Effects of Concentration and Soaking Duration of Shallot Extract on Yield and Growth of Sweet Potato (*Ipomoea batatas* L.)

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ABSTRACT

Sweet potato is an important agricultural commodity in Indonesia and it is the source of carbohydrates after rice. However, the quality and quantity of sweet potatoes produced decreased and did not fulfill the demand. Provision of growth regulators is one of the efforts to increase the growth of sweet potatoes, shallot extract is one of the natural growth regulators that can be used. This study aims to determine the interaction between the concentration of shallot extract and the duration of immersion on sweet potato cuttings. This research was conducted in Garut from February to June 2021. This study used an experimental method with a Randomized Block Design 3x3 factorial pattern with 3 replications. The first factor is the concentration of shallot extract (K), namely k1 (30% shallot extract concentration), k2 (60% shallot extract concentration), and k3 (90% shallot extract concentration). The second factor is the soaking duration (P), namely, p1 (soaking duration 30 minutes), p2 (soaking duration 60 minutes), and p3 (soaking duration 90 minutes). The experimental results showed that there was an interaction between the concentration of shallot extract and the soaking duration of sweet potato (Ipomoea batatas L.) cuttings on leaf area, tuber weight, and tuber length, the best concentrations being k1 (30% concentration) and p3 (soaking duration 90 minutes).

Keywords: *Shallot Extract, Soaking duration, Cutting, Sweet Potato*

1. INTRODUCTION

Sweet potato is an important commodity in Indonesia that has potential in terms of nutrition and health [1]. Indonesia is the fifth sweet potato producer in the world with a total production of 4 million tons [2]. The demand for sweet potato export markets in Indonesia for fresh raw materials is around 15 tons/day. The unmet consumption needs of sweet potatoes amounted to 5,763.2 tons per year [3]. However, in this potential, there are several problems such as the lack of guarantee of continuity from producers both in terms of quality and quantity. This increase in demand has not been matched by increasing the quality of tubers produced. An effort to overcome low productivity is the use of superior seeds for sweet potato cultivation obtained from a long process of genetic engineering, sorting, and grading to produce quality seeds that are resistant to pests and diseases. Superior seeds can be produced from vegetative propagation, often done with the original material in the form of cuttings or the form of clones [4].

Vegetative propagation can be done by stem cuttings. The cutting method was chosen because the cuttings can be done easily, and cheaply and do not require special techniques like other techniques. Sweet potato cuttings take approximately one month or more for actual growth or return to normal activities, alternatives that can be done include the need for growth regulators to accelerate growth roots. In vegetative propagation by cuttings, the application of growth regulators is intended to stimulate and trigger the formation of root cuttings, so that the cuttings take root better and more [5].

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The application of auxin as a growth regulator can increase the percentage of cuttings that form roots, accelerate root initiation, and uniformly root cuttings [6]. Stated that one of the natural auxins can be obtained from shallot extract, the use of natural growth regulators is more profitable than synthetic growth regulators, because natural growth regulators are cheaper than synthetic growth regulators, besides that, they are also easy to use. However, there are drawbacks to in using shallot extract, it needs a lot, and the auxin content cannot be calculated directly.

2. MATERIALS AND METHODS

The research was carried out in the experimental garden of the Faculty of Agriculture, University of Garut, located at an altitude of 759 m above sea level from March to July 2021. The materials and tools used were cuttings of sweet potato (*Ipomoea batatas* L.), shallot extract, NPK fertilizer, hoe, measuring cups, basins, rulers, meters, calipers, analytical balances, ovens, and cameras for documentation.

The research method used was an experimental method with a factorial randomized block design 3x3 with 3 replications, the first factor was the concentration of shallot extract (K) and soaking duration (P) with levels of k1 (90% march shallot extract concentration), k2 (shallot extract concentration) red shallot 60%), and k3 (shallot extract concentration 30%). The second factor was the soaking duration (P) with levels of p1 (90 minutes immersion), p2 (60 soaking duration), and p3 (30 minutes immersion).

Cutting material in the form of cuttings of sweet potato plants aged more than 3 months, sweet potato plant stems along 10-15 shoots after sweet potato garden cuttings. The cuttings were soaked before planting using shallot extract 90%, 60%, and 30% and soaked for 90 minutes, 60 minutes, and 30 minutes, respectively. Maintenance is done by water in the morning, then pest control and weeding are done by mechanical means, and embroidery is done if there are plants that die after a week.

Parameters observed were vine length (cm), number of branches, leaf area (m), dry weight (g), tuber length (cm), tuber diameter (mm), and tuber weight per plot (g). Observational data were analyzed based on the ANOVA factorial randomized block design tested F at the 5% level, if there was an influence on the results of the treatment, then it was continued with the Duncan's Multiple Range Test (DMRT) at the 5% level.

3. RESULTS AND DISCUSSION

There is an interaction between shallot extract treatment factors and soaking duration on observations of leaf area (cm), tuber weight (g), and tuber length (cm), there is no interaction on observations of vine length (cm), number of leaves and diameter of tubers (mm).

3.1. Vine Length

ResultsThe analysis of the observation of vine length at the age of 30 DAP, 40 DAP, 50 DA,P and 60 DAP showed that the treatment with shallot extract concentration (K) and soaking duration (P) had no interaction or independent effect. All levels were not significantly different on vine length (Table 1).

Table 1. Average Results of Observation Data Analysis of Vine Length (cm)

Treatment	Observation time			
	30 HST	40 HST	50 HST	60 HST
Shallot Concentration(K)				
k1 (30% concentration)	17.60 a	27.81 a	38,80 a	52.21 a
k2 (60% concentration)	19.10 b	29.50 a	39.04 a	50.46 a
k3 (90% concentration)	17 a	27.76 a	38.07 a	44.50 a
Soaking duration (P)				
p1 (30 minutes)	17.26 a	27.40 a	37.33 a	48.57 a
p2 (60 minutes)	18.44 a	28,48 a	39.85 a	47.43 a
p3 (90 minutes)	18 a	29.19 a	38.72 a	51.16 a

Note: The mean number marked with the same letter shows that it is not significantly different according to DMRT at the 5% level.

The application of the concentration of shallot extract and the soaking duration of sweet potato cuttings did not significantly affect the length of the sweet potato plant vines. This could be because, in low concentrations, auxin could work optimally, whereas in high concentrations it would inhibit plant growth Several other

things can affect the growth of vine length, such as internal and external factors. Internal factors are plant genetics with a series of genes that control plant growth, these gene sets affect the shape and nature of plants such as resistance to disease and growth speed. The external factors such as temperature and light intensity

Plants need a lot of nutrients at the beginning of their growth for cell division, cell extension and the first stage of cell differentiation [8]. Therefore, the vegetative development phase is very important for the formation of leaves and stems until the generative period takes place. Sweet potato plants will grow optimally when using superior varieties and if they grow optimally, the length of the vines will grow well. Varieties greatly determine the genetic characteristics of a plant [9], but sweet potatoes also have good environmental adaptability, some varieties have poor adaptation so that planting appropriate varieties will support vegetative growth and crop yields.

3.2. Number of Leaf

The results of statistical analysis on the number of leaves aged 30 DAP and 40 DAP did not show any interaction, but there was an independent effect on the concentration of shallot extract (K) which is presented in Table 2.

The results of the analysis showed that there was no interaction on the number of leaves but there was an independent effect. The number of leaves at k1 increased, this was presumably because the concentration of auxin at k1 was optimal in influencing tissue cell division and tissue formation. So, it can increase leaf growth. Provision of the provisionulators with optimum concentrations can increase protein synthesis. The protein formed will be used as a building block for plant organs such as roots, stems, and leaves [10].

Because the length of the vines did not differ significantly and there was no interaction, the number of branches also had an effect. This is supported by the statement that the longer the vines formed, the more the number of leaf branches that will be produced [11].

Table 2. Average Results of Observation Data Analysis of the Number of Leaf

TreatLeaves	Observation time	
	30 HST	40 HST
Shallot Concentration(K)		
k1 (30% concentration)	2.40 a	12.86 ab
k2 (60% concentration)	2.16 a	12.29 a
k3 (90% concentration)	2.51 a	13.40 b
Soaking duration (P)		
p1 (30 minutes)	2.42 a	12.83 a
p2 (60 minutes)	2.42 a	12.78 a
p3 (90 minutes)	2.22 a	12.94 a

Note: The mean number marked with the same letter is not significantly different according to DMRT at the 5% level

3.3. Dry Weight (g)

The results of data analysis regarding the treatment of giving various concentrations of shallot extract and soaking duration on the dry weight of plants aged 10 WAP showed that there was no interaction or independent effect between the application of shallot extract concentration and soaking duration. The results are presented in the Tabl

The effect of giving various concentrations and soaking duration of shallot extract on cuttings of sweet potato plants had no significant effect and there was no independent effect on the dry weight of sweet potato plants. This is because the number of leaf branches that can affect photosynthesis with a smaller number of leaves will affect the results of photosynthesis which will affect the dry weight of the plant, that apart genetic factors in a plant that determine crop yields are biomass production and the allocation of photosynthate to the harvested part [12]. Plants require an effective Growth Regulatory Substance in a certain amount with a concentration that is too high or too low, causing ineffective plant growth.

Table 3. Results of Average Dry Weight Observation Data Analysis (g)

Treatment	Dry Weight(g)
Shallot Concentration(K)	
k1 (30% concentration)	22,60 a
k2 (60% concentration)	20,22 a
k3 (90% concentration)	23,69 a
Soaking duration (P)	
p1 (30 minutes)	25,44 a
p2 (60 minutes)	19,97 a
p3 (90 minutes)	21,11 a

Information: The mean number marked with the same letter shows that it is not significantly different according to DMRT at the 5% level.

3.4. Leaf Area

The results of data analysis regarding the treatment of various concentrations of shallot extract and soaking duration on leaf area of plants aged 10 WAP showed an interaction, which is presented in Table 4.

The concentration of shallot extract can provide fertility for plants so that it can accelerate the growth of organs in plants. Growth regulator auxin stimulates root growth and vitamin B1 which plays an important role in the process of converting carbohydrates into energy in plant metabolism. In the root initiation process, plants require energy, glucose, nitrogen, and other compounds in sufficient quantities to accelerate plant growth [13].

One of the roles of auxin is to stimulate cell elongation in shoots. Good root growth will affect the state of the organs [14], when there is an increase in the number of root lengths it will increase the absorption of water and nutrients by plants so that it can run well on photosynthetic activity.

Table 4. Results of Analysis of Average Leaf Area Data (cm^2)

Shallot Extract Concentration (K)	Soaking duration (P)		
	p1 (30 minutes)	p2 (30 minutes)	p3 (30 minutes)
k1 (30% concentration)	7684.76 a A	10101.43 a B	13486.67 b C
k2 (60% concentration)	10454.76 b A	13082.38 b B	11655.24 b AB
k3 (90% concentration)	8355.71 ab A	12148,10 ab B	6169,05 a A

Note: The mean value followed by the same lowercase letters read vertically and the same uppercase letters read horizontally did not differ significantly according to the DMRT of 5%.

3.5. Tuber Weight

The results of data analysis regarding the treatment of giving various concentrations of shallot extract and soaking duration on the weight of tubers planted, tuber plants aged 17 DAP showed an interaction between the administration of shallot extract concentration and soaking duration (theyble 5).

IAA is identical to auxin which can trigger root initiation. The mechanism of action of auxin will affect the elongation of cells in plants. The way auxin works is by influencing the loosening/flexing of the cell wall [15]. The growth cells then elongate due to water entering by osmosis. After this elongation occurs, the cell continues to grow and resynthesize minerals from the cytoplasmic cell wall that can form the process of photosynthesis.

Shallot extract contains Growth Regulatory Substances which have roles such as Indole Acetic Acid (IAA) [13]. IAA is identical to auxin which can trigger root initiation which can affect the rate of photosynthesis which will have an impact on assimilate produced. Meanwhile, the resulting assimilate will be stored as a sink and some will be used as growth energy and food reserves. Perfect photosynthesis can also produce good photosynthate for good tuber formation.

Table 5. Average Results of Observation Data Analysis of Tuber Weight (g)

Shallot Extract Concentration (K)	Soaking duration (P)		
	p1 (30 minutes)	pare (30 minutes)	p3 (30 minutes)
k1 (30% concentration)	762.67 a AB	531.70 a A	885.67 b B
k2 (60% concentration)	523.37 a A	705.87 a A	510.73 a A
k3 (90% concentration)	668.27 a A	685.53 a A	423.67 a A

Note: The mean value followed by the same lowercase letters read vertically and the same uppercase letters read horizthatly did not differ significantly according to the DMRT of 5%.

3.6. Tuber Length

The results of data analysis regarding the treatment of various concentrations of shallot extract aassimilationation of immersion on the length of assimilation plants aged 17 WAP showed an interaction between the administration of the concentration of shallot extract and the duration of photosynthesis is can be caused because the shallot extract contains auxin which results in an increase in the endogenous auxin content. Endogenous auxin-like compounds play a role in triggering the process of elongation and development of root cells which results in an increase in root length and root number [16].

Table 6. Average Results of Observation Data Analysis of Tuber Length (cm)

Shallot Extract Concentration (K)	Soaking duration (P)		
	p1 (30 minutes)	p2 (30 minutes)	p3 (30 minutes)
k1 (30% concentration)	17,17 b A	18.33 a B	20.36 b C
k2 (60% concentration)	15.78 a A	19.72 b C	18.11 a B
k3 (90% concentration)	16.17 ab A	20.47 b C	19.15 a B

Note: The mean value followed by the same lowercase letters read vertically and the same uppercase letters read horizontally did not differ significantly according to the DMRT of 5%.

3.7. Tuber Diameter (mm)

The results of data analysis regarding the treatment of various concentrations of shallot increases on the diameter of tubers of plants aged 17 WAP showed no interaction between the administration of shallot extract concentration and the duration increases the diameter of the tuber, there is no interaction between the two but there is an independent influence, it caused by several internal and external factors. The carbohydrates produced will be diverted to the shape of the tuber on display so that it inhibits the diameter of the tuber [8]. Environmental factors can also affect the diameter of the tubers [17].

Table 7. Average Results of Observation Data Analysis of Tuber Diameter (mm)

Treatment	Tuber Diameter
Shallot Concentration(K)	
k1 (30% concentration)	40,05 a
k2 (60% concentration)	41,03 ab
k3 (90% concentration)	42,69 b
Soaking duration (P)	
p1 (30 minutes)	36,14 a
p2 (60 minutes)	43,73 a
p3 (90 minutes)	43,90 a

Note: The average value followed by the same lowercase letters read vertically and the same uppercase letters read horizontally was not significantly different according to the DMRT of 5%.

4. CONCLUSION

1. There was an interaction between the concentration of shallot extract and soaking duration on the observations of leaf ar tuber weight and tuber length at age.
2. There is the best treatment at the k1p3 level (30% shallot extract concentration and 90 minutes soaking duration).

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