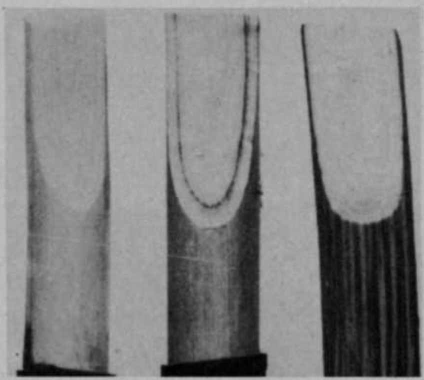
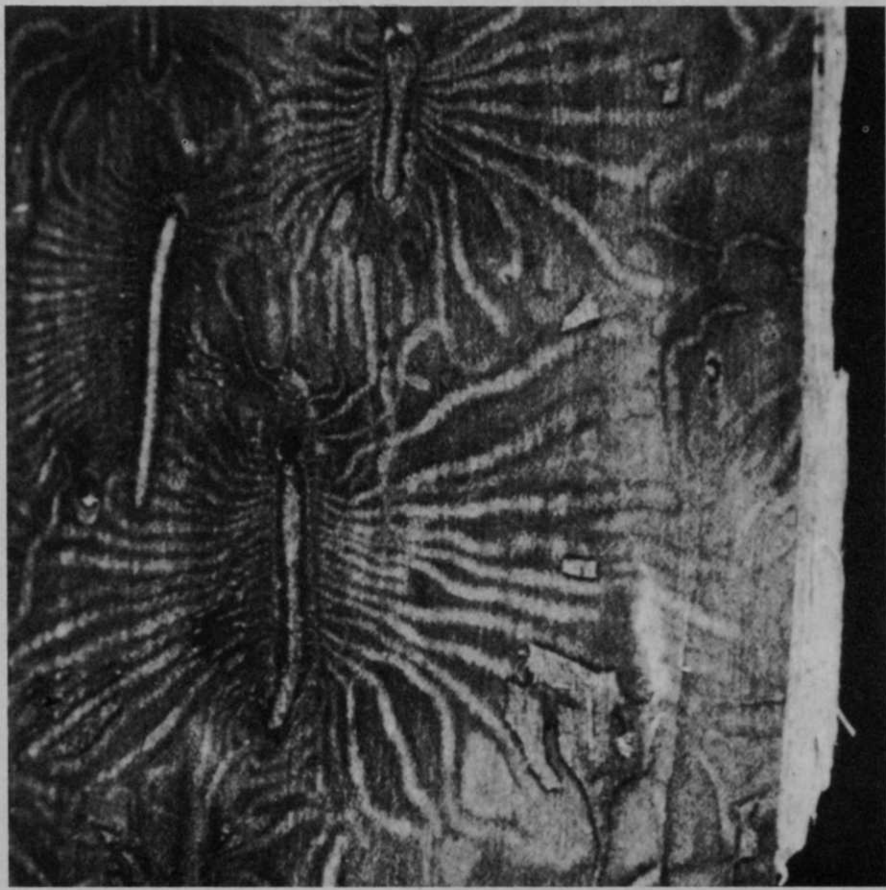
One part of an integrated control method for important specimens is the dormant spraying of methoxyclor. Photos courtesy of Illinois Natural History Survey.



Dutch Elm Disease on twigs. The twig on the left is normal. The wood of the two on the right is typically discolored.



Dutch Elm Disease is carried from tree to tree by bark beetles. These are the brood chambers of one of them.

DED Controls: Will Systemics Work?

By RICHARD J. CAMPANA
Dept. of Botany and Plant Pathology
University of Maine

From its history of spread and development in Europe and North America, there is nothing to indicate that the Dutch elm disease can be contained. The ecological forces at work are such that is is clearly beyond the capacity of man to prevent massive and often accelerating rates of infection in populous elm stands.

These forces involve balances in population dynamics among at least three living species: (1) the elm (usually *Ulmus americana* L.); (2) at least one, and sometimes two, insect vectors (the introduced smaller European elm bark beetle, *Scolytus multistriatus* (Marsh.), or the Native elm bark beetle, *Hylurgopinus rufipes* (Eichh.); and (3) the casual fungus (*Deratocystis ulmi* (C. Buisman) Moreau). In a broad sense Dutch Elm disease is a man-made problem.

Once sporadically distributed mostly along streams, the American elm was planted extensively as pure stands in cities and towns throughout eastern North America as an urban or suburban "tree monoculture." Having established the elm as "the" urban tree over all others, inadvertently we next introduced from Europe (*circa* 1905) the European elm bark beetle, and later (*circa* 1930) at least one virulent strain of the casual fungus.

Thus, the basic factors involved in this devastating epidemic of elm populations are: (1) extensive stands of closely spaced, highly susceptible trees often connected by root grafts; (2) an insect vector capacity enhanced by addition of the European beetle; and (3) presence of the causal fungus. These were combined under climatic conditions favorable to the proliferation and development of both the pathogen and its vectors.

The disease is not restricted to urban elm stands; most native elms of field, stream and forest are highly susceptible and just as badly affected. The difference is that volunteer elms on open land develop naturally from seeds cast annually, whereas groups of elms lining streets, or used as specimen trees were usually established through plantings of colnal stocks, and most often at one specific time.

Thus, there are significant differences between natural and horticultural elm populations with respect to site, spacing, numbers, age, variation in susceptibility, etc.

Therefore, for various reasons, most urban elm populations may be reduced beyond restoration, whereas natural ones will be replaced in part by natural seeding. The new natural populations will be reduced in size, with little or no regularity of spacing in spite of what man does or does not do in attempts at disease control. Thus, whatever we do is seen either as a delay of disease incidence in relatively small selected elm populations, or as the treatment of individual trees of sufficient value to warrant intensive control efforts.

In 1956,[1] I tried to design a blueprint for "community-wide control" of the disease with only two control methods (both indirect). But now I see little prospect that satisfactory disease control (saving most of the elms) will be achieved very often or for very long throughout extensive elm populations. Such control now appears possible only with complete and intensive application of at least five control methods on limited numbers of highly valued trees.[2]

These methods are: sanitation; dormant spraying; severance of root grafts; early removal of single-branch infections; and fungicide applications for internal action. At least two of these methods, (early surgery, and use of systemic chemicals) are direct.

The concept of integrated control is still valid even where systemic chemicals can be used effectively to help prevent infection, because no single control measure has been demonstrated to be completely successful. Even if the application of systemic chemicals to diseased trees could result in complete recovery, re-infection might well nullify original curative efforts. At least with present knowledge and in the absence of greater certainty in the efficacy of chemical treatment, an integrated control approach has the merit of enhanced security.

Based on early field tests, the two highly promising chemicals for the control of Dutch elm disease at the present time are Benlate benomyl fungicide and an antibiotic known as Nystatin.

IS BENLATE SUITABLE?

For at least the past thirty years plant pathologists have sought in vain a suitable systemic chemical to prevent or arrest Dutch elm disease. Hundreds of chemicals highly toxic in the laboratory against *C. ulmi*, failed to arrest the fungus in inoculated elms. Some of the reasons explaining such failures were reviewed in an earlier paper[3] on the requirements for a suitable systemic fungicide.

Within the past five years Benlate was found to be effective in preventing Dutch elm disease with applications by soil amendments, trunk injections or foliar sprays. A use permit issued by the U.S. Environmental Protection Agency in March of 1972 for the control of Dutch elm disease, was restricted to applications by trained and licensed arborists using specific methods of application. How well does Benlate meet requirements for a suitable systemic fungicide?

1. *Is it toxic to the fungus in elm tissue?* The chemical is quite effective in preventing infection, but most results indicate only partial success or failure in arresting the fungus after infection is well established.

Post-infection treatment with Benlate applied by Maujet injection is often not recommended if more than five percent of the crown is visibly wilted before treatment. However, most published data are based on use of the chemical in an aqueous suspension, in which only a minor fraction of the fungicide is in the dissolved state! The particulate matter in the suspension clogs vessels through which the solubilized fraction must move to get where it can be most effective. Thus, Benlate in suspension appears to have a low capacity for being widely systemic. *(Editor's Note: Research conducted by Dr. T. C. Ryker and others indicates that the xylem vessels appear to be about 11 microns in diameter. The particle size of Benlate is about two to four microns in diameter. Thus, it would appear that the chemical could move through the xylem tissues without clogging.)*

But the degree of fungitoxicity in elm tissue is still unresolved, since there are no carefully designed studies to answer this question.

Tests on a new, solubilized Benlate, especially those involving pressure injection, have been initiated too recently to provide an answer here. My experiments in using solubilized Benlate with pressure injection in 1972 produced evidence that the fungus may not be killed completely with post-infection treatment. With good distribution, it is easy to visualize death of fungus spores as they are exposed in open vessels; however, it is also easy to visualize impacted hyphae of the causal fungus deep in cellulose layers of wall tissue of cells not contiguous to open vessels.

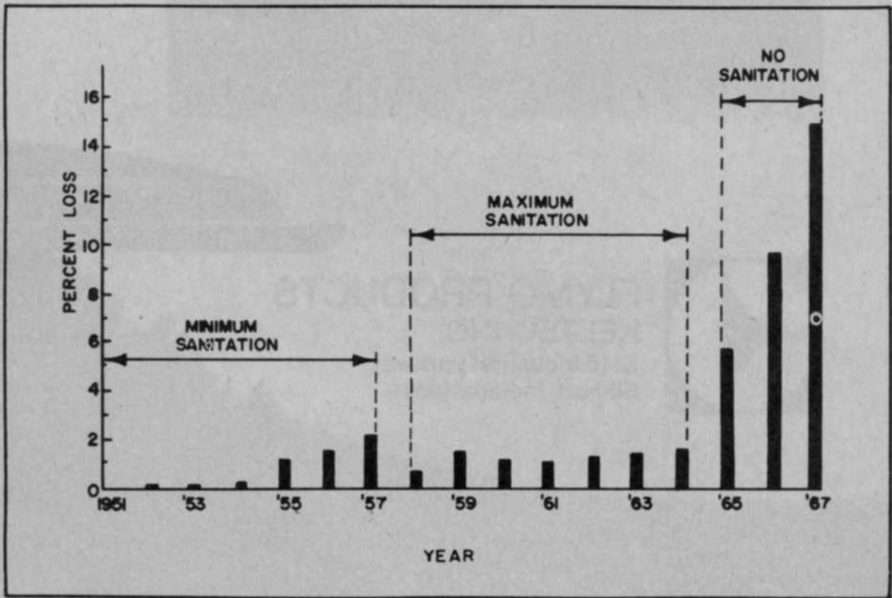
Can we be certain that such hyphal structures will be killed? Is it possible for the fungus to "ride out" the Benlate "storm" in such tissues until the chemical loses its punch, and then emerge from the "woodwork" to continue the infection process? Will the disease symptoms so visibly arrested in July and August appear, or fail to appear in the following June? These and many other questions have yet to be answered. We can say with confidence at present that fungitoxicity in elm tissue has been demonstrated beyond question only before an infection is well established.

2. *Is Benlate stable; does it or its derivatives retain toxicity?* All of the evidence points to its early transition to MBC (methyl-2-benzimidazole carbamate) reported to be fully as toxic as Benlate *per se*. On this point, the fungicide clearly meets the requirement.

3. *Is Benlate mobile?* There seems little question here that it is; certainly in upward mobility, reliable bioassay tests show that fungitoxicity can be detected in strength far from points of injection. However, as noted above, mobility can be impared by clogging of vessels, and there is evidence that this happens often with non-solubilized material. But even though mobility is now assured in the new solubilized form, can we be certain that Benlate will get into all of the branches where infection could be present? Unfortunately, even with pressure injection of the solubilized form, bioassay tests indicate difficulty in detection of fungitoxcity in many small branches where infection is possible.

4. *Is Benlate residual? Does it remain long enough in the plant system to be effective?* There is no body of reliable data on effective longevity of toxicity in elm tissue, even though it is reported to persist in some plant tissues up to 18 weeks. Unfortunately, the same physical factors that favor mobility may favor

(continued on page 71)



Sanitation is still one of the most important elements of an integrated control program. Much greater losses may be expected if it is abandoned. Photo courtesy of R.J. Campana.

people": forestry in Maryland. Cross Ties 50(9): 37-44.

5. Capps, Osal B. 1969. Urban forestry, a program to meet expanding needs. Forest Farmers 28(10): 8-9, 17-18.

6. ________. 1972. How a state helps cities, towns to plant trees. U.S. Dep. Agr. Yearbook "Landscape for living," pp. 308-309.

7. Dolberg, P. R., G. W. Grey, J. J. Nighswonger, and J. E. Rowland. 1972. Community forestry program, City of Cottonwood Falls, Kansas. Kans. State Univ. State and Ext. Forestry. 27 pp. (processed)

8. Felt, Ephraim Porter. 1942. Our shade trees. 2nd Ed., 316 pp. Orange Judd Publishing Company, Inc. New York.

9. Gallaher, Harold G. and Gene W. Grey. 1973. The Kansas Community Forestry Program. Kans. State Univ. 55 pp. (processed)

10. Georgia School of Forest Resources. 1971. The role of trees in the South's urban environment. Univ. Ga. Cent. Contin. Educ. 105 pp.

11. Grey, Gene W. 1972. The Kansas Community Forestry Program. J. Forestry 70(11): 688-689.

12. ________. 1972. A forester can help you. Kans. State Univ. Coop. Ext. Serv. L-173. 4 pp.

13. Kansas Session Laws. 1961. Cities and Municipalities: 213-215.

14. Kansas State University Cooperative Extension Service. 1973. Arbor Day. Kans. State Univ. Coop. Ext. Serv. L-241, 11 pp.

15. Little, Silas and John H. Noyes, Ed. 1970. Trees and forests in an urbanizing environment. Univ. Mass. Coop. Ext. Serv. Plan. Resour. Dev. Ser. 17. 168 pp.

16. Mixon, John W. 1971. Urban or metro forestry. Int. Shade Tree Conf. Proc. 47: 30a-32a.

17. ________. and Harry B. Sewell. 1972. Metro forestry's growing role in the urban environment. U.S. Dep. Agr. Yearbook "Landscape for living," pp. 305-308.

18. Neely, Dan and E. B. Himelick. 1972. A standard municipality tree ordinance. Int. Shade Tree Conf. 14 pp.

19. Nighswonger, James J. 1972. Plants, man, and environment. Kans. State Univ. Coop. Ext. Serv. C-448. 15 pp.

20. Reinert, George and Jim Gordon. 1971 ca. Forest resource report for the Indian River Planning Commission. Fla. Div. Forestry. 71 pp.

21. Ruckelshaus, William D. 1971. Forestry in an urbanizing society. J. Forestry 69(10): 712-714.

22. Thompson, H. E., W. G. Willis, and R. A. Keen. 1970. Dutch elm disease and its control in Kansas. Kans. State Univ. Coop. Ext. Bull. 434. 14 pp.

23. Tilford, Paul E., Ed. 1962. Kansas Arborist's Resolution. Arborist's News 27(5): 39.

These American elms, planted in a "tree monoculture," are dying from the combined forces of Dutch Elm disease and phloem necrosis, another disease. Photo courtesy of Illinois Natural History Survey.

DED *(from page 17)*

elimination from the vascular conduits through which the infecting fungus moves. Time is critical here and its significance depends on whether the treatment is designed to be preventive or curative.

If preventive, the chemical must be applied in early spring (late May or early June in most places) and remain effective over a period of 4-6 weeks (into July in most places).

If curative, initial strength and rapid mobility might be decisive factors to achieve rapid and complete toxicity to the fungus. But in postinfection application, complete toxicity to all fungus elements of an established infection is unresolved.

5. *Is Benlate phytotoxic?* In concentrations necessary to be effectively fungicidal, does it cause side effects damaging to plant tissues into which it must move as a systemic?

All reports indicate little or no phytotoxicity at levels well above those required. However, some damage is reported at unusually high dosages in applications both of emulsified and solubilized forms. Probably because the initial evidence of lack of significant phytotoxicity is so encouraging, this point has not yet been evaluated critically.

To the extent that foliar application by spraying continues to show promise for preventive control, a critical study here to establish threshold levels of phytotoxicity is essential. Also, in flushing of Benlate emulsions into drilled holes in bark and wood, with resulting encrustation of exposed tissue surface by precipitated particulate matter, there is some possibility of localized toxicity.

However, it may be difficult, to separate apparent toxicity from wound-tissue reactions and subsequent microbial colonization. Many such wounds in 1972 healed quickly; thus, localized tissue damage by chemical toxicity or trauma is not considered serious. In effect, Benlate appears to satisfy the requirement for relative non-phytotoxicity.

USE AND RESULTS

One of the most hopeful signs that a satisfactory systemic chemical may now be at hand, is the wide variety of research being done. Many pathologists are testing new techniques to put Benlate into vessels of elm, the main sites of initial infections and ultimate spread of the causal fungus throughout the tree.

When first used against Dutch elm disease, Benlate was incorporated into the soil to be absorbed by the root system of the tree. Its effectiveness by this method was based on sustained presence of the fungicide over long periods of time, in some cases exceeding a year, as well as on uniformity of distribution throughout the vascular systems of the trees. However, soil application is disadvantageous for many practical and economic reasons.

Foliar spray by mist blower at the rate of 8 pounds per hundred gallons of water was effective in preventing new infections both in Wisconsin and Michigan,[4, 5] but is not considered to have value against established infections.

Systemic fungicides applied to foliage have limited ability to move downward in woody tissues, where the causal pathogen becomes deeply established. Therefore it is not likely that infection could be arrested, unless the fungus were limited in its distribution to relatively small twigs when the chemical spray was applied. Thus, in spite of its promise, spraying is limited to prevention of infection, and has potential for environmental damage.

Stem injection of Benlate poses no environmental hazard. In addition, it is more promising against established infections than any other method. In most cases methods involve direct stem or root application of water emulsions of particulate matter, encapsulated "pills," or water-acid solubilized chemical; injections are by pressure, or gravity flow. In all cases, the chemical is introduced by mechanical devices directly to xylem vessels exposed by drilled holes or incisions.

The earliest successful stem injection technique involved the use of the Maujet injector. Thin metal tubes hammered into tree trunks to a precise depth, are designed to allow liquid flow directly to vessels exposed in the wood of the current season. With this method, success depends largely on precision of timing and positioning of tubes. Much success and many failures are reported.

From personal observations, certain disadvantages seem apparent. The method is time consuming and thus expensive; it delivers a limited amount of chemical; the emulsified chemical clogs the openings and prevents or delays absorption; feeding cups in place are subject to vandalism; and the method requires a degree of patience, understanding and precision not conducive to treatment of large numbers of trees.

In spite of this, many elms have been saved because of it, and modifications may bring enhanced efficacy. In practice, the method is most effective in prevention, but has limited success against established infections.

Perhaps the most exciting development in stem injection of Benlate was the recent use of solubilized material applied under pressure. Several laboratories have developed similar methods. In our cooperative research with the U. S. Forest Service, acid-solubilized Benlate is forced under pressure by nitrogen gas (40-70 psi) through tubing and metal feeder pipes into small incisions made by chisel in the outer one or two rings of the xylem. The fluid chemical, whose volume is based on tree diameter, moves into the tree in 20-30 minutes.

This technique has both advantages and limitations. Since the chemical is forced into the tree in a liquid form, there is a high probability of fast action, high toxicity, and wide distribution. However, it is time-consuming and costly as with the Maujet technique. Also, speed of distribution could be a liability rather than an asset, if the chemical is swept out of the tree too fast. In spite of high expectations for uniform distribution, there is some evidence suggesting difficulties here. The method was first fieldtested in 1972. Preliminary results indicate significant progress in arresting visible progress of disease, but final evaluations cannot be made until June or July in 1973.

A novel approach to stem injection was initiated in 1972 by the Elm Research Institute with which the writer is working cooperatively. Holes (½ in. diam., 2 inches deep) are drilled around the tree 6 inches apart. Iron fittings with hose nozzle attachments are screwed tightly into holes to a depth of 1-1½ inches. Hosing connecting all of the fittings is connected to a two-gallon, hand-pump garden-type spray can, then the injection is made under pressure up to 40 psi.

As with the Maujet treatment, the use of emulsified material results in conspicuous clogging of holes and vessels. Also, the bulk of the suspension is fed too deeply into the wood for maximum distribution into vessels of the current season, and most may be deposited in wood spaces of no significance for disease control. However, with solubilized Benlate, and improvement of the injection delivery, this method has much promise for the homeowner.

CURRENT RECOMMENDATIONS

But what is the commercial arborist, the municipal forester and the tree owner to make of all these new developments? How can the new information on chemical control be used to advantage? The evidence is clear that Benlate poses bright prospects for control, but caution is urged. It should be used experimentally within the provisions specified by the EPA in its approval: i.e., by trained and licensed arborists, as a productive spray or by stem injection through any method allowed by EPA. The following guidelines are suggested for maximum protection of elms not known to be diseased.

(It should be clear that all use of Benlate is still essentially experimental; these suggestions are based on limited but promising, data. Further critical research is essential before firm recommendations are warranted.)

1. Continue to practice thorough sanitation in areas of trees to be protected (i.e., eliminate dead, diseased or weakened elm wood in trees or on ground);

2. Apply dormant methoxychlor spray as recommended by USDA (i.e., at least before leaf emergence; before flower emergence is preferred);

3. Sever mechanically or treat chemically potential root graft connections between closely-spaced (50 feet) trees.

4. Apply Benlate by one of the following methods:

a. Apply foliage spray of Benlate as recommended by University of Wisconsin (8 lbs. of formulated Benlate per 100

(continued on page 74)

DED*(from page 72)*

gals. of water; 2-3 gals. per tree; mist blower recommended); or

b. Use injector tubes (Maujet type) with cups of about 2 oz. capacity; use Benlate as recommended by Virginia Polytechnic Institute and State University (2 lbs. per hundred gallons of water); or

c. Use drilled holes with nozzles, tubing and pressure spray can as recommended by the Elm Research Institute (2 lbs. per 100 gals. of water).

For therapy of diseased elms in early stages (not more than 10 percent crown visibility wilted), the following guidelines may be of interest, but little hope is currently offered for cure of such trees with chemical treatment by itself:

1. Prune the diseased branch back to the main trunk as quickly as possible; removal within 24 hours is recommended (this treatment is recommended only for single branch infections);

2. Stem inject with Benlate as indicated above with heavy application, concentrating on that side of the tree affected. If using the Maujet injector, make new injections two or three times at 10 day intervals.

As a final note of caution, chemical treatment should not be used as a substitute for sanitation, spraying, root graft treatment, or pruning out a diseas-

(continued on page 75)

Advertisers Index

Agro-Chem, Inc. 50, 74
Amchem Products, Inc. 39, 42
American Arborists Supplies 68
Asplundh Tree Expert Co. 5
Beck Mfg. Co. 10
Bermuda King, Inc. 72
Bishop Company 45
Bowie Industries 49
Samuel Cabot Co. 54
Cowbell Seeds 38
Creative Sales, Inc. 28
Davis Mfg. Co. 31
Deere & Company 9
Diamond Shamrock Corp. 3
Dow Chemical Co. 36, 37
Flymo Div., Keltec, Inc. 18
FMC Corp., Ag. Chemical Div. .. 7
FMC Corp., Ag. Machinery Div. 27
FMC Corp., Municipal & Industrial Service Equip. Div. . 29
FMC Corp., Side Winder Div. . 63
Grass Growers, Inc. 62
Hercules, Inc. 6, 64, 73
Hypro, Inc. 60
International Shade Tree Conference 70
International Spike, Inc. 25
Jacklin Seed Company 33
Jacobson Mfg. .... 2nd cover
Kay-Fries Chemicals 57
Lofts Pedigreed Seed Co. . 4th cover
Lehara Equipment Co., Inc. 58
The Lely Corp. 56
3M Company 6
Magline, Inc. 22
Manhattan Ryegrass Growers Assn. 47
J. J. Mauget Co. 61
Mitts & Merrill, Inc. 12
Mobile Aerial Towers, Inc. 64
Nalco Chemical Co. 40, 41
PBI, Gordon Corp. 68
Pennstar/Pennfine Perennial Ryegrass 69
Pennwalt Corp. 53
Rain Bird Sprinkler Mfg. Corp. .... 3rd cover
Rain Jet Corp. 22, 28
Rhodia Inc., Chipman Div. .. 15, 67
Safety Test & Equipment Co. 30
O. M. Scott & Sons 55
Servis Equipment Co. 51
Snow Company 65
Stihl American, Inc. 8
Swift Chemical Co. 11
The Toro Company 19, 20
The Toro Company, Irrigation Div. 43
Tuco Products, Ag Chem. Div. .. 46
U. S. Gypsum Co. 23
Vermeer Mfg. Co. 52
Waldon, Inc. 59

— classifieds —

When answering ads where box number only is given, please address as follows: Box number, c/o Weeds Trees and Turf, 9800 Detroit Ave., Cleveland, Ohio 44102.

Rates: All classifications 50¢ per word. Box number, $1. All classified ads must be received by Publisher the 10th of the month preceding publication date and be accompanied by cash or money order covering full payment.

HELP WANTED

NURSERY & GREENHOUSE FOREMAN. To perform skilled supervisory work in establishing and maintaining a nursery and greenhouse operations for a progressive and expanding Parks Department. Must have considerable knowledge of nursery and greenhouse management which might typically be demonstrated by possession of a Bachelor's degree in Forestry, Ornamental Horticulture, Botany or related field plus some experience in nursery or greenhouse management; or by possession of extensive experience in these fields. Salary $9,644-$12,288 depending upon experience. Send complete resume including salary requirements to: St. Louis County, Division of Personnel. 7900 Forsyth, Clayton, Missouri 63105. An equal opportunity employer.

HORTICULTURE INSTRUCTOR: Able to teach Landscape Construction, Design, Turf Establishment, Landscape Maintenance and be familiar with operation and servicing of horticultural equipment. Full time position begins June 18, 1974. Prefer B.S. Degree and minimum of 3 years field experience. Job description available upon request. Edmonds Community College is an equal opportunity employer; Minorities and women are encouraged to apply. Send resume before May 15, 1974 to Chairman, Natural Science Division, Edmonds Community College, 20000 -68th West, Lynnwood, Va. 98036. (206) 775-3511.

DISTRIBUTORS for D. J. Andrews, Inc. stump cutter teeth, pockets and bolts. Best wholesale and retail price in U.S.A. Add to this exclusive area, local advertising at our expense, etc., and you have our story. D. J. Andrews, Inc., 17 Silver St., Rochester, N.Y. 14611. Call 716 235-1230, or 716 436-1515.

SALESMAN-SUPERVISOR for Tree Department B. S. plus minimum 5 years experience. Hospitalization, vacation, pension, company car, salary plus commission. Heyser Landscaping, Inc., 400 N. Park Ave., Norristown, Pa. 19401.

SALESMAN-SUPERVISOR for tree department, minimum 5 years experience. Hospitalization, vacation, pension, company car, salary plus commission. Heyser Landscaping, Inc., 400 N. Park Ave., Norristown, Pa. 19401.

EXPERIENCED TRACTOR OPERATOR for finish grading. Good Pay — paid vacation-profit sharing. Sunrise Acres, Inc., Landscape Contractor, South Holland, Ill. Phone 312 333-3647.

EXPERIENCED LANDSCAPERS. We need four hard working men to start now. This work is in the Chicago, area. Fifty hours per week is average. Phone 312/333-3647.

SEEDS

SOD QUALITY Merion Seed for discriminating growers. Fylking, Delta, Park, Newport, Nugget, Adelphi, Cheri, Glade and Baron bluegrasses as well as fine fescues. Also Manhattan fine leaved rye grass. We will custom mix your specifications. Michigan State Seed Co., Div. of Vaughan-Jacklin Corp., Grand Ledge, Michigan 48837. Phone No. 517 627-2164.

FOR SALE

DOUBLE EDGE sod cutter blades. Will fit any Ryan sod cutter. Works like double edge razor blade. Cuts much more sod per blade. Made to bolt on both ways. $24.00 plus postage. New automatic sod loaders for direct loading to pallets, trucks or trailers. No workers needed on ground. Both products developed and designed by Hadfield. Write or call Glen Hadfield, 4643 Sherwood, Oxford, Michigan 48051. Phone 313 628-2000.

SOD BLADES for Ryan, Brouwer, Beck. 12" to 18" heavy duty—$15.95, 24"—$17.95. Cut-off blades 12", 15", 16", 18"—$6.00, 20", 24", 26"—$8.00. All prices F.O.B. factory. Please write for complete literature. Money back guarantee. R & R Products, 3334 E. Milber, Tuscon, Arizona 85714. Phone 602 889-3593.

ARPS stump cutter teeth, top quality and best price in U.S.A., D. J. Andrews, Inc., 17 Silver St., Rochester, New York 14611. Call 716 235-1230.

USED EQUIPMENT

24" REBUILT RYAN sod cutter and roller, $1500.00. 24" Daymon sod roller, $1900.00. Two side mount sod conveyors for loading trucks, $100 each. Model 3000 Motorola base station with two mobile units and antenna, $1000.00. Green Acres Turf Farm, Inc., Mason, Michigan 48854. Phone 517 676-2362.

FOR SALE: Sprayers: used and new; hydraulic and mist, all makes; Royal 20, 35, and 55 pumps. Used rotomist parts, big discount! Phone: 313 6655-338 or 313 662-3507. Write: Ralph McFarland, 209 Pleasant Place, Ann Arbor, Michigan 48103.

1972 JOHN BEAN Roto-Mist 100, 300 gallon stainless steel tank, like new, less than 50 hours on machine. Over $8,000.00 new, will sacrifice at $5,500.00. Contact Tom Williams, Cheshire Tree Service, Cheshire, Conn. 06410. Phone 203 272-0391.

70 PIECES—30' x 4" aluminum irrigation pipe. Tico-Wade couplers. Risers and sprinklers available. 4 years old. $24.00 per piece. Green Valley Turf Farms, Box 163, Canfield, Ohio.

SKID-MOUNT SPRAYER, like new, 300 gallon, 12 horsepower B. S. engine, high pressure hose, electric reel, $1,095.00. Phone 612 929-1070; 854-3508.

MISCELLANEOUS

TREE APPRAISALS, SURVEYS, loss evaluations and expert consultation services. For names of members of the American Society of Consulting Arborists, Inc., throughout the country, contact: Executive Director ASCA, 12 Lakeview Ave., Milltown, New Jersey 08850.

DED *(from page 74)*

ed branch, but as a supplement. Benlate and other systemic chemicals are on trial; prospects for control have never seemed better than at the present time, but only careful study and cautious evaluation can resolve the questions raised. In the final analysis, the record will speak for itself. □

REFERENCES CITED

1. Campana, R. J., *et al.* 1956. Guide for communitywide control of Dutch elm disease. Midw. Chap., I.S.T.C. Broch. 35 pp.
2. Campana, R. J. 1968. Dutch elm disease: a matter of priorities. Trees, Weeds and Turf 7(8): 6-11,-24-26, 37.
3. Campana, R. J. 1969. Systemic fungicides for control of tree disease. Proc. Fifth Ann. Mtg., Soc. Municip. Arborists, Providence, R. I. (Reprinted in Trees Mag. 30(5), 4 pp. 1970).
4. Hart, J. 1972. Control of Dutch elm disease with foliar applications of benomyl. Pl. Dis. Rptr. 56(8): 685-688.
5. Smalley, E. B. 1971. Prevention of Dutch elm disease in large nursery elms by soil treatment with benomyl. Phytopath. 61: 1351-1354.