

The host pathogen relationship between *Phytophthora cinnamomi*, the causal organism of root rot, and avocado (*Persea americana* Mill.), characterization of resistance components

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Phytophthora cinnamomi isolates collected from avocado (*Persea americana* Mill.) trees at different groves were classified into two groups differing in their aggressiveness. Both groups were identified as A2 mating type, which is known to be highly virulent to avocado.

In the current research representatives of both groups were used to characterize avocado rootstock reaction to their infection. Their germination and penetration into the roots were similar in both groups. In the infected root zone: three distinct zones were defined: zone A, the necrotic portion at the root tip; zone B, the root portion without external disease symptoms, extending up to the point where discoloration of the vascular cylinder ends; and zone C, the symptomless and pathogen free root portion. With both isolates, the necrotic lesion that develops 48 h after inoculation, as well as the pathogen mycelia, proceed more rapidly in the vascular cylinder than in the cortex. Forty eight hours later, the highly virulent isolate (HVI) killed the entire root, while with the low virulence isolate (LVI) the necrotic lesion that developed was contained to the root tip area. Localized necrotic lesion caused by LVI was observed in other hosts as well (*Persea indica*, *Cupressus arizonica*, *Pinus pinea*) and intact roots.

The plants development was affected by infection with both isolates. When 'Topa Topa' seedlings were inoculated with HVI, eighty percent of the roots showed disease symptoms, and root growth, measured by dry weight increase, was reduced by 85% compared with non-infected plants. After inoculation with LVI only 5% of the roots showed disease symptoms, and increase of root dry weight did not differ significantly from the control plants.

The regions of the root to which zoospores are mostly attracted were also penetrated most frequently. Although the elongation zone was penetrated by both isolates, no infection had occurred in their part due to external inoculation.

However, inoculating cut area at the same zone caused disease depending on the entire root became necrotic. But a LVI isolate caused a localized necrotic lesion. These findings show that in a rootstock susceptible to HVI, a resistance mechanism exists, that is partially effective against the LVI.

It was found that initial inoculation with LVI induced resistance against HVI, at a distance from the inoculated site where the fungus had not yet reached. While with an immediate challenge inoculation, no resistance was elicited, high resistance was obtained when there was 5-day-interval between first and the challenge inoculation. Similar results were obtained after using mercuric-chloride and fosetyl-Al, as pre-treatment, instead of inoculation with LVI. This proves that the resistance mechanism was not induced as a result of the necrotic lesion that developed at the root tip. Waterlogging treatment before inoculation altered the resistant reaction into a susceptible one. Build-up of the resistance reaction was associated with concentration of phenylalanine-ammonia-lyase (PAL) in the root. Forty-eight hours after inoculation of 'Topa

Topa' root tip with LVI, PAL activity increased in the distant zone (Zone C), three-fold more than in uninfected control root, or in a root infected with HVI, and then started to decline.

Prevention of PAL accumulation by using a specific PAL inhibitor, Aminooxyacetic acid (AOA) prior to inoculation, prevented resistance induction by LVI or abiotic treatments. The resistance reaction of 'Topa Topa' infected with LVI was characteristic by increased activity of at least one isozyme of PAL that was not observed in the susceptible reaction (control or root infection with HVI).

While the increase in PAL activity reached a peak 48 h after the inducing treatment and then started to decline, resistance became most effective 3 days later. These findings point out that the induced systemic resistance is correlated with barrier formation that prevents the fungus extension. The necrotic lesions that developed in 'G6' (a moderate by resistant rootstock) inoculated with either HVI or LVI were limited, and plant growth was not affected by the inoculation. Increased PAL activity was measured in Zone C as a reaction to inoculation with either isolate.

The resistance reaction of both rootstocks indicates that a similar resistance mechanism exists in both rootstocks, but it differs in the speed and magnitude with which it is expressed.

In this research work, a new screening method to differentiate between rootstocks of avocado resistant and susceptible to root rot disease was developed. It enabled us to distinguish between two moderately resistant rootstocks and susceptible ones. The method is applicable to mature trees that survived in infested groves, or among a population of horticulturally outstanding fruit bearing trees. It allows trees to be screened quickly and simply without destroying or damaging the tested trees.