Soil Nutrient Levels on Grazing Farms in Northeast US

by Matt Sanderson, USDA-ARS-Pennsylvania

Livestock producers in the northeastern US rely more on forages, pasture and grazing management to reduce production costs and remain competitive. Soil nutrient levels are one indicator of the level of nutrient management on farms. Pastures have often been classified as low in soil fertility. Many graziers have intensified grazing management in recent years (e.g., increased stocking rates, rapid rotations, supplemental feeding). These practices could affect the soil resource through nutrient additions and the concentration of grazing animals. The research objective was to gain insight into the level of various soil nutrients on grazing farms in this region.

Soil data collected, as supporting information, were used in a number of surveys dealing with biodiversity in northeastern pastures. In all of these surveys, a common soil sampling protocol was followed and samples were analyzed at the same laboratory. In total, 215 pastures were sampled on 66 farms in nine states. All farms sampled used some form of intensive grazing management. Two to eight pastures were sampled on each farm. When possible, the distance of the pastures was noted relative to the main barnyard area with the aid of a farm map. Composite soil samples of 15-20 soil cores to a 6" depth were taken within each pasture. Samples were analyzed by the Agricultural Analytical Laboratory at Penn State University for pH, organic matter, P and K (Mehlich 3 extractant).

Soil nutrient results were grouped into agronomic fertilizer recommendation categories (low, optimum, high) according to the criteria of the Penn State Agricultural Analytical Services Laboratory. Data were also grouped according to location (near, intermediate, far; a qualitative estimate) of the paddocks relative to the main barnyard area.

The majority of pastures sampled had optimum to high levels of soil P and K (Table 1). Nearly one-half of pastures were "high" in soil P and 20% had soil P levels greater than 100 ppm. Paddocks farthest from the barn tended to have lower soil P levels; however, there was a large range in soil P regardless of distance from the barn. The low, optimum and high soil fertility categories are based on agronomic criteria and are not necessarily environmental thresholds. Increased levels of soil test P have been associated with an increased risk of P loss in surface water runoff; however, other risk factors such as the amount of soluble P from manure, landscape position of the pasture and hydrologic connections must be considered as well. A well-managed grazing system should maintain a dense, vigorous sod in pastures and reduce the potential for soil erosion, water runoff and nutrient losses.

More than 40% of paddocks had soil K levels in the "high" category (Table 1). Soil K also tended to be lower in pastures farther from the barn. Although high levels of soil K are not a water quality problem, high soil K may result in high forage K concentrations, which can cause metabolic problems in dry cows. Thus, dairy producers need to test both soils and forages in pastures to determine if specific pastures are a high risk for dry cows and if specific dietary supplements (e.g., anionic salts) may be necessary. If high K pastures are set aside for hay or silage harvest, the forage should be tested for K.

Table 1. *Phosphorus, potassium, pH and organic matter in the 0-6" soil layer of 215 pastures on 31 farms across the northeastern US.*

	Number of Pastures (% of total)	Average	Range
Agronomic Category	**Phosphorus (ppm)**		
Low	52(22)	20	4-30
Optimum	71(30)	44	31-59
High	117(49)	107	61-313
Location From Barn			
Near	87	79	4-288
Intermediate	64	76	7-220
Far	75	62	13-208
Agronomic Category	**Potassium (ppm)**		
Low	44(18)	65	35-89
Optimum	103(43)	126	83-172
High	93(39)	258	175-546
Location From Barn			
Near	57	199	38-386
Intermediate	64	169	35-546
Far	75	160	39-507
Agronomic Category	**pH**		
Low	147(61)	5.94	5.10-6.40
Optimum	87(36)	6.76	6.50-7.40
High	6(2)	7.52	7.50-7.60
	Organic Matter (%)		
	233	5.24	2.3-11.2

The categories are based on the criteria of the Agricultural Analytical Laboratory of Penn State University. The distance categories for location from barn are qualitative

Nearly 60% of the pastures sampled had a low soil pH (5.1-6.4) indicating that liming may be beneficial on these pastures. Soil pH levels for legumes should be above 6.0. Organic matter content varied widely and averaged about 5%.

Other research indicates that soils in northeastern pastures have low native soil fertility and require lime and P for adequate forage production. For example, a recent survey of pastures in West Virginia revealed that soil pH ranged from 4.9-7.2 (average of 6.2) and that 30% of pastures had soil P below adequate levels. It was also found that most pastures had a relatively low soil pH.

Results for this study, however, indicate that farms with more intensive grazing management have greater soil P and K levels than reported by others. Thus, producers who have adopted intensive grazing management practices also need to monitor soil fertility and implement appropriate nutrient management practices.