

Plant Pathology Seminar Series

“Quorum Sensing & Quorum Quenching Can We Stop Plant Pathogenic Bacteria from Talking”

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Abstract

Quorum-sensing (QS) is a mechanism by which bacteria produce, detect and respond to small signal molecules in a population density-dependent manner, thus synchronizing the expression of traits that allow them to survive, adapt and compete better in particular environments (1,14,17). Most of the processes regulated by QS in bacteria are unproductive when undertaken by individual bacterial cells but effective when undertaken by a group of cells (7). QS allows bacteria to communicate and function as multicellular organisms, thus reaping benefits that could not be obtained when bacterial cells function alone (1). Antibiotic production and resistance, conjugation, replication, virulence determinant production, exoenzyme synthesis, swarming, biofilm formation and bioluminescence are some of the QS controlled processes (3). Acyl homoserine lactones (AHLs), oligopeptides and butyrolactones, also known as “autoinducers”, are widely used signal molecules for a range of bacterial species (3,6,7,8). At present, QS has been described in more than 70 species of Gram negative bacteria, a number of Gram positive bacteria and, recently, some fungi (8,15). Notably, many plant pathogenic bacteria, including *Agrobacterium*, *Pantoea*, *Pectobacterium*, *Pseudomonas*, *Ralstonia*, *Xanthomonas* and *Burkholderia* species, utilize this system for expression of virulence or pathogenicity factors, enabling them to better colonize or inflict disease on a particular host (2,13).

Understanding the mechanisms of QS and its importance in bacteria paved the way for unraveling mechanisms that disrupt or interfere with this cell-cell communication (4). The term quorum-quenching (QQ) was coined to describe control of bacterial infections by paralyzing QS systems through inactivation of QS signals (4). Recently, research has been directed towards understanding QQ due to its potentially wide application at preventing or limiting the impact of bacterial diseases in humans or animals, and as a promising biological control tool in plants (3,12). This strategy is attractive because it exerts more limited selective pressure for microbial survival or resistance to antibiotics than biocide/bactericide treatments (12). Many QQ enzymes and inhibitors, such as AHL lactonases and acylases, have been identified from prokaryotes and eukaryotes (5,6,11,12). Some have been evaluated as novel antimicrobial agents and have revealed promising results (4,5,9,10). Interestingly, organisms discovered to produce QQ enzymes or inhibitors are widespread in soil and plant environments (10), with potential applications in controlling diseases caused by plant pathogenic bacteria (6). In this presentation, recent advances in QS and promising discoveries on the mechanisms and applications of QQ as a novel biological control tool for plant pathogenic bacteria will be explored (12,16). Also, specific examples of successful attenuation of symptoms caused by plant pathogenic bacteria (e.g., soft rot by *Pectobacterium carotovorum*) using QQ enzymes produced by other bacteria (e.g., *Bacillus* sp.) will be highlighted. Information will also be presented on biotechnological innovations such as genetic engineering of plants and other organisms to formulate practical ways to control bacterial diseases, and potential environmental impacts of these methods (2,12,16,17).

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