EFFECT OF NANO FOLIAR FERTILIZATION ON GROWTH PARAMETERS OF SWEET CORN (*Zea mays saccharata* Sturt.)

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Abstract

Addressing the challenge of global food security amidst a growing population requires innovative approaches to enhance crop productivity. Sweet corn (*Zea mays saccharata* Sturt.), a valuable dietary and processing crop, demands novel methodologies to boost yield and preserve nutritional value. The intersection of agriculture and nanotechnology offers transformative potential. Nanotechnology, operating at the nanoscale, can influence plant processes such as nutrient absorption, stress response, and pest management. Nano foliar fertilization, involving direct nutrient application to leaves, presents a promising approach. Nanoparticles encapsulate and protect nutrients, enabling sustained release and optimized absorption. The objective of this study is to explore the effects of nano foliar fertilization on sweet corn growth parameters, including plant height and leaf area. Results reveal that a 50-fold dilution of nano fertilizer formulation significantly enhances plant height and leaf area. This can be attributed to augmented nitrogen supply, promoting photosynthesis and auxin modulation. Nano foliar fertilization emerges as a strategy to enhance crop growth sustainably, potentially reducing ecological impact. The study underscores the synergy between nanotechnology and agriculture, presenting a holistic understanding of implications for crop growth, resource efficiency, and global food security.

***Keywords*:** Sweet corn, Nano fertilizer spray, plant height, leaf area

Introduction

The challenge of ensuring global food security has intensified alongside the burgeoning global population, necessitating innovative approaches to optimize agricultural practices and enhance crop productivity. In this context, sweet corn (*Zea mays saccharata* Sturt.) emerges as a pivotal player, not only as a vital dietary component but also as a raw

material for an array of processed food products. As the demand for sweet corn continues to escalate, there arises an imperative to explore novel methodologies that can not only boost yield but also ensure the quality and nutritional value of the harvest.

Amid this backdrop, the intersection of agriculture and nanotechnology offers a compelling avenue for transformative change. Nanotechnology, which entails the manipulation of materials at the nanoscale (typically 1 to 100 nanometers), has demonstrated remarkable potential across various sectors, and its application in agriculture is no exception. The distinct physicochemical properties exhibited by nanomaterials endow them with the ability to profoundly influence plant processes, including nutrient absorption, stress response modulation, and pest management. Thus, the idea of harnessing nanotechnology for the benefit of crop production, such as through nano foliar fertilization, has garnered substantial attention.

Foliar fertilization, a technique involving the direct application of nutrient solutions to plant leaves, presents an alluring prospect in modern agricultural paradigms. This method offers a gamut of advantages, including the rapid and efficient delivery of nutrients, circumvention of nutrient losses through leaching, and targeted nourishment of plant tissues. While conventional foliar fertilization has been utilized to great effect in augmenting crop performance, recent strides in nanotechnology have paved the way for a new dimension in nutrient delivery – nano-formulated foliar sprays.

Central to this transformative shift is the intrinsic potential of nanoparticles to redefine the dynamic between plants and nutrients. Through the encapsulation and protection of vital nutrients, nanoparticles act as custodians, staving off degradation and extending the window of nutrient availability. This orchestrated mechanism enables a regulated and sustained nutrient release, culminating in the finely tuned optimization of nutrient absorption. Capitalizing on this augmented nutrient bioavailability, complemented by nanoparticles' remarkable ability to navigate biological barriers, a realm of untapped potential emerges – one where nutrient uptake efficiency is elevated, ultimately fostering comprehensive enhancements in overall plant growth.

The overarching objective of the present study is to delve into the effects of nano foliar fertilization on the growth parameters of sweet corn (*Zea mays saccharata* Sturt.). This entails a comprehensive examination of how nano-formulated nutrient sprays impact not only the physical attributes of sweet corn, such as plant height, leaf area, and biomass accumulation, but also the intricate physiological processes that underpin growth, including

photosynthesis and nutrient assimilation. As we endeavor to unravel the implications of this innovative approach, the potential ramifications for sustainable agriculture and global food security come sharply into focus.

The significance of this investigation extends beyond the realm of crop science. If proven effective, nano foliar fertilization could represent a breakthrough strategy to not only amplify agricultural output but also mitigate the ecological footprint associated with excessive fertilizer application. By optimizing nutrient utilization and minimizing runoff, this approach aligns with the imperatives of environmentally conscious and sustainable farming practices.

In light of these considerations, this study aspires to contribute valuable insights into the dynamic interplay between nanotechnology and agriculture, specifically in the context of sweet corn cultivation. By elucidating the impacts of nano foliar fertilization, we aim to unlock the potential of this innovative technique, fostering a holistic understanding of its implications for crop growth, resource efficiency, and global food security.

Material and Methods

A mini-plot trial was executed at the Eastern Block Farm of Tamil Nadu Agricultural University, situated in Coimbatore, India. The primary objective of this endeavor was to evaluate the efficacy of a foliar application of nano-formulated fertilizer on the Sugar 75 cultivar of sweet corn. The experimental design encompassed six distinct treatments, each iterated thrice, and was implemented employing a randomized block design.

The treatment regimens encompassed varying degrees of dilution of the nano-formulated fertilizer, specifically at dilutions of 50, 100, 200, and 300 times, in addition to a conventional urea spray set at a concentration of 2%, and an unaltered control group.

The sowing of the sweet corn seeds was orchestrated at a spacing configuration of 60 cm × 20 cm, and subsequent irrigation was administered to facilitate optimal crop germination. Dual instances of foliar spraying were conducted at the 15th and 35th Days After Sowing (DAS), utilizing a spray volume of 500 liters per hectare.

Results and Discussion

Plant height

Plant height serves as a visible indicator of overall growth and development. An increase in plant height signifies healthy and vigorous growth, while reduced height could

indicate stress or inadequate nutrient availability. In case of present experiment, at both the 30 and 45 Days After Sowing (DAS) stages, the most substantial plant height, measuring 40.80 cm and 123.20 cm respectively, was observed when employing a 50-fold dilution of the nano fertilizer formulation. Remarkably, this noteworthy plant height corresponded not only to the application of conventional urea at a 2% concentration but also to the foliar application of the nano fertilizer formulation at dilutions of 100 and 200 times. In contrast, the smallest plant height of 32.20 cm at 30 DAS and 101.80 cm at 45 DAS was documented in the control plots where no foliar application was administered (Table 01). The observed elevation in plant height resulting from the employment of a 50-fold dilution of the nano fertilizer formulation in comparison to alternative treatments can be attributed to the augmented nitrogen supply facilitated by the lesser dilution ratio. Consequently, the heightened nitrogen availability engendered by treatment T_2 potentially contributed to escalated photosynthetic activity and the effective modulation of auxin levels, thereby culminating in superior plant height. These findings align harmoniously with the research conducted by Warpe *et al*. (2022) and Ullasa *et al*. (2016).

Table 01: Effect of nano fertilizer formulation on plant height (cm) of sweet corn

Treatment	30 DAS	45 DAS
T_1: Control	32.20	101.80
T_2: 50X	40.80	123.20
T_3: 100X	38.00	109.80
T_4: 200X	36.38	107.40
T_5: 300X	34.20	104.80
T_6: Urea (2% foliar spray)	39.50	118.20
SEd	2.58	7.84
C.D.	5.46	16.35

Leaf area (cm^2)

Leaf area directly influences the photosynthetic capacity of plants. A larger leaf area translates to a greater surface area available for photosynthesis, which is the process by which plants convert light energy into chemical energy, essential for growth and development. More extensive leaf area allows for increased nutrient assimilation, as leaves are the primary sites of nutrient absorption. Fertilizer foliar sprays aim to provide essential nutrients directly to the

leaves, and monitoring leaf area helps assess the plant's capacity to uptake the nutrients. In the present trial, highest leaf area of 1201.65 cm^2 and 4142.70 cm^2 was obtained from the treatment T_2 (Table 02). While, the plots treated with conventional urea @ 2% and nano fertilizer formulation diluted 100 times were found to be on par with the highest. However, the lowest leaf area was recorded from the control plots. The observed augmentation in leaf area could be attributed to the amplified plant height, characterized by an increased count of internodes, consequently resulting in a greater abundance of functional leaves and, consequently, an expanded leaf area. The results were similar to the work of Jakku Prasanna *et al*. (2020) and Jadhav *et al*. (2020).

Table 02: Effect of nano fertilizer formulation on leaf area (cm^2) of sweet corn

Treatment	30 DAS	45 DAS
T_1: Control	608.32	1921.57
T_2: 50X	1201.65	4142.70
T_3: 100X	1068.60	3648.90
T_4: 200X	861.37	3363.07
T_5: 300X	782.25	3264.75
T_6: Urea (2% foliar spray)	1100.47	3836.81
SEd	89.707	321.80
C.D.	202.46	726.29

Conclusions:

To conclude, the research demonstrates the efficacy of nano-formulated foliar sprays in promoting the growth of sweet corn. The study provides valuable insights into the potential of nanotechnology-driven agricultural practices to enhance crop productivity and underscores the need for continued investigation into innovative approaches for sustainable food production.

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