Incidence of Septoria canker of hybrid poplars in eastern Ontario

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Septoria musiva is an endemic pathogen that causes leaf spots and cankers on hybrid poplar (Populus spp.) clones. Although canker incidence was lower in eastern Ontario, a 1984 study found little difference in the morphology and physiology of different isolates of *S.* musiva collected from plantations in the north central United States and those collected in eastern Ontario. By 1987, however, a high incidence of severe cankers in a few plantations was observed. A survey of canker incidence in all plantations (203 ha) of six exotic *P.* nigra x *maximowiczii* (NM) clones found that 79% of the area was affected to some degree with Septoria damage. This represented 11% of the total area planted to hybrid poplar (1,450 ha) in eastern Ontario. Three things are speculated to have contributed to the increase in Septoria damage: (i) the area planted to susceptible NM clones had increased dramatically since 1981, (ii) the amount and type of secondary inoculum produced by the fungus in these exotic clones, rather than in the native poplar, may differ in aggressiveness and (iii) precipitation levels for the 1986 growing season were higher than normal. Five of the clones were determined to be too susceptible for further plantation establishment.

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Septoria musiva est un agent pathogene endémique responsable de la tache des feuilles et du chancre chez des clones de peupliers hybrides (Populus spp.). L'incidence du chancre est plus basse dans l'est de l'Ontario, mais une etude realisee en 1984 a démontré qu'il existe peu de differences morphologiques et physiologiques entre les isolats de *S.* musiva provenant de plantations du centre-nord des Etats-Unis et ceux de l'est de l'Ontario. Par contre, en 1987, quelques plantations ont ete gravement frappées par le chancre. Une enquête sur l'incidence du chancre dans toutes les plantations (203 hectares) de six clones exotiques de P. *nigra* x *maximowiczii* (NM) a révélé que 79% de la superficie avait subi des dommages plus ou moins importants. Ce pourcentage représentait 11% de la superficie totale de culture du peuplier hybride (1 450 hectares) dans l'est de l'Ontario. On croit que trois facteurs ont contribue a l'augmentation des dommages causés par Septoria. En premier, la superficie de culture dos clones NM sensibles à l'agent pathogene a augmente de façon spectaculaire depuis 1981. Deuxiement, l'aggressivite de Septoria peut être affectée par des differences dans la quantite et le type d'inoculum secondaire produit par le champignon entre les clones exotiques et les peupliers indigenes. Et finalement, les precipitations ont ete plus abondantes que la normale pendant la saison do croissance de 1986. On a determine que cinq des clones sont trop sensibles pour servir a l'établissement d'autres plantations.

Introduction

Septoria musiva Peck (teleomorph *Mycosphaerella populorum*), a pathogen that causes leaf spots and cankers on hybrid poplar *(Populus* spp.) clones, has become an increasing concern for many poplar programs in both the United States and Canada. S. *musiva* is indigenous to North America; on native poplars it exists predominantly as a leaf spot and rarely develops into a canker (Bier, 1939). Septoria canker is primarily reported on clones with Tacamahaca origin (Waterman, 1946).

Hybrid poplar plantations established in the north central United States during the mid-seventies were extensively damaged by S. *musiva* (Ostry and McNabb, 1985). Although canker incidence was lower in eastern Ontario, a 1984 study found little difference in the morphology and physiology of different isolates of S. *musiva* collected from plantations in the north central United States and those collected in eastern Ontario (Spielman *et al.*, 1986). However, population levels of S. *musiva* in eastern Ontario have risen since then.

In 1976, a dwindling wood supply in eastern Ontario led to the development of a cooperative program between the Ontario Ministry of Natural Resources and Domtar Incorporated, for the establishment and management of hybrid poplar plantations. To date, approximately 1,450 hectares of hybrid poplar have been planted within a 25 km radius of the Cornwall fine paper mill. During the early years of the program, primarily clones of Aigeiros (*i.e. P. deltoides* x *nigra* hybrids) origin were screened for growth and adaption to eastern Ontario soil and climatic conditions. However, following a recommendation by an international committee of poplar breeders who reviewed the program in 1981, screening of clones with exotic Tacamahaca parentage began.

During the 1978-1982 period no Septoria canker was found in any of the plantations surveyed (Spielman *et al.*, 1986). In 1984 and 1985, an increase in Septoria leaf spot and cankers was observed. During the two following years leaf infection became severe on many clones, thereby increasing the amount of inoculum in many plantations.

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In 1987, a high incidence of severe cankers was observed in a few hybrid poplar plantations in the Cornwall district of eastern Ontario. The need to determine the extent of the disease damage, and the clones affected, became apparent. Septoria canker damage was particularly evident on six clones of *P.* nigra x maximowiczii origin. Due to limited resources, it was decided to concentrate a survey on plantations of these clones.

Methodology

The Septoria survey was conducted from August 1st through August 20th, 1987 on the Domtar Agreement Lands (DALs), and from October 1st to the 30th, 1987 on the Tree Farm Agreements (TFAs). DALs are owned by the company, but managed by the Ministry of Natural Resources whereas the TFAs are leased from local landowners and managed by the company. DALs have been established since 1975 whereas the TFAs have been established more recently, since 1982. Therefore, survey results have been kept distinct.

Six *P.* nigra x *maximowiczii* (NM) clones were surveyed and their origins are given in Table 1. *P.* maximowiczii, a species in the Tacamahaca Section of the genus *Populus*, is native to Japan and Korea. Five of the clones were imported from West Germany to Canada in the late 1970s, although they were originally selected in Japan from open-pollinated seedlings. The clone NM1 was imported directly from Japan. It is not known if any of the clones are related.

Table 1. Origins of clones surveyed for *S. musiva.*

Clone Identification				Country of Origin
Ontario	West Germany	Parentage (OJI Paper Co.)		
NM1	n/a	*P. nigra x maximowiczii*		Japan
NM2	MAXI	"	NM101	Japan
NM3	MAX2		NM102	Japan
NM4	MAX3	"	NM106	Japan
NM5	MAX4		NM105	Japan
NM6	MAX5		NM104	Japan

All properties planted with NM clones from 1981 through 1986 were surveyed. Properties on which hybrid poplar clones are planted vary in size, and monoclonal blocks of several clones are commonly planted at each site. A single clonal block is usually one to four hectares in size, rarely exceeding four hectares. In total, 97 stands comprising 131 hectares of DALs and 36 stands comprising 72 hectares of TFAs were surveyed.

After walking the two diagonal transects in each stand, two observations were made: (i) the severity of damage to the trees and (ii) the percent incidence of damage within the stand. The severity criteria used were as follows:

Negative = trees sampled show no signs of S. musiva;
Low = new or small cankers just starting to develop;
Moderate = any number of cankers on a tree which together cover less than half the circumference of the tree;
High = any number of cankers on a tree which together cover more than half the circumference of the tree, resulting in severe girdling and broken tops.

Percent incidence of Septoria damage within a stand was calculated based on a random sample of 100 trees per stand. Estimates of severity and percent incidence were made by the same person to avoid biasing the results.

Results

Of the 1,450 ha of production plantations established to date, 13.8% are planted to NM clones on DALs and 13.3% are planted to NM clones on TFAs. The total area planted to NM clones, and affected to some degree with Septoria damage comprised 9.3% and 11.9% of the total area planted to hybrid poplar on DALs and TFAs, respectively.

Figures 1 and 2 show the area affected by severity class for the DALs and TFAs, respectively. The largest percentage of stands surveyed were affected to a low degree, 46.8% and 53.4% for the DALs and TFAs, respectively. However, the second largest percentage of stands were affected to a high degree, 38.5% and 25.2% for the DALs and TFAs, respectively. A total of 38.7 ha (2.7%) of plantations were rated as having very high Septoria canker damage and these stands were subsequently harvested prematurely.

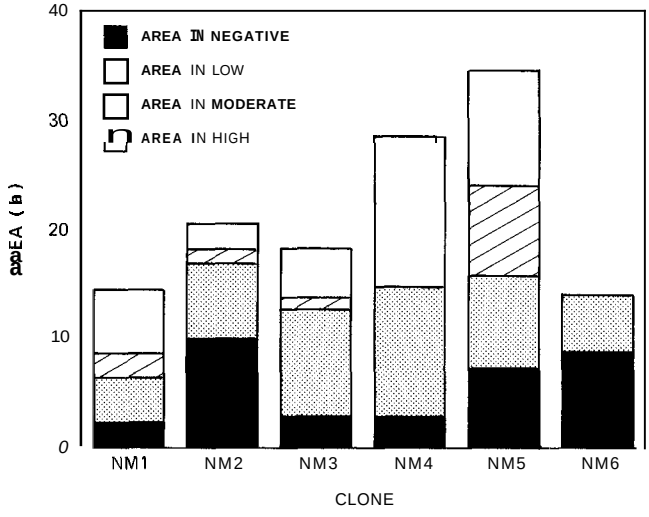

Figure 1. Area in each severity class by clone for DALs.

The area affected by clone is summarized in Table 2. Only one of the clones, NM6, appears to be much less susceptible than the other NM clones. Clones NM3 and NM4 appear to be the most susceptible, while clones NM1, NM2 and NM5 are also too susceptible to consider for further plantation establishment. Figure 3 shows that no areas were found with moderate or high severity for the clone NM6. No relationship between severity of Septoria damage and year of plantation establishment could be determined.

During the early summer of 1988, several samples of canker damage from the study area were sent to the Forest Insect and Disease laboratories in Sault Ste. Marie for verification of S. rnusiva as the causal agent. From these samples, seven

Table 2. Percent incidence of Septoria damage by clone.

Clone	Domtar Agreement Lands (DALs)			Tree Farm Agreements (TFAs)		
	Area Planted (ha)	Area Affected (ha)	Percent Affected %	Area Planted (ha)	Area Affected (ha)	Percent Affected %
NM 1	14.6	12.2	83.6	15.3	13.4	87.0
NM2	20.6	10.5	51.0	0.0	0.0	0.0
NM3	18.4	15.3	83.0	4.0	4.0	100.0
NM4	28.6	25.6	89.5	8.4	8.4	100.0
NM5	34.6	27.1	78.3	33.1	30.8	93.0
NM6	14.2	5.2	36.6	11.3	7.7	68.1
Total	131	95.9		72.1	64.3	

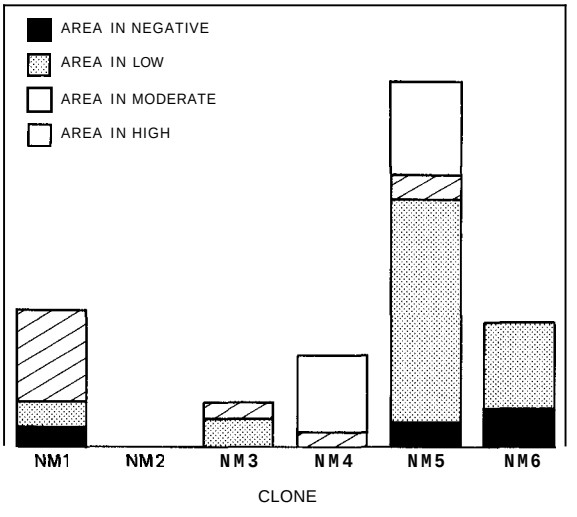

Figure 2. Area in each severity class by clone for TFAs.

isolations of *S.* musiva have been made (C.N. Davis, Pathology Technician, Great Lakes Forest Research Centre, Sault Ste. Marie, pers. comm.).

Discussion

In 1984, Spielman *et al.* (1986) speculated that the incidence of Septoria canker may be rising in Ontario due to the increasing area being planted to susceptible clones of Tacamahaca origin. The area planted to NM clones increased dramatically from 1981 to 1984 (see Table 3). At the same time the area planted with other susceptible Tacamahaca clones, for example, ***P. jackii, P. deltoides*** x trichocarpa and ***P. maximowiczii*** x deltoides, was also increasing. It is conceivable that the higher incidence of Septoria canker found in 1987 may be a result of the greater availability of susceptible hosts.

However, Zalasky et a/. (1968) offer an alternative explanation. Although S. musiva is indigenous to these sites, it also must adapt itself to the introduced hosts. Therefore, the differences in severity and incidence of Septoria canker found between 1984 and 1987 may also be an expression of the amount and type of secondary inoculum produced by the fungus in the new hosts, rather than in the native poplar nearby. This may explain why several ***P.*** deltoides x nigra clones are now showing varying degrees of susceptibility to Septoria canker.

Table 3. Area planted to NM clones from 1981 to 1986.

Year	Area Planted D.A. L. (ha)	Area Planted T. F. A. (ha)	Total Area Planted (ha)
1981	13.6	00.0	13.6
1982	26.4	00.0	40.0
1983	34.1	22.3	96.4
1984	17.5	31.0	144.9
1985	00.0	8.2	153.1
1986	32.0	10.7	195.8

Spielman et *al.* (1986) also theorized whether changes in climate could be responsible for increases in Septoria canker incidence in the future. Data obtained from the Kemptville, Ontario weather station (see Table 4) indicate that precipitation levels for the 1986 growing season were higher than normal (B. Hosie, Ontario Agriculture and Food Weather Station, Kemptville, Ontario, pers. comm.). The heavier precipitation would certainly have contributed to greater spread of spores and higher incidence of new infections during the 1986 growing season.

Management implications:

The results of this survey led to a number of developments in an attempt to reduce the further spread of S. musiva. The clones NM1, NM2, NM3, NM4 and NM5 have been eliminated from stoolbeds at the OMNR Kemptville, Ontario nursery which supplies cuttings for the establishment of plantations. Many of the NM6 plantations were close to highly affected

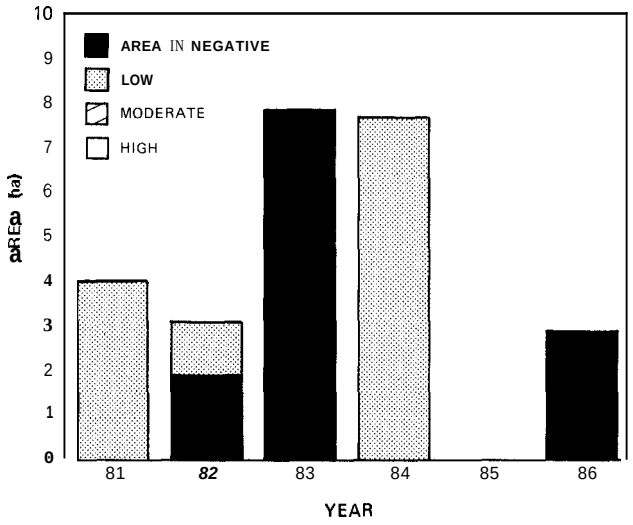

Figure 3. Severity by year for clone NM6 in DALs and TFAs.

NM4 and NM5 plantations and did not have high Septoria canker incidence, therefore it was felt that NM6 showed field tolerance and could continue to be planted on a small scale.

The stands which had a very high incidence of Septoria canker (38.7 ha) were harvested prematurely to reduce the inoculum levels in those plantation areas. It is hoped that this measure will slow the speed of infection to nearby plantations of other susceptible clones. To assist managers in making stand management decisions, the severity and incidence information obtained from this survey was added to the information database which estimates current stand yields.

It is apparent, however, that local screening for resistance is the most promising long-term control strategy in areas where S. *musiva* is known to be a problem (Bussieres and Vallee, 1987). To increase the reliability of artificial screening tests, support research must be conducted. Little is known about the genetic variation of the fungus throughout its range in northeastern North America and it is important to understand the natural range of variation of inoculum virulence to select meaningful isolates for artificial screening tests.

Table 4. Precipitation levels (cm) for the period 1982 to 1987 at Kemptville, Ontario.

	Year					
Month	1982	1983	1984	1985	1986	1987
April	51.8	71.0	147.7	43.4	36.8	40.1
May	55.6	117.0	104.5	65.6	140.6	80.7
June	105.3	33.1	43.3	73.7	118.2	123.2
July	137.3	01.6	113.3	65.2	170.2	62.0
Aug.	94.5	30.9	158.0	63.7	125.9	28.7
Sept.	84.6	57.0	30.4	63.6	115.2	139.2
Oct.	44.1	18.2	34.2	75.9	89.6	86.6
Total	573.1	528.8	631.4	451.1	796.5	560.5

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