

Article ID: 7324  
DOI: 10.5586/aa.7324

**Publication History**  
Received: 2020-10-25  
Accepted: 2020-05-05  
Published: 2020-06-30

**Handling Editor**  
Barbara Łotocka; Warsaw  
University of Life Sciences –  
SGGW, Poland;  
<https://orcid.org/0000-0001-5913-8424>

**Authors' Contributions**  
EW, WSDY: designing the experiments, reviewing and finalizing the manuscript; AS, AHZ: performing experiments, analyzing data, and writing the manuscript; MRP: collecting and analyzing data

**Funding**  
This study was funded by BOPTN 2018 Faculty of Agriculture, University of Brawijaya.

**Competing Interests**  
No competing interests have been declared.

**Copyright Notice**  
© The Author(s) 2020. This is an open access article distributed under the terms of the [Creative Commons Attribution License](#), which permits redistribution, commercial and noncommercial, provided that the article is properly cited.

ORIGINAL RESEARCH PAPER in HORTICULTURAL PLANTS

# The Effect of Leaf Bud Trimming and Fruit Position Arrangement on the Quality of Golden Melon (*Cucumis melo* L.)

Eko Widaryanto <sup>\*</sup>, Megawati Ristiaji Putri,  
Wiwin Sumiya Dwi Yamika, Akbar Saitama ,  
Akbar Hidayatullah Zaini

Department of Agronomy, Faculty of Agriculture, University of Brawijaya, Malang, 65145, Indonesia

<sup>\*</sup>To whom correspondence should be addressed. Email: [weedard.eko@gmail.com](mailto:weedard.eko@gmail.com)

## Abstract

Melon are one of the most popular fruit commodities, but, despite the demand, its production in Indonesia has declined. One measure that can be used to optimize the quality of melon fruit is to trim off the leaf buds and arrange the position of fruiting on the stem, and this study, using the golden melon cultivar 'Apollo,' aimed to identify the effects of leaf bud trimming and fruit position arrangement in improving the quantity and quality of the fruit harvest. The experiment was conducted from March to May 2018 in the greenhouse of Food Crop and Horticulture Agribusiness Development (UPT Pengembangan Agribisnis Tanaman Pangan dan Hortikultura), in Lebo, Sidoarjo, Indonesia. It was based on a split-plot design, with leaf bud trimming as the main factor, consisting of two groups (trimming or not trimming), and fruit positions as the secondary factor, consisting of four stages, all repeated at four different time intervals. A correlation was found between leaf bud trimming and fruit position arrangement toward the number of leaves. However, the treatments did not affect the growth and yield of the plants, but did have a significant effect on fruit weight, sweetness, and volume. It was concluded that trimming off the leaf buds and arranging the fruiting position on golden melon plants can increase the quality of fruits, with the treatment involving trimming combined with arranging fruiting on the twelfth–thirteenth segment showing the best results.

## Keywords

arranging the fruiting; fruit sweetness; lateral buds

## 1. Introduction

Golden melon (*Cucumis melo* L.) is a very popular and sought-after fruit for human nutrition in Indonesia. Besides having a good taste, melons have a rich chemical composition, which makes them a very good biological source for human health. Melon fruits contain carbohydrates, including glucose, fructose, and 4.6% to 16.0%–18.0% sucrose, starch, up to 4.5% pectin, vitamins A, C, D, K, and vitamin groups B and E, folic acid, carotene, minerals (potassium, magnesium, phosphorus, sodium, selenium, and calcium), and various aromatic compounds (Petkova & Antova, 2015). Nonetheless, melon production in Indonesia has declined recently. However, there is an increasing demand for melons along with increases in the population, whose changing incomes and dietary patterns correspond to increasing awareness of the need for fresh fruit as a component of daily healthy lifestyle. One way to improve yields is to improve the trimming techniques. According to earlier studies on melon or watermelon (Lins et al., 2013; Pereira et al., 2003) trimming the main stems has a positive effect on fruit quality due to the removal of apical dominance. It results in branching and expansion of the leaf area, causing higher

intakes of photoassimilates for fruits. Trimming also improves the efficiency of utilization of sunlight, simplifies pest/disease control, and facilitates harvesting. Trimming of melon plants inhibits their vegetative phase, diverting photosynthates to be used in the generative phase and fruit production. As a result, fruit quality is improved as well as the size and weight of the fruit (Saprudin, 2013).

Trimming in melon cultivation is applied not only to the shoots, but also to the lateral buds where the flowers grow. Too large a number of shoots will reduce the size and quality of the fruit, because each lateral shoot has the potential to produce fruit. The lateral buds of melon plants can grow up to 25 leaves. On these buds, fruit position can be arranged. The optimum position for fruit productivity is on the ninth to thirteenth segments (Veronica, 2009), because the number of leaves is adequate and the stems are wide enough to support the growing melon fruits, allowing them to reach their optimum quality.

This research aims at discovering the effects of bud trimming and fruit position arrangement on the yield components of melon fruits.

## 2. Material and Methods

This study was conducted from March to May 2018 in the greenhouse of the Technical Implementation Unit of Food Crop and Horticulture Agribusiness Development located at Lebo street No. 48, Lebo, Sidoarjo, Indonesia. The average temperature of the greenhouse during the study was 32 °C and the relative humidity was 70%. The materials used included melon seeds of 'Golden Apollo' cultivar, water, manure, urea, KNO<sub>3</sub>, NPK, carbofuran (Furadan 3GR), and soil.

The experiments were carried out according to a split-plot design. Bud trimming was the first-level treatment, and it consisted of the control (no trimming, P0) and trimming the two top segments (P1), which was performed at the forty-fifth day after planting (DAP). In the subplots, the arrangement of fruit position was randomized with four locations for the fruit: on the sixth–seventh segment (L<sub>6–7</sub>), the eighth–ninth segment (L<sub>8–9</sub>), the tenth–eleventh segment (L<sub>10–11</sub>), and the twelfth–thirteenth segment (L<sub>12–13</sub>). These eight different treatment combinations were replicated four times, resulting in 32 experimental units, each consisting of 20 plants, so that there were 640 plants with plant spacings of 50 × 50 cm.

Melon seedlings were transferred to the plots after they developed two–three leaves or 7 days after emergence. Seedlings were planted into holes of 12 cm diameter and 9 cm depth, and their roots were covered with substrate. As the stems elongated, they were pruned, leaving a single stem, which was gradually twined on a supporting string.

The planting substrate used in this study was a mixture of one part of soil and one part of cow manure. Plants were fertilized three times: at 7 days after planting (DAP) with NPK fertilizer 4 g plant<sup>-1</sup> and urea 2.5 g plant<sup>-1</sup>, and at 28 DAP and 42 DAP with NPK doses of 5 g plant<sup>-1</sup> and 3.5 g plant<sup>-1</sup> KNO<sub>3</sub>.

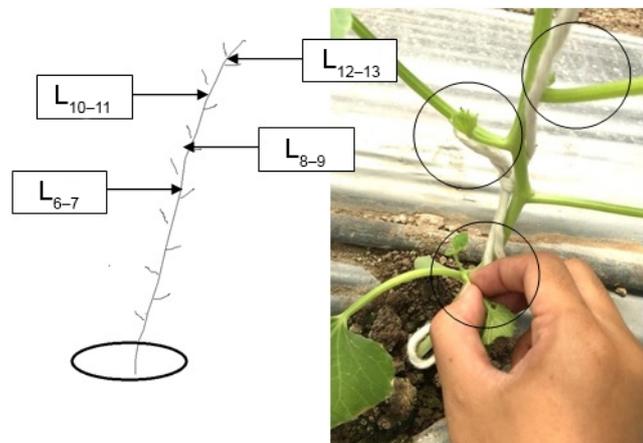
The leaf buds were trimmed from the top two segments at 45 DAP, when the fruits had visibly set (P1), or the apical buds were left growing without trimming (P0). As is shown in Figure 1, on the stem with a fruit already set, the top of the stem was cut off (trimmed), leaving two leaves (two segments) above the fruit. Melon plants in this study had two lateral buds after trimming. This was followed in all treatments by trimming off all lateral stems that did not bear fruit.

The fruit position was arranged by trimming off the lateral buds to facilitate enlargement of fruits set on the L<sub>6–7</sub> segment, the L<sub>8–9</sub> segment, the L<sub>10–11</sub> segment, or the L<sub>12–13</sub> segment (Figure 2). The lateral buds were trimmed by cutting them up to the segment on which the fruit would grow. For example, in the L<sub>6–7</sub> treatment, the lateral buds were trimmed up to the fifth segment so that the growing fruit was positioned on the sixth and seventh segment. After trimming, one fruit per plant was left.

The number of leaves, leaf areas, leaf area index (LAI), age of flowering, number of flowers, stem diameters, and fruit parameters were determined at the end of the experiment. The yield analysis included fruit weight, volume, sweetness, and



**Figure 1** Trimming the top segment of the stem.



**Figure 2** Arranging the position of melon fruit and trimming lateral buds.

diameter. Leaf area was measured with a Leaf Area Meter LI 3100C (LI-COR Biosciences). The number of branches was recorded periodically until harvest at 70 DAP. LAI was calculated as the leaf area divided by the spacing used ( $50 \times 50$  cm). The diameter of the fruit was calculated from its circumference as measured by the meter. Fruit sweetness was measured by placing the fruit sap on the Brix Refractometer. Fruit volume was determined by submerging the fruit in a vessel filled fully with water and then measuring the spilled water in mL.

The data were analyzed using the analysis of variance (ANOVA) with 5% significance level to determine the effect of the treatments. If a treatment was significantly different, further analysis of the least significant difference (LSD) was performed at 5% significance (Gomez & Gomez, 1995). In addition, the observational data were subjected to a regression test between the fruit position treatment and yield parameters, specifically fruit weight, volume, diameter, and sweetness, to find out whether the location of the fruit affected its quality.

### 3. Results

#### 3.1. Growth Parameters

The results of treatments on leaf area are shown in Table 1. These showed that there was no correlation between trimming the leaf buds and arranging the fruit position at 14 and 28 DAP with leaf area, but arranging the fruit position influenced the leaf area at 42 DAP, and trimming the leaf buds significantly affected the leaf area at 56 and 70 DAP. The results of treatments on leaf area index (LAI) are shown in Table 2. Statistical analysis indicated that there was no correlation between trimming the leaf buds and arranging the fruit position with LAI. However, trimming the leaf buds significantly influenced the LAI of melons at 56 and 70 DAP, while arranging the fruit position affected LAI at 42 DAP.

**Table 1** Effects of bud trimming and fruit position arrangement on the leaf area per plant at 14, 28, 42, 56, and 70 DAP.

Treatment	Leaf area (cm <sup>2</sup> plant <sup>-1</sup> ) at different DAP				
	14	28	42	56*	70*
P0	196.17	2,049.71	11,750.86	9,732.35 b	10,137.26 b
P1	201.69	2,070.81	11,925.04	9,105.44 a	9,428.08 a
LSD 5%	ns	ns	ns	494.68	517.22
CV (P) 5%	5.54	9.68	22.81	5.74	5.75
L <sub>6-7</sub>	192.91	2,143.53	13,090.30 b	9,235.62	9,595.95
L <sub>8-9</sub>	200.05	2,085.43	12,421.20 b	9,221.50	9,647.41
L <sub>10-11</sub>	202.29	2,005.03	11,195.07 a	9,588.33	9,909.64
L <sub>12-13</sub>	200.47	2,007.26	10,645.24 a	9,630.13	9,977.67
LSD 5%	ns	ns	1,012.48	ns	ns
CV (L) 5%	11.14	7.70	8.14	3.66	3.57

Numbers with the same letter on the same column are not significantly different in the LSD test of 5%. DAP – days after planting; \* leaf area after trimming at 45 DAP.

**Table 2** Effects of bud trimming and fruit position arrangement on the leaf area index at 14, 28, 42, 56, and 70 DAP.

Treatment	Leaf area index at different DAP				
	14	28	42	56*	70*
P0	0.093	0.976	5.60	4.63 b	4.83 b
P1	0.096	0.986	5.68	4.34 a	4.49 a
LSD 5%	ns	ns	ns	0.24	0.25
CV (P) 5%	5.54	9.68	22.81	5.74	5.75
L <sub>6-7</sub>	0.092	1.02	6.23 b	4.40	4.57
L <sub>8-9</sub>	0.095	0.993	5.92 b	4.39	4.59
L <sub>10-11</sub>	0.096	0.955	5.33 a	4.57	4.72
L <sub>12-13</sub>	0.095	0.956	5.07 a	4.59	4.75
LSD 5%	ns	ns	0.48	ns	ns
CV (L) 5%	11.14	7.70	8.14	3.66	3.57

Numbers with the same letter on the same column are not significantly different in the LSD test at 5%. DAP – days after planting; \* leaf area after trimming at 45 DAP.

#### 3.2. Yield Parameters

The results of different treatments on fruit weight, volume, sweetness, and diameter at harvest at 70 DAP are shown in Table 3. Statistical analysis indicated that there was no correlation between trimming the leaf buds and arranging the fruit position with these yield parameters, although there was a significant influence of each of these treatments separately on these yield parameters.

The results showed that bud trimming with the fruit located on the L<sub>12-13</sub> segment gave a higher yield compared to other treatments. Figure 3 shows the relationship between the position and weight of the melon fruit, obtained by an R<sup>2</sup> coefficient of

**Table 3** Effects of bud trimming or fruit position arrangement on fruit weight, fruit volume, fruit sweetness, and fruit diameter at harvest at 70 DAP.

Treatment	Fruit weight (g plant <sup>-1</sup> )	Fruit volume (mL)	Fruit sweetness (%brix)	Fruit diameter (cm)
P0	1,561 a	2,081.88 a	11.81 a	15.34 a
P1	1,873 b	2,579.00 b	12.14 b	16.08 b
LSD	99.51	71.70	0.23	0.42
CV (P) %	3.51	1.93	1.57	2.34
L <sub>6-7</sub>	1,187 a	1,776.75 a	11.50 a	14.19 a
L <sub>8-9</sub>	1,458 b	2,070.00 b	11.59 a	15.07 b
L <sub>10-11</sub>	1,931 c	2,498.13 c	12.40 b	17.27 c
L <sub>12-13</sub>	2,293 d	2,976.88 d	12.45 b	17.31 c
LSD	96.36	91.69	0.30	0.32
CV (L) %	3.78	3.75	2.39	1.96

Numbers with the same letter on the same column are not significantly different in the LSD test at 5%; DAP – days after planting.

0.96 in Figure 3A, which means that the parameters of fruit weight were strongly influenced (96%) by the location of the fruit. In Figure 3B, the fruit position and fruit volume parameters have a close relationship of 99%, in Figure 3C the relationship with sweetness is 95%, and in Figure 3D there is 93% relationship between fruit location and diameter of the fruits. This indicated that the higher positions of the fruit increased the weight, volume, sweetness, and diameter of the melon, up to a limit at the L<sub>12-13</sub> segment. All figures show that the L<sub>12-13</sub> fruit position is the optimal segment for all parameters of the melon plants.

## 4. Discussion

### 4.1. Growth of Melon Plants

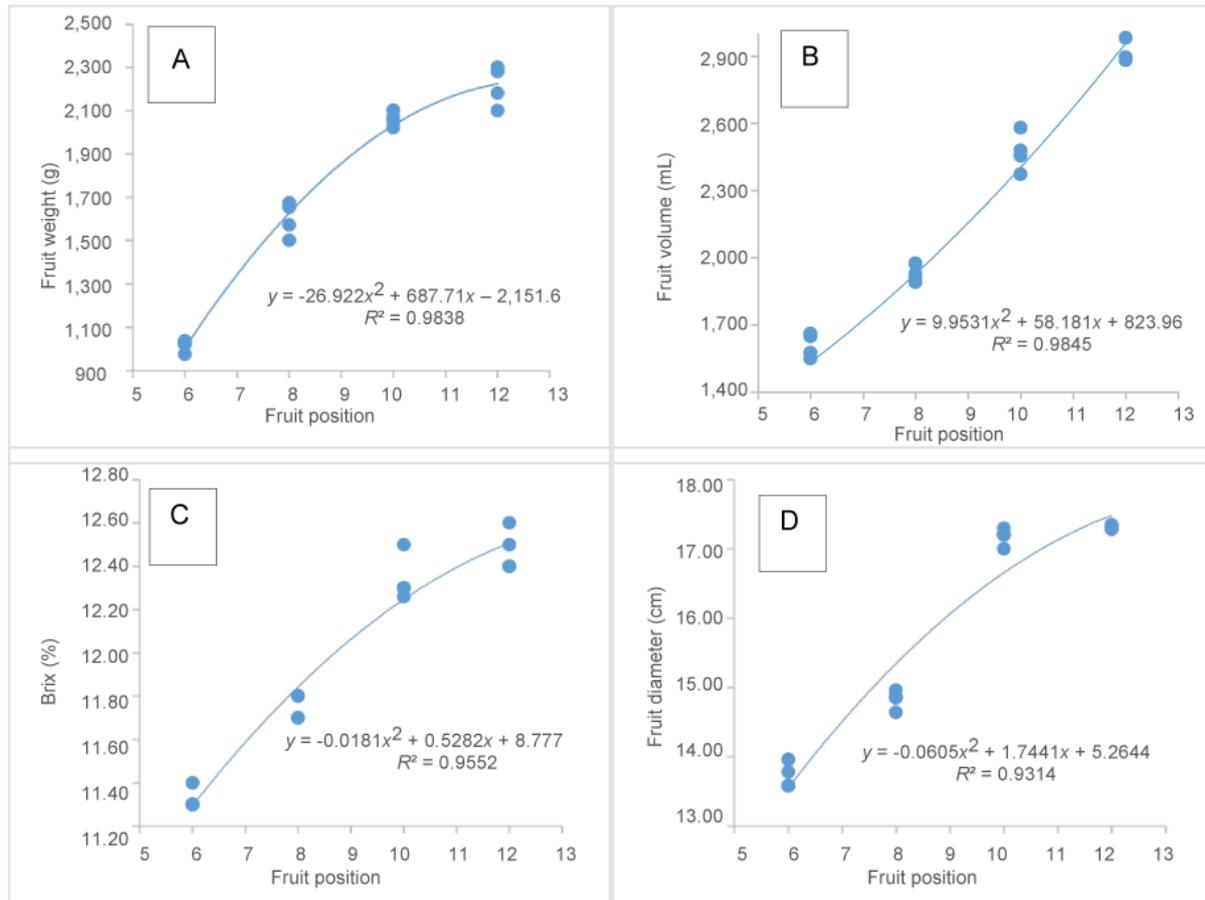
Arranging the fruit position by trimming the shoot back to the desired segment also reduces the leaves and branches. Removing the apical dominance of plants results in lateral branch growth and strong leaf area growth, thereby resulting in higher absorption of photoassimilates for fruits (Martins et al., 2016).

According to an earlier study (Friedrich & Fischer, 2000), light intensity is the main factor affecting the translocation of photosynthates in plants. The amount of light received is determined by the effectiveness of the plant canopy. Canopy shape, leaf area index, and leaf spread can all affect the rate of photosynthesis in the canopy. One way of shaping the canopy is by trimming lateral buds which reduces branching, so trimming the branches can increase yield. To obtain a good and productive canopy and branching, trimming needs to be done in a timely and effective way at the right position (Mastur, 2015; Rajaona et al., 2011).

In the present study, control plants (no trimming) had lower averages of growth and yield than the trimmed plants with the same fruit position. Plants are not able to form sufficient assimilates, so there is competition between vegetative and generative organs. Growth in melon fruits occurs through cell division in the fruit tissue (Triwulaningrum, 2009; Widaryanto & Saitama, 2017). Enlargement and division of cells in the fruit tissues require photosynthate as a substrate for metabolic energy and synthesis, which depends on the maturity level of the leaf to fruit ratio and genetic variations in growth (Burger et al., 2006).

### 4.2. Yield Component of Melon Plants

Trimming buds and arranging the fruit position have different effects on fruit yield parameters. The yield of trimmed melon plants was higher because trimming the main stem has a positive effect on fruit quality (Lins et al., 2013; Petkova & Antova, 2015). The ability of plants to produce photosynthate (source), distribute or translocate pure photosynthates into storage organs (sinks), and convert photosynthates to fruits is important for increasing crop yields. In the treatment entailing fruit arrangement, the selection of segments for fruit enlargement affects



**Figure 3** Relationship between fruit position and yield parameters. Fruit position in relation to fruit weight (A), fruit volume (B), fruit sweetness (C), and fruit diameter (D) of melon plants.

both the source and the sink. The higher the location of the fruit, the more leaves and branches need to be removed. Adult leaves translocate photosynthates to other vegetative organs and fruit enlargement segments. In the generative phase, photosynthates are translocated to the main sink, namely fruit. By trimming the apical buds, the vegetative phase of the plant is stopped and photosynthate is directed to the generative phase of the plant or to fruit enlargement. The bud trimming treatment was carried out at 45 DAP when all plants had already set fruits. Photosynthetic activity is influenced by the light received. The translocation of a photosynthate to the receiving organ (sink) is determined by its position and relative strength. The photoassimilate translocation rate from source to sink is influenced by the sink strength of a plant or leaves capable of photosynthesis (Abdoli et al., 2013). Each plant has different source and sink capacities because, according to (Fisher et al., 2012), the source and sink of plants are affected by the interaction of genetic and environmental factors (such as pruning the top and lateral buds).

## 5. Conclusion

Leaf bud trimming and arranging the fruiting position show different influence but are able to increase the components of melon yield, including fruit weight, volume, sweetness, and diameter. Leaf bud trimming can increase the yield from melon plants by up to 16.66% fresh weight of the fruit, and arranging a higher position for the melon fruit can increase both the quantity and quality of the fruit.

## References

- Abdoli, M., Saeidi, M., Honarmand, S. J., Mansourifar, S., Ghobadi, M. E., & Cheghamirza, K. (2013). Effect of source and sink limitation on yield and some agronomic characteristics in modern bread wheat cultivars under post anthesis water deficiency. *Acta Agriculturae Slovenica*, 101(2), 173–182. <https://doi.org/10.2478/acas-2013-0013>
- Burger, Y., Sa'ar, U., Paris, H. S., Lewinsohn, E., Katzir, N., & Tadmor, Y. (2006). Genetic variability for valuable fruit quality traits in *Cucumis melo*. *Israel Journal of Plant Sciences*, 54, 233–242. [https://doi.org/doi/abs/10.1560/IJPS\\_54\\_3\\_233](https://doi.org/doi/abs/10.1560/IJPS_54_3_233)
- Fisher, P. J., Merchan, A., & Ramirez, F. (2012). Source–sink relationships in fruit species. *Revista Colombiana De Ciencias Horticulture*, 6(2), 238–253. <https://doi.org/10.17584/rcch.2012v6i2.1980>
- Friedrich, G., & Fischer, M. (2000). *Physiologische Grundlagen des Obstbaues* [Physiological basics of fruit growing]. Ulmer Verlag.
- Gomez, A. K., & Gomez, A. A. (1995). *Prosedur statistik untuk penelitian pertanian* [Statistical procedures for agricultural] (2nd ed.). Universitas Indonesia Press.
- Lins, H. A., Queiroga, R. C. F., Pereira, A. M., Silva, G. D., & Albuquerque, J. R. T. (2013). Productivity and quality of watermelon fruits due to changes in source-drainage grating. *Green Magazine on Agroecology and Sustainable Development*, 8, 143–149. <https://doi.org/10.14295/CS.v7i3.1351>
- Martins, R. A. F., Aroucha, E. M. M., Paiva, C. A., Medeiros, J. F., & Barreto, F. P. (2016). Influence of the main stem pruning and fruit thinning on quality of melon. *Revista Ceres*, 63(6), 789–795. <https://doi.org/10.1590/0034-737x201663060007>
- Mastur. (2015). Sinkronisasi source dan sink untuk peningkatan produktivitas biji pada tanaman jarak pagar [Source and sink synchronize to improve seed productivity of physic nut]. *Buletin Tanaman Tembakau, Serat dan Minyak Industri*, 7(1), 52–68. <https://doi.org/10.21082/bultas.v7n1.2015.52-68>
- Pereira, F. H. F., Nogueira, I. C. C., Pedrosa, N., Z., M., & Bezerra, N. F. (2003). Poda da haste principal e densidade de cultivo na produção e qualidade de frutos em híbridos de melão [Pruning of main stem and plant density on yield and fruit quality of melon hybrids]. *Horticultura Brasileira*, 21(1), 192–196. <https://doi.org/10.1590/S0102-05362003000200014>
- Petkova, Z., & Antova, G. (2015). Proximate composition of seeds and seed oils from melon (*Cucumis melo* L.) cultivated in Bulgaria. *Food Science and Technology*, 3(1), 101–179. <https://doi.org/10.1080/23311932.2015.1018779>
- Rajaona, A. M., Bruek, H., & Asch, F. (2011). Effect of pruning history on growth and dry mass partitioning of jatropha on a plantation site in Madagascar. *Biomass and Bioenergy*, 35(1), 189–249. <https://doi.org/10.1016/j.biombioe.2011.10.017>
- Saprudin. (2013). Pengaruh umur tanaman pada saat pemangkasan terhadap pertumbuhan dan hasil ketimun (*Cucumis sativus* L.) [Effect of plant age at pruning on the effect and results of cucumbers (*Cucumis sativus* L.)]. *Juristek*, 1(2), 51–62.
- Triwulaningrum, W. (2009). Pengaruh pemberian pupuk kandang sapi dan pupuk fosfor terhadap pertumbuhan dan hasil buncis tegak (*Phaseolus vulgaris* L.) [The effect of cow manure and phosphorus fertilizer on growth and yield of erected kidney bean (*Phaseolus vulgaris* L.)]. *Ilmiah Pertanian*, 23(4), 154–162.
- Veronica, K. (2009). Kajian pemulsaan dan letak duduk buah terhadap hasil melon (*Cucumis sativus* L.) [Studying the effect of mulch and fruit position on yield of melon (*Cucumis melo* L.)]. *Ilmiah Pertanian*, 2(1), 197–270.
- Widaryanto, E., & Saitama, A. (2017). Analysis of plant growth of ten varieties of sweet potato (*Ipomoea batatas* L.) cultivated in rainy season. *Asian Journal of Plant Sciences*, 16, 193–199. <https://doi.org/10.3923/ajps.2017.193.199>