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Nutrient management in sweet corn: A key to productivity and sustainability

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Abstract
Sweet corn has emerged as a new-age super food for health-conscious individuals and is one of the most popular vegetables in many Western and developed countries. It is a special type of corn characterized by a thin pericarp layer and a translucent, horny appearance of kernels at maturity, which become wrinkled upon drying. Sweet corn is typically harvested at the milky stage of the endosperm, around 20 days after fertilization. The primary cause of low sweet corn productivity is the absence of suitable production technologies, especially in the area of nutrient management. Nutrient management is a critical factor influencing the growth and yield of sweet corn, as it is a nutrient-intensive crop requiring both macro and micronutrients for optimal performance. Maintaining soil fertility sustainably requires a balanced use of both organic and inorganic nutrient sources to enhance plant growth and yield. Hence balanced fertilization using a combination of organic manures and synthetic fertilizers is essential. Integrated nutrient management in sweet corn is crucial for improving soil health and maintaining long-term crop productivity.

Keywords: Integrated nutrient management, inorganic fertilizer, organic manures, bio fertilizers, biostimulants, productivity

Introduction

Sweet corn (*Zea mays* var. *saccharata*) is an important maize subtype, widely valued for its natural sweetness and high nutritional content. Sweet corn is a specialty corn *viz*., a naturally occurring recessive mutant form of regular field corn. Sweet corn holds a significant place in the human diet due to its health-promoting nutritional qualities, making it a popular "new-age super diet" among health-conscious individuals. It is rich in dietary fiber, vitamins, antioxidants, and contains a moderate amount of essential minerals. Notably, sweet corn provides substantial levels of beneficial carotenoids such as lutein and zeaxanthin (Junpatiw *et al*., 2013) [19]. It is also well-known for its high sugar content, with total sugars ranging between 25–30 percent (Ramachandrappa and Nanjappa, 2006) [39]. Taste is the main factor that separates sweet corn from normal corn. Many different cuisines around the world use sweet corn as a vegetable because of its tender, tasty kernels. It results from a naturally occurring recessive mutation in the genes responsible for converting sugar to starch in the corn kernel's endosperm. In contrast to field corn, which is harvested at full maturity when the kernels are dry and hard (dent stage), sweet corn is harvested at the immature milk stage and is consumed as a vegetable instead of a grain (Erwin, 1951) [11].

The growth and yield of sweet corn are greatly affected by the application of different plant nutrients. Unlike many other crops, sweet corn has a high capacity to efficiently convert these nutrients into economically valuable produce. Sweet corn is a nutrient-demanding crop that requires sufficient amounts of nitrogen, phosphorus, and potassium to support its proper growth and development (Ortas and Sari, 2003) [34]. The nutrient needs of sweet corn differ based on factors such as the natural fertility of the soil, the cropping season, the variety grown, and the management practices followed. Applying a balanced mix of plant nutrients positively influences the growth and development of the crop. Higher doses of NPK fertilizers lead to greater biomass production by improving the efficient use of sunlight, thereby boosting the photosynthetic activity. The nutrient recommendation is considered as major yield determining factor required for sweet corn production (Sahoo and Mohanty 2020) [42].But, excessive chemical fertilizers usage can lead to environmental pollution while deficiency results in low plant growth which reduces the grain yield, leaf area duration and rate of photosynthesis (Abhishek and Basavanneppa, 2020) [2]. Thus, balanced and optimum use of inorganic fertilizers plays a pivotal role in increasing the yield of sweet corn.

Efficient nutrient management is crucial for sweet corn cultivation, as the crop requires substantial amounts of both macro- and micronutrients to achieve optimal growth and yield. Therefore, integrating organic manures with chemical fertilizers in a balanced manner is key to ensuring sustainable production. Integrated nutrient management has a multifunctional role in maize by improving crop yield and soil fertility in a sustainable way (Sindhi *et al.*, 2018) [45]. This review article primarily focuses on the nutrient management practices for sweet corn.

Effect of inorganic fertilizers on growth, yield and quality of sweet corn

Managing nitrogen in sweet corn can be difficult because the crop needs a high amount of it for growth and better yields. Sufficient availability of phosphorus and potassium is essential for achieving the desired yield in sweet corn. In corn, the application of the full recommended NPK dose (100:50:25 kg ha^{-1}) significantly improved plant height, dry matter accumulation, leaf area index (LAI), and crop growth rate (CGR) compared to the untreated control. (Pathak *et al.*, 2002) [37]. Likewise, a field study conducted at the College of Agriculture in Pune, Maharashtra, on sweet corn, indicated a marked increase in both LAI and CGR with the application of 100 percent of the recommended dose of fertilizers (RDF) at a ratio of 225:50:50 kg of N, P_2O_5, and K_2O per hectare (Wagh, 2002) [54]. Furthermore, the application of 150 percent of the recommended fertilizer dose yielded the highest growth and yield parameters for maize, with the 125 percent application rate following closely behind (Mundra *et al.*, 2003) [30]. Application of NPK at 90:30:15 kg ha^{-1} significantly increased plant height, dry matter production, leaf area index (LAI), and crop growth rate (CGR) at all growth stages of maize compared to the control (Verma *et al.*, 2006) [52]. The lack of fertilizer application in sweet corn cultivation resulted in more barren plants, reduced cob weight, and fewer small kernels(Sahoo and Mahapatra, 2007) [43]. Dry matter accumulation in sweet corn showed a significant increase with the application of 90 kg nitrogen and 45 kg phosphorus (P_2O_5) per hectare (Nath *et al.*, 2009) [32].Increasing nitrogen application positively influenced the mineral composition of sweet corn kernels and significantly improved fresh ear yield, plant height, ear length, ear diameter, single ear weight, and protein content (Oktem *et al.*, 2010) [33].The application of applying 100 per cent of the recommended doses of nitrogen and phosphorus, along with 125 per cent of the recommended dose of potassium, enhanced growth parameters such as leaf area index and total dry matter production in sweet corn (Kumar *et al*. 2010) [24]. Application of the recommended dose of fertilizers (180:60:50 kg NPK ha^{-1}), combined with foliar spraying of $ZnSO_4$ (0.5%) and $FeSO_4$ (0.2%) at the booting and silking stages, significantly enhanced dry matter production in sweet corn (Karrimi *et al.*,2018) [21].

In sweet corn cultivation, the application of potassium at 60.0 kg ha^{-1} enhanced biomass production and growth parameters, including shoot length, fresh and dry shoot biomass, number of leaves, and leaf area (Adnan, 2020) [3]. Application of 125 per cent of the recommended dose of nutrients (125:60:40 kg ha^{-1}) resulted in significantly improved growth and yield parameters of sweet corn such as number of leaves, leaf area, dry matter accumulation cob length, cob diameter, cob weight, and grain weight per cob (Pachoriya *et al.*, 2025) [35]. Sweet corn yield is largely influenced by major yield components, including plant population, number of ears per plant, number of kernels per cob, and individual kernel weight. The application of plant nutrients directly influences these yield-determining factors. Higher fertilizer application significantly enhances these attributes by stimulating physiological processes in the sweet corn plant. In sweet corn, the application of the recommended dose of fertilizers (150:50:0 kg NPK ha^{-1}) led to significantly higher cob girth, cob length, and green cob weight compared to other inorganic fertilizer dose (Khadtare *et al.*, 2006) [23]. Application of 120 kg N ha^{-1} in sweet corn recorded the highest grain yield among the nitrogen levels (Chauhan, 2010) [6]. The application of 120 kg nitrogen ha^{-1}obtained maximum green cob yield from sweet corn Singh *et al.* (2012) [46]. In corn, the application of 100 kg nitrogen ha^{-1} combined with 7.5 tons of FYM ha^{-1} significantly improved yield attributes, including cob diameter, cob weight per plant, and both grain and straw yields (Verma *et al.* 2012) [53]. The application of 90 kg N and 40 kg P_2O_5 per hectare led to a significant increase in green cob and fodder yields in sweet corn (Priyanka *et al.*,2014) [38].

In a sweet corn experiment conducted on clayey soil in Gujarat, the application of 120 kg N and 60 kg P_2O_5 per hectare resulted in the highest green cob and fodder yields (Mathukia *et al.*, 2014) [28]. Fertilization of sweet corn with120-60 kg N-P_2O_5 ha^{-1} resulted in higher yield and greater net returns under South Gujarat (Dangariya *et al.*,2017) [8]. Variations in fertilizer management influence the protein, sugar, and starch content of sweet corn. (Capon *et al.*,2017) [5]. The potassium uptakes by sweet corns significantly influenced weight of husked ear and sweet corn yields per plot (Fahrurrozi *et al.*, 2018) [12]. The highest green cob yield of sweet corn was achieved with the application of 150:50:60 kg N:P_2O_5:K_2O per hectare (Kumar and Chawla,2018) [25].

The combined application of 240 kg ha^{-1} of DAP fertilizer, 200 kg ha^{-1} of potassium sulfate, 360 kg ha^{-1} of urea, and 120 mg kg^{-1} of boron resulted to a significant increase in spring corn grain yield. This yield enhancement was due to improved relative water content, better pollen moisture and viability, which together enhanced fertility and increased the number of grains per ear (Abbas *et al.*, 2019) [1]. The application of the recommended dose of fertilizers (100:50:25:10 kg ha^{-1} N,P,K and SO_4) along with 7.5 tons ha^{-1} of farmyard manure, in combination with foliar sprays of zinc (0.2%), boron (0.1%), and iron (0.1%), resulted in a significant enhancement of yield, fodder yield, and shelling percentage(Jolli *et al.*,2020) [18].The fertilizer management @150:50:60kg N:P_2O_5:K_2O ha^{-1} can be optimally decided to obtain profitable yield of sweet corn (Sahoo and Mohanthy 2020) [42]. The maximum cob yield was obtained with the sole application of 135:65:15 kg N, P_2O_5, and K_2O per hectare. Conversely, the minimum cob yield was recorded when the recommended dose of fertilizers was combined with a 1.0% foliar spray of $ZnSO_4$ applied at 20 and 40 days after sowing (Varghese,2020) [51]. The foliar application of boron at a concentration of 0.3% proved to be more effective in enhancing the yield of sweet corn (Kumar *et al.* 2023) [26].

The market value of sweet corn largely depends on its harvest quality, which is influenced by the protein, sugar, and starch content present in the kernels. The application of the recommended dose of fertilizers significantly increased the protein and sugar content in sweet corn compared to plots without fertilizer application (Gosavi *et al.*, 2009) [13]. Furthermore, applying 112.5 kg N, 75.5 kg P_2O_5, and 37.5 kg

K_2O per hectare significantly improved quality parameters such as non-reducing sugar, total sugar, and protein content in sweet corn (Kumar *et al*., 2010) [24].

Effect of organic manures on growth, yield and quality of sweet corn

The application of RDF at 150:50:0 kg NPK ha⁻¹ significantly improved the yield and yield-related traits of sweet corn, including cob girth, cob length, cob weight, green cob yield, and green fodder yield. This was followed by treatments with 25% RDN supplied through vermicompost derived from *Parthenium hysterophorus* and *Amaranthus spinosus*, both of which also showed considerable enhancements in these parameters (Khadtare,*et al* 2006) [23]. The application of 50% RDF combined with 50% nitrogen through poultry manure resulted in higher values for dry fodder yield, fresh cob yield, crude protein content, reducing sugars, non-reducing sugars, and total sugars in sweet corn (Dalavi *et al*., 2009) [7]. Sweet corn kernels showed the highest protein content with the application of 180:80:55 kg $N:P_2O_5:K_2O$ per hectare (Sunitha and Reddy 2012) [49]. The application of vermicompost at 5 t ha^{-1} along with the full recommended dose of fertilizers (120:60:00 kg N:P:K ha^{-1}) significantly improved key yield attributes in maize, including the number of grains per cob, 100-seed weight, and overall grain yield (Kannan *et al*.,2013) [20]. The integrated application of 180-75-60 kg NPK ha^{-1} along with vermiwash resulted in the highest growth parameters in sweet corn (Keerthi *et al*.,2013) [22]. The maximum protein content and protein yield in corn were achieved by applying the full recommended dose of fertilizers (120:60:40 kg $N:P_2O_5:K_2O$ ha^{-1}) along with 10 tons of farmyard manure per hectare (Shinde *et al*.,2014) [44].

Among the different manurial practices, applying the recommended dose of nitrogen through urea (120-60-60 kg N, P_2O_5, K_2O kg ha^{-1}) gave the best results for plant height, leaf area index, and dry matter, yield, cob length, girth, cob weight, protein, carbohydrates, reducing and non-reducing sugars and total sugars. However, similar results were also seen with the combination of 75 per cent nitrogen from poultry manure and 25 per cent from panchagavya foliar spray. The lowest values for all growth, yield, and quality traits were observed when 100per cent nitrogen was supplied through green manuring with *Gliricidia maculate* (Pande, *et al*., 2015) [36]. The combination of green leaf manure, enriched compost, and vermicompost applied as a top dressing during the growth stage resulted in higher yield and better quality of sweet corn compared to applying only vermicompost at the basal application. However, foliar spraying of 10% bio-digester liquid and cow urine significantly improved the yield and quality of sweet corn compared to the untreated control (Waghmode *et al*., 2015) [55].

The application of the full recommended dose of inorganic fertilizer (70:50:0 N, P_2O_5, K_2O kg ha^{-1}), either alone or combined with 1 ton per hectare of vermicompost, significantly increased the dry matter yield of sweet corn (Canatoy,2018) [4]. Application of the full recommended dose of nutrients (120:60:40 kg NPK ha^{-1}) along with farmyard manure(5tons ha^{-1}) resulted in green cob yield and higher profitability in sweet corn cultivation(Jayant *et al*.,2019) [17].The application of vermicompost at 25 Mg ha⁻¹ combined with 100 per cent liquid organic fertilizer (LOF) resulted in the highest plant height, leaf area, fresh shoot weight and dry shoot weights, as well as the weight of both husked and un husked ears, ear diameter, and husked ear weight, leading to enhanced growth and yield of sweet corn. Additionally, vermicompost significantly improved the uptake of nitrogen, phosphorus and potassium (Muktamar *et al*.,2017) [29]. Using the full recommended amount of nitrogen through farmyard manure (18 t ha^{-1}), along with adding 200 kg per hectare of silicon, greatly improves the growth, yield, and quality of sweet corn when grown using organic farming methods(Naik *et al*., 2022) [31].

Effect of Biofertilizers on growth, yield and quality of sweet corn

The application of 100 per cent RDF (225:50:50 kg $N:P_2O_5:K_2O$ ha⁻¹) combined with 5 tons of FYM per hectare, *Azotobacter*, and PSB resulted in minor increases in protein content of both grain and green fodder, as well as sucrose content and Brix value in grain. However, these improvements were not statistically significant compared to other fertilizer and FYM treatments in sweet corn(Wagh, 2002) [54]. The application of zinc sulphate, farmyard manure (FYM), and phosphate-solubilizing bacteria (PSB) inoculation significantly enhanced the grain yield of maize. Hence, the integrated nutrient management approach comprising 75 per cent of the recommended NPK dose, 100 per cent FYM, 100 per cent zinc, and PSB inoculation can be recommended as the most effective treatment for improving maize grain yield (Dinesh *et al.*, 2011) [10]. Applying 125 per cent of the recommended chemical fertilizers (218.75:93.75:93.75 N P K kg ha^{-1}) along with 5 tons per hectare of farmyard manure and treating seeds with liquid bio fertilizers like phosphate-solubilizing bacteria (PSB) and Azospirillum (10 ml per kg of seed) greatly improves the growth, nutrient availability and uptake, as well as the yield and quality of sweet corn (Jadhav *et al* 2019) [16]. The integration of the full recommended fertilizer dose (120:60:60 kg $N:P_2O_5:K_2O$ ha⁻¹) with a biofertilizer consortium containing *Azotobacter, Azospirillum* and *Phosphobacteria* at 15 kg ha⁻¹ has been found effective in enhancing crop growth, yield attributes, overall productivity, and economic returns in sweet corn cultivation(Rao *et al*.,2020) [40]. The integrated application of 75 per cent of the recommended NPK dose (90:60:40 kg ha⁻¹), farmyard manure at 4.5 t ha⁻¹, and bio fertilizers (Azotobacter and phosphate-solubilizing bacteria) significantly improved cob length and diameter, number of cobs per plant, rows per cob, grains per row, and cob weight in the sweet corn variety Super-75 (Rasool *et al.* 2021) [41]. The combined use of bacterial biofertilizers (*Azospirillum brasilense* and *Pseudomonas fluorescens*) with foliar application of magnesium and calcium at 50 mg L⁻¹ each significantly improved plant height, leaf area, leaf area index, and total dry matter accumulation in the sweet corn hybrid ROI SOLEIL (Wasan, and Al-Juboori,2023) [56]. The use of Panoramix biofertilizer, a formulation containing *Trichoderma spp* and *Bacillus spp* led to a significant improvement in sweet corn quality parameters such as total soluble solids (TSS), reducing sugars, starch content, carotene, and antioxidant activity (Soare *et al*., 2023) [47].

Effect of biostimulants on growth, yield and quality of sweet corn

Biostimulants are organic or synthetic compounds that promote plant growth, improve nutrient absorption, and increase resistance to stress, without acting as direct sources of nutrients. Applying 125 per cent of the recommended fertilizer dose (187.50:93.75:56.25 kg N:P:K ha⁻¹) along with a 0.2% foliar spray of humic acid significantly increased plant height, leaf area index, yield, total sugars, reducing sugars, and protein content. (Haranal,2021) [15]. Foliar application of amino acid-based biostimulant, (Perfectose TM, liquid) 4 ml L^{-1} at the milk stage and 1 ml L^{-1} and 2 ml L^{-1} at the 7th leaf stage significantly enhanced plant height, root length, ear length, chlorophyll content, concentrations of nitrogen, phosphorus, potassium, and protein in sweet corn variety Merkur (Tadros *et al*.,2019) [50]. The higher corn yield was obtained from the treatment with 100 per cent of the recommended dose (150-75-75 kg NPK ha⁻¹) applied through chemical fertilizers reflecting an approximate 150 per cent increase over the control. However the combined applications sea weed extract SoliGro granular (*Ascophyllum nodosum*) with vermicompost produced comparatively lower yield. The highest corn sugar content was recorded with the application of the full recommended dose of chemical fertilizers (150-75-75 kg NPK ha⁻¹). This result was statistically comparable to the treatment that combined 50 per cent of the recommended chemical fertilizers with 50 per cent of the recommended nitrogen supplied through the seaweed extract Soligro (granular form of *Ascophyllum nodosum*) in sweet corn variety Sugar-75(Das *et al*.,2024) [9].Application of the growth stimulant Lithovite CO_2 at 0.5 g L^{-1} three times starting one month after sowing and repeated at two-week intervals significantly enhanced various growth and quality parameters including plant height, number of leaves, leaf area, yield. protein content, reducing sugar, and non-reducing sugar in the Nuziveedu-Misthi sweet corn variety (Halawa *et al*.,2024) [14]. Spraying 10% seaweed sap made from *Sargassum wightii* gave the best results in sweet corn, improving yield and parts like cob size and cob weight (Kumari *et al*., 2025) [27].

Conclusion

In conclusion, the expanding cultivation of sweet corn in India and other Asian countries reflects its growing market potential and adaptability to diverse agro-climatic conditions. To fully realize the crop's economic and agronomic benefits, it is essential to focus on region-specific nutrient management strategies that support the optimal growth and productivity of sweet corn hybrids. Integrated and balanced nutrient management improves both yield and crop quality while also maintaining soil health and promoting long-term sustainability. Therefore, the development and adoption of efficient nutrient packages, tailored to local conditions, will play a crucial role in supporting the continued growth and profitability of sweet corn cultivation in the coming years.

Future Perspectives

The future prospects of sweet corn cultivation in India are highly promising due to rising consumer demand, urbanization, and changing food preferences toward healthier and ready-to-eat options. With its shorter crop duration, high market value, and suitability for multiple cropping systems, sweet corn presents an attractive alternative to traditional cereals. Expansion of processing industries, improvement in supply chains, and increased awareness among farmers about high-yielding hybrids and proper nutrient management can further boost its cultivation. Additionally, the development of early-maturing and climate-resilient varieties tailored to regional conditions will enhance productivity and sustainability, making sweet corn a viable crop for both small and large-scale farmers.

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