

Effect of Integrated Nutrient Management on Growth and Yield Parameters of Maize(*Zea mays*.)(Poaceae)

Abstract

Aim: To study effect of integrated nutrient management on growth and yield of maize (*Zea mays* L.).

Study design: A field experiment was conducted at Agronomy farm, school of agriculture, Lovely Professional University, Punjab, India during *kharif* season of 2022.

Methodology: The experiment trail was laid out in randomized block design. It consisted of three replications with ten treatment combinations *i.e.* T₁- 100% Recommended dose fertilizers (RDF) + Farmyard manure(FYM)15 t ha⁻¹;; T₂- 100% RDF + Vermicompost7.5 t ha⁻¹;; T₃-100% RDF + seed priming with Biofertilizers (*Azotobacter*);, T₄- 75% RDF + FYM 11 t ha⁻¹;; T₅- 75% RDF + Vermicompost 5.6 t ha⁻¹;; T₆-75% RDF +seed priming with Biofertilizers (*Azotobacter*);,T₇- 50% RDF basal dose + Nano urea spray 0.15% (25 and 50 Days After Sowing);, T₈- 50% RDF basal dose + Nano urea spray0.30% (25 and 50 DAS);, T₉- Vermicompost 3.5 t ha⁻¹ + seed priming with Biofertilizers (*Azotobacter*); T₁₀- control.

Result: The results showed that application of T₂ 100% RDF + Vermicompost 7.5 t ha⁻¹ had significant effect on growth and yield of maize. The plant height, number of leaves per plant and dry matter accumulation were also significantly higher in T₂ followed by T₁100% RDF + FYM 15 t ha⁻¹. The highest grain yield (64.36 q ha⁻¹) was obtained in T₂ followed by T₁ (63.6 q ha⁻¹), T₃ (57.92 q ha⁻¹) and T₈ (56.16 q ha⁻¹).

Conclusion: Overall, the results and the study suggest the use of integrated nutrient management can improve the growth and yield of maize and provide sustainable solution to meet the nutrient requirements of the crop.

Key words: Biofertilizer, Farmyard manure, Nano urea, Recommended dose fertilizers, Vermicompost

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal, next to rice and wheat and is used as both humanfood and animal feed. The annual C4 plant belongs to the family Poaceae with its origin in

Central America. Maize being one of the most important cereal or grain crop and plays a significant role in the world agriculture economy. It is cultivated throughout the world as it has higher genetic yield potential than any other cereal crop and hence referred to as “Queen of cereals” [1]. Maize is one of the most versatile crops having wider adaptability under varied agroclimatic conditions. It is cultivated on nearly 190 million ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 40 percent in the global grain production [2]. The maize development path in India remains very impressive, with production rising almost 16 times from less than two million tons in the 1950s. Currently 47% of the corn produced in India is utilized in the food industry and 13% as animal feed and starch industry consumes about 14% of the corn. However, there is a growing trend to use maize as digested food, which contributes to about 7% of annual maize consumption in the country. [3]

Developing new techniques and varied cropping practices around the world has led to massive production of the crop all over the world. The indigenous and native methods of cultivation have proven to be insufficient to fulfil the food requirement for the rapidly growing population and thus the world has paved the way to use the chemical fertilizers for the immediate surge in the production and match the demand of the food. [4, 5]. Poor management of fertilizer is the key factor responsible for obtaining low yield as well as it leads to various environmental hazards such as eutrophication, leaching of nutrients and soil pollution etc., so in order to achieve optimum supply of nutrients application of organic sources, bio-fertilizers and micro-nutrients is recommended. [6]

Therefore, integrated nutrient management (INM) aims to maintain soil fertility by supplying plant nutrients to an optimal level for sustaining crop productivity. Adoption of this method also helps farmers to alleviate many issues such as poverty by cutting cost of products and food insecurity and enhancing crop production and improving quality of produce. However, the lack of information about integrated nutrient management in different crops and its various practices, is posing restrictions for its adoption and expansion. Thus, keeping in view the INM as a need has present research was structured. The information about the importance and need of INM needs to be properly addressed and simplified so that ordinary farmers can understand and use it as much as possible.

MATERIAL AND METHODS

The field experiment was conducted in Agri farm at School of Agriculture, Lovely Professional University, Phagwara, Punjab during *kharif* season 2022. to study effect of integrated nutrient

management (INM) on growth and yield of *kharif* maize. The experiment was conducted in randomized block design with ten treatments and 3 replications the treatments were as follows

Table 1: Treatment details

S.no	Treatments
T ₁	100% RDF (N:P:K 120:60:30) + FYM @ 15 t ha ⁻¹
T ₂	100% RDF + Vermicompost @ 7.5 t ha ⁻¹
T ₃	100% RDF + Seed priming with Biofertilizers (<i>Azotobacter</i>)
T ₄	75% RDF + FYM @ 11.5 t ha ⁻¹
T ₅	75% RDF + Vermicompost @ 5.6 t ha ⁻¹
T ₆	75% RDF + Seed priming with Biofertilizers (<i>Azotobacter</i>)
T ₇	50% RDF basal dose + two Nano urea spray @ 0.15% (25 and 50 DAS)
T ₈	50% RDF basal dose + two Nano urea spray @ 0.30% (25 and 50 DAS)
T ₉	Vermicompost @ 4 t ha ⁻¹ + Seed priming with Biofertilizers (<i>Azotobacter</i>)
T ₁₀	Control

The experimental area was 450 square meters with 30 plots (5m*3m) 15m² and 'PMH 13' Maize variety as sown in the field with spacing 60 cm (row to row)*20 cm (plant to plant) spacing. Throughout the experiment different growth and yield parameters were recorded.

RESULT AND DISCUSSION

Growth Parameters

Plant height: Plant height is the important growth parameter in maize which relates with crop growth and knows time to maturity and related with maize life span. In Fig. 1, data reveals that significantly highest height at harvest (191.13 cm) was recorded in T₂ 100% RDF + vermicompost @ 7.5 t ha⁻¹ followed by T₁ 100% RDF + FYM @ 15 t ha⁻¹ (191.07 cm) and lowest plant height (130.87 cm) was recorded in T₁₀ control. T₃ (175.63 cm) and application of T₈ basal dose RDF + nano urea 2 sprays plant height (176.80 cm) is statistically at par with T₁ and T₂. Similar plant height were observed by [7].

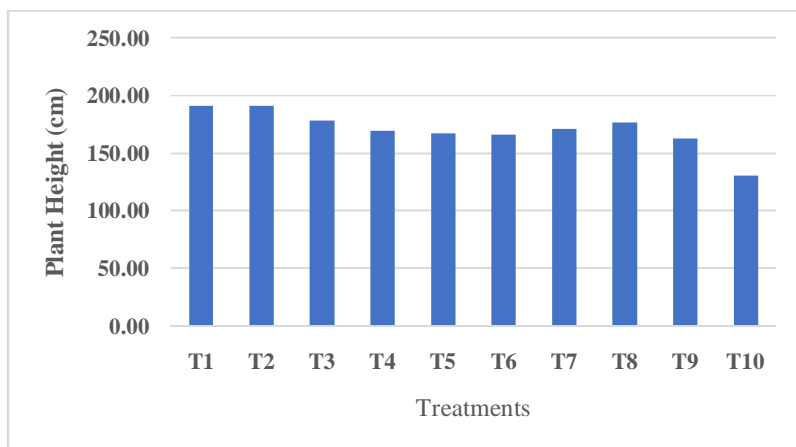


Figure1: Effect of plant height at different integrated nutrient management(INM) treatments in maize (*Zea mays*).

Stem girth: Stem girth is an important parameter to evaluate the growth and development of maize crop. Results (Fig. 2) showed that significantly similar stem girth was observed in T₁ and T₂(6.81 cm) followed by T₈ basal dose RDF (NPK) + Nano urea @ 0.30% two sprays (6.67 cm).The lowest stem girth was observed in T₁₀ control (4.69 cm).Similar results were finding with[8]. Singh and Misal (2022)^[8] reported thatthe presence of growth hormones, and other earthworm secretions in vermicompost that promotes plant growth and development.

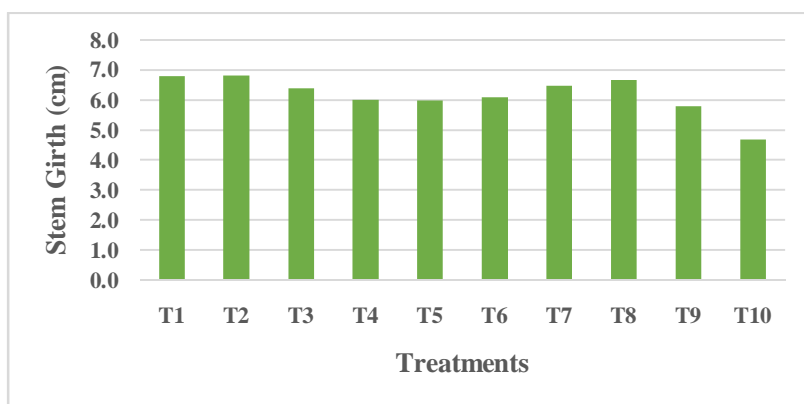


Figure2:Effect of stem girth at different INM treatments in maize (*Zea mays*).

Dry matter accumulation: Plant dry matter is an important parameter that reflects overall productivity of maize crop. In Fig. 3 is shown data onsignificantly higher dry matter accumulation for T₁ (313.33 g p⁻¹)and T₂(315 g p⁻¹) followed by T₃ 100% RDF + Seed priming with *Azotobacter* (290 g p⁻¹) andwith the basal dose RDF(NPK) + nano urea 2 sprays at 0.15 (T₇) and 0.30%ppm (T₈) thedata areT₇ (278.33 g p⁻¹)and T₈ (283.33) are par with T₃.The lowest was found in control. The results suggest that applying of organic fertilizers such as FYM and Vermicompost along with

inorganic fertilizers may have a positive impact on plant growth and development. Similar findings were observed by [9].

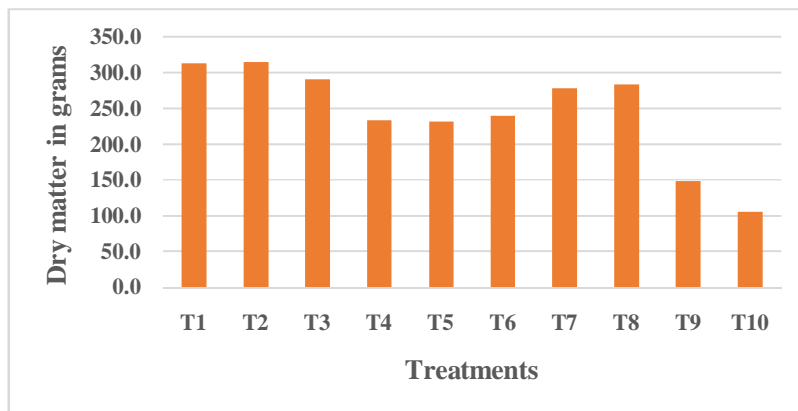


Figure3:Effect of dry matter accumulation at different INM treatments in maize (*Zea mays*).

Yield attributes:

Yield attributes are yield characters which directly influence the maize crop yield. Yield attributes like cob length (cm), cob girth (cm), number of grains per row, test weight (g), stover yield and biological yield. In Figs. 4 and 5 data revealed that maximum cob length (16.8 cm) and cob girth (13.05 cm), 100 grain weight (test weight) (31.67 g) was recorded in T₂ with application 100% RDF + Vermicompost @ 7.5 t ha⁻¹ followed by T₁ (100% RDF + FYM @ 15 t ha⁻¹) (cob length of 16.4 cm) and (cob girth of 13.04 cm), test weight (31 g) and T₈ basal dose RDF(NPK) + Nano urea 0.30% two sprays (15.1 cm) and (12.90 cm) test weight (29.67 g). The lowest cob length (10.3 cm) and cob girth (9.45 cm) and test weight (17.67 g) was recorded in control (10.3 cm). Sujatha *et al.* (2008)^[10] reported that maize yield attributes have positive impact by using organic sources like FYM, vermicompost combined with inorganic sources of nutrients. The use of integrated nutrient management produces nutrients are balanced in soil for plant growth, yield and sustainability. similar results were observed by [11, 12].

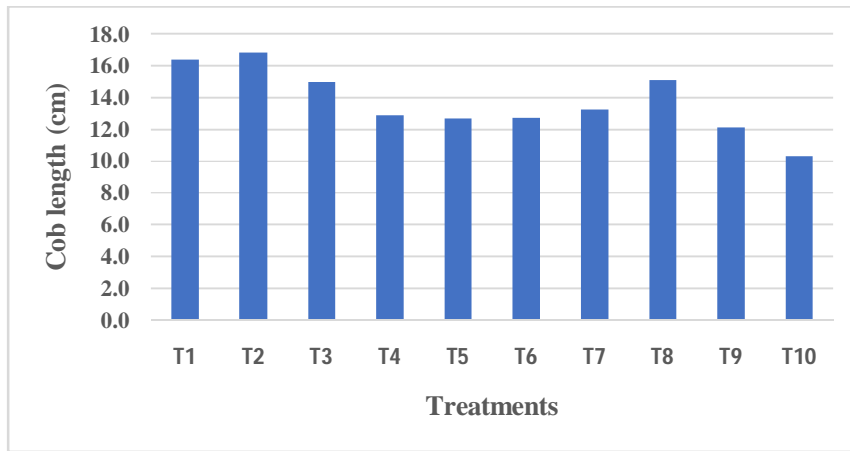


Figure4: Effect of cob length at different INM treatments in maize (*Zea mays*).

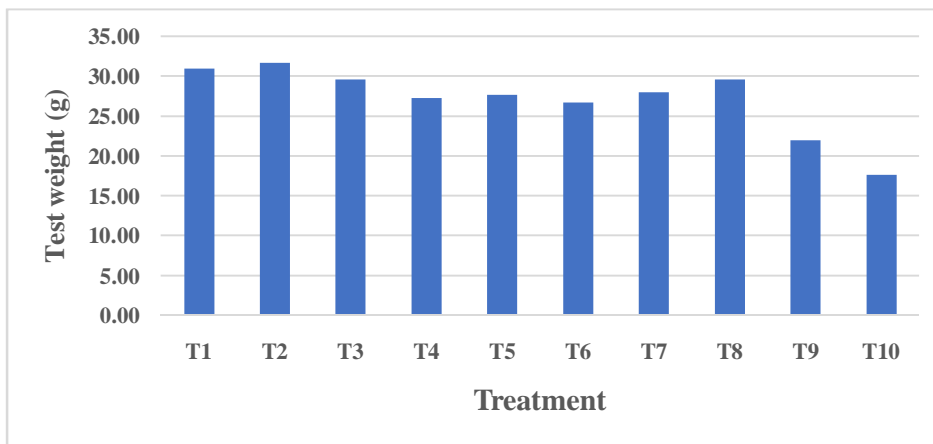


Figure5: Effect of Test weight on different INM treatments in maize (*Zea mays*).

Grain yield: In Fig. 6 the data showed the effect of integrated nutrient management of different treatments on maize grain yield. Maximum grain yield (64.36 q ha^{-1}) was resulted in T₂ with application of 100% RDF + Vermicompost 7.5 t ha^{-1} followed by T₁ (63.66 q ha^{-1}) with application of 100% RDF + FYM @ 15 t ha^{-1} . The lowest grain yield was recorded in control (21.28 q ha^{-1}). Similar findings were observed [13].

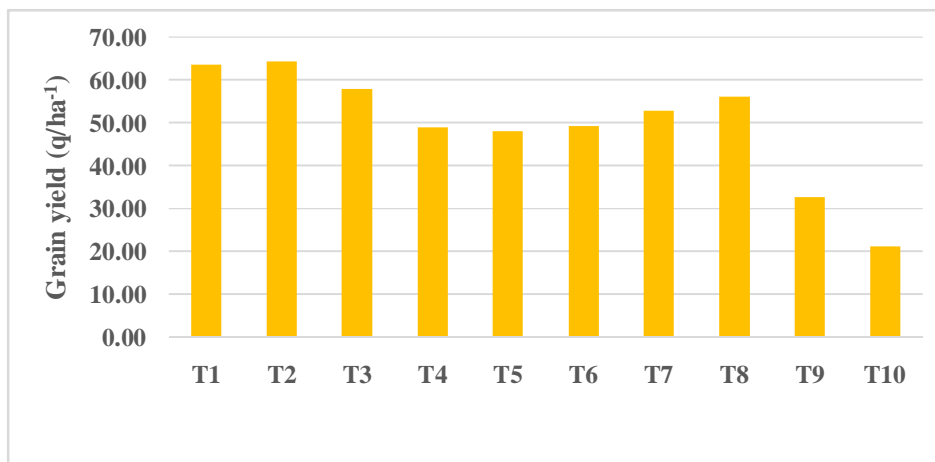


Figure6:Effect of grain yield on different INM treatments in maize (*Zea mays*).

Stover yield: Stover yield is related with maize stalks and stem total dry matter which usually used as animal fodder after grain has been harvested. In Fig. 7 results showed that maximum stover yield (117.8 q ha⁻¹) was recorded T₂with application of 100% RDF + Vermicompost @ 7.5 t ha⁻¹ followed by (116.9 q ha⁻¹) by applying 100% RDF + FYM @ 15 t ha⁻¹(T₁). The lowest stover yield (56.9 q ha⁻¹) in control (T₁₀).Similar results were observed by [14].

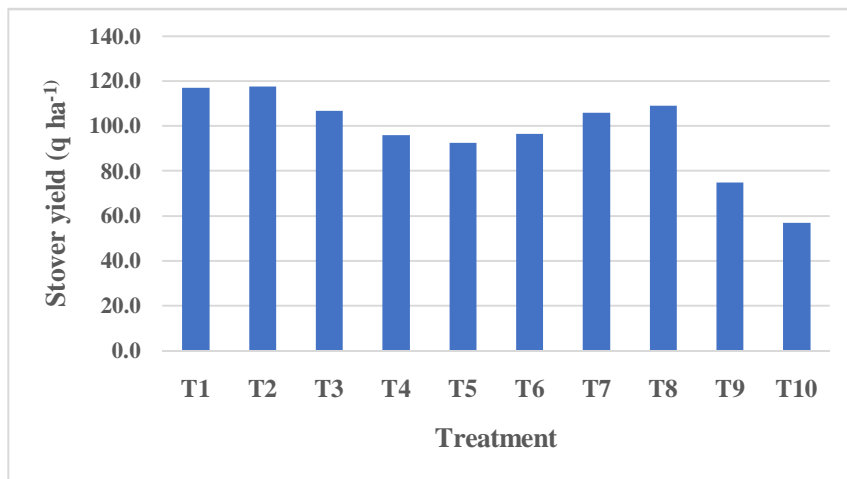
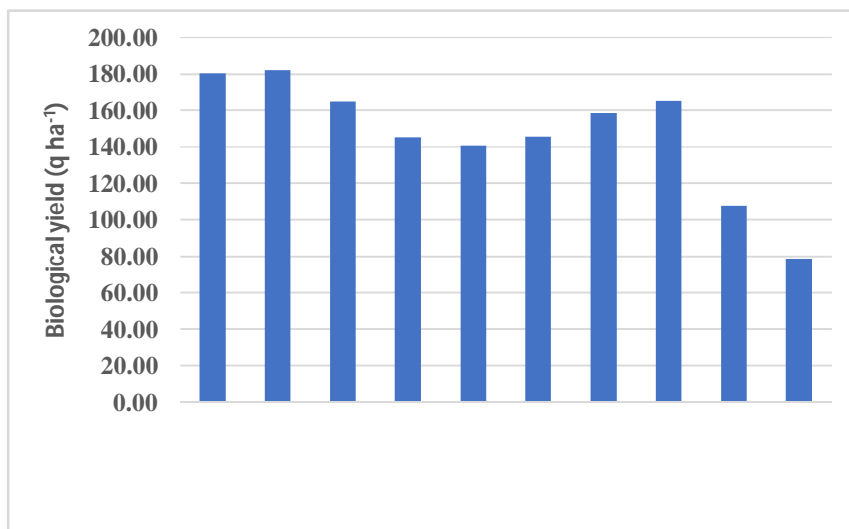


Figure7:Effect of stover yield on different INM treatments in maize (*Zea mays*).

Biological yield:Biological yield is an important parameter in maize cultivation which refers the total amount of drymatter produced by the crop including grain and vegetative parts. Higher biological yield indicates higher plant productivity. In Fig. 8results shown in maximum biological yield (182.13 q ha⁻¹) was resulted by applying 100% RDF + Vermicompost 7.5 t ha⁻¹ followed by applying 100% RDF + FYM 15 t ha⁻¹ (180.58 q ha⁻¹)(T₁). The lowest biological yield was resulted in control (78.20



q ha⁻¹). Similar results were observed by [15].

Figure8:Effect of Biological yield on different INM treatments in maize (*Zea mays*).

CONCLUSION

Based on results of the experiment conducted at Agri farm lovely professional university, Punjab, it can be concluded that application 100% RDF + Vermicompost @ 7.5 t ha⁻¹ had higher plant growth parameters and yield attributes and higher grain yield of maize. The study shows that the application of organic manures in combination with chemical fertilizers had positive impact on maize yields and enhancing soil quality and promoting sustainable crop production. Hence, the adoption of integrated nutrient management can be an effective approach to improving maize productivity while maintaining the soil health and reducing the use of chemical compounds.

REFERENCES

1. RatuararySK, GhoshBC, and MittraBN. Effect of fly ash, organic wastes and chemical fertilizers on yield, nutrient uptake, heavy metal content residual fertility in rice mustard cropping

- sequence under acidlateriticsoils. *BioresourceTechnology*. 2013; 90: 275-2.
2. ReddyYT and Reddy GH. *Principles of Agronomy* (3rd ed). Kalyani publishers, New Delhi, India.2016; 164, 527 p.
 3. Annualmaizereport. 2020;<http://iimr.res.in>.
 4. Kannan RL, Dhivya M, Abinaya DKrishna RL, and Kumar SK, Effect of integrated nutrientmanagement on soil fertility and productivity in maize. *Bulletin of Environment, Pharmacology and LifeSciences* 2013;2(8): 61-67.
 5. Verma G, Mathur AK, and Verma A. (2012). Effect of continuous use of organics and inorganics onnutrientstatusofsoilandyieldundermaize-wheatintensivecroppingsysteminaninceptisol.*JournalofSoilsand Crops*. 2012; 22 (2): 280-286.
 6. Ghaffari A, Ali A, Tahir M, Waseem M, and Ayub M. Influence of integrated nutrients ongrowth,yield and quality of maize. *American Journal of Plant Science*. 2011; 63-69.
 7. Kadam SR, Jadav NJ, and Bagwan IR. Effect of farm yard manure, sulphur and zinc on growth, yield and quality of maize. 2022.
 8. Singh S, and Misal NB. Effect of different levels of organic and inorganic fertilizers on maize (*Zea mays* L.). *Indian Journal of Agricultural Research*. 2022; 56(5): 562-566.
 9. ChoudharyVK, &Suresh, KP. Maize production, economics and soil productivity under different organic source of nutrients in eastern himalayan region, India. 2013.
 - 10.Jeevabharathi S, Srinivasan G, and Krishnaprabu S.Effect of integrated nutrient management of growth and yield attributes of hybrid maize (*Zea mays* L.). *International Journal of Chemical Studies*. 2020; 8(4): 3877-3880.
 - 11.Prajapati VK, Swaroop N, Masih A, and Lakra R. Effect of different dose of NPK and vermicompost on growth and yield attributes of maize [*Zea Mays* (L.)] Cv. MM2255. *Journal of Pharmacognosy and Phytochemistry*. 2018; 7(1): 2830-2832.
 - 12.Jeevabharathi S, Srinivasan G, and Krishnaprabu S.Effect of integrated nutrient management of growth and yield attributes of hybrid maize (*Zea mays* L.). *International Journal of Chemical Studies*. 2020; 8(4): 3877-3880.

13. Rao PM, Sagar GV, Suresh K, Padmaja G and Reddy SN. Influence of organic and inorganic sources of nitrogen on nutrient uptake and yield of maize in maize-mustard cropping system in Northern Telangana zone. 2021.
14. Mahato M, Biswas S, and Dutta D. Effect of integrated nutrient management on growth, yield and economics of hybrid maize (*Zea mays* L.). Current Journal of Applied Science and Technology. 2020; 39(3), 78-86.
15. Patil S. Integrated weed management studies in kharif maize (*Zea mays* L.). 2022.