Integrated Nutrient Management in Dryland Agriculture

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All plants require 16 nutrient elements for their normal growth and development. Of these nitrogen (N), phosphorus (P), and potassium (K) are required in large quantities even though all nutrients are equally important. A fertile soil supplies most of the plant nutrients adequately as per the crop requirement. Due to continuous cropping and multiple cropping in fertile lands as well as cultivation in poorer marginal lands, crop nutrient requirement is not met completely by the soil. The nutrients required in moderate to small quantities are supplied by the soil in most areas except in highly eroded soils. However, plant nutrients that are required in large quantities have to be supplied through external sources to the soil. External sources of plant nutrients are: organic manures; biological nitrogen fixation; and mineral or inorganic (commercial) fertilizers.

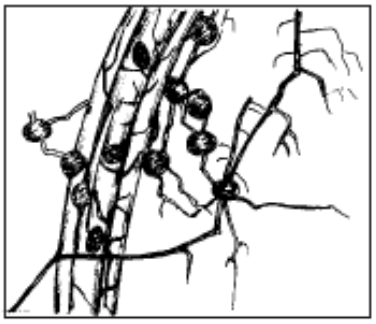
Organic Manures

- Farmyard manure (FYM) – 100 kg supplies: 0.5 to 1.0 kg N
0.1 to 0.3 kg P
0.5 to 1.0 kg K
Other nutrients in smaller quantities
- Compost (rural and urban) – content varies with the composition
- Concentrates
  - Oil cakes
  - Poultry manures
  - Bone meal
  - Fish meal
  - Slaughterhouse waste
- Crop residues – 100 kg sorghum stalks contain: 0.2 to 0.5 kg N
0.02 to 0.04 kg P
0.7 to 1.3 kg K
- Green manures
  - In situ *Sesbania*
Crotalaria
  - Ex-situ (on bunds and wastelands) *Gliricidia*
Pongamia
  - Most of the legume green manures contain 2% N.

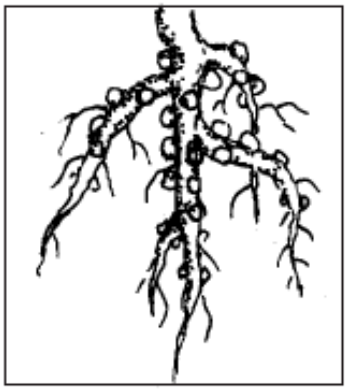
In addition to N, P, K, organic manures supply other plant nutrients unlike fertilizers. Compost can be prepared in the village itself using weeds, crop residues, etc. New methods by using earthworms can hasten the preparation. Crop residues as such can be used provided they do not have other uses and there is enough time for decomposition. Green manure legumes such as *Gliricidia*, *Sesbania*, and other leguminous shrubs and small trees can be grown on bunds and wastelands. They provide nearly 50 kg N ha^{-1} in addition to small quantities of other nutrients. All these bulky organic manures not

only supply plant nutrients but also increase soil organic matter resulting in improved soil physical conditions; nutrient losses are reduced and nutrient availability is improved through the support of microorganisms. In many farm conditions, availability of FYM has been declining due to decrease in animal populations for various reasons. Therefore, compost making and green manure production should be encouraged. Concentrates like oil cakes are costly and many of them have alternate uses. Poultry manure and town compost should be used in greater amounts. But, transporting these manures is costly.

Biological Nitrogen Fixation (BNF)



Most legumes fix atmospheric N in their root nodules and often they are almost self-sufficient up to 80% of their requirements. Crop residues of these legumes can be used or they can be exclusively grown as green manure crops. The N-fixation of legumes can be improved by treating the seeds with *Rhizobium* culture. Even crop rotation with grain legumes (mung bean, black gram, and chickpea) or intercropping of pigeonpea with cereals (sorghum or maize) benefit the succeeding crops by about 20 to 40 kg N ha^{-1} resulting in 0.5 to 1 ton of extra grain yield of cereals. Some important aspects of BNF are:



- BNF is an integral part of N cycling in nature.
- *Rhizobium* inoculation is practiced instead of fertilizer N application to ensure adequate N nutrition of legumes.
- Efficient strains of *Rhizobium/Bradyrizobium* supplied as inoculants of seed or soil are used as biofertilizers.

Use of Biofertilizer through Seed Inoculation

- Different crops require different rhizobia.
- Select the right type of biofertilizer (inoculant).
- The inoculant must be fresh and within the expiry date limit.
- Use well-tested inoculants produced by reputable manufacturers.
- Users in India must insist on inoculants with ISI mark.
- Specify rate of inoculant per kg of seed.
- Specify the fungicide/insecticide/*Rhizobium* treatment sequence.
- Prepare inoculum slurry using a sticking agent such as jaggery, rice porridge, gum arabic, etc.
- Mix seeds with inoculum slurry by hand.
- Dry seeds on a plastic sheet kept under shade.
- Sow seeds within 48 hours after inoculation.
- Cost of biofertilizers varies from Rs 20–80 ha^{-1}.

Mineral Fertilizers

Mineral fertilizers are concentrated simple fertilizers such as urea, single super phosphate, and muriate of potash or complex fertilizers like di-ammonium phosphate (18:46), and 17:17:17, etc.

Approach

An integrated approach has to be followed. First, use all farm available sources of nutrients like FYM, compost, green manure, etc. Later, the remaining nutrient amounts of recommended dose for particular target yield of specified crop should be supplemented by inorganic fertilizers. Improved methods of application of manure and fertilizers along with proper timing will enhance the efficiency of nutrients.

Benefits

Integrated nutrient management is economical because it reduces the dependency on costly fertilizers. This approach also supplies most of the plant nutrients, improves soil structure, and reduces losses of nutrients from soil. It will also make the soil more productive for years to come.