Soil Fertility & Sampling & Forage Crop Fertilization Requirements

Following soil test recommendations for nutrient and lime application is important for achieving maximum forage production in pastures and hayfields. Soil fertility requirements vary according to forage and soil types. The goal of soil testing is to determine the quantity of lime and fertilizer that should be applied to maximize crop production while preventing environmental pollution. Fertilizer and lime recommendations for Alabama were developed as a result of decades of research.

ESSENTIAL NUTRIENTS FOR FORAGE PRODUCTION

Seventeen essential elements are needed for forage production. Out of these seventeen nutrients, fourteen are supplied from the soil (table 5). Application of primary macronutrients (N, P, K) typically must be supplied through fertilizer application. Secondary macronutrients (Ca, Mg, S) also can be limiting for forage production, but lime and nitrogen fertilizer applications often supply enough of these nutrients to maintain forage growth.

As long as soil pH is maintained at an appropriate level, micronutrients are abundant enough in most soils of Alabama to support maximum plant growth. Therefore, micronutrients rarely need to be supplied through fertilizer applications. Soil testing provides recommendations for the amount of fertilizer required to meet economic production and quality potential of forages.

Table 5. Essential Nutrients for Forage Growth

Primary Macronutrients	Secondary Macronutrients	Micronutrients
Nitrogen (N)	Calcium (Ca)	Boron (B)
Phosphorus (P)	Magnesium (Mg)	Chlorine (Cl)
Potassium (K)	Sulfur (S)	Copper (Cu)
		Iron (Fe)
		Manganese (Mn)
		Molybdenum (Mo)
		Nickel (Ni)
		Zinc (Zn)

Figure 44. Soil samples are processed to determine soil pH, soil buffer pH, and plant-available nutrient content.

SOIL PH

Most Alabama soils are naturally acidic and must be limed periodically to create proper soil conditions that increase plant nutrient availability and avoid aluminum toxicity. Most forages grown in Alabama perform best in soil with a pH between 5.8 and 6.5. However, there are a few exceptions. For example, alfalfa needs a soil pH of at least 6.0. Maintenance of soil pH ensures that (1) nutrients are in forms that are available to the plant, (2) aluminum toxicity does not occur, and (3) beneficial soil microorganisms, such as those that fix nitrogen for legumes, can function properly. Soil testing reports provide recommendations for the amount of lime required to increase soil pH to the level needed for optimal forage growth.

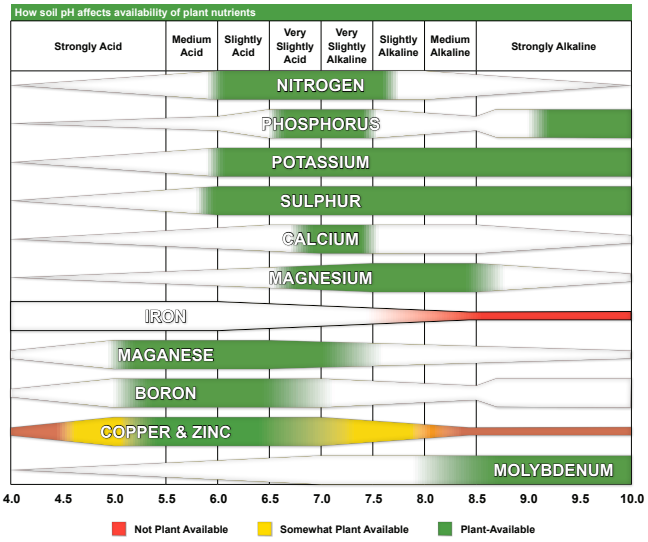

Figure 45. Soil testing provides recommendations for the amount of lime required to increase soil pH.

Figure 46. Use a soil sample box to submit to the Soil Testing Lab.

COLLECTING SOIL SAMPLES

Soil acidity and nutrient content can vary widely throughout a field, especially in pastures, so it is important to take a representative sample of the field/area you are testing. A soil sample should consist of fifteen or more uniform subsamples to form a composite sample of a field.

Take samples to a depth of 3 to 4 inches for pastures and hayfields. These can be collected with a soil probe or shovel. Place subsamples in a bucket and mix well prior to placing into a soil sample box.

In pastures it is important to avoid sampling areas where cattle congregate the most, including feeding areas, shaded areas, and around water sources. These areas tend to be much higher in nutrient content due to manure and urine deposition by livestock, and they are not representative of the entire field.

Figure 47. Avoid taking samples from areas around water sources.

Collect separate samples from areas of a field that are managed differently. For example, if one area is grazed but an adjacent area is not, sample these soils separately. An individual soil sample should not represent more than 10 acres, so divide fields into smaller areas for sampling if they are greater than 20 acres. Collect soil samples every year for hayfields and every 1 to 2 years for pastures.

INTERPRETING SOIL RESULTS

There are three sections within a soil test report that provide important recommendations:

Lime recommendations provide the amount of agricultural limestone needed to amend soil pH to the correct level for good production. Recommendations are given in tons per acre of ground agricultural lime.

Fertilizer recommendations for N, P_2O_5, K_2O (nitrogen, phosphorus, potassium) are given in pounds per acre. Various fertilizers contain different percentages of N, P_2O_5, and K_2O (table 5. The appropriate amount of fertilizer to apply must be calculated for specific fertilizer products. For example, if your soil test calls for 120 pounds of K_2O, and your fertilizer contains 60 percent K_2O, you need to apply 200 pounds of fertilizer to meet forage potassium demands.

An online calculator is available on the Soil, Forage, and Water Testing Laboratory website. The calculator will convert soil test recommendations to pounds of fertilizer per unit area for a variety of common fertilizers. Simply input your soil test recommendations, select the fertilizer you will be using, and click Calculate or scan the QR code to go directly to the site.

Comments give special instructions for fertilizing a specific crop. Always read the comments section of the soil test report as it may give recommendations regarding timing and placement of fertilizers. It may also provide recommendations for micronutrients that are required for optimal growth of a specific forage.

For hayfields, fertilizer recommendations may be based on anticipated yields. For example, a recommendation for bermudagrass hay production after each cutting is to apply 50 pounds nitrogen per ton of anticipated hay removed at the next cutting. This recommendation is based on nutrient removal in hay production systems. Nutrient removal can be an important consideration in overall soil fertility management. Fertilizing based solely on nutrient removal, however, could lead to nutrient deficiencies or result in overuse of some fertilizer nutrients. Most common fertilizers used and their compositions are shown in table 6.

						SOIL TEST RESULTS				RECOMMENDATIONS			
LAB No.	Test Date	Sample Designation	Crop	Soil Group*	pH**	Phosphorus P***	Potassium K***	Magnesium Mg***	Calcium Ca***	LIME-STONE	N	P_2O *	K_2O
						Pounds/Acre				Tons/Acre	Pounds/Acre		
05400	02/02/21	3211 NE See Comment 1	Bahia Hay	2	5.6	L 14	M 113	H 164	H 722	0.0	100	75	200
05401	02/02/21	3211 NW See Comment 1	Bahia Hay	1	5.6	L 20	H 95	H 154	H 765	0.0	100	75	100
13704	04/09/21	Tower pasture See Comment 2 See Comment 3	Bermuda Pasture	3	5.4	H 50	H 296	H 343	H 2100	1.5	60	0	0

Comment No.1: For bahiagrass hay, apply N, P and K as recommended before growth begins in spring. After each cutting up to September 1, apply 50 pounds N per ton of anticipated hay removed at the next cutting. Loss of stand is sometimes due to K deficiency. Where large yields of hay are removed, apply 40 pounds K2O per ton of hay removed the previous season. Very high (VH) or extremely high (EH) phosphorus (P) and/or a soil pH>6.5 may result in yellowing of bahiagrass due to iron deficiency.

Comment No.2: Soil acidity (low pH) can be corrected with either dolomitic or calcitic lime.

Comment No.3: On summer grass pastures apply P and K as recommended and 60 pounds of N before growth starts. Repeat the N application up to September 1 when more growth is desired. If less than 40 pounds of N is applied annually, then no P or K is needed.

Figure 48. Soil test reports provide valuable recommendations.

Table 6. Common Fertilizers and Their Nutrient Contents

Fertilizer Source	N (%)	P_2O_5 (%)	K_2O (%)	Other
Ammonium Nitrate	34	0	0	-
Ammonium Sulfate	21	0	0	24% S
Anhydrous Ammonia	82	0	0	-
Di-ammonium phosphate (DAP)	18	46	0	-
Monoammonium phosphate (MAP)	10	50	0	-
Muriate of Potash	0	0	60	-
Nitrogen Solution (28%)	28	0	0	5% S
Nitrogen Solution (30%)	30	0	0	2% S
Nitrogen Solution (32%)	32	0	0	-
Sulfate of potash-mag (K-Mag)	0	0	22	21% S; 11% Mg
Triple super phosphate (TSP)	0	46	0	-
Urea	46	0	0	-

NUTRIENT DEFICIENCY

In addition to soil testing, visual observation is commonly used to aid in diagnosis of nutrient deficiencies since plant symptoms, such as yellowing and stunted growth, are associated with specific nutrients. For trained observers, this approach may be helpful. However, more than one nutrient may be out of balance. In many cases, plant tissue sample analysis can be of great value.

A plant tissue report provides a detailed description of main macro- and micronutrients within plant tissue. For tissue analysis, it is recommended that plant tissue samples be taken randomly throughout a field to get a representative sample of the canopy strata of interest. Before collecting a tissue sample, check with the laboratory to determine how they suggest taking the sample and the amount required. For most forages, a plant tissue analysis is taken when soil test results have been inconclusive.

USING BROILER LITTER FOR FORAGE PRODUCTION

Broiler litter is a mixture of chicken manure, spilled feeds, and bedding materials. The primary nutrients present are nitrogen, phosphorus, and potassium. Unlike commercial fertilizers, however, broiler litter does not come with a guaranteed nutrient analysis or a specific grade, and composition is highly variable.

Broiler litter contains significant amounts of plant nutrients that are beneficial to forage plants. Unlike commercial fertilizers, however, it does not release nutrients at the same time. Most nutrients in poultry litter are bound in complex organic molecules and must be broken into simpler molecules by a process known as mineralization. This is a natural process accomplished by soil microbes and is greatly influenced by environmental factors such as soil temperature, soil moisture, and soil characteristics.

Broiler litter applied in winter months in Alabama mineralize very slowly. Additionally, Alabama receives about 50 percent of its annual rainfall in winter months. Application of litter in winter months is particularly susceptible to runoff and leaching losses. The best timing of litter application is spring, a few weeks before spring green-up. Research conducted in three locations on three different soil types suggests that mineralization rates vary between location and soil types (table 7).

Table 7. Estimate of Nutrient Amounts Released within 30 Days of Broiler Litter Application

		Percent Released Within 30 Days		
Location	**Soil Type**	**N**	**P**	**K**
North Alabama	Silty clay lam	up to 37	6 to 21	up to 86
Central Alabama	Loamy sand	25 to 29	up to 39	48 to 94
South Alabama	Fine sandy loam	10 to 22	26-61	85 to 92

Figure 49. Poultry litter in house prior to removal.

Figure 50. Poultry litter stacked in a storage facility.

ENVIRONMENTAL CONSIDERATIONS

Litter is typically a more economical source of nutrients, but it needs to be used wisely to prevent environmental issues. When broiler litter is regularly applied to pastures, phosphorus levels are likely to build to high levels. Litter also can potentially wash into nearby creeks during rainstorms.

Since most freshwater bodies are limited in phosphorus, an influx of this element can trigger algal growth or favor nuisance aquatic plants that can degrade water quality. Good environmental stewardship practices can avoid unnecessary complaints and problems related to litter application. The following are important considerations when using broiler litter:

Figure 51. Calibrate the spreader truck to ensure appropriate delivery.

Figure 52. .Do not apply litter on a windy day to avoid conflict with neighbors.

- Use the principle of *don't guess but test*. Test your litter before applying. It is always good to know the nutrient content of the litter you are applying.
- Avoid litter application several months ahead of spring green-up.
- Calibrate the spreader truck to ensure you are delivering the appropriate rate.
- Keep records of litter application rate, application timing, and litter transfer to a third party (if any).
- Use soil test reports to determine the application rate.
- Observe the Alabama Department of Environmental Management (ADEM) required setback distances while applying litter. See table 8 for the setback distances.
- Keep the litter covered if stored in an open field for several weeks.
- Do not apply litter if a significant rainfall event is predicted within 72 hours.
- Do not apply litter on a windy day to avoid conflict with neighbors.

Table 8. Setback Distances for Litter Application

	Setbacks for Land Application for Animal Feeding Operation
Property Line	Cannot cross property line
Public use area or non-owner existing occupied dwelling, church, school, hospital, or park	100 ft for dry waste 200 ft for liquid waste 500 ft for spray
Water or sinkholes	200 ft public supply water 200 ft outstanding water
Well	100 ft nonpotable well or water supply 200 ft potable well or water supply
Road	Cannot be applied in road