APPLICATION *Chemical Industry*

Fertilizers

Fertilizers can supply nitrogen to plants in the form of ammonium sulfate, ammonium nitrate, and urea, all of which are made from NH_3. Now you know why there is such a demand for ammonia. Though some soils contain sufficient concentrations of phosphorus and potassium, most soils need additional nitrogen for adequate plant growth. Ammonia, ammonium nitrate, or urea can fill that need.

Most fertilizers contain all three major plant nutrients N, P, and K, and are called *complete fertilizers*. A typical complete fertilizer might contain ammonium nitrate or sodium nitrate to provide nitrogen. Calcium dihydrogen phosphate, $Ca(H_2PO_4)_2$, or the anhydrous form of phosphoric acid, P_4O_{10}, can provide phosphorus. Potassium chloride, KCl, or potassium oxide, K_2O, can provide potassium.

The proportion of each major nutrient in a fertilizer is indicated by a set of three numbers printed on the container. These numbers are the N-P-K formula of the fertilizer and indicate the percentage of N, P, and K, respectively. A fertilizer graded as 6-12-6, for example, contains 6% nitrogen, 12% phosphorus, and 6% potassium by weight.

Nitrogen stimulates overall plant growth. Phosphorus promotes root growth and flowering. Potassium regulates the structures in leaves that allow CO_2 to enter the leaf and O_2 and H_2O to exit. Fertilizers are available in N-P-K formulas best suited for their intended use. For example, plants that produce large amounts of carbohydrates (sugars) need more potassium than most other types of plants. Grain crops need higher concentrations of phosphorus. Lawn fertilizers applied in the spring are generally high in nitrogen to stimulate shoot growth in grasses. Lawn fertilizers applied in the fall of the year should have a higher phosphorus content to stimulate root growth during the winter.

TABLE 6A Some Commercial Fertilizers and Uses

Fertilizer composition (N-P-K)	Uses
1-2-1 ratio 10-20-10 15-30-15	early-spring application for trees and shrubs with flowers and fruit; general-purpose feedings of the following: cucumbers, peppers, tomatoes
3-1-2 ratio 12-4-8 15-5-10 21-7-4 16-4-8 20-5-10	lawns and general-purpose feedings of the following: trees, shrubs, most berries, apple trees, grapes, vines, walnut trees, broccoli, cabbage, carrots, onions
High nitrogen 33-0-0 21-0-0 40-4-4 36-6-6	pecan trees, lawns, early feedings of corn
Balanced 13-13-13	general purpose feeding of the following: broccoli, cabbage, melons, potatoes
Special purpose: acid-loving flowering shrubs 12-10-4	azaleas, rhododendrons, camellias, gardenias
Special purpose 18-24-16	roses
Special purpose: flowering 12-55-6	flowering plants and shrubs (annuals and perennials)
Special purpose: root growth 5-20-10	starter fertilizer for transplants