Archives of Current Research International

Volume 24, Issue 12, Page 225-230, 2024; Article no.ACRI.128671
ISSN: 2454-7077

Assessment of Growth and Yield of Maize through Integrated Nutrient Management Practices

Aman Yadav [a++], V. V. Panchal [a#] and A. A. Kawade [a#*]

[a] *Shri Vaishnav Institute of Agriculture, SVVV, Indore, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/acri/2024/v24i121013

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/128671

Original Research Article

Received: 18/10/2024
Accepted: 21/12/2024
Published: 27/12/2024

ABSTRACT

A field trial was conducted at experimental cum demonstration field, Shri Vaishnav Institute of Agriculture, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore, Madhya Pradesh during the year 2023-24 to study the effect of integrated nutrient management on growth and yield of maize. The treatment consisted of integrated nutrient management viz., T_1: Absolute control, T_2: 100 % RDF (100:60:40 kg N, P_2O_5, K_2O ha^{-1}), T_3: 50 % RDF + 50 % RDN through FYM, T_4: 50 % RDF + 50 % RDN through Vermicompost, T_5: 75 % RDF + 25 % RDN through FYM, T_6: 75 % RDF + 25 % RDN through Vermicompost, T_7: 100 % RDN through FYM and T_8: 100 % RDN through Vermicompost. The experiment was laid out in a randomized block design (RBD) with eight treatment combinations and replicated three times. The various growth and yield characters were studies during the results and found that, application of 75 % RDF + 25 % RDN through vermicompost recorded significantly maximum growth characters *viz*., plant height $plant^{-1}$ (294.33 cm), number of functional leaves $plant^{-}$

[++] *M.Sc Agronomy;*
[#] *Assistant Professor of Agronomy;*
**Corresponding author: Email: kawde.archana@gmail.com;*

Cite as: *Yadav, Aman, V. V. Panchal, and A. A. Kawade. 2024. "Assessment of Growth and Yield of Maize through Integrated Nutrient Management Practices". Archives of Current Research International 24 (12):225-30. https://doi.org/10.9734/acri/2024/v24i121013.*

[1] (7.90) and leaf area plant^{-1} (34.73 dm^2) and yield attributes *viz*. length of cob with husk and without husk, diameter of cob with and without husk, weight of cob with (20.50 cm) and without husk (16.83), number of cobs plant^{-1} (1.40) and weight of grain cob^{-1} with (213.33 g) and without husk (205.33 g) and yield *viz.,* grain yield (61.55 q ha^{-1}) and dry fodder yield (69.76 q ha^{-1}) as compared to rest of the treatments. However, absolute control treatment recorded maximum number of days for 50 % tasseling (69.33) and 50 % silking (73.33).

Keywords: Maize; INM; grain yield; growth; FYM and vermicompost.

1. INTRODUCTION

“Maize, also known as the "Queen of cereals," is a crop with high economic potential worldwide. Its grain, leaves, stalks, and cob are used to produce large amounts of food and non-food products. Maize, a part of the Poaceae family, is cultivated worldwide and is an adaptable crop that can be grown in various agro-climatic zones. It is the largest producer of maize in the United States, contributing 30% of the total production and driving the US economy. In India, *kharif* maize has been sown in around 85.79 lakh hectares (212 lakh acres) as on 29th September 2023 contributing 37% to global grain production. Major maize growing states are Madhya Pradesh 17.44 lakh ha, Karnataka 16.09 lakh ha, Rajasthan 9.42 lakh ha, Maharashtra 9.16 lakh ha, Uttar Pradesh 7.63 lakh ha, Bihar 3.41 lakh ha, Gujarat 2.82 lakh ha, Himachal Pradesh 2.38 lakh ha, Odisha 2.68 lakh ha and Telangana 2.21 lakh ha. According to 3rd Advance Estimates of Production of Food grains for 2022-23, all India Maize production estimate was 35.91 million tonnes” (Anonymous, 2023).

Maize is a versatile crop that requires both micro and macro nutrients for high growth and yield. Poor nutrient management can lead to low yield productivity, making organic sources of nutrients crucial. Nitrogen is a vital plant nutrient, and its deficiency can reduce grain yield, leaf area duration, and photosynthesis rate. Nutrients can be provided to soil and plants through organic and inorganic sources of fertilizers. Organic fertilizers, such as compost, seaweed, manure, and crop residue, can improve soil health by enhancing enzymatic activities and microbial populations. Bulky manures like vermicompost and farmyard manure can also be used as nutrient sources. Vermicomposting enhances soil properties and water holding capacity, while farmyard manure (FYM) is a widely used organic manure in India. By providing a balanced and natural source of nourishment to the soil, FYM plays a crucial role in sustainable farming practices and overall agricultural system health.

Chemical fertilizers are the primary source of plant nutrients, but excessive use can lead to soil degradation and soil pollution. Maize, a heavy feeder of nutrients, requires fertile soil for good yield. Organic sources are less effective in meeting crop nutrient requirements, but a joint use of chemical fertilizers and organic sources can improve soil quality and crop productivity. The highest productivity in a sustainable manner without deteriorating soil and natural resources can be achieved by applying an appropriate combination of organic manures and inorganic fertilizers. Identifying the best available organic resources and their optimal combination with inorganic fertilizers is crucial.

2. MATERIALS AND METHODS

The field experiment was conducted at experimental cum demonstration field, SVIAG, SVVV, Indore, Madhya Pradesh during the year 2023-24. The soil of experimental field was medium black clayey in texture, low in available nitrogen (216.80 kg ha^{-1}), medium in organic carbon (0.51 %) and available phosphorus (16.30 kg ha^{-1}) wherever high in available potash (461.22 kg ha^{-1}). The treatment consisted of integrated nutrient management viz., T_1: Absolute control, T_2: 100 % RDF (100:60:40 kg N, P_2O_5, K_2O ha^{-1}), T_3: 50 % RDF + 50 % RDN through FYM, T_4: 50 % RDF + 50 % RDN through Vermicompost, T_5: 75 % RDF + 25 % RDN through FYM, T_6: 75 % RDF + 25 % RDN through Vermicompost, T_7: 100% RDN through FYM and T_8: 100 % RDN through Vermicompost. The experiment was laid out in a randomized block design (RBD) replicated three times. The field was divided into 24 plots with gross plot size of 3.60 m x 4.80 m each. The test variety of maize cultivar Dekalb 9126 with spacing of 60 x 20 cm was adopted. Recommended dose of fertilizer 100:60:40 kg N: P_2O_5 K_2O ha^{-1} was applied through urea, MOP and SSP respectively in 100 % RDF treatment. The 50 % dose of N and full dose of p and K was applied at the time of sowing, remaining half dose of nitrogen was top dressed through urea as per treatment. Organic manures *viz.*, well decomposed farmyard manure and vermicompost were applied a week before sowing on dry weight basis as per treatments. Before application, these organic sources were analyzed for their nutrient content by using standard analytical methods. The standard method of analysis of variance was used for analyzing the data for Randomized Block Design (Panse and Sukhatme,1985). The significant and non-significant treatment effects were judged with the help of "F" (variance ratio) table. The significant difference between the mean were tested against the critical difference (C.D.) at 5 per cent probability level.

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

The data on growth attributing characters of maize as influenced by different treatments are presented in Table 2.

3.1.1 Plant height

Plant height of hybrid maize was influenced by different treatments of organic and inorganic fertilizers combinations. The data (Table 1) showed that plant height increased gradually as the growth stages of plant advances. Application of 75% RDF + 25% RDN through Vermicompost (T_6) resulted significantly the tallest plant height of (294.33cm) at harvest followed by the application of 75% RDF + 25% RDN through FYM (T_5) which resulted (290.0 cm). The lowest plant height was recorded by control where no manure nor fertilizer were applied (272.20 cm). The tallest plants due to conjunctive application of vermicompost and chemical nitrogen fertilizer might be due to the more availability of plant nutrients, enzymes, vitamins and congenial soil characters which helped the plant to uptake more soil nutrient along with water. This result was corroborated by Makwana et al., (2023), Kumar et al., (2008), and Biswasi et al., (2020).

3.1.2 Number of functional leaves

The number of functional leaves plant^{-1} was significantly influenced due to different treatments. The 75 % RDF + 25 % RDN through vermicompost recorded significantly higher number of functional leaves plant^{-1} over rest of the treatments and it was on par with 75 % RDF + 25 % RDN through FYM.

The higher number of functional leaves under 75 % RDF + 25 % RDN through vermicompost and75 % RDF + 25 % RDN through FYM may be the rise in assimilation rate, cell division, and metabolic activities within plants has led to the implementation of integrated nutrient management. This approach may be linked to the increased nutrient availability in the soil, resulting in enhanced absorption and uptake of nutrients by the crop plants, thereby fostering better plant growth. Similar results were reported by Kumar et al., (2008).

3.1.3 Leaf area (dm^2)

The mean leaf area plant^{-1} increased with increasing crop age and recorded maximum at 84 DAS. It was recorded significantly higher with application of 75 % RDF + 25 % RDN through vermicompost over rest of the treatments during all the crop growth stages except, 75 %

Table 1. Growth attributes of maize as influenced by different treatments at harvest

Treatments	Plant height (cm)	Number of functional leaves plant^{-1}	Leaf area (dm^2 plant^{-1})	Dry matter (g plant^{-1})	Days to 50 % tasselling	Days to 50% silking
T_1	272.20	3.93	19.17	368.07	69.33	73.33
T_2	288.67	5.73	30.40	418.67	53.33	54.00
T_3	283.33	5.47	25.40	403.33	62.67	64.67
T_4	283.33	5.53	27.73	410.17	59.33	62.33
T_5	290.00	6.47	32.40	436.87	57.67	61.00
T_6	294.33	7.90	34.73	443.63	59.33	63.00
T_7	279.00	4.10	22.47	387.50	60.00	63.33
T_8	280.00	4.53	23.23	393.40	65.00	69.67
S Em (±)	1.77	0.44	1.14	5.50	1.90	2.73
CD at 5%	5.37	1.34	3.45	16.67	5.78	8.28
General mean	283.86	5.46	26.94	407.70	60.83	63.92

Table 2. Yield attributes of maize as influenced by different treatments

Treatments	Yield attributes of maize								
	No. of cobs plant^{-1}	Length of cob (cm)		Diameter of cob (cm)		Weight of cob (g)		No. of grains cob^{-1}	Grain weight cob^{-1}
		W/	W/O	W/	W/O	W/	W/O		
T_1	1.31	14.00	9.73	4.27	3.73	180.33	177.00	362.00	114.33
T_2	1.30	18.33	14.40	4.87	4.27	205.00	198.33	438.73	139.33
T_3	1.32	15.83	13.07	4.77	4.07	200.33	191.00	410.33	133.67
T_4	1.22	17.37	13.73	4.80	4.23	202.33	193.00	424.67	136.67
T_5	1.34	19.70	15.87	5.57	4.67	209.33	199.33	446.73	148.67
T_6	1.40	20.50	16.83	5.83	4.80	213.33	205.33	460.00	152.33
T_7	1.30	14.43	11.03	4.67	3.83	193.33	180.67	390.20	126.33
T_8	1.36	15.43	11.90	4.73	3.93	197.33	187.67	403.67	129.87
S Em (±)	0.05	0.60	0.56	0.29	0.16	2.32	2.21	4.32	1.39
CD at 5%	NS	1.82	1.69	0.87	0.48	7.04	6.71	13.11	4.21
General mean	1.32	16.95	13.32	4.94	4.19	200.17	191.54	417.04	135.15

Table 3. Grain yield, dry fodder yield and biological yield of maize as influenced by different treatments

Treatments	Grain yield (q ha^{-1})	Dry fodder yield (q ha^{-1})	Biological yield (q ha^{-1})
T_1 : Absolute control	29.99	38.51	68.50
T_2 : RDF	54.99	63.19	118.18
T_3 : 50 % RDF + 50 % RDN through FYM	48.52	58.18	106.69
T_4 : 50 % RDF + 50 % RDN through VC	53.03	60.80	113.83
T_5 : 75 % RDF + 25 % RDN through FYM	59.82	67.55	127.37
T_6 : 75 % RDF + 25 % RDN through VC	61.55	69.76	131.31
T_7 : 100 % RDN through FYM	42.14	52.56	94.70
T_8 : 100 % RDN through VC	43.24	54.61	97.85
S. Em. (±)	1.15	1.31	1.99
CD at 5%	3.50	3.96	6.04
General mean	49.16	58.14	107.30

RDF + 25 % RDN through FYM. This might be due to the beneficial effect of organic and inorganic nutrient sources on plant metabolism which effects the physiological process of crops and thereby increases the leaf area plant^{-1}. The increased plant height and total number of leaves plant^{-1} may also have resulted in increased leaf area. Similar results were reported by Ponmozhi et al. (2019), Biswasi et al. (2020), Mahato et al. (2020) and Desai et al. (2022).

3.1.4 Dry matter (gm) plant^{-1}

The mean dry matter production plant^{-1} increased with increase in crop age and recorded maximum at harvest. It was significantly influenced due to different treatments. The dry matter production plant^{-1} was recorded significantly higher with application of 75 % RDF + 25% RDN through vermicompost over rest of the treatments during flowering and at harvest. This might be due to higher uptake of nutrients and their assimilation in source and sink resulted in increase in plant growth rate and higher dry matter production. Similar results were reported by Ponmozhi et al., (2019), Biswasi et al., (2020), Mahato et al., (2020) and Desai et al., (2022).

3.1.5 Days to 50 % tasseling and silking

The mean number of days for 50 % tasseling 60.83 DAS and silking was 63.92 DAS and was significantly influenced by different treatments. The treatment control took significantly maximum days for 50 % tassel and silk emergence over rest of the treatments, which was on par with treatment 100 % RDN through VC. This might be because of nutrient stress occurs during vegetative phase of crop growth which inhibits the vegetative phase and initiate the reproductive phase earlier. Similar results were reported by Kumar et al., (2002), and Tetarwal et al., (2011).

3.2 Yield Attributes

The data on yield attributing characters of maize as influenced by different treatments are presented in Table 2.

The average number of cobs plant^{-1} did not show significant differences across the different treatments.

The treatment 75 % RDF + 25 % RDN through vermicompost recorded significantly the highest length of cob with husk (20.50 cm) and without husk (16.83 cm), diameter of cob with husk (5.83 cm) and without husk (4.80 cm), weight of cob with husk (213.33 g) and without husk (205.33 g) plant^{-1}, number of grains cob^{-1} (460) and weight of grains cob^{-1} (152.33 g) over the remaining integrated nutrient management treatments. However, the treatment was at par with 75 % RDF + 25 % RDN through vermicompost for all the yield attributing characters. This might be due to sufficient and balanced supply of plant nutrients through organic and inorganic sources. These attributed the increase in physiological and biochemical processes of plants leading to higher growth and increasing the uptake, photosynthates transportation and assimilation of plant nutrients from source to sink. Similar results were also reported by Desai et al., (2022), Makwana et al., (2023), Mahato et al., (2020), Biswasi et al., (2020) and Kumar et al., (2008).

3.3 Grain, Dry Fodder and Biological Yield

The data related to grain yield, dry fodder yield and biological yield is presented in Table 3. The data indicates that, significantly highest grain yield (61.55 q ha^{-1}), dry fodder yield (69.76 q ha^{-1}) and biological yield (131.31 q ha^{-1}) was obtained with the application of 75 % RDF + 25 % RDN through Vermicompost (T_6) which was found statistically at par with the 75 % RDF + 25 % RDN through FYM treatment. On the other hand the least grain yield, dry fodder yield and biological yield was registered with control treatment.

The higher grain yield was obtained with combined application of NPK with organic sources might be due to significant improvement in growth and yield attributes resulting into higher grain yield of maize. The similar results were reported by V. Sanjivkumar (2014), Makwana et al., (2023), Nanjappa et al., (2001), Desai et al., (2022), Biswasi et al., (2020), Ponmozhi et al., (2019), and Mahato et al., (2020).

4. CONCLUSION

During the course of investigation, it was found that application of 75 % RDF + 25 % RDN through vermicompost recorded significantly maximum growth characters, yield attributes, grain yield (61.55 q ha^{-1}) and dry fodder yield (69.76 q ha^{-1}) of maize as compared to rest of the treatments. Thus, it could be concluded that combine application of fertilizers and organic sources such as FYM, vermicompost in the ratio 75:25 may help to improve that growth and yield attributes of maize, finally resulting in increasing maize production. This also reduces the reliance on chemical fertilizers and thus improving soil fertility and productivity.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Anonymous. (2023). *Maize outlook report October 2023*. Agricultural Market Intelligence Centre, ANGRAU, Lam, 1–6.

Biswasi, S. K., Barik, A. K., Bastia, D. K., Dalei, B., Nayak, L., & Ray, M. (2020). Effect of integrated nutrient management on growth, productivity, and economics of hybrid maize in Odisha state. *International Journal of Bio resource and Stress Management, 11*(5), 465–471.

Desai, N. B., Mevada, K. D., & Ganvit, K. J. (2022). Influence of integrated nutrient management on yield and economics of rabi maize (Zea mays L.). *The Pharma Innovation Journal, 11*(9), 504–509.

Kumar, A., Rana, D. S., & Sheoran, R. S. Effect of integrated nutrient management on herbage yield and nutrient uptake of forage sorghum [Sorghum bicolor (L.) Moench]. *Haryana Journal Of Agronomy*, 82.

Kumar, A., Singh, R., Rao, L. K., & Singh, U. K. (2008). Effect of integrated nitrogen management on growth and yield of maize (Zea mays L.). *Madras Agricultural Journal, 95*(7/12), 467–472.

Mahato, M., Biswas, S., & Dutta, D. (2020). Effect of integrated nutrient management on growth, yield, and economics of hybrid maize (Zea mays L.). *Current Journal of Applied Science and Technology, 39*(3), 78–86.

Makwana, N. D., Bhanvadia, A. S., & Gediya, K. M. (2023). Effect of integrated nutrient management in maize. *The Pharma Innovation Journal, 12*(11), 887–890.

Nanjappa, H. V. (2001). Effect of integrated nutrient management in yield and nutrient balance in maize. *Indian Journal of Agronomy, 46*(4), 698–701.

Panse, V. G., & Sukhatme, P. V. (1985). *Statistical methods for agricultural workers* (2nd enlarged ed.). I.C.A.R., New Delhi, 135–136.

Ponmozhi, C. N. I., Kumar, R., Baba, Y. A., & Rao, G. M. (2019). Effect of integrated nutrient management on growth and yield of maize (Zea mays L.). *International Journal of Current Microbiology and Applied Sciences, 8*(11), 2675–2681.

Sanjivkumar, V. (2014). Effect of integrated nutrient management on soil fertility and yield of maize crop (Zea mays) in Entic Haplustart in Tamil Nadu, India. *Journal of Applied and Natural Science,* 6(1), 294-297.

Tetarwal, J. P., Ram, B., & Meena, D. S. (2011). Effect of integrated nutrient management on productivity, profitability, nutrient uptake and soil fertility in rainfed maize (Zea mays). *Indian journal of Agronomy*, 56(4), 373-376.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/128671