Improvement Vegetative Growth Of Rice Under Nacl Stress By Ascorbic Acid Application

Efrida Lubis, Wan Arfiani Barus, Risnawati, Dafni Mawar Tarigan

Abstract: This study aims to obtain the optimum concentration of Ascorbic Acid on increasing growth and production of rice under the stress of NaCl salt. This research was carried out in the house of the Deli Tobacco Research Center, Sampali Village, Percut Sei Tuan, Deli Serdang Regency with a height of 15 m above sea level. This study used a factorial randomized block design with two treatment factors and 3 replications. The first factor was ascorbic acid concentration (A) consisting of 0, 250, 500 and 750 ppm. The second factor is the NaCl salt concentration consisting of: S_0 (0 mM), S_1 (40 mM), S_2 (80 mM) and S_3 (120 mM). The varieties used are Banyuasin varieties. The results showed that administration of ascorbic acid affected plant height, the total number of tillers and leaf area. Furthermore, salt stress decreases the vegetative growth of Rice plants.

Keywords: Ascorbic Acid, NaCl, Rice, Growth, Production

1 Introduction

Rice is a strategic commodity that has social, political and economic value because it is the staple food of the Indonesian population. Therefore efforts to increase the production of food commodities have a high priority. One of the technological innovations produced by the IAARD is superior varieties. Until now more than 200 superior rice varieties produced by various research institutions in Indonesia have been released, 85% of which are innovative products from the IAARD [1]. Efforts to increase rice production are carried out through extensification and intensification. The decreasing fertile area due to land use change has resulted in extensification being directed to marginal lands, for example, saline soil. Soil salinity is a state of high and low salt content in the soil. Kitchen salt (NaCl) is the dominant salt, but the salts of Na_2SO_4, $MgSO_4$, $NaHCO_3$, Na_2CO_3, $CaSO_4$, $CaCO_3$ also determine soil salinity, the higher the concentration of these salts in the soil solution, the higher the electrical conductivity (DHL) soil solution [2][3]. The effect of salinity on rice plants is in the form of stunted growth [4] and [5], reduced sapling, whitish leaf tips and often seen chlorosis in leaves, and although rice plants are tolerant plants moderate, at EC values of 6-10 dS m-1 the decrease in grain yield reaches 50%. Furthermore, [6] concluded that rice is relatively more tolerant of salinity during germination, but plants can be affected when transplanting, young seedlings, and flowering. Further effects on rice plants are: 1) Decreased germination speed; 2) Decreased plant height and number of tillers; 3) Bad root growth; 4) Seed sterility increases; 5) Lack of 1000 grain weight and total protein content in seeds due to excessive absorption of Na; and 6) Reduced biological N_2 belay and slow soil mineralization.

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Salinity results in ion stress and oxidative stress in plants [7]. Salinity causes a significant decrease in SOD . Oxidative stress results from an imbalance between antioxidants (reactive oxygen species) and antioxidants. Oxygen reactive compounds (ROS) are free radicals and compounds that tend to be reactive and easily react with other compounds. In the body of ROS, plants tend to react with tissues, causing chain reactions that cause tissue damage. The application of ascorbic acid (vitamin C) is an effort to increase tolerance to oxidative stress. Ascorbic acid is a small molecule, soluble in water, an antioxidant that acts as the main substrate in the cyclic enzymatic detoxification of hydrogen peroxide. Ascorbic acid is the first substance in detoxifying and neutralizing superoxide radicals and plays an important role in photoprotection, photosynthetic regulation, and plant growth processes such as cell division and cell wall expansion [8] and [9]. As reported by [10] that the application of exogenous ascorbic acid at a dose of 400 ppm in salinity stress conditions can increase the percentage of soybean germination, root and canopy dry weight. [10] also stated that the application of ascorbic acid in sugar cane can help increase vegetative growth, antioxidant enzyme activity (POD and SOD), and proline content in salinity stress. Application of ascorbic acid in green beans that experience stress salinity can also increase the activity of antioxidant enzymes and prevent the activity of oxygen reactive compounds. In addition, ascorbic acid also increases the chlorophyll content in green. Some of the physiological and biochemical effects of salinity stress are high Na + transport in the canopy, resulting in a high Na / K ratio. Physiological conditions experienced by plants gripped by salinity are Na accumulation in old leaves, high Cl-uptake, low K + absorption, the decrease in wet weight and shoot and root dry weight, low P and Zn absorption, esterase isozyme pattern changes, increase in non-organic matter toxic compatible in solutes and increase in levels of polyamine. Ascorbate has good antioxidant properties in detecting reactive oxygen species (ROS) and reactive nitrogen species and recycles oxidized α-tocopherols. In short, the in vitro system has shown ascorbate to detect superoxide, hydroxyl, hydrophilic peroxyl, thienyl, and nitroxide radicals.

2 MATERIALS AND METHODS

This research was carried out at the Deli tobacco research centre at the Deli tobacco village in Sampali Village, Percut Sei Tuan Subdistrict, Deli Regency, with an altitude of ± 25 m above sea level. This research was conducted in June 2017 until mid-October 2017. This study uses factorial Randomized

Group Design (RBD). The first factor is: Ascorbic Acid Concentration, consisting of four (4) levels, namely A0 = Without ascorbic acid (Control), A1 = 250 ppm, A2 = 500 ppm and A3 = 750 ppm. The second factor is the NaCl concentration, consisting of 4 (four levels), namely S0 = No NaCl (Control), S1 = 40 mM = 2.34 g / 500 ml water, S2 = 80 mM = 4.68 g / 500 ml water and S3 = 120 mM = 9.36 g / 500 ml of water.

3 RESULT AND DISCUSSION

Plant height

The application treatment of Ascorbic Acid was significantly different from plant height at the age of 4, 6, and 8 MSPT. Application of Ascorbic Acid significantly affects the growth of plant height for all levels of salinity. Increased growth in plant height was obtained after application of Ascorbic Acid. This increase occurs because the effect of salinity stress is immediately resolved by the availability of ascorbic acid as an antioxidant during stress. This is in line with that reported by [11], that the application of ascorbic acid through leaves can prevent and overcome stress due to salinity stress. Most stress is the most responsive to the application of ascorbic acid. The results of this study are in line with those reported by [6] who concluded that rice is relatively more tolerant of salinity during germination, but plants can be affected when transplanting, young seedlings, and flowering. Further effects on rice plants are: 1) Decreased germination speed; 2) Decreased plant height and number of tillers; 3) Bad root growth; 4) Seed sterility increases; 5) Lack of 1000 grain weight and total protein content in seeds due to excessive absorption of Na; and 6) Reduced biological N2 belay and slow soil mineralization. The development of rice plant height in saline soil with the application of Ascorbic Acid can be seen in Table 1 below.

Table 1. *Plant Height of Rice Under NaCl Stress By Ascorbic Acid Application Through Leaves at Age 8 WAT (Weeks After Transplanting)*

Salinity (mM)	Ascorbic Acid (ppm)				Average
	A_0	A_1	A_2	A_3	
........(cm)........					
S_0	84,43	88,24	89,67	93,40	88,94
S_1	83,31	91,37	92,67	94,93	90,57
S_2	88,29	91,37	92,67	94,93	91,81
S_3	92,33	99,28	99,86	102,94	98,60
Average	87,09b	92,57a	93,72a	96,55a	

Note: *The numbers followed by letters that are not the same in the same column are significantly different according to DMRT at the level of 5%.*

Total Tiller Number

An increase in the number of tillers is obtained after the application of Ascorbic Acid. This increase occurs because the effect of salinity stress is immediately resolved by the availability of ascorbic acid as an antioxidant during stress. This is in line with that reported by [11], that the application of ascorbic acid through leaves can prevent and overcome stress due to salinity stress. The results of this study are in line with those reported by [6] who concluded that rice is relatively more tolerant of salinity during germination, but plants can be affected when transplanting, young seedlings, and flowering. Further effects on rice plants are: 1) Decreased germination speed; 2) Decreased plant height and number of tillers; 3) Bad root growth; 4) Seed sterility increases; 5) Lack of 1000 grain weight and total protein content in seeds due to excessive absorption of Na; and 6) Reduced biological N2 belay and slow soil mineralization. The development of the number of rice tillers in saline soil with the application of Ascorbic Acid can be seen in Table 2. Table 2 showed that the number of tillers for all levels of salinity. An increase in the number of tillers is obtained after the application of Ascorbic Acid. This increase occurs because the effect of salinity stress is immediately resolved by the availability of ascorbic acid as an antioxidant during stress. This is in line with that reported by [11], that the application of ascorbic acid through leaves can prevent and overcome stress due to salinity stress (NaCl stress).

Table 2. *Total of Tiller Number of Rice Under NaCl Stress By Ascorbic Acid Application Through Leaves at Age 8 WAT (Weeks After Transplanting)*

Salinity (mM)	Ascorbic Acid (ppm)				Average
	A_0	A_1	A_2	A_3	
........(Tiller)........					
S_0	17,50	21,00	23,57	24,55	21,65
S_1	22,12	24,37	24,37	37,95	27,20
S_2	20,23	22,77	25,70	38,86	26,89
S_3	22,60	27,38	35,97	41,48	31,86
Average	20,61c	23,88c	27,40b	35,71a	-

Note: *The numbers followed by letters that are not the same in the same column are significantly different according to DMRT at the level of 5%.*

Leaf Area

Leaf area of Rice under NaCl stress by ascorbic acid application can be seen in Table 3.

Table 3. *Leaf Area of Rice Under NaCl Stress By Ascorbic Acid Application Through Leaves at Age 8 WAT (Weeks After Transplanting)*

Salinity (mM)	Ascorbic Acid (ppm)				Average
	A_0	A_1	A_2	A_3	
........(cm^2)........					
S_0	26,96	26,90	36,52	34,64	31,25
S_1	26,12	33,43	34,57	39,18	33,32
S_2	32,41	36,35	36,35	45,70	37,70
S_3	28,39	31,45	31,45	43,95	33,81
Average	28,47c	32,03b	34,72b	40,87a	-

Note: *The numbers followed by letters that are not the same in the same column are significantly different according to DMRT at the level of 5%.*

Table 3 showed that the application of ascorbic acid in rice plants with several levels of NaCl salt concentration showed that an increase in ascorbic acid concentration produced wider leaves compared to rice plants that were not given ascorbic acid. [12] that ascorbic acid affects various physiological processes including regulation of growth, differentiation and plant metabolism in salt stress. In addition, ascorbic acid protects the metabolic process against the presence of free radicals H_2O_2 and other toxic oxide derivatives that affect enzyme activity, minimizes damage caused by oxidative processes through synergistic functions with other antioxidants, and also stabilizes membranes. The application of Ascorbic Acid increases the content of IAA which stimulates cell division and enlargement which in turn will increase the growth of plant growth. Therefore it can be said that due to the division of stimulation and cell enlargement resulting in an increase in vegetative growth.

4 CONCLUSIONS

a. Application of ascorbic acid had a significant effect on vegetative growth of rice plants under NaCl stress.
b. The salinity levels treatment have a significant effect on vegetative growth of rice plants.
c. Ascorbic acid concentration in 750 ppm have the best effect on plant height, the number of tiller and leaf area of the rice plant.

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