

Soil pH; What Is the Big Deal

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With the rising cost of commercial fertilizers almost everyone I know is in the habit of pulling soil samples for nutritional analysis before any nutritional amendments are added. Often missed in all of this is the importance of soil pH. Soil pH is one of the most important forces that affect the overall soil fertility and nutrient management of our pasture forages.

Soil pH measures the relative amount of acidity or alkalinity in the soil. The pH scale ranges from 0 to 14 (figure 1). 0 is extremely acidic and 14 is extremely alkaline. A pH of 7.0 indicates that the amount of acid and alkalinity is equal, and it is therefore referred to as neutral. Each number on a pH scale represents ten times the value of the previous number, for example, looking at the scale below, orange juice is ten times more acidic than boric acid.

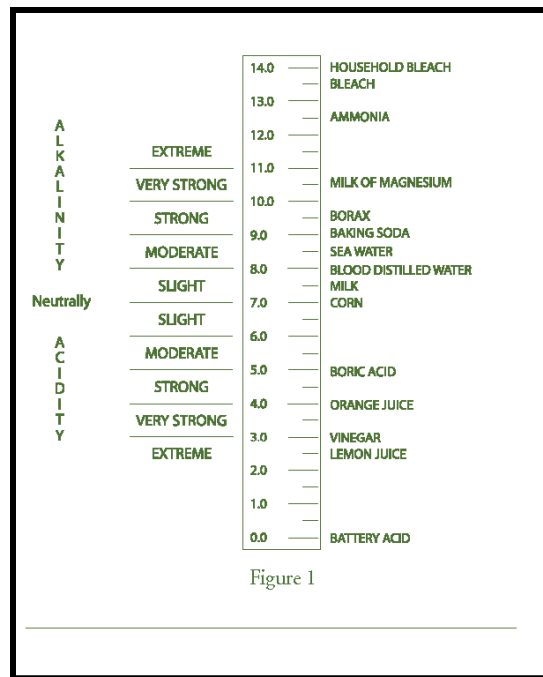


Figure 1

Figure 1. pH Scale

Normally soil pH ranges from 5.0 to 8.5, but in extreme situations soil pH will be as high as 9.5 and can be as low as 3.0. It is very important to note that soil pH values lower than 5.0 or higher than 8.5 can be detrimental for most all plants. These extreme growing conditions are best explained by understanding that the availability or lack thereof of most plant nutrients can be directly influence by the soil pH (Figure 2). For example, at soil pH values lower than 5.0, aluminum and manganese become overly available to the plant to the point where they can become toxic. Conversely, when soil pH values are higher than 7.5, manganese, iron, zinc and copper become insoluble and are therefore not available to the plant, possibly resulting in micronutrient deficiencies. The availability of

our major nutrients, nitrogen, potassium and phosphorous is considered optimum at a pH between 6.5 and 7.5. At pH below 6.0 phosphorous can bond with aluminum and iron and at pH above 7.5 it can bond with calcium; both situations can lead to phosphorous being unavailable to the plant. It should be noted that most plants grow best in slightly acidic soils, where pH ranges from 5.8 to 7.0; and many of our forage crops prefer soils that are even slightly more acidic than that, with soil pH for most Bahia grass considered optimum at 5.5.

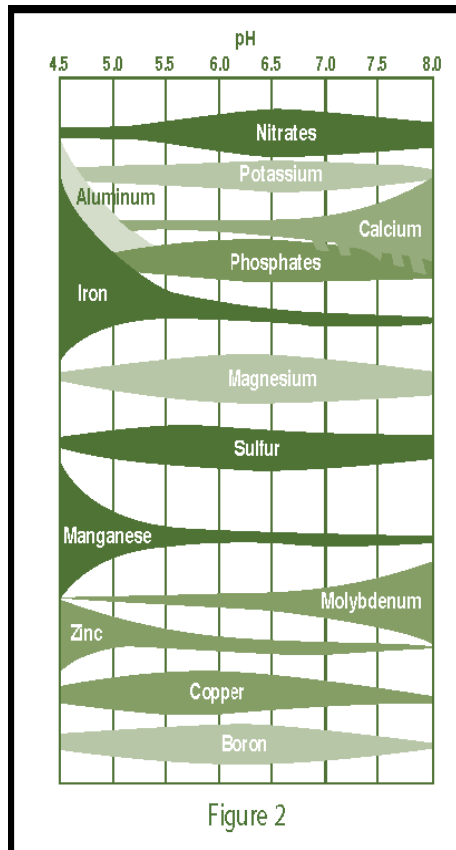


Figure 2. Nutrient availability as affected by soil pH

Most of our soils in the southeast are on the acidic side of the pH scale (below 7.0). Soil acidity is generally influenced by several factors including rain, soil parent material, microbial activity and management such as the use of commercial nitrogen fertilizers or organic residues. The effect of fertilization, particularly nitrogen, on soil pH can be effectively managed by the grower. Nitrogen fertilizers containing ammonium create acidity during the nitrification process. On the average 1.8 pounds of limestone is needed to neutralize the acidity from one pound of ammonium nitrogen. Because of all of these factors, soils that are routinely fertilized can become overly acidic (pH below 5.0); fortunately it is possible to manipulate low soil pH with lime (consult with your local extension agent to develop an effective liming program).

Less common, in the southeast are dealing with soil pH's that are considered extremely high. Although we do have some calcareous soils that are naturally high in pH, for the most part if your soil is above 7.0 you should be finding out why. In spite of the fact that most of us pull soil samples and regularly check our soil pH, it is still not uncommon to over lime our soils. Many of us apply lime every year because "Dad always applied lime", or because we have always had to apply lime so I applied lime this year before I even pulled my soil samples. Additionally excessive application of lime-stabilized biosolids to pasture forage crops can increase soil pH above the desirable level. Any of these situations can create high soil pH and lead to severe micronutrient deficiencies, resulting in general yellowing of your forage crop, poor growth and severe weed infestation.

Most of us are less familiar with having to lower soil pH than having to raise it; fortunately in most cases soil pH can be lowered simply by using fertilizers that contain ammonium nitrogen. However, not all ammonium nitrogen fertilizers have the same acidifying affect; in high pH situations it is best to use ammonium sulfate or sulfur coated urea as your nitrogen source, to more rapidly lower the soil pH (Table 1).

Table 1. Acidifying effect of some common fertilizers and soil amendments.

<u>Material</u>	Pure CaCO₃ needed to neutralize acidity in 100 pounds of material ----- pounds -----
ammonium nitrate	60
ammonium sulfate	110
32% liquid nitrogen	55
Urea	81
sulfur-coated urea	118
diammonium phosphate	70
flowers of sulfur (elemental S)	312
aluminum sulfate	45

If you have a high soil pH situation, you might do well to remember that some forage species do perform better than others in a high pH. In rare cases with extremely high soil pH and in pre-plant situations it may be desirable to lower the pH by applying an acidifying agent such as elemental sulfur or aluminum sulfate to the field before you plant. Although it would require six times as much aluminum sulfate, it is the safest of

these choices, as it much more difficult to over-apply. Aluminum sulfate is converted to sulfuric acid as a chemical process, while elemental sulfur is converted to sulfuric acid by naturally occurring soil bacteria; therefore in order for elemental sulfur to work the following conditions must be satisfied:

- The sulfur must be mixed with the soil to provide contact.
- The soil must be moist.
- The soil must be aerated.
- The soil must be warm for rapid bacterial growth.
- Time is required for the reaction to go to completion.

Before applying any material to acidify your soil make sure the soil pH is too high and try to determine why. In most cases using an acid forming source of nitrogen (ammonium sulfate or sulfur coated urea), will gradually correct the problem. If not, consider applying aluminum sulfate as your first choice, as you will be much less likely to over-apply this material. For extreme cases you can use elemental sulfur to lower your soil pH in pre-plant situations. Before applying any acidifying agent to lower your soil pH, you should take the time to discuss available options with your local county extension agent, extension specialist or certified crop advisor.

Sources: "Soil Acidity & Liming Part 2"; Charles C. Mitchell, Extension Agronomist – Soil Fertility, Clemson University & James F. Adams, Assistant Professor, <http://hubcap.clemson.edu/~blpprt/lowerpH.html>