**Mining alleles of agronomic value from wild *Cicer* species, with implications for soil health.**

Cook DR1,2, Said Yusuf A2, Jamshidi Goharrizi K1, Sani SGAS1, Perilla-Henao L1

*drcook@ucdavis.edu*

*1Department of Plant Pathology, University of California Davis.*

*2Horticulture and Agronomy Graduate Group, University of California Davis.*

In agricultural systems, aluminum toxicity and nitrogen status of soils are linked. Prolonged use of inorganic nitrogen fertilizers can lead to decreased soil pH, which solubilizes aluminum that is, in turn, toxic to dividing plant cells. Legume biological nitrogen fixation (BNF) offers an alternative to nitrogen fertilizers. BNF is more sustainable than inorganic nitrogen fertilizers, in part because BNF is less perturbing to soil pH. However, in soils that are already acidified and where BNF might have added benefit, legume nitrogen fixation is compromised and dependence on fertilizer application is increased, perpetuating a vicious cycle. Working with chickpea’s wild progenitors we identified both aluminum tolerance and more effective nitrogen fixation. Aluminum tolerance is controlled by single wild *Cicer* gene, enabling marker-based selection to create new *C. arietinum* crop varieties. By contrast, efficient nitrogen fixation, for which beneficial alleles also derive from wild *Cicer* species, is a highly complex trait that depends on both host and bacterial genetics. Complexity of nitrogen fixation in cultivated chickpea may involve the accumulation of deleterious alleles in crop germplasm, requiring non-traditional breeding strategies. In addition to the obvious agronomic benefits of aluminum tolerance and efficient nitrogen fixation, we are interested in combining these two traits as a possible means to remediate soil health, reducing the aspirational goal of “regenerative agriculture” to mechanism.