Phylogenomic Discovery and Engineering of Nitrogen Fixation into the Bioenergy Woody Crop Poplar

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Nitrogen (N) availability is critical for high biomass productivity of bioenergy crops. Despite the abundance of N_2 in the atmosphere, plants cannot access it. Instead, plants must absorb available N in the soil, provided through intensive and costly fertilization. Some species acquired the capability to obtain N through a mutualistic relationship with bacteria and archaea, but this capability is absent from most bioenergy crops. Our overall goal is to discover the underlying genome novelties that evolved this mutualistic relationship using a comparative phylogenetic framework to contrast related species that possess and lack this ability. Genomic novelties will be evaluated for their effect on root nodule development in *Medicago* (nodulating) and poplar *hairy root* organ cultures (non-nodulating). Next will engineer nodule development in poplar plants and test the impact of these structures on N-fixation, whole-plant development and biomass productivity and composition.

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