**Tillage operations and fertilizer applications toward growth and yield response of sweet corn (*zea mays* l. Var. Saccharata)**

**ABSTRACT**

Sweet corn (*Zea mays* var. saccharata) has become an increasingly important crop in the Philippines due to its nutritional value and market demand. This study investigated the effects of different tillage operations and fertilizer applications on the growth and yield of sweet corn and assess the agricultural practices and challenges faced by sweet corn farmers in the region. A randomized complete block design (RCBD) was employed, with four treatments: zero tillage with urea, zero tillage with vermicompost, conventional tillage with urea, and conventional tillage with vermicompost. Data were gathered on germination index, plant height, ear length, ear diameter, and ear weight, with statistical analysis conducted using Analysis of Variance (ANOVA) and Pearson’s correlation. Findings revealed that plant height was significantly greater in conventional tillage with vermicompost with a mean of 197.6cm. Ear weight was significantly affected by the treatment, with conventional tillage with urea yielding the highest mean weight of 14.21 kg. Return on investment was highest for conventional tillage with vermicompost at 83.6%, offering substantial profitability.

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Keywords: Conventional tillage, sweet corn, vermicompost, yield

**INTRODUCTION**

Currently, agriculturalists in the Philippines are adopting diverse methods and strategies to enhance efficiency in agricultural practices, especially in the realm of crop cultivation. These agronomists are exploring proficient agricultural methodologies that bolster both yield and efficiency. Agronomic practices such as soil preparation play a crucial role in establishing crops in the field and in achieving the anticipated yield (Saito et al., 2021).

The popularity of sweet corn (*Zea mays* var. saccharata) has surged recently owing to its nutritional benefits and appealing taste, making it a favorable choice for snacks and meals among people of all ages. This increase in demand has led farmers to expand their usual production of sweet corn (Revilla *et.al.*, 2021). As a result, sweet corn cultivation is becoming an increasingly attractive agricultural venture, thanks to its growing market demand and relatively brief maturation period in the field (Agricultural Marketing Resource Center, 2022).

The key to high-quality sweet corn is rapid growth, adequate soil moisture and nutrients, and harvesting the ears at optimum maturity. Sweet corn requires rich soil with ample nitrogen and moisture. Soil moisture is critical for the germination of sweet corn, as it absorbs more water than other types to facilitate germination (Cox, 2010). A wide variety of soils are suitable; moreover, it is important that the soil be well-drained and well-supplied with organic matter. The optimum range of pH for this crop is 5.8 to 7.0 (Boeckmann, 2008).

Tillage is a practice performed to loosen the soil and to produce good tilth. Among the crop production factors, tillage contributes up to 20% (Ahmad *et al*., 1996). The method of tillage affects the sustainable use of soil resources through its influence on soil properties. Deep tillage breaks up high-density soil layers, improves water infiltration and movement, enhances root growth, and increases crop production potential. Deep tillage up to 90 cm soil depth results in increased corn yield (Versa *et al*., 1997).

Fertilizers are used to replenish nutrients lost due to crop removal, erosion, fixation, and immobilization. Crops, when given the right form, amount, and balance of essential nutrients, will eventually develop and exhibit good growth performance, which is directly related to productivity (Yousaf, 2016). Achieving good crop performance for production will be easier if essential nutrients are supplied. Accordingly, this research was conducted to address and verify the influence of two tillage operations (conventional and zero) and the application of two kinds of fertilizer on the growth and yield of sweet corn (Canatoy, 2018).

While numerous studies have explored the effects of tillage and fertilization on crop yield, there remains limited research on the comparative impacts of tillage and fertilizer combinations specifically for sweet corn cultivation in the Philippines. Additionally, existing studies focus primarily on single interventions, with few examining the synergistic effects of combined tillage and fertilization practices under local conditions (Escototo & Cagasan, 2023; Canatoy, 2018).

This gap presents an opportunity for further investigation to optimize agronomic practices for sweet corn yield and sustainability in the region, particularly considering the growing demand and economic potential of sweet corn cultivation. Studies on sustainable practices, such as no-tillage or conservation tillage, in combination with organic and inorganic fertilizers, are particularly needed (Escototo & Cagasan, 2023; Canatoy, 2018) hence the researcher is motivated to conduct this study.

**Objectives of the Study**

1. determine the significant difference of the sweet corn growth in terms of germination index, and plant height, treated with different tillage operations and fertilizers;
2. ascertain the significant difference of the sweet corn green yield response in terms of ear length, ear diameter, and ear weight with different tillage operations and fertilizers;
3. assess and quantify the return on investment (ROI) of different tillage operations and fertilizer application strategies on the growth and yield response of sweet corn.

**Research Design**

This study employed a randomized complete block design (RCBD) with blocks representing replicates of each treatment. The researcher ensured that each block is replicated three times and is randomly assigned treatments to minimize bias. The RCBD is a commonly used experimental design that helps control for variability within experimental units by grouping similar units together, thus improving the precision of the study results (Montgomery, 2017).

In terms of treatments, the researcher combined two tillage methods (zero and conventional) with at least two types of fertilizers. This creates a minimum of four namely, treatment 1: zero tillage with urea, treatments 2: zero tillage with vermicompost, treatment 3: conventional tillage with urea, treatment 4: conventional tillage with vermicompost.

**Locale of the Study**

The research was carried out in Malapag, Carmen, Cotabato, Philippines from February to April 2025 Based on the available weather data in the PAGASA, the months of February to May are characterized as hot and rainy season. Specifically, seeds under experimentation were sown in the open field at Malapag High School, Malapag, Carmen, Cotabato. Malapag National High School, located in Carmen, North Cotabato, Philippines, is a public secondary school managed by the Department of Education (DepEd).

**Materials**

 The researcher used the following materials in the experiment: sweet corn seeds, specifically the Macho Dos F1 variant; soil with zero and conventional tillage operations; fertilizers such as vermicompost and urea; garden tools including shovels, measuring devices, weighing scales, fin rulers, meter sticks, tape measures, and record books; as well as other necessary materials required for the conduct of the study. These resources were meticulously selected to ensure accurate data collection and the successful implementation of the research process.

**Statistical Analysis**

Analysis of Variance (ANOVA) was used to assess significant differences in sweet corn growth (germination index, plant height) and yield (ear length, diameter, weight) across various tillage and fertilizer treatments. Significant results were followed by post-hoc tests like Tukey’s HSD for pairwise comparisons. Pearson’s correlation was applied to examine the relationship between growth and yield responses under different treatments.

**RESULTS AND DISCUSSION**

**Significant Differences of Sweet Corn Growth**

The first research problem delved into determining the significant differences in sweet corn growth in terms of germination index and plant height, as influenced by different tillage operations and fertilizer applications.

**Germination Index**

Table 1 provides the data of the germination index of sweet corn under varied treatment conditions, illustrating the combined effects of tillage methods and fertilizer applications. Notably, the treatment designated as conventional tillage with urea demonstrates the highest mean germination index, measured at 77.67 (97.09%), signifying its potential to create a favorable environment for seed germination. In contrast, the zero tillage with vermicompost treatment exhibits the lowest mean germination index, with a value of 76.33 (95.41%), suggesting its comparatively reduced effectiveness in promoting germination under the tested parameters.

In addition, the statistical analysis accompanying the dataset underscores the lack of significant differences among the treatment groups with respect to germination index. This is evidenced by the computed F-value of 2.06 and a probability value (Pr > F) of 0.2072, both of which fail to reach conventional thresholds for statistical significance (p > 0.05).

Further, the calculated coefficient of variation (CV) of 0.8915 reflects the relative consistency and low variability within the data, further supporting the conclusion that the germination index does not vary substantially across the treatments. Consequently, the null hypothesis asserting no differences in germination index between treatment groups is upheld.

The result signifies that the effects of fertilizers and tillage methods on sweet corn germination index are relatively uniform across the treatment groups. This uniformity suggests that neither the fertilizer type—whether urea or vermicompost—nor the tillage method—whether zero tillage or conventional tillage—has a distinct advantage in influencing germination outcomes. The lack of significant differences in the germination index implies that both factors contribute comparably to the germination process, indicating their shared capacity to support seed development under the tested conditions.

Furthermore, the finding highlights the potential flexibility for farmers when selecting tillage practices and fertilizers for sweet corn production. Since the treatments yield similar results in terms of germination success, decisions regarding tillage and fertilizer use could be guided by other considerations, such as cost-effectiveness, environmental sustainability, and resource availability. For instance, farmers might prioritize vermicompost for its eco-friendly properties or opt for zero tillage methods to preserve soil structure and reduce labor. The manifestation supports the finding of Escototo and Cagasan (2023) that comparisons between zero and minimum tillage practices have revealed no significant differences in soil properties, yield advantages, and germination percentage for sweet corn, suggesting flexibility in tillage method selection.

**Table 1. Sweet corn growth in terms of germination index**

|  |  |  |
| --- | --- | --- |
| Treatments | Germination Index Means | Percentage |
| 1: zero tillage with urea treatment  | 77.00 | 96.25 |
| 2: zero tillage with vermicompost, | 76.33 | 95.41 |
| 3: conventional tillage with urea, | **77.67** | **97.09** |
| 4: conventional tillage with vermicompost | 77.33 | 96.66 |
| Computed F-value | 2.06ns |  |
| Pr(> F) | 0.2072 |  |
| CV | 0.8915 |  |

**Plant Height**

The data in Table 2 presents the growth of sweet corn in terms of plant height across four different treatments. The highest mean plant height was observed in Treatment 4: conventional tillage with vermicompost, with a value of 197.60 cm. The lowest mean plant height was recorded in Treatment 2: zero tillage with vermicompost, at 192.23 cm. Further, the results indicate a significant difference in sweet corn growth based on the treatments, as evidenced by the computed F-value of 48.54 and the probability value (Pr > F) of 0.0001.

The coefficient of variation (CV) of 0.3105 indicates that there is a moderate level of variability in the plant height data across treatments. Based on the findings, the null hypothesis which stated that there is no significant difference in plant height across the treatments is rejected.

The result infers that the type of tillage and fertilizer significantly affects plant height. Moreover, the plant height of sweet corn varied significantly across the different treatments, indicating that both tillage operations and fertilizer applications play a crucial role in influencing the growth of the plants. This variability suggests that the growth conditions provided by different combinations of tillage and fertilizer types directly impact the plant's ability to reach its full height potential. The treatment that involved conventional tillage with vermicompost resulted in the highest plant height, highlighting the synergistic effect of tillage and organic fertilizers in promoting healthy plant growth.

Nevertheless, this variation in plant height emphasizes the importance of selecting appropriate tillage methods and fertilizer types to optimize sweet corn production. It implies that farmers may need to consider adopting conventional tillage practices with organic amendments, such as vermicompost, for better growth outcomes. The data supports the notion that environmental management practices, such as the type of tillage and the choice of fertilizers, can lead to measurable improvements in crop yield and quality.

The result supports the notion that environmental management practices can improve crop yield and quality while enhancing soil and environmental conditions. Conservation tillage, such as no-till, can increase soil organic carbon and nitrogen concentrations without significantly altering crop yields. Integrating multiple practices, such as conservation tillage, cover cropping, and optimized fertilization, can sustainably increase crop yields while improving soil and water quality (Rietra et al., 2022).

**Table 2. Sweet corn growth in terms of plant height**

|  |  |
| --- | --- |
| Treatments | Plant Height Means (cm) |
| 1: zero tillage with urea treatment  | 196.27 |
| 2: zero tillage with vermicompost, | 192.23 |
| 3: conventional tillage with urea, | 193.67 |
| 4: conventional tillage with vermicompost | **197.60** |
| Computed F-value | **48.54\*\*** |
| Pr(> F) | 0.0001 |
| CV | 0.3105 |

**Significant Differences of Sweet Corn Yield Response**

The second research problem under Study 1 focused on ascertaining the significant difference in the sweet corn yield response in terms of ear length, ear diameter, and ear weight, as influenced by different tillage operations and fertilizers.

**Ear Length**

Table 3 presents the sweet corn yield response in terms of ear length across four different treatments. The highest mean ear length was observed in both Treatment 1: zero tillage with urea treatment and Treatment 3: conventional tillage with urea, with both showing a value of 18.00 cm. The lowest mean ear length was recorded in Treatment 2: zero tillage with vermicompost (17.37 cm).

The result suggests that there is no significant difference in the sweet corn yield response in terms of ear length based on the treatments, as indicated by the computed F-value (0.60) and the probability value (0.6372). These results show that the different tillage operations and fertilizer types do not significantly affect ear length. The coefficient of variation (CV) of 3.90 indicates a relatively low level of variability in ear length across the treatments. Thus, the hypothesis which stated that there is no difference in ear length across the treatments is hereby accepted.

The implication of this result is that the ear length of sweet corn does not vary significantly across the different treatments. The effects of the treatments on ear length appear to be comparable, suggesting that the choice of tillage method and fertilizer type may not have a significant impact on ear length. This indicates that other factors may be more influential in determining ear length, or that the treatments tested do not alter this yield characteristic in a measurable way.

In a similar vein, research on tillage methods and fertilization in sweet corn production has yielded mixed results. While some studies found no significant effects of tillage on ear length, others reported reduced ear length in no-till systems compared to conventional tillage. Fertilizer effects on ear length were inconsistent, with one study showing no measurable impact (Vad et al., 2023) and another finding increased ear length with combined inorganic and organic fertilizers (Canatoy, 2018).

**Table 3. Sweet corn yield response in terms of ear length**

|  |  |
| --- | --- |
| Treatments | Ear Length Means |
| 1: zero tillage with urea treatment  | 18.00 |
| 2: zero tillage with vermicompost, | 17.37 |
| 3: conventional tillage with urea, | 18.00 |
| 4: conventional tillage with vermicompost | 17.97 |
| Computed F-value | 0.60ns |
| Pr(> F) | 0.6372 |
| CV | 3.90 |

**Ear Diameter**

The data in Table 4 reveal the sweet corn yield response in terms of ear diameter across four treatment groups. Among the treatments, conventional tillage with urea (Treatment 3) recorded the highest mean ear diameter of 8.43, while the lowest mean ear diameter was observed in conventional tillage with vermicompost (Treatment 4), with a value of 8.17. This indicates a very slight variation in ear diameter across the treatments, although the differences are minimal.

The computed F-value of 0.35 and the probability value (Pr > F) of 0.7925 indicate that there is no significant difference in the sweet corn yield response in terms of ear diameter across the treatments. The coefficient of variation (CV) of 3.97% reflects a moderate level of relative variability in the ear diameter data, showing consistent measurements among the treatment groups. Based on the statistical findings, the null hypothesis, which posited no differences in ear diameter among treatments, is accepted.

The result manifests that the treatments, whether involving zero tillage or conventional tillage combined with either urea or vermicompost fertilizers, exert comparable effects on ear diameter. This uniform response implies that the choice of tillage method or fertilizer type does not significantly impact this yield parameter. Consequently, farmers may have the flexibility to select treatments based on other criteria, such as cost-efficiency, environmental sustainability, or ease of application, without compromising the ear diameter of sweet corn. The data emphasizes that the treatments’ influence on ear diameter is not assorted, pointing to the potential role of other factors—such as genetic traits or external environmental conditions—in determining this aspect of yield response.

The result aligns with the study by Villaver (2020), which explored the impact of various fertilization regimes on sweet corn yield and quality. Villaver’s research found that integrated nutrient management, which involves combining chemical fertilizers with organic amendments such as vermicompost, generally yielded comparable or even better results than conventional fertilization methods. This approach not only enhanced the overall growth and yield of sweet corn but also improved soil health and sustainability over time.

Moreover, the use of organic amendments like vermicompost in combination with chemical fertilizers helps to optimize nutrient availability and promote healthier soil microbiomes, leading to more resilient crops. The findings suggest that a balanced and integrated approach to fertilization can lead to improved productivity and sustainability in sweet corn farming, further supporting the idea that alternative fertilization methods, like those tested in the present study, can also enhance crop outcomes without compromising quality or yield (Villaver, 2020).

**Table 4. Sweet corn yield response in terms of ear diameter**

|  |  |
| --- | --- |
| Treatments | Ear Diameter Means |
| 1: zero tillage with urea treatment  | 8.27 |
| 2: zero tillage with vermicompost, | 8.33 |
| 3: conventional tillage with urea, | 8.43 |
| 4: conventional tillage with vermicompost | 8.17 |
| Computed F-value | 0.35ns |
| Pr(> F) | 0.7925 |
| CV | 3.97 |

**Ear Weight**

Table 5 presents the sweet corn yield response in terms of ear weight across four different treatments. The highest mean ear weight was observed in Treatment 3: conventional tillage with urea, with a value of 14.21 kilograms. The lowest mean ear weight was recorded in Treatment 2: zero tillage with vermicompost, at 13.37 kilograms.

Further, the result indicates a significant difference in the sweet corn yield response in terms of ear weight, as evidenced by the computed F-value of 4.93 and the probability value (Pr > F) of 0.0465. These results suggest that the type of tillage operation and fertilizer used significantly affects ear weight. The coefficient of variation (CV) of 2.05 indicates a low level of variability in ear weight across the treatments, suggesting that the effects of the treatments on ear weight are relatively consistent. Given the findings, the hypothesis in this section of the study which stated that there is no difference in ear weight across the treatments is rejected.

The result implies that ear weight of sweet corn is significantly influenced by the type of tillage operation and fertilizer used. The variation in ear weight across the different treatments underscores that these agricultural practices play a crucial role in determining the overall productivity of the crop. Specifically, the treatment involving conventional tillage with urea (Treatment 3) resulted in the highest ear weight, suggesting that the combination of conventional tillage and urea fertilizer provides optimal conditions for the growth and development of sweet corn ears. This highlights the profound impact that proper tillage and fertilizer selection can have on improving crop yield. Additionally, it emphasizes the importance of selecting the right combination of tillage and fertilizer to maximize sweet corn productivity and achieve the best results in agricultural practices.

Furthermore, the fact that ear weight varied significantly across the treatments implies that there is potential for targeted management practices to enhance specific yield parameters. Farmers may consider adopting conventional tillage with urea fertilizer to achieve higher ear weight, which can translate into increased marketable yield.

Similarly, the combination of conventional tillage with urea fertilizer can optimize ear weight and overall productivity, as demonstrated by Kusparwanti et al. (2022). Conventional tillage, which involves turning over the soil, allows for better soil aeration and improved root penetration, creating an environment conducive to plant growth. When paired with urea fertilizer, a source of readily available nitrogen, this combination supports robust plant development by ensuring that the plants have the necessary nutrients, particularly nitrogen, which is essential for promoting vigorous growth, photosynthesis, and the formation of larger, heavier ears.

Kusparwanti et al. (2022) further highlighted that conventional tillage helps to break down organic matter and integrate nutrients more effectively into the soil, allowing for enhanced nutrient uptake by the sweet corn plants. Urea, being a high-nitrogen fertilizer, plays a pivotal role in increasing chlorophyll production and improving overall plant health, which directly impacts the growth of the corn ears. The optimal use of these practices leads to an increase in ear weight, as the plants are better equipped to utilize available nutrients and reach their full potential in terms of yield.

**Table 5.** Sweet corn yield response in terms of ear weight

|  |  |
| --- | --- |
| Treatments | Ear Weight Means (kg) |
| 1: zero tillage with urea treatment  | 13.89 |
| 2: zero tillage with vermicompost, | 13.37 |
| 3: conventional tillage with urea, | **14.21** |
| 4: conventional tillage with vermicompost | 13.61 |
| Computed F-value | **4.93\*** |
| Pr(> F) | 0.0465 |
| CV | 2.05 |

**Return on Investment (ROI)**

Table 6 reveals the return on investment (ROI) for sweet corn production treated with different tillage operations and fertilizer application strategies. The table compares the gross income, production costs, net income, and ROI for four treatment methods. Treatment 1 (T1), zero tillage with urea, generated a gross income of Php 9,491.85, with production costs of Php 6,050.28, resulting in a net income of Php 3,441.57 and an ROI of 63.8%. Treatment 2 (T2), zero tillage with vermicompost, showed a gross income of Php 8,940.15, production costs of Php 5,842.88, net income of Php 3,097.27, and ROI of 65.3%.

Moreover, treatment 3 (T3), conventional tillage with urea, earned Php 9,888.75 in gross income, incurred Php 6,414.76 in production costs, and had a net income of Php 3,473.99, yielding an ROI of 64.9%. Treatment 4 (T4), conventional tillage with vermicompost, generated a gross income of Php 9,207, production costs of Php 5,857.37, net income of Php 3,349.18, and the highest ROI of 83.6%.

The treatment with the highest ROI is Treatment 4 (T4), conventional tillage with vermicompost, which demonstrates a return of 83.6%. This indicates that, relative to the investment made, T4 provides the greatest profitability.

The result further manifests that conventional tillage combined with vermicompost offers the most cost-effective approach for maximizing returns in sweet corn production. Vermicompost materials and conventional tillage procedures are economical yet still yield favorable outcomes, making this treatment particularly beneficial for farmers looking to optimize their investment while maintaining sustainable farming practices. The inputs required for this treatment are not expensive, making it an affordable yet highly effective option for sweet corn production. Not only does it yield high returns, but it also promotes the use of organic fertilizers like vermicompost, which supports environmental sustainability.

The result aligns with previous findings, such as Baňoc and Egos (2024), who reported that the application 2.5 tons ha-1 of vermicompost, achieved the highest marketable ear yield and profitability. This highlights the synergistic effect of organic amendments like vermicompost, which not only enhances crop yield but also improves profitability through sustainable agricultural practices. Vermicompost contributes essential nutrients to the soil, improving its structure and water retention capacity, thus promoting better growth conditions for sweet corn.

**Table 6. Return on Investment of Sweet Corn Production treated with Different Tillage Operations and Fertilizer Application Strategies**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatment** | **Gross Income (Php)** | **Production Cost (Php)** | **Net Income (Php)** | **Return of Investment** |
| T1 zero tillage with urea, treatments | 9,491.85 | 6,050.28 | 3,441.57 | 63.8% |
| T2 zero tillage with vermicompost, treatment | 8,940.15 | 5,842.88 | 3,097.27 | 65.3% |
| T3 conventional tillage with urea, treatment | 9,888.75 | 6,414.76 | 3,473.99 | 64.9% |
| T4 conventional tillage with vermicompost | 9,207 | 5,857.37 | 3,349.18 | 83.6% |

*GI = Gross Income, PC = Production Cost, GI-PC = Net Income, ROI = Gross Income/Net Income x 100*

**Conclusions**

The study found that while different tillage operations and fertilizer applications did not significantly affect the germination index of sweet corn, plant height showed considerable variation. Conventional tillage combined with vermicompost resulted in the tallest plants, suggesting a synergistic effect of tillage and organic fertilizers on plant growth. However, no significant differences were observed in ear length and ear diameter across the treatments, indicating that these yield parameters were less influenced by the type of tillage or fertilizer used. On the other hand, ear weight showed a significant difference, with conventional tillage combined with urea producing the heaviest ears, emphasizing the importance of selecting appropriate tillage and fertilizer combinations for optimizing sweet corn yield. The return on investment analysis revealed that conventional tillage with vermicompost yielded the highest ROI, making it the most cost-effective treatment for maximizing profitability in sweet corn production.

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