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EFFECTIVENESS OF ORGANIC INPUT AND CULTURAL PRACTICES IN EGGPLANT (Solanum melongena L.) CULTIVATION: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

This systematic literature review synthesizes empirical evidence on the effectiveness of organic inputs and cultural practices in eggplant (Solanum melongena L.) cultivation. Ten peer-reviewed articles published between 2012 and 2025, comprising five national and five international studies, were analyzed. The results indicate that organic fertilizers and mulching improve soil fertility, enhance plant growth, and increase yield stability, while mycorrhizal inoculation significantly strengthens nutrient uptake and stress tolerance. Technological innovations, such as biodegradable mulching films and energy-efficient greenhouses, further enhance productivity while reducing environmental impacts. Beyond agronomic benefits, eggplant farming demonstrates economic feasibility, supports household food security, and contributes to women's empowerment in rural communities. Despite these promising outcomes, limitations remain due to short study durations, single-site experiments, and insufficient integration of socio-economic aspects. The review highlights the need for multi-season, multi-location research that combines agronomic, technological, and socio-economic dimensions to support sustainable eggplant production systems.

Keyword: eggplant, organic fertilizer, mycorrhizae, mulching, sustainable agriculture, socio-economic impact

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I. INTRODUCTION

Eggplant (Solanum melongena L.) is one of the most important horticultural commodities with considerable nutritional, economic, and cultural value. Market demand for eggplant continues to grow in line with increasing public awareness of its health benefits and its potential as a profitable crop for farmers. However, conventional cultivation practices that heavily rely on synthetic inputs have raised serious concerns, including soil degradation, dependency on chemical fertilizers, and negative impacts on the environment and human health.

In the context of sustainable agriculture, the adoption of organic fertilizers, bio-inputs, and environmentally friendly cultural practices has gained significant attention. Organic fertilizers, mycorrhizal inoculation, and mulching techniques have been shown to improve soil physical, chemical, and biological properties, while enhancing plant productivity. In addition, home-garden based cultivation practices contribute not only to household food security but also to women's empowerment in rural communities.

A number of national and international studies have explored the effectiveness of organic inputs and cultural practices in eggplant cultivation. Nevertheless, most of these studies remain limited to specific sites, short-term growing seasons, and often lack comprehensive integration of socio-economic aspects.

Therefore, this article provides a systematic review of empirical evidence regarding the application of organic fertilizers, mycorrhizae, mulching techniques, and community-based practices in eggplant cultivation. The findings are expected to serve as a foundation for developing more sustainable agricultural practices and policies that are relevant to farmers' needs across diverse regions and production systems.

II. METHODOLOGY

This study employed a systematic literature review (SLR) approach to synthesize empirical evidence on the use of organic inputs and cultural practices in eggplant cultivation. A total of ten peer-reviewed articles were analyzed, consisting of five national and five international studies published between 2012 and 2025.

The selection of articles was conducted using the following criteria: (1) the study focused on eggplant cultivation (Solanum melongena L.); (2) it examined the application of organic fertilizers, mycorrhizal inoculation, mulching techniques, or other sustainable cultural practices; (3) it reported agronomic parameters and/or socio-economic impacts; and (4) it was published in a reputable national or international journal.

The reviewed studies employed various research methods, including experimental designs such as Randomized Block Design (RBD), Factorial Randomized Block Design, and Completely Randomized Design (CRD), as well as surveys, participatory training, and socio-economic assessments. Data collection techniques involved field measurements, structured questionnaires, and statistical analyses such as ANOVA, DMRT, T-test, Life Cycle Assessment (LCA), and R/C ratio analysis.

For each article, relevant information was extracted and synthesized, including the study objectives, experimental design, main results, theoretical and practical contributions,

as well as the strengths and limitations. The systematic comparison of these studies allowed for identifying trends, knowledge gaps, and potential directions for future research on sustainable eggplant cultivation.

III. RESULT AND DISCUSSION

The systematic review of ten selected studies reveals consistent evidence that organic inputs and sustainable cultural practices substantially enhance the growth, yield, and socio-economic value of eggplant cultivation across diverse agroecological contexts.

3.1 Organic Fertilizer and Mulching

The reviewed studies consistently indicate that the application of organic fertilizers and mulching practices contributes positively to the growth and yield of eggplant. Sahetapy (2012) demonstrated that the use of Herbafarm at the optimal dose increased early plant height, although the effect was not significant across all parameters. Similarly, Al Rizal et al. (2022) reported that the combination of 15 ml/L bio-slurry with straw mulch resulted in higher fruit weight, greater number of fruits, and increased stalk biomass. These findings highlight the important role of organic matter in improving soil structure, enhancing nutrient availability, and supporting plant productivity.

The addition of organic fertilizers provides not only essential macro- and micronutrients but also stimulates beneficial microbial activity in the rhizosphere, thereby creating a more favorable environment for root development. Mulching, on the other hand, plays a vital role in conserving soil moisture, regulating soil temperature, and suppressing weed growth, which collectively reduce plant stress and facilitate more efficient nutrient uptake. When combined, these practices generate a synergistic effect that supports both vegetative and generative growth of eggplant, resulting in better yield performance. Furthermore, such integrated practices align with the principles of sustainable agriculture by minimizing reliance on chemical fertilizers and reducing negative environmental impacts.

From a practical perspective, the integration of organic fertilizers and mulching offers considerable benefits for farmers, especially in resource-limited settings. These practices utilize locally available materials such as compost, animal manure, bio-slurry, and crop residues, thereby lowering input costs while maintaining soil fertility in the long term. By improving soil health and ensuring more stable yields, farmers can achieve greater economic resilience and reduce vulnerability to fluctuating market prices of synthetic inputs. Thus, promoting the adoption of organic fertilization and mulching techniques can serve as a

strategic step toward sustainable eggplant production systems that are both environmentally friendly and economically viable for smallholder farmers.

3.2 Mycorrhizal Inoculation

Mycorrhizae play an important role in improving plant root development and nutrient absorption. Sacita and Jibrul (2023) found that mycorrhizal inoculation at 21 g/plant significantly increased root biomass and nutrient uptake efficiency. This finding reinforces the well-established concept that mycorrhizal symbiosis enhances plant tolerance to environmental stress and contributes to more sustainable production systems.

The symbiotic association between mycorrhizal fungi and plant roots facilitates greater access to soil nutrients, particularly phosphorus and micronutrients that are often limited in availability. By extending the effective root surface area through fungal hyphae, plants benefit from enhanced nutrient and water uptake, which in turn promotes better growth and yield performance. Moreover, mycorrhizal colonization has been shown to improve soil aggregation and microbial diversity, thereby creating a more resilient soil ecosystem that supports long-term productivity.

From a practical perspective, the application of mycorrhizal inoculants can be integrated into existing fertilization strategies to reduce dependence on chemical inputs and mitigate production costs. For smallholder farmers, this practice offers a sustainable alternative that not only enhances crop performance but also strengthens resilience against abiotic stresses such as drought and soil degradation. Consequently, encouraging the adoption of mycorrhiza-based technologies holds considerable promise for advancing environmentally friendly and economically viable agricultural systems.

3.3 Biodegradable Mulch and Greenhouse Innovations

Recent international studies also provide evidence of technological innovation in sustainable eggplant cultivation. Iacuzzi et al. (2024) reported that BION4-based biodegradable mulching films improved soil temperature regulation and increased agronomic performance under hot-arid conditions. Similarly, Saadi et al. (2025) showed that energy-efficient greenhouse models not only improved eggplant yield but also reduced environmental impacts, emphasizing the relevance of environmentally friendly technologies in resource-limited environments.

The use of biodegradable mulching films represents a significant advancement compared to conventional plastic mulch, which often contributes to soil contamination and waste management problems. By maintaining soil moisture, moderating temperature fluctuations, and gradually decomposing into non-toxic residues, biodegradable mulches

provide both agronomic and ecological benefits. This innovation aligns with global efforts to reduce plastic pollution in agriculture while sustaining crop productivity under increasingly variable climatic conditions.

In addition, the development of energy-efficient greenhouse systems offers a strategic solution to optimize microclimate management for eggplant cultivation. These systems reduce dependence on fossil fuels, lower greenhouse gas emissions, and ensure stable yields despite environmental constraints. When combined with biological inputs such as organic fertilizers, mulching, and mycorrhizal inoculants, such technologies form an integrated approach that balances productivity, sustainability, and environmental responsibility. Hence, the adoption of eco-friendly innovations can significantly strengthen the resilience of eggplant production systems, particularly in regions facing resource limitations and climate-related challenges.

3.4 Socio-economic Aspects

Beyond agronomic improvements, several studies highlight the socio-economic dimensions of eggplant farming. Bau Bani et al. (2020) confirmed that eggplant production is economically feasible, as reflected in an R/C ratio greater than 1, indicating profitability and relatively efficient marketing channels. This evidence underscores that eggplant cultivation not only contributes to food supply but also provides a reliable source of income for smallholder farmers, making it an attractive option in diverse agroecological settings.

Trisnaningsih et al. (2021) further demonstrated that home-garden cultivation and participatory training programs enhanced women's knowledge and skills in eggplant production. These initiatives not only expanded household-level agricultural capacity but also contributed to women's empowerment, particularly in decision-making and income-generating activities. Such practices simultaneously strengthened household food security and diversified dietary intake, highlighting the broader role of eggplant farming in rural livelihoods.

Moreover, ethnonutrition research by Epanda et al. (2024) emphasized the cultural and health significance of local eggplant consumption. Their findings illustrate that eggplant is valued not only as an economic commodity but also as a dietary component linked to cultural identity, traditional cuisine, and nutritional well-being. Taken together, these socio-economic perspectives reveal that eggplant farming operates at the intersection of economic viability, social empowerment, and cultural sustainability—dimensions that are equally important in promoting its role within sustainable agricultural development.

3.5 Strengths and Limitations of Reviewed Studies

The majority of the reviewed studies adopted sound experimental designs, applied appropriate statistical tools, and generated practical recommendations for farmers. These efforts provide a strong scientific foundation for understanding the role of organic fertilizers, mulching, mycorrhizal inoculation, and eco-friendly technologies in improving eggplant growth and yield. The inclusion of socio-economic analyses further strengthens the relevance of these studies by demonstrating the feasibility, profitability, and cultural value of eggplant production across different contexts.

Nevertheless, several limitations were identified, particularly in terms of research scope and duration. Many of the studies were conducted within short timeframes, relied on single-site experiments, or lacked long-term assessments of economic sustainability. Such constraints limit the generalizability of findings and their applicability under diverse agroecological conditions. Moreover, there remains a gap in understanding how integrated practices—combining biological inputs, technological innovations, and socio-economic interventions—perform over extended periods and across varied farming systems.

These gaps suggest the need for future research that adopts a multi-season, multi-location approach while integrating both agronomic and socio-economic perspectives. Such holistic studies would provide more robust evidence to guide farmers, policymakers, and development practitioners in promoting sustainable eggplant cultivation. By addressing long-term productivity, profitability, and cultural dimensions, future investigations can better inform strategies that balance food security, environmental stewardship, and rural livelihoods.

IV. CONCLUSION

This review concludes that the integration of organic fertilizers, mulching, mycorrhizal inoculation, and eco-friendly technological innovations provides significant agronomic, economic, and socio-cultural benefits in eggplant cultivation. Organic inputs improve soil health and crop productivity, while mycorrhizal inoculation strengthens nutrient efficiency and plant resilience. The adoption of biodegradable mulch and energy-efficient greenhouse systems further supports environmentally responsible production. In addition to agronomic outcomes, eggplant cultivation proves to be profitable, enhances household food security, and contributes to rural women's empowerment. However, most existing studies remain limited in duration and geographic coverage, underscoring the need for future research that is multi-season, multi-location, and integrative in nature. Strengthening the link between agronomic innovations and socio-economic dimensions will

be crucial in promoting sustainable eggplant farming systems that align with farmers' livelihoods and environmental stewardship.

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