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Outbreaks of varying intensity of pitch nodule makers Petrova spp. were detected in several mature (50 to 60 years) jack pine stands in the Vermillion River watershed of Quebec in June, 1971. Previous reference to this insect (Turnock 1953) indicated it was primarily a pest of young pine plantations, and that its populations were maintained in natural stands in the presence of susceptible young hosts. As determinated from rearings of nodules collected at Lac Caousacouta, Laviolette Co., P.Q., and from light trap collections at Lac Normand, Laviolette Co., P.Q. during the summer of 1971, the population in the above areas is composed mainly of Petrova albicapitana (Busck) and small numbers of Petrova metallica Busck (Table 1).

According to Turnock (op. cit.), P. albicapitana has a 2 year cycle: eggs are laid in early summer and the young larvae form small nodules of pitch by girdling the base of terminal shoots. The young larvae pass the winter within the small nodules and the following spring migrate to internodes on the main stem or to lateral branches, where they feed beneath the bark, forming new pitch nodules. It is at this stage that damage by the insect may first become noticeable. The mature larvae pass the second winter within the nodules and pupate the following spring after a short period of feeding. Adults emerge in June. The life history of P. metallica has never been described in detail but is believed similar to P. albicapitana (Stark 1957).

A population study was carried out in a severely infested stand at Lac Caousacouta on June 15 and 16, 1971, when most of the insects were either in the pupal stage or had recently emerged. Fifteen jack pine trees ranging from 2 to 7 inches d.b.h. were felled, and all nodules that contained living insects, or from which insects had recently emerged, were counted and assigned

to the current generation. Old hardened nodules, presumably from previous generations, were counted separately. At the time of sampling, approximately 45% of the population had already vacated the nodules, 36% were pupae, 3% were living larvae, 12% were dead larvae, and 4% contained parasites. This indicated there was little overlapping of generations here, and elsewhere throughout the Vermillion River watershed, as was determined later. Turnock (1951) reported that populations of P. albicapitana in jack pine forests of Minnesota are composed of two separate populations that emerged as adults on alternate years and did not interbreed;also, the one population usually was considerably higher than the other.

The results showed the current infestation at Lac Caousacouta to be particularly severe, averaging 125 nodules per tree (Table 2). The number of nodules per tree varied exponentially with tree size; populations on large trees were over 9 times higher than on small trees. This relationship is well described by the formula $\ln Y = a + b \ln X$, where Y = the number of current nodules per tree, and X = the D.B.H. in inches. Nodules of both the current and previous generations were similarly distributed (Fig. 1). In addition, the number of current nodules was over 1.5 times greater than the number of old ones, suggesting that, although the infestation has been present in the stand for some years, it is now considerably more severe than in the past (Table 2).

Infestation levels of the pitch nodule maker were compared in eight jack pine stands in the Vermillion River watershed, including that stand at Lac Caousacouta. Three dominant or co-dominant trees, selected randomly at each

locality, were felled and counts made of the number of current nodules on the lower 2/3 and upper 1/3 of the crown. In addition the number of shoots killed because of nodule maker damage, was counted on the upper third of the crown, where most of the population was concentrated and damage was most apparent (Table 3). The foliage had acquired a reddish colour where stems had been killed as a result of girdling, and this "flagging" was easily visible from the ground in the more severely infested stands at Lacs Caousacouta, Atenis, McLaren, Oriskany, and Gagnon. Since the infestation at Lac Caousacouta had been in progress for some time, considerable killing of the terminals in the upper third of the crown had occurred (Fig. 2), and the population was distributed almost equally at both crown levels. Infestations in the other stands appeared to be of a more recent origin, and consequently total damage was less pronounced.

Although some height-growth reduction, stem killing in the upper crown, and deformation of the main stem had already occurred in the more severely infested stands, particularly at Lacs Caousacouta and Atenis, it is not likely that tree mortality will result, since only a small proportion of the total foliage complement is affected. However, as infestations persist, the attacks tend to be repeated at the same internodes, causing severe deformation, and providing infection courts for fungi (Fig. 3). It is this sort of damage, rather than direct stem killing, which may ultimately have the greatest impact on the vigour and quality of the tree. There is also some evidence, although not conclusive, that jack pine stands on the poorer sites, are particularly susceptible to attacks by this insect (Table 3). Lightest infestations currently occurred in those stands where trees had the largest number of current shoots, and showed superior height growth.

Two of the stands appeared to have suffered severely from previous pitch nodule maker infestations, as indicated by numerous old nodules on the main stem and laterals of the mid and lower crowns. Furthermore, there was a remarkably uniform deformation (bending) of the main stems at approximately the same height throughout the forest, apparently because of extensive leader killing. These phenomena occurred at Gilardo Dam about 12 years ago and at Lac Oriskany about 30 years ago. At the latter locality, stem deformation was particularly pronounced.

The pitch nodule makers are presently the dominant insects in the jack pine forests of the Vermillion River watershed. Populations of the Swaine jack pine sawfly, Neodiprion swainei Middleton, which caused considerable damage to the forests in the mid-1960's in these areas, are presently very low, but are expected to erupt again in the near future (McLeod 1970). In the event that severe outbreaks of these two groups of insects coincide, the effect on jack pine forests could well be disastrous. Henceforth, population trends of the pitch nodule makers should also be monitored very carefully.

References

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Stark, R.W. 1957. Pitch nodule maker in Banff National Park. Can. Dep. Agr. Bimon. Prog. Rep. 13(4):2-3.

Turnock, W.J. 1951. Some aspects of the biology of the pitch nodule maker, Petrova albicapitana (Busck). M.S. Thesis, Univ. Minnesota, Minn. 74 p.

_____ 1953. Some aspects of the life history and ecology of the pitch nodule maker Petrova albicapitana (Busck). (Lepidoptera: Olethreutidae). Can. Ent. 85:233-243.

Table 1

Species composition of Petrova spp. collected by light trap, Lac Normand, Laviolette Co., P.Q., and reared from nodules collected at Lac Caousacouta, Laviolette Co. in 1971

Source of material	Petrova albicapitana		P. metallica		Total
	No.	Per cent	No.	Per cent	
Light trap Lac Normand, June, July 1971	261	91.9	23	8.1	284
Reared from nodules: Lac Caousacouta	65	91.5	6	8.5	71

Table 2

Number of current and old nodules of Petrova spp. on 15 jack pine trees from Lac Caousacouta, Laviolette Co.,P.Q., June 15, 16, 1971

Tree No.	d.b.h.	No. of nodules			No.of trees per acre	No. of current nodules per acre
		Current	Old	Total		
1	2.1	1	2	3		
2	2.4	20	11	31	≤ 3.5" =204.4	5,396
3	2.8	43	49	92		
4	3.2	19	38	57		
5	3.5	49	42	91		
6	3.6	90	81	171		
7	4.0	113	77	190	3.6" - 5.5" =399.2	41,916
8	4.4	101	45	146		
9	4.9	37	17	54		
10	5.3	184	126	310		
11	5.6	199	128	327		
12	5.6	243	164	407	≤ 5.6" =117.6	28,741
13	6.3	183	149	332		
14	6.4	437	296	733		
15	7.1	160	160	320		
Total	67.2	1879	1385	3264		76,053
Mean	4.5	125.3	92.3	217.6		

Table 3

Infestation levels of *Petrova* spp. on individual trees in each of eight jack pine stands in the Vermillion River watershed of Quebec in 1971

Locality	Tree No.	d.b.h.	Height	Current nodules per tree	Upper third of the crown					
					Current nodules	Per cent of total nodules	No. of current shoots	Per cent killed by *Petrova* spp.	Per cent killed by other causes	Per cent living
L. Caousacouta	1	5.7	46	109	43	39.4	481	22.2	9.1	68.6
	2	6.0	46	172	87	50.6	345	33.0	1.4	65.5
	3	7.0	49	365	146	40.0	1172	16.6	0.9	82.5
	$\bar{x}$	6.2	47	215.3	92.0	42.7	660.0	20.8	3.0	76.2
L. Atenis	1	5.9	47	121	96	79.3	341	12.6	0.3	82.7
	2	6.0	44	40	23	57.5	458	3.7	0.0	96.0
	3	5.5	43	102	79	77.4	528	4.4	0.0	90.9
	$\bar{x}$	5.8	44.7	87.7	66	75.3	442.3	9.5	0.1	90.6
L. McLaren	1	4.6	42	42	38	90.5	500	5.8	1.1	93.1
	2	5.1	41	63	52	82.5	619	3.1	3.2	93.7
	3	5.3	46	40	35	82.5	422	8.3	0.0	91.5
	$\bar{x}$	5.0	43	48.3	41.7	86.6	520.3	5.4	1.7	92.9

Table 3 (Cont'd)

Locality	Tree No.	d.b.h.	Height	Current nodules per tree	Upper third of the crown					
					Current nodules	Per cent of total nodules	No. of current shoots	Per cent killed by *Petrova* spp.	Per cent killed by other causes	Per cent living
L. Oriskany	1	5.0	48	15	14	93.3	385	1.6	0.0	98.4
	2	5.9	46	55	50	90.8	718	5.3	0.0	94.7
	3	7.0	50	17	9	51.9	332	4.5	0.3	95.2
	$\bar{x}$	6.0	48	29	24.3	83.7	478.3	4.1	0.0	95.8
L. Gagnon	1	5.2	49	16	15	93.7	364	2.2	0.0	97.8
	2	5.5	49	18	14	77.8	659	1.2	0.5	98.3
	3	6.2	53	14	12	85.7	682	0.7	0.0	99.3
	$\bar{x}$	5.6	50.3	16	13.7	85.4	568.3	1.3	0.2	98.5
L.des Chiennes	1	5.9	46	18	18	100.0	941	0.6	1.7	97.7
	2	6.0	43	6	5	83.3	972	0.4	0.0	99.6
	3	7.0	47	4	3	75.0	506	0.2	0.2	99.7
	$\bar{x}$	6.3	45.3	9.3	8.7	92.9	339.7	0.4	0.7	98.8

Table 3 (Cont'd)

Locality	Tree No.	d.b.h.	Height	Current nodules per tree	Upper third of the crown					
					Current nodules	Per cent of total nodules	No. of current shoots	Per cent killed by Petrova spp.	Per cent killed by other causes	Per cent living
Gilardo Dam	1	6.2	44	3	2	66.7	937	0.0	0.5	99.5
	2	6.5	50	1	1	100.0	882	0.0	0.0	100.0
	3	7.4	51	3	2	66.7	585	0.0	0.2	99.8
	$\bar{x}$	6.7	48.3	2.3	1.7	71.4	801.3	0.0	0.2	99.8
L. du Chevalier	1	5.2	50	0	0	----	325	0.0	0.0	100.0
	2	7.1	51	1	1	100.0	2415	0.04	2.3	97.7
	3	8.5	55	0	0	----	1468	0.0	12.6	87.4
	$\bar{x}$	6.9	52	0.3	0.3	100.0	1402.7	0.0	5.7*	94.3

* Old infestation of N. swainei

List of Illustrations

Fig. 1. Number of nodules of Petrova spp. per tree as a function of d.b.h. (inches). Fifteen jack pine trees, Lac Caousacouta, Laviolette Co., P.Q.

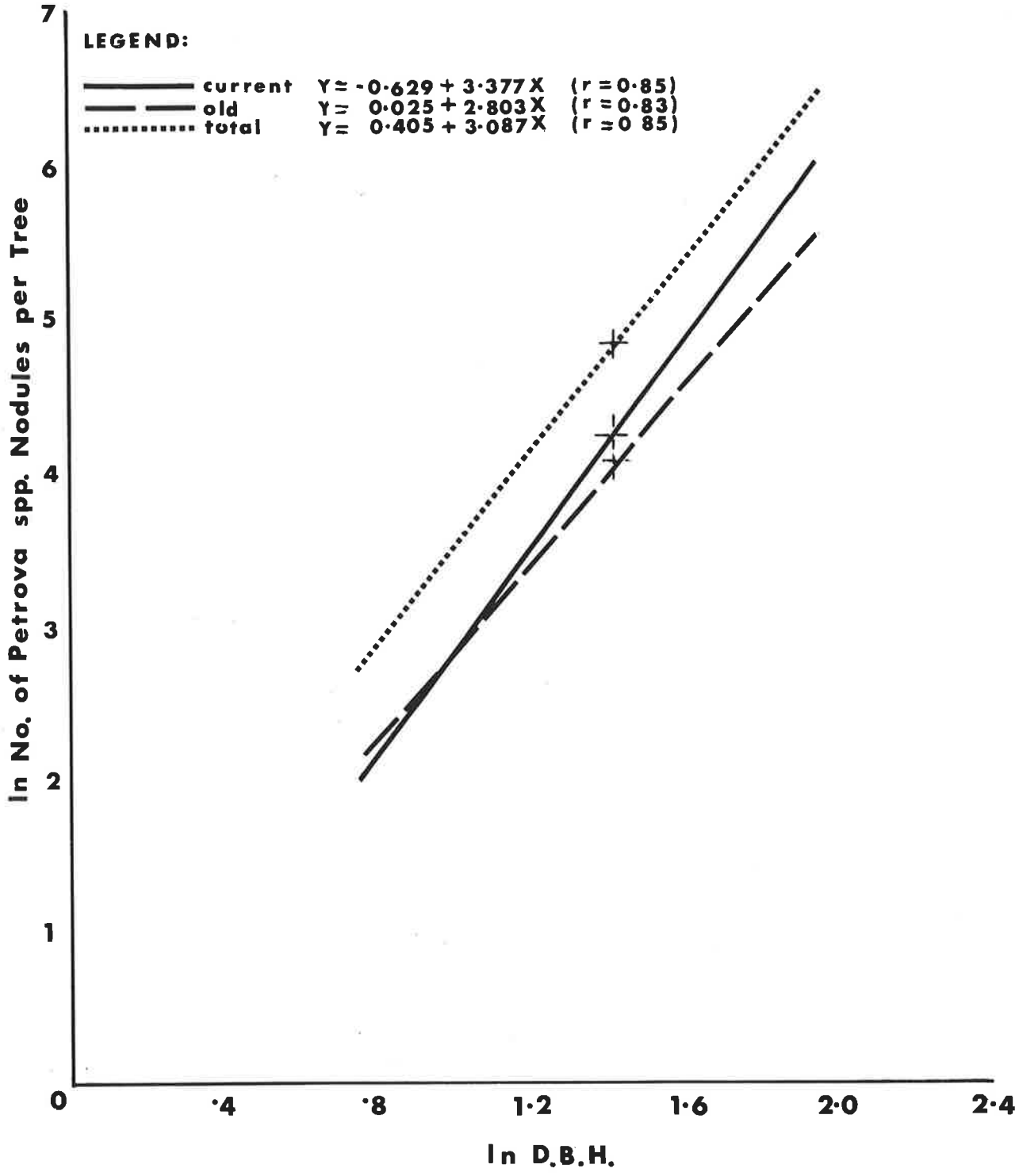

LEGEND:
current Y = -0·629 + 3·377X (r = 0·85)
old Y = 0·025 + 2·803X (r = 0·83)
total Y = 0·405 + 3·087X (r = 0 85)
ln No. of Petrova spp. Nodules per Tree
0
1
2
3
4
5
6
7
·4
·8
1·2
1·6
2·0
2·4
ln D.B.H.

Fig. 2. Crown of mature jack pine tree, Lac Caousacouta, heavily infested with Petrova spp.

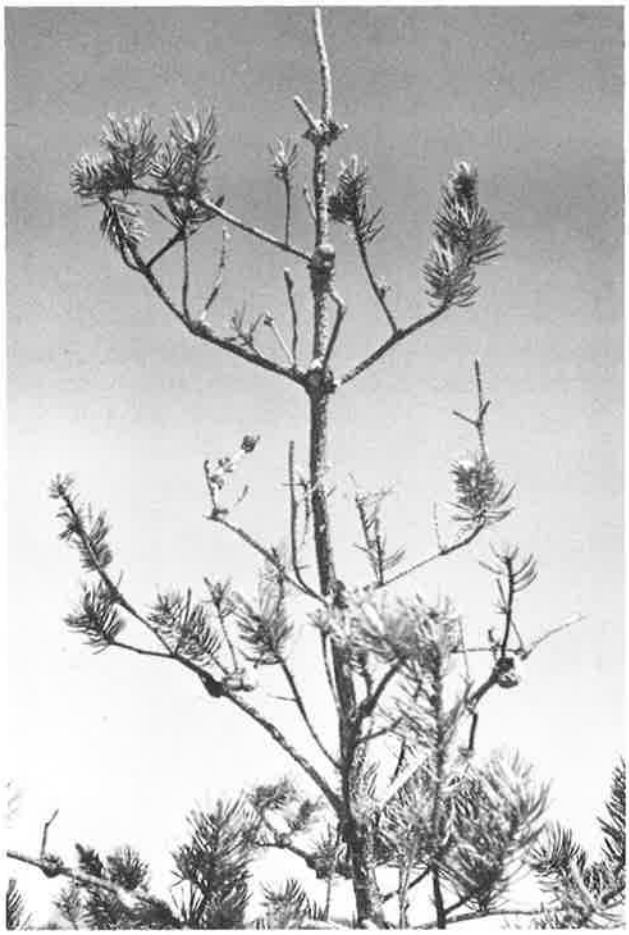
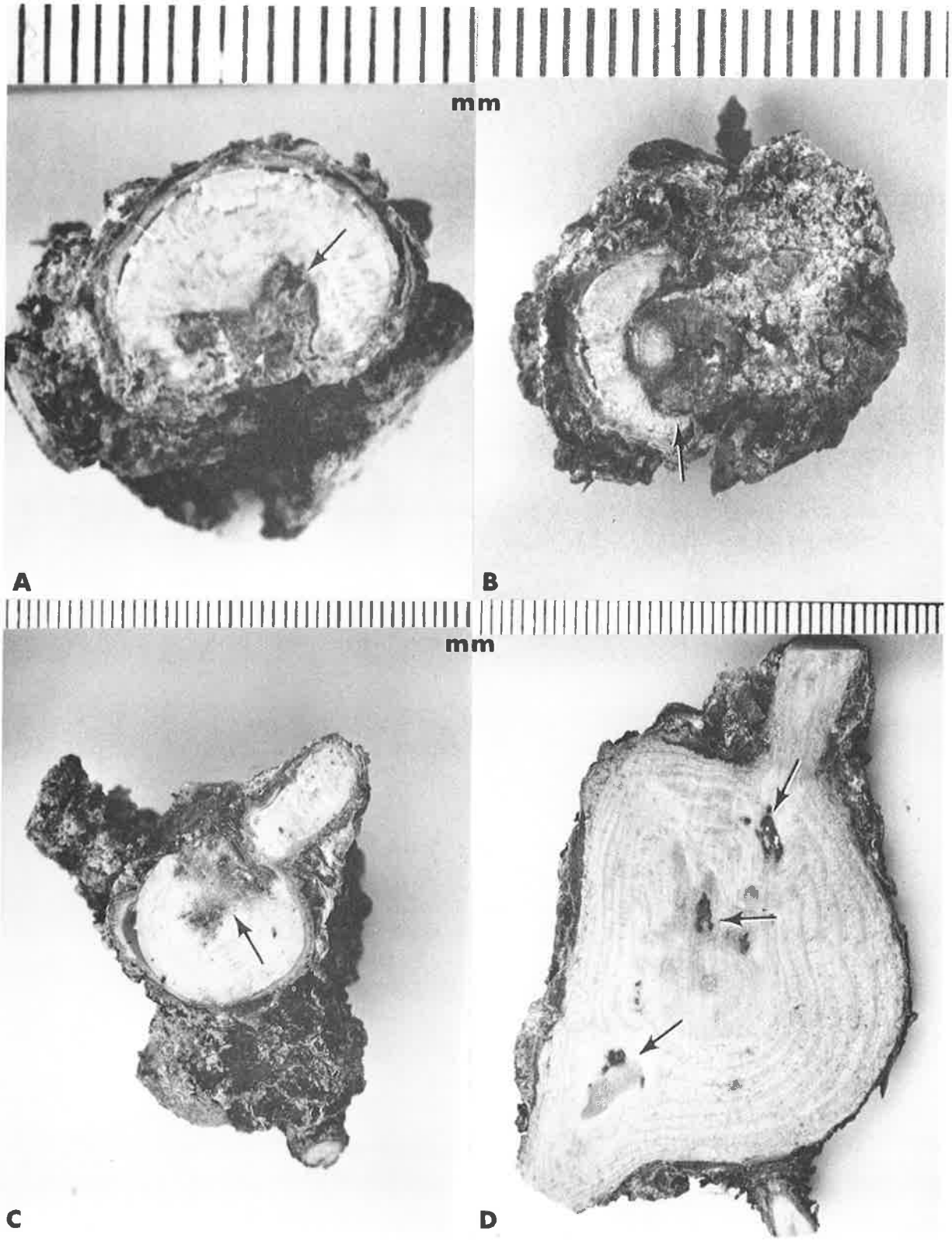


Fig. 3. Cross section of internodes from laterals and main stem of jack pine trees heavily infested with Petrova spp. Lac Caousacouta; (a,b)laterals; (c) main stem, current nodules; (d) main stem, old nodules.


mm
A
B
mm
C
D