# How Do Flavonoids and Isoflavonoids Improve Nodulation in Legumes

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Legumes form root nodules in which nitrogen-fixing bacteria are housed and flavonoids are necessary to activate nodulation genes in rhizobia. Isoflavonoids are known to protect legumes from pathogens, but it is not known if this would also affect nodulation. This was investigated by generating two different transgenic lines of M. truncatula in petri dishes, one control line and one line designed to overproduce isoflavonoids by overexpressing isoflavone synthase, the gene that controls isoflavonoid synthesis. After the plants had grown, a mass spectrometer analysis was conducted on the roots to measure the concentrations of flavonoids and isoflavonoids in roots. Different flavonoids were also added to rhizobia before inoculating them onto untransformed Medicago to see the direct effect of particular flavonoids on the nodulation process. The overexpression of isoflavone synthase was found to cause an increase in nodule number and a higher concentration of most flavonoids and isoflavonoids were found in these samples compared to the control transgenic line. A statistically significant increase was found in the plants overexpressing isoflavone synthase of the flavonoids 6,7,4–trihydroxyisoflavone, quercetin, daidzin, isoliquiritigenin and astragalin. When adding flavonoids to rhizobia inoculated onto untransformed Medicago roots it was concluded that 7,4’-dihydroxyflavone increased the nodule number of Medicago, and aformosin and medicarpin decreased the nodule number. From this experiment it can be concluded that overexpressing isoflavone synthase, which protects the plant from the pathogenic fungi Rhizoctonia solani, also causes an increase in the nitrogen fixation process.

**Awards Won:**
Second Award of $2,000