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The Effectiveness Of Substances In Growth Regulators On Growth Of Root Cutting Of Mother-In Law's Tongue Leaves (*Sansevieria trifasciata*)

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ABSTRACT

Air pollution is often a major problem in industrial cities because it causes various respiratory diseases. Mother-in law's tongue (*Sansevieria trifasciata*) is an ornamental plant that has many benefits. One of them is to help reducing the concentration of carbon monoxide gas in the air. In addition, this plant is easily propagated by cutting. The purpose of this study was to determine the effectiveness of natural and synthetic growth regulators (ZPT) with various doses on root growth of three materials from plant cuttings. This study used a completely randomized design (CRD) with three factors and three replications. The first factor was the type of ZPT, among others, shallot filtrate and Rootone-F. The second factor is the forth ZPT concentration. They are 25%, 50%, 75% and 100%. The third factor is the origin of the plant cuttings. If the collected data has a significant effect it would be further tested by using DMRT (*Duncan Multiple Range Test*) at a level of 5%. The results showed that the difference in ZPT had a significant effect on root length, but did not affect significantly the number of roots, fresh weight and dry weight. The treatment interaction had a very significant effect on the root length of *Sansivera*. The interaction with the highest value was found in the interaction of treatment with PGR type Rootone-F with a concentration of 100% with the cuttings originating from the middle of the plant, while the lowest was in the interaction between PGR type and onion filtrate with a concentration of 25% with the cuttings originating from the tip of the plant.
Keywords*: the origin of cutting tool material, onion, filtrate, mother-in-law's tongue*

1. INTRODUCTION

Mother-in-law's tongue plant (*Sansevieria trifasciata*) is an ornamental plant that has many benefits. One of them is to help reduce the concentration of carbon monoxide gas (Adita et al. 2011). Air pollution due to high concentrations of this gas can have an impact on health, ecosystems and climate. Health effects of air pollution occur in the respiratory tract and organs of vision.

Air pollution is often a major problem in industrial cities, including Pasuruan. Based on a survey from the Central Statistics Agency, the number of companies in Pasuruan until the end of 2018 reached 811 companies. This number became the fourth largest number in East Java Province. In addition, the increase in the number of motorized vehicles is also the cause of the high concentration of carbon monoxide gas in Pasuruan city. According to the Ministry of Environment, motor vehicles and industrial activities are the main sources of carbon monoxide and NO2 pollution in the air.

Propagation of mother-in-law's tongue can be conducted generatively through seeds and vegetatively by cutting tillers or shoots, leaf cuttings, shoot cuttings, rhizome cuttings and tissue culture. Plant propagation using leaf cuttings is more profitable because it can save cutting material, use leaf pieces and save time. Because in a short time it can produce cuttings in large quantities (Sulistiana, 2013).

One way to stimulate the growth of cuttings is by giving growth regulators. Growth regulators are able to influence plant physiological processes such as encouraging, inhibiting, and regulating growth movements (Davies, 2010). There are five types of hormones in plants. Ther are auxins, gibberellins, cytokinins, ethylene, and abscisic acid. Auxin and gibberellins are the main hormones in stimulating the growth of cuttings because according to Rusmin (2011) the collaboration between auxin and gibberellins stimulates the development of vascular tissue and encourages cell division. It also encourages the growth of new roots. One of the plants considered to be used as a natural growth regulator is shallot (*Allium cepa* L.). Because shallots contain growth hormones in the form of auxin and gibberellins. Therefore, they can stimulate seed growth (Marfirani, 2014). In addition, the use of the synthetic hormone Rootone-F can be an alternative growth regulator containing auxin.

Therefore, this study aimed to determine the effectiveness of natural and synthetic growth stimulants (PGR) with various doses on root growth of three materials from cuttings of the mother-in-law's tongue plant (*Sansevieria rifasciata*) and to determine the appropriate dose of PGR to stimulate root growth.

2. RESEARCH METHOD

The research was carried out at the Greenhouse Laboratory of the Faculty of Agriculture, Merdeka University of Pasuruan, Pasuruan City by using polybags. The research was started from September to October 2021.

The *Sansivera* plant used in this study came from a smallholder plantation in Puspo Village, Pasuruan Regency with an area of ± 2 Ha. The method used for taking Sansivera plants was done by pulling the roots out and then the plants were cleaned using distilled water and then cut into three parts with each part measuring 15 cm.

This study used a completely randomized design (CRD) with three factors. The first factor is differences in growth regulators, the second factor is the concentration of growth regulators and the third factor is the origin of cutting tool material of mother-in-law's tongue plant. The regulated substances used are shallot filtrate (J1) and Rootone-F (J2), the concentration of shallot filtrate and Rootone-F used include; K1 = 25%, K2 = 50%, K3 = 75% and K4 = 100%.

Production of 100% shallot filtrate was obtained by weighing 3 kg of shallots then mashed by mashing and then taking the filtrate. Concentrations of 75%, 50%, and 25% were obtained from the dilution of the shallot filtrate with aquadest. While the concentration of Rootone-F was obtained by:

1) Concentration 100% = 10 g Rootone-F + 90 ml Aquadest
2) Concentration 75% = 7.5 g Rootone-F + 92.5 ml Aquadest
3) Concentration 50% = 5 g Rootone-F + 95 ml Aquadest
4) Concentration 25% = 2.5 g Rootone-F + 97.5 ml Aquadest

The application of Rootone-F treatment and shallot filtrate was carried out once. It was done before the *Sansivera* cuttings were planted by soaking for 5 minutes. After that, the plants with a depth of ± 7 cm were then watered every two days to maintain the humidity of the growing media. The

planting medium used was a mixture of top soil, sand, cocopeat and goat manure with a ratio of 1:1:1:1.

The third factor is the origin of the cutting tool material used, including the base (T1), middle (T2) and tip (T3). Each factor was repeated three times to obtain 72 treatment combinations. Data analysis was carried out by analysis of variance. If it had a significant effect, further analysis would be carried out with the multiple range test or DMRT (*Duncan Multiple Range Test*) at the 5% level. Observations were made at the end of the research period when the plants were 45 DAP after being given treatment. Parameters observed were root length, number of roots, fresh weight of roots and dry weight of roots. Observation of dry weight was carried out when the plant had measured root length, number of roots and fresh weight then baked at 60oC for 24 hours and then weighed using a cutting scale.

3. RESULTS AND DISCUSSION

Length and Number of Roots

The root is the part of the plant that grows downward in the planting medium. Roots function to provide water and nutrients that are essential for plant growth and development. Root growth includes elongation, enlargement, number and growth of branches which are influenced by biotic and abiotic conditions. According to Benjamin (2000), plant root systems can be influenced by soil conditions or plant growing media.

The results of analysis of variance showed that the concentration of growth regulators substance (ZPT) affected the growth of root length and root number of *Sansivera* plants (Table 1). Based on Table 1, treatment K1 obtained a root length of 2.71 cm, while treatment K4 was 3.81 cm. This indicated that the K4 treatment (100% concentration) gave a positive response to the growth of root length. Observation of the number of roots showed that the K4 treatment had the highest mean compared to other treatments at 16.17 and had a different effect from the K1 and K2 treatments on the root length of *Sansivera*. The administration of growth regulators such as cytokinins had many roles in plant growth and development, such as cell division, formation and activity of shoot meristems, nutrient mobilization, seed germination, root growth and stress response (Haberer and Kieber, 2002).

Table 1. Effect of treatment on length and number of roots

Treatment	Observation Parameter	
	Rooth Length (cm)	Number of Roots
Type ZPT		
J1	2.19 b	10.33 b
J2	4.16 a	12.14 b
Concentration ZPT		
K1	2.71 b	7.83 b
K2	3.06 b	9.00 b
K3	3.13 ab	11.94 ab
K4	3.81 a	16.17 a
Cutting Material		
T1	2.74 b	12.71 a
T2	3.73 a	13.46 a
T3	3.06 b	7.54 b

Information: The numbers followed by the same letter in the same column are not significantly different at 5% DMRT test.

The results of the analysis of variance in Table 1 show that the treatment from the cutting material has an effect on the growth of root length and the number of roots of the *Sansivera* plant. In Table 2, it can be seen that the T2 treatment (from the middle cutting material) produced the highest root length compared to other treatments of 3.76 cm and the lowest was T1 treatment (from the base cutting material) at 2.74 cm. This is directly proportional to the number of roots found in T2 treatment at 13.46. This condition is thought to have originated from the middle cutting material containing more meristem tissue than other cutting materials. This condition is in accordance with the research of Sulistiana (2013) who reported that the combination treatment (Rootone-F) with the origin of the cutting material in the middle gave the best results on the parameters of root length and number of roots from leaf cuttings of *Sansevieria* plant.

In addition, according to Rismunandar (1988) cuttings with high carbohydrate content have the ability to take root more easily than cuttings with low carbohydrate content. Leopold and Kriedemann (1975) stated that at the beginning of root formation there is a process of differentiation of meristem tissue which will become root primordia. This statement is also in accordance with the research on giving IBA ZPT to mother-in-law's tongue cuttings (*Sansevieria trifasciata* var. Lorentii) conducted by Ramadiana (2008) which stated that a cutting from the middle produced the best response for the variables of root emergence time, number of roots, root length, number of shoots, and shoot wet weight. In addition, research conducted by Hardjanti (2005) reported that a cutting from the middle in *Adenium* resulted in better root growth than cuttings from the top or shoots.

Fresh Weight and Dry Weight of Roots

The fresh weight of the roots indicates the water and nutrient content of the root tissue. According to Salisbury and Ross (1995) fresh weight is the weight of the plant after being harvested before the plant withers and loses water. Based on the results of analysis of variance showed that the treatment concentration level had an effect on the fresh weight and dry weight of the roots (Table 3).

The highest mean fresh root weight in K4 treatment (100% concentration) was 0.64 g, while K1, K2 and K3 treatments were 0.12 g, 0.20 g and 0.45 g, respectively. The 100% concentration treatment was able to produce the highest fresh root weight because the content of several growth regulators such as auxin, gibberellins and cytokinins could be optimally absorbed in Sansivera plant cuttings. Aida (2015) stated that roots develop with the growth of lateral roots intensively in nutrient-rich areas. Roots are able to respond to the distribution of nutrients and water and then translocated to the plant body to support cellular metabolic processes.

Table 2. Effect of treatment on fresh weight and dry weight of roots

Treatment	Observation Parameter	
	Root Fresh Weight (g)	Root Dry Weight (g)
Type ZPT		
J1	0.28a	0.15 a
J2	0.19 a	0.12 a
Consentration ZPT		
K1	0.10 b	0.06 b
K2	0.15 b	0.08 b
K3	0.25b	0.14 b
K4	0.46 a	0.26 a
Cutting tools materials		
T1	0.24ab	0.15 a
T2	0.36 a	0.20 a
T3	0.12 b	0.06 b

Information: The numbers followed by the same letter in the same column are not significantly different in the 5% DMRT test.

Shallots naturally contain various growth regulators such as auxin, gibberellins, cytokinins, ethylene and inhibitors. Auxin can stimulate root formation, especially in plant propagation by using cuttings (Taiz and Zeiger, 2002). Meanwhile, Choudhary and Kumar (2016) stated that Auxin contains an important growth-regulating compound called *Indole Acetic Acid* (IAA). These compounds play a role in seed development, shoot tips and roots, regulate flowering, phototropism, geotropism and prevent fruit fall.

The results of the analysis of variance in Table 2 showed that the origin of the cutting material had an effect on the fresh weight of the roots and the dry weight of the roots. Treatment T2 (from the middle cuttings) was able to respond to fresh weight of roots and dry weight of plants better than other treatments at 0.60 g and 0.37 g. The average fresh weight and dry weight of the lowest roots were found in the T1 treatment (from the base cutting material) at 0.12 g and 0.07 g. Fresh weight of a plant was strongly influenced by water status. The water status of a tissue or the entire plant body was influenced by soil moisture conditions and the ability to penetrate roots to obtain nutrients. Moore (1979) stated that based on its functions and benefits, plant PGRs were non-nutritive organic compounds which in low concentrations encourage, inhibit or qualitatively change or influence physiological processes which include plant growth, differentiation and development processes.

Interaction of Treatment on Root Length Parameters

Growth regulators (ZPT) are substances used to accelerate and slow down growth. The most widely used growth regulators in plant cultivation are *Indole-3-butyric acid* (IBA) and *Naphthalene acetic acid* (NAA) (Leopold & Kriedemann, 1975). Both ZPT have the same function and role as natural ZPT namely auxin. The formulation of the second mixture of ZPT already exists in a synthetic form called Rootone-F. The application of ZPT to stimulate rooting and shoot formation on cuttings varies depending on the type of cuttings and their concentration (Sulistiana 2013).

Based on Table 3, the results of the interaction among treatments have a very significant effect on root length. The

J2K4T2 treatment interaction was the highest interaction of 6.67 cm, while the lowest was at 0.17 cm in the J1K1T3 treatment interaction. The J2K4T2 interaction was a combination of treatment with ZPT Rootone-F at 100% concentration with the cuttings from the center of the plant. Rootone-F treatment had a higher mean than onion treatment. This result is in line with research conducted by (Sulistiana 2013) which concluded that synthetic PGR treatment (Rootone-F) gave the best results on root length parameters. However, the administration of shallot filtrate and Rootone-F could increase the length and number of roots. This was conducted Mafirani (2014) on jasmine flower cuttings.

Table 2. Interaction between treatments and root length

Treatment Interaction	Observation Parameter	
	Rooth Length (cm)	
J1K1T1	2.87	cdefg
J1K1T2	2.37	efgh
J1K1T3	0.17	h
J1K2T1	2.00	fgh
J1K2T2	2.17	efgh
J1K2T3	2.23	efgh
J1K3T1	2.50	defgh
J1K3T2	2.73	cdefgh
J1K3T3	1.57	gh
J1K4T1	1.73	fgh
J1K4T2	3.43	bcdefg
J1K4T3	2.00	fgh
J2K1T1	2.07	fgh
J2K1T2	3.70	bcdef
J2K1T3	4.50	bcd
J2K2T1	3.60	bcdefg
J2K2T2	4,13	bcde
J2K2T3	4.20	bcde
J2K3T1	2.23	efgh
J2K3T2	4.60	bc
J2K3T3	5.17	ab
J2K4T1	4.90	ab
J2K4T2	6.67	a
J2K4T3	4.13	bcde

Information: The numbers followed by the same letter in the same column are not significantly different at 5% DMRT test.

While the concentration of 100% is the best concentration because it contains large amounts of ZPT. Rootone-F contains Indole Butyric *Acid (IBA) and Napthalene Acetamide* (NAA) which have been adapted for cuttings propagation needs. The results of Ghasemi's research (2012) showed that the administration of IBA and NAA (auxin hormone group) increased the number of roots and root length in explants of African violets (*Saintpaulia lonantha*) flower plants. Therefore, the plants could respond well to the growth of root length. Auxin would be synthesized in the meristematic area located in the shoot

and then transported to the root tip of the plant (Blakesle et al. 2005). Choudhary and Kumar (2016) stated that auxins in shallots such as IAA were the result of an amino acid reshuffle which was often used for cultivating horticultural crops. This was in accordance with the opinion of Setiawan and Wahyudi (2014), that the amino acid tryptophan was a precursor of auxin, so that auxin increased.

The middle cutting material was the part of the plant that responded well to root length growth because it was suspected that this part contains a lot of amino acids for elongation of meristematic cells. Krisdianto et al. (2020) stated several amino acids were strung together by protein synthesis involving various gene expression, transcription, and translation. A number of proteins became the basic ingredients of protoplasm and most of them form enzymes. Enzymes entered the meristem area which caused growth and formation of new leaves and roots.

4. CONCLUSION

Treatment of synthetic growth regulators (Rootone-F) and natural (shallot filtrate) could significantly affect root length, but had no effect on root number, fresh weight and dry weight of *Sansivera* plants. The best concentration that affected these parameters was at 100% concentration treatment.

The treatment of differences in the origin of the cutting material also affected significantly the growth of root length, number of roots, fresh weight and dry weight of *Sansivera* plants. The origin of the cutting material responded optimally to the treatment of the origin of the cutting material in the middle.

The treatment interaction had a very significant effect on the root length of *Sansivera*. The interaction with the highest value was found in the interaction of the ZPT Rootone-F type treatment with a concentration of 100% with the cuttings coming from the middle of the plant, while the lowest was in the interaction of the PGR type of onion filtrate with a concentration at 25% with the cuttings coming from the tip of the plant.

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