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Popular Article

Principles and Methods of Fertilizer Application in Soil

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Introduction:

Fertilizers are substances containing chemical elements that improve the growth of plants. They give nutrition to the crops. Fertilizers do not only assist in increasing yields but also promote healthy growth and development of plants. They contain nitrogen which acts as a growth booster which can be characterized by the green color of plants. Phosphorus substance in fertilizers aids in the faster formation of seeds and root development. In order to get maximum benefit from manures and fertilizers, they should not only be applied in proper time and in right manner but any other aspects should also be given careful consideration. Different soils react differently with fertilizer application. Similarly, the N, P, K requirements of different crops are different and even for a single crop the nutrient requirements are not the same at different stages of growth. Theses fertilizers are available in solid granules and are fully soluble or partially soluble. Fertilizers are also available in liquid form. The modes of application solid and liquid fertilizers differ.

Solid Fertilizers Application Methods:

1. Broadcasting:

Broadcasting of fertilisers means the uniform spreading of fertiliser over the entire field. It proves effective when the roots uniformly permeate the soil, when heavy doses of nitrogenous and potassic fertiliser are to be applied, and when citrate soluble phosphatic fertilisers like bone meal and basic slag are to be applied to the acidic the soil. This method of fertilizer application should not be practiced where placement of fertilizers in the root zone is feasible because in this practice more amount of fertilizer is required to produce the same yield. Broadcasting of fertilizers is carried out at two stages.

Time of Planting:

Depending on the crop, broadcasting of the fertilizer is carried out prior to sowing/planting or just before the last ploughing and incorporated in the field. Broadcasting of fertilizers at the time of planting is generally done under conditions:

i When the soils are highly deficient in nitrogen and
ii When the previous crop has been exhaustive such as sugarcane, jowar, maize, etc.

During Crop Growth Period:

Broadcasting in standing crop is done mainly for nitrogenous fertilizers and mostly for close spaced crop like paddy and wheat. It is called top dressing. Muriate of potash is also applied as top dressing in some crops but this is not a general practice.

Procedure:

Measure the field, divide the field into convenient units, calculate and weight the fertilizer for each unit and spread the fertilizer uniformly on the entire surface of each unit. Division of plot and quantity of fertilizer ensures greater ensures greater uniformity in fertilizer application.

- In India, cultivators broadcast the fertilisers on the field and incorporate them in the soil by ploughing. Thereafter the field is thoroughly prepared and seeds of the crop are sown.
- Broadcasting of fertilisers (usually nitrogenous) over the standing crop is known as top dressing. The only advantage of broadcasting is that fertilisers may be more conveniently applied in the hilly regions by this method. Fertilisers are also broadcast on grasslands.

2. Placement:

Fertilizers are placed in the soil before sowing irrespective of the position of the seed. Placement in standing crop can also be done in widely spaced crop growing in a limited area. For example, in young maize crop fertilizer add can be manually placed 3-4 cm away from the stem.Placement of fertilizer restricts the surface area of the fertilizer coming in contact with soil particles and thus decreases the fixation of phosphorus and potassium.

Plough Furrow or Single Band Placement:

Fertilizer is placed in a continuous band at the bottom of the furrow opened during ploughing. Each band is covered with soil after the application. In single band placement fertilizer is applied on one side of the planted row.

Procedure:

a. Open the furrow with the help of plough.
b. Count the number of furrows and measure the total area of operation.
c. Calculate and weigh the required dose of fertilizer for each furrow and place the fertilizer in the furrow.
d. Cover the furrow with the soil.

Double Band Placement:

In double band placement method, fertilizer is placed and on both the sides of the row. Furrows can be opened with the help of two tyned harrow (if available); keeping the planted row in the centre. After fertilizer is placed, the furrows are covered with the soil by planking.

Placement of fertilizer is generally employed for the application of nitrogenous, phosphatic and potassic fertilizers in the intensive agriculture and in orchards.Deep placement of fertilizer is generally practiced for application of nitrogenous and phosphatic fertilizers in paddy fields. In this method, 15-

20 cm deep furrows are opened with the help of plough and ammoniacal fertilizer is placed in them. They are covered with soil usually by planking.This operation is done after draining out water from the field. After placement of fertilizer, field can be flooded again. This practice is also useful for concentration dry land areas. In dry land areas moisture is found to be deeper layers of soil. Therefore deep placement can be adopted for both seed sowing and fertilizer application.

Ring Placement:

Ring placement method is mostly practiced for the fruit trees in orchard or for individually grown trees.

Procedure:

i. Open a ring like trench of one foot wide and four to six inches deep around the fruit tree with the help of spade corresponding to the circumference of the shoot system of the tree.
ii. Calculate and weigh the amount of fertilizers for each separately.
iii. Apply fertilizer uniformly in the trench.
iv. Cover the ring with soil.
v. Apply irrigation if required.

3. In Situ Application:

When fertilizers are applied on a specific spot, it is called 'in situ' application or localized application of fertilizer in wide fertilizers. The following are the kinds of in situ application of fertilizers:

Drill Application:

Drill application refers to the drilling of fertilizer at sowing time. Drilling the fertilizer together with seed should be avoided as it may adversely affect the germination or the young plants may get damaged due to high or concentration of chemicals in the root zone. It is advisable in to use a separate attachment for seed and fertilizer drilling. This is one of the best methods for applying phosphatic (P) and potassic (K) fertilizers to closely spaced row planted crops like wheat, maize, jowar, bajra etc. This method is also better for applying nitrogenous fertilizers. However, it is safer to drill only small quantities of fertilizers so that germination may not be adversely affected.

Procedure:

i.Attach the fertilizer drilling to be to the plough.
ii. Measure the area of operation.
iii. Calculate and weight the required fertilizers.
iv. Drill the fertilizer taking care of the uniform distribution in the field.

Dollop Method:

The entire quantity of fertilizer is calculated per plant and is applied on both the sides of the plant with the help of a cup by dividing it into two parts. This is considered to be very efficient method of applying nitrogenous fertilizer in widely spaced crops like cotton and fruit trees.

Procedure:

i.Count the number of plant in the area of operation.
ii. Calculate and weight the required fertilizer.
iii. Put a mark in the fertilizer cup for the desired quantity of fertilizer for each plant.
iv. Dig a hole on both the side of the plants with help of spade/appropriate tools to a depth of 10 cm.
v. Apply the fertilizer equally in both the holes and cover it with soil.

Pellet Application:

In pellet method, the fertilizer is mixed with the soil in the ratio of- 1: 10 (one part fertilizer and ten parts of soil) and made into a paste. Then small pellets of convenient size are prepared. These pellets are then applied cost to the field by depositing them in soft mud. This method is especially useful for the application (of nitrogenous fertilizers in paddy field). This practice greatly increases the nitrogen use efficiency of paddy crop.

4. Foliar Application:

Foliar application refers to the spraying fertilizer solution on foliage (leaves) of growing plants. Normally, these solutions are prepared in low concentration (2-3%) either to supply anyone plant nutrient or a combination of nutrients. Several nutrient elements are readily absorbed by leaves when they are dissolved in water and sprayed on them. The concentration of the spray solution has to be controlled; otherwise serious damage may result due to scorching of the leaves. Foliar application is effective for the application of minor nutrients like iron, copper, boron, zinc and manganese. Sometimes insecticides are also applied along with fertilizer.

Advantages:

i. Foliar spraying is useful to correct the nutrient deficiency growing crops.
ii. In extremely dry weather condition where the plants are not able to take up nutrients from soil because of low moisture contents of soil, foliar spray is useful.
iii. When quick response of fertilizer (especially nitrogenous fertilizer) is required.
iv. When the widely spread foliage of plant poses difficulty, for soil application.

Disadvantages:

i. Marginal leaf burns or scorching may occur if strong solutions are used.
ii. As a solution of low concentration, only a small quantity of nutrients can be supplied at a time.
iv. It cannot be recommended as a sole method of application of fertilizer.
v. Only urea and micro-nutrients can be applied through this method.

5. Starter Solutions:

The use of liquid fertilizers as a means of fertilization has assumed considerable importance in foreign countries. Solutions of fertilizers, generally consisting of N, P_2O_5, and K_2O in the ratio of 1: 2: 1 and 1:1:2 are applied to young vegetable plants at the time of transplanting. These solutions are known as 'Starter Solutions'. They are used in place of the watering that is usually given to help the plants to establish. Only a small amount of fertilizer is applied as a starter solution.

6. Fertigation:

Fertilizers are allowed to dissolve in the irrigation stream. The nutrients are thus carried into the soil in solution. This save the application cost and allows the utilization of relatively inexpensive water. Intensification of agriculture by irrigation and enhanced use of fertilizers may generate pollution by

increased levels of nutrients in underground and surface waters. Therefore, judicious management of plant nutrients available through different fertilizers need be catered. A higher efficiency is possible with the help of pressurized irrigation system is placed around the plant roots uniformly and allow for rapid uptake of nutrients by plants. Fertigation is the technique of supplying dissolved fertilizers to crops through an irrigation system. Small application of soluble nutrients saves labour, reduces compaction in the field and thereby enhancing productivity.

Advantages of Fertigation:

(i) Increase in crop yield by 25-30%. And Savings in fertilizers by about 30%.
(ii) Precise application and uniform distribution of fertilizers.
(iii) Acidic nature helps in avoiding clogging of drippers, in cleans up drip system.
(iv) Increase nutrient use efficiency by minimizing loss of nutrients..

Principles of Fertilizer Application:

1. Frequency of fertilizer Application:

Usually larger quantities of fertilisers are added to clayey soils at longer intervals, than to the sandy soils because clayey soils are richer in humus than sandy soils and both clay and humus have a high capacity to retain nutrient ions, by a phenomenon called Base Exchange.These absorbed nutrient ions are not lost by leaching and can be gradually taken up by the roots. If a heavy dose of water soluble fertiliser is applied to a sandy soil, most of it will be leached down by high rainfall in the humid region.

2. Quantity of fertilizer to be applied:

Cultivated soils where grain crops are raised have been placed in Low, or Medium or High categories, according to their content of available Nitrogen and/or Phosphoric acid and/or Potash. If the soils are low in one or more of the concerned nutrients, application of that nutrient in a full dose to the soil, will increase the crop yield. If the nutrients are present in a medium amount, only half the dose of that nutrient is applied to the soil.Different crops require different amounts of nutrients. Vegetables and sugarcane require very high amounts. A requisite amount of nutrients must be given to the crop if the soil contains low quantities of that nutrient.The nutrient requirement of dwarf varieties of wheat and paddy are more than those of the tall varieties of wheat and paddy less nitrogen is given to the tall varieties, because they will lodge if they as given the dose of nitrogen meant for dwarf varieties.

3. Time of Fertilizer Application:

The rate of assimilation of nitrogen by crops is equal to their rate of growth. Crops require less nitrogen immediately after germination because they grow less at that time.The Crops demand for nitrogen increases from the early growth stage to the flowering stage, when their growth rate increases. Therefore nitrogenous fertilisers should be applied in split doses at least twice; once just before sowing or planting the crop and then about one and half to two months after sowing or planting.The crops utilize about two-thirds of their phosphatic and potash requirements during their early growth period. So then entire quantity of phosphate and potash may be applied as a basal dose just before sowing the crop.

4. Kind or Fertilisers to be applied:

Nitrate should not be applied to sandy soil, especially under conditions of high rainfall, because they are readily leached. So nitrate fertilisers are usually not applied to paddy fields where ammoniacal and amide fertiliser (Urea) should be applied.Ammoniacal and amide fertilisers can be continuously applied to neutral and alkaline soils, but not too acidic soils because they increase soil acidity. Water soluble single super phosphate is best suited for application to neutral soils.If it is added to strongly acidic or alkaline soil, the water soluble mono-calcium phosphate contained in it is precipitated as water insoluble aluminum and ferric hydroxyl phosphate in strongly acidic soil, and as water insoluble tricalcium phosphate in strongly alkaline soil.Hence lime and gypsum should be added to strongly acidic soil and strongly alkaline soil respectively, in order to adjust the soil pH to approximately 6.8, at which most of the nutrients are made available to crops.Citrate soluble bone meal or basic slag should be applied to acidic soils. They will continue to release phosphorus for the growth of the crop during the growing season. Sodium Meta and pyro phosphates should be applied to calcareous soil because they do not react with calcium carbonate.

5. Placement of Fertilisers:

Plant nutrients should be placed in the root zone, so that roots can assimilate them quickly. The fertilisers should come in minimum contact with the soil in order to reduce the fixation of nutrient ions like potassium, ammonium and phosphate.Acidic soils contain aluminum and ferric ions, which precipitate water soluble/phosphate as water insoluble phosphate. Phosphate is also fixed by aluminum, iron oxide and kaolinite. Phosphate ions also move very slowly from their place of application.Hence single super phosphate or di-ammonium phosphate should be placed in a band at a distance of about two inches from the rows of seeds.

In order to prevent weeds from using the fertilisers, nitrogenous fertilisers should also be placed in a band near rows of widely spaced crops.The uptake of phosphate from the band by the crop increases if the fertiliser band also contains nitrogenous fertiliser.Roots of closely spaced crops like wheat evenly permeate the soil, so nitrogenous fertilisers may also be uniformly scattered over the surface.Ammoniacal fertilisers like ammonium sulphate di-ammonium phosphate etc. should be placed in the reducing zone (about nine inches deep) of paddy soil where they remain as ammonium ions which are assimilated by the crop.If they are placed in the surface oxidizing zone, they are oxidized to nitrate which more down to the reducing zone where they are reduced to oxides of nitrogen and nitrogen gas, which is lost to the atmosphere.