IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 16, Issue 7 Ser. I (July. 2023), PP 30-34
www.iosrjournals.org

The Effect Of Ga_3 And Iaa In The Growth And Yield Of Lettuce In Floating Hydroponic Systems

Ahmad Afandi[1)], Joko Purnomo[2)], Bambang Fredrickus[3)]
[1]*Study Program of Magister Agronomy, Faculty of Agriculture, University of Lambung Mangkurat, Indonesia*

Abstract: *Research on the role of growth regulators GA_3 and growth regulators IAA on the growth and yield of lettuce is still limited. This study aimed to determine the role of GA_3 and IAA on the growth and yield of lettuce in floating hydroponic systems. The study employed a two-factor factorial randomized block design (RBD). The first factor, GA_3, had three levels: g0 (0 ppm), g1 (10 ppm), and g2 (20 ppm). The second factor was IAA (i), which had three levels: i0 (0 ppm), i1 (1 ppm), and i2 (2 ppm). Observations were made on plant height, number of leaves, plant fresh weight, root dry weight, shoot dry weight and root-to-shoot ratio. The results showed that plant height had a significant effect on the interaction of GA_3 20 ppm and IAA 2 ppm. Applying a single factor, GA_3 had significantly affected plant height aged 7-35 DAP, number of leaves aged 21 and 35 DAP, plant fresh weight, shoot dry weight, root dry weight, and a very significant effect on root-to-shoot ratio. The administration of single factor IAA significantly affected plant height at 21 and 35 HST, number of leaves at 21 HST observations, shoot dry weight, root dry weight, and root-to-shoot ratio.*

Key Words: *Floating raft, GA_3, Hydroponic, IAA, Lettuce*

Date of Submission: 20-07-2023 Date of Acceptance: 30-07-2023

I. Introduction

Lettuce is a variety of leafy vegetables that grow in temperate regions. According to historical archives, this plant has been cultivated for over 2,500 years. It can be traced back to the Americas, which Christopher Columbus discovered in 1493 in the western hemisphere and the Bahamas (Rukmana, 1994). Lettuce is a vegetable crop with high economic value. This plant is predominantly grown for its leaves, used as fresh vegetables, cooking accompaniments, and garnishes. Lettuce is also rich in nutrients and vitamins, including calcium, phosphorus, iron, and vitamins A, B and C (Setyaningrum and Saparianto, 2011).

Due to numerous obstacles in its cultivation, the demand for lettuce in Indonesia has not been adequately addressed. In 2010, lettuce production in Indonesia reached 41.11 tons per year, dropping to 39.284 tons in 2015. From 2010 to 2015, the rate of lettuce production varied between 5.19% and 6%. Despite declining lettuce production, consumption in Indonesia remains high at approximately 35.30 kg per capita per year. It caused lettuce imports in 2015 to reach 21.1 tons. Therefore, there is an opportunity to increase lettuce production in Indonesia (BPS, 2016).

One effort that can be made to increase the quality and quantity of plants is the administration of growth regulators. Growth regulators are non-nutritive organic compounds which, in low concentrations, can affect, stimulate or change the growth and development of plants qualitatively. Gibberellin (GA_3) is a commonly used growth regulator that significantly regulates numerous plant physiological processes. Gibberellins can stimulate stem growth, affect flowering initiation, stimulate seed germination, and stimulate fruit formation and growth in plants (Salisbury and Ross, 1995). According to (Linda Riza, 2018), by utilizing Gibberellin as a growth regulator, farmers and cultivators can optimize plant growth and development to increase crop yields and utilize plant genetic potential more effectively.

In plant growth, GA_3 does not work alone but interacts with other growth regulators, one of which is IAA. Plants quickly absorb IAA because its chemical structure is identical to the natural auxin in plants. However, it is easily decomposed by conjugate compounds produced by plants in the form of IAA oxidase. Forming vegetative organs such as roots and stems is the first step in propagation (Hartmann *et al*., 2002). PGR auxin can aid in the growth of vegetative organs such as roots (Dewi, 2008). Auxin influences stem length, growth, differentiation, root branching, fruit development, apical dominance, phototropism and geotropism. In plant cultivation, the condition of the plant's roots must be given priority because it provides nutrients.

II. Materials and Method

This research was conducted from May to June 2023 at the Green House of SMK-PP Banjarbaru, Guntung Manggis Village, Landasan Ulin District, Banjarbaru City, South Kalimantan. This study used Batavia

type caipira lettuce (*Lactuca sativa* L.), AB mix fertilizer from the Goodplant brand, which functions as a nutrient in a hydroponic system, IAA and GA_3 growth regulators (ZPT) solutions, and water as a planting medium. The experimental design was a randomized block design (RBD) with two factors. The first factor was the administration of ZPT GA_3 (g) g0 = Control 0 ppm, g1 = ZPT GA_3 10 ppm, g2 = ZPT GA_3 20 ppm. The second factor was ZPT IAA (i), i0 = control 0 ppm, i1 = ZPT IAA 1 ppm, i2 = ZPT IAA 2 ppm.

The growth parameters observed were plant height and number of leaves. This observation is carried out once a week until harvesting. The yield parameters observed included plant fresh weight, root dry weight, shoot dry weight and root-to-shoot ratio. Observational data were initially examined using the Bartlett test for homogeneity. If the data are homogeneous, the variance analysis (ANOVA) is performed; if the data are not homogeneous, data transformation is conducted. The variance analysis was conducted using the F-test at the levels of 0.05 and 0.01. Furthermore, if the treatment has a significant or very significant effect, it will be continued with Tukey's HSD (Honestly Significant Difference) test. Data was processed using Minitab 19 software.

III. Results and Discussion

Based on the research carried out, the results of observations and analysis of variance are presented in Table 1 and Table 2.

Table 1. Analysis of variance on plant height 7 DAP (x1), plant height 14 DAP (x2), plant height 21 DAP (x3), plant height 28 DAP (x4), plant height 35 DAP (x5), number of leaves 7 DAP (x6), number of leaves 14 DAP (x7)

Sk	db	Middle Square								F-Table	
		X_1	X_2	X_3	X_4	X_5	X_6	X_7		0.05	0.01
Group	2	0.47_{ns}	0.02_{ns}	0.1_{ns}	0.60_{ns}	0.18_{ns}	0.22_{ns}	0.49_{ns}		3.63	6.23
G	2	6.14**	14.08**	13.11*	7.21*	7.24*	0.34_{ns}	0.49_{ns}		3.63	6.23
I	2	0.88_{ns}	1.36_{ns}	13.47*	3.75_{ns}	5.80*	0.34_{ns}	0.70_{ns}		3.63	6.23
G*I	4	0.34_{ns}	1.63_{ns}	1.65_{ns}	3.89*	1.99_{ns}	0.05_{ns}	0.50_{ns}		3.01	4.77
Error	16	0.34	1.17	2.77	1.23	1.41	0.11	0.27			
KK (%)		10.42	13.08	14.13	28.42	6.10	7.14	8.04			

Note:
ns = No significant effect
* = Significant effect
** = Very significant effect

Table 2. Analysis of variance: number of leaves 21 DAP (x8), number of leaves 28 DAP (x9), number of leaves 35 DAP (x10), fresh weight 35 DAP (x11), shoot dry weight 35 DAP (x12), root dry weight 35 DAP (x13) and root-to-shoot ratio 35 DAP (x14).

sk	db	Middle Square								F-Table	
		X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}		0,05	0,01
Group	2	0.11_{ns}	0.17_{ns}	0.08_{ns}	13.97_{ns}	0.3485_{ns}	0.0003_{ns}	0.5889_{ns}		3.63	6.23
G	2	1.71*	0.97_{ns}	6.85*	172.71**	5.3876**	0.0445**	4.4179**		3.63	6.23
I	2	1.29*	0.52_{ns}	1.88_{ns}	33.92_{ns}	2.9250**	0.0289*	2.2515*		3.63	6.23
G*I	4	0.21_{ns}	0.32_{ns}	0.68_{ns}	29.71_{ns}	0.6147_{ns}	0.0018_{ns}	1.4196_{ns}		3.01	4.77
Error	16	0.32	0.65_{ns}	1.43	11.96	0.2814	0.0068	0.6125			
KK (%)		6.50	7.07	7.47	9.72	14.43	11.89	15.02			

Note:
ns = No significant effect
* = Significant effect
** = Very significant effect

Plant Height

The interaction of GA_3 with IAA resulted in a significant response to plant height at 28 DAP, according to the data. The interaction of GA_3 20 ppm and IAA 2 ppm produced more growth than the other treatments on the average plant height measure. It is likely because GA_3 and IAA have nearly identical roles in plant growth,

mainly stem growth (plant height). Auxin is involved in cell division, whereas gibberellins is involved in cell growth. Cell size increases as a result of the synergy between auxin and gibberellin. The exogenous addition of growth hormone gibberellins causes cell size to increase due to cell division and expansion. Cell walls with weak intercellular connections generate an increase in cell walls and cell membranes. This, in turn, affects the increase in plant height physiologically (Wijiyanti and Soedradjad, 2019). The effect of gibberellin on plant growth is far greater than the effect of auxin when given independently. Auxin, even in tiny amounts, is required for GA_3 to function optimally (Kunta *et al*., 2015).

Administration of ZPT GA_3 as a single factor resulted in a significant response on all plant height. Higher concentrations are thought to affect lettuce plant height, allowing it to absorb nutrients more quickly (Nurlatifah & Setiati, 2016). GA_3 is a growth regulator that plays a physiological role in the elongation of plant stems and shoots. The action of GA_3 is most noticeable in the elongation of plant segments, where the size and quantity of cells increase. Apart from playing a role in stem elongation, gibberellin also contributes to increasing leaf area in various types of plants. In addition, GA_3 can also affect the growth of plant organs as a whole and influence other physiological processes.

The single factor of IAA administration resulted in a significant response to observing plant heights aged 21 and 35 DAP. It is suspected that auxin could stimulate the growth of new shoots. This hormone is concentrated in the young shoots and meristem tissue in plant shoots. The primary function of auxin is to regulate cell enlargement and stimulate cell elongation behind the end meristem. Furthermore, auxin is involved in stem development (Hasibuan, 2014).

Numbe of Leaves

The results showed no significant response to the interaction between GA_3 and IAA. The effect of a single factor of GA_3 administration had a significant effect at the age of 21 and 35 DAP. It is suspected that gibberellins applied directly to plant water can cause an increase in the number of leaves because when the stomata are open, gibberellins will enter through the stomata and accelerate the uptake of GA_3. Gibberellins can also increase auxin levels in plants, which play a role in differentiating plant cells and organs (Arsy and Barunawati, 2018).

The single factor of ZPT IAA resulted in no significant response at observations 7, 14, 28 and 35 DAP. It is presumed that treatment with growth regulators did not produce significant changes in growth parameters because the plants already had sufficient endogenous hormones. Therefore, exogenous hormone administration may not have a significant effect (Agusti Apriliani *et al*., 2015). At 21 DAP, IAA growth regulators had a significant effect. It is suspected that auxin could also affect leaf growth. Leaves are one of the essential plant organs that play a crucial role in photosynthesis to produce food and ensure optimal plant growth. The more the number of leaves and the greater the length and width of the leaves, the greater the effect on plant growth (Sylvia, 2009). According to (Zaini *et al*., 2017), 1-3 ml of auxin per 1 L of water is optimal for promoting plant growth. The addition of excessive IAA could inhibit stem cell elongation.

Plant Fresh Weight

The interaction of GA_3 with IAA resulted in an insignificant response, whereas the single factor administration of GA_3 resulted in a significant response on the fresh weight yield of lettuce plants. It is suspected that gibberellin in lettuce plants has an effect that inhibits leaf loss and increases the number of leaves, thereby increasing the plant's weight. GA_3 regulates plant growth, particularly by stimulating leaf formation. With gibberellins, plant cells are induced to grow larger, resulting in a larger overall plant size. In addition, administering gibberellin increases metabolic activity and the rate of photosynthesis, increasing the formation of carbohydrates, which are utilized in plant development (Triani Nova *et al*., 2020).

According to (Febrianto *et al*., 2019), administering GA_3 to plants during the vegetative phase (rapid growth) can increase their fresh weight. GA_3 can stimulate the production of endogenous growth substances in plants, increasing cell differentiation activity and plant growth and development. The new cell produced by cell enlargement is larger than the parent cell. This increase in cell size increases the size of tissues and organs and the overall size and weight of the plant. Additionally, an increase in cell division results in an increase in cell number. This increase in the number of cells in leaf tissue permits photosynthesis to generate carbohydrates. These carbohydrates can influence the plant's overall mass (Salisbury and Ross, 1995).

Shoot Fresh Weight

The results showed that the interaction of GA_3 with IAA resulted in an insignificant response. In contrast, the effect of a single factor of GA_3 administration showed a significant response on the yield of the dry weight of lettuce plant shoots. It is suspected that the organic matter produced by photosynthesis influences the dry weight of the shoot. Ideally, increased cell size accumulation due to the administration of gibberellin can impact shoot

dry weight. It is consistent with the findings of (Riko *et al*., 2019), who found that an increase in cell size and cytoplasm could affect the dried weight of plant shoots.

The influence of a single factor of IAA administration showed a very significant response on the yield of the dry weight of lettuce plant shoots. Auxin is synthesized close to the shoot meristem, especially in the shoots of stems and young tissues, such as young leaves. Auxin undergoes polar transport, which proceeds downward along the stem. This results in varying auxin concentrations between root tips, stem tips, and other plant parts. Although auxin is translocated to all plant parts, each part receives a different quantity. The variation in auxin concentration induces distinct responses in each plant part. Positive responses stimulate growth, whereas negative responses inhibit growth (Adamwoski and Friml, 2015).

Root Dry Weight

According to the findings, the interaction between GA_3 and IAA did not respond significantly. In contrast, the effect of a single factor of GA_3 administration resulted in a very significant response in the yield of the dry weight of lettuce plant roots. Gibberellin growth regulators are suspected to stimulate metabolic activity, supporting higher growth and accumulation of biomass (dry weight). This statement aligns with (Basri, 2018) which states that gibberellins' administration can increase seed metabolic activity. This metabolic activity will support the growth and accumulation of higher biomass (dry weight) if there is an adequate supply of water, moisture, and nutrients from the growing medium.

The effect of a single factor of IAA administration on the root dry weight of lettuce plants was very significant. It is believed that auxin, which affects root growth by stimulating root elongation (root initiation), is responsible for root dry weight. Several auxins can influence this process, including NAA, IAA, and IAN. The administration of IAA at high concentrations can increase the number of roots but also inhibit root elongation. Stem growth has a close relationship with auxin.

Rootto-Shoot Ratio

The results indicated that the interaction between GA_3 and IAA did not produce a significant effect. In contrast, the root-to-shoot ratio of lettuce responded significantly to the effect of a single factor of GA_3 administration. According to (Suprianto, 1998) the root-to-shoot ratio can be determined by comparing the root and shoot dried weights. If root development is more active than shoot development, the root-to-shoot ratio will be greater (Kakanga *et al*., 2017). The comparison between the size of the shoot and the root plays an essential role in plant growth because it indicates the plant's ability to absorb nutrients. The relative dry weight of the plant's upper (shoots) and lower (roots) portions indicates the roots' ability to absorb water and nutrients, which are then transferred to the plant's shoots. An increase in plant shoot mass is typically accompanied by an increase in root mass (Astuti Prami *et al*., 2015).

The single factor of ZPT IAA gave a significant response to the root-to-shoot ratio. It is because photosynthesis runs optimally so that plants can produce the energy sources needed for growth and the formation of phytohormones which act as growth stimulants. According (to Dewi, 2007) if growth hormone is added to a plant at modest concentrations when photosynthetic conditions are optimal, the hormone concentration in the plant's body will be optimal. According to (Karjadi and Buchory 2008), the accuracy of adding Plant Growth Subastance (ZPT) is crucial for organogenesis because ZPT and endogenous substances in plant tissues interact. If ZPT is administered outside the recommended dosage range, the interaction will not occur as intended. It could cause plant growth to slow down and even be inhibited.

IV. Conclusion

The application of growth regulators GA_3 with IAA did not show a significant effect on plant height at 7, 14, 21 and 35 DAP, number of leaves at 7,14,21,28 and 35 DAP, plant fresh weight, shoot dry weight, and root-to-shoot ratio except for plant height at 28 DAP. Application of growth regulator GA_3 had a significant effect on plant height aged 7, 14, 21, 28 and 35 DAP, number of leaves 21 and 35 DAP, plant fresh weight, shoot dry weight, root dry weight, and root-to-shoot ratio. The application of IAA growth regulators had a significant effect on plant height aged 21 and 35 DAP, number of leaves 21 and 35 DAP, root dry weight, and root-to-shoot ratio.

References

[1]. Adamwoski, M. Dan Friml, J. (2015). Dependent Auxin Transport: Action, Regulation And Evolution. The Plant Cells. 27(1): 20-32

[2]. Apriliani Agusti, Zozy Aneloi Noli Dan Suwirmen (2015). "Pemberian Beberapa Jenis Dan Konsentrasi Auksin Untuk Menginduksi Perakaran Pada Stek Pucuk Bayur (Pterospermum Javanicum Jungh.) [Administration Of Several Types And Auxin Concentrations To Induce Rooting In Bayur Shoots (Pterospermum Javanicum Jungh.) Cuttings] Jurnal: Biologi. Volume 4 (Hlm 178-187). Padang: Universitas Andalas. In Indonesian Language.

[3]. Arsy, Andra Fatiqha, And Nunun Barunawati. (2018). "Pengaruh Aplikasi GA_3 Terhadap Pertumbuhan Dan Hasil Dua Varietas Tanaman Terung (Solanum Melongena L.)" [Effect Of GA_3 Application On Growth And Yield Of Two Eggplants (Solanum Melongena L.) Varieties] Jurnal Produksi Tanaman 6(7): 1250–57. In Indonesian Language.

[4]. Badan Pusat Statistik. (2016). Produksi Dan Produktivitas Selada 2010-2015 [Lettuce Production And Productivity 2010-2015]. Diakses Melalui Http://Www.BPS.Go.Id. In Indonesian Language.

[5]. Basri, Z., Arianto Dan Wahyudi, I. (2018). Pengaruh Pemberian Giberelin Dan Berbagai Media Tanam Terhadap Perkecambahan Dan Pertumbuhan Benih Pala (Myristica Fragrans Houtt) [Effect Of Gibberellins And Various Growing Media On Germination And Growth Of Nutmeg (Myristica Fragrans Houtt) Seeds]. Program Studi Magister Ilmu Pertanian. Universitas Tadulako. E-Jurnal Mitra Sains, Volume 6 (1) : 1 - 12. In Indonesian Language.

[6]. Dewi, IR. (2007). Fotosintesis Sebagai Proses Dasar [Photosynthesis As Basic Process]. Universitas Padjajaran, Bandung. In Indonesian Language.

[7]. Dewi, I.R. (2008). Peran Dan Fungsi Hormon Bagi Pertumbuhan Tanaman [The Role And Function Of Hormones For Plant Growth]. Artikel. Bandung: Universitas Padjajaran. In Indonesian Language.

[8]. Dinda, A.P., Y.S Rahayu Dan E. Ratnasari. (2016). Pengaruh Pemberian Hormon Giberelin Terhadap Pertumbuhan Buah Secara Partenokarpi Pada Tanaman Tomat Varietas Tomat F1 [Effect Of Gibberellin Hormone Administration On Parthenocarpic Fruit Growth In Tomato Plants Of The F1 Variety]. Lentera Bio. 5(1):25-31. In Indonesian Language.

[9]. Febrianto M, Supono Budi Sutoto, Suwardi (2019). Efektivitas Pemberian Giberelin Terhadap Pertumbuhan Dan Hasil Tomat Ceri (Lycopersicon Esculentum Var. Cerasiforme) Pada Berbagai Jenis Media Tanam Dengan Sistem Hidroponik Substrat [The Effectiveness Of Gibberellin Administration On The Growth And Yield Of Cherry Tomatoes (Lycopersicon Esculentum Var. Cerasiforme) In Various Types Of Growing Media With Substrate Hydroponic Systems]. Universitas Pembangunan Nasional Veteran Yogyakarta, Yogyakarta, Indonesia. In Indonesian Language.

[10]. Hartmann, H. T., Kester, D. E., Davies, F. T., & Geneve, R. L. (2002). Plant Propagation: Principles And Practices, Prentice-Hall. Upper Saddle River, New Jersey, 7458.

[11]. Hasibuan, S.P., & Malayu. (2014). Manajemen Sumber Daya Manusia [Human Resource Management]. Jakarta (ID): Bumi Aksara. In Indonesian Language.

[12]. Kamalia, S., Dewanti, P., & Soedradjad, R. (2017). Teknologi Hidroponik Sistem Sumbu Pada Produksi Selada Lollo Rossa (Lactuca Sativa L.) Dengan Penambahan Cacl2 Sebagai Nutrisi Hidroponik [Axis System Hydroponic Technology In The Production Of Lollo Rossa Lettuce (Lactuca Sativa L.) With The Addition Of Cacl2 As A Hydroponic Nutrient]. Jurnal Agroteknologi, 11(1), 96. In Indonesian Language.

[13]. Kakanga, C. J. R., Nio, S. A., & Siahaan, P. (2017). Rasio Akar : Tajuk Tanaman Padi Lokal Sulawesi Utara Yang Mengalami Cekaman Banjir Dan Kekeringan Pada Fase Vegetatif [Root-To-Shoot Ratio Of North Sulawesi Local Rice Experiencing Flood Stress And Drought In The Vegetative Phase]. Jurnal Bios Logos, 7(1). Diakses Tanggal 10 Juni 2023. In Indonesian Language.

[14]. Karjadi Dan Buchory. (2007). Pengaruh NAA Dan BAP Terhadap Pertumbuhan Jaringan Meristem Bawang Putih Pada Media B5 [Effect Of NAA And BAP On Garlic Meristem Tissue Growth In B5 Media]. J.Hort. 17(3): 217- 223. In Indonesian Language.

[15]. Kunta, A. T., Sarjana Parman Dan Munifatul Izzati. (2015) Pengaruh Interaksi Hormon Tumbuh Giberelin Dan Auksin Terhadap Perkecambahan Biji Dan Pertumbuhan Tanaman Karet (Hevea Brasiliensis Mull. Arg.) [Effect Of Gibberellin And Auxin Growth Hormone Interaction On Seed Germination And Growth Of Rubber Plants (Hevea Brasiliensis Mull. Arg.)]. Jurnal Biologi, Volume 4 No 1, Januari 2015 Hal. 61-72. In Indonesian Language.

[16]. Mas'ud, H. (2009). Sistem Hidroponik Dengan Nutrisi Dan Media Tanam Berbeda Terhadap Pertumbuhan Dan Hasil Selada [Hydroponic Systems With Different Nutrients And Growing Media For Lettuce Growth And Yield]. Sulteng: Media Litbang. In Indonesian Language.

[17]. Nurlatifah D Dan Setiati S. (2016). Pengaruh Zat Pengatur Tumbuh Giberelin(GA_3)Dan Pemangkasan Terhadap Pertumbuhan Dan Hasil Tanaman Rami (Boehmeria Nivea, L. Gaud) [Effect Of Growth Regulatory Substances Gibberellin (GA_3) And Pruning On The Growth And Yield Of Hemp (Boehmeria Nivea, L. Gaud)]. UIN Sunan Gunung Djati. Bandung. In Indonesian Language.

[18]. Prami Astuti, Sampoerno, & Ardian. (2015). Uji Beberapa Konsentrasi Pupuk Cair Azolla Pinnata Pada Bibit Kelapa Sawit (Elaeis Guineensis Jacq.) Di Pembibitan Awal [Test Several Concentrations Of Azolla Pinnata Liquid Fertilizer On Oil Palm (Elaeis Guineensis Jacq.) Seeds In Initial Nurseries]. JOM Faperta. Diakses Tanggal 10 Juni 2023. In Indonesian Language.

[19]. Riko, Sitti N. A., Dan Euis A. (2019). Aplikasi Berbagai Konsentrasi Giberelin (GA_3) Ter\Hadap Pertumbuhan Dan Hasil Tanaman Kailan (Brassica Oleracea L.) Dengan Sistem Budidaya Hidroponik (Wick System) [Application Of Various Concentrations Of Gibberellin (GA_3) On Growth And Yield Of Kailan (Brassica Oleracea L.) With Hydroponic Cultivation System (Wick System)]. Skripsi Program Studi Agroekoteknologi, Fakultas Pertanian Perikanan Dan Biologi. Universitas Bangka Belitung. In Indonesian Language.

[20]. Riza Linda, W. S. R. M. (2018). Pertumbuhan Tanaman Selada (Lactuca Sativa L. Var. New Grand Rapids) Menggunakan Teknologi Hidroponik Sistem Terapung (THST) Tanpa Sirkulasi Dengan Penambahan Giberelin (GA_3) [Lettuce Plant Growth (Lactuca Sativa L. Var. New Grand Rapids) Using Floating System Hydroponic Technology (THST) Without Circulation With The Addition Of Gibberellin (GA_3)]. Jurnal Protobiont. In Indonesian Language.

[21]. Salisbury, FB & Ross, CW, (1995), Fisiologi Tumbuhan [Plant Physiology], Jilid 3, Edisi 5, Diterjemahkan Oleh Lukman, DR, Dan Sumaryono, Penerbit ITB, Bandung. In Indonesian Language.

[22]. Saroh, M. (2016). Pengaruh Jenis Media Tanam Dan Larutan Ab Mix Dengan Konsentrasi Berbeda Pada Pertumbuhan Dan Hasil Produksi Tanaman Selada 9 The Effect Of Types Of Growing Media And Ab Mix Solutions With Different Concentrations On The Growth And Yield Of Lettuce]. Jurnal Agrohita, 1(1), 29–37. In Indonesian Language.

[23]. Setyaningrum, H. D Dan C. Saparinto. (2011). Panen Sayur Secara Rutin Di Lahan Sempit [Harvesting Vegetables Routinely In Narrow Land]. Penebar Swadaya, Jakarta. In Indonesian Language.

[24]. Suprianto E (1998) Evaluasi Beberapa Varietas Dan Galur Padi Pada Kondisi Kekeringan [Evaluation Of Several Rice Varieties And Lines Under Drought Conditions]. Skripsi. Institut Pertanian Bogor, Bogor. In Indonesian Language.

[25]. Sylvia, I. (2009). Pengaruh IBA Dan NAA Terhadap Stek Aglonema Var. Donna Carmen Dengan Perendaman [Effect Of IBA And NAA On Cuttings Aglonema Var. Donna Carmen By Immersion]. Skripsi Fakultas Pertanian. Institut Pertanian Bogor. Bogor. In Indonesian Language.

[26]. Wijayanti. N., Dan Raden Soedradjad. (2019). Pengaruh Pemberian Pupuk Kalium Dan Hormon Giberelin Terhadap Kuantitas Dan Kualitas Buah Belimbing Tasikmadu Di Kabupaten Tuban [The Effect Of Potassium Fertilizer And Gibberellin Hormone Administration On The Quantity And Quality Of Tasik Madu Carambola Fruit In Tuban Regency]. Jurnal Pertanian. 2(4), 169-172. In Indonesian Language.

[27]. Zaini, M., Adnan., & Juanda, B.R. (2017). Pengaruh Konsentrasi Dan Lama Perendaman Dalam ZPT Auksin Terhadap Viabilitas Benih Semangka (Citurullus Lunatus) [Effect Of Concentration And Soaking Time In Auxin ZPT On The Viability Of Watermelon Seeds (Citurulus Lunatus)]. Penelitian 4(1), 45-55. In Indonesian Language.