# Breeding for Alfalfa Compatibility with Corn

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Alfalfa is the primary forage legume grown in the United States. Research and demonstration projects have shown that alfalfa can be successfully interseeded during its establishment year with corn grown for silage. This practice can increase overall system profitability and sustainability. The alfalfa establishment environment in this system is, however, very challenging due to shading, interspecies competition, and humid conditions under corn and this often results in poor stands of alfalfa during wet growing seasons. Studies carried out during 2015 and 2016 demonstrated considerable differences among alfalfa varieties in their ability to establish under corn. A subsequent study under corn in 2019 found one cycle of selection improved stand density of five alfalfa synthetics by an average of 35% over their parental base germplasms (105 vs. 78 plants $m^{-2}$). Based on these results further cycles of selection for alfalfa establishment under corn silage were initiated in 2020 and 2022. During 2022, fall ground cover of cycle-2 and cycle-1 selected intercropped alfalfa germplasms after corn harvest averaged 91% and 67% respectively compared 39% for non-selected germplasms. In another study, alfalfa RNA was isolated in July from leaf and root tissue after corn canopy closure from several selected germplasms and their non-selected base germplasms. Using an RNAseq approach comparing selected and non-selected germplasms, 345 differentially expressed genes (DEGs) were identified in leaves and 250 DEGS were identified in roots with 18 DEGs identified in both tissues simultaneously. Based on our results we anticipate further selection gains for alfalfa established under corn silage, possibly accelerated by DNA-based molecular markers. Ideally with enough selection, alfalfa varieties could be developed that successfully establish under corn silage without the need of pesticides or growth regulators. Such varieties would improve the reliability, profitability and sustainability of this intercropping system.