Effects of Lime on Alfalfa, Red Clover, and White Clover

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Forage legumes are important for livestock production as components of pastures and in pure stands. Forage yield and quality of legume crops are generally negatively affected by soil acidity. This study was conducted to determine the effect of lime applications to an acidic soil at 5 rates on soil pH, stand establishment, yield, and stand persistence of alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), and white clover *(T. repens* L.).

Soil samples were collected and analyzed twice a year for three years. Soil pH increased as lime rates increased for about a year after lime was applied and then declined slightly over the course of the study for all lime treatments. Different treatments had a slightly different initial pH due to residual prior liming effects. The 0.9 Mg ha^{-1} treatment had an initial pH of 4.1. Three treatments (1.6, 2.7, 4.5 Mg ha^{-1}) had initial pH of 4.3; while the 8.3 Mg ha^{-1} treatment had an initial pH of 4.7. The two highest treatments (4.5 and 8.3 Mg ha^{-1}) increased most rapidly, while the lowest treatment (0.9 Mg ha^{-1}) increased the slowest.

Lime application did not affect legume seedling density, but suppressed certain weed populations. Seedlings collected and weighed 6 months after sowing show legume species had a significant ($P < 0.05$) difference on the number of seedlings per m^2, seedling weight per m^2, and weight per legume seedling, but neither lime rate nor the "species x lime rate" interaction was significant ($P > 0.05$). Cutleaf eveningprimrose (*Oenothera laciniata* Hill) seedlings were more numerous in the clovers than alfalfa; although, the number of seedlings per m^2 was too low to cause serious problems for legume establishment. Rattail fescue (*Vulpia myuros* (L.) K.C.Gmel) seedlings were more prevalent than all other weeds and tended to be more numerous in plots with low pH.

Red clover and alfalfa had a significant increase in yields with increasing pH, but white clover did not respond to lime with an increase in yield above a pH of 5.2. Both legume species and lime treatments strongly influenced forage yield during the first two years, and alfalfa yield was significantly affected also during the third year. The three legumes responded to lime differently to variable pH as indicated by significant ($P < 0.05$) "species x lime" treatments interaction. This is an important finding because lime recommendations to correct low pH are sometimes the same regardless of the legume species.

Red clover responded to increased pH in both years, showing a yield increase of about 1.1 and 1.5 Mg ha^{-1} per pH unit increase in 2001 and 2002, respectively. Alfalfa was somewhat more responsive in 2001 and 2003 to lime rates. It increased yield of almost 2.0 and 1.7 Mg ha^{-1} per pH unit increase. White clover, however, showed no substantial increase in yield; therefore, a pH of 5.2 was probably satisfactory for white clover production.

Soil pH did not affect alfalfa and red clover plant density in 3.5 years, but higher pH resulted in larger plants. Alfalfa stand density, as measured by the number of plants per m^2, was not statistically affected by pH after 3.5 years but higher lime treatments tended to have somewhat thinner stands (41 vs. 44 plants per m^2). Plants grown in the lowest pH weighed only about 59% of those grown in the high pH treatments. Heavier root/crown is consistent with the higher above ground yields. Plants with larger crowns and upper roots may indicate a better ability to secure nutrients needed for higher forage yield.