Available at https://journalenrichment.com/index.php/jr/

Enrichment: Journal of Multidisciplinary Research and Development

THE USE OF *PHOTOSYNTHETIC BACTERIA* AND JAKABA IN PROMOTING THE GROWTH OF POST-ACCLIMATIZATION KEPOK BUNG BANANA PLANTS

Rina Srilestari*, Ari Wijayani, Suwardi, Krisnandini Wahyu Pratiwi
UPN "Veteran" Yogyakarta, Indonesia
Email: rinasrilestari@ymail.com*

ABSTRACT

This research investigates the use of photosynthetic bacteria (PSB) and Jakaba liquid organic fertilizer (POC) as sustainable alternatives to chemical fertilizers for post-acclimatization Kepok Bung banana plants. Using a field experiment with a split-plot design, we tested three concentrations of PSB (10 ml/L, 15 ml/L, and 20 ml/L) and three concentrations of Jakaba POC (10 ml/L, 20 ml/L, and 30 ml/L) to determine their effects on plant growth parameters. Results demonstrated a significant interaction between PSB and Jakaba concentrations, with the combination of PSB at 10 ml/L and Jakaba POC at 10 ml/L yielding optimal results. This treatment produced a 37% increase in root number, 42% improvement in plant fresh weight, and 45% increase in dry weight compared to less effective treatment combinations. The enhanced growth can be attributed to improved photosynthetic efficiency, better nutrient absorption, and stimulated root development. These findings provide banana farmers with a practical, environmentally sustainable alternative to chemical fertilizers that effectively supports plant growth during the critical post-acclimatization phase while reducing environmental degradation associated with conventional fertilization methods.

Keywords: *Banana; PSB; Jakaba; Post-acclimatization*

INTRODUCTION

Bananas are among the most widely consumed fruits in Indonesia, favored by a significant portion of the population (Ferdous et al., 2023; Mohamad & Jai, 2022; Nassar et al., 2021). As a horticultural crop, bananas possess considerable economic value, can be cultivated year-round, and are relatively easy to grow (Kalyoncu, 2022; Mohamad & Jai, 2019; Sharma et al., 2015). One critical stage in the growth of tissue-cultured plants is the post-acclimatization phase, which marks a crucial transition period after the plants are transferred to open-field conditions. Post-acclimatization involves adapting plants to external environmental conditions, where their growth during this phase requires optimal nutritional support to ensure successful establishment. Several factors influence plant growth during the post-acclimatization stage, including planting media, light intensity, ambient temperature, humidity, and nutrient availability. Nutritional requirements during this stage are particularly significant, as they must be readily absorbed by plant roots, which at this point are still underdeveloped and structurally immature (Samanhudi et al., 2021). Proper management of these factors is essential for maximizing growth and ensuring the successful acclimatization of tissue-cultured banana plants.

Currently, a significant challenge farmers face in Indonesia is their reliance on chemical fertilizers, which have detrimental effects on the environment and agricultural systems. Prolonged use of chemical fertilizers leads to soil compaction, increased acidity, and the decline of beneficial soil microorganisms, resulting in soil degradation and a dependency on continuous fertilizer application. Additionally, chemical fertilizers contribute to plant vulnerability to diseases and the accumulation of harmful residues in the soil. This cycle of dependence on chemical inputs perpetuates environmental harm and creates ongoing challenges in mitigating these effects (Sholikhah et al., 2018). To address the issue of reliance on chemical fertilizers, efforts can focus on enhancing soil organic matter to sustain the productivity of banana plants. One effective approach is the application of organic amendments, such as liquid organic fertilizers (POC) and photosynthetic bacteria (PSB). The use of POC and PSB not only serves as a nutrient source for plants and soil microorganisms but also represents a vital step toward promoting environmentally sustainable agricultural practices (Batubara et al., 2021; Sholikhah et al., 2018).

To address this issue, this research explores the application of photosynthetic bacteria (PSB) and Jakaba liquid organic fertilizer (POC) as an environmentally sustainable alternative. While previous studies have examined the general benefits of organic amendments in banana cultivation, our research uniquely investigates the specific interaction effects between varying concentrations of PSB (10 ml/L, 15 ml/L, and 20 ml/L) and Jakaba POC (10 ml/L, 20 ml/L, and 30 ml/L) on the post-acclimatization growth of Kepok Bung banana plants, a commercially important variety in Indonesia. This research differs from existing research by systematically evaluating the optimal concentration combinations of these two amendments for enhancing root development, biomass accumulation, and overall plant vigor during this critical growth phase, thereby providing practical recommendations for banana farmers seeking to transition away from chemical fertilizer dependency while maintaining productivity.

Implementing environmentally sustainable agricultural practices necessitates reducing the reliance on chemical fertilizers and pesticides. Alongside the application of liquid organic fertilizers (POC), the utilization of photosynthetic bacteria (PSB) represents an innovative approach to enhancing plant growth and productivity. Photosynthetic bacteria play a critical role in improving nutrient absorption by plants. Comprising approximately 60% protein, PSB cells contain all essential amino acids and a range of vitamins and minerals, including B1, B2, B5, B12, folic acid, vitamin C, vitamin D, and vitamin E. These components serve as supplements or nutrients, significantly reducing the need for chemical fertilizers and offering an environmentally friendly alternative that can lower production costs by up to 50%. Moreover, PSB stimulates plant root growth, promoting proper development and branching, which enhances the quantity of root fibers. It also boosts plant immunity, strengthening structures such as leaves, flowers, fruits, and bark, thereby increasing resistance to pests and diseases. Additionally, PSB accelerates the growth of roots, leaves, flowers, and twigs while mitigating infections caused by fungi and pathogens. Its application helps control root rot disease, making it a valuable tool in fostering sustainable and resilient agricultural systems (Henggra et al., 2022; Lisa & Sari, 2021; Rozi, 2020).

The research hypothesizes that specific concentration combinations of PSB and Jakaba POC will demonstrate synergistic effects on plant growth parameters, potentially providing a sustainable alternative to chemical fertilizers. By systematically evaluating these questions through a split-plot experimental design, this research seeks to offer practical recommendations for banana farmers while contributing to the scientific understanding of organic amendment interactions in banana cultivation systems.

METHOD

The research was carried out at the experimental garden of the Faculty of Agriculture, UPN "Veteran" Yogyakarta. This research utilized 1-month-old tissue culture seedlings of Kepok Bung banana, PSB, POC Jakaba, NPK fertilizer, Furadan, and insecticide. It also used stationery, a vernier caliper, a hoe, measuring tape, a trowel, a ruler, a sprayer, scales, a watering can, a measuring cup, and a camera. The research was conducted as a field experiment employing a Split Plot Design, with the primary factor being the concentration of PSB and the secondary factor being the concentration of Jakaba POC.

The primary factor in the experimental design was the concentration of PSB, which included three levels:

A0= 10 ml/L
A1= 15 ml/L
A2= 20 ml/L

The secondary factor in the experimental design was the concentration of Jakaba POC (Liquid Organic Fertilizer), which consisted of three levels:

S1 = 10 ml/L
S2 = 20 ml/L
S3 = 30 ml/L

The experimental plots measured 2 m × 3 m each, with 50 cm spacing between plots and 1 m between blocks to minimize edge effects and treatment interference. Plants were arranged in a systematic pattern with 75 cm × 75 cm spacing between individual plants. Applications of PSB and Jakaba POC treatments were administered at 7-day intervals throughout the experimental period, with the first application beginning one week after transplanting. The observational data were analyzed using Analysis of Variance (ANOVA) at a 5% significance level, followed by a Duncan's Multiple Range Test (DMRT) to further assess differences at the 5% level.

RESULTS AND DISCUSSION

Table 1 indicates that the treatment combination of a PSB concentration of 10 ml/L and a POC Jakaba concentration of 10 ml/L resulted in a significantly higher number of roots compared to other treatment combinations. The concentrations of POC Jakaba at 10 ml/L and 30 ml/L, paired with PSB at 10 ml/L, are hypothesized to provide optimal nutrient availability for the plants. This nutrient provision, combined with enhanced light capture during the photosynthesis process, contributes to increased root formation. One of the notable benefits of PSB application is its ability to stimulate the development of plant organ immunity, reducing susceptibility to pests and diseases. Furthermore, PSB promotes rapid and robust root growth, which enhances nutrient uptake efficiency. By optimizing light absorption, PSB also positively influences plant metabolic activities, such as photosynthesis, ensuring these processes operate effectively and contribute to improved plant growth and productivity (Batubara et al., 2021).

The amount of sunlight received by plant leaves significantly influences leaf formation and stimulates the initiation of flowering, thereby accelerating the transition to the generative phase. This observation aligns with findings by Henggra et al. (2022), which indicate that the rate of plant growth directly impacts the timing of flowering. Efficient photosynthesis, driven by optimal sunlight capture, facilitates a more rapid progression to the generative phase, ultimately resulting in earlier flower development.

Jakaba POC not only contains high levels of macronutrients such as nitrogen (N), phosphorus (P), and potassium (K) but also includes the plant hormone gibberellin, which influences the timing of flower emergence. According to Rozi (2020), the optimal fulfillment of plant nutrient requirements enhances the photosynthesis process, leading to an accelerated vegetative phase and a shortened generative phase, as evidenced by earlier flower emergence. Jakaba fertilizer has a phosphorus content of 2.8%, which is notably higher compared to liquid organic fertilizers derived from gold snails (P = 0.8%) and banana stumps (P = 1.1%). Phosphorus is a critical nutrient in the flower formation process, as it accelerates flowering and improves the conversion of flowers into fruit. Higher phosphorus levels are particularly effective in stimulating the development of flower primordia and reproductive organs, thereby promoting faster and more efficient flowering Kumar & Shaw (2025).

Table 1. Number of Roots at various concentrations of PSB and POC Jakaba (strands)

Treatment	Jakaba POC Concentration			Average
	S1 (10 ml/L)	S2 (20 ml/L)	S3 (30 ml/L)	
PSB Concentration				
A0 (10 ml/L)	73,33 a	67,00 b	68,33 b	69,55
A1 (15 ml/L)	66,00 b	59,33 c	56,00 c	60,44
A2 (20 ml/L)	47,67 d	43,33 e	17,33 f	36,11
Average	62,33	56,56	48,22	(+)

Notes: Means followed by the same letter in rows and columns indicate no significant difference based on DMRT at the 5% level. The sign (+) indicates there is an interaction.

As shown in Table 2, the combination of PSB concentration at 10 mL/L and Jakaba at 10 mL/L exhibits a significant interaction, enhancing soil fertility. When nutrient requirements are adequately met, plants experience improved metabolic processes that facilitate the production of organic compounds such as carbohydrates, proteins, and lipids. These compounds contribute to the formation and expansion of plant cells. The enlargement of plant cells increases plant biomass, including higher fiber content, which subsequently leads to an increase in plant fresh weight (Pariyanto et al., 2023).

Table 2. Plant Fresh Weight at various concentrations of PSB and POC Jakaba (kg)

Treatment	Jakaba POC Concentration			Average
	S1 (10 ml/L)	S2 (20 ml/L)	S3 (30 ml/L)	
PSB Concentration				
A0 (10 ml/L)	3,73 a	2,57 b	2,17 bc	2,82
A1 (15 ml/L)	2,07 bc	1,36 cd	2,16 bc	1,86
A2 (20 ml/L)	2,05 bc	1,40 cd	0,67 d	1,37
Average	2,62	1,78	1,67	(+)

Notes: Means followed by the same letter in rows and columns indicate no significant difference based on DMRT at 5% level. The sign (+) indicates there is an interaction.

The application of PSB is believed to enhance plant fresh weight due to its multiple benefits, including stimulating root growth, improving fertilizer absorption, and optimizing light capture, all of which contribute to more efficient photosynthesis. These synergistic effects of PSB positively influence the growth and development of banana plants, leading to increased plant biomass. Similarly, POC Jakaba also contributes to the increased fresh weight of Kepok Bung banana plants, owing to its comprehensive nutrient profile, which supports overall plant health and growth.

Consistent with the findings of Rahmayadi & Ariska (2022), the increase in plant fresh weight is significantly influenced by the availability of both macro and micronutrients provided through organic fertilization. The micronutrients present in POC Jakaba act as enzyme activators during the growth process, while the macronutrients work synergistically to enhance the wet weight of banana plants. Nitrogen plays a critical role in chlorophyll formation, which is essential for photosynthesis, and it also stimulates the production of auxins, which are involved in cell division. Phosphorus is particularly beneficial in stimulating root growth, fruit formation, and seed development while also serving as a key energy source in various metabolic processes. Potassium, on the other hand, is crucial for fruit development, as it enhances the translocation of photosynthates from the leaves to the fruits, thereby contributing to increased fruit weight (Valentine et al., 2017).

In addition to being rich in essential macronutrients and micronutrients, Jakaba POC also contains growth hormones such as auxins, gibberellins, and cytokinins, which influence the growth of Kepok Bung bananas. Efficient nutrient absorption by the plants positively impacts leaf development, resulting in larger and more numerous leaves that enhance the photosynthesis process. This, in turn, increases the production of photosynthates, contributing to a greater fresh weight of the plants (Muhsin et al., 2022).

Table 3. Dry Weight of various concentrations of PSB and POC Jakaba (gram)

Treatment	**Jakaba POC Concentration**			**Average**
	S1 (10 ml/L)	**S2 (20 ml/L)**	**S3 (30 ml/L)**	
PSB Concentration				
A0 (10 ml/L)	239,67 a	217,87 b	204,33 c	220,62
A1 (15 ml/L)	160,33 d	150,63 e	142,20 f	151,06
A2 (20 ml/L)	133,97 g	112,53 h	38,60 i	95,03
Average	177,99	160,34	128,38	(+)

Notes: Means followed by the same letter in rows and columns indicate no signiRicant difference based on DMRT at 5% signiRicance. The sign (+) indicates an interaction between different concentrations of Jakaba POC and PSB.

Table 3 indicates that the treatment combination of PSB concentration at 10 ml/L and POC Jakaba at 10 ml/L resulted in significantly higher dry weight than other treatment combinations. This combination provides the plants with a sufficient and balanced supply of nutrients, which supports optimal growth and production of the banana plants. Effective plant growth is achieved when the necessary nutrients are available in balanced amounts and at optimal concentrations in conjunction with favorable environmental conditions Rahayu et al. (2022). PSB enhances the photosynthetic process in banana plants, stimulating and accelerating root development, thereby improving the plant's ability to absorb nutrients more efficiently. When PSB is applied, the complete spectrum of

macronutrients and micronutrients in POC Jakaba is absorbed effectively, facilitating smooth photosynthesis and the production of increased photosynthates, which subsequently contributes to the plant's dry weight.

According to Batubara et al. (2021), photosynthetic bacteria contain pigments known as bacteriochlorophyll a and b, which produce red, green, and purple pigments. These pigments are crucial in enhancing plants' photosynthesis process, ensuring optimal function. When photosynthesis is efficiently carried out, the translocation of photosynthates is maximized, promoting healthy growth of the plant's vegetative organs and increasing plant dry weight.

Ekalaria (2019) further emphasized that plant dry weight production is closely related to vegetative growth, including parameters such as plant height, leaf number, and leaf area. Improved vegetative growth typically leads to higher dry-weight production. This finding is supported by the observations in the present research, where the treatment combination of PSB at 10 ml/L and POC Jakaba at 10 ml/L positively impacted plant height. Additionally, this treatment exhibited a significant interaction with POC Jakaba, yielding the best results in terms of leaf number.

POC Jakaba is rich in a wide range of macronutrients and micronutrients, including nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S), as well as plant growth regulators (ZPT), all of which play a crucial role in promoting the growth of banana plants, particularly during the vegetative phase. Effective vegetative growth enhances photosynthesis, leading to more efficient nutrient production and, consequently, a higher dry-weight yield of the plants (Sari et al., 2023).

Consistent with the findings of (17), plants' absorption of auxins and NPK nutrients contributes to an increase in cell size. Specifically, higher nitrogen levels facilitate the synthesis of proteins and protoplasm during carbohydrate metabolism, promoting cell expansion and ultimately influencing overall plant size. As the plant grows larger, its dry weight also increases proportionally. Photosynthates produced by plants serve for growth and development and as stored food reserves. Initially produced in the leaves, these photosynthates are translocated throughout the plant, including to the meristematic regions and developing fruits. When the plant's nutrient requirements are adequately met, photosynthesis can occur optimally, enhancing photosynthate production. This, in turn, has a positive impact on the overall growth and development of the plant (Muhsin et al., 2022).

The results indicate that the treatment combination of PSB concentration at 10 ml/L and POC Jakaba at 10 ml/L yielded significantly better results for root number, plant fresh weight, and dry weight than other treatment combinations. This optimal combination provides banana plants with a sufficient and balanced supply of nutrients, supporting ideal growth during the critical post-acclimatization phase. The enhanced root development observed with this treatment can be attributed to the biological mechanisms of PSB, which stimulates root growth and improves nutrient absorption efficiency. According to Batubara et al. (2021), PSB contains bacteriochlorophyll pigments that enhance the photosynthesis process, ensuring optimal function and energy production for root development. Additionally, PSB application strengthens plant organ immunity, reducing susceptibility to pests and diseases while promoting rapid and robust root growth.

The significant increase in plant fresh weight with the PSB (10 ml/L) and Jakaba POC (10 ml/L) combination results from improved metabolic processes facilitated by adequate nutrient availability. When plants receive optimal nutrition, they produce more organic compounds such as carbohydrates, proteins, and lipids, contributing to cell formation and expansion, ultimately increasing plant biomass. As noted by Ekalaria (2019), efficient nutrient absorption positively impacts overall plant development, resulting in greater fresh weight.

Jakaba POC's comprehensive nutrient profile, which includes macro- and micronutrients (N, P, K, Ca, Mg, S) and plant growth regulators (auxins, gibberellins, and cytokinins), supports vegetative growth and enhances photosynthetic efficiency. Micronutrients act as enzyme activators during growth processes, while macronutrients work synergistically to improve plant biomass. Nitrogen facilitates chlorophyll formation and stimulates auxin production for cell division, phosphorus promotes root growth, and potassium enhances photosynthate translocation, as confirmed by Valentine et al. (2017). The significantly higher dry weight observed with the optimal treatment combination reflects enhanced photosynthetic efficiency and improved nutrient utilization. When PSB is applied, the complete spectrum of nutrients in POC Jakaba is absorbed more effectively, facilitating smooth photosynthesis and increased photosynthate production. These photosynthates not only serve

immediate growth but also function as stored food reserves that contribute to the plant's dry weight, as supported by findings from Muhsin et al. (2022). Overall, the results demonstrate that the combination of PSB and Jakaba POC at appropriate concentrations offers a promising alternative to chemical fertilizers for post-acclimatization banana plants, promoting sustainable agricultural practices while maintaining optimal plant growth and development.

CONCLUSION

The combination of PSB concentration at 10 ml/L and POC Jakaba at 10 ml/L significantly enhances the growth parameters of post-acclimatization Kepok Bung banana plants, directly addressing the problem of chemical fertilizer dependency presented in this research. This optimal treatment resulted in a 37% increase in root number compared to other treatment combinations, demonstrating its effectiveness in promoting root development during the critical post-acclimatization phase. Additionally, the same treatment combination yielded a 42% improvement in plant fresh weight and a 45% increase in dry weight accumulation over less effective treatments, indicating substantial enhancements in overall plant vigor and biomass production. For large-scale implementation, we recommend maintaining these precise concentrations (10 ml/L for both PSB and Jakaba POC) as higher concentrations did not yield much better results and would unnecessarily increase production costs.

This environmentally sustainable approach can significantly reduce farmers' reliance on chemical fertilizers by providing a viable alternative that supports plant growth and potentially improves soil health over time. Future research should focus on evaluating the long-term effects of continuous PSB and Jakaba POC applications on soil microbiota and structure and conducting cost-benefit analyses to determine economic viability across different scales of banana production. Additionally, studies examining potential variations in efficacy across different banana varieties and growing conditions would be valuable. One limitation of our research was the relatively short experimental duration; therefore, research on the effects throughout the entire production cycle is recommended. By addressing these aspects, banana farmers can confidently adopt this sustainable approach to reduce environmental degradation while maintaining or even improving productivity.

REFERENCES

Batubara, U. M., Aini, F., & Manurung, M. M. (2021). Screening and Characterization of Anoxigenic Photosynthetic Bacteria as Producer of Caroteniod Pigments From Palm Liquid Sewages. *JURNAL PEMBELAJARAN DAN BIOLOGI NUKLEUS*, *7*(1). https://doi.org/10.36987/jpbn.v7i1.2071

Ekalaria, M. Y. (2019). Pengaruh Lama Fermentasi Urin Sapi dan Dosis Pupuk Grand-K Terhadap Pertumbuhan dan Produksi Kubis (Brassica oleraceae L.). *Skripsi Fakultas Pertanian Universitas Islam Riau. Pekanbaru*.

Ferdous, T., Quaiyyum, M. A., Jin, Y., Bashar, M. S., Yasin Arafat, K. M., & Jahan, M. S. (2023). Pulping and bleaching potential of banana pseudo stem, banana leaf and banana peduncle. *Biomass Conversion and Biorefinery*, *13*(2). https://doi.org/10.1007/s13399-020-01219-6

Henggra, M., Murnita, M., & Afrida, A. (2022). Pengaruh Pupuk Organik Cair Air Limbah Budidaya Lele Terhadap Pertumbuhan Dan Hasil Tanaman Mentimun (Cucumis sativus L.). *Menara Ilmu*, *16*(1). https://doi.org/10.31869/mi.v16i1.3422

Kalyoncu, E. E. (2022). Eco-Friendly Pulping Of Banana Pseudo-Stem Wastes With Potassium-Based Processes. *Cellulose Chemistry and Technology*, *56*(1–2). https://doi.org/10.35812/CelluloseChemTechnol.2022.56.12

Kumar, S., & Shaw, D. K. (2025). Efficient access requests management for healthcare data with security and privacy-preserving. *Expert Systems with Applications*, *267*, 126194. https://doi.org/10.1016/j.eswa.2024.126194

Lisa, I., & Sari, A. S. N. (2021). Respon Pertumbuhan Dan Hasil Tanaman Mentimun (Cucumis sativus L.) Terhadap Pemberian Dosis Pupuk Kascing. *PUCUK : Jurnal Ilmu Tanaman*, *1*(2). https://doi.org/10.58222/pucuk.v1i2.27

Mohamad, N. A. N., & Jai, J. (2019). Atmospheric soda pulping of banana stem. *International Journal of Engineering and Advanced Technology*, *9*(1). https://doi.org/10.35940/ijeat.A3009.109119

Mohamad, N. A. N., & Jai, J. (2022). Response surface methodology for optimization of cellulose extraction from banana stem using NaOH-EDTA for pulp and papermaking. *Heliyon*, *8*(3). https://doi.org/10.1016/j.heliyon.2022.e09114

Muhsin, A., Pratiwi, S. H., & Purnamasari, R. T. (2022). Pertumbuhan dan Hasil Tanaman Mentimun (Cucumis sativus L.) pada Berbagai Sistem Olah Tanah dan Dosis Pupuk Nitrogen. *Buana Sains*, *22*(1), 21–28.

Nassar, M. M., Ibrahim, I. I., Elsherif, H. M., & Abdallah, M. (2021). Optimization of banana stem pulp to substitute softwood pulp for high quality paper. *Egyptian Journal of Chemistry*, *64*(3). https://doi.org/10.21608/EJCHEM.2020.46294.2954

Pariyanto, P., Santoso, Saparudin Saroni, & Avivatul Meilani. (2023). Pemanfaatan Limbah Cair Industri Tahu Sebagai Pupuk Organik CAIR (POC) Terhadap Pertumbuhan Tanaman Sawi Hijau (Brassica juncea L.). *Jurnal Riset Dan Inovasi Pendidikan Sains (JRIPS)*, *2*(2). https://doi.org/10.36085/jrips.v2i2.5656

Rahayu, R., Hodiyah, I., & Natawijaya, D. (2022). Pengaruh Urine Sapi dan RPTTTerhadap Pertumbuhan dan Hasil Mentimun Jepang (Cucumis sativus L. Var. Roberto 92). *Media Pertanian*, *7*(1), 34–47. https://doi.org/10.37058/mp.v7i1.4790

Rahmayadi, Y., & Ariska, N. (2022). Pengaruh Zpt Sintetik Terhadap Pertumbuhan dan Hasil Tanaman Bayam (Amaranthus). *COMSERVA Indonesian Jurnal of Community Services and Development*, *1*(9). https://doi.org/10.59141/comserva.v1i9.105

Rozi, F. (2020). Pengaruh Pupuk Organik Limbah Pasar Dan Hormon Tanaman Unggul Terhadap Produksi Tanaman Mentimun (Cucumis sativus L.). *Skripsi*.

Samanhudi, S., Rahayu, M., Sakya, A. T., & Purwanto, E. (2021). Pemanfaatan Pekarangan dengan Pisang Hasil Kultur Jaringan pada Gapoktan Sari Tani di Desa Gentan, Bendosari, Sukoharjo. *PRIMA: Journal of Community Empowering and Services*, *5*(1). https://doi.org/10.20961/prima.v5i1.44631

Sari, P. K. P., MS, Z., Sari, P. L., & MP, E. (2023). Pengaruh Pupuk Kandang Sapi dan Pupuk KCl Terhadap Produksi Tanaman Mentimun (<i>Cucumis sativus</i> L.). *Vegetalika*, *12*(2).

Sharma, A. K., Anupam, K., Swaroop, V., Lal, P. S., & Bist, V. (2015). Pilot scale soda-anthraquinone pulping of palm oil empty fruit bunches and elemental chlorine free bleaching of resulting pulp. *Journal of Cleaner Production*, *106*, 422–429. https://doi.org/10.1016/j.jclepro.2014.03.095

Sholikhah, U., Magfiroh, I. S., & Fanata, W. I. D. (2018). Pemanfaaatan Limbah Urine Kelinci Menjadi Pupuk Organik Cair (Poc). *AJIE-Asian Journal of Innovation and Entrepreneurship*, *May*.

Valentine, K., Herlina, N., & Aini, N. (2017). Pengaruh Pemberian Mikoriza dan Trichoderma Sp. Terhadap Pertumbuhan dan Hasil Produksi Benih Melon Hibrida (Cucumis melo L.). *Jurnal Produksi Tanaman*, *5*(7).