Dutch Elm Disease: Biology and Control of Vectors in Michigan
Michigan State University Agricultural Experiment Station and Cooperative Extension Service
Research Report

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SUMMARY OF
TECHNICAL RESEARCH

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Dutch Elm Disease:

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TECHNICAL Information

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by

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INTRODUCTION

This report is a brief summary of research work on Dutch Elm Disease done at Michigan State University.

A more detailed report will be published in the near future. Following is a listing of the contents of the more detailed report.

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During the period 1964-1973, the biology and control of the Dutch Elm Disease vectors *Scolytus multistriatus* Marsham and *Hylurgopinus rufipes* (Eichoff) were investigated in Michigan. This report consolidates and summarizes this research.

Biology

Life history and seasonal distribution studies were conducted on both *S. multistriatus* and *H. rufipes* on the Michigan State University (MSU) campus. Both beetles had one and a partial second generation per year. Emergence of *S. multistriatus* began the middle of May and peaked the first of June. Emergence of *H. rufipes*, although variable, commenced generally in July, peaking at the end of the month or the first of August.

The feeding behavior of *S. multistriatus* was observed in relation to its habits, physical characteristics of the twig crotch, and duration. Generally, most feeding on twig crotches occurred during the first two weeks after emergence. Feeding attack rate increased linearly from the bottom of the tree to the top, indicating a preference for the upper tree region. The size of the angle between the main and lateral member of a twig crotch had no influence on feeding. However, twig crotches with a more rounded base were significantly associated with lateral feeding compared to central feeding.

Biological Control

The most frequently collected parasites of *S. multistriatus* were *Entedon leucogramma* (Ratz), *Spathius canadensis* Ashmead, *Trigonura ulmi* Burks, and the nematode *Parasitaphelenchus oldhami* Ruhm.

The native European parasite of *S. multistriatus*, *Dendrosoter protuberans* (Ness) Wesm., was successfully mass reared in the laboratory and several thousand released in the East Lansing area during the period between September 1965 and October 1966.

The life cycle of *D. protuberans* under controlled conditions was approximately 26 days. The male to female ratio was found to be 1:2. The female was generally fertilized immediately upon emergence. The adult parasite was found to live significantly longer when supplied with a cane sugar diet, compared to four diet alternatives.

The ability of *D. protuberans* to survive Michigan winters was demonstrated by both supercooling and actual field releases. Studies of tree influence on actual temperature exposure indicates greater potential survival of the parasite and its host in the south facing branches of standing trees. The northern distribution for *D. protuberans* and *S. multistriatus* may be expected to coincide with the entire lower peninsula, but increased winter mortality probably occurs in extremely cold areas.

A trend index was developed to determine optimum susceptibility of *S. multistriatus* larvae to parasitization by *D. protuberans*. Peak parasitism occurred between the fourth and sixth week after beetle infestation.

D. protuberans effectiveness was found to be severely limited by bark thickness and correlated with tree diameter at breast height. In the smallest branches the parasites ovipositor could only reach 50% of the cambial area with the percentage decreasing with increasing branch size. *S. canadensis* was shown to have approximately the same length ovipositor, suggesting that possible interspecific competition was occurring. This competition for the same host resource may account for the lack of success in establishing the new parasite in the study area.

Emergence of *D. protuberans* began in early April and two generations per year were observed on natural *S multistriatus* populations. Following the initial field release in St. Charles, Michigan, the parasite was collected both in trap-logs and logs from standing trees. After these initial collections only one specimen of *D. protuberans* was collected the same fall, and no further recoveries were made in rotary traps or in logs from standing trees. Rotary traps were found to be less efficient for sampling *E. leucogramma* flight activity than for *S. canadensis*.

A reliable method of sampling closed crown American elms was developed which give estimates within 20% of the total *S. multistriatus* egg-galleries present. This method is applicable only for research studies since it requires intensive sampling of each tree.

The analysis for possible density-dependent regulation of *S. multistriatus* by the native parasites revealed that both *E. leucogramma* and *S. canadensis* had no effect on the observed beetle density-dependent regulation. Both parasites together accounted for 2% of the observed 96.1% total beetle mortality. No increase in parasitism with increasing host density was observed. The operation of other non-selective mortality factors completely masked any regulatory properties of the parasites. Intraspecific competition, woodpecker predation and desiccation were examined for their role in the observed regulation. Competition was shown to be of little importance. The remaining two mortality factors, woodpeckers and desiccation, are interrelated and their effects were not quantified in this study.

Chemical Control

Elm trees on the MSU campus have undergone a rigorous and well planned control program yearly since 1958. DDT use was replaced in 1967 with methoxychlor.

In 1964, research began on several systemic insecticides for Dutch Elm Disease vector control. Bioassays were conducted on *S. multistriatus* and *H. rufipes* using six inch twigs removed at random from test trees. Because of significant variation in the effectiveness of individual insecticides, results of the study were inconclusive. Twig and dead beetle residue analysis were performed. The chemicals were detected in the twigs and beetles but the quantities necessary to produce mortality were not known. Signficiant discoloration of inner bark and sapwood resulted when several of the candidate insecticides were injected into the trees.

Residue analysis of the soil around treated trees and water samples from the Red Cedar River were made. Significant amounts of DDT and methoxychlor were found.

In 1969 and 1970, mist blower and helicopter applications were evaluated by residue analysis and feeding trials using S. *multistriatus*. Overall, the mist blower was the more effective application method. It delivered 4 to 6 times more spray to each tree (2 to 3 gallons), reached twice as many feeding sites and gave between 80 and 90% protection during the first 10 weeks after spraying, as compared to 15 to 30% for the helicopter. The helicopters' spray input to the environment is considerably lower (2 quarts per tree), which should be considered when environmentally hazardous insecticides are used. In addition, helicopter application is 2 to 3 times cheaper than the mist blower method, requires less manpower, and completes the job in a shorter time. However, the helicopter method gave inferior protection.

If you would like to receive a copy of the detailed report please ask for Research Report 354, "Dutch Elm Disease: Biology and Control of Vectors in Michigan," and send your request to:

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