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Fertilizing Shade and Ornamental Trees

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Appearance, growth and disease resistance of shade and ornamental trees can be greatly improved through regular tree care, and fertilizing is necessary for rapid development of attractive and healthy landscape trees. Helpful in developing good leaf color and general tree vigor, fertilizers also help trees recover from insect attacks, disease or injuries.

Most homeowners are aware of the need for fertilizing gardens and lawns. Too frequently, though, they forget trees also benefit from fertilization. Like all plants, trees are dependent on sunlight, water, air and fertilizer nutrients for growth. Under natural conditions, as in a forest, the annual decomposition of leaves, needles and twigs provides a fresh source of fertilizer nutrients for plant use. However, when trees are growing in lawns, along driveways or walks or similar areas, they are usually denied this nutrient source.

The type of soil in which the tree is growing affects its fertilizer needs. Topsoil — the surface layer or layers of a normal or undisturbed soil — is more favorable for tree growth than the underlying subsoil. Subsoil material has lower organic matter content, lower fertility and less favorable soil structure than topsoil material. Low organic matter content and low fertility reduce the soil's capacity to store and supply nutrients needed for plant growth. Soil structure also affects tilth, root development, water-holding capacity, aeration and pore space.

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Soil structure and closely related soil texture are two important soil physical properties. Soil texture refers to the amount of various sized particles (sand, silt and clay) making up the soil. Soil structure refers to the physical arrangement of soil particles. Soil structure and soil texture influence the movement of water and air through the soil and the amount of water and nutrients held in the soil.

A clayey soil, one that is high in fine particles (clay), or a soil that has been compacted has very small pores that restrict water and air movement into and through the soil. A sandy soil, one that is high in coarse particles (sand), has large pores that have little capacity to store water and nutrients. Soil texture can only be changed on small areas by hauling and mixing in large amounts of sand, silt or clay. Where this is not feasible, a homeowner with too much sand or too much clay can "live with" these unfavorable soil textures by adding organic materials. These organic materials help improve soil structure thus reducing effects of poor texture. Organic materials must be mixed into the soil to be effective.

Subsoil materials are commonly found on the surface around houses, especially new houses. Topsoil is often removed during building or landscaping operations or covered by subsoil materials removed during excavation for a basement or foundation. The addition of fertilizer materials will benefit trees growing in subsoil materials by improving their growth and vigor.

Trees growing in good topsoil materials, however, will also benefit from fertilization. This is especially true where the soil is compacted or where normal root growth may be restricted by sidewalks, driveways or other structures.

Fertilizer Composition

Fertilizers are materials added to the soil to supply one or more of the 13 nutrients needed for plant growth. Many kinds of materials may be added to the soil to provide these nutrients. However, some are more effective than others.

Organic Fertilizers

Organic residues such as peat moss, sawdust and wood chips have little nutritive value and may in fact remove or tie up nutrients already in the soil. Manure, compost and green manure crops supply substantial amounts of nutrients if applied in large amounts. Organic material can also be beneficial in improving the soil's physical properties.

Inorganic Fertilizers

Most commercial fertilizers consist of inorganic compounds blended together to provide a given amount of one or more essential nutrients. The three most common ingredients include nitrogen (N), phosphorus (P) and potassium (K). All plants require large amounts of these three nutrients.

Manufactured fertilizers differ in amount of available nutrients contained (Fig. 1). State laws require that amounts and forms of nutrients present in fertilizer materials be printed on the container. Fertilizer analyses are commonly expressed with three numbers, e.g. 9-12-8.[1] The first number (9) in this example refers to the percentage of elemental nitrogen present. The second number (12) is the available phosphorus expressed as percentage P_2O_5. The third number (8) is the available potassium expressed as percentage K_2O.

Since many different analyses are available, the homeowner needs to understand that a pound of fertilizer labeled 12-12-5 contains twice as much nitrogen, one-fifth (20 percent) more phosphorus (P_2O_5) and one-fourth (25 percent) more potassium (K_2O) than a pound of 6-10-4. This difference means twice as many pounds of 6-10-4 are required to apply nitrogen at the rate of 6 pounds per 100 square feet of soil surface than 12-12-5 used to provide the same application level. This is why some fertilizers are more expensive than others.

Other Fertilizer Needs

While nitrogen, phosphorus and potassium are required in the largest amounts, several other nutrients are required by all green plants. These include calcium, magnesium, sulfur, chlorine, iron, manganese, copper, boron, zinc and molybdenum. Most Idaho soils contain adequate amounts of these materials, except for iron which is frequently deficient. One or more of these nutrients may also occasionally be deficient.

[1]Sometimes four numbers are used, with the fourth number giving the content of sulfur (S).

net wt 20 pounds

9-12-8

GUARANTEED ANALYSIS

Total Nitrogen (N) 9.0%
9.0% Ammoniacal Nitrogen

Available Phosphoric Acid (P_2O_5) 12.0%

Soluble Potash (K_2O) 8.0%

Iron (Fe) 1.0%

Potential acidity 875 lb. Calcium Carbonate equivalent per ton. Derived from ammonium sulfate, ammoniated phosphates, muriate of potash and ferrous sulfate.

Fig. 1. The amount and form of nutrient materials in a manufactured fertilizer are expressed on the package. Other information regarding the composition of the fertilizer is also included.

Note: Homeowners should avoid using lawn fertilizers that contain weed killers, often called "weed and feed" fertilizers. The herbicides in these fertilizers can severely injure or kill trees and shrubs if the formulation is not applied according to specific label directions.

Recognizing Fertilization Needs

A homeowner has no single indicator to tell him if his trees need fertilization. Some specific conditions or symptoms may indicate the need for certain fertilizers. However, similar symptoms can also be caused by disease, poor root system, inappropriately applied herbicides or other problems. These symptoms include leaves of smaller than usual size, presence of light green or off-color foliage, dead twigs on the ends of branches, very short elongation of branches during the growing season and general lack of thriftiness or vigor. If any of these symptoms are present, the tree may benefit from fertilization. Similarly, if the tree has been physically injured or has sustained severe defoliation by insects, disease, hail, etc., fertilization may be helpful during the recovery period.

Some nutrient deficiencies may be recognized by specific foliage discoloration. Prolonged nutrient deficiency will result in poor vigor, making the tree vulnerable to disease and insect attacks that in turn often cause the tree's death.

In southern Idaho, the most commonly occurring discoloration of leaves is the development of a yellow or light, yellow-green color. This discoloration occurs in the areas between the leaf veins, usually leaving the leaf veins and leaf tissue near the veins a darker green color (Fig. 2). This condition, called "chlorosis," is associated with a lack of available iron. The chlorosis may occur only on part of the tree (Fig. 3) such as a single branch or may affect the entire tree.

Fig. 3. Portion of tree showing chlorosis typical of iron deficiency.

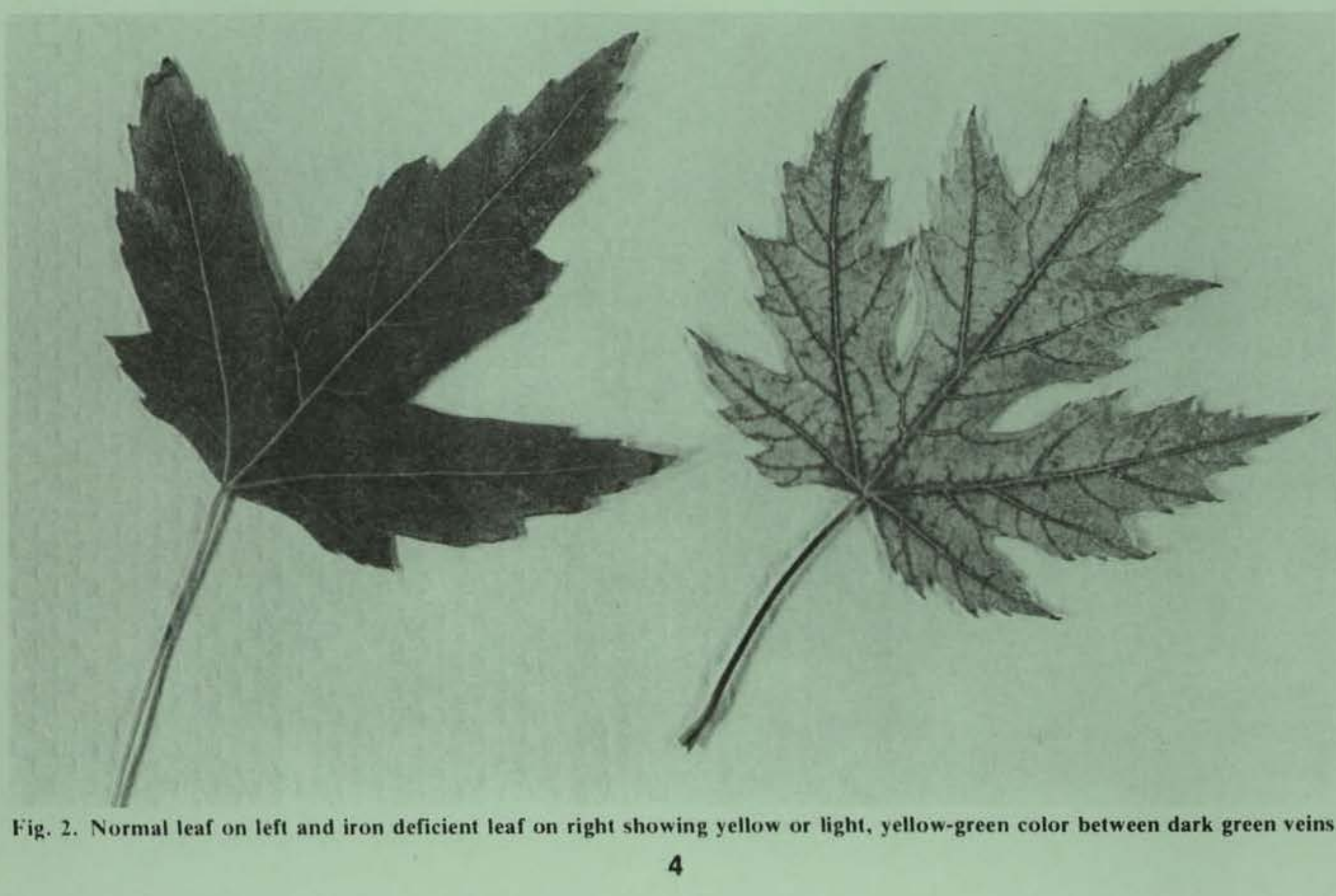

Fig. 2. Normal leaf on left and iron deficient leaf on right showing yellow or light, yellow-green color between dark green veins.

Lack of zinc and nitrogen can also cause light green coloring in leaves. Zinc deficiency results in chlorosis very similar to iron deficiency, but zinc deficiency is rare in Idaho. Nitrogen deficiency usually results in a uniform light green color throughout the leaf and does not result in darker color near the veins. Other essential nutrient deficiencies including phosphorus and potassium also exhibit symptoms; however, such symptoms are not as apparent as those of zinc and nitrogen.

Iron Chlorosis and Other Nutrition Problems

Iron chlorosis conditions in trees can be corrected by adding available iron or by increasing the acidity of the soil solution. Iron sulfate [$FeSO_4 \cdot 7H_2O$ or $Fe_2(SO_4)_3 \cdot 4H_2O$] or iron chelates (synthetic organic material containing iron) can be used to increase available soil iron. These compounds can provide an immediate supply of available iron. They may be applied to the foliage. However, soil applications are preferred for longer lasting benefits.

In calcareous or limey soils where iron chlorosis most frequently occurs, iron sulfate is not very effective. Under these conditions, soil applied or foliar applied chelates are recommended because they are not affected by soil conditions. When using iron chelates, be sure to follow the manufacturer's recommendations.

Increasing soil acidity by adding acidic materials such as powdered sulfur can also be effective. Sulfur should be effective in increasing soil acidity when applied at the rate of about 2 pounds per 100 square feet. Successive treatments with sulfur may be required to get a satisfactory acidity level.

Other nutrient deficiencies may be present in local situations, and soil tests and foliar analysis can help identify these conditions. For more information, contact your University of Idaho Extension county agent.

Timing Fertilizer Applications

For greatest value to the tree, fertilizer should be applied in the spring as soon as the soil is frost-free. This time varies in different portions of the state but should occur sometime in March or April. Fertilizer applied in early spring is available for the tree to use as soon as growth resumes. Since root growth will begin before leaf development, fertilizers should be applied as early as possible.

Fertilizer can be applied in the fall or after the growing season is over. Since root growth may continue in some areas until November or later, fertilizers will be available and beneficial to the tree. Keep evergreen trees watered after frost occurs if fertilizer is applied in the fall. Most fertilizer nutrients not used by the tree in the fall will be available when growth resumes in the spring. However, some nutrient loss, especially nitrogen, may occur because of leaching during the winter months.

In general, trees should not be fertilized in midsummer. In some instances, such as where injury or defoliation has occurred, some benefit can be obtained from a summer application. However, precautions regarding summer fertilization are in order. Use heavy applications of irrigation water after fertilization. Late summer application of fertilizer may result in flushes of new growth. Such tissue will not "harden-off" sufficiently before fall freezes and may result in winter injury. If summer fertilization is necessary, apply fertilizers in early summer or after the middle of September to avoid this danger. Two or three light applications of fertilizer during the growing season is superior to a single large application.

In general, young trees should not be fertilized at the time of planting unless the planting site is known to be extremely low in fertility. The root systems of transplanted trees are susceptible to damage by fertilization.

Fertilizer Application Methods

To be effective, fertilizer nutrients must reach a tree's sap stream. While most nutrient uptake occurs through absorption by the roots, some uptake may take place by absorption through the leaves from solutions sprayed on the foliage or from direct injection of fertilizer materials into the trunk of the tree.

Many different application methods have been developed for tree fertilization. Methods include:

- Application directly to the soil surface.
- Application (dry or liquid form) in holes in the soil.
- Foliar sprays.
- Injections (dry or liquid) into the trunk of the tree.

No one method may be considered superior to the others. All are effective and used by commercial arborists. Fertilizer compounds applied to the soil surface or in holes in the soil provide a longer-lasting effect than materials applied as foliar sprays.

The application methods suggested are based on a tree's requirements for nitrogen, phosphorus, potassium and other nutrients. The size of the tree and its environment (lawn area or cement or asphalt) are considered in determining the application method. A combination of methods may be best.

Fertilization frequency depends on the application method and the amount and form of material applied. For example, since nitrogen is a major factor in plant vegetative growth, nitrogen needs are three times greater than phosphorus or potassium. Because of differences in tree requirements, nitrogen fertilizers should be applied annually while phosphorus and potassium can be applied every 3 to 5 years. Potassium is the least important of the three major nutrients, as it is usually abundant in Idaho soils.

Nitrogen rate is the key factor in determining fertilizer amounts to apply because excess nitrogen can be detrimental to plant growth. There is little or no chance for detrimental effects on plants because of excess phosphorus and potassium.

Water will readily move nitrogen into the root zone from the surface, making it available for use by tree roots. In contrast, both potassium and phosphorus do not move readily in the soil and must be placed in the root zone.

When fertilizer is placed in the soil, make small holes with a punch bar or soil auger. Holes should be 12 to 18 inches deep and 1½ to 2 inches in diameter. Diameters larger than these are not recommended since the fertilizer will fall to the bottom of the hole rather than be distributed throughout its length. Make the hole at a slight angle slanted towards the trunk for best distribution.

Holes should be made in concentric circles around the tree trunk. The first circle should be no closer than 3 feet from the trunk with successive circles at 2-foot intervals. Distances between any two holes on each circle should be 2 feet (Fig. 4). The circular pattern of holes should extend for a few feet beyond the drip line or edge of the crown. The amount of fertilizer placed in each hole will depend on the total amount being applied to the tree and the number of holes. This amount is determined by dividing the number of holes into the total amount of fertilizer required for the rate being used.

To avoid uneven grass growth, do not place fertilizers on the surface or within 2 to 3 inches of the soil surface. After the prescribed amount of fertilizer is placed in each hole, the hole may be filled with peat, other organic materials or sand. These materials are preferable to the original soil for better water penetration to the fertilizer material.

Determining Fertilizer Quantities

Since nitrogen is the key factor in deciding the fertilizer rate, all applications begin by determining how much nitrogen is needed and what fertilizer material is to be used (Table 1). Nitrogen rates range from 0.25 to 0.4 pounds N per 100 square feet.

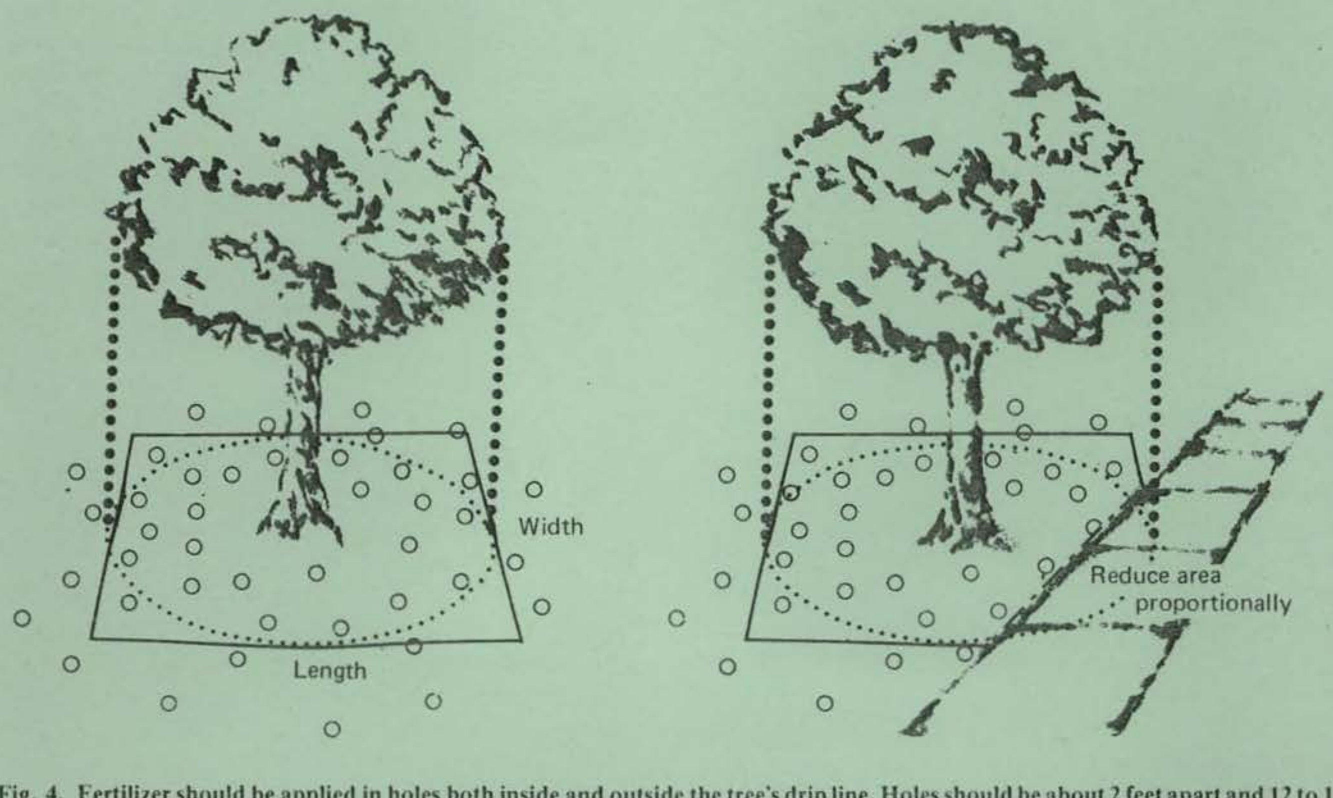

Fig. 4. Fertilizer should be applied in holes both inside and outside the tree's drip line. Holes should be about 2 feet apart and 12 to 18 inches deep. Where sidewalks, driveways or other structures are present, reduce fertilizer application in proportion to the reduced soil area.

Here are examples of fertilizer application rates in several different situations:

- **Small deciduous tree (less than 25 feet high)**

a. Apply nitrogen (such as 21-0-0) annually at the rate of 0.4 pounds per square feet of soil surface beneath the tree.

b. At 3- to 5-year intervals, apply a nitrogen and phosphorus fertilizer such as 15-10-0 or a complete fertilizer such as 6-10-4 or 12-12-5 in holes at a rate equal to 0.4 pounds of nitrogen per 100 square feet of soil surface beneath the tree.

- **Flowering ornamental and other small fruit trees**

Excess applications of nitrogen may tend to reduce flowering and fruiting. If fertilization is necessary, apply N and P fertilizer such as 15-10-0 or a complete fertilizer such as 6-10-4 or 12-12-5 in soil holes in the spring at the rate of 0.25 pounds of N per 100 square feet.

- **Small evergreens and shrubs (less than 15 feet)**

Use complete fertilizer at a rate of 0.25 pounds of actual nitrogen per 100 square feet at 2- to 4-year intervals.

- **Large trees (deciduous and evergreen)**

At 3- to 5-year intervals, apply a nitrogen and phosphorus fertilizer such as 15-10-0 or a complete fertilizer such as 6-10-4 or 12-12-5 in holes at a rate equal to 0.4 pounds of N per 100 square feet of soil surface beneath the tree's crown.

Recommended rates of fertilizer are based on the ground area under the tree canopy (Fig. 4). This approach is used rather than the traditional approach of relating fertilizer needs to trunk diameter.

Table 1. Quantity of common fertilizers needed to provide equivalent amounts of nitrogen. Application rates expressed in pounds of fertilizer material per 100 square feet of ground area.

Fertilizer analysis[1]	0.4 lb N per 100 sq. ft.	0.25 lb N per 100 sq. ft.
2-3-2	20	12.5
4-10-4	10	6.2
6-10-4	6.8	4.2
8-10-8	4.8	3.0
10-10-5	4.0	2.5
12-12-5	3.2	2.0
14-10-0	2.4	1.5
16-20-0	2.2	1.4
20-16-0	2.0	1.3
21-0-0	2.0	1.3
33-0-0	1.2	0.8
45-0-0	0.8	0.5

[1]The fertilizer analysis is shown on all containers. The first number gives percent total nitrogen (N); the second, percent available P_2O_5; the third, percent water-soluble K_2O. A 2-3-2 analysis contains 2 lb N, 3 lb P_2O_5 and 2 lb K_2O per 100 lb of fertilizer. A 16-20-0 analysis contains 16 lb N, 20 lb P_2O_5 and no K_2O per 100 lb of fertilizer. A 45-0-0 analysis contains 45 lb of N and no phosphorus or potassium per 100 lb of fertilizer. Ammonium sulfate (21-0-0) contains 24 percent sulfur and 16-20-0 contains 15 percent sulfur. Other mixes may contain zinc and other micronutrients. Check the label. All nutrients in the fertilizer will be listed.

Trunk diameter has not been shown to be a good indicator of fertilizer needs.

To make computation easier, the circular area beneath the tree's crown may be considered to be a square or a rectangle (Fig. 4). The sides of this rectangle are the length and width of the tree's crown, remembering where possible to extend the distances a few feet beyond the tree's drip line.

If the area beneath the tree's crown is obstructed by a sidewalk, driveway or other structures that will prevent fertilizer distribution, the total amount of fertilizer applied to the tree should be proportionally reduced (Fig. 4). Do not apply excessive amounts of fertilizer to only one side of the tree. More frequent fertilizer applications may be necessary in this situation. Where extreme obstruction of soil surface area exists or where rooting is limited, such as when trees have been planted in containers, special practices are required. Fertilizer nutrients should be applied in very small amounts and very frequently or applied as foliar sprays.

For a fertilizer with an analysis not listed in Table 1, select the closest analysis and apply that rate. To convert rates to larger areas, first divide square feet of ground area to be fertilized by 100 square feet. Then multiply times the rate given for 100 square feet (Table 1).

Sample calculations:

1. Given: Area = 20 ft × 20 ft; fertilizer analysis = 10-10-5; N application rate = 0.4 pounds N per 100 sq ft

   Desired: Fertilizer application rate (Table 1), 4 pounds of 10-10-5 fertilizer material per 100 sq ft of ground area.

   Calculations: $20 \text{ ft} \times 20 \text{ ft} = \dfrac{400 \text{ sq ft}}{100 \text{ sq ft}} = 4.0$

   4.0×4 lb (rate of application) = 16 pounds.

   Conclusion: 16[2] pounds of a 10-10-5 fertilizer applied to 20 ft × 20 ft area under tree canopy.

2. Given: Area = 8 ft × 12 ft; fertilizer analysis = 4-10-4; N application rate = 0.25 pounds per 100 sq ft

   Desired: Fertilizer application rate (Table 1), 6.2 pounds of 4-10-4 fertilizer per 100 sq ft of ground area.

   Calculations: $8 \text{ ft} \times 12 \text{ ft} = \dfrac{96 \text{ sq ft}}{100 \text{ sq ft}} = 0.96$

   $0.96 \times 6.2 = 5.24$ pounds.

   Conclusion: 5.24[2] pounds of 4-10-4 fertilizer material applied to 8 ft × 12 ft area under tree canopy.

[2]Most dry fertilizers weigh about 1 pound per pint, 0.5 pounds per cup or 2 pounds per quart.

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