PLANT SCIENCE TODAY
Vol 12(sp3): 01–06
https://doi.org/10.14719/pst.10307

eISSN 2348-1900

RESEARCH ARTICLE

Significance of integrated plant nutrition system (IPNS) and foliar application practices for enhancing the growth, yield and quality parameters of maize

A G Mohanapragash[1], D Leninraja[2*], Kathirvel L[3], P Libi robin[4], T Rajavarshini[1], J Sivanantha[5], S Madhusree [5], M Bharathi Raja [4], Madhupriyaa D[1]

[1]Department of Soil Science and Agricultural Chemistry, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Trichy 620 027, Tamil Nadu, India

[2]Department of Natural Resources Management, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Periyakulam 625 604, Tamil Nadu, India

[3]Department of Soil and Water Conservation Engineering, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Kumulur, Trichy 621 712, Tamil Nadu, India

[4]RVS Agricultural College, Thanjavur 613 402, Tamil Nadu, India

[5]Department of Agronomy, Faculty of Agriculture, Annamalai University, Chidambaram 608 002, Tamil Nadu, India

*Correspondence email - mohanapragashagri@gmail.com

Received: 27 June 2025; Accepted: 20 November 2025; Available online: Version 1.0: 11 December 2025

Cite this article: Mohanapragash AG, Leninraja D, Kathirvel L, Libi RP, Rajavarshini T, Sivanantha J, Madhusree S, Bharathi RM, Madhupriyaa D. Significance of integrated plant nutrition system (IPNS) and foliar application practices for enhancing the growth, yield and quality parameters of maize. Plant Science Today. 2025;12(sp3):01–06. https://doi.org/10.14719/pst.10307

Abstract

In the *Rabi* season of 2024, a field experiment was conducted in the village of Ahilandapuram to identify the effects of integrated plant nutrition system (IPNS) and foliar nutrition on maize growth, yield and quality parameters. Using maize as the test crop, the experiment was conducted using a randomized block design with 13 treatments and 3 replications. The treatments included the control (T_1), 100 % soil test crop response- integrated plant nutrition system (STCR-IPNS) alone, 75 % STCR-IPNS alone and foliar application products: TNAU Maize Maxim, TNAU PPFM, *Aloe vera* leaf extract and amino acids. The treatment T_{12}, which received 100 % STCR-IPNS along with foliar application of TNAU Maize Maxim, TNAU PPFM, *Aloe vera* leaf extract and amino acids, recorded the maximum leaf area index. Noticeably, the same treatment (T_{12}) also recorded the best performance in 100-grain weight, cob weight, number of grains per cob and number of grains per row. Interestingly, the same treatment (T_{12}) showed the greatest increase in quality parameters such as crude protein and crude fibre. Based on these findings, the combined use of STCR-IPNS along with a foliar spray of TNAU Maize Maxim + TNAU PPFM+ *A. vera* leaf extract + amino acid (T_{12}) can be considered one of the most efficient methods for improving the growth, yield and quality characteristics of maize.

Keywords: foliar nutrition; maize; quality; STCR-IPNS

Abbreviations: STCR-IPNS - soil test crop response-integrated plant nutrition system, FS - foliar spray, PPFM - pink pigmented facultative methylotrophs, AA - amino acid, ALE - *Aloe vera* leaf extract, MM - Maize Maxim.

Introduction

Most of the developed and developing countries throughout the world grow maize (*Zea mays L.*), which is a significant grain crop (1). It is referred to as both a “miracle crop” and the "queen of cereals" due to its higher productivity. In addition to grain, stalks provide excellent cattle feed and are referred to as the “king of fodder” (2). Although it is primarily cultivated for grain, maize is also used as a source of fodder and as a raw ingredient in industrial processes (3). One factor contributing to decreased production is farmers applying unbalanced amounts of fertiliser without understanding the nutritional requirements of their crops or the soil's fertility status (4). Due to nutrient toxicity and deficiencies, this has a negative effect on soil and crops (5). To maximise production and sustain soil fertility, the crop requires an adequate amount of balanced nutrition.

Applying fertilizer in accordance with studies on the soil test crop response under the integrated plant nutrition system (STCR-IPNS) is the most effective way to determine the optimal fertiliser doses (6). The major goal of the integrated plant nutrient system (IPNS) is to improve soil fertility by using a combination of organic manure, inorganic fertilisers and bio-fertilizers in order to sustain crop productivity (7). When fertilizers are applied to the soil, nutrient losses occur in the form of leaching, volatilization and fixation, which lowers nutrient-use efficiency (8). As a result, efforts are being made to increase crop productivity by supplementing the recommended fertiliser dosage with foliar fertilisation of nutrients.

Foliar feeding is typically an effective and economical strategy to correct plant nutrient deficiencies or bridge the nutrients gaps in crop requirements (9). In recent decades, foliar nutrient feeding has become standard practice in crop production, with the

dual goals of yield potential and improving crop quality (10). Plant hormones have an impact on plants at every stage of their growth and development, so they can be employed to increase yield per unit of land area. The plant growth regulator and crop booster Maize Maxim help in increasing plant productivity and drought resistance. *Aloe vera* leaf peeling powder and extract enhance plant growth because they contain nutrients and phytohormones (7).

The positive effects of amino acids on growth of plants, yields and their ability to lessen the impacts of abiotic stress on plants make them a well-known bio stimulant (10, 11). Utilizing pink-pigmented facultative methylotrophs (PPFM) helps reduce the detrimental effects of drought stress while increasing plant germination, growth, development and yield (12). The current study investigated the impact of foliar spraying nutrients and plant growth regulators on the growth, yield and quality characteristics of maize.

Materials and Methods

Experimental site

During the Purattasipattam season of 2024-25, a field experiment was conducted in a farmer's field in Ahilandapuram Village of Kayathar Block, Tuticorin district of Tamil Nadu to evaluate the impact of foliar nutrition and IPNS on maize growth and yield. The physical characteristics of the experimental soil were sandy clay texture, with a bulk density of 1.11 Mg/m^3, a particle density of 2.46 Mg/m^3 and a pore space of 39 %. The experimental soil's chemical characteristics include pH of 8.25 and an electrical conductivity of 0.23 dS/m. According to the soil fertility status, the soil's available N was 163 kg ha^{-1} (low), available P was 18 kg ha^{-1} (medium) and available K was 300 kg ha^{-1} (high), while the soil's organic carbon content was 2.43 g/kg and the DTPA-extractable micronutrients were sufficient. In this experiment, which had thirteen treatments and three replications, a randomised block design was used.

Experimental design and data collection

The treatments use TNAU Maize Maxim at 1.5 %, PPFM at 1 %, amino acid at 0.2 % and aloe leaf extract at 50 ppm as foliar applications. Early in the morning 30, 40 and 50 days after sowing (DAS), foliar spraying of TNAU Maize Maxim, *A. vera* leaf extract, PPFM and amino acids was carried out. Ankur Aditya hybrid maize was used as a test crop, with a plot size of 6 cm × 4 cm, a row spacing of 60 cm × 25 cm and plant spacing of 25 cm. Fertilizers are applied to the plots in accordance with the STCR recommendations (155:90:56 kg N, P_2O_5, K_2O ha^{-1}), which are based on the initial soil test values with a target yield of 6-8 t ha^{-1}. The five samples in the plot's data were averaged and the mean data was also taken.

Statistical analysis

The data collected during the experiment and were statistically analysed using the AGRESS statistical software (13).

Results

Growth parameters

Leaf area index (LAI)

A significant increase in the leaf area index of maize at different growth stages was observed with the application of STCR-IPNS along with the foliar application of different nutrients (Table 1; Fig. 1). Among the different treatments, the highest LAI of 3.82 cm, 5.77 cm and 6.08 cm was recorded by the treatment T_{12}at all maize growth stages. This treatment T_{12} was found to be on par with treatment T_{13} recording LAI values of 3.58 cm, 5.53 cm and 5.97 cm at 30, 60 DAS and harvest, respectively. The lowest LAI values of 1.18 at 30 DAS, 1.70 at 60 DAS and 2.08 at harvest were observed in the control (T_1).

In plants, LAI serves as an indicator of the total area available for photosynthesizing, which accumulates in sinks as photosynthates are produced. The foliar spray of PPFM also enhances several physiological and biochemical processes, including root development, photosynthesis, energy-transfer reactions and symbiotic biological nitrogen fixation (14). A substantial increase in LAI due to the foliar application of PPFM was also reported by earlier studies (12).

Yield parameters of maize

Hundred grain weight and cob weight

The data on the maize yield components, namely hundred grain weight and cob weight are presented in Table 2. Among the different treatments, the treatment T_{12} significantly recorded the highest 100-grain weight and cob weight of 34.5 g and 286.1 g, followed by the treatment T_{13} recording 33.1 g and 275.7 g and this treatment was comparable to T_{10}. The treatment T_1 recorded the lowest 100-grain weight and cob weight of 17.2 g and 155.1 g respectively. This improvement is directly linked to better grain filling supported by consistent nutrient supply from the IPNS and foliar treatments (15).

Table 1. Effect of integrated plant nutrition system and foliar nutrition on leaf area index (cm) of maize

Treatment	Treatment details	Leaf area index (cm)		
		30 DAS	60 DAS	Harvest
T_1	Control	1.18	1.70	2.08
T_2	STCR-IPNS	2.31	3.28	3.40
T_3	75 % STCR-IPNS	2.15	3.01	3.11
T_4	T_2 + foliar spray (FS) of 0.2 % amino acids (AA)	2.22	4.45	5.05
T_5	T_3 + FS of 0.2 % AA	2.09	4.11	4.85
T_6	T_2 + FS of 1.5 % maize maxim (MM)	3.31	4.73	5.59
T_7	T_3 + FS of 1.5 % MM	3.24	4.22	5.37
T_8	T_2 + FS of 50 ppm *Aloe vera* leaf extract (ALE)	2.59	5.11	5.77
T_9	T_3 + FS of 50 ppm ALE	2.54	5.08	5.44
T_{10}	T_2 + FS of 1 % pink pigmented facultative methylotrophs (PPFM)	3.33	5.46	5.78
T_{11}	T_3 + FA of 1 % PPFM	3.31	5.38	5.66
T_{12}	T_2 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	3.82	5.77	6.08
T_{13}	T_3 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	3.58	5.53	5.97
	Mean	**2.59**	**4.36**	**4.94**
	SEd	**0.06**	**0.08**	**0.10**
	CD (p = 0.05)	**0.14**	**0.16**	**0.22**

DAS = days after sowing.

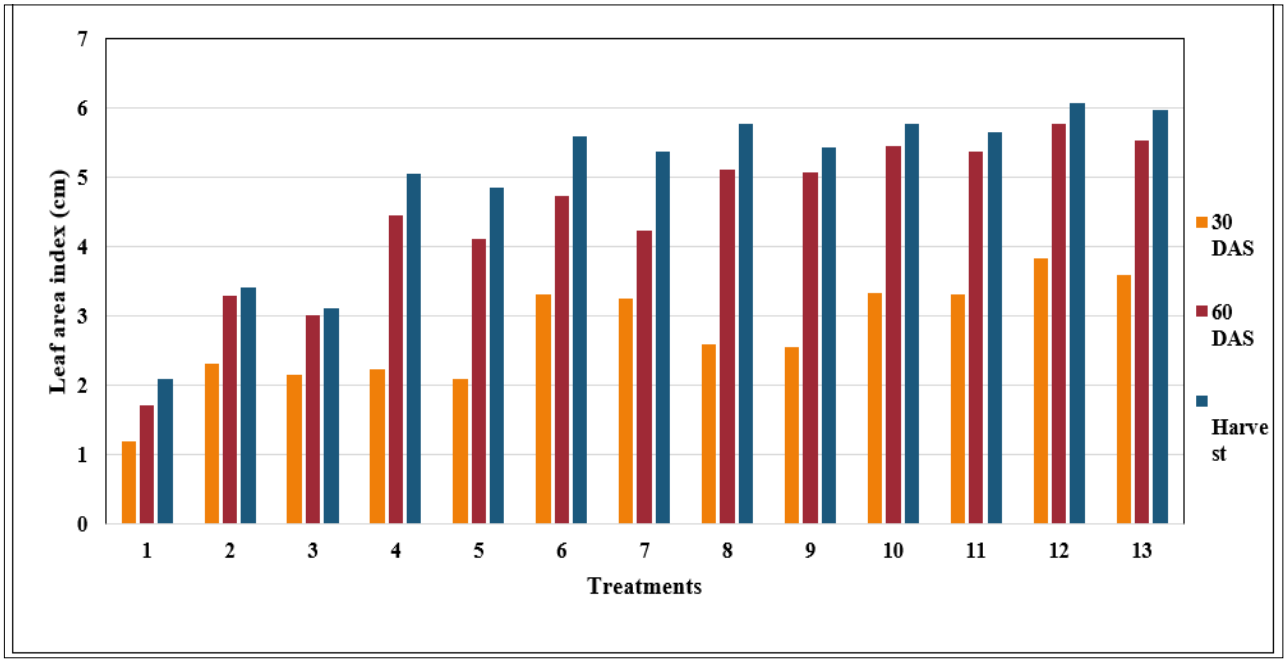

Fig. 1. Effect of IPNS and foliar spray on leaf area index (cm) of maize.

Table 2. Effect of integrated plant nutrition system and foliar nutrition on hundred grain weight (g) and cob weight (g) of maize

Treatment	Treatment details	Yield parameters	
		Hundred grain weight (g)	Cob weight (g)
T_1	Control	17.2	155.1
T_2	STCR-IPNS	20.8	177.5
T_3	75 % STCR-IPNS	19.5	166.6
T_4	T_2 + foliar spray (FS) of 0.2 % amino acids (AA)	22.8	190.3
T_5	T_3 + FS of 0.2 % AA	21.5	185.5
T_6	T_2 + FS of 1.5 % maize maxim (MM)	24.0	221.5
T_7	T_3 + FS of 1.5 % MM	23.6	200.3
T_8	T_2 + FS of 50 ppm *Aloe vera* leaf extract (ALE)	28.7	226.7
T_9	T_3 + FS of 50 ppm ALE	27.2	220.4
T_{10}	T_2 + FS of 1 % pink pigmented facultative methylotrophs (PPFM)	32.6	250.0
T_{11}	T_3 + FA of 1 % PPFM	30.2	245.4
T_{12}	T_2 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	34.5	286.1
T_{13}	T_3 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	33.1	275.7
	Mean	**25.8**	**203.6**
	SEd	**0.3**	**1.4**
	CD (p = 0.05)	**0.6**	**3.0**

Amino acids enhance protein synthesis, while ALE and PPFM stimulate carbohydrate accumulation. These biomolecules promote better translocation of assimilates into sink tissues like cobs and grains (7, 10).

Number of grains per cob

The number of grains per cob was significantly influenced by the IPNS and foliar nutrition practices (Table 3). Application of 100 % STCR-IPNS along with the foliar application of TNAU Maize Maxim, TNAU PPFM, *A. vera* leaf extract and amino acids (T_{12}) significantly produced the maximum number of grains per cob of 484.59. It was on par with the treatment T_{13} recording 461.62. The minimum number of grains per cob was observed in the control (T_1). Enhanced grain numbers are due to improved pollination and better nutrient allocation during reproductive stages. Bio-stimulants and micronutrient-rich foliar applications have shown to enhance pollen viability and ovule fertilization (16).

Number of grains per row

Foliar nutrition, organic manures and inorganic fertilizers were used in combination to significantly influence the number of grains per row of maize (Table 3). Among the different treatment combinations, the treatment T_{12} has recorded the highest number of grains per row (38.19), followed by T_{13} and the least was observed in the control (T_1).

Number of rows per cob

The maximum number of rows per cob (36.30) was observed in the treatment T_{12}, followed by T_{13} (32.05). This value was on par with treatment T_{12}. The minimum number of grain rows per cob (24.16) was observed in the treatment T_1 (Table 3). This result reinforces that effective nutrient partitioning especially through foliar means supports ear development. Maize maxim and PPFM likely contributed to hormonal regulation leading to better floret retention and row uniformity (17, 18).

Quality attributes of maize

Crude fiber

The crude fiber content of maize ranged from 2.53 % to 5.1 % (Table 4; Fig. 2). Among the treatments, T_{12} recorded the maximum crude fiber content of 5.10 %, followed by T_{13}, which recorded 4.79 %. The minimum crude fiber of 2.53 % was observed in the control plot (T_1).

Table 3. Effect of integrated plant nutrition system and foliar nutrition on number of grain rows cob^{-1}, number of grains cob^{-1} and number of grains row^{-1} of maize

Treatment	Treatment details	Yield parameters		
		No. of grain rows cob^{-1}	No. of grains cob^{-1}	No. of grains row^{-1}
T_1	Control	24.16	312.96	19.87
T_2	STCR-IPNS	29.47	418.00	29.88
T_3	75 % STCR-IPNS	28.15	404.33	27.99
T_4	T_2 + foliar spray (FS) of 0.2 % amino acids (AA)	29.97	387.37	25.44
T_5	T_3 + FS of 0.2 % AA	26.66	359.40	24.06
T_6	T_2 + FS of 1.5 % maize maxim (MM)	29.15	445.58	29.38
T_7	T_3 + FS of 1.5 % MM	28.47	426.49	26.48
T_8	T_2 + FS of 50 ppm *Aloe vera* leaf extract (ALE)	26.20	413.99	28.60
T_9	T_3 + FS of 50 ppm ALE	24.38	404.20	25.38
T_{10}	T_2 + FS of 1 % pink pigmented facultative methylotrophs (PPFM)	29.55	440.95	29.73
T_{11}	T_3 + FA of 1 % PPFM	29.34	436.90	27.50
T_{12}	T_2 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	36.30	484.59	38.19
T_{13}	T_3 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	32.05	461.62	34.27
	Mean	**27.77**	**415.11**	**26.76**
	SEd	**0.9**	**7.4**	**0.4**
	CD (p = 0.05)	**2.0**	**15.4**	**0.9**

Table 4. Effect of integrated plant nutrition system and foliar nutrition on quality attributes of maize grain

Treatment	Treatment details	Quality attributes	
		Crude protein (%)	Crude fiber (%)
T_1	Control	8.90	2.53
T_2	STCR-IPNS	10.03	3.23
T_3	75 % STCR-IPNS	9.52	3.17
T_4	T_2 + foliar spray (FS) of 0.2 % amino acids (AA)	11.13	4.17
T_5	T_3 + FS of 0.2 % AA	10.33	3.63
T_6	T_2 + FS of 1.5 % maize maxim (MM)	12.00	4.27
T_7	T_3 + FS of 1.5 % MM	9.26	3.90
T_8	T_2 + FS of 50 ppm *Aloe vera* leaf extract (ALE)	11.99	4.73
T_9	T_3 + FS of 50 ppm ALE	10.40	4.50
T_{10}	T_2 + FS of 1 % pink pigmented facultative methylotrophs (PPFM)	11.45	4.63
T_{11}	T_3 + FA of 1 % PPFM	10.34	4.27
T_{12}	T_2 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	14.74	5.10
T_{13}	T_3 + FS of 0.2 % AA + 1.5 % MM + 50 ppm ALE + 1 % PPFM	12.78	4.79
	Mean	**10.49**	**3.91**
	SEd	**0.28**	**0.09**
	CD (p = 0.05)	**0.58**	**0.19**

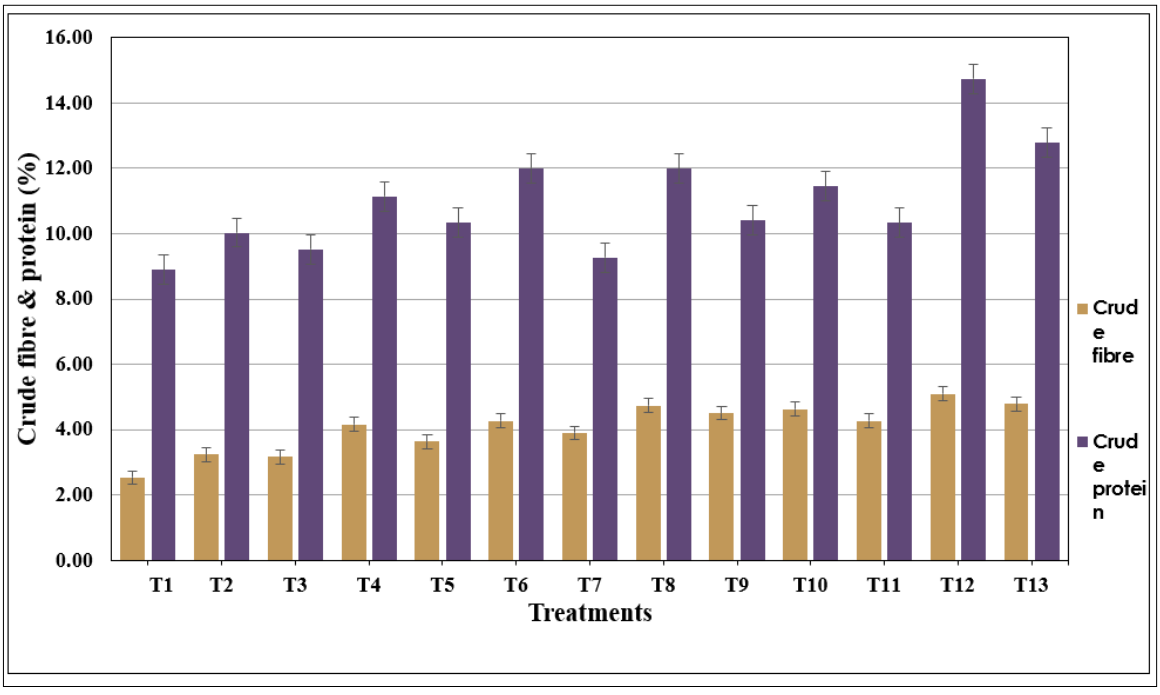

Fig. 2. Effect of IPNS and foliar nutrition on quality parameters in maize grains.

Nitrogen is the central element for protein synthesis; IPNS ensures continuous nitrogen availability, while amino acids act as precursors for enzyme and protein formation (19). PPFM and ALE may also supply additional nitrogen and micronutrients, boosting protein content (20, 21).

Crude protein

The range of crude protein content of maize was between 8. 9 % to 14.74 % (Table 4; Fig. 2). The treatment T_{12}recorded the higher crude protein content of 14.74 %, followed by T_{13} observed the crude protein content of 12.78 %. The treatments T_6 and T_8 were found to be on par with each other. The lowest crude protein content of 8.90 % was recorded by the control (T_1). In some instances, the increase in crude protein content is attributed to nitrogen supplied by fertilizers, amino acids, ALE, MM and PPFM. The STCR-IPNS nutrition, along with amino acids, plant extracts, biofertilizers and crop boosters, would have supported increased protein synthesis and led to adequate storage of maize grain. The maximum crude protein was obtained by using 75 % RDF, 12.5 % vermicompost and neem cake nutrients combined application. Higher fiber accumulation results from robust cell wall development, which is supported by balanced nutrition and phytohormonal stimulation (22). The interaction between STCR-IPNS and foliar bio-stimulants boosts structural carbohydrate deposition (7, 23).

Conclusion

The use of STCR-IPNS in combination with a foliar spray of TNAU Maize maxim, TNAU PPFM, amino acid and *A. vera* leaf extract was found to be more effective in terms of maize growth and yield, according to the results of the trials. The results of this study clearly demonstrate that the integrated application of 100 % STCR-IPNS along with a foliar combination of amino acids (0.2 %), Maize Maxim (1.5 %), ALE (50 ppm) and PPFM (1 %) significantly enhanced all growth, yield and quality parameters of maize compared to individual or partial applications. This comprehensive nutrient strategy improved photosynthetic capacity (via LAI), reproductive success (via grain count and cob traits) and seed quality (via protein and fiber content). The synergistic effect of balanced soil-applied macro and micro nutrients (through STCR-IPNS) and biostimulant-enriched foliar applications resulted in improved physiological functions, stress resilience and nutrient uptake. This integrated approach can be recommended as a sustainable and efficient nutrient management practice for maximizing maize productivity and grain quality, especially in regions aiming for high yields under limited input use. Future research should also examine the economic feasibility, long-term soil health impacts and scalability of this integrated strategy under varied agro-ecological zones.

Acknowledgements

The authors are thankful to AC & RI, Killikulam Department of soil science and Agricultural Chemistry for providing all necessary facilities for this study.

Authors' contributions

AGM carried out the experiment, developed the work plan and methodology, recorded observations, analyzed the data and prepared the draft manuscript. DL contributed to the work plan, conceptualization, funding acquisition, methodology and supervision and also coordinated the overall study. LK, PLR and TR assisted in imposing the experiment, conducting laboratory analyses and reviewing and editing the manuscript. JS, SM and MBR supported the summarization and revision of the manuscript, while AGM and DL jointly coordinated the work, contributed to the methodology and participated in editing. MD also assisted in editing, summarizing and revising the manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

References

1. Adiaha MS. The impact of maize (*Zea mays* L.) and its uses for human development: A review. Int J Sci World. 2017;5(1):93–5. https://doi.org/10.14419/j7yksy12
2. Suresh MVS. Studies on response of maize to inoculation with consortiums of nitrogen fixers and phosphate solubilizers.
3. Klopfenstein T, Erickson G, Berger L. Maize is a critically important source of food, feed, energy and forage in the USA. Field Crops Res. 2013;153:5–11. https://doi.org/10.1016/j.fcr.2012.11.006
4. Zingore S, Delve RJ, Nyamangara J, Giller KE. Multiple benefits of manure: The key to maintenance of soil fertility and restoration of depleted sandy soils on African smallholder farms. Nutr Cycl Agroecosyst. 2008;80:267–82. https://doi.org/10.1007/s10705-007-9142-2
5. Singh Y, Parihar M, Singh S, Sharma P, Dey P. Soil test based fertilizer prescriptions under integrated plant nutrient management system for maize in an Inceptisol of Varanasi. J Indian Soc Soil Sci. 2015;63(1):83–7.
6. Raghuramakrishnan M, Sankaran V, Somasundaram E, Ramesh P. Effect of micronutrients and STCR based macronutrients on growth, yield and nutrient uptake of hybrid maize. Pharma Innov J. 2021;10 (11):251–5.
7. Hemalatha M, Selvi D, Vasanthi D. Integrated plant nutrients supply and foliar nutrition on fruit yield, nutrient uptake and availability in okra (*Abelmoschus esculentus* (L.) Moench) hybrid COBhH-4 in an Alfisol of Tamirabarani command area. Int J Adv Agric Sci Technol. 2018;5:47–66. http://10.5555/20083259748
8. Alva A, Paramasivam S, Fares A, Delgado J, Mattos D Jr, Sajwan K. Nitrogen and irrigation management practices to improve nitrogen uptake efficiency and minimize leaching losses. J Crop Improv. 2006;15(2):369–420. https://doi.org/10.1300/J411v15n02_11
9. Singh J, Singh M, Jain A, Bhardwaj S, Singh A, Singh D, et al. An introduction of plant nutrients and foliar fertilization: A review. In: Precision farming: a new approach. New Delhi: Daya Publishing Company; 2013. p. 252–320. http://dx.doi.org/10.13140/RG.2.1.1629.3844
10. Shehata S, Abdel-Azem HS, Abou El-Yazied A, El-Gizawy A. Effect of foliar spraying with amino acids and seaweed extract on growth, chemical constituents, yield and its quality of celeriac plant. Eur J Sci Res. 2011;58(2):257–65. https://doi.org/10.1590/1519-6984.263302
11. Shahrajabian MH, Cheng Q, Sun W. The effects of amino acids, phenols and protein hydrolysates as biostimulants on sustainable crop production and alleviated stress. Recent Pat Biotechnol. 2022;16 (4):319–28. https://doi.org/10.2174/1872208316666220412133749
12. Ajaykumar R, Selvakumar S, Harishankar K, Sivasabari K. Effect of pink-pigmented facultative methylotrophs, PGRs and nutrients on growth, yield and economics of irrigated blackgram (*Vigna mungo* (L.) Hepper). Legume Res. 2022;45(1):52–7.
13. Gomez KA, Gomez AA. Statistical procedures for agricultural research. New York: John Wiley & Sons; 1984.

14. Subramani M, Solaimalai A. Influence of plant populations and methods of nutrient application on growth and yield of blackgram. Legume Res. 2000;23(3):197–8.

15. Mohanapragash A, Leninraja D, Manikandan K, Ramesh P, Sanjivkumar V. Effect of IPNS and foliar nutrition on growth and yield of maize. Pharma Innov J. 2022;11:3644–7. https://doi.org/10.22271/tpi.2022.v11.i7at.14593

16. Sherlala A, Raman A, Bello M, Asghar A. A review of the applications of organo-functionalized magnetic graphene oxide nanocomposites for heavy metal adsorption. Chemosphere. 2018;193:1004–17. https://doi.org/10.1016/j.chemosphere.2017.11.093

17. Muthukumar V, Velayudham K, Thavaprakaash N. Growth and yield of baby corn (*Zea mays* L.) as influenced by plant growth regulators and different time of nitrogen application. Res J Agric Biol Sci. 2005;1(4):303–7. https://10.5958/0976-058X.2015.00064.5

18. Al-Ani MH, Al-Dulaimi OI, Mahmood GH, Al-Rawi AR, Seadh SE. Response of some maize hybrids to foliar spraying treatments 1 - Growth characteristics. Syst Rev Pharm. 2020;11(11). https://dx.doi.org/10.21608/aasj.2020.130764

19. Bahgat AR, Dahab AA, Elhakem A, Gururani MA, El-Serafy RS. Integrated action of rhizobacteria with aloe vera and moringa leaf extracts improves defense mechanisms in *Hibiscus sabdariffa* L. cultivated in saline soil. Plants. 2023;12(21):3684. https://doi.org/10.3390/plants12213684

20. Wagh S, Laharia G, Iratkar A, Gajare A. Effect of INM on nutrient uptake, yield and quality of okra (*Abelmoschus esculentus* (L.) Moench). 2014. https://doi.org/10.20546/ijcmas.2018.710.115

21. Katharine SP, Mariappan G, Radhika K, Hemalatha S. Influence of amino acid formulation on okra and brinjal. 2016.

22. Mirheidari F, Hatami M, Ghorbanpour M. Effect of different concentrations of IAA, GA_3 and chitosan nanofiber on physio-morphological characteristics and metabolite contents in roselle (*Hibiscus sabdariffa* L.). S Afr J Bot. 2022;145:323–33. https://doi.org/10.1016/j.sajb.2021.07.021

23. Poorniammal R, Prabhu S, Senthilkumar M, Anandhi K. Effect of phyllosphere application of *Methylobacterium* on growth and yield of barnyard millet (*Echinochloa frumentacea* var. COKV 2). Int J Curr Microbiol Appl Sci. 2020;9(4):1860–6.

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

Publisher information: Plant Science Today is published by HORIZON e-Publishing Group with support from Empirion Publishers Private Limited, Thiruvananthapuram, India.