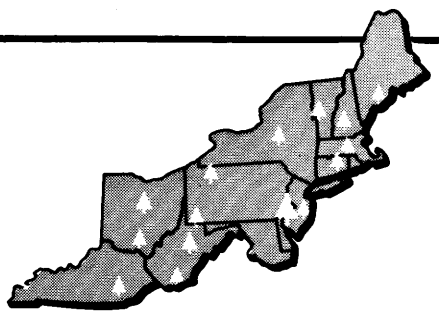
USDA FOREST SERVICE RESEARCH NOTE NE-179

1973

Northeastern Forest Experiment Station



FOREST SERVICE, U.S. DEPT. OF AGRICULTURE, 6816 MARKET STREET, UPPER DARBY, PA. 19082

EFFECT OF DEFOLIATION ON CARBOHYDRATE CONTENT OF YELLOW-POPLAR SEEDLINGS

Abstract. — Sixty yellow-poplar seedlings were divided into two groups. One group was defoliated twice, and the second group served as the control. Three months after the second defoliation there was no difference in carbohydrate content between the defoliated and undefoliated seedlings in either the stems or roots.

Fusarium solani (Mart.) App. & Wr. emend Synd. & Hans. is a pathogen on hosts weakened by stress factors such as drought (*Dochinger and Seliskar 1962; Skelly and Wood 1966; True and Tryon 1956*). Recently, it has been suggested that, when trees are placed in a stress condition, a change in the carbohydrate composition of the tree may occur, making it more susceptible to fungal attack (*Parker 1970*). Our study was conducted to determine whether or not defoliation would alter the carbohydrate composition of yellow-poplar (*Liriodendron tulipifera* L.) seedlings. If a change in the carbohydrate composition is found, this study will serve as a guide for further pathogenicity studies of *F. solani.*

Materials and Methods

Sixty vigorous 1-year-old yellow-poplar seedlings were selected and placed on a greenhouse bench in a completely randomized design. Half of the seedlings were assigned to the defoliation treatment, and half were assigned to the nondefoliation treatment. The defoliation treatment, which was applied on June 1 and July 6, consisted of removing all leaves from the seedlings except the terminal leaves.

The plants were harvested in October. The stems or roots in each group were divided into six groups, dried overnight at 80° C., ground in a Wiley mill to pass through a 20-mesh screen, and stored at room temperature in sealed bottles.

To analyze the samples, 0.5 g. of ground material was placed in an extraction thimble and extracted with 100 ml. of 80 percent ethyl alcohol for 4 hours. The extract was concentrated and clarified according to the procedure of Siminovitch, Wilson, and Briggs (*1953*). The reducing sugars were determined by Nelson's test, and the sucrose concentration was determined by Noggle's procedure (*1953*). The starch content of the residue was measured by the procedure of Smith, Paulsen, and Raguse (*1964*).

Table 1.—*Carbohydrate content in stems and roots of defoliated and nondefoliated yellow-poplar seedlings*

Treatment	Reducing sugars[a]		Sucrose[a]		Starch[a]	
	Stem	Root	Stem	Root	Stem	Root
Nondefoliated	6.5	5.9	3.7	7.0	28.8	45.9
Defoliated	6.6	7.3	3.5	4.2	26.0	42.5
Average	6.6	6.6	3.6	5.6	27.4	44.2

[a] mg./0.5 g. sample.

Results and Discussion

The results of the carbohydrate analyses are given in table 1. Analyses of variances were completed on all the stem and root carbohydrate fractions. No significant differences were found between the defoliated and nondefoliated seedlings. However, the starch content was severalfold higher than either the reducing sugar content or the sucrose content. The starch and sucrose content in the roots was higher than it was in the stem.

Although Parker (*1970*) reported that two defoliations caused a reduction in food reserves in sugar maple seedlings, and Parker and Houston (*1971*) observed that defoliated sugar maple trees had lower root extractives than nondefoliated trees, our defoliation treatments did not reduce the carbohydrate content in the yellow-poplar seedlings.

These differences may be due to the different lengths of time between the final defoliation and the harvesting of the seedlings. Parker harvested his seedlings 1 month after the final defoliation, whereas the seedlings in our study were harvested 3 months after the final defoliation. Parker and Houston harvested their seedlings 2 to 6 weeks after defoliation. Parker found no significant reduction between his control treatment and seedlings harvested 2 months after one defoliation.

The stress treatment, defoliation, did not cause a change in the carbohydrate content in yellow-poplar seedlings under the conditions in this investigation. Additional investigations are needed with more severe treatments and different sampling times before a correlation between defoliation and change in carbohydrate content can be made. After this relationship is defined, studies between stress conditions and fungal attack can be made to determine whether or not any relationship exists between carbohydrate content of the host and fungal attack by *F. solani*.

References

Dochinger, L. S., and C. E. Seliskar.
1962. FUSARIUM CANKER FOUND ON YELLOW-POPLAR. J. Forest. 60: 331-333.

Noggle, G. R.
1953. THE USE OF CATION-EXCHANGE RESINS FOR THE HYDROLYSIS OF SUCROSE IN PLANT EXTRACTS. Plant Physiol. 28: 736-740.

Parker, J.
1970. EFFECTS OF DEFOLATION AND DROUGHT ON ROOT FOOD RESERVES IN SUGAR MAPLE SEEDLINGS. USDA Forest Serv. Res. Pap. NE-169, 8 p.

Parker, J., and D. R. Houston.
1971. EFFECTS OF REPEATED DEFOLIATION ON ROOT AND ROOT COLLAR EXTRACTIVES OF SUGAR MAPLE TREES. Forest Sci. 17: 91-95.

Siminovitch, D., C. M. Wilson, and D. R. Briggs.
1953. STUDIES ON THE CHEMISTRY OF THE LIVING BARK OF THE BLACK LOCUST IN RELATION TO ITS FROST HARDINESS. V. SEASONAL TRANSFORMATIONS AND VARIATIONS IN THE CARBOHYDRATES STARCH-SUCROSE INTERCONVERSIONS. Plant Physiol. 28: 383-400.

Skelly, J. M., and F. A. Wood.
1966. THE OCCURRENCE AND ETIOLOGY OF AN ANNUAL CANKER OF SUGAR MAPLE IN PENNSYLVANIA. Can. J. Bot. 44: 1401-1411.

Smith, D., G. M. Paulsen, and C. A. Raguse.
1964. EXTRACTION OF TOTAL AVAILABLE CARBOHYDRATES FROM GRASS AND LEGUME TISSUE. Plant Physiol. 39: 960-962.

True, R. P., and E. H. Tryon.
1956. OAK STEM CANKERS INITIATED IN THE DROUGHT YEAR 1953. Phytopathology 46: 617-622.

—KEITH F. JENSEN*
ROBERTA G. MASTERS

* Jensen and Masters are plant physiologist and biological laboratory technician, respectively, USDA Forest Service, Northeastern Forest Experiment Station, Forest Insect and Disease Laboratory, Delaware, Ohio 43015.

MANUSCRIPT RECEIVED FOR PUBLICATION 14 FEBRUARY 1973