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Guidelines for Maximizing Fertilizer Use Efficiency

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Fertilizers are main component for high yield sustainable agriculture. Choice of a fertilizer depends on unit cost of nutrient present in it and its agronomic efficiency under a given situation. Fertilizer is a valuable input and measures should be taken to reduce its losses and to increase its uptake and utilization by the crop. Selecting a situation-specific fertilizer and choosing the time and method of application according to crop demand would minimize losses and increase its efficiency.

N-FERTILISER

Most crop plants recover only 25-35% of the nitrogen applied as fertilizers. Losses occur by ammonia volatilisation, denitrification, and immobilization to organic forms, leaching and run off. Utmost care should be bestowed in selecting the type of fertiliser as well as the timing and method of application. The right choice of fertilizer and right dose along with right time of application leads a bumper maize crop (Fig. 01).

Choice of Nitrogenous Fertilisers

- In submerged rice soil, ammoniacal and ammonia-producing fertilizers like urea are most suitable since ammonia is the most stable form of nitrogen under such conditions.
- For acidic upland soils, ammoniacal fertilizers are most suitable during rainy season since ammonium is adsorbed on soil particles and hence leaching losses are reduced. Adsorbed ammonium is gradually released for nitrification and thus becomes available to crops for a longer period.
- In highly acidic upland soils, urea is preferred to ammonium sulphate as the former is less acid forming.
- In alkaline upland soils of low rainfall regions, nitrate fertilizers are preferred to ammoniacal fertilizers or urea since ammonia may be lost by volatilization under alkaline conditions.

Management of Nitrogenous Fertilizers

- Almost all the nitrogenous fertilizers are highly amenable to losses and since most of the crops require nitrogen during the entire growth period, split application is necessary to ensure maximum utilization by crops.
- More number of splits may be given for long duration crops as well as perennial crops.
- Nitrogen losses from fertilizers are more in coarse textured soils with low cation exchange capacity (CEC) than in fine textured soils. Hence more number of splits is necessary to reduce loss of fertilizer nitrogen from sandy and other light soils.
- For medium duration rice varieties, nitrogenous fertilizers should be given in three splits, as basal, at maximum tillering and at panicle initiation stage.
- In coarse textured sandy or loamy soils, the entire dose of nitrogenous fertilizers may be applied in 3-4 splits at different stages of growth of rice crop.
- In areas where split application of nitrogen is not feasible due to water stagnation after planting/sowing, full dose of nitrogen as basal may be given in the form of neem coated or coal tar coated urea.
- In double-cropped wetlands, 50% of N requirement of the first crop may be applied in the organic form.

- As far as possible, liming should be done one or two weeks prior to the application of ammoniacal or ammonia forming fertilizer like urea since ammonia is likely to be lost by volatilization if applied along with lime.
- Almost 70% of N in urea applied by broadcast to flooded soil is lost by volatilization, immobilization and by denitrification.

Figure 1: Bumper maize crop in field due to best fertilizer management practices.

Measures to Reduce the Loss of Nitrogen from Applied Urea

- Urea super granules or urea briquettes may be used in places where soil is clayey and has cation exchange capacity more than 10 cmol (+) per kg of soil.
- Sulphur or lac coated urea is suitable where soil is liable to intermittent flooding and in situations where water management is difficult. This is more suitable for direct sown crop.
- Urea may be mixed with moist soil and kept for 24-48 hours before application to the field. Alternatively, urea may be mixed with moist soil, made into balls of about three inch diameter and dried under shade. The balls may be placed deep into subsoil.
- Mixing urea with five times its weight of neem cake prolongs the period of nitrogen availability to the crop.
- For submerged soils, coating urea with coal tar and kerosene (100 kg urea is mixed with 2 kg coal tar dissolved in one litre kerosene) before mixing with neem cake is preferred to simple mixing with neem cake.
- Coating urea with neem extract (containing about 5% neem triterpenes) at 1% rate and shade-drying for 1 to 1.5 hours before applying in direct-seeded puddled lowland rice increases nitrogen use efficiency.
- As far as possible, urea may be applied by deep placement or plough sole placement. Deep placement of prilled urea or super granules during the last ploughing followed by flooding and planting is beneficial in light soils. Urea briquettes or super granules may be placed between four hills of transplanted rice, whereas sulphur coated or lac coated urea may be broadcast on the surface.
- Foliar spray of 5% urea solution can be practised in situations where quick response to applied nitrogen is required. If power sprayers are used, the concentration may be increased to 15%. Fresh urea should be used to avoid toxicity due to biuret.
- Awareness and training to farmers helps in dissemination of knowledge about fertilizer use and management in modern farming system.

P-FERTILIZERS

Fertilizer phosphorus is an expensive input and its management poses serious problems due to several complexities in its behaviour in different types of soil. This often results in its poor recovery from applied fertilizers.

Choice of P fertiliers

- In slightly acid, neutral or mildly alkaline soils, water-soluble phosphatic fertilizers are more suitable.
- In wetland rice soils, water-soluble phosphatic fertilizers are preferable as pH of most of the submerged soils is near neutral.
- In strongly acidic soils whose pH does not rise above 5.5 to 6.0 even on submergence, phosphatic fertilizers containing citrate soluble form of P like basic slag, dicalcium phosphate, steamed bone meal etc. are suitable.
- For highly acidic upland soils or submerged soils whose pH will not rise above 5.5 even on submergence, powdered rock phosphate is suitable. Soil acidity converts tricalcium phosphate in rock phosphate to plant available monocalcium form.
- For short duration crops where quick response is required, water-soluble phosphatic fertilizers are most suitable.
- For perennial crops like rubber, oil palm, coffee, tea, cardamom etc. phosphorus in the form of rock phosphate can be applied.
- In black soil phosphatic fertilizers containing water-soluble phosphate like single superphosphate are most suitable.

Management of phosphate fertilizers

- Acid soils have to be amended with lime, dolomite or magnesium silicate and alkali soils with iron pyrite or sulphur before application of phosphatic fertilizers. This will help to reduce fixation and increase availability of P.
- Surface application or broadcasting is preferred for shallow rooted crops whereas placement in the root zone is advantageous in deep rooted crops.
- Rock phosphates can be used advantageously in rice grown in acid soils during the virippu season. Powdered rock phosphate may be applied and mixed thoroughly with soil by ploughing. After two or three weeks, the field may be flooded, worked up and planted with rice. Under this situation, phosphorus in rock phosphate gets converted to iron phosphate, which on subsequent waterlogging becomes available to the rice crop.
- Rock phosphate can be used successfully as a phosphatic source for leguminous crop since its root system can extract phosphorous from rock phosphate.
- In single crop wetlands where rice is grown in the virippu season, application of phosphatic fertilizers can be dispensed with for the rice crop, if the second crop (usually legume or green manure) is given phosphatic fertilizers.
- In case of rice-legume cropping sequence in acid soils, application of rock phosphate to the pulse crop helps to skip phosphatic fertilizers in the succeeding rice crop.
- Since phosphorus requirement of seasonal crops is confined to the early stages, phosphatic fertilizers are to be applied at the time of seeding or planting.
- Topdressing of phosphatic fertilizer leads to wastage of the fertilizer nutrient. Further, excessive phosphates may lead to deficiency of micronutrients such as zinc, boron etc.
- Under adverse soil conditions and where quick result is required, spraying water-soluble phosphatic fertilizers like triple superphosphate or hot water extract of superphosphate can be resorted to.

Figure 2: Awareness among farmers must be created through training and workshop. (Author interacting farmers of Uri Sector of Kashmir during training).

K-FERTILISERS

For most crops, potassium can be supplied as muriate of potash. But in crops like tobacco and potato, muriate of potash may cause chloride injury, reducing quality of the produce. In such cases, K may be applied as potassium sulphate.

Management of K fertilizers

- In coarse textured soils and in heavy rainfall regions, potassium fertilizers should be applied in as many splits as possible, to reduce loss of potassium.
- In fine textured soils, the entire dose of potassium fertilizers may be applied as basal.
- In acid soils, potassium fertilizers should be applied only after lime application to prevent loss of potassium by leaching.

Conclusion

Besides major nutrient, it is essential to use secondary and micronutrient fertilizer mixture for maximum benefits from fertilizer. Wise use of fertilizer not only increases the crop productivity and water but reduces cost of cultivation. Best fertilizer management practices (BMPs) are important for sustainable crop productivity and soil health in modern farming system where nutrient turnover is higher.

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