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Applying biostimulants and propagation techniques through training for farmer groups in Mluweh Village

Anggiresti Kinasih[1], Jafron Wasiq Hidayat[1,3], Sri Puryono[3], Aqilah Rizky Fiya[2], Asri Kusuma Cahyaningtyas[2], M. Regina Lintang Shafura[2]

[1]Departement of Biology, Faculty of Science and Mathematics, [2]Department of Chemical Engineering, Faculty of Engineering, Universitas Diponegoro
Jl. Prof. Jacob Rais, Tembalang Semarang, Central Java 50275, Indonesia
[3]Special Purpose Forest Area (KHDTK), Universitas Diponegoro
Jl. Ke Desa Mluweh, Kaligawe, Ungaran Tim., Semarang Regency, Central Java 50516, Indonesia

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ABSTRACT

Low availability and quality of horticultural seedlings are key challenges faced by farmer group in Mluweh Village, Indonesia. Propagation techniques and plant biostimulants offer improvements in propagation success and reduce seedling production costs. This community service program aimed to strengthen farmers' knowledge and practical skills in producing and applying biostimulants and implementing vegetative and generative propagation techniques. Activities included technical presentations, biostimulant preparation, grafting and cutting, coffee seed germination, and preparation of cocopeat-based growing media for air-layering and polybag seedlings. Thirty propagation materials were used in grafting and cutting practices involving biostimulant application, with a reported survival rate of 57 percent. After one month, 35 percent of 100 scarified coffee seeds had germinated. In addition, 297 economically valuable seedlings, comprising stink beans, dog fruits, avocadoes, and soursops, were allocated for planting within the partner community. Participants also received training in basic packaging and product labeling to support the potential commercialization of seedlings and biostimulants. The program established a foundation for developing local seedling and biostimulant enterprises, although sustained independent marketing and improvements in seedling quality require further evaluation.

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1. INTRODUCTION

Mluweh village lies in agricultural area in which community relies predominantly on horticultural crop cultivation and seedling production as a source of household income. Farmers in Mluweh Village, Central Java, Indonesia, has opportunities to develop seedling production as an agricultural activity that supports household income and environmental sustainability. Despite the potential, preliminary observations identified challenges in the availability of initial seedlings and the continuity of propagation activities among the partner farmers. Before the program, the partners had fewer than 200 seedlings in inventory, including 30 cassava seedlings, 98 silk tree seedlings, and 60 other agricultural seedlings.

✉ Corresponding Author: **Anggiresti Kinasih**: Tel. +62 341 404424 | E-mail: anggirestikinasih@live.undip.ac.id

In addition, seedling propagation was conducted infrequently, with only three propagation activities reported over a two-year period. Only 30 percent individual among the partners possessed the relevant technical skills for vegetative propagation or the preparation and application of plant biostimulants.

Limited seedling availability and the lack of regular propagation activities can restrict the supply of planting materials, reduce nursery production, and limit opportunities for seedling sales. Vegetative propagation techniques, particularly grafting and cuttings, are therefore offered as practical approaches to produce planting materials while retaining desirable traits of the plants. In comparison with seed propagation, these techniques can also facilitate the multiplication of plants with selected traits, although their success depends on plant species, physiological condition, propagation methods, and environmental factors (Hartmann et al., 2018).

The scientific rationale for introducing biostimulants is based on research regarding their potential to improve plant physiological processes and crop performance. Du Jardin (2015) described how biostimulants can stimulate plant nutritional processes independently of their nutrient content, potentially improving nutrient-use efficiency, plant development, and tolerance to abiotic stress. Calvo et al. (2014) further reviewed evidence on various biostimulant categories, including microbial inoculants and other biologically active substances, highlighting their potential to support root development, nutrient uptake, and plant growth. Meanwhile, Hartmann et al. (2018) described established principles and practices of vegetative propagation, including the physiological and environmental factors affecting the outcomes of grafting and cuttings. Drawing on these studies and the community empowerment perspective, participatory training and technology transfer can help translate scientific knowledge into practical skills that farmers can apply within their own production systems. Previous studies have also emphasized that farmer empowerment through participatory training improves technology adoption, strengthens group institutions, and enhances economic resilience at the community level (Davis et al., 2012).

This community service program was designed to strengthen the capacity of farmer groups in Mluweh Village to establish more independent and sustainable seedling production. The program aimed to improve farmers' practical skills in grafting and cuttings, introduce the preparation and application of plant propagation biostimulants, and encourage more regular propagation activities, all of which involving local resources. The program also sought to improve seedling availability through planting activities and the application of the newly introduced propagation techniques. In addition to technical capacity building, training in simple packaging and product identification was also provided to improve economical value of biostimulant products. In the long term, the program is expected to empower partners to independently produce seedlings and biostimulants, maintain a sustainable supply of planting materials, and explore income-generating opportunities through the sale of quality seedlings and locally produced agricultural inputs.

2. METHODS

Program Design, Partner, and Location

This community service program employed a participatory, practice-oriented, and technology-transfer approach to empower farmers to independently prepare and apply locally sourced plant propagation biostimulants and improve vegetative propagation techniques. The program was conducted in Mluweh Village, Ungaran Timur District, Semarang Regency, Central Java, Indonesia, in collaboration with a local farmer group and the East Ungaran Agriculture Office. The target participants consisted of 15 members of farmer group and one agricultural extension officer, totaling 16 participants. The farmer group served as the primary community partner, while the extension officer supported technical

facilitation and the potential continuation of the introduced practices. The program was designed to address challenges related to the availability of affordable agricultural inputs, the capacity to produce plant propagation biostimulants independently, and the application of vegetative propagation techniques.

The implementation covered a two-month period and comprised needs assessment, preparation, training, mentoring, and evaluation. The participatory approach involved the partner in identifying local needs, preparing materials, practicing the introduced technologies, and evaluating their applicability under local farming conditions. Implementation was supported by the partner's agricultural work area and available facilities for training, discussion, preparation of biostimulant formulations, and vegetative propagation practice. The equipment and supporting facilities included worktables or other suitable preparation surfaces, clean water, fermentation containers, plastic bottles, measuring cups, filtering cloth, labels, knives, pruning shears, blenders or mortars, and plant materials for grafting and cutting. Printed training modules and stationery were provided to support learning and documentation. The use of locally available materials and simple equipment was intended to minimize production costs and facilitate the independent adoption of the technologies after the program ended.

Technology Transfer

The technology transfer focused on two complementary interventions: the preparation and application of locally sourced plant propagation biostimulants and the improvement of vegetative propagation techniques. In this program, appropriate technology is defined by practical, affordable, accessible, and easily reproducible methods adapted to the resources and operational capacity of the partner.

To fulfill the appropriate technology requirements, three formulations were therefore introduced: (1) A local microorganism solution prepared through fermentation of cooked rice; (2) A fermented bud starter prepared from rice washing water, coconut water, molasses, and an EM4 microbial inoculant; and (3) A shallot-based extract used as a natural rooting stimulant. These formulations were introduced as locally producible alternatives to support propagation activities. Their composition and preparation methods were demonstrated to participants, who then practiced measuring ingredients, preparing mixtures, conducting fermentation where applicable, labeling containers, and storing the products.

The formulations were integrated into practices, including grafting and stem cuttings. Participants were introduced to the selection and preparation of plant materials, the treatment of scions or buds, the preparation of cuttings, and the application of the corresponding formulations. Local microorganism was introduced for application to planting media or plant materials, the bud starter was demonstrated as a pretreatment for buds or scions, and the shallot extract was demonstrated as a treatment for the basal portions of cuttings. These activities were designed to improve participants' practical competencies and reduce dependence on externally supplied inputs.

The technology transfer process followed a learning-by-doing sequence involving explanation, facilitator demonstration, participant practice, feedback, and field mentoring. Participants received a printed module containing formulation procedures, recommended dilution ratios, application methods, storage guidelines, and troubleshooting instructions. The effectiveness of the intervention was assessed based on participants' ability to prepare the formulations independently, apply the techniques correctly, and sustain propagation activities throughout the mentoring period. The formulations were introduced as practical interventions rather than products with proven efficacy. Their effects on rooting, bud break, graft establishment, and plant survival therefore required further observation and documentation during implementation.

Materials and Formulation Procedures

The materials included stale cooked rice, rice-infused water, coconut water, molasses, EM4 microbial solution, fresh shallots, clean water, fermentation containers, plastic bottles, measuring cups, filtering cloth, labels, and plant materials for grafting and cutting. Knives, pruning shears, blenders or mortars, and other basic preparation equipment were utilized during practical sessions. Clean containers and appropriate handling practices were emphasized throughout formulation preparation.

Local Microorganism Solution (MOL)

The MOL formulation was prepared using fermented cooked rice as the initial substrate, followed by adding water and molasses. This formula is adapted from the procedures described by Ummah et al. (2025), Lewi et al. (2024), and Zhang et al. (2022). Cooked rice around 50-70 grams was placed in a loosely covered container and incubated at ambient temperature for 3-5 days to let microbial colonization. The fermented rice was then mixed with 500 milliliters of clean water and 20 grams of molasses as a carbon source. The mixture was transferred to a fermentation container and fermented for 7-10 days under the specified conditions. The resulting liquid was filtered to remove solid residues and transferred into labeled bottles for storage (Areeshi, 2022). The MOL solution was diluted at a ratio of 1:100 (v/v), equivalent to 10 mL of MOL per liter of water. The diluted solution was introduced for application to planting media or appropriate plant materials through soil drenching or foliar spraying, depending on the propagation method and the intended application site (Ranasinghe et al., 2021).

Bud Starter Formulation

The bud starter was prepared using 2 liters of rice-infused water, 1 liter of coconut water, 120 milliliters of molasses, and 30 milliliters of EM4 microbial solution, following the formulation principles described by Ali et al. (2023) and Simbolon et al. (2024). All ingredients were mixed thoroughly and transferred into a closed fermentation container. The mixture was fermented at ambient temperature for 12-14 days, according to the procedure described by Syafi'i et al. (2025).

After fermentation, the formulation was prepared according to the training protocol. Before application, the stock solution was diluted with clean water at the prescribed working concentration. Participants were instructed to apply the diluted solution as a short pretreatment for buds or scions before grafting, following the practical guidance provided during training. The intended purpose was to introduce a treatment that could be evaluated for its potential contribution to bud development and graft establishment; these outcomes were not assumed to occur without observation (Chutimanukul et al., 2023; López-Rubio et al., 2025).

Shallot-Based Rooting Stimulant

A natural rooting stimulant was prepared from 150 grams of fresh shallots crushed with 1 liter of clean water. The mixture was filtered, and the resulting liquid was allowed to stand for approximately 5 hours to obtain the stock extract (Achmad, 2016). The extract was introduced as a locally sourced pretreatment intended to support the rooting process during vegetative propagation.

The stock extract was diluted according to the training protocol: 1:10 for soil drenching, 1:15 for foliar application, and 1:5 for soaking the basal portion of cuttings (approximately 2-3 cm) for 30-60 minutes (Yuniarti et al., 2022). The recommended treatment schedule was demonstrated during practical sessions, with the timing and frequency adjusted to the selected plant material and propagation method. Participants were also instructed to label the preparation date, use clean containers, store the extract in

a cool and dark location, and avoid using extract that showing signs of contamination. The proposed storage period of 5-7 days was treated as a practical guideline requiring appropriate monitoring rather than a validated shelf-life determination (Hafri et al., 2020).

Table 1. Training activity meeting schedule

Session 1	
Activities	- Opening ceremony and prayer - Introduction of the community service team - Presentation of training objectives and overview of the program - Activity planning and cost analysis for vegetative plant propagation
Objectives	- Create a proper learning atmosphere at the beginning of the training - Introduce the implementation team to the participants - Provide an initial understanding of the objectives and workflow of the training program - Enhance participants' knowledge of technical planning and cost estimation in plant propagation
Session 2	
Activities	- Presentation on vegetative and generative plant propagation methods - Explanation of natural hormones and nutrient concepts for plant growth and propagation
Objectives	- Improve participants' understanding of plant propagation techniques - Provide fundamental knowledge about the role of natural hormones and nutrients in plant development - Increase participants' awareness of appropriate and sustainable propagation practices
Session 3	
Activities	- Explanation and practical demonstration of cocopeat growing media preparation for air layering - Explanation and practical demonstration of polybag growing media preparation for nursery activities
Objectives	- Equip participants with practical skills in preparing suitable growing media - Enhance participants' ability to utilize environmentally friendly planting materials - Support the success of vegetative propagation processes
Session 4	
Activities	- Demonstration of vegetative propagation techniques (cuttings and grafting) - Demonstration of coffee seed germination and seedling practices
Objectives	- Provide direct examples of proper vegetative propagation techniques - Strengthen participants' technical skills through hands-on demonstrations - Reinforce theoretical knowledge through field-based practice
Session 5	
Activities	- Hands-on practice of plant propagation by participants (women farmer group members) with facilitator assistance - Interactive discussion during practical sessions
Objectives	- Train participants to independently apply plant propagation techniques - Increase participants' confidence in conducting nursery and propagation activities - Optimize skill transfer through direct practice and mentoring
Session 6	
Activities	- Collection of feedback and evaluations from participants - Closing ceremony - Activity documentation and content creation for reporting
Objectives	- Evaluate the implementation of the training program based on participant feedback - Formally conclude the activity - Document the training outcomes for reporting and publication purposes

Coffee Seed Scarification and Germination

A total of 100 coffee seeds underwent mechanical scarification by sanding before sowing. The seed coats were gently abraded with sandpaper to facilitate water uptake while avoiding damage to the underlying tissues and embryos. The scarified seeds were then sown in a suitable growing medium and maintained under the actual conditions during the training activity. Germination was monitored for one month, and seeds showing visible emergence of the radicle or seedling were recorded as germinated. The germination percentage was calculated as the number of germinated seeds divided by the total number of seeds sown, multiplied by 100.

This activity introduced participants to a simple seed pretreatment technique and basic monitoring of germination outcomes. Since no untreated control group was formed, the results represent germination following sanding treatment and do not establish the effect of scarification relative to untreated seeds.

Training and Implementation Procedures

The training activities employed a combination of presentation, discussion, demonstration, hands-on practice, and module-based learning. Presentations were used to deliver theoretical concepts regarding vegetative propagation, the role of biostimulants, formulation principles, and application techniques. The session was also followed by interactive discussions to encourage participant engagement and clarify technical aspects of the materials presented. Demonstrations were conducted by facilitators to show step-by-step procedures for producing MOL, bud starters, and rooting hormone solutions, as well as their application in grafting and cutting practices (Yusuf et al., 2024). Hands-on practice was emphasized to ensure that each participant directly experienced the formulation and application processes. A printed training module containing formulation recipes, safety guidelines, dosage recommendations, and troubleshooting tips was distributed to participants to serve as a long-term reference after the completion of the program.

Evaluation of the program used both qualitative and quantitative approaches. Qualitative data were collected through participant interviews, group discussions, and facilitator observations to assess changes in knowledge, attitudes, and confidence. Quantitative data included attendance rates, the number of participants able to independently produce biostimulants, and the survival rate of grafted and cut plants after applying the formulated products. Program success was assessed based on adherence to the planned schedule, improvements in participants' competencies in formulation and application techniques, and the effectiveness of facilitation and mentoring activities.

3. RESULTS AND DISCUSSION

Preparation of Training Materials and Technical Guidance

Training materials were developed in three complementary formats such as educational posters, training modules, and standard operating procedures (SOPs). The posters provided visual information on the preparation and application of plant biostimulants and propagation techniques (Figure 1). The training modules detailed the underlying concepts, required materials, procedures, and practical applications of biostimulants, vegetative propagation, coffee seed germination, and growing-media preparation. The SOPs provided step-by-step technical guidance to support consistent implementation and facilitate independent practice after the training. These materials were used as supporting resources during the presentations, demonstrations, and hands-on sessions. To enable verification and promote continued learning, digital copies of the posters, modules, and SOPs can be accessed through a publicly available link.



Figure 1. Visualization of training material for a training program on:
(a) MOL; (b) Bud starters; and (c) Rooting hormones creation

Training and Demonstration of Biostimulant Preparation

Participants attended demonstrations on preparing MOL, a bud-growth starter, and a shallot-based rooting stimulant. The sessions introduced the materials, preparation procedures, and intended applications of each formulation. Participants were also introduced to the potential use of these preparations as supporting inputs during plant propagation. The training emphasized that biostimulant application should be integrated with appropriate propagation techniques and seedling care. The activity produced three prepared formulations for demonstration and provided participants with practical exposure to locally accessible resources (Figure 2-4).



Figure 2. Raw materials for the production of biostimulant for plant propagation such as:
(a) MOL; (b) Bud starters; and (c) Rooting hormone

Hands-on Training in Vegetative Propagation

Following the biostimulant demonstrations (Figure 5-6), participants practiced grafting and stem-cutting techniques. The practical session focused on handling propagation materials, practicing the techniques, and understanding the importance of aftercare. Biostimulant was incorporated into the practical activities to introduce its potential role in supporting vegetative propagation. A total of 30 propagation materials were used during the practical exercise. The reported survival rate was 57 percent, equivalent to approximately 17 surviving materials if the percentage was calculated using all 30 materials as the denominator.



Figure 3. Design of biostimulant product composition for:
(a) MOL; (b) Bud starters; and (c) Rooting hormones packaging



Figure 4. Packaging and logo of the three biostimulant products:
(a) MOL; (b) Bud starters; and (c) Rooting hormones

This result represents an initial measure of establishment following the practical activity. Since an untreated comparison group and a comparable baseline survival rate were not available, the observed survival rate cannot be attributed solely to biostimulant application.



Figure 5. Demonstration of grafting and stem-cutting techniques



Figure 6. Practice in vegetative propagation techniques

Coffee Seed Scarification and Germination

Generative propagation was introduced through coffee seed scarification and germination. A total of 100 coffee seeds underwent mechanical scarification by sanding before sowing. The seeds were monitored for one month, and germination was recorded based on visible emergence of the radicle or seedling. After one month, 35 of the 100 seeds had germinated, corresponding to a germination percentage of 35 percent. The remaining 65 seeds had not been recorded as germinated by the end of the observation period.

This session provided participants with a practical opportunity to apply a seed pretreatment technique and quantify the outcome of germination. The observed results demonstrate that germination occurred following mechanical scarification by sanding under the conditions of the training. Since a comparison with untreated seeds was not conducted, it does not demonstrate that scarification increased germination. Further experiments comparing treated and untreated seeds would be necessary to evaluate the effect of this procedure.

Preparation of Cocopeat-Based Growing Media

Participants also practiced preparing cocopeat-based growing media for air-layering and seedlings grown in polybags. The activity complemented the propagation sessions by introducing the preparation of growing media as another component of seedling production. Participants were introduced to the intended use of the medium in supporting propagation and subsequent seedling maintenance.

This session broadened the practical scope of the program beyond biostimulant preparation and propagation techniques. However, measurements comparing different growing media or quantifying subsequent seedling growth were not available. Therefore, this activity is reported as a practical training output rather than evidence of improved seedling quality.

Seedling Distribution and Planting

The program also facilitated the allocation and planting of 297 seedlings of economically valuable tree species within the partner community. The seedlings comprised 97 avocadoes (*Persea americana*), 93 soursops (*Annona muricata*), 56 dog fruits (*Archidendron pauciflorum*), and 51 stink beans (*Parkia speciosa*). The allocation was coordinated with local representatives and adjusted to community preferences.

For example, the revised allocation for RT 06 (neighborhood unit 06) consisted of 10 avocado and 20 soursop seedlings in response to the local preference for fruit-bearing trees. Stink bean and dog fruit seedlings were placed in a separate nursery bed. The activity provided an immediate program output by making planting materials available to the community.

Table 2. Distribution of seedlings across neighborhood units (RTs) in Mluweh Village

RT (Neighborhood units)	Stink bean	Dog fruit	Avocado	Soursop	Total
RT 01	5	5	10	16	36
RT 02	—	—	—	—	—
RT 03	14	12	32	11	69
RT 04	5	10	5	10	30
RT 05	5	5	10	10	30
RT 06	0	0	10	20	30
RT 07	10	5	13	7	35
RT 08	7	9	6	8	30
RT 09	5	10	11	11	37
Total	**51**	**56**	**97**	**93**	**297**

Mentoring, Product Packaging, and Evaluation

The mentoring activities reinforced the training on biostimulant preparation and propagation techniques. Participants were also introduced to simple packaging and product labeling for biostimulants and seedlings to support their potential commercialization. These activities were intended to provide a foundation for developing community-based seedling and biostimulant enterprises. The training was conducted through structured sessions combining theoretical explanation and hands-on practice.

All planned sessions were successfully implemented with an average attendance rate of 60 percent, indicating high participant commitment and interest in the program. Participants expressed positive responses to the practicality and low cost of the technology introduced. The session concluded with mutual appreciation between the implementation team and farmer groups, strengthening commitment to apply and further develop the innovation within their farming systems.

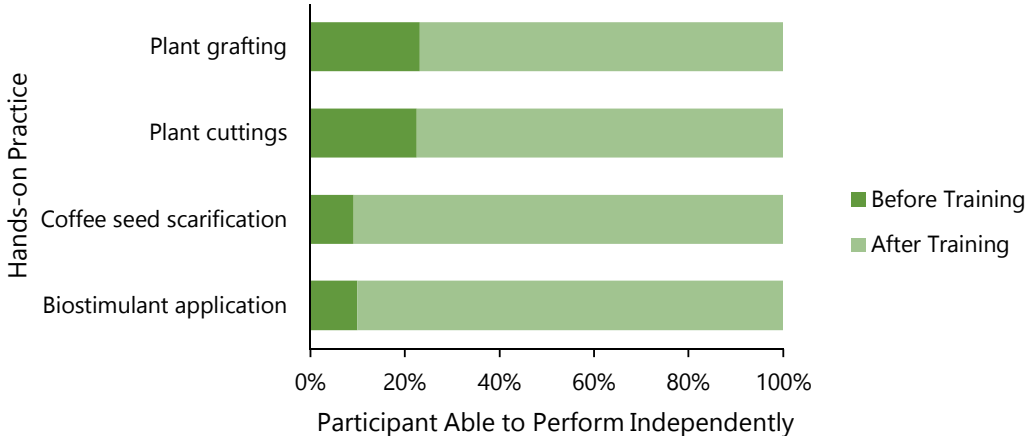


Figure 7. Assessment report results

Based on the reported assessment, the proportion of participants able to perform practical tasks independently increased from 11 percent to 100 percent for biostimulant application, from 10 percent to 100 percent for coffee seed scarification, from 29 percent to 100 percent for plant cuttings, and from 30 percent to 100 percent for plant grafting.

The community service program in the form of training on the production and application of plant propagation biostimulants has strong relevance to the needs of farmer groups in Mluweh Village, particularly in improving the success rate and efficiency of vegetative plant propagation. Based on unstructured interviews between the implementation team and participants, as well as direct observations during the activities, the community service program produced several important outcomes. First, the program significantly increased farmers' knowledge and practical skills in plant propagation using. This improvement was evident from the participants' ability to independently apply propagation methods, such as cuttings and grafting. In addition, the farmers demonstrated increased confidence in applying rooting hormones, MOL, and bud starters products during vegetative propagation practices (Antwi-Wiredu et al., 2025). Their active participation throughout all training sessions indicated a high level of engagement and learning motivation, as each session provided new theoretical explanations followed by direct hands-on practice.

Second, participants gained a deeper understanding of the role of biostimulants in supporting plant growth, root formation, and bud development through the integration of presentations and practical demonstrations. This finding is consistent with previous community service studies which reported that participatory training combined with practical demonstrations is effective in strengthening farmers' comprehension of agricultural innovations and increasing the likelihood of long-term adoption (Artanti, 2023). Moreover, introducing packaging and logo design increased farmers' awareness of the formulations' value, both as agricultural inputs and as potential products with commercial value.

The program facilitated the planting of 297 seedlings of economically valuable tree species across the partner community. The seedlings comprised stink beans (*Parkia speciosa*), dog fruits (*Archidendron pauciflorum*), avocadoes (*Persea americana*), and soursops (*Annona muricata*). This planting activity increased the availability of fruit-bearing and multipurpose tree seedlings within the community and supported the development of local vegetation resources. The planted seedlings are expected to provide long-term environmental and economic benefits as they grow and become productive. A total of 30 seedlings were used in practical training on vegetative propagation techniques, including grafting and cutting, accompanied by the application of locally sourced biostimulants. The observed seedling survival rate reached 57 percent, corresponding to approximately 17 surviving seedlings out of 30 treated seedlings. This result provides a quantitative indicator of seedling survival during the training and demonstrates the practical implementation of vegetative propagation techniques and biostimulant application. However, since no untreated control group was available, the observed survival rate cannot be attributed solely to the biostimulant treatment.

Several supporting factors contributed to the successful implementation of this community service program. First, strong cooperation from the local partner, particularly the farmer group leaders who facilitated the provision of training venues and participant mobilization. Second, the high level of enthusiasm and active involvement among participants support the discussions and practical sessions. Farmers frequently asked questions related to material composition, fermentation duration, storage methods, and application dosage, indicating genuine interest and critical engagement. Third, the program schedule was well-coordinated, minimizing interference from other local activities and ensuring a conducive learning environment. Fourth, logistical support from the local community, including the provision of refreshments, helped maintain participant comfort and focus during the training sessions.

In comparison with community-based agricultural training that emphasizes knowledge transfer and practical demonstrations, this program combined capacity building with direct planting activities and the introduction of locally prepared propagation inputs. This integration is relevant to the seedling availability challenge because training alone may not immediately increase the number of planting materials available to a community, while seedling distribution or planting alone may not develop the technical capacity required for continued local propagation. By combining these components, the program sought to address both the immediate need for seedlings and the longer-term need for practical propagation skills. This interpretation is consistent with the participatory training approach described by Artanti (2023), while the role of propagation treatments can be considered in relation to the application-oriented discussion in Antwi-Wiredu et al. (2025). A more direct comparison of effectiveness, however, requires verified confirmation from previous studies concerning the species treated, formulations used, propagation methods, assessment periods, and measured outcomes.

Despite these positive conditions, several limiting factors were also identified during the program implementation. First, since the training emphasized hands-on practice, a considerable amount of time was required to provide individual guidance to participants, particularly those who were unfamiliar with basic fermentation processes or vegetative propagation techniques. Second, a small number of participants initially expressed hesitation when handling organic materials used in MOL production due to concerns about odor and hygiene. This was largely due to lack prior exposure to such practices and was gradually reduced after further explanation and demonstration by the facilitators. Third, differences in participants' learning pace required facilitators to repeat certain demonstrations, slightly reducing time efficiency. Lastly, limited facilities and equipment constrained the possibility of simultaneous practice, requiring participants to take turns during some stages of production and application.

Overall, the program demonstrated that community-based training on locally formulated plant biostimulants can effectively enhance farmers' technical capacity, reduce dependence on commercial agricultural inputs, and promote sustainable farming practices. In addition to technical benefits, the program fostered a sense of innovation and collective confidence among farmer groups. These outcomes indicate that the integration of simple biotechnology, participatory learning methods, and product development elements has strong potential to be replicated in other rural communities. Ultimately, this approach supports the broader objectives of community service by transferring knowledge and empowering farmers to become active agents of agricultural innovation.

4. CONCLUSION AND RECOMMENDATIONS

The community service program addressed the farmer group's limited capacity to produce planting materials by providing practical training in plant biostimulant preparation and application, vegetative propagation, coffee seed scarification, and growing-media preparation. Based on the assessment, the proportion of participants able to perform practical tasks independently increased from 11 percent to 100 percent for biostimulant application, from 10 percent to 100 percent for coffee seed scarification, from 29 percent to 100 percent for plant cuttings, and from 30 percent to 100 percent for plant grafting. In addition to strengthening practical skills, the program supported local access to planting materials through the allocation of 297 seedlings comprising four economically valuable species: stink bean (*Parkia speciosa*, 51 seedlings), dog fruit (*Archidendron pauciflorum*, 56 seedlings), avocado (*Persea americana*, 97 seedlings), and soursop (*Annona muricata*, 93 seedlings).

Practical propagation activities involving 30 seedlings materials resulted in a reported survival rate of 57 percent, while 35 of 100 (35 percent) scarified coffee seeds germinated after one month. These quantitative outputs demonstrate progress in practical capacity and the provision of planting materials to address the partner's seedling shortage. However, improvements in seedling quality and the long-

term sustainability of local seedling production cannot yet be confirmed as the comparable baseline and follow-up measurements of seedling growth, health, survival, and production capacity were not available. Continued monitoring is therefore needed to determine whether the training and propagation practices lead to sustained increases in the availability and quality of seedlings.

Future community service programs are encouraged to allocate longer training durations, which allow more intensive practice and mentoring, particularly for participants with limited prior experience in fermentation processes and vegetative propagation. It is also suggested to include follow-up monitoring and evaluation sessions to assess long-term adoption, product consistency, and impacts on crop productivity. Collaboration with local agricultural extension officers and small-scale agribusiness institutions should be improved to support product standardization, quality control, and potential market development. Additionally, future programs may expand the scope by incorporating simple laboratory testing, shelf-life analysis, and cost–benefit evaluation to further validate the effectiveness and economic feasibility of the biostimulant products and to enhance their potential for wider replication in other farming communities.

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