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Interactive Effects of Corn (Zea mays L.) Varieties and Integrated Fertilizer Management on Growth, Yield and Profitability

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Abstract: Corn (Zea mays L.) is an important agricultural crop used for food, animal feed, and various industrious purposes. Its productivity depends on several factors, particularly varietal characteristics, soil fertility, and appropriate nutrient management. This study, entitled "Interactive effects of corn (Zea mays L.) Varities and Integrated fertilizer management on growth, yield, and profitability aims to evaluate the individual and four fertilizer management treatments. . Specifically, it will assess their effects on vegetative growth, yield components, grain yield, and economic performance. The experiment will employ a two-factor factorial arrangement in a Randomized Complete Block Design (RCBD) with three replications. Growth parameters will include plant height, number of leaves, leaf area index, stem diameter, and days to tasseling and silking. Yield parameters will include ear length, ear diameter, number of kernel rows per ear, total kernels per ear, kernel weight, grain yield, and shelling percentage. Economic analysis will consider production costs, gross income, net income, return on investment, and benefit-cost ratio. The findings are expected to provide useful information on the interaction between corn varieties and integrated fertilizer management and help identify a productive and economically favorable treatment combination under the conditions of the study.

Keywords: *Corn Varieties, Integrated Fertilizer Management, Growth, Grain Yield, Profitability, Nutrient Management.*

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I. INTRODUCTION

Corn (Zea mays L.) is an important cereal crop used for food, animal feed, and various industrial purposes. Its productivity is influenced by several factors, including genetic characteristics, soil fertility, environmental conditions, and crop management practices. Among these factors, the selection of suitable varieties and the proper management of soil nutrients are important considerations in achieving favorable growth, high grain yield, and profitable production. Differences among corn varieties may result in variations in plant height, leaf development, flowering time, stem growth, ear characteristics, and grain production. At the same time, fertilizer management affects the availability of essential nutrients required throughout crop development.

The continuous use of inorganic fertilizers may provide readily available nutrients, but relying exclusively on these inputs may not adequately maintain soil organic matter and long-term soil productivity. Organic fertilizers, on the other hand, contribute organic materials and nutrients to the soil, although their nutrient release may be slower and influenced by environmental conditions. Integrating organic and inorganic fertilizers may therefore provide a more balanced nutrient supply while supporting crop growth and soil fertility. Recent field studies have investigated different combinations of organic nutrient sources and recommended fertilizer rates to determine their effects on maize productivity, nutrient-use efficiency, and economic returns.

In this regard, the present study, entitled Interactive Effects of Corn (Zea mays L.) Varieties and Integrated Fertilizer Management on Growth, Yield, and Profitability, evaluates three corn varieties under four fertilizer management treatments. It aims to determine whether the response of corn varieties differs according to fertilizer combination and to identify the treatment combination that provides favorable growth, yield, and economic performance.

II. REVIEW OF RELATED LITERATURE

➢ *Growth Performance of Corn as Influenced by Variety*

Corn varieties differ in their genetic potential and adaptability, which may influence their vegetative growth and reproductive development. Plant height, number of leaves, leaf area index, stem diameter, and the number of days to tasseling and silking are useful indicators for evaluating crop growth. These characteristics help describe how varieties respond to environmental conditions and

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management practices. Papong and Cagasan (2024) evaluated the growth and yield performance of different sweet corn varieties under integrated nutrient applications. Their study used three hybrid sweet corn varieties and different nutrient treatments in a field experiment with three replications. The research demonstrates the importance of examining variety performance together with nutrient management rather than evaluating fertilizer treatments independently.

Liga et al. (2026) also investigated the effects of integrated nutrient management on different sweet corn varieties in Lakewood, Zamboanga del Sur, Philippines. Their experiment used a 3 × 5 factorial arrangement in a randomized complete block design with three replications. This Philippine study is particularly relevant because it considers variety and fertilizer management within the same experimental framework.

Singh, Saini, and Singh (2025) reported that integrated nutrient management influenced plant height, leaf development, leaf area index, and other growth characteristics of maize. Their experiment included different combinations of recommended fertilizer rates and organic nutrient sources. The treatment involving 75% of the recommended fertilizer dose and 25% of nitrogen supplied through poultry manure produced favorable growth performance. These findings support the inclusion of plant height, number of leaves, leaf area index, stem diameter, and flowering dates in the present investigation. Measuring these variables across the three varieties and four fertilizer treatments may help establish whether differences in vegetative development are associated with varietal characteristics, fertilizer management, or their interaction.

- *Effects of Integrated Fertilizer Management on Corn Growth*

Integrated fertilizer management involves combining organic nutrient sources with inorganic fertilizers to supply essential nutrients for crop development. Inorganic fertilizers generally provide nutrients in readily available forms, while organic materials contribute nutrients and organic matter as they decompose. The combined application may help improve nutrient availability and support the development of roots, stems, and leaves.

A 2024 field study by researchers examining chicken manure and inorganic fertilizer in different agroecological zones evaluated the growth and yield response of maize under different nutrient combinations. The study involved field trials in two locations in Ghana and compared the sole and combined application of chicken manure and NPK fertilizer. Its findings provide evidence that the performance of integrated nutrient management should be assessed under the specific environmental conditions where maize is cultivated.

Singh et al. (2025) likewise examined combinations of recommended fertilizer rates with organic sources, including biogas slurry, vermicompost, farmyard manure, poultry manure, and green manure. Their results showed that integrated nutrient treatments significantly affected growth and yield characteristics. The highest grain yield in their experiment was obtained from the combination of 75% recommended fertilizer dose and 25% nitrogen through poultry manure.

A 2026 field experiment published in the Journal of Agriculture and Food Research evaluated goat manure, poultry manure, and vermicompost combined with different levels of recommended fertilizer rates. The researchers reported that integrated nutrient management improved maize productivity, nutrient-use efficiency, and soil fertility. Vermicompost combined with the full recommended fertilizer dose produced the highest reported grain yield, while some treatments using 75% of the recommended dose achieved statistically comparable productivity.

These studies indicate that combining organic and inorganic nutrient sources may improve corn growth. However, the most favorable combination may depend on the organic material, nutrient contribution, fertilizer rate, soil conditions, and corn variety used.

- *Effects of Fertilizer Management on Yield and Yield Components*

Grain yield is Influenced by several yield components, including ear length, ear diameter, kernel rows per ear, total kernels per ear, and individual kernel weight. These characteristics are important because they help explain differences in the final grain production of corn. Adequate nutrient availability during vegetative and reproductive development may contribute to better ear formation and kernel development.

Papong and Cagasan (2024) investigated the yield response of sweet corn varieties under different integrated nutrient applications. Their work highlights the importance of assessing both varietal differences and nutrient treatments when evaluating ear and yield characteristics.

In a two-year field experiment, the 2026 study published in the Journal of Agriculture and Food Research evaluated different organic manures combined with varying levels of recommended fertilizer. The researchers reported differences in cob yield and grain yield among the nutrient treatments. Vermicompost combined with the full recommended fertilizer dose produced the highest grain yield, while poultry manure combined with the full recommended dose produced the highest cob yield.

Another field experiment conducted during the 2023 and 2024 rainy seasons at the Indian Agricultural Research Institute evaluated integrated nutrient management under a rainfed maize production system. The combination of 50% recommended nitrogen dose with farmyard manure and leaf compost produced favorable cob characteristics, 1,000-grain weight, and grain yield. This finding illustrates the potential of combining organic nutrient sources with reduced inorganic fertilizer application.

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Singh et al. (2025) also reported improvements in yield attributes, including the number of grains per cob and seed index, under integrated nutrient management. Their results suggest that fertilizer combinations can influence both the development of yield components and final grain production.

The present study will therefore evaluate ear length, ear diameter, kernel rows per ear, total kernels per ear, 100-kernel weight, 1,000-kernel weight, grain yield per plot, computed grain yield, and shelling percentage. These measurements will provide a broader assessment of how the three corn varieties respond to the four fertilizer management treatments.

- *Integrated Nutrient Management and Soil Fertility*

Soil fertility is an important foundation of sustainable corn production. Essential nutrients such as nitrogen, phosphorus, and potassium are required for vegetative growth, root development, flowering, and grain formation. When nutrient availability is insufficient or unbalanced, crop growth and yield may be reduced. Organic fertilizers can contribute nutrients and organic matter, while inorganic fertilizers provide more concentrated nutrient sources.

A long-term field experiment published in Frontiers in Plant Science in 2026 examined organic fertilizer substitution in a continuous maize cropping system. The study assessed changes in soil fertility and maize yield under different nutrient management approaches. Its long-term perspective is useful because it shows why fertilizer management should be considered not only in relation to one harvest but also in terms of soil productivity over time.

The 2024 study on chicken manure and inorganic fertilizer in Ghana also emphasized the importance of combining organic and mineral nutrient sources under different agroecological conditions. The researchers evaluated maize growth and yield across two contrasting production environments, illustrating that fertilizer performance may vary with local growing conditions.

The 2026 study on organic and inorganic nutrient management further reported improvements in soil organic carbon and available nitrogen under selected integrated treatments. These results support the consideration of organic fertilizer as a component of nutrient management rather than simply as a replacement for mineral fertilizer.

Although the present study primarily focuses on corn growth, yield, and profitability, the findings from these studies provide a basis for understanding why different proportions of organic and inorganic fertilizers may produce different crop responses.

- *Profitability of Corn Production Under Integrated Fertilizer Management*

The profitability of corn production depends not only on grain yield but also on the expenses incurred during production. Seed costs, fertilizer expenses, and labor requirements contribute to total production cost. Gross income is determined by the value of harvested produce, while net income represents the amount remaining after production costs are deducted. Return on investment and benefit-cost ratio are additional measures used to evaluate the economic performance of production treatments.

The 2026 study published in the Journal of Agriculture and Food Research evaluated both nutrient-use efficiency and economic returns under different integrated nutrient treatments. The researchers reported that goat manure combined with the full recommended fertilizer dose produced the highest net returns and benefit-cost ratio among the treatments examined. This demonstrates that the treatment producing the highest grain yield does not necessarily produce the highest economic return.

A 2025 study by Jamakhandi and colleagues examined the integration of organic supplements and inorganic nutrients in maize production under acidic soil conditions in Assam, India. The researchers reported that farmyard manure combined with the full recommended fertilizer dose produced high grain and stover yields, as well as favorable gross and net returns. Some other treatments, including combinations involving vermicompost or reduced fertilizer rates, also showed comparable performance for selected parameters.

Egos and Bañoc (2024) examined the growth and yield performance of sweet corn supplied with organic and inorganic fertilizers under different crop establishment methods. Their study considered agronomic performance and profitability, making it relevant to the economic component of the present research.

These findings establish the importance of evaluating production costs alongside yield. In the present study, seed cost, fertilizer cost, labor cost, total production cost, gross income, net income, return on investment, and benefit-cost ratio will be considered to identify the treatment combination that provides favorable economic performance.

- *Interaction Between Corn Varieties and Fertilizer Management*

The response of corn to fertilizer application may vary among varieties because different genotypes may have different growth patterns, nutrient requirements, and capacities to use available nutrients. A fertilizer combination that performs well with one variety may not necessarily produce the same response with another. For this reason, factorial experiments are useful in determining whether the effects of fertilizer management depend on the variety being cultivated.

Papong and Cagasan (2024) evaluated three sweet corn varieties under integrated nutrient applications using a field experimental design with three replications. Their study provides a relevant basis for examining varietal responses under different nutrient treatments.

Liga et al. (2026) used a 3 × 5 factorial arrangement in an RCBD with three replications to evaluate sweet corn

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varieties and integrated nutrient management in the Philippines. This design is closely related to the structure of the present study because it allows the researchers to evaluate the effects of two experimental factors and their interaction.

The 2026 study involving maize and different organic manure and inorganic fertilizer combinations also demonstrates that nutrient sources and fertilizer levels may influence yield and economic outcomes differently. These results reinforce the need to evaluate the complete variety-by-fertilizer combination rather than relying only on the separate average performance of varieties or fertilizer treatments.

Accordingly, the present study will use a two-factor factorial experiment arranged in a randomized complete block design with three replications. Factor A will consist of three corn varieties, while Factor B will consist of four fertilizer management treatments. The analysis will determine whether significant differences exist among varieties, fertilizer treatments, and their interaction.

III. RESEARCH GAPS

- *Population Gaps*

Previous studies have examined maize and sweet corn varieties under different fertilizer management systems. However, the varieties used in those studies may differ from the three corn varieties included in the present investigation. Their results may therefore not fully represent the performance of the selected varieties under the production conditions of the present study. Evaluating the three selected varieties will provide additional information about their growth, yield, and response to integrated fertilizer management.

- *Methodological Gap*

Several previous studies used randomized block, split-plot, or factorial experimental arrangements. However, their treatments, number of varieties, fertilizer combinations, and measured parameters differed. The present study will use a two-factor factorial experiment arranged in RCBD with three replications. This approach will allow the evaluation of the individual and interactive effects of three corn varieties and four fertilizer management treatments.

- *Empirical Gap*

Previous research has reported favorable effects of integrated nutrient management on maize growth, yield attributes, and grain production. Nevertheless, the results vary according to fertilizer sources, application rates, varieties, and growing environments. Additional field-based evidence is needed to determine which of the four fertilizer management treatments will produce favorable results when applied to the three selected corn varieties.

- *Knowledge and Evidence Gap*

Although previous studies have examined plant growth and yield under integrated fertilizer management, not all have evaluated the complete set of variables included in the present investigation. These include leaf area index, flowering dates, stem diameter, ear characteristics, kernel weights, shelling percentage, and computed grain yield. Examining these parameters together may provide a more comprehensive understanding of the response of corn varieties to different fertilizer combinations.

- *Practical Gap*

Farmers need fertilizer management practices that support crop productivity while considering the cost of production. A treatment that produces high grain yield may also require greater fertilizer expenses. There is therefore a need to evaluate production costs, gross income, net income, return on investment, and benefit-cost ratio together with yield performance. The present study will provide information that may help identify a practical and economically favorable fertilizer combination.

- *Outdated Research gap*

Some available studies on integrated nutrient management were conducted under different production conditions or used fertilizer recommendations that may not directly represent current local practices. More recent field evaluations are useful for determining whether different organic and inorganic fertilizer combinations remain effective under present production conditions. The present study will contribute additional experimental evidence on the performance of selected corn varieties under integrated fertilizer management.

- *Overall Research Gap*

The reviewed studies provide evidence that corn varieties and integrated fertilizer management influence growth, yield, and profitability. However, further evaluation is necessary to determine the interaction between the three selected corn varieties and the four fertilizer management treatments included in this investigation. Specifically, the study will determine which variety-by-fertilizer combination produces favorable growth, yield components, grain yield, and economic returns. It will also compare the performance of the treatments to identify a productive and economically viable combination under the conditions of the study.

The following studies further strengthen the discussion of integrated fertilizer management, corn growth, yield, and economic performance.

Yadav, Panchal, and Kawade (2024) evaluated integrated nutrient management practices in maize during the 2023–2024 growing season. Their experiment compared different combinations of recommended fertilizer rates, farmyard manure, and vermicompost. The application of 75% recommended fertilizer dose combined with 25% recommended nitrogen through vermicompost produced favorable plant height, functional leaves, leaf area, ear characteristics, and grain yield. This supports the importance of determining the appropriate balance between organic and inorganic nutrient sources.

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Chandrawanshi, Bagri, and Karade (2024) studied the effects of integrated nutrient management on maize growth and yield during the 2023 growing season. Their treatments included recommended fertilizer rates, farmyard manure, vermicompost, and biofertilizer applications. Their work provides additional evidence that combining organic and inorganic nutrient sources can influence maize growth and yield characteristics.

Ramesh, Kaur, and Chhabra (2023) examined integrated nutrient management practices in maize using different fertilizer and organic input combinations. Their findings indicated that the combination of recommended fertilizer dose and vermicompost produced favorable growth and grain yield. This provides support for evaluating vermicompost-based fertilizer combinations in the present study.

Gogoi, Dutta, Sarmah, and Kurmi (2022) investigated integrated nutrient management in maize under different microclimatic regimes. Their research considered the influence of sowing conditions and nutrient management on crop growth and yield. The study is relevant because it demonstrates that fertilizer performance should be interpreted in relation to the growing environment.

Prusty and colleagues (2022) evaluated integrated nutrient management practices for sweet corn in Odisha, India. Their study examined yield, economic performance, and post-harvest soil properties. The integrated treatment involving biofertilizer consortia and additional nutrients produced favorable yield and benefit-cost results. This supports the inclusion of both agronomic and economic indicators when evaluating fertilizer management.

Sharma, Biswas, and Jolly (2022) evaluated fertilizer levels and sowing dates in kharif maize. Their findings showed that fertilizer rate and planting time influenced yield attributes, grain yield, and production economics. Although the study did not focus exclusively on organic and inorganic fertilizer combinations, it demonstrates that fertilizer management and environmental timing both contribute to crop productivity and profitability.

Dalei and colleagues (2023) investigated the yield and economics of hybrid maize under integrated nutrient management practices in Odisha, India. Their study evaluated combinations of soil-test-based fertilizer recommendations, green manure, farmyard manure, and biofertilizers. The results provide additional evidence that integrated nutrient management can influence both grain production and financial returns.

Pal and colleagues (2023) assessed integrated nutrient management practices in hybrid maize using different combinations of chemical fertilizers, vermicompost, poultry manure, and foliar nutrient applications. Their findings indicated improvements in plant growth, biomass production, and grain yield under selected integrated treatments. This study supports the importance of evaluating different nutrient combinations rather than assuming that one fertilizer source will perform equally under all conditions.

Saini, Singh, and Singh (2025) also examined integrated nutrient management in maize during the 2023 and 2024 growing seasons. Their experiment included different organic nutrient sources combined with recommended fertilizer rates. The study provides further evidence that nutrient combinations can influence maize growth, yield attributes, and quality.

Yadav and colleagues (2025) evaluated integrated nutrient management in maize under Vertisol conditions in southeastern Rajasthan. Their treatments included inorganic fertilizer, farmyard manure, poultry manure, and biofertilizers. The research is relevant because it examines fertilizer combinations under a specific soil environment and includes economic considerations.

The study on maize productivity and profitability in acidic soils of Assam by Jamakhandi and colleagues (2025) further demonstrated that combining organic supplements with inorganic nutrients can improve grain yield and economic returns. Their results also showed that some reduced-rate fertilizer combinations may provide performance comparable to treatments using the full recommended fertilizer dose.

IV. SYNTHESIS

The reviewed literature establishes that corn growth, yield, and profitability are influenced by varietal characteristics and nutrient management practices. Studies conducted in the Philippines and other maize-producing countries have shown that organic and inorganic fertilizers can be combined to improve nutrient availability and support crop development. Research has also demonstrated that different nutrient combinations may influence plant growth, ear characteristics, kernel weight, grain yield, and economic returns.

The studies further indicate that the fertilizer treatment producing the highest yield may not always provide the highest net income or benefit-cost ratio. Therefore, both agronomic and economic indicators are necessary when identifying an appropriate fertilizer management strategy. The literature also emphasizes the importance of considering the interaction between corn varieties and fertilizer treatments because varietal responses may differ under varying nutrient conditions.

Despite these findings, results from other locations cannot automatically be applied to every production environment. Differences in soil properties, climate, corn variety, organic fertilizer source, and fertilizer rates may influence treatment performance. The present study addresses this concern by evaluating three corn varieties under four integrated fertilizer management treatments using a factorial RCBD with three replications. Through the assessment of growth, yield components, grain yield, and

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profitability, the study seeks to identify a productive and economically favorable variety-by-fertilizer combination.

V. CONCLUSION

The reviewed literature establishes that corn growth, yield, and profitability are influenced by varietal characteristics and fertilizer management practices. Different corn varieties possess varying genetic potentials and adaptability, which may affect their vegetative growth, reproductive development, and overall productivity. Similarly, the integration of organic and inorganic fertilizers can contribute to nutrient availability, soil fertility, and improved crop performance.

Previous studies have demonstrated that appropriate combinations of organic nutrient sources and inorganic fertilizers can positively influence plant growth, yield components, and grain production. However, the effectiveness of these combinations may vary depending on the corn variety, fertilizer source, application rate, soil characteristics, and prevailing environmental conditions. Furthermore, the fertilizer treatment that produces the highest grain yield does not necessarily provide the greatest economic return. Therefore, evaluating production costs, gross income, net income, return on investment, and benefit-cost ratio is essential in determining the economic viability of different fertilizer management practices.

The reviewed studies also highlight the importance of examining the interaction between corn varieties and fertilizer management rather than considering their effects independently. Despite existing research, further investigation is necessary to determine how the three selected corn varieties respond to the four fertilizer management treatments under the conditions of the present study.

In this regard, the proposed investigation will evaluate the individual and interactive effects of corn varieties and integrated fertilizer management using a factorial Randomized Complete Block Design with three replications. By examining growth characteristics, yield components, grain yield, and profitability, the study aims to identify the variety and fertilizer treatment combination that demonstrates favorable agronomic performance and economic returns.

Ultimately, the findings of this research are expected to provide additional scientific information that may serve as a basis for developing productive, practical, and economically viable fertilizer management strategies for corn production.

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