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These compounds were used successfully for many years. In fact, they were so successful that research on turf insects declined at universities and agricultural experiment stations. The importance of insects in turfgrass management courses also declined in turf schools.

Another significant event occurred in the early 1960's when an instrument known as the gas chromatograph (GLC) was developed. The GLC provided the capability of measuring pesticide residues in parts per million. This sophisticated instrument was to have a major impact on the use of all pesticides. With the GLC we soon learned that DDT and the chlorinated cyclodienes left unacceptable residues in the environment, including the food chain. Paradoxically, the major advantageous characteristic of these compounds, long residual activity, ultimately led to their demise.

The residual characteristics of these insecticides led to other problems. Among the more serious was the development of insect strains resistant to them.

With the removal of aldrin, dieldrin, and heptachlor from use in the early 1970's and, more recently, chlordane, the few remaining turf research entomologists recognized the need to conduct research designed to provide substitutes for

these insecticides. Their efforts, together with those of the chemical industry, led to the labelling of the organophosphates, diazinon, chlorpyrifos (dursban®), and trichlorfon (Dylox®-Proxol®) for grubs and other insect pests. While these insecticides generally provide good control of chinchbug, sod webworm and other pests that inhabit the turf surface and thatch, they frequently provide only fair control of grubs that inhabit the soil. We now know that among the factors limiting their effectiveness against soil pests is the fact that the insecticide can be bound to the thatch before it reaches the target pest. Another major factor is that consumers are unaccustomed to using short residual insecticides, and therefore do not properly follow required irrigation and other procedures to immediately move the insecticide to the target.

Loss of the chlorinated cyclodiene insecticides means shifting from the "spread it and forget it" philosophy long associated with these compounds, to one of "reach the target pest NOW" necessary with organophosphates. This causes many problems. For the consumer it places new emphasis on the need for safety. It also means more attention must be given to rates and uniform distribution of the product. Proper distribution of liquid insecticides requires higher volumes of water than are

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used for fungicides or herbicides, and few golf courses have equipment to apply granular insecticides properly. Applications must also be accurately timed because the long residual activity is not there to 'eventually' control the pest.

Now, more than ever before, the consumer must have knowledge of the target pest's life cycle. Many still do not understand why this is necessary when the objective is to kill the pest, not study it. The answer, of course, is that the life history points out when the insect is most vulnerable to control and therefore sets the time of application. Without that knowledge treatment timing is a guess.

The change in philosophy and need for new knowledge requires additional training. Unfortunately, extension entomology in most states is overburdened and does not have adequate personnel to provide the specific training turf managers and other consumers need. Frequently, the turf specialist, who is likely an agronomist or a horticulturist, finds himself called upon for such input. Since most of these specialists have had little or no formal training in entomology or insecticides and their use, the information communicated to the consumer can be inadequate and sometimes inaccurate. The need for extension entomologists and others with professional knowledge of turf insects and the principles of their control must be made known before the consumer's needs for information can be met properly.

The shift from long residual to short residual insecticides for control of insect pests of turf has clearly identified that more research is needed in turfgrass entomology. While most states have an agronomist or horticulturist doing research on the agronomic aspects of turf, there are about five turf research entomologists in the U.S. Little or no research has been done on control of recently "discovered" pests like the greenbug aphid and winter grain mite. With so few researchers it will be some time before information needed to form the basis for labelling controls for these pests can be developed. We must know more about such important matters as: (1) the duration of the residual effectiveness of insecticides currently in use; (2) the susceptibility or resistance of present turfgrass varieties and strains to insect injury; (3) the physical, chemical, and biological factors relating to the movement of insecticides through thatch; and (4) cross resistance characteristics of the southern chinchbug resistance to certain organophosphate insecticides . . . just to name a few.

In summary, the future requires more emphasis on research and extension in turfgrass entomology. Research must show how we can best use the insecticides and management practices we now have to accomplish control of turf pests. New compounds for turf insect control are simply not currently being developed, and prospects for the future look equally dim.

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 state extension services and the industry must rise to meet this challenge by seeking people with professional expertise to communicate the needed information. If such people are not available, then let the need be known so we can begin training them **now**.

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The unit also incorporates a 3000-watt A.C. power source generated from the truck's engine that will allow operation of a variety of electrical tools from the 110-volt power source.

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TERSAN 1991, a product of E.I. Du Pont de Nemours, is now available in a water-soluble package. The convenient package goes into solution in minutes without any direct user-exposure to the fungicide from measuring and handling. Three ½ lb. soluble packets are packed into each 1.5 lb. bag. Quantities of the soluble packet will be limited this season, according to Du Pont. They recommend Tersan 1991 for the control of turf diseases, including dollar spot, large brown patch, Fusarium blight and stripe smut.

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MINIBRUTE is claimed to be the first

12-volt battery-powered chain saw by Tensen Company. Operation is simple, according to Tensen. The battery clips of the saw's power cable are attached to any 12-volt automotive battery and the saw is ready to go. Minibrute has an all-metal seven pound powerhead with a 20-ft. power cable and 14-in. sprocket nose bar. The power output is 985 watts. The saw only uses power when it is cutting. Tensen claims most automotive batteries have power enough to cut a pick up load of wood.

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THE TRACKER, a detection system designed for locating water pipes, conduit, sewer pipes, and PVC water pipes that have water in them, has been introduced by Progressive Electronics. The system consists of a transmitter with clip-type connectors and a 33-in. tracking unit weighing less than three pounds. Each unit operates on a nine-volt battery.

Features, according to Progressive Electronics, include: aluminum construction with protected, water resistant receiver; easy-to-read meter for accurate tracking; optional headphones for hearing the tone; fingertip control for maximum sensitivity; normal operation on dead or active lines up to 480 volts; no earth grounds required and one hand operation.

The Tracker can also be used to trace opens and shorts to ground in buried, covered or sheathed wires or cables as well as cable path.

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VEGETATION MANAGEMENT

By Roger Funk, Ph.D., Davey Tree Expert Co., Kent, Ohio

Q: What grass species have trouble growing in heavily shaded areas?

A: None of the common turfgrasses are adapted to heavily shaded areas although some will tolerate more shade than others. In the northern states, the most common turfgrass with poor shade tolerance is Kentucky bluegrass (*Poa pratensis* L.), although a few improved cultivars will tolerate up to 65% shade. In the South, Bermudagrass (*Cynodon* L. C. Rich) displays the least shade tolerance. Conversely, the most common turfgrass species with good shade tolerance in the North is red fescue (*Festuca rubra* L.), and, in the South, is St. Augustine [*Stenotaphrum secundatum* (Walt.) Kuntze].

Q: Is there any product other than Endothall for control of veronica?

A: If you are concerned with the control of veronica in an established lawn, both Silvex and Trimec (2,4-D + MCPP + Dicamba) will give good control when the weeds are actively growing. Check the labels to see if either of these herbicides is recommended for your particular turfgrass.

Q: I seem to have some difficulty obtaining good control with my webworm spray. By good, I mean lasting control. I have used Diazinon and Sevin, but in some cases, when I check a couple or three weeks later, new webs have appeared. Is there any other material that offers longer residual?

A: There is no insecticide labeled for webworm control that gives longer residual than Sevin or Diazinon. However, you should not be observing new webs within three weeks of an application of either chemical. Perhaps you are applying too early, before all of the eggs have hatched. Also, be sure you have sufficient pressure to penetrate the webs with your spray.

Q: When is the latest date to apply a crabgrass control?

A: Crabgrass control is best achieved by pre-emergent herbicides that must be applied before the seeds germinate. The latest date is dictated by your climatic region and local weather conditions. Crabgrass seeds germinate when the temperature of the top one inch of soil stabilizes above 55° F. (about two weeks after soil first reaches 55° F.), which may vary as much as six weeks from one year to the next.

The spring flowering shrub, forsythia, is a fairly good indication of conditions for crabgrass germination. Your pregermination herbicide should be applied by the time forsythia bloom drop occurs.

One application should be sufficient unless you are in an area that also is plagued with silver crabgrass (goosegrass).

Q: How much value to lawns and shrubbery are the expensive foliar nutrients? Is the cost worth any advantage?

A: I would not pay a premium price for foliar fertilizers unless the plant was not responding to soil-applied fertilizers. Any soluble fertilizer can be used for foliar fertilization and the runoff can be absorbed by the root system. The real benefit of foliar fertilization is in providing nutrients to the plant when the roots have been injured or when soil conditions — primarily improper pH — prevents the availability and absorption of soil nutrients. This is particularly a problem with micro-nutrients such as iron, manganese and zinc in alkaline soils.

Q: Please recommend trees that can be grown in extremely wet soils.

A: Following is a list of trees which thrive in very wet soil:

Deciduous

<i>Acer dasycarpum</i>	Silver Maple
<i>negundo</i>	Box Elder
<i>rubrum</i>	Red Maple
<i>Alnus glutinosa</i>	European Alder
<i>Betula lutea</i>	Yellow Birch
<i>nigra</i>	River Birch
<i>populifolia</i>	Gray Birch
<i>Carpinus caroliniana</i>	American Hornbeam
<i>Carya ovata</i>	Shagbark Hickory
<i>Fraxinus caroliniana</i>	Water Ash
<i>lanceolata</i>	Green Ash
<i>Gleditsia aquatica</i>	Waterlocust
<i>Larix americana</i>	American Larch
<i>Liquidambar styraciflua</i>	Sweetgum
<i>Magnolia glauca</i>	Sweet Bay Magnolia
<i>Nyssa sylvatica</i>	Sourgum, Tupelo
<i>Platanus occidentalis</i>	Buttonwood
<i>Populus balsamifera</i>	Carolina Cottonwood
<i>grandidentata</i>	Largetooth Aspen
<i>Quercus bicolor</i>	Swamp White Oak
<i>palustris</i>	Pin Oak
<i>phellos</i>	Willow Oak
<i>Salix alba</i>	White Willow
<i>babylonica</i>	Weeping Willow
<i>fragilis</i>	Brittle Willow
<i>nigra</i>	Black Willow
<i>pentandra</i>	Laurel Willow
<i>vitellina</i>	Golden Willow
<i>Taxodium distichum</i>	Bald Cypress
<i>Tilia americana</i> [glabra]	American Linden

Evergreen

<i>Abies balsamea</i>	Balsam Fir
<i>Chamaecyparis thyoides</i>	White Cedar
<i>Picea mariana</i>	Black Spruce
<i>rubra</i>	Red Spruce
<i>Thuja occidentalis</i>	American Arborvitae
<i>Tsuga canadensis</i>	Hemlock

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PROSCAPE

By Michael Hurdzan, Ph.D., golf course architect and consultant

Q. *We plan to rebuild some tees — what should we consider? H.M., Bedford, In.*

A. You should consider: (1) the number of rounds of golf played each year, (2) where the building material will come from, (3) who will do the rebuilding, (4) the possibility of incurred liability if you change the tee angle or position, (5) the time of year, and (6) the turfgrass that will provide the tee surface. This list is by no means comprehensive, but it should answer most of your questions.

First, the number of rounds of golf you anticipate will be played each year will help determine the size of your new tees. (In the northern latitudes about 40,000 rounds a year is a very busy golf course whereas in more moderate climates it is not unusual to play two to three times that amount.) The rule of thumb is to allow 150 sq. ft. for every 1,000 rounds on a wood shot hole and 200 sq. ft. per 1,000 on an iron shot hole. This means on a course playing 40,000 rounds per year, the tee on wood shot holes should be 150 sq. ft. x 40 = 6,000 sq. ft. and 8,000 sq. ft. on an iron shot hole. Naturally this figure reaches a limit of practicality no matter how many rounds are played a year and it is a maximum of about 10,000 sq. ft. This figure refers to usable space with normal soil conditions, so that the injured turf can have time to heal itself.

Many superintendents either do not have the luxury of space to build such large tees, or do not wish to maintain such large areas during the healing process and prefer a tee surface that permits more intensive management to accelerate recovery. Thus, when building or rebuilding tees they have chosen to employ a U.S.G.A. type construction or a PURR-Wick system. Although much more expensive to build than a soil tee their performance is superior. Others who do not have the money to build such sophisticated systems have simply opted to incorporate about 60 percent sand into the topsoil to increase the resistance to compaction, to improve internal air and water spaces, and to encourage deeper rooting and hence stronger turf plants.

It is normally recommended that a tee have a slight crown in the middle of about 6 in. on a 60 ft. wide tee to give some surface drainage.

The second consideration in rebuilding tees is where the building material comes from. [I am of course assuming that the tee will be elevated above the existing terrain to provide it with surface drainage, give the tee definition, and improve the visual presentation of the hole.] If the material is to be trucked in, there is the resulting damage from the trucks and the increased chance of differential settling resulting from the condition of the fill material (composition and consistency) not to mention the possibility of widely varying chemical or physical properties unless taken from the same source. If the material is available on the property, not only will its cost be less and its response be more predictable, but also it may allow for moving

the fill during dry periods with less damage to the turf and as men and resources are available. Usually fill material will settle 15 percent of its depth but since this is so unpredictable it is suggested to place the fill in the proposed location in the dry season, assuming it does not adversely affect play patterns, and allow it to settle over the rainy season.

Who does the rebuilding of the tees will influence not only the cost but also the scope of the rebuilding. A professional golf course contractor is the best buy but funds may dictate that you must subcontract the work or do it yourself. A golf course contractor has the special equipment and operators to quickly and efficiently do any size job so that the turf is either sodded or planted with maximum establishment time and with the highest quality.

A book could be written about the assumed liability that a club takes on when ever they change the tee location or playing angle. Since safety to other golfers is paramount and neglect of safety leads to law suits, one must be careful about the proper siting of a tee. It is a well known fact that 80 percent of golfers slice the ball and the play emphasis is to the right. To neglect this fact and other such information and place a golf feature in unsafe position is a risk too great to ignore. If any change in play pattern may result from a tee relocation, it is strongly suggested that a competent golf course designer be retained for the project. A list of golf course designers is available from the American Society of Golf Course Architects, 221 N LaSalle Street, Chicago, Illinois 60601 or from The National Golf Foundation, 200 Castlewood Drive, North Palm Beach, Fla., 33408.

The time of year that the tees are to be rebuilt is a consideration, especially if the new tees will occupy the exact position of the old ones. Since few golfers want to play from poorly conditioned or temporary tees, new tees should have 6-8 weeks of good growing weather after seeding, sodding or sprigging to establish a strong, tightly knitted sward. Therefore in northern climates the ideal starting date is just after Labor Day and in bermuda grass areas it is early to mid May. Consider your manpower, normal maintenance, irrigation needs, and weather of these periods if you intend to rebuild them yourself.

Since 20 percent of golf shots are played from the tees (by the average golfer), with a turf damaging golf swing, it is reasonable that the tees should not only be as large as possible but also have the best turf quality. Therefore it is recommended that the very best cultivar or blend of cultivars be selected and used, for the cost increase will be small compared to the maintenance savings. All things being equal using the most aggressive varieties for wound healing is a very important consideration.

You asked me for the time and I told you how to build a watch, but rebuilding tees should be considered a major construction project. **WTT**



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