



## HAWAII COOPERATIVE EXTENSION SERVICE

College of Tropical Agriculture and Human Resources

University of Hawaii

GENERAL HOME GARDEN SERIES No. 12

### THE COMPOSITION OF FERTILIZER MATERIALS

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#### What Are Fertilizer Materials?

Plants require nutrients for normal growth and development. These nutrients may be obtained from the air, water, and soil. When these nutrients are absent or unavailable from the soil, they must be added to meet the plants' needs. Fertilizers are materials added to the soil for the purpose of supplying the needed plant nutrients. Fertilizer materials are those used to supply nutrients in manufactured or mixed fertilizers or for direct application to the soil.

Plants cannot utilize the nutrients in their elemental forms. For example, nitrogen is a gas that must be converted into some other form for use by the plant; phosphorus is a solid waxy metal that bursts into flame when exposed to the air; potassium is a light gray metal that reacts violently with water; some other elements are relatively inert materials. To be available to plants, these elements must be associated with other elements to form specific chemical compounds. Because of this, the actual amount of plant nutrient in a fertilizer material is only a portion of the total weight.

Chemical compounds used to supply plant nutrients are known as fertilizer materials, plant food carriers, or "straight" materials.<sup>1</sup> Usually they contain only one plant nutrient element, although some may contain more than one, and some may contain the same plant nutrient element in more than one chemical form. So that plants may receive all of the needed elements at one time, two or more of these chemical compounds may be combined either chemically or physically to produce "mixed" fertilizers. These are also known as manufactured fertilizers or commercial fertilizers.

<sup>1</sup>The average composition of some fertilizer materials is given in the following General Home Garden Series: No. 13, Primary (Major) Plant Nutrients; No. 14, Secondary (Minor) Plant Nutrients and Micronutrients (Trace Elements); and No. 15, Organic Fertilizer Materials.

#### How to Choose a Fertilizer Material

When choosing a particular fertilizer material, several factors must be considered. These are: (1) the plant food (nutrients) needed; (2) the form of the plant food (nutrient) in the material; (3) the availability of the material in the local market; (4) the cost of the material; (5) the convenience of using the material upon the soil reaction. These factors are discussed in detail as follows:

(1) Obviously, the fertilizer material should contain the nitrogen, phosphorus, potassium, or other plant nutrient(s) needed in the soil for plant growth. Sufficient quantities of the material or mixture should be used to supply the needs of the plant. If nitrogen is needed at the rate of 30 pounds per acre for proper plant growth, it would require 143 pounds of ammonium sulfate to supply this amount. This quantity is obtained by dividing the amount of nitrogen needed (30 lb/acre) by the amount contained in the material (21 percent) and rounding it to the nearest pound:  $30 \div .21 = 143$  pounds. Similarly, the amount of other carriers needed may be determined.

(2) The form of the plant nutrient in the material is important, because this affects the ease with which the plant can utilize it. It also affects the rate of chemical, physical, and biological transformations that occur in the soil. These transformations determine the rate of availability of the nutrient to the plant and/or the rate of fixation of the nutrient by the soil or soil microorganisms.

(3) Some materials are readily available on the market and can be obtained easily, others are found infrequently, and some that once were common are no longer available except perhaps in localized areas. Ammonium sulfate generally is readily available on the market. Sodium nitrate—once the most popular source of nitrogen—is seldom found now except near deep water ports.

(4) The availability of a material on the market will often determine its cost. The use of a fertilizer material for some other purpose affects its cost; for example, cottonseed meal is often used as a source of water-insoluble nitrogen in a fertilizer. It is an excellent feed for livestock and is used in many feed mixtures. The feed industry can pay a much higher price, profitably, than can the fertilizer industry; so consequently this material is no longer used extensively as a fertilizer. The cost per container divided by the number of pounds of plant nutrient in the container (weight of container  $\times$  percent of plant nutrient) will give the cost per pound of plant nutrient. Generally, the higher the percent of the plant nutrient in a fertilizer material, the cheaper is the cost of that nutrient.

(5) Convenience of use is an important consideration in selecting a fertilizer material. The physical condition of the product is important, because powdery (pulverized) materials tend to blow easily and are often very dusty; granulated materials usually spread more easily and evenly; and liquid materials and/or suspended materials require special type distributors but are very convenient because only hoses need to be handled.

(6) The effect of the material upon the soil reaction is important. Some materials make the soil more acid (lower pH) or less alkaline than it was before they were applied. Ammonia, chemically alkaline, is converted to nitric acid by the microorganisms in the soil. The associated ions with the ammonia are important because some of them increase the acidity more than others. Ammonium sulfate is more acid forming than ammonium nitrate because the sulfate ion increases acidity more than the nitrate ion. The associated ion is also important because it may con-

tain an essential plant nutrient. In ammonium sulfate, the sulfate ion is an important source of sulfur for soils where this element is deficient. Some fertilizer materials have an alkaline reaction.

When some fertilizer materials are added to the soil, they may increase the soluble salt content of the soil solution. An excess of soluble salts in the soil solution may increase the osmotic pressure of the solution beyond that of the plant sap. This will cause dehydration, permanent injury or "burning", or even death of the plant. Fertilizer materials differ in the effect they have upon the soluble salt level in the soil solution. The "salt index" is a measure of the relative effect of fertilizer materials on the "burning" of plants. The higher the "salt index" the greater is the danger of injury to plants during dry weather and from localized placement of the fertilizer material. The salt index of mixtures of known composition may be determined by multiplying the salt index per unit<sup>2</sup> of plant food in each material by the total number of units that the material supplies in the mixture and adding the results.

<sup>2</sup>Each unit of plant food is 20 pounds, or 1 percent of a ton.

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**NOTE:** The use of trade names is for the convenience of readers only and does not constitute an endorsement of these products by the University of Hawaii, the College of Tropical Agriculture and Human Resources, the Hawaii Cooperative Extension Service, and their employees.

Reprinted June, 1980—2M