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The Effect of Gibberellin in Salin Soil on Growth of Vetiver (*Vetiveria zizanioides* L.)

Efek Pemberian Gibberellin Di Tanah Salin Terhadap Pertumbuhan Akar Wangi (Vetiveria zizanioides L.)

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ABSTRACT

Salinity is one of the problems in agricultural land in the world, including Indonesia. Vetiver is quite tolerant of planting in saline soils at a certain level of salinity, but vetiver growth is inhibited at high salinity levels. The purpose of this study was to evaluate the effect of gibberellin in saline soils on the growth and production of vetiver (Vetiveria Zizanioides L.). This research was conducted in the greenhouse of the Faculty of Agriculture, Universitas Sumatra Utara, Medan. This study used a non-factorial completely randomized design, It was salinity stress (S) which consisted of 3 factors: Gibberellin concentrations of 0 (without treatment), 50 ppm and 100 ppm. The results of this study indicate that giving Gibberellins in salinity stress conditions has a significant effect on the observed variables of plant height, specific leaf area and cuticle thickness.

Keywords : Vetiveria zizanioides, salt stress, Gibberellin

ABSTRAK

Salinitas merupakan salah satu permasalahan pada lahan pertanian didunia termasuk Indonesia. Akar wangi cukup toleran ditanam di tanah salin pada tingkat salinitas tertentu, namun pertumbuhan akar wangi terhambat pada tingkat salinitas yang tinggi. Tujuan dilakukan penelitian ini yaitu untuk mengevaluasi efek pemberian Gibberellin di tanah salin terhadap pertumbuhan dan produksi akar wangi (Vetiveria Zizanioides L.). Penelitian ini dilakukan di rumah kaca Fakultas Pertanian Universitas Sumatera Utara, Medan. Penelitian ini menggunakan Rancangan Acak Lengkap Non Faktorial yaitu cekaman salinitas (S) yang terdiri dari 3 faktor: konsentrasi Gibberellin sebesar 0 (tanpa perlakuan), 50 ppm dan 100 ppm. Hasil dari penelitian ini menunjukkan bahwa pemberian Gibberellin pada kondisi cekaman salinitas memberikan pengaruh nyata pada peubah amatan tinggi tanaman, luas daun spesifik dan tebal kutikula.

Kata kunci : *akar wangi, cekaman salinitas, Gibberellin*

INTRODUCTION

Fragrant root (*Vetiveria zizanioides*) is one of the essential oil-producing plants commonly called vetiver oil. This oil is widely used in the manufacture of perfumes, cosmetics, soap scents, medicines, as well as insect repellent and insecticide. Vetiver oil has a soft and subtle aroma due to the ester of vetinenic acid and the presence of vetivenol compounds (Ghotbizadeh and Sepaskhah. 2015).

The decline in export volume and the lower price of vetiver oil in Indonesia were caused by the low production and quality of vetiver oil. The yield of vetiver oil produced is low, only about 1.2% of the potential 2-3% oil and the vetiverol content is below 50% (Amonymous, 2006). The plant cultivation center and vetiver oil production in Indonesia are located in Kabupaten Garut, Jawa Barat. The centers are scattered in the Kecamatan of Samarang, Bayongbong, Cilawu, Pasirwangi and Leles. Some farmers in Kabupaten Garut harvest vetiver roots before reaching the age of harvest because they are driven by the need for the cost of living which results in low yield and quality of the oil produced. Sometimes the harvested plants are too old, they are not even harvested, instead they are burned because the selling price is too low (PT. Djasula Wangi, 2006)

One of the most important abiotic factors that limit plant germination and early seedling growth is water stress leading to drought and salinity (Almansouri et al., 2001), which are widespread problems worldwide (Soltani et al. 2006). The application of Gibberellin in salinity stress conditions showed a significant effect on growth variables such as germination percentage. Gibberellin can increase germination, leaf expansion, stem elongation and flowering in plants (Novita. 2017). The low vetiver production is expected to increase by utilizing salinity stress and the use of gibberellin to increase the production and content of secondary metabolites in plants.

Based on this, it is deemed necessary to conduct research on the Growth Response and Production of Vetiver (*Vetiveria Zizanioides* L.) to Gibberellin in Salinity Stress Conditions.

MATERIALS AND METHOD

The materials used in this study were 6 month old vetiver seeds, sodium chloride, , Giberellic acid and others. The tools used in this study were refractometer, plastic color labels, scissors, polybags, microscope carl zeiss, leaf area meters, and others. The design used in this study was a non-factorial randomized block design (RBD), namely the salinity stress (S) which consisted of 3 factors: Gibberellin concentrations of 0 (no treatment), 50 ppm and 100 ppm. Each treatment was repeated 3 times, then obtained 9 treatment combinations.

Research Implementation

The land was cleared of weeds and trash until it was clean. The polybags ware filled with saline soil. The seedling used in this study came from 6 months old vetiver seedling. The seedling of vetiver were taken with uniform growth, not attacked by pests and diseases. If the plants have been planted, a marker is placed on each crop plot.

Application the salinity treatment, the NaCl level in the soil was measured using a digital refractometer. Adjusted to a predetermined salinity level so as to get the appropriate salinity level at 4 dSm^{-1}. The sorted seedling with uniform growth are planted in soil that has been given salinity treatment at 4 dSm^{-1}.

Gibberellin application was carried out at 2 weeks after planting (WAP) according to the respective concentration levels by spraying all over the leaves Seedlings are doused with sufficient distilled water (if necessary) to prevent salt accumulation and increase the concentration of polybags at 4 dSm^{-1}.

Parameters Observed

Plant height (cm). Plant height was measured at the age of 2, 4, 6 weeks after planting, measurements were taken from the root neck to the point of growth using a meter, where to determine the limit of the soil surface used a standard benchmark.

Specific Leaf Areas (cm^2 g^{-1}). The specific leaf area is the leaf area per unit dry weight of the leaf. SLA measurements are carried out in the phase before harvest. SLA value is calculated as the ratio between leaf area (L) and dry matter weight (leaf DM); So, SLA = L: BK leaves, the unit is cm2 g-1 (Suwarto. 2013). Specific leaf area analysis was carried out at the Plant Ecology Laboratory, Faculty of Agriculture, Universitas Sumatra Utara, Medan.

Cuticles Thickness (μm). Cuticle thickness observations were carried out using the Carl Zeiss Primo Star microscop compound, at the age 8 WAP at the Terpadu Laboratory, Faculty of Medicine, Universitas Sumatera Utara, Medan. The cuticle thickness was observed by sterilizing the leaf surface using sodium hypochloride and then rinsing the leaves with distilled water. The leaves are cut pinnate, then the cut leaves are placed on the glass preparation. By using the Carl Zeiss Primo Star microscop compound, for the thickness of the cuticle was observed at a magnification of 400 times, photographed and measured the thickness using a measurement program.

RESULTS AND DISCUSSION

Gibberellin treatment had a significant effect on plant height variables. The results of the different test results for the average plant height in the salinity stress treatment can be seen in Table 1.

Table 1. Average Plant Height in Salinity Stress Treatment.

Treatment	Plant Height (cm)		
	2 WAP	4 WAP	6 WAP
Gibberellin			
G0	32,67c	57,33bc	87,00bc
G1	55,33ab	113,00b	133,33b
G2	67,67a	152,67a	175,67a

Note: Numbers in the same column followed by the same letter are not significantly different at the 5% level based on the LSD test

Gibberellin gave a significant effect on the average plant height. Treatment G2 (67.67 cm) was significantly different from G0 (32.67 cm) but not significantly different from G1 (55.33 cm) for 2 WAP observations. Treatment G2 (152.67 cm) was significantly different from G0 (57.33 cm) but was not significantly different from G1 (113 cm) for 4 WAP observations. Treatment G2 (175.67 cm) was significantly different from G0 (87 cm) but not significantly different from G1 (133.33 cm) for the 6 WAP observations. Gibberellin 50 ppm and 100 ppm increased plant height compared without giving Gibberellin (G0) for each type of observation (ages 2, 4 and 6 WAP).

Giving the hormone gibberellin (GA3) will increase the auxin content so as to spur the height growth of the plant. Setiati and Derati (2016) states that the use of gibberellin is able to support the formation of proteolytic enzymes which later liberate tryptophan as the initial form of auxin. This shows that the presence of gibberellin will be able to increase the auxin content to spur plant height.

In this study, giving gibberellin played a role in cell extension, cambium activity, increasing stem growth, enlargement and cell multiplication in plants. The same thing was also stated by Wicaksono, et al. (2016) which stated that gibberellin stimulates cells in the G1 phase to enter the S phase, and because gibberellin also shortens the S phase. Vegetetive growth can not only be measured by plant height, stem diameter can also be seen from the growth in the number of leaves. The exogenous application of gibberellin has an optimal effect if there is a regulation on the frequency of spraying the gibberellin hormone according to plant needs (Sundahri et al. 2016).

Plant hormones are organic compounds which are synthesized in one part of the plant and transferred to another, and at very low concentrations they can cause a physiological difference. So it is necessary to have the right concentration and frequency settings to produce high growth and production in plants (Taiz and Zenger, 2006).

Gibberellin treatment had a very significant effect on specific leaf area variables at 8 WAP. The results of the specific leaf area mean difference test in the Gibberellin treatment can be seen in Table 2.

Gibberellin gave a significant effect on specific leaf area at 8 WAP. Gibberellin treatment of 100 ppm (G2 = 7.95 cm g-1) and 50 ppm (G1 = 7.26 cm g-1) increased the dry weight of leaves compared without giving Gibberellin (G0 = 6.42 cm g-1) for observation 8 MST. The use of gibberellin will be able to stimulate the synthesis of enzymes that can soften the cell walls, especially proteolytic enzymes which will release the amino tryptophan as an auxin forming so that the auxin levels in these plants increase. So gibberellin is able to activate auxins in plants. Auxin and gibberellin work together in terms of not cell elongation so that the plant growth rate increases and the growth of plant organs exceeds its normal limits (Setiati and Deratih, 2016).

Table 2. The Average Specific Leaf Area on Gibberellin Treatment.

Treatment	Specific Leaf Area ($cm\ g^{-1}$)
Gibberellin	
G0	6,42c
G1	7,26b
G2	7,95a

Note: Numbers in the same column followed by the same letter are not significantly different at the 5% level based on the LSD test

The same thing was stated by Wahyudi and Setiawan (2014) who stated that gibberellin had a significant effect on the number of branches and leaves, according to the work of the auxin and cytokinin hormones. Gibberellin induces enzymes that soften cell walls and increase auxin levels. The formation of IAA in the shoot apical meristem will stimulate the formation of leaves.

Gibberellin treatment had significantly affected the cuticle thickness variable. The results of the mean difference test for cuticle thickness in the Gibberellin treatment can be seen in Table 3.

Table 3. Average Cuticle Thickness on Gibberellin Treatment.

Treatment	Cuticle Thickness (µm)
Gibberellin	
G0	11,43 c
G1	15,74 a
G2	15,36 ab

Note: Numbers in the same column followed by the same letter are not significantly different at the 5% level based on the LSD test

Gibberellin gave a significant effect on cuticle thickness at age 8 WAP. Gibberellin treatment of 50 ppm (G1 = 15.74 µm) and 100 ppm (G2 = 15.36 µm) increased leaf dry weight compared to without giving Gibberellin (G0 = 11.43 µm) for 8 WAP observations. Gibberellin 100 ppm treatment was not significantly different from giving Gibberellin 50 ppm but was significantly different from giving Gibberellin.

This is because plants that are in a high salinity stress condition adapt to the existing cuticles on the leaves, where the leaf area is narrowed but the cuticles thicken so that the plant can survive in conditions of high salt stress. This is in line with the results of research by Hajibagheri et al. (1983), who stated that the observation at high salinity significantly increased cuticle thickness. Leaf cuticle thickness directly correlates with drought tolerance and increases with increasing water stress and can be used as a marker for identification of resistant varieties (Rasuli and Gol-Mohammadi. 2009). The same thing was stated by Novita (2020), who stated that in conditions of salinity stress increases the thickness of the cuticle.

CONCLUSION

Gibberellin 100 ppm with salinity stress conditions at 4 dSm^{-1} showed the best results and had a significant effect on the observation variables of plant height, specific leaf area and cuticle thickness.

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