



Review Article

INTEGRATED NUTRIENT MANAGEMENT-A NEED OF HOUR FOR SUSTAINABLE MAIZE YIELDS

SARTHI, VISHAL JOHAR* AND VIKRAM SINGH

Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara, 144411, Punjab, India

*Corresponding Author: Email - vishal.26021@lpu.co.in

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Abstract: The integrated nutrient management (INM) focuses towards the maintenance and suitably adjusting the soil fertility besides providing the desirable plant nutrients for their growth and development so to have a sustained and regular yield without affecting the fertility and health of soil. It also plays an important role to cut down the requirement of the chemical fertilizers thereby helping to protect from the environmental pollution. For the maintenance of soil productivity and fertility the application of balanced dose of nutrients is an essential requirement which can be easily fulfilled with the application of inorganic fertilizers in combination with the organic manure that helps to reduce the dependency over inorganic fertilizers besides maintaining the desirable yield. The integrated nutrient management practices not only help to maintain the soil fertility but also helps to provide food security and enhancing the yield of the different crops hence provides a beneficial effect towards the growth and development of the agriculture sector. So, keeping in view the above facts an attempt has been made to review the importance of integrated nutrient management for improving the yield of maize crop.

Keywords: *Integrated nutrient management, Maize, Vermicompost, Farm yard manure and fertilizers*

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Introduction

Human being has always utilized crops for their survival and development to achieve good nutrition, medical, pharmaceutical, herbal, economic and industrial development from different crops. Maize (*Zea mays* L.) belonging to Gramineae family has been reported as one of the most important cereal crops after rice and wheat which plays a very important role for the fulfilling the requirements of the mankind. It is regarded as the "Queen of Cereals" or "miracle crop" as it considerably contributes towards the world agriculture for food, feed and industrial raw material [1, 2]. In India, maize is found to be grown over 8.33 m ha area with an overall production of approx. 16.68 mt and average productivity of 2002 Kg ha⁻¹ which shows that this "miracle crop" can be cultivated over a very wide agro climatic zones of the country [3]. In India, Andhra Pradesh has been reported as the major producer (21 per cent) of maize followed by Karnataka (16 per cent), Rajasthan (10 per cent) and further closely followed by Bihar and Maharashtra (9 per cent), respectively [4]. The versatile nature of maize makes it fit and one of the most desirable crop for fulfilling the human needs. Besides this, maize also provide a good feed for both poultry and the domestic animals as the grains contain a high concentration of crude fibers (0.8-2.3 per cent), proteins (7.7-14.6 per cent), carbohydrates (69.7-74.5 per cent), ash (0.7-1.3 per cent) and fats (3.2-7.7 per cent) [5]. However, the poor availability of nutrients and fertilizers drastically affects the quality and yield of maize in India. Therefore, for achieving the sustained yield and productivity of maize optimum management of nutrients is needed to be carried out with the help of the judicious use of organic resources, cultural practices, chemical fertilizers etc. to obtain the higher yields [6]. Hence fore, for carrying out the judicious use of the nutrients the integrated nutrient management (INM) practices play a very important role for the equal distribution of resources. Integrated Nutrient management (INM) is defined as a judicious and integrated use of organic and inorganic sources of nutrients in combination with the different cultural practices for equal and timely distribution of nutrient to the crop plants for sustainable and yield and maintaining the soil productivity [7]. The integrated nutrient management techniques besides maintaining the crop productivity also helps to check the price increase of the inorganic fertilizers and the deterioration effect of soil fertility.

So, considering the above mentioned points and on the basis of the literature available the paper has been reviewed to determine the importance of Integrated Nutrient management (INM) technique for intensifying and getting sustained maize yield [8].

Integrated Nutrient Management (INM) for crop growth

Integrated nutrient management technique is considered as the most significant method to promote the vegetative growth in the maize crop [9]. Similarly, it has also been reported by Yigermal *et al.* that the integrated nutrient management practices in combination with the application of vermicompost and the recommended dose of fertilizers *i.e.*, N, P and K results in the maximum plant height in maize as compared to the other methods of propagation [10]. Further, it was also delineated that the application of 100 per cent recommended dose of fertilizers in addition with the bio fertilizer (*Azotobacter* + PSB) in combination with the green manuring and further addition of compost can supplement the further superior height development in the maize crop [11]. Similarly, Golla *et al.* witnessed higher growth parameters of the maize crop with the addition of recommended dose of fertilizers (RDF) *i.e.*, 120-60-30 kg/hac of N, P and K, respectively in combination with the application of 10 t/ha of farm yard manure (FYM) [12].

It has been observed that having an integration of 75 per cent nitrogen *i.e.*, 75 % of RDF value with the poultry manure can provide superior plant growth attributes in maize that may be due to fulfilling the nutrient requirement for plant growth with the addition of the extra dose of poultry manure [13]. Supporting evidences has also been provided by Nagavani *et al.* who reported that addition of 50 per cent nutrients through poultry manure and 50 per cent through inorganic fertilizers can result in same growth attributes such as plant height, leaf area index etc. at par with those obtained from the 100 per cent application of inorganic fertilizers [14]. The results were further supported by the studies conducted by Sarkar which stated that with the addition of 75 per cent of nutrient as of RDF value in addition to 10 t/ha of farm yard manure resulted in 57 per cent higher growth parameters as compared to the control (100 per cent of RDF value) [Table-1] [15].

Table-1 Effect of combined treatments on different parameters

Combined Treatments	Effects on parameters	Ref
50 % N +50 %PM	Grain yield highest in maize	[20]
25% RDF+ biofertilizers (Azotobacter+ PSB)+ green manuring with sunhemp+ compost	Highest infiltration rate (3.74cm/hr) after harvesting the maize crop	[21]
125% NPK	Highest pH observed in the soils	[22]
75% NPK + 5 t ha ⁻¹ PEC	Maximum positive effect on soil health.	[23]
75% RDF + PGPR + Panchagavya spray (N2)	Highest in dry fodder	[24]
120% RDF	Maximum leaf area index and ear height was observed	[25]
Sole Maize + 75% RDN + 25% FYM + Biofertilizers	Highest plant growth parameters was observed	[26]

Similarly, Leoni *et al.* also reported that with the application of 150 per cent recommended dose of fertilizer may results in much higher growth behavior in maize as compared to the approved recommended dose of fertilizers [16]. It was further reported by Kalhapure *et al.* that the application of well decomposed farm yard manure in combination with the recommended dose of fertilizers significantly maximizes the total dry matter content in the maize crop [17].

Supporting evidence have also been provided the studies conducted by Ali *et al.* which clearly reveals that the addition of vermicompost manure or farm yard manure in the soil in combination with the recommended dose of inorganic fertilizer results in higher plant growth parameters in maize crop over singly application of recommended dose of fertilizers [18]. The addition of the organic manure in combination with the inorganic fertilizers and the desirable cultural practices can help to provide higher plant growth parameters in combination these also helps to reduce the dependency over the chemical use thus cutting the cost of cultivation and help to check the environmental pollution [19].

Integrated Nutrient management (INM) for yield attributes

The integration of various nutrient management techniques not only help to boost the growth parameters but beside this they also play a very important role towards the improvement and maximization of different yield attributes. It is suggested that the integrated nutrient management (INM) practices including the use of vermicompost, farm yard manure, recommended dose of fertilizers and the different cultural practices plays an important role towards higher yield attributes as compared to the conventional methods of cultivation of maize crop [26]. Likewise, Kumar, *et al.* (2018) [29] also reported that the addition of the desirable plants nutrients with help of both *i.e.*, organic manure and inorganic fertilizers have a positive and significant effect on the different yield attributes of the maize crop plants. It was observed that significantly higher number of kernels per cob, cob length and other higher yield attributes were obtained under integrated nutrient management practices [27].

Similarly, Immanue *et al.* (2020) [28] also reported that the integrated nutrient management strategies can result in higher and superior yield attributing parameters such as cobs per plant, cob length, number of kernels per cob *etc.* It is further also an established fact that crop can result in higher number of cobs per plant and cob length with the addition of 10 t/hac of well rotten farm yard manure in combination with the recommended dose of fertilizer in comparison to the application of inorganic fertilizer alone [30].

Likewise, it has also been reported by Ghosh *et al.* (2019) [31] that the combined application of inorganic fertilizers with suitable quantity of vermicompost and optimum cultural practices can result in higher test weight and higher number of kernels per cob thereby influencing the overall productivity and yield of maize. It is observed that the application of 10 t/hac of farm yard manure in addition to the recommended dose of fertilizer can suitably help to increase the cob length of maize. Therefore, the judicious combination of organic and inorganic fertilizers can not only suitably help to improve and increase the productivity and yield of maize crop beside it also helps to maintain the soil fertility and helps in the reclamation of damaged and degraded soils [32].

Integrated Nutrient Management (INM) for maize yield

Use of high yielding varieties in combination with the application of chemical fertilizers can results in higher and enhanced yield however, it imposes immense adverse effects towards productivity and health of soil, that's why to conquer this situation several agricultural scientists have advocated the use of integrated nutrient management technologies to maintain good soil health besides maintain higher yield and productivity. To support the above mentioned fact Mahapatra *et*

al. (2018) [33] recorded higher seed and cobs yield in maize with the application of 120 kg of nitrogen in addition to 10 t/hac application of farm yard manure and 5 kg zinc ha⁻¹ in comparison to the application of chemical fertilizers only. Similarly, Singh *et al.* (2018) [34] also witnessed higher diameter of cob, weight of cobs per plant, grain yield and straw yield with the application of 100 kg of nitrogen as inorganic fertilizer in combination with 7.5 t of farm yard manure per hectare of the cultivation area. Further, Baradhan *et al.* (2018) [35] also observed higher corn yields as influenced due to the variation of row spacing and plant densities in addition to the application of 1.5 t/hac of vermicompost which yielded significantly higher straw yield and total biological yield as compared to yield obtained under recommended spacing and nutrient dose in maize crop. The results are further supported by the finding of who also recorded significantly higher yield with the combination of 2.5 t/hac of vermicompost in addition to the recommended dose of fertilizers [36,37].

Summary

Significantly higher values of harvest index were also observed during this study which clearly shows the importance and beneficial effects of integrated nutrient management practices for improving and amplification of net yield and productivity of maize crop beside maintaining the soil health and checking the environmental pollution to have a regular and a sustained yield keeping in mind the requirements of the future generations.

Application of research: The research will enlighten upon the use and importance of integrated nutrient management in maize crop besides reducing down the dependency of grower towards the use of chemical thereby promoting the sustainable yield and productivity.

Research Category: Horticulture

Abbreviations: INM-Integrated Nutrient management

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Study area / Sample Collection: School of Agriculture, Phagwara, 144411, Punjab, India

Cultivar / Variety / Breed name: Maize (*Zea mays* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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