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Cost and return analysis in using beneficial microbes in organic fertilizer versus chemical fertilizer in eggplant production: A research note

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Abstract

This research note examines the cost and benefit evaluation of utilizing beneficial microbes in organic fertilizers versus traditional chemical fertilizers in the production of eggplant (*Solanum melongena*). With agriculture progressively looking for sustainable options to synthetic inputs, the use of organic fertilizers enriched with microbial inoculants offers a practical solution. The research highlights the importance of beneficial microbes in boosting soil quality, increasing nutrient absorption, and supporting plant development, which may lead to higher economic profits. This project utilized experimental design—from no fertilizer to conventional and organic fertilizer inputs with beneficial microbes—were utilized to assess crop performance. Initial results suggest that eggplants amended with organic fertilizer with beneficial microbes along with wastewater showed the greatest return on investment, highlighting the success of microbial use in enhancing agricultural output. Furthermore, the study emphasizes the existing issue of local communities not fully utilizing organic waste, which makes up a substantial part of municipal waste. Raising understanding of the advantages of utilizing organic fertilizers and microbial bioactivators is vital for transforming waste into a resource. As consumer demand for organic products increases, the results indicate that farmers adopting these sustainable methods can gain financially and aid in maintaining ecological balance. This study highlights the real-world effects of utilizing beneficial microbes in farming, establishing a basis for future research aimed at improving sustainability and profitability in agricultural crop yields.

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Introduction

Beneficial microbes in organic fertilizer: A promising alternative

Eggplant (*Solanum melongena*) is a commonly grown vegetable that holds considerable economic importance, especially in tropical and subtropical areas. Fertilizer utilization is essential for improving yield and quality, with organic and chemical fertilizers as the two main alternatives (Huang *et al.*, 2020). Organic fertilizers, especially those inoculated with beneficial microorganisms, have been suggested as a sustainable substitute for traditional chemical fertilizers because of their ability to enhance soil health and minimize environmental effects (Smith *et al.*, 2019). This research seeks to evaluate the costs and returns of employing beneficial microbes in organic fertilizer compared to chemical fertilizer in the production of eggplants.

Many research efforts have emphasized the benefits of organic fertilizers and helpful microbes in sustainable farming. As stated by Jat *et al.* (2021), microbial inoculants like nitrogen-fixing bacteria, phosphate-solubilizing bacteria, and mycorrhizal fungi can boost nutrient absorption and promote plant development. Moreover, a study by Mishra *et al.* (2020) indicated that the ongoing application of chemical fertilizers can result in soil degradation and nutrient imbalance, adversely impacting crop yield over time. Research also shows that the demand from consumers for organically grown fruits and vegetables is rising, resulting in elevated market prices for organically farmed products (González *et al.*, 2022).

Breakthrough initiative

The Don Mariano Marcos Memorial State University (DMMMSU), Philippines partners with an Organiculture Industry in Nueva Ecija, Philippines. This multi-million organic agriculture innovation company was able to discover a bioactivator that enhances degradation and conversion of organic waste into fertilizers which can be used to improve plant growth and development. The problem is that many local communities are not aware of the functionality of this organic bioactivator. Because of this, majority of organic wastes are treated as something not useful and profitable. As a result, more than 50% of municipal wastes generated are organic wastes.

The novel ideation that DMMMSU has contributed is the potential use of domestic liquid waste (laundry and dishwashing wastewater) to water backyard vegetables amended with the organic waste-now-turned-fertilizers, exploiting the ability of the BMB (beneficial microorganism bioactivator) to bioremediate wastewater to make it useful for vegetable production. DMMMSU performed experimental setups to compare vegetables grown in organic amended substrate versus those vegetables grown in organic amended substrates treated with liquid domestic wastes. If the bioactivators are able to provide a bioremediating effect, then plants grown in organic-amended-wastewater-treated will give more produce. This potential breakthrough could give multifold benefits; it could help local stakeholders generate more income through (1) organic fertilizer production; (2) re-use of wastewater and (3) organic vegetable production.

Organic fertilizers are sold for 250 pesos per bag, wastewater re-use is estimated to save Php 250.00 per household per day; and organic vegetable production is estimated to profit more than conventional vegetable production, based on published studies.

Objectives of the project

The study generally aims to enhance the production of organically grown eggplant using the combined beneficial microbes bioactivated (BMB) plus wastewater utilization. Specifically, the study aims to analyze the cost and return among: (a) no-fertilizer-, (b) conventional-, (c) BMB organic fertilizer- and (d) BMB organic fertilizer and wastewaterized eggplant production treatment groups.

Materials and methods

Research design

This research utilized a true experimental research approach. There will be a total of 210 eggplant seedling pots. These seedlings were distributed into three blocks using a Randomized Complete Block Design (RCBD). Each block contained seven (7) treatments that were randomly assigned per block. Each treatment had 10 replicates.

The treatment groups representing water and fertilizer application techniques were as follows:

T0 - Tap water with no fertilizer (Negative control)

T1 - Tap water + conventional/synthetic fertilizer (Positive control)

T2 - 100% tap water + BMB organic fertilizer

T3 - 25% wastewater + 75% tap water + BMB organic fertilizer

T4 - 50% wastewater + 50% tap water + BMB organic fertilizer

T5 - 75% wastewater + 25% tap water + BMB organic fertilizer

T6 - 100% wastewater + BMB organic fertilizer

Cost and return analysis

The Eggplant Package of Technology adapted from Agricultural Training Institute (Department of Agriculture) (ATI-DA, n.d.) was used as initial basis for the cost and return analysis. However, specific costs incurred per treatment group was accounted and used for the computation of the total production cost, and gross sales was estimated using the actual yield and prevailing market price of eggplant.

Return on investment (ROI) online calculator

Return on Investment, usually abbreviated as ROI, is a common, widespread metric used to evaluate the forecasted profitability on different investments. Before any serious investment opportunities are even considered, ROI is a solid base from which to go forth. The metric can be applied to any agricultural costs with the potential to derive gains can thereby have an ROI assigned to it. ROI is lauded and still widely used due to its simplicity.

The basic formula for ROI is:

ROI= (Gain from investment - Cost of investment)/ Cost of investment

The online ROI Calculator used in this research note included an investment time input to hurdle this weakness by using something called the annualized ROI, which is a rate normally more meaningful for comparison. When comparing the results of two calculations computed with the calculator, oftentimes, the annualized ROI figure is more useful than the ROI figure (Calculator.net, n.d.).

Results and discussion

The cost and return analysis was computed by determining the total approximate cost of expenses accrued in transplanting, growing, and in the maintenance of eggplants. On the other hand, the return is the investment gain or the monetized value of the harvested eggplants.

The comparison of the investment and the profit on the different eggplant fruits harvested per treatment group can be gleaned in Fig. 1. It can be gleaned from the table that the highest investment gain was computed in Treatment 4. The eggplants grown in this treatment group were applied with organic fertilizer with effective microbes. Moreover, these eggplants were watered with 75% laundry waste and 25% tap water. This salient data provide tangible evidence that there is a greater return of investment when eggplants are grown in OFEM soil even when these plants are watered with laundry waste. This also indicates that laundry waste can replace tap water as long as soil is amended with OFEM. On the other hand, the control groups gained the least return of investment.

The findings of this study align with previous research indicating that organic fertilizers with beneficial microbes contribute to improved soil health, reduced dependency on synthetic inputs, and long-term sustainability (Smith *et al.*, 2019). Although the initial investment in organic fertilizers and microbial inoculants may be higher due to labor-intensive

application, the long-term benefits outweigh the costs. Enhanced soil microbial activity promotes better nutrient cycling, leading to improved plant growth and yield stability over successive growing seasons (Jat *et al.*, 2021). Additionally, the increasing market demand for organic produce (González *et al.*, 2022) suggests a promising economic incentive for farmers transitioning to organic cultivation methods.

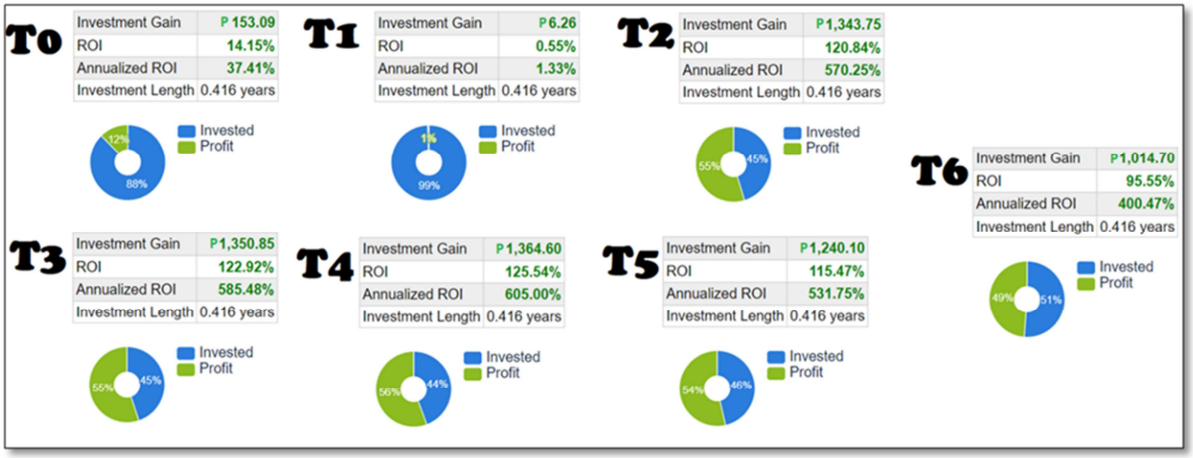

Fig. 1. Comparison of the investment and the profit on the different eggplant fruits harvested per treatment group

Practical implications

The practicality of using beneficial microbes versus chemical fertilizers in agriculture is increasingly supported by research highlighting the advantages of microbial applications.

Beneficial microorganisms enhance soil health, promote plant growth, and reduce reliance on chemical inputs, making them a sustainable alternative. In contrast, chemical fertilizers can degrade soil structure and lead to environmental issues over time. The following sections outline the key benefits of using beneficial microbes in agriculture.

Benefits of beneficial microbes

1. Soil health improvement: Microbial inoculants enhance soil microbiota balance, promoting nutrient cycling and soil structure (He *et al.*, 2024).
2. Plant growth promotion: Effective microorganisms (EMs) and plant growth-promoting microbes (PGPMs) contribute to nitrogen fixation and phytohormone synthesis, leading to increased crop yields (Qadir *et al.*, 2024).
3. Pest and disease management: Certain microbes produce volatile organic compounds that inhibit pathogens, reducing the need for chemical pesticides (Canfora *et al.*, 2024).

Limitations of chemical fertilizers

1. Soil Degradation: Prolonged use of chemical fertilizers can lead to soil health deterioration, reducing long-term agricultural productivity (Qadir *et al.*, 2024).
2. Environmental Impact: Chemical inputs contribute to pollution and can lead to resistance in pests and diseases, complicating agricultural practices (Chaudhary *et al.*, 2024).

While beneficial microbes present a promising alternative, the transition from chemical fertilizers may require further research and adaptation in agricultural practices to ensure effectiveness and sustainability.

Conclusion

In conclusion, this research note emphasizes the considerable promise of using beneficial microbes in organic fertilizers as a sustainable substitute for

chemical fertilizers in eggplant cultivation. The research shows that the addition of microbial inoculants not only improves soil quality but also boosts nutrient accessibility, leading to enhanced plant growth and greater crop production. This is vital as the interest in organically cultivated produce increases, indicating shifting consumer trends and the readiness to spend higher amounts for eco-friendly goods.

The experimental results show that eggplants cultivated with organic fertilizers infused with beneficial microbes, especially when paired with wastewater, generate greater returns on investment than traditional methods. This highlights the twofold benefit of enhancing economic sustainability for farmers while also tackling urgent environmental issues, like organic waste management. The capacity to repurpose household wastewater for irrigation illustrates innovative methods that can address waste problems and support a circular economy.

Even with the upfront expenses involved in switching to organic fertilizers and microbial inoculants, the long-term advantages—spanning improved soil microbiota to decreased reliance on synthetic inputs—surpass these obstacles. Farmers are motivated to embrace these novel methods not just for enhanced productivity but also for the sustainability of farming systems.

Nevertheless, it is essential to improve understanding and education in local communities regarding the importance of organic fertilizers and the proper utilization of microbial bioactivators. In doing so, we can enable stakeholders to convert organic waste into a valuable resource, ultimately resulting in a more sustainable agricultural environment. Future studies ought to keep investigating the wider uses of helpful microbes in different crops and farming practices, making certain that the advancement of sustainable agriculture stays central to agricultural innovation.

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