

Root Invasion by *Ralstonia solanacearum*

Subjects: Plant Sciences

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The plant pathogenic bacterium *Ralstonia solanacearum*, causal agent of the devastating bacterial wilt disease, is a soil-borne microbe that infects host plants through their roots. The initial mutual recognition between host plants and bacteria and the ensuing invasion of root tissues by *R. solanacearum* are critical steps in the establishment of the infection, and can determine the outcome of the interaction between plant and pathogen.

Keywords: *Ralstonia* ; plant defence ; bacterial colonization ; root invasion ; plant-bacteria interactions

1. Introduction

Ralstonia solanacearum is one of the top ten plant pathogenic bacteria worldwide according to its scientific and economic importance [1]. *R. solanacearum* is the causal agent of bacterial wilt disease in more than 250 plant species, including agriculturally important crops such as tomato, potato, banana, and peanut [1][2], and can also infect model plants, such as *Arabidopsis thaliana* (hereafter, *Arabidopsis*) and *Medicago truncatula* [1]. As a soil-borne pathogen, *R. solanacearum* enters plants through the root, using wounds, root tips, and secondary root emerging points as penetration sites; it then progresses via the root cortex, finally reaching the vascular system [3][4][5], as shown in Figure 1. From this point onwards, and mostly through xylem vessels, the infection spreads systemically in the plant [5][6]. The invading bacteria multiply massively in the xylem and produce abundant exopolysaccharides (EPSs), which ultimately leads to the obstruction of the vessels and the subsequent development of the typical wilting symptoms due to impaired water conductance [7].

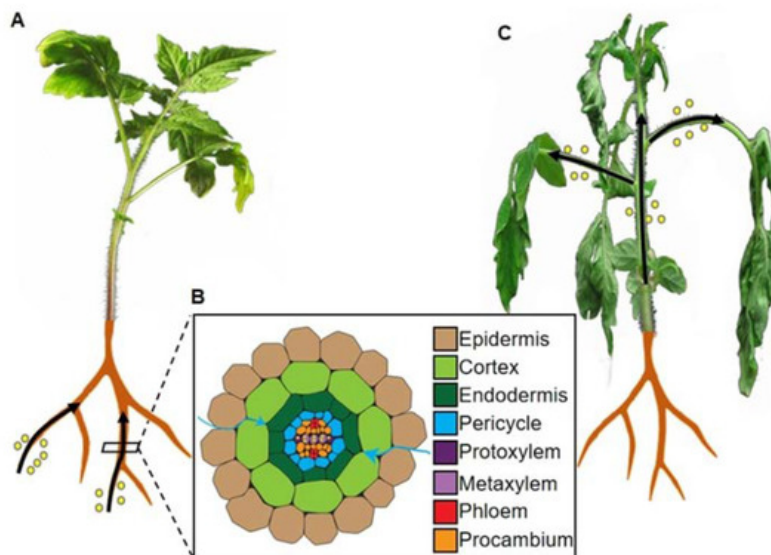


Figure 1. Plant invasion by the pathogenic bacterium *Ralstonia solanacearum*. (A). In the first stage of invasion, bacteria (depicted as yellow circles) enter roots through wounds, emerging lateral roots, and root tips. (B). Schematic representation of a cross-section of a root; different cell types are indicated. In the second stage of invasion, bacteria massively multiply in the intercellular spaces between cortex cells (blue arrows), and cause plasmolysis of epidermal cells. (C). In the last stage of invasion, bacteria (depicted as yellow circles) move throughout the plant through xylem vessels, causing clogging of the vascular system and the typical wilting symptoms. Bacterial movement is depicted as black arrows.

2. Development

R. solanacearum is a devastating pathogen with a dramatic economic impact worldwide. Gaining a deeper understanding of the molecular and physiological mechanisms underlying the pathogenicity of this bacterial species is a necessary stepping stone in the design of effective and durable strategies for crop protection in order to guarantee food security. Considering that *R. solanacearum* is present in the soil, the initial recognition between host plants and bacteria and the ensuing invasion of root tissues are crucial steps in the establishment of the disease, and as such deserve special attention. In this minireview, we will focus on the early stages of the bacterial infection, providing an overview of the defence mechanisms deployed by the host plants upon recognition of the bacteria, of the manipulation exerted by the pathogen in order to promote its own multiplication and spread, and of the developmental changes occurring in the root system during bacterial colonization.

References

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