

The Silent Decline in Soil Potassium Levels and Its Effect on Alfalfa Productivity in the Central and Western U.S.

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Abstract

Alfalfa (*Medicago sativa* L.), the most important perennial forage crop, is grown in the U.S. and many parts of the world. The production of alfalfa depends on soil nutrients and management practices. Intensive and continuous production of crops have resulted in depletion of most soil nutrient reserves. These nutrient deficits must be met through fertilization. Potassium (K) is a key element and removed in high quantities with hay harvesting in alfalfa production systems. Studies suggest that fertilizing alfalfa stands with K and phosphorus (P) improves yield and increases stand longevity. However, it is elusive whether fertilizing alfalfa with K in an unlimiting or limiting soil will result in any yield increase. Also, our knowledge on the effects of application of K to soils with adequate residual amounts and soils with declining K in conjunction with agronomic managements, such as cultivars and harvesting frequencies, is still rudimentary. The objective of the study was to determine the effects of K, cultivar, and harvest time on growth, yield, nutritive value, and stand persistence of alfalfa. Treatments were two cultivars (low lignin, 'Hi-Gest 360'; conventional, 'AFX 457') of alfalfa, four rates of K (0, 56, 112, and 168 kg K₂O ha⁻¹), and two harvest times (early harvest, late bud to 10% bloom; late harvest, 7 days after the first harvest). The study was set up in a randomized complete block design with four replicates. In 2016, preliminary results showed no significant effect of K rates or cultivars on emergence and seedling counts of alfalfa. No nutrient deficiency symptoms were noticed in the young seedlings of alfalfa. However, in 2017, some differences were observed among treatments, especially for growth, yield, and nutritive values. For example, late harvest significantly ($P < 0.005$) produced higher yield (2250 kg ha⁻¹) compared to early harvest (2050 kg ha⁻¹). Hi-Gest 360 produced the highest total yield (8,283 kg ha⁻¹) at the 168 kg K₂O ha⁻¹ rate, whereas AFX 457 produced the highest total yield (8,283 kg ha⁻¹) when treated with 112 kg K₂O ha⁻¹. This indicates that a moderate level of K is needed for a high yield of AFX 457, while a high level of K is needed for similar yield of Hi-Gest 360. Nutritive value was not affected ($P > 0.05$) by the application of K. Continuous and long-term monitoring is needed to accurately determine the effects of K, cultivar, and harvest on alfalfa growth, yield, nutritive value, and stand persistence. Detailed results of the study will be discussed in the presentation.