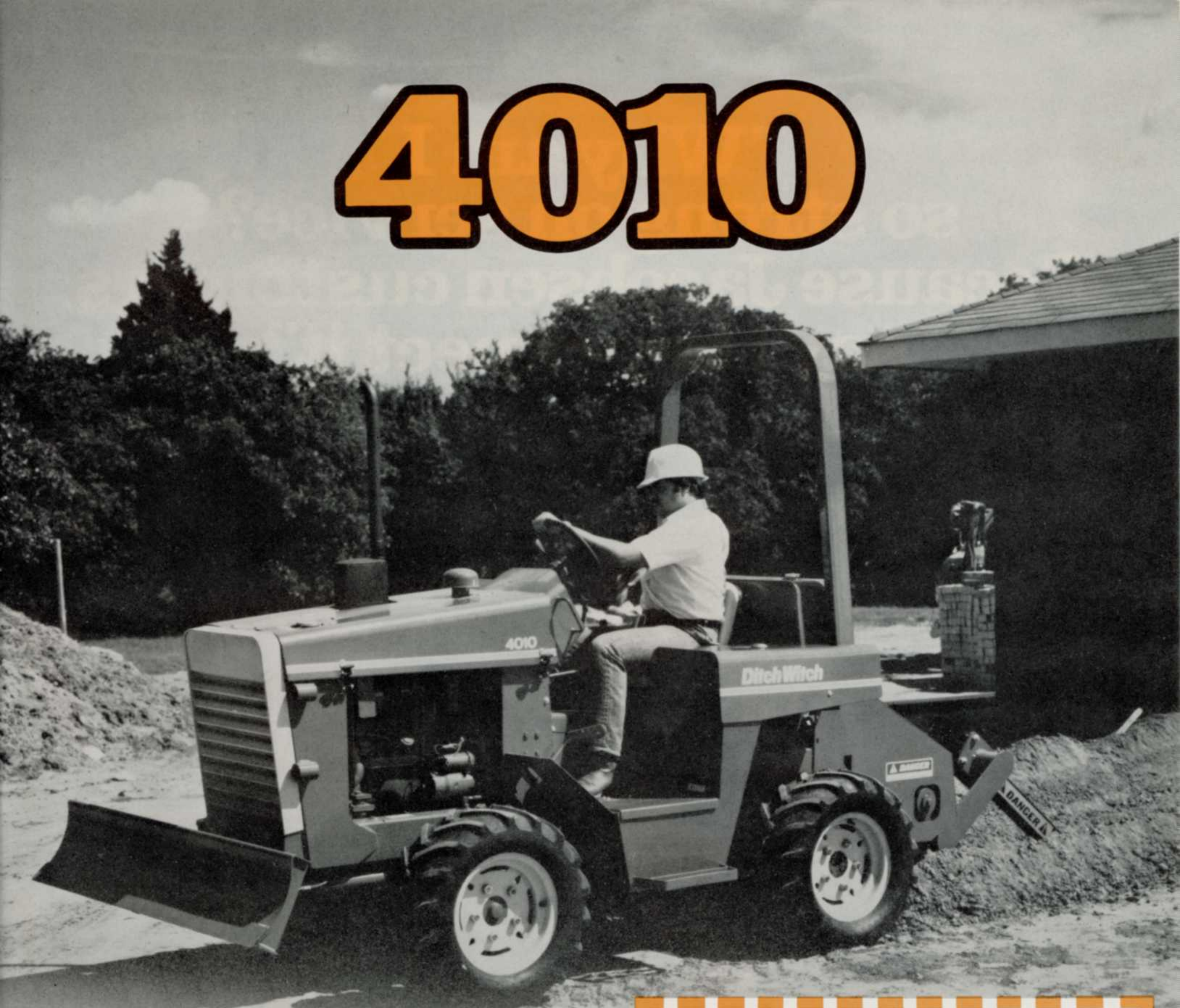
4010



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GOVERNMENT UPDATE

EPA announces pesticide labeling program

The Environmental Protection Agency recently initiated a program to upgrade labels of pesticide products that provides instructions for their proper use and information on their hazards.

The EPA has designed the Label Improvement Program to enable the Agency to respond rapidly to labeling needs identified within the Agency and by the industry, the users, and the public. This program will also provide for needed uniformity in compliance and enforcement activities.

The Agency will require that registrants amend their registrations to modify their labels in certain ways within reasonable time frames to be established.

For further information, contact Jean Frane, Registration Div. (TS767), Office of Pesticide Programs, EPA, 401 M St. S.W., Washington, D.C. 20460, 202/426-2510.

USDA uses parasites against gypsy moths

Nine species of parasitic flies and wasps are helping the U.S. Department of Agriculture and state agencies wage biological war against the gypsy moth in infested areas of the Northeast.

The parasite lays its eggs in or on the moth's eggs, caterpillars, or pupae. Later, a fly maggot hatches and feeds on the caterpillar, eventually killing it. Some parasites attack only gypsy moths; others also attack other destructive caterpillars.

A pilot project, conducted by the Pennsylvania Department of Environmental Resources with USDA assistance, is underway in a Pennsylvania state park. Gypsy moth experts will survey plots intensively every year and apply light doses of chemical or biological insecticides only when infestations are at a critical level.

According to Stanley McNally, a USDA area director and coordinator, "This is the role we see for parasites—not a replacement for pesticides but one of a variety of tools that can reduce gypsy moth damage within the infested area while allowing pesticides to be used less often."

Bergland cites boost in ethanol production

Secretary of Agriculture Bob Bergland thinks President Carter's goal of producing 500 million gallons of alcohol fuels during 1981 is reachable through a combination of factors.

"These factors include the provision of Federal tax incentives for a substantial portion of the amortized life of a plant (through 1992), continuing increases in the real price of petroleum and gasoline, some clarification of regulatory policies involving the manufacture and use of fuel ethanol, and marked reductions in the cost of debt capital," he said.

Bergland said there are two areas for which the Department of Agriculture has primary responsibility in supporting and accommodating ethanol production. These are:

1. Managing the agricultural programs and policies for which USDA has primary responsibility with sensitivity to the requirements of fuel ethanol plants for farm-produced feedstocks, and reduction of any adverse impacts on the agricultural sector and the economy generally; and

2. Use of the established state and local credit processing and servicing system of USDA to provide loan assistance for expanded distillation capacity to meet the President's production goal.

"In addition," Bergland said, "the USDA in cooperation with the Department of Energy is expanding research and testing activities to find alternative crop and forestry feedstocks for ethanol production (including cellulosic feedstocks), and to improve conversion technologies enabling the use of cellulosic and other alternate feedstocks."

ing the height of the breeding season.

The tests also found that the male beetles were more attracted by the sex attractant early in the season and by the food attractants later. However, the two kinds of attractants are more effective combined than when used separately, said Klein.

ARBORISTS

Ohio ISA to sponsor arborist foreman show

The special needs of arborist foremen will be the subject of a day-long seminar at the Agricultural Technical Institute in Wooster, OH, on Dec. 6.

Extension horticulturist Fred Buscher, NAA Executive Director Bob Felix, and other tree experts will cover responsibility and management of all areas of arboriculture. The session will run from 10 a.m. to 4 p.m.

Preregistration is strongly advised. Contact Fred Buscher, OARDC, Wooster, OH 44691, 216/262-8176. Lunch is provided to those who preregister.

SEMINAR

Arborists plan talks on tree injuries

The National Arborist Association will hold its 6th annual technical seminar on Dec. 9-10 concerning "non-parasitic injuries to trees."

Dr. Terry Tatter, associate professor of plant pathology at the Shade Tree Laboratory, University of Massachusetts, will present the program at the Hyatt Regency O'Hare in Chicago. It will cover environmental stress, people pressure, and the interaction between infectious and non-infectious diseases of trees.

For further information, contact: National Arborist Association, 3537 Stratford Road, Wantagh, NY 11793.

PROMOTION

Frazier named pres of Simplicity Mfg.

Jacques F. Trevillyan, executive vice president of Allis-Chalmers Corp., announced that Warner C. Frazier of Glendale, WI, has been named president of the Simplicity Manufacturing Co., an Allis-Chalmers Co.

Frazier, previously vice president, marketing, has been with Allis-Chalmers since 1955. He also served in engineering application and sales promotion posts in various divisions, as merchandising manager for the Industrial Truck division, and manager of the Material Handling Sales & Service operation.

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TRAGEDY OF DUTCH ELM DISEASE BEARS HOPE FOR MODERN CONTROL

By John L. Hart

The stately American elm *(Ulmus americana)* is still very much a part of our forests, parklands, and urban plantings. While millions of these exceptional trees have fallen to Dutch elm disease, many millions more are still living. There are large areas in the East where it has ravaged, leaving behind a small, heavily protected population; there are other large areas where it rages; and still other areas, principally in the West, where the disease has not yet entered. The elm is still very much a concern of most grounds managers, both financially and emotionally.

The popularity of the American elm as a shade tree is almost legend: it is hardy vigorous over a wide span of latitude and climate, with a native range blanketing all of North America east of the Rockies; it tolerates soils from sand to swamp; it is long-lived (typically 100 to 150 years), providing excellent shade for most of those years; its "vase" or "umbrella" form is a vegetative classic; it resists pollution; and until Dutch elm disease arrived around 1930, it was not readily susceptible to insects or disease. For good reason, the American elm is the most widely planted tree in the US, and concerted efforts to rescue this species from the fate of the American chestnut continue.

The Deadly Disease

Dutch elm disease was first described in 1919 in the Netherlands, hence its nominal reference to the Dutch. The probability is that the blight entered Holland via Asian ships during the First World War: both the Chinese and Siberian elms *U. parvifolia and U. pumila)* show great resistance to the disease, indicating a long mutual evolution in Asia. The spread across the continent was rapid, and by the end of one decade the disease was present throughout Western Europe and England.

The first positive diagnosis in the US was in June of 1930, with a total of five elms affected in Cleveland and Cincinnati, Ohio—source of disease unknown. This outbreak was controlled by the rapid destruction of the diseased trees, but three years later the disease was reported throughout northeastern New Jersey, in New York City, and in the Westchester area. Then in August of 1933 both the disease and the European elm bark beetle were found in a shipment of elm burls from Europe; further checks proved that numerous shipments were contaminated, destined for locations throughout the East and South. Such importations were presumed to be the source of the disease's entry into the US.

Since that time the story has been a tragic one. All of the elm species commonly planted as shade trees in the US are susceptible, but the American elm—the most highly valued and most widely planted — is also the most susceptible. Dutch elm disease—or DED, a chillingly appropriate acronym — has swept across the country like a prairie fire, leaving six-foot-diameter stumps, barren city streets, and broken budgets in its devastating swath. In 1933 there were fewer than 1,000 fatalities, in 1934 almost 7,000 and by 1936 there had been more than one million removals. At that time the disease was reported to be contained within a fifty-mile radius of New York City. By 1949, less than fifteen years later, DED extended from New England west to Indiana and south to Virginia and Tennessee, with an isolated outbreak in Colorado. And twenty years thereafter, DED had spread to 41 of the 48 contiguous states. By the early 1970's it had leaped the barrier of the Rockies into California and Oregon. At least in part, the elm story is a tragic example of being swamped by success: the elm's overwhelming popularity lead to a virtual monoculture—the perfect habitat for epidemic.

But population density doesn't explain it all. DED is an especially mobile and efficient killer. The disease itself is actually a fungus, *Ceratocystis ulmi.* The most common and effective vector which transmits this fungus in the US is the European elm bark beetle *(Scolytus multistriatus).* The bark beetle is capable of flying for several miles, which gives the disease considerable mobility. Since the beetle is also elm-specific (to all US species), the disease often reaches its target. This border insect typically feeds in the small branches and twigs of the tree crown; it lays eggs beneath the bark by tunneling through to the sapwood, particularly in weak, dying or dead trees. If the beetle carries fungal spores and if it penetrates the bark while feeding or breeding, DED may be introduced.

Once in the tree tissue the fungus can grow rapidly by extending its rootlets (hyphae) into the cambium and wood. When it penetrates the large vessels of spring wood, it produces spores which are carried through the tree in the flow of sap. Accompanying this invasion are the characteristic symptoms of DED, usually appearing from late spring to mid-summer: wilting, yellowing, and/or dropping of leaves; gray-brown staining of the last annual ring of sapwood just beneath the bark; the spreading of these symptoms progressively through the tree; and — within days or months or occasionally years, depending on the virulence of the fungal strain and the health and genetic resistance of the particular elm—death. Death has been attributed to toxins produced by the fungus, and/or to simple mechanical plugging of the water vessels, killing by dehydration. It appears that the presence of DED triggers the tree to produce gums or resins in an attempt to isolate the infection. These self-generated materials and their clogging of the vessels, rather than the fungus itself, may be the final cause of death.

The fungus can continue to grow and produce spores saprophytically after the tree dies, and the beetles prefer the dead or dying tree for breeding— which means the rapid multiplication of fungus-carrying vectors. In a typical annual life-cycle, eggs laid in the early fall by a spore-laden beetle (or by a "clean" beetle in an infected tree) will give rise to many DED-carrying, first-generation adults the following spring. Each of these will infect new elms while feeding, then will breed and lay eggs for a second vector generation to emerge as adults during early summer. This new and geometrically larger generation will feed, infect, and breed, creating a third generation by late summer. Eggs produced by this new population will overwinter as larvae under the bark, providing a new cycle for the next spring (see Figure 1). To give an over-simplified example of the European elm bark beetle's population growth, two late-summer beetles giving rise to fifty adults the next spring could lead to almost one million eggs the following winter.

The elm bark beetle as a vector is indeed a model of efficiency and effectiveness. To make matters worse, there are other models: DED can be transmitted by root grafts between neighboring elms—an especially dangerous situation in a closely planted park or boulevard; other bark borers are either known or suspected to be additional insect vectors; and there is evidence that DED can be spread by rainwater, wind, birds, pruning tools — basically any method of bringing DED in contact with a tree wound. The bottom line of this plague is an estimated death rate of one-half to one million American elms per year. At the height of infection in an uncontrolled urban area, mortality may surpass twenty percent of the total population each year.

Prevention, Treatment, Cure

Faced with the high mobility and high toxicity of DED, it became clear in the 1930's that an epidemic rivalling the Chestnut blight was underway. The quest for control methods began quickly—a quest which still continues today. And while new cures are announced with some regularity, so far none has proven both safe and effective, much less economical. The search for a solution has focussed on three areas: insect vector control, control of the fungus itself, and—throwing in the towel—genetic selection for a new elm which possesses the many positive characters of *Ulmus americana* and in addition shows high resistance to DED.

Sanitation. From the first it was obvious that destruction of bark beetle breeding sites was critical in any effort to slow and curb the spread of DED. This treatment was pioneered in the 1920's in Europe, with fair success. Since weak, infected, dying, and dead elm trees are a prime site of breeding, and since new hatches may occur through the summer in addition to the overwintering population, immediate removal and destruction of the trees is required, often by state or local law. This process should include removal of *any* elm in an unhealthy condition: weak, wounded, storm-damaged, sickly, old and ailing, etc. It should also include periodic removal of natural dieback, approximately on a five-year cycle.

In many communities the deadwood is either buried at a landfill site or burned. The former method is a high expense, may lead to the eventual collapse of the site as the wood decays, and is a waste of a natural resource; the latter also wastes wood, and moreover adds particulate matter to the air—it is therefore illegal. In some areas the trees are sold as firewood or saw-logs (e.g., for rough-cut pallets), and in other areas they are chipped for use in landscaping, animal husbandry, etc. If so utilized, mid-summer fatalities should be used immediately, and late-summer fatalities before the spring hatch; otherwise, they will continue to contribute to the DED problem by supplying new hatches of infected beetles to the area. If the trees must be left standing due to large population size or difficulty of rapid removal, either an agent lethal to the beetles (from eggs to adults) must be applied, or the trees must be mechanically or chemically de-barked. Chemical de-barking with cacodylic acid has recently received EPA registration and is the procedure currently recommended. The compound is applied through cuts in the bole during the tree's last stages of life; the sap distributes the acid through the tree, which then dries out, shrinks, and sheds its bark.

Early investigators also noted that DED often traveled between closely planted elms via root grafts connecting the vessels of adjacent trees. In a dense population such grafts may connect essentially all trees together. Hence another of the first sanitary recommendations was to sever the roots between a diseased and a healthy tree. (A general rule of thumb is that the distance that roots extend outward from the trunk equals the height of the tree.) Trenching to a depth of 24 inches in the area of root overlap is usually sufficient. For additional protection, a second barrier may be placed beyond the adjacent healthy elm, thus isolating it also from its neighbor(s) in the event it is infected but does not yet show symptoms. Such trenches may be backfilled immediately and the diseased tree then removed. Trenching must precede removal; otherwise diseased sap may be pulled from the severed tree into adjacent healthy trees.

In the past decade chemical soil fumigants (e.g.,

The deadly disease has swept through American elms like wildfire since the 1930's when it hit the continent via shipments of elm burls from Europe. Early symptoms of the fungus appear in wilting and yellowing of the leaves.

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Vapam, VPM) have been used increasingly to sever root grafts. One-inch by 24-inch holes, six to 12 inches apart, are drilled in the root overlap zone, the chemical solution is poured in, and the holes are sealed. Since action is not immediate, two weeks should be allowed between treatment and tree removal to avoid backflow of diseased sap into the healthy trees. A cautionary note: such fumigants are non-specific in action and should be used sparingly and with the utmost care, strictly following label directions. Turf will be killed in a 12-inch strip along the line of application, and spills can be disastrous; use near ornamentals should be avoided.

Isolation of diseased trees by severing root grafts remains a recommended practice where elms are densely planted. It has been shown to be an effective method of preventing the rapid loss of an entire population, and should be included in any good program of sanitation.

One additional recommendation regarding sanitation is the thorough cleansing, in alcohol, of all pruning equipment, saws, chisels, drills, and other tools used on elm trees. The DED fungus enters the tree through wounds: one spore carried on a pruning saw may be sufficient to infect a tree and lead to its death.

A number of studies have been undertaken to evaluate the impact of sanitation on DED's spread. After thirteen years of good sanitation in Syracuse, NY, elm losses amounted to thirteen percent of the initial population. In a study of a number of localities in Illinois, communities practicing only sanitation showed mean mortality of four percent annually over more than a decade; comparable communities without such cleanup lost 80 percent to 95 percent of their original elm population in little more than ten years. In Fredericton, New Brunswick, fifteen years of careful sanitation have resulted in only five percent loss (less than one-half of one percent per year); in neighboring, uncontrolled areas, an average of sixty percent of the initial elm populations has died (up to fifteen percent per year). In short, strict sanitation often reduces elm mortality to less than two percent per year; without sanitation, the disease may claim 10 to 20 percent per year.

The sanitation strategies enumerated above, aimed at slowing the increase and migration of the bark beetle populations, and at preventing root or mechanical transmission of the disease, were the first control measures recommended. They remain the most vital part of the battle against DED. Unfortunately, fortunately, communities which practice strict sanitation and follow all recommendations are too rare. Those few which do, however, have shown marked reductions in DED mortality. It is certainly not an ultimate solution: both species of bark beetle can breed in all elm species grown in the US; further, an urban effort to clean up will not affect the neighboring rural areas where dead elms often remain standing for years. So while a strict sanitation program will not bring the disease to a complete halt, it will greatly decrease the rate of death, thus allowing sound planning, long-term budgeting, a headstart on replacement—and perhaps the time necessary for a satisfactory cure to be developed.

Insecticides. The chemical war against the disease began seriously with the advent of the insecticide DDT. First formulated in the late 19th century, DDT was not used as an insecticide until 1939, with commercial applications not gaining momentum until after the Second World War. In the late 1940's and throughout the 1950's, its deployment mushroomed. For control of the insect vectors of Dutch elm disease, this chlorinated hydrocarbon was used extensively by communities, public agencies, and private arborists for almost thirty years. Along with sanitation, DDT remained the principal recommended control until Carson's *Silent Spring* alerted the public to the chemical's dangerous characteristics: high and broad toxicity, mobility in the environment, long life, and ability to move up the food chain at increasing concentrations. (To drive the latter points home, there are indications that DDT, or any broad-spectrum insecticide, may actually favor the target insect by removing all natural controls on it; that DDT damage to avian, aquatic, land, and soil life is still being felt; and indeed that while DDT was banned almost totally in 1972, its concentration in human tissue, if the ban remains in effect, is projected to peak in the 1990's.)

When the more treacherous effects of DDT began to surface in the 1950's, other organic compounds began to be phased slowly into the chemical warfare arsenal as DDT was phased out. One of the most widely used and recommended in the 1960's and through the 1970's was methoxychlor, a close relative of DDT. Although considered safer than DDT, methoxychlor is nonetheless poisonous to birds, fish, mammals, and a broad spectrum of insects. It should be used discriminately and with caution, if at all.

Perhaps the most enlightening fact here is that good sanitation alone has been shown to reduce annual elm mortality to less than one percent in certain cases; the insecticides, at some expense in material, labor, and equipment, do not greatly improve this rate. Indeed, in the previously cited study on communities in Illinois, there was no statistical difference in elm mortality rates between communities using sanitation alone and those using both sanitation and methoxychlor. In addition to the high and recurring expense, the broad spectrum of toxicity, and in some cases persistence and mobility, insecticides for DED control are unable to ensure a 100 percent kill of the bark beetle. One beetle carrying one spore can fell, with several nibbles, a six-foot-diameter tree. In light of the above, use of insecticides to prevent DED seems a risky investment at best. If the fullest protection program is desired — e.g., to preserve a particularly venerable, historic, or in some other way an especially valuable elm—better approaches are now available, as noted below. Finally a spraying program cannot replace good sanitary practices: sanitation remains the most vital control program and the highest priority in the battle against DED.

Biological Control of Insects. For a number of years, researchers have been investigating other, more biological means to control the fungus-carrying insects. Possible biocontrols might include insect attractants, repellants, release of sterilized males, and introduction of disease or predators. A few such methods have been tried.

Attractants which have been developed include elm bark extract and bark beetle pheromones: a trap is baited with one or the other (food or sex!), and the beetles thereby lured into the trap are killed. One pheromone in particular, which stimulates both sexes to amass for breeding and feeding, has been tested but has not yet received EPA registration. There are indications that such attractants may be self-defeating,

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serving only to attract more beetles into the area.

The opposite pole of beetle repellants is being investigated, in particular by Dr. Dale Norris of the University of Wisconsin. Preliminary results indicate this to be a promising avenue of research. Testing continues.

And a symbiont of bark beetle eggs, the tiny wasp *Dendrosoter protuberans*, was introduced into the US from France in the late 1960's. Thousands were bred and released with the hope that the wasp would become established and spread, helping control the bark beetle population. Results have been disheartening. Problems with the wasp are that it is not effective on thickbarked trees, it does not usually attack the native beetle, and it may not survive in the northern US.

As in the case of sanitation and insecticides, these biological controls and others like them can help slow the continental sweep of DED; they will not ultimately solve the problem or cure the disease. But as retardants they may prove to be valuable, helping reduce the beetle population to more manageable levels. Such methods of control have worked in the past to an appreciable degree in management of the gypsy moth, citrus scale, Japanese beetle, and other insects viewed as pests. Further, if properly researched and planned, biological controls are more ecologically preferrable and less expensive over the long term than the more artificial methods such as insecticides. Pursuit of an effective biocontrol agent should be a primary path for DED research.

Fungicides. A more direct approach than an attack on the insect vectors of DED is an attack on the disease itself, *C. ulmi*. Much current research is being done in the area of fungicides. The ideal DED fungicide would exhibit several characteristics: specificity and high toxicity for the fungus; non-toxicity elsewhere in the environment — including the tree itself, ability to incorporate into and distribute throughout the tree, immunizing all parts of the tree against infection; persistence in the elms and persistence of virulence to the fungus, not requiring frequent renewals; and practicality, ease of application, and economy.

The first such "cure" was the garden fungicide Benomyl (marketed as Benlate), approved in 1972 for restricted use on elms as a DED preventative. The hope was to kill the fungus when it first came into contact with the tree. An early summer spray application of Benlate, often combined with a dormany spray of methoxychlor, achieved sporadic success. Benlate was used less successfully as a soil treatment, relying on root uptake to distribute it throughout the tree. Both methods of application were preventative rather than curative in intent, and neither could ensure complete coverage and protection. Meanwhile, a further refinement was being tested: injection of the chemical directly into the tree, a process which was hoped to be the long-sought ideal solution.

Injection is not a new idea. It has been traced at least as far back in history as Leonardo da Vinci, who bored holes in peach trees and injected arsenic into the rising sap to determine if the treatment would produce poisonous peaches. (It did.) There are other reports of similar injection experiments in the 18th, 19th, and 20th Centuries. At its simplest, the chemical injection process relies on the natural pressure of transpiration to pick up the chemical extremities of the tree. Benlate in theory would kill the DED fungus on contact with the protected wood. The principal problem was in getting a sufficiently high concentration of the chemical in all portions of the tree.

Drilling holes at 6-inch intervals around the lower trunk helps ensure even distribution throughout the tree. A pressurized solution of Lignasan is injected through the nozzles, which are connected by tubing to a pressure tank. The process can be time-consuming, costly, and ineffective against some strains of DED.

The natural pressure of transpiration was then supplemented with positive injection. The Elm Research Institute, a non-profit organization in Harrisville, NH, made this process widely accessible through the publicizing and marketing of a low-pressure tank injection system. With little financial outlay, a two-foot-diameter elm could be treated in as little as thirty or forty minutes on a good day. Unfortunately Benlate was not highly soluble in water—highly insoluble in some water—often resulting in low uptake of the chemical even under pressure: it either did not reach all parts of the tree, or did not reach the extremities in a suitable toxic concentration. Once again, success was limited.

It was not long, however, before a more soluble form of Benlate's active ingredient was developed. Hailed more than ever before as the miracle cure, Lignasan BLP was cleared for use in 1976. It is still in use today. Research originally indicated that Lignasan met several of the requisites for miracle-cure status: it appeared to be fairly specific and toxic for DED and relatively harmless to other organisms and to elms; injection around the circumference of the tree was thought to give the chemical thorough distribution in the tree; and the cost of the chemical itself was usually below ten dollars per tree.

Since the initial glowing reports, Lignasan has become simply a good method — preferable to spraying for beetles—for helping slow the spread of DED and for increasing the protection of selected elms. Typically, holes are drilled at six-inch intervals around the lower trunk, either into the root flares or into the excavated roots themselves: this helps ensure distribution and protection throughout the tree. Holes should preferably be shallow, into the outer two or three growth rings (indicated by white shavings): this creates a smaller wound and gives better distribution of the chemical than deep holes. Nozzles, connected by tubing to a pressure tank, are then secured in the holes and the pressurized solution of Lignasan is injected, a process requiring fifteen minutes to several hours depending on a large number of soil, tree, and weather factors.

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