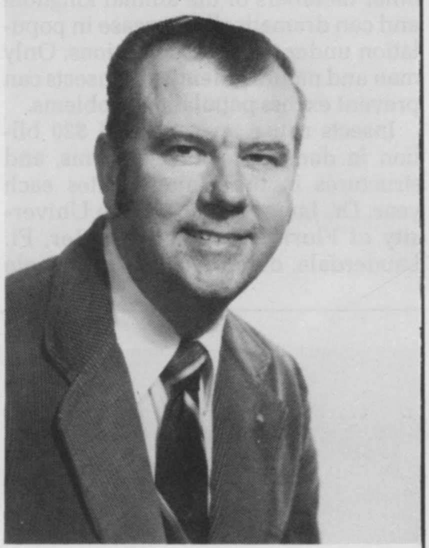
Turfgrass Entomology

The final part of the Turf Management Series would not have been possible without the generous assistance of Dr. Harry Niemczyk, Department of Entomology, Ohio Agricultural Research and Development Center, Wooster. The week after Dr. Niemczyk had co-directed a symposium on Turfgrass Entomology, he energetically helped collect the information needed for this section. The following week he flew off to a very important ichthyology mission in his favorite Michigan (in other words he went fishing).

Dr. Niemczyk, and the approximately 50 other contributors to this series, deserve recognition. They cared enough to take the time to help compile a varied stack of information which had never been organized before. They helped recognize the people who trained them. In doing so, they built a historical record of the turf industry.

If your promising employee asks about the turf industry, give him the last six issues of Weeds Trees & Turf to read. I'll bet he becomes even more promising.

Once again, if you'd like to add to the information and history presented in this series, please write me within the next month. All six parts will be combined into book form by the spring of 1981. The book should be as thorough as possible and you may be able to help. Contributors will be recognized in the book.



Dr. Harry Niemczyk

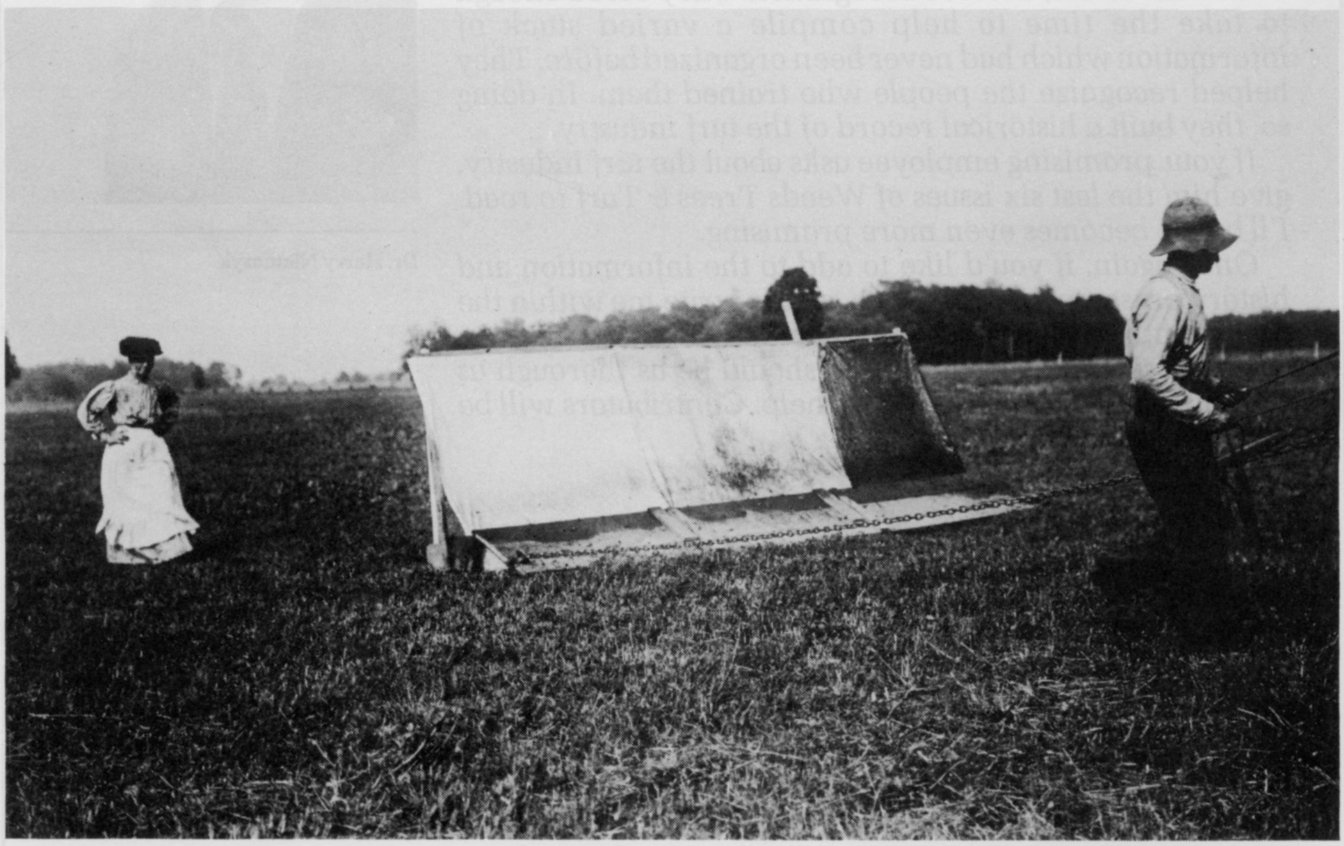
PAST, PRESENT & FUTURE

Insects have been responsible for plagues, agricultural disasters, destruction of stored food and clothing, and a great deal of discomfort to man and his beasts. Insects and their arachnid relatives (spiders, mites) outnumber all other members of the animal kingdom and can dramatically increase in population under the right conditions. Only man and natural enemies of insects can prevent excess population problems.

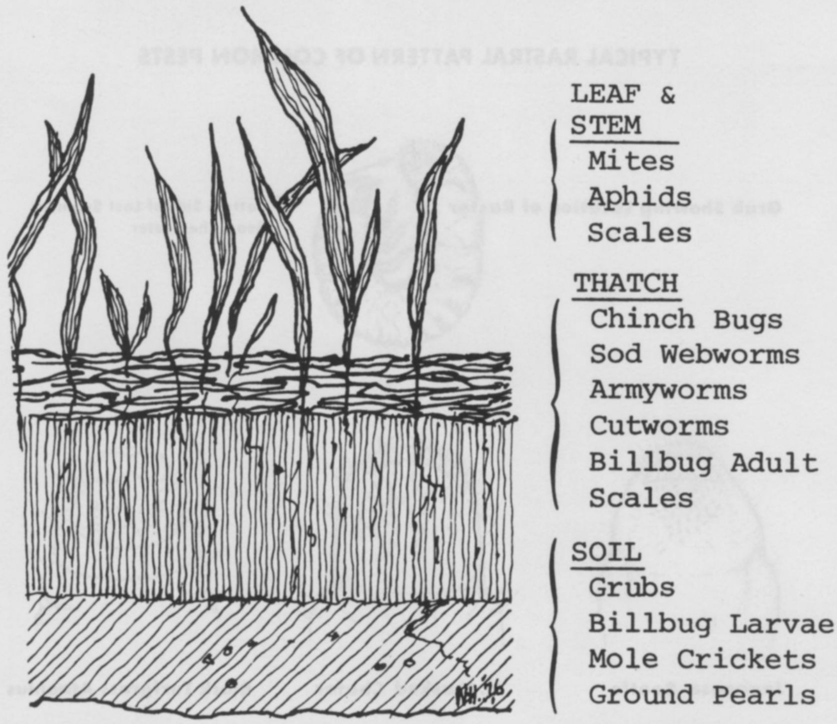
Insects cause an estimated $20 billion in damage to forests, farms, and structures in the United States each year. Dr. James Reinert of the University of Florida Research Center, Ft. Lauderdale, determined that the mole cricket caused more than $100 million in damage to turf and pasture from 1976 to 1978 in the state of Florida alone. Professional turf managers spend more than $30 million per year for turf insecticides (WTT Survey 1980). Homeowners purchase large amounts of turf insecticides as well.

The need for control of damaging insect populations is evident. However, methods to achieve control are undergoing scrutiny due to heightened environmental awareness and resistance to some insecticides by target pests. Research on pesticide use, diminished by an overreliance on pesticides now cancelled or greatly restricted, needs to be restored. Only nine entomologists at U.S. universities and extension centers devote a majority of their time to turfgrass pests. The chemical companies are faced with extremely high product development costs. If many agricultural products could not be applied to turfgrass uses, a serious problem would exist. Even then, it takes specialized research to get agricultural labels expanded to turfgrass uses.

Shorter residual chemicals require more precise application and timing. Control efforts need to be directed specifically at times when the pest is most vulnerable. "Now, more than ever before, the applicator must have



Mechanical grasshopper catcher used in the late nineteenth century. Reliance upon chemicals for insect control started growing in the 1920's and 30's.



Location of the pest at the time of control is absolutely necessary information.

knowledge of the target pest's life cycle," stresses Dr. Harry Niemczyk, professor of turfgrass entomology, Ohio Agricultural Research and Development Center, Wooster, Ohio. Additional training will be needed to apply turf pesticides in the future, Niemczyk suggests. "Virtually every segment of the turfgrass industry is in serious need of a basic foundation in the principles of dealing with today's insect problems."

The original insecticides included materials such as soap suds, turpentine, petroleum and fish oils, lime, sulfur, vinegar, pepper, tobacco, and wood ashes. Paris green, a copper/arsenic compound, was developed in 1867 and proved effective against chewing insects. Later in the century, arsenates of lead and calcium were developed and put to use. Plant derivatives such as pyrethrum, from the flowers of the genus *Chrysanthemum*; rotenone, from the roots of leguminous plants; and nicotine, from tobacco, have been used for centuries.

Early turf managers borrowed control measures from garden and agricultural sources. One source of pest control information for turf managers prior to World War I was a book still published, *Insect Pests of Farm, Garden and Orchard*. First written by E. Dwight Sanderson in 1912 and published by John Wiley and Sons, the book has since been revised by Leonard M. Peairs, R. H. Davidson, and W. F. Lyon. A Seventh Edition is now available, having been revised in 1979. Perhaps the longest continuously published book on the subject, it provides a good profile of economic entomology in the U.S. as it developed.

A great deal of the early literature on entomology was written in the mid- and late-30's. In a speech before the National Association of Greenskeepers of America in Cleveland in 1936, J. S. Houser, chief, Ohio Agricultural Experiment Station, Wooster, gave a thorough account of the description and control of sod webworms and chinch bugs. He reported on the severe outbreak of sod webworm in the summer of 1931 when, "the moths were so abundant on the windows of lighted rooms in the vicinity of grasslands that one could not place one's fingertip on the glass without disturbing one or more of the insects." Houser added, "It is of the utmost importance that an outbreak of sod webworm be detected in the early stages, because if checked in time, serious harm, particularly to greens, may be averted. At the outset, the taller grass of aprons and of other areas is more subject to damage, and if the insect is not controlled it may spread to the greens. Moreover, the smaller, partly-grown larvae are more susceptible to the effect of treatment than are the larger, more nearly mature individuals."

For control Houser recommended lead arsenate dust brushed into the turf with stiff fiber brooms. One good indication of sod webworm is an abundance of grackles and starlings on greens, Houser added.

Lead arsenate dust, however, would not control the "hairy chinch bug" said Houser. The insect feeds on the sap of the grass plant giving it a desiccated appearance. It is most active on hot, sunny days. Houser reported nicotine-lime dust and commercial tobacco dust most effective when applied and the turf covered with canvas for five hours. Alternative controls were liquid sprays of nicotine sulfate and pine tar soap, a type of alcohol, or other penetrant. Certainly, covering a green for five hours was a severe interruption to play.

K. E. Maxwell, an entomologist at Cornell University, Ithaca, NY, reported in 1934 that nicotine sulfate (Black leaf 40) alone or combined with rosin fish oil soap or potassium cleate soap was effective against chinch bugs.

An extension release bulletin by R. H. Pettit of Michigan State College in 1932 gave these control recommendations:

Webworms—carbon disulfide emulsion, pyrethrum extract spray, or arsenate of lead.

June beetle grubs—arsenate of lead.

Wireworms—carbon disulphide or liming.

Ants—Paris green mixed with brown sugar.

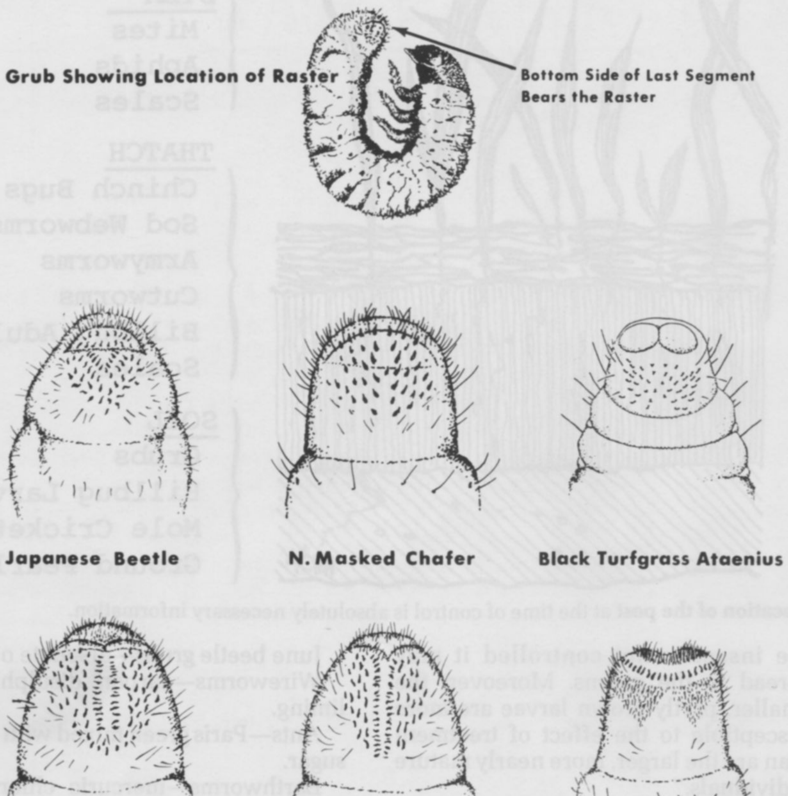
Earthworms—mercuric chloride or corrosive sublimate.

In general, arsenicals were used for chewing insects and nicotine was used for sucking insects. Carbon disulphide emulsion and pyrethrum were used as contact poisons.

Insect control became oversimplified after World War II with the development of the long residual DDT and the chlorinated cyclodiene insecticides (aldrin, dieldrin, heptachlor, chlordane, bandane). These materials lasted for years in the soil, providing almost timeless control. Chlordane received extra use as a herbicide for crabgrass. Today, years after applications, chlordane residues can be found in the soil of many fine turf areas. Insect resistance to these products has counteracted their residual life.

The simplicity was not to last. Environmental pressure was bought upon chemical companies and the United States Department of Agriculture primarily because the technology to find minute traces of chemicals in soil and water was discovered, the gas chromatograph. In the late 60's the pressure grew, and in 1972 a law stronger than the 1947 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was passed. This new act, the Federal Environmental Pesticide Control Act, created the Environmental Protection

TYPICAL RASTRAL PATTERN OF COMMON PESTS



Hair patterns on the last segment of a grub indicate the type of insect. Control measures may vary with the type of insect and there is no single control for all grubs.

Agency and took control of pesticide regulation away from USDA and the Department of the Interior. Revisions to the law in 1975 and 1978 have changed greatly the use of pesticides in the U.S.

One of these changes was the cancellation of all uses of DDT and many uses of the chlorinated cyclodiene insecticides. Substitutes had to be found. The chemical industry and the few turfgrass entomologists combined efforts to gain new use for a group of pesticides called organophosphates (diazinon, chlorpyrifos, and trichlorfon). Due to their lower mammalian toxicity, carbamates (carbaryl, propoxur, aldicarb, etc.) received favorable treatment by EPA.

These products remain the basis for turf insect control. Development of new products has not stopped completely. Research outside of the U.S. has produced a few promising candidates for this country. But the dominant source of new materials is the agricultural insecticides market. New uses for existing compounds may provide some relief in the future.

To understand insect control, one must have a basic knowledge of the vulnerability of the target pest. Control methods vary with the type of insect, rendering some controls useless against some insects.

In a sense, insects are made up of many container-like segments attached together. Support comes from the container walls and not from an internal skeleton like vertebrates. Openings in the walls, or the exoskeleton, permit toxic materials to enter and disrupt life processes. Some of these openings include the mouthparts and breathing holes called the spiracles. Some insecticides have the ability to penetrate the exoskeleton, but for the most part, toxins must enter the insect's body through ingestion.

The type of mouthparts largely determines the control method. Chewing mouthparts indicate the insect consumes the exposed leaf tissue of a plant. Pesticide placed on the plant surface will be ingested. Piercing-sucking mouthparts are used to feed on fluids inside the plant surface. Therefore, pesticides located on the plant surface will have little effect on the insect. Rasping-sucking mouthparts are similar to piercing-sucking except for the method of entry to the plant fluids. Siphoning mouthparts are used to draw in surface liquids as are sponging type. To control sucking insects the pesticide must be in the plant juices. These materials are termed systemics, since they must enter the plant through the leaves or roots and work their way into plant fluids.

The circulation system of an insect does not use arteries and veins. A heart-like structure forces the blood to circulate within the exoskeleton. Running through the body are tubes which are attached to the spiracles or breathing holes. Gases flow through these tubes into the body of the insect for direct absorption by the blood. Fumigants can enter the body through the respiratory system and thus into the blood.

Another factor of vulnerability is the life phase of the insect. The growth process of insects is termed metamorphosis. There are four stages: egg, larva, pupa, and adult. In some insects the larva and pupa stage are replaced with a nymph stage. Grubs are the larval stage. If an adult can be stopped from laying eggs, then a grub problem can be avoided. Often, however, the larva stage is more susceptible to pesticides than the adult. It is important to know when the insect is in each phase.

Location of the insect is the third vulnerability factor. Chewing insects located on exposed leaf surfaces are the easiest to control. However, some insects burrow deeply into the crown of the turfgrass plant or into the soil, greatly reducing their exposure to pesticides.

Reaching the insect in the soil necessitates getting the pesticide to the pest by thorough drenching. Often the active ingredients will get tied up to the thatch or to soil particles before reaching the target. Organophosphates are generally less effective as soil insecticides than the now-restricted chlorinated cyclodiene insecticides. They can be applied either in solutions or as