Mutualism and Competition between cultivars of Nitrogen-fixing legumes species (*Trifolium pratense* L., *Medicago sativa* L.) and grasses (*Phleum pratense* L., *Lolium perenne* L.) under contrasting nitrogen fertilization levels

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Abstract: Temperate legumes and grasses in the field have a complex below-ground relationship, with both competitive and mutualistic aspects. While both plants will compete for nutrients and root space, grasses can benefit from increased access to nitrogen (N) fixed by legumes, in a mechanism described as 'N-transfer'. To determine what effect species and cultivar of both legumes (N-donor) and grasses (N-receivers) might play on this efficiency of this transfer, a pot study was conducted to measure the growth and N accumulation of grass-legume combinations. Two diverse cultivars, respectively, of alfalfa (*Medicago sativa* L.; Apica, CRS1001) and red clover (*Trifolium pratense* L.; AC Christie, Tempus) were paired with two cultivars of Perennial Ryegrass (*Lolium perenne* L; Bastion, Feeder) and Timothy (*Phleum pratense* L; Champ, Richmond) in all pair-wise grass-legume (1:1 plant) and all single plant (1:0 plant) combinations. Pots were established for four weeks on an N-supply of 0.6 mg N $week^{-1}$, then grown for an additional 4 weeks on one of three N-fertility treatments: 0.6, 0.3, or 0 mg N $week^{-1}$. Increased N fertility had a generally positive effect on the growth of grasses, confirming that they were N-limited in the conditions provided. Legumes grown in combination with grasses had lover levels of accumulated dry matter (D.M.) biomass and total accumulated N, though tissue %N remained constant. Grass growth was affected by the presence of legumes, resulting in reduced root and shoots DM yield, but a higher tissue %N. Total accumulated plant N in grasses was higher in grasses paired with alfalfa plants versus those paired with clover or grown alone. When considering the total plant D.M. and N accumulation per pot (legume + grass), both DM and total N were significantly increased by the presence of red clover, while the presence of perennial ryegrass cultivars significant increased total D.M. only. Results show that pairing legumes and grasses in common soil can impact plant growth at the very early stages of mixed sward establishment, and that the magnitude of that impact can vary between species. Additional research is required to assess the impact of genotypes of associated grasses and legumes to better improve species compatibility and reduce competition in a mixed forage swards.