

EVALUASI KONSENTRASI NUTRISI TERHADAP PERTUMBUHAN SAWI PAKCOY (*Brassica rapa* L.) MENGGUNAKAN HIDROPONIK NFT (NUTRIENT FILM TECHNIQUE) BERSENSOR

*EFFECT OF NUTRIENT SOLUTION CONCENTRATION ON THE GROWTH PERFORMANCE OF PAKCOY MUSTARD (*Brassica rapa* L.) UNDER A SENSOR-BASED NUTRIENT FILM TECHNIQUE HYDROPONIC SYSTEM*

Zelia Camoes dos Santos¹, Stefan Saputra Sugiarno¹, Timothy Amadeus Filhend Plessers¹, and Popy Hartatie Hardjo^{1*}

¹Faculty of Biotechnology, University of Surabaya, Surabaya

*Corresponding Author. E-mail address: poppy_hardjo@staff.ubaya.ac.id

ARTICLE HISTORY:

Received: 3 March 2025

Peer Review: 11 July 2025

Accepted: 30 October 2025

KATA KUNCI:

Konduktivitas listrik

KEYWORDS:

Electrical conductivity

ABSTRAK

Pertumbuhan tanaman sawi pakcoy dapat dipengaruhi oleh konsentrasi dan komposisi larutan nutrisi hidroponik. Tujuan dari penelitian ini adalah untuk mengidentifikasi konsentrasi larutan nutrisi yang ideal untuk pertumbuhan sawi pakcoy saat panen. Pengaturan eksperimen yang diadopsi adalah desain blok acak dengan 5 level konduktivitas listrik (KL) yang berbeda, yaitu 0,8 mS.cm⁻¹, 1,2 mS.cm⁻¹, 1,6 mS.cm⁻¹, 2,0 mS.cm⁻¹, dan 2,4 mS.cm⁻¹, dengan sepuluh ulangan untuk setiap perlakuan. Parameter yang dievaluasi untuk menilai efektivitas masing-masing perlakuan meliputi tinggi tanaman, jumlah daun, luas daun, berat segar keseluruhan tanaman, dan tingkat klorofil. Data dianalisis menggunakan Duncan Multiple Range Test (DMRT) ($p < 0,05$) untuk mengidentifikasi perbedaan di antara perlakuan. Temuan menunjukkan bahwa EC 2,0 mS.cm⁻¹ menghasilkan pertumbuhan tertinggi sawi pakcoy, dengan tinggi tanaman mencapai 9,6±2,38 cm, jumlah daun 23,9±2,13, luas daun 32,81±8,95 cm², dan konsentrasi klorofil 5,9±0,52 mg.l⁻¹ pada umur panen 4 minggu.

ABSTRACT

*The growth of pakcoy mustard (*Brassica rapa* L.) is strongly influenced by the concentration and composition of hydroponic nutrient solutions. This study aims to determine the optimal nutrient solution concentration for maximized pakcoy mustard growth at harvest. The experimental setup adopted was a randomized block design featuring 5 different levels of electrical conductivity (EC), specifically 0.8 mS.cm⁻¹, 1.2 mS.cm⁻¹, 1.6 mS.cm⁻¹, 2.0 mS.cm⁻¹, and 2.4 mS.cm⁻¹, with replicated ten times. The parameters evaluated to assess the efficacy of each treatment include plant height, number of leaves, leaf area, overall fresh weight of the plant, and chlorophyll levels. Data were analyzed using Duncan Multiple Range Test (DMRT) at a 5% significance level ($p < 0.05$). The results indicated that an EC of 2.0 mS.cm⁻¹ led to the greatest growth of pakcoy mustard, achieving a plant height of 9.6±2.38 cm, a leaf count of 23.9±2.13, a leaf area of 32.81±8.95 cm², and a chlorophyll concentration of 5.9±0.52 mg.l⁻¹ with a harvest period of four weeks.*

1. INTRODUCTION

Pakcoy mustard (*Brassica rapa* L.) is a leafy vegetable belonging to the mustard family. It is considered an economically valuable crop and provides numerous health advantages. Pakcoy mustard is high in minerals and vitamins (including vitamins K, A, C, and E), as well as folic acid. The increasing demand for vegetable consumption among the Indonesian population must be matched by higher production levels. Therefore, to enhance the yield of vegetable crops such as pakcoy, hydroponic methods have been widely adopted. Vegetables are particularly suited for hydroponic methods since they have relatively small and light stems (Rosman *et al.*, 2019). Furthermore, the reduction of agricultural land due to the conversion of agricultural land to non-agricultural areas has encouraged the agricultural sector, both the government and farmers, to increase crop production in a restricted area. Consequently, the adoption of hydroponic farming systems provides an effective solution to this issue (Sardare and Admane, 2013; Barbosa *et al.*, 2015; Khan *et al.*, 2018; Rajaseger *et al.*, 2023).

The hydroponic farming method involves growing plants without soil, instead relying on nutrient solutions to promote plant development (Fuzzy and Papenbrock, 2022). The Commercial Nutrient Film Technique (NFT) hydroponic system has been utilized globally, resulting in high yields of leafy vegetables and other crops while conserving 70% to 90% less water (Sharma *et al.*, 2019). NFT is a hydroponic system in which the nutrient solution continuously circulates. Plant nutrient requirements are supplied in the form of inorganic nutrient solutions consisting of dissolved macronutrient and micronutrient salts commonly prepared in nutrient stock solutions A and B.

Meeting the optimal nutrient requirements is a crucial factor in cultivating *Brassica oleraceae* L. (Sinaga *et al.*, 2014), mustard greens (Pakpahan *et al.*, 2020), sweetpotato (Sakamoto and Suzuki, 2020) under hydroponic conditions. The nutrient levels in the solution were determined based on electrical conductivity (EC) measurements. Electrical conductivity indicates the total concentration of dissolved ions in the solution, reflecting its overall nutrient strength. Enhancing the nutrient availability can therefore increase yield and overall productivity. In conventional soil-based cultivation, pakcoy mustard typically requires approximately ± 45 days to reach harvest maturity. Nevertheless, hydroponic cultivation is expected to be quicker, requiring only about four weeks to achieve the equal biomass to those traditional grown plants. This study aims to determine the optimal nutrient solution concentration for mustard greens growth in a sensor-driven hydroponic NFT system within a four-week cultivation period.

2. MATERIALS AND METHODS

This study was conducted from October to November 2024 in the greenhouse of the University of Surabaya, Indonesia. The study site is located at an altitude of approximately 50 meters above sea level (m asl). The instruments and materials used in this research included an EC-meter, pH-meter, hygrometer, aerator, water pump, leaf area meter, digital scale, pakcoy mustard seeds, rockwool growing medium, AB Mix nutrient solutions, and a NFT hydroponic system equipped with sensors to monitor nutrient electrical conductivity (EC), solution pH, and relative humidity (RH).

The experiment was arranged in a randomized block (RBD) consisting of five treatments, with different electrical conductivity (EC) levels: 0.8, 1.2, 1.6, 2.0, and 2.4 mS.cm⁻¹. Each treatment was replicated ten times. The pH of the nutrient solution was maintained at a constant value of 6.0 throughout the experiment. During the initial week, seedlings were supplied with a nutrient solution at an EC of 0.5 mS.cm⁻¹, followed by the application of the five EC treatments described earlier in the subsequent weeks.

Non-destructive observations were conducted weekly to assess plant height, leaf number, leaf area, total fresh weight, total dry weight, and chlorophyll content were measured at 4 weeks after transplanting. Data were analyzed using Analysis of Variance (ANOVA) at a significance level of $\alpha = 0.05$ and followed by the Duncan Multiple Range Test (DMRT) to determine significance differences among treatments. Harvesting was carried out in the fourth week after transplanting to the hydroponics system.

Shoot and root samples were oven-dried at 85°C for 48 hours. The root/shoot ratio was calculated by dividing the root dry weight by the shoot dry weight (Li *et al.*, 2018). Chlorophyll content was conducted from the largest leaves. Approximately 0.3 g of the leaves were ground in a mortar under cryogenic conditions using liquid nitrogen (N₂) until a fine powder was obtained. The fine powder was placed in a falcon tube and mixed with 5 mL of acetone, then incubated for 24 hours. The extract was centrifuged, and the supernatant was collected for absorbance measurement using a spectrophotometer at wavelengths of 645 nm and 663 nm. Chlorophyll a = $12.72 \cdot A_{663} - 2.59 \cdot A_{645}$; Chlorophyll b = $22.9 \cdot A_{645} - 4.67 \cdot A_{663}$; Total chlorophyll = $20.31 \cdot A_{645} + 8.05 \cdot A_{663}$ (Sukweenadhi *et al.*, 2018).

3. RESULT AND DISCUSSION

The average height of pakcoy mustard at various concentrations of nutrient solution during 4 weeks is shown at Figure 1. Based on Figure 1, an electrical conductivity (EC) of 2.0 mS.cm⁻¹ resulted in the tallest average plant height of pakcoy mustard, reaching approximately 9.6 cm after four weeks of growth. Increasing EC levels generally promotes vegetative growth (figure 1), which is consistent with the findings of Del Carmen Salas *et al.*, (2020) who reported that an EC of 3.0 dS.m⁻¹ was ideal for saffron growth and corm yield compared to lower EC levels such as 2.0 dS.cm⁻¹ and 2.5 dS.cm⁻¹. Conversely, Dewir and Alsadon (2022) state that the lowest EC level in their study enhance the vegetative growth of saffron, as the roots were continuously submerged in the nutrient solution. Similarly Pratiwi *et al.*, (2015) found that the ideal EC level for the fresh weight of mustard was 2.5 mS.cm⁻¹ produced the highest fresh weight in mustard plants. These findings indicate that EC levels substantially influence the vegetative growth performance of pak choy mustard during the four-week growth period.

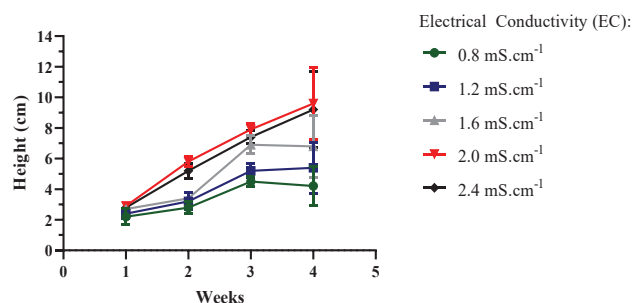


Figure 1. Average height of pakcoy mustard at various concentration of nutrient solution during 4 weeks

Table 1. Average plant height, number of leaves, and leaf area at various nutrient solution concentrations for 4 weeks.

Value of EC (mS.cm ⁻¹)	Plant height (cm)	Number of leaves	Leaf area (cm ²)
0.8	4.2±1.25 ^a	16.4±1.85 ^a	28,96±2,89 ^a
1.2	5.4±1.67 ^a	17.7±1.57 ^a	29,05±5,48 ^a
1.6	6.8±2.05 ^b	19.6±2.89 ^b	31,15±7,86 ^b
2.0	9.6±2.38 ^c	23.9±2.13 ^c	32,81±8,95 ^c
2.4	9.2±2.46 ^c	23.2±2.46 ^c	32,00±2,42 ^c

Note(s): values followed by the same letter in the same column were not significantly different at $p < 0.05$ by DMRT.



Figure 2. Hydroponic pakcoy mustard ready to harvest (4 weeks)

Nevertheless, the optimal EC level varies among plants species and is influenced by several factors such as growth stage, species, season, and water quality (Sangeetha and Periyathambi, 2024). Determining the appropriate EC level for plant growth is essential, as an excessively high EC level can hinder nutrient absorption (Hosseini *et al.*, 2021) by increasing the osmotic potential of the nutrient solution. Conversely, an EC level that is too low may induce nutrient deficiency stress, thereby reducing plant growth and overall quality (Ding *et al.*, 2018). In general, elevated EC levels can enhance vegetative growth, particularly plant height, by improving nitrogen availability and promoting its role in stems and leaf development (Tripama and Yahya, 2018). Average plant height, number of leaves, and leaf area at various nutrient solution concentrations for 4 weeks can be shown at Table 1 and Figure 2.

Based on Table 1, the highest number and leaf area of pakcoy were observed at an EC value of 2.0 mS.cm^{-1} , with 23.9 ± 2.13 leaves and a total leaf area of 32.81 ± 8.95 , respectively. The EC value influences plant metabolism by affecting the rate of photosynthesis, enzyme activity, and the efficiency of ion uptake through the roots (Pratiwi *et al.*, 2015; Nafiah *et al.*, 2023). Both the number and area of leaves increased with rising EC value, reaching their maximum at 2.0 mS.cm^{-1} , before declining at higher EC values. The reduction in leaf number and size under excessive EC conditions may be attributed to osmotic stress or ion toxicity resulting from the high concentration of dissolved salts (Albornoz & Lieth, 2015). Similarly, Ding *et al.*, (2018) reported enhanced growth at EC levels of 1.8 dS.m^{-1} and above. Leaf area is closely related to photosynthesis performance, where larger leaves enhance light interception and photosynthetic efficiency, thereby supporting optimal growth (Rosman *et al.*, 2019). Consequently, the tallest and heaviest plants were observed at an EC value of 2.0 mS.cm^{-1} . Additionally, the increase in nitrate accumulation observed at higher EC levels was a physiological response to elevated nutrient concentration in the solution (Falovo *et al.*, 2009). Since nitrate plays a key role in plant growth and metabolism, determining the optimal EC value is essential to maximize nutrient absorption while avoiding toxic and inhibitory effects on plant development.

Based on Table 2, the highest root-to-shoot ratio of pakcoy mustard (4.8 ± 18.95) was specifically observed in the EC treatment at 2.0 mS.cm^{-1} . This indicates that the translocation of photosynthates was more concentrated in the shoot than in the root system, resulting in enhanced vegetative shoot growth and relatively limited carbohydrate allocation to the roots. The EC value of the nutrient solution directly affects nutrient availability within the root zone, thereby influencing nutrient uptake, root development, and overall plant productivity (Chang *et al.*, 2011).

The maximum total fresh weight observed at an EC level 2.0 mS.cm^{-1} can be attributed to optimal nutrient availability throughout the growth stage, which promotes higher biomass fresh weight (Embarsari *et al.*, 2015). Additionally, the fresh weight of plants is strongly influenced by the leaf number and leaf area, as increase in both parameters enhances the plant's photosynthetic capacity and consequently elevates fresh weight (Stefanov *et al.*, 2016). Subsequently, the greater fresh weight results in the higher total dry weight, reflecting improved plant growth performance under the optimal EC treatment.

Table 2. Average total fresh weight, shoot fresh weight, and shoot/root ratio at various nutrient solution concentrations for 4 weeks.

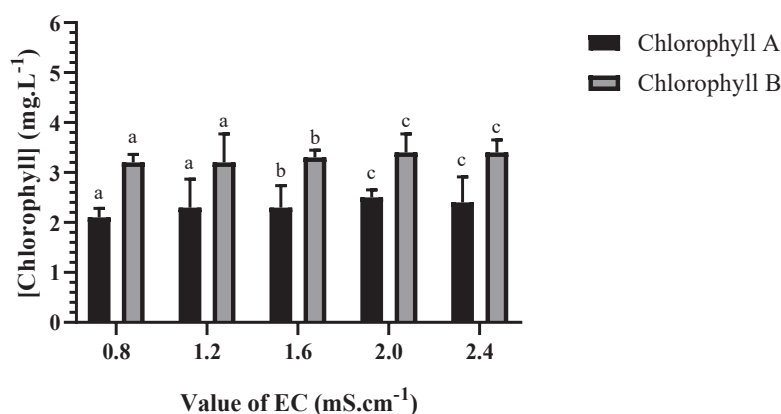
Value of EC (mS.cm ⁻¹)	Total fresh weight (g)	Total oven dry weight (g)	Root/shoot ratio
0.8	158.8±2.45 ^a	6.7±2.46 ^a	2.9±12.89 ^a
1.2	165.9±2.75 ^a	7.5±3.57 ^a	3.1±15.48 ^a
1.6	195.7±2.49 ^b	8.6±2.95 ^b	3.5±17.86 ^a
2.0	210.5±2.79 ^c	10.3±2.45 ^c	4.8±18.95 ^b
2.4	211.3±2.93 ^c	9.1±2.78 ^c	4.9±20.42 ^b

Note(s) : values followed by the same letter in the same column were not significantly different at $p < 0.05$ by DMRT.

Table 3. Correlation between the variation of EC to growth parameter.

Variable X		Variable Y			
EC Value		Plant Height (cm)	Number of Leaves	Leaf Area (cm ²)	Fresh Weight (g)
	P value	0,0108	0,0146	0,0394	0,0110
	R ²	0,9152	0,8965	0,8035	0,9140

Note(s): P value < 0.05 was significantly correlated between two variables (X and Y) which analysis using pearson correlation ($\alpha < 0.05$).



Note(s): bar followed by the same letter in the same chlorophyll types were not significantly different at $p < 0.05$ by DMRT.

Figure 3. Average Chlorophyll a and b at various nutrient solution concentrations for 4 weeks.

Average Chlorophyll a and b at various nutrient solution concentrations for 4 weeks are shown at Figure 3. According to Figure 3, the highest chlorophyll content was observed at EC values of 2.0 mS.cm⁻¹ and 2.4 mS.cm⁻¹. Similar to the findings of Ding *et al.*, (2018) both excessively low and high EC levels can greatly reduce the photosynthesis process. Variation in EC influences photosynthetic rates primarily through the availability of essential elements, such as nitrogen (N), magnesium (Mg), and iron (Fe), which are essential for chlorophyll biosynthesis. Consequently, the deficiency of these elements resulted in a decline in chlorophyll content.

Furthermore, under salinity stress conditions, chlorophyll concentration may increase as a physiological response to enhance salt tolerance, since elevated EC levels can induce osmotic or salinity stress (Stefanov *et al.*, 2016). Thus, higher chlorophyll accumulation under moderate EC stress might reflect an adaptive mechanism rather than an indicator of improved photosynthetic performance. Chlorophyll content strongly correlates with photosynthetic capacity, and higher photosynthetic activity generally supports improved vegetative growth.

The correlation between EC variation and several growth parameters, including plant height, leaf number, leaf area, fresh weight, and dry weight, is presented in Table 3. As presented in Table 3,

several growth parameters exhibited significant correlation with the EC value ($p < 0.05$). The positive correlation coefficients indicate that increasing EC levels were associated with higher values of plant height, leaf number, leaf area, and fresh weight. These results suggest that a moderate increase in EC enhances vegetative growth by improving nutrient availability and uptake efficiency. However, excessively high EC values may adversely affect plant growth due to osmotic stress or ion toxicity, thus emphasizing the importance of determining the optimal EC range for hydroponic cultivation (Hoang et al., 2019; Desmasari dkk., 2022; Sun et al., 2023; Vought et al., 2024). The overall influence of EC on the observed growth parameters has been consistently demonstrated in the preceding sections.

4. CONCLUSION

This study concludes that an electrical conductivity (EC) of $2.0 \text{ mS}\cdot\text{cm}^{-1}$ represents the optimal nutrient concentration for pakcoy mustard grown hydroponically, resulting in superior vegetative growth, biomass accumulation, and a shortened cultivation period of four weeks.

5. ACKNOWLEDGMENTS

This study is supported by grants Empowerment Program Community Based (Program Berbasis Masyarakat) with the scope of Community Partnership Empowerment from the Directorate of Research, Technology and Community Service (DRTPM) Ministry of Education, Culture, Research and Technology with the contract number of 017/SPP-PPM/LPPM-02/Dikbudristek/FTB/VI/ 2024 31st July 2024 (on behalf of Dr. Ir. Popy Hartatie Hardjo, M.Si.).

6. REFERENCES

- Albornoz, F. & J.H. Lieth. 2015. Over-fertilization limits lettuce productivity because of osmotic stress. *Chilean Journal of Agricultural Research*. 75(3):284–290.
- Barbosa, G. L., F.D.A. Gadelha, N. Kublik, A. Proctor, L. Reichelm, E. Weissinger, G.M. Wohlleb & R.U. Halden. 2015. Comparison of land, water, and energy requirements of lettuce grown using hydroponics vs. conventional agricultural methods. *International Journal of Environmental Research and Public Health*. 12(6):6879–6891.
- Chang, D. C., I.C. Cho, J.T. Suh, S.J. Kim, & Y.B. Lee. 2011. Growth and yield response of three aeroponically grown potato cultivars (*Solanum tuberosum* L.) to different electrical conductivities of nutrient solution. *American Journal of Potato Research*. 88(6):450–458.
- Del Carmen Salas, M., J.L. Montero, J.G. Diaz, F. Berti, M.F. Quintero, M. Guzmán, and F. Orsini. 2020. Defining optimal strength of the nutrient solution for soilless cultivation of saffron in the Mediterranean. *Agronomy*. 10(1311):1–10.
- Desmasari, N., O. Hidayat, & E. Masnenah. 2022. Pengaruh jenis nutrisi dan jenis media tanam terhadap pertumbuhan dan hasil tanaman pakcoy (*Brassica chinensis* L.) Varietas Nauli F-1 secara hidroponik sistem wick. *Orchid Agro*. 2(2):1-8.
- Dewir, Y. H. and A. Alsadon. 2022. Effects of nutrient solution electrical conductivity on the leaf gas exchange, biochemical stress markers, growth, stigma yield, and daughter corm yield of saffron in a plant factory. *Horticulturae*. 8(673):1–12.
- Ding, X., Y. Jiang, H. Zhao, D. Guo, L. He, F. Liu, Q. Zhou, D. Nandwani, D. Hui, & J. Yu. 2018. Electrical conductivity of nutrient solution influenced photosynthesis, quality, and antioxidant enzyme activity of pakchoi (*Brassica campestris* L. ssp. *chinensis*) in a hydroponic system. *PloS One*. 13(8):1–15.

- Embarsari, R. Pradina, A. Taofik, & B. Frasetya. 2015. Pertumbuhan dan hasil Seledri (*Apium graveolens* L.) pada sistem hidroponik sumbu dengan jenis sumbu dan media tanam berbeda. *Jurnal Agro*. 2(2):41–48.
- Fallovo, C., Y. Rouphael, E. Rea, A. Battistelli, & G. Colla. 2009. Nutrient solution concentration and growing season affect yield and quality of *Lactuca sativa* L. var. acephala in floating raft culture. *Journal of the Science of Food and Agriculture*. 89:1682–1689.
- Fuzzy, A. & J. Papenbrock. 2022. An Overview of Soil and Soilless Cultivation Techniques—Chances, Challenges and the Neglected Question of Sustainability. *Plants*. 11(9),1153:1-32.
- Hoang, N.N., Y. Kitaya, T. Shibuya, & R. Endo. 2019. Development of an in vitro hydroponic culture system for wasabi nursery plant production—Effects of nutrient concentration and supporting material on plantlet growth. *Scientia Horticulturae*. 245:237-243.
- Hosseini, H., V. Mozafari, H.R. Roosta, H. Shirani, P.C.H. van de Vlasakker, & M. Farhangi. 2021. Nutrient use in vertical farming: Optimal electrical conductivity of nutrient solution for growth of lettuce and basil in hydroponic cultivation. *Horticulturae*. 7(283):1–14.
- Khan, F.A., A. Kurklu, A. Ghafoor, Q. Ali, M. Umair, & Shazaib. 2018. A review on hydroponic greenhouse cultivation for sustainable agriculture. *Internatonal Journal ofAgrculture, Environment and Food Scences*. 2(2):59-66.
- Li, Q., X. Li, B. Tang, & M. Gu. 2018. Growth responses and root characteristics of lettuce grown in aeroponics, hydroponics, and substrate culture. *Horticulturae*. 4(35):1–9.
- Nafiah, O.Z., P. Nugrahani, & Makhziah. 2023. The Effect of Hydroponic Nutrient Sources and Planting Media Types on the Growth and Production of Chinese Kale (*Brassica oleraceae* L.). *Jurnal Teknik Pertanian Lampung*. 12(2):443-457.
- Pakpahan, T.E., A.H.H. Basri, & Mahmudah. 2020. Pengaruh kadar nutrisi hidroponik terhadap pertumbuhan tanaman sawi (*Brassica* sp.). *Sinta Journal (Science, Technology and Agriculture Journal)*. 1(1):1-6.
- Sangeetha, T. & E. Periyathambi. 2024. Automaticnutrientestimator:distributing nutrient solution in hydroponic plants based on plant growth. *Peer J Computer Science*. 10:e1871:1-28.
- Perwitasari, B., M. Tripatmasari, & C. Wasonowati. 2012. Pengaruh media tanam dan nutrisi terhadap pertumbuhan dan hasil tanaman pakchoi (*Brassica juncea* L.) dengan sistem hidroponik. *Jurnal Agroekoteknologi*. 5(1):14–25.
- Pratiwi, P.R., M. Subandi, & E. Mustari. 2015. Pengaruh tingkat EC (electrical conductivity) terhadap pertumbuhan tanaman sawi (*Brassica juncea* L.) pada sistem instalasi aeroponik vertikal. *Jurnal Agro*. 2(1): 50–55.
- Rajaseger, G., K.L. Chan, K.Y. Tan, S. Ramasamy, M.R. Khin, A. Amaladoss, & P.K. Haribhai. 2023. Hydroponics: current trends in sustainable crop production. *Bioinformation*. 19(9):925-938.
- Rosman, A. S., D.R. Kendarto, & S. Dwiratna. 2019. Respon pertumbuhan dan hasil tanaman pakcoy (*Brassica rapa* L.) secara hidroponik dengan berbagai jenis media tanam dan aerasi berbeda. *Jurnal Pertanian Tropik*. 6(2):180–189.
- Sakamoto, M. & T. Suzuki. 2020. Effect of Nutrient Solution Concentration on the Growth of Hydroponic Sweetpotato. *Agronomy*. 10(11),1708:1-14.
- Sardare, M. D. & S.V. Admane. 2013. A review of plant without soil – hydroponics. *International Journal of Research in Engineering and Technology*. 02(03):299–304.
- Sharma, N., S. Acharya, K. Kumar, K., N. Singh, & O.P. Chaurasia. 2019. Hydroponics as an advanced technique for vegetable production: An overview. *Journal of Soil and Water Conservation*. 17(4):2455-7145.

- Sinaga, P., Meiriani, & Y. Hasanah. 2014. Respons pertumbuhan dan produksi kailan (*Brassica oleraceae* L.) pada pemberian berbagai dosis pupuk organik cair paitan (*Tithonia diversifolia* (Hemsl.) Gray). *Jurnal Agroekoteknologi*. 2(4):1584–1588.
- Stefanov, M., E. Yotsova, G. Rashkov, K. Ivanova, Y. Markovska, & E.L. Apostolova. 2016. Effects of salinity on the photosynthetic apparatus of two Paulownia lines. *Plant Physiology and Biochemistry*. 101:54–59.
- Sukweenadhi, J., S.R. Balusamy, Y.J. Kim, C.H. Lee, Y.J. Kim, S.C. Koh, & D.C. Yang. 2018. A growth-promoting bacteria *Paenibacillus yonginensis* D.C.Y84T enhanced salt stress tolerance by activating defence-related systems in *Panax ginseng*. *Frontiers in Plant Science*. 9(813):1-17.
- Sun, T., Y. Zhao, D. Zhou, Z. Gao, & X. Hu. 2023. Effects of amount, electric conductivity, and frequency of a nutrient solution on melon yield and flavor quality. *Scientia Horticulturae*. 310(3):111737.
- Tripama, B. & M.R. Yahya. 2018. Respon konsentrasi nutrisi hidroponik terhadap tiga jenis tanaman sawi (*Brassica juncea* L.). *Agritop*. 16(2):237-249.
- Vought, K., H.K. Bayabil, J. Pompeo, D. Crawford, Y. Zhang, M. Correll, & A. Martin-Ryals. 2024. Dynamics of micro and macronutrients in a hydroponic nutrient film technique system under lettuce cultivation. *Heliyon*. 10. E32316:1-12.

eISSN 2620 - 3138
pISSN 2337 - 4993

JURNAL AGROTEK TROPIKA

The Journal of Tropical Agrotech



**Volume 13, Nomor 4,
November 2025**

Diterbitkan oleh:
Jurusan Agroteknologi, Fakultas Pertanian, Universitas Lampung
Jl. Sumantri Brojonegoro No.1 Bandar Lampung, 35145

[Home](#) / Editorial Team

Editorial Team

Chief Editor

Prof. Dr. Sri Yusnaini, Department of Agrotechnology, Faculty of Agriculture, University of Lampung, ([Scopus ID: 6505609500](#)), Indonesia

Associate Editor

Prof. Abdul Kadir Salam, Department of Soil Science, Faculty of Agriculture, University of Lampung, ([Scopus ID: 7102612990](#)) Indonesia

Dr. Ashutosh Pathak, University of Rajasthan, ([Scopus ID: 58718677800](#)), India

Prof. Dr. Setyo Dwi Utomo, Department of Agronomy, Faculty of Agriculture, University of Lampung, ([Scopus ID: 35249687600](#)), Indonesia

Prof. Pil-Son Choi, Department of Medicinal Plant Resource, Nambu University, ([Scopus ID: 57223635636](#)), South Korea

Iin P. Handayani, Murray State University, Murray, (Scopus ID: 6507765631), United States

Ria Wulansarie, Universitat de Barcelona, (Scopus ID: 57201500773), Spain

Jacqueline A. Malvestiti, The University of São Paulo (USP) & UNICAMP, (Scopus ID: 57200108150), Brazil

Prof. Dr. Ir. MS Riwardi Riwardi, University of Bengkulu (Google Scholar ID: KiGyQ94AAAAJ), Indonesia

Prof. Priyono Prawito, Faculty of Agriculture, University of Bengkulu (Scopus ID: 54973719100), Indonesia

Prof. Herviyanti Herviyanti, Department of Soil Science, Faculty of Agriculture, Andalas University (Scopus ID: 57194601300), Indonesia

Prof. Hadiwiyono Hadiwiyono, Department of Agrotechnology, Faculty of Agriculture, Sebelas Maret University (SINTA IS: 6040089), Indonesia

Prof. Dr. Ir. Rusdi Evizal, M.S., Department of Agro-technology, Faculty of Agriculture, Universitas Lampung (Scopus ID: 57188559011), Indonesia

Prof. Maryati Maryati, Department of Agrotechnology, Dharma Wacana College of Agricultural Sciences (Google Scholar ID: w7QyrPUAAAAJ), Indonesia

Prof. Dr. Ir. Soni Isnaini, STIPER Dharma Wacana Metro (Scopus ID : 58090086400), Indonesia

Kustomo, Faculty of Science, National University of Singapore (NUS) (Orcid ID: 0000-0002-9255-6369), Singapore

Ir. M.Sc. Hery Novpriansyah, Department of Soil Science, Faculty of Agriculture, Lampung University (Google Scholar ID: sKgX49gAAAAJ), Indonesia

Dr. Ir. M.Sc. Titik Nur Aeny, Department of Plant Protection, Faculty of Agriculture, Lampung University (Google Scholar ID: VHVNa5YAAAAJ), Indonesia

Dr. Suskandini Ratih, Department of Agrotechnology, Faculty of Agriculture, University of Lampung, (Scopus ID: 9900978899), Indonesia

Dr. Junita Barus, National Research and Innovation Agency (SINTA ID: 6672194), Indonesia

Citra Bakti, S.P., M.Sc. PhD., Padjadjaran University (Scopus ID: 57209181830),

ABOUT THE JOURNAL

- [FOCUS & SCOPE](#)
- [AUTHOR GUIDELINES](#)
- [SUBMISSION](#)
- [EDITORIAL TEAM](#)
- [PUBLICATION ETHICS](#)
- [COPYRIGHT NOTICE](#)
- [OPEN ACCESS POLICY](#)
- [GENERATIVE AI POLICY](#)
- [INFO & CHARGES](#)
- [JOURNAL HISTORY](#)
- [JOURNAL CONTACT](#)

Download Template



[Author Guideline](#)



[Author Statement](#)

INDEX IN



Writing Check



Journal Visitors



Indonesia

Dr. Gusnidar Gusnidar, Department of Soil Science, Faculty of Agriculture, Andalas University (Scopus ID: 57194175457), Indonesia

Dr. Robet Asnawi, National Research and Innovation Agency (Scopus ID: 57218935881), Indonesia

Dr. Meksy Dianawati, SP, M.Si, BPTP West Java (Orcid ID: 0000-0002-8963-7870), Indonesia

Fitri Yelli, S.P., M.Si., Ph.D, Department of Agrotechnology, Faculty of Agriculture, Lampung University (Scopus ID: 57204602323), Indonesia

Dr. Sutarman Sutarman, Department of Agrotechnology, Universitas Muhammadiyah Sidoarjo (Google Scholar ID: PDwcpKQAAAAJ), Indonesia

Dr. Husnain Husnain, Indonesian Center for Agricultural Land Resources Research and Development (SINTA ID: 6678007), Indonesia

Dr. Tino Orciny Chandra, Tanjungpura University (Scopus ID: 57217826766), Indonesia

Ir. M.Sc. Setyo Widagdo, Department of Agrotechnology, Faculty of Agriculture, University of Lampung (Google Scholar ID: Cu2XxJ8AAAAJ), Indonesia

Dr. Ir. Yulia Pujiastuti, Sriwijaya University (Scopus ID: 50262740500), Indonesia

Dr. Agustiansyah S.P., M.Si., Agriculture Faculty, University of Lampung (Scopus ID: 58315904500), Indonesia

S.P., M.Si Septi Nurul Aini, Soil Science Department, Faculty of Agriculture, University of Lampung (Google Scholar ID: JL7QX78AAAAJ), Indonesia

Dr. Ida Nur Istina, Balai Pengkajian Teknologi Pertanian Riau, Indonesia

S.P., M.Si. Purba Sanjaya, Departement of Agrotechnology, Agriculture Faculty, Universitas Lampung (Scopus ID: 57207757000), Indonesia

Liska Mutiara Septiana, S.P., M.Si., Jurusan Ilmu Tanah, Universitas Lampung

Ph.D. Endang Sri Dewi HS, Sintuwu Maroso University (Sinta ID: 6178202), Indonesia

S.P., M.P., Ph.D. Partoyo Partoyo, Pembangunan Nasional University "Veteran" Yogyakarta (Scopus ID: 55611621400), Indonesia

Dr. P. K. Dewi Hayati, Andalas University (Google Sholar ID: 4sFT8w4AAAAJ), Indonesia

Reviewer Team

Prof. Dr. Ir. Sukarman Sukarman, National Research and Innovation Agency (Google Scholar ID: IjP0IZwAAAAJ), Indonesia

Dr. Asmarhansyah Asmarhansyah, Indonesian Center for Agricultural Land Resource Research and Development (SINTA ID: 6669824), Indonesia

Dr. Ir. Yulia Nuraini, Department of Soil Science, Faculty of Agriculture, Brawijaya University (Scopus ID: 56271859000), Indonesia

Dr. A. Arivin Rivaie, National Research and Innovation Agency (Scopus ID: 23568322700), Indonesia

Dr. Ir. Darwin H. Pangaribuan, Department of Agronomy, Faculty of Agriculture, Lampung University (Scopus ID: 57193984671), Indonesia

Prof Loekas Soesanto, Jenderal Soedirman University (Scopus ID: 6504085331), Indonesia

Dr. Hartati Oktarina, Syiah Kuala University (Scopus ID: 57215079771), Indonesia

Prof. Zainal Muktamar, Department of Soil Science, University of Bengkulu (Scopus ID: 57189369349), Indonesia

Dr. Yusniwati Yusniwati, Department of Agrotechnology, Faculty of Agriculture, Andalas University (Scopus ID: 57200968274), Indonesia

Dr. Ali Rahmat, National Research and Innovation Agency (SINTA ID: 6761124), Indonesia

Dr. Zumi Saidah, Padjadjaran University (Scopus ID: 56419859100), Indonesia

Dr. Laila Nazirah, Malikussaleh University (Scopus ID: 57202813543), Indonesia

Sri Widinugraheni, Nusa Cendana University (Scopus ID : 57204315822), Indonesia

Dr. Maria Viva Rini, Department of Agronomy, Faculty of Agriculture, Lampung University
(Google Scholar ID: qes2hdsAAAAJ), Indonesia

Dr. Arminudin Ahmad Taufik, UIN Sulthan Syarif Kasim Riau (Scopus ID : 57217152127),
Indonesia

Dad R. J. Sembodo, Department of Agronomy, Faculty of Agriculture, Lampung University
(SINTA ID: 6890527), Indonesia

Yulmira Yanti, Universitas Andalas (Scopus ID: 57191856137), Indonesia

Dr. Nugroho Susetya Putra, Gajah Mada University (Scopus ID: 57053053800), Indonesia

Dr. Rina Sri Kasiamdari, Gadjah Mada University (Scopus ID: 6507916857)

Dr. Mareli Telaumbanua, Department of Agricultural Engineering, University of Lampung
(Scopus ID: 57194013218), Indonesia

Dr. Danner Sagala, Agrotechnology Department, Faculty of Agriculture, Universitas Prof.
Dr. Hazairin SH. Bengkulu (Scopus ID:57200853811), Indonesia

Dr. Darmawan Saptadi, Plant Breeding Laboratory, Faculty of Agriculture, Universitas
Brawijaya (Scopus ID: 57193852160), Indonesia

Dr. Bakhtiar Bakhtiar, Syiah Kuala University (Scopus ID: 17134307200), Indonesia

Dr. Armansyah Armansyah, Andalas University (Scopus ID: 57200965764), Indonesia

Dr. Haryuni Haryuni, Tunas Pembangunan University (Scopus ID : 57195403175),
Indonesia

Erni Suminar, Padjajaran University (Scopus ID: 57208547242), Indonesia

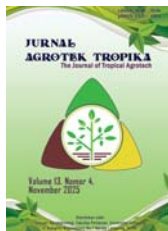
Ir. M.Si. Niar Nurmauli, Department of Agronomy, Faculty of Agriculture, Lampung
University (Google Scholar ID: zWNLnx8AAAAJ), Indonesia

Indri Fariroh, Department of Agronomy, Faculty of Agriculture, Jember University (Scopus
ID: 58246649700), Indonesia

[Home](#) / [Archives](#) /

Vol. 13 No. 4 (2025): JURNAL AGROTEK TROPIKA VOL 13, NOVEMBER 2025 (ON PROGRESS)

Vol. 13 No. 4 (2025): JURNAL AGROTEK TROPIKA VOL 13, NOVEMBER 2025 (ON PROGRESS)



Published: 2025-11-30

Articles

PERTUMBUHAN DAN HASIL TANAMAN KACANG HIJAU PADA BERBAGAI TINGKAT SALINITAS DAN DOSIS SILIKA



Abstract View: 52

didik darmono, Sakhidin, Ponendi Hidayat

838 - 848



APLIKASI BAHAN ORGANIK DAN *Arachis pintoii* PADA MATERIAL LETUSAN GUNUNG API (KELUD DAN BROMO): PERUBAHAN UNSUR HARA C DAN N



Abstract View: 52

Christianti Agustina, Anita Novita Sari, Bella Nurdyanti, Sri Rahayu Utami

849 - 856



EKSPLORASI DAN UJI POTENSI JAMUR DARI LAHAN PERTANAMAN KENTANG DI KABUPATEN BREBES SEBAGAI REMEDIATOR KADMIUM (Cd)



Abstract View: 30

Okti Herliana, Willis Cahyani, Ahmad Fauzi, Rostaman, Shofiyatun Khasanah

857 - 869



PARAMETER GENETIK AKSESI JAHE MERAH (*ZINGIBER OFFICINALE* VAR. RUBRUM) YANG DIKOLEKSI DARI PULAU JAWA, INDONESIA



Abstract View: 35

Eka Oktaviani, Agleri Rante, Agus Suroto

870 - 878



PEMBERIAN MIKORIZA DAN PUPUK MAJEMUK GRAND K DALAM PENINGKATAN PRODUKTIVITAS TANAMAN BAWANG MERAH (*Allium ascalonicum* L.) PADA LAHAN KERING MASAM



Abstract View: 33

Ernita Ernita, Raisa Baharuddin, Pandu Setyo Aji

879 - 888



ABOUT THE JOURNAL

[FOCUS & SCOPE](#)

[AUTHOR GUIDELINES](#)

[SUBMISSION](#)

[EDITORIAL TEAM](#)

[PUBLICATION ETHICS](#)

[COPYRIGHT NOTICE](#)

[OPEN ACCESS POLICY](#)

[GENERATIVE AI POLICY](#)

[INFO & CHARGES](#)

[JOURNAL HISTORY](#)

[JOURNAL CONTACT](#)

Download Template



[Author Guideline](#)



[Author Statement](#)

INDEX IN



Writing Check



Journal Visitors



PENGHAMBATAN CENDAWAN ENDOFIT BUNGA BAWANG DAYAK *Fusarium solani* EnI TERHADAP CENDAWAN KONTAMINAN SECARA IN VITRO DAN CENDAWAN PATOGEN SECARA IN VIVO



Abstract View: 117

Noorkomala Sari, Untung Santoso, Akhmad Rizali, Siti Norhaliza, Tiya Dwi Nanda, Kris Budi Santoso

889 - 899



PDF

KARAKTERISASI MORFOLOGI, AGRONOMI, DAN MOLEKULER PADI LOKAL SIGOLONG ASAL KABUPATEN BENKAYANG



Abstract View: 25

Pipit Prihatini, Tantri Palupi, Wasi'an

900 - 910



PDF

PENGUNAAN WADAH SARINGAN PUPUK LEPAS TERKENDALI (WSPLT) DALAM PENYEDIAAN HARA TANAMAN KELAPA SAWIT (*Elaeis guineensis* Jacq.) DI TANAH GAMBUT DENGAN KEDALAMAN MUKA AIR TANAH BERBEDA



Abstract View: 19

Indrawan Indrawan, Syafrinal Syafrinal, Wawan Wawan

911 - 924



PDF

ANALISIS KESESUAIAN LAHAN DAS SAMPEAN BARU UNTUK BUDIDAYA PISANG CAVENDISH(*Musa acuminata* L) PT.XYZ DI KABUPATEN BONDOWOSO



Abstract View: 31

Elida Novita, Idah Andriyani, Siswoyo Soekarno, Heru Ernanda, Halimatus Silvia

925 - 939



PDF

MODEL RESPON KEMUNDURAN SELAMA PERIODE III HIDUP BENIH SORGUM (*Sorgum bicolor* [L.] Moench) VARIETAS NUMBU DALAM RUANG SIMPAN BER-AC



Abstract View: 26

Monik Nurhidayati, Eko Pramono, Agustiansyah Agustiansyah, Muhammad Kamal

940 - 951



PDF

UJI KOMPOS AZOLLA DAN BIOSAKA TERHADAP PERTUMBUHAN SERTA PRODUKSI TANAMAN PARE (*Momordica charantia* L.)



Abstract View: 35

Safira Az Zahra, Fathurrahman

952 - 965



PDF

EFEK KONSENTRASI ASAP CAIR DAN WAKTU PERENDAMANNYA TERHADAP KUALITAS KOPRA PUTIH



Abstract View: 37

Budy Rahmat, Dewi Hamadatus Solihah, Dedi Natawijaya, Yanto Yulianto

966 - 977



PDF

MUTU FISIK DAN KIMIA GABAH DAN BERAS GALUR – GALUR DIHAPLOID PADI HITAM



Abstract View: 28

Danu Kuncoro, Iswari Saraswati Dewi, Willy Bayuardi Suwarno, Awang Maharijaya, Bambang Sapta Purwoko

978 - 988



PDF

RESPON KACANG TANAH (*Arachis hypogaea* L) TERHADAP PEMBERIAN PUPUK HIJAU DAN PUPUK ORGANIK CAIR KIRINYUH



Abstract View: 28

Hafifah Hafifah, Laila Nazirah, Muhammad Nazaruddin

989 - 1000



**Pengaruh Cekaman Kekeringan dan Dosis Biochar Jerami Padi terhadap
Pertumbuhan dan Produksi Padi (*Oryza sativa* L.)**



Abstract View: 28

Frumentio Costa Araujo De Jesus, I Nyoman Rai, Ni Nyoman Ari Mayadewi 1001 - 1014



**EFEKTIVITAS ASAM HUMAT DAN BAKTERI PENAMBAT NITROGEN DALAM
PERTUMBUHAN BIBIT KOPI ROBUSTA**



Abstract View: 20

Intan Ratna Dewi Anjarsari, Anindya Khairunnisa, Mira Ariyanti 1015 - 1027



**RESPON PEMBERIAN FITOHORMON EKSTRAK LIDAH BUAYA DAN PUPUK NITROGEN
TERHADAP PERTUMBUHAN STEK BATANG TANAMAN VANILI (*Vanilla planifolia*
Andrews)**



Abstract View: 43

Distiana Wulanjari, Hepniatul Hasanah, Setiyono Setiyono, Muhammad Ghufroh Rosyady 1028 - 1034



**EFEKTIVITAS EKSTRAK KULIT UMBI UBI JALAR PADA PERKECAMBAHAN BIJI DAN
PERTUMBUHAN GULMA JAJAGOAN (*Echinochloa crus-galli*)**



Abstract View: 21

Hidayat Puji Siswanto, Alamanda Lily Astari, Nanik Sriyani, Dad Resiwooro J. Sembodo, Purba Sanjaya 1035 - 1046



**PENGARUH BIOAMELIORAN TERHADAP SERAPAN NITROGEN DAN FOSFOR SERTA
HASIL TUMPANGSARI JAGUNG-KEDELAI**



Abstract View: 17

Wahyu Astiko, Mohamad Taufik Fauzi, Lolita Endang Susilowati, Lalu Zulkifli 1047 - 1057



**PERILAKU PERTUKARAN AMONIUM PADA TANAH ULTISOL DAN NITROGEN TERPANEN
PADA TANAMAN JAGUNG AKIBAT PERLAKUAN OLAH TANAH DAN PEMUPUKAN PADA
MUSIM TANAM KE-9**



Abstract View: 23

Azzah Alfia, Septi Nurul Aini, Nur Afni Afrianti, Supriatin Supriatin, Astriana Rahmi Setiawati, Jamalalam Lumbanraja Jamalalam Lumbanraja 1058 - 1073



**KINETIKA DEKOMPOSISI TANAMAN JAGUNG (BATANG, DAUN, DAN TONGKOL
KOSONG) DI PERMUKAAN DAN DI LAPISAN OLAH TANAH)**



Abstract View: 22

Jessica Amarastha Hayu Panjerratri, Sri Yusnaini, Jamalalam Lumbanraja, Supriatin 1074 - 1087



**IDENTIFIKASI DAN UJI SENSITIVITAS FUNGISIDA PENYEBAB PENYAKIT HANGUS DAUN
(LEAF SCORCH) PADA TANAMAN TEBU DI PT GUNUNG MADU PLANTATIONS**



Abstract View: 27

Nora Apriska Verdiana, Titik Nur Aeny, Rosma Hasibuan, Heru Pranata, Tri Maryono 1088 - 1095



PENGARUH APLIKASI EKSTRAK KUNYIT (*Curcuma longa* Linn.) DAN *Trichoderma* sp. TERHADAP PERTUMBUHAN, PRODUKSI DAN KETERJADIAN PENYAKIT ANTRAKNOSA PADA TANAMAN CABAI RAWIT (*Capsicum frutescens* L.)



Abstract View: 25

Andre Janu Wibowo, Suskandini Ratih Darmawati, Rugayah, Joko Prasetyo 1096 - 1109



PDF

PENGARUH APLIKASI KOMPOS KOTORAN SAPI DAN PUPUK PREMIUM TERHADAP BIOMASSA KARBON MIKROORGANISME TANAH PADA PERTANAMAN NANAS RATOON, LAMPUNG TENGAH



Abstract View: 30

Winih Sekaringtyas Ramadhani, Ulia Karlismayani, Dermiyati, M. A. Syamsul Ardi10 - 1120



PDF

PENGARUH APLIKASI ASAM HUMAT DAN DOSIS PUPUK P TERHADAP P TERSEDIA TANAH DAN P TERPANEN TANAMAN KACANG TANAH (*Arachis hypogea* L.) PADA TANAH ULTISOL



Abstract View: 26

Ragil Saputra, Kuswanta Futas Hidayat, Nur Afni Afrianti, Sri Yusraini 1121 - 1129



PDF

TEKNOLOGI PERBANYAKAN TANAMAN UBI KAYU (*Manihot esculenta* Crantz.) MELALUI EMBRIOGENESIS SOMATIK DENGAN MENGGUNAKAN EKSPLAN DAUN MUDA



Abstract View: 22

Sabrina Salsabila Sulaeman, Fitri Yelli, Agus Karyanto, Radix Suharjo 1130 - 1141



PDF

RESPON TIGA VARIETAS TANAMAN TEBU (*Saccharum officinarum* L.) TERHADAP LAMA PENGGENANGAN



Abstract View: 32

Shinta Puspita Sari, Rusdi Evizal, Afandi, Purba Sanjaya 1142 - 1152



PDF

KADAR HARA KELAPA SAWIT PADA LAHAN GAMBUT YANG DIAPLIKASI MIKORIZA



Abstract View: 106

Firlana Firlana, Nelvia, Delita Zul, Kumbara 1153 - 1162



PDF

EFFECT OF NUTRIENT SOLUTION CONCENTRATION ON THE GROWTH PERFORMANCE OF PAKCOY MUSTARD (*Brassica rapa* L.) UNDER A SENSOR-BASED NUTRIENT FILM TECHNIQUE HYDROPONIC SYSTEM



Abstract View: 14

Poppy Hartatie Hardjo, Zelia Camoes dos Santos, Stefan Saputra Sugiarno, Timothy Amadeus Filhend Plessers 1163 - 1170



PDF

KARAKTERISTIK BEBERAPA SIFAT KIMIA ULTISOL AKIBAT MASA BERA PADA SISTEM OLAH TANAH DAN PEMUPUKAN NITROGEN JANGKA PANJANG (TAHUN TANAM KE-37)



Abstract View: 9

irene zaqyah, Nur Afni Afrianti, Hery Novpriansyah, Sri Yusraini, Rusdi Evizal 1171 - 1182



PDF