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Evaluate The Effect of Different Concentrations of Gibberelin (GA3) on The Gemination and Early Seedling Growth of F1 Hybird Cucumber *Cucumis sativus* in Malaysia

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Abstract

Conditions and factors that can influence the development of cucumber cultivation in Malaysia are climate and soil because Malaysia has a warm and humid climate, ideal for growing cucumbers. Farmers' cultivation methods often use hydroponic techniques and planting systems in open fields. Providing gibberellin to cucumber plants can be a solution to overcome several problems that cause suboptimal production. Objective: This study aims to evaluate the effect of different concentrations of gibberellin (GA3) on the germination and initial growth of F1 hybrid cucumber seeds. This research method was prepared in a Non-Factoral Completely Randomized Design (CRD) in 4 replications which were repeated once. The first factor is without concentration (control), (200 ppm), (500 ppm), (800 ppm). The gibberellin concentration can significantly influence all cucumber growth parameters, except for the root length of cucumber plants. The best treatment is P3 (500 ppm).

Keywords: Cucumber, Gibberellin (GA3), Growth and Plants, Seed

1. Introduction

Cucumber cultivation in Malaysia has quite large potential, considering the tropical climate that supports the growth of this plant. Conditions and factors that can influence the development of cucumber cultivation in Malaysia are climate and soil because Malaysia has a warm and humid climate which is ideal for growing cucumbers (Saptana et al., 2006). Fertile soil, especially sandy loam, can also support the growth of cucumber plants. In cultivation methods, farmers often use hydroponic techniques and planting systems in open fields. The hydroponic approach is increasingly popular due to its efficiency in using water and space. There are various types of cucumbers grown, including Japanese cucumbers and vegetable cucumbers. The varieties selected are usually adapted to market needs and local climate (Saptana et al., 2006). The market demand for cucumbers is quite high, both for local consumption and export. The domestic market is usually filled with small farmers and larger agricultural companies. In the conditions of development of cucumber cultivation, cucumber cultivation includes pest and disease attacks, weather changes, as well as a lack of knowledge about modern cultivation techniques among farmers. The Malaysian government provides support through training programs, counseling and access to agricultural technology to increase crop yields and innovation and technology in the use of technology, such as efficient irrigation systems and smart agricultural applications, are starting to be introduced to increase productivity. Horticultural commodities in Malaysia are intrinsically prone to decay, damage and high shrinkage. This could be a possible problem creates physical and price risks. The main problem in developing horticultural agribusiness is the lack of variety, quality, continuity of supply and quantity in accordance with market demand. This problem is evident in horticultural products for institutional and export consumer markets. Many of these problems are caused by a lack of mastery of technology, both seeding, cultivation and post-harvest handling technology, as well as a lack of coordination between agribusiness actors, which can result in the institutional structure of horticultural agribusiness becoming fragile and weak linkages in the supply chain management of horticultural products. So now it is still difficult for

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horticultural products to compete to enter the Malaysian export market due to quality problems, supply continuity, high levels of damage during transportation, and domestic socio-political conditions that are not yet fully conducive. This is closely related to the absence of planning for production arrangements that are adjusted to market demand, an excellent harvesting and post-harvest handling system, a distribution system that poses a high risk of physical damage, as well as domestic social and political stability. An important implication of the results of this study is the (Saptana et al., 2006).importance of realizing comparative advantage into competitive advantage through institutional business partnership strategies so that price integration will be created through fair market mechanisms and integration between actors (Saptana et al., 2006).

Hydroponics is agricultural cultivation without using soil media, so only run using water as a soil replacement medium. So that hydroponic planting system can utilize narrow land. Agriculture using the system Hydroponics does not require land extensive, but in a viable agricultural business Considered because it can be done in yard, house, roof of house, etc other land. Several advantages of farming hydroponically compared to planting using soil media is Pest and disease problems can be reduced, resulting in generally better products the quality is better so the price the sales are higher and the land is narrow not an obstacle to making it the environment becomes green and beautiful (Siregar & Novita, 2021).

The presence of ZPT inhibited growth can stimulate cell division, cell elongation, and other metabolic processes. Without PGRs, plants may experience slow or stunted growth, especially in the initial phase of growth, there are flowering problems. Several types of PGRs, such as auxin and gibberellin, play an important role in the flowering and fruiting process. Without proper use of PGRs, plants may experience delays or failure in flowering and inability to root. PGRs such as auxin are very important in the formation of healthy and strong roots. Without PGR, plants may have difficulty expanding their root systems, which can reduce the plant's ability to absorb water and nutrients and can cause difficulties in plant propagation. PGR is also used to speed up plant propagation through cuttings, tissue culture, or grafting. Without ZPT, this process could take longer or fail.

Growth regulators are non-nutrient organic compounds which in low concentrations can enc ourage, inhibit or qualitatively change plant growth and development. One of the growth regulators that is often used is gibberellin, which plays many roles in influencing various plant physiological processes. The function of gibberellins can play a role in cell expansion and division, breaking seed dormancy so that seeds can germinate, mobilizing reserve endosperm during early embryo growth, breaking shoot dormancy, stem growth and elongation, flower and fruit development, in rosette plants it is able to lengthen the internodes so they grow elongated. The exogenous gibberellin that is commonly used and available on the market is GA3 (gibberellin-3), which is also known as gibberellic acid (Asra and Ubaidillah, 2012).

Seed germination, shoot and embryo development, stem elongation, leaf growth, flowering, fruit development, root growth, and root differentiation are all positively influenced by gibberellin, a plant hormone. Knowledge of how to determine dosage is very important to control the use of growth regulators. Errors in these estimates can be disastrous for network expansion. Callus development can be suppressed by using excessive amounts of growth regulators. Plant height, number of leaves, flowering age, number of flowers, number of fruit, and fruit weight per plant are all greatly influenced by the concentration and frequency of gibberellin application. One approach to improving fruit quality and cucumber production is by providing growth regulators and correct weeding times. The growth regulator used in this research is gibberellin (GA3). Gibberellin is a hormone found in almost every plant life cycle. This hormone encourages seed germination, sprouts, stem elongation and leaf growth, stimulates flower and fruit development, and can influence root growth and root differentiation (Khoirimah et al., 2024).

Low fruit yield and poor fruit growth as well as a low ratio between female and male flowers are also causes of low fruit production. One effort to improve the description of the obstacles above can be done by adding exogenous growth regulators, namely gibberellin (GA3). GA3 is able to suppress and prevent flower abortion. This process is related to the synergism of GA3's work with auxin. GA3 supports the formation of protolytic enzymes, which can activate protein synthesis by releasing tryptophan as the initial form of auxin. GA3 will increase the concentration of endogenous auxin. In the generative phase, the addition of exogenous GA3 can increase the capacity in terms of storing harvested photosynthesis results, namely gibberellin will enlarge the storage tissue cells so that they are able to receive more photosynthesis results, which results in a larger storage tissue (fruit) size. Treatment with growth regulators can significantly increase the highest average plant height 146 found at GA3 500 ppm, giving a GA3 concentration of 500 ppm to cucumber plants provides a significant increase in cucumber plant height (Hidayatullah et al., 2009).

Based on the research results, it can be seen that varieties have a significant effect on cucumber growth. Table 1 shows the results that cucumber variety treatment has an effect on the length of cucumber plants. Apart from that, gibberellin application also showed an effect on plant length. Application of the hormone gibberellin to cucumber plants can trigger cell division so that the stems of cucumber plants elongate. An increase in gibberellin will stimulate the division of meristem cells in the growing point area, causing an increase in the length of cucumber plants. Spraying the gibberellin hormone is known to cause an increase in the gibberellin hormone content in the shoot meristem of the plant. It is known that the application of gibberellin can influence an increase in the length or height of a plant (Rosa et al., 2024).

Gibberellins (GA3) can accelerate seed germination, shoot growth, stem elongation, leaf growth, and triggers flowering and fruit development, while affects root growth and differentiation. GA3 is able to influence genetic traits and physiological processes found in plants, such as flowering, parthenocarpy and mobilization of carbohydrates during germination period. Increasing concentration of gibberellin from 0, 5, 10 to 15 ppm can accelerate flowering age and improves fruit production. Gibberellin is one of growth regulators (ZPT) and encourages seed development and leaf growth, in addition to promoting flowering and fruit development. The appearance of flowers is the beginning of fruit formation. The faster the occurrence of flowering, the faster the formation of fruit. Consequently, this would increase economic values of tomato as it produces tomatoes in a short time (Novita, 2021).

Cucumber cultivation extends throughout the world, both in hot (tropical) and temperate (subtropical) climates. In Indonesia, cucumbers are often cultivated in the lowlands, their prospects are very good because they are popular with many people. This commodity has a large and continuous demand. One way to make cucumbers attract people's attention is by creating seedless cucumbers (parthenocarpic). Parthenocarpy is a process of forming seedless fruit because pollination and fertilization do not occur so that fruit productivity increases well (Patel and Maked, 2014). The advantages obtained from parthenocarpy are stable fruit production even in an unfavorable environment, increased productivity, improved fruit quality, and is one of the characteristics that is highly desired by consumers (Octaviani et al., 2021).

Plant hormones or phytohormones are compounds that can influence various physiological processes in plants. Naturally, plants already have growth hormones or what are usually called endogenous hormones. However, due to intensive plant cultivation patterns, the endogenous hormone content in plants becomes deficient for the plant growth process. Intensive plant cultivation and improper soil processing can cause endogenous hormone content to decrease. Therefore, exogenous addition of hormones is very necessary in plant cultivation, especially gibberellin hormones. Gibberellins play a role in the flowering process so that the potential for cucumber fruit to form is high. The aim of this research is to determine the interaction between phosphorus fertilizer dosage and gibberellin concentration on the growth and yield of cucumber plants (Santoso et al., 2022).

Objective: This study aims to evaluate the effect of different concentrations of gibberellin (GA3) on the germination and initial growth of F1 hybrid cucumber seeds.

2. Material and Methods

The research was carried out at the Malaysian Agricultural Research and Advancement Institute (MARDI). With an altitude of 2°58'52.3"N 101°41'55.0"E. This research starts from 10 September to 18 September 2024. The Malaysian Institute for Agricultural Research and Progress (MARDI) was selected by sampling around 1- 4 samples. Field identification activities were carried out to determine phenotypic and agronomic characters, this activity was carried out at the PTJ Horticulture MARDI location. The materials used in this research were F1 Hybrid Cucumber Seeds, Tissue, Water, 200 ppm GA3 Gibberrelin, 500 ppm GA3 Gibberrelin, and 800 ppm GA3 Gibberrelin. The tools used in this research were Petri dishes, spray, camera, paper and cars. This research method uses a factorial Completely Randomized Design (CRD) consisting of four treatments which are repeated once. The first factor is variety (T), consisting of four levels, namely: T = Hybrid Cucumber Variety F1. The second factor is growth regulator (P), consisting of 4 levels, namely : Control (No Treatment), GA3 200 ppm, GA3 500 ppm dan GA3 800 ppm. The research data analysis method was analyzed using analysis of variance (ANOVA) and continued with the Duncan's mean difference test (DMRT). growth regulator given to micropropagation of cucumber plants (Cucumis sativus) through shoot explants in vitro. If the results are significantly different, continue with the mean difference test according to Duncan's Multiple Range Test (DMRT) at a confidence level of α 5%. Following the factorial Completely Randomized Design (CRD) linear mathematical model as follows:

$$\mathbf{Yij = \mu + \tau i + \varepsilon ij}$$

I : 1, 2, 3,……,a j = 1,2,3.....,u

Yijk: Observation of Main Factors at the ith level, Replications at the jth level and Additional Factors at the kth level

μ : General Average

Ai : Main Influence at level i

єij : Effect of Error I on the i-th Main Factor and j-th Replication

єijk : Effect of error II on the main factor at the ith level, repetition at the jth and additional factors at the kth level.

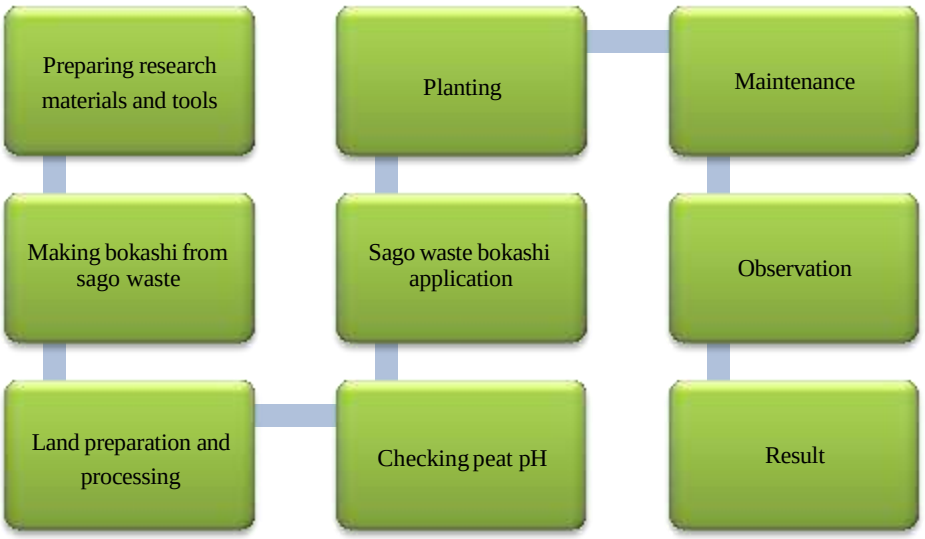

Figure 1. Research flow diagram

3. Results and Discussion

3.1. Germination Percentage

Table 1. Percentage of germination

Treatment	Constant			F-value	Approx. Pr>F	Approx. R^2
	A	B	C			
Control	102,5	13,9044	0,7704	1005,7	<.0001	0,99
GA_3 (200 ppm)	101,7	13,5419	0,7354	915,39	<.0001	0,99
GA_3 (500 ppm)	102,7	14,4014	0,765	1062,24	<.0001	0,99
GA_3 (800 ppm)	101,8	14,0507	0,7691	970,38	<.0001	0,99

In table 1, the percentage value of cucumber germination is in the table above with the highest value in the GA3 treatment (500 ppm) with a constant value of 14.4014, which is significantly different from all treatments, which is 13.5419 with the GA3 treatment (200 ppm), while in the GA3 treatment (800 ppm) with a constant value of 14.0507 and while the lowest value was without Control treatments which had a constant value of 13.9044, this was due to a slowdown in the growth of cucumber seed germination in the Control trearments so that it had an impact on the height of the cucumber plants. This is due to lack of absorption of the nutrients it takes. The GA3 treatment (500 ppm) has sufficient nutrients for germination of cucumber seeds, although the GA3 treatment (800 ppm) has a higher value but does not cover the growth of cucumber seeds in Petri dish planting media. This is in line with research by Fikriyah and Sitawati (2019) which states that at all ages of observation, giving 500 ppm GA3 can provide higher results than other treatments. This can occur allegedly because Gibberellin Acid applied after planting can have a direct influence on the growth of cucumber germination in petri dish planting media. By administering GA3 at high concentrations, it can produce germination heights below the maximum desired plant height limit. Giving Control without GA3 cannot suppress plant height because it produces the same germination height as the control, whereas giving GA3 can play a role in suppressing cucumber germination height at the ideal concentration limit, and giving GA3 without GA3 treatment can provide good germination height.

3.2. Mean Germination Time

Table 2. Average germination time

Number of Days	Control	GA_3 (200 ppm)	GA_3 (500 ppm)	GA_3 (800 ppm)
0	0,00	0,00	0,00	0,00
1	73,67	69,65	73,46	73,09
2	127,73	118,08	127,84	126,89
3	143,59	135,69	146,25	143,36
4	95,77	95,80	99,46	96,11
5	48,95	51,51	51,42	49,27
6	23,17	25,40	24,52	23,37
7	10,78	12,26	11,47	10,88
8	4,99	5,88	5,34	5,05

Table 2 above shows that the average germination time, apart from the GA3 treatment, has an influence on the storage of petri dishes stored in a drawer every day, which occurs for several cucumber seeds, which can indicate the same decrease in germination. In the table below which shows the average germination time, there was a decrease in the percentage of germination after being stored for 8 days in a petri dish and in a drawer, which occurred in the treatment without GA3 treatments with a value of only 4.99. Meanwhile, on day 3 the average value was 143.59 because it was on day 4 there is a lack of nutrients taken up by cucumber sprouts. Apart from that, in the treatments, GA3 (500 ppm) on day 3 had an average value of 146.25, where on day 4 there was a decrease which could affect the germination of cucumbers in petri dishes. GA3 nutrition is very important for the germination of cucumbers which has a good effect on the growth of cucumber plants. This is in line with research by Khamid et al., (2019) which states that germination is the most widely used measure of seed viability in testing seed quality. Seed viability is the vitality of the seed, is metabolically active, and has enzymes that can catalyze metabolic reactions needed for germination and sprout growth. There are factors that can influence seed germination consisting of external factors and internal factors. External factors consist of water, oxygen, temperature, media and light, while internal factors consist of seed maturity level, seed size, dormancy and germination inhibitors. Concentrations that are too low do not show significant changes in plants, whereas giving high concentrations will actually result in a decrease because ZPT at high concentrations will be toxic to plants. From the figure below it can be seen that the highest average value was on day 3, reaching 140 with treatments GA3 (500 pmm).

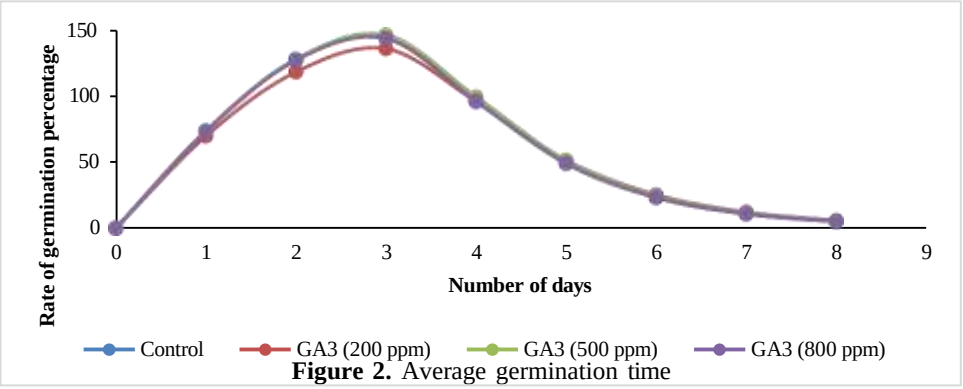

Figure 2. Average germination time

3.3. Germination Rate

Table 3. Germination rate

Number of Days	Control	GA_3 (200 ppm)	GA_3 (500 ppm)	GA_3 (800 ppm)
0	6,877	6,994	6,66822	6,76381
1	13,786	13,577	13,3351	13,5525
2	25,764	24,738	24,9368	25,3383
3	43,094	40,824	41,90	42,4439
4	62,576	59,309	61,30	61,7685
5	79,133	75,749	78,15	78,287
6	90,176	87,355	89,60	89,3619
7	96,402	94,279	96,16	95,6314
8	99,585	98,003	99,55	98,8452

In table 3 above, it can be seen that the germination rate, apart from the absence of GA3 treatments on cucumber seeds, can have a very real effect on the growth rate of cucumber seeds on day 8. However, this is different from the presence of GA3 treatments (200 ppm), GA3 treatments (500 ppm) and GA3 treatments (800 ppm) with different concentrations can have no significant effect on the growth rate of cucumber seeds. This can be seen in the graph below which shows that there is no difference in the germination rate. This is in line with research by Elfianis et al., (2019) which states that the speed of growth of cucumber seeds in treatment without the GA3 treatment by planting with petri dish planting media and with the treatment is better when compared to without a decrease in cucumber seed germination. This is thought to be because the condition of the cucumber seed coat which is slightly thin can cause water to be able to enter the imbibition process. However, when the seeds are a little thick, water and GA3 nutrients do not easily enter during the imbibition process. The figure below shows that the germination rate of cucumber seeds occurred on day 8 without GA3 treatments during the research.

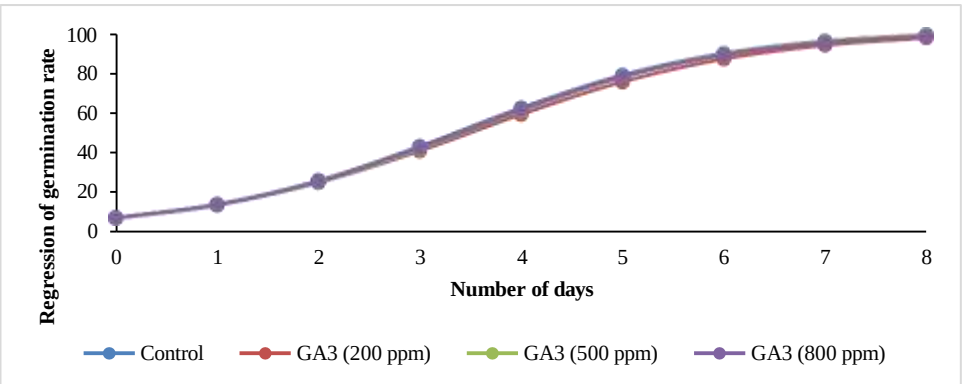

Figure 3. Germination rate

3.4. Seedling Vigor Measure root

Table 4. Size of root seedling vigor

Treatment	Constant			F-value	Approx. Pr>F	Approx. R^2
	A	B	C			
Control	7,2805	8,6429	0,7613	300,55	<.0001	0,99
GA_3 (200 ppm)	7,8896	9,7259	0,7282	411,05	<.0001	0,99
GA_3 (500 ppm)	7,9764	8,9657	0,6765	318,84	<.0001	0,99
GA_3 (800 ppm)	8,138	9,1332	0,7415	300,58	<.0001	0,99

Table 5. Average size of root seedling vigor.

Number of Days	Control	GA_3 (200 ppm)	GA_3 (500 ppm)	GA_3 (800 ppm)
0	0,76	0,74	0,80	0,80
1	1,35	1,39	1,44	1,52
2	2,32	2,42	2,50	2,65
3	3,67	3,77	3,86	4,09
4	4,90	5,16	5,29	5,53
5	6,11	6,29	6,41	6,65
6	6,68	6,91	7,02	7,35
7	6,99	7,40	7,45	7,74
8	7,14	7,57	7,67	7,95

In table 4 above, after selecting 5 seeds to be used as samples from the 15 seeds planted in Petri dishes, the 5 cucumber seeds selected and counted from day 8 had the highest constant there are treatments GA3 (200 ppm) worth 9.7259 which has a very real effect when compared to other treatments such as treatments GA3 (500 ppm) worth 8.9657, treatments GA3 (800 ppm) worth 9.1332 and without treatments GA3 worth 8.6429. Using the GA3 treatment really makes the seeds germinate on the roots better when compared to without the treatment in the petri dish planting medium. In Table 5, the highest average cucumber seed vigor was found in treatments GA3 (800 ppm) on day 8, where each day there were a lot of nutrients absorbed by the cucumber roots. When compared with without treatment, GA3 had the lowest value of 7.14 obtained from the cucumber plants, due to the lack of nutrients that occurred in the petri dish. This is in line with research by Harsono et al., (2021) which states that the seed germination process is very determining in a plant's life cycle which is directly related to vigor, growth speed and the quality of the sprouts. So, to minimize failure in seed germination, it is necessary to give special treatment to the seeds before planting. The storage period will affect seed viability. Seed viability will decrease as storage time increases. During storage, seeds experience a decline in viability and vigor, mainly related to seed water content. The level of safe water content for storing seeds depends on the type of seed, storage method, and the length of time the seeds are stored in the form of petri dish planting. The graph below shows that the size of the root length of cucumber seeds occurred on day 8 with treatments GA3 (800 ppm) in conducting research.

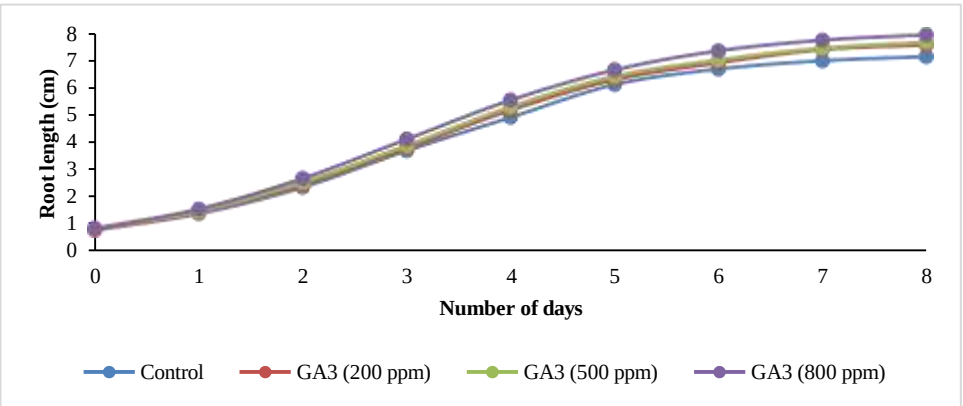

Figure 4. Average size of root seedling vigor

3.5. Seedling Vigor Measure Shoot Lengths

Table 6. Measurement of seedling vigor, shoot length

Treatment	Constant			F-value	Approx. Pr>F	Approx. R^2
	A	B	C			
Control	6,009	45,0534	0,8107	227,1	<.0001	0,99
GA_3 (200 ppm)	7,3227	33,2636	0,8523	66,63	<.0001	0,99
GA_3 (500 ppm)	7,3227	58,577	1,1063	66,63	<.0001	0,99
GA_3 (800 ppm)	8,4532	36,3242	1,0081	70,1559	<.0001	0,99

Table 7. Average size of seedling vigor, shoot length.

Number of Days	Control	GA_3 (200 ppm)	GA_3 (500 ppm)	GA_3 (800 ppm)
0	0,76	0,74	0,80	0,80
1	1,35	1,39	1,44	1,52
2	2,32	2,42	2,50	2,65
3	3,67	3,77	3,86	4,09
4	4,90	5,16	5,29	5,53
5	6,11	6,29	6,41	6,65
6	6,68	6,91	7,02	7,35
7	6,99	7,40	7,45	7,74
8	7,14	7,57	7,67	7,95

In table 6 above, after selecting 5 seeds to be used as samples from 15 seeds planted in petri dishes, from 5 cucumber seeds selected and calculated from day to day 8, it has the highest constant without GA3 treatments worth 45.0534 which has a very real effect when compared to other treatments such as GA3 treatments (200 ppm) worth 33.2636, GA3 treatments (500 ppm).) worth 58,577 and treatments GA3 (800 ppm) worth 36,3242. Not using GA3 treatments can really make the seeds germinate in shoots better when compared to the GA3 (200 ppm), GA3 (500 ppm) and GA3 (800 ppm) treatments in petri dish planting media. In Table 6, the highest average vigor size of cucumber shoot seeds was in treatments GA3 (800 ppm) on day 8, where each day there were a lot of nutrients absorbed by the cucumber roots. When compared with without treatment, GA3 had the lowest value of 5.62 obtained from the cucumber plants, due to the lack of nutrients that occurred in the petri dish. This is in line with research by Kartikasari et al., (2016) which states that the function of growth regulators is to stimulate plant physiological processes but not just as a nutrient, so that to obtain the benefits of gibberellin and obtain optimal results, adequate additional nutrition is needed, that GA3 has a role in supporting cell elongation, cell division and the formation of RNA and protein in the development of cucumber germination. As a result of this physiological process, it will encourage increased activity of plant organs. Interaction of several plant types and external factors. This is highly dependent on the production and mobilization of carbohydrates, absorption of nutrients and water, hormonal balance and several environmental factors during the growth period. The graph below shows that the length of cucumber seed shoots occurred on day 8 with treatments GA3 (800 ppm) in conducting research.

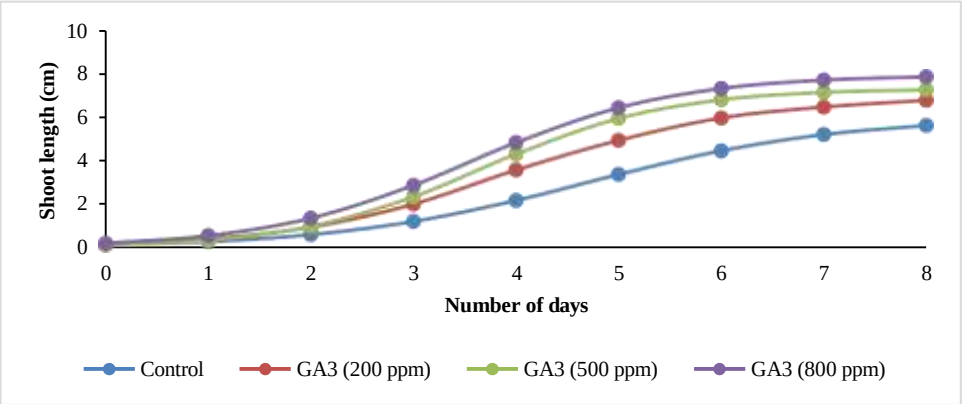

Figure 5. Average size of seedling vigor, shoot length

4. Conclusion

In conditions and factors that can affect the development of Gibberellin (GA3) is one of the groups of plant hormones that can have an important role in regulating plant growth and development. This hormone can stimulate various biological processes such as stem elongation, flowering, seed germination, and fruit formation in cucumber plants. Giving gibberellin to

cucumber plants can be a solution to overcome several problems that cause less than optimal production. Of the 5 cucumber seeds selected and have been counted with days up to 8, the highest constant is found without GA3 treatments worth 45.0534 which has a very real effect when compared to other treatments and the average size of the vigor of the long shoot seedlings in the GA3 treatment (800 ppm) on the 8th day has a vigor shoot length of 7.95 which is very real in the growth of cucumber seeds with gibberellin concentration.

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