

Time and Methods of Fertilizer Application

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Concept

The method of application of fertilizers (organic manure or mineral fertilizers) is an essential component of good agricultural practices. The amount and timing of nutrient uptake depends on various factors, such as crop variety, planting date, crop rotation, soil and weather conditions. For good agricultural practices, the farmer chooses the timing and the quantity in such a way that as much as possible of the nutrients is used by the plants. For optimum crop use efficiency and minimum potential for environmental pollution, farmers must apply the nutrients as near to the time the crop needs them as is practical. This is of particular importance for mobile nutrients such as nitrogen, which can easily be leached out of the soil profile, if they are not taken up by the plant roots.

In the cases of urea and diammonium phosphate application, losses may occur through emission of ammonia to the air. Both these fertilizers must be incorporated into the soil immediately after application, if there is no immediate rainfall or irrigation to wash it into the soil. This is of particular importance on alkaline (calcareous) soils.

All primary and secondary nutrients should be incorporated immediately after application in regions where intense rainfall is expected, to avoid losses due to run-off and erosion.

When fertilizer is applied by hand, extreme care should be taken to distribute nutrients uniformly and at the exact rates. Where fertilizer application equipment is used, it should be adjusted to ensure uniform spreading and correct rates. The equipment should be well maintained.

Fertilizers are applied by different methods mainly for 3 purposes:

- 1) To make the nutrients easily available to crops,
- 2) To reduce fertilizer losses and
- 3) For ease of application.

The aspects that require consideration in fertilizer application are listed below:

- 1) Availability of nutrients in manures and fertilizers.
- 2) Nutrient requirements of crops at different stages of crop growth.
- 3) Time of application.
- 4) Methods of application, placement of fertilizers.
- 5) Foliar application.
- 6) Crop response to fertilizers application and interaction of N, P, and K.
- 7) Residual effect of manures and fertilizers.
- 8) Unit cost of nutrients and economics of manuring.

The time and method of fertilizer application vary in relation to

- 1) The nature of fertilizer.
- 2) Soil type and
- 3) The differences in nutrient requirement and nature of field crops.



Time of Fertilizer Application

1. Basal application

A. Before preparatory tillage: Bulky organic manures, green manures, soil amendments and soil conditioners are applied before preparatory tillage for thorough mixing with the soil.

B. Basal dressing: Application of manures and fertilizers before last ploughing/puddling or before sowing or planting.

C. At sowing or planting: Concentrated organic manures, readily soluble and higher mobile fertilizers, slow release fertilizers, starter dose of N fertilizer to legume crops and fertilizer for specific nutrient deficient soil are applied during this time.

2. Top dressing: It is the application of manures and fertilizers to the established crop within crop duration. Top dressing may be done to the soil or to the foliage. Split application of nitrogen and potassium is done throughout the cropping period to increase the fertilizer use efficiency.

Methods of Fertilizer Application

A. Application of fertilizers in solid form

It includes the methods like:

1. Broadcasting

Even and uniform spreading of manure or fertilizers by hand over the entire surface of field while cultivation or after the seed is sown in standing crop, termed as broad casting.

It is suitable for crops with dense stand, the plant roots permeate the whole volume of the soil, large doses of fertilizers are applied and insoluble phosphatic fertilizers such as rock phosphate are used. Broadcasting of fertilizers is of two types.

Depending upon the time of fertilizer application, there are two types of broadcasting:

- a) Broadcasting at planting or basal application and
- b) Top dressing.

a) Broadcasting at planting

Broadcasting of manure and fertilizers is done at planting or sowing of the crops with the following objectives:

- To distribute the fertilizer evenly and to incorporate it with part of, or throughout the plough layer and
- To apply larger quantities that can be safely applied at the time of planting/sowing with a seed-cum-fertilizer driller.

It is adopted with the following condition:

- When nitrogenous fertilizers like ammonium sulphate, ammonium sulphate nitrate, concentrated organic manures, are to be applied to the soil deficient in N or where N is exhausted by previous crops like maize, pearl millet.
- When citrate soluble phosphatic fertilizers like basic slag and diacalcium phosphate, are to be applied to moderately acid to strongly acid soils.
- When potashic fertilizers like muriate of potash and potassium sulphate are to be applied in potash deficient soil.



b) Top dressing

Spreading or broadcasting of fertilizers in the standing crop (after emergence of crop) is known as top-dressing. Generally, NO_3^- N fertilizers are top dressed to the closely spaced crops like wheat, paddy. e.g. sodium nitrate, ammonium nitrate and urea, so as to supply N in readily available from the growing plants. The term side dressing refers to the fertilizer placed beside the rows of a crop (widely spaced) like maize or cotton. Care must be taken in top dressing that the fertilizer is not applied when the leaves are wet or it may burn or scorch the leaves. The top dressing of P and K is ordinarily done only on pasture lands which occupy the land for several years.

In some countries, aero planes are used for fertilizer application in hill terrains where it is difficult to transport fertilizers and where large amount are to be applied because of severe deficiency and under following situations:

- Where very small quantities of fertilizers are needed over large areas. E.g.: Micro nutrients.
- When high analysis materials are applied.
- When fertilizer application may be combined with insect control or some other air operation and
- As a labor and time saving device.

Disadvantages of broadcasting

The main disadvantages of application of fertilizers through broadcasting are:

- Nutrients cannot be fully utilized by plant roots as they move laterally over long distances.
- The weed growth is stimulated all over the field.
- Nutrients are fixed in the soil as they come in contact with a large mass of soil.

2. Placement

- It refers to the placement of fertilizers in soil at a specific place with or without reference to the position of the seed.
- Placement of fertilizers is normally recommended when the quantity of fertilizers to apply is small, development of the root system is poor, soil have a low level of fertility and to apply phosphatic and potashic fertilizer.

Placement method includes (a) plough sole placement, (b) deep placement or sub-surface placement, and (c) Localized placement or spot application

a. Plough sole placement

- In this method, fertilizer is placed at the bottom of the plough furrow in a continuous band during the process of ploughing.
- Every band is covered as the next furrow is turned.
- This method is suitable for areas where soil becomes quite dry up to few cm below the soil surface and soils having a heavy clay pan just below the plough sole layer.

By this method, fertilizer is placed in moist soil where it can become more available to growing plants during dry seasons. It results in less fixation of P & K than that which occurs normally when fertilizers are broadcast over the entire soil surface.

b. Deep placement or sub-surface placement

In this method, fertilizers like ammonium sulphate and urea, is placed in the reduction zone as in paddy fields, where it remains in ammonia form and is available to the crop during the active vegetative period. It ensures better distribution in the root zone, and prevents any loss by surface runoff. It is followed in different ways, depending upon local cultivation practices such as:



- **Irrigated tracts:** The fertilizer is applied under the plough furrow in the dry soil before flooding the land and making it ready for transplanting.
- **Less water condition:** Fertilizer is broadcasted before puddling which places it deep into the reduction zone.
- **Sub – soil placement:** This refers to the placement of fertilizers in the sub-soil with the help of heavy power machinery. It is followed in humid and sub-humid regions where many sub-soils are strongly acid, due to which the level of available plant nutrients is extremely low. phosphatic and potashic fertilizers are applied by this method in these regions for better root development.

c) Localized placement or spot application

It refers to the application of fertilizers into the soil close to the seed or plant. It is usually employed when relatively small quantities of fertilizers are to be applied.

Advantages:

- The roots of the young plant are assured of an adequate supply of nutrients,
- Promotes a rapid early growth,
- Make early Intercultivation possible for better weed control,
- Reduces fixation of phosphorus and potassium.

Localized placement or spot application includes different methods like (i) contact placement or combined drilling or drill placement, (ii) band placement, (iii) pellet application, (iv) side dressing, (v) circular placement, (vi) pocket placement, (vii) pellet application

i. Contact placement or combined drilling or drill placement

It refers to the drilling of seed and fertilizer together while sowing. It places the seed and small quantities of fertilizers in the same row. This is found useful in cereal crops, cotton and grasses but not for pulses and legumes. This may affect the germination of the seed, particularly in legumes due to excessive concentration of soluble salts.

ii. Band placement

In this, fertilizer is placed in bands which may be continuous or discontinuous to the side of seedling, some distances away from it and either at level with the seed, above the seed level or below the seed level. There are two types of band placement: It includes hill and row placement.

- **Hill placement:** When the plants are spaced 3 ft. or more on both sides, fertilizers are placed close to the plant in bands on one or both sides of the plants. The length and depth of the band and its distance from plant varies with the crop and the amount of fertilizer as in cotton.
- **Row placement:** When the seeds or plants are sown close together in a row, the fertilizer is put in continuous band on one or both sides of the one or both sides of the row by hand or a seed drill. It is practiced for sugarcane, potato, maize, tobacco, cereals and vegetable crops.

Higher rates of fertilizers are possible with row placement than hill placement. For applying small amount of fertilizers, hill placement is usually most effective.

iii. Pellet application

In this method, fertilizer (nitrogenous fertilizers) is applied in the form of pellets 2.5 – 5.0 cm. deep between the rows of paddy crop. Fertilizer is mixed with soil in the ratio of 1:10 and make into dough. Small pellets of a convenient size are then made and deposited in the soft mud of paddy fields. It increases the efficiency of nitrogenous fertilizers.

iv. Side dressing

Fertilizers are spread in between the rows or around the plants. It includes i) application of nitrogenous fertilizers in between the rows by hand to broad row crops like maize, S.cane tobacco,



cereals which is done to supply additional doses of N to the growing crop. ii) Application of mixed or straight fertilizer around the base of the fruit trees and done once, twice or thrice in a year depending upon age.

v. Circular placement

Application of manures and fertilizers around the hill or the trunk of fruit tree crops in the active root zone.

vi. Pocket placement

Application of fertilizers deep in soil to increase its efficiency Especially for the sugarcane pocket placement is done. Fertilizers are put in 2 to 3 pockets opened around every hill by means of a sharp stick.

Generally placement of fertilizer is done for three reasons.

- Efficient use of plant nutrients from plant emergence to maturity.
- To avoid the fixation of phosphate in acid soils.
- Convenience to the grower.

Advantages of placement of fertilizers

The main advantages are as follows:

- When the fertilizer is placed, there is minimum contact between the soil and the fertilizer, and thus fixation of nutrients is greatly reduced.
- The weeds all over the field cannot make use of the fertilizers.
- Residual response of fertilizers is usually higher.
- Utilization of fertilizers by the plants is higher.
- Loss of nitrogen by leaching is reduced.
- Being immobile, phosphates are better utilized when placed.

B. Application of fertilizers in liquid form

a. Starter solutions

It refers to the application of solution of N, P_2O_5 and K_2O in the ratio of 1:2:1 and 1:1:2 to young plants at the time of transplanting, particularly for vegetables.

Starter solution helps in rapid establishment and quick growth of seedlings.

The disadvantages of starter solutions are

- Extra labor is required, and
- The fixation of phosphate is higher.

b. Foliar Application

1. It refers to the spraying of fertilizer solutions containing one or more nutrients on the foliage of growing plants.
2. Several nutrient elements are readily absorbed by leaves when they are dissolved in water and sprayed on them.
3. The concentration of the spray solution has to be controlled, otherwise serious damage may result due to scorching of the leaves.
4. Foliar application is effective for the application of minor nutrients like iron, copper, boron, zinc and manganese. Sometimes insecticides are also applied along with fertilizers.



3. Application through irrigation water (Fertigation)

- It refers to the application of water soluble fertilizers through irrigation water.
- The nutrients are thus carried into the soil in solution.
- Generally nitrogenous fertilizers are applied through irrigation water.

4. Injection into soil

- Liquid fertilizers for injection into the soil may be of either pressure or non-pressure types.
- Non-pressure solutions may be applied either on the surface or in furrows without appreciable loss of plant nutrients under most conditions.
- Anhydrous ammonia must be placed in narrow furrows at a depth of 12-15 cm and covered immediately to prevent loss of ammonia.

5. Aerial application

In areas where ground application is not practicable, the fertilizer solutions are applied by aircraft particularly in hilly areas, in forest lands, in grass lands or in sugarcane fields etc.

C. Application of fertilizers in gaseous form

Anhydrous ammonia, which supplies nitrogen, is the only gaseous fertilizer used. Farmers usually hire trained specialists to apply the 5.7 million tons of ammonia used annually in the United States.

Anhydrous ammonia is typically stored in a liquid form, most commonly under pressure, and to a lesser degree, under refrigeration. Anhydrous liquified ammonia is applied by subsurface injection. The ammonia quickly vaporizes, but is captured by several components in the soil including water, clay, and other minerals.

