

# Silvicultural Strategies for Forest Stands with Ash Dieback

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## Abstract

*Chalara fraxinea* ash dieback may have devastating consequences for the survival and wood quality of *Fraxinus excelsior*. In this paper we suggest alternative silvicultural strategies for forest stands with ash dieback. The relevant strategy depends on stand age and the degree of dieback. Generally, the strategy should be conservative, if the dieback is less severe. An operational approach would be to identify and mark healthy trees. In case of severe dieback, the suggested approach is to harvest remaining timber as soon as possible and replant the area.

**Keywords** | *Fraxinus excelsior*, *Chalara fraxinea*, *Hymenoscyphus pseudoalbidus*, silviculture

## Kurzfassung

### Waldbauliche Maßnahmen für Waldbestände mit Eschentriebsterben

Das Eschentriebsterben durch *Chalara fraxinea* könnte gewaltige Auswirkungen auf das Überleben und die Holzqualität der Gemeinen Esche haben. In diesem Artikel schlagen wir alternative waldbauliche Strategien für vom Eschentriebsterben betroffene Bestände vor. Die Maßnahme hängt vom Bestandesalter und der Intensität des Zurücksterbens ab. Im Allgemeinen sollte eine konservative Vorgehensweise gewählt werden, wenn das Zurücksterben nicht sehr stark ausgeprägt ist. Ein praktischer Zugang wäre die Identifizierung und Markierung gesunder Bäume. Im Falle von starkem Zurücksterben wird empfohlen, die übrig bleibenden Bäume raschest möglich zu ernten und die Fläche wieder aufzuforsten.

**Schlüsselwörter** | *Fraxinus excelsior*, *Chalara fraxinea*, *Hymenoscyphus pseudoalbidus*, Waldbau

## Introduction

During recent years severe crown dieback has led to great concern for the future of ash (*Fraxinus excelsior* L.) in many parts of Europe. In Denmark, the disease was first noted in 2002, but soon became widespread in the whole country. Ash is a valuable species, economically, aesthetically and in relation to biodiversity and the forest ecosystem. The immediate impacts as well as the long-term consequences of the disease may be serious.

The hyphomycete *Chalara fraxinea* T. Kowalski is now considered a causal agent of the disease (Kowalski 2006), and the ascomycete *Hymenoscyphus pseudo-*

*albidus* has been identified as the teleomorph of the pathogen (Queloz et al. 2011).

## Primary and secondary agents of ash dieback

Ash dieback caused by *C. fraxinea* directly affects leaves, shoots and bark. Usually, symptoms are confined to the crown, and only young trees may be killed immediately when the fungus attacks the main stem. For trees up to 40 years of age, the typical disease development is repeated shoot dieback in the crown and dry necroses of the bark on branches (Skovsgaard et al. 2010).

The main stem below the crown often remains healthy, and vigorous trees respond prolifically with regrowth of affected shoots and development of epicormic branches in the crown. While the development of new shoots delays the progress of the disease, accompanying attack by *Armillaria lutea* (syn. *A. gallica*), a common parasite of stressed trees, often results in a quite rapid decline.

In young ash stands, where the bark of the trees is still smooth and fairly thin, the attacks of *Armillaria* become visible shortly after ash dieback has weakened the trees. Often the first symptoms of *Armillaria* appear within one to three years after decline symptoms in the crown. The fungus spreads at the base of the tree, killing the cambium, and subsequently the whole tree gradually dies. During this process, the bark at the lower part of the stems of affected trees progressively changes from its normal green-gray to a conspicuously red-brown colour (Figure 1).

On older trees with thicker bark the attack by honey fungus (*Armillaria*) is initially confined to the roots. Here, spots of bark and wood may die. These necroses can be found on the upper roots near the stem by scraping away the top soil or moss covering surface roots. Older trees with colonized cambium and discoloured wood beneath the bark has been observed even before the tree is clearly dying as judged by its crown decline (Figure 2) and by widespread *Armillaria* colonization of the roots. In addition to discolouration at the base of the stem due to *Armillaria* attack, epicormic branches may act as a port of discolouration in the stem due to *Chalara* infection.



Figure 1: White fans of honey fungus (*Armillaria*) mycelium below dead bark (a). Typical discolouration of wood at the base of the tree and accompanying fruitbodies of *A. lutea* (b).

Abbildung 1: Weiße Myzelfächer von Hallimasch (*Armillaria*) unter der toten Rinde (a). Typische Holzverfärbung an der Stammbasis und zugehörige Fruchtkörper von *A. lutea* (b).

### Silvicultural strategies

Based on our experience from Denmark and Sweden, we recommend two separate silvicultural strategies for young and old stands of ash with dieback symptoms. For young stands, the main aim is to identify apparently resistant trees and promote their long-term survival and wood quality. For older stands, the aim is to delay the final harvest for as long as possible without jeopardizing wood quality. However, it should be noted that diameter growth will probably be negligible, as most of the energy of affected ash trees will be directed towards regeneration of shoots in the crown and resisting honey fungus attacks in the roots. In either case, severely infected stands should be cut and replanted. As a general rule, we suggest to inspect ash stands during the growth season because the identification of ash dieback is easier than at other times of the year. However, prolific regeneration of the crown by epicormic shoots may disguise the presence of dieback during the growth season, and in such cases the extent of the disease may actually be easier to detect during winter.

Depending on stand age, the frequency of infected trees and the degree of dieback, we suggest the following alternative procedures:

#### Severely infected young stands

1. Clearcut trees and replant.
2. Use ash trees as shelter and replant under these. Surviving ash trees may be left.

#### Young stands with a high percentage of healthy trees

1. Turn your back to the stand and hope for the best.
2. Mark healthy ash trees (paint on stems) during growth season. Mark at least 200 trees per ha and thin among the unmarked trees.

### Older stands

- Inspect your stands for ash dieback during the growth season as well as in winter time.
- All trees with epicormic shoots on the stem should be felled as soon as possible, as *C. fraxinea* may



Figure 2: Ash tree at age of 70 years with severe crown dieback and prolific epicormic branching in the primary crown. The roots were colonized by *Armillaria*. The stem may still be used for timber, if the tree is cut immediately.

Abbildung 2: Siebzigjährige Esche mit starkem Zurücksterben der Krone und massiver Ausbildung von Ersatztrieben. Die Wurzeln waren von *Armillaria* befallen. Wenn der Baum rasch gefällt wird, kann das Holz des Stammes noch genutzt werden.

cause stem wood discolouration through infection of such shoots.

- Ash trees, where most of the primary crown is dead and survival is based on epicormic shoots in the crown, should be harvested within the next year.
- Ash trees, where more than 50 % of the primary crown is dead, should be considered for harvest.
- Ash trees with more than 75 % of the primary crown intact may be considered healthy enough to keep for several years, unless there are signs of honey fungus attack at the base of the trees.

Ideally, all ash stands should be inspected at least once a year. Any trees of high vitality and with only few symptoms of ash dieback should be left as potential seed sources. Remember to identify both male and female trees. Resistance to *C. fraxinea* ash dieback seems highly heritable, so natural regeneration from healthy trees is one of the hopes for the future.

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