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Methods of Fertilizer Application and Site Specific Nutrient Management

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Fertilizer

A fertilizer any material where one or more nutrients are found in soluble and available from, which are prepared by the form of natural or synthetic origin that is applied to soil or to plant tissues to supply one or more plant nutrients to the growth of plants, e.g. .Urea, Super Phosphate, D.A.P etc.

Principles of Fertilizer Application

Mainly the principle to depend on to increase the use efficiency of fertilizer and make to increase the level of soil fertility i.e. depend on the 4 R application (Right time, Right place, Right amount and Right source or method).Where are two is most important to fertilizer application depend on as fallow :

Time of Application

A close relationship exists between available soil moisture and response of crops to fertilizers. In arid and semiarid regions, soil moisture is the limiting factor for fertilizer use. All the fertilizers are recommended as basal application for rain fed crops grown on stored soil moisture. Early application is more effective for short duration crops. Rate of crop growth is proportional to the rate of assimilation of nutrients, especially nitrogen. Demand for nitrogen increases from early vegetative to flowering stage. Hence, nitrogen fertilizers should be applied at least twice, one at sowing planting and again before flowering. Phosphorus & potash requirement are higher during early phases of crop growth. As such entire dose may be applied at sowing.

Placement of Fertilizers

Placement of fertilizers in the root zone improves their effective. There should be minimum contact of fertilizers with the soil to avoid fixation of nutrients. Phosphorus fixation in acid soils can be minimized by placement of water soluble phosphate fertilizers.

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Ammonical fertilizers should be placed in reduced zone for lowland rice to avoid losses of applied nitrogen. Response of dry land crops to fertilizers increase with their placement at about 5-10 cm below the surface, where soil moisture will be available for over long period of time. Response of dry land crops to fertilizers increase with their placement at about 5-10 cm below the surface, where soil moisture will be available for over long period of time.

Methods of Application

Fertilizer is in mainly in two forms like solid and liquid form.

A. Solid Fertilizer Application Method

Method of Solid Fertilizer Application

Broad Casting

The application of fertilizer at the time of sowing in the form of basal dressing. Solid Fertilizer Broadcasting is the method of application of fertilizer uniformly over the entire field. It may be at planting or in standing crop as top dressing. Broadcasting at planting is adopted under certain conditions. Soils highly deficient, especially in nitrogen. Where fertilizers like basic slag, dicalcium phosphate, bone meal and rock phosphate are to be applied to acid soils. When potassic fertilizers are to be applied to potash deficient soilsTop Dressing

Top dressing is application of fertilizer to the standing crop. Usually, nitrate nitrogen fertilizers are top dressed. Depending on the duration of the crop and soil type, top dressings may be more than one to meet the crop needs at times of greatest need of the crops. Here the application of fertilizer in standing crop throw the broad casting ,spot dressing and side dressing.

Placement Method

An important item in efficient use of fertilizer is that of placement in relation to plant. Fertilizers are placed in the soil either before sowing or after sowing. Here the application of fertilizer as fallow.

Deep Placement

Deep placement is application of fertilizers, especially nitrogen, in the reduced zone to avoid nitrogen losses in lowland rice.

Subsoil Placement

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It refers to placement of fertilizer in the subsoil with the help of machinery. It is usually adopted where the subsoil is strongly acidic. Usually, phosphatic and potassic fertilizers are applied with this method.

Plough Sole Placement

Plough-sole placement consists of placing the fertilizer in a continuous band at the bottom of the furrow during the process of ploughing, which is usually covered by the next furrow adjacent to it. Since the fertilizer is placed in subsoil where soil moisture is available for over a longer period, it will be available to the plant for longer time, especially during dry season. Localized Placement

In this method fertilizers are applied close to the seed or plant. It is usually adopted when relatively small quantities of fertilizers are to be applied. Here the method of fertilization application is so many type of placement in sub soil. Eg Dibbling placement, Drilling Placement, Band Placement, Ball or pellet placement, ring placement and contact placement.

Contact Placement or Drill Placement

Contact Placement or Drill Placement refers to drilling seed and fertilizer simultaneously at sowing. Care must be taken to place the seed and fertilizer at different depths to avoid salt injury to the germinating seed.

Ferti-Seed Drills

Ferti-seed drills are popular in dry land agriculture for drill placement.

Band Placement

Band placement consists of applying the fertilizer in continuous or discontinuous bands, close to the seed or plant. When the plants are widely spaced, fertilizer is placed on one or both sides of the plant. It is called hill placement. Crops like cotton, castor, etc. are well suited for this method. Band placement is done under the following situations: (1) when the crop needs initial good start, (2) when soil fertility is low, (3) when fertilizer materials react with soil constituents leading to fixation, and (4) where volatilization losses are high. Depending on the root system, fertilizer band is placed directly beneath the seed or by the side of the row. For crops like castor, red gram, cotton etc., with tap root system, fertilizer band can be 5 cm below the seed. In cereals and millets, which produce fibrous root system, it is advantageous to place fertilizers 5 cm away from the seed row and 5 cm deeper than the

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seed placement. Row placement consists of placing the fertilizer in a row in continuous bands on one or both sides of row by hand or seed drill. This method is ideal for sugarcane, tobacco, maize and vegetable crops.

Pellet Placement

Pellet placement is application of fertilizer, especially nitrogen in pellet form in the lowland rice to avoid nitrogen loss from applied fertilizer. Soil and fertilizer are mixed, usually, in the reduced zone. Side dressing consists of spreading the fertilizer between the rows or around the plants. As such it is a broad term converting methods such as row placement and hill placement.

B. Liquid Fertilizer Application Method

To use of liquid fertilizer firstly prepared a starter fertilizer solution. These are solutions of fertilizers prepared in low concentrations used for soaking seed, dipping roots or spraying on seedlings for early establishment and growth. The use of that solution in different form as fallow:

Liquid fertilizers such as anhydrous ammonia are applied directly to the soil with special injecting equipment. Liquid manures such as urine, sewage water and shed washings are directly let into the field.

Application of Fertilizer with Irrigation Water

This is the application of fertilizer in irrigation water in either open or closed system. Nitrogen and sulphur are the principal nutrients applied by fertigation.

Foliar Application of Spray Fertilization

In this method, nutrients are applied to the standing crops in the form of spray for quick recovery from the deficiency. It avoids fixation of nutrients in thesoil. This method is suitable for application of small quantities of fertilizers, especially micronutrients.

- Sinking seed in nutrient solution
- Coating seeds with nutrients paste.
- Injection of nutrient solution in to the plants.

What does Site-Specific Nutrient Management Offer?

Site-specific nutrient management provides a plant-based approach for:

- Determining the amount of fertilizer N to apply in the first N application near crop establishment.

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- Estimating approximate fertilizer N rates for within-season applications.
- Dynamically varying the within-season rates of fertilizer N to match the spatial and temporal needs of the crop for N
- A pre-season estimate for total fertilizer N is used to determine the rate for the first N application at crop establishment and to set ranges for within-season fertilizer N rates that are then dynamically determined through monitoring of the crop.
- The total fertilizer N required by a crop for an entire growing season is directly related to the anticipated crop response to fertilizer N, which is the difference between a yield target and yield without fertilizer N - referred to as the N-limited yield.
- Yield response to fertilizer N = Yield target – N-limited yield
- The yield target is the grain yield attainable by farmers with good crop and nutrient management and average climatic conditions for a given location. It can be estimated from measured yields of previous crops in the field or through the use of crop models.

The yield target can for example be set at a percentage of the climate-determined yield potential of the crop varieties. In the case of rice, the economic yield target is typically about 75-80% of the yield potential.

1. The N-limited yield is directly related to the supply of N from indigenous (non-fertilizer) sources, which include soil, crop residues, organic inputs, rainfall, atmospheric deposition and irrigation water. It can be estimated with soil analysis, soil sensors, and with the nutrient omission plot technique. With the nutrient omission plot technique, the N-limited yield is determined from the grain yield for a crop not fertilized with N but fertilized with other nutrients to ensure they do not limit yield.
2. Within-season monitoring of the crop N status enables the use of corrective N applications adjusted to the spatial and temporal variations in crop need for supplemental N. Tools across a range of sophistication including high-tech measurements of spectral reflectance or biomass density of the crop canopy, intermediate-tech measurements of light reflectance or light transmission on individual plants, and low-tech manual measurements of leaf color, as well as direct determination of N concentration in plant tissue or sap are available.
3. In case of plant-based approach of SSNM for rice in Asia, strategies for midseason N applications strive to ensure the supply of N is synchronized with the crop need for N

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at critical growth stages of active tillering (to achieve an adequate number of panicles), panicle initiation (to increase grain number per panicle) and ripening (to enhance grain filling).

4. A simple, inexpensive low-tech tool such as the leaf color chart (LCC) is well suited as an indicator of the leaf N status for small-scale farmers in Asia. A standardized plastic LCC with four panels ranging in color from yellowish green to dark green has been developed through the International Rice Research Institute, IRRI and calibrated for many rice cultivars and production systems across. Phosphorus and potassium management.
5. The SSNM approach is based on the direct relationship between crop yield and the need of the crop for a nutrient, as determined from the total amount of the nutrient in the crop at maturity.
6. The yield target provides an estimate of the total P and K needed by the crop. The portion of this requirement that can be obtained from non-fertilizer sources such as soil, crop residues, organic inputs and irrigation water is referred to as the indigenous nutrient supply.
7. SSNM developed for rice in Asia uses a nutrient balance approach, in which fertilizer P and K are recommended in amounts sufficient to close the gap between the needs of the crop to achieve the yield target and the indigenous supply and to ensure soil fertility is maintained by not mining the soil of the nutrient. Because rice grain yield is directly related to thetotal amount of P taken up by rice, indigenous P supply can be determined from the P-limited yield, which is the grain yield for a crop not fertilized with P but fertilized with other nutrients to ensure they do not limit yield.
8. The indigenous K supply can similarly be estimated from the K-limited yield, which is the grain yield for a crop not fertilized with K but fertilized with other nutrients to ensure they do not limit yield. Irrigation water can be an important indigenous source of K that is accounted for with K-limited yield in the SSNM approach but not with soil testing.
9. The attainable yield target and P-limited yield are used with a nutrient decision support system to determine the amount of fertilizer P2O5 required to both overcome P deficiency and maintain soil P fertility.

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10. The attainable yield target and K-limited yield, together with an estimate of the amount of retained crop residue, are used to determine the amount of fertilizer K2O required to both overcome K deficiency and maintain soil K fertility. Implementation of Site-Specific Nutrient Management
    a. Site-specific nutrient management as developed for small-scale rice production in Asia similarly uses within-season variable rate adjustments of fertilizer N but with a low-tech leaf color chart (LCC).
    b. SSNM approach as compared to existing farmers' fertilizer practices has demonstrated increased yields and benefits for rice farmers across Asia.
    c. In southern India, a considerable portion of the added benefit was associated with improved K management. Farmers practicing SSNM in southern India also reduced their use of pesticides.

Conclusion

Since the agricultural land area is shrinking, due to the increase in population and land being removed from agriculture by industrial and other human activities, in-creasing global food production to meet the needs of the world population will more and more require an increased use of fertilizers. However, this must be to use of accompanied by the promotion and the increased use efficiency of fertilizer , practices or method of fertilizer and use of SSNM practices that ensure a more efficient use of plant nutrients and natural resources (e.g. the soils), while enhancing the environment.

References

Fundamentals of Soil Science. 1998. Published by ISSS, New Delhi.

Introduction to soil Science. Dilip Kumar Das. 2010. Kalayani Publishers New Delhi.

Manures and fertilizers. Yawalkar K.S, Agarwal, T.P and Bokde, S 1995. Agril. Publishing House, Nagpur.

Nature and Properties of Soils. 2005. Brady N.C.and Ray Well. Saurabh Printers Private Ltd., ND.

Pampolino, M.F., I.J. Manguiat, S. Ramanathan, H.C. Gines, P.S. Tan, T.N. Chi, R. Rajendra and R.J. Buresh. 2007. Environmental impact and economic benefits of site-specific nutrient management (SSNM) in irrigated rice systems. Agricultural Systems 93, 1–24.

Soil Fertility – Theory and Practices. Kanwar J.S. (Ed.), 1976, ICAR, N.D.