Stephen H. Brown, Horticulture Agent
Danielle Ammeson, Intern Florida Gulf Coat Univ.
Lee County Extension, Fort Myers, Florida
(239) 533-7513 brownsh@ufl.edu
Brown's Web Page

pH and Available P, K, and Mg in Landscape Soils of Lee County, Florida

Soils in many residential and commercial areas of Lee County, Florida, often contain crushed calcareous bedrock material placed on top of native soils. This is done to elevate the land thereby reducing the chance of flooding to houses and commercial buildings. These materials are commonly called "fill" which are inheritably poor in most essential plant nutrients but are excessively high in calcium (Ca), also an essential plant nutrient.

Lee County landscapers sometimes send soil samples to the Soil Testing Laboratory at the University of Florida, Gainesville, for soil plant nutrient analyses. In 2012, the results of 130 analyses, completed in 2011 and part of 2012, were surveyed to determine soil pH, and the plant availability of Phosphorus (P), Potassium (K), and Magnesium (Mg). All three are important and essential nutrients for the growth of all plants.

The Importance of Soil pH

Soil pH is a measure of the alkalinity or acidity of the soil solution, which can be altered in certain conditions. pH is measured numerically from 1 to 14. Less than 7.0 soils are acidic. Greater than 7.0 soils are alkaline. A soil with a pH of 7.0 is neutral or equal in acidity and alkalinity. Soil pH in itself is not a nutrient but pH does govern the ability of the plant roots to absorb plant nutrients. Particular nutrients that a plant needs may be in the soil in abundance but if the pH is either too low (acidic) or too high (alkaline) the nutrients remain in the soil unabsorbed by the plant roots.

The pH value of the bedrock calcareous material ranges between 7.5 to 8.5. Excessive calcium may bind essential nutrients in the soil causing those nutrients to be unavailable for plant uptake.

pH Results

Results of the 130 analyses indicated that only 1.5% of the soils had a pH less than 5.0 (Table 1.). Fourteen percent of the soils were moderately to strongly alkaline having a pH of 8.0 or greater. Twenty-one and one-half percent of the soils were neutral. The descriptive terms in Table 1 are those used by the USDA Natural Resources Conservation Agency (NRCS), formerly the Soil Conservation Service, to describe soil pH's. A pH range of 6.0-6.9 is usually considered most desirable for the uptake of most plant nutrients.

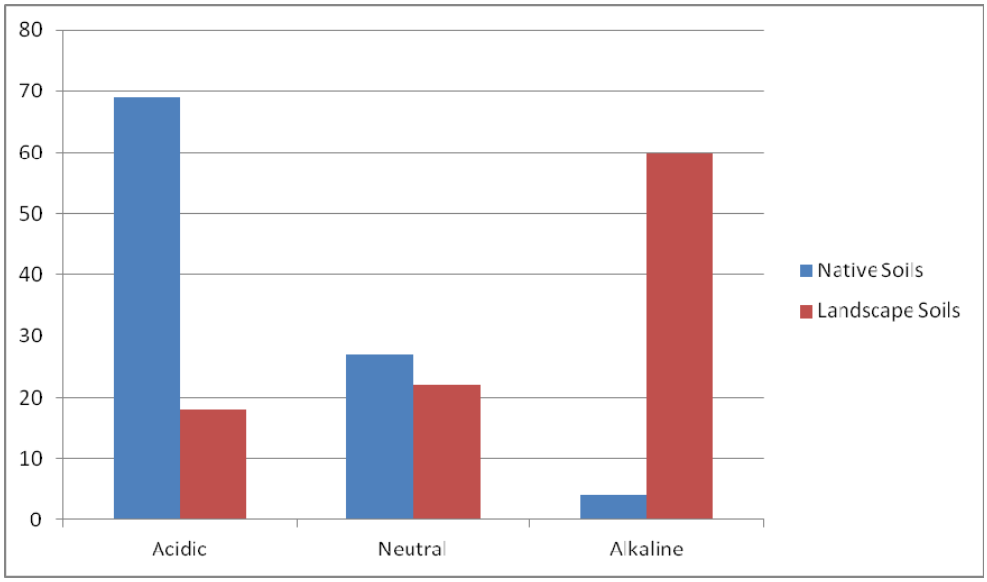
Table 1. Numbers and percentage of landscape soils in various pH ranges

pH Range	Descriptive Terms	Nos. of Samples	Percent of Samples
4.4-4.7	Very strongly Acid	2	1.5
5.0-5.9	Strongly Acid	5	4.0
6.0-6.5	Moderately Acid	17	13.0
6.6-7.3	Neutral	28	21.5
7.4-7.9	Slightly Alkaline	60	46.0
8.0-8.4	Moderately Alkaline	15	11.0
8.5	Strongly Alkaline	4	3.0

pH Comparisons of Native and Landscape Soils

Native soils in Lee County are usually composed of deep sand. In 1981, NRCS published a survey of soils in Lee County. The survey was mostly of undistributed native soils but included some altered soils. The results indicated that 69% of the soils had a pH that was acidic, 27% were neutral (6.6-7.3) and 4% of the soils had a pH that was alkaline. In this most recent survey that included only landscape soils, 18.5%, 21.5%, and 60% were acidic, neutral, or alkaline, respectively (Figure 1). This finding indicates that the majority of landscape plants are grown in alkaline and not acidic soils, the latter being the primary pH's of native soils in the county.

Figure 1. pH comparisons of native and landscape soils



Ranges of P, K, and Mg Availability

Table 2 indicates the plant availability of P, K, and Mg in a typical Florida soil as measured by ppm. The table should only be used as a guide since many factors affect the availability of plant nutrients. One of these many components includes the plant species. Some plant species may be quite tolerant of a low concentration of a particular soil nutrient while another species might require a larger amount of the same nutrient to prevent nutrient deficiency. A soil test of medium or lower indicates the need for application of the element by fertilizers, while high or very high typically indicate no fertilizer is needed.

Table 2. Current Mehlich-1 soil-test interpretations used for agronomic crops

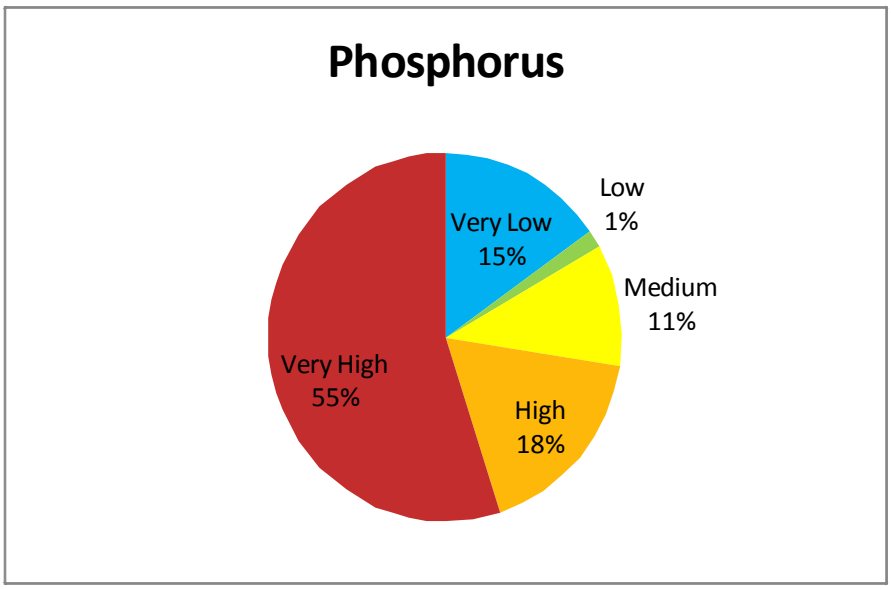
Element	Very low	Low	Medium	High	Very high
---------- parts per million soil ----------					
P	<10	10-15	16-30	31-60	>60
K	<20	20-35	36-60	61-125	>125
Mg	—	<15	15-30	>30	—

Source: SL129, UF/IFAS

Phosphorus Results and Availability

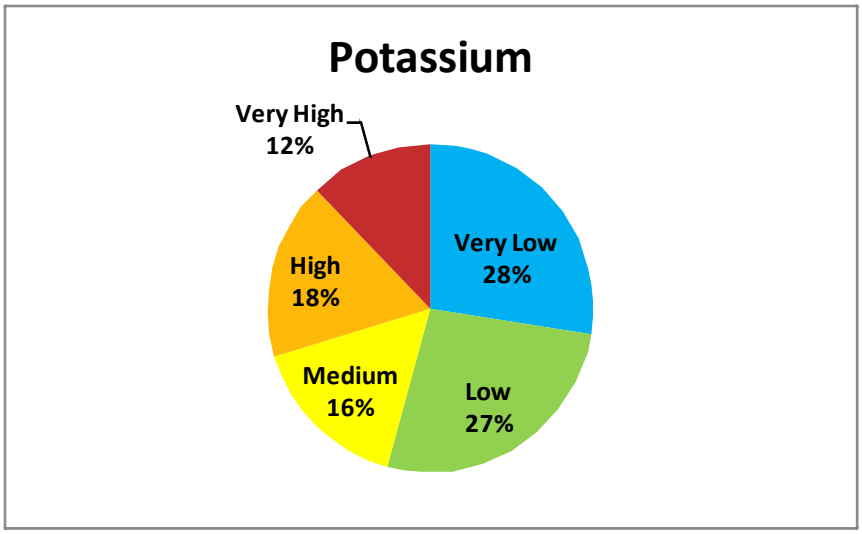
Sixteen percent of the sampled soils were determined to be very low to low in phosphorus. This finding does not mean that 16% of landscape plants showed symptoms of P deficiency. The analyses indicated that the vast majority of landscape soils in the county have high to very high P. However, P is generally not available for plant absorption because of interference from the high calcium content. In calcareous soils, P reacts with calcium to form calcium phosphates, which are either slightly soluble or insoluble in soil solutions. This low solubility makes most of the P unavailable for immediate plant uptake. The stored P is slowly released with time to become plant available. In the meantime, some plants may suffer from P deficiencies. Lowering the pH is generally not an option to induce higher P availability for most soils. Instead, other strategies must be employed to supply P to plants including the use of slow-release fertilizer P, in-season fertilizer applications, and the addition of organic matter to the soil.

Figure 2. Phosphorus plant availability of 130 landscape soils



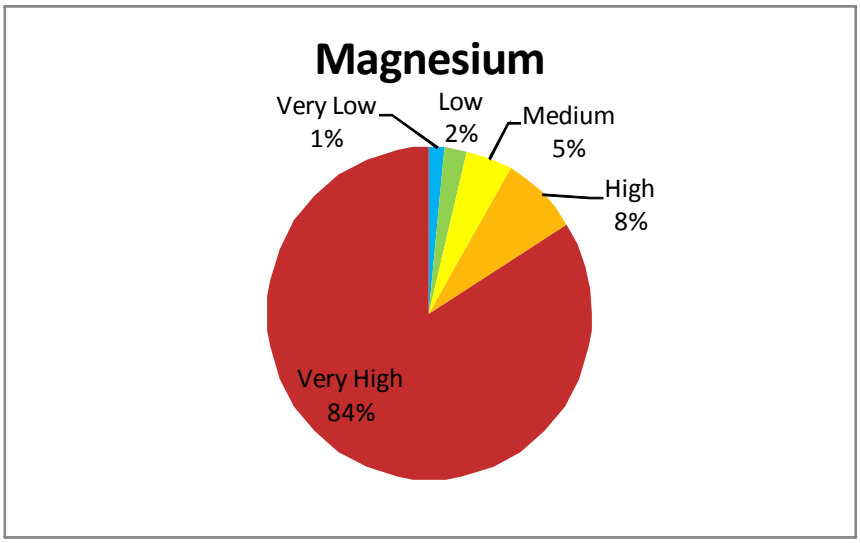
Potassium Results and Availability
A slight majority of landscape soils in Lee County have low to very low (55%) plant available K (Figure 2). However, 45% of soils sampled had medium to very high concentrations of K. Potassium is usually less available in acidic soils. Symptoms of K deficiency are not common in dicot plants (most trees and shrubs) in South Florida. These symptoms are sometimes seen in monocot palms.

Figure 2. Potassium plant availability of 130 landscape soils



Magnesium Results and Availability
Magnesium is particularly limiting to landscape plants throughout the state. Yet of the three nutrients analyzed, Mg appeared to be the most available for plant uptake. As many as 92% of soils analyzed had high to very high plant Mg availability. However, the high Ca concentrations in calcareous soils suppress Mg uptake and its translocation from the roots to upper plant parts. Magnesium can be applied to the soil as dry fertilizer or as a foliar application. Foliar applications of magnesium nitrate and magnesium sulfate have been shown to be efficacious.

Figure 3. Magnesium plant availability of 130 landscape soils



Conclusions
Due to the extensive use of "fill" as a construction base, the vast majority of landscape plants are grown in soils that cannot be considered native soils. These calcareous soils affect the availability of plant nutrients including P, K, Mg, and Fe. Native plants are no longer in native soils and management of all plant species has to be considered with respect to soil compaction, fertilizer choice, and the right plant in the right place.

Acknowledgements
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References
Hopkins, B. and Ellsworth, J. 2005. Phosphorus Availability with Alkaline Calcareous Soils. University of Idaho, Idaho Falls and Twin Falls

Li, Yuncong. 2009. Calcareous Soils in Miami-Dade County. UF/IFAS Tropical Research and Education Center, Homestead, FL

Mylavarapu, R., Wright, D. and Chambliss, G. 2009. UF/IFAS Standardized Fertilization Recommendations for Agronomic Crops. SL129. UF/IFAS University of Florida, Gainesville, FL

Soil Survey of Lee County, Florida. 1981. USDA Soil Conservation Service, Washington D.C.

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Nutrition and Fertilization of Palms

This fact sheet was reviewed by Dr. E.A. Hanlon, professor, Soil and Water Science Dept., University of Florida; Dr. Kelly Morgan, associate professor, Soil and Water Science Dept., University of Florida Southwest Florida REC, Immokalee; Peggy Cruz, Lee County Extension; Pat Rooney, Lee County Master Gardener.

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