ABSTRACT

Nodulation of soybean (*Glycine max* (L.) Merr.) cultivar Lambert and genotype PI417566 by *Bradyrhizobium japonicum* USDA110 in a sterile system is regulated in a population density-dependent manner. Increased nodulation was observed in plants receiving a low density of inoculum, relative to those receiving a high density. The suppression of nodulation was attributed to the presence of a compound (s) produced by *B. japonicum* USDA110 when grown to high population density, and one of these compounds, bradyoxetin, was previously identified. The compound (s) existing in culture supernatant repressed the expression of nodulation genes. A *nodD2*$^-$ mutant of *B. japonicum* USDA110 was insensitive to this quorum- controlled nodulation. The *nodD2*$^-$ mutant not only had enhanced nodulation, but it is also more competitive for nodulation against USDA123 than is a *nolA*$^-$ mutant. Additionally, *nodW* and *nwsB* genes were also involved in the population density-controlled nodulation, since nodulation by these two mutant strains did not decrease even when a high density of inocula were applied. Quorum-controlled nodulation was alleviated by the addition of either a mixed bed resin or a cation exchange resin into sterile plant growth media prior to soybean planting. Furthermore, enhancement of nodulation was demonstrated by planting soybean at suitable soil conditions of 60% of field capacity and a soil pH of 6.5. With respect to plasmid ecology, studies on geographically and genetically diverse *Bradyrhizobium* strains using CHEF-PFGE analysis demonstrated that 11

of the 46 strains (24%) investigated harbored at least one plasmid. The plasmid sizes varied from 75 to 285 kb. Plasmids were detected from all geographic regions, and in strains of *B. japonicum* and *B. elkanii*. This suggests that large plasmids are a common feature in *Bradyrhizobium*. However, hybridization studies done using *nod* and *hup* gene probes indicated that none of the strains carry symbiosis-related genes on plasmids.