

Preserving environment in farming is now becoming main concern since use of inputs like fertilizers & pesticides has been widely employed. Site-specific application of agricultural chemicals is an effective way of resource saving and environmental protection. Precise farming implementation is now gaining popularity and widely accepted as one of smart solutions to sustain agriculture production without ignoring environment. In appropriate nutrient inputs has affected environment and human's health. Indiscriminate use of nitrogen and phosphorus fertilizers has led to ground water pollution. So the farmers has to pay attention to nutrient control into their farming techniques. The balanced nutrition level to plant is provided by managing pH and Electrical conductivity level of fertilizer solution according to soil pH and electrical conductivity. Design consist of two sensors to measure pH and EC of the fertilizer solution and soil.

The pH and EC (electrical conductivity) are the two important indices of fertilization. They represent the whole quality and characteristics of fertilizers and water. It varies for different plants and soils.

(a) **pH**

pH give the information of acidity or alkalinity of solution. . A pH reading of 7 is neutral because there are equal concentrations of (H+) and (OH-) is ideal for many plants and spray materials. $\text{pH} = -\log [\text{H}^+]$ (neg. log of the H+ conc.) pH level gives the availability of nutrients in the soil or fertilizer solution. pH range of fertilizers solution delivered in soil effects the soil properties. Calcium, Phosphorus, potassium and magnesium are unavailable to plants in acidic soil. Plants have difficulty in absorbing micronutrients like copper, zinc, boron, manganese and iron in basic soils; however their presence in soil can also be excessive and become toxic to plants. A higher quantity of bicarbonate ions are contained in basic soil which affects the optimum growth in plants by interfering with the normal uptake of other ions.

(b) **Electrical Conductivity**

Salinity of solution is measured by common way using electrical conductivity (EC) sensor. This sensor measures the electricity moves through a saltier solution, the electricity moves through it is directly proportional to the conductivity readings. EC is measured in dS/cm (deciSiemens per centimeter). In all soils salts are naturally present additional salts build up in the soil by higher concentration of fertilizers applied.

Fertilizers selection

The main factors affecting fertilizers composition are the plant characteristics, soil characteristics, irrigation water quality and growing place. Major nutrients nitrogen (N), phosphorus (P) and potassium (K) are supplied to plant through fertigation process. However calcium (Ca) and magnesium (Mg) are sometimes supplied in the field. When potassium sulphate and magnesium sulphate are used to supply K and Mg respectively, soil also gets Sulphur (S) in addition. The micronutrients such as boron (B), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu) and molybdenum (Mo) are generally applied as foliar sprays because they are required in small amounts. Fertilizers to manage pH and EC - Soil pH is altered by the application of fertilizers solution. Ammonium forming fertilizers make solution acidic while nitrate forming fertilizers contains basic ions and are less acid forming make solution alkaline. Ammonium and ammonium forming fertilizers (ex. urea) are used to decrease pH level. Elemental sulphur, ammonium sulphate, and compounds such as iron or aluminium sulphates can reduce the soil pH. Acidic soils are neutralized with the application of lime addition in soil. The requirement of lime dependent upon the buffering capacity of the soil. The Saline soils are also termed as alkaline soil. Gypsum is the most common amendment used to remove excessive

amounts of sodium ions (Na⁺) from soil profile and improve saline soil. Gypsum is used to improve saline and alkaline soil having pH range up to 9.0. Sulphur, iron sulphate, iron pyrite used for soil having pH level 8.0-9.0, lime stone is used having pH less than 8.0. Mixing of fertilizer - The mixing container with 50 - 75% of the required water should be used in the mixture if mixing dry soluble fertilizers. Always put acid into water rather than water into acid. When chlorinating water with chlorine always add chlorine to water and not vice versa. Acid or acidified fertilizers cannot be mixed with chlorine.

A. Measuring pH

Fertilizer's pH is measured using pH electrode. The output signal of pH electrode is in millivolts (mV). The working of pH electrode is based on the principle that a potential is developed when two solutions of different pH comes in contact through a thin glass membrane. The pH electrode consists of glass electrode and reference electrode the potential between these two electrodes.

B. Measuring EC

The electrical conductivity of a solution is measured by determining the resistance of the solution between two flat or cylindrical electrode separated by a fixed distance. The resistance is measured by a conductivity cell. An alternating voltage is used in to avoid electrolysis. The parameter cell constant of conductivity cell is used to convert the conductance measured by conductivity cell and is defined by

$$K = d/A$$

K = Cell constant or Cell factor

d = Distance between the electrodes

A = Area of the electrodes