

Soil pH and Forage Production

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Many Texas soils have an acid soil pH; that is, the soil pH is less than 7.0. Soil acidity is caused by various environmental, climatic, and cultural factors. The most common of these factors are:

- 1) Parent material from which the soil is derived.
- 2) Leaching by rainfall or irrigation that removes basic elements such as calcium, magnesium, and sodium from the soil profile leaving acidic elements hydrogen, aluminum, and manganese.
- 3) Cultural practices such as nitrogen fertilization, removal of harvested crops and associated basic elements, and soil erosion, which results in a loss of basic elements.

Optimum nutrient uptake by most crops occurs at a soil pH between 6.0 and 7.0. The availability of fertilizer nutrients such as nitrogen (N), phosphorus (P), and potassium (K) generally is reduced as soil pH decreases, while micronutrient availability may actually increase to toxic levels. Phosphorus is particularly sensitive to pH and can become a limiting nutrient in strongly acid soils. Thus, reduced fertilizer use efficiency and crop performance occurs when soil acidity is not managed by the addition of limestone. Another important benefit of applying limestone to acid soils is to limit the solubility of the potentially toxic elements aluminum, hydrogen, and manganese. As soil pH drops below 5.5, the concentration of soluble aluminum increases and becomes toxic to plant roots when it exceeds 1.0 part per million (ppm). Below pH 5.2, the concentration of manganese also can become toxic to plants. Hydrogen ions only become toxic to plants in extremely acid soils (pH<4.0) and at very low calcium levels.

Soil pH also affects the types, concentrations, and activities of soil microorganisms. Soil microbes play critically important roles in the recycling of soil nutrients through mineralization of organic matter and N fixation associated with forage legumes. As soil pH decreases, the soil microbe population is adversely affected due to aluminum and manganese toxicity and lower nutrient availability.

Finally, some plants are more sensitive to acid soil conditions than others. For example, bahiagrass is less sensitive to soil pH values in lower 5s, but ryegrass or some legumes may be significantly impacted. It is important to understand which species are most sensitive to soil acidity so limestone inputs may be made at the appropriate time. Table 1 presents a list of common forage species in Texas and suggested soil pH ranges for optimum production.

Soil pH should be routinely monitored as part of annual soil testing to determine crop nutrient needs. The Texas A&M AgriLife Extension Service's Soil, Water, and Forage Testing Laboratory in College Station evaluates soil pH and provides a limestone recommendation, where appropriate, as part of a routine soil test (<http://soiltesting.tamu.edu>). Various commercial laboratories offer similar services.

For additional information on managing soil acidity, including comparing limestone products and determining appropriate application rates, see SCS-2001-05, *Managing Soil Acidity* or SCS-2001-06, *Soil Acidity and Liming*.

Warm-Season Perennial Grasses	Target Soil pH
Bermudagrass	5.5 - 8.0
Bahiagrass	5.5 - 6.5
Dallisgrass	5.5 - 7.5
Johnsongrass	5.5 - 7.5
Kleingrass	5.5 - 7.5
Native Species	6.0 - 8.0
Old World Bluestems	6.0 - 8.0
Wilman Lovegrass	5.5 - 7.5
Weeping Lovegrass	5.0 - 8.0

Warm-Season Annual Grasses	
Corn	6.0 - 7.5
Crabgrass	5.5 - 7.0
Milletts (Pearl millet, browntop, foxtail)	5.5 - 7.0
Forage sorghum, sorghum-sudan hybrids	6.0 - 7.5

Cool-Season Perennial Grasses	
N/A in Texas	

Cool-Season Annual Grasses	
Barley	6.0 - 7.0
Oat	5.5 - 7.0
Rye	5.0 - 7.0
Ryegrass (annual)	6.0 - 7.0
Triticale	5.5 - 7.0
Wheat	6.0 - 7.0

Warm-season Legumes	
Cowpea	5.5 - 8.0
Lablab	6.0 - 7.0
Lespedeza (annual)	5.5 - 6.5
Rhizoma (perennial) Peanut	6.0 - 7.0
Soybean	6.0 - 7.0

Cool-season Legumes	
Alfalfa	6.5 - 7.5
Arrowleaf Clover	6.0 - 7.0
Austrian Winter Pea	6.0 - 7.5
Ball Clover	6.5 - 8.5
Berseem Clover	6.5 - 7.0
Bur Medic	6.5 - 7.5
Crimson Clover	6.0 - 7.0
Persian Clover	6.0 - 8.0
Red Clover	6.5 - 8.0
Rose Clover	5.5 - 7.5
Sweetclover	6.5 - 8.0
Hairy Vetch	5.5 - 7.0
White Clover	5.5 - 7.5

Produced by:
The Department of Soil and Crop Sciences

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