Nano Urea and Plant Density Optimization for Enhanced Sweet Corn (*Zea mays* L. saccharata) Productivity: A Comprehensive Review

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Abstract— *Sweet corn (Zea mays L. saccharata) is renowned for its high sugar content and nutritional value, making it a staple crop in many diets worldwide. Achieving optimal growth and yield in sweet corn requires efficient nutrient management and appropriate plant density. Nano urea, a novel fertilizer known for its controlled-release properties, promises enhanced nutrient delivery and utilization compared to traditional urea. This review synthesizes recent studies on the effects of nano urea and plant density on sweet corn growth, yield and yield attributes. The findings suggest that integrating nano urea with optimal plant density can significantly boost sweet corn productivity. Additionally, the review explores future research directions and implications for sustainable agricultural practices.*

Keywords*— *Nano Urea, Plant Density, Sweet Corn, Productivity.

I. INTRODUCTION

Sweet corn (*Zea mays* L. saccharata) holds significant agricultural and economic importance due to its high nutritional value and versatile culinary applications. Efficient management of nutrients, particularly nitrogen (N), is crucial for maximizing sweet corn productivity. Traditional nitrogen fertilizers, such as urea, are widely used but often suffer from inefficiencies like leaching and volatilization, leading to suboptimal nutrient utilization and environmental concerns. In contrast, nano urea presents a promising alternative with its slow-release mechanisms, potentially enhancing nitrogen uptake efficiency and minimizing environmental impacts.

Plant density is another critical factor influencing sweet corn productivity, affecting light interception, water use efficiency, and nutrient availability. Optimizing plant spacing can directly influence growth parameters and yield components. This review aims to comprehensively explore recent advancements and findings on the combined effects of nano urea application and plant density manipulation on sweet corn productivity.

II. PRELIMINARY WORK DONE

2.1 Effect of Nano Urea on Sweet Corn:

2.1.1 Growth and Physiological Parameters:

[1] Investigated the application of nano NPK (12-12-36) and nano chelated micro fertilizers, observing significant improvements in maize plant height and stem diameter. These findings underscore the potential of nano fertilizers in enhancing nutrient uptake efficiency and promoting robust growth.

[2] Reported that combining 75% conventional nitrogen with 25% nano nitrogen resulted in enhanced growth and yield in maize and cowpea. Notably, chlorophyll content and photosynthetic activity were notably increased, highlighting the role of nano urea in optimizing plant physiological processes.

[3] Studied treatments involving Nano N, Cu, Zn, and Iffco Sagarika, noting significant improvements in maize growth attributes such as plant height and leaf area. These findings emphasize the importance of nano fertilizers in supplying essential micronutrients critical for plant health and productivity.

[4] Conducted research on nano urea spray applications and found that a concentration of 6 ml/l resulted in increased plant height, leaf length, and leaf number per plant in maize. This suggests that foliar application of nano urea effectively meets maize's nitrogen requirements, promoting vigorous growth.

[5] Explored specific combinations of granular and nano urea, noting improvements in sweet corn growth characteristics such as plant height and dry matter accumulation. The study highlighted enhanced nutrient availability and utilization with nano urea formulations.

[6] Investigated the synergistic effects of combining 50% conventional urea with 50% nano urea, along with nano zinc, which resulted in increased plant height and leaf area index in maize. These findings underscore the potential of nano fertilizers in enhancing overall crop productivity through balanced nutrient supply.

[7] Evaluated the application of $ZnSO_4$ with nano urea, observing significant increases in the plant height and dry weight of baby corn. This highlights the role of combining nano urea with essential micronutrients to enhance growth and yield performance.

[8] Concluded that integrating 75% conventional fertilizer with nano urea improved growth parameters, yield, and cost-to-benefit ratios in maize and rice. These findings support the use of nano urea as a strategy to reduce conventional fertilizer usage while maintaining high crop productivity and economic returns.

2.1.2 Yield and Yield Attributes:

[9] Observed that increased fertilizer inputs, including nano urea, significantly enhanced maize yield, particularly in baby corn and green forage. This suggests that higher nutrient doses can effectively boost crop productivity.

[10] Studied combinations of nitrogen with foliar applications of nano nitrogen and nano zinc, reporting increased fresh cob and green fodder yields in maize. These results highlight the role of nano urea in improving nutrient efficiency and enhancing yield attributes.

[11] Found that combining mineral nitrogen with nano nitrogen optimized maize yield attributes such as cob weight and grain number. This underscores the effectiveness of nano urea in enhancing yield components and overall crop performance.

[4] Demonstrated that nano urea spray applications at specific concentrations improved cob weight, grain number per plant, seed yield, and straw yield in maize. These findings indicate the efficacy of nano urea in promoting reproductive growth and maximizing yield metrics.

[5] Noted that specific combinations of granular and nano urea resulted in the highest green cob and green fodder yields in sweet corn, suggesting potential integration benefits in mixed fertilizer applications.

[6] Highlighted significant increases in grain and stover yields in maize with combined applications of nano urea and nano zinc, emphasizing their synergistic effects on productivity enhancement.

[12] Reported superior yield attributes in Rabi maize with foliar applications of nano urea, indicating supplementary benefits to soil-applied fertilizers in optimizing yield components.

[13] Concluded that integrating nano nitrogen with traditional NPK fertilizers resulted in higher grain yield and grain number per row in maize, illustrating the potential of nano urea to enhance crop yield under varied agronomic conditions.

2.2 Effect of Chemical Fertilizers on Productivity:

[14] Found that balanced fertilization with nitrogen (90 kg N) and phosphorus (40 kg P_2O_5) per hectare increased green cob and fodder yields in sweet corn, highlighting the importance of nutrient balance in maximizing productivity.

[15] Observed that higher fertilizer doses improved yield attributes and nutrient uptake efficiency in sweet corn, emphasizing the role of adequate fertilization in achieving optimal yield potential.

[16] Reported that increased nitrogen (150 kg N) and phosphorus (75 kg P_2O_5) application per hectare significantly increased green cob yield in sweet corn, supporting the use of higher nutrient rates to enhance yield.

[17] Demonstrated that nitrogen application (120 kg N) per hectare increased green cob yield in baby corn, highlighting the critical role of nitrogen fertilization in maximizing yield potential.

[18] Concluded that balanced applications of nitrogen (150 kg N), phosphorus (75 kg P2O5), and potassium (45 kg K_2O) per hectare using the flatbed planting method improved cob length and seed weight in sweet corn, emphasizing the importance of integrated nutrient management practices.

[19] Observed significant impacts of varying plant spacing and fertilizer levels on sweet corn growth and yield attributes, underscoring the need for optimizing both plant density and fertilization practices to achieve optimal yields.

2.3 Effect of Plant Density on Sweet Corn:

2.3.1 Growth and Physiological Parameters:

[20] Reported that wider plant spacing (60×20 cm) promoted taller plants and increased leaf area in sweet corn, suggesting enhanced vegetative growth due to reduced competition for resources.

[21] Found that a plant spacing of 50×15 cm resulted in higher plant height and leaf area index in sweet corn, indicating improved light interception and photosynthetic efficiency at optimal spacing.

[22] Observed that a spacing of 45×20 cm optimized growth and yield attributes in sweet corn, balancing resource utilization and crop development effectively.

[23] Reported that a plant spacing of 60×20 cm resulted in superior growth attributes in sweet corn, including increased plant height and leaf area, highlighting the benefits of wider spacing for promoting vegetative growth.

[24] Found that a spacing of 30×30 cm recorded higher plant height and leaf area index in sweet corn, indicating the critical role of plant density in determining growth parameters and overall crop health.

[16] Investigated various plant spacing configurations (e.g., 60×30 cm and 45×20 cm), observing improved growth and yield attributes in sweet corn with optimal plant density adjustments.

[25] Noted that a spacing of 45×20 cm promoted taller plants and higher leaf area index in sweet corn, underscoring the importance of optimal plant density in maximizing growth parameters and overall crop performance.

2.3.2 Yield & Yield attributes:

Researchers at CRIDA, Hyderabad **[19]** found that a planting geometry of 60×20 cm resulted in the highest cob yield compared to wider spacings of 75×20 cm and 45×20 cm. Similarly, **[26]** observed that increasing inter-plant spacing from 15×30 cm enhanced attributes like cob weight and kernel recovery, while decreasing spacing to 30×15 cm increased plant dry weight and number of cobs per hectare. They highlighted 60×20 cm as optimal for cob yield, outperforming 60×25 cm which reduced yield by 33.2%.

[27] Linked row spacing (55 cm) of the Chase variety to increased cob yield due to factors like tassel length and ear production per plant. **[28]** identified 75,000 plants per hectare as optimal for green cob and fodder yield, showing increases over lower plant densities. **[23]** highlighted 60×20 cm spacing as significantly improving cob length, weight, grain yield, and protein content.

[29] Found maximum cob length and yield with 60×25 cm spacing sown in late October. **[16]**, focusing on Rabi sweet corn in Southern Gujarat, noted 45×20 cm spacing for superior cob traits and 60×30 cm for maximum cobs per plant.

Finally, **[30]** affirmed that 60×20 cm spacing enhanced green cob and fodder yield, while 60×30 cm spacing increased cob protein content during the Rabi season in Gujarat.

III. CONCLUSION

In conclusion, the integration of nano urea and optimal plant density management represents a promising approach for enhancing sweet corn productivity and economic sustainability. Nano urea technologies offer improved nutrient use efficiency and environmental stewardship compared to conventional fertilizers, contributing to enhanced growth, yield, and yield attributes in sweet corn cultivation. Optimal plant density management plays a pivotal role in maximizing resource utilization and promoting robust growth parameters in sweet corn crops. Future research directions should focus on assessing the longterm impacts of nano urea applications and plant density optimization on sweet corn, ensuring sustainable agricultural practices and economic viability.

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