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by

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NOTES ON HYLPOXYLON CANKER OF ASPEN IN ALBERTA

By J. A. BARANYAY[1] Oxf. 172.8:176.1 Populus

ABSTRACT

The rate of canker growth, caused by HYPOXYLON PRUINATUM *(Klotzsch)* Cke. (H. MAMMATUM *(Wahl.) Miller) and the intensification of the disease were investigated on trembling aspen,* POPULUS TREMULOIDES *Michx. in Elk Island National Park, Alberta. In 1963, 45.1 per cent of the trees on a 1/3-acre plot were either killed or infected. This number increased to 49.0 per cent during the following three years. All stem cankers were located below the 9 foot level and 75.0 per cent were facing north or northeast. The disease was not confined to a particular crown class. Infected trees were killed in 4 to 8 years. Fifteen cankers were sectioned to study the nature of canker growth. The rate of girdling was not related to either the diameter or dominance of the tree. The cankers grew at a faster rate on dominant and co-dominant trees during the initial year of infection than on intermediate and overtopped trees. The disease did not cause increment loss during the infection period.*

EXTRAIT

Enquête sur le Peuplier faux-tremble, POPULUS TREMULOIDES *Michx. au Parc National d'Elk Island (Alberta) pour déterminer le taux d'expansion et l'intensification du Chancre hypoxylonien,* HYPOXYLON PRUINATUM *(Klotzsch) Cke.* (H. MAMMATUM *(Wahl.) Miller).*

En 1963, sur rune parcelle d'1/3 d'acre, 45.1 p. 100 des arbres étaient morts ou infectés. Trois ans après, ce chiffre avait atteint 49 p. 100. Tous les Chancres sur la tige se situaient à moins de 9 pieds audessus du sol et 75.0 p. 100 d'entre eux faisaient face au nord ou au nord-est. La maladie ne se limitait pas à une classe particulière de houppiers. Les arbres infectés succombaient dans 4 à 8 années. Quinze Chancres ont été sélectionnés en vue d'étudier leur processus d'évolution. Le taux d'annélation n'avait aucun rapport avec le diamètre ou la dominance de l'arbre. Pendant la première année d'infection, le Chancre progressait à un taux plus accéléré chez les arbes dominants et co-dominants que chez les sujets intermédiaires ou dominés. La maladie n'inhibait aucunement l'accroissement en diamètre durant la pèriode d'infection.

INTRODUCTION

Hypoxylon pruinatum (Klotsch) Cke. (*H. mammatum* (Wahl.) Miller) was found throughout the range of trembling aspen (3), *Populus tremuloides* Michx., in Alberta, with the exception of the Sub-alpine Forest Region of the Rocky Mountains. The highest incidences of the disease were recorded from the Mixedwood and Aspen Grove Sections of the Province (5). The allowable

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annual cut for aspen and balsam poplar amounts to 474 million cubic feet in Alberta, which is the highest for poplars in Canada (6). Although various authors have studied the damage caused by *H. pruinatum,* information is not available concerning the characteristics of the damage and rate of canker growth in Alberta. An investigation was therefore initiated in 1963 to study these factors in the epidemiology of *H. pruinatum.* The results are reported in this paper.

Materials and Methods

In 1963 a permanent sample plot, 100x125 feet, was established in an aspen stand, heavily infected with *H. pruinatum,* in the Elk Island National Park of central Alberta. The sample plot was located in a pure aspen patch with light understory of *Rosa Amelanchier* and *Spiraea* spp. Balsam poplar, *Populus balsamifera* L., and willow, *Salix* spp., occupied the nearby moist depressions. The average age of the stand was 24 years with a range of 19-26 years and the height averaged 32 feet ranging from 14 to 45 feet. Fifty-one standing aspen trees were recorded on the sample plot, representing a combined volume of 238 cubic feet per acre. The height-age relationship of the stand indicated that the site was of average productive capacity (8). All trees on the plot were tagged, their height, d.b.h. and crown class recorded and the stem and branch cankers tallied. The center of initial infection of each stem canker was marked with an aluminum tag. The axial growth, both below and above the infection court, and the circumferential growth was measured for each canker. The height from the ground and orientation of the stem cankers were also noted. The sample plot was re-examined in 1966.

Fifteen trees killed in 1966 were cut from within and outside the sample plot, and the hypoxylon cankers were sectioned to study the rate of canker growth and its effect on annual increment. Mortality was attributed to the infection only if complete girdling had occurred. Increment borings were obtained from 21 healthy trees of the same aspen clone of comparable age and crown classes outside the sample plot in order to compare the growth between healthy and infected trees.

Results and Discussion

In 1963, 23 of the 51 trees were either killed or infected (45.1 percent); in 1966 this number increased to 25 (49.0 per cent). Neither mortality nor infection were confined to a particular crown class, but 15 of the 24 dominants and codominants were affected by the organism as compared to 8 of the 27 intermediate and overtopped (Table I). Host suppression did not appear to be a predisposing factor. These results contradict the findings of Lorenz and Christensen (9) but support Anderson's statement (1) that dominant and suppressed trees are equally susceptible in the Lake and Central States of the United States.

TABLE 1
THE INCIDENCE OF INFECTION AND MORTALITY IN TREES OF DIFFERENT CROWN CLASSES IN 1963 AND 1966

Condition	Crown Classes												Total		
	Dominant			Codominant			Intermediate			Overtopped					
	1963	Change	1966	1963	Change	1966	1963	Change	1966	1963	Change	1966	1963	Change	1966
Healthy	8	0	8	1	0	1	11	—1	10	8	—1	7	28	—2	26
								+1			+1			+2	
Infected	3	—1	2	7	—4	3	1	—1	1	2	—2	1	13	—8	7
Killed	3	+1	4	2	+4	6	4	+1	5	1	+2	3	10	+8	18
Total	14		14	10		10	16		16	11		11	51		51

Description of Figures 3-5

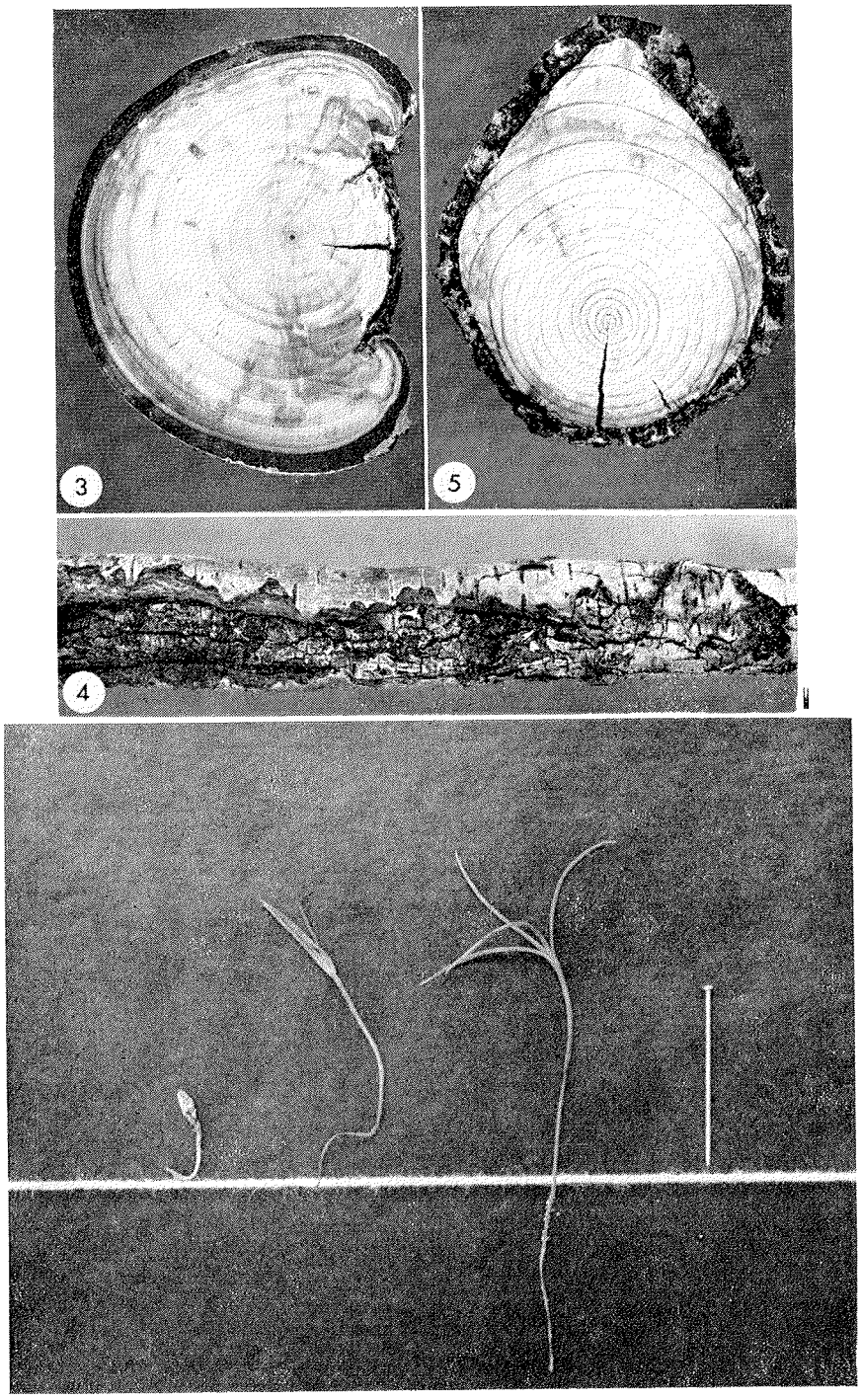
FIGURE 3. Callus formation localized circumferential canker growth for 4 years. Approx. 0.75x.

FIGURE 4. Same infection as on Figure 3. Rapid girdling after escape. Approx. 0.15x.

FIGURE 5. Eccentric growth, due to infection by hypoxylon. Approx. 0.75x.

Description of Figure 1. Paper by Cayford and Waldron

FIGURE 1. Abnormal germinants from surface-sown jack pine seed treated with Captan-50W. Normal germinant is shown at right.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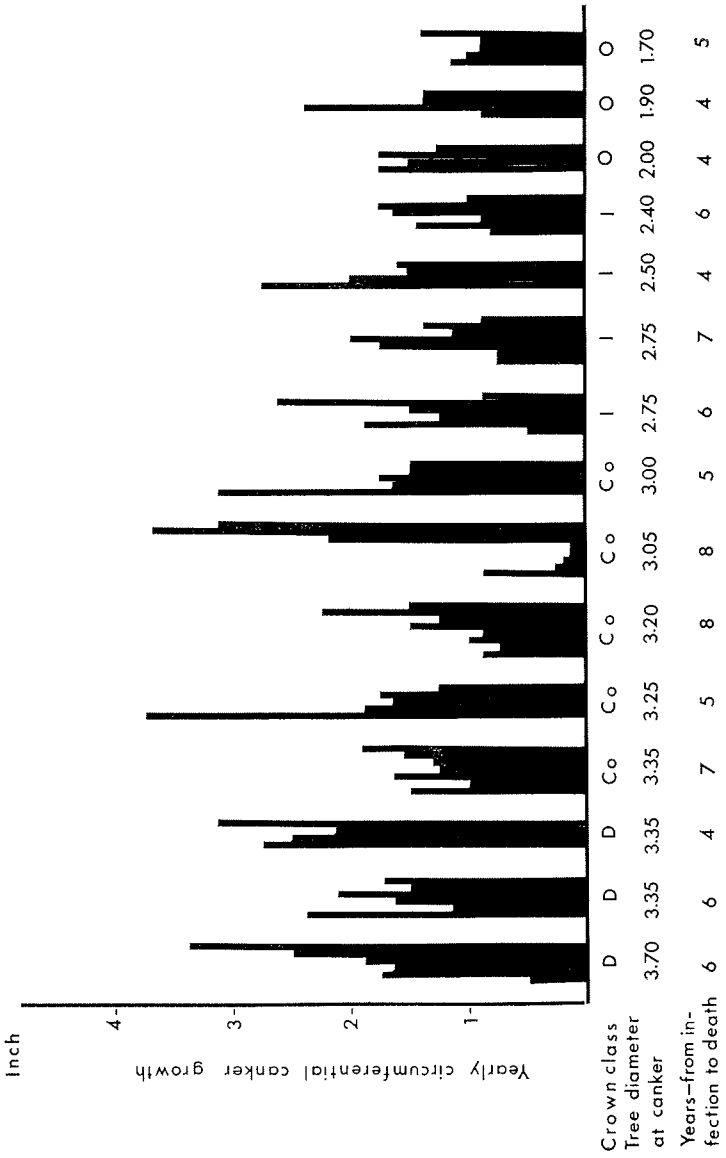

FIGURE 1. Yearly circumferential growth of cankers of 15 trees girdled in 1966.

Dead branches seemed to be the major source of infection. All but two cankers were centered around branch stubs; the two exceptions emanated from large mechanical wounds. No relationship was found between insect activity and infection during the study as was described by Graham and Harrison (7) in southern Michigan. All the stem cankers were located below the 9-foot level and only 3 branch cankers were found. The average number of cankers per infected living tree was 1.3 (17 cankers on 13 trees) in 1963. These numbers increased to 1.6 (11 cankers on 7 trees) during the subsequent 3-year period. Seventy-five percent of the stem cankers were facing north or northeast. The uniform orientation of cankers, the closeness of stem cankers to the ground and the lack of branch cankers is indicative of certain favorable microclimatic conditions available only in the lower stratum of the stand. This observation confirms Anderson's earlier findings in the Lake States (2).

A "t" test carried out on paired observations of the lower and upper halves of canker growth indicated that there was no significantly greater rate of longitudinal growth in either direction.

The period from initiation of infection to the ultimate death of the tree varied from 4 to 8 years, a considerably longer period than previously reported (4). The results in Fig. 1 show that circumferential fungal growth was not related to the diameter of the tree. The rate of yearly circumferential canker growth fluctuated considerably from tree to tree and from year to year.

The effect of tree dominance on the rate of canker growth was also investigated. Average yearly circumferential canker growth was calculated and plotted against the length of infection period for dominant and codominant and intermediate and overtopped trees. Linear regression lines were fitted to the data and compared for differences in slopes and intercepts. The significant difference in the intercepts at the .01 probability level indicates the hypoxylon canker grows at a faster rate on dominant and codominant trees than on intermediate and overtopped trees throughout the initial years of infection. No significant differences were found between the slopes of the two regression lines (Fig. 2). The results can be interpreted to mean that the average rate of circumferential growth of hypoxylon canker remained constant until the death of the host and that the crown class has no bearing on the circumferential rate of canker growth. Since the rate of girdling of infected trees could not be related either to the diameter or to the dominance of the tree, it may be related primarily to the virulence of the fungus.

Although recovery from infection was not observed, strong callus formation reduced the circumferential growth of canker in certain cases (Plate 1, Fig. 3). Girdling of the tree was very rapid when callus was not formed, or when the fungus grew longitudinally beyond the callus (Fig. 1 and Plate 1, Fig. 4.)

The average annual basal area increments of infected trees produced during the infection period were compared to those of healthy trees. Due to infection, the living cambial area was reduced but the average yearly increment, although re-allocated from the normal pattern and produced in an off-centered manner (Plate 1, Fig. 5) did not show any significant change when compared to the annual growth of healthy trees (Fig. 6).

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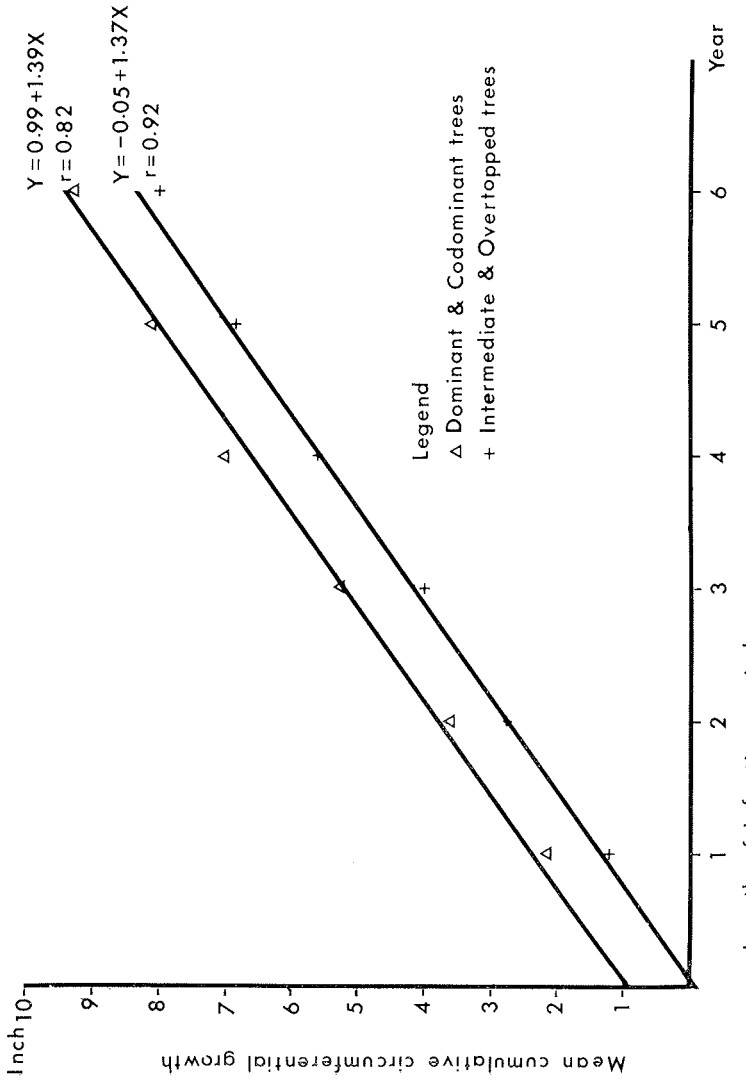

FIGURE 2. Relationship between circumferential growth of hypoxylon canker and infection period on aspen.

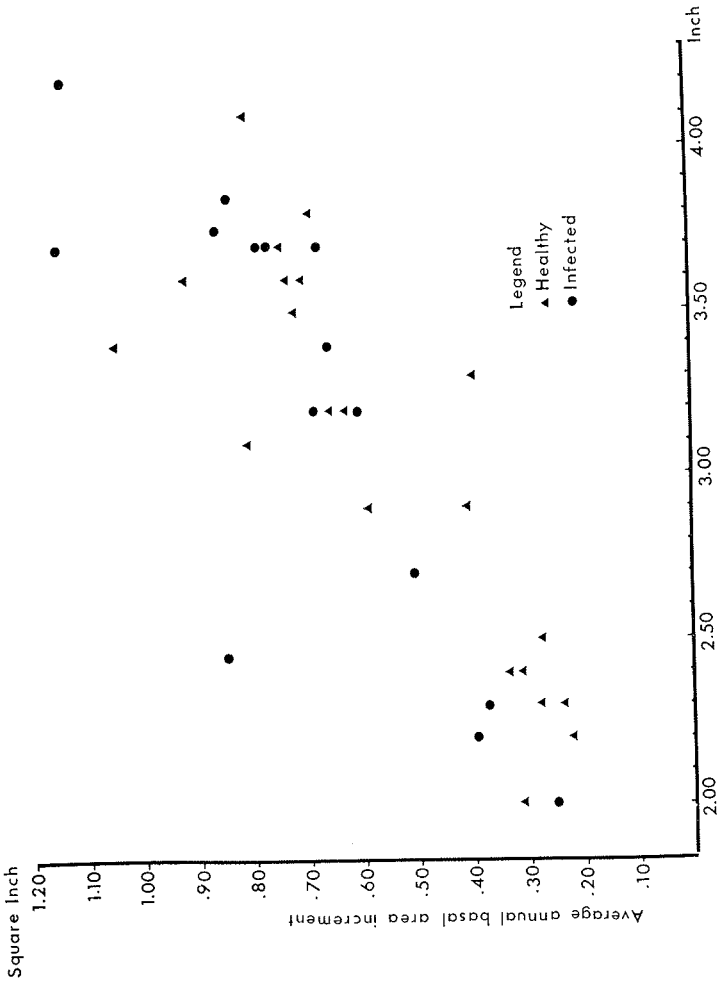

FIGURE 6. Average annual basal area increment of healthy and infected trees.

The high infection rate and mortality found during this study show that *H. pruinatum* causes a potentially serious disease of aspen stands in Alberta and losses caused by the organism are comparable to, if not greater than, those caused by decay fungi in the region (10). Hypoxylon kills 1 to 2 per cent of aspen volume annually in the Lake and Central States of the United States. This is approximately 31 per cent of the net growth for aspen and is more than the volume used by the industry (2). Since Anderson (2) found that infection by Hypoxylon is positively correlated with stand age, density and geographical location, a more intensive study is justified in Alberta to investigate the rate of infection and the amount of losses within different age and density classes.

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