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Effectiveness of Auxin and Gibberellin Hormone Application on Tomato Plant Growth and Yield (*Solanum Lycoprisicum* L)

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Abstract
Tomatoes are one of the most commonly consumed vegetables in the world. Tomatoes are used as a source of vitamins and minerals, among other things. Auxin plays a role in stimulating the cell elongation process. Another function of auxin is to stimulate the cambium to form xylem and phloem. Gibberellin is a hormone that works synergistically with the auxin hormone. Gibberellin affects the development and germination of embryos. This study was conducted in Sp Kelaping Village, Pegasing District, Central Aceh Regency from May 2024 to July 2024. This study used a factorial randomized block design (RBD) with 16 treatments and was repeated 3 times, resulting in a total of 48 plant units. The treatment factors were auxin (A) doses consisting of 4 levels, namely A0: 0 Control, A1: 0.2 ml/L, A2: 0.4 ml/L, A3: 0.6 ml/L, and gibberellin (G) doses consisting of 4 levels, namely: G0: 0 Control, G1: 0.2 ml/L, G2: 0.4 ml/L, G3: 0.6 ml/L. The data were analyzed using Analysis of Variance (ANOVA) and produced significantly different results, followed by a 5% BNJ analysis. The variables observed included plant height (cm), number of leaves, stem diameter (cm), number of fruits, and fruit weight. Based on the results, it can be concluded that the application of auxin hormone affects the fruit weight of tomato plants at a dose of A3, which is 0.6 ml/L. The application of gibberellin hormone has a very significant effect on the height of tomato plants at 15 days after transplanting at a dose of G2, which is 0.4 ml/L, and has a significant effect on the stem diameter at 15 days after transplanting. The G2 dose was 0.4 ml/L, and had a significant effect on stem diameter at 15 days after transplanting. The A2 dose was 0.4 ml/L, and fruit weight was highest in the G2 treatment, which was 0.4 ml/L.

Keywords:
Tomat, Auksin, Giberelin

1. Introduction

Indonesia is an agricultural country known for its agricultural sector, which supports the national economy. In the agricultural sector, horticulture is a promising commodity, and domestic market demand for horticultural crops is very high [1]. One of Indonesia's horticultural crops is the tomato. Tomatoes are shrubs with green, lobed leaves arranged on stems [2]. In addition to having

a delicious taste, tomatoes also have a fairly complete and good nutritional composition. The most notable nutrients in tomatoes are vitamins A and C. The nutritional composition of 100 grams of tomatoes is as follows: protein (1 g), carbohydrates (4.2 g), fat (0.3 g), calcium (5 mg), phosphorus (27 mg), iron (0.5 mg), vitamin A (carotene) 1500 IU, vitamin B (thiamine) 60 mg, vitamin C 40 mg [3].

Tomato plants are classified as plants that are quite tolerant to altitude; these plants can grow well in highlands, midlands, and lowlands, depending on the variety [4]. According to [5], tomato plants have a fairly wide distribution, with tomato production in tropical areas tending to be more productive in highlands than in lowlands. Therefore, the use of stimulants on plants is highly recommended, including auxin and gibberellin. Auxin plays a role in stimulating the cell elongation process. Another function of auxin is to stimulate the cambium to form xylem and phloem. Gibberellin is a hormone that works synergistically with auxin. Gibberellin affects embryo development and germination [6]. Gibberellin hormone at various concentrations shows differences in fruit weight and seed weight of the Tombat F1 tomato variety [7]. The optimal gibberellin hormone concentration is 100 ppm, as indicated by a fruit weight of 81.07 ± 1.59 g and a seed weight of 0.05 ± 0.010 g [8].

Based on the above background, the objectives of this study were to determine the effect of auxin and gibberellin hormone application on tomato growth in order to obtain the most optimal auxin and gibberellin hormone treatment for tomato growth and yield.

2. Material and Methods

This research was conducted on the grounds of the Faculty of Agriculture, University of Papua, West Manokwari subdistrict, Manokwari district, West Papua. Agroclimatology and Agronomy Laboratory, University of Papua. This research was conducted from July 2025 to September 2025.

The tools used in this research were seedling plastic, hoes, soil sieves, watering cans, marker stakes, writing instruments, measuring tapes, cameras, knives, analytical scales, scissors, sacks, and plastic clips. The materials used were Sakina tomato seeds, manure fertilizer, plastic rope, 10 kg polybags, auxin, gibberellin, water, and topsoil.

Research Design The research was designed using a randomized block design (RBD) with a factorial pattern consisting of two factors. The factors in this study are: The auxin dose treatment factor (A), which consists of 4 levels, namely: A0: Control, A1: 0.2 ml/L, A2: 0.4 ml/L, A3: 0.6 ml/L. The gibberellin dose treatment factor (G) consists of 4 levels, namely: G0: Control, G1: 0.2 ml/L, G2: 0.4 ml/L, G3: 0.6 ml/L. This study used a factorial randomized block design (RBD) consisting of 16 treatment combinations, each treatment with 3 replicates, resulting in a total of 48 experimental units.

The application of auxin hormone is done by spraying all parts of the plant and the specified concentration. Spraying is done when the plant is 14 days old and 21 days old. Auxin hormone spraying is done in the morning at 8:00 a.m. Application of Gibberellin Hormone is performed on buds exactly one day before the flowers bloom, i.e., on the sixth day since the buds appeared. Gibberellin application is performed in the morning at 08:00.The variables observed included plant height (cm), number of leaves, stem diameter (cm), number of fruits, and fruit weight.

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3. Results and Discussion

3.1 The Effect of Auxin Hormone Application on the Growth and Yield of Tomato Plants

3.1.1 Plant Height (cm)

Observational data on tomato plant height at 15, 30, and 45 days after transplanting due to the application of auxin hormone showed that the auxin hormone treatment studied had no significant effect on tomato plant height.

Table 1.
Average height of tomato plants due to the application of auxin hormone at 15, 30, and 45 days after transplanting.

Treatment Auxin	Plant Height		
	15 days after transplanting	30 days after transplanting	45 days after transplanting
kontrol	8,81	26,06	55,31
0,2 ml/L	9,13	28,69	61,81
0,4 ml/L	9,56	27,44	63,25
0,6 ml/L	9,75	29,19	60,19

Table 1 shows that the highest plants at 15 and 30 days after transplanting were found in treatment 0.6 ml/L, namely 9,75 cm and 29,19 cm, but not significantly different from all treatments. At 45 HST, the highest value was found in treatment 0.4 ml/L, namely 63.25 cm, which was not significantly different from all treatments. This is thought to be because the nutrients carried by the roots were few and would inhibit the growth and development process in tomato plants. This is in accordance with [9] There was an increase in plant height and number of branches in tomato plants at concentrations of 20 ppm NAA and 5 ppm GA3. However, there was a decrease in plant height and number of branches in plants treated with 40 ppm NAA and 10 ppm GA3. NAA and GA3 hormones can stimulate growth, but at high concentrations they can inhibit growth. inhibit plant growth and development . If the nutrients carried by the roots are low, it will inhibit the growth and development of the plant [10].

3.1.2 Number of leaves

Observational data on the number of tomato leaves at 15, 30, and 45 days after trasplanting due to the application of auxin hormone showed that the auxin hormone treatment studied had no significant effect on the number of tomato leaves.

Table 2.
Average number of tomato leaves due to the application of auxin hormone at 15, 30, and 45 days after planting.

Treatment	Number of leaves		
	15 days after transplanting	30 days after transplanting	45 days after transplanting
kontrol	27,38	46,75	81,69

0,2 ml/L	31,25	44,56	78,81
0,4 ml/L	31,31	46.56	76,94
0,6 ml/L	32,50	44,31	80,00

Table 2 shows that the largest number of leaves at 30 and 45 days after transplanting was found in the control treatment, namely 46.75 cm and 81.69 cm, which was not significantly different from all treatments. while the highest number of leaves at 15 days after transplanting was found in treatment 0,6 ml/L, which was 32.50 cm, which was not significantly different from all treatments. This is thought to be because the nutrients and water absorbed by the plants reflect the fresh weight of the plants and will affect the growth of the number of leaves and leaf area of the plants. 20 This is in accordance with [11] Plants grow and reach high production levels because the nutrients needed by plants are sufficient and balanced in the soil. The nutrients and water absorbed by plants reflect the fresh weight of the plants. Nutrients absorbed by plants through their roots along with water will affect growth, such as height, number of leaves, and leaf area [12].

3.1.3 Stem Diameter (cm)

Observational data on tomato plant stem diameter at 15, 30, and 45 days after trasplanting showed that the auxin hormone treatment studied had no significant effect on tomato plant stem diameter.

Table 3.
Average diameter of tomato plant stems due to auxin hormone application at 15, 30, and 45 days after trasplanting

Treatment	Stem Diameter		
	15 days after transplanting	30 days after transplanting	45 days after transplanting
kontrol	1,44	2,41	3,08
0,2 ml/L	1,65	2,39	3,08
0,4 ml/L	1,69	2,39	3,03
0,6 ml/L	1,78	2,48	2,98

Table 3 shows that the highest stem diameter at 15 and 30 days after transplanting was found in treatment 0,6 ml/L , namely 1.78 cm and 2.48 cm, which was not significantly different from all treatments. while the highest number of stem diameters at 45 days after transplanting was found in the control and 0,2 ml/L treatments, namely 3.38 and 3.38, which were not significantly different from all treatments. This suggests that auxin hormone application can stimulate growth, flowering, and fruiting, but auxin does not affect the stem diameter of tomato plants. This is consistent with [13], which states that applying different concentrations of auxin does not have an effect. This is because the endogenous auxin content in plants is sufficient, and therefore exogenous auxin application will not accelerate plant growth.

3.1.4 Number And Weight Of Tomatoes

Observation data on the number of fruits and weight of tomatoes produced from the application of auxin hormone shows that the auxin hormone treatment studied had no significant effect on the number of tomato fruits, but had a significant effect on the weight of tomato fruits.

Table 4.
Average number and weight of tomatoes produced from the application of auxin hormones

Treatment Auxin	Number of Fruits	Fruit Weight
kontrol	6,06	455,63a
0,2 ml/L	6,13	475,31b
0,4 ml/L	5,50	517,19c
0,6 ml/L	6,19	521,31c
BNJ0,05		3,35

Table 4 shows that the largest number of fruits at 60 days after transplanting was found in treatment A3:ml/L, namely 6.19, which was not significantly different from all treatments. This suggests that hormones at the right concentration can produce the best results in terms of the total number of fruits harvested per plant. This is consistent with [14], which states that hormone application can provide the best results in terms of total fruit yield per plant, thereby producing the maximum number of fruits per plant.

the highest fruit weight in tomato plants was found in treatment A3:ml/L, which was 521.31 grams, not significantly different from A2:ml/L but significantly different from all other treatments. This is thought to be due to the formation of the enzyme a-amylase, which increases sugar in the cells, causing water outside the cells to enter by osmosis, resulting in cell elongation in plants. This is in accordance with [15], which states that the presence of hormones in the fruit will stimulate the formation of the enzyme a-amylase, which will increase the sugar content in the cells so that water outside the cells will enter by osmosis and cause cell elongation, resulting in an increase in fruit weight in the plants.

3.2 The Effect of Gibberellin Hormone Application on Tomato Plant Growth and Yield

3.2.1 Plant Height (cm)

Observational data on tomato plant height at 15, 30, and 45 days after planting due to the application of gibberellin hormone showed that the gibberellin hormone treatment studied had a very significant effect on height at 15 days after planting and no significant effect at 30 and 45 days after planting.

Table 5.
Average tomato plant height with gibberellin hormone application at 15, 30, and 45 days after transplanting.

Treatment	Plant Height		
	15 days after transplanting	30 days after transplanting	45 days after transplanting
kontrol	7,56a	25,00	56,13
0,2 ml/L	9,19a	28,69	61,88
0,4 ml/L	10,06b	29,94	62,00
0,6 ml/L	10,44b	27,75	60,56

BNJ0,05	0,34

The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

Table 6 shows that the highest plant height at 15 days was found in treatment 0,6 ml/L, which was 10.44, not significantly different from 0,4 ml/L but significantly different from 0,2 ml/L and kontrol. At 30 and 45 days after transplanting, the highest values were found in the 0,4 ml/L treatment, namely 29.94 and 62.00, which were not significantly different from all treatments. This is thought to be due to the exogenous application of gibberellin hormone stimulating the growth of stems and young leaves. Gibberellin also has a significant effect on the length parameter of tomato plants. This is in line with [16] that gibberellin induction has a significant effect on tomato plant length parameters. This is consistent with the research conducted by [17] that plant height increased due to the administration of 30 ppm, while a concentration of 40 ppm did not increase plant height.

3.2.2 Number of Leaves

Observation data on the number of tomato leaves at 15, 30, and 45 days after transplanting due to the application of gibberellin hormone showed that the gibberellin hormone treatment studied had no significant effect on the number of tomato leaves.

Table 6.
Average number of tomato leaves with auxin hormone application at 15, 30, and 45 days after transplanting.

Treatment	Number of Leaves		
	15 days after transplanting	30 days after transplanting	45 days after transplanting
kontrol	31,31	45,25	77,63
0,2 ml/L	31,00	46,13	78.63
0,4 ml/L	30,31	47,69	82,19
0,6 ml/L	29,81	43,13	80,00

Table 7 shows that the highest number of leaves at 15 days was found in the control treatment, namely 31.31, which was not significantly different from all treatments. At 30 and 45 days after planting, the highest values were found in the 0,4 ml/L treatment, namely 47.69 and 82.19, which were not significantly different from all treatments. This is thought to be due to the direct application of gibberellin to the leaves, which stimulates leaf growth. Gibberellin functions to increase cell division, thereby enlarging leaf size. This is in line with [18] in his research, which states that the hormone gibberellin functions to increase cell division, thereby enlarging leaf size. This is because gibberellin sprayed directly onto plant leaves will cause an increase in the number of leaves because when the stomata open, gibberellin enters the stomata and causes gibberellin auxin to be absorbed more quickly [19].

3.2.3 Stem Diameter (cm)

Observational data on tomato plant stem diameter at 15, 30, and 45 days after transplanting following gibberellin hormone application showed that the gibberellin hormone

treatment studied had a significant effect on tomato plant stem diameter at 15 days after transplanting and no significant effect at 30 and 45 days after transplanting.

Table 7.
Average stem diameter of tomato plants treated with gibberellin hormone at 15, 30, and 45 days after transplanting.

Treatment	Stem Diameter		
	15 days after transplanting	30 days after transplanting	45 days after transplanting
kontrol	1,42a	2,36	3,02
0,2 ml/L	1,51b	2,38	3,01
0,4 ml/L	1,82c	2,46	3,09
0,6 ml/L	1,81c	2,40	3,04
BNJ0,05	0,46		

The numbers followed by the same letter in the same column are not significantly different in Duncan's 5% test.

Table 8 shows that the highest diameter at 15 days was found in treatment 0,4 ml/L, which was 1.82, not significantly different from 0,6 ml/L but significantly different from 0,2 ml/L and kontrol. At 30 and 45 HST, the highest values were found in the G2:ml/L treatment, namely 2.46 and 3.09, which were not significantly different from all treatments. This is thought to be due to the faster rate of cell division and elongation, which promotes the formation of tissues and organs such as leaves, stems, and roots. This is in accordance with [20], which states that in general, the application of auxin and gibberellin hormones increases growth through cell division and elongation, resulting in faster cell development, which promotes the formation of tissues and organs such as leaves, stems, and roots in plants.

3.2.4 Number And Weight Of Tomatoes

Observation data on the number and weight of tomatoes produced from the application of gibberellin hormone show that the gibberellin hormone treatment studied had no significant effect on the number of fruits but had a significant effect on the weight of tomatoes.

Table 8.
Average number Number And Weight Of Tomatoes fruits at 60 days after transplanting resulting from the application of gibberellin hormone

Treatment gibberellin	Number of Fruits	Fruit Weight
kontrol	5.81	491,88a
0,2 ml/L	6,50	489,69b
0,4 ml/L	5,56	494,44b
0,6 ml/L	6,00	493,44b
		3,53

Table 9 shows that the highest number of fruits was found in treatment 0,2 ml/L , namely 6.50 g, which was not significantly different from all treatments. This is because the total number of fruits per plant (30 tomatoes) will directly determine the total fruit weight per plant, resulting in a greater number of fruits. This is in accordance with [21], which states that a large number of

flowers can also produce more fruit on plants. An increase in the number of cells, including those in leaf tissue, enables photosynthesis to produce carbohydrates that can affect plant weight [22].

the highest fruit weight was found in treatment 0,4 ml/L, namely 494.44 g, which was not significantly different from 0,6 ml/L and 0,2 ml/L but was significantly different from kontrol. This is thought to be due to the concentration and frequency of gibberellin application, which can form plant fruit and fruit weight in tomato plants, significantly increasing fresh fruit weight and fruit number. This is in accordance with [23]. The concentration and frequency of gibberellin application can form plant fruit and fruit weight. Gibberellin application to tomato plants significantly increases fresh fruit weight and fruit number. According to [24], gibberellin can help increase cell division and enlargement, thereby increasing fruit size. According to [25], gibberellin application can increase growth and yield in tomato plants.

3. Conclusion

Based on the results and discussion above, it can be concluded that the application of auxin hormone has a significant effect on the fruit weight of tomato plants at a dose of 0,6 ml/L , which is 0.6 ml/L. The application of gibberellin hormone has a very significant effect on the height of tomato plants at 15 days after transplanting at a dose of G2, which is 0.4 ml/L, and has a significant effect on the stem diameter at 15 at a dose of A2, which is 0.4 ml/L, and fruit weight, which is the G2 treatment at 0.4 ml/L.

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