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Sink formation during shoot infection of tomato Micro-Tom by *Moniliophthora perniciosa*, the causal agent of cacao witches' broom disease, limits sugar supply for effective development of lateral roots

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Abstract

Moniliophthora perniciosa causes the witches' broom disease of cacao, and it can infect the tomato Micro-Tom (MT). Typical symptoms are stem swelling and shoot outgrowth, whereas reduction in root biomass is another side effect. We investigated whether the impairment of root growth derives from a hormonal imbalance or sink competition. Intense stem swelling coincided with a reduction in root biomass, predominantly of lateral roots. A few genes involved in hormone metabolism were activated; however, hormonal levels were not altered. Inoculation of the auxin highly-responsive *entire* genotype maintained the impaired root phenotype. Genes involved in root respiration, carbohydrate, amino acid and cell wall metabolism were repressed, whereas genes linked to water/nitrogen/phosphorous starvation were upregulated. Lower levels of sugars and amino acids suggested carbohydrate deprivation. Less ¹³C accumulated in roots of infected MT, but not in the symptomless low-cytokinin MT-transgenic line that overexpresses *CYTOKININ OXIDASE-2* (*35S::AtCKX2*). We show evidence that the impairment of root development potentially derives from a reduction of photoassimilate supply by the establishment of a strong sink at the shoot symptomatic infection site, rather than hormonal imbalance. We speculate that this impact may contribute to the dramatic decrease in cocoa yields after *M. perniciosa* invasion.

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