

## EGGPLANT (*Solanum melongena* L.) PRODUCTION AS AFFECTED BY PHENOLOGICAL STAGES AND ORGANIC FERTILIZER TREATMENT

Marites U. Peralta PhD<sup>1</sup>, Richard D. Dela Cruz<sup>2</sup>, Analyn D. Abella PhD<sup>3</sup>, Cherrise May L. Hayohay PhD<sup>4</sup>

<sup>1</sup> Ilocos Sur Polytechnic State College, Santa Maria Campus, Philippines

### Abstract

A factorial experiment was conducted to examine the effects of phenological stages and organic fertilizer treatments (vermicast and vermitea) on the growth, yield, and profitability of eggplant (*Solanum melongena* L.). Growth and yield parameters, including plant height, branching, leaf production, flowering, fruit yield, and cost–return performance, were assessed. Phenological stages showed minimal influence on most traits, with only slight variations in leaf number, leaf area, and days to flowering. In contrast, organic fertilizer treatments significantly enhanced plant growth and reproductive performance. The highest input level (80g vermicast/plant + 1000 ml vermitea/16 lit water) produced the tallest plants, greatest branching, highest leaf area, and the largest number and weight of marketable fruits while lowering non-marketable yield. Interaction effects were mostly nonsignificant, although higher fertilizer rates applied during flowering and fruiting tended to improve yield traits. Cost and return analysis indicated that organic inputs ensured profitability, with the P1 vegetative stage achieving the highest return on investment (121.54%). Plants treated with F3 consistently outperformed F1 and F2, producing the highest number of flowers (24.99), marketable fruits (11.89 per plant), fruit weight (1091.27 g per plant), and yield (29.1 t/ha). Profitability analysis confirmed that F3 generated the highest return on investment (ROI) at 168.36%. The study demonstrates that vermicast and vermitea are effective organic amendments that enhance eggplant productivity and profitability, offering a sustainable alternative to chemical fertilizers.

**Keywords:** Eggplant, Phenological Stages, Vermicast, Vermitea, Organic Fertilizer, Yield Performance, Profitability

**Citation:** Marites U. Peralta PhD, Richard D. Dela Cruz, Analyn D. Abella PhD, Cherrise May L. Hayohay PhD. 2025. EGGPLANT (*Solanum melongena* L.) PRODUCTION AS AFFECTED BY PHENOLOGICAL STAGES AND ORGANIC FERTILIZER TREATMENT. *FishTaxa* 36(1s): 214-234.

### Introduction

Global attention to sustainable agriculture is growing as concerns rise over the environmental and health risks linked to synthetic fertilizers and chemical-intensive farming. Organic fertilizers are increasingly recognized for their role in enhancing soil fertility, reducing greenhouse gas emissions, and supporting long-term agricultural productivity (FAO, 2023). At the same time, understanding crop phenology—the sequence and timing of growth and developmental stages—is crucial for improving nutrient efficiency and achieving higher yields (IPCC, 2022). Recent research highlights the importance of integrating organic nutrient management with crop-specific phenological scheduling as a climate-smart approach to sustain productivity while minimizing ecological impacts (Bhattarai et al., 2023).

Eggplant (*Solanum melongena* L.) is the most economically important solanaceous vegetable in the Philippines and a key income source for smallholder farmers in lowland areas. Despite its importance, production is still heavily reliant on synthetic fertilizers, which degrade soil health and increase production costs. To address these challenges, the Organic Agriculture Act of 2010 (RA 10068) mandates the promotion of organic inputs to reduce chemical dependence and protect both environmental and human health. The Department of Agriculture (DA) and the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) have likewise identified the development of organic and ecological crop production systems as a national priority.

In the Ilocos Region, one of the country's leading eggplant producers, soil fertility decline and inefficient nutrient management remain critical issues. Provincial statistics highlight both the crop's economic importance and the need for improved practices: Ilocos Sur produced 6,882 metric tons (mt) of eggplant in 2021, 7,990 mt in 2022, and 8,373 mt in 2023, before a slight decrease to about 8,205 mt in 2024 (Philippine Statistics Authority [PSA], Regional Statistical Services Office I, 2024). Most growers are smallholders who often apply fertilizers based on habit rather than crop stage, resulting in suboptimal yields and higher costs. Limited access to science-based guidance on organic fertilization and phenology-based nutrient timing further constrains productivity.

Research that links eggplant phenological stages with stage-specific organic fertilizer application directly supports the objectives of RA 10068 and the Department of Agriculture's climate-smart agriculture initiatives. Region-specific best practices can inform local

agricultural development plans and be integrated into farmer field schools (FFS) and municipal agriculture extension programs. Such guidance will help smallholders optimize input use, improve profitability, and enhance soil health, thus reducing reliance on costly synthetic fertilizers.

This study addresses these needs by identifying the most effective phenological stage and level of organic liquid fertilizer application for eggplant. Its findings will contribute to sustainable vegetable farming systems, align with the United Nations Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), and provide practical recommendations for local government units, farmer organizations, and agricultural extension workers. By demonstrating how organic nutrient management can be synchronized with crop growth stages, the research supports the transition toward resilient, low-input eggplant production in Ilocos Sur and similar agro-ecological zones.

### Research Objectives

Generally, this study aims to find the optimal phenological stage and organic liquid fertilizer treatment for eggplant (*Solanum melongena* L.) production, specifically it seeks to: a) Compare the growth and yield across phenological stages; b) Evaluate different levels of organic fertilizer treatment application on the growth and yield of eggplant; c) Assess the interaction effect between phenological stages and organic fertilizer treatments application; and d) Analyze the profitability of eggplant production under phenological stages and organic fertilizer treatments.

### Materials and Methods

**Research Design.** The experiment was laid out in a 3x3 Factorial Randomized Complete Block Design (RCBD), with three replications. Each replication was composed of nine treatment combinations. Each plot had a dimension of 3 meters x 3.5 meters or 10.5 meters per plot with four rows at 0.75 meters and 0.5 meters between hills and one (1) meter between plots. Each plot consisted of four rows, with seven hills per row and an alley of 2 meters between replication was provided for convenience in field operations. The different treatments were as follows:

**Mainplot Factor A: Phenological Stages** P1 – Vegetative Stage (15 to 35 DAT), P2 – Flowering Stage (36 to 55 DAT) and P3 – Fruiting Stage (56 to 80 DAT) and the **Subplot Factor B: Organic Liquid Fertilizer Treatment:** F1 – Vermicast (40grams /plant) and Vermitea (500 ml/16 liter water), F2 – Vermicast (60grams/plant) and Vermitea (750ml/16 liter water) and F3-Vermicast (80grams/plant) and Vermitea (1000ml/16 liter water).

**Land Preparation.** The soil was thoroughly cultivated using a tractor, with plowing and harrowing performed twice to achieve a fine soil tilth. Each experimental plot measured 3.5 meter × 3.0 meter, covering a total area of 10.5 m<sup>2</sup>. Furrows were spaced 75 cm apart, and seedlings were transplanted at 50 cm intervals per hill.

**Seedling production.** Before sowing, the seeds were soaked in clean water enough to imbibe for faster germination. One seed of eggplant was placed in each hole of the seedling tray and covered with sacks to maintain adequate moisture and promote uniform germination.

**Mulching.** Mulching controls weeds, preserves soil moisture, prevents soil erosion and leaching of fertilizers, and reflects sunlight to repel insect pests hiding under the leaves. The material used for mulching was a polyethylene plastic sheet. The mulch was placed and stretched over the planting bed in every plot three days before transplanting. The edges of the plastic mulch were covered by soil.

**Transplanting.** At 25 days after sowing, the seedlings were acclimatized for 5 days, and at 30 days, the seedlings were ready for transplanting on the prepared plots. The planting distance was 0.75 meters between rows and 0.50 meters between hills. Transplanting was done late afternoon to avoid plant stress. Immediately after transplanting, irrigation follows.

**Water Management/Irrigation.** A follow-up irrigation was done the following day. An interval of five days for the first month, then irrigation was done every seventh day succeeding month, followed by 10 days thereafter.

**Fertilizer Application.** Vermicast was applied once beside the eggplant crop, with 40, 60, and 80 grams per plant per treatment or rates of 1,066.68kg/ha, 1,600.02kg/ha, and 2,133.36kg/ha. Vermitea application were done every week, early in the morning or late in the afternoon. Following the treatment of 500ml/16lit water, 750 ml/16 lit water, and 1000ml/16lit water. The first application was done at 15 DAT for P1 (Vegetative Stage) every week up to 35 DAT. For P2 (Flowering Stage), application was started on 36 DAT and continued weekly up to 55 DAT, and for P3 (Fruiting Stage), application was done at 56 DAT and every week up to 80 DAT.

**Harvesting.** Harvesting started 59 days after transplanting (DAT). To prevent damage to the plants, harvesting was done using scissors or scythes. Consistent and timely harvesting not only ensures high-quality produce but also reduces fruit borer damage. Moreover,

gathering all available fruits at each harvest stimulates continuous fruiting and extends the crop's productive period.

**Data Gathered**

All the data gathered were selected at random from 10 sample plants per plot.

**Initial plant height (cm).** This was gathered 15 days after transplanting (DAT). The height of the plant was measured from the base of the plant to the tip of the highest leaves. A ruler was used to measure the initial height of the plant.

**Final height (cm).** This was gathered one week after the data gathering was terminated (120 DAT). The height of the plant was measured from the base of the plant to the tip of the highest leaves. Metering stick was used to measure the final height of the plant.

**Number of primary branches.** These are the main branches that grow directly from the main stem after the plant's initial growth.

**Number of Leaves per plant.** These was gathered at 120 days after transplanting (DAT).

**Total leaf area per plant.** The sum of the surface areas of all the leaves on a single eggplant. It is an important growth parameter used to measure the plant's photosynthetic capacity, which directly affects its growth, development, and yield.

**Number of days to flowers.** The date when 50% of the plants per plot flowered. This was used in determining the number of days from transplanting to flowering.

**Number of flowers per plant.** The total count of flowers produced by a single eggplant during its reproductive stage. It is a key indicator of the plant's reproductive potential, as each flower has the possibility of developing into a fruit.

**Number of Marketable fruits per plant.** This was done by counting the number of marketable fruits per plant.

**Number of non-marketable fruits per plant.** This was determined by counting the number of fruits damaged by insect, pest and diseases.

**Weight of marketable fruits per plant (g).** This was determined by weighing the marketable fruits. A mechanical weighing scale for 10 kg was used to weigh the harvested fruits.

**Weight of non- marketable fruits per plant.** This was determined by weighing the fruit damage by insect, pest and diseases.

**Yield per Plant (kg).** This was computed by using the formula:  
$$\text{Yield per plant} = \text{Average Yield per Plant (kg)} \times \text{Plant Population per ha.}$$

**Gross income (PhP).** This was taken by getting the yield in kilo gram per hectare and valuing it with the farm gate price.

**Total expenses (PhP).** This was taken from the sum total of all expenses incurred during the whole operation and deducted from the total gross income in order to get the net income.

**Net income (PhP).** This was computed by subtracting the total expenses from the gross sale.

**Return on Investment (ROI).** This was computed by dividing the net returns by the total investment.

**ANALYSIS OF DATA**

All the data gathered were arranged, tabulated, and statistically analyzed using the Analysis of Variance (ANOVA) and significant result was further subjected to the least significant different (LSD) test at 0.05 and 0.01 level of significance.

**Profitability Analysis**

All expenses incurred and expected sales were recorded properly. Profitability was assessed using the formula:  
$$\text{ROI (\%)} = \text{Net Income} / \text{Total Expense} \times 100$$

## Results and Discussion

### 3.1 Height of Plants.

Table 1 presents the Initial Height of the plants at 15 days after transplanting, Final height at 120 days after transplanting and Height Increment of the plant as affected by phenological stages, organic fertilizer treatments and interaction effects.

The initial height was measured at 15 days after transplanting (DAT). Plants in P2 (flowering stage), recorded as the tallest with an average height of 14.33 centimeters, followed by plants in P3 (fruiting stage) with a mean of 14.22 centimeters and P1 (vegetative stage) with an average mean of 14.05 centimeters, respectively. However, these differences were not statistically significant, which means that the growth stage had minimal effect on plant height at this early stage.

In terms of organic fertilizer treatments, the initial height presented similarities among treatments F1(40g vermicast + 500ml vermitea/16 lit water), F2 (60g vermicast + 750ml vermitea/16 lit water), and F3 (80g vermicast + 1000ml vermitea/16 lit water), suggesting that the effect of vermicast and vermitea may take longer to manifest in plant growth.

The interaction effects on the initial height shows that plant in P2F2 (Flowering x Vermicast 60g/plant + Vermitea 750ml/16 lit water) registered tallest among combined treatments with an average of 14.54 centimeters and P1F2 (Vegetative x Vermicast 60g/plant + Vermitea 750ml/16 lit water) with 13.72 cm registered as the shortest among combined treatments and the rest of the combined treatments are comparable the F-test results indicated no interaction between the two factors affecting early plant height. Statistical analysis showed no significant effects between and among treatment means. The results indicates that either phenological stages and organic fertilizer may not significantly influence early vegetative growth but tend to show marked improvements during flowering and fruiting stages.

These results align with existing studies of Gupta et al. (2022) noted that vermitea boosts microbial activity and root development, but its impact on shoot growth is often delayed. Similarly, Kale et al. (2021) observed that organic treatments may not significantly influence early vegetative growth but tend to show marked improvements during flowering and fruiting stages.

In a recent study, Nguyen et al. (2023) confirmed that while vermicast and vermitea improve nutrient uptake and root health, their benefits on shoot height and biomass become evident only after 5–6 weeks, particularly under warm growing conditions.

The final height was measured at 120 days after transplanting. Based on the data, plants in P1 vegetative, P2 flowering, and fruiting (P3) stages were 94.32 cm, 94.32 cm, and 94.52 cm, respectively, showing a comparative result. The results indicate that regardless of phenological stages, there was no significant effects on the final height of eggplant. These results suggest that the vegetative growth had reached a stable height before reproductive differentiation, consistent with findings by Rahman et al. (2022), who observed minimal height differences post-flowering in *Solanum melongena*.

The tallest plants were recorded in F3 (80 g vermicast/plant + 1000 ml vermitea/16 lit water) with a mean height of 96.07 cm, followed by F2 (60 g + 750 ml) at 94.33 cm, and F1 (40 g vermicast/plant + 500 ml vermitea/16 lit water) at 92.76 cm. Analysis of variance reflected a highly significant ( $p < 0.01$ ) difference among the treatments involving varying rates of vermicast and vermitea. These findings indicate that higher application rates of organic amendments positively influenced plant growth.

The improvement in height can be attributed to the increased availability of macro- and micronutrients, beneficial microbes, and plant growth regulators found in vermicast and vermitea. Reddy et al. (2021) also reported that eggplants treated with higher doses of vermicompost and vermiwash exhibited enhanced vegetative growth due to improved nutrient uptake and soil fertility.

The interaction between phenological stages and vermicompost/vermitea treatments showed slight numerical variations, with the highest final height of (96.27 cm) being recorded in the P3F3 combined treatment under the highest rate of (fruiting stage x 80 g vermicast/per plant +1000ml vermitea/16 lit water), while the lowest 92.63 cm was in P1F1, (vegetative x 40 g vermicast/plant + 500ml vermitea/16 lit water). There was no significant difference in the result. This suggests that the growth-promoting effects of vermicast and vermitea were consistent across all phenological stages.

The results demonstrate that increased applications of vermicast and vermitea significantly improve final plant height, highlighting their potential as effective organic fertilizers in sustainable eggplant production. These inputs can reduce dependency on synthetic fertilizers while maintaining productivity, thereby supporting eco-friendly agriculture and soil health improvement.

The mean growth increment of eggplant as affected by the different phenological stages was 80.37 cm (P1 vegetative), 80.22 cm (P3 fruiting), and 80.00 cm (P2 flowering). The results revealed a comparable effect but did not differ significantly. With a coefficient of variation (CV) of 0.60%. The data suggest uniform vertical growth regardless of the crop's developmental phase. This implies that plant growth continued steadily across stages once the plants were well established. This result is consistent with the findings of

Suganthi et al. (2021), who observed minimal variation in eggplant height across different stages when provided with consistent nutrition and care.

The highest growth increment was recorded in F3 (80 g vermicast/plants + 1000 ml vermitea/16 lit water) at 81.79 cm, followed by F2 (60 g vermicast/plants + 750 ml vermitea/16 lit water) at 80.27 cm, and the lowest in F1 (40 g vermicast/plants + 500 ml vermitea/16 lit water) at 78.52 cm. The influence of organic fertilizer treatments on growth increment was highly significant ( $p < 0.01$ ). The trend indicates a positive dose-response relationship between the amount of organic input and the growth performance of eggplant.

This finding aligns with the results of Adekiya et al. (2020), who emphasized that higher rates of vermicast significantly enhance plant biomass, stem elongation, and root development due to improved soil structure, nutrient availability, and microbial activity. Vermicast contains growth-promoting substances such as humic acids, enzymes, and plant hormones, while vermitea further enhances microbial colonization and nutrient assimilation.

The interaction effects of combined treatment mean ranged from 78.41 cm P3F1 (Fruiting x Vermicast (40g/plant) and Vermitea (500ml/16 lit water) to 81.97 cm P3F3 Fruiting x Vermicast (80g/plant) and Vermitea (1000ml/16 lit water). This indicates that while growth increment responded significantly to increasing organic input rates, this effect was stable across all phenological stages. The interaction effect between phenological stage and organic fertilizer treatment was statistically nonsignificant (ns), though comparable results were observed among the combinations. This suggests that higher applications of vermicast and vermitea can significantly enhance eggplant growth regardless of the plant's developmental stage. This supports the integration of organic amendments into eggplant production as a sustainable strategy to boost vegetative growth. Adoption of these practices can contribute to improved productivity while maintaining ecological balance by minimizing chemical input dependency.

**Table 1. Initial height of the plants at 15 days after transplanting, Final height of the plant at 120 DAT and Height Increment of the plant as affected by Phenological stages, Organic fertilizer treatments and Interaction effects.**

ns - Not Significant    \*\* - Highly Significant

| Factor A: Phenological Stages                                                                     | INITIAL HEIGHT (15DAT cm) | FINAL HEIGHT (120 DATcm) | Growth Increment (cm) |
|---------------------------------------------------------------------------------------------------|---------------------------|--------------------------|-----------------------|
| P <sub>1</sub> - Vegetative                                                                       | 14.05                     | 94.32                    | 80.37                 |
| P <sub>2</sub> - Flowering                                                                        | 14.33                     | 94.32                    | 80.00                 |
| P <sub>3</sub> - Fruiting                                                                         | 14.22                     | 94.52                    | 80.22                 |
| F-test                                                                                            | ns                        | ns                       | ns                    |
| CV                                                                                                |                           |                          | 0.60%                 |
|                                                                                                   | 2.05%                     | 0.43%                    |                       |
| <b>Factor B: Organic Fertilizer Treatments</b>                                                    |                           |                          |                       |
| F <sub>1</sub> – Vermicast 40grams/plant and Vermitea 500ml/16 lit water                          | 14.16                     | 92.76c                   | 78.52c                |
| F <sub>2</sub> – Vermicast 60grams/plant and Vermitea 750ml/16 lit water                          | 14.16                     | 94.33b                   | 80.27b                |
| F <sub>3</sub> – Vermicast 80grams/plant and Vermitea 1000ml/16 lit water                         | 14.29                     | 96.07a                   | 81.79                 |
| F-test                                                                                            | ns                        | **                       | **                    |
| CV                                                                                                |                           | 0.30%                    | 0.49%                 |
|                                                                                                   | 2.38%                     |                          |                       |
| <b>Interaction Effects of Factor A and Factor B</b>                                               |                           |                          |                       |
| P <sub>1</sub> F <sub>1</sub> -Vegetative+Vermicast 40grams/plant and Vermitea 500ml/16 lit water | 14.15                     | 92.63                    | 78.48                 |
| P <sub>1</sub> F <sub>2</sub> -Flowering+Vermicast 60grams/plant and Vermitea 750ml/16 lit water  | 13.72                     | 94.16                    | 80.73                 |
| P <sub>1</sub> F <sub>3</sub> -Fruiting+Vermicast 80grams/plant and Vermitea                      | 14.29                     | 96.16                    | 81.89                 |

|                                                                                                         |       |       |       |
|---------------------------------------------------------------------------------------------------------|-------|-------|-------|
| 1000ml/16 lit water                                                                                     |       |       |       |
| P <sub>2</sub> F <sub>1</sub> - Flowering+Vermicast<br>40grams/plant and Vermitea<br>500ml/16 lit water | 14.16 | 92.83 | 78.67 |
| P <sub>2</sub> F <sub>2</sub> -Flowering+Vermicast<br>60grams/plant and Vermitea<br>750ml/16 lit water  | 14.54 | 94.35 | 79.82 |
| P <sub>2</sub> F <sub>3</sub> -Flowering+Vermicast<br>80grams/plant and Vermitea<br>1000ml/16 lit water | 14.29 | 95.79 | 81.50 |
| P <sub>3</sub> F <sub>1</sub> -Fruiting+Vermicast<br>40grams/plant and Vermitea<br>500ml/16 lit water   | 14.17 | 92.82 | 78.41 |
| P <sub>3</sub> F <sub>2</sub> -Fruiting+Vermicast<br>60grams/plant and Vermitea<br>750ml/16 lit water   | 14.21 | 94.48 | 80.27 |
| P <sub>3</sub> F <sub>3</sub> -Fruiting+Vermicast<br>80grams/plant and Vermitea<br>1000ml/16 lit water  | 14.29 | 96.27 | 81.97 |
| F-test                                                                                                  | ns    | ns    | ns    |
| CV                                                                                                      | 1.5 % |       |       |

### 3.2 Number of primary branches

Table 2 presents the number of primary branches of eggplant as affected by phenological stages and organic fertilizer treatments and its interaction effects.

The mean value of primary branches across phenological stages ranged from 9.27 at the flowering stage (P2) to 9.62 at the fruiting stage (P3), with the vegetative stage (P1) showing 9.32 branches. The coefficient of variation (CV) was low at 3.04%, indicating consistency of data were comparable. Results revealed no significant difference among the treatments.

This suggests a natural branching tendency as the plant matures, which aligns with the findings of Sultana et al. (2023), who reported that eggplants tend to develop more lateral branches as they transition from vegetative to reproductive stages due to hormonal shifts.

The highest number of primary branches was recorded in organic fertilizer treated with (80 g vermicast + 1000 ml vermitea/16 lit water) at F3, 10.45, followed by F2 (60 g vermicast + 750 ml vermitea/16 lit water) at 9.38, and the lowest in F1 (40 g vermicast + 500 ml vermitea/16 lit water) at 8.39. A highly significant effect ( $p < 0.01$ ) was observed among the organic fertilizer treatments. A highly significant difference between vermicast and vermitea on branch development highlights its potential as an effective organic alternative to synthetic fertilizers. Enhanced branching translates into better photosynthetic capacity and more fruit-bearing sites, which may improve yield.

These results are corroborated by Adekiya et al. (2020) and Pathak & Ram (2022), who reported that vermicast and vermitea enhance shoot development due to their high content of plant growth-promoting hormones like auxins and cytokinins, humic substances, and beneficial microbial populations.

The numerical trends indicate that the highest number of branches (10.53) occurred at P3F3 (Fruiting x Vermicast 80g/plant) + Vermitea (1000ml/16 lit water), the lowest (8.16) was seen in P2F1 (Flowering x Vermicast (40 g/plant) + Vermitea (500 ml/16 lit water). The Remaining data of interaction effects in final height of eggplant ranged from. The interaction between phenological stage and organic fertilizer application was not statistically significant. This indicates that the positive effect of increased organic input levels on branch development is consistent across all growth stages.

The results support the application of higher doses of vermicast and vermitea to enhance vegetative growth, particularly in branching, which is vital for canopy expansion and potential fruit-bearing parts. Higher-level organic input may improve yield potential due to a better vegetative framework and plant architecture.

**Table 2: Number of primary branches of eggplant as influenced by phenological stages, organic fertilizer treatment application and its interaction effects.**

ns - Not Significant    \*\* - Highly Significant

| <b>Factor A: Phenological Stages</b>                                           | <b>Number of primary branches</b> |
|--------------------------------------------------------------------------------|-----------------------------------|
| P <sub>1</sub> - Vegetative                                                    | 9.32                              |
| P <sub>2</sub> - Flowering                                                     | 9.27                              |
| P <sub>3</sub> - Fruiting                                                      | 9.62                              |
| F-test                                                                         | ns                                |
| CV                                                                             | 3.04%                             |
| <b>Factor B: Organic Fertilizer</b>                                            |                                   |
| F <sub>1</sub> - Vermicast (40 grams/plant) and Vermitea (500ml/16 lit water)  | 8.39c                             |
| F <sub>2</sub> - Vermicast (60 grams/plant) and Vermitea (750ml/16 lit water)  | 9.38b                             |
| F <sub>3</sub> - Vermicast (80 grams/plant) and Vermitea (1000ml/16 lit water) | 10.45a                            |
| F-test                                                                         | **                                |
| CV                                                                             | 2.53%                             |
| <b>Interaction Effects of Factor A and Factor B</b>                            |                                   |
| P1F1 – Vegetative x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water)  | 8.37                              |
| P1F2 – Vegetative x Vermicast (60g/plant and Vermitea (750ml/16 lit water)     | 9.20                              |
| P1F3 – Vegetative x Vermicast (80g/plant and Vermitea (1000ml/16 lit water)    | 10.40                             |
| P2F1 – Flowering x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water)   | 8.16                              |
| P2F2 – Flowering x Vermicast (60 g/plant) and Vermitea (750 ml/16 lit water)   | 9.23                              |
| P2F3 – Flowering x Vermicast (80 g/plant) and Vermitea (1000 ml/16 lit water)  | 10.43                             |
| P3F1 – Fruiting x Vermicast (40g/plant) and Vermitea (500ml/16 lit water)      | 8.63                              |
| P3F2 – Fruiting x Vermicast (60g/plant) and Vermitea (750ml/16 lit water)      | 9.70                              |
| P3F3 – Fruiting x Vermicast (80g/plant) and Vermitea (1000ml/16 lit water)     | 10.53                             |
| F-test                                                                         | ns                                |
| CV                                                                             |                                   |

### 3.3 Number of leaves at 120 Days After Transplanting (DAT)

Table 3 reflects the number of leaves at 120 days after transplanting as affected by phenological stages, organic fertilizer treatments application and its interaction effects.

As can be seen in the table, P2 flowering stage, with a mean of 116.81, and the P3 fruiting stage, with a mean of 116.72, have a comparative mean value that produced significantly more leaves than the P1 vegetative stage, with a mean value of 115.72, which shows slight numerical differences. Analysis of variance reveals a significant difference ( $p < 0.05$ ) in the number of leaves among the phenological stages. This result suggests a steady increase in leaf formation as the crop progresses through its growth phases.

These findings align with the study by Silva et al. (2022), who reported that eggplant continues producing new leaves throughout its reproductive stages due to its indeterminate growth habit. The accumulation of leaves during the flowering and fruiting phases contributes to energy demands for flower and fruit development, highlighting the plant's adaptive allocation of photosynthates.

The effect of organic fertilizer treatments was observed among the different vermicast and vermitea application rates. F3 (80g vermicast + 1000 ml vermitea) recorded the highest number of leaves of 120.26, followed by F2 (60g vermicast + 750 ml vermitea/16 lit water) had a number of leaves of 116.06, while F1 (40g vermicast + 500 ml vermitea/16 lit water) with 112.94 number of leaves showed the least. A highly significant difference ( $p < 0.01$ ) was shown statistically. These results strongly suggest that increasing the rate of organic inputs positively affects foliar development.

The results support the study of Adekiya et al. (2020) and Ahmed et al. (2023), who found that higher doses of vermicompost enhanced leaf number and area in Solanaceous crops.

The interaction effects of phenological stages and organic fertilizer treatments on the number of leaves at 120 DAT ranged from 112.53 to 121.03 across treatments. Although the F-test revealed non-significant (ns) interaction effects, observable trends were consistent.

Within each phenological stage, the number of leaves increased with higher organic fertilizer application rates. Plants at the flowering stage (P2) exhibited the highest leaf count under the maximum organic fertilizer level (P2F3, 121.03), closely followed by the fruiting stage (P3F3, 120.47). The vegetative stage also showed positive responses, peaking at 119.13 under P1F3. These results suggest that while differences were not statistically significant, plants benefited from increased vermicast and vermitea application, particularly during flowering and fruiting stages where nutrient demand is typically elevated.

The trend corroborates findings by Arancon et al. (2004) and Atiyeh et al. (2017), who reported that vermicast significantly enhances vegetative traits by improving nutrient retention and soil structure, while vermitea enhances nutrient uptake efficiency and plant metabolic activity (Pant et al., 2011; Joshi et al., 2020).

**Table 3. Number of leaves at 120 days after transplanting (DAT) as influenced by Phenological Stages and Organic Fertilizer treatment and its Interaction Effects.**

ns - Not Significant \* - Significant \*\* - Highly Significant

| Factor A: Phenological Stages                                                 | Number of Leaves at 120 Days |
|-------------------------------------------------------------------------------|------------------------------|
| P <sub>1</sub> - Vegetative                                                   | 115.72b                      |
| P <sub>2</sub> - Flowering                                                    | 116.81a                      |
| P <sub>3</sub> - Fruiting                                                     | 116.72a                      |
| F-test                                                                        | *                            |
| CV                                                                            | 0.48%                        |
| <b>Factor B: Organic Fertilizer</b>                                           |                              |
| F <sub>1</sub> - Vermicast (40grams/plant) and Vermitea (500ml/16 lit water)  | 112.94c                      |
| F <sub>2</sub> - Vermicast (60grams/plant) and Vermitea (750ml/16 lit water)  | 116.06b                      |
| F <sub>3</sub> - Vermicast (80grams/plant) and Vermitea (1000ml/16 lit water) | 120.26a                      |
| F-test                                                                        | **                           |
| CV                                                                            | 0.75%                        |
| <b>Interaction Effects</b>                                                    |                              |
| P1F1 – Vegetative x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water) | 113.13                       |
| P1F2 – Vegetative x Vermicast (60g/plant and Vermitea (750ml/16 lit water)    | 114.77                       |
| P1F3 – Vegetative x Vermicast (80g/plant and Vermitea (1000ml/16 lit water)   | 119.13                       |
| P2F1 – Flowering x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water)  | 112.53                       |
| P2F2 – Flowering x Vermicast (60 g/plant) and Vermitea (750 ml/16 lit water)  | 116.87                       |
| P2F3 – Flowering x Vermicast (80 g/plant) and Vermitea (1000 ml/16 lit water) | 121.03                       |
| P3F1 – Fruiting x Vermicast (40g/plant) and Vermitea (500ml/16 lit water)     | 113.17                       |
| P3F2 – Fruiting x Vermicast (60g/plant) and Vermitea (750ml/16 lit water)     | 116.53                       |
| P3F3 – Fruiting x Vermicast (80g/plant) and Vermitea (1000ml/16 lit water)    | 120.47                       |
| F-test                                                                        | ns                           |
| CV                                                                            |                              |

### 3.4 Total Leaf Area

Table 4 presents the total leaf area of eggplant as affected by phenological stages and organic fertilizer treatments and its interaction effects.

The effect of phenological stages on the total leaf area of eggplant is presented in Table 6. Results revealed that plants at the vegetative (P1) and flowering (P2) stages recorded significantly higher leaf area (0.46 m<sup>2</sup>) compared with those at the fruiting stage (P3), which had 0.45 m<sup>2</sup>. This difference, though numerically small, was statistically significant at the 5% level, indicating that the developmental stage had a mild but measurable influence on leaf area. This suggests that the eggplant's leaf expansion is most active during the vegetative and flowering stages and slightly reduces as the plant diverts more energy to fruit production. Since leaf area peaks during the vegetative and flowering stages, timely application of organic inputs during early stages is crucial to maximize foliage development. The reduced leaf area during the fruiting stage may be attributed to resource allocation shifts, wherein assimilates are redirected from vegetative growth to reproductive structures. Marcelis et al. (2006) explained that in fruit-bearing crops, assimilate

partitioning favors developing fruits at the expense of leaf expansion.

For organic fertilizer treatments, the highest total leaf area of 0.47 m<sup>2</sup> was observed in plants treated with F3 (80g vermicast/plant + 1000ml vermitea/16 lit water), followed by 0.46 m<sup>2</sup> F2 (60g vermicast/plant + 750ml vermitea/16 lit water), and 0.44 m<sup>2</sup> F1 (40g vermicast/plant + 500ml vermitea/16 lit water). Results revealed a highly significant difference between and among treatment means. This trend shows that increasing amounts of vermicast and vermitea led to increased leaf area, likely due to better nutrient availability and improved soil health supporting more vigorous foliage growth.

The results validate the effectiveness of organic fertilizers, particularly at higher doses, in supporting leaf development. Singh et al. (2023) reported that increasing levels of vermicast and vermitea improved chlorophyll content, leaf area, and photosynthetic efficiency in tomato and eggplant, particularly under organic cultivation systems. Likewise, Nguyen et al. (2023) found that vermicast improved soil structure, nutrient cycling, leaf expansion, and canopy development in leafy vegetables. The study confirmed that organic treatments stimulate leaf area growth, especially when applied in larger quantities. Further, Ali et al. (2022) noted that leaf area index increased significantly with higher rates of vermitea due to the improved uptake of macro and micronutrients essential for foliar development.

The interaction between phenological stage and organic fertilizer, all combinations produced similar results with no statistically significant differences. However, the highest leaf area of 0.48 m<sup>2</sup> (Fruiting x Vermicast 80g/plant + Vermitea1000ml/16 lit water was recorded in the fruiting stage with the highest organic input (P3F3), suggesting a consistent positive effect of organic fertilizer regardless of the growth stage. This suggests that organic fertilizer inputs sustained leaf area even during the reproductive phase, when leaf growth is often limited, the results highlight that phenological development and fertilizer application independently influenced leaf area.

The practical implication is that continuous application of vermicast and vermitea sustains leaf expansion across all stages, thereby enhancing the photosynthetic surface required to support reproductive growth and yield (Taiz et al., 2018).

**Table 4. Total Leaf Area of eggplant as affected by Phenological Stages and Organic Fertilizer Treatments and its Interaction Effects.**

| <b>Factor A : Phenological Stages</b>                                         | <b>Total Leaf Area in (m<sup>2</sup>)</b> |
|-------------------------------------------------------------------------------|-------------------------------------------|
| P <sub>1</sub> - Vegetative                                                   | 0.46a                                     |
| P <sub>2</sub> - Flowering                                                    | 0.46a                                     |
| P <sub>3</sub> - Fruiting                                                     | 0.45b                                     |
| F-test                                                                        | *                                         |
| CV                                                                            | 0.45%                                     |
| <b>Factor B: Organic Fertilizer</b>                                           |                                           |
| F <sub>1</sub> - Vermicast (40grams/plant) and Vermitea (500ml/16 lit water)  | 0.44c                                     |
| F <sub>2</sub> - Vermicast (60grams/plant) and Vermitea (750ml/16 lit water)  | 0.46b                                     |
| F <sub>3</sub> - Vermicast (80grams/plant) and Vermitea (1000ml/16 lit water) | 0.47a                                     |
| F-test                                                                        | **                                        |
| CV                                                                            | 1.23%                                     |
| <b>Interaction Effects of Factor A and Factor B</b>                           |                                           |
| P1F1 – Vegetative x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water) | 0.44                                      |
| P1F2 – Vegetative x Vermicast (60g/plant and Vermitea (750ml/16 lit water)    | 0.46                                      |
| P1F3 – Vegetative x Vermicast (80g/plant and Vermitea (1000ml/16 lit water)   | 0.47                                      |
| P2F1 – Flowering x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water)  | 0.44                                      |
| P2F2 –Flowering x Vermicast (60 g/plant) and Vermitea (750 ml/16 lit water)   | 0.46                                      |
| P2F3 –Flowering x Vermicast (80 g/plant) and Vermitea (1000 ml/16 lit water)  | 0.47                                      |
| P3F1 –Fruiting x Vermicast (40g/plant) and Vermitea (500ml/16 lit water)      | 0.44                                      |
| P3F2 –Fruiting x Vermicast (60g/plant) and Vermitea (750ml/16 lit water)      | 0.46                                      |
| P3F3 –Fruiting x Vermicast (80g/plant) and Vermitea (1000ml/16 lit water)     | 0.48                                      |
| F-test                                                                        | ns                                        |
| CV                                                                            |                                           |

---

ns – Not Significant    \* - Significant    \*\* - Highly Significant

---

### 3.5 Number of days to flower and number of flowers per plant

The Number of days to flower and number of flowers per plant as affected by Phenological Stages and Organic Fertilizer Treatment and its Interaction is shown in Table 5.

The plants in the vegetative stage (P1) took the longest time to flower with an average mean of 38.38 days, which was significantly higher than those in the flowering stage (P2) with a mean of 38.16 days, and the fruiting stage (P3), with a mean of 38.01 days, respectively. Post hoc analysis using LSD revealed that the (P1) vegetative stage was significantly different from P2 flowering and P3 fruiting stages, but P2 and P3 did not significantly differ. This suggests that earlier phenological stages delay flowering due to the plant's focus on vegetative growth processes rather than reproductive development.

The study of Kumar et al. (2020) emphasized that phenological responses are tightly regulated by both internal (growth stage) and external (nutrient availability) factors, corroborating the independent effects seen in this study.

The highest mean of 39.36 days was observed in F1 which has a lowest fertilizer rate (Vermicast (40grams/plant) and Vermitea (500ml/16 lit water), while the lowest with a mean of 36.83 days was recorded in F3 with the highest fertilizer rate of (Vermicast (80grams/plant) and Vermitea (1000ml/16 lit water). There was a highly significant difference ( $p < 0.01$ ) in the number of days to flower among different organic fertilizer treatments. This demonstrates a dose-dependent reduction in days to flowering increasing the rate of vermicast and vermitea application accelerates flowering.

According to Gopal et al. (2021), organic fertilizers improve soil biological activity and supply essential micronutrients that trigger hormonal signals linked to flowering.

The data showed that the plants in combination P2F3 (Flowering x Vermicast (80 g/plant) and Vermitea (1000 ml/16 lit water) reveal the shortest day to flower with a mean of 36.63 days, versus 39.43 days for both P1F1 (Vegetative x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water) and P2F1 Flower x Vermicast (40g/plant) and Vermitea (500ml/16 lit water) which projected as the longest days to flower. Although numerical differences were observed in all treatment combination, the interaction between phenological stages and organic fertilizer levels was not significant (ns), suggesting that the effect of fertilizer on days to flower was consistent across phenological stages. This indicates that each factor independently influenced flowering time.

The results imply that advancing to reproductive stages and applying higher organic fertilizer rates significantly reduce the time required for flowering. Specifically, vermicast and vermitea, rich in humic acids, beneficial microbes, and plant growth-promoting substances, may enhance root development and nutrient uptake, thereby hastening floral induction. This insight is vital for scheduling planting and harvesting in organic farming systems.

These findings align with the work of Olawale et al. (2023), who reported that vermicast application reduced the vegetative period and promoted earlier flowering in tomato. Similarly, Dineshkumar et al. (2022) found that foliar application of vermitea improved flowering synchronization and hastened the onset of reproductive stages in chili pepper.

The phenological data on the number of flowers per plant has a comparable mean value from 22.81 P1 vegetative, to 23.25P2 flowering, and to 23.91 P3 fruiting stages respectively. Across the phenological stages P1 (Vegetative), P2 (Flowering), P3 (Fruiting), the differences were statistically not significant. This suggests that the progression of phenological stages alone had limited influence on flower production under the study's conditions.

These results may be due to overlapping hormonal balances and nutrient remobilization that did not differ significantly among the stages in influencing flower initiation.

The application of organic fertilizer significantly affected the number of flowers per plant ( $p < 0.01$ ). The highest number of flowers was observed in F3 (80g vermicast + 1000ml vermitea/16 lit water) with 24.99 flowers per plant, followed by F2 (60g vermicast + 750ml vermitea/16 lit water) with 23.10, and the lowest in F1 (40g vermicast + 500ml vermitea/16 lit water) with 21.88. Analysis of variance revealed a significant difference between and among treatment level. The significant linear increase in flower number with higher organic fertilizer rates supports the idea that increased organic inputs enhance reproductive growth. This enhancement may be attributed to the improved nutrient availability, microbial stimulation, and root system development from vermicompost and vermitea, which are rich in nitrogen, phosphorus, potassium, and beneficial rhizobacteria. The consistent increase in flowers per plant with increasing rates of vermicast and vermitea highlights the potential of these inputs to serve as sustainable alternatives to synthetic fertilizers in boosting reproductive output.

These results are consistent with previous studies that support the use of organic fertilizers for enhancing reproductive growth. Raut et al. (2023) reported that higher doses of vermicast significantly increased the number of flowers and fruits in eggplant, attributing the effect to improved soil organic matter and microbial biomass. Similarly, Kaur et al. (2022) demonstrated that vermitea application increased flowering and pollinator activity in tomato plants, suggesting better nutrient assimilation and hormonal stimulation. Likewise, Lal et al. (2021) found that organic amendments improved flower initiation and development through the enhanced availability of plant growth regulators like auxins and cytokinins. Furthermore, FAO (2020) emphasized that organic inputs contribute to soil health, which indirectly influences flowering by improving root function and nutrient uptake capacity.

The interaction between phenological stage and fertilizer was not significant, indicating that the effect of organic fertilizer on flower number was consistent regardless of the plant's phenological stage. For instance, while P3F3 (fruiting + 80g Vermicast/plant + 1000ml vermitea/16 lit water) had the highest flower count (25.63), and P1F1 (vegetative + 40g vermicast + 500ml vermitea/16 lit water) the lowest (21.10), the pattern was stable across stages, reinforcing that organic input, not growth stage, was the primary influencing factor.

The results suggest that organic fertilizer application is a key determinant of flower production, while phenological stage alone does not significantly influence flower number. This finding is particularly relevant for organic horticulture and agroecological systems where maximizing floral development is critical for yield, especially in fruit-bearing crops.

**Table 5. Number of days to Flower and Number of Flowers per plant as influence by Phenological Stages and Organic Fertilizer Treatments and its Interaction Effects.**

| <b>Factor A: Phenological Stages</b>                                      | <b>Number of Days to Flower</b> | <b>Number of Flowers per Plant</b> |
|---------------------------------------------------------------------------|---------------------------------|------------------------------------|
| P <sub>1</sub> - Vegetative                                               | 38.38a                          | 22.81                              |
| P <sub>2</sub> - Flowering                                                | 38.16b                          | 23.25                              |
| P <sub>3</sub> - Fruiting                                                 | 38.01b                          | 23.91                              |
| F-test                                                                    | **                              | ns                                 |
| CV                                                                        | 0.29%                           | 6.08%                              |
| <b>Factor B: Organic Fertilizer Treatments</b>                            |                                 |                                    |
| F <sub>1</sub> – Vermicast 40grams/plant and Vermitea 500ml/16 lit water  | 39.06                           | 21.88c                             |
| F <sub>2</sub> – Vermicast 60grams/plant and Vermitea 750ml/16 lit water  | 38.36b                          | 23.10b                             |
| F <sub>3</sub> – Vermicast 80grams/plant and Vermitea 1000ml/16 lit water | 36.83c                          | 24.99a                             |
| F-test                                                                    | **                              | **                                 |
| CV                                                                        | 0.63%                           | 1.56%                              |
| <b>Interaction Effects of Factor A and Factor B</b>                       |                                 |                                    |
| P <sub>1</sub> F <sub>1</sub>                                             | 39.43                           | 21.10                              |
| P <sub>1</sub> F <sub>2</sub>                                             | 38.60                           | 22.87                              |
| P <sub>1</sub> F <sub>3</sub>                                             | 37.10                           | 24.46                              |
| P <sub>2</sub> F <sub>1</sub>                                             | 39.43                           | 21.77                              |
| P <sub>2</sub> F <sub>2</sub>                                             | 38.40                           | 23.10                              |
| P <sub>2</sub> F <sub>3</sub>                                             | 36.63                           | 24.87                              |
| P <sub>3</sub> F <sub>1</sub>                                             | 39.20                           | 22.77                              |
| P <sub>3</sub> F <sub>2</sub>                                             | 38.06                           | 23.33                              |
| P <sub>3</sub> F <sub>3</sub>                                             | 36.77                           | 25.63                              |
| F-test                                                                    | ns                              | ns                                 |
| CV                                                                        |                                 |                                    |
| ns - Not Significant    ** - Highly Significant                           |                                 |                                    |

### 3.6.1 Number of Marketable Fruit

Table 6 showed the number of marketable fruits per plant as affected by phenological stages, organic fertilizer treatments and its interaction.

The flowering stage (P2) had the highest mean of 10.96 and vegetative (P1) got the lowest mean of 10.67 numerically, the results are comparable. This means that the number of marketable fruits per plant did not significantly differ across phenological stages from Vegetative (P1), Flowering (P2) and Fruiting stages (P3). This suggests that within the scope of this study, the phenological stage at the time of evaluation did not independently influence the yield of marketable fruits.

The highest number of marketable fruits was observed in F3 (11.89 fruits/plant), followed by F2 (10.81), and the lowest in F1 (9.80). In contrast, the organic fertilizer treatments produced a highly significant effects on the number of marketable fruits ( $p < 0.01$ ). Statistical result revealed a highly significant difference between and among treatment means. This indicates that increasing rates of organic fertilizer consistently improved marketable yield. The higher availability of nutrients such as potassium and calcium in vermicast and the microbial and enzymatic activity in vermitea likely contributed to better fruit set and reduced fruit drop, resulting in a higher number of quality fruits reaching market standards.

This supports the study of Singh et al. (2023) observed that vermicompost combined with compost tea significantly increased marketable fruit yield in chili and tomato, attributing improvements to enhanced nutrient uptake and fruit quality. Likewise, Zhao et al. (2022) found that microbial and enzymatic activity from organic teas improved fruit firmness and reduced spoilage, contributing to higher marketability. Furthermore, Kumar and Mishra (2021) emphasized that nutrient-rich vermicast, especially when applied during reproductive stages, supports stronger fruit development and uniform sizing. Lastly, FAO (2020) supports the use of biofertilizers and composts to sustainably enhance crop yield and postharvest quality.

Notably, the combination P3F3 (fruiting stage x 80g vermicast/plant + 1000ml vermitea/16 lit water) produced the greatest number of marketable fruits with a mean of (12.03), while P1F1 (vegetative stage x 40g vermicast + 500ml vermitea/16 lit water) had the lowest mean with (9.70). The interaction between phenological stages and organic fertilizer levels was statistically highly significant, suggesting that the effect of organic fertilizer on marketable fruit production depended on the phenological stage of the plant. The data demonstrate a synergistic interaction where timing and dosage of organic fertilizer matter, particularly as the plant transitions from flowering to fruiting.

### 3.6.2 Number of Non-Marketable Fruit

Table 6 presents the data on the number of non-marketable fruits affected by phenological stages, organic fertilizer treatments and its interaction effect.

There was no significant effect of phenological stage on the number of non-marketable fruits. Although plants evaluated at the vegetative stage (P1) had the highest number of non-marketable fruit, with a mean of 4.33, and those at flowering (P2) had the lowest number of non-marketable fruit, with a mean of 3.93. The analysis result was statistically nonsignificant. This indicates that the timing of plant assessment in terms of developmental stage had minimal influence on non-marketable fruits. These could be due to physical deformation, pest damage, or improper ripening, which may not correlate strongly with phenological stage.

The data reflects the results in the number of non-marketable fruits as affected by organic fertilizer treatment. F3 (80g vermicast/plant + 1000ml vermitea/16 lit water ) resulted in the lowest number of non-marketable fruits (3.62), followed by F2 (4.20) (60g vermicast/plant + 750ml vermitea/16 lit water), and the highest in F1 (4.53) (40g vermicast/plant + 500ml vermitea/16 lit water). Organic fertilizers significantly affected the number of non-marketable fruits ( $p < 0.01$ ). Analysis of variance shows statistically significant differences among all treatments, confirming a dose-dependent improvement in fruit quality with increasing organic fertilizer levels. The reduction in non-marketable fruits with higher vermicast and vermitea application may be attributed to: a) Enhanced calcium and micronutrient availability, improving fruit health; b)

Increased microbial activity reducing disease incidence; and c) Improved soil structure and moisture retention, reducing physiological disorders. This implies that reducing the number of non-marketable fruits is critical for improving crop profitability, postharvest efficiency, and resource use.

The interaction between phenological stage and fertilizer was not statistically significant, though numeric differences exist. Notably, the combination P2F3 (flowering stage x 80 g vermicast/plant + 1000 ml/16 lit water) had the lowest number of non-marketable fruits (3.50), while P1F1 (vegetative + 40 g vermicast/plant + 500 ml/16 lit water) had the highest (4.73) number of non-marketable fruits. While the interaction wasn't statistically significant, this trend suggests that higher nutrient availability during or after flowering may be particularly effective in minimizing fruit loss.

**Table 6. Number of marketable and non-marketable fruits per plant as affected by the Phenological Stages and Organic Fertilizer treatments.**

| <b>Factor A: Phenological Stages</b>                                      | <b>Number of Marketable Fruits/Plants</b> | <b>Number of Non-marketable fruits/plants</b> |
|---------------------------------------------------------------------------|-------------------------------------------|-----------------------------------------------|
| P <sub>1</sub> - Vegetative                                               | 10.67                                     | 4.33                                          |
| P <sub>2</sub> - Flowering                                                | 10.96                                     | 3.93                                          |
| P <sub>3</sub> - Fruiting                                                 | 10.86                                     | 4.09                                          |
| F-test                                                                    | ns                                        | ns                                            |
| CV                                                                        | 3.49%                                     | 6.84%                                         |
| <b>Factor B: Organic Fertilizer Treatments</b>                            |                                           |                                               |
| F <sub>1</sub> – Vermicast 40grams/plant and Vermitea 500ml/16 lit water  | 9.80c                                     | 4.53a                                         |
| F <sub>2</sub> – Vermicast 60grams/plant and Vermitea 750ml/16 lit water  | 10.81b                                    | 4.20b                                         |
| F <sub>3</sub> – Vermicast 80grams/plant and Vermitea 1000ml/16 lit water | 11.89a                                    | 3.62c                                         |
| F-test                                                                    | **                                        | **                                            |
| CV                                                                        | 1.07%                                     | 3.95%                                         |
| <b>Interaction Effects of Factor A and Factor B</b>                       |                                           |                                               |
| P <sub>1</sub> F <sub>1</sub>                                             | 9.70                                      | 4.73                                          |
| P <sub>1</sub> F <sub>2</sub>                                             | 10.60                                     | 4.50                                          |
| P <sub>1</sub> F <sub>3</sub>                                             | 11.70                                     | 3.77                                          |
| P <sub>2</sub> F <sub>1</sub>                                             | 9.83                                      | 4.27                                          |
| P <sub>2</sub> F <sub>2</sub>                                             | 11.13                                     | 4.03                                          |
| P <sub>2</sub> F <sub>3</sub>                                             | 11.93                                     | 3.50                                          |
| P <sub>3</sub> F <sub>1</sub>                                             | 9.86                                      | 4.60                                          |
| P <sub>3</sub> F <sub>2</sub>                                             | 10.70                                     | 4.06                                          |
| P <sub>3</sub> F <sub>3</sub>                                             | 12.03                                     | 3.60                                          |
| F-test                                                                    | **                                        | ns                                            |
| CV                                                                        |                                           |                                               |
| ns - Not Significant    ** - Highly Significant                           |                                           |                                               |

### 3.7 Weight of Marketable and Non- Marketable Fruits

The weight of marketable fruits per plant as affected by phenological stages and organic fertilizer treatments and its interactions can be seen Table 7.

The mean weight of marketable fruits per plant across phenological showed a slight variation ranging from 1008.11 g (vegetative stage), to 1028.42 g (flowering Stage), and (fruiting stage) at 1013.43 g. Statistical analysis revealed no significant effect of phenological stage on fruit weight. This indicates that the stage of crop development at which the organic inputs were emphasized did not differentially influence the eventual yield of marketable fruits. The relatively uniform results may suggest that the consistent application of organic fertilizer throughout growth stages adequately supported nutrient availability, thereby reducing stage-specific variability in yield performance.

In contrast, organic fertilizer treatments exerted a highly significant influence between and among treatment means at ( $p < 0.01$ ) on the weight of marketable fruits. Plants receiving the highest application rate F<sub>3</sub> (80 g vermicast + 1000 ml vermitea/16 lit water) produced the greatest fruit weight with a mean of 1091.27 g, while the lowest fruit weight recorded was 958.20 g under F<sub>1</sub> 40 g vermicast + 500 ml vermitea/16 lit water). Intermediate treatment F<sub>2</sub> yielded 1009.49 g, significantly higher than F<sub>1</sub> but lower than F<sub>3</sub>. This clear gradient suggests that increasing levels of vermicast and vermitea enhanced fruit yield potential. The improvement in yield with higher organic input levels can be attributed to increased nutrient supply, improved soil fertility, and enhanced plant physiological functions. Vermicast supplies essential macro- and micronutrients while improving soil physical properties and microbial activity. Vermitea complements this by providing soluble nutrients and beneficial microorganisms that can improve nutrient uptake efficiency and fruit set.

Similar findings were reported by Arancon et al. (2004) and Chatterjee et al. (2021), who demonstrated that vermicompost and liquid organic fertilizers significantly increased fruit yield in solanaceous crops by improving nutrient availability and physiological activity.

The results corroborate recent studies emphasizing the role of vermicompost and liquid bio-fertilizers in improving yield attributes of fruiting vegetables. Chatterjee et al. (2021) reported that organic fertilizers improved both marketable yield and fruit quality in tomato. Similarly, Singh et al. (2022) demonstrated that vermicompost and organic teas significantly enhanced nutrient uptake, photosynthetic activity, and fruit yield in eggplant and other solanaceous crops. These studies affirm that organic inputs not only sustain vegetative growth but also translate into higher reproductive performance, consistent with the present findings.

The interaction between phenological stages and fertilizer treatments was not significant, although trends indicated that higher fertilizer levels consistently improved fruit weight across all stages. The highest fruit weight was observed under P2F3 (flowering stage  $\times$  highest fertilizer level), with 1134.70 g per plant, followed by P1F3 (1072.91 g) and P3F3 (1066.19 g). While statistical evidence does not support a synergistic effect, the consistent yield advantage with higher fertilizer rates across all stages underscores the independent but complementary contributions of organic inputs and phenological progression to yield performance.

These findings highlight the practical importance of sustained and adequate organic fertilization for maximizing eggplant yield. Although phenological stages did not significantly alter yield, continuous application of higher rates of vermicast and vermitea was shown to enhance marketable fruit weight. This suggests that farmers should prioritize the integration of higher organic fertilizer doses during crop production to optimize yield performance in a sustainable manner. Moreover, since organic inputs improve soil health and reduce reliance on synthetic fertilizers, these practices align well with ecological and economic sustainability goals in crop production systems.

**Table 7. Weight of marketable fruits and non-marketable fruit per plant (Grams) as influence by the different phenological stages, and Organic fertilizer treatment and its interaction**

| <b>Factor A: Phenological Stages</b>                                      | <b>Weight of Marketable Fruits/plant (grams)</b> | <b>Weight of non-marketable fruits/plant (grams)</b> |
|---------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------|
| P <sub>1</sub> - Vegetative                                               | 1008.11                                          | 545.55a                                              |
| P <sub>2</sub> - Flowering                                                | 1028.42                                          | 534.32b                                              |
| P <sub>3</sub> - Fruiting                                                 | 1013.43                                          | 5323.60b                                             |
| F-test                                                                    | ns                                               | *                                                    |
| CV                                                                        | 0.92%                                            | 1.01%                                                |
| <b>Factor B: Organic Fertilizer Treatments</b>                            |                                                  |                                                      |
| F <sub>1</sub> – Vermicast 40grams/plant and Vermitea 500ml/16 lit water  | 958.20c                                          | 530.38c                                              |
| F <sub>2</sub> – Vermicast 60grams/plant and Vermitea 750ml/16 lit water  | 1009.4b                                          | 536.62b                                              |
| F <sub>3</sub> – Vermicast 80grams/plant and Vermitea 1000ml/16 lit water | 1091.2a                                          | 545.47a                                              |
| F-test                                                                    | **                                               | **                                                   |
| CV                                                                        | 1.31%                                            | 0.78%                                                |
| <b>Interaction Effects of Factor A and Factor B</b>                       |                                                  |                                                      |
| P <sub>1</sub> F <sub>1</sub>                                             | 970.26                                           | 536.83                                               |
| P <sub>1</sub> F <sub>2</sub>                                             | 981.16                                           | 544.92                                               |
| P <sub>1</sub> F <sub>3</sub>                                             | 1072.91                                          | 554.89                                               |
| P <sub>2</sub> F <sub>1</sub>                                             | 952.56                                           | 528.88                                               |
| P <sub>2</sub> F <sub>2</sub>                                             | 998.01                                           | 533.10                                               |
| P <sub>2</sub> F <sub>3</sub>                                             | 1134.70                                          | 540.97                                               |
| P <sub>3</sub> F <sub>1</sub>                                             | 951.78                                           | 525.42                                               |
| P <sub>3</sub> F <sub>2</sub>                                             | 1022.31                                          | 531.83                                               |
| P <sub>3</sub> F <sub>3</sub>                                             | 1066.19                                          | 540.55                                               |
| F-test                                                                    | ns                                               | ns                                                   |
| CV                                                                        |                                                  |                                                      |

ns - Not Significant \* - Significant

\*\* - Highly Significant

### Weight of Non-Marketable Fruits per plant (g)

The weight of non-marketable fruits per plant was significantly influenced by the phenological stages of eggplant ( $p < 0.05$ ). The vegetative stage (P1) recorded the highest mean of 545.55 g, which was significantly higher than the P2 flowering 534.32 g and P3 fruiting stages 532.60 g. The higher weight of non-marketable fruits during the vegetative stage may indicate that plants, when subjected to early nutrient stress or imbalanced assimilate allocation, tend to produce malformed or undersized fruits once reproductive initiation occurs. In contrast, the lower values during flowering and fruiting stages suggest that once reproductive growth is fully established, plants may regulate assimilate partitioning more efficiently, reducing the proportion of non-marketable yield. The results imply that careful management of nutrient inputs and cultural practices during the vegetative stage is critical to minimize later production of non-marketable fruits. Ensuring a balanced transition from vegetative to reproductive growth could help reduce losses.

This trend corroborates the findings of Maboko et al. (2017), who noted that fruit quality in solanaceous crops is highly sensitive to the stage of growth at which nutrient stress or management interventions occur. Similarly, Khan et al. (2021) emphasized that vegetative dominance without sufficient reproductive sink strength can lead to irregular fruit development, contributing to higher non-marketable yields.

A highly significant differences ( $p < 0.01$ ) were observed between and among organic fertilizer treatments. The lowest non-marketable fruit weight was recorded with F1 Vermicast (40grams/plant) and Vermitea (500ml/16 lit water) at 530.38 g, while the highest was with F3 Vermicast 80grams/plant and Vermitea (1000ml/16 lit water) with 545.47g. This suggests that excessive nutrient supply may promote fruit set beyond the plant's capacity to sustain uniform fruit quality, leading to a higher proportion of misshapen or undersized fruits. A moderate application of vermicast and vermitea F2 - 60 g vermicast + 750 ml vermitea/16 lit water may represent an optimal balance, reduce non-marketable fruit production while still enhance overall productivity. Farmers should consider precision in organic fertilizer application rates to minimize waste and maintain fruit quality.

This observation aligns with Arancon et al. (2020), who reported that although vermicompost and its extracts improve yield, excessive dosages may increase the incidence of physiological disorders due to imbalances in nutrient uptake. Adhikary (2020) also noted that organic inputs, when applied beyond optimal levels, can create disproportionate nutrient availability, potentially affecting fruit quality. The interaction between phenological stages and organic fertilizer treatments on non-marketable fruit weight was not significant (ns). However, numerical trends indicated that higher organic input (F3) consistently produced greater non-marketable weights across stages P1F3 = 554.89g; P1F2 = 544.92g; P2F3 = 540.97g), compared to the lowest inputs (F1). The uniformity of this trend suggests that the effect of organic fertilizer rate is consistent regardless of the growth stage, highlighting the importance of dosage rather than timing. While the timing of organic fertilizer application may not drastically influence non-marketable yields, the quantity applied is critical. Further studies on split applications or stage-specific dosages may help refine recommendations to optimize both quantity and quality of eggplant fruits.

These findings corroborate those of Joshi et al. (2020), who emphasized that organic amendments generally improve crop growth across all stages, but excessive application may not necessarily translate to quality improvements.

### 3.8 Computed Yield

The computed yield per hectare as affected by different phenological stages and organic fertilizer treatments and its interactions can be glance at Table 8.

The computed yield per hectare was not significantly affected by the phenological stages of the crop. However, numerical differences were observed, with the highest mean yield recorded at the flowering stage (27,413.68 kg ha<sup>-1</sup>), followed by the fruiting stage (27,025.13 kg ha<sup>-1</sup>), and the vegetative stages (26,883.26 kg ha<sup>-1</sup>). The trend suggests that the reproductive transition during flowering may optimize assimilate partitioning, supporting higher yield potential. Additionally, while phenological stages did not show significant statistical differences, targeted nutrient supplementation during the flowering stage may help maximize potential yield gains by supporting both vegetative maintenance and reproductive development.

This observation is consistent with the findings of Wang et al. (2022), who emphasized that the flowering stage represents a physiological turning point where photosynthates are redirected from vegetative structures to reproductive sinks, leading to enhanced yield efficiency. Similarly, Taiz et al. (2018) highlighted that crop yield is strongly influenced by the timing and efficiency of assimilate allocation during reproductive development.

Organic fertilizer treatments exhibited a highly significant effect on computed yield per hectare. Among the treatments, F3 (80 g vermicast + 1000 ml vermitea/16 lit water) produced the highest yield 29,100.90 kg ha<sup>-1</sup>, followed by F2 (60 g vermicast + 750 ml vermitea/16 lit water) 26,920.06 kg ha<sup>-1</sup>, and the lowest under F1 (40 g vermicast + 500 ml vermitea/16 lit water) 25,552.32 kg ha<sup>-1</sup>. The results clearly demonstrate that increasing levels of vermicast and vermitea contribute to improved productivity. The enhanced yields under higher organic fertilizer applications can be attributed to the synergistic effects of vermicast, which improves soil structure, cation exchange capacity, and microbial diversity, and vermitea, which supplies readily available nutrients and plant growth regulators.

These findings corroborate those of Singh et al. (2021), who reported significant increases in vegetable yield following the application of vermicompost-based amendments. Similarly, Joshi et al. (2020) noted that vermitea not only provides soluble nutrients but also enhances rhizospheric microbial activity, leading to improved nutrient uptake efficiency.

The application of F3 is recommended for maximizing yield potential in eggplant production systems. However, F2 offers a practical balance between yield performance and input cost, making it a feasible alternative for resource-constrained farmers.

The interaction between phenological stages and organic fertilizer treatments was not statistically significant. Nonetheless, the highest yield 30,259.04 kg ha<sup>-1</sup> was observed under the combination of P2 flowering stage and F3 Vermicast (80 g/plant) and Vermitea (1000 ml/16 lit water) treatment, while the lowest yield 25,381.11 kg ha<sup>-1</sup> was obtained at the P1 fruiting stage under F1 Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water). The consistent superiority of F3 across all phenological stages indicates that organic fertilizer effects are stable and independent of crop growth stage. These results align with Arancon et al. (2020), who reported that vermicompost and vermitea applications promote sustained nutrient release, ensuring improved productivity regardless of crop phenological stage. Although the interaction was not significant, the trend suggests that combining high organic fertilizer inputs with the flowering stage may maximize yield. Future research may explore split or stage-specific applications to improve input-use efficiency.

**Table 8. Computed Yield per hectare as influence by Phenological Stages, Organic Fertilizer Treatment and Its Interaction Effects.**

ns - Not Significant    \*\* - Highly Significant

| Factor A: Phenological Stages                                                 | Computed  | Yield/ ha |
|-------------------------------------------------------------------------------|-----------|-----------|
| P <sub>1</sub> - Vegetative                                                   | 26,883.26 |           |
| P <sub>2</sub> - Flowering                                                    | 27,413.68 |           |
| P <sub>3</sub> - Fruiting                                                     | 27,025.13 |           |
| F-test                                                                        | ns        |           |
| CV                                                                            | 1.15%     |           |
| <b>Factor B: Organic Fertilizer Treatments</b>                                |           |           |
| F <sub>1</sub> - Vermicast (40grams/plant) and Vermitea (500ml/16 lit water)  | 25,552.32 |           |
| F <sub>2</sub> - Vermicast (60grams/plant) and Vermitea (750ml/16 lit water)  | 26,920.06 |           |
| F <sub>3</sub> - Vermicast (80grams/plant) and Vermitea (1000ml/16 lit water) | 29,100.90 |           |
| F-test                                                                        | **        |           |
| CV                                                                            | 1.15%     |           |
| <b>Interaction Effects of Factor A and Factor B</b>                           |           |           |
| P1F1 – Vegetative x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water) | 25,873.92 |           |
| P1F2 – Vegetative x Vermicast (60g/plant and Vermitea (750ml/16 lit water)    | 26,164.59 |           |
| P1F3 – Vegetative x Vermicast (80g/plant and Vermitea (1000ml/16 lit water)   | 28,611.29 |           |
| P2F1 – Flowering x Vermicast (40 g/plant) and Vermitea (500 ml/16 lit water)  | 25,401.92 |           |
| P2F2 –Flowering x Vermicast (60 g/plant) and Vermitea (750 ml/16 lit water)   | 26,613.93 |           |
| P2F3 –Flowering x Vermicast (80 g/plant) and Vermitea (1000 ml/16 lit water)  | 30,259.04 |           |
| P3F1 –Fruiting x Vermicast (40g/plant) and Vermitea (500ml/16 lit water)      | 25,381.11 |           |
| P3F2 –Fruiting x Vermicast (60g/plant) and Vermitea (750ml/16 lit water)      | 27,261.94 |           |
| P3F3 –Fruiting x Vermicast (80g/plant) and Vermitea (1000ml/16 lit water)     | 28,432.09 |           |
| F-test                                                                        | ns        |           |
| CV                                                                            |           |           |

**Cost and Return Analysis**

Table 9 exhibiting the cost and return analysis of eggplant as affected by phenological stages, organic fertilizer treatment and its interaction.

The cost and return analysis revealed that phenological stages influenced the profitability of production, with the vegetative stage (P1) generating the highest return on investment (ROI) at 121.54%, followed by the flowering stage (P2) with 115.48%, and the fruiting stage (P3) with 103.05% (Table 14). Although gross sales were slightly higher during flowering ₱411,205.20, the relatively lower expenses requirement at the vegetative stage ₱182,015.20 contributed to its superior ROI. Conversely, fruiting stage treatments incurred the highest production expenses (₱199,640.00), resulting in reduced net income and ROI despite maintaining comparable gross sales.

This finding corroborates the principle that earlier growth stages often allow for more efficient resource allocation and reduced operational costs, ultimately enhancing profitability (Rahman et al., 2021). Similarly, Kaur and Singh (2020) emphasized that profitability is not only determined by yield output but also by input-use efficiency, with the vegetative stage being a critical point for cost-saving strategies.

It implies that farmers should optimize input application during the vegetative stage to maintain profitability while avoiding excessive expenses during fruiting, where diminishing economic returns may occur despite higher yields.

Significant economic differences were observed across organic fertilizer treatments. The highest gross sales (₱436,513.46), net income (₱336,123.46), and ROI (168.36%) were obtained under F3 (80 g vermicast + 1000 ml vermitea/16lit water), followed by F2 Vermicast (60grams/plant) and Vermitea (750ml/16 lit water) with 111.60% ROI, while the lowest was recorded in F1 Vermicast (40grams/plant) and Vermitea (500ml/16 lit water) with 110.57% ROI. The enhanced profitability under F3 is attributed to the synergistic effects of higher nutrient availability from vermicast and vermitea, resulting in improved yield and income that outweighed the incremental input costs.

These results are in agreement with Mupangwa et al. (2020), who reported that organic inputs improve soil fertility, leading to yield increments that directly enhance farm profitability. Additionally, Nguyen et al. (2022) highlighted that organic fertilizer use, though sometimes costlier at the onset, translates into higher economic returns due to long-term soil health improvements and premium market value for organically grown produce.

It implies that the application of F3 Vermicast (80grams/plant) and Vermitea (1000ml/16 lit water) is economically viable and recommended for farmers seeking to maximize profitability, though F2 Vermicast (60grams/plant) and Vermitea (750ml/16 lit water) offers a moderate alternative where budget constraints limit high-level organic inputs.

Although interaction effects between phenological stages and fertilizer treatments were not statistically significant, the trend showed that combining the vegetative stage with F3 resulted in the highest profitability (net income ₱229,529.36; ROI 114.97%). Similarly, flowering + F3 (₱226,841.31; ROI 113.63%) demonstrated consistently favorable outcomes. Meanwhile, the lowest economic returns were observed in flowering + F2 (₱198,701.00; ROI 109.16%) and fruiting + F1 (₱198,701.45; ROI 109.17%).

This suggests that profitability benefits are largely driven by the level of organic input rather than phenological timing, supporting the argument of Arancon et al. (2020) that vermicast and vermitea provide sustained benefits regardless of growth stage. This implies that, for practical farm management, high-level organic input (F3) remains the most profitable regardless of stage. However, aligning higher input applications during the vegetative and flowering stages may further stabilize ROI while ensuring efficient resource use.

Table 14. Cost and Return Analysis of eggplant as affected by Phenological Stages, Organic Fertilizer Treatment and its Interaction Effects.

| Treatments                                      | Gross Sales<br>(Php) | Expenses<br>(Php) | Net<br>Income (Php) | ROI (%)       |
|-------------------------------------------------|----------------------|-------------------|---------------------|---------------|
| <b>FACTOR A – Phenological Stages</b>           |                      |                   |                     |               |
| <b>P1- Vegetative Stage</b>                     | 403,248.90           | 182,015.20        | 221,233.70          | <b>121.54</b> |
| <b>P2- Flowering Stage</b>                      | 411,205.20           | 190,827.50        | 220,377.70          | <b>115.48</b> |
| <b>P3- Fruiting Stage</b>                       | 405,377.06           | 199,640.00        | 205,737.06          | <b>103.05</b> |
| <b>FACTOR B - Organic Fertilizer Treatments</b> |                      |                   |                     |               |
| <b>F1</b>                                       | 383,284.79           | 182,015.20        | 201,269.59          | <b>110.57</b> |
| <b>F2</b>                                       | 403801.05            | 190,827.50        | 212,973.55          | <b>111.60</b> |
| <b>F3</b>                                       | 436,513.46           | 199,640.00        | 336,123.46          | <b>168.36</b> |
| <b>INTERACTION EFFECT</b>                       |                      |                   |                     |               |
| <b>P1F1</b>                                     | 388,108.85           | 182,015.20        | 206,093.65          | <b>113.23</b> |
| <b>P1F2</b>                                     | 392,468.90           | 190,827.50        | 201,641.40          | <b>105.67</b> |
| <b>P1F3</b>                                     | 429,169.36           | 199,640.00        | 229,529.36          | <b>114.97</b> |
| <b>P2F1</b>                                     | 380,716.76           | 182,015.20        | 198,701.00          | <b>109.16</b> |
| <b>P2F2</b>                                     | 408,929.11           | 190,827.50        | 218,101.61          | <b>114.29</b> |
| <b>P2F3</b>                                     | 426,481.31           | 199,640.00        | 226,841.31          | <b>113.63</b> |
| <b>P3F1</b>                                     | 380,716.65           | 182,015.20        | 198,701.45          | <b>109.17</b> |
| <b>P3F2</b>                                     | 408,929.11           | 190,827.50        | 218,101.61          | <b>114.29</b> |
| <b>P3F3</b>                                     | 426,481.31           | 199,640.00        | 226,841.31          | <b>113.63</b> |

### Conclusions

The study demonstrated that phenological stages exerted minimal influence on most vegetative and reproductive parameters of eggplant, with only slight variations observed in leaf number, leaf area, and days to flowering. In contrast, organic fertilizer treatments, particularly vermicast and vermitea, significantly enhanced plant growth, flowering, and yield performance. The highest application rate (80 g vermicast/plant + 1000 ml vermitea/16liter water) consistently promoted superior vegetative development, increased marketable fruit yield, and reduced non-marketable production. Interaction effects between phenological stages and fertilizer levels were largely nonsignificant, suggesting that the benefits of organic fertilization are stable across developmental phases. Cost–return analysis further confirmed the profitability of organic inputs, with the vegetative stage achieving the highest ROI. Overall, the results validate the role of vermicast and vermitea as effective and sustainable alternatives to synthetic fertilizers in eggplant production systems.

**Declaration.** This study was conducted at the Ilocos Sur Polytechnic State College Pinakbet Farm, Poblacion Norte, Santa Maria, Ilocos Sur from November, 2022 to July, 2023, and the completed report paper was submitted August, 2025.

### Recommendations

Based on the conclusions, it is recommended that the adoption of organic fertilizers, particularly the application of vermicast at 80 g per plant in combination with vermitea at 1000 ml per 16 liter water, be practiced to maximize the vegetative and reproductive performance of eggplant. Although stage effects were generally nonsignificant, supplying higher organic inputs during flowering and fruiting is suggested to enhance reproductive efficiency. To optimize fruit quality and minimize the risk of excessive non-marketable yield, further research on split or stage-specific applications of organic inputs is warranted. From an economic perspective, farmers aiming for profitability may prioritize organic input use during the vegetative stage while ensuring a continuous nutrient supply during reproductive stages to achieve consistent yields. Moreover, the wider adoption of vermicast and vermitea is encouraged, as this practice not only improves soil fertility but also reduces reliance on synthetic fertilizers, thereby promoting a sustainable and environmentally sound eggplant production system.

### Acknowledgement

The researchers sincerely express their heartfelt appreciation to the Office of the Vice President for Research, Development and Extension for their unwavering support and guidance in completing this study. Their steadfast encouragement, provision of essential resources, and dedication to promoting academic excellence played a crucial role in successfully executing this research. We are deeply grateful for their invaluable contributions to advancing research and innovation within the college and community.

## Conflict of Interest

The authors declare no conflicts of interest.

## Funding

Office of the Vice President for Research, Development and Extension of Ilocos Sur Polytechnic State College, and the College of Agriculture, Forestry Engineering and Development Communication (CAFED) Santa Maria, Ilocos Sur, Philippines.

## REFERENCES

1. Adekiya, A. O., Agbede, T. M., & Olayanju, A. (2020). Vermicompost and biochar effects on soil properties and growth of eggplant (*Solanum melongena* L.) in Tropical soil. *Journal of Soil Science and Plant Nutrition*, 20(4), 1803–1815. <https://doi.org/10.1007/s42729-020-00241-z>
2. Adeleke, O., E.Ewemoje and A. Adedeji. (2015). Comparative analysis of pit composting and vermicomposting in a tropical environment.
3. Alam, M. Z., Rahman, M. M., & Hossain, M. I. (2023). Use of vermicompost and vermiwash for sustainable growth and yield performance of brinjal (*Solanum melongena* L.). *International Journal of Environment, Agriculture and Biotechnology*, 8(2), 296–302.
4. Al Ali, M., C. Gencoglan, and S.Gencoglan. 2019. The effect of organic and inorganic fertilizer applications on yield and plant vegetative growth of eggplant (*Solanum melongena*, L.)
5. Ali, M., Rahman, M. M., & Khan, M. I. (2022). Influence of liquid organic fertilizer on growth traits of eggplant under tropical conditions. *International Journal of Plant and Soil Science*, 34(5), 44–53. <https://doi.org/10.9734/ijpss/2022/v34i530894>
6. Anwar, M. R., Ghani, M. A., & Khalid, M. (2021). Organic fertilization enhances vegetative growth and fruit yield of eggplant (*Solanum melongena* L.). *Agricultural Science Digest*, 41(3), 215–220.
7. Ayhan Kocaman et al. (2024). The effect of novel biotechnological vermicompost on tea yield, plant nutrient content, antioxidants, amino acids, and organic acids as an alternative to chemical fertilizers for sustainability
8. Ayilara, MS. (2020). Waste Management through Composting: Challenges and Potentials
9. Banerjee, R., & Singh, A. (2022). Organic liquid fertilizers in sustainable vegetable production: roles and mechanisms. *Journal of Plant Nutrition and Soil Science*, 185(3), 412–428.
10. Baniya, R. and G.S. Vaidya. (2011). Antifungal activity of actinomycetes from vermicompost and their morphological and biochemical characterization.
11. Bellitürk, K., S. Adiloglu, Y. Solmaz, A. Zahmacioglu and A. Adiloglu. (2017). Effects of increasing doses of vermicompost applications on P and K contents of pepper (*Capsicum annum*, L.) and eggplant (*Solanum melongena*, L.)
12. Bellitürk, K. (2018). Vermicomposting in Turkey: Challenges and opportunities in future.
13. Brown, G.G. (1995). How do earthworms affect microfloral and faunal community diversity.
14. Cabangon, M. A., & Balaria, F. C. (). Enhancing vegetable production through integrated nutrient management in Ilocos Norte. *Ilocos Agriculture Journal*, 12(1), 23–31.
15. Chaoui, H. (2019). Vermicasting (or Vermicomposting): Processing Organic Waste through Earthworm
16. Chaulagain, A., P.Dhurva, G.J. Lamichhane. (2017). Vermicompost and its role in plant growth promotion.
17. DA-RFO I (2022). *Regional Agriculture and Fisheries Modernization Plan 2023–2027*.
18. Department of Agriculture – Bureau of Agricultural Statistics (2022). *Major Vegetables and Root Crops Quarterly Bulletin*.
19. FAO. (2023). *Organic agriculture and climate change*. <https://www.fao.org>
20. IPCC. (2022). *Climate Change and Land: Summary for Policymakers*.
21. Lal, R., Patel, V., & Mehta, D. (2021). Role of organic manure and vermicompost in flower and fruit development of horticultural crops. *International Journal of Agricultural Sciences*, 13(2), 112–118.
22. Nguyen, T. H., Herrera, E., & Li, F. (2021). Comparative analysis of compost tea and fermented plant extracts: nutrient content and plant growth bioactivity. *Journal of Applied Horticulture*, 23(4), 255–267.
23. Pant, A. P., Radovich, T. J. K., Hue, N. V., & Talcott, S. T. (2011). Biochemical properties of compost tea associated with compost quality and effects on pak choi growth. *Scientia Horticulturae*, 128(3), 273–278. <https://doi.org/10.1016/j.scienta.2011.01.019>
24. Raut, A. M., Deshmukh, R. N., & Bhagat, M. (2023). Effect of organic nutrient sources on growth, flowering, and fruiting in brinjal. *Organic Agriculture Research*, 8(4), 223–230.
25. Ramos, E. P., Lopez, A. S., & Torres, G. M. (2021). Phenological benchmarks of eggplant varieties under tropical field conditions. *Philippine Journal of Crop Science*, 46(1), 12–24.
26. Rodriguez, J. R., Wong, M. S., & Cruz, L. T. (2021). Split application of organic liquid fertilizer aligned with phenological stages improves eggplant yield. *Sustainable Agriculture Reports*, 9(2), 89–102.
27. Singh, A., Suthar, S., & Kumar, K. (2021). Effect of vermicompost and biofertilizers on growth, yield and quality of vegetables: A review. *Journal of Applied and Natural Science*, 13(2), 678–686. <https://doi.org/10.31018/jans.v13i2.2632>

```

graph TD
    Step1[1. Prepare the Vermi-bed or Bin] --> Step2[2. Pre-compost the Waste]
    Step2 --> Step3[3. Add the Worms]
    Step3 --> Step4[4. Feed the Worms]
    Step4 --> Step5[5. Maintain the System]
    Step5 --> Step6[6. Harvest the Vermicompost]
    Step6 --> Step7[7. Store the Vermicast]
  
```

- 1. Prepare the Vermi-bed or Bin**
  - Choose a shaded, well-ventilated area.
  - Ensure drainage holes at the bottom to avoid waterlogging.
  - Layer 2–3 inches of bedding (dry banana leaves and branches thinly chopped) and moisten until it feels like a wrung-out sponge.
- 2. Pre-compost the Waste**
  - Chop organic materials into small pieces (Vegetable leaves, plant, mushroom, banana branches, and biodegradable wastes coming from the market).
  - Pre-compost for seven (7) days to lower heat and acidity. (This prevents harming the worms).
- 3. Add the Worms**
  - Spread the purchased starter population of African Night Crawler (*Eudrilus eugeniae*) around 1 kg worms per 1 m<sup>2</sup> bed) evenly over the moist bedding.
  - Let them burrow naturally.
- 4. Feed the Worms**
  - Place a thin layer (about 2–3 cm) of the pre-composted organic waste on the bedding.
  - Cover with moist leaves or burlap to keep it dark and moist.
- 5. Maintain the System**
  - Moisture: Keep at 60–80%. Sprinkle water lightly if the bedding feels dry.
  - Temperature: Ideal range is 18–30 °C (65–86 °F).
  - Aeration: Fluff or gently turn the top layer every 3–2 weeks to avoid anaerobic conditions.
  - Add new food waste once the previous feed is mostly consumed (every 7 days, depending on worm activity).
- 6. Harvest the Vermicompost**
  - After 6–8 weeks, you'll see dark, crumbly, earthy-smelling material.
  - Light Method:** Push finished compost to one side, add fresh feed on the other; worms migrate to the new food in a few days. Collect the castings from the vacated side.
  - Screening:** Sift to remove larger particles and remaining worms.
- 7. Store the Vermicast**
  - Air-dry in shade for a few hours.
  - Store in breathable sacks or containers in a cool, dry place to maintain microbial activity.
  - Apply directly in the intended area as scheduled.

© 2025 FISHTAXA. All rights reserved

## Steps in Making Vermitea

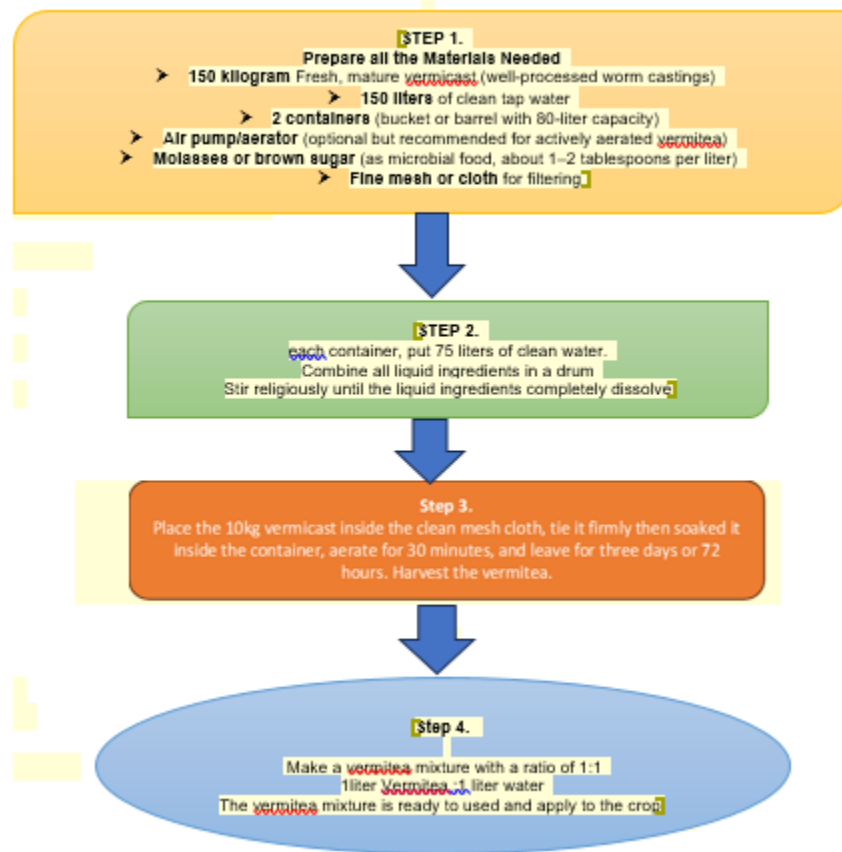


Figure 2. Procedure in Making Vermitea