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Effect of Various Doses of Growth Regulators and Soaking Time on the Growth and Yield of Sweet Potato Cuttings (*Ipomoea batatas* L.)

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Abstract

This research was carried out in the Batulappa environment, Samataring Village, East Sinjai District, Sinjai Regency which took place from May to August 2025. This study aims to determine the effect of growth regulator dose, soaking duration, and interaction between growth regulator dose and soaking duration on sweet potato growth growth and yield cuttings. This study uses Separate Plot Design (RPT) in a two-factor factorial design. The first factor is Growtone Growth Regulator (Z) and the second factor is Soaking Length (L). There are 9 combinations of treatments repeated 3 times so that there are 27 combinations of treatments. Each treatment there are 6 plants for a total of 162 plants. For each treatment, 3 plant samples were taken, so that the number of plant samples observed was 81 plants. The results showed that the treatment of Growtone 30 ml/l of water (Z2) obtained a result of 44.9 had a real effect on the length of the plant (cm). The treatment time of soaking was 120 minutes (L3) and the result was 454.33 grams which had a real effect on the weight of the tubers (gr). The interaction of Growtone treatment of 40 ml/l water (Z3) and soaking time of 80 minutes (L2) obtained the results of 34 leaves had a real effect on the number of leaves (strands). The interaction of Growtone 20 ml/l water (Z1) and the soaking time of 120 minutes (L3) obtained the result of 59.67 tubers had a very noticeable effect on the number of tubers (fruits).

Keywords: Growtone; Length_of_immersion; Sweet_ potato

1. Introduction

Sweet potatoes (*Ipomoea batatas* L.) or cassava vines originating from the American continent are food additives or rice substitutes that have attracted public attention. This plant is a bulbous plant that has high nutritional value and is one of twenty types of food that function as a source of carbohydrates. Sweet potatoes also have good adaptability to various environmental conditions [1]. According to [2] sweet potatoes are not only used as a food ingredient, but also as industrial raw materials such as flour, liquid sugar, animal feed, and alcohol. In addition to wheat, rice, corn and potatoes, sweet potatoes are also one of the important food crops in the world.

Based on data from the Central Statistics Agency of South Sulawesi Province, sweet potato production in Sinjai Regency has increased for 3 consecutive years from 2021 – 2023. In 2021, the productivity of sweet potatoes in Sinjai Regency was 112.68%, then in 2022 it increased to 115.74%. Furthermore, in 2023, sweet potato production in Sinjai Regency will increase again by 116.69%. The consistent increase in sweet potato production each year can be attributed to several factors, including the use of superior varieties, good cultivation techniques, pest and disease management, and favorable environmental conditions. This is also explained in the research by [3] that sweet potatoes that have the best quality will continue to experience an increase in commodity demand.

The increase in sweet potato production in Indonesia can continue to be increased. One of the efforts that can be made is by fertilizing and providing the right growth regulator substances that can have an effect on increasing plant production.

2. Research Methodology

2.1 Place and Time

This research will be carried out in the Batulappa Environment, Samataring Village, East Sinjai District, Sinjai Regency. The study began in May to August 2025.

2.2 Tools and Materials

The tools used in this study are sweet potato cuttings, namely, hoes, scissors, containers, measuring cups, sieves, bars, digital scales, marker boards, cameras, and writing stationery.

The materials used in this study are sweet potato cuttings from sari varieties, beds, growtons, water, cow manure, pearl NPK fertilizer, burnt husks and labels.

2.3 Research Methods

This study was conducted using a separate plot design (RPT) as the first factor of growth regulator (Z) consisting of 3 levels of treatment, namely: Z1: Growtone (20ml/1 water) Z2: Growtone (30 ml/l water) Z3: Growtone (40 ml/l water). The second factor of immersion time (L) consists of 3 levels, namely: L1 : Soaking Length 40 minutes L2 : Soaking time 80 minutes L3 : Soaking time 120 minutes

Based on these two factors, the following treatment combinations were obtained: Z1L1, Z1L2, Z1L3, Z2L1, Z2L2, Z2L3, Z3L1, Z3Z2, Z3L3. This experiment consisted of 9 treatment combinations and each treatment was repeated 3 times so that there were 27 combinations of treatment units. Each treatment has 6 plants so that the number of plants used in this study is 162 plants. For each treatment, 3 plant samples were taken to be observed, so that the number of plant samples observed was 81 plants.

2.4 Implementation Method

2.4.1 Land treatment

The land is cleared of weeds. Then the soil is treated with a hoe. Land clearing aims to prevent competition for nutrients between main crops and weeds and to avoid the attack of brown leaf spot disease, because some weeds are disease hosts.

2.4.2 Preparation of planting media

The planting media used in this study is soil, burnt husk and cow manure, while the ratio of cow manure and burnt husk is 1:1. The planting medium is prepared and mixed until well mixed.

2.4.3 Plot creation

The land that has been cleaned of previous plant residues and also from weeds is then processed and loosened using a hoe. Then a plot with a size of 100 cm x 140 cm was made, then the planting distance was 50 cm x 50 cm with a bed height of 40 cm, the distance between plots was 30 cm, the distance between blocks was 50 cm and the drainage ditch was 40 cm deep, to avoid waterlogging.

2.4.4 Label installation

The installation of the label is carried out after the creation of the plot according to the research plan.

2.4.5 Preparation of cuttings material

Juicy sweet potato cuttings were first taken from the garden of one of the residents in Tellulimpoe Village, Tellulimpoe District. And then cut into pieces using sharp scissors, the size of the cuttings taken on the stem is 30 cm and has 3 segments, this cuttings material is taken from a parent that is ± 2 months old after planting whose planting conditions are healthy, the leaves do not turn yellow and the plant does not grow dwarf and has good production. Cuttings are taken at noon at 11.00, where the location of the cuttings collection site and the location of the cuttings planting land are about 1 hour away to the cuttings planting land then after soaking then the cuttings are planted in the afternoon at 17.00 WITA.

2.4.6 Treatment application

a. Treatment of various doses of growtone

The administration of treatment of various doses of ZPT was adjusted to each treatment which was differentiated into 3 different containers. Each container contains a solution of growtone growth regulator with various doses, namely: (Z1) 20 ml/l water, (Z2) 30 ml/l water, (Z3) 40 ml/l water.

b. Soaking length

The soaking length treatment is given by dissolving the growtone growth regulator in 1 liter of water into each container, each container has 54 cuttings, then the soaking of sweet potato cuttings is adjusted to the treatment, namely: 40 minutes, 80 minutes, and 120 minutes.

2.4.7 Planting

The plot that has been prepared for planting is made a planting hole 12.5 cm deep with a planting distance of 50 cm. The number of seedlings is one cuttings per planting hole. The part used is a stem cuttings and has 3 segments. Seedlings are planted 1/2 part of the cuttings that have been provided, then the soil is compacted close to the base of the cuttings. . The cuttings grown correspond to the treatment used in the study.

2.4.8 Maintenance

a. Watering

Watering is done every day, namely morning and evening. If it is raining, water is not carried out. In the period of tuber formation and development, i.e. 3 weeks before harvest, watering is reduced or stopped.

b. Weed weeding

Weeding is carried out to control weeds as well as loosen the soil. Pesticide plants need to be controlled so that they do not become rivals to the main crop in terms of nutrient absorption and to prevent pest and disease attacks. Weeding is done manually by pulling out weeds so that the plant's roots are not disturbed. Furthermore, weeds are uprooted so that there is no competition with the cuttings planted, weed removal is carried out every two weeks, then adjusted to the growth of weeds.

c. Fertilization

The application of NPK pearl fertilizer is carried out one week after planting, the dose given is 12 g/plant. The method of giving is in the previous way to make a fertilization hole 5 cm deep with a distance of 10 cm from the sweet potato stem.

2.4.9 Harvest

Harvesting is done by pulling the plant out to the roots. The plants are dried and ventilated and then cleaned from sticky dirt. Tubers are cut from the stems of the plant. The harvest criteria for sweet potato plants are that the leaves on sweet potato plants begin to turn yellow and dry and the plant age is between 12-14 MST..

3. Results and Discussion

3.1 Result

3.1.1 Plant Length (cm)

The results of plant length observation and variegated fingerprint analysis are presented in appendix tables 1a and 1b of the results of the variegated fingerprint analysis show that the growtone treatment has a real effect, while the long treatment of soaking has an unreal effect and the interaction has an unreal effect.

Table 1. Average plant length (cm) at growtone treatment and soaking time

Immersion Length (L)	Growtone (Z)			average	NP. BNT 0.05 %
	20 ml/l water (Z1)	30 ml/l Water (Z2)	40 ml/l Water (Z3)		
40 minutes (L1)	31,1	28,8	10,3	10,6	23981
80 minutes (L2)	28,2	56,6	81,5	55,5	
120 minutes (L3)	59,6	49,4	48,6	52,6	
average	30.3a	44.9a	43.4a		

Remarks: Numbers followed by the same letter (a) mean that there is no significant difference at the test level of BNT=0.05.

The results of the BNT 0.05 % test in table 1 show that the growtone treatment of 30 ml/l of water produces the highest average plant length of 44.9 cm and is not real from other treatments.

3.1.2 Number of Leaves (strands)

The results of the observation of the number of leaves and the analysis of the variegated fingerprints are presented in the table appendices 2a and 2b, the results of the variegated fingerprint analysis show that there is a real interaction between the treatment of Growtone and the length of soaking.

Table 2 Average number of leaves (strands) in Growtone treatment and Soaking time

Immersion Length (L)	Growtone(Z)			NP. BNT 0.05 %
	20 ml/l Water (Z1)	30 ml/l water (Z2)	40 ml/l water (Z3)	
40 minutes (L1)	11.00 b	22.0 AB	34.00 to	
80 Minutes(L2)	30.33 AB	9.00 b	22.00 AB	22.31
120 Minutes (L3)	10.00 b	29.7 ab	10.33 b	

Remarks: Numbers followed by the same letter (a,b) mean that there is no significant difference at the test level BNT=0.05.

The results of the BNT 0.05 % test in table 2 show that the interaction of the Growtone (Z) treatment and the soaking time (L) resulted in the average number of plant leaves which is 34.00 leaves and is significantly different from the treatment (Z3L1), but is not real with the treatment (Z1L1),(Z1L2),(Z1L3), (Z2L1),(Z2L2),(Z2L3), (Z3L2), (Z3L3).

3.1.3 Number of Tubers (tubers)

The results of the observation of the number of fruits and the analysis of the fingerprints are presented in tables 3a and 3b. The results of the fingerprint analysis showed that the growone treatment had a very real effect and the long soaking treatment had a very real effect, while the interaction had a very real effect on the average number of bulbs.

Table 3. Average number of planting tubers (tubers) in the Growtone treatment and soaking time

Immersion Length (L)	Growtone(Z)			average	NP. BNT 0.05 %
	20 ml/l water (Z1)	30 ml/l water (Z2)	40 ml/l water (Z3)		
40 minutes (L1)	599.67 A	581.00 A	544.00 b	574.9	

80 minutes (L2)	588.33 a	41.43 c	38.67 c	222.8	36.09
120 minutes (L3)	46.33 c	40.67 c	41.67 c	42.9	
average	411.44	221.03	208.11		

Remarks: Numbers followed by the same letter (a,b and c) mean that there is no significant difference at the test level BNT=0.05.

The results of the BNT 0.05 % test in table 3 showed that the interaction of the 20 ml/L water (Z1) Growtone treatment and the 40-minute soaking time (L1) treatment resulted in the highest average number of bulbs of 599.67 pieces and was significantly different from the treatment (Z3L1), but it was not noticeable from the other treatments.

3.1.4 Tuber weight (gr)

The results of the observation of tuber weight and variegated fingerprint analysis are presented in tables 4a and 4b. The results of the fingerprint analysis showed that the treatment of Growtone (Z) had no real effect, while the long treatment of soaking had a real effect and the interaction and interaction had an unreal effect on the average weight of the bulbs.

Table 4. Average tuber weight at Growtone treatment and soaking length

Immersion Length (L)	Growtone (Z)			average	NP. BNT 0.05 %
	20 ml/l water (Z1)	30 ml/l water (Z2)	40 ml/l water (Z3)		
40 minutes (L1)	414.97	443.07	420.53	426.19b	27,18
80 minutes (L2)	486.53	440.63	410.17	445.78a	
120 minutes (L3)	575.60	383.20	404.20	454.33a	
average	492.37	422.30	411.63		

Remarks: Numbers followed by the same letter (a,b) mean that there is no significant difference at the test level BNT=0.05.

The results of the BNT 0.05 % test in table 4 show that the 120-minute soaking time treatment (L3) resulted in the highest average tuber weight of 454.33 grams and is not significantly different from the 80-minute soaking time treatment (L2), but it is significantly different from the 40-minute soaking time treatment (L1).

3.2 Discussion

The results of the BNT 0.05 % test showed that the average length of the best plant was found in the Growtone treatment of 30 ml/l of water, which was 44.9 cm, the highest number of leaves showed that the interaction of Growtone treatment of 40 ml/l of water (Z3) and the soaking time of 40 minutes (L1) was 34.00 leaves, the highest number of tubers was found in the interaction of Growtone treatment of 20 ml/L of water (Z1) and the treatment of 40 minutes of soaking time (L1) which was 599.67 bulbs and the best weight of the bulbs was found in the soaking length treatment 120 minutes (L3) is 454.33 grams.

3.2.1 Plant Length (cm)

The results of the BNT 0.05 % test showed that the average length of the best plant was found in the Growtone treatment of 30 ml/l of water (Z2), which is 44.9 cm. This happens because Auxin with the growtone brand is a plant chemical found at the tips of the stem, roots and flower development that functions as a regulator of cell expansion at the back of the meristem tip. This growtone capacity is to help the path to accelerated development, both root and stem development, accelerate germination, help the cell division cycle. Development chemicals are chemicals that can regulate various physiological cycles, such as cell development, division and separation, as well as protein combinations [4]

Growth regulators can stimulate the growth of cuttings (roots, stems and shoots), while planting media is a place to grow cuttings so that there is an interaction between growth regulators and media as providers of nutrients needed by plants so that cuttings growth becomes fertile, healthy and strong. Growtone is one of the ingredients that contains naphthalene acetic acid or naphthane acetic acid which plays a role in stimulating the formation of roots and shoots. A flour-shaped growth regulator that can be dissolved in gray water, the way of application is very decisive for the response of Growtone in plants. One of the efforts made in the application is to determine the right application. This soaking treatment is expected to be able to increase the absorption of the Growtone solution by the cutting material [5]

3.2.2 Number of Leaves (strands)

The results of the BNT 0.05 % test showed that the interaction of the Growtone treatment of 40 ml/l of water (Z3) and the soaking time of 40 minutes (L1) resulted in the average number of plant leaves which was 34.00 leaves. This happens because the capacity of the growth regulator Growtone and the length of this soaking is to contain auxin hormones to help the path to accelerated development, both root and stem development, accelerate germination, help the cell division cycle.

The administration of auxin hormones from the outside can affect the occurrence of cell division and tissue formation so that it can accelerate leaf growth. According to [6], the administration of auxin hormones with appropriate concentrations can increase the formation of roots, shoots, the longest bud length and leaves. The leaves that form with the highest number indicate that the plant is experiencing better growth and development.

According to the statement of [7] that in vegetative growth, including the growth of the number of leaves, is influenced by the amount of photosynthesis. A greater number of leaves allows for faster photosynthesis, resulting in more photosyntheses. The more

leaves can be interpreted, the more light that can be captured so that the photosynthesis process will increase [8].

3.2.3 Number of Tubers

The BNT 0.05 % result showed that the interaction of the 20 mllL water (Z1) Growtone treatment and the 40-minute soaking time (L1) treatment resulted in the highest average number of bulbs of 599.67 bulbs. This happens because Growtone contains growth hormones such as auxin, gibberellins, and cytokines that have an important role in the formation of roots and shoots. Auxin plays a role in stimulating cell division in the root meristem tissue, thereby accelerating the formation of new roots [9]. Well-developed roots will increase the plant's ability to absorb water and nutrients from the soil, so that vegetative and generative growth can take place more optimally.

The role of cytokinins in Growtone is to stimulate cell division at the shoot, thereby spurring the formation of new shoots and leaves [7]. More and healthier leaves will increase the rate of photosynthesis. The resulting photosynthate is then allocated to storage organs such as bulbs. This is in line with the opinion of [10] that crop yields are highly dependent on photosynthesis capacity and assimilate distribution to the crop organs.

According to [11] the more leaves are formed, the greater the plant's ability to capture light and increase photosynthesis, so the number and size of bulbs increases. The results of this study are in line with the findings of [12] which states that the administration of auxin ZPT to sweet potato cuttings can increase the number of tubers by up to 25% compared to controls. In addition, research by [13] shows that the length of soaking sweet potato cuttings in a hormonal solution has a significant effect on the success of root formation and the increase in tuber yield.

3.2.4 Tuber weight (gr)

The observation results of BNT 0.05% showed that the treatment of 120 minutes of soaking time (L3) resulted in the highest average tuber weight of 454.33 grams. This happens due to the optimal absorption of the auxin hormone contained in Growtone during the soaking process. Auxins play an important role in stimulating adventitious root formation and increasing cell division and enlargement [7]. With a better root system, plants are able to absorb water and nutrients more efficiently, so that photosynthesis runs optimally. The results of photosynthesis are then translocated to the bulbs as food reserves, which ultimately increases the weight of the bulbs [10].

The increase in tuber weight is thought to be caused by the optimal absorption of the auxin hormone contained in Growtone during the soaking process. Auxins play an important role in stimulating adventitious root formation and increasing cell division and enlargement [7]. With a better root system, plants are able to absorb water and nutrients more efficiently, so that photosynthesis runs optimally. The results of photosynthesis are then translocated to the bulbs as food reserves, which ultimately increases the weight of the bulbs [10].

According to [14] stated that soaking cuttings in a hormone solution with the appropriate concentration and time will increase the growth ability of cuttings and produce better vegetative and generative growth. According to research by Wuryaningsih et al. (2014) which states that the treatment of auxin ZPT by the soaking method is able to

increase root growth and tuber weight in sweet potato plants. Thus, the combination of the right concentration of hormones and optimal soaking time is a key factor in increasing plant productivity.

4. Cover

4.1 Conclusion

Based on the results of the research that has been carried out, it can be concluded as follows.

4.1.1 The treatment of the Growtone growth regulator dose of 30 ml/l water (Z1) has a noticeable effect on the length of the plant.

4.1.2 The treatment length of 120 minutes of soaking (L3) exerts a noticeable effect on the weight of the bulbs.

4.1.3 The interaction between the Growtone treatment of 40 ml/l of water (Z3) and the treatment of 40 min soaking time (L1) had a significant effect on the number of leaves. The interaction between the Growtone treatment of 20 ml/l of water (Z1) and the treatment of a soaking length of 40 minutes (L1) had a very noticeable effect on the number of bulbs.

4.2 Suggestion

Based on the results of the research that has been carried out, for further research it is recommended to use a higher dose and soaking duration.

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