Soil fertility– Concepts of soil fertility and soil productivity. Soil as a source of plant nutrients.

As civilization moves to beginning of the twenty first century and as World's population continues to increase, the importance of a continuing increase in food production is obvious. India alone is contributing more than a Billion people. It means that our crop production must be at least doubled by the end of the century. There are two options open to us. One way is to increase the area under the plough and the other to increase production per unit area. The scope is limited for the first option. So greater attention will have to be paid to the increasing of the production per unit area, per unit time. The strategy is to maintain soil fertility and proper nutrient management without impairing soil quality (sustainable agriculture).

Soil fertility: Soil fertility is defined as the quality that enables the soil to provide proper nutrient compounds in proper amounts and in proper balance for the growth of specified plants. Soil fertility is also defined as the ability of soil to supply adequately the nutrients normally taken from the soil by plants.

Soil Chemistry: It deals with the chemical constitution of the soil - the chemical properties and the chemical reactions in soils. It is the study of chemical composition of soil in relation to crop needs. Traditional soil chemistry focuses on chemical and biochemical reactions in soils that influence nutrient availability for plant growth, and potential environmental consequences associated with inorganic and organic fertilization. Soil chemistry has increasingly focused on the environment over the past few decades, especially as related to ground and surface water quality. Understanding the reactions and biogeochemical processes of potential pollutants and contaminants in soils will enable a more accurate prediction of fate and toxicity of contaminants, and development of remediation strategies.

The overall goal of soil chemistry/fertility research is a more fundamental understanding of chemical and biochemical reactions in soils related to plant growth, sustainability while maintaining soil and environmental quality. Soils are the medium in which crops grow to provide food and cloth to the world. Soil is the major factor that limits the type of vegetation and crops. Under similar climatic conditions, a loose and porous soil that retains little water will

support sparse vegetation when compared to deep, fertile loam or clay. The basic need of crop production is to maintain soil fertility and soil productivity.

Soil fertility and Soil productivity

	Soil fertility		**Soil productivity**
1	It is the inherent capacity of the soil to provide essential chemical elements for plant growth	1.	Soil productivity emphasizes the capacity of soil to produce crops and is expressed in terms of yield.
2	A combination of soil properties and an aspect of soil – plant relationships.	2.	An economic concept and not a property of soil
3	Soil fertility is vital to a productive soil. But a fertile soil is not necessarily be a productive soil. Many factors can limit production, even when fertility is adequate. For eg., soils in arid region may be fertile but not productive.	3.	Soil fertility is one factor among all the external factors that control plant growth like air heat (temp.), light, mechanical support, soil fertility and water. Plant depends on soil for all these factors except for light.
4	Organic matter in the soil improves soil fertility by mineralization of nutrients.	4.	Organic matter also improves soil productivity by improving soil porosity, aggregation and physical condition of soil thus modifying the soil environment for crop growth.

Concepts of soil fertility and soil productivity

- It is evident from the early writing of Theophrastus (372 – 287 BC) even before the advent of Christian era, Greek and Romans realized the impact of soil on the growth of plants and made a mention about the application of organic wastes and saltpeter for the plants.

- The first experiment aimed at elucidating the increase in the weight of plant during its growth was reported by Nicholas (1401 - 1446).
- Jan Baptiste van Helmont (1577-1644) attributed the increase in weight of willow shoot to water.
- But a German chemist, Glauber (1604-1668), who attributed the growth of plants to the absorption of saltpeter (KNO_3) from the soil.
- John Woodward (during the year about 1700) first conducted water culture experiments on spearmint and emphasised that the growth factor is some terrestrial matter but not the water.
- Jean Baptiste Boussingault (1802-1882) carried out field plot experiments. He was called as 'father of field plot technique'.
- Justus von Liebig (1803-1873) put forth the 'law of minimum' which states that the yield is governed by the limiting nutrient and is directly proportional to the factor which is minimum in the soil.

Soil as a source of plant nutrients

Soils are complex natural formations on the surface of the earth and consist of five main components: mineral matter, organic matter, water, air and living organisms. The rocks and minerals on weathering release nutrients into the soil. The most important part of the soil with respect to plant nutrition is the colloidal fraction which consists of inorganic colloids (clay) and organic colloids (humic substances). Most of soil colloids possess electronegative adsorption sites available for attracting cations including calcium, magnesium, potassium, ammonium etc as well as H^+ arising from the biological activity. Organic matter on decomposition releases nutrients. The cations adsorbed on the surface of the colloids are capable of exchanging rapidly and reversibly with those in soil solution. The principal immediate source of mineral nutrients to plant roots is ions in the soil solution. This nutrient supply is gradually depleted by absorption of nutrient ions by plant roots and continuously replenished by desorption of exchangeable ions on the clay-humus complex and break down of readily decomposable organic debris. The microbes in the soil also help in supplementing nutrients by the way of nutrient transformations. These sources represent the reserves that serve to replace but only at a relatively slow rate. For intensive cultivation of crop plants, however, application of mineral salts to soil is required.