

Increasing the nutritive value of forage legumes through the enhancement of lipid production in vegetative tissues

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Leguminous forage crops such as alfalfa (*Medicago sativa* L.) and sainfoin (*Onobrychis viciifolia* Scop.) play a major role in livestock production. Although alfalfa exhibits many positive attributes, it also suffers from various drawbacks related to inefficiencies in rumen fermentation. This leads to the inferior conversion of plant-derived nitrogen into milk and meat products, and associated economic losses for producers, as well as negative environmental impacts, including greenhouse gas emissions. While the proanthocyanidin-containing sainfoin is known for its anti-bloat characteristics and improved protein utilization, like alfalfa, its consumption by livestock also leads to greenhouse gas emissions. Increasing the amount of lipids in the diet of livestock is known to mitigate greenhouse gas emissions; however, both alfalfa and sainfoin contain very little lipid (up to 1% dry weight) in their vegetative tissues. As such, we are determining the feasibility of increasing the lipid content of alfalfa and sainfoin vegetative tissues using both conventional and advanced molecular breeding approaches. Ethyl methanesulfonate (EMS)-induced mutagenesis has been carried out on both alfalfa and sainfoin populations, and preliminary results indicate that mutants have been achieved in both species that exhibit increased leaf lipid content (~5% dry weight). In addition, CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats)/Cas9, which induces targeted mutations in a highly precise manner, is also being explored for this purpose in the case of alfalfa.