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The Prime Combination of Growing Media and Watering Frequency to the Growth of Sunflower *Microgreens* (*Helianthus annuus* L.)

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ABSTRACT

*Microgreen*s of sunflower (*Helianthus annuus* L.) are small and nutritious vegetables consumed at the early stages of growth. The growing process dictates the *microgreen* quality, such as planting media and watering frequency. This study aims to determine the interaction of various planting media with the watering on the *microgreen* growth parameters. This study conducts an experiment using 9 total treatments replicated 3 times. The research followed a randomized group design (RGD) and utilized analysis of variance (ANOVA) with a significance level of 5%, as well as Duncan's further test at a 5% significance level. The research parameters include plant height, hypocotyl length, epicotyl length, number of leaves, wet weight, consumable weight, and dry weight. The results showed that the interaction of planting media and watering frequency had a significant effect (P<0,01) on the growth parameters of sunflower *microgreen*s. The best treatment combination is M_1P_3, Rockwool with watering three times a day with a plant height of 7,67 cm, hypocotyl length of 7,09 cm, epicotyl length 0.36 cm, number of leaves 2,53, wet weight 6,67 g, consumable weight 20.67 g and dry weight 1,22 g. Rockwool is sterile and has a structure that absorbs and stores water sufficiently for the growth of *microgreen*s. The results of this study contribute significantly to improving the growth of sunflower (*Helianthus annuus* L.) *microgreen*s through a combination of proper growing media and watering frequency.

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1. INTRODUCTION

Sunflower microgreens (*Helianthus annuus* L.) are young vegetables harvested in a short time, 7-10 days after sowing (Dalal et al., 2020; Farmia, 2020). Microgreens have a unique taste and color with a soft texture and are rich in nutrients. Sunflower microgreens are rich in protein, fiber, minerals and vitamins, and high in antioxidants (Dalal et al., 2020; Kusumah and Nurjasmi, 2021). The consumption style includes being a garnish for soups and sandwiches (Tan et al., 2020). The microgreen planting process affects the quality of the resulting crop. According to Hilmy et al. (2021) the problems with microgreen cultivation today include small leaves, weak stems, pale plants, odor, and frequent fungal infections. Abiotic factors such as planting media, light intensity, humidity, water, pH and temperature greatly influence microgreen growth.

Planting media is a medium for growing plants as a provider of nutrients and water, a place for root primordia to attach, grow and develop (Bui et al., 2015; Mariana 2017). The right choice of planting media is crucial to the success of plant production. The ideal planting medium is free from weeds and disease, has good porosity and aeration for the plant root system (Kumar, 2015). Previous studies have shown that planting media that can support growth in vegetable microgreens include a mixture of soil and compost from animal manure, vermiculite and perlite, cocopeat, rockwool, and husk charcoal (Ikrarwati et al., 2020; Sisriana et al., 2021; Nurjasmi and Wahyuningrum, 2022). The best planting media were cocopeat, rockwool, and husk charcoal for Basil plants (Ocimum basilicum L.), Broccoli (Brassica oleracea L) and wheatgrass (Triticum aestivum) (Farmia., 2020; Ikrarwati et al., 2020; Anggraini., 2021). The good ability of the planting media is related to its water storage capacity.

In the early stages of microgreens development, water triggers plant germination, dissolving O_2 and CO_2, ethylene and other metabolites. When metabolism in the seed begins, imbibition and elongation of axial organ cells occur, indicating that germination has begun (Obroucheva et al., 2017). Incorrect watering frequency can cause plants to experience stress, both drought and excess water. Lack of water can disrupt plant germination and cause plants to die (Ai Nio and Ballo, 2010). Conversely, excess water conditions can cause the planting media to become moist and initiate fungal growth on microgreens (Aprilia et al., 2020; Rooyen et al., 2021). The background above shows that planting media and watering frequency have a close relationship for the growth of microgreens plants. Therefore, this study aims to determine the interaction of planting media and watering frequency for sunflower microgreens (*Helianthus annuus* L.).

2. RESEARCH METHOD

This research was conducted for two weeks in a Greenhouse. Sunflower microgreen seeds (PT Known You Seed, Indonesia) were soaked in water (8 hours) to accelerate the breaking of seed dormancy (Salim, 2021). There were 27 microgreen trays with 9 treatment combinations of different growing media and watering frequencies, each with 3 replicates. Each tray was planted with 30 seeds, with 10 of them as samples. Seeds were sown in microgreen trays measuring 32.5 × 25 × 5 cm containing rockwool (M_1), cocopeat (M_2) and husk charcoal (M_3) growing media according to the treatments given. Rockwool, husk charcoal, and cocopeat were produced by PT Amris Andalas Putra and PT Trubus Mitra Swadaya. After the seeds were sown in the growing media, the trays were placed on microgreen shelves and watered evenly. According to Salim (2021), after the seeds were sown in the growing media, the microgreen trays were covered (blackout conditions). Blackout functions to accelerate growth in plants because the auxin hormone works optimally in the dark. Blackout was carried out from day 0 to day 2. On day 3, the microgreen trays could be opened and placed in a place exposed to sunlight.

The watering frequency treatment was carried out from day 1 to day 10. Each microgreen tray was watered according to the treatment combinations P_1 (watering once a day), P_2 (watering twice a day), and P_3 (watering three times a day). The watering times were 06.00 WIB, 12.00 WIB and 18.00 WIB. The amount of water applied per watering to each tray was 30 mL using the pouring technique.

On the 10th day, measurements were carried out on 10 microgreen samples from each tray. The parameters measured were plant height, epicotyl length, hypocotyl length and number of leaves. Measurements of plant height, epicotyl length and epicotyl length were carried out using a ruler with an accuracy of 0.05 cm. Plant height measurement was measuring from the base of the stem to the tip of the leaf at the apical tip. Hypocotyl length measurement was measuring the length of the prospective stem that is below the cotyledon. Epicotyl length measurement was measuring the length of the prospective stem that grows above the cotyledon leaves. Measurement of the number of leaves was counting the leaves directly that grow in good condition in a fully open state with a leaf diameter of ± 0.5 cm. Then harvesting of microgreens and weighing of fresh weight and consumable weight were carried out using a digital scale (accuracy 1 g). Fresh weight was weighed from 10 microgreen samples per tray consisting of all parts of the plant from the roots to the tips of the leaves. Consumable weight was weighing 30 microgreen plants per tray consisting of the base of the stem to the tips of the leaves that are suitable for consumption. Dry weight was carried out by weighing 10 samples of microgreen plants per tray from the roots to the tips of the leaves that had been dried in an oven (80ºC for 48 hours). The observed data that had been obtained were analyzed using IBM SPSS Statistics 25. The Factorial Randomized Block Design (RBD) with analysis of variance (ANOVA) at a 5% significance level and Duncan's further test was carried out at a 5% significance level.

3. RESULT AND DISCUSSION

The results of the study of the effect of planting media and watering frequency on the growth parameters of sunflower microgreen are presented in Table 1. The microgreen comparison image of each treatment is presented in Figure 1.

Table 1. Growth Parameter Results of Sunflower Microgreens 10 HST

No	Treatments	Growth Parameters						
		Plant Height (cm)	Hipocotyl Lenght (cm)	Epcotyl Lenght (cm)	Leaves Number	Wet Weight (g)	Consumable Weight (g)	Dry Weight (g)
1	M_1P_1	5,25[a]	5,17[a]	0,08[a]	1,80[ab]	4,33[bc]	7,33[a]	1,04[ab]
2	M_1P_2	7,91[bc]	7,62[bc]	0,29[cd]	2,47[cd]	5,00[cd]	13[b]	1,15[cd]
3	M_1P_3	9,57[c]	9,21[c]	0,36[d]	2,53[d]	6,67[e]	20,67[c]	1,22[d]
4	M_2P_1	5,13[a]	4,99[a]	0,15[ab]	2,07[bc]	4,33[bc]	8,33[a]	1,06[ab]
5	M_2P_2	9,44[c]	9,18[c]	0,26[bcd]	2,47[cd]	5,67[de]	16[b]	1,15[cd]
6	M_2P_3	7,60[b]	7,38[b]	0,22[bc]	2,07[bc]	4,67[cd]	12,33[b]	1,12[bc]
7	M_3P_1	3,92[a]	3,89[a]	0,03[a]	1,53[a]	3,00[a]	5[a]	1,03[a]
8	M_3P_2	4,52[a]	4,44[a]	0,09[a]	1,53[a]	3,33[ab]	4,67[a]	1[a]

9	M_3P_3	5,06[a]	4,99[a]	0,08[a]	1,47[a]	3,33[ab]	5,33[a]	1,05[ab]
	Sig.	0,019	0,017	0,095	0,038	0,021	0,000	0,036

Notes: M_1 = rockwool; M_2 = cocopeat; M_3 = husk charcoal; P_1 = watering once a day; P_2 = watering twice a day; P_3 = watering three times a day. Numbers followed by different letters in the same column mean significantly different according to the 5% Duncan test.

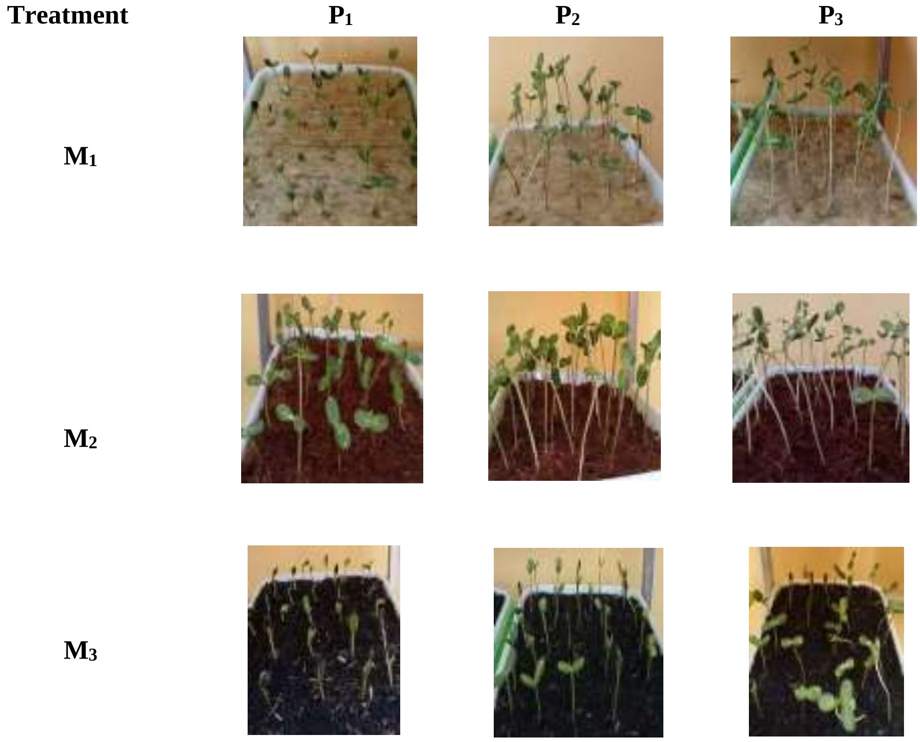

Figure 1. Sunflower microgreen on day 10 with various treatments of planting media (M) 1) Rockwool; 2) Cocopeat; 3) Husk charcoal, and variation of watering frequency (P) 1) once a day; 2) twice a day, and 3) three times a day.

Based on Table 1. ANOVA analysis showed that the combination factor of plant media and watering had a significant effect ($P < 0.05$) on the growth factors of microgreens. The most effective planting media supporting the factors of plant height, hypocotyl length, wet weight, consumable weight and the highest dry weight is rockwool (M1). While the best watering treatment is watering three times (P3). The best combination treatment is M1P3 with the score of growth parameters in order, namely plant height 7.67 cm, hypocotyl length 7.09 cm, epicotyl length 0.36 cm, number of leaves 2.53, wet weight 6.67 g, consumable weight 20.67 g and dry weight 1.22 g. Rockwool as a planting medium has the ability to increase the growth rate of the plants.

Rockwool is the best planting medium for water absorption. Rockwool retains water and oxygen, which are crucial for plant germination (Ramli et al., 2021). Junaidi and Ahmad (2021) confirm that the content of water and oxygen in the planting medium plays a very important role in the germination process. Water breaks down carbohydrates in the cotyledons, which are necessary for embryo growth, and oxygen facilitates respiration in the roots. Surtinah (2016) definitively shows that root respiration's energy is crucial for the assimilation process of water and nutrients. Water rockwool planting media three times a day. The results are clear: treatments M1P1 (watering once a day) and M1P2 (watering twice a day) resulted in lower plant height compared to watering three times a day. The available evidence clearly indicates that the presence of water in the planting medium stimulates seed imbibition and activates the enzymes responsible for germination metabolism (Junaidi and Ahmad, 2021).

Optimal microgreen growth depends on nutrients and minerals that store water and come from seeds. The germination phase of seeds is critical for plant growth. The availability of environmental factors supports microgreen growth. The shoot apical meristem is the main regulatory element of a plant's body and controls its shape. Meristems are regions of active tissue cell division. The activity of the shoot meristem results in increased plant length. The activity of apical meristem tissue is influenced by the availability of the nutrients and minerals in water that seeds need to germinate. Rockwool's granulate-shaped media components are useful for water absorption and transportation and have a high water holding capacity (Nurifah & Fajarfika). Plant height is a combination of hypocotyl and epicotyl length, and they affect the height of microgreens.

In epigeal germination, hypocotyls elongate, lifting the cotyledons and epicotyls up. The hypocotyl is the embryonic/sprout stem below the cotyledon. The epicotyl is the stem above its attachment point (apical meristem) (Nursita et al., 2020). Different plant growth rates can be indicated by measuring hypocotyl and epicotyl lengths (Ramdhini et al., 2021). Gibberellin hormones form hypocotyls and epicotyls. At the start of germination, seeds absorb water, activating the gibberellin growth hormone (Mistian et al., 2012). This hormone functions to stimulate enzymes in seeds and activates the synthesis of proteases and other enzymes needed for germination.

Leaves are plant organs that synthesize organic matter through photosynthesis (Mulyani, 2019). The number of leaves is a reliable benchmark for determining the rate of plant growth (Hidayat et al., 2020). Water absorbed by plants can affect the growth and development of leaves (Medyouni et al., 2020). Plants need water for cell division and leaf formation (Jafar et al., 2013). Planting media that can store water will increase plant growth (Simanjuntak, 2018). Murniati (2021) definitively shows that Rockwool stores more water, is highly resistant to drying, and is sterile. This makes it an excellent planting medium for plants.

Wet weight is the weight of plants that are weighed immediately after harvest or before the plant loses water. The wet weight measured all parts of the plant, from the roots to the tips of the leaves (Prasetyo et al., 2019). The consumable weight is the wet weight measured from the base of the stem to the tip of the leaves that are suitable or can be consumed. Rizal's (2017) research definitively shows that wet weight and consumable weight are related to plant height. The study clearly shows that the treatment with the highest plant height was the rockwool planting media and watering 3 times a day (M1P3). Root development undoubtedly affects wet weight and consumable weight. The root system is influenced by the planting media. Good root development increases water absorption, which is essential for the growth of stems and leaves (Hidayat et al., 2020). Rockwool is soft, so it is easily penetrated by roots (Laksono, 2020). Rockwool's unique ability to absorb water and air, coupled with its easily penetrated texture, ensures that roots can grow unimpeded, promoting optimal plant growth (Warjoto et al., 2020).

Dry weight is plant biomass. Plants undergo photosynthesis and produce photosynthates during the growth period. The accumulation of photosynthates is called dry weight (Khasanah et al., 2020). Wet weight is directly proportional to dry weight. If the wet weight of the plant is high, the dry weight will also be high (Ulfa et al., 2021). The study clearly shows that the rockwool planting media treatment with watering 3 times a day (M1P3) is the most effective. Dry weight is also related to the photosynthesis process. Photosynthesis is the process of converting carbon dioxide and water to produce carbohydrates and oxygen with the help of sunlight (Ai Nio and Ballo, 2010). Water is the main ingredient of photosynthesis. Wahono et al. (2018) definitively show that water availability affects plant growth and photosynthate yield. Dry weight is directly influenced by the photosynthate produced in the photosynthesis process. High water availability will produce high growth and dry weight. Rockwool is a medium that absorbs and stores water better than other planting media, according to Aini and Azizah (2018).

4. CONCLUSION

The interaction of planting media and watering frequency has a significant effect on the growth parameters of sunflower microgreens. The best treatment combination with optimal growth results for Sunflower Microgreens is M_1P_3, which is a combination of rockwool planting media with watering three times a day. Furthermore, it can be used as a reference for microgreen cultivation of other plants.

5. REFERENCES

Ai, Nio. S., & Ballo, M. 2010. Peranan Air dalam Perkecambahan Biji. *Jurnal Ilmiah Sains*. 10(2): 190-195. http://repo.unsrat.ac.id/id/eprint/508

Aini, N., & Azizah, N. 2018. *Teknologi Budidaya Tanaman Sayuran Secara Hidroponik*. Malang: Universitas Brawijaya Press.

Anggriani, D. 2021. Pertumbuhan Microgreens Rumput Gandum (*Triticum aestivum* L.) pada Perlakuan Variasi Air Kelapa dan Media Tanam.*Skripsi*. Medan: Universitas Sumatera Utara.

Aprilia, C. Y., Liman, M., & Wijaya, A. K. 2020. Pengaruh Perlakuan Skarifikasi terhadap Daya Kecambah Tanaman Saga Pohon (*Adenanthera pavonina* L.). Jurnal Riset dan Inovasi Peternakan (Journal of Research and Innovation of Animals). 4(1): 27-34. https://jrip.fp.unila.ac.id/index.php/JRIP/article/view/83

Beck, C. B. 2010. *An introduction to plant structure and development: plant anatomy for the twenty-first century*: Cambridge: Cambridge University Press.

Bui, F., Lelang, M. A., & Taolin, R. I. C. O. 2016. Pengaruh Komposisi Media Tanam dan Ukuran Polybag Terhadap Pertumbuhan dan Hasil Tomat (*Licopercicum escelentum* Mill). *Savana Cendana*. 1(1): 1-7. https://core.ac.uk/download/pdf/268229095.pdf

Dalal, N., Siddiqui, S., & Phogat, N. 2020. Post-Harvest Quality of Sunflower *Microgreens* as Influenced by Organic Acids and Ethanol Treatment. *Journal of Food Processing and Preservation*. 44(9): 1-9. https://doi.org/10.1111/jfpp.14678

Dalal, N., Siddiqui, S., & raj, N. 2020. Sensory Attributes of Sunflower *Microgreens* with Storage under Ethanol Vapour and Organic Acid Treatments. *Inte rnational Journal of Current Microbiology and Applied Sciences*. 9(2): 208-214. https://doi.org/10.20546/ijcmas.2020.902.026.

Farmia, A. 2020. Pengaruh Beberapa Macam Media Tanam dan Dosis Serbuk Cangkang Telur Ayam terhadap Pertumbuhan *Microgreen* Brokoli (*Brassica oleracea* var. Italica Planck). In Prosiding Seminar Nasional Pembangunan dan Pendidikan Vokasi Pertanian. 1(1): 30-39. https://doi.org/10.47687/snppvp.v1i1.123

Hidayat, Y. V., Apriyanto, E., & Sudjatmiko, S. 2020. Persepsi Masyarakat Terhadap Program Percetakan Sawah Baru di Desa Air Kering Kecamatan Padang Guci Hilir Kabupaten Kaur Dan Pengaruhnya Terhadap Lingku ngan. *Naturalis: Jurnal Penelitian Pengelolaan Sumber Daya Alam dan Lingkungan*. 9(1): 41-54. https://doi.org/10.31186/naturalis.9.1.12230

Hilmy, R. H., Susana, R., & Hadiatna, F. 2021. Rancang Bangun Smart Grow Box Hidroponik untuk Pertumbuhan Tanaman *Microgreens* Berbasis Internet of Things. *Power Elektronik: Jurnal Orang Elektro*. 10(2): 41-47.

Ikrarwati, F. N. U., Zulkarnaen, I., Fathonah, A., Nurmayulis, F. N. U., & Eris, F. R. 2020. Pengaruh Jarak Lampu LED dan Jenis Media Tanam terhadap Micro green Basil (*Ocimum basilicum* L.). In *Agropross: National Conference Proceedings of Agriculture*. 4(3): 15-25. DOI: 10.25047/agropross.2020.7

Jafar, S. H., Thomas, A., Kalangi, J. I., & Lasut, M. T. 2013. Pengaruh Frekuensi Pemberian Air Terhadap Pertumbuhan Bibit Jabon Merah (*Anthocephalus macrophyllus* (Roxb.) Havil). *Cocos Journal*. 2(2): 2-13. DOI: https://doi.org/10.35791/cocos.v2i2.1469

Junaidi, J., & Ahmad, F. 2021. Pengaruh Suhu Perendaman Terhadap Pertumbuhan Vigor Biji Kopi Lampung (*Coffea canephora*). *Jurnal Inovasi Pene litian*. 2(7): 1911-1916.

Khasanah., A., Hajoeningtiyas, O. D., Budi, G. P., Pamungkas, R. B. 2020. Uji Pupuk Urea Slow Release Matriks Komposit Pada Pertumbuhan Dan Hasil Tanaman Caisin (*Brassica chinensis* L.). *Prosiding Semnas Pertanian.* : 173-180. https://digitallibrary.ump.ac.id/988/

Kumar, Vikas. 2015. Growing Media for Healthy Seedling Production. *Tropical Forest Research Institute*. 2(9) :19-20.

Kusumah, A. V. C., & Nurjasmi, R. 2021. Potensi *Microgreen*s Meningkatkan Kesehatan Lansia Di Masa Pandemi. Jurnal Ilmiah Respati. 12(1): 1-10. https://ejournal.urindo.ac.id/index.php/pertanian/article/view/1404

Laksono, R. A. 2020. Uji Efektivitas Jenis Media Tanam dan Jenis Sumbu Sistem Wick Hidroponik terhadap Produksi Tanaman Pakcoy (*Brassica rapa* L.) Varietas Nauli F1. *Jurnal Agrotek Indonesia*. 2(5): 229-233.

Mariana, M. 2017. Pengaruh Media Tanam Terhadap Pertumbuhan Stek Batang Nilam (Pogostemon cablin Benth). Agrica Ekstensia. 11(1): 1-8. https://www.polbangtanmedan.ac.id/pdf/Jurnal%20Vol%2011/01%20MERLYN%20MARIANA%2017.pdf

Medyouni, I., Zouaoui, R., Rubio, E., Serino, S., Ahmed, H. B., & Bertin, N. 2021. Effects of Water Deficit on Leaves and Fruit Quality During The Deve lopment Period in Tomato Plant. *Food Science & Nutrition*. 9(4): 1949-1960. https://doi.org/10.1002/fsn3.2160

Mistian, D., Meriani. E, dan Purba. 2012. Respons Perkecambahan Benih Pinang (*Areca catechu* L.) terhadap Berbagai Skarifikasi dan Konsentrasi Asam Giberelat (Ga3). *Jurnal Online Agroekoteknologi*. 1 (1): 15-25. 10.32734/jaet.v1i1.657

Mulyani, Sri. (2019). *Anatomi Tumbuhan*. Yogyakarta: PT Kanisius.

Murniati, N., Oktaria. W. 2021. Aplikasi Berbagai Media Tanam dan Dosis Nutrisi AB Mix Pada Pertumbuhan Tanaman Sawi Manis (*Brassica juncea* L) Sistem Hidroponik. *Jurnal Lansium*. 3(1) :16-19. DOI: https://doi.org/10.20956/ja.v13i2.42966

Nugroho, T. A., & Salamah, Z. 2015. Pengaruh Lama Perendaman dan Konsentrasi Asam Sulfat (H_2SO_4) terhadap Perkecambahan Biji Sengon Laut (*Paraserianthes falcataria*) sebagai Materi Pembelajaran Biologi SMA Kelas XII untuk Mencapai K. D 3. 1 Kurikulum 2013. *Jurnal Pembelajaran dan Materi Sains Biologi*. 2(1): 230-236.

Nurifah, G., & Fajarfika, R. 2020. Pengaruh Media Tanam pada Hidroponik terhadap Pertumbuhan dan Hasil Kailan (Brassica Oleracea L.). *Jagros : Jurnal Agroteknologi Dan Sains (Journal of Agrotechnology Science)*. 4(2): 281-291. DOI: https://doi.org/10.52434/jagros.v4i2.925

Nurjasmi, R., & Wahyuningrum, M. A. 2022. Pengaruh Media Tanam Organik terhadap Kandungan Klorofil dan Karoten *Microgreen*s Brokoli (*Brassica oleracea* L.). Jurnal Ilmiah Respati. 13(1): 43-52. DOI: https://doi.org/10.52643/jir.v13i1.2282

Nursita, I. W., Busono, W., Huda, A. N., Irsyammawati, A., Ndaru, P. H., Widodo, E., Isnaini, N. 2020. *Biologi Peternakan*. Malang: Universitas Brawijaya Press.

Obroucheva, N. V., Sinkevich, I. A., Lityagina, S. V., Novikova, G. V. 2017. Water Relations in Germinating Seeds. *Russian Journal of Plant Physiology*. 64(4): 625-633. https://link.springer.com/article/10.1134/S102144371703013X

Prasetyo, J., Mukaromah, S. L., Argo, B. D. 2019. Pengaruh Pemaparan Cahaya LED Merah Biru Dan Sonic Bloom Terhadap Pertumbuhan dan Produktivitas Tanaman Sawi Sendok (*Brassica rapa* L.). *Jurnal Keteknikan Pertanian Tropis dan Biosistem*. 7(2): 185-192. DOI: https://doi.org/10.21776/ub.jkptb.2019.007.02.8

Ramli., Imansyah, A. A., Centaury, M. B. A. 2021. Uji Kelayakan Media Tanam Alternatif Hidroponik Arang Sekam dan Sabut Kelapa Terhadap Tanaman Selada Hijau (*Lactuca sativa*). *Jurnal Pro-STek*. 3(2): 59-69. https://jurnal.unsur.ac.id/pro-stek/article/view/1919

Rizal, S. 2017. Pengaruh Nutrisi yang Diberikan terhadap Pertumbuhan Tanaman Sawi Pakcoy (*Brassica rapa* L.) yang Ditanam Secara Hidroponik. *Sainmatika: Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam*. 14(1): 38-44. DOI: https://doi.org/10.31851/sainmatika.v14i1.1112

Rooyen. J. V., Khine. S. E., Inzali. Y., Seng. M. B. 2021. Potential Of The *Microgreen* Industry In Myanmar and to Consumer Response This Recently Devel oped Market. *International Journal of Innovation Scientific Research and Review*. 3(1): 625-631. https://www.journalijisr.com/sites/default/files/issues-pdf/IJISRR-323.pdf

Salim, M. A. 2021. *Budidaya Microgreens Sayuran Kecil Kaya Nutrisi dan Menyehatkan.* Bandung: Yayasan Lembaga Pendidikan dan Pelatihan Multiliterasi. https://digilib.uinsgd.ac.id/43613/

Schnablová, R., Herben, T., & Klimešová, J. 2017. Shoot apical meristem and plant body organization: a cross-species comparative study. *Annals of Botany*. 120(5): 833-843. https://doi.org/10.1093/aob/mcx116

Sisriana, S., Suryani, S., & Sholihah, S. M. 2021. Pengaruh Berbagai Media Tanam Terhadap Pertumbuhan dan Kadar Pigmen *Microgreen*s Selada. Jurnal Ilmiah Respati. 12(2): 163-176. DOI: https://doi.org/10.52643/jir.v12i2.1886

Simanjuntak, P. G., & Heddy, Y. B. S. 2018. Re spon Tanaman Horenso (*Spinacia oleraceae* L.) terhadap Media Serbuk Sabut Kelapa (*Cocopeat*) dan Pupuk Cair Kotoran Kelinci. *Jurnal Produksi Tanaman*. 6(5): 723 – 728. http://repository.ub.ac.id/id/eprint/131060

Surtinah. 2016. Penambahan Oksigen pada Media Tanam Hidroponik terhadap Pertumbuhan Pakcoy (*Brassica rapa*). *Jurnal Bibiet*. 1(1): 27-35.

Tan, L., Nuffer, H., Feng, J., Kwan, S.H., Chen, H., Tong, X., and Kong, L., 2020. Antioxidant Properties and Sensory Evaluation of *Microgreen*s from Commercial and Local Farms. *Food Science and Human*. 9(1): 45-51. https://doi.org/10.1016/j.fshw.2019.12.002

Ulfa, M., Pranoto, H., & Susylowati, S. 2021. Respons Pertumbuhan dan Hasil Tanaman Seledri (*Apium graveolens* L.) Terhadap Media Tanam dan Konsentrasi Larutan Nutrisi yang Berbeda Pada Wick System. *Ziraa'ah Majalah Ilmiah Pertanian*. 46(2): 232-240. https://ojs.uniska-bjm.ac.id/index.php/ziraah/article/viewFile/4330/2964

Wahono, E., Izzati, M., & Parman, S. 2018. Interaksi antara Tingkat Ketersediaan Air dan Varietas terhadap Kandungan Prolin serta Pertumbuhan Tanaman Kedelai (*Glycine max* L. Merr). *Buletin Anatomi dan Fisiologi (Bulletin Anatomy and Physiology)*. *3*(1): 65-74. https://doi.org/10.14710/baf.3.1.2018.11-19

Warjoto, R. E., Barus, T., & Mulyawan, J. 2020. Pengaruh Media Tanam Hidroponik Terhadap Pertumbuhan Bayam (*Amaranthus* sp.) dan Selada (*Lactuca sativa*). *Jurnal Penelitian Pertanian Terapan*. 20(2): 118-125. DOI: https://doi.org/10.25181/jppt.v20i2.1610