Maryland Licensed Tree Expert Exam Study Guide

For Exam Domain:

Nutrition, Fertilization, Soil, and Water

Version 5.1

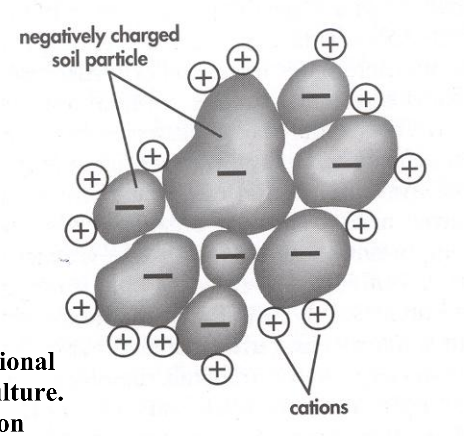
Soil is very important to plant health and success. It provides plants with nutrients, root anchorage, and water.

Though soil appears solid when you look at it with the casual eye, the ideal soil is made up of solids and voids. An ideal soil is 50 percent solids and 50 percent pore space, which contains water and air. The solid portion is mostly mineral soil with a percentage of organic matter. The voids are pore spaces or gaps between the particles of soil. The pore spaces allow for air and water exchange and uptake by plant roots.

The term soil texture refers to the size of the particles in the soil. There are three main types of particles: sand, silt, and clay. Sand is the largest, clay the smallest, and silt is intermediate. Because sand particles are the largest, sandy soils drain very well but do not hold water well. Soils with high clay content do not drain well. They hold water and flood easily because they have fine particles and little pore space. Most soils have some combination of the three soil types. A loam soil combines the desirable attributes of each particle size, exhibits intermediate characteristics, and is ideal for growing a wide variety of plants.

When all pores (micropores and macropores) in the soil are filled with water, the soil is considered to be saturated. When excess water drains away and soil pores are primarily filled with air but water is held by the soil particles, the soil is considered to be at field capacity. This is a desirable state as plants have both air and water available. When both the water in the pore spaces and the water held by the soil particles are gone, drought conditions begin. Plants in drought conditions may wilt due to water loss and ultimately reach the permanent wilting point when the water is held so tightly by the soil particles that it is unavailable to the plants. This is "the point of no return" for plants – the point at which they will die if adequate water is not added to the soil.

The capacity of a soil to adsorb (gather) positively charged ions is called its cation exchange capacity (CEC). The CEC of a soil can be determined by a soil test. It is important because it indicates the ability of a soil to attract and hold elements and nutrients that plants need for growth, and is a measure of soil fertility.



The term “pH” refers to the acidity or alkalinity of a soil. The soil pH can also be determined by a soil test. The pH is important because various nutrients required by plants bind to the soil and become unavailable at certain pH ranges. This is why the ANSI (American National Standards Institute) standards state that soil pH shall be considered when selecting a fertilizer. The pH of the soil may limit the availability of a nutrient even if you apply a considerable amount of it. The pH range varies depending on the nutrient in question, and is one reason why certain plants flourish in a particular pH range.

Compaction, one of the biggest problems in urban soils, can be caused by pedestrian and vehicular traffic or grading and other construction activity. In preparing soils for structures, roads, and pavement, engineering specifications usually require that load-bearing soil be compacted to 90-97% compaction. While this compaction provides stability to buildings and other improvements, it is bad for trees. When compacted to meet load-bearing engineering specifications, soil is almost impenetrable to roots. The best way to address soil compaction is to prevent it. Compacted soils are difficult to remedy after the fact. Sometimes people try to remedy compaction by adding organic material to the soil, but in most cases this will not be of any particular benefit. Remember, a good soil is mostly mineral soil with a lot of pore space. Once the soil structure is destroyed by compaction, it is hard to get those pore spaces back.

Mycorrhizae are fungi that live in a symbiotic relationship with roots, and increase the roots’ ability to absorb water and essential elements. These occur naturally in forest soils but may be lacking in urban soils. Many urban soils are low in organic matter due to the fact that nutrient cycling is often interrupted because plant debris (leaves, etc.) is generally removed from the soil surface. In forests, leaf litter decomposition creates a zone of complex biological activity that is beneficial to trees. In urban areas, these processes are often simulated through the use of organic mulch.

The most beneficial times to irrigate plants are late at night or in the early morning. Evaporation is minimized and the foliage has a chance to dry during peak daylight hours, reducing the opportunity for the spread of fungal pests if watering is done in the early morning. Antitranspirants are sometimes used to reduce plant water loss through transpiration. They are best used over short periods of time, and a proper soil moisture regimen is preferable. Tensiometers are soil moisture sensors used to measure soil wetness or dryness. They can be useful in establishing and monitoring the soil regimen for plants being managed.

Fertilization shall not be undertaken without establishing an objective. Why are you fertilizing the plant? To induce growth? To make up for a nutrient deficiency in the soil? Knowing why you are fertilizing will drive other decisions in the process such as fertilizer type and rate. A nutrient is an element or compound required for plant growth, reproduction or development. Nutrients are categorized as macronutrients (needed in relatively large quantities by plants), secondary nutrients (needed in relatively moderate quantities by plants), and micronutrients (needed in relatively small quantities by plants). These nutrients are listed in Table 1.

Nutrient	Symbol	Type
Nitrogen	N	Macronutrient
Phosphorous	P	Macronutrient
Potassium	K	Macronutrient
Sulfur	S	Macronutrient
Calcium	Ca	Secondary nutrient
Magnesium	Mg	Secondary nutrient
Iron	Fe	Micronutrient
Manganese	Mn	Micronutrient
Zinc	Zn	Micronutrient
Copper	Cu	Micronutrient
Boron	B	Micronutrient

Table 1 - Nutrients

The nutrient to which plants most commonly respond is nitrogen. Nitrogen is what most fertilization prescriptions are based on. Soil and/or foliar nutrient analysis should be used to determine the need for fertilizer. In the absence of soil and/or foliar nutrient analysis, fertilizers with higher ratios of P_2O_5 (phosphorus) and K_20 (potassium) should be avoided. Nitrogen often comes in salt form. However, salts can dry out and damage plant tissues (this is where the phrase 'fertilizer burn' comes from). This is why ANSI standards say that fertilizers with a salt index of less than 50 should be preferred.

A fertilizer analysis is the composition, expressed as a percentage by weight, of nutrients in the fertilizer. A fertilizer that contains nitrogen, phosphorous, and potassium is called a complete fertilizer. The three numbers listed on the packaging of a complete fertilizer stand for the percentages of nitrogen, phosphorous, and potassium present. For example, a 100 pound bag of 10-10-10 fertilizer has 10% each of N, P, and K, and so contains 10 pounds of nitrogen, 10 pounds of phosphorous, and 10 pounds of potassium. A 140 pound bag of 10-10-10 fertilizer also has 10% each of N, P, and K, but has 14 pounds of nitrogen, 14 pounds of phosphorous, and 14 pounds of potassium.

Slow-release fertilizers should be applied at rates between 2 and 4 pounds of actual nitrogen per 1,000 square feet. However, slow-release fertilizers should be applied at rates that do not exceed 6 pounds of actual nitrogen per 1,000 square feet within 12 months. This is important if you plan to fertilize more than once per year. Quick-release fertilizers should be applied at rates 1 and 2 pounds of actual nitrogen per 1,000 square feet.

How do I calculate the amount of fertilizer needed? You need to know the following things:

- The size of the area to be fertilized. According to ANSI standards, the fertilization area is determined by the tree expert or arborist, based on site considerations.
- The amount of nutrient (normally based on the amount of nitrogen or N) you want to apply per 1,000 square feet of area to be fertilized. This will vary

depending on whether you are using slow-release nitrogen or quick-release nitrogen as noted above.

- The fertilizer analysis for the fertilizer you intend to use (i.e., 10-10-10, 46-0-0, etc.).

Example: If applying ammonium nitrate (16-20-0), how many pounds of fertilizer should be applied to a 5,000 square foot area to apply 2 pounds N per 1,000 square feet?

Solution:
Size of area to be fertilized = 5,000 square feet
Amount of N = 2 pounds per 1,000 square feet (again, this number will vary depending on whether slow-release or quick-release fertilizer is used and what the soil analysis recommends).
Fertilizer analysis: 16-20-0 (16% N, or 0.16 N)

Use the general formula –

$$\frac{\text{Fertilization area (ft}^2\text{)}}{1000} \quad \text{X} \quad \frac{\text{N application rate (lbs. N per 1000 ft}^2\text{)}}{\text{\% nitrogen in the fertilizer (decimal form)}} = \text{lbs. of fert.}$$

$$\frac{\text{5,000 sq. ft.}}{1000} \quad \text{X} \quad \frac{\text{2 (lbs of N per 1000 ft}^2\text{)}}{0.16} = \text{62.5 lbs. of fertilizer}$$

To check: 62.5 lbs of fertilizer x 0.16 (percentage of N) = 10 lbs of N.

The preferred method of fertilizer application where turf or ground covers exist is sub-surface liquid application. However, other methods may also be used. When applying a sub-surface liquid fertilizer injection, injection sites should be 12 inches to 36 inches apart, and 4 inches to 8 inches deep.