Agriculture and Landscape Program
Soil and Plant Nutrient Testing Laboratory

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Adjusting Soil pH

What is soil pH? Soil pH is a measure of active acidity based on the concentration of hydrogen ions (H^+) in soil solution. It is an indicator of the soil's current condition, and is a primary factor controlling nutrient availability, microbial processes, and plant growth. A pH of 7.0 is neutral, less than 7.0 is acidic, and greater than 7.0 is alkaline. As acidity increases, soil pH decreases. Maintaining proper soil pH is one of the most important aspects of soil fertility management.

Due to the climate and geology of New England, soils here tend to be naturally acidic (4.5 to 5.5). When the soil is acidic, there are usually low amounts of calcium and magnesium in the soil, and the availability of macronutrients such as nitrogen, phosphorus, and potassium is reduced. Most micronutrients are more soluble and therefore become more available to plants in acidic soil. Under very acidic conditions aluminum, iron and manganese may be so soluble they can reach toxic levels.

Soil acidity also influences soil microbes. For example, when soil pH is low (below 6.0), bacterial activity is significantly reduced. Acidic soil conditions also reduce the effectiveness of some herbicides. When soil pH is maintained at the proper level, plant nutrient availability is optimized, solubility of toxic elements is minimized, and beneficial soil organisms are most active.

While many plants grow best in soil with a pH between 6 and 7, there are some notable acid-loving exceptions, including blueberry and rhododendron, which perform best under soil conditions with a lower soil pH.

The most effective way to manage soil acidity is to apply agricultural limestone. The quantity of lime required is determined by the target pH (based on what you are growing) and the soil's buffering capacity. Buffering capacity refers to a soil's tendency to resist change in pH. When limestone is added to a soil, active acidity is neutralized by chemical reactions that remove hydrogen ions from the soil solution.

As active acidity is neutralized by limestone, hydrogen and aluminum ions held on soil particle surfaces are released, lowering pH further and requiring more limestone to neutralize that acidity. This is called exchangeable acidity.

Soils such as clays or those high in organic matter have a higher cation exchange capacity (CEC). These soils have an increased ability to retain and supply nutrients, as wells as a potential for large amounts of exchangeable acidity. Soils with higher CECs are said to be well buffered and are more resistant to pH change.

To effectively raise the soil pH, both active and exchangeable acidity must be neutralized. The lab determines buffering capacity and lime requirement by estimating the exchangeable acidity. Exchangeable acidity is directly related to the quantity of lime required to increase the pH from its current level to the target level determined by the desired crop.

Occasionally soil pH must be lowered, because either the plant requires acidic soil, or relatively high levels of base cations such as calcium and magnesium are present. Incorporating elemental sulfur (S) is the most effective way to lower soil pH. Once applied, the sulfur oxidizes to sulfuric acid, thus lowering the pH.

To determine the appropriate amount of sulfur needed to lower pH, some information is needed. First, you must know the texture of your soil. To get a rough estimation of soil texture, place about two teaspoons of soil in the palm of your hand and moisten. A sandy soil feels gritty when moistened and does not remain in a ball when squeezed; loamy soils can be formed into a short ribbon, up to 2 inches long before it breaks; clay soils can be formed into a ribbon greater than 2 inches long.

Next, you need to know your current pH and target pH (from your soil test results). Use the table on the next page to determine how much sulfur is needed to reach your target pH. If you need assistance, please do not hesitate to contact the lab.

LOWERING SOIL PH USING ELEMENTAL SULFUR

- Table lists lbs. of **Elemental Sulfur** required per **1,000 square feet**.
- **Apply no more than 15 lbs. Sulfur per 1,000 square feet at any one time.**
- The chemical reaction needed to lower soil pH takes time. **Re-test in 4-6 months before applying additional sulfur**.
- If using **Aluminum Sulfate**, apply **six times the amount of Elemental Sulfur** recommended here.
- **Take care not to over-apply Sulfur! Soil that is too acidic will not support plant growth.**

	Desired Soil pH																				
Initial Soil pH	**4.0**			**4.5**			**5.0**			**5.5**			**6.0**			**6.5**			**7.0**		
	Sand	**Loam**	**Clay**	**Sand**	**Loam**	**Clay**	**Sand**	**Loam**	**Clay**	**Sand**	**Loam**	**Clay**	**Sand**	**Loam**	**Clay**	**Sand**	**Loam**	**Clay**	**Sand**	**Loam**	**Clay**
4.0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.5	4	10	16	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.0	8	20	32	4	10	16	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
5.5	12	29	47	8	20	32	4	10	16	0	0	0	-	-	-	-	-	-	-	-	-
6.0	15	38	61	12	29	47	8	20	32	4	10	16	0	0	0	-	-	-	-	-	-
6.5	19	48	77	15	38	61	12	29	47	8	20	32	4	10	16	0	0	0	-	-	-
7.0	23	57	92	19	48	77	15	38	61	12	29	47	8	20	32	4	10	16	0	0	0
7.5	27	67	107	23	57	92	19	48	77	15	38	61	12	29	47	8	20	32	4	10	16
8.0	30	76	123	27	67	107	23	57	92	19	48	77	15	38	61	12	29	47	8	20	32

Prepared by Tracy Allen, Laboratory Supervisor, UMass Soil and Plant Nutrient Testing Laboratory. This fact sheet contains information previously published on UMass Soil and Plant Tissue Testing Laboratory fact sheet SPTTL_2. January 2015, Ref. No. SPTTL_3