AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 04 Issue: 04 April 2023 Article No: 02

Integrated Nutrient Management

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SUMMARY

An essential element performs important role in biochemical or physiological functions that are required for normal growth and /or reproduction, in which it cannot be replaced by another element. Plants required at least 17 such elements, called micro and macro nutrient. Now a days these essential elements are supplied to plant by fertilizers. Replacement of a part of chemical fertilizers by organic manure through a simple technique of using minimum effective dose of sufficient and balanced quantities of organic and inorganic fertilizers in combination with specific microorganisms, called INM. Recently, several investigators reported that integrated use of chemical fertilizers with organic manure is becoming a quite promising practice not only for maintaining higher productivity and maintaining the soil health but also for greater stability to crop production. In addition, INM acts as a source of energy, organic carbon, and available nitrogen for the growth of soil microbes and improvement of physical properties of soil, and also have great residual effect on subsequent crops. So, the key component of the INM goal is to reach the eco-friendly practice through the harmonious properties of both sources by making a combination that can be used for decreasing the enormous use of chemical fertilizers and accreting a balance between fertilizer inputs and crop nutrient requirement, maintaining the soil fertility, optimizing the level of yield, maximizing the profitability, and subsequently reducing the environmental pollution.

INTRODUCTION

Food security, food quality, soil health sustainability and climate resilience are the key thrust areas under integrated crop management (ICM) concept. At the same time, we are dependent enough on organic sources to meet out the nutritional requirement of our crops in addition to chemical fertilizer use to feed huge global population in general and India in particular. On the other, the chemical fertilizers are in short supply besides their high escalating prices and ill-effects on soil-plant-human-environment interface. Food insecurity and receding livelihoods under climate change may even threaten the national security in resource poor developing countries. Thus, better plant nutrition and crop management can greatly contribute in global food security. There are about 17 nutrient elements required for proper growth and development of crops [C, H, O, N, P, K , Ca, Mg, S, Zn, Mn, Fe, Mo, Cu, B, Cl, Ni]. The C, H, O are freely available in the atmosphere. Micronutrients are required in very small amounts and applied mostly as foliar sprays. Nitrogen, phosphorus and potassium are the major nutrients and require in large quantities followed by 20-25 kg of calcium, Magnesium and sulphur by plant for sustaining their life cycle and higher yields. Long term fertilizer experiments reveal a declining trend in productivity even with recommended NPK fertilizers, although, chemical fertilizers and organic manures helped in improvement of physical, chemical and biological properties and eventually soil health and crop productivity. Hence, it becomes imperative to use both organic and inorganic sources. Hence, adoption of INM (integrated nutrient management) strategies holds the key in enhancing the productivity as well quality of various crops in an eco-friendly manner. Integrated nutrient management (INM) aims at achieving a harmony in the judicious and efficient use of chemical fertilizers in conjunction with organic manures, crop residues, green manures, legumes in cropping systems, use of bio-fertilizers and other locally available nutrient sources for sustaining soil health and environment as well as crop productivity on long term basis.

Components of Integrated Nutrient Management

INM is a judicious and efficient use of chemical fertilizers in conjunction with organics, crop residues, green manures, legumes in cropping systems, use of bio-fertilizers and other locally available nutrient sources for plant nutrient supply and to maintain soil fertility. Components of INM are as under:

Inorganic/synthetic fertilizers:

Use of chemical fertilizers in balanced proportions and recommended amounts is the quickest way of boosting crop production. Their use is inevitable because the entire nutrients demand cannot be met by organic

manures and biofertilizers alone. Further, chemical fertilizers alone are unable to maintain and sustain the soil health and crop productivity because they are unable to supply micronutrients like organic manures. However, in the application of chemical fertilizers their application should be in a balanced form. Time and method of application is equally important for the efficient utilization of resources.

Organic manures: The organic manures are mainly prepared from animal dung/urine and plant residues. Organic manure improves the soil physical, chemical and biological properties. Build up of secondary and micronutrients and sustenance of soil health are the key beneficial effects associated with organics application. Fertilizer use efficiency is improved by organic manures. FYM is the most important and commonly used organic manure in India.

Crop residues: Crop residues contain all the nutrients essential for plants growth and can be diverted to agricultural fields to improve the soil quality and productivity to some extent where mechanical harvesting is done as mostly used as dry fodder for animals in certain regions. India has a vast potential of crop residues such as rice, wheat and sugarcane, which are substantially rich source of plant nutrients. But there are limitations in the use of crop residues i.e. required in large quantities, used as animal feed, burnt in the field, wider C:N ratio require longer time for decomposition, and un-decomposed residues profusely causing termites problem.

Bio-composts: The process of decomposition of organic wastes is termed as composting and the decomposed material is called as compost. In post-green revolution era, a huge amount of agricultural waste is produced in the country which needs to be scientifically disposed-off in an environment-friendly mode like conversion into valuable composting materials as organic source of plant nutrients. Sufficient research efforts have been made so far to generate sufficient amount of quality organic manures using advanced biocomposting technologies. To overcome the above mentioned problems in the use of organic manures and crop residues in biogas technology and vermi-composting can be made efficiently. Thus, in compost making process the bulk of the material used is plant residues. Types of compost are urban or town compost, rural or village compost and vermi-composts.

Green Manures:

Green manuring is an age old farm practice of ploughing and turning into the soil undecomposed green plant tissue for the purpose of improving soil fertility and productivity. It increases the soil fertility by the direct addition of nitrogen and also improves the soil structure, water holding capacity and microbial population of soil by the addition of humus or organic matter. Green manuring is practiced according to suitability of soil and climatic conditions. The crop generally used for green manuring is dhaincha (Sesbania aculeata) though the cultivation of sun-hemp and guar is also in vogue. Leguminous crops should be preferred as a green manure crop since it adds a lot of nitrogen into soil due to Rhizobium symbiosis. An ideal green manure crop should have following characteristics

- It must have deep rooting system, facilitating nutrient mining from subsurface soil.
- It should have low water and nutrient requirement.
- It should be quick growing to produce abundant biomass.
- The biomass produced should have low fibrous material to facilitate quick decomposition.
- Should have high capacity to fix atmospheric nitrogen.

Commonly used crops for green manuring in our country are Sunn hemp (crotolaraia juncea), Dhaincha (Sesbania aculeate), senji (Melilotus parviflora), berseem (Trifolium alexandrinum) etc.

The under mentioned advantages have been ascribed to the green manure:

- They absorb nutrient from the deeper soil layers and leave them in the surface soil.
- The amount of green plant material buried stimulates the activity of the micro-organisms inhabitant to the soil. They respire and decompose the organic matter CO2, which help in producing carbonic acid. The carbonic acid decomposes the soil minerals to release plant nutrients bind in them
- Green material on decomposition also produces certain organic acids which enhance the availability of certain plant nutrients like phosphorus, calcium, potassium, magnesium and iron.
- The green manuring crop absorbs nutrients from the soil and protects them against leaching losses.

Biofertilizers:

Bio-fertilizers constitute an important component of integrated plant nutrient management (INM) that leads to sustainable agriculture. Bio-fertilizers add nutrients through processes of atmospheric nitrogen fixation, phosphorus solubilization & mobilization and stimulating plant growth by synthesis of growth-promoting bio-molecules etc. Therefore, it is an eco-friendly, low external input intensive, low cost INM technology to conserve natural resources besides maintaining food safety and environmental quality in a sustainable manner. These include nitrogen fixers (both symbiotic as well as non-symbiotic bacteria), phosphate solubilizers (bacteria and fungi), mycorrhizal fungi, sulphur and Fe oxidizing bacteria. Biofertilizers are microbial inoculants of bacteria, algae, fungi alone or in combination and they augment the availability of nutrients to the plants. Biofertilizers are the preparations containing microorganisms beneficial to agricultural production in terms of nutrient supply especially N and P.

Other organic plant nutrition sources.

Some non-conventional materials such as sewage-sludge, urban wastes, press mud, basic slag, fly ash, spent wash and other industrial effluent etc. could also be the potential sources of plant nutrients. However, due precaution should be taken while using sewage sludge and industrial wastes as these contain toxic metals. Therefore, regular monitoring of these pollutants in soil- plant system is essential. Common non-conventional materials are as follows:

- Night soil
- Sewage and sludge
- Oil cakes • Blood- meal/Meat meal/Fish manure
- Horn and hoof-meal, Chicken manure

CONCLUSION

INM entails using all available plant nutrients to optimize nutrient inputs, geographical and temporal matching of soil nutrient availability with crop demand, and decreasing nitrogen losses while increasing crop output. Agricultural input interaction leads to increased crop yield while minimising N losses and GHG emissions, judicious mineral and organic fertilisation with greater resource-use efficiency, and improved soil-plant-microbeenvironmental sustainability. The balanced use of organic manures will be essential for crop production and environmental issues, which should be a top focus for INM practises, providing a “win–win” chance to boost crop output while also maintaining agricultural sustainability.

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