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Heterologous expression of *nifA* or *nodD* genes improves chickpea-Mesorhizobium symbiotic performance

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Abstract

Aims: The aim of this study was to investigate whether the overexpression of *NifA* and *NodD* regulators contribute to the symbiotic improvement of chickpea mesorhizobia.

Methods: The native strains V-15b, ST-2 and PMI-6 were transformed with extra copies of *nifA* or *nodD* genes and several plants trial were performed.

Results: Plant growth assays showed that *nifA* overexpression was able to improve the symbiotic effectiveness of V-15b, while *nodD* overexpression lead to the improvement of ST-2 and PMI-6. Hydroponic assays showed that plants inoculated with V15bnifA+ and PMI6nodD+ started developing nodules earlier than those inoculated with the corresponding control strains. In addition, the number of nodules was always higher in plants inoculated with the strains overexpressing the symbiotic genes. Analysis of histological sections of nodules formed by V15bnifA+ showed a more developed fixation zone when compared to control. On the other hand, nodules induced by PMI6nodD+ did not show a senescent zone, which was observed in nodules from plants inoculated with the control strain. Plants inoculated with PMI6nodD+ and ST2nodD+ showed a higher number of infection threads than the corresponding control inoculations.

Conclusion: These results indicate that overexpressing *nifA* and *nodD* may be an important tool to achieve the improvement of the symbiotic performance of mesorhizobia.