

## Lecture 1

### Introduction to Plant nutrients, Fertilizer specifications, Terminology and Definitions

#### **1.1 Introduction**

A fertilizer is a material that furnishes one or more of the chemical elements necessary for the proper development and growth of plants. The most important fertilizers are fertilizer products (also called chemical or mineral fertilizers), manures, and plant residues. A fertilizer product is a material produced by industrial processes with the specific purpose of being used as a fertilizer. Fertilizers are essential in today's agricultural system to replace the elements extracted from the soil in the form of food and other agricultural products.

#### **1.2 Plant Nutrients**

Chemical elements that are essential for the proper development and growth of plants are typically referred to as plant nutrients. The list of plant nutrients recognized as being necessary for plant growth has increased over the years and now totals sixteen,

##### **1.2.1 Expression**

Many countries express quantities or percentages of the primary nutrients in terms of elemental nitrogen (N), phosphorus pentoxide ( $P_2O_5$ ), and potassium oxide ( $K_2O$ ). Secondary nutrients and micronutrients usually are expressed on an elemental basis although calcium and magnesium sometimes are expressed in the oxide form. However, several countries express all plant nutrients on an elemental basis.

## Classification of Elements Essential for Plant Growth

Major elements (Macronutrients)	(Available from air or water)	Carbon
		Hydrogen Oxygen
	Primary nutrients	Nitrogen Phosphorus Potassium
	Secondary nutrients	Calcium Magnesium Sulfur
Minor elements (Micronutrients)		Boron Chlorine Copper Iron Manganese Molybdenum Zinc

### 1.2.2 Fertilizer Grade

All fertilizer labels have three bold numbers. The first number is the amount of nitrogen (N), the second number is the amount of phosphate ( $P_2O_5$ ) and the third number is the amount of potash ( $K_2O$ ). These three numbers represent the primary nutrients (nitrogen(N) - phosphorus(P) - potassium(K)).

This label, known as the fertilizer grade, is a national standard. A bag of 10-10-10 fertilizer contains 10 percent nitrogen, 10 percent phosphate and 10 percent potash.

Fertilizer grades are made by mixing two or more nutrient sources together to form a blend that is why they are called "mixed fertilizers." Blends contain particles of more than one color. Manufacturers produce different grades for the many types of plants.

You can also get fertilizers that contain only one of each of the primary nutrients. Nitrogen sources include ammonium nitrate (33.5-0-0), urea nitrogen (46-0-0), sodium nitrate (16-0-0) and liquid nitrogen (30-0-0). Phosphorus is provided as 0-46-0 and potash as 0-0-60 or 0-0-50.

### **1.2.3 Fertilizer Specifications**

Specifications are the requirements with which a fertilizer should conform, as agreed upon between buyer and seller. Fertilizer specifications meet differing requirements depending on the use or intent of the specification information.

Specifications are normally used in the contract between the buyer and seller of a fertilizer to ensure agreement on product characteristics or more often to define the product in sufficient detail to effect the satisfaction of both buyer and seller.

### **1.3 Terminology and Definitions**

The below specified definitions are those given by International Association for Standardization (ISO) and Association of American Plant Food Control Officials (AAPFCO)

**Fertilizer Material-** A fertilizer that meets any of the following conditions (AAPFCO):

1. Contains important quantities of no more than one of the primary plant nutrients (nitrogen, phosphorus, or potassium).
2. Has 85% or more of its plant nutrient content present in the form of a single chemical compound.

3. Is derived from a plant or animal residue or by product or natural material deposit which has been processed in such a way that its content of plant nutrients has not been materially changed except by purification and concentration.

**Fertilizer**- In the simplest terminology, a material, the main function of which is to provide plant nutrients.

**Soil Conditioner** – Material added to soils, the main function of which is to improve their physical and/ or chemical properties and/ or their biological activity.

**Liming Material** – An inorganic soil conditioner containing one or both of the elements calcium and magnesium, generally in the form of an oxide, hydroxide, or carbonate, principally intended to maintain or raise the pH of soil.

**Straight Fertilizer**: A qualification generally given to a nitrogenous, phosphatic, or potassic fertilizer having a declarable content of only one of the primary plant nutrients, i.e. nitrogen, phosphorus, or potassium.

**Compound Fertilizer**: A fertilizer that has a declarable content of at least two of the plant nutrients nitrogen, phosphorus and potassium, obtained chemically or by blending or both.

**Granular Fertilizer**:– Solid material that is formed into particles of a predetermined mean size.

**Coated Fertilizer** – Granular fertilizer that is covered with a thin of a different material in order to improve the behavior and/ or modify the characteristics of the fertilizer.

Other related terms are:

**Coated Slow-Release Fertilizer (AAPFCO)**- A product containing sources of water-soluble nutrients, release of which in the soil is controlled by a coating applied to the fertilizer.

**Polymer-Coated Fertilizer (AAPFCO)**-A coated slow-release fertilizer consisting of fertilizer particles coated with a polymer (plastic) resin. It is a source of slowly available plant nutrients.

**Controlled-Release Fertilizers**- Fertilizers in which one or more of the nutrients have limited solubility in the soil solution, so that they become available to the growing plant over a controlled period.

**Nitrogen Stabilizer (AAPFCO)** - A substance added to a fertilizer to extend the time that the nitrogen component of the fertilizer remains in the soil in the ammonia cal form.

**Liquid Fertilizer** – A term used for fertilizers in suspension or solution and for liquefied ammonia (ISO).

**Solution Fertilizers (ISO)** – Liquid fertilizer free of solid particles.

**Suspension Fertilizer (ISO)** – A two-phase fertilizer in which solid particles are maintained in suspension in the aqueous phase.

**Suspension Fertilizer (AAPFCO)** – A fluid containing dissolved and UN dissolved plant nutrients. The suspension of the undissolved plant nutrients may be inherent with the materials or produced with the aid of a suspending agent of nonfertilizer properties. Mechanical agitation may be necessary in some cases to facilitate uniform suspension of undissolved plant nutrients.

**Suspension Fertilizer** – A liquid (fluid) fertilizer containing solids held in suspension, for example, by the addition of a small amount of clay. The solids may be water-soluble in a saturated solution, or they may be insoluble, or both.

**Slurry Fertilizer (AAPFCO)**–A fluid mixture that contains dissolved and undissolved plant nutrient materials and requires continuous mechanical agitation to assure homogeneity.

**Powder** – A solid substance in the form of very fine particles. Powder is also referred to as “no granular fertilizer” and is sometimes defined as a fertilizer containing fine particles, usually with some upper limit such as 3 mm but no lower limit.

**Formula** – A term used in some countries to express, by numbers, in the order N-P-K (nitrogen- phosphorus- potassium), the respective content of these nutrients in a compound fertilizer.

**Bulk** – Qualification given to a fertilizer or soil conditioner not packed in a container (ISO).

**Guarantee (of Composition)** – Quantitative and/ or qualitative characteristic with which a market product must comply for contractual or legal requirements.

**Declarable – Content** – That content of an element (or an oxide) which, according to national legislation, may be given on a label or document associated with a fertilizer or soil conditioner.

**Fertilizer unit** – The unit mass of a fertilizer nutrient (in the form of the element or an oxide) generally 1 kg.

**Plant Food Ratio** – The ratio of the numbers of fertilizer units in a given mass of fertilizer expressed in the order N – P – K.