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Integrated Nutrient Management: a feasible way towards sustainable Agriculture

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Abstract

Integrated Nutrient Management (INM) as a feasible way towards sustainable agriculture that combines use of chemical fertilizers, organic manures and biofertilizers. INM reduces chemical fertilizer use by maintaining yields, improving soil health by increasing organic carbon and water retention capacity, helps to increase income benefits and reduces environmental pollution by minimizing nitrate leaching. This includes practical applications for some crops, implementation methods including soil testing, and addresses farmer obstacles like awareness gaps and organic manure availability, suggesting solutions through training programs and government subsidies and basically proving why INM is better than Conventional Agriculture.

Keywords: INM, Bio fertilizers, Organic

Introduction

Soil fertility and crop production, both are negatively affected due to continuous use of chemical fertilizers alone. The rising level of inorganic fertilizers negatively affects the human health (Toor *et a*l., 2020) soil texture and structure. Thereupon, integrated nutrient management is the use of all sources of nutrients (Chemical fertlizers, Organic manure and biofertilizers to maintain soil fertility and sustainable high productivity and reduce environmental pollution. The effect of integrated application of inorganic and organic fertilizers combinedly increase use of mineral fertilizer and balanced supply of all essential nutrients required for proper growth & development and also to improve soil health.

Components Of INM

Organic Sources: Farmyard manure (FYM), Vermicompost, Compost, Green manuring & crop residues are common or major sources of organic materials. Farmyard manure has (0.5% N,0.2% P, 1.5 % K) thus, improves soil physical properties while Vermicompost improves soil microbial activity as it contains (2% N, 1% P, 1.5% K). Compost supply balanced nutrients and enhances water retention capacity while green manuring crops like sesbania & dhaincha sum up 50-60 kg nitrogen per hectare in fields and crop residues when incorporated back return nutrients and improve organic carbon availability.

Chemical Fertilizers: Inorganic fertilizers such as Urea, MOP and DAP supply preferably available nutrients in concentrated form. A normal fertilizer if containing all NPK elements give nitrogen for vegetative growth, Phosphorous for flowering & root development and Potassium for proper plant growth and development. They provide fast results and accurate nutrients based on crop and soil requirements.

Biofertilizers: all nutrients are available in soil by nature itself but they are in fixed form biofertilizers are used to make them available for plants from fixed form to available form. Mainly the biofertilizers used are Azotobacter & Azospirillum that fixes nitrogen for non-legume crops (15-20 kg N/ha) while Rhizobium fixes nitrogen (20-40 kg/ha) in legume crops. Phosphate solubilizing Bacteria (PSB) converts phosphorous into available form for plants.

Interaction Effect: Organic sources enhance soil structure, improves cation exchange capacity, and minimizes nutrient loss through leaching. This enhances the impact of chemical fertilizers by 16-20%. Biofertilizers benefits more if used in integration of organic matter.

Benefits of adopting Integrated Nutrient Management:

Soil wellness Enhancement: Improves soil organic carbon from 0.4-0.5% to 0.7-0.9% by 4-6 years. It also enhances soil texture & structure, porosity, and water holding capacity by 30-40%.

Improves microbial population and enzymatic reaction. Maintains favourable soil pH and minimizes soil degradation.

Income Benefits: it reduces the use of inorganic fertilizer requirement by 20-35% without yield loss. it Saves ₹3000-4000 per hectare. Increases nutrient use efficiency: nitrogen from 35-40 % to 50-60%, phosphorus from 10-20% to 35-40%. It aims to provide high yields over long duration compared to only inorganic sources.

Saves Environment: minimizes nitrate leaching to groundwater by 50-60%. Decreases greenhouse gas emissions such as CH4 & CO and particularly nitrous oxide. Restrict soil and water pollution. Allow carbon sequestration in soil.

Increases Crop Quality, Quantity and Yield: Maintains 80-85% of maximum yield with reduced chemical fertilizers. Improves crop quantity & quality parameters like grain protein, vitamin content, and shelf life. Controls pest and disease incidence due to balanced nutrition. Improves crop tolerance to drought and other stresses.

Practical Application of INM:

Soil Testing Method: perform soil testing every 1-3 years to analyse nutrient status. Based on test, prepare fertilizer recommendations and apply nutrients according to crop needs and soil potential.

For Leguminaceous crops: give recommended phosphorus and potassium. Add only 25-30% of recommended nitrogen as basal dose. Treat the seeds with Rhizobium culture. Apply 3-4 tonnes compost/ha. Rhizobium can fix 85-100 kg nitrogen/ha.

For Vegetables & Fruits: Apply 20-25 tonnes FYM or 6-8 tonnes vermicompost. Additional with 75% of recommended NPK fertilizers. Use PSB and Azotobacter biofertilizers for balancing phosphorous and nitrogen respectively.

Time and method of application: first of all, apply organic manures 2-3 weeks before sowing for proper decomposition. Apply phosphorus and potassium at sowing time. Split nitrogen dozes at critical growth stages. Use biofertilizers at transplanting time.

Challenge Faced by Farmers & How to Deal It?

Major obstacles: Absence of awareness and knowledge among farmers about INM, its benefits and techniques. unavailability of quality organic manures in optimum quantities. Bulky nature of organic sources doubles transportation cost.

Practical Solutions: Organize training programs and result demonstrations for farmers. Promote composting and vermicompost production units on-farm itself. Make aware about the subsidies on biofertilizers and organic sources by government schemes. Establish farmer producer organizations for facing the issues. Implement crop residue management instead of burning.

Table 1: Comparison between Integrated Nutrient Management (INM) and Conventional Agriculture

Parameters	Integrated Nutrient Management (INM)	Conventional Agriculture
Nutrient Source	Combined use of organic manures, inorganic fertilizers & biofertilizers	Only uses Chemical Fertilizers
Soil Health	Improves Soil physical Properties	Decrease Soil Health by rapid increase in use of chemicals
Cost	Reduce fertilizer cost and increases yield	High cost, Yield reduces over time
Environment impact	Eco-friendly	Pollute Environment by use of harmful chemicals
Nutrient Use	High	Low

Conclusion

Through the integration of chemical fertiliser application with organic practices, Integrated Nutrient Management is a sustainable approach for agriculture. It maintains soil health and environment safety for future generations while ensuring food security. While maintaining productivity levels, this has been accepted by minimizing use of chemical fertilisers by 30–40%. INM is not only an option but a must as it provides a balanced nutrition supply and enhances growth and development of plants.

Reference

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