Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 02, Issue: 06 (NOV-DEC, 2022)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Nutrient Management Strategies for Enhancing Productivity of Dryland Agriculture

(*Pushkar Dev, Subhash Chandra Yadav and Suman Khandelwal)
Krishi Vigyan Kendra, Alwar-I
*Corresponding Author's email: pushkardevgurjar@gmail.com

Need for integrated nutrients management

- Use of mineral (chemical) fertilizers is the surest and quickest way to increase crop production.
- The high cost, unavailability and risks associated with fertilizer deter farmers from using them in recommended and balanced proportions.
- INM is essential to maintain soil fertility and increase food production without harming the environment.

Sources of nutrients for crop Production

- Soil organic matter
- Soil reserves
- Biological nitrogen fixation (BNF)
- Organic manures
- Mineral fertilizers
- Precipitation and irrigation water

Do you know that?

Over 29% (96.4 million hectares) of India's total geographical area (328.7 million hectares) is degraded.

Soil pollution

Heavy metals -31%
Mineral oil -20%
Other -7%
Hydrocarbons -42%

INM strategy

- The INM strategy includes maintenance or adjustment of soil fertility and plant nutrient supply to sustain the desired level of crop productivity.
- INM is a holistic system approach focusing on the cropping system rather than on individual crop.
- INM also focuses on the farming system rather than on individual field
- It does not preclude the use of mineral fertilizers.
- It relies heavily on optimal use of renewable nutrient sources such as BNF and organic manures and minimal use of mineral fertilizers.

Biological inputs for nutrient management

Biological process

- Several microorganisms in the soil decompose plant and animal residues.
- Microorganisms regulate nutrient flow in the soil by assimilating nutrients and producing soil biomass (immobilization) and converting carbon, nitrogen, phosphorus and sulphur to mineral forms (mineralization).
- Several groups of microorganisms are involved in important biological processes.

Beneficial microorganisms

- Symbiotic nitrogen fixers-symbiotic partnership between bacteria (Rhizobium/Bradyrhizobium) and legumes contributes substantially (up to 450 kg/ha/yr) to total BNF.
- Non-symbiotic and associative nitrogen fixers-Inoculation with bacteria (Azotobacter and Azospirillum) reduces N requirement of cereals or non-legume crops up to 20 kg/ha.
- Plant growth promoting rhizobacteria (PGPR)-these Improve plant growth through hormonal effects and reduce disease severity.
- Phosphate solubilising microorganisms-these bacteria and fungi solubilise inorganic phosphates and make them available to plants in usable form.
- Vesicular-arbuscular mycorrhizae (VAM)-these help Increased uptake of nutrients such as P, S, Cu, etc. and improve plant growth.

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BNF

- BNF is an integral part of nitrogen cycling in nature.
- Rhizobium inoculation is practised to ensure adequate nitrogen nutrition of legumes instead of fertiliser nitrogen.
- Efficient strains of Rhizobium/Bradyrhizobium supplied as inoculants are used as biofertilisers by seed or soil inoculation.

Use of biofertiliser by seed inoculation

- Different crops require different rhizobia.
- Select the right type of biofertiliser (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.
- 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 a shade. Sow seeds within 48 hours after inoculation.
- Cost of biofertilisers varies from Rs. 20 – Rs. 80 per hectare

Advantages of BNF

- An economically- attractive and ecologically-sound process.
- Reduces external nitrogen inputs.
- Improves the quality and quantity of internal resources of nitrogen.

Management practices to Improve plant growth and BNF in soil

- Use high nitrogen-fixing crops/varieties.
- Practice mixed cropping and intercropping (row and Strip) with legumes.
- Use appropriate tillage practices, landform treatments and nutrient amendments.

Legumes, grown in rotation or as intercrops, increase crops yields of succeeding non-legume crop by 0.5 to 3 tonnes/ha saving up to 120 kg N/ha compared to sequential cropping of non-legume crops.

Organic Inputs for nutrient management

- Addition of organic matter to the soil is essential to maintain soil fertility and productivity.
- Organic manures are of two types: bulky – FYM, Composts (rural and town), crop residues; and Concentrated-oilcakes, poultry manure, slaughter house waste, etc.
- FYM is the most commonly used organic manure in India, particularly for high value crops. It is prepared from animal-shed wastes and straw and contains 0.5- 1.0% N, 0.05-0.07% P and 0.03-0.035% K.
- Crop residues can be recycled by composting, mulching and direct incorporation. About 240 million t yr' straw/ stover is produced from rice, wheat, sorghum, pearl millet and maize.
- Based on N content, organic manures are less efficient than mineral fertilizers; however, combined use of these nutrient sources is superior than using mineral fertilizer alone.
- A combination of crop residue restitution (based on the availability), fallowing or green manuring can be used to maintain organic matter levels in the soil.

Mineral fertilizers

- Use appropriate mineral fertilizers to meet the demand for necessary nutrients.
- Ensure that efficiency of applied fertilizers is optimized trough adoption of suitable practices.

Types of soil degradation

> Loss of organic carbon
> Erosion
> Acidification
> Pollution
> Nutrient imbalance
> Stalinization
> Biodiversity loss.

Fertilizer application

- Form or type as recommended for the crop.
- Method-furrow placement and covering with soil instead of broadcasting.
- Time- Split N doses instead of one application.
- Quantity just sufficient to meet plant demand without adversely affecting BNF.

Implementation of INM

- The knowledge available about different sources of nutrients such as BNF, organic manures and mineral fertilizers can be used to develop a suitable strategy for INM to sustain crop productivity.
- INM strategy is realistic, attractive, and environment- friendly.
- INM will enhance the efficiency of biological, organic and mineral inputs for sustaining productivity of dryland soils.

Advantages

- Increases biological activity in the soil.
- Reduces nitrogen losses through Immobilization.
- Improves the performance of microorganisms such as azotobacters, azosporilla, PGPR and VAM.
- Improves soil fertility, soil productivity and crop productivity.