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# Sustainable intensification of integrated application of NPK fertilizers, biofertilizers and farmyard manure: Impacts on soil health, nutrient dynamics, and profitability of baby corn (*Zea mays* L.)

**Durgvijay Yadav, Arun Alfred David, Vikram Singh, Ram Bharose, Amreen Hasan, Shreshthi Maurya, Palash Chaoudhary, Nikhil Yadav and Shalini Chauhan**

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## Abstract
Sustainable intensification of agriculture requires nutrient management strategies that not only maximize crop yields but also enhance functional soil health and improve nutrient-use efficiency. INM is a resource-efficient, soil-restorative, and economically viable strategy for sustainable intensification of crop. By improving soil fertility, nutrient dynamics, and farm profitability, integrated practices offer a robust alternative to fertilizer-dependent systems and directly support national goals of soil health management, climate-resilient agriculture, and sustainable food security. Baby corn is a short-duration and high-value crop, is increasingly recognized as a promising option for crop diversification and farmer profitability in India. However, its high nutrient demand and the widespread reliance on chemical fertilizers alone threaten soil fertility and long-term system sustainability. By improving soil fertility, nutrient dynamics, and farm profitability, integrated practices offer a robust alternative to fertilizer-dependent systems and directly support national goals of soil health management, climate-resilient agriculture, and sustainable food security. The results showed that integrated nutrient regimes significantly enhanced soil organic carbon, available N, P, and K outperforming fertilizer-alone and control treatments. The combination of (RDF @ 100% + FYM @ 7.5 t $ha^{-1}$ + *Pseudomonas* @ 100 %) recorded the highest baby corn yield and produced comparable yields, indicating potential for fertilizer reduction without yield penalties. Economic evaluation revealed maximum profitability under integrated practices, with gross returns of ₹1,68,350 $ha^{-1}$, net returns of ₹1,21,610 $ha^{-1}$, and a benefit-cost ratio of 3.60.

**Keywords:** Soil health parameters, inorganic fertilizers, organic manure, biofertilizers, baby corn, *etc.*

## Introduction
In India, baby corn production is largely concentrated in rural areas, while its consumption is mainly urban, creating a clear demand-supply imbalance. Average yields range from 7.5 to 8.7 t $ha^{-1}$, with the potential for 3-4 cycles annually, yet weak storage and marketing infrastructure hinder rural farmers from accessing profitable urban markets (Feedipedia, 2024; PCBMB, 2024) [8, 25]. Urban demand continues to rise through hotels, restaurants, and supermarkets, while rural communities primarily use baby corn residues as fodder (Feedipedia, 2024) [8]. The global baby corn market, valued at USD 1.2 billion in 2024, is projected to reach USD 2.5 billion by 2033, and India alone exported 562 consignments to 40 countries in one year, highlighting strong commercial potential (Verified Market Research, 2024; Volza, 2024) [37, 38]. To bridge this gap, strategies such as hybrid adoption, integrated nutrient management, cold storage, processing units, and FPO-based marketing are essential (NABARD, 2022) [18]. These interventions can reduce post-harvest losses, enhance rural-urban connectivity, and make baby corn a profitable and sustainable crop in India.

Agriculture in India, as in many parts of the world, is facing a deficit nutrient imbalance. Farmers are expected to produce more food to meet the needs of a growing population demand, but they must also protect the soil and natural resources that future generations will depend on.

The new problems, such as declining soil fertility, nutrient imbalances, and low efficiency of applied inputs. This has led researchers to search for better solutions that can support productivity while improving soil health. One of the most promising approaches is integrated nutrient management (INM), which blends inorganic fertilizers with organic manures and biofertilizers.

In India, the practice of Integrated Nutrient Management (INM) combining inorganic fertilizers, organic sources like farmyard manure (FYM), and biofertilizers has been increasingly seen as a promising strategy for long-term productivity and soil health (Garg *et al*. 2024) [10]. Integrated nutrient management (INM), which combines chemical fertilizers with organic manures and biofertilizers, is now seen as a promising pathway to achieve sustainable farming. Sustainable nutrient management has therefore become a cornerstone of modern farming, as it directly influences crop productivity, soil fertility, and resource-use efficiency. The excessive reliance on chemical fertilizers, while contributing to yield enhancement, has often resulted in nutrient imbalances, soil degradation, and declining factor productivity, raising concerns about long-term sustainability. Hence, integrated approaches that combine inorganic, organic, and biological sources of nutrients are being increasingly emphasized to maintain soil health, enhance nutrient uptake, and improve profitability in a climate-resilient manner. Sustainable crop production has become a global challenge in the face of increasing food demand, land degradation, and climate variability. India, being one of the largest fertilizer consumers, faces the dual challenge of maintaining productivity while safeguarding soil health. Hence, the concept of Integrated Nutrient Management (INM)-which combines inorganic fertilizers, organic manures, and biofertilizers has gained importance as a viable strategy to ensure productivity, soil sustainability, and profitability (Prasad *et al.*, 2023) [34]. Nutritionally, it is low in calories and cholesterol-free but rich in dietary fiber, vitamins A and C, and essential minerals, which makes it highly suitable for modern health-conscious diets. Economically, baby corn offers dual-purpose benefits—the tender cobs are consumed as a vegetable, while the husk, silk, and green stalks serve as nutritious fodder, thereby ensuring zero waste. Its increasing use in urban diets, food processing, and hotel industries has created strong domestic demand, while its export potential is notable, with the United Kingdom alone importing nearly 90-95% of India's baby corn exports. Thus, the crop holds significant promise for both smallholder farmers and commercial enterprises by providing quick returns, employment opportunities, and market linkages. The cultivation of baby corn is becoming popular among the growers in periurban areas in recent years due to its diverse utility, high net returns in short growing period and changing food preferences in the life style of Indian people. Cost effective production and processing of baby corn may occupy an important place in the area of agri-business.

It provides carbohydrates, protein, fat, sugar, minerals and vitamins in palatable, wholesome, hygienic and digestible form. Baby corn's nutritive value is comparable to other vegetables such as cauliflower, cabbage, and tomato. Baby corn contains 89.1% Moisture, 0.2 g fat, 1.9 g Protein, 8.2 g Carbohydrate, 0.06g ash, 28.0 mg Ca, 86.0 mg P, and 11.0 mg of Ascorbic acid (Singh *et al*. 2017) [32].

Organic manure application is a common practice in sustainable agriculture, with significant effect for soil health, fertility, and productivity. The effects of organic manure on various soil properties, including physical, chemical, and biological parameters. The complex interactions between organic manure and soil, highlighting the impacts on soil structure, nutrient availability, microbial activity, and overall soil health. Additionally, the role of organic manure in mitigating soil degradation, enhancing crop productivity, and promoting sustainable agricultural practices. By understanding the diverse effects of organic manure on soil properties, farmers and policymakers can make informed decisions to improve soil management practices and ensure long-term agricultural sustainability Farm Yard Manure (FYM) besides improving physical, chemical and biological properties of soil have carry-over effect on succeeding crops Farm yard manure (FYM) contains around 0.5% nitrogen (N) 0.2 % Phosphorus (P) and 0.5% Potassium (K). Farm yard manure (FYM) contains around 0.5% Nitrogen, 0.2% Phosphorus and 0.5 % Potassium (Parihar *et al*. 2012) [24].

Biofertilizers are microorganisms that support the growth of plants by enhancing the nutrient supply to the host plant when given to seeds, plants, or the soil (Kumar *et al.* 2018) [15].

Baby corn is increasingly recognized in India as a nutrient-rich, short-duration, and high-value crop that serves both dietary and economic purposes. It is a low-calorie, cholesterol-free vegetable, rich in dietary fiber, vitamins A and C, phosphorus, and essential minerals, making it suitable for modern health-conscious diets (Prasad *et al*. 2024) [27]. In addition to its role in human nutrition, baby corn has a dual-purpose utility, since the husk, silk, and green stalks remaining after harvest are highly nutritious and are widely used as cattle feed, thus minimizing waste and adding value to the production system (Bakshi *et al*. 2017) [2].

Organic manure application is a common practice in sustainable agriculture, with significant effect for soil health, fertility, and productivity. The effects of organic manure on various soil properties, including physical, chemical, and biological parameters. The complex interactions between organic manure and soil, highlighting the impacts on soil structure, nutrient availability, microbial activity, and overall soil health. Biofertilizers are microorganisms that support the growth of plants by enhancing the nutrient supply to the host plant when given to seeds, plants, or the soil (Kumar *et al.* 2018) [15]. Baby corn is increasingly recognized in India as a nutrient-rich, short-duration, and high-value crop that serves both dietary and economic purposes. It is a low-calorie, cholesterol-free vegetable, rich in dietary fiber, vitamins A and C, phosphorus, and essential minerals, making it suitable for modern health-conscious diets. In addition to its role in human nutrition, baby corn has a dual-purpose utility, since the husk, silk, and green stalks remaining after harvest are highly nutritious and are widely used as cattle feed, thus minimizing waste and adding value to the production system (Feedipedia, 2024) [8]. Although reliable estimates on per capita baby corn consumption in India are not available, the increasing presence of baby corn in urban diets, modern retail outlets, and processing industries reflects its growing acceptance and demand. Unlike staple maize, where per capita consumption has declined over the past decades, baby corn represents a niche but rapidly expanding segment, offering opportunities for both domestic nutrition security and export-oriented income generation.

Sustainable crop production depends on balanced nutrient management that maintains soil fertility while addressing the growing demand for food. In India, farmers apply about 133-140 kg ha$^{-1}$ of N P K, yet the nutrient ratio has shifted from the recommended 4:2:1 to a less balanced 2.6:1.4:1 (FAI, 2024; NITI Aayog, 2023) [7, 20]. At the same time, biofertilizer production has grown from 1,21,000 MT in 2017-18 to 3,26,000

MT in 2022-23, but field-level adoption remains limited, with consumption dropping to just 7,205 MT in 2022-23 (IARI, 2025). Similarly, India produces about 38.7 million tonnes of farmyard manure (FYM) annually, which meets only ~3% of nutrient requirements, and its share has declined to 7% compared with 93% from chemical fertilizers (NCOF, 2023; IFA, 2019) [19, 13]. These imbalances highlight the urgent need for integrated nutrient management (INM) strategies that combine fertilizers, biofertilizers, and organics to improve nutrient-use efficiency, revive soil health, and ensure long-term sustainability.

## Materials and Methods

### Experimental site

The field experiment was conducted during the *Zaid* seasons of 2021 and 2022 at the Soil Science Research Farm, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India. The site is geographically situated at 25°24′42″ N latitude, 81°50′56″ E longitude, and an altitude of 98 m above mean sea level, representing the Central Plain Zone of Uttar Pradesh. The experimental farm is well-equipped with irrigation and other necessary facilities for successful baby corn cultivation.

Prayagraj experiences a subtropical and semi-arid climate, with distinct summer, rainy, and winter seasons. Summers are extremely hot, with maximum temperatures often reaching 46-48 °C**,** while winters are moderately cold, with minimum temperatures occasionally dropping to 4-5 °C. The region receives an average annual rainfall of about 1100 mm**,** predominantly during the southwest monsoon (July-September)**.** The relative humidity varies between 20% and 94%**,** depending on the season. Such climatic conditions are favorable for diversified cropping systems, including baby corn cultivation during the *Zaid* season.

Prior to the initiation of the experiment, soil samples were collected from the experimental site at a depth of 0-15 cm and analyzed for their physicochemical properties. Prior to the initiation of the experiment, soil samples were collected from the experimental site at a depth of 0-15 cm and analyzed for their physicochemical properties. The soil was classified as sandy loam in texture, slightly alkaline in reaction (pH 7.31)**,** Electrical Conductivity dS $m^{-1}$ 0.150 and low in organic carbon (0.41%). The available nutrient status of the soil was categorized as low in nitrogen (282.92 kg $ha^{-1}$)**,** medium in phosphorus (18.30 kg $ha^{-1}$), and medium to high in potassium (176.59 kg $ha^{-1}$). These baseline characteristics indicated the requirement of integrated nutrient management practices to sustain soil fertility and enhance crop productivity. The experiment was carried out in Factorial Randomized Block Design (*f*RBD) with three replications and twenty eight treatment combinations. The NPK was applied at the rate 120:60:40 through Urea, SSP, and MOP. The sowing of the baby corn was done 27.03.2021 and 24.03.2021 before which pre analysis of the pre sowing soil was done. Pre sowing operation like ploughing with mould board, harrowing, rotavator and levellig removal of weeds. FYM, NPK applications were done at the time of layout operation preparation. Soil samples were randomly collected to conducted the pre-sowing analysis using the auger, air dried, sieved with 2 mm screen and tested for various parameters and the initial unit recorded as shown in (Table 1**)**. The experimental data were statistically analyzed following the standard procedures for analysis of variance by Panse and Sukhatme (1967) [22].

**Table 1:** Soil Physical-chemical properties

| Components | Unit | Methods |
|---|---|---|
| Sand | 61.43 | Bouyoucos,(1927) [1] |
| Silt | 21.57 | |
| Clay | 17.00 | |
| Bulk density (Mg $m^{-3}$) | 1.17 | (Muthuvel *et al.*1992) [17] |
| Particle density (Mg $m^{-3}$) | 2.85 | (Muthuvel *et al.*1992) [17] |
| Water Holding Capacity (%) | 37.5 | (Muthuvel *et al.*1992) [17] |
| Organic carbon (%) | 0.41 | Walkley and Black, (1947) [39] |
| Av. Nitrogen (Kg $ha^{-1}$) | 282.92 | Subbiah and Asija, (1956) [35] |
| Av. Phosphorus (Kg $ha^{-1}$) | 18.30 | (Olsen *et al.* 1954) [21] |
| Av. Potassium (Kg $ha^{-1}$) | 176.59 | Toth and Prince, (1949) [36] |
| pH (1:2.5) W/V | 7.31 | Jackson, (1958) [14] |
| EC (dS $m^{-1}$) | 0.150 | Wilcox, (1950) [40] |

**Table 2:** Soil test rating chart used for interpretation for fertility for major nutrients

| Nutrients | Low | Medium | High |
|---|---|---|---|
| **Soil texture (Sandy loam)** | | | |
| (i) Sand (%) | < 45 | 45-65 | > 65 |
| (ii) Silt (%) | < 28 | 28-50 | > 50 |
| (iii) Clay (%) | < 20 | 20-35 | > 35 |
| Bulk density (Mg $m^{-3}$) | < 1.3 | 1.3-1.6 | > 1.6 |
| Particle density (Mg $m^{-3}$) | < 2.4 | 2.4-2.7 | > 2.7 |
| Water holding capacity (%) | < 40 | 40-60 | > 60 |
| Soil pH (1:2.5 w/v) | < 6.5 | 6.5-7.0 | > 7.5 |
| Electrical conductivity (dS $m^{-1}$) | < 1.0 | 1.0-2.0 | > 2.0 |
| Organic carbon (%) | < 0.5 | 0.5-0.75 | > 0.75 |
| **Macro Nutrients** | | | |
| **Parameter** | **Low** | **Medium** | **High** |
| Av. N (Kg $ha^{-1}$) | < 280 | 280-560 | > 560 |
| Av. $P_2O_5$ (Kg $ha^{-1}$) | < 10 | 10-25 | > 25 |
| Av. $K_2O$ (Kg $ha^{-1}$) | < 110 | 110-280 | > 280 |

## Result and Discussion

### Soil Physical Properties

The pooled data (Table 3) revealed that the maximum soil bulk density was recorded in $T_{28}$ [$F_6B_2$] 1.54 Mg $m^{-3}$ and followed by $T_{24}$ [$F_5B_2$] 1.53 Mg $m^{-3}$ and lowest was recorded in $T_1$ [$F_0B_0$] 1.41 Mg $m^{-3}$ due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant. Similar findings reported by (Pushpendra Kumar *et al*. 2022) [30] and (Shiva Prasad *et al*. 2023) [31]. The maximum soil particle density was recorded in $T_{28}$ [$F_6B_2$] 2.69 Mg $m^{-3}$ and followed by $T_{24}$ [$F_5B_1$] 2.62 Mg $m^{-3}$ and lowest was recorded in $T_1$ [$F_0B_0$] 2.31 Mg $m^{-3}$ due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant, similar findings reported by (Shiva Prasad *et al*. 2023) [31]. The pooled data revealed that the maximum water holding capacity was recorded in $T_{28}$ [$F_6B_2$] 43.78 % and followed by $T_{24}$ [$F_5B_1$] 42.95 % and lowest was recorded in $T_1$[$F_0B_0$] 37.40 % due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant, similar findings reported by (Shiva Prasad *et al*. 2023) [31].

### Soil Chemical Properties

The pooled data in (Table 3) revealed that the maximum soil pH was recorded in $T_{28}$ [$F_6B_1$] 7.35 and followed by $T_{24}$ [$F_5B_2$] 7.33 and lowest was recorded in $T_1$[$F_0B_0$] 6.92 due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant. Similar findings reported by (Shiva Prasad *et al*. 2023) [31]. The maximum electrical conductivity (dS $m^{-1}$) was recorded in $T_{28}$ [$F_6B_2$] 0.25 dS $m^{-1}$ and followed by $T_{24}$ [$F_5B_2$] 0.21 dS $m^{-1}$ and lowest was recorded in $T_1$ [$F_0B_0$] 0.12 dS $m^{-1}$

due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant. Similar findings reported by (Bhattacharyya *et al*. 2023) [3]. The maximum organic carbon (%) was recorded in $T_{28}$ [$F_6B_2$] 0.69 % and followed by $T_{24}$ [$F_5B_1$] 0.68 % and lowest was recorded in $T_1$ [$F_0B_0$] 0.37 % due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant, similar findings reported by (Sri *et al*. 2023) [34]. The maximum available nitrogen (kg $ha^{-1}$) was recorded in $T_{28}$ [$F_6B_2$] 280.50 kg $ha^{-1}$ and followed by $T_{24}$ [$F_5B_2$] 280.33 kg $ha^{-1}$ and lowest was recorded in $T_1$ [$F_0B_0$] 265.34 kg $ha^{-1}$ due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant, similar findings reported by (Gupta *et al*. 2024) [11]. The maximum available phosphorus (kg $ha^{-1}$) was recorded in $T_{28}$ [$F_6B_2$] 24.12 kg $ha^{-1}$ and followed by $T_{24}$ [$F_5B_1$] 23.10 kg $ha^{-1}$ and lowest was recorded in $T_1$ [$F_0B_0$] 19.01 kg $ha^{-1}$ due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant Similar findings by (Sofyan *et al*. 2023) [33]. The maximum available potassium (kg $ha^{-1}$) was recorded in $T_{28}$ [$F_6B_2$] 235.00 kg $ha^{-1}$ and followed by $T_{24}$ [$F_5B_1$] 233.53 kg $ha^{-1}$ and lowest was recorded in $T_1$ [$F_0B_0$] 175.00 kg $ha^{-1}$ due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant respectively. Similar findings reported by (Shiva Prasad *et al*. 2023) [31].

The pool data in (Table 3) revealed that the maximum was recorded in $T_{28}$ [$F_6B_2$] 33.33 and followed by $T_{24}$ [$F_5B_2$ ] 32.00 and lowest was recorded in $T_1$ [$F_0B_0$] 17.23 due to sub factor (FB) main factor (I) and due to interaction (FB × I) it was found to be significant.

## Summary and Conclusion

This research shows that integrated nutrient management (INM**)**, combining NPK fertilizers, biofertilizers, and farmyard manure (FYM**)**, is a practical and sustainable way to improve baby corn cultivation. By enhancing nutrient-use efficiency, improving soil health, and increasing yields, INM not only boosts farm profits but also reduces reliance on costly chemical fertilizers. It provides an eco-friendly and affordable solution that supports food security, protects natural resources, and helps farmers adapt to climate change. The balanced use of organic, inorganic, and biological sources emerges as a promising strategy for sustaining productivity and ensuring long-term soil fertility, making INM highly relevant for farmers, researchers, and policymakers working towards sustainable agriculture in India.

## Result and Discussion

**Table 3:** Effect of Various level of N P K Biofertilizers and Organic Manure on Soil Physico-chemical Properties of Soil and Yield of Baby Corn

| Treatment | Bulk density (Mg $m^{-3}$) Pooled | Particle density (Mg $m^{-3}$) Pooled | Water Holding Capacity (%) Pooled | Soil pH (1:2.5 w/v) Pooled | Electrical Conductivity (dS $m^{-1}$) Pooled | Organic Carbon (%) Pooled | Organic matter Pooled | Av. N (Kg $ha^{-1}$) Pooled | Av. $P_2O_5$ (Kg $ha^{-1}$) Pooled | Av. $K_2O$ (Kg $ha^{-1}$) Pooled | Baby corn Yield (q $ha^{-1}$) Pooled Pooled |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | 1.41 | 2.31 | 37.40 | 6.92 | 0.12 | 0.37 | 11.93 | 265.34 | 19.01 | 175.00 | 17.23 |
| $T_2$ | 1.43 | 2.39 | 38.26 | 6.91 | 0.17 | 0.51 | 11.91 | 272.67 | 20.21 | 188.59 | 17.52 |
| $T_3$ | 1.48 | 2.42 | 40.74 | 7.17 | 0.18 | 0.65 | 12.36 | 276.00 | 21.16 | 207.77 | 18.25 |
| $T_4$ | 1.36 | 2.42 | 42.04 | 7.13 | 0.19 | 0.65 | 12.29 | 277.50 | 22.12 | 226.26 | 18.65 |
| $T_5$ | 1.42 | 2.43 | 37.29 | 6.73 | 0.14 | 0.39 | 11.60 | 268.50 | 19.34 | 176.14 | 20.90 |
| $T_6$ | 1.44 | 2.44 | 39.44 | 6.99 | 0.17 | 0.53 | 12.05 | 273.17 | 20.34 | 190.94 | 22.30 |
| $T_7$ | 1.49 | 2.45 | 40.79 | 7.09 | 0.18 | 0.63 | 12.22 | 274.84 | 21.30 | 210.40 | 22.58 |
| $T_8$ | 1.37 | 2.46 | 41.56 | 7.21 | 0.20 | 0.66 | 12.43 | 275.67 | 22.25 | 227.29 | 20.27 |
| $T_9$ | 1.36 | 2.47 | 38.33 | 6.79 | 0.15 | 0.41 | 11.71 | 269.00 | 19.56 | 177.32 | 21.33 |
| $T_{10}$ | 1.38 | 2.48 | 39.72 | 7.03 | 0.17 | 0.55 | 12.12 | 273.34 | 20.48 | 193.33 | 24.03 |
| $T_{11}$ | 1.43 | 2.49 | 40.24 | 7.14 | 0.18 | 0.61 | 12.31 | 276.34 | 21.43 | 213.28 | 21.90 |
| $T_{12}$ | 1.50 | 2.50 | 42.28 | 7.28 | 0.20 | 0.67 | 12.55 | 276.83 | 22.39 | 228.93 | 26.82 |
| $T_{13}$ | 1.37 | 2.51 | 38.41 | 6.89 | 0.15 | 0.43 | 11.88 | 270.34 | 19.66 | 178.72 | 27.95 |
| $T_{14}$ | 1.39 | 2.52 | 40.17 | 7.15 | 0.17 | 0.57 | 12.33 | 274.00 | 20.62 | 195.73 | 28.92 |
| $T_{15}$ | 1.44 | 2.53 | 40.75 | 7.19 | 0.18 | 0.59 | 12.40 | 275.33 | 21.57 | 216.25 | 21.13 |
| $T_{16}$ | 1.51 | 2.54 | 41.28 | 7.36 | 0.20 | 0.68 | 12.69 | 277.17 | 22.48 | 229.67 | 22.12 |
| $T_{17}$ | 1.38 | 2.55 | 39.21 | 6.82 | 0.15 | 0.45 | 11.76 | 270.50 | 19.80 | 180.48 | 23.97 |
| $T_{18}$ | 1.40 | 2.56 | 39.42 | 7.05 | 0.17 | 0.59 | 12.15 | 274.17 | 20.75 | 198.38 | 25.08 |
| $T_{19}$ | 1.45 | 2.57 | 40.28 | 7.18 | 0.19 | 0.57 | 12.38 | 276.00 | 21.71 | 219.12 | 26.20 |
| $T_{20}$ | 1.52 | 2.58 | 43.16 | 7.21 | 0.21 | 0.69 | 12.43 | 279.50 | 22.56 | 231.59 | 27.37 |
| $T_{21}$ | 1.39 | 2.59 | 38.36 | 6.92 | 0.15 | 0.49 | 11.93 | 270.84 | 19.93 | 182.80 | 30.12 |
| $T_{22}$ | 1.41 | 2.60 | 40.20 | 7.04 | 0.17 | 0.63 | 12.14 | 275.00 | 20.89 | 201.24 | 23.20 |
| $T_{23}$ | 1.46 | 2.61 | 41.15 | 7.08 | 0.19 | 0.53 | 12.21 | 276.67 | 21.84 | 221.84 | 24.95 |
| $T_{24}$ | 1.53 | 2.62 | 42.95 | 7.33 | 0.21 | 0.68 | 12.64 | 280.33 | 23.10 | 233.53 | 24.25 |
| $T_{25}$ | 1.40 | 2.63 | 38.10 | 6.90 | 0.16 | 0.47 | 11.90 | 272.34 | 20.07 | 185.41 | 25.17 |
| $T_{26}$ | 1.42 | 2.64 | 40.17 | 7.04 | 0.18 | 0.61 | 12.14 | 274.34 | 21.03 | 204.43 | 30.87 |
| $T_{27}$ | 1.47 | 2.65 | 41.13 | 7.10 | 0.19 | 0.55 | 12.24 | 277.00 | 21.98 | 223.32 | 32.00 |
| $T_{28}$ | 1.54 | 2.69 | 43.78 | 7.35 | 0.25 | 0.69 | 12.67 | 280.50 | 24.12 | 235.00 | 33.33 |

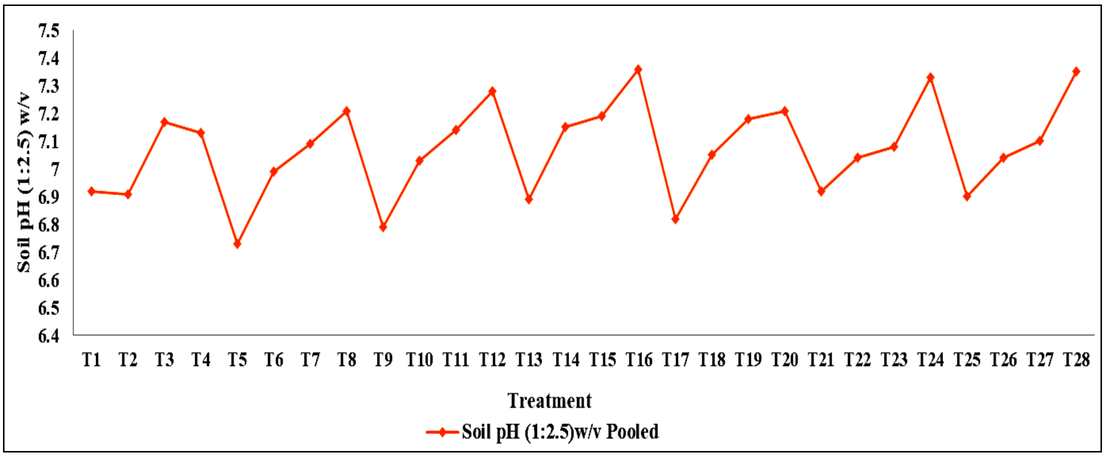


**Fig 1:** Effect of various level of N P K Biofertiizers and Organic manure on Soil pH (1:2.5) w/v Pooled

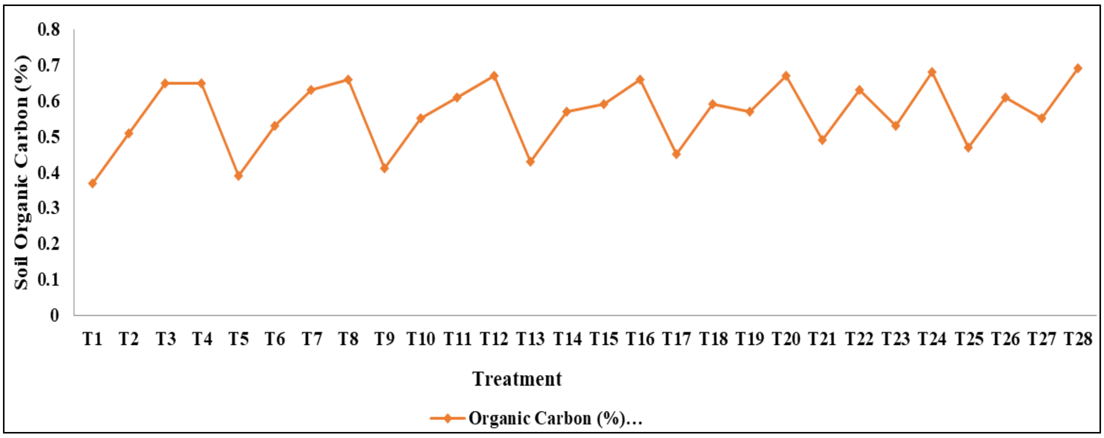


**Fig 2:** Effect of various level of N P K Biofertilizers and Organic manure on Soil Organic carbon (%)

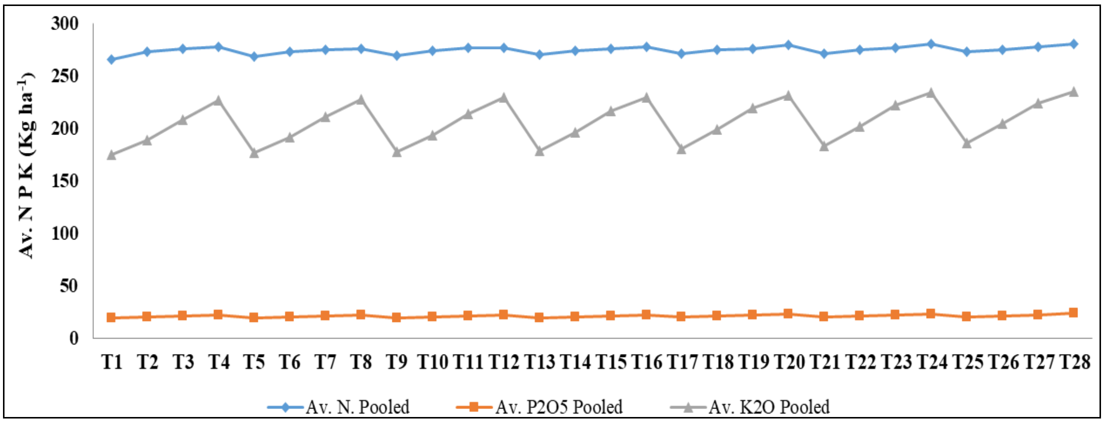


**Fig 3:** Effect of various level of N P K Biofertilizers and Organic manure on Soil Available Nitrogen, Phosphorus, Potassium (Kg $ha^{-1}$)

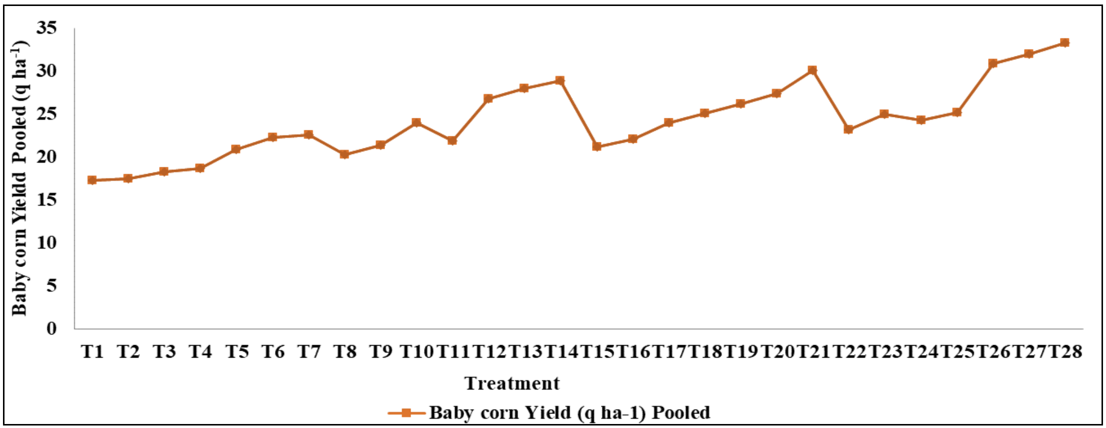


**Fig 4:** Efffect of various level of N P K Biofertilizers and Organic manure on Baby corn Yield Pooled (q $ha^{-1}$)

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**References**

1. Bouyoucos GJ. The hydrometer as a new method for the mechanical analysis of soils. Soil Sci. 1927;23(5):343-54.
2. Bakshi MPS, Wadhwa M, Makkar HPS. Utilization of baby corn by-products and waste as livestock feed. Feedipedia Bull. 2017;44:1-10.
3. Bhattacharya P, Mandal S, Singh R. Integrated nutrient management enhances phosphorus availability and productivity of maize (*Zea mays* L.). J Plant Nutr. 2023;46(12):1789-99.
4. Black CA. Methods of soil analysis. Part II. Chemical and microbiological properties. Agron Monogr. 1965;9:18-25.
5. Brady NC, Weil R. The nature and properties of soils. 15th ed. New Delhi: Pearson Education; 2016.
6. Dar ZM, Lone AA, Ali T, Khan MH, Rather AG, Wani SA. Genetic resources of maize and their utilization. Maize Genet Breed Res. 2014;6(2):45-52.
7. Fertilizer Association of India (FAI). Fertilizer statistics 2023-24. New Delhi: FAI; 2024.
8. Feedipedia. Utilization of baby corn by-products and waste as livestock feed. 2024. https://www.feedipedia.org
9. Fresh Plaza Editorial Team. Indian baby corn exports to the UK. Fresh Plaza. 2021. https://www.freshplaza.com
10. Garg R, Singh A, Meena RS, Kumar P. Integrated nutrient management for sustainable agriculture: Approaches and prospects. Indian J Agric Sci. 2024;94(2):115-23.
11. Gupta RK, Yadav D, Meena S. Exploring the potential of enhanced organic formulations in baby corn for improving nitrogen availability and agronomic efficiency. Front Sustain Food Syst. 2024;8:1380279.
12. Indian Agricultural Research Institute (IARI). The bio-agri revolution: Status and prospects of biofertilizers in India. New Delhi: IARI; 2025.
13. International Fertilizer Association (IFA). Nutrient consumption sources: Organic manures and fertilizers. Paris: IFA; 2019.
14. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India; 1958. p.219-21.
15. Kumar V, Singh M, Yadav AN. Biofertilizers: An eco-friendly approach for sustainable crop production. Int J Curr Microbiol Appl Sci. 2018;7(5):1047-54.
16. Muhr GR, Datta NP, Shankara Subramoney H, Dever F, Lecy VK, Donahue RL. Soil testing in India. New Delhi: USAID; 1965.
17. Muthuvel P, Udayasoorian C, Natesan R, Ramaswamy PP. Introduction to soil analysis. Coimbatore: Tamil Nadu Agric Univ; 1992.
18. NABARD. Farmer producer organizations (FPOs): Concept, practices and impact. Mumbai: National Bank for Agriculture and Rural Development; 2022.
19. National Centre for Organic and Natural Farming (NCOF). Organic inputs production in India. Ghaziabad: NCOF; 2023.
20. NITI Aayog. Fertilizer use and imbalance in India. New Delhi: Government of India; 2023.
21. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circ. 1954;939:1-19.
22. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: ICAR; 1967.
23. Paramesh V, Rani P, Kumar R, Meena RS. Sustainable nutrient management: Challenges and opportunities in Indian agriculture. J Plant Nutr Soil Sci. 2023;186(3):457-69.
24. Parihar CM, Rana KS, Jat SL, Kantwa SR, Rana DS. Nutrient management in pearl millet (*Pennisetum glaucum*)-mustard (*Brassica juncea*) cropping system: Nutrient budgeting and soil fertility. Indian J Agron. 2012;57(2):162-7.
25. Punjab Centre for Biotechnology and Microbiology (PCBMB). Baby corn production and prospects in India. Ludhiana: PCBMB; 2024.
26. Punjab Centre for Biotechnology and Microbiology (PCBMB). Production potential and utilization of baby corn: A review. Plant Cell Biotechnol Mol Biol. 2024;25(11-12):112-24.
27. Prasad M, Srinivas J, Cheena J, Majjiga S, Kumar B. Importance and future prospects of baby corn (*Zea mays* L.) in India. Biochem J. 2024;8(12 Suppl Q):184-8.
28. Prasad R, Sharma SN, Singh S. Integrated nutrient management: A pathway to sustainable crop production and soil health. Indian J Fertil. 2023;19(4):402-10.
29. Prasad R, Kumar A, Singh R. Integrated nutrient management improves soil physical properties, fertility and productivity of baby corn (*Zea mays* L.). Int J Curr Microbiol Appl Sci. 2023;12(6):1120-8.
30. Kumar P, Singh S, Patel R. Integrated nutrient management effects on soil physical properties, nutrient uptake and productivity of baby corn (*Zea mays* L.). Int J Chem Stud. 2022;10(1):415-20.
31. Prasad SM, Reddy K, Rao P. Study on the performance of integrated nutrient management on soil fertility of baby corn (*Zea mays* L.). Biol Forum Int J. 2023;15(10):544-7.
32. Singh PK, Singh MK, Verma DK. Nutritional composition and health benefits of baby corn (*Zea mays* L.). Int J Chem Stud. 2017;5(6):128-32.
33. Sofyan A, Suryanto A, Hadi A. Integrated use of organic manures and biofertilizers improves phosphorus availability and productivity of maize. Int J Agric Environ Biotechnol. 2023;16(1):55-62.
34. Sri K, Reddy DR, Prasad V. Effect of organic manures and biofertilizers on growth and yield of baby corn (*Zea mays* L.). Int J Plant Soil Sci. 2023;35(6):56-64.
35. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soils. Curr Sci. 1956;25:259-60.
36. Toth SJ, Prince AL. Estimation of cation exchange capacity

and exchangeable Ca, K and Na content of soil by flame photometer techniques. Soil Sci. 1949;67(6):439-45.
37. Verified Market Research. Baby corn market size and forecast (2024-2033). 2024. https://www.verifiedmarketresearch.com/product/baby-corn-market/
38. Volza. India export data of baby corn (Oct 2023-Sep 2024). 2024. https://www.volza.com/p/baby-corn/export/export-from-india/
39. Walkley AJ, Black IA. Estimation of soil organic carbon by chromic acid titration method. Soil Sci. 1947;37:29-38.
40. Wilcox LV. Electrical conductivity. Am Water Works Assoc. 1950;42:775-6.