

A winner of the climate change: Black rot canker on pome trees in Southern Germany

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Abstract

*The spread of black rot canker, a disease caused by fungi of the genus *Diplodia* (anamorph of *Botryosphaeria*), proceeds rapidly during the last years. It is a winner of the climate change, because of its fondness for hot and dry weather conditions. Especially organic pome orchards are concerned as well as extensively managed high trunk orchards (EMO's), where the pathogen causes damages already since 2003. Resistant cultivars have been identified by field surveys and citizen science. In orchards with deep soil, moderate heat and sufficient water supply, black rot canker was considerably less aggressive. Measures like good tree maintenance and gentle harvesting practices apparently reduced the risk of infestation.*

Keywords: Black rot canker, *Diplodia*, fungal plant disease, pome trees

Introduction

Since 2018 black rot canker has prevailed increasingly in organic pome orchards, leading to considerable tree losses (Hinrichs-Berger, 2019). The symptoms are caused by fungi of the genus *Diplodia* (anamorph of *Botryosphaeria*). The genus is extremely rich in species. More than 1000 species have been described, from which more than ten are pathogenic on apples or pears worldwide (Mycobank, 2021)

In hot and dry summers in particular, *Diplodia* spp. infect trees that have been weakened e.g. by sunburn and drought (Hinrichs-Berger et al., 2021, Slippers & Wingfield, 2007, Slippers et al., 2013). The fungus infects the bark via cracks and injuries or through the stomata (Britton & Hendrix, 1989, Ficke, W., 1981 Kim et al., 2001). Fruits and leaves can also be affected (Hinrichs-Berger, 2020).

It can be assumed, that the fungus spread to organic pome orchards from extensively managed high trunk orchards (EMO's) and surrounding woodland trees (Hinrichs-Berger, 2020).

The first massive appearance of the disease in EMO's was noticed after the dramatic summer heatwave in 2003. As a result, numerous trees died at that time (Hinrichs-Berger, 2020). Up to now the situation in EMO's is alarming: many trees are close to die back and one of the most important harms is black rot canker.

Surveys and laboratory evidence of responsible fungal pathogens on pome trees in different climatic areas of Baden - Württemberg showed high infestation levels with *Diplodia* spp. especially in the Neckar and Rhine regions (including Stuttgart, Backnanger Becken, Weinsberger Tal and Gäue) and in the region of Heilbronn - Franken. Incidence is also reported from other parts of Germany, e.g. Bavaria, Thuringia.

A further worsening of the situation is to be expected in the course of climate change. Already, black rot canker was detected on adventitious roots of rootstocks in IPM orchards.

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Because of this and the ongoing restrictions on pesticides use in fruit production, it can be foreseen that orchards with integrated pest management (IPM) will also be affected by this fatal disease in the medium term.

Material and Methods

Our research activities focus on preventive measures (selection of resistant cultivars, site selection, white coating of the trunks) and therapeutic measures (cutting out cankers, wound treatments) against the disease.

The frequency of infection and the growth of cankers in a time course were monitored in infested orchards.

Moreover, different plant material (rootstock types, cultivar, double grafting) was exposed under infestation conditions in field trials. To characterize site specific risks, disease monitoring is completed by interviews on site conditions and management schemes.

To characterize cultivar susceptibility as well as the effect of cultivation conditions and site selection black rot canker questionnaires (citizen science) and field surveys were conducted.

Results and Discussion

The growth of cankers has been observed over a period of 2 years in a pear orchard (Table 1). The absolute growth of 66,75 cm within 2 years shows the rapid increase of the cankers. If the canker grasped round the trunk, the nutrient and water flow is interrupted and the tree is girdled and died.

Table 1: Measurements of growth of black rot cankers at "Novembra" pears in an organic orchard during 3 years

Number of trees: 13	canker-length (cm) 17.12.2019	canker-length (cm) 03.03.2021	canker-length (cm) 11.11.2021
mean	35,5	79,1	102,25
absolut growth (2019-2021): 66,75 cm			

Approximately 140 persons had participated in the survey. In addition, almost 2.000 apple and pear trees in EMO's and about 20.000 trees in organic grown orchards have been monitored to rank the infestation level. The cultivars "Brettacher", "Rheinischer Winterrambur" and "Rubinola" were highly resistant to black rot while cultivars "Glockenapfel", "Oldenburger" and "Topaz" were extremely susceptible (Table 2). But there is no absolute resistance to *Diplodia*.

Table 2: Ranking of different apple cultivars regarding the susceptibility to black rot canker.

Rank	resistant	susceptible
1	Brettacher	Glockenapfel
2	Rheinischer Winterrambur	Oldenburger
3	Rubinola	Topaz, Kaiser Wilhelm
4	James Grieve	Öhringer Blutstreifling, Cox Orange
5	Rheinischer Bohnapfel	Kardinal Bea, Hauxapfel
6	Jonagold	Goldparmäne

In areas with high infestation pressure, we recommend the planting of resistant cultivars. Due to little data on pear trees, we observed only a trend: "Novembra" was more susceptible than "Alexander Lukas" and "Köstliche von Charneux".

The evaluation of the impact of cultivation sites and cultivation management showed, that the disease occurred less at locations with deep soil, moderate heat and sufficient water supply. Further measures to reduce the risk of infestation are good tree maintenance and gentle harvesting practices. Other infestation reducing practices are the whitening of trunks and cutting techniques that prevent the risk of sunburn injuries. Treatments with chemically-synthetic fungicides against apple scab seem to be effective against black rot canker, because in orchards with integrated pest management black rot canker was almost not of concern. Cutting-out of canker was counterproductive since it creates huge wounds that were potential infection sites for *Diplodia* and other pathogens. Most promising was cutting-out small cankers on vigorous trees during May until June, especially if the wound was subsequently covered with a bandage of loam. Investigations on wound treatment have not yet been completed.

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