Quorum-sensing is a mechanism of bacterial gene regulation, in which some genes are induced (or sometimes repressed) in response to the population density of the bacteria. There are several different mechanisms of achieving this, but typically the gene induction occurs as the result of the accumulation of some metabolites or possibly proteins in the bacterial culture supernatant. As the concentration of these metabolites or proteins reaches a threshold, they are detected by the bacteria, and this results in the induction of gene expression. In some cases, the product of one of the genes induced can be involved in the production of more of the signal, resulting in a positive feedback loop and this is referred to as autoinduction. The first example of such regulation was in relation to light production by the bioluminescent bacterium *Vibrio fischeri* (Nealson, 1977). In this bacterium the signalling molecule is an N-acyl homoserine lactone (AHL), which is made up of homoserine lactone carrying an N-linked acyl chain of six carbons, substituted with an oxo group at the three position (and is referred to in shorthand as 3-O-C₆-HSL). It is now clear that cell-density-dependent regulation of gene expression mediated by AHLS occurs in many different bacteria which has been reviewed extensively (Swift et al., 2001; Fuqua and Greenberg, 2002; Fuqua et al., 2001; Dunny and Leonard, 1997).

In this chapter, I will review progress (mostly from my own group), on understanding AHL-mediated regulation of gene expression in *Rhizobium leguminosarum* biovar *viciae*. It turns out that this bacterium has a particularly complex quorum sensing regulatory network, suggesting that the expression of several different genes is controlled by quorum sensing. It is evident that many plant-associated soil bacteria also produce AHLS (Cha et al., 1998), indicating that they also use quorum sensing as a mechanism of gene regulation. In different species of bacteria, phenotypes influenced by quorum-sensing regulation include: plasmid conjugation; production of antibiotics, siderophores and secondary metabolites such as HCN; swarming; motility; biofilm growth and protein secretion (reviewed by Swift et al., 2001; Fuqua et al., 2001). It is likely that many more phenotypes have yet to be uncovered, but it seems clear that most of these characteristics are related to the adaptation of bacteria to their environment. The environment in soil...