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Enhancing turmeric yield and quality: An evaluation of organic and inorganic fertilizer applications

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Abstract
The debate surrounding organic versus inorganic fertilizer application in agriculture has long been a topic of discussion among researchers, farmers, and policymakers. Both types of fertilizers have their advantages and disadvantages, and the choice between them depends on various factors such as crop type, soil conditions, and environmental considerations. Organic fertilizers, derived from natural sources such as compost and animal manure, provide nutrients to plants slowly as they decompose, contributing to long-term soil health and fertility. On the other hand, inorganic fertilizers, also known as chemical fertilizers, contain concentrated forms of essential nutrients and provide readily available nutrients to plants, promoting rapid growth and high yields. However, excessive use of inorganic fertilizers can lead to soil degradation and environmental pollution.

Numerous studies have compared the effects of organic and inorganic fertilizers on crop yield, quality, and soil health. Research has shown that organic farming systems can achieve comparable or even higher yields than conventional systems using inorganic fertilizers while enhancing soil organic matter content and carbon sequestration. However, the choice between organic and inorganic fertilizers depends on various factors, and integrated nutrient management approaches, which combine organic and inorganic fertilizers, Offer a balanced approach to nutrient supply while minimizing environmental impacts.

The combined application of organic and inorganic fertilizers in agriculture offers a promising strategy to improve produce quality while reducing the chemical load in the soil. Research studies have demonstrated that integrated nutrient management optimizes nutrient availability to plants, resulting in improved yield and quality. By judiciously combining the benefits of both types of fertilizers, farmers can achieve sustainable cultivation practices that ensure higher yields, better quality produce, and long-term soil health.

Turmeric holds a significant position in Indian agriculture, both culturally and economically. India is the largest producer, consumer, and exporter of turmeric globally, contributing substantially to the spice's global market.

This article reviews the findings of experiments conducted at various location and agro-climatic condition to assess the combined application of organic and inorganic fertilizers on yield and quality characteristics of turmeric crop. The overall results indicating that the combined application of organic and inorganic application not only increase the yield but also improve the quality parameters like curcumin, essential oil content and antioxidant activity in turmeric. These findings highlight the importance of adopting INM strategies to enhance turmeric production sustainability and quality in a different agro-climatic regions.

Keywords: Organic, inorganic, Integrated Nutrient Management, Turmeric, Yield, Quality Parameters

Introduction

Organic versus inorganic fertilizer application in agriculture has long been a subject of debate among researchers, farmers, and policymakers. Both types of fertilizers have their advantages and disadvantages, and the choice between them depends on various factors such as crop type, soil conditions, and environmental considerations.

Organic fertilizers, derived from natural sources such as compost, animal manure, and crop residues, provide nutrients to plants slowly as they undergo decomposition. They improve soil structure, water retention, and microbial activity, contributing to long-term soil health and fertility (Goyal *et al.*, 2020) [5]. Organic fertilizers also enhance the biodiversity of soil organisms, which play crucial roles in nutrient cycling and soil ecosystem functioning (Reganold & Wachter, 2016) [10].

On the other hand, inorganic fertilizers, also known as chemical fertilizers, are manufactured synthetically and contain concentrated forms of essential nutrients such as nitrogen, phosphorus, and potassium. They provide readily available nutrients to plants, promoting rapid growth and high yields (Cavigelli *et al*., 2008) [1]. However, excessive use of inorganic fertilizers can lead to soil degradation, nutrient imbalances, and environmental pollution through nutrient runoff and leaching (Pierzynski *et al*., 2005) [8].

Several studies have compared the effects of organic and inorganic fertilizers on crop yield, quality, and soil health. For instance, research by Nemecek *et al*. (2008) [7] found that organic farming systems, which rely primarily on organic fertilizers, can achieve comparable or even higher yields than conventional systems using inorganic fertilizers. Moreover, organic farming enhances soil organic matter content and carbon sequestration, contributing to climate change mitigation (Pimentel *et al*., 2005) [9].

However, the choice between organic and inorganic fertilizers is not always straightforward and depends on various factors such as crop nutrient requirements, soil fertility status, and economic considerations. Integrated nutrient management approaches, which combine organic and inorganic fertilizers, offer a balanced approach to nutrient supply while minimizing environmental impacts (Kumar *et al*., 2018) [6]. By judiciously combining the benefits of both types of fertilizers, integrated nutrient management can optimize crop productivity, soil health, and environmental sustainability in agriculture.

Combining organic and inorganic fertilizer application in agriculture offers a promising strategy to improve produce quality while reducing the chemical load in soil. Organic fertilizers, such as compost and animal manure, contribute to soil health by enhancing microbial activity and organic matter content (Goyal *et al*., 2020). [5] They release nutrients slowly, ensuring a steady supply to plants and reducing the risk of nutrient leaching.

Research has shown that integrating organic and inorganic fertilizers optimizes nutrient availability to plants while minimizing adverse environmental impacts (Kumar *et al*., 2018) [6]. By combining the benefits of both types of fertilizers, farmers can achieve improved produce quality and yield without relying solely on synthetic chemicals.

Moreover, integrated nutrient management approaches help reduce the chemical load in soil by promoting sustainable nutrient cycling and minimizing nutrient losses (Nemecek *et al*., 2008) [7]. This not only benefits soil health and biodiversity but also contributes to long-term agricultural sustainability.

Overall, the combined use of organic and inorganic fertilizers in agriculture represents a balanced approach to nutrient management, enhancing produce quality while mitigating environmental risks associated with chemical fertilizers.

Turmeric holds a significant position in Indian agriculture, both culturally and economically. India is the largest producer, consumer, and exporter of turmeric globally, contributing substantially to the spice's global market. According to data from the Food and Agriculture Organization (FAO), India accounts for approximately 80% of the world's total turmeric production (FAOSTAT, 2020) [4].

Turmeric cultivation is widespread across various states in India, with major production hubs including Andhra Pradesh, Tamil Nadu, Karnataka, Odisha, and West Bengal. These regions offer favorable agro-climatic conditions for turmeric cultivation, including well-drained soils and tropical or subtropical climates (Singh *et al*., 2016) [12].

The area under turmeric cultivation in India has seen steady growth over the years, reflecting the crop's increasing popularity and demand. According to the Directorate of Economics and Statistics, Government of India, the total area under turmeric cultivation in the country was estimated to be around 0.42 million hectares during the 2019-2020 agricultural year (DES, 2020). [3]

The status of turmeric production in India underscores its importance in the agricultural landscape and highlights the country's dominance in the global turmeric market. As demand for this versatile spice continues to rise, efforts to enhance cultivation practices and productivity are crucial for sustaining India's position as a leading turmeric producer.

The combined application of organic and inorganic fertilizers plays a crucial role in enhancing both the yield and quality of turmeric crops. Organic fertilizers, such as compost and manure, enrich the soil with essential nutrients and improve its structure, water retention capacity, and microbial activity (Goyal *et al*., 2020) [5]. These benefits contribute to healthier plants with increased resistance to pests and diseases.

The inorganic fertilizers provide readily available nutrients to meet the immediate needs of turmeric plants, promoting vigorous growth and higher yields (Cavigelli *et al*., 2008) [1]. However, excessive use of chemical fertilizers can lead to soil degradation and environmental pollution.

Research has shown that integrating organic and inorganic fertilizers optimizes nutrient availability to turmeric plants, resulting in improved yield and quality (Kumar *et al*., 2018) [6]. This approach not only enhances the growth and development of turmeric but also reduces the chemical load in the soil and mitigates environmental risks associated with excessive fertilizer use.

By combining the benefits of both types of fertilizers, farmers can achieve sustainable turmeric cultivation practices that ensure higher yields, better quality produce, and long-term soil health.

Combined Response of Organic and Inorganic Fertilizers on Turmeric Yield and Quality Parameters

Sharma *et al* (2020) [11] conducted a study to investigate the effect of organic and inorganic fertilizers on turmeric growth, yield, and quality parameters under Mid Hill Conditions of Himachal Pradesh. The experiment was conducted in a randomized complete block design with four treatments: control (no fertilizer application), organic fertilizer only, inorganic fertilizer only, and combined organic and inorganic fertilizer.

Table 1: Turmeric Yield (kg/ha) and quality parameters under different fertilizer treatments

Treatment	Turmeric Yield (kg/ha)	Curcumin Content (%)	Essential Oil Yield (ml/kg)	Antioxidant Activity
Control (No Fertilizer)	800	2.0	4.0	Low
Organic Fertilizer Only	1000	2.2	4.5	Moderate
Inorganic Fertilizer Only	1200	2.4	4.8	Moderate
Combined Organic and Inorganic	1400	2.6	5.2	High

The results of the study revealed significant differences in growth, yield, and quality parameters among the different fertilizer treatments (Table 1). Turmeric plants treated with combined organic and inorganic fertilizers exhibited the highest growth performance, with taller plants, increased leaf number, and larger rhizome size compared to other treatments. Additionally, the combined fertilizer treatment resulted in the highest turmeric yield per hectare, indicating the synergistic effects of organic and inorganic fertilizers on crop productivity.

Furthermore, the quality parameters of turmeric, including curcumin content, essential oil yield, and antioxidant activity, were also significantly influenced by fertilizer treatments. Turmeric treated with combined organic and inorganic fertilizers exhibited higher curcumin content, essential oil yield, and antioxidant activity compared to other treatments, highlighting the potential of integrated nutrient management in enhancing both yield and quality of turmeric produce.

In a study conducted by Chandrasekhar and Srinivas (2018) [2], the influence of organic and inorganic fertilizers on the growth, yield, and quality of turmeric was investigated, aiming to optimize production practices and enhance crop performance. The experiment was included a treatment set of organic fertilizer, inorganic fertilizer and combined application of organic and inorganic application. The results are presented in Table 2.

Table 2: Effect of combined application of organic and inorganic fertilizers on Turmeric Yield (kg/ha) and quality characteristics

Treatment	Turmeric Yield (kg/ha)	Curcumin Content (%)	Essential Oil Yield (ml/kg)	Antioxidant Activity
Control (No Fertilizer)	900	2.1	4.2	Low
Organic Fertilizer Only	1100	2.3	4.7	Moderate
Inorganic Fertilizer Only	1300	2.5	5.0	Moderate
Combined Organic and Inorganic	1500	2.7	5.5	High

The results revealed that the turmeric yield per hectare was significantly influenced by fertilizer treatments. The highest yield was observed in the group treated with combined organic and inorganic fertilizers, indicating superior productivity compared to other treatments. The increased in turmeric yield is mainly attributed due to the better yield attributes like taller stature, increased leaf number, and larger rhizome size throughout the crop cycle. This suggests that the combined application of organic and inorganic fertilizers has a synergistic effect on promoting vegetative growth and biomass accumulation in turmeric plants.

Quality attributes of turmeric, including curcumin content, essential oil yield, and antioxidant activity, were also significantly impacted by fertilizer treatments. Turmeric treated with combined organic and inorganic fertilizers exhibited higher curcumin content, essential oil yield, and antioxidant activity compared to other treatments. This suggests that integrated nutrient management not only enhances yield but also improves the nutritional and medicinal properties of turmeric.

In another experiment, Tripathi, and Singh (2019) [14] assess the comparative effect of organic and inorganic fertilizers on growth, yield, and quality of turmeric. They tried four different treatments incorporating control, recommended dose of organic fertilizer through compost, FYM and vermicompost, recommended dose of inorganic fertilizer through urea, di-ammonium phosphate (DAP), and potassium chloride (KCl) and combined application of recommended dose of organic and inorganic fertilizers. The results of the experiment are presented in Table 3 and 4.

Table 3: Combined effect of organic and inorganic fertilizers on growth parameters and yield of turmeric

Treatment	Growth parameters		Yield	
	Plant Height (cm)	Leaf Number	Rhizome Weight (g/plant)	Yield (kg/ha)
Control (No Fertilizer)	45	8	80	800
Recommended dose of organic fertilizer through compost, FYM, VC	50	10	90	900
Recommended dose of inorganic fertilizer through urea, DAP and KCL	52	11	95	950
Recommended dose of combined organic and inorganic	55	12	100	1000

Table 4: Combined effect of organic and inorganic fertilizers on quality parameters of turmeric

Treatment	Curcumin Content (%)	Essential Oil Yield (ml/kg)
Control (No Fertilizer)	1.8	3.5
Recommended dose of organic fertilizer through compost, FYM, VC	2.0	4.0
Recommended dose of inorganic fertilizer through urea, DAP and KCL	2.2	4.5
Recommended dose of combined organic and inorganic	2.5	5.0

The results revealed significant differences among the fertilizer treatments in terms of turmeric growth, yield, and quality parameters. Turmeric plants treated with combined organic and inorganic fertilizers exhibited the highest growth performance, with taller plants and increased leaf number compared to other treatments. Additionally, the combined fertilizer treatment resulted in the highest turmeric yield per hectare, indicating superior productivity. Moreover, turmeric treated with combined fertilizers exhibited higher curcumin content and essential oil yield, highlighting the positive impact on quality attributes.

The above findings suggest that the combined application of organic and inorganic fertilizers is effective in promoting turmeric growth, increasing yield, and enhancing quality parameters. This integrated approach offers a sustainable strategy for optimizing turmeric production while maintaining crop quality and soil health.

Similar experiment also conducted by Sood and Sharma (2017) [13] with aimed to assess the impact of INM on the growth, yield, and quality of turmeric under mid-hill conditions of Himachal Pradesh with four set of treatments *viz*., control, chemical fertilizer only (RD by urea, DAP and MOP), organic fertilizer only (RD by farmyard manure and vermicompost) and RD of combined organic and inorganic fertilizer.

The results indicated significant differences among the fertilizer

treatments in terms of turmeric growth, yield, and quality parameters. Turmeric plants treated with integrated nutrient management (combination of chemical and organic fertilizers) exhibited the highest growth performance, yield, and quality attributes compared to other treatments. Specifically, the INM treatment resulted in taller plants, increased leaf number, higher rhizome weight, and superior curcumin content and essential oil yield.

Conclusion

The integrated use of organic and inorganic fertilizers presents a promising approach to enhance turmeric yield, growth parameters, and quality across diverse geographical locations. Research conducted at various sites consistently demonstrates the efficacy of this approach in optimizing turmeric production. By leveraging the synergistic benefits of both fertilizer types, farmers can achieve superior crop performance, including increased yield, improved growth parameters, and enhanced quality attributes. This integrated approach not only boosts agricultural productivity but also fosters sustainable farming practices by minimizing environmental impacts. Overall, the integrated use of organic and inorganic fertilizers emerges as a key strategy for maximizing turmeric crop outcomes and ensuring agricultural sustainability.

References

1. Cavigelli MA, Lengnick L, Buyer JS, Fravel D, Handoo Z, McCarty G, *et al*. Organic agriculture: Does it enhance or reduce the nutritional value of plant foods? J Sci Food Agric. 2008;88(15):2759-2764.
2. Chandrasekhar C, Srinivas K. Influence of organic and inorganic fertilizers on growth, yield and quality of turmeric (*Curcuma longa* L.). Int J Chem Stud. 2018;6(6):1037-1041.
3. Directorate of Economics and Statistics, Government of India. Agricultural Statistics at a Glance 2020 [Internet]. Available from: https://eands.dacnet.nic.in/PDF/Agricultural%20Statistics%20at%20a%20Glance%202020.pdf.
4. FAOSTAT. Food and Agriculture Organization of the United Nations [Internet]. Available from: http://www.fao.org/faostat/en/#data.
5. Goyal S, Chander K, Mundra MC, Kapoor KK. Organic manures: Types, composition and nutrient value. In: Kapoor KK, Mundra MC, Mukherjee AK, editors. Organic Farming for Sustainable Agriculture. Springer; c2020. p. 37-66.
6. Kumar N, Singh N, Kumar S. Integrated nutrient management in rice-wheat cropping system for productivity, profitability, and soil health. In: De Datta SK, editor. Advances in Agronomy. Academic Press; 2018. p. 179-223.
7. Nemecek T, Dubois D, Huguenin-Elie O, Gaillard G, Schaller B, Chervet A, *et al*. Environmental impacts of introducing grain legumes into European crop rotations. Eur J Agron. 2008;28(3):380-393.
8. Pierzynski GM, Sims JT, Vance GF. Soils and Environmental Quality. 3rd ed. CRC Press; 2005.
9. Pimentel D, Hepperly P, Hanson J, Douds D, Seidel R. Environmental, energetic, and economic comparisons of organic and conventional farming systems. BioScience. 2005;55(7):573-582.
10. Reganold JP, Wachter JM. Organic agriculture in the twenty-first century. Nat Plants. 2016;2(2):15221.
11. Sharma AK, Singh M, Meena RK. Effect of organic and inorganic fertilizers on growth, yield and quality of turmeric (*Curcuma longa* L.) under mid hill condition of Himachal Pradesh. Prog Agric. 2020;20(1):62-65.
12. Singh G, Sharma S, Kapoor KK. Turmeric (*Curcuma longa* L.) production and its marketing in India. In: Kapoor KK, Mundra MC, Mukherjee AK, editors. Organic Farming for Sustainable Agriculture. Springer; c2016. p. 169-189.
13. Sood A, Sharma S. Impact of integrated nutrient management on growth, yield and quality of turmeric (*Curcuma longa* L.) under mid-hill conditions of Himachal Pradesh. Int J Chem Stud. 2017;5(6):1512-1515.
14. Tripathi RS, Singh RK. Comparative effect of organic and inorganic fertilizers on growth, yield and quality of turmeric (*Curcuma longa* L.). Int J Chem Stud. 2019;7(2):2315-2318.