Forage News

MISSISSIPPI STATE UNIVERSITY EXTENSION SERVICE

Soil P & K Nutrient Levels: Key to Forage Nutrient Management

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Mississippi is made up of several different types of soil. Despite this array of soil types, they all provide, to some degree, a reservoir of nutrients required by forage crops and livestock. Although soil nutrients can be present in the soil at different soil depths, they are not necessarily at optimum levels or always in available form for plant uptake. Soil nutrient levels can be impacted by a large number of factors such as acidity, soil texture, soil structure, mineral composition, and soil moisture, etc. The most efficient method to assess soil nutrient levels for optimum production is by taking a representative sample of the area in question and obtain a soil nutrient analysis. Knowing this information will avoid a miscalculated application of some nutrients that could impact the environment (for example phosphorus runoff) and ensure that suitable levels of nutrients are provided for maximum crop potential.

A soil sample will provide a more accurate recommendation to maintain the nutrient-supplying capacity of the soil. A good nutrient estimate will depend on collecting a representative soil sample. A representative soil sample should be obtained for every 10 to 15 acres by collecting at least 20 to 25 soil cores to a minimum soil depth of six inches. This is the reason why a soil analysis is recommended every 2 to 3 years in pasture land and every year or every other year in hay land situations. It is also best to sample fields at the same time of year each time you sample. Pasture or hay land with highly variable soil fertility levels across the field can make it difficult to collect a god soil sample. When sampling a paddock or field, avoid sampling in areas that are unrepresentative of the field such as winter feeding areas, shade trees, close to water sources, areas with fresh manure piles and urine spots, and bottom land areas with high moisture content.

Forage and livestock producers should get in the habit of developing a nutrient management plant that can keep the stand healthy and productive. A soil sample estimates the plant-available concentrations of the major nutrients such as phosphorus (P) and potassium (K) in the soil. Measuring available soil nitrogen (N) can be useful in forage systems, but it is more complex than other nutrients and could be more expensive to analyze.

Soil acidity – Soil acidity is measured as pH (concentration of hydrogen ions) and plant tolerance can range from 4.5 to 6.8 in most forage crops across the state depending on forage species. Average soil pH in forage systems across Mississippi ranges from 5.2 to 6.0. Soil pH can be impacted by several factors that include vegetation (grasses vs. legumes), soil parent material, topography, climate, soil organisms, temperature, rainfall and soil mineral weathering. It is important that while some grasses may sustain productivity at a pH of 5.8, legumes will need an optimum pH ranging from 6.0 to 6.8 to be productive and persistent. Acidity can reduce root growth which then reduces nutrient uptake. Soil acidity can lead to plant toxicity by certain elements such as aluminum, iron, manganese, and zinc. It also slows down organic matter decomposition by soil organisms. Soil acidity has also long been known to decrease symbiotic nitrogen fixation in legumes, negatively affecting growth and yield, especially in plants depending exclusively on symbiosis to acquire nitrogen during the growing season. Lime application is the most effective treatment at neutralizing soil acidity. Lime can be applied at any time during the growing season, but it is recommended to apply at least 6 months before the

Table 1. Soil phosphorus levels for all forage crops based on Mississippi State University Lancaster's soil test method.

Level	*Range (lb P/ac)*
Very Low (VL)	0 – 18
Low (L)	19 – 36
Medium (M)	37 – 72
High (H)	73 – 144
Very High (VH)	144+

Note: Sufficiency levels can vary depending on soil extraction method used.
Source: Oldhman, 2012.

green up to allow an effective treatment. There are different types of lime that are commercially available and each type of lime amendment has its benefits and drawbacks such as effectiveness, price, purity, and neutralizing value.

Table 2. Soil potassium levels for forage crops group 1 based on Mississippi State University Lancaster's soil test method and soil cation exchange capacity (CEC).

	Range (lb/ac)			
Level	**CEC ≤ 7**	**CEC 7-14**	**CEC 14-25**	**CEC 25+**
Very Low (VL)	0 – 40	0 – 50	0 – 60	0 – 70
Low (L)	41 – 80	51 – 110	61 – 130	71 – 150
Medium (M)	81 – 120	111 – 160	131 – 180	151 – 200
High (H)	121 – 210	161 – 280	181 – 315	201 – 350
Very High (VH)	201+	280+	315+	350+

Annual grasses (wheat, oats, barley, ryegrass).
Perennial cool-season grasses (tall fescue or orchardgrass).
Cool-season annual clovers (arrowleaf, ball, berseem, balansa, crimson, persian) with annual ryegrass
Perennial or mixed warm-season grass pasture (bahiagrass, bermudagrass, dallisgrass).
Note: Sufficiency levels can vary depending on soil extraction method used.
Source: Oldhman, 2015.

Phosphorus (P) – Phosphorus is very stable in the soil and moves very little with soil depth as compared to nitrogen and potassium (cation exchange dependent). The quantities of phosphorus in soil are generally small and it is often a limiting factor for plant growth. There are several factors that can impact phosphorus mineralization and availability such as pH, rainfall, temperature, moisture, and aeration (oxygen level). A soil pH that is less than 5.5 could limit P availability by 30% or more. Phosphorus release from organic matter such as poultry litter will occur more quickly in warm, humid climates than in cool, dry climates. A soil pH above 6.0 is ideal to increase P availability for plant uptake. Adequate soil P levels can encourage the formation of a vigorous root system, stimulate shoot growth, and promote efficient water use by forage crops. Phosphorus deficiency occurs in low-input managed grasslands and may affect the ability to produce legumes, particularly white clover, to obtain an input of N that is sufficient to ensure a productive system. Phosphorus deficiency is usually manifested by development of purple leaves. The symptoms appear first in the tip of the leaves and progresses until the entire leaf turn purple. Symptoms are usually observed in the lower leaves because P is usually mobilized from the younger leaves. The symptoms of P deficiency are usually common as young plants are cool and wet conditions. Phosphorus sufficiency levels for forage production in Mississippi are provided in Table 1.

Table 3. Soil potassium levels for forage crops group 2 based on Mississippi State University Lancaster's soil test method and soil cation exchange capacity (CEC).

	Range (lb/ac)			
Level	**CEC ≤ 7**	**CEC 7-14**	**CEC 14-25**	**CEC 25+**
Very Low (VL)	0 – 50	0 – 60	0 – 70	0 – 80
Low (L)	51 – 110	61 – 140	71 – 160	81 – 180
Medium (M)	111 – 160	141 – 190	161 – 210	181 – 240
High (H)	161 – 280	191 – 335	211 – 370	241 – 420
Very High (VH)	280+	335+	370+	420+

Lespedeza (annual and sericea)
Perennial mixed grass hay (bahiagrass, bermudagrass, dallisgrass).
Forage Legumes [annual (clovers: arrowleaf, ball, berseem, balansa and crimson clovers and other: caley peas, and vetch) and perennial clovers (red and white)].
Perennial cool-season grass (tall fescue or orchardgrass) with clovers (white, red, subterranean).
Note: Sufficiency levels can vary depending on soil extraction method used.
Source: Oldhman, 2015.

Potassium (K) – Potassium is the second most important nutrient to forage production besides nitrogen and it is required in large amount for growth and reproduction. There are several factors that can affect potassium uptake by plants such as soil moisture, aeration, temperature, cation exchange capacity, and tillage system. Increase in soil moisture tends to increase K availability and therefore enhances plant root uptake. Good soil aeration is needed for root respiration and K uptake. Compaction and with water saturation (very wet soils) can decrease oxygen levels and subsequently decrease K uptake. Potassium uptake is usually reduced at low soil temperatures. An optimum soil temperature of 60 to 80 °F can increase microbial activity and increase K uptake. Cation exchange capacity (CEC) is a measure of the soil's ability to hold positively charged ions such as K. The CEC of soils varied according to the type of amount of clay, the type of clay, soil pH and amount of organic matter. *Soils with a higher clay fraction tend to have a higher CEC* while sandy soils tend to have lower CEC and are more likely to develop K deficiencies. Potassium sufficiency levels for forage production in Mississippi based on CEC are provided in Tables 2, 3, and 4.Some studies have also indicated that soil availability of K in no-till systems can be reduced, although the exact cause of this reduction is not yet known. However, there are speculations that this reduction could be related to root growth restriction resulting in unexplored K reserves within the soil. In pastures with potassium-deficient soils, grasses are more efficient at securing their potassium needs than associated clovers. Potassium deficiency in forage crops (especially in legumes) can impact stand persistence, reduce plant survival under drought or very cold conditions, and reduce insect and disease resistance. Typical symptoms of potassium deficiency in forage

Table 4. Soil potassium levels for forage crops group 3 based on Mississippi State University Lancaster's soil test method and soil cation exchange capacity (CEC).

	Range (lb/ac)			
Level	**CEC ≤ 7**	**CEC 7-14**	**CEC 14-25**	**CEC 25+**
Very Low (VL)	0 – 70	0 – 90	0 – 120	0 – 150
Low (L)	71 – 150	91 – 100	121 – 240	151 – 260
Medium (M)	151 – 200	191 – 240	241 – 290	261 – 320
High (H)	201 – 350	241 – 420	291 – 510	321 – 560
Very High (VH)	350+	420+	510+	560+

Alfalfa.
Hybrid bermudagrass.
Note: Sufficiency levels can vary depending on soil extraction method used.
Source: Oldhman, 2015.

crops include brown scorching in the leaves, curling of the leaf tips, yellowing (chlorosis) between the leaf veins, and purple spots under the leaf.

Summary – One important aspect of developing a good nutrient management program for forage production is not only making sure that a good representative soil sample is collected, but also selecting a soil laboratory with a good soil testing method to estimate nutrient levels and receive a good nutrient recommendation. Sometimes, producers take a representative soil sample, split it and send it to different laboratories. The results and recommendations obtained from the laboratories might be different and this can cause confusion and frustration for the producer. There are several reasons why the results might be different: (1) the soil analysis method and extractants used are usually different; (2) differences in the results can occur within a method if protocols or techniques are not properly followed such as drying, grinding, sieving, shaking, extractant concentrations, equipment temperature, stirring, filtering, and extraction time. It is recommended that a producer consult with a laboratory about the soil analysis methodology and ensure that samples were collected and submitted within the same sampling period (spring, summer, or fall) that they were recommended. Other factors that can also affect soil nutrient interpretation includes organic matter and soil sampling depth. Soil with greater organic matter can have higher microbial activity and increase plant available nutrients.

Upcoming Events

April 20, 2018—Beef Cattle Boot Camp, Raymond
April 27-28—MSU Animal and Dairy Sciences Alumni Weekend and Farm Tours, Starkville, MS
May 22, 2018—Coastal Plain Experiment Station Hay Production Field Day, Newton, MS
May 24, 2018—Hinds Co Forage Field Day, Terry, MS

For upcoming forage related events visit: ***http://forages.pss.msstate.edu/events.html***