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Effect of Foliar Silicon Application on the Growth and Yield of Datu F1 Sweet Corn (*Zea mays var. saccharata*)

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Abstract

This study evaluated the effect of foliar silicon application on the growth and yield performance of Datu F1 sweet corn under local field conditions. It aimed to determine the influence of varying silicon rates on growth parameters, reproductive traits, and yield. The study was anchored on the concept that silicon enhances plant performance through physiological, structural, and biochemical mechanisms. A Randomized Complete Block Design (RCBD) was employed with four treatments and four replications, involving different rates of foliar silicon applied at three growth stages. Data were collected using standard field measurements, including plant height, leaf area, number of days to silking, ear length, ear diameter, and yield per hectare, and were analyzed using Analysis of Variance (ANOVA). Results showed that foliar silicon application significantly improved leaf area, plant height, ear length, ear diameter, and yield, while also promoting earlier silking compared to the control. Silicon-treated plants consistently outperformed untreated plants across all parameters, although differences among silicon rates were minimal. The findings confirm that silicon enhances growth performance and crop productivity of sweet corn under the given conditions. The study concludes that foliar silicon application is an effective strategy for improving sweet corn production, with moderate application rates recommended for optimal results and cost efficiency. This study supports SDG 2 (Zero Hunger) by contributing to increased agricultural productivity and food security, and SDG 8 (Decent Work and Economic Growth) by improving the income potential of farmers. The findings contribute to agricultural and socio-economic sustainability by promoting efficient crop management practices that enhance productivity while supporting resource-efficient and resilient farming systems.

Keywords: Ear Diameter, Ear Length, Foliar Silicon Application, Hybrid Sweet Corn, Plant Height, Yield Per Hectare

1. Introduction

Maize (*Zea mays L.)* is a major cereal crop in the Philippines, with sweet corn gaining importance due to its nutritional value and income potential. However, productivity is constrained by nutrient limitations, pest pressures, and environmental stresses. Silicon has emerged as a promising supplement to enhance plant growth, stress tolerance, and yield, yet its application in local sweet corn systems remains underexplored. This study evaluates the effects of foliar silicon application on the growth and yield performance of hybrid sweet corn under local conditions, aiming to contribute to sustainable crop production.

1.1 Background of the Study on Sweet Corn Yield and Foliar Silicon Application in Hybrid Systems

Maize (*Zea mays L.)* is the second-most important cereal crop in the Philippines after rice, with sweet corn recognized as a high-value crop due to its consumer demand and economic benefits. It is harvested at the milk stage and widely consumed in various forms. In 2023, the Cordillera Administrative Region produced 171,771.54 metric tons of corn, with Kalinga contributing 37% (PSA-CAR, 2024). National production is projected at 8.15 million metric tons for 2024/2025, with a 2.4% increase recorded in early 2024 (Philippine Statistics Authority, 2024). Despite increasing production, yield optimization is challenged by nutrient deficiencies and pest infestations, particularly fall armyworm (*Spodoptera frugiperda*) and corn borers (*Ostrinia nubilalis*). Silicon has shown potential to improve plant growth and yield, but its specific effects, optimal application, and economic feasibility remain insufficiently studied in local conditions. This study addresses these limitations by evaluating foliar silicon application in hybrid sweet corn.

1.2 Themes and Insights from Related Literature on Silicon Application, Growth Parameters, and Yield of Hybrid Sweet Corn

Hybrid sweet corn such as Datu F1 demonstrates high yield potential, strong agronomic traits, and adaptability under Philippine conditions (East West Seed, 2025). Effective nutrient management is essential, with combined organic and inorganic fertilization supporting growth and yield (Syngenta Philippines, 2018). Silicon complements these practices by enhancing nutrient uptake, physiological efficiency, and structural integrity. Studies consistently report positive effects of silicon on plant growth and yield. Silicon improves photosynthesis, water balance, and grain production (Marques et al., 2022), enhances nutrient uptake and agronomic efficiency (Galindo et al., 2021), and increases yield components under various conditions (Galindo-Gutiérrez and Garcés-Gómez, 2023; Amin et al., 2016). It also contributes to stress tolerance by improving water retention, reducing oxidative damage, and enhancing physiological resilience (Gong et al., 2005; Amin et al., 2016; Kim et al., 2017; Seal et al., 2018; Alayafi et al., 2022). Additionally, silicon strengthens plant defense against pests by reducing feeding efficiency and enhancing biochemical resistance (Ul Haq et al., 2023; Nascimento et al., 2018; Seal, Das, & Biswas, 2018). Its integration with fertilizers further improves nutrient use efficiency and yield (Zhu et al., 2016; Naik et al., 2022; Samuvel Dhinakaran et al., 2024).

1.3 Local, National, and Global Context of Sweet Corn Production and Silicon Use

At the local level, corn production in Kalinga significantly contributes to regional output, reflecting the importance of maize in rural livelihoods (PSA-CAR, 2024). National trends show increasing production but also highlight the need for improved management strategies (Philippine Statistics Authority, 2024). Globally, silicon application has been widely studied in Asia and America, demonstrating its role in enhancing crop productivity and stress resilience. However, limited localized research in the Philippines and Southeast Asia constrains its adoption under specific agroecological conditions.

1.4 Theoretical or Conceptual Basis on Silicon-Mediated Growth, Stress Tolerance, and Yield Enhancement

The study is anchored on the concept that silicon enhances plant performance through physiological, structural, and biochemical mechanisms. It improves nutrient uptake, strengthens cell walls, regulates water balance, and activates defense-related enzymes, leading to improved growth, stress tolerance, and yield (Marques et al., 2022; Galindo et al., 2021; Seal et al., 2018). This framework supports the integration of silicon into nutrient management systems, where it complements traditional fertilization and contributes to sustainable crop production.

1.5 Research Gaps and Rationale for Evaluating Foliar Silicon Application in Hybrid Sweet Corn

Despite extensive evidence on silicon benefits, gaps remain in region-specific studies, particularly in the Philippines. Limited research compares different silicon sources, evaluates long-term effects, and determines optimal application rates and economic feasibility. This study addresses these gaps by assessing the effects of varying rates of foliar silicon application on growth parameters, reproductive traits, and yield of hybrid sweet corn under local conditions.

1.6 Alignment with Relevant Sustainable Development Goals (SDGs)

This study aligns with SDG 2 – Zero Hunger by contributing to improved agricultural productivity and food security through enhanced sweet corn yield and production efficiency. It also supports SDG 8 – Decent Work and Economic Growth by increasing the income potential of farmers through the adoption of improved crop management practices such as foliar silicon application.

1.7 Importance of the Study to Multidisciplinary Sustainability

The study contributes to agricultural and socio-economic sustainability by improving productivity and profitability of sweet corn farming. It supports environmental sustainability through reduced pesticide dependence and improved nutrient efficiency. Additionally, it promotes technological and innovation sustainability by advancing the application of silicon in crop management.

2. Material and methods

2.1 Research Design

The study utilized a Randomized Complete Block Design (RCBD) in a single-factor experiment with four treatments and four replications over a total area of 563.5 m². The treatments included a control with recommended fertilization based on soil analysis without silicon and three treatments with the same fertilization combined with foliar silicon at 10 ml, 15 ml, and 20 ml. Silicon was applied at three growth stages: V1 (14 days after sowing), V6 (28 days after sowing), and V10 (42 days after sowing).

2.2 Locale of the Study

The study was conducted in a field setting during the onset of the rainy season, where natural rainfall served as the primary water source. Soil samples were collected randomly from ten sites at a depth of 15 cm, processed through air-drying and pulverization, and submitted to the Cagayan Valley Integrated Agricultural Laboratory (CVIAL) in Tuguegarao City for analysis to guide fertilizer application.

2.3 Respondents of the Study

The experimental crop consisted of hybrid sweet corn, specifically the Datu F1 variety produced by East-West Seed Company. Approximately three-fourths kilogram of seeds were used for planting to evaluate growth and yield responses under different silicon treatments.

2.4 Sample and Sampling Procedure

The experimental area was laid out into plots measuring 5 m × 5 m, with 1-meter spacing between plots and 1.5 meters between blocks. Seeds were directly sown at a depth of 3 cm with one seed per hill, following a spacing of 70 cm between rows and 20 cm between plants. Ten sample plants per plot were selected for detailed data collection. Soil sampling followed a random procedure across the field prior to planting.

2.5 Research Instrument

Data were collected using standard field measurement tools. Plant height was measured from the ground level to the base of the tassel using a measuring tape. The number of days to silking was recorded from sowing until the appearance of silks. Leaf area was determined by measuring the leaf length from base to tip and the maximum width, then calculating the product of these measurements multiplied by a correction factor of 0.75. Ear length was measured from the peduncle to the tip using a ruler, while ear diameter was measured using a caliper. Yield per hectare was computed by converting the total plot yield into tons per hectare using the standard conversion formula based on plot area.

2.6 Data Gathering Procedure

The field was prepared by applying herbicide to control weeds, followed by manual clearing and plowing. Layout of plots was conducted after land preparation. Fertilizers were applied according to soil analysis recommendations, with basal application during planting and additional application at 30 days after planting using complete fertilizer, urea, and muriate of potash. Foliar silicon was applied using a knapsack sprayer at designated growth stages, with corresponding concentrations depending on the treatment. Water requirements were met through natural rainfall. Pest incidence, particularly fall armyworm, was monitored and controlled using insecticide application twice during the study period. Weed control was maintained through manual hand weeding twice a month. Harvesting was conducted 75 days after sowing. Ten sample plants per plot were harvested first for data collection, while the remaining plants were harvested and weighed to determine total yield.

2.7 Data Analysis Techniques

The collected data were summarized and analyzed using Analysis of Variance (ANOVA) appropriate for a Randomized Complete Block Design. The results served as the basis for evaluating treatment effects and drawing conclusions.

3. Results and Discussion

3.1 Agronomic Performance of Hybrid Sweet Corn under Foliar Silicon Application

Table 1: Mean leaf area (cm^2) 35, 49 and 66 days after sowing of sweet corn applied with foliar silicon

Treatments	Mean		
	35 das	49 das	66 das
T_0	348.698	611.258	539.710
T_1	376.002	668.805	595.255
T_2	374.663	670.500	594.958
T_3	376.462	673.603	596.837

3.1.1 Leaf Area at Different Growth Stages

The results presented in Table 1 show that foliar silicon application increased the leaf area of sweet corn at 35, 49, and 66 days after sowing. At 35 days after sowing, the control recorded the lowest leaf area of 348.698 cm², while silicon-treated plants ranged up to 376.462 cm². At 49 days after sowing, the control had 611.258 cm², whereas silicon treatments reached up to 673.603 cm². Similarly, at 66 days after sowing, the control recorded 539.710 cm², while silicon-treated plants increased up to 596.837 cm². Across all growth stages, silicon-treated plants consistently produced larger leaf areas compared to the control, although the differences among silicon rates were minimal. The findings indicate that foliar silicon application significantly enhanced leaf area development throughout the growth stages of sweet corn. This supports the study of Amin et al. (2016), which reported that silicon application significantly increased the leaf area index. The increase in leaf area suggests improved photosynthetic efficiency and plant vigor, contributing to better growth performance. However, the lack of significant differences among silicon rates implies that increasing the amount of silicon beyond a certain level does not result in further improvement, indicating that even lower application rates are sufficient to enhance leaf development.

Table 2. Mean plant height (cm) of the different treatments applied with foliar silicon

Treatments	Mean
T_0	239.625
T_1	249.025
T_2	248.650
T_3	248.275

3.1.2 Average Plant Height of Sweet Corn

The results presented in Table 2 show that foliar silicon application increased the average plant height of sweet corn compared to the control. The control recorded the lowest plant height of 239.625 cm, while silicon-treated plants exhibited higher values, with the highest mean of 249.025 cm observed in the 10 ml treatment, followed closely by the 15 ml and 20 ml treatments with values of 248.650 cm and 248.275 cm, respectively. The findings indicate that foliar silicon application significantly improved plant height, demonstrating its positive effect on vegetative growth. This result is supported by Marques et al. (2022), who reported increased plant growth in maize with silicon application. Similarly, Amin et al. (2016) and Samuvel Dhinakaran et al. (2024) observed significant improvements in plant height due to silicon treatment. The increase in plant height may be attributed to enhanced nutrient uptake and improved physiological processes, although the minimal differences among silicon rates suggest that increasing the application level does not proportionally enhance plant height beyond a certain point.

Table 3: Mean number of days to silking of the different treatments applied with foliar silicon

Treatments	Mean
T_0	46.475
T_1	46.100
T_2	46.050
T_3	46.050

3.1.3 Number of Days to Silking of Sweet Corn

Table 3 presents the effect of rates of foliar silicon application on the average number of days to silking. T2 and T3 obtained the earliest average number of days to silking with 46.05 days, followed by T1 with 46.1 days and T0 obtained the latest average days to silking with 46.475 days. The result revealed that foliar silicon application significantly affected the number of days to silking in sweet corn. Plants sprayed with different rates of silicon reached silking earlier compared with no application. It indicates that foliar application of silicon promotes earlier reproductive development. This was supported by the study of Galindo-Gutiérrez and Garcés-Gómez (2023) which showed that silicon treated maize plants significantly increased the nutrient uptake which accelerates the vegetative growth and leaf development, allowing the plant to reach the required physiological maturity for flowering sooner.

Table 4: Mean ear length (cm) and ear diameter (cm) of the different treatments applied with foliar silicon

Treatments	Mean	
	Ear Length	Ear Diameter
T_0	18.513	5.008
T_1	19.700	5.240
T_2	19.625	5.260
T_3	19.625	5.270

3.1.4 Ear length and Ear diameter

Table 4 presents the effect of the different rate of foliar silicon application on the ear length and ear diameter of sweet corn. T2 obtained the longest ear length of 19.7 cm, followed by T1 and T3 with the same mean of 19.625 cm and T0 obtained the shortest ear length with 18.513 cm. While T3 obtained the biggest ear diameter of 5.270 cm followed by T2 with a mean of 5.260 cm, then T1 with a mean of 5.240 cm and T0 obtained the smallest ear diameter with 5.008 cm. The result showed that foliar silicon application significantly affects the ear length and ear diameter of sweet corn. This was further validated by the study of Galindo-Gutiérrez and Garcés-Gómez (2023) who found that silicon-treated maize plants significantly increased grain production which generally associated with increase in physical traits like ear length. The study of Zhu et al. (2016), also revealed that maize plants applied with silicon, produced a higher grain yield which generally associated with an increase in ear diameter.

Table 5: Mean yield per hectare (tons) of the different treatments applied with foliar silicon

Treatments	Mean
T_0	13.951
T_1	18.384
T_2	18.612
T_3	18.354

3.1.5 Yield per Hectare

Table 5 presents the effect of rates of foliar silicon application on the yield per hectare of sweet corn. T_2 produced the heaviest yield per hectare of 18.612 tons, followed by T_1 with 18.383 tons, then T_3 with 18.354 tons, and T_0 produced the lowest yield of 13.951 tons. The result revealed that foliar silicon application significantly increases the productivity of sweet corn. This indicates that silicon plays a vital role in enhancing the crop yield. It was also demonstrated that all silicon treated plots produced a higher yield compared to the control, confirming its beneficial effect. This further validated the result of the study of Zhu et al. (2016) which showed an increased grain yield on the maize applied with silicon and the study of Galindo-Gutiérrez and Garcés-Gómez (2023) which found that silicon-treated maize plants significantly increased crop productivity.

4. Conclusion and Recommendations

The study demonstrated that foliar silicon application significantly improved the growth and yield performance of Datu F1 sweet corn across different parameters. Silicon-treated plants showed increased leaf area at various growth stages, enhanced plant height, earlier silking, and improved ear characteristics, including length and diameter. Furthermore, the application of silicon resulted in a significant increase in yield per hectare, confirming its effectiveness in enhancing overall crop productivity under the given experimental conditions.

Based on the findings, foliar silicon application is recommended for improving sweet corn production due to its positive effects on growth and yield. The use of a moderate application rate is advised, as it provides optimal results while minimizing input costs. It is also recommended to maintain uniform field conditions to ensure consistent crop performance. Future studies should evaluate the long-term effects of silicon on soil health and productivity, test its effectiveness under varying environmental conditions and crop varieties, and include economic analyses. Additionally, extension efforts should focus on promoting proper application techniques to support effective adoption among farmers.

The study was limited to specific environmental conditions, location, and crop variety, which may influence the generalizability of the results. Variability in environmental factors across the experimental area may have affected plant growth and yield responses. Furthermore, the study focused only on short-term effects of foliar silicon application and did not assess long-term impacts on soil health, economic feasibility, or performance under different agroecological conditions.

Compliance with ethical standards

The authors declare no conflict of interest, and this study received no external funding. The research was conducted with the cooperation of the farm owner at Corpuz's Farm in Burayucan, Balong, Tabuk City, Kalinga, and all procedures were

carried out with voluntary participation and informed consent. Data were collected using non-invasive field measurements on plant samples, ensuring that no harm was caused during the process. Confidentiality was maintained throughout the study, and no identifying information of individuals or entities was disclosed.

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