Wood Decay of *Abies sachalinensis* Forest in the Tokyo University Forest, Hokkaido. IV.

Inoculation Experiment on Living Root with *Fomitopsis annosa* (FR.) KARST.*

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Introduction

Studies on the fungus decay in the natural forest in Hokkaido have been conducted by YAMANO (1931)[16] who surveyed the decay in the natural forest of *Picea jezoensis* in the crown forest at Tomakomai, by KAMEI et al. (1948)[9] in the national forest at Akan, where they found out that the decay of Sakhalin fir (*Abies sachalinensis* MAST.) was mainly due to the attack of *Fomes annosus*, and recently detailed survey on the decay of coniferous and broad-leaved species, especially on an ecological status of wood-rotting fungi in the national forest at Sounkyo was carried out by IMAZEKI and AOSHIMA (1955)[8].

The writer has investigated the decay of *Abies sachalinensis* forest in the Tokyo University Forest, Hokkaido, and reported the damage by fungus decay (1955[13], 1956[14], 1957[19]) and made it clear that root and butt rot propagates by root system from one to another (1956)[18]. This finding coincides well with the results conducted by HEPTING et al. (1944)[6] on the roots of white pine, by WAGENER et al. (1946)[15] on several species of pines, by BIER et al. (1948)[2] on *Abies lasiocarpa* and *A. amabilis*, and by RISHBETH (1950[10], 1951-a[11], 1951-b[12]) on Scots pine. But when a root and butt rot fungus infects a root, the spreading velocity of decay progressing in it is almost unknown, although RISHBETH investigated in detail the biology of *Fomes annosus* on Scots pine, and HIRT et al. (1933)[7] conducted the inoculation with *Fomes pinicola* into the trunk of several tree species.

Ideas that the forest managements to insure the shortening of the age of felling must be considered in the case where the damage caused by root and butt rot fungi is severe, and that the other tree species immune to them should be afforested, are accepted in general to reduce the damage caused by wood-rotting fungi, without any scientific basis. However, those cannot be accepted simply, so long as the basic results are made clear, i.e., the velocity of spreading of decay in roots, the durability of ability of decayed roots to infect to another healthy roots, etc. It has been cleared up according to the results of the survey the writer has

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ever conducted that the living trees of Sakhalin fir in the natural forest in the Tokyo University Forest, Hakkaido, suffer from a considerable damage by the fungus attack and that above the half of the damage (number of infected trees and the decayed volume) was associated with the fungus, *Fomitopsis annosa* (FR.) KARST. Therefore, it seems the most important to ascertain the spreading velocity of the decay or discoloration proceeding in living roots when the fungus once established in them.

This paper dealt with the results obtained from minute observations on the phenomena happened in roots by the fungus during two years after inoculation.

Materials and methods

Living trees of Sakhalin fir were chosen for the purpose of inoculation in the compartment 99 and 48 and stumps were taken in the compartment 99, in the University Forest. The breast height diameter and the age of living trees, and the diameter and the number of annual rings at cut surfaces of stumps were shown in Table 1. These trees and stumps were divided into four groups. Group A consisted of the trees vigorously growing and group B consisted of the trees inferior to group A, probably due to root and butt rot or damage done by insects. All the stumps belonging to group C. B-5 and B-6 contained a heart rot and ages at the breast height could not be measured. C-6, C-7, and C-9 were also in the same situation. Group D was all the living trees selected in the compartment 48 and was mixed with vigorously and poorly growing trees. That the two types of growth of trees were chosen, was to compare the difference happened between them in the velocity of proceeding of decay or discoloration in inoculated roots, if any. Acidity of soil in the compartment 99 was 6.2~6.3 and that in the compartment 48 was 6.5.

Fomitopsis annosa (FR.) KARST., used in the present work for inocula, was isolated in 1954 from a decayed wood of *Abies sachalinensis* at Sounkyo, Hokkaido, by Dr. K. AOSHIMA and was kindly presented to the writer. The fungus had been cultured on potato sucrose agar until the experiment was started.

Wedges of $2\times1.5\times4$ (height) cm for inocula were prepared and were buried in the saw dust of Sakhalin fir in glass containers with appropriate volume of nutrient solution. Then they were autoclaved and inoculated with *Fomitopsis annosa*. Wood species of wedges and the period of incubation (at 25°C) were shown in Table 1.

Lateral roots, diameters of which were between 3 to 25 cm, were carefully exposed and tested whether they have any root rot or not by drilling. Only healthy roots were used as test materials.

Inoculation was done in late October, 1956. These roots were bored a hole with a drill of 2 cm in diameter and were inoculated by plugging it with a wedge previously cultured with the test fungus. The interstice made by insertion of an

Table 1. Details of trees inoculated and the inocula used

Compartment	Number of tree	Age*	Breast-Height Diameter (cm)	Inocula A	F-0	F-1	s.d.	Compartment	Number of tree	Age*	Breast-Height Diameter (cm)	Inocula A	F-0	F-1	s.d.
99	A-1	74	45	1		1		99	C-1	81**	61.5**	1	2	1	1
〃	-2	82	43	2	1	1	2	〃	-2	82**	42.5**	1	1	2	1
〃	-3	76	36	1	1	1	2	〃	-3	72**	47.5**	1	1	1	1
〃	-4	75	43	1	2	2	1	〃	-4	85**	36**	1	1	1	1
〃	-5	65	41	1	1	2	2	〃	-5	84**	59**	1	1	1	1
〃	-6	68	35.5	1	1	1		〃	-6	Heart rot	51.5**	1	1	1	1
〃	-7	67	48	1	1	1	3	〃	-7	Heart rot	47.5**	1	1	1	1
〃	-8	68	47.5	1	2	2	1	〃	-8	88**	47**	1	2	2	1
〃	-9	78	50	1	2	2	1	〃	-9	Heart rot	46**	1	2	2	1
〃	-10	65	46	1	2	1	2	〃	-10	88**	47**	1	2	2	1
99	B-1	80	37.5			1	1	48	D-1	90	32	1	1	1	2
〃	-2	83	31.5	1	1	1		〃	-2	78	32.5	1	2	1	1
〃	-3	80	31	1	2	1	1	〃	-3	82	44	1	2	2	4
〃	-4	61	32		1	1		〃	-4	88	33.5	1	1	1	
〃	-5	Heart rot	44.5				2	〃	-5	85	34	1	1	2	3
〃	-6	Heart rot	50		1	1		〃	-6	68	37		2	5	3
〃	-7	113	48	1	1	2	1	〃	-7	74	28.5	1	1	1	
								〃	-8	77	46	1	1	2	2
								〃	-9	83	35	1	1	1	1
								〃	-10	90	33.5	1	2	2	1

Note. 1. * Measured by annual rings at the breast-height
** Measured at cut surfaces

2. A: Vigorously growing group
B: Poorly growing group
C: Cut stumps in 1955
D: All the tree in the compartment 48, in which D-9, D-10 are poorly growing trees

3. Explanation of inocula (wedges)

	Species of wedges	Inoculated with	Temp. (°C)	Duration (month)
A	*Abies sachalinensis*	*F. annosa*	25	5
F-0	〃 〃	〃	〃	3
F-1	*Picea jezoensis*	〃	〃	3
s.d.	Saw dust of *A. sachalinensis*	〃	〃	5

angular inoculum into the hole was filled with saw dust culture of 5 months' incubation. After the inoculation, each hole was covered up with a lid of the same size made from the bark of the same tree species and the juncture was pasted with grafting wax for the purpose to inhibit the contamination with other soil inhabiting fungi. Then these inoculated roots were covered with soil and were left for two years as in the original state.

Results and considerations

a) Establishment of the fungus.

The fungus has been established well in the inoculated roots of living trees, but it failed to grow into the roots of stumps. These stumps were left for a year after felling in 1955. It seems probable that, this is not because of the inability of the fungus to be established in the dead roots, but because of the antagonism with other wood-rotting fungi already attacking them. In fact, some of the roots of stumps showed the typical decay type attacked by *Poria subacida* (PECK) SACC. and some stumps had sporophores of *Fomitopsis insularis* (MURR.) IMAZEKI. If the inoculation were carried out just after felling, the fungus should be successfully established in the roots of stumps.

b) Appearance of discoloration and decay in the roots.

Roots brought into the loboratory were cut into appropriate length and were observed minutely. The difference of external appearance between healthy and infected roots could not be observed. There was no mycelium grown on inoculated roots and no exudation of resin along with the proceeding of decay or discoloration. According to the results described by RISHBETH (1950)[10], it was often observed that the mycelium of *Fomes annosus* grew on infected roots in alkaline soils and not in acid soils. The acidity of forest soils in the University Forest is acid and the present result coincides well with that of RISHBETH in the point of view of acidity of soil.

Discoloration of the wood in the inoculated roots was obvious. The discolored wood became pale yellowish brown or pale reddish brown and was easily differentiated from white, healthy wood. The same result was obtained by RISHBETH (1951-b)[12] who reported that early stages of invasion by *Fomes annosus* were normally marked by a brown discoloration in the roots of Scots pine. The shape of discolored wood was circular or somewhat irregular. The discoloration proceeded in the central part of roots, though the outer wood (sapwood) also discolored near the inoculum. It is very interesting that the proceeding of discoloration with *F. annosa* shows a character of a heart rot fungus.

The fact that the discoloration was due to the inoculated fungus, *F. annosa*, was ascertained by following circumstances; i) the color and the shape of discoloration resembled one another, ii) the color was the same with that of saw dust medium of Sakhalin fir caused by inoculation with the fungus, iii) conidiophores characteristic to the fungus were formed abundantly on the transversely cut surfaces of discolored roots near inoculated points. The fact that the discoloration is an incipient stage of decay is ascertained by the decay, characteristic to the fungus already formed near the inoculum in some of the roots. In the heartwood in these roots, in which the stage of decay advanced to an intermediate stage, small white pits of elliptical shape, long in the longitudinal direction, were formed abundantly.

The shape of these decayed areas appearing in transversely cut surfaces is very similar to that of a hole prepared for inoculation and it seems that this offers a proof that the decay must be due to the fungus.

c) Progress of discoloration in the roots.

Inoculated roots were cut, as a rule, at the point of every 5 centimeters and the state of discoloration or decay appearing at the surface was observed. At the same time, the length of the discoloration advanced in the roots could be ascertained by this procedure. Small roots less than about 3 cm were discarded, since the extent of advance of discoloration was measured by the procedure based upon the disappearance of discoloration and it was very difficult to take accurate data on such roots. Furthermore, the roots naturally infected by the finish of the experiment were also discarded. For these reasons, the number of samples shown in Table 2 was less than those of the wedges shown in Table 1. The results were shown in Table 2.

The extent of progress of discoloration towards boles, unfortunately, was not determined except the case of A-2 (s.d.), since the velocity of advance was strikingly fast and the discoloration ran farther beyond the end of almost all the samples. According to the results reported by RISHBETH (1951-b)[12], *F. annosus* advanced 0.6~0.8 m in the root of Scots pine in alkaline soils and 0.2~0.3 m in acid soils per year. Though the writer's results cannot be compared with those by RISHBETH, since the writer failed to ascertain the length of discoloration advanced in the roots, it is apparent that the discoloration runs considerably farther beyond the end of the samples. difference of the velocity, caused by the difference of vigor of trees between group A and B, could not be determined. On the contrary, the progress of discoloration advanced in the opposite direction stopped in a considerable number of samples at various length from the inoculated point.

As shown in Table 2, it seems likely that there appears the difference in the length of discoloration advanced towards opposite directions in the same roots. For example, in the case of A-2 (A), the length of discoloration towards the bole exceeded 55 cm, whereas that towards the opposite side disappeared at the length of 20 cm, from the inoculated point. The same situations are often seen in the Table. Therefore, it may be safe to say that the length of discoloration towards the bole is longer than that towards the opposite direction. Then for what reasons did the difference between opposite directions happen?

d) Suggestions for explanation of the difference in the length of discoloration happened between opposite directions.

RISHBETH (1951-a)[11] used the method to incubate the pieces of wood of roots to be tested in a moist condition for the determination of existence of the fungus, *F. annosus*, inoculated to the roots of Scots pine. By this treatment, characteristic conidiophores of Oedocepharum type appear abundantly and this provides a proof that the fungus exists in the wood. The writer applied this method for the same

Table 2. Distance of discoloration in the root (cm.)

Re-marks	←—Opposite direction														From the inoculated point															Towards the bole—→	Re-marks
	70	65	60	55	50	45	40	35	30	25	20	15	10	5		5	10	15	20	25	30	35	40	45	50	55	60	65	70	
						+ x	+	+	+	+	+	+	+	+	A-1 A	+	+	+	+	+	+	+	+	+	+ x					
												+ x	+	+	F-1	+	+	+	+	+	+	+	+	+	+ x					
					D	+	+	+	+	+	+	+	+	+	A-2 A(1)	+	+	+	+	+	+	+	+ x							
											D	+	+	+	A(2)	+	+	+	+	+	+	+	+	+	+	+ x				
			+ x	+	+	+	+	+	+	+	+	+	+	+	F-0	+	+	+	+	+	+	+	+	+ x						
								D	+	+	+	+	+	+	F-1	+	+	+	+	+	+	+	+	+	+	+	+	+ x		
											D	+	+	+	s.d.(1)	+	+	+	+	+	+	+	+	+ x						
													D	+	s.d.(2)	+	+	+	+	+	D									
							+ x	+	+	+	+	+	+	+	A-3 A	+	+	+	+	+	+	+	+	+ x						
							D	+	+	+	+	+	+	+	F-0	+	+	+	+	+	+	+	+ x							
										+ x	+	+	+	+	F-1	+	+ x													
												D	+	+	s.d.	+	+	+	+	+	+	+	+	+ x						
						+ x	+	+	+	+	+	+	+	+	A-4 A															N. I.
															F-0	+	+	+	+	+	+	+	+ x							
					D	+	+	+	+	+	+	+	+	+	F-1(1)	+	+	+	+	+	+	+	+	+ x						
					+ x	+	+	+	+	+	+	+	+	+	F-1(2)	+	+	+	+	+	+	+	+	+	+ x					(F-0 s.d.
								D	+	+	+	+	+	+	s.d.															
(A s.d.(1)															A-5 A	+	+	+	+	+	+	+ x								
											+ x	+	+	+	F-0	+	+	+ x												
															F-1	+	+	+ x												
									D	+	+	+	+	+	s.d.(1)															
									D	+	+	+	+	+	s.d.(2)	+	+	+	+	+	+ x									
									D	+	+	+	+	+	A-6 A	+ x														
							+ x	+	+	+	+	+	+	+	F-0	+	+	+ x												
								+ x	+	+	+	+	+	+	F-1	+	+	+ x												
											D	+	+	+	A-7 A	+	+	+	+	+	+	+ x								
							D	+	+	+	+	+	+	+	F-0	+	+	+	+	+	+ x									
								D	+	+	+	+	+	+	F-1	+	+	+	+	+	+	+	+	+	+	+ x				
												D	+	+	s.d.(1)	+	+	+	+	+	+	+	+	+ x						
											D	+	+	+	s.d.(2)	+	+	+	+	+	+	+	+	+	+	+	+ x			

	70	65	60	55	50	45	40	35	30	25	20	15	10	5		5	10	15	20	25	30	35	40	45	50	55	60	65	70	
(A F-1(1)					+ x	+	+	+	+	+	+	+	+	+	A-8 A	+	+ x													
															F-0(1)	+	+	+	+	+	+	+	+	+ x					
															F-0(2)	+	+	+	+	+	+	+	+	+	+	+ x			
						+ x	+	+	+	+	+	+	+	+	F-1(1)														
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					D	+	+	+	+	+	+	+	+	+	s.d.														
(A s.d.								D	+	+	+	+	+	+	A-9 A	+	+	+	+	+	+	+	+	+	+	+	+	+ x	
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			+ x	+	+	+	+	+	+	+	+	+	+	+	B-2 A	+	+	+	+	+	+	+	+ x							
					+ x	+	+	+	+	+	+	+	+	+	F-0	+	+	+	+	+	+	+	+	+	+ x					
					+ x	+	+	+	+	+	+	+	+	+	F-1	+	+	+	+	+	+	+	+	+	+ x					
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									D	+	+	+	+	+	s.d.	+	+	+ x											

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N. I.																													
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									+ x	+	+	+	+	+	F-1(2)	+	+ x												
											D	+	+	+	s.d.	+	+	+ x											

Note: +: Discoloration has been recognized at this distance.

D: Disappeared at this distance.

+ x: Discolorations proceeded farther from this point, but their distance could not be recognized by the writer's sample.

(: Two inocula were used in the same root, separately.

purpose, but he could not find any of them in the discolored wood far from the inoculum. Woods near the inoculum (10~20 cm in both sides), however, always contained hyphae of the fungus. This was ascertained by wood anatomical procedures. Therefore it became necessary to make it clear that whether the discolored wood has received chemical changes as an incipient stage of decay in some of the components of wood or not.

It is said that the most prominent change in chemical composition of wood in that stage of decay is the increase of alkali extract. The writer carried out the alkali extraction of discolored and healthy woods in the same roots and compared the values obtained. As a result of the analysis, it was recognized that percentages of alkali extract in the discolored wood was 2~2.5 times larger than that in the healthy wood. Therefore, it seemed that the discoloration was in the incipient stage of decay and was surely attributed to the fungus.

Some suggestions to explain the difference of the length of discoloration advancing in inoculated roots will be conducted from these facts that the writer could not find any of mycelium in the discolored wood far from the inoculum and some chemical changes as an incipient stage of decay took place in the components of the discolored wood.

Many enzymes, which attack the components of wood, such as oxidases, are known to be secreted extracellularly by wood-rotting fungi. CAMPBELL (1930)[4] said that oxidases secreted by wood-rotting fungi decompose lignin and pentosan and produce acids. Oxidases and these acids act cooperatively upon cellulose and other substances and accelerate the degradation of wood substances. In fact, the secretion of these extracellular enzymes is recognized by GARREN (1938)[5] and many other workers. The writer (1955)[17] also ascertained cellulase produced by wood-rotting fungi in culture solutions.

The considerable increase of alkali extract probably attributes to the oxidation of some fragments of lignin molecule by these enzymes. These oxidases secreted from hyphae, the writer supposes, are carried with the flow of sap to the direction of bole and discolor the wood in considerable length in the roots as a result of their enzymic actions. As for the explanation of the discoloration in the opposite direction, the writer considers that oxidases secreted extracellularly are carried by capillary action mainly in the tracheid. Therefore, the similar shape of discoloration was observed in each cut surface in a root. This was ascertained by the measurement of discolored and total areas in each cut surface and taking the ratio of them. Results are shown in Table 3. The length of discoloration must be shorter in the adverse direction than that towards the bole, because discoloration of the former, based upon capillary action, will be confined to the dormant season of growth of trees.

Based upon these hypotheses, following considerations will be conducted; the length of discoloration towards the bole must be longer in vigorously growing trees

Table 3. Ratios of discolored area to cut surface area

Sample	Direction	Distance from the inoculum (cm)	Area of cut surface (cm^2)	Discolored area (cm^2)	Ratio (%)
A-2 F-1	Towards the bole ↑	65	50.5	19.5	38.6
		60	48.1	17.8	37.0
		50	42.3	15.1	35.7
		40	24.5	9.0	36.7
		30	25.5	8.2	32.2
		20	21.8	8.2	37.6
		10	20.3	7.2	35.5
		5	19.4	7.2	37.1
		Inoculated point	18.5	10.0	54.1
	Opposite direction ↓	5	17.9	6.5	36.3
		10	16.5	5.1	30.9
		20	11.8	1.5	12.7
		30	9.8	0.8	8.2
A-8 F-1(2)	Towards the bole ↑	60	33.9	9.5	28.0
		50	32.1	8.3	25.9
		40	31.4	7.6	24.2
		30	29.3	7.4	25.3
		20	25.7	6.6	25.7
		10	23.6	5.5	23.3
		5	24.4	7.8	32.0
		Inoculated point	23.2	11.7	50.4
A-10 A	Towards the bole ↑	55	87.4	40.9	46.8
		50	83.4	36.8	44.1
		40	73.1	31.4	43.0
		30	70.7	27.6	39.0
		15	36.4	12.3	33.8
		10	33.7	13.5	40.1
		5	32.6	14.6	44.8
		Inoculated point	30.1	14.9	49.5
	Opposite direction ↓	5	30.5	12.2	40.0
		10	27.0	10.7	39.6
		20	25.9	9.6	37.1
		30	24.2	6.4	26.4
		40	25.0	6.3	25.2
B-4 F-0	Towards the bole ↑	50	39.8	12.7	31.9
		40	37.5	11.3	30.1
		30	32.4	9.5	29.3
		20	26.6	9.3	35.0
		10	23.4	8.7	37.2
		5	20.1	8.0	39.8
		Inoculated point	21.0	11.0	52.4
	Opposite direction ↓	5	18.8	8.7	46.3
		10	19.2	4.5	23.4
		20	16.5	2.1	12.7
		30	11.8	1.2	10.2
		40	9.1	0.2	2.2
D-6 F-0(1)	Opposite direction ↓	Inoculated point	95.5	36.4	38.1
		5	90.7	25.5	28.1
		10	86.9	21.9	25.2
		15	85.9	22.5	26.2
		20	76.9	18.8	24.4
		25	74.5	18.0	24.2
		30	70.9	18.3	25.8
		35	72.5	14.1	19.4
		45	64.2	6.8	10.6
D-6 F-1(1)	Towards the bole ↑	35	99.4	40.3	40.5
		30	95.1	39.2	41.2
		25	90.7	37.1	40.9
		20	89.8	36.6	40.8
		15	90.2	33.6	37.3
		10	87.9	31.0	35.3
		5	86.9	31.9	36.7
		Inoculated point	81.0	36.1	44.6
	Opposite direction ↓	5	87.0	36.6	42.1
		10	85.2	36.3	42.6
		15	84.1	36.3	43.2
		20	75.9	28.1	37.0
		25	72.7	27.0	37.1
		30	71.5	22.0	30.8
		35	69.5	22.8	32.8

than that in poorly growing trees and the adverse result must be obtained in discoloration towards the opposite direction. This relationship in the direction towards the bole, however, could not be recognized in the present work, because the length of discoloration could not be ascertained. On the other hand, that in the opposite direction, the writer considers, could be ascertained to some extent.

In any case, velocity of the spread of discoloration caused by inoculation with *F. annosa* in the roots was considerably great, considering that the actual period the fungus acted upon wood tissue must be less then 2 years. For the next step of investigation, it is necessary to make it clear the velocity of spread of white pitted decay characteristic to the fungus.

Summary

Remarkable discoloration has been produced as a result of the inoculation of *Fomitopsis annosa* in the roots of living Sakhalin fir (*Abies sachalinensis* MAST.) in the period of two years, though the length of which could not be determined accurately. White pitted decay characteristic to the fungus has already been formed in some of the roots near the inoculated point.

Regarding the difference in the length of discoloration between two opposite directions from the inoculated point, it may be explained by the cooperation of enzymes, such as oxidases secreted extracellularly by the fungus acting upon wood components of roots, capillary action, and flow of sap, etc.

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Explanation of the figures

I—A. Contrast of the appearance of the tree belonging to group A and B. Left: group A, Right: group B.

—B. Roots inoculated with *Fomitopsis annosa* (FR.) KARST. in the tree A-4. Inoculated points, F-0 (1), F-1 (2), and s.d., were seen.

—C. Roots inoculated with *Fomitopsis annosa* (FR.) KARST. in the tree D-6. Inoculated points, F-0 (1), F-1(2), and F-1 (3), were seen.

II—A. Conidiophores of the fungus two years after isolation formed on the potato sucrose agar. The culture was used for the source of inoculation experiment. (×270)

—B. Hyphae spreading into the wedge (F-0). (×270)

—C. Conidiophores of the fungus at the time when the experiment was completed, formed on the potato sucrose agar at 22°C (28 days after inoculation). (×210)

—D. Conidiophores of the fungus reisolated from the root A-6 (A) on the potato sucrose agar at 22°C (28 days after inoculation). (×210)

III—A. Marked discoloration in the root A-6 (A) on the cut surface at 15 cm apart from the inoculated point towards the bole. (×1/5)

—B. Hyphae of the fungus in a radial section of the root A-6 (A) near the cut surface. (×100)

—C. Conidiophores and conidia appearing abundantly from the marked discoloration on the cut surface of the root A-6 (A). (×430)

IV—A. Longitudinal section of the decayed root D-10 (F-1). (×1/3)

—B. Considerable discoloration and decay appearing on the cut surface at 15 cm apart from the inoculated point towards the bole. (×2/5)

—C. Magnified picture of the same discoloration and decay with B. White pits are seen clearly.

—D. Hyphae of the fungus in the ray of the decayed part. (×210)

—E. Hypase of the fungus in the radial section of the decayed part near the inoculum. (×210)

V Changes of discoloration corresponding to the distance from the inoculated point in the root A-8 (F-0). (×3/8)

—A. Left to right in the upper row 20cm and 15cm, in the lower row 10cm and 5cm, apart from the inoculated point towards the bole, respectively.

—B. Left to right in the upper row 0cm (inoculated point) and 5cm, in the middle row 10cm and 15cm, and in the lower row 20cm, apart from the inoculated point towards the opposite direction, respectively.

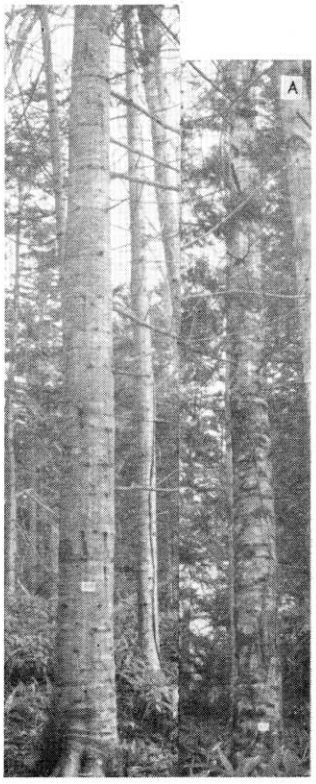
北海道演習林におけるトドマツ生立木の材質腐朽について　第4報

—根に対する接種試験—（摘要）

横　田　俊　一

東京大学北海道演習林内のトドマツ天然林は根株腐朽によって著しい被害をうけており，その主要な腐朽菌はマツノネクチタケであることが明らかとなった。しかも，本菌は根系を通して被害を拡大していくことが知られるに至ったので，一度本菌が根に侵入したならば，どの位の速さで腐朽或は変色が進んでいくものかを確かめることを目的として，生立木及び伐倒後1年を経過した伐根の根に本菌を接種して満2年間放置し，腐朽及び変色の状況を精査した。その結果，伐根には既に他の腐朽菌が侵入していたために活着が認められなかったが，生立木の根にはよく活着した。樹幹の方向への変色は極めて早く，採取した資料の殆ど総てについて，資料の長さよりも先迄変色が進んでいたために，その限度を知ることが出来なかった。又樹幹と反対方向への変色は資料の約半数のものについて確認出来た。資料の数が非常に多かったのでその一つ一つについては確認することは出来なかったが，あるものでは既に本菌特有の白色孔状腐朽が明らかにみとめられた。

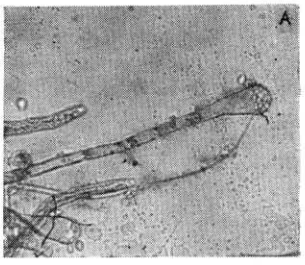
菌の進行方向の違いによって変色の距離が異なることは，本菌の分泌する酸化酵素等が方向によって到達距離に差があることが主要な原因であると考えられる。



I—A

I—B

I—C



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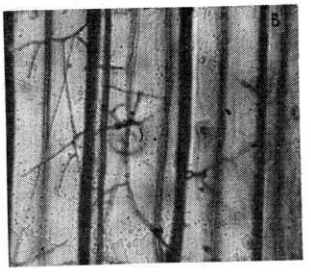

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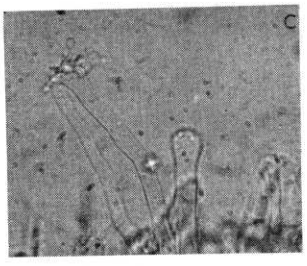

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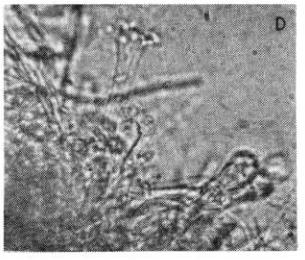

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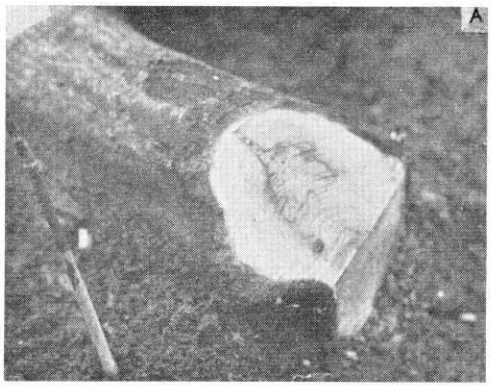

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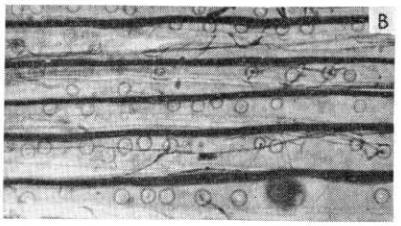

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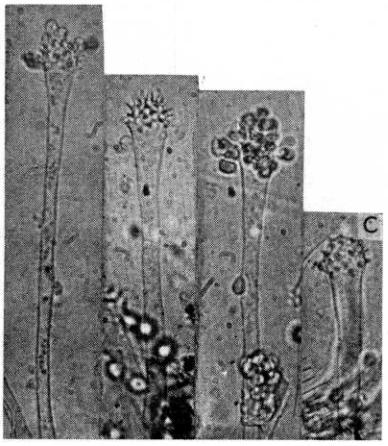

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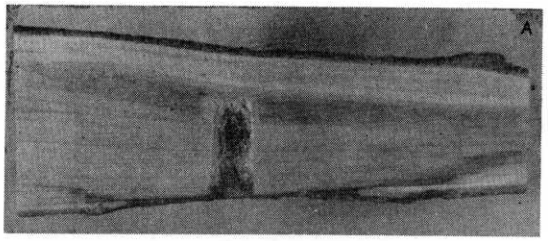

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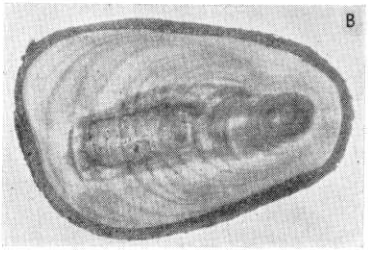

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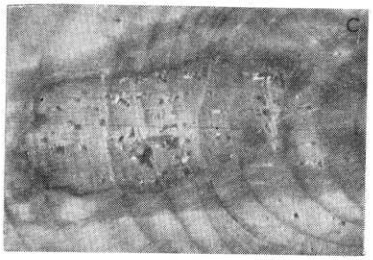

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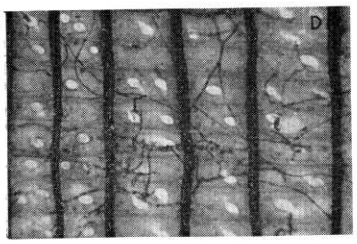

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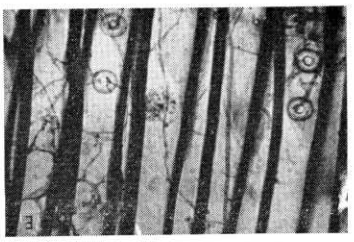

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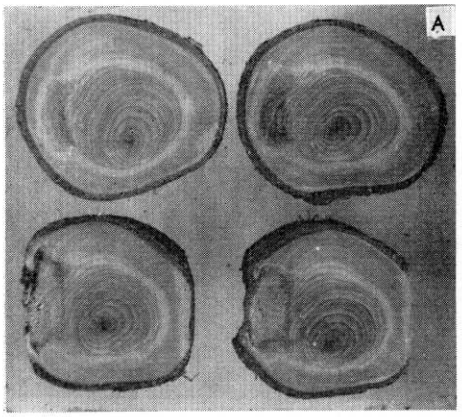

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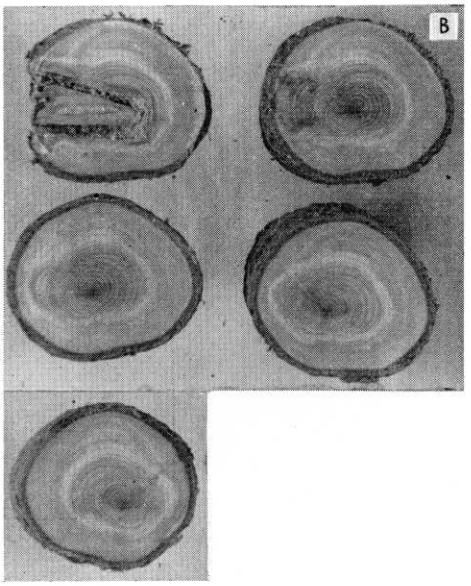

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