Impact of P and K Nutrition on Alfalfa Taproot C and N Pools During Cold Acclimation and Spring Regrowth

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Proper phosphorus (P) and potassium (K) nutrition is essential for optimum alfalfa performance and stand longevity. Our objective was to better define the role of P and K in improving winter hardiness and initiation of shoot growth in spring through detailed examination of the biochemical and molecular mechanisms known to improve alfalfa yield and winter survival. In September 2001, a factorial arrangement of P (0 and 75 kg/ha) and K (0 and 400 kg/ha) treatments was replicated in the field four times. Roots were sampled following defoliation in mid September, and 7, 14, 21, 28, 42, 56, 70, and 80 days after shoot removal until plants went dormant in early December. Roots also were sampled at the initiation of shoot growth in spring and weekly thereafter until plants were defoliated in late May. The influence of P and K fertilization on stored reserves (sugar, starch, buffer-soluble protein, and amino nitrogen pools), gene expression patterns (P transporters, vegetative storage proteins), and protein profiles in taproots were analyzed. During cold acclimation in fall and throughout spring regrowth, application of K increased root starch concentrations and decreased soluble sugar levels. Across all harvesting dates, root N pools were consistently lowest in the unfertilized plants. In both the fall and spring sampling dates, application of K without P increased root VSP levels.

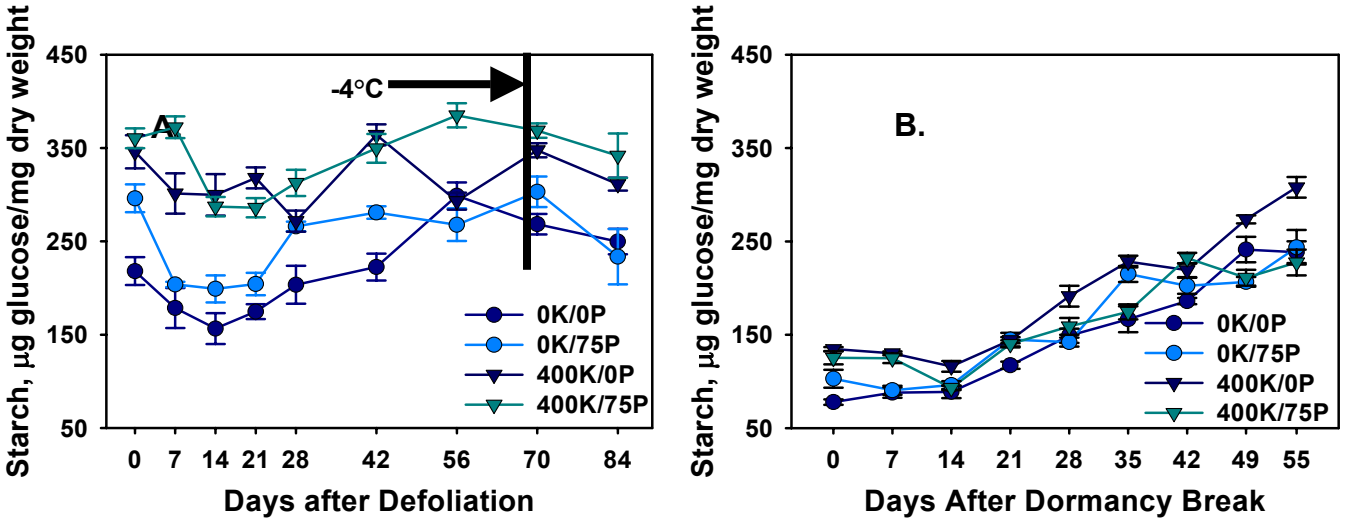

Figure 1. The influence of P and K fertilizer on root starch during cold acclimation in fall (Fig. 1A) and spring shoot growth (Fig. 1B). Application of 75 kg P/ha/yr without K reduced taproot starch for 3 weeks after harvest in Sept., and during spring growth due to increased starch utilization in P-sufficient roots as compared to roots of P-deficient plants. Roots of unfertilized plants generally had the lowest starch levels during fall acclimation and throughout spring regrowth.