Strategies to Integrate Aluminum Tolerance in Alfalfa (*Medicago sativa* L.)

Dong-Man Khu[1], Joseph H. Bouton[1], E. Charles Brummer[1, 2], Maria J. Monteros[1]
[1]The Samuel Roberts Noble Foundation, 2510 Sam Noble Parkway, Ardmore, OK 73401
[2]Center for Applied Genetic Technologies, Univ. of Georgia, 111 Riverbend Rd, Athens, GA 30602

Aluminum (Al) tolerance is an important target trait to increase alfalfa productivity in acid soils. Currently, no alfalfa germplasm with Al tolerance is commercially available. Al tolerance from a diploid *Medicago sativa* subsp. *caerulea* was introduced to cultivated alfalfa using 2X × 4X crosses resulting in the Al tolerant tetraploid genotype Altet-4. The objectives of this research are to integrate Al tolerance from Altet-4 into elite breeding lines of alfalfa varying in fall dormancy using two complimentary and parallel approaches. These are: 1) understanding the mechanisms of acid and Al tolerance in alfalfa and 2) implementation of molecular breeding tools (marker assisted selection and/or genomic selection) for cultivar development. Genomic regions associated with Al tolerance quantitative trait loci (QTL) were identified in a tetraploid mapping population. Candidate genes positioned on QTL regions and with differential gene expression induced by Al-treatment of were identified using alfalfa transcriptome sequences and resources in *Medicago truncatula*. Ongoing efforts include evaluating expression levels of Al tolerant and Al sensitive alfalfa in growing conditions with and without Al in combination with RNA-Seq and metabolic profiling to identify mechanisms of Al tolerance in alfalfa. These approaches are moving forward in parallel with trait-integration efforts that began by making crosses between Al-tolerant alfalfa genotypes with elite breeding lines selected from the alfalfa cultivars and breeding lines Bulldog805 and NFAA07. An enhanced phenotypic screen and SNP genotyping pipeline is in place to screen the resulting seed from multiple plant families and increase the performance of the resulting population. We are integrating a combination of mechanistic understanding, phenotyping and molecular breeding approaches to generate Al tolerant alfalfa cultivars with enhanced productivity in acid soils.