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Fertilizers for Trees and Shrubs

Trees and shrubs need an adequate supply of plant nutrients for good growth. When the right amounts of nutrients are present, plants are more healthy and vigorous and better able to withstand stresses such as drought, plant disease, and pest infestation. An appropriate schedule of fertilizer applications can increase leaf size, foliage quality (both the amount of leaves and the intensity of their color), and flower and fruit production (both in size and number).

Fertilizer will not "take care" of every landscape problem. No amount of added nutrients can make up for lack of water, poor soil drainage, or similar limiting factors. Excessive fertilizer applications, especially of nitrogen (N), may increase the incidence of some plant pests, pollute surface waters, and contaminate groundwater.

When soil nutrients are not present in adequate amounts, they must be supplied by adding fertilizers. Landscape sites are frequently stripped of topsoil or filled with poor-quality material. During maintenance, natural nutrient recycling processes are disrupted when we collect plant debris and grass clippings before the nutrients in them can be returned to the soil. Fertilizer application is a routine but very important part of the maintenance of every landscape site.

Which fertilizers to apply

The amount and type (analysis) of fertilizer needed depend on the soil, the amount of nutrients available in it, the age and type of plants, and the environment (rain, temperature, etc.).

Most soils in Hawaii are highly leached, leaving them low in potassium (K), magnesium (Mg), and other nutrients. Some soils in Hawaii "fix" phosphorus (P), converting it into forms that are not available to plants. Many of our soils have low *cation exchange capacity* (the ability to store and supply certain nutrient ions) and therefore do not retain large amounts of nitrogen or potassium.

Plant nutrition and the availability of fertilizers are also affected by the acidity or alkalinity of the soil (the soil pH). When the pH is above 7.0 (alkaline), the availability of many nutrients, especially the micronutrients iron (Fe) and manganese (Mn), is reduced. In many strongly acidic soils, with pH below 5.2, phosphorus is tied up and aluminum (Al) may be present at levels toxic to many plants.

The soil's salinity (expressed in soil analyses as electrical conductivity, EC) also affects availability of some plant nutrients. Excessive salinity can result from exposure to the ocean or brackish irrigation water.

Large, old plants require greater amounts of nutrients than small, young plants but have larger root systems that absorb nutrients from a much larger area. Fruiting plants require more fertilizer than flowering plants, and flowering plants require more than foliage plants. More fertilizer is required in areas receiving a lot of rainfall or irrigation.

Nitrogen is the nutrient used by plants in the greatest amount, and in general it produces the greatest response in growth. Much of the N that plants take up is in the nitrate (NO_3) form, which is very soluble and is readily leached below the root zone. Therefore, frequent, carefully calibrated N applications to turf and landscape plants are needed to ensure an adequate supply. Because leached nitrate can pollute groundwater supplies, care should be taken to apply no more than the amount of N fertilizer that the plants require for good growth.

Phosphorus, potassium, calcium, magnesium, iron and the other soil nutrients do not readily move through the soil, except in coarse soils or those with low cation exchange capacity. The best way to determine the need for these nutrients is a soil analysis.

How much fertilizer to apply

An all-purpose recommendation for most soils and moderate plant growth rates in Hawaii is 2–6 lb of N per 1000 square feet (ft^2) of tree crown or planting bed area

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per year. This fertilizer should applied in several small amounts over the year.

The crown area of trees is area within the *dripline* (edge of the leaf canopy). While the roots of trees often extend beyond the canopy in all directions, the area beneath the canopy is a convenient area to measure. There are more than enough active roots in this area to absorb fertilizer.

Soils with high levels of organic matter may require only 2 lb of N per year. Sandy, coarse, or rapidly drained soils that do not retain large amounts of nutrients may require 6–8 lb of N per year. Where a lot of rainfall or irrigation is received, especially on coarse soils, up to 6 lb of N per year may be needed.

Nitrogen is not used efficiently by plants that are in poor condition. Diseases, damaged roots, improper soil pH, waterlogged soil, drought, and improper planting technique can cause inefficient nutrient absorption resulting in nutrient deficiency symptoms. Applications at the upper end of the recommended range are wasted until the problem is solved.

Established trees (3–5 years after transplanting) growing in landscapes where turf and shrub beds are fertilized do not need additional fertilizer. Their root systems extend throughout the area and receive nutrients when the grass or groundcover is fertilized.

Too much N promotes excessive growth, increasing maintenance time and cost. Excessive fertilizer that cannot be used by the plants can leach into water supplies and pollute surface waters.

Trees in confined areas, such as parking lot islands, along streets and sidewalks, or in planters, have restricted root systems and limited clear-surface area. Nitrogen fertilization rates should be based on *open root area*, not crown spread. Rates of N based on crown area applied to the few square feet of surface available in these situations can result in accumulation of salts that damage the roots. In root-confined situations, N applications should be based on the low end of the range of recommended rates, and they should be divided into small applications made several times per year. Foliar sprays of fertilizer can work well for plants with restricted root areas.

Soil testing

Soil analysis provides information about the nutrient status of the soil, aids in detecting potential problems, and may save money. Test the soil before purchasing fertilizer. Obtain a composite sample by removing subsamples from 10–12 small holes dug throughout the sample area. Carefully pull back mulch, grass, or groundcovers to expose bare soil. Dig a 6-inch deep hole and remove a 1-inch thick by 6-inch deep slice of soil from the side of each hole. Combine and mix the subsamples in a clean plastic bucket.

Most home lots in Hawaii will usually need only one composite soil sample. Obtain separate samples from areas that have different soil types, drastic cuts, fill, receive different maintenance practices, or contain plants that have distinctly different nutrient requirements.

Soil samples should be sent to the laboratory immediately, either to the UH Agricultural Diagnostic Service Center, via your local Cooperative Extension Service office, or to a commercial laboratory. Contact the laboratory for handling instructions. Remember to plan ahead (several weeks) so that the analysis results will be available when you wish to apply fertilizer.

Types of fertilizer

Most fertilizers used by home and professional gardeners are dry (granular) formulations. These are spread onto lawns or around plants and either left on the surface or mixed into the soil by raking or digging. In the case of trees, granular fertilizers can also be placed in holes spaced at random under the crown area. The granules dissolve when contacted by water, releasing the nutrients. Most of the plant nutrients in dry formulations are quickly available and can remain available to the plant for up to several weeks, depending on the product and the watering conditions (the more water, the shorter the period of availability).

Water-soluble fertilizers. Liquid or water-soluble fertilizers are especially appropriate for container plants because there is little risk of "burning" a plant as long as label directions for mixing and applying are followed. The nutrients are available immediately. Liquids are not practical for large areas because they are more expensive per pound of the nutrient than dry formulations.

Foliar fertilizers. Some nutrients, particularly N and micronutrients such as Fe, Mn, and zinc (Zn), can be quickly absorbed through plant leaves. Many water-soluble fertilizers include instructions for foliar applications on their labels. Consider foliar feeding a quick fix, not a substitute for a good soil fertilizer program.

Complete fertilizers. Any fertilizer that contains all three of the primary nutrient elements—nitrogen (N), phosphorus (P), and potassium (K)—is a complete fertilizer. Fertilizer manufacturers must put their product's N, P, and K percentage (for example, 10-10-10) on the label in large numbers—this is the *guaranteed analysis.* A 10-10-10 fertilizer contains 10% total nitrogen, 10% phosphate (P_2O_5), and 10% potash (K_20). Many fertilizers are commonly referred to by their guaranteed analysis; for example, "ten thirty ten" or "triple fourteen."

The higher the numbers in the guaranteed analysis, the stronger or more concentrated the fertilizer. A 22-5-10 formulation contains twice as much nitrogen as does an 11-5-10 fertilizer. The higher the concentration, especially of nitrogen, the less of the product applied at one time.

Simple fertilizers. Simple fertilizers contain just one of the three major nutrients. The most common simple fertilizers are ammonium sulfate (21-0-0), urea (43-0-0), superphosphate (0-20-0), triple (or "treble-") superphosphate (0-46-0), and potassium chloride (KCl, also called muriate of potash) (0-0-60). Simple fertilizers are used when only one nutrient is needed.

Special-purpose fertilizers. Some packaged fertilizers are formulated for specific types of plants: "citrus fertilizer," "azalea fertilizer," and "rose fertilizer," for example. The azalea and citrus formulations are acidic, which helps make micronutrients more available to the plant.

Organic fertilizers. Organic sources of nutrients are derived from living or once-living organisms. Cottonseed meal, blood meal, bonemeal, hoof-and-horn meal, and manures are organic fertilizers. Organic fertilizers usually have very low percentages of nutrients and therefore are sometimes fortified with inorganic fertilizers to give them a better balance of nutrients or to increase the percentages of N, P, or K.

True organic fertilizers depend on soil organisms to assist the release of nutrients, which occurs over a fairly long period rather than becoming available to the plant all at once. This can be an advantage and a drawback, in that not enough nutrient may be released to provide for good plant growth.

Although manures and composts are complete organic "fertilizers," they are very low in N, P, and K (usually having an analysis of 1-1-1, or 2-1-2). The nutrient content of manure varies with the type of animal and its diet. Manures and composts work best as mulches or soil conditioners. Fresh manures have high salt content, which can burn plants.

Sticks, stakes, and tablets. Some fertilizers are compressed into hard cylinders or tablets, which are applied by pushing or hammering the sticks or stakes into the soil or dropping the tablets into holes. They dissolve slowly, releasing nutrients over a long period. These products are convenient but expensive for the amount of nutrients they supply.

Combination products. Fertilizers can be combined with insecticides (as is common for roses) or herbicides (for lawns). These fertilizers are only useful if the extra product is needed; use regular fertilizers to supply nutrients when the extra product is not needed. It is often more economical to purchase the pesticides and fertilizers separately and apply each when they are needed.

Controlled-release fertilizers. Controlled-release or slow-release fertilizers contain complete fertilizer in granules coated with wax, resin, sulfur, or another permeable material. When the granules are moistened in the landscape, the fertilizer gradually diffuses through the coating into the soil over a period of time that varies with the product. Controlled-release fertilizers are useful to reduce the number of applications made during the year. Used properly, these formulations are less likely to result in leaching of nitrates into streams and groundwater. However, they are often more expensive than quickly available fertilizers. Some controlled-release products are effective for up to 4–6 months in Hawaii. They can be applied to the surface for lawns or worked into the soil for gardens and flower beds. These products are especially useful for fertilizing container plants or turfgrasses that need frequent but low levels of nutrients.

How much fertilizer to apply?

The number of pounds of any fertilizer that must be applied to obtain the desired rate of N or other nutrient is easily calculated: divide the pounds of nutrient required by the percent of nutrient in the fertilizer analysis.

For example:

- You wish to apply 1 lb of N as urea to 1000 square feet (ft^2). Urea (45-0-0) is 45% (0.45) N. Therefore, 1 (pound of N desired) divided by 0.45 (% N in urea) equals 2.2 pounds of product: 1 / 0.45 = 2.2.
- To apply 1 lb of N using a complete fertilizer with an analysis of 20-5-10, apply 5 pounds of the fertilizer: 1 / 0.20 = 5.
- To apply 2 lb of P_2O_5 per 1000 ft^2 using superphosphate (0-20-0), apply 10 lb superphosphate: 2 / 0.20 = 10.

When and how often to apply fertilizer

The best time to apply N and other nutrients is just before a new flush of growth. For many plants in Hawaii, this is three times a year: in February, June, and October. However, the specific time for a growth flush depends on temperature and rainfall.

Fertilizer applications at planting

Based on soil analysis recommendations, bring shrub and turfgrass areas to recommended levels before planting. Nitrogen is usually incorporated during bed or soil preparation but should not exceed 2 lb N per 1000 ft^2.

For woody landscape plants, it is often thought that P and sometimes K should be mixed into the planting hole to stimulate root growth. This is only useful if the surrounding soil is deficient in them. Because P and K are not readily mobile in the soil, they should preferably be brought up to proper levels (as recommended after soil analysis) *before* planting by mixing them thoroughly into the soil to a depth of 6–8 inches over the entire anticipated root zone. Research has shown that if P and K are at adequate levels in the soil, it is not necessary to incorporate them in the planting hole of woody landscape plants, because this has no stimulating effect on top or root growth. Also, the use of high-phosphate, "vitamin-fortified" root "enhancers" or "stimulators" has not been shown by research to have any positive effect on landscape plant establishment or growth.

In summary, the following steps will help to ensure attractive, healthy, and long-lasting landscapes:

- have the soil analyzed and follow the resulting recommendations for amending it before planting
- provide for ongoing plant nutrient needs with appropriate and regular fertilizer applications
- provide adequate water with irrigation to supplement rainfall
- keep good management records
- regularly observe the plants' condition

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For a guide to soil sampling and analysis, see *Testing your soil: why and how to take a soil-test sample*. This and other recent CTAHR publications can be viewed on the CTAHR website at <www.ctahr.hawaii.edu/publications>