DIEBACK AND ABNORMAL GROWTH OF YELLOW BIRCH INDUCED BY HEAVY FRUITING

by

H. L. GROSS and A. A. HARNDEN

FOREST RESEARCH LABORATORY

ONTARIO REGION

SAULT STE. MARIE, ONTARIO

INFORMATION REPORT O-X-79

CANADA

DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT

FORESTRY BRANCH

MAY, 1968

Copies of this report may be obtained from

Director, Ontario Region,
Canada Department of Forestry and
Rural Development,
P.O. Box 490,
Sault Ste. Marie, Ontario.

TABLE OF CONTENTS

INTRODUCTION[1]

In 1967, mature and over-mature yellow birch (Betula alleghaniensis Britt.) produced abnormal or underdeveloped foliage, giving tree crowns a "thin" appearance. This condition was first noticed in July by several district technicians of the Insect and Disease Survey Section, Canada Department of Forestry and Rural Development, Ontario Region. They reported that the flush of yellow birch foliage was unusually sparse, and eventually similar reports of birch with thin crowns were received from most districts throughout the range of birch in Ontario. The condition was detectable by aerial reconnaissance and appeared to be present wherever mature yellow birch occurred. White birch (Betula papyrifera Marsh.) appeared similarly affected, but this species was not extensively sampled.

This noticeable condition of birch crowns was also observed by many foresters and woods workers, who were concerned with the probable impact of the condition and requested information concerning cause. Inquiries were also directed to the Forest Research Laboratory from district offices of the Ontario Department of Lands and Forests.

First observations revealed that an exceptionally large crop of seed was being produced by birch and crowns appeared thin because the foliage was dwarfed or absent in heavily seeded crown areas. Affected crown portions remained thin throughout the entire season.

Defoliation can have drastic effects on the physiology of trees. Giese, Kapler and Benjamin (1964) showed that defoliating sugar maple (Acer saccharum Marsh.) during a critical period from mid-June through August, could cause disease symptoms characteristic of maple blight.

---

[1]Authors are Disease Survey Officer and Associate Technician Supervisor, Entomology, respectively, Insect and Disease Survey Section, Ontario Region, Canada Department of Forestry and Rural Development.

That this condition could possibly represent an early stage of the birch dieback disease was not overlooked. That disease caused widespread mortality of birch in the forests of Quebec and the Maritimes during the late 1940's and early 1950's. Heavy seeding was not associated with the birch dieback disease, symptoms of which were described in the Symposium on Birch Dieback (1953). The symptomatology of the birch dieback disease was also checked by personal communication with several pathologists who were familiar with that disease. Subsequent use of the term dieback in this report refers to the symptom dieback and not the disease birch dieback.

This information report is an attempt to describe the crown conditions which were observed in 1967 and to explain the dieback conditions which are expected to develop in 1968.

DESCRIPTION OF FIELD METHODS

In August, several study plots were established in Division 36 of the Sault Ste. Marie Forest District to appraise the problem. This area was chosen because of the high value of yellow birch stands present and the ease of accessibility. Detailed field observations were made at the sites of cutting operations by Weyerhaeuser of Canada Limited. Stands which had been heavily defoliated by a Dimorphopteryx sawfly in August, 1966 were avoided. Trees were rated for the percentage of crown appearing thin or dead, and cone production was determined by counting the numbers present on 2-ft. branch tips (see Table 1). Crown thinness was visually rated from the ground and several trees were felled at each location to confirm the accuracy of ratings. Trees were examined during the 1967-68 dormant season by rating five branches from the upper crown of each tree for vegetative and reproductive tissue growth.

SEED PRODUCTION AND FLOWERING

Both male and female flower development was heavy in 1967. Four over-mature trees were examined early in August to rate male flower production. At that time catkins were still attached to the shoots and cones were developing. In general, three to four catkins per terminal were present on all shoots inspected (400). Catkins, which bloomed in 1967, were missing when the trees were sampled during the dormant season; however, the tips of the shoots to which catkins had been attached were still present (see Figs. 1 and 2). During the dormant season 330 additional terminals were examined, of which 96% produced catkins, 3% were indeterminate and 1% did not produce catkins. In other words, all trees rated had produced large numbers of male catkins. Catkins were almost non-existent when the trees were examined during the 1967-1968 dormant season.

Cone production was considered a good indication of female flower production. Cones developed at 95% of the bud sites in the crowns of mature and over-mature yellow birch (see Table 2), indicating that female flowers must have been present at practically every bud site. Figures 3 and 4 show the heavy cone production by one of these trees as it appeared in January, 1968.

Comparative data are not available to indicate if this amount of flowering is abnormally high, but it is difficult to visualize how it could have been much greater. Flower initials are developed in the year previous to flowering; so it is possible that the impetus for heavy seeding took place in 1966. Red maple (Acer rubrum L.), sugar maple (A. saccharum), black spruce (Picea mariana (Mill.) B.S.P.), white spruce (Picea glauca (Moench) Voss) and balsam fir (Abies balsamea (L.) Mill.) also produced large crops of seed in 1967 indicating that conditions favouring seed production did not only affect birch.

Yellow birch reportedly produces good seed crops every 1 or 2 years (Fowells, 1965). The Ontario Department of Lands and Forests began trapping seed as part of seed-bed preparation studies in 1966 and some of their data pertinent to this report are summarized in Table 4. Total seed measured in 1967 was eight times greater than in 1966, a year which foresters regarded as a good seed year. Benzie (1959), in a study of seed dispersal from a fully stocked northern hardwood stand, trapped an average of 1,330,000 birch seeds per acre at the edge of a clear-cut area during a good seed year; therefore, 1966 was a good seed year as an average of 3,508,000 birch seeds per acre was trapped in the Ontario studies.

VEGETATIVE GROWTH

Growth from lateral buds frequently results in the production of a rosette of two or three leaves, a single bud, and occasionally a cone. This type of twig is frequently referred to as a spur. Spurs below the heavily seeded crown areas did not flush to shoot growth as frequently happens when birch is damaged by other agents.

Most buds in the upper crowns of heavily seeded trees developed negligible shoot growth. Usually the only stem growth in these crown portions was the short stubs which supported cones, as indicated by comparing terminal extensions of 1966 with 1967 (see Table 3). Less than 1% of the terminals developed small shoots which lacked vigor (see Fig. 2). Buds were generally lacking on the short stubs to which cones were attached in all of the mature and over-mature trees examined. Some younger trees developed cones on short stubs which lacked buds, but most young vigorous trees in the 50- to 100-year-old class developed terminal shoots with some buds (see Table 2).

Leaves in heavily seeded crown areas were usually small and rarely developed to more than one-quarter normal size. This apparently contributed to the poor bud production since the very little food produced was used for seed development. Thinness of foliage was rated according to the percentage of total crown affected, as shown in Table 1, thinness was associated with heavy seed production as indicated by the number of cones per 2-ft. branch section. The physiologic demands of seed production were probably responsible for the poor vegetative growth.

NECROTIC AREAS

Most shoots associated with heavy fruiting, when examined during the dormant season, appeared green and succulent. This included the short stubs to which cones had been attached but which lacked buds and virtually lacked foliage during the growing season (see Figs. 1 and 2). However, a wide variety of bacteria and fungi were recovered from these apparently healthy tissues, particularly the 1966 and 1967 shoot extensions, when isolations were made during the dormant season. Older branch sections (1/2 in. diameter or larger) usually failed to yield any organisms. Some necrosis was evident in the smaller twigs, but this was usually confined to the twig tip. The tip of the shoot to which catkins had been attached was always dead but usually remained (see Fig. 1). These tissues were also sampled and the same variety of organisms were generally present.

CONCLUSIONS AND PROGNOSIS

The heavy crop of seed produced in 1967 is considered to have been responsible for poor vegetative growth in the crowns of numerous mature and over-mature birch trees in Ontario. In these trees, it is expected that branch tips will die back to the first healthy buds usually found

on the spurs which developed normal foliage in 1967. In most instances, the dying back is expected to be confined to the peripheral 2 to 3 feet of crown.

In the past, birch has shown good recovery from the ravages of ice storms, defoliation, drought and some diseases. Crown recovery is expected to develop through the flushing of epicormic buds and buds on spur shoots below necrotic areas. Heart-rots are not expected to develop if the dieback is confined to small branches.

Seed production in 1968 will be low. Male catkins are almost completely lacking on the trees examined. Birch seed-bed preparation and other forest management decisions should consider the low seed production potential for 1968.

The dieback condition and abnormal growth herein described is considered to be caused by the lack of sufficient food to develop normal vegetative growth and also produce an exceptionally large crop of seed. Food reserves were probably depleted in 1966 by the production of a heavy seed crop. Then in 1967 the food supply for developing an enormous amount of seed dominated the supply for vegetative growth.

ACKNOWLEDGEMENTS

The cooperation and assistance of the Ontario Department of Lands and Forests and the Woodlands Division of Weyerhaeuser of Canada Limited is gratefully acknowledged.

LITERATURE CITED

Benzie, J.W. 1959. Sugar Maple and Yellow Birch Seed Dispersal from a Fully Stocked Stand of Mature Northern Hardwoods in the Upper Peninsula of Michigan. U.S. Forest Serv., Lake States Exp. Sta. Tech. Note 561. 1 p.

Canada Department of Agriculture. 1953. Report of the Symposium on Birch Dieback. Part 1 and 2. 182 p. Chairman J.E. Bier.

Fowells, H.A. 1965. Silvics of Forest Trees of the United States. U.S. Dept. of Agriculture. Forest Service. Agriculture Handbook No. 271. 762 p.

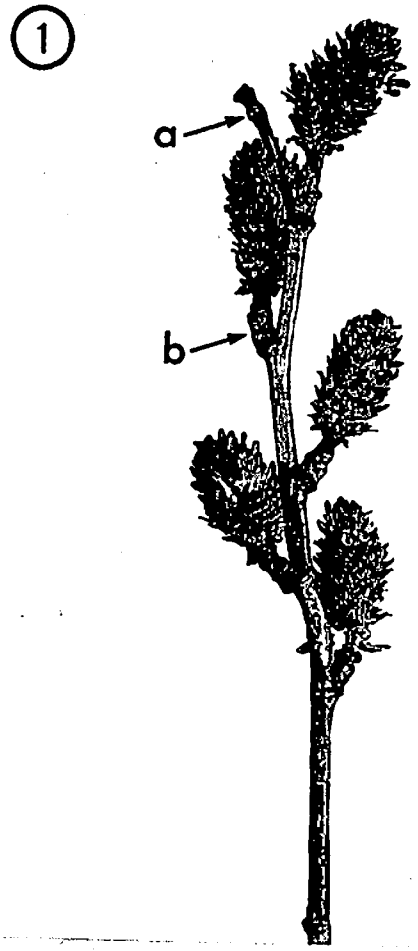
Giese, R.L., J.E. Kapler and D.M. Benjamin. 1964. Studies of Maple Blight. Part IV. Defoliation and the Genesis of Maple Blight. Univ. of Wisconsin. Research Bull. 250:81-114.

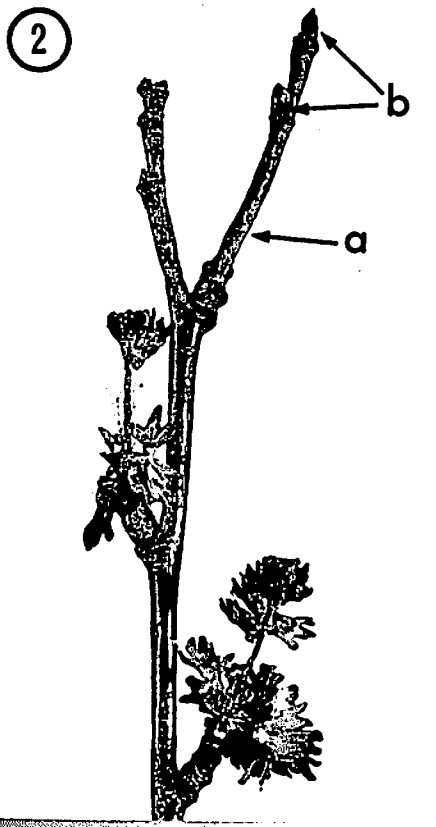
Fig. 1 A branch terminal from the heavily seeded portion of an over-mature yellow birch tree. Both 1967 and 1966 growth is shown. (a) Dead tip to which catkins had been attached. (b) Short spurs (1967 growth) which developed cones but on which foliage was dwarfed or lacking in 1967.

Fig. 2 A branch terminal similar to that shown in Fig. 1 but which developed a short atypical shoot in 1967, (a). Note the small abnormal size of the buds developed, (b).

Fig. 3 A heavily seeded crown section of the tree shown in Figure 4. Dieback is expected to average 2 to 3 feet in these branches.

Fig. 4 An over-mature yellow birch, as it appeared in January 1968, typical of the trees which had thin foliage in their upper crowns in 1967 owing to heavy seed production.


1
a
b


2
b
a


3


4

TABLE 1

Crown characteristics of mature and over-mature yellow birch examined August, 1967, Sault Ste. Marie District, Ontario

Location	No. of trees examined	Percentage of crown rated thin		Average number of cones per 2-ft. branch
		average	range	
Twp. 28 Rge. 14 Lot 2 Con. 3	11	75	20-90	124
Twp. 28 Rge. 14 S.W. side Huff Lake	26	40	5-90	64
Twp. 28 Rge. 13 Lot 3 Con. 2	28	75	20-90	174

TABLE 2

Birch cone production 1967, Sault Ste. Marie District, Ontario

Yellow birch 200 yrs. + old	Tree no.	Av. no. of bud sites per 1966 terminal shoot (A)	Av. no. of cones produced per 1966 terminal shoot (B)	Column A in % of B
	1	3.3	3.3	100
	3	3.9	3.8	97
	4	2.7	2.7	100
	5	4.6	4.3	94
	8	2.7	2.6	96
	10	3.7	3.3	89
	11	2.9	2.6	90
Average		3.4	3.2	95
Yellow birch 50 - 100 yrs. old				
	2	5.6	5.5	98
	6	4.4	2.4	55
	7	3.4	3.3	97
	9	4.0	1.1	28
Average		4.3	3.1	72
White birch 50 - 100 yrs. old				
	12	1.9	1.6	84
	13	1.9	2.0	105[a]
	14	2.2	0.4	18
Average		2.0	1.3	69

[a]Several white birch trees have been observed which developed two cones at some of the bud sites.

TABLE 3

Birch terminal growth and bud production evaluated in the dormant season 1967-68, Sault Ste. Marie District, Ontario

Yellow birch 200 yrs. + old	Tree no.	Av. terminal extension (inches) 1966	1967	% of terminals developing shoot growth in 1967	Av. shoot growth in 1967 (inches)	% of terminals with buds for 1968
	1	4.6	0.1	0	0	4
	3	4.4	0.2	4	1.1	4
	4	2.5	0.1	0	0	0
	5	5.5	0.4	12	1.2	16
	8	3.6	0.1	0	0	4
	10	2.1	0.1	0	0	0
	11	4.7	0.1	0	0	0
Average		3.9	0.2	1	1.2	4
Yellow birch 50 - 100 yrs. old						
	2	5.8	0.1	0	0	4
	6	7.2	0.9	25	3.4	84
	7	3.9	0.1	0	0	0
	9	5.4	0.1	0	0	100
Average		5.3	0.3	6	0.8	47
White birch 50 - 100 yrs. old						
	12	2.4	0.3	4	1.8	88
	13	2.6	0.3	0	2.7	100
	14	3.6	0.1	32	2.7	100
Average		3.1	0.2	12	2.4	96

TABLE 4

Data[b] from yellow birch seed trapping studies interpreted to show volume of seed deposited per acre

	Location Algoma District, Ontario	Seeds per acre 1966-67	Seeds per acre 1967-68
1.	Thelano A Twp. 29 Rge. 14	3,882,000	29,008,000
2.	Thelano E " " " "	4,842,000	36,067,000
3.	Thelano H " " " "	2,954,000	20,433,000
4.	Ryan 1964 Ryan Twp.	3,589,000	30,495,000
5.	Ryan 1966 " "	2,274,000	27,031,000
	Average	3,508,000	28,607,000

[b]Data supplied by Harry Graham, Management Forester, Sault Ste. Marie District, Ontario Department of Lands and Forests.