Stump Decay in Japanese Larch Plantation at the Hokkaido Experimental Station of Kyushu University Forests

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https://doi.org/10.15017/10940

出版情報：九州大学農学部演習林報告. 79, pp.1-11, 1998-12-28. 九州大学農学部附属演習林
バージョン：
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九大演報 (Bull. Kyushu Univ. For.), 79 : 1 -11, 1998

Original Article

Stump Decay in Japanese Larch Plantation at the Hokkaido Experimental Station of Kyushu University Forests

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Abstract

The frequency of stump decay in precommercial thinning stumps of Japanese larch (*Larix kaempferi* Carr.) was investigated at plantations in the Hokkaido Experimental Station of Kyushu University Forests. The examined stump were 17-, 24-, 31-, 38- and 41- year-old, and varied to upper, middle and lower slope positions. Stump infection by *Phaeolus schweinitzii* and *Sparassis crispa* were abundant in this survey, and observed fruit body in an advanced stage. On the basis of examination of stumps, root decay or stain was found in more than 40 % of 2,126 stumps. The occurrence and intensity of wood-rotting fungi were found to increase with tree age. The ratio of stump damage was higher in moist zones than dry one.

Key words : Japanese larch; *Larix kaempferi*; stump; wood rotting fungi; *Phaeolus schweinitzii*; *Sparassis crispa*.

1. Introduction

The importance of Japanese larch (*Larix kaempferi* Carr.) in Hokkaido is indicated by the plantation area of this species at 462,000 ha. It comprised about 31 % of all the trees planted in 1996 (Hokkaido Government Department of Forestry, 1997). Japanese larch is the most abundant species in the Hokkaido Experimental Station of Kyushu University Forests. The plantation area of this species is accounted 1,000 ha, and it occupied 80% of all artificial plantation. Wood rotting fungi cause root disease in natural forests world-wide (Kile *et al.*, 1991). To acquire a better understanding of the damage that results from root and its relationship to forest management practices and forest inventories, determinations were undertaken to study the extent of mortality caused by root rot, premature windthrow, and net volume loss due to root rot in black spruce, white spruce, and balsam fir (Whitney, 1989). Losses due to stem decay, including the upward extension of root-rotting fungi into the trunk, and the identity of fungi found in this species in Hokkaido have been determined (Igarashi and Takeuchi,

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1985; Yamane *et al.*, 1990; Yamaguchi *et al.*, 1995). *Phaeolus schweinitzii, Tyromyces balsameus* and *Sparassis crispa* were identified for Japanese larch stump rotting fungi by Sasaki (1983). *P. schweinitzii* has been isolated in the most frequency on the trunk of Japanese larch (Kuroda *et al.*, 1991; Ohsawa *et al.*, 1994). Yamaguchi *et al.* (1995) reported 2 main species of wood rotting fungi, *Fuscoporia weirii* and *Heterobasidion annousm* in Japanese larch stump, and indicated that root rot and butt rot also affect the management of larch plantation in Hokkaido. In this report I provide an estimate of the rate of disease spread caused by wood rotting fungi in Japanese larch plantation from observations made in various age stumps.

2. Materials and Methods

2.1. Site locations

The Japanese larch, *Larix kaempferi* plantations are located in Ashoro, Hokkaido: Hokkaido Experiment Station of Kyushu University Forests (43°14' N, 143°33' E) (Fig. 1). The plantations were established in 1950 following logging of an old-growth oak stand. The site was slashed prior to planting of bare-root *L. kaempferi* seedlings at a spacing of about 2×2 m (Fig. 2). This Japanese larch plantation is continuously established each year in plots in the Hokkaido Experiment Station of Kyushu University Forests.

2.2. Stump surveys

The stumps in 17-, 24-, 31-, 38-, and 41-year-old plantation stands (Fig. 3) were surveyed for infection by wood-rotting fungi (Basidiomycetes). Average plantation area was 4.3 ha. Sites were stratified into upper, mid, and lower slope positions to examine variation over the slope. The age of each tree was estimated from the number of rings on its thinning stump. The diameter across the bark of sample stumps was measured, then the cross-sectional area of stumps was used to calculate the percentage of decay that was infected. Infection of wood rotting fungi on the cleanly cut surface was estimated by tracing the decaying stain area (Figs. 4, 5, and 6). Number of surveyed stumps and roots were 2,126 on this study.

3. Results and Discussion

The damage ratio of thinning stumps by wood rotting fungi are presented in Fig. 7. This is indicated by the percentage of infected stumps to all evaluated stumps. Decay and stain caused by wood rotting fungi were consistently higher in old aged tree stumps, over 31-year-old compared with younger ones. The ratio of stump infection over 31-year-old tree stumps were calculated over 40%. On the other hand, 17-year-old tree stumps were decayed and stained only 15%.

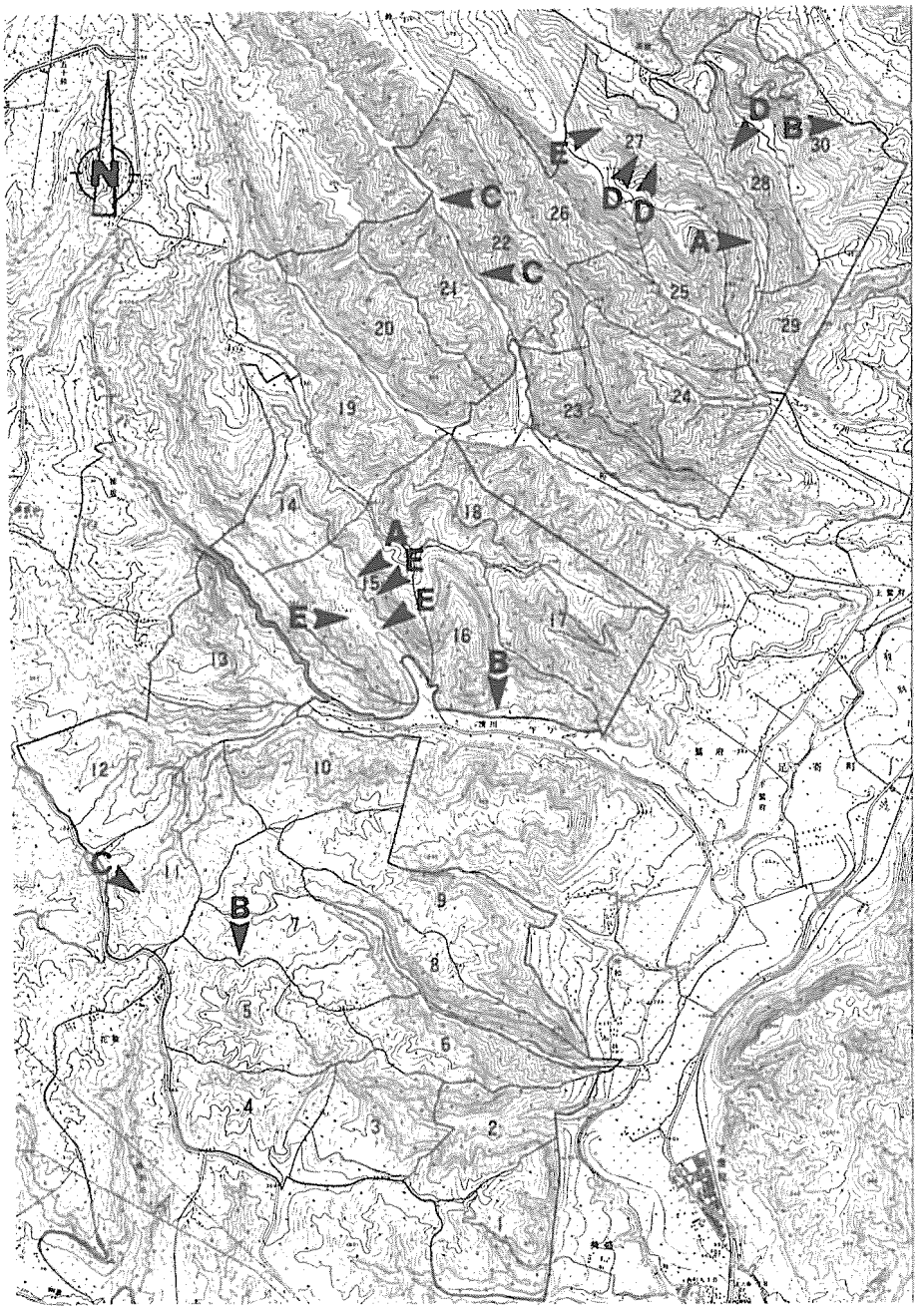

Fig. 1. Plot locations for evaluating thinning stump decay in Hokkaido Experimental Station of Kyushu University Forests. Arrowheads indicate the direction of several plantations, and alphabet initials indicate plantation ages, respectively. Plantation age: A, 17-; B, 24-; C, 31-; D, 38-; E, 41-year-old. Number means the several compartments in Hokkaido Experimental Station of Kyushu University Forests.

Fig. 2. Plantation newly planted Japanese larch seedling after commercial cutting for 41-year-old trees in No. 15 compartment shown in Fig. 1.

Fig. 3. Japanese larch plantation at 31-year-old, planted in No 11 compartment shown in Fig. 1.

Precommercial thinning can increase inoculum levels following colonization of the stumps by a pathogenic wood rotting fungi, and colonized stumps are associated with disease in crop tree (Filip, 1979). Following stump creation, mycelium can spread

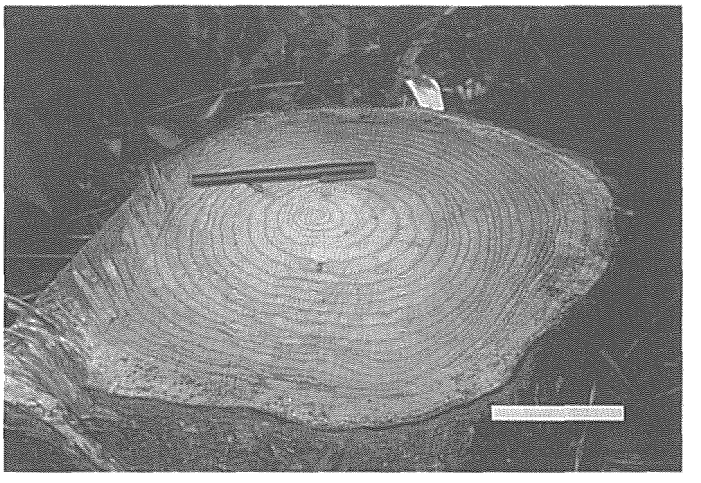

Fig. 4. Sound stump, which has no decay staining by wood rotting fungi. Scale bar 10 cm.

Fig. 5. A representative sample of stump decay showing a phyhae of wood rotting fungi. Arrowhead indicates decaying stain positions. Scale bar 10 cm.

proximally and distally from existing lesions on roots to colonize the root system. Root contacts established before thinning provide a pathway for the fungus to move from stump to crop tree while inoculun potential is at a maximum (Shaw, 1980). However, ratio of infection area tends to decrease with tree age (Fig. 8). Stratifying samples by age-class does not clarify the relationship between tree growth and stump infection in Japanese larch (Fig. 9). Precommercial thinning, a type of partial cut, is done in 24- to 38-year-old plantations, reduce stocking to optimum density, and remove trees with defects, thus improving form and volume of the remaining trees. In portions of some stands the thinning effect of mortality and windfall undoubtedly results in improved

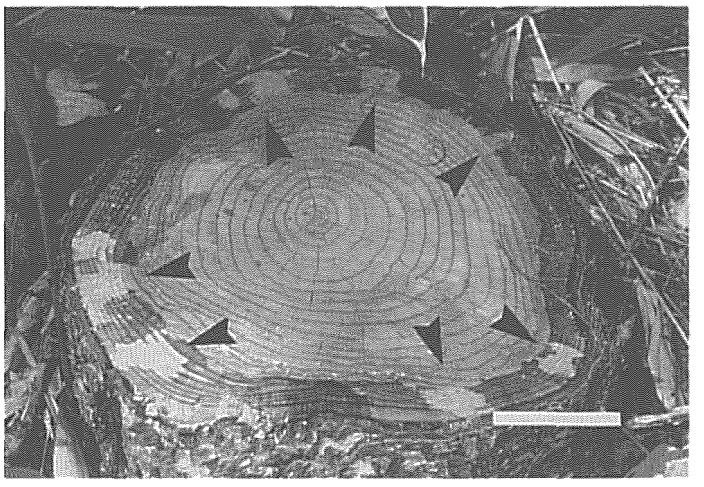

Fig. 6. A representative sample of stump decay showing a crescent shaped having small, discreate patches. Arrowheads indicate decaying stain positions. Scale bar 10 cm.

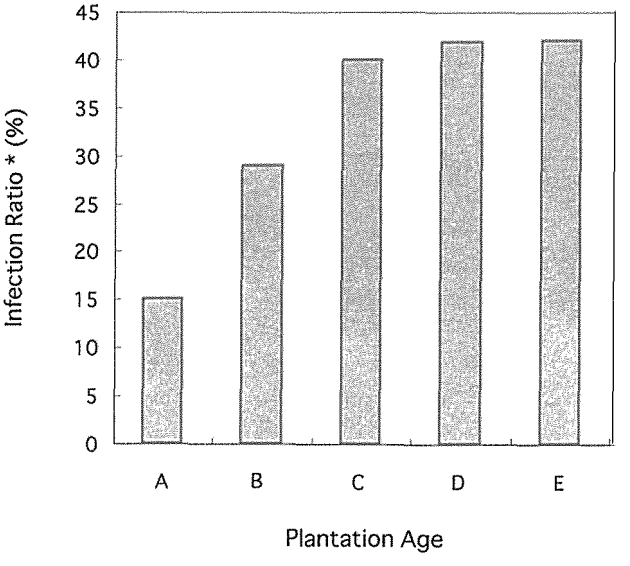

Fig. 7. The percentage of the stumps which decay recognized in various tree age.

$$* \text{ Infection ratio } (\%) = \frac{\text{Number of infected stump}}{\text{Number of evaluated stump}} \times 100$$

Plantation age: A, 17-; B, 24-; C, 31-; D, 38-; E, 41-year-old.

growth of the remaining trees.

The incidence of wood rotting fungi in stumps differed among lower, mid, and upper slope transcects (Fig. 10). The frequency of stumps colonized by wood rotting fungi varied among lower, middle, and upper slope transects. Wood rotting fungi infected higher proportions of Japanese larch on higher ground moisture site. In this

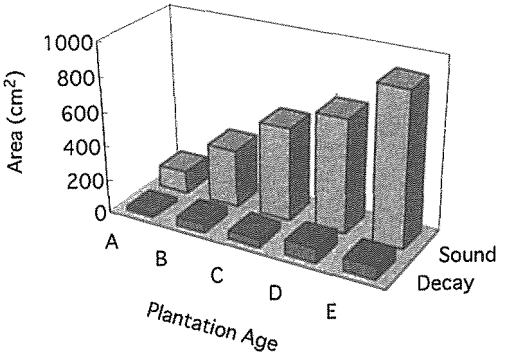

Fig. 8. Comparison of sound and decay area on cross section of damaged stump. Plantation age: A, 17-; B, 24-; C, 31-; D, 38-; E, 41-year-old.

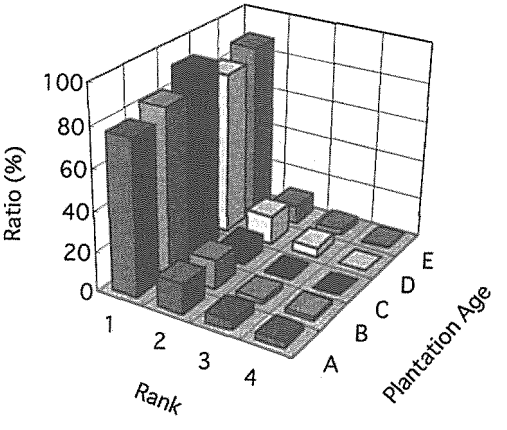

Fig. 9. Classification of damage degree of stump in various age. Ranked: 1, 20%; 2, 20-50%; 3, 50-70%; 4, over 70%. The figures reveal percentage of decay area to the cross sectional surface of stump. Plantation age: A, 17-; B, 24-; C, 31-; D, 38-; E, 41-year-old.

study, conditions favoring growth of Japanese larch also favored the growth of the wood rotting fungi, and frequently occurring fungi are capable of growing in roots on a high moisture and wet soil conditions.

The brown cubical decay as shown in Fig. 11 occupied almost high percentage of the cross section of Japanese larch stumps. Wood rotting fungi may be invading near ground level, from where they spreads several meters upward in the heartwood and downward in root centerwood. Heartwood of the lower stem and stump and center wood of roots were invaded by *P. schweinitzii*, without extensive bark, cambium, and

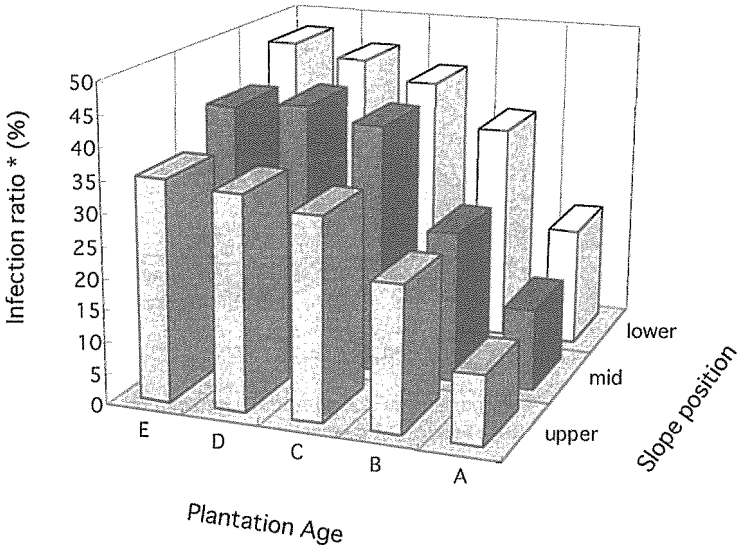

Fig. 10. Infection ratio of various aged Japanese larch at various slope positions. Plantation age: A, 17-; B, 24-; C, 31-; D, 38-; E, 41-year-old. See in Fig. 7 for the infection ratio.

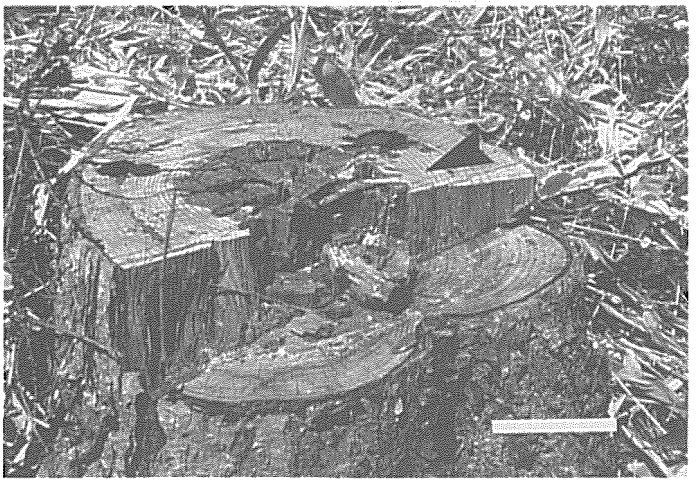

Fig. 11. A representative sample of stump decay of 41-year-old Japanese larch showing a brown cubical rot that occupies approximately 25% of the stump surface area. This fungus was isolated. Scale bar 10 cm.

sapwood invasion in Japanese larch (Figs. 11 and 12). In cross sections of either large roots or the lower stem, decay or stain of another wood rotting fungi was frequently crescent shaped, having small, discrete patches on the outer side of the crescent (Fig. 6). Root rot by *P. schweinitzii* and *S. crispa* is usually in an advanced stage when fruiting becomes useful for diagnosis. Fruit bodies of *P. scweinitzii* and *S. crispa*

Fig. 12. Fructification of *Phaeolus schweinitzii* in stump of 41-year-old Japanese larch. The infected area occupies approximately 75% of the stump surface area. This fungus is brown rot decaying type. Scale bar 10 cm.

Fig. 13. Fructification of *Sparassis crispa* in stump of 41-year-old Japanese larch. The infected area occupies approximately 60% of the stump surface area. This fungus is brown rot decaying type, and is edible mushroom. Scale bar 10 cm.

appeared on the warm and damp conditions on the cross section of stump (Figs. 12 and 13).

Isolation and identification methods of wood rotting fungi has been reported. Korhonen (1978) identified various species using dimon mating tests. *Armillaria ostoyae* stump isolates from excavations were challenged in a diploid-diploid paring with corresponding isolates from crop tree lesions to determine genotype similarity

(Anderson and Ullrich, 1982). Isolates from stump surveys and stump excavations were also identified using analysis of restriction fragment length polymorphisms of the intergenic region between the 26s and 5s regions of the ribosomal RNA genes (Harrington and Wingfield, 1995).

More work is needed to discuss the relationship between Japanese larch growth and wood rotting fungi infection. I should like to monitor further progress of the wood rotting fungi epidemic and would therefore appreciate information on the occurrence of the disease in all parts of places planted Japanese larch.

References

ANDERSON, J. B. and ULLRICH, R. C. (1982) : Diploids of *Armillaria mellea* : synthesis, stability, and mating behaviour. Can. J. Bot. **60** : 432-439

FILIP, G. M. (1979) : Root disease in Douglas-fir plantations is associated with infected stumps. Plant. Dis. Rep. **63** : 580-583

HARRINGTON, T. C. and WINGFIELD, B. D. (1995) : A PCR-based identification method for species of *Armillaria*. Mycologia **87** : 280-288

Hokkaido Government Department of Forestry (1997) : Forests of Hokkaido 1998 (in Japanese)

IGARASHI, T. and TAKEUCHI, K. (1985) : Decay damage to planted forest of Japanese larch by wood-destroying fungi in the Tomakomai experiment forest of Hokkaido University. Res. Bull. Hokkaido Univ. For. **42** : 837-847

KILE, G. A., MCDONALD, G. I. and BYLER, J. L. (1991) : Ecology and disease in natural forests. in *Armillaria* root disease, U.S. Dep. Agric. Handbook, pp. 102-121

Korhonen (1978) : Interfertility and clonal size in the *Armillariella mellea* complex. Karstenia **18** : 31-42

KURODA, Y., OHSAWA, M. and KATSUYA, K. (1991) : Development of butt-rot fungi in the trunks of Japanese larch trees. J. Jpn. For. Soc. **73** : 232-237 (in Japanese with English summary)

OHSAWA, M., KURODA, Y. and KATSUYA, K. (1994) : Heart-rot in old-aged larch forest (I) State of damage caused by butt-rot and stand conditions of Japanese larch forests at the foot of Mt. Fuji. J. Jpn. For. Soc. **76** : 24-29

SASAKI, K. (1983) : Infection of Japanese larch in precommercial thinning stumps. Hoppou Ringyou **35** : 108-113 (in Japanese)

SHAW, C. G. (1980) : Characteristics of *Armillaria mellea* on pine root system in expanding centers of root rot. Northwest Sci. **54** : 137-145

WHITNEY, R. D. (1989) : Root rot damage in naturally regenerated stands of spruce and balsam fir in Ontario. Can. J. For. Res. **19** : 295-308

YAMAGUCHI, T., SASAKI, K., SAKAMOTO, Y., TANAKA, K. and AOSHIMA, K. (1995) Fungi and decay damage. Hoppou Ringyou **47** : 38-39 (in Japanese)

YAMANE, G., USUI, G. and KITAGAWA, Y. (1990) Decay damage to stemwoods on afforested *L. leptolepis* Gordon in Hokkaido. Bull. Hokkaido Forest Res. Inst. **28** : 64-74 (in Japanese)

(Received 22 June 1998; Accepted 25 September 1998)

九州大学北海道演習林におけるカラマツ根株の腐朽

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要　　約

九州大学北海道演習林に植栽されているカラマツ根株の腐朽菌による侵害について検討した．調査したカラマツの林齢は17，24，31，38，41年生で，それぞれ尾根，中腹，沢筋に分けて観察した．カラマツの根株にはカイメンタケ，ハナビラタケによる侵害が多くみられ，腐朽が進んだものでは子実体の着生が観察された．調査した2126本の根株のうち約40％で木材腐朽菌による侵害が認められ，侵害割合は高年次林分になるほど高くなった．沢筋に植栽されたカラマツで侵害割合が高くなった．

キーワード：カラマツ，根株，木材腐朽菌，カイメンタケ，ハナビラタケ