Review Article

Integrated Nutrient Management for Enhancing Cereal Crop Production: A review

Abstract

Integrated Nutrient Management (INM) is a holistic approach that aims to optimize nutrient use efficiency in cereal crop production by combining various sources of nutrients, including organic and inorganic fertilizers. The integration of organic materials, such as crop residues and manures, with chemical fertilizers is emphasized to enhance soil fertility, improve nutrient availability, and promote sustainable agricultural practices. The synergistic effects of combining different nutrient sources contribute to balanced nutrition, reduced environmental impact, and increased resilience to changing climatic conditions. This abstract highlights the significance of integrated nutrient management as a comprehensive strategy for achieving higher cereal crop yields while addressing the challenges of nutrient management and environmental sustainability in modern agriculture.Integrated Nutrient Management not only boosts the growth, yield attributes, overall yield, and quality parameters of cereal crops but also fosters soil health, thereby fostering long-term agricultural sustainability.

Key Words: Integrated nutrient management, Inorganic fertilizers, Soil health, Organic matter

Introduction

Cereal crops are essential for global food security, providing basic nutrition and energy for a significant portion of the world's population. They serve as a fundamental food source, are economically significant, and have diverse uses beyond human consumption, including animal feed and industrial purposes. Cereal crops contribute to agricultural sustainability and resilience, are culturally significant, and are relatively efficient in terms of caloric production per unit of land. Overall, they play a critical role in ensuring food access, economic development, and cultural heritage worldwide.

The Final Estimates of production of major crops for the year 2022-23 have been released by the Department of Agriculture and Farmers Welfare. As per Final Estimates for 2022-23, total Foodgrain production in the country is estimated at record 3296.87 Lakh tonnes which is higher by 140.71 Lakh tonnes than the production of foodgrains of 3156.16 Lakh tonnes achieved during 2021-22. Further, the production during 2022-23 is higher by 308.69 Lakh tonnes than the previous five years' (2017-18 to 2021-22) average production of foodgrains.

The recent stagnation in food grain production is a matter of increasing concern, posing a substantial threat to our national food security. One of the prominent factors contributing to this stagnation is the degradation of soil health, particularly evident in intensively cultivated regions. India boasts an abundant supply of organic manures, including animal dung manure, crop residues, green

manure, rural compost, city compost, and bio-fertilizer. These resources present promising alternatives to inorganic fertilizers, playing a vital role in sustaining soil physical, chemical and biological properties. Organic manures, such as Farm Yard Manure and vermicompost, are instrumental in restoring soil health. The use of vermicompost serves as an effective means to counteract the detrimental impacts of chemical fertilizers on soil health, while crop residues contribute to optimizing the efficiency of applied fertilizers. Overall, the integration of organic manures results in an enhancement of nutrient content and uptake by plants.

The fundamental principle underpinning Integrated Nutrient Management revolves around preserving and potentially enhancing soil fertility to sustain crop productivity over the long term. In practical terms, INM involves a crop nutrition system where plant nutrient requirements are met through a carefully integrated use of mineral fertilizers, organic manures (including green manure, vermicompost, crop residues, Farm Yard Manure etc), and bio-fertilizers. The judicious combination of these varied nutrient sources is customized to the specific needs of the system, land use practices, and local ecological, social, and economic conditions.

Basic of Integrated Nutrient management

Integrated Nutrient Management aims to optimize nutrient use efficiency, enhance crop productivity, and sustainably manage soil fertility by integrating organic and inorganic nutrient sources, adopting precision farming techniques, promoting soil conservation practices, and monitoring soil and crop health. Here basics of integrated nutrient management

- ✓ Soil testing and analysis
- ✓ Balanced fertilization
- ✓ Organic matter management
- ✓ Nutrient recycling
- ✓ Precision farming techniques
- ✓ Crop rotation and diversification
- ✓ Soil conservation practices
- ✓ Monitoring and evaluation

Effect of INM on growth attributes

Combination of organic and inorganic sources plays a significant role in growth parameters. Integrated Nutrient Management (INM) has positive effects on the growth of plants due to its holistic approach to nutrient supply. The highest plant height at harvest and total tillers/hillobserved in rice with application of general RDF (100-30-00 NPK kg/ha) + 10 t FYM/ha (Imade*et al*., 2017). A significant effects observed by INM in plant height and dry matter accumulation of barley with application of 75 % NPK + 5 t FYM/ha + biofertilizer (*Azotobacter*) (Singh 2017). The maximum plant height and dry matter accumulation in wheat found in application of 75 % NPK + 2.5 t vermicompost/ha + *Azotobacter*(Kaur *et* al., 2018). Application of 75 % RDF + 2 t vermicompost/ha + foliar application of $ZnSO_4$ at 0.5 % recordedsignificantlyhigher plant height, dry

matteraccumulation in hybridmaize (Mahato*et al*., 2020).Ponmozhi *et al*. (2019) observed that application of 100 % RDF + 25 % Vermicompost + 25 % FYM + 25 kg $ZnSO_4$ recorded significantly higher plant height, plant dry weight in*kharif* maize.

Effect of INM on yield attributes and yield

The maximum value of yield attributes and yield of rice and wheat were recorded under application of 100 % NPK + 5 t FYM/ha (Singh *et al*., 2013). Application of 150-75-00 NPK kg/ha + 5 t FYM/ha + *Azotobacter* + PSB + Sulphur 40 kg/ha (gypsum) found significantly higher no. of spike/metre row length, length of spike, no. of grains/spike, test weight, grain and straw yield in wheat (Desai *et al*., 2015). Combined use of 75 % NPK + 5 t FYM/ha + biofertilizer (*Azotobacter*) give higher spike length, test weight, grain and straw yield in barley. (Singh 2017). Application of 100 % RDF (40-20-20 kg/ha) produced higher no. of fingers/ear head, test weight, length of fingers, grain and straw yield in finger millet (Harika*et al*., 2019). Patel *et* al. (2017) studied the effect of integrated nutrient management on yield attributes and yield of wheat and revealed that application of 75 % RDF + 10 t FYM/ha recorded higher no. of spikelets/spike, test weight, grain and straw yield. Application of RDF + 20 kg $ZnSO_4$/ha in pearl millet recorded higher no. of tillers/plant, grain and straw yield (Kadam*et al*., 2019). Shankar *et al.* (2020) recorded higher tillers/m2, no. of panicles/m2, spikelets/panicle, test weight, grain and straw are found in application 75 % RDN + 25 % RDN throughpoultrymanure in summerrice. Application of 100 % RDF+10 t FYM/ha recorded significantly highest growth, yield attributes and yield parameters of *rabi* sorghum studied by Tudu*et al*. (2023).

Effect of INM on soil properties

The integration of various nutrient sources through INM positively influences soil properties, fostering a healthier and more productive soil environment for sustainable agriculture. It also helps in mitigating the environmental impacts associated with conventional fertilizer use. Application of 75 % RDF-IF + dhaincha green manuring incorporation in alternate year in rice recorded higher soil organic carbon and available N, P_2O_5, K_2O (Kumar *et al*. 2017). Higher organic carbon, nutrients uptake like NPK and available N, P_2O_5, K_2O, S in oat recorded under the application of 75 % NPK + 5 t FYM/ha + 20 kg S/ha as compare to the rest of the treatments (Pandey, 2018). Application of 100-40 (N-P kg/ha) + *Azospirillum* (Soil treat.) gave higher NPK content and uptake of nutrients in fodder sorghum (Bhuriya*et al*., 2022).

Conclusion

In summary, it is evident that the widespread nutrient deficiencies or toxicities are progressively compromising soil health. This degradation is contributing to low productivity and profitability in cereal crops, primarily attributed to poor nutrient use efficiency. A strategic approach that combines the judicious use of chemical fertilizers with naturally available organic sources has a transformative impact on maintaining soil health and sustaining the environment.Based on foregoing discussion, it can be concluded that the combined application of organic manures (such as 2-10 t

FYM/ha, 2-6 t vermicompost/ha, green manuring) and biofertilizer (such as *Azotobactor*, *Azospirillum*andPSB at 10 ml/kg of seed treatment or 2-6 kg/ha of soil application) along with chemical fertilizer (RDF) was found to enhance cereal crop production not only for increasing the growth, yield attributes, yield and quality parameters of cereal crops but also promotes soil health and supports long-term agricultural sustainability.

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