# Comparative Production of Selected High Value Crops Adopting Container Gardening

**Edrhea Fhel S. Atanozo, Nycel Jhay C. Umpad and Maedel Joy V. Escote**

**Assumption College of Nabunturan, Nabunturan, Davao de Oro, Philippines**

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## ABSTRACT

This study aimed to investigate the potential of container gardening to increase the yield of selected high-value crops and address food security amidst climate change. Specifically, the research focused on the production of grafted tomatoes onto eggplant, potatoes, and carrots using various soil media combinations and fertilizer applications. An experimental research methodology employing a Completely Randomized Design (CRD) was used. The study was conducted in Purok 3 Malinawon, Mawab, Davao de Oro, Philippines, spanning 165 days from September 29, 2023, to April 10, 2024. Five treatments with two replicates each were applied, involving different combinations of garden soil, vermicast, organic, and inorganic fertilizers. Data on the number and weight of harvested fruits and tubers were analyzed using ANOVA to compare production outputs across treatments. The findings indicated that the combination of 50% garden soil and 50% vermicast with inorganic fertilizers (Treatment 4) yielded the highest production for both grafted tomatoes and carrots. Specifically, Treatment 4 resulted in the highest number and weight of fruits for grafted tomatoes and the highest number and weight of tubers for carrots. However, no tuber development was observed for potatoes under any treatment, highlighting the need for optimized growing conditions for this crop in container gardening. However, while container gardening showed significant potential for improving the yield of grafted tomatoes and carrots, the economic viability requires scaling up the number of containers used per cycle. Based on sample cost and income calculation, to recover production costs and ensure profitability, planting bags should be more than 5 for eggplant, 6 for tomato, and 3 for carrots per planting cycle in 4-5 months. Therefore, the more bags planted using treatment 4, the greater the potential to enhance productivity and generate more income. Overall, this study offers significant perspectives on using container gardening as an alternate farming method.

**Keywords:** Container gardening, high-value crops, grafted tomatoes, potatoes, carrots, soil media *combinations, fertilizer applications, Completely Randomized Design (CRD).*

## INTRODUCTION

Climate change has significantly impacted agriculture, causing severe droughts, fluctuations in precipitation, and temperature changes that reduce agricultural product supply. These changes pose higher risks for farmers and economic collaborators, affecting crop accessibility and pricing []. The adverse effects of climate change are already evident in regions like the European Union, where severe temperatures and droughts have increased food costs and disrupted agricultural and economic activities (Ivanova, 2023).

The concept of container gardening is gaining traction as a viable solution to augment food production and combat food insecurity amidst climate change and global health threats like COVID-19 (Denzon et al., 2023). Historically, container gardening has been utilized to address space constraints in urban environments and has roots dating back to Egyptian temple carvings around 3,500 years ago (Manso & Castro-Gomes, 2015). This method is prevalent in urban settings with limited ground-level soil access and is integrated into vertical and horizontal living architectures (Nagase & Lundholm, 2021). It addresses space constraints in cities, improves economic and environmental well-being, and supports urban green infrastructure (Nagase & Lundholm, 2021; Taculao, 2021).

Despite limited participation in urban agriculture, container gardening offers food and income, prompting local authorities to promote its benefits (Denzon et al., 2023). In the Philippines, container gardening helps address hunger and rising food prices by enabling the efficient use of vertical and horizontal spaces (Deveza & Holmer, 2002). It provides fresh, healthy vegetables and efficient use of space, making it ideal for urban environments (Deveza & Holmer, 2002). Additionally, it aids in vegetation restoration, minimizes pollutants, and promotes sustainable waste disposal techniques (Choonsingh et al., 2010; Nagase & Lundholm, 2021).

It has also been reported to enhances environmental sustainability by restoring vegetation, reducing pollutants, and promoting organic waste repurposing (Choonsingh et al., 2010). It offers flexibility and accessibility, allowing urban dwellers to grow fresh vegetables despite limited land (Nagase & Lundholm, 2021). Studies emphasize its role in improving food security and urban sustainability (Mamoko et al., 2022; Barrameda et al., 2017). Case studies, such as in Urdaneta City, Philippines, highlight successful community gardening programs addressing health, self-sufficiency, and environmental conservation (Matejowsky, 2013).

However, container gardening is underutilized even with governmental support, as seen in urban environments where space is a significant constraint (Taculao, 2021; Denzon et al., 2023). In regions like Davao de Oro, container gardening is not widely practiced due to a lack of knowledge and idleness among locals (Kilbride, 2023). This gap in practice hinders the potential benefits of container gardening, such as improved economic, environmental, and well-being dimensions.

Against this backdrop, this research aims to utilize the container gardening method to investigate the potential for increased yield using different settings as an alternative way of addressing food security, global warming, and calamities. Specifically, it aims to conduct a comparative analysis of the production of high-value crops grafted and not, involving different combinations of soil media and fertilizer application within container gardens.

### A. Grafting

Grafting, an ancient technique, combines the scion and rootstock to form a chimeric plant, enhancing plant growth and resilience (Melnyk & Meyerowitz, 2015). It has been used since the fifth century BCE to propagate plants, improve disease resistance, and modify growth patterns (Melnyk & Meyerowitz, 2015). Techniques include cleft, bark, side-veneer, splice, whip and tongue, saddle, bridge, and inarch grafting, each serving different purposes (Bilderback et al., 2014).

Grafting success depends on the compatibility between scion and rootstock, with interspecies grafting often facing challenges (Goldschmidt, 2014). Benefits include bypassing juvenile phases, improving resilience, and addressing environmental stresses, as demonstrated in the European wine industry and modern horticulture (Melnyk & Meyerowitz, 2015; Devi et al., 2020). However, it also faces limitations like increased costs and potential incompatibility (Edelstein, 2004).

### B. Soil Media

Soil media, such as garden soil and vermicast, play crucial roles in plant growth. Garden soil’s structure, texture, pH, and organic matter content significantly impact plant health (Brady & Weil, 2002).

As soil media, vermicast, derived from earthworm digestion, offers a nutrient-rich, sustainable alternative to chemical fertilizers, enhancing soil fertility and plant growth (Rehman et al., 2023). Research indicates vermicompost's benefits in improving plant growth and health, providing essential nutrients, and promoting environmentally friendly farming practices (Chanda et al., 2011; Hussain & Abbasi, 2018). Studies emphasize the importance of understanding soil properties and optimizing mixtures to enhance plant production and soil health (Jones et al., 2019).

### C. Fertilizer Combinations

Soil mixtures, combining different components like compost, biochar, and mineral fertilizers, influence plant growth and productivity. Research highlights the potential of these mixtures to improve soil properties, nutrient availability, and water retention, thereby enhancing plant yields (Hassan et al., 2023). Combining organic and inorganic fertilizers can mitigate soil fertility decline and improve crop health and yield (Roba, 2018). Integrated nutrient management, combining organic and inorganic fertilizers, offers a sustainable approach to enhancing soil fertility and productivity (Roba, 2018). Organic fertilizers improve soil structure and nutrient content, while inorganic fertilizers provide immediate nutrient availability. Studies on various crops demonstrate the benefits of this integrated approach, optimizing yields and maintaining soil health (Adekiya et al., 2022; Wan et al., 2021).

Guided by the significant effects of various soil media combinations and fertilizer applications, a comparative assessment of grafted tomatoes (*Solanum lycopersicum* L.) onto eggplant (*Solanum melongena*), potato (*Solanum tuberosum*), and carrots (*Daucus carota*), using container gardening techniques. The research will overall utilize the container gardening system to investigate the potential for increased yieldusing different settings as an alternative way of addressing food security, global warming, and calamities.

## METHODOLOGY

### A. Research Design

This study employs an experimental research methodology using a completely randomized design (CRD), which is a quantitative research design method that relies on randomization and replication. CRD is applicable in both single-factor and multiple-factor trials and is widely used in agricultural testing and greenhouse research projects (Sinba, 2023).

### B. Research Locale

The experiment was conducted in Purok 3 Malinawon, Mawab, Davao de Oro, Philippines. This area, with a population of 2,823 inhabitants, relies primarily on agriculture for income. The selected crops were grown within the grounds of one of the researchers' homes that is deemed for its optimal location for sunlight and growth.

### C. Research Materials

The materials used in this study include Styro boxes, garden shade nets, various soil media (garden soil and vermicast), sack containers, organic and inorganic fertilizers, poly bags, plastic containers, tissue, small basins, garden sprinklers, sowing tools, sprouting and grafting instruments, seeds and tubers, and weighing scales.

### D. Research Procedures

The study began on September 29, 2023, and was completed on April 10, 2024, spanning exactly 165 days. Researchers gathered necessary supplies and selected a location with optimal sunlight. Seeds were germinated in poly bags, and potato tubers were sprouted in cardboard boxes. The potting medium was prepared using combinations of garden soil and vermicast. Transplantation of germinated seedlings followed, with grafting performed during the observation period. Fertilization was carried out twice a month, focusing on treatments involving different combinations of soil media and fertilizers. Researchers monitored crop growth, recording data on the number and weight of fruits and tubers throughout the experiment.

### E. Fertilizer Treatment and Application

The study was conducted using CRD with ten replicates per experiment. Five treatments were applied, with two replicates for each high-value crop (grafted tomatoes onto eggplant, potato, and carrots). The treatments were as follows:

T1: 50% garden soil with 50% organic fertilizer.

T2: 50% garden soil and 25% vermicast with 25% organic fertilizer.

T3: 100% garden soil with inorganic fertilizer (14g-N, 14g-P, and 14g-K).

T4: 50% garden soil and 50% vermicast with inorganic fertilizer (14g-N, 5g-P, and 20g-K).

T5: 100% garden soil (Control).

### F. Data Collection

Researchers observed the plants over 165 days, focusing on the production of high-value crops by examining the number and weight of harvested fruits and tubers. Data were recorded meticulously, including details on crop variety, weight, time of harvest, date, and location. A comparative analysis of the production data was performed using statistical methods to derive findings, conclusions, and recommendations.

### G. Statistical Analysis

Data were analyzed using mean calculations and ANOVA to compare production outputs across different treatments. Significance testing was performed using p-values and F-tests to determine the effectiveness of the treatments with the following null hypothesis: there is no significant difference in the production outputs (yield quantity and quality) of selected high-value crops (grafted tomatoes onto eggplant, potatoes, and carrots) across different soil media combinations and fertilizer applications.

## RESULTS AND DISCUSSIONS

In terms of production output of grafted tomato onto eggplant using different soil media combinations and application of fertilizer, the data indicates that Treatment 4, which combines 50% garden soil and 50% vermicast with inorganic fertilizer, yields the highest number of eggplants (10) and the greatest weight (78.7g) as shown in Table 1. This suggests that inorganic fertilizers significantly enhance fruit yield (Satish, 2023). Treatment 3, relying solely on 100% garden soil with inorganic fertilizer, shows no eggplant production. This may be due to the early cutting of the eggplant for use as rootstock for tomatoes, emphasizing the adaptability and resilience provided by grafting (Melnyk & Meyerowitz, 2015). Treatments 1 and 2, which include organic components, show moderate success with 2 and 5 eggplants, respectively, indicating the beneficial but less immediate effect of organic fertilizers compared to inorganic ones (Zhang et al., 2020). Treatment 5, the control with only garden soil, results in the least number of eggplants (1), highlighting the limitations of nutrient availability in pure garden soil setups.

TABLE 1. PRODUCTION OUTPUT OF GRAFTED TOMATOES ONTO EGGPLANT ADOPTING CONTAINER GARDENING IN DIFFERENT SOIL MEDIA COMBINATIONS AND APPLICATION OF FERTILIZERS

| Treatment | Number of Eggplants | Weight of Eggplants (g) | Number of Tomatoes | Weight of Tomatoes (g) |
|---|---|---|---|---|
| Treatment 1 | 2.00 | 51.5 | 0.00 | 0.00 |
| Treatment 2 | 5.00 | 61.4 | 0.00 | 0.00 |
| Treatment 3 | 0.00 | 0.00 | 11.0 | 15.09 |
| Treatment 4 | 10.0 | 78.7 | 5.0 | 41.20 |
| Treatment 5 | 1.00 | 22.5 | 0.00 | 0.00 |

Treatment 3, which used 100% garden soil with inorganic fertilizer, yielded the highest number of tomatoes (11), thereby proving efficient nutrient provision by inorganic fertilizers for tomato development (Mareri et al., 2022). Treatment 4, mixing garden soil, vermicast, and inorganic fertilizer, produced 5 tomatoes, with the results demonstrating the advantages of the type of integrated nutrient management (Roba, 2018). Meanwhile, Treatments 1, 2, and 5 produced no tomatoes, stressing the need of further investigation on elements affecting tomato development in grafted plants (Nagraj et al., 2020). Based on weight, Treatment 4 led with 78.7g of eggplants and 41.2g of tomatoes because the combined impacts of vermicast and inorganic fertilizers (Zhang et al., 2020; Zhao et al., 2020). Treatment 2 followed with 61.4g of eggplants, while Treatment 3 generated 15.09g of tomatoes but no eggplants, so stressing the need of nutrient availability for best fruit production (Assefa, 2019; Latifah et al., 2021; Bai et al., 2022).

However, the findings highlight that inorganic fertilizers outperform organic fertilizers in terms of fruit weight in grafted plants in container garden set-ups. This suggests that readily available nutrients from inorganic fertilizers affect rapid growth and higher productivity (Zhang et al., 2020) in container gardens. Organic fertilizers, while beneficial for soil health, may not alone provide sufficient nutrients for optimal fruit production in container gardening (Shang et al., 2020).

Meanwhile for the production output of potatoes adopting container gardening in different soil media combinations and application of fertilizers,the study found no tuber development across all treatments. Despite six attempts using different strategies and combinations of garden soil, vermicast, and fertilizers, no viable tuber growth occurred due to multiple factors experienced during the production period, including adverse weather conditions and the inherent challenges of sprouting potatoes in a warmer climate (Stark et al., 2020; Swainston, 2023). The high temperatures, excessive rainfall, and environmental stressors, such as waterlogging and early blight experienced, hindered tuber initiation and growth (Jovović et al., 2021). This complete absence of tuber production highlights the need for optimizing potato cultivation methods in container gardening, particularly in addressing environmental constraints and ensuring adequate aeration, drainage, and nutrient balance (Poddar et al., 2021).

Meanwhile, the production output of carrots in container gardening with different soil media and fertilizer applications in Table 2 shows that Treatment 4, combining 50% garden soil with 50% vermicast and inorganic fertilizers, yields the highest number of tubers (14), highlighting the benefits of vermicast in enhancing soil structure and fertility, and the rapid nutrient availability from inorganic fertilizers as reported by studies such as Dollison (2023). Treatment 3, with 100% garden soil and inorganic fertilizer, follows with 10 tubers, indicating that inorganic fertilizers alone also significantly promote tuber development (Kushwah et al., 2020). Treatments 1 and 2, which include organic fertilizers, result in moderate success with 6 and 4 tubers, respectively, suggesting that while organic components contribute to soil health, their slower nutrient release may not meet the rapid growth demands of carrots as effectively as inorganic fertilizers (Shaji et al., 2021). Treatment 5, the control with 100% garden soil, produces the fewest tubers (2), underscoring the limitations of relying solely on native soil fertility in container gardening (Li et al., 2022).

TABLE 2 PRODUCTION OUTPUT OF CARROTS ADOPTING CONTAINER GARDENING IN DIFFERENT SOIL MEDIA COMBINATIONS AND APPLICATION OF FERTILIZERS

| Treatment | Number of Tubers | Weight of Tubers (g) |
|---|---|---|
| Treatment 1 | 6.00 | 18.67 |
| Treatment 2 | 4.00 | 38.35 |
| Treatment 3 | 10.00 | 37.90 |
| Treatment 4 | 14.00 | 52.36 |
| Treatment 5 | 2.00 | 11.00 |

Treatment 4 also achieves the highest total weight of tubers (52.36g). This deemed due to the synergistic effects of vermicast and inorganic fertilizers enhancing soil microbial activity and providing readily available nutrients (Igdanes-Marañan & Ratilla, 2022). Treatment 2, with 38.35g, and Treatment 3, with 37.90g, show that vermicast combined with organic or inorganic fertilizers can promote substantial growth, although not as effectively as the combination used in Treatment 4 (Chaoui et al., 2003). Treatment 1, with 18.67g, and Treatment 5, with 11g, indicate that the absence of vermicast and reliance on garden soil or organic fertilizers alone may limit tuber size and health (Krasilnikov et al., 2022).

The findings suggest that in container gardening in carrot production, integrating inorganic fertilizers with vermicast leads to superior tuber quantity and quality, with the rapid nutrient availability of inorganic fertilizers complementing the long-term soil health benefits of vermicast (Mupambwa & Mnkeni, 2018). Conversely, treatments relying solely on organic fertilizers or unamended garden soil yield poorer outcomes, highlighting the importance of nutrient density and immediacy for optimal growth in container environments (Hasnain et al., 2020).

From the findings of the production output, statistical analysis shows no significant difference in the number of fruits produced across treatments in grafted tomatoes onto eggplant, with an F-value of 1.191 and a p-value of 0.417, leading to the acceptance of the null hypothesis (Nahar et al., 2021). This indicates that the different soil media and fertilizers did not significantly impact the number of fruits. However, there is significant difference in the weight of fruits, with an F-value of 9.410 and a p-value of 0.000, rejecting the null hypothesis. Treatment 4, combining garden soil, vermicast, and inorganic fertilizers, produced the highest average fruit weight (66.20g), indicating that this combination significantly enhances fruit development (Krasilnikov et al., 2022).

In carrots, an F-value of 4.833 and a p-value of 0.057 for the number of tubers indicate no significant difference among treatments, leading to the acceptance of the null hypothesis. Similarly, results shows no significant difference in the weight of tubers, with an F-value of 2.632 and a p-value of 0.052. These results suggest that carrots are less responsive to the variations in soil media and fertilizers compared to grafted tomatoes (Nagraj et al., 2020).

TABLE 3 STATISTICAL ANALYSIS OF PRODUCTION OUTPUT USING DIFFERENT SOIL MEDIA AND FERTILIZERS

| Crop Type | Parameter | F-value | p-value | Decision | Conclusion |
|---|---|---|---|---|---|
| Grafted Tomatoes onto Eggplant | Number of Fruits | 1.191 | 0.417 | Accept Ho | No significant difference |

| | | | | | |
|---|---|---|---|---|---|
| Grafted Tomatoes onto Eggplant | Weight of Fruits | 9.410 | 0.000 | Reject Ho | Significant difference |
| Carrots | Number of Tubers | 4.833 | 0.057 | Accept Ho | No significant difference |
| Carrots | Weight of Tubers | 2.632 | 0.052 | Accept Ho | No significant difference |
| Overall | Number of Fruits/Tubers | 4.597 | 0.013 | Reject Ho | Significant difference |
| Overall | Weight of Fruits/Tubers | 8.353 | 0.000 | Reject Ho | Significant difference |

For the overall production in container gardening, highlight significant differences in both the number and weight of fruits and tubers among the treatments. The overall F-values are 4.597 (p-value of 0.013) for the number of fruits/tubers and 8.353 (p-value of 0.000) for the weight, leading to the rejection of the null hypothesis. Treatment 4 consistently shows the best results, indicating that integrating inorganic fertilizers with vermicast significantly enhances crop production in container gardening (El-Goud & Amal, 2020; Shrestha et al., 2020).

Overall, the study indicates that while the number of fruits produced by grafted tomatoes is not significantly influenced by different soil media and fertilizers, the weight of the fruits is significantly affected, with the best results from a combination of garden soil, vermicast, and inorganic fertilizers. Carrots show no significant response to the variations in treatments, highlighting the complexity of plant-soil interactions and the potential need for optimized nutrient management strategies (Jones et al., 2019; Nahar et al., 2021).

The cost analysis of crop production using various soil media and fertilizers is shown in Table 4.

TABLE 4 SAMPLE COST ANALYSIS OF CROP PRODUCTION USING VARIOUS SOIL MEDIA AND FERTILIZERS

| **Cost of Materials** | **Unit** | **Price** | **No. or Kilos used** | **Eggplant Cost (₱)** | **Tomato Cost (₱)** | **Carrot Cost (₱)** |
|---|---|---|---|---|---|---|
| Seeds | Pieces | 70/pack | 20 pieces | 7 | 7 | 7 |
| Vermicast | Kg | 25/Kg | 10 kg | 250 | 250 | 250 |
| Humus | Kg | 50/Kg | 5 kg | 500 | 500 | 500 |
| Complete Fertilizer | Kg | 35/Kg | 1 kg | 35 | 35 | 35 |
| Urea | Kg | 60/Kg | 500 g | 30 | 30 | 30 |
| Total Material Cost | | | | ₱ 822.00 | ₱ 822.00 | ₱ 822.00 |
| Labor Cost | | | | | | |
| 1 day/week x 4 weeks = 4days/month x 5 months =20 days | | ₱ 300/8h = 37.5 per hour | ₱ 37.5 x 20 days | ₱ 750 | ₱ 750 | ₱ 750 |
| Total Cost | | | | ₱ 1,572.00 | ₱ 1,572.00 | ₱ 1,572.00 |
| Cost Per Trial | | | ₱ 1,572)/(5 trials) | ₱ 314.40 | ₱ 314.40 | ₱ 314.40 |

The sample cost analysis of eggplant, tomato, and carrot production shows that the total material cost for each crop is ₱822.00, which includes the cost of seeds, vermicast, humus, complete fertilizer, and urea. The labor cost, calculated based on 20 days of work at ₱ 37.5 per hour, amounts to ₱ 750 for each crop. Therefore, the total cost per trial is ₱ 1,572, and when divided by five trials, it results in a cost per trial of ₱ 314.40. The cost analysis reveals that the material and labor costs are substantial, making the total cost per trial high relative to the potential income from the harvests. The labor cost is a significant portion of thetotal cost, due to the intensive manual effort required in container gardening.

The income analysis of crop production using various soil media and fertilizers is shown in Table 5.

TABLE 5 INCOME CALCULATION FOR EGGPLANT, TOMATO, AND CARROT PRODUCTION USING CONTAINER GARDENING

| Income Calculation | Eggplant | Tomato | Carrot |
|---|---|---|---|
| Total Harvest | 18 pcs (1 kg) | 16 pcs (1 kg) | 36 pcs (2 kg) |
| Market Price | ₱ 60/kg | ₱ 50/kg | ₱ 80/kg |
| Total Trial Cost | ₱ 314.4 | ₱ 314.4 | ₱ 314.4 |
| Income Calculation (₱ 314.4)/(Market Price) | 5.24 | 6.29 | 3.93 |
| Conclusion | One container yields negative income. | One container yields negative income. | One container yields negative income. |
| | More than 5 bags per cycle needed. | More than 6 bags per cycle needed. | More than 3 bags per cycle needed. |

It shows a total harvest of 18 pieces, approximately 1 kg, with a market price of ₱ 60 per kg. The total trial cost is ₱ 314.4, resulting in a calculated value of 5.24, indicating a negative income for one plantingcontainer per cycle. For tomato production, the total harvest is 16 pieces, approximately 1 kg, with a market price of ₱ 50 per kg. The calculated value is 6.29, again indicating a negative income. For carrot production, the total harvest is 36 pieces, approximately 2 kg, with a market price of ₱ 80 per kg. The calculated value is 3.93, also indicating a negative income. To achieve positive income, more than five bags for eggplant, more than six bags for tomato, and more than three bags for carrot are needed per planting cycle.

The income calculations across all crops demonstrate that with the current number of planting containers, the production is not economically viable. The number of bags used per planting cycle must be increased to achieve a positive income. The findings highlight the need for optimizing the scale of container gardening to enhance economic returns. The results align with Nagase and Lundholm (2021), who suggest that increasing the number of containers or improving the density and turnover of crop cycles can optimize the economic viability of container gardening. Jules (2023) supports this by noting that containers have a finite space for growth, restricting the size and number of plants that can be grown compared to conventional gardening methods. The study by Spofford (2021) also emphasizes that while the financial costs of container gardening are substantial, the non-financial benefits, such as social justice and community welfare, should be considered in the overall analysis. This underscores the varying advantages of container gardening beyond mere economic returns, including environmental sustainability, food security, and social equity.

## CONCLUSIONS

The study overall shows that grafted tomatoes onto eggplant have significant improvements in fruit number and weight with the use of a combination of organic and inorganic fertilizers, specifically in Treatment 4, which provided the highest yield and weight of fruits. Conversely, potato production faced substantial challenges, resulting in no tuber development across various soil media and fertilizer treatments. This indicates a need for optimized growing conditions and possibly different crop varieties to achieve successful potato cultivation in containers. Carrot production varied significantly, with Treatment 4 again showing the best results in terms of both the number and weight of tubers, highlighting the effectiveness of combining vermicast and inorganic fertilizers.

Meanwhile, the sample cost analysis highlights the economic challenges of container gardening due to higher unit costs and limited production scales. To improve productivity and market competitiveness, the study recommends the following: for grafted tomatoes, a combination of organic and inorganic fertilizers should be used to maximize yield. Further research should be conducted to identify optimal growing conditions for potatoes in containers, potentially exploring different crop varieties or enhanced environmental controls. For carrots, while current treatments suffice for basic growth, additional amendments or conditions should be explored to further enhance yield and size. Scaling up container gardening production is recommended to reduce per-unit costs and improve market competitiveness, which could involve increasing the number of containers or enhancing crop density within existing setups to achieve economies of scale. The sample cost-income analysis indicates that using more containers per cycle is essential to achieve positive income, with more than five bags needed for eggplant, more than six for tomato, and more than three for carrot.

Moreover, exploring niche markets where consumers are willing to pay a premium for local, organic, or sustainably produced container-grown crops could help offset higher production costs. Integrating more controlled environmental conditions, such as using greenhouses or modified container designs to better regulate temperature and protect against adverse weather, is also recommended. Regular monitoring and adjusting soil conditions, nutrient levels, and moisture in container gardening will ensure optimal growth conditions and boost productivity.

Overall, the study highlights the potential of container gardening for high-value crops like grafted tomatoes and carrots, particularly when using Treatment 4, which combines 50% garden soil with 50% vermicast and inorganic fertilizers. This treatment consistently showed the best results in terms of yield and weight, making it the most cost-effective option based on the cost sample cost and income analysis. Further research and optimization of growing conditions are necessary to fully realize the benefits of container gardening and improve its economic viability.

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