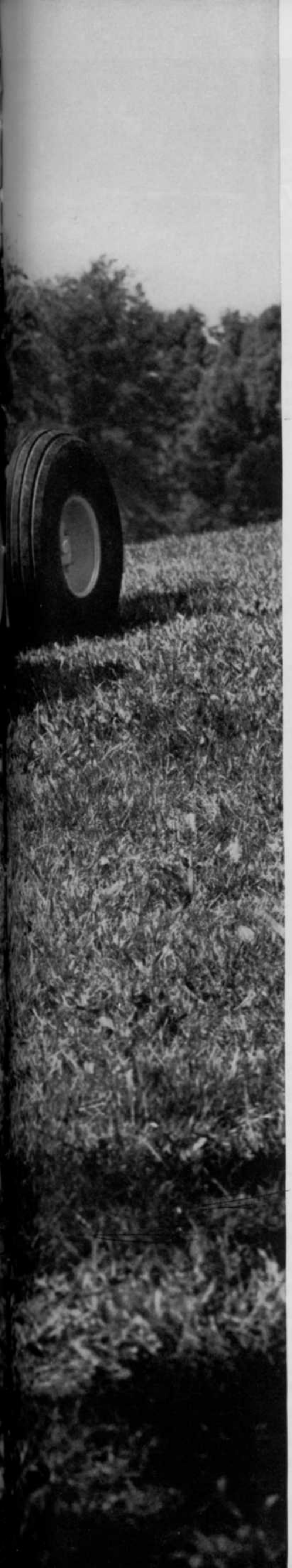

Many methods of handling residue of harvested aquatic weeds have been tried. Among new innovations under trial is this new piece of equipment, designed for pelletizing to be used as cattle feed.

Robert E. Eron, St. Petersburg, Fla., demonstrates his newly developed foam generator for pesticide applications.

USDA, at Fort Lauderdale, in the annual presidential report discussed Society efforts to aid those charged with aquatic weed control.

He reviewed the purpose for which the Society was founded —that of providing practical information for those who need such whether they be drainage district supervisors, mosquito control district directors, custom applicators, or crew chiefs of spray boats.

Removing aquatics has in the past been attempted by mechanical methods such as chains, drags, disks, and more sophisticated equipment. But today, the only practical approach is use of chemicals. Safe herbicides, Blackburn said, are available for use in areas where drift might affect surrounding vegetation. Studies, he stated, show that mechanical removal costs 5 to 10 times as much as chemical means.

Public apathy for large scale spraying programs probably results from the fact that aquatic weeds are never totally eradicated. Blackburn implied that aquatic weed control groups have failed in efforts to explain modern aquatic weed control to the public. The fine control job done to date is unsung largely because of the impossibility of completely eradicating the undesirable plants.

Mechanical harvester at right is owned by city of Winter Park, Fla., and is used to harvest aquatics as a means of keeping lake open for recreational purposes.

Helicopter pilot and veteran sprayman William J. Perdue, left, Lake Wales, Fla., and W. T. DeBusk, Pennsalt Chemicals Corporation, Montgomery, Ala., discuss aquatic control.

Concern and efforts to control noxious aquatics will continue, Blackburn said, because such weeds have become more than a nuisance. Today, he said they are a national problem and rapidly growing more serious. The nation's 170,000 miles of irrigation canals and 190,000 miles of drainage canals and ditches are becoming less and less effective because of aquatic weed growth. Further, there are similar problems nationally with the nation's 2 million farm ponds and small reservoirs, streams and waterways which are 10 feet or less in depth. All waters, regardless of depth, he said, are subject to floating aquatics. In fact, he went on, Hydrilla verticillata has been found growing in water which was 30 feet in depth.

Among leaders of aquatic weed control for the Hyacinth Control Society are the following, left to right: Fred John, Belle Glade Drainage District, retiring director; Dr. Lyle Weldon, ARS, USDA, Society editor; James D. Gorman, Hillsborough County Mosquito Control Unit, retiring vice-president; Frank Wilson, Polk County Mosquito Control Unit, president; Robert D. Blackburn, ARS, USDA, vice-president and retiring president; Paul R. Cohee, Hercules, Inc., secretary-treasurer; Stan Abramson, Southern Mill Creek, director; R. P. Blakeley, Old Plantation Flood District, director; and John W. Woods, Florida Game and Fish Commission, director.

Main reason for the speed up of aquatic growth is the input of nutrients from sewage effluent, fertilizer run-off from farm lands, and the urban residential movement to water areas. Today, he said, the homeowner, sportsman, civic club member, and many in the population at large are familiar with names like water hyacinth, elodea, sea lettuce, alligatorweed, and eurasian milfoil. In Florida, he stated, various civic and conservation clubs have taken the problem of aquatic weeds as conservation projects.

The problem of aquatic weeds in many lakes and streams has progressed to the point that according to Blackburn we can no longer discuss control, but must discuss aquatic vegetation management. Control of all weeds, he said, would not be desirable, or economically feasible. A further concern must be the tremendous amount of nutrients released should all such plants be decomposed in water. To remove them mechanically would be even more expensive. Thus, the choice is to manage them.

Nonchemical methods of control have received broad publicity, Blackburn said, and need to be thoroughly investigated. He mentioned such methods as use of insects, snails, fish, manatees (sea cows), and other biocontrol agents. Possible use of aquatic plants for human or animal food supplements, mulch, fertilizers, and other economical uses also need further study, he stated. Blackburn called for continuing research and study of the physiology, life cycle, anatomy, and morphology of aquatic weeds in relation to their control.

State Control Sought

In a resolution aimed at the Florida legislature, the Society asked for an adequate research

(Continued on page 37)

Equipment demonstrated by Aqua Weed Control Corp., Orlando, Fla., included swamp vehicle, below. Left to right are: Jim Jones, Tim Blair, Art Barrett, and Mike Abrahram.

L. E. Bitting, Sr., left, Old Plantation Water Control District, Broward County, Fla., and Paul W. Kolm, Stull Chemical, San Antonio, Tex., talk shop.

Dutch elm disease

(from page 11)

such a symptom is indicative to the writer that the fungus had been present in stems larger than twigs for some time, and is more suggestive of an infection that had occurred initially in the previous year, rather than one occurring in the present one. While the writer has been able to produce such "shepherds crooks" with massive inoculations of large stems, in eight years of successive inoculations he has never seen such a symptom from terminal inoculations.

Diagnosis:

The Dutch elm disease is so common over the landscape in the northeast, the midwest and adjacent parts of Canadian Provinces, that almost everyone who observes trees can and does accurately pinpoint much genuine Dutch elm disease. Accordingly, the point is often raised, that positive diagnosis is only of academic significance, because diseased elms from any origin are potentially dangerous as sources of bark beetles carrying the causal fungus. There is much truth to this, and positive diagnoses are only required under certain conditions. They are often required by state law for partial compensation, and must be continued by those concerned with reimbursement for tree removals, as well as by those seeking to avoid legal action, to placate a client, to satisfy ones curiosity, or to ascertain the cause in any case.

However, there is often unnecessary misunderstanding about the nature of diagnosis and the significance of results. In a few words, samples of an ailing tree suspected of the disease are treated in the laboratory to favor growth and development of the causal fungus. If present, the fungus most often grows out from the sample and may be identified either in pure culture, or by characteristic asexual structures. Since other fungi also cause similar field symptoms, and separation of the causal fungus from them is necessary, only trained persons can make diagnoses with confidence. Unfortunately, it is not often appreciated by amateur pathologists, who can learn easily to recognize characteristic features of the causal fungus, that there may be other fungi present that resemble *Ceratocystis ulmi*, and that there are atypical strains of the causal fungus as well. Every pathologist or mycologist who works with the causal fungus comes to recognize these variations, and at one time or another has had serious reservations and disagreements with colleagues as to what *is* it, and what *is not* it.

But aside from the identification itself, what is the significance of a positive test? We can say with confidence that the Dutch elm disease fungus has been isolated from a certain diseased tree. Usually this means the tree will die if the fungus has entered the main stem. With most such cases in the past, I never doubted that such trees should be destroyed. However, within the past few years I have seen more than one elm recover where the fungus had invaded the main stem, and for this reason, I have become more cautious about such a recommendation. It is possible for the causal fungus to be limited to the growth ring of one year, and if for any reason it is unable to cross into the growth ring of the following year, the tree may and often does recover on its own.

But what of a negative test result? Does it mean that Dutch elm disease is not present? Not necessarily, often another sample will be positive. In one situation where I had examined the tree in the field, I refused to be satisfied with three successive negative tests and obtained a positive only on the fourth one. However, if one isolates another known pathogen than the Dutch elm disease fungus, there is good reason to consider the test truly negative; but if no microorganism is obtained, and all field symptoms are indicative, another sample should be taken. It is my opinion that at least one kind of microorganism must be isolated from discolored elm wood, or the test is void.

Transmission:

Fungus transmission is the vital point in spread and distribution of the disease, and is presently the focal point of control. Until recently spread of the fungus was believed to occur almost exclusively through the activity of either one of the 2 elm bark beetles (the native, *Hylurgopinus rupifes* Eicch., and the European, *Scolytus multistriatus* Marsh.). Although transmission of the fungus in the vascular system by root graft between noninfected trees had been demonstrated over twenty years ago, and some transmission in this manner was known to occur, it was given little attention until quite recently. However, studies have shown that probability of root grafts among closely spaced urban elms may be substantially high, and spread of the fungus by this means must now be given careful consideration. Unfortunately it has not been given the attention that it deserves. Although the writer is unaware of any studies on the speed of graft formation and subsequent transmission, he has seen evidence to suggest that grafting may be possible within a 2-year period from the first contact between adjacent root systems. Also, field observations by others suggest that speed of fungus transmission by spore movement may be rapid. Unfortunately, there is as yet relatively little evidence on actual frequency of transmission of the causal agent and subsequent development of disease. A question is raised as to whether or not actual transmission occurs naturally by forces within the grafted system, by active growth or migration of the fungus, or by mechanical disruption occasioned by cutting one of the 2 grafted trees. Even before the frequency of root grafts had been explored by others, the writer had seen positive evidence in the field of root transmission of the fungus only following cutting of a known diseased tree. Of course grafted healthy trees may become diseased eventually without the cutting of attached diseased ones, but transmission is most probably accelerated by such cutting. This is the basis for the recommendation made over ten years ago by the writer and others, that immediately on confirmation of Dutch elm disease, action be taken to sever potential root connections between nearby healthy trees *before* (and not after) the diseased tree was removed. This point emphasizes the need for further studies on the nature and speed of spore movement across such grafts.

Returning to beetle transmission of the fungus, we know that some beetles may be carrying enormous loads of viable fungus spores, but we know also that some beetles may carry none at all. We know further that all spores are not viable, and that viability is to some degree a function of desiccation. It is also apparent that spores deposited in wounds made by feeding beetles do not always gain access to vessels, and it is suspected by the writer on the basis of studies, that many viable spores either do not travel far in the vascular system or are inactivated at the infection point by antagonism from other microorganisms.

Another aspect of beetle transmission that requires comment is the timing of beetle emergence and activity. Depending on climatic conditions at various latitudes, beetle emergence usually begins from late April to mid-May. At least two broods of either beetle are possible, but the European species may have two and one half or even three. Much emphasis has been placed on peak emergence of broods, so that some people actually believe that these are the only significant times that beetles are available for transmission. However, beetles are reported to be emerging and active over the entire growing season from early May at least to early frost. Thus the emphasis on peak emergence may be misleading, unless interpreted accurately. The first peak emergence around mid-June is unusally significant in that this is the period of maximum available fungus-carrying beetles precisely in the middle of the most susceptible period for the elms with respect to new vessel development. Although a second brood of beetles may occur in August, this one has much less significance because the elms are beyond maximum susceptibility. However, this does not mean that infection cannot occur at this time; it only means that it is less probable. The writer has had no difficulty inoculating elm in August, with positive disease development. However, such late season infections are often likely to be walled off by the tree and remain isolated. When this occurs, they are in effect inactivated.

Control:

Of all the different aspects of Dutch elm disease on which we have definite information for guidance, control seems to me to be the least understood. As a general concept the word implies more than it really means for Dutch elm disease. In this sense it is an unfortunate choice of a term, that may not only enlist public support for a worthy cause, but may lead also to bitter disillusion and total lack of support when a misunderstanding becomes clear. Among those who try to understand the disease in all of its immense biological complexity, control means only a limitation of disease among a limited population of elms within a limited area, given careful and systematic application of tested procedures. But few public officials understand the complexities involved and in practice are allowed to believe that they have done or are doing the proper thing to insure disease control.

As currently understood by the writer, there are only 4 control measures accepted generally as effective both in theory and actual test. Two of these are indirect and are designed generally to reduce the probability of fungus-carrying elm bark beetles in or nearby healthy trees to be protected. The most significant of these is sanitation, which involves the elimination not only of all diseased and/or beetle breeding elm wood, but of all such wood potentially hazardous for such breeding as well. In effect this means elm wood diseased or weakened from any cause. The significance of this measure is the need for wholesale cleaning of weakened elm wood by constant cutting, trimming and pruning generally. This in itself when properly done is a most formidable chore, and for this reason can only be done effectively for limited numbers of highly valued elms. The other indirect method is general maintenance involving watering and fertilizing when and where essential to prevent or minimize weakening of branches sufficient to allow invasion by beetles. In a well managed shade tree population, these practices should be routine and systematic, but here, too, numbers of trees so treated will be limited by time and resources.

The remaining 2 methods of control are direct. Spraying is designed to coat every square millimeter of bark annually with a chemical that will kill every visiting beetle, and by so doing prevent infection completely. The theory is sound, experimental results have been proven, but in practice results have often been disappointing. Economics, insecticidal controversy, cluttered streets, parked cars, logistics, weather, time available labor, ignorance, irresponsibility of labor, *et al. ad infinitum* combined, appear to preclude the precision and meticulous care necessary for effective spraying of large numbers of trees with due attention to all required conditions. Adequate manpower and resources within time limits alone, are rarely available for the assignment. The result seems to be a diffusion of effort and spray over a widely scattered elm population, too large for the resources used. If spraying for Dutch elm disease is to retain or regain confidence in the eyes of the public, it is my view that it must be more limited and more carefully applied.

Unfortunately, spraying has been used too often as a control measure at the expense of both sanitation and root graft treatment. It has often been shown to be ineffective for this reason alone. Since good sanitation complements spraying, in its near or total absence, even moderately good spraying may be relatively ineffective. Under extremely intensive beetle pressure it is difficult to see how even excellent spraying can be perfect, and many contaminated beetles, with viable spores should be expected to survive for successful inoculation.

Concerning root grafts, it should be obvious that overhead spraying will be wasted, if the fungus is moving underground. And yet it is my understanding that treatment for root graft is widely neglected, and in some areas is not used. As with all control measures economics plays a major role here. But again this emphasizes a point that keeps recurring in control, i.e. the inadequacy of money, manpower, machines and time to exercise all proper control measures.

The question of pruning a single infected limb from an otherwise healthy tree as a control measure, has been raised by many with hopeful anticipation. As with many pathologists I have seen severely wilted limbs pruned and complete recovery of the tree, especially where the fungus apparently had been removed completely. On the other hand, I have seen scores of trees die following pruning. Saving a tree by pruning still seems to be a relatively rare phenomenon in spite of many successful cases. In one situation, a large severely wilted branch was pruned but discoloration of the vascular system was evident in the main stem. The owner was informed that the tree would die, but the tree was not removed, so that its demise could be studied. Two years later the tree still lives in a perfectly healthy condition. However, such cases are rare. In most cases, by the time a tree wilts conspicuously enough to be sampled, the chances are good that the fungus is by then deep in the tree, has been able to cross from one growth ring to another, and cannot be removed by pruning. Thus, there is little likelihood that such a tree will survive. However, there is much here that we do not know. I have altered my own views here radically, and no longer condemn a desirable elm to the axe until I am certain the disease will not cease, either with man's aid or none at all. A few words of warning, however, known diseased trees cannot be left unattended. At the very least they must be pruned carefully. Also, every tree owner who elects to try to save a diseased tree must be informed fully, so that the practicing arborist will not assume an unwarranted responsibility that might result in embarassment or even legal action.

Conclusion:

Over the past sixteen years the writer has observed with interest the operation of many Dutch elm disease programs. In spite of some noteworthy successes in control over a long period of time, even the best programs sustain substantial losses in certain years. Unfortunately, more programs than not have failed disastrously. This has led the writer to ask himself if it is really possible to control Dutch elm disease satisfactorily on a community-wide basis. In evaluating each of the control methods necessary for a successful program, it is now my view that the community will indeed be rare that will actually support in practice the kind of complete and thorough control program necessary according to theory. If there is any community in the U.S. that, over a period of years, has practiced complete, thorough and timely spraying, complete thorough and timely root graft treatment where needed, and complete and timely maintenance under conditions of adverse environmental stress, such as drouth, I have yet to hear of a detailed report. In practice most control programs appear to involve at least some of these measures, some use even one or 2 thoroughly, most use but one or 2 on a piece meal basis, but how many, if any, use all as prescribed?

In my experience, much sanitation is inadequate or too late, because of the sheer enormity of the wood to eradicate. Most spraying is inadequate in deposition or untimely in application. Root graft treatment seems to be generally ignored, except for certain areas, and complete maintenance with water and fertilzer when and where needed for an entire population of elms seems prohibitive economically and physically.

In effect, where community-wide control of the disease is in

(Continued on page 37)

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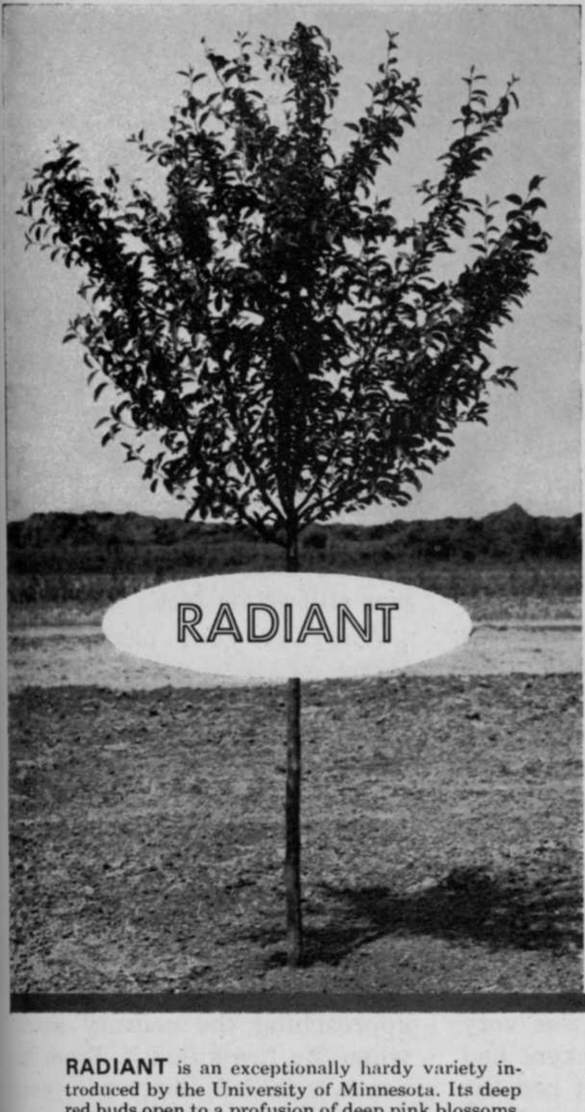

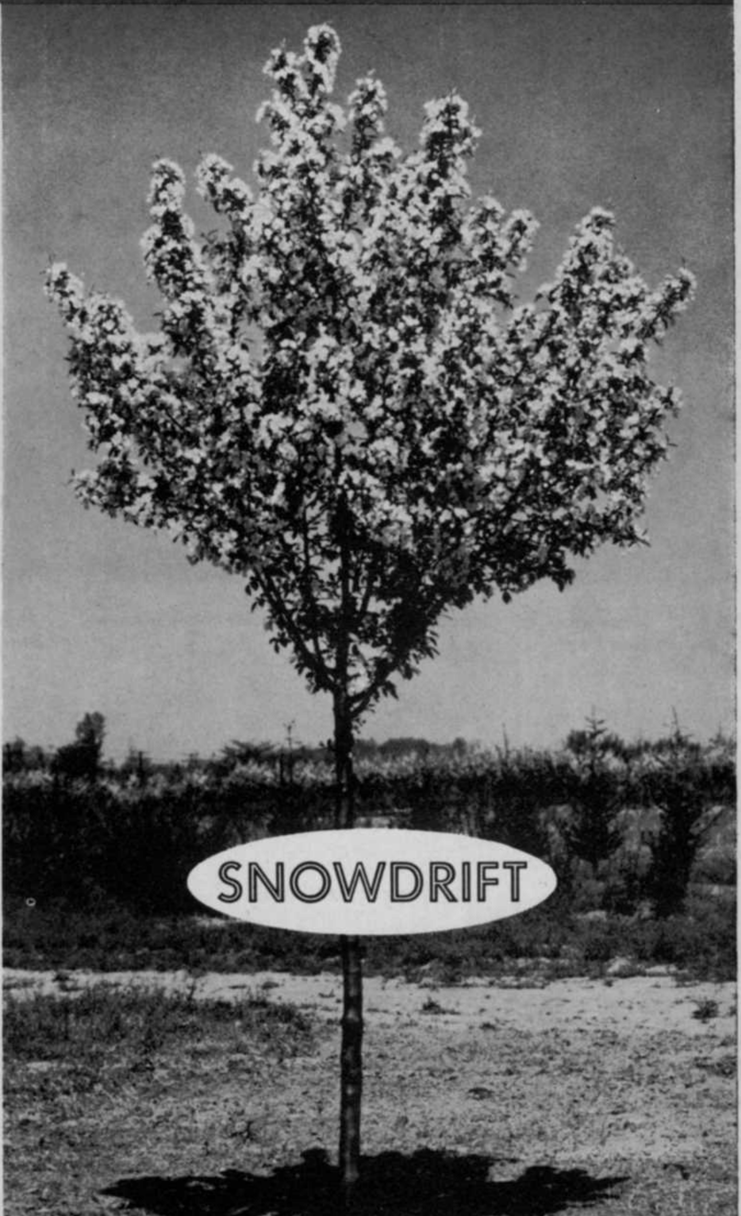

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Photo 1. More than 25 years ago I noticed this white oak tree, singed by fire, dead.

Photo 2. Five years later I passed the same spot. The tree was still standing.

Death of A Forest Giant

By Grover Brinkman

More than twenty-five years ago I passed this white oak tree, in the bottomlands of an Illinois creek. A grass fire had singed it, and the tree had died. Already some of the smaller branches were falling, although the trunk was still dry and solid. Lumbermen for some reason passed it up, even though at this stage it would still be valuable to the logger.

Five years later I chanced to pass the same spot again. The old tree was still up there, on its feet. But its trunk was denuded of most of its bark now, and most of the smaller limbs were gone as well. I tested the trunk. The rotting process was starting, but it hadn't penetrated more than the sap of the trunk. The ruggedness of the old tree was impressive. Life had left it possibly seven or eight years ago, yet during all of this time it had buffeted storms and the elements without falling.

The years rolled by. I didn't get back to the old tree. I presumed it was long down.

Then one day, fifteen years from the time I'd taken the last photo of it, I had a chance to make another check.

I was visibly surprised. It was still standing, remarkable as it seemed.

The rotting process was very evident now. Woodpeckers had bored into its trunk. It had the look of a defeated warrior. I was positive that it would fall within weeks.

But it didn't. I checked with a friend, who hunted in the area. Months later he assured me it was still on its feet.

Another year passed. Still there.

But this Spring, when I went back to the spot, it had fallen. It had broken up, in its last ride to earth. But the trunk was still intact. I dug down with an axe—the center of it was still sound, hard and brittle.

Its age, from a leaflet in the forest mould, to its death?

I'm not sure. No doubt it was approaching the century mark when the fire killed it. From its death, to its fall, thirty-two years elapsed.

Trees are tough. This old white oak was tough as they come.

Photo 3. Then, 15 years later, a rotten shell now, the tree was still on its feet.

Photo 4. Finally, I chanced to pass again. The tree was down. From death to fall, 32 years elapsed.

Checking for Borer Damage in Shade Trees

Insect borers (beetle larvae) attack both established and newly transplanted trees weakened by lawnmower injury, disease, sunscald, or the transplanting itself, says Richard L. Miller, Extension entomologist at The Ohio State University.

Feeding on that part of the tree just beneath the outer bark, several of these larvae can girdle a tree, causing its death.

The first sign of borer damage on an established tree may be a large patch of peeling bark. Underneath you'll find small grooves where borers have burrowed in all directions. To save the tree, cut out the dead area back to live bark and down to hard wood. Paint the area with tree wound material, then follow with a thorough chemical spraying.

DDT or dieldrin are recommended sprays for all trees. Four applications at 30-day intervals (beginning mid-May) are required, as egg-laying adults are active over 3 to 4- month periods. Spray the trunk thoroughly to the lower branches.

Miller says that wrapping newly translanted trees before the larvae have had a chance to enter them will help prevent borer attack. Wrap the trunk from the ground to the lower branches with burlap or with tree wrapping paper.

Herbicide Incorporation Requirements Vary

The type of herbicide you use determines whether you should incorporate it, says Gerald Miller, University of Minnesota extension agronomist.

Volatile herbicides such as EPTC should be incorporated deep enough to reduce surface loss. Those less volatile but that tend to lose effectiveness when left on the soil surface (such as atrazine) may also perform best when incorporated.

However, herbicides such as CDAA and linuron are usually most effective when applied to the surface.

Leaching can decrease effectiveness of highly soluble herbicides, Miller says. This is also true at times of low solubility herbicides when incorporated. The loss of effectiveness may be caused by greater absorption onto the soil or organic matter particles when mechanical incorporation is involved.

Miller cites recent evidence that many preemergence herbicides control certain grass weeds best when the chemicals are positioned for uptake in the shoot zone. He also describes a "dilution effect" that occurs as incorporation depth is increased. When incorporated, he says, herbicides should be kept relatively shallow and concentrated in the shoot zone.

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