MISSOURI

Soil Fertility Affects Establishment and Persistence of Red Clover in Grazed Pastures

By Jim Gerrish

Interseeded legumes play an integral role in pasture improvement programs in the humid-temperate region of the U.S., but producer success with overseeding legumes in grazed pastures has been quite variable. Soil fertility may be one factor affecting establishment and subsequent persistence of overseeded red clover. Numerous small plot studies have addressed questions of legume response to soil pH, P and potassium (K) levels. Less information is available regarding plant response in grazed situations.

> Forage grass and red clover components in grazed pastures were evaluated relative to the soil fertility status of the pasture. Soil phosphorus (P) appears to be a critical factor in establishment and maintenance of red clover in grazed pastures.

We conducted a study at the University of Missouri-Forage Systems Research Center located in north-central Missouri to evaluate the effect of soil pH, Bray P-1 and exchangeable K on the establishment and persistence of red clover overseeded into forage grass pastures. Eight pastures...four in smooth bromegrass and four in orchardgrass sods...were subdivided into three paddocks for rotational grazing. One 5.33-acre paddock from each base pasture was used, providing four replicates of each base grass sward.

Within each sample paddock, five transects were established originating at the water source. Another objective of this study was to measure the transfer of soil nutrients by grazing animals, thus the sampling transects were placed relative to stock water location. Permanent sampling sites, approximately 2 yards square, were established along each transect at 100-ft. intervals. Due to variance in paddock shape, the number of sample sites in each paddock ranged from 26 to 33. At each sample site, soil samples were collected from a one yard square quadrant each September for four consecutive years. A different quadrant of the 2-yard square sample site was used each year to avoid any effect the sample probe holes may have had on water or nutrient movement to deeper soil strata. Samples were taken to a 6-in. depth and were divided into 0 to 3 in. layer and 3 to 6 in. layers. At the same time soil samples were collected, red clover stand was assessed by two methods. Visual estimates of ground cover percentage of red clover, base grass, and bare ground were made when the clover had regrown to approximately 4 in. during the rest period. Individual mature plants and red clover seedlings were also counted within a one square yard quadrant. The same two methods of red clover stand evaluation were used in mid-April at all sample sites.

While individual paddocks differed in mean soil fertility levels and red clover population, smooth bromegrass and orchard-

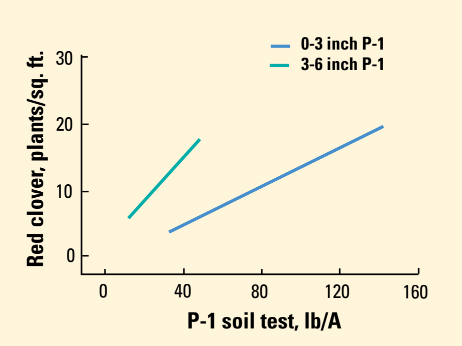

Figure 1. Impact of P-1 soil test level on mature red clover plant population present in grazed pastures in late summer.

Note: The equations which describe Figure 1 follow.

$1.55 + 0.339*x$; R-sq. = .40 (3-6 inch P-1)

$-0.39 + 0.143*x$; R-sq. = .29 (0-3 inch P-1)

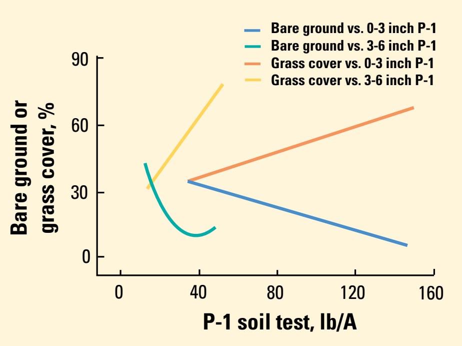

Figure 2. Impact of P-1 soil test level on bare ground and grass canopy cover in grazed pastures during late summer.

Note: The equations which describe Figure 2 follow.

$45.4 - 0.275*x$; R-sq. = .29 (Bare ground vs. 0-3 in. P-1)

$85.4 - 3.91*x + 0.051*x^2$; R-sq. = .38 (Bare ground vs. 3-6 in. P-1)

$24.05 + 0.346*x$; R-sq. = .23 (Grass cover vs. 0-3 in. P-1)

$16.99 + 1.33*x$; R-sq. = .51 (Grass cover vs. 3-6 in. P-1)

grass paddocks did not differ in any of the measured parameters. Data were pooled across all eight paddocks for regression analysis of soil and sward characteristics.

Spring sward measurements of grass and clover components were not highly correlated with any soil parameters. Spring grass cover increased slightly in response to higher exchangeable K levels in the 3 to 6 in. layer, but neither red clover plant population nor estimated ground cover was significantly affected by any soil variable. Spring clover populations appear to be more affected by severity of winter weather and grazing pressure during the previous fall and winter rather than by soil fertility.

Red clover seedling plants, mature plants, and estimated ground cover were all significantly affected by soil variables at the September observation date. Clover seedling number increased significantly as pH in the 0 to 3 in. layer increased above 6.0, indicating that the soil environment for seedling establishment may be improved by surface lime application. Observed bare ground percentage decreased linearly with increasing pH in the 0 to 3 in. layer. The range of observed soil pH was from approximately 5.6 to 6.8. This range in pH may not have been great enough for a measurable increase in red clover population due to increasing soil pH.

Soil P had the greatest impact of the measured soil variables on most sward parameters (**Figures 1 and 2**). Both grass cover and mature red clover plants measured in September increased linearly as P in both the 0 to 3 and 3 to 6 in. layers increased. Estimated red clover ground cover increased at a more rapid rate as 3 to 6 in. P increased compared to 0 to 3 in. P. This response may be due to more extensive rooting at greater depths as 3 to 6 in. P increased. Two of the four years of this study had below normal rainfall during the July to September period. We believe that deeper roots due to higher P levels may have offset some drought stress.

Visual estimate of red clover canopy cover was not highly correlated to soil fertility parameters. Number of mature plants in the sward appears to be a better indicator of pasture fertility status than does visual estimate of canopy cover.

A surprising result was a highly significant response of mature red clover plants to increasing exchangeable K levels which indicated declining plant numbers at higher levels of K. The higher levels of K are far below any potential toxicity level, so the result was initially confusing. However, as these data are sample site-specific, the cause of this response is easily explained. In this same grazing study, soil nutrient redistribution by grazing livestock was also measured. Almost all of the sample sites with K soil tests in excess of 400 lb/A exchangeable K were within 150 ft. of watering sites. These sites also had the highest bare ground estimates and lowest grass canopy cover estimates, probably due to overgrazing and soil compaction in these areas. Thus, while red clover plant population initially increased in the general grazing areas as K levels increased, the declining plant population at higher fertility levels is in response to grazing factors, not soil fertility. The red clover population response to soil K described above is one of the reasons why it is important to study forage fertility responses in the pasture environment, not only in small plot settings.

In summary, soil P appears to be a critical factor in establishment and maintenance of red clover in grazed pastures. Red clover plant population increased linearly as soil P increased throughout the range of Bray P-1 values measured in this study. Even though red clover plant population increased at higher P levels, dry matter yield has been shown to peak at much lower soil P levels. BC

Mr. Gerrish is Research Assistant Professor, University of Missouri - Forage Systems Research Center, 21262 Genoa Rd., Linneus MO 64653.

Aglime Facts Booklet Now Available

Agricultural lime (aglime) can be a valuable part of nutrient management for profitable crop production systems. Correcting acid soil conditions and maintaining optimum soil pH range are keys to achieving best results with nitrogen (N), phosphorus (P), potassium (K) and other essential nutrients in crop and forage production.

A new booklet...prepared jointly by the Potash & Phosphate Institute (PPI), Foundation for Agronomic Research (FAR), and the National Stone Association (NSA)...offers a useful overview of considerations on aglime. While not an "in-depth" reference text, the 16-page booklet discusses several topics, including: the importance of aglime in agriculture; why soils become acid; determining aglime needs; aglime quality and types; aglime and crop production; and applying aglime. Color photos and charts help illustrate responses and benefits of aglime.

The *Aglime Facts* booklet is available at $2.50 per copy (reduced price of $1.25 each for member companies of PPI, contributors to FAR, schools, and government agencies)...plus shipping cost. To order or for more information, contact:

Circulation Department, PPI
655 Engineering Drive, Suite 110
Norcross, Georgia 30092-2837
Phone (770) 447-0335,
ext. 213 or 214
Fax (770) 448-0439