GSC Biological and Pharmaceutical Sciences

eISSN: 2581-3250 CODEN (USA): GBPSC2

Cross Ref DOI: 10.30574/gscbps

Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

Check for updates

Stability test and identification of factors causing inconsistency of results and yield quality of melon (*Cucumis melo* L.) At different planting times and different fruit growth positions in deep flow technique hydroponic systems

I Putu Werdhi Winata, I Nyoman Rai* and Ni Nyoman Ari Mayadewi

Agronomy and Horticulture Laboratory, Faculty of Agriculture, Agrokompleks Building 2nd floor, PB Sudirman Campus, Denpasar-Bali, Indonesia.

GSC Biological and Pharmaceutical Sciences, 2025, 30(02), 109-116

Publication history: Received on 19 November 2024; revised on 04 February 2025; accepted on 07 February 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.30.2.0492

Abstract

Melon plants belong to the cucurbiceae family which is a tribe of gourd plants with plant characteristics such as creeping stems, leaves with long stalks, unisexual flowers, and fibrous roots. The high demand for melon plants in Indonesia has led to a shift in the use of hydroponic systems in green houses to produce a stable quantity and quality of melons throughout the year. The purpose of this study was to find the best planting time period and fruit growing position on the main stem internode that produced the best quantity and quality of melons. The research was conducted with a 2-factor split plot in time design, there were 8 treatment combinations with 4 replications, so there were 32 experimental sample units. The main plot was different planting time (W) consisting of 2 levels, namely: July - October planting period 2024 (W_s) and August - November planting period 2024 (W_d). The second factor is the fruit growinf position on the internode of the main stem until harvest (P) consisting of 4 levels, namely: stem internode 8-10 (P_1), stem internode 11-13 (P_2), stem internode 14-16 (P_3) and stem internode 17-19 (P_4). The treatment of planting time had a significant effect on the variables of fruit hardness and percentage of edible fruit. The treatment of fruit growth position on the main stem internode significantly affected the variables of fruit diameter, fresh weight, and total soluble solids.

Keywords: Melon; Planting time; Fruit growing position; Hydroponics; Deep Flow Technique

1. Introduction

Melon plants belong to the cucurbiceae family which is a horticultural plant spread evenly throughout the world due to its good adaptation to the environment through the distribution of buying and selling between countries. Melon plants have taproots, creeping stems that have internodes as a place for the emergence of shoots and leaves [1], green leaves with fingered leaf bones and rough hair, tendrils as a support for plant growth [2], male flowers appear in the leaf axils of the main stem segment. Female flowers appear in the leaf axils of lateral branches [3]. Melon fruit production in 2020 reached 138,177 tons with a harvest area of 8,120 Ha [4]. however, melon production in Indonesia is currently only able to meet about 40% of national needs while the rest is met through imports [5]. Melon crop production must run throughout the year with high quality to meet consumer demand.

One of the hydroponic models that can be applied to maintain the stability of the quantity and quality of melon production is the deep flow technique in the green house. The DFT (Deep Flow Technique) Hydroponic System is a closed hydroponic system that works by flowing water as high as 3-5 cm in the gutter for 24 hours continuously so that constant solution circulation remains in the root zone [6]. Melon cultivation practices in hydroponic systems in green houses have this standard operating production that must be followed to produce a stable quantity and quality of

* Corresponding author: I Nyoman Rai.

melons from time to time which include the planting and harvest time, use of AB mix concentration, water pH, greenhouse temperature, hydroponic system and tools maintenance, pest and disease prevention and more

The use of green houses in melon hydroponic systems can reduce the risk of crop failure and allow year-round harvesting. In Indonesia, the rainy season starts from October-March and the dry season from April-September. Melon plants are conventionally planted during the dry season. Melon plants can grow well in areas with air temperatures of 25-30^0 C with sunshine intensity of 10-12 hours, air humidity of 70 - 80% and rainfall between 2,000 to 3,000 mm per year [3] .

In hydroponic melon cultivation, one tree is generally only developed one fruit, it is intended that the results of photosynthate and assimilate translocation are focused on the development of one fruit, and it is expected that with maximum photosynthate absorption in one fruit, it can produce fruit with good quality. the higher the position of the fruit, the quality of the fruit which includes weight, volume, diameter and sweetness level will be better [7]. In the middle stem segment, the stem circumference is large and allows normal fruit formation and develops perfectly [8].

2. Material and Method

The research was conducted from July to November 2024 at PJ Fresh Hydroponic green house, Malang, a partner of PT Surabaya Vegetable Garden. The research location is located at coordinates 7°56'28.9 "S 112°34'08.6 "E with an altitude of approximately 696 meters above sea level. Laboratory tests will be carried out at the Agronomy and Horticulture Lab, Faculty of Agriculture, Udayama University, Sudirman campus, Denpasar.

Materials required include inthanon melon seeds, AB Mix Supernova, seedling trays, rockwool, raw water, amylum solution, distilled water, iodine solution. The tools needed include PVC pipe installation, water pump, water hose, nutrient reservoir, netpot, EC meter, cutting scissors, rope, stationery, refractometer, penetrometer, vernier, analytical scales, color chart, funnel, Chlorophyll Meter SPAD-502, styrofoam box, thinwall, Rhizo Vision, explorer, luxmeter, hygrometer.

AB Mix Supernova has with 6 macro elements and 13 micro nutrients namely Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulfur (S), Iron (Fe), Boron (B), Manganese (Mn), Zinc (Zn), Copper (Cu), Molybdenum (Mo), Chlorine (Cl), Nickel (Ni), Sodium (Na), Cobalt (Co), Iodine (I), Vanadium (V) and Argetum (Ag).

The research was conducted with a 2-factor split plot in time design with 4 replications, thus there were 8 treatment combinations with 4 replications, so there were 32 experimental sample units. The first factor tried as the main plot is different planting time (W) consisting of 2 levels, namely: July - October planting period 2024 (W_s) and August - November planting period 2024 (W_d). The second factor is the position of fruit growth on the main stem internode (P) as a subplot consisting of 4 levels, namely: stem internode 8-10 (P_1), stem internode 11-13 (P_2), internode 14-16 (P_3) and internode 17-19 (P_4).

The observed variables were number of male flowers, number of female flowers, chlorophyll content of leaves, relative light intensity, relative water content of leaves, fruit color, fruit fresh weight, fruit diameter, fruit firmness, percentage of edible fruit, total soluble solids, vitamin C content. Observational data were analyzed using analysis of variance (ANOVA). If the interaction between different planting times and fruit growing positions had a significant effect, it was tested with the Duncan test at the 5% level. If the interaction effect is not significant, the mean value of the variable for each single factor effect is tested with the BNT (Least Significant Difference) test at the 5% level.

3. Result

Table 1 Treatment of planting time and fruit growth position on the number of male flowers (florets), number of female flowers (florets) and leaf chlorophyll content (SPAD)

Treatment	**Number of male flowers (flowers)**		**Number of female flowers (flowers)**		**Leaf chlorophyll content (SPAD)**	
Planting Time (W)						
Ws	101.93	a	33.81	a	51.87	a
Wd	99.53	a	32.62	a	63.25	a

BNT 5%	14.82		4.25a	33.61		
Fruit growth position (P)						
P1	90.75	b	30.62	a	50.78	a
P2	103.00	ab	33.62	a	50.89	a
P3	105.50	a	33.62	a	53.97	a
P4	103.68	a	35	a	53.79	a
BNT 5%	12.60		4.99	31.36		

3.1.1. Male Flowers

The number of male flowers in the treatment of planting time was not significantly different between the levels of Ws and W_d with values of 101.93 and 99.53, respectively. The highest number of male flowers in the fruit growth position treatment was at the P_3 level with a value of 105.50 which was not significantly different from the P_4 and P_2 levels which had values of 103.68 and 103.00, respectively, but significantly different from the P_1 level with a value of 90.75. The level of P_2 is not significantly different from the level of P_1.

3.1.2. Female Flowers

The number of female flowers in the treatment of planting time was not significantly different between the levels of Ws and W_d with values of 33.81 and 32.62, respectively. The highest number of female flowers in the fruit growth position treatment was found at the P_2 dam P_3 level with the same value of 33.62, which was not significantly different from the P_1 and P_4 levels with values of 30.62 and 35 respectively.

3.1.3. Leaf Chlorophyll Content (SPAD)

The content of leaf chlorophyll in the treatment of planting time was not significantly different between the levels of Ws and W_d with values of 51.87 and 63.25, respectively. The chlorophyll content of leaves in the treatment of growing position was not significantly different in all treatments with the level values of P_1, P_2, P_3 and P_4 with values of 50.78, 50.89, 53.97, 53.79 respectively.

Table 2 Treatment of planting time and fruit growing position on relative light intensity (%), relative water content of leaves (%) and fruit color

Treatment	**Relative Light Intensity (%)**		**Relative Water Content of Leaves (%)**		**Fruit color**	
Planting Time (W)						
Ws	23.50	a	72.22	a	5.31	a
Wd	16.14	a	75.15	a	5.37	a
BNT 5%	9.44		10.21		0.75	
Fruit growth position (P)						
P1	20.93	a	71.90	a	5.33	a
P2	21.80	a	74.33	a	5.25	a
P3	17.52	a	73.91	a	5.43	a
P4	19.02	a	74.59	a	5.35	a
BNT 5%	4.74		6.52		0.60	

3.1.4. Relative Light Intensity

The relative light intensity in the planting time treatment was not significantly different between the Ws and W_d levels with values of 23.50% and 16.14%, respectively. The highest relative light intensity in the treatment of growing position was not significantly different in all treatments with the level of P_1, P_2, P_3 and P_4 with values of 20.93%, 21.80%, 17.52%, 19.02% respectively.

3.1.5. Relative Water Content of Leaves

The relative water content of leaves in the treatment of planting time was not significantly different between the levels of Ws and W_d with values of 72.22% and 75.15%, respectively. Relative water content in the treatment of growing position was not significantly different in all treatments with the level values of P_1, P_2, P_3 and P_4 with values of 71.90%, 74.33%, 73.91%, 74.59% respectively.

3.1.6. Fruit color

Fruit color in the planting time treatment was not significantly different between the Ws and W_d levels with values of 5.31 and 5.37, respectively. Fruit color in the treatment of growing position is not significantly different in all treatments with the level values of P_1, P_2, P_3 and P_4 with values of 5.33, 5.25, 5.43, 5.35 respectively.

Table 3 Treatment of planting time and fruit growing position on fresh weight (g), fruit diameter (mm) and fruit hardness (kg/cm3)

Treatment	Fresh weight (g)		Fruit diameter (mm)		Fruit hardness (kg/cm^3)	
Planting Time (W)						
Ws	1068.06	a	118.48	a	1068.06	a
Wd	1199.78	a	123.98	a	1199.78	a
BNT 5%	218.72		8.49		56.17	
Fruit growth position (P)						
P1	1059.81	b	118.24	a	1059.81	b
P2	1123.12	b	119.42	a	1123.12	b
P3	987.5	b	117.05	a	987.5	b
P4	1365.25	a	130.20	a	1365.25	a
BNT 5%	186.81		7.16		103.74	

3.1.7. Fresh Weight

Fresh weight in the treatment of planting time was not significantly different between the levels of Ws and W_d with values of 1068.06 g and 1199.78g, respectively. The highest fresh weight in the treatment of growing position was obtained by P_4 with a value of 1365.25 g, significantly different from the level of P_1, P_2, P_3 and with values of 1059.81 g, 1123.12 g, 987.5 g respectively. Levels P_1, P_2, P_3, are not significantly different from each other.

3.1.8. Fruit Diameter

Fruit Diameter in the planting time treatment was not significantly different between the Ws and W_d levels with values of 118.48 mm and 123.98 mm, respectively. The highest fruit diameter was found at the P_4 level with a value of 130.20 mm which was significantly different from the P_1, P_2, P_3 levels with values of 118.24 mm, 119.42 mm, and 117.05 mm, respectively.

3.1.9. Fruit hardness

Fruit hardness in the treatment of planting time was significantly different between the levels of Ws and W_d with values of 310.76 kg/cm^3 and 425.95 kg/cm^3 respectively. Fruit color in the treatment of growing position was not significantly different in all treatments with the level values of P_1, P_2, P_3 and P_4 with values of 343.78 kg/cm^3 , 374.58 kg/cm^3 , 369.40 kg/cm^3 385.66 kg/cm ^{3}.

Table 4 Treatment of planting time and fruit growing position on percentage of edible fruit (%), total soluble solids (%brix), vitamin c content (mg/g)

Treatment	Percentage of edible fruit (%)		Total Dissolved Solids (%Brix)		Vitamin C content (mg/g)	
Planting Time (W)						
Ws	81.54	a	13.72	a	45.10 (6.76)	a
Wd	79.02	b	13.78	a	60.30 (7.74)	a
BNT 5%	0.91		1.27		1.60	
Fruit growth position (P)						
P1	80.62	a	14.14	a	57.22 (7.55)	a
P2	79.50	a	14.31	a	48.40 (7.01)	a
P3	80.55	a	13.08	b	50.60 (7.04)	a
P4	80.44	a	13.49	ab	54.58 (7.40)	a
BNT 5%	2.89		0.76		1.02	

3.1.10. Percentage of edible fruit

The percentage of edible fruit in the planting time treatment was significantly different between the Ws and W_d levels with values of 81.54% and 79.02%, respectively. The percentage of edible fruit in the treatment of growing position was not significantly different in all treatments with the level of P_1, P_2, P_3 and P_4 with the value of 80.62%, 79.50%, 80.55%, 80.44% respectively.

3.1.11. Total Dissolved Solids

Total soluble solids in the planting time treatment differed not significantly between the levels of Ws and W_d with values of 13.72 %Brix and 13.78 %Brix, respectively. The highest total soluble solids in the position treatment was obtained at P_2 with a value of 14.31 and was not significantly different from P_1 and P_4 with values of 14.14 %Brix and 13.49 %Brix, respectively, but significantly different from P_3 with a value of 13.08 %Brix. The level of P_4 was not significantly different from the level of P_3

3.1.12. Vitamin C content

Vitamin C content in the treatment of planting time was not significantly different between the Ws and W_d levels with values of 45.10 mg/g and 60.30 mg/g, respectively. Fruit color in the treatment of growing position was not significantly different in all treatments with the value of P_1, P_2, P_3 and P_4 levels of 57.22 mg/g, 48.40 mg/g, 50.60 mg/g 54.58 mg/g respectively.

4. Discussion

The treatment of planting time, fruit growth position, and the interaction of the two factors had no significant effect on the variables of number of male flowers, number of female flowers, leaf chlorophyll content, relative light intensity, leaf water content, fruit color and vitamin C content. All values were not significantly different from each other. Green house microclimate conditions are quite different from time to time, melon plants require conditions with high temperatures and high humidity.

The treatment of planting time had a significant effect on the variable of fruit hardness and percentage of edible fruit. In the variable of fruit hardness, the level of Ws and W_d has a value of 310.76 kg/cm^3 and 425.95 kg/cm$^{3.}$ respectively while in the variable of fruit hardness, the level of Ws and W_d with a value of 81.54% and 79.02% respectively. The results of assimilation in sufficient conditions will encourage fruit formation [9]. Environmental conditions that meet the requirements of planting and sufficient nutrients will produce enough assimilates for plant needs and produce fruit with a high percentage of pulp. Fruit with a low maturity level has a high hardness [10]. Generally, consumers or the public prefer fruit with a crunchy texture. Fruit hardness occurs because the fluid pressure in the cells is still quite large and the cell tissue in the fruit has not been damaged. Fruit that has reduced water content compared to the time of harvest, will show symptoms of wrinkles so that the fruit will be softer [11].

Fertilization of plants in the first planting period occurs in summer with higher light intensity than during the fertilization phase of plants in the second planting time period. The intensity of sunlight during the fertilization phase in the greenhouse ranges from 40,000-65,000 lux while at the second planting time it ranges from 35,000-45,000 lux. The production of a plant is the resultant of the photosynthesis process, a decrease in assimilate due to respiration and translocation can affect yield [12]. The fruit yield of the second time harvest is less ripe than and the percentage of pulp is lower as the assimilate produced is inhibited due to decreased photosynthesis. Fruit hardness value and edible fruit percentage have a negative correlation value (r = -1) which states an inverse relationship. The higher the percentage of edible pulp, the softer the fruit becomes and hence the hardness of the fruit decreases.

Melon plants can grow well in areas with air temperatures between 25-30^{o}C and air humidity between 70 - 80% [3]. The average air temperature in the green house where the research has met the planting requirements, but the air humidity ranges from 60 - 75% which is lower than the planting requirements. The use of AB mix supernova nutrition used in melon hydroponics is AB mix with a dose of 400-600 ppm.

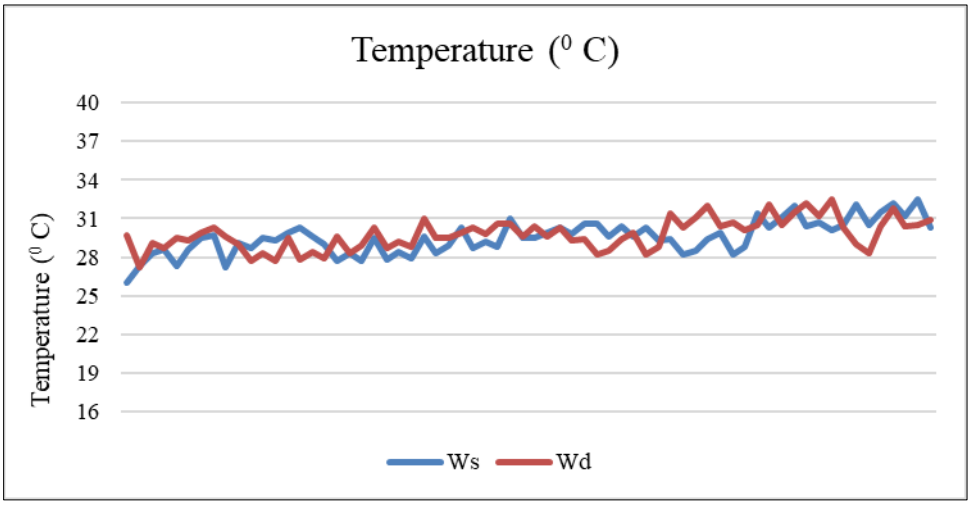

Figure 1 Temperature (^{o} C) period W_s (July-October) and W_d (August-November)

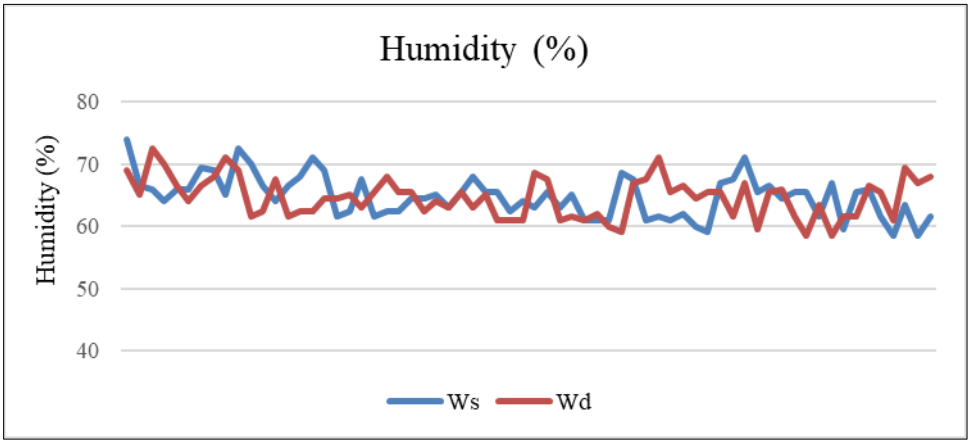

Figure 2 Air humidity for the period W_s (July-October) and W_d (August-November)

The treatment of fruit growth position on the main stem internode had a significant effect on the variables of fruit diameter, fresh weight, and total soluble solids and significantly different on the variable number of male flowers. The number of male flowers decreases with the lower position of the fruit grown on the main stem because the photosynthate is no longer prioritized for flower formation but prioritized for enlargement and fruit maturation so that the lower and faster the fruit is grown, the number of male flowers decreases. Flower level P_3 has the highest value of 105.50 which is not significantly different from level P_4 and P_2 , but significantly different from level P_1 with a value of 90.75 and level P_2 is not significantly different from level P_1.

Fruit growth position affects the size of the fruit produced, the higher the position of the fruit, the larger the fruit and the weight of the fruit produced. The highest fruit diameter was obtained at level P_4 with a value of 130.20 mm and the highest fruit fresh weight was obtained at level P_4 with a value of 1365.25 g. Fruit diameter and fruit fresh weight have a positive correlation value (r = 0.98) which states a directly proportional relationship.

The larger the size of the harvested fruit, the greater the diameter and fresh weight of the fruit. The size of the fruit is influenced by the translocation of photosynthetic assimilates that are distributed to all parts of the plant, the increase in assimilates from the accumulation of food reserves causes translocation carried out by plants to focus on the sink when the plant enters the generative phase as an effort to improve yield and yield quality [13]. Pruning is also an effort to improve yield and yield quality because old unproductive leaves do not become part of the sink that reduces assimilate yield [14].

The absorption of assimilates varies with each position of the fruit. The fruit absorbs the assimilate from the leaves that are nearby. The higher the position of the fruit, the more assimilate is obtained compared to the fruit in the lower position because the fruit in the lower position only gets assimilate from old leaves that are already shaded and less productive while the fruit in the upper position gets a lot of assimilate from young leaves at the top.

The growing position of the fruit affects the total soluble solids which can be used as a measure of fruit sweetness. During the process of fruit ripening, the breakdown of complex compounds into simple compounds causes an increase in total soluble solids. The increase in total soluble solids in fruits is due to the formation of simple sugars from degradation in the ripening phase [11], 1%brix is equivalent to one gram of sucrose in 100mL of solution (1°Brix = 1% sugar) so that total soluble solids indicate the sweetness of the fruit [15]. .

The lower the fruit growth position, the higher the total soluble solids, as low-growing fruits have formed first so that they can absorb more photosynthate than fruits in high positions if the fruits are harvested relatively close together. Fruit growth position and total soluble solids have a negative correlation value (r = -0.72) indicating an inverse relationship.

The treatment of different planting times and different fruit growth positions provides results and quality of yields that tend to be consistent because the results of the observed variables have no real effect, only a few variables that show the results of the analysis have a real effect.

5. Conclusion

Based on the research, the treatment of planting time, fruit growth position, and the interaction of the two factors had no significant effect on the variable number of male flowers, number of female flowers, leaf chlorophyll content, relative light intensity, leaf water content, fruit color and vitamin C content. This shows that the yield and quality of melon crops are consistent.

The treatment of planting time had a significant effect on the variable of fruit hardness with the highest value in treatment W_d and the percentage of edible fruit with the highest value in treatment Ws. The treatment of fruit growth position on the main stem internode had a significant effect on the variables of fruit diameter and fresh weight with the highest in the P_4 treatment and the highest total soluble solids in the treatment P_2.

Compliance with ethical standards

Acknowledgments

Thank you to Udayana University through the Institute for Research and Community Service (LPPM) for providing funding and facilitating this research, as well as to PJ Fresh and Kebun Sayur Surabaya for accepting, permitting, and supporting the research process.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Suntoyo., Makful and N. L.P. I. Indrayani, T. Setyowati. Technical Guidelines for Melon Seed Production and Management. West Sumatera :Research Center for Tropical Fruit Crops.2010. [Indonesian]

[2] Daryono, B. S., D. S. Maryanto, S. Nissa, & G. R. Aristya, Analysis of vitamin content in melon (Cucumis melo L.) cultivar melody gama 1 and commercial melon. Biogenesis: Scientific Journal of Biology. 2016 ; 4(1) :1-9. [Indonesian]

[3] Supriyanta, B., Mangaras, & Indah, Widowati. Hydroponic Melon Cultivation with Smart Farming. Yogyakarta : Institute of Research and Community Service UPN "Veteran" Yogyakarta. 2022 [Indonesian]

[4] Ministry of Agriculture.. Horticulture Fixed Figures for 2021. Jakarta: Directorate General of Horticulture Ministry of Agriculture. 2022 [Indonesian]

[5] Irawan, E., A. Agustono, & I. S. Andriani. Patterns of Farm Labor Allocation and Its Effect on Melon Farm Productivity: A Generalized Additive Model Approach. JSEP (Journal of Social and Agricultural Economics). 2023 ; 16(2) : 159-172. [Indonesian]

[6] Vega, I., D. Bien-amié., G. Augustin., W Heiden., & N. Heiden. DFT hydroponic system for lettuce and pepper production with limited electricity. AgriRxiv. 2022 : 1 -1-19

[7] Widaryanto, E., Putri, M. R., Yamika, W. S. D., Saitama, A., & Zaini, A. H. The effect of leaf bud trimming and fruit position arrangement on the quality of golden melon (Cucumis melo L.). Acta Agrobotanica. 2020 ; 73(2) : 1 - 7

[8] Puspitorini, P. Pruning Apical Shoots and Fruit Position in Melon (Cucumis Melo L.) Var. Honeydew Orange Cultivated in a Screenhouse. Agrika. 2023 ; 17(1) : 183-193. [Indonesian]

[9] Christy, J. Increasing Fruit Production of Melon Plants (Cucumis melo L.) Hydroponically. AGRIUM: Journal of Agricultural Sciences. 2020 ; 22(3) : 150-156. [Indonesian]

[10] Nurhayati, A. A., Rahayuni, A., & Ambarwati, R. Effect of Ozonization Process on Total Bacteria, Vitamin C Stability, and Texture in Cut Melon Fruit. Journal of Nutrition Research. 2019 ; 7(2) : 79-82. [Indonesian]

[11] Darmajana, D. A., Afifah, N., Solihah, E., & Indriyanti, N. Effect of carrageenan edible coatings on cut melon quality in cold storage. Agritech. 2017 ; 37(3) ; 280-287. [Indonesian]

[12] Jumin, H.B. Basics of Agronomy. Revised Edition. Jakarta : Rajawali Press. 2014. [Indonesian]

[13] Nursyamsi, A., Nasrudin, N., & Nurhidayah, S. Effect of organic fertilizer type and thinning of ovules on melon growth and yield. Journal of Agrotek Tropika. 2023 ; 11(1) : 119-126. [Indonesian]

[14] Santi, R., Aini, S. N., & Darmawan, N. Growth and Production of Melon Plants (Cucumis melo L) in Ultisol Soil with the Addition of Liquid Organic Fertilizer (POC) Pineapple Peel. Journal of Agricultural Science and Technology. 2018 ; 2(1) : 31-39. [Indonesian]

[15] Jaywant, S. A., Singh, H., Arif, K. M. 202 Sensors and Instruments for Brix Measurement: A Review. Sensors. 2022 ; 22 (6) : 1-20.