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# Study of root and butt rot frequency in hybrid larch stands in southern Sweden

Lars-Göran Stener &
Gudmund Ahlberg

Uppsala Science Park, SE 751 83 UPPSALA • Tel: 018-18 85 00 • Fax: 018-18 86 00
skogforsk@skogforsk.se • http://www.skogforsk.se

**Cover:** Example of butt rot in hybrid larch.**Photo**: Lars-Göran Stener
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# Contents

## Abstract

A survey of the incidence of root and butt rot in 18 *L. x eurolepis* stands (ages 21–47 years) was carried out in southern Sweden by visual classification of inections on newly cut stumps. It was found that 1) The infection rate varied a lot among sites and seemed to be a serious problem (>10% of the surveyed stumps were infected with a mean stump infection area >16%) in 6 out of the 18 surveyed stands. 2) The spread of rot along the stem was analysed in one of the stands showing a mean of 2 m, i.e. a large proportion of the butt log was affected 3) The frequency of rot damage was of the same magnitude irrespective of stump diameter, indicating that the rot infection was not related to growth. 4) No differences in infection rate among 15 different hybrid families were found (only one trial evaluated).

## Introduction

Root and butt rot damage causes large economic loss annually to Swedish forestry (Bendz-Hellgren et al., 1998) due to 1) degradation of decayed timber to pulp or fire wood, 2) reduction of growth of infected trees and 3) increased susceptibility to wind throw and bark beetle attacks. As a consequence, the rotations are often shortened, resulting in further financial loss. Root and butt rot is mainly caused by *Heterobasidion annosum* (Fr.) Bref. and *Armillaria* spp., where the former is the most serious (Stenlid, 1986). The fungus is primarily spread via spores to freshly cut stumps or wounds on stems and roots. The mycelium that is produced is then spread throughout the roots and infects healthy trees by the root contacts between stumps and trees (Risbeth, 1951). There are three different intersterility groups of *H. annosum*. 1) The S-group is most common on Norway spruce (*Picea abies*) but also attacks young Scots pine (*Pinus silvestris*) seedlings. 2) The P-group has been found on several species. It is most common on Scots pine but also attacks other conifers such as spruce and larch and even certain broad leaf species (Korhonen, 1978). The S-group has been found all over Scandinavia, while the P-group is present in the southern part of Scandinavia (Stenlid, 1987, Karlsson, 1993). 3) The F-group is merely infecting silver fir (*Abies alba*). It has not been found in Scandinavia but is common in middle and southern part of Europe (Capretti et al., 1990, Lakomy, 1996).

Larch has by silviculturists in Scandinavia been considered to be a better alternative to N. spruce on forest land where the former generation of spruce was heavily infected by *H. annosum*. However, heavy attacks of *H. annosum* have been reported on *L. decidua* Mill. and *L. kaempferi* (Lamb.) planted on sites infected by *H. annosum* (Vollbrecht et al., 1995). There are also results from stands and field trials indicating that *L. x eurolepis* is highly susceptible (Low & Gladman, 1960, Vollbrecht & Stenlid, 1999, Rönnberg & Vollbrecht, 1999, Greig et al., 2001). Furthermore, in controlled infection experiments on seedlings it was concluded that *L kaempferi* and *L. x eurolepis* were highly susceptible (Swedjemark & Stenlid, 1994).

Many practical Swedish foresters are sceptical about *L.x eurolepis* being highly susceptible to butt rot. The objective with the present study was to get some basic information about the incidence of root and butt rot infections in stands of hybrid larch (*Larix x eurolepis*) in southern Sweden.

## Material and methods

The survey was carried out in 2 genetical trials and in 16 commercial stands of *L. x eurolepis* (ages 21–47 years) in southern Sweden (Appendix 1). A great deal of the stands was regionally clustered, which is indicated by the stand identification numbers. Stands with the same figure but with different letters belong to the same region as for instance stands 4A, 4B, 4C and 4D. The stands were located by contacting a number of forest-owners during the years 1998–2001. Stands of *L.x eurolepis* (according to information from management plans) to be thinned at least a second time were selected for the study. The two genetical trials included full sib crossings between *L. decidua* and *L. kaempferi*, i.e. these stands were truly 100% *L. x eurolepis*.

The inventory was made during the autumns and winters of 1998–2002 directly in connection with the thinning operations, i.e. within 0–3 days after felling, apart from stand number 6A to 6F (Appendix 1) where it was delayed 2 months. Classification of the incidence of root and butt rot on each fresh stump was made visually into three types: 1) firm and light, 2) firm and dark, and 3) soft and hollow butt rot (Appendix 2). The proportion of each rot type was estimated in percent of the stump area. The stump diameter was registered as the average of the maximum and minimum stump diameter. In addition, in one of the trials (stand no 2) the maximum height to which the rot had spread were studied by cutting discs at 20 cm intervals along the stem until no decay was found. No identification of the type of fungus was made from the infected stumps. Before the stump inventory started, the stand area was divided into blocks based upon differences in local topography and site conditions.

## Statistical analyses

All statistical analysis was based on individual stump observations within each stand. Evaluation of differences among blocks was made for the trait rot/no rot by the Proc GenMod (SAS, 1997) by using a logit transformation and chi2-test. The same procedure was used in stand number 1 for evaluation of possible differences in root and butt rot infections among different full sib families. Furthermore, in this stand an analysis of variance (Proc GLM, SAS, 1997) was performed according to the model: $y_{ijk} = \mu + b_i + f_j + e_{ijk}$, where $y_{ijk}$ = proportion rot of stump area for observation k, in block i for family j, $\mu$ = trial mean, $b_i$ = fix effect of block i, $f_j$ =fix effect of family j and $e_{ijk}$ = random error term for observation ijk, $N(0,\sigma_e^2)$.

The t-test procedure (SAS, 1997) was used for evaluation of differences in diameter among stumps with and without root and butt rot. Pearson correlations were estimated between stump diameter and proportion rot of the stump area.

## Results

The frequency of stumps with root and butt rot infections is presented for each site in Figure 1. The mean (stand area weighted ) infection rate for all sites was 20% but the rate varied a lot among sites. From Figure 1 and 2 it is obvious that in stands with a high frequency of infected stumps the mean proportion of infected stump area is large as well. In order to get indications of stands more seriously damaged by rot, frequencies were estimated by excluding stumps with less than 10% infected stump area (white bars in Figure 1 and Appendix 3).

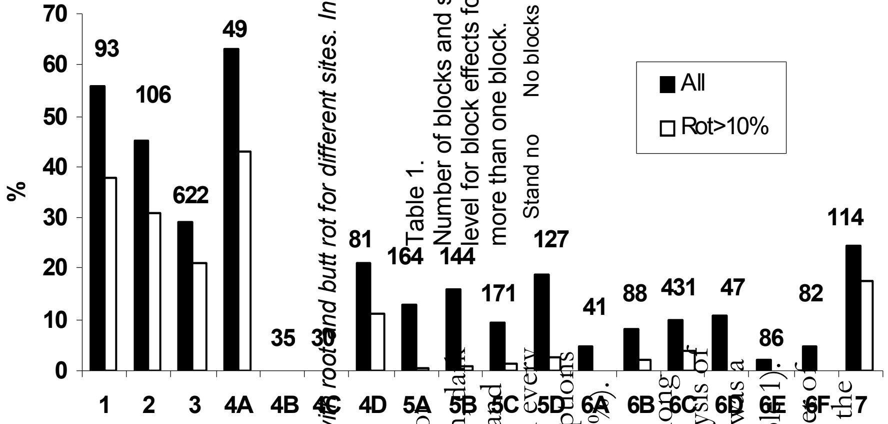


*Figure 1.*
*Frequency of stumps (%) with root and butt rot infections for different sites. "All" refers to all stumps with rot, i.e. no consideration was taken to the proportion of the infected stump area and "Rot >10%" refers to stumps where the proportion of the infected stump area was at least 10%. The number of total surveyed stumps in each stand are given above each bar.*

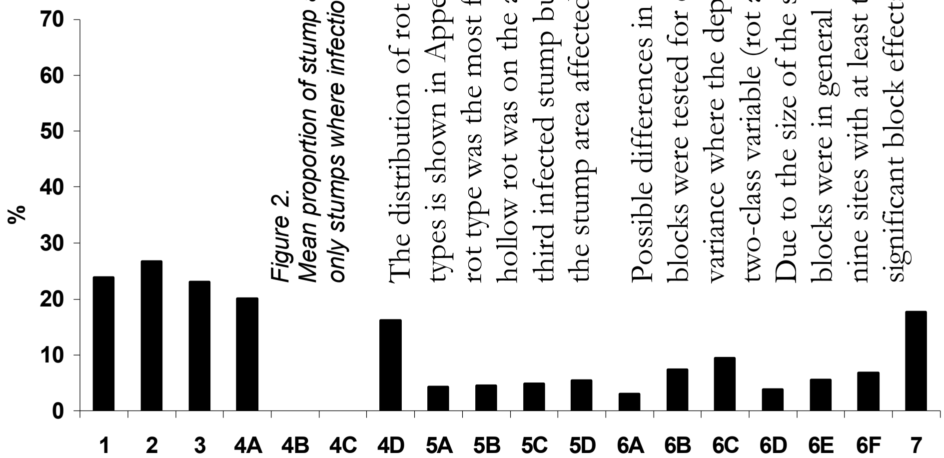


*Figure 2.*
*Mean proportion of stump area (%) infected with root and butt rot for different sites. Includes only stumps where infections were observed.*

The distribution of rot over different rot types is shown in Appendix 4. The firm dark rot type was the most frequent. Loose and hollow rot was on the average found in every third infected stump but with few exceptions the stump area affected was small (<10%).

Possible differences in rot infection among blocks were tested for each site by analysis of variance where the dependent variable was a two-class variable (rot and no rot) (Table 1). Due to the size of the stands the number of blocks were in general few. Five out of the nine sites with at least three blocks had significant block effects on rot infection.

Table 1.
Number of blocks and significance level for block effects for sites with more than one block.

| Stand no | No blocks | P >F |
|---|---|---|
| 1 | 5 | 0.6862 |
| 2 | 3 | 0.0098 |
| 3 | 6 | 0.0001 |
| 4A | 2 | 0.9612 |
| 4D | 2 | 0.4583 |
| 5A | 3 | 0.0001 |
| 5B | 3 | 0.1004 |
| 5C | 3 | 0.0184 |
| 5D | 3 | 0.2601 |
| 6B | 3 | 0.5012 |
| 6C | 6 | 0.0001 |
| 7 | 2 | 0.7564 |

There were no indications of differences in mean stump diameter between stumps with and without rot (Table 2). The correlations between proportion of infected stump area and stump diameter for trees where infection had been found were all weak and not significant ($p<0.05$).

Table 2.
Number of observations, mean diameter and t-test of differences in diameter for trees with and without rot for different sites. Also correlations between diameter and proportion of infected stump area are given.

| Stand | Number of obs | | Mean diam (cm) | | | |
|---|---|---|---|---|---|---|
| no | No rot | Rot | Rot | No rot | t-test | Corr |
| 1 | 41 | 52 | 18 | 17 | 0.4477 | -0.18 |
| 2 | 58 | 48 | 32 | 30 | 0.2877 | -0.18 |
| 3 | 444 | 178 | 26 | 27 | 0.0993 | -0.10 |
| 4A | 18 | 31 | 41 | 41 | 0.7419 | -0.18 |
| 4B | | | | | | |
| 4C | | | | | | |
| 4D | 64 | 17 | 37 | 35 | 0.1459 | 0.22 |
| 5A | 143 | 21 | 28 | 28 | 0.5038 | -0.13 |
| 5B | 121 | 23 | 33 | 33 | 0.6819 | 0.30 |
| 5C | 155 | 16 | 29 | 28 | 0.6203 | 0.22 |
| 5D | 103 | 24 | 24 | 24 | 0.6827 | -0.01 |
| 6A | 39 | 2 | 29 | 31 | 0.6040 | |
| 6B | 81 | 7 | 25 | 27 | 0.2086 | 0.16 |
| 6C | 389 | 42 | 20 | 24 | 0.0716 | 0.24 |
| 6D | 42 | 5 | 32 | 35 | 0.1504 | 0.30 |
| 6E | 84 | 2 | 29 | 30 | 0.9403 | |
| 6H | 78 | 4 | 32 | 33 | 0.6055 | 0.40 |
| 7 | 86 | 28 | 29 | 28 | 0.8195 | 0.24 |

One of the most infected sites was stand number 2, i.e. the genetical trial at Aspanäs (Figure 1 and 2). From this trial there is also information about how far the rot was spread along the stem (Table 3). On the average the rot had reached to 2 m height of the stem and at the most close to 5 m. The correlation between proportion of rot infection at stump height and spread along the stem was positive and significant (Table 4).

Table 3.
Spread (dm) of different rot types along the stem in stand number 2.

| | Firm-light | Firm-dark | Loose-Hollow | All rot |
|---|---|---|---|---|
| Mean | 7.0 | 23.0 | 25.7 | 19.6 |
| Std dev | 5.3 | 11.0 | 11.0 | 12.2 |
| Min | 1 | 6 | 13 | 1 |
| Max | 16 | 48 | 44 | 48 |
| Number of obs | 13 | 38 | 7 | 48 |

Table 4.
Correlations between proportions of infected stump area, spread of infection along the stem and stump diameter in stand number 2. Includes stumps with all types of rot (N=48). Figures in bold are significant ($p<0.05$).

| | Spread in length | Diam |
|---|---|---|
| Proportion | **0.64** | -0.18 |
| Spread in length | | 0.02 |

In the genetic trial at Häckeberga (stand number 1), possible differences between the 15 various hybrid families were evaluated by analysis of variance for the two dependent variables rot/no rot and proportion of infected stump area. However, no such differences were found.

## *Discussion*

### Material

There were great problems to get objects for the study since the number of stands to be thinned was drastically reduced in the years 2000 and 2001 due to the effects of the December 1999 hurricane. Thus the material cannot be considered to be selected randomly and therefore was not representative for middle aged *L. x eurolepis* populations in southern Sweden. Hence, the results merely reflect the infection rate within the selected stands.

According to information from management plans the larch species in all stands was *L. x eurolepis*. In most cases the origin was unknown but it is likely that most of them originate from the Swedish seed orchard of Maglehem. This seed orchard consists of one *L. kaempferi* and nine *L. decidua* clones. Aiming at 100% hybrids, harvesting is only carried out on the *L. kaempferi* clone whereas the *L. decidua* clones are used as pollinators. However, there are indications that even seed orchards of such a design produce regeneration material, which is not homogenous in species (Achere et al., 2002). Hence, apart from the stumps in the two genetical trials including *L. x eurolepis* full sibs (stand no 1 and 2) we cannot be sure that all surveyed stumps really are hybrids but it is likely that the major part of them are.

### Susceptibility of L. x eurolepis to root and butt rot infections

Lately there are numerous reports about the *L x eurolepis* susceptibility towards root and butt rot. In an experimental area in southern Sweden where the previous rotation of *P. abies* was heavily infected by *H. annosum* serious damage caused by *H. annosum* (P-type) was found in a 15 year-old (38%) and 20 year-old (57%) *L x eurolepis* stand (Vollbrecht & Stenlid, 1999). The infection rate in a nearby 25-year old *P. abies* stand was 5% and the infection percentage of the decayed trees was 75 to 82% for *L x eurolepis* and 50% for *P. abies*. In the same study a rot height in the infected trees of 14 to 15 dm for *L. x eurolepis* and 6 dm for *P. abies* was reported.

Greig et al. (2001) studied butt rot disease in experimental species plantings established during 1960–1971 in western Britain. In one of these trials the infection rate was at age 23 (first thinning) 63% for *L. decidua*, 49% for *L.x eurolepis* and 59% for *L. kaempferi* compared to 16% for *P. abies*. The mean height of *H. annosum* infection along the stem was 2.1 m for *L. decidua* and 1.3 m for *P. abies*. Probable explanations for the higher susceptibility have been suggested: 1) Larch is thinned at an earlier age and more frequently than spruce, indicating a higher risk for spore infections, 2) the exposed stump surface area of larch is larger when compared with spruce of the same age up to at least ages around 30 years, due to its higher initial growth capacity (Yde-Andersen, 1960) and 3) the fast growth of larch at juvenile age results in early contacts with infected roots and stumps from previous generations (Vollbrecht et al., 1995).

The present study confirms that *L. x eurolepis* can be susceptible to root and butt rot. Rot damage seemed to be serious in 6 of the 18 surveyed stands at the time when the survey was carried out (Figure 1 and 2). However, since there is no evidence of infections dying out or decreasing in heavily infected crops once it has become established (Low, 1958) there is a risk that the number of seriously infected stands will increase in the years to come. Since no isolation of the fungus in the infected stumps was carried out, we cannot say what kind of fungus that caused the infections. From results from the studies mentioned we can only assume that the major part of the infections was caused by the P-type of *H. annsoum*.

The information available about each site is varying but there does not seem to be any obvious relations between site data and infection rate. The material is also too weak to make such conclusions. However it should be pointed out that spruce had been used in the previous generation in 3 out of 5 of the most infected sites (2, 3, 4A, 4D and 7) where information about former land use was available (Appendix 1). Furthermore, the previous generation in the most heavily damaged stand in Trolleholm (4A) was spruce, while in the three other stands (4B, 4C and 4D) with less or no damage there had been beech forest.

Vollbrecht & Stenlid (1999) showed that most *H. annosum* infections initially expand in the heartwood-sapwood boundary in *Larix* trees. This was our experience as well (e.g. Appendix 2).

There were no differences in mean stump diameter for infected and non-infected stumps. Furthermore, no correlation between proportion of infected stump area and diameter of infected stumps was found (Table 2), i.e. the proportion of rot was of the same magnitude irrespective of stump diameter. Risbeth (1957) found a tendency for fast growing crops to be more seriously damaged by *H. annosum* than slow growing crops. A slightly higher infection rate was found in larger trees than in smaller ones by Swedjemark & Stenlid (1993). They concluded that larger trees have a higher possibility of coming in contact with infected roots, since they have large root systems covering a larger area. On the other hand in two experiments, the first including a *H. annosum* inoculation study on N. spruce cuttings and the second including naturally infected N. spruce clones, no correlation between fungal extension and tree size was found (Gunilla Svedjemark, pers. comm.)

It has been found that trees damaged by butt rot are distributed in clusters (Stenlid, 1987, Piri et al., 1990). This was also indicated from the results in the present study since five out of nine sites with at least three blocks had significant block effects for infection rate.

Several inoculation experiments with *H. annosum* on different clones of N. spruce have been conducted showing significant clonal differences in sensitivity to the pathogen (Weissenberg, 1975, Dimitri & Schuman, 1989, Swedejemark & Stenlid, 1996). In the present study no differences among the 15 different hybrid families in stand number 1 were found. The few replications per family (6–8) are the most possible explanation for this low resolution between the genetic entries but it might also be due to the very homogenous test material. All 15 families originated from 15 different *L. decidua* fathers but from the same *L. kaempferi* mother.

The survey of the decay on the stumps was performed as close to the fellings as possible. Difficulties finding the decay increased the older the stumps were, at least for the light, firm rot. Hence there is a risk that infection rate was underestimated in stands number 6A to 6F since the survey in these stands took place 2 months after felling. It could be questioned what influence this light decay has for the practical use of the wood, since there are small chances that the personnel grading the wood prior for transport to the industry would detect it.

It is obvious that *L. x eurolepis* can be infected by root and butt rot. However, the loss in economy much depends on how far the decay is spread along the stem. In the present study the most serious and common rot types, the firm–dark, and the loose–hollow rots, on the average reached approximately 2.5 m (Table 3, based on results from one site), which is similar to those results achieved in the studies referred above. This in combination with high infection rates implies that economic loss can be substantial.

### Conclusions

The results can be concluded as follows: 1) The infection rate varied considerably among sites and seemed to be a serious problem in 6 out of the 18 surveyed stands. 2) The average spread of rot along the stem was 2 m (based on one stand only), i.e. a large proportion of the bottom log was affected 3) The proportion of rot damage was of the same magnitude irrespective of stump diameter, indicating that the rot infection is not related to growth. 4) No differences in infection rate among different hybrid families were found (based on one stand only).

The overall conclusion is that *L. x eurolepis* can be seriously damaged by root and butt rot, which has to be considered by the forest owner when deciding what species to plant on former heavily infected root and butt rot land.

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**Description of the sites included in the study** **Appendix 1**

| **Stand number** | **1** | **2** | **3** | **4A** | **4B** | **4C** |
|---|---|---|---|---|---|---|
| Name | Häckeberga, S21F78801 | Aspanäs, S21F618698 | Dragesholm | Trolleholm | Trolleholm | Trolleholm |
| County | Skåne | Östergötland | Skåne | Skåne | Skåne | Skåne |
| Latitude | 55°35' N | 58°00' N | 56°04' N | 55°55' N | 55°56' N | 55°57' N |
| Longitude | 13°27' E | 15°18' E | 13°07' E | 13°18' E | 13°18' E | 13°20' E |
| Altitude | 105 m ö.h. | 150 m ö.h. | 180 m ö.h. | 95 m ö.h. | 110 m ö.h. | 100 m ö.h. |
| Area, ha | 0.36 | 0.80 | 5.0 | 1.10 | 0.80 | 1.20 |
| Total age, years | 25 | 40 | 21 | 40 | 36 | 38 |
| Total no of thinnings | 2 | 4 | 3 | 6 | 5 | 3 |
| Origin | | | S.O. Maglehem | | | |
| Site index, Soil texture | G36, - | G35, Moraine:Sand-fine sand | G33, Moraine: Sand-Fine sand | G36, Moraine: Silt | G36, Moraine: Silt | G36, Moraine: Silt |
| Soil moisture, Mobile soil water | Mesic, Absent | Mesic, Absent | Mesic, Short periods | Mesic, Absent | Mesic, Absent | Mesic, Absent |
| Former land use | | Grazing land | Spruce, rotdamage | Spruce | Beech | Beech |

| **Stand number** | **4D** | **5A** | **5B** | **5C** | **5D** | **6A** |
|---|---|---|---|---|---|---|
| Name | Trolleholm | Rössjöholm | Rössjöholm | Rössjöholm | Rössjöholm | Ekebråna |
| County | Skåne | Skåne | Skåne | Skåne | Skåne | Halland |
| Latitude | 55°55' N | 56°20' N | 56°20' N | 56°20' N | 56°20' N | 56°21' N |
| Longitude | 13°20' E | 13°02' E | 13°05' E | 13°02,5' E | 13°03' E | 13°11' E |
| Altitude | 100 m ö.h. | 140 m ö.h. | 170 m ö.h. | 160 m ö.h. | 180 m ö.h. | 75 m ö.h. |
| Area, ha | 1.10 | 0.93 | 2.27 | 1.28 | 0.50 | 0.50 |
| Total age, years | 36 | 31 | 38 | 40 | 43 | 42 |
| Total no of thinnings | 6 | 3 | 4 | 3 | 3 | ≈3 |
| Origin | | Holbaek | Langesö | | | |
| Site index, Soil texture | G36, Moraine: Silt | G33, Moraine: Sand-fine sand | G33, Moraine: Sand-fine sand | G33, Moraine: Sand-fine sand | G33, Moraine: Sand-fine sand | T28, - |
| Soil moisture, Mobile soil water | Mesic, Absent | Mesic, Short periods | Mesic, Short periods | Mesic, Short periods | Mesic, Short periods | |
| Former land use | Beech | Beech | Beech | Beech | Beech | |

| **Stand number** | **6B** | **6C** | **6D** | **6E** | **6F** | **7** |
|---|---|---|---|---|---|---|
| Name | Ekebråna | Ekebråna | Ekebråna | Ekebråna | Ekebråna | Bårarp |
| County | Halland | Halland | Halland | Halland | Halland | Halland |
| Latitude | 56°21' N | 56°21' N | 56°21' N | 56°21' N | 56°21' N | 56°48' N |
| Longitude | 13°11' E | 13°10,5' E | 13°10' E | 13°10' E | 13°11' E | 12°42' E |
| Altitude | 110 m ö.h. | 105 m ö.h. | 145 m ö.h. | 160 m ö.h. | 150 m ö.h. | 50 m ö.h. |
| Area, ha | 0.60 | 1.70 | 0.40 | 0.80 | 0.90 | 1.00 |
| Total age, years | 42 | 24 | 42 | 38 | 47 | 29 |
| Total no of thinnings | ≈3 | ≈2 | ≈3 | ≈3 | ≈3 | 2 |
| Origin | | | | | | Maglehem |
| Site index, Soil texture | T30, - | T30, - | T30, - | T28, - | T28, - | G36, Moraine: Clay |
| Soil moisture, Mobile soil water | Mesic, - | Mesic, - | Mesic, - | Mesic, - | Mesic, - | Mesic, - |
| Former land use | | | | | | Spruce |

## Appendix 2

**Example of firm, dark rot classified to cover 15% of the stump area.**

## Appendix 3

**Distribution of number of stumps with any kind of rot over proportion (%) of infected stump area, total number of surveyed stumps where rot was observed, mean proportion of infected stump area and its standard deviation.**

| Stand | Percent infected stump area | | | | | | | | | Tot N | Mean | Stddev |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| no | -5 | -10 | -15 | -20 | -30 | -40 | -50 | -75 | -100 | | | |
| 1 | 17 | 5 | 2 | 5 | 9 | 2 | 6 | 6 | | 52 | 23.8 | 21.6 |
| 2 | 15 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 3 | 48 | 26.7 | 25.8 |
| 3 | 36 | 33 | 18 | 13 | 30 | 16 | 18 | 14 | | 178 | 22.7 | 18.0 |
| 4A | 10 | 5 | 2 | 5 | 5 | | | 4 | | 31 | 20.0 | 19.7 |
| 4B | | | | | | | | | | 0 | | |
| 4C | | | | | | | | | | 0 | | |
| 4D | 8 | 4 | 1 | 1 | 1 | | | 1 | 1 | 17 | 16.2 | 21.8 |
| 5A | 18 | 2 | 1 | | | | | | | 21 | 4.2 | 0.6 |
| 5B | 19 | 3 | 1 | | | | | | | 23 | 4.5 | 3.2 |
| 5C | 11 | 4 | 1 | | | | | | | 16 | 4.9 | 3.0 |
| 5D | 19 | 3 | | 1 | 1 | | | | | 24 | 5.4 | 5.4 |
| 6A | 2 | | | | | | | | | 2 | 2.5 | 0.7 |
| 6B | 5 | 1 | 1 | | | | | | | 7 | 7.3 | 6.8 |
| 6C | 16 | 14 | 6 | 5 | | 1 | | | | 42 | 9.4 | 6.7 |
| 6D | 4 | 1 | | | | | | | | 5 | 3.8 | 2.7 |
| 6E | 1 | 1 | | | | | | | | 2 | 5.5 | 6.4 |
| 6F | 2 | 2 | | | | | | | | 4 | 6.8 | 2.4 |
| 7 | 8 | 2 | 6 | 5 | 4 | | 2 | 1 | | 28 | 17.7 | 15.1 |

## Appendix 4

**Proportion of infected stump area (%) and number of stumps with rot infections distributed over rot types.**

| Stand | Mean infected stump area, % | | | | Number of infected trees | | | |
|---|---|---|---|---|---|---|---|---|
| no | Firm-Light | Firm-Dark | Loose-Hollow | Total rot | Firm-Light | Firm-Dark | Loose-Hollow | Total rot |
| 1 | | 23 | 5 | 24 | | 52 | 6 | 52 |
| 2 | 11 | 28 | 8 | 27 | 13 | 38 | 7 | 48 |
| 3 | 10 | 18 | 12 | 23 | 8 | 166 | 113 | 178 |
| 4A | 6 | 24 | 8 | 20 | 8 | 23 | 2 | 31 |
| 4B | 0 | 0 | 0 | 0 | | | | 0 |
| 4C | 0 | 0 | 0 | 0 | | | | 0 |
| 4D | 5 | 29 | 20 | 16 | 9 | 7 | 1 | 17 |
| 5A | | 4 | 3 | 4 | | 17 | 9 | 21 |
| 5B | | 4 | 3 | 5 | | 23 | 6 | 23 |
| 5C | | 4 | 3 | 5 | | 15 | 6 | 16 |
| 5D | | 5 | 3 | 5 | | 23 | 7 | 24 |
| 6A | | 3 | | 3 | | 2 | | 2 |
| 6B | | 7 | 4 | 7 | | 7 | 1 | 7 |
| 6C | | 8 | 7 | 9 | | 38 | 16 | 42 |
| 6D | | 4 | 3 | 4 | | 3 | 3 | 5 |
| 6E | | | 6 | 6 | | | 2 | 2 |
| 6F | | 7 | | 7 | | 4 | | 4 |
| 7 | | 16 | 9 | 18 | | 28 | 5 | 28 |