

A rot of the primary root of the apple seedling

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Introduction

Both in Indiana (Maciejowska and Williams, 1961) and in Canada (McIntosh, 1965, 1966) *Phytophthora* spp. have been described as the cause of rootrot of apple seedlings. In both cases *Phytophthora cactorum* was supposed to be one of the causes. *P. cactorum* had already been found earlier to be the cause of collar rot and crown rot of the apple tree (Baines, 1938; Welsh, 1942).

In Europe Braun and Krober identified *P. cactorum* as the cause of collar rot in 1953, but no rootrot of apple due to *Phytophthora cactorum* has hitherto been recorded in Europe. Fritsche and Vogel (1954), however, mentioned the fact that they saw *Phytophthora*-like oospores in the neighbourhood of diseased roots and they were able to reproduce the symptoms by inoculation with diseased roots.

In view of these findings an attempt was made to find out whether apple seedlings show signs of rootrot when grown in orchard soil.

Method

During this study of the development of apple seedlings in apple orchard soils use was made of a method of Hoestra (personal communication) by which he grew cherry seedlings on sterile perlite in culture tubes for studying a rootrot caused by *Thielaviopsis basicola*.

Ten culture tubes were filled with a moist sample of the soil to be investigated and each tube was sown with one pregerminated seed of the apple variety 'Bittenfelder Sämling'. By placing the tube slightly slanting, growth of the root along the glass was promoted. Observations were made with a binocular microscope. The root could also be photographed directly through the glass. The extent of rootrot was determined in two ways: firstly by counting the number of lesions on each seedling after one and two weeks and secondly by counting the number of seedlings that succumbed after two to three weeks.

Since, as far as we know, *Phytophthora* spp. are the only fungal pathogens on rootlets of apple seedlings, inoculation experiments were carried out with *P. cactorum* and *P. syringae*.

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Results

1. Sterilized and non-sterilized soil were placed in alternate layers in a culture tube. In this way the root of a seedling was allowed first to grow through sterilized soil, then through non-sterilized orchard soil and subsequently again through sterilized soil. This procedure resulted in a rot of the root in the non-sterilized soil which did not extend into the sterilized soil until after a fairly long period. Evidently the central cylinder remained intact since the growth of the tip of the root continued in the sterilized soil.
2. The rot starts as a yellowish-brown discoloration of the root hairs and then develops into an oval lesion which finally girdles the root. The colour changes to dark brown.
3. The rot almost always starts where the root hairs are in close contact with soil particles. Parts of the root growing free in the air in between these places of contact usually stay healthy.
4. The capacity to cause a rot of apple seedlings was found to be present in all tested orchard soils (about 40 in total) and to a much lesser extent in some agricultural soils. The extent of infection varied from death of all 10 test plants to a light infection on only a few plants. This latter situation occurred in a loess soil from the south of the province of Limburg.
5. Soil samples which had previously been treated with chloropicrin appeared to have lost almost completely the capacity to cause infections.
6. A phycomycetous isolate from a diseased orchard soil proved pathogenic to healthy seedling roots. Further identification of the pathogen is in progress.
7. After inoculation of an apparently "healthy" soil with the fungi *Phytophthora cactorum* and *P. syringae* only the plants in the *P. cactorum* tubes showed signs of rootrot. The symptoms of this rootrot seemed to be similar to the ones observed in orchard soil samples.
8. In conclusion we might summarize the situation as follows. On apple seedling roots growing in the laboratory in apple orchard soils numerous lesions have been observed. From one of these soils a pathogen was isolated that causes a similar rootrot. Inoculation experiments with *Phytophthora cactorum* on apple seedling resulted in a rootrot that again according to preliminary observation appeared to be the same. There is, however, at this stage no reason to suppose that all observed lesions on apple seedlings roots are due to an attack by *Phytophthora* spp.

Samenvatting

Een rot van de kiemwortel van appelzaailingen

Appelzaailingen gekweekt in verschillende boomgaardgronden vertoonden symptomen van een wortelrot. Uit één van de grondmonsters werd een Phycomyceet geïsoleerd die ogenschijnlijk eenzelfde wortelrot veroorzaakt. Inoculatieproeven met *Phytophthora cactorum* hadden eveneens een dergelijk wortelrot bij appelzaailingen ten gevolge. Er is echter in dit stadium nog geen reden om te onderstellen dat alle waargenomen lesions aan wortels het gevolg zijn van een aantasting door *Phytophthora*-soorten.

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