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THE EFFECT OF DIFFERENT CONCENTRATIONS OF PHYTOHORMONES ON THE GROWTH AND YIELD OF SWEET CORN (*Zea mays sturt* L.)

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Abstract

This study aims to determine the growth and yield of sweet corn based on the concentration of phytohormones sprayed day and night. As well as to find out which concentration of phytohormones gives the best effect on the parameters of plant height, number of leaves, age of flowering, fruit weight, and number of fruit. This study used a two-factor completely randomized design (CRD). The first factor of phytohormone concentrations consisted of T0 = 0 ml/L, T1 = 6 ml/L, T2 = 8 ml/L, T3 = 10 ml/L, T4 = 12 ml/L with 3 repetitions and 27 experimental units. The subject of this research is phytohormone and the object of this research is sweet corn of bonanza F1 variety. Collecting data in this study is by direct observation and documentation. Data were analyzed by ANOVA (Analysis of Variance) followed by the DMRT test if there was an effect. Based on the results of the DMRT test, treatment T4 = 12 ml/L had an effect on plant height and fruit weight with values of 195.4 cm and 162 grams, respectively. Treatment T3 = 10 ml/L had an effect on the number of leaves with a value of 18.7 and treatment T1 = 6 ml/L had an effect on the age of flowering with a value of 46.2 HST. The best phytohormone administration is produced from the administration of phytohormone which is sprayed during the day.

Keywords: Phytohormone, Spraying Time, Sweet Corn

1. INTRODUCTION

Plant growth and development result from several cellular processes such as division, differentiation, and elongation. This process is usually triggered by factors in plants in the form of biochemical compounds (hormones and enzymes). Because of the presence of chemical compounds that are transported (circulated) from one part of the plant to another. Hormones are one type of such compound.Hormones affect and regulate plant development.

Hormones regulate metabolism, growth and development. Plant hormones (phytohormones) can affect the rate of growth in certain plant parts. Small concentrations of plant hormones can cause physiological effects. This physiological effect is caused by the process of plant growth and development. Hormones act as growth regulators which are very important. Phytohormones are organic compounds that are not nutrients but can change the physiological processes of plants and are active at certain concentrations that are too high to be harmful and too low to be ineffective (Novitasari et al., 2015).

Depending on the source, growth regulators can be obtained either synthetically or naturally and are usually available at farm supply stores. In contrast to natural growth regulators which are directly available in nature and derived from organic materials (Leovici et al., 2014). The use of exogenous growth regulators can increase the concentration of plant hormones in the plant body, so that the role of ZPT can increase the rate of absorption of water and nutrients and increase the translocation of assimilation products (Mutryarny et al., 2020).

In plants there are various hormones and each has an important role, for example the hormones auxin, cytokinin, and gibberellins. Natural ZPT has not been widely used by farmers because the price is expensive and the use of natural ZPT is easily available around us, it is relatively cheap and safe to use (Lindung, 2014). In general, natural ZPT is available directly in nature and comes from organic materials. Examples of natural materials used as ZPT are coconut water, onion extract, bamboo shoot extract and peanut shoot extract (Tri & Nopiyanto, 2020).

Phytohormones consisting of a mixture of coconut water, bean sprouts and bamboo shoots contain the hormones auxin, cytokinins and gibberellins (Purdyaningsih, 2013). Increased production of sweet corn can be achieved in various ways such as good varieties, appropriate fertilization, plant hormones (ZPT) and improved cultivation methods. One effort to achieve good plant growth is the use of phytohormones. The use of phytohormones has been growing rapidly and is carried out intensively, several studies have shown that the right dose of plant hormones can promote vegetative growth and plant reproduction. Therefore, based on the description above, this study aims to analyze the effect of different concentrations of phytohormones on the growth and yield of sweet corn (*Zea mays Sturt L.*).

2. RESEARCH METHOD

This research was conducted from April 7 2022 to July 8 2022 at the Product Laboratory of the Science Education Study Program, Faculty of Teaching and Education, Lambung Mangkurat University, Banjarmasin. The tools and materials used in this study were stationery, blender, gallon, stirrer, cloth, sprayer, measuring cup, bamboo shoots, bean sprouts, coconut water, leftover vegetables, red dula, EM4, polybags, and Bonanza F1 variety corn kernels. The design used in this study was a completely randomized design (CRD) consisting of two factors. The first factor was 5 treatments of phytohormone concentrations (T0= 0 ml/l, T1= 6 ml/l, T2= 8 ml/l, T3= 10 ml/l, and T4=12 ml/l) and the second treatment was the time of spraying (day and night). It consists of 3 repetitions so there were 27 experimental units. The variables that had an effect as independent variables were phytohormone concentration and spraying time, and the variables that were affected as dependent variables were plant height, number of leaves, flowering age, fruit weight, and number of fruits. After the data was obtained, it was analyzed using the analysis of variance, and if the results of the analysis of variance were significantly or very significantly different, it was continued with the DMRT test data (Duncan 5% (0,05)) to find out the differences in each treatment.

3. RESULT AND DISCUSSION

3.1. Research Result

3.1.1. Statistical Test Results for Each Observation Parameter

1) Plant height

In this study, the height of sweet corn plants was measured by measuring from the base to the tip of the highest leaf using a tape measure. Plant height measurements were made when sweet corn was from 1 week to 8 weeks old with measurements taken once a week. The results of the average height of sweet corn plants as a result of the administration of phytohormones during the day are presented in Table 1, while the average results of the administration of phytohormones at night are presented in Table 2.

Table 1 The Average of Plant Height during the Day with Phytohormones

No.	Treatment	Average Plant Height
1	T0	162,6[a]
2	T3	186,7[b]
3	T1	194,7[c]
4	T2	194,9[c]
5	T4	195,4[c]

Note: The average plant height followed by the similarity of lowercase letters was not significantly different based on the DMRT test with a significance level of 5%.

Based on table 1, the results of the average afternoon spraying plant height data show that the T4 treatment or a concentration of 12 ml/L of phytohormone gave the highest average height yield with a value of 195.4 cm. While the lowest average yield of sweet corn plant height was obtained from the T0 or control treatment with a concentration of 0 ml/L, namely 162,6 cm.

Table 2 The Average of Plant Height by Giving Phytohormones at Night

No.	Treatment	Average Plant Height
1	T0	162,6[a]
2	T1	162,6[a]
3	T3	171,9[b]
4	T4	183[c]
5	T2	187,6[c]

Note: The average plant height followed by the similarity of lowercase letters was not significantly different based on the DMRT test with a significance level of 5%.

Based on Table 2, the average results of night spraying plant height data show that the T2 treatment or a concentration of 8 ml/L of phytohormone gave the highest average height yield with a value of 187,6 cm. While the lowest average yield of sweet corn plant height was obtained from the T0 or control treatment with a concentration of 0 ml/L, namely 162,6 cm.

2) Number of Leaves

In this study, the number of leaves was calculated based on the number of perfectly opened leaves, the calculation of the number of leaves was carried out when the sweet corn plants were 1 week to 8 weeks old with measurements taken once a week. The results of the average number of sweet corn leaves resulting from the administration of phytohormones during the day are presented in Table 3, while the average results of the administration of phytohormones at night are presented in Table 4.

Table 3 The Number of Leaves Average Given by Phytohormones during the Day

No.	Treatment	Average Number of Leaves
1	T0	15,6[a]
2	T2	17,6[b]
3	T4	17,8[b]
4	T1	18,4[c]
5	T3	18,7[c]

Note: The average number of leaves followed by the similarity of lowercase letters was not significantly different based on the DMRT test with a significance level of 5%.

Based on Table 3 the average results of the data on the number of leaves of the sweet corn plant with night spraying, it can be seen that the T3 treatment with a concentration of 10 ml/L of phytohormone gave the highest average height yield with a value of 18,7 strands. While the lowest average yield of sweet corn plant height was obtained from the T0 or control treatment with a concentration of 0 ml/L, namely 15,6 strands.

Table 4 The Number of Leaves Average Given by Phytohormones at Night

No.	Treatment	Average Number of Leaves
1	T2	14,8[a]
2	T0	15,6[b]
3	T4	15,9[bc]
4	T3	16[c]
5	T1	16,3[c]

Note: The average number of leaves followed by the similarity of lowercase letters was not significantly different based on the DMRT test with a significance level of 5%.

Based on table 4 the average results of the data on the number of leaves of the sweet corn plant with night spraying, it can be seen that the T1 treatment with a concentration of 6 ml/L of phytohormone gave the highest average height yield with a value of 16,3 strands. While the lowest average yield of sweet corn plant height was obtained from the T2 treatment with a concentration of 8 ml/L, namely 14,8 strands.

3) Flowering Age

In this study, the flowering age was calculated based on the number of perfectly opened leaves. Data collection was carried out when the male flowers appeared on the sweet corn the day after planting. The results of the average flowering age of sweet corn as a result of the administration of phytohormones during the day are presented in Table 5, while the average results of the administration of phytohormones at night are presented in Table 6. In the previous discussion, the average plant observation was determined by the magnitude of the average treatment value to determine which treatment was better. Observations on the parameters of flowering age can be used to determine the best treatment if the average value produced by the treatment is of small value.

Table 5 The Flowering Age Average given by Phytohormones during the day

No.	Treatment	Average Age of Flowering
1	T1	46,3[a]
2	T4	47[a]
3	T3	47,2[ab]
4	T2	49,5[b]
5	T0	58,2[c]

Note: The average age of flowering followed by the similarity of lowercase letters is not significantly different based on the DMRT test with a significance level of 5%.

Based on table 5, the average results of the flowering age data of sweet corn plants with noon spraying, it can be seen that the T1 treatment with a concentration of 6 ml/L of phytohormone gave the fastest flower appearance value with a value of 46.3 HST. While the results of the largest average flowering age of sweet corn or the longest appearing flowers were obtained from the T0 treatment or the control with a concentration of 0 ml/L, namely 58.2 HST.

Table 6 The Flowering Age Average given by Phytohormones at night

No.	Treatment	Average Age of Flowering
1	T3	54,3[a]
2	T2	56,7[a]
3	T1	57[a]
4	T4	58[a]
5	T0	58,2[a]

Note: The average age of flowering followed by the similarity of lowercase letters is not significantly different based on the DMRET test with a significance level of 5%.

Based on table 6 the average results of the flowering age data of sweet corn plants with night spraying, it can be seen that the T3 treatment with a concentration of 10 ml/L of phytohormone gave the fastest flower appearance value with a value of 54,3 HST. While the results of the largest average flowering age of sweet corn or the longest appearing flowers were obtained from the T0 treatment or the control with a concentration of 0 ml/L, namely 58,2 HST.

4) Fruit Weight

In this study, data collection on fruit weight was calculated based on the yield after 3 months. The results of the average fruit weight of sweet corn resulting from the administration of phytohormones during the day are presented in table 7, while the average results of the administration of phytohormones at night are presented in table 8.

Table 7 The Fruit Weight Average of the Administration of Phytohormones during the Day

No.	Treatment	Average Fruit Weight
1	T0	141,3[a]
2	T3	146,3[b]
3	T1	153,2[c]
4	T2	155,8[d]
5	T4	162,0[e]

Note: The average fruit weight followed by the similarity of lowercase letters was not significantly different based on the DMRT test with a significance level of 5%.

Based on table 7, the average yield of sweet corn fruit weight during the afternoon spraying can be seen that the T4 treatment with a concentration of 12 ml/L of phytohormones gave the heaviest fruit weight of 162 grams. While the lowest average yield of sweet corn fruit weight was obtained from the T0 or control treatment with a concentration of 0 ml/L, namely 141,3 grams.

Table 8 The Fruit Weight Average of the Administration of Phytohormones during the Day

No.	Treatment	Average Fruit Weight
1	T2	134[a]
2	T3	139,7[b]
3	T1	140[b]
4	T4	140,7[b]
5	T0	141,3[b]

Note: The average fruit weight followed by the similarity of lowercase letters was not significantly different based on the DMRT test with a significance level of 5%.

Based on table 8, the results of the average fruit weight data on the sweet corn plant during the afternoon spraying can be seen that the T0 treatment or control concentration of 0 ml/L of phytohormone gave the heaviest fruit weight of 141.3 grams. While the lowest average yield of sweet corn fruit weight was obtained from the T2 treatment with a concentration of 8 ml/L, namely 134 grams.

5) Number of Fruits

Table 9 Number of Fruits

Fruit Weight (grams)			
Phytohormone Concentration	**Test**	**Spraying Time**	
		Afternoon	**Evening**
T0	1	2	2
	2	2	2
	3	2	2
T1	1	2	2
	2	2	2
	3	2	2
T2	1	2	2
	2	2	2
	3	2	2
T3	1	2	2
	2	2	2
	3	2	2
T4	1	2	2
	2	2	2
	3	2	2

Based on Table 10 above, the parameter of observing the number of fruits when spraying phytohormones has the same number of fruits in each treatment repetition. As a result, statistical tests on the number of fruits parameter are not required.

3.2. Discussion

3.2.1. The Effect of Phytohormones on Plant Height

Plant height is one of the parameters that is often used as an indicator of growth. An increase in plant height indicates that the plant is undergoing cell division (Sabatini et al., 2017). Plant height itself is a growth process during the vegetative period. During the vegetative period the hormone auxin has several physiological effects including causing cell enlargement, root growth, and cambium activity (Khairuna, 2019).

The following is a comparison of the average height of sweet corn plants that were sprayed with phytohormones during the day and night which are displayed in the form of a bar chart to see comparisons between treatment groups. The diagram can be seen in Figure 1.

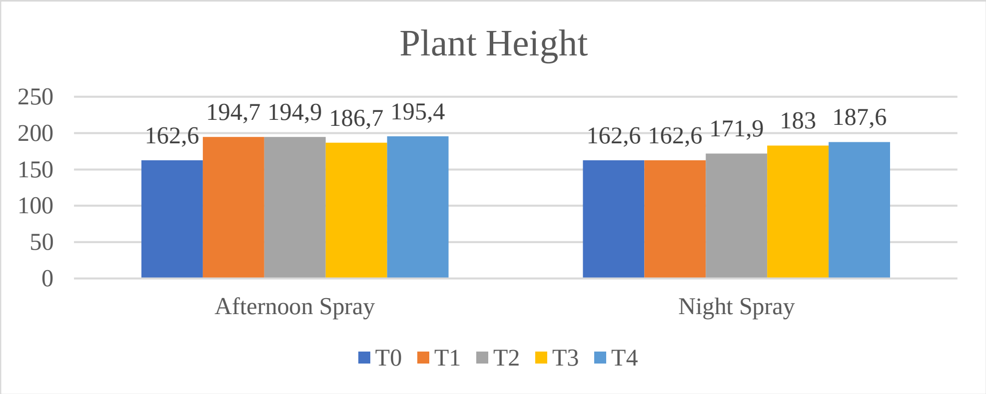

Figure 1 Comparison of Plant Height

Based on the diagram, spraying during the day shows that the average height of sweet corn plants is better than the average height of spraying at night. This is because the auxin hormone absorbed by plants activates food reserve energy and stimulates cell division, elongation, and differentiation resulting in elongation of plant shoots (Simtalia & Khoiri, 2014). This is also influenced by the opening of stomata on corn plants where the corn plant itself is a C4 plant type whose stomata are open during the day (Perkasa et al., 2017).

Phytohormones consisting of a mixture of coconut water, bean sprouts and bamboo shoots, which contain the hormones auxin, cytokinins and gibberellins (Purdyaningsih, 2013). The auxin phytohormone contained in bean sprouts can help accelerate and support the vegetative period of plants so that they enter the generative period more quickly (Miftakurrohmat & Dewantara, 2020). Optimum administration of auxin can increase meristematic cell division, and this increase in cell division can accelerate plant growth, especially plant height (Khairuna, 2019). Likewise, the provision of cytokinin phytohormones contained in coconut water has benefits in increasing plant growth (Miftakurrohmat & Dewantara, 2020).

Auxins and cytokinins will play a role in maximizing cell metabolism and spurring plant growth. Auxin acts as a regulator of cell enlargement and elongation and stimulates plant growth. while cytokinins stimulate cell division and enlargement thereby spurring plant growth and development (Ariyanti et al., 2020).

Like auxin, gibberellin relaxes the cell wall but does not acidify it. One hypothesis states that gibberellins stimulate enzymes and relax the cell wall, so that proteins more easily penetrate the cell wall. Auxin acidifies the cell wall and processes division. Gibberellin, on the other hand promotes cell elongation.

The following are auxin metabolic processes that make cell division and elongation occur:

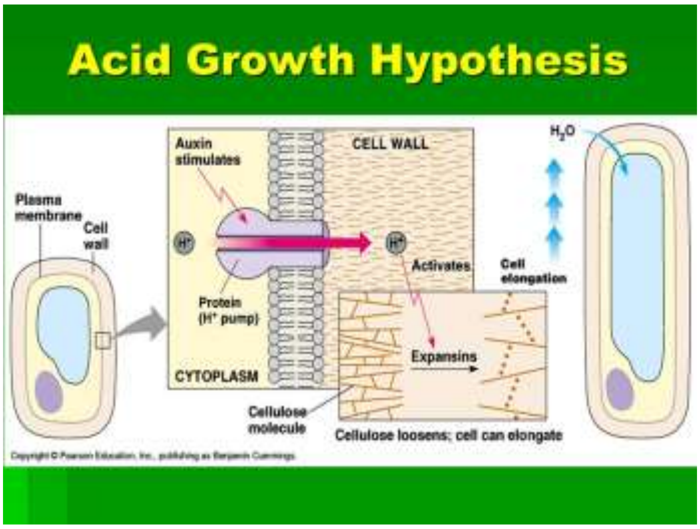

Figure 2 Acid Growth Hypothesis

Information:

a. The acidic cell wall area will be entered by auxin so that hydrogen can enter.
b. As a relatively small neutral molecule, auxin penetrates the plasma membrane.
c. The pH of the environment inside the cell is 7, so that auxin is ionized into auxin and H ions are negatively charged. During this short time, the hormone resides within the cell because the plasma membrane is more permeable to ions than a neutral molecule of the same size.
d. ATP-driven proton pumping regulates the difference in pH inside and outside the cell.
e. Auxin can leave the cell only at the base of the cell, where a specific carrier protein (aucin carrier protein) is incorporated into the membrane (Campbell et al., 2002).

3.2.2. The Effect of Phytohormones on the Number of Leaves

Leaves are where the process of photosynthesis takes place. The results of photosynthesis will increase if the number of leaves produced by plants is more. Therefore, the number of leaves is widely used as a parameter to observe plant growth (Sriwigati et al., 2021).

The following shows the average number of sweet corn leaves sprayed with phytohormones which are sprayed day and night which will be displayed in the form of a bar chart to see comparisons between treatment groups. The diagram can be seen in Figure 3.

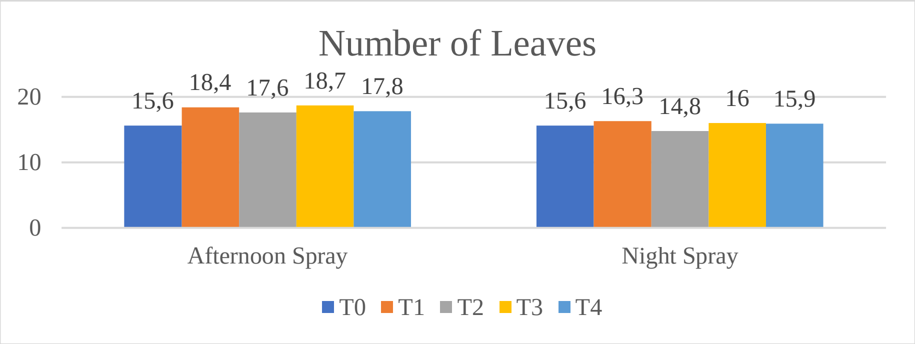

Figure 3 Comparison of Number of Leaves

Based on the comparison diagram for the number of leaves sprayed with phytohormone during the day and at night above, it can be seen that spraying phytohormone during the day has a better effect on the number of sweet corn leaves. This is also influenced by the opening of stomata on corn plants where the corn plant itself is included in the C4 plant type whose stomata are open during the day (Perkasa et al., 2017).

Each corn leaf consists of a petiole attached to the stalk, ligule and leaf sheath. The number of leaves is equal to the number of nodes on the stem. The number of leaves usually varies between 10-18 strands (Khairiyah et al., 2017). Leaf formation is influenced by many hormonal stimuli (Goldswothy & Fisher, 1992).

Based on this statement, it can be concluded that as the height of the corn plant increases, the formation of leaves also follows. This is because the stem of the sweet corn plant has segments which will later be covered by the leaf sheaths. Remember the three hormones contained in PGR, such as auxin, cytokinin, and gibberellins, which aid in the growth and development of sweet corn plants.

3.2.3. The Effect of Phytohormones on Male Flowering Age

The first reproductive growth parameter observed was flowering. This is important to note because the reproductive phase of a plant is known when flower buds appear on the plant. Flowers that develop from the apical meristem of the stem. The meristella cells are actively developing to produce primary flowers. The flowering of corn plants is marked by the presence of stamens that emerge from the ears at the ends (Ekowati & Nasir, 2011).

The following is the average age of sweet corn flowering given phytohormones which are sprayed day and night which will be displayed in the form of a bar chart to see comparisons between treatment groups. The diagram can be seen in Figure 4.

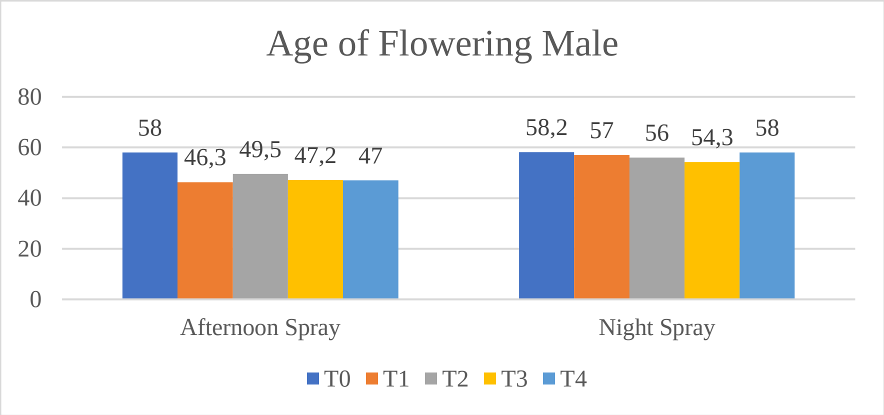

Figure 4 Flowering Age Comparison

The phytohormone gibberellin in bamboo shoots stimulates growth, which has a significant effect from germination to plant senescence. The presence of gibberellin in bamboo shoots can be seen in the rapid growth of bamboo shoots (Rahmawati, 2021). In plant extraction, bamboo shoots are used as a natural source of gibberellins. Cytokinins and gibberellins are hormones that are thought to be responsible for accelerating flower emergence (Campbell et al., 2002).

3.2.4. The Effect of Phytohormones on Fruit Weight

Corn plants produce one or more ears or pods of corn. Ears emerge from the nodes in the form of buds, which then develop into ears. Corn kernels are neatly arranged on corn cobs (Paeru & Trias Qurnia Dewi, 2017). On the corn cob there are hairs that extend out of the wrapping (husks). On each corn plant 1-2 cobs are formed (Sahri, 2018).

The following is the average fruit weight of sweet corn given phytohormones which are sprayed day and night which will be displayed in the form of a bar chart to see comparisons between treatment groups. The diagram can be seen in Figure 4.

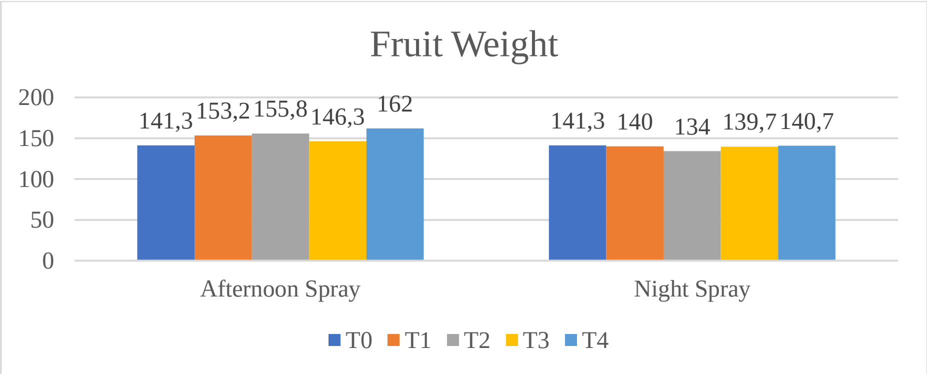

Figure 5 Fruit Weight Comparison

The hormone that plays a role in increasing the number of fruits is auxin. The increase in the number of fruits is somehow related to the growth of the fruits. This is due to the results of cell division and development (Wiraatmaja, 2017). The stages of cell division usually overlap (can cause the same thing) in cell development. Fruit size always follows this level of development. Regarding auxin, the endosperm and embryo within the seed produce auxin which stimulates the growth of the endosperm. The claim that the hormone auxin plays a role in fruit growth was proven by a scientist named Crane in 1999 using 2, ,5-T as an exogenous auxin applied to blackberries, grapes, strawberries and oranges (Weafer, 1972). Gibberellin metabolism occurs in tissue growth, tissue differentiation and fruit and seed development.

3.2.5. The Effect of Phytohormones on the Number of Fruits

Figure 6 The Effect of Phytohormones on the Number of Fruits

The last reproductive growth parameter observed was the number of fruit. Corn that is ready to be harvested is picked from the tree (Ekowati & Nasir, 2021). Based on table 10 above for the parameters for observing the number of fruits on the sweet corn plant when given the phytohormone spraying treatment it has the same number of fruits in each treatment repetition. Therefore, it is not necessary to carry out statistical tests for the parameter of the number of sweet corn plants.

The small amount of corn that is produced is because the corn stalks are small so that fruit growth can only occur one fruit per stalk. Plants can grow and produce optimally if the availability of nutrients is guaranteed, especially during the growing season. Plant growth is not only determined by internal factors, but also external factors.

The availability of nutrients is an external factor that influences plant growth.If these elements are not available to plants, the growing plants will be disturbed. One of the most abundant nutrients found in the soil and which is needed by plants is the elements N, P, and K.

Even though the plants have been given N, P, and K fertilizers according to the needs and the right dosage, their growth and development are still disturbed. This is because in one plant medium there are two corn plants at once, so that the two plants will compete in taking nutrients.

4. CONCLUSION

Based on the results of research conducted by utilizing phytohormones as natural growth regulators to see the effect on growth and yield of sweet corn of the Bonanza F1 variety, it can be concluded that:

1) The administration of phytohormones as natural growth regulators can influence the observed variables of plant height, number of leaves, age of male flowering, and fruit weight. While the parameter of the number of fruits does not have any effect.
2) Further test results using the DMRT level of 5% T4 treatment with a concentration of 12 ml/L gave the best effect on plant height with a value of 195,4 cm and fruit weight with a value of 162 grams. This was followed by T3 treatment with a concentration of 10 ml/L which had the best effect on the number of leaves parameter with a value of 18,7 and T1 with a concentration of 6 ml/L which had the best effect on the age of flowering parameter with a value of 46,2 HST.
3) The best treatment of phytohormones resulted from the administration of phytohormones during daytime spraying.
4) Based on the results of the analysis and discussion, it can be concluded that the administration of natural ZPT can help the process of growth and yield of sweet corn in terms of parameters that have a significant effect. So that the use of synthetic ZPT made from chemicals can be reduced and the use of natural ZPT can be increased.

REFERENCES

Ariyanti, M., Maxiselly, Y., & Soleh, M. A. (2020). Pengaruh Aplikasi air kelapa sebagai Zat Pengatur Tumbuh Alami terhadap Pertumbuhan Kina (Cinchona ledgeriana Moens) setelah Pembentukan Batang di Daerah Marjinal. *Agrosintesa Jurnal Ilmu Budidaya Pertanian*, *3*(1), 12–23.

Campbell, N. A., Reece, J. B., & Mitchll, L. G. (2002). *Biolog*. Erlangga.

Ekowati, D., & Nasir, M. (2011). Pertumbuhan Tanaman Jagung (Zea Mays, L.) Varietas Bisi-2 Pada Pasir Reject Dan Pasir Asli Di Pantai Trisik Kulonprogo (the Growth of Maize Crop (Zea Mays L.) Bisi-2 Variety on Rejected and Non Rejected Sand at Pantai Trisik Kulon Progo). *Jurnal Manusia Dan Lingkungan*, *18*(3), 220–231.

Ekowati, D., & Nasir, M. (2021). The Growth of Maize Crop (Zea mays L.) BISI-2 Variety on Rejected and non Rejected Sand at Pantai Trisik Kulon Progo. *Jurnal Manusia Dan Lingkungan*, *3*(18), 224–226.

Goldswothy, P. R., & Fisher, N. M. (1992). *Fisiologi tanaman budidaya tropik*. Gadjah Mada University.

Khairiyah, K., Khadijah, S., Iqbal, M., Erwan, S., Norlian, N., & Mahdiannor, M. (2017). Pertumbuhan dan hasil tiga varietas jagung manis (Zea mays saccharata Sturt) terhadap berbagai dosis pupuk organik hayati pada lahan rawa lebak. *Ziraa'ah Majalah Ilmiah Pertanian*, *42*(3), 230–240.

Khairuna. (2019). *Diklat fisiologi tumbuhan*. Program Studi Pendidikan Biologi Fakultas Tarbiyah dan Keguruan Universitas Islam Negeri Sumatera Utara.

Leovici, H., Kastono, D., & Putra, E. T. S. (2014). Pengaruh macam dan konsenterasi bahan organik sumber zat pengatur tumbuh alami terhadap pertumbuhan awal tebu (Saccharum officinarum L.). *Vegetalika*, *3*(1), 22–34.

Lindung. (2014). *Teknologi aplikasi zat pengatur tumbuh*. Balai Pelatihan Pertanian.

Miftakurrohmat, A., & Dewantara, M. D. (2020). Application of Phytohormones of Bean Sprouts Extract on Growth of Cayenne Pepper (Capsicum frutescens L.). *Nabatia*, *8*(2), 45–51.

Mutryarny, E., Wulantika, T., & Kuning, R. (2020). Pengaruh Zpt Alami Terhadap Pertumbuhan dan Produksi Tanaman Bawang Merah (Allium ascalonicum L.). *SINTA Journal–Science, Technology and Agriculture Journal*, *1*(1), 1–9.

Novitasari, B., Meirani, & Haryati. (2015). The Growth of Dragon Fruit Plant Cuttings with Application of Indole Butyric Acid and Naphthalene Acetic Acid Plant Growth Regulator Combinations. *Jurnal Agroteknologi*, *1*(4), 1738.

Paeru, R. H., & Trias Qurnia Dewi, S. P. (2017). *Panduan Praktis Budidaya Jagung*. Penebar Swadaya Grup.

Perkasa, A. Y., Siswanto, T., Shintarika, F., & Aji, T. G. (2017). Studi identifikasi stomata pada kelompok tanaman C3, C4 dan CAM. *Jurnal Pertanian Presisi (Journal of Precision Agriculture)*, *1*(1).

Purdyaningsih, E. (2013). Kajian pengaruh pemberian air kelapa dan urine sapi terhadap pertumbuhan stek nilam. *Balai Besar Perbenihan Dan Proteksi Tanaman Perkebunan*.

Rahmawati, A. A. (2021). Rebung Bambu Sebagai Alternatif Fitohormon Dalam Memacu Pertumbuhan Tunas, Pada Benih Dorman. *Biofarm: Jurnal Ilmiah Pertanian*, *17*(1).

Sabatini, S. D., Budihastuti, R., & Suedy, S. W. A. (2017). Pengaruh pemberian pupuk nanosilika terhadap tinggi tanaman dan jumlah anakan padi beras merah (Oryza sativa L. var. Indica). *Buletin Anatomi Dan Fisiologi (Bulletin Anatomy and Physiology)*, *2*(2), 128–133.

Sahri, M. (2018). *Korelasi Sifat Pertumbuhan Dan Hasil Jagung Putih Lokal*. Universitas Mercu Buana Yogyakarta.

Simtalia, M., & Khoiri, M. A. (2014). Pertumbuhan bibit karet (Hevea brasiliensis) stum mata tidur dengan pemberian air kelapa dan ampas teh. *Jurnal Online Mahasiswa (JOM) Bidang Pertanian*, *1*(1), 1–10.

Sriwigati, R. W., Widiastuti, L., & Ihsan, M. (2021). Efektivitas Perendaman Benih Dalam Air Panas Terhadap Daya Kecambah Dan Pertumbuhan Bibit Adas (Foeniculum vulgare Mill). *AGRISAINTIFIKA: Jurnal Ilmu-Ilmu Pertanian*, *5*(1), 70–74.

Tri, S. S., & Nopiyanto, R. (2020). Pengaruh Zat Pengatur Tumbuh Alami Dari Ekstrak Tauge Terhadap Pertumbuhan Pembibitan Budchip Tebu (Saccharum officinarum L.) VARIETAS BULULAWANG. *Mediagro*, *16*(1).

Weafer, R. J. (1972). *Plant growth substance in agriculture*. W. H. Freeman and Company.

Wiraatmaja, I. W. (2017). *Bahan ajar zat pengatur tumbuh giberelin dan sitokinin*. Universitas Udayana.