The Growth And Biochemical Characteristics Of Some Upland Rice Varieties In Conditions Of Salinity Stress

Wan Arfiani Barus, Dafni Mawar Tarigan, Rizki Fahillah Lubis

Abstract : This study aims to determine the response of growth and production of upland rice in saline soils with salicylic acid technology. This research uses factorial randomized block design with two factors studied, namely: Variety, consisting of V_1 (Inpago 9), V_2 (Inpago 10) and V_3 (Situ Bagendit) and Salicylic Acid Concentration with 4 levels, namely: A0 (In 0 mM), A_1 (1 mM), A_2 (2 mM) and A_3 (3 mM). The results showed that salinity stress affected the growth and biochemical characteristics of the three upland rice varieties tested. Inpago 10 variety has better adaptability to salinity stress. The application of salicylic acid with a concentration of 2 mM tends to increase the growth and biochemical character of upland rice.

Keywords: Growth, Production, Salicylic Acid, Salinity, Upland Rice

1. INTRODUCTION

Rice (Oryza sativa L.) is an important commodity and ranks first in Indonesia. This food contains 8 g of protein and 73 g of carbohydrates in every 100 g. As the main food, sustainable production is needed so that the quality and quantity is maintained. Besides technology improvement, improved varieties, improved cultivation techniques, and post-harvest needs to be done on an ongoing basis so that rice production continues. Cocoa crop productivity is a classic problem that is still often faced[1]. One of the causes of the low productivity of upland rice planted by farmers compared to its potential, is the amount of fertilizer used is too little, so it does not meet the needs of plants. Fertilization should be done in accordance with the status of soil nutrients and plant needs for these nutrients. Rational and balanced fertilization can be achieved, if the fertilizer dosage takes into account the status of soil nutrients, and the plant's need for nutrients to achieve optimum production. This approach can be implemented well and profitably if fertilizer recommendations are based on the results of soil test research. Inhibition of the process of photosynthesis caused by oxidative stress[2]. Salinity problems occur when soils contain dissolved salts in amounts high enough to interfere with plant growth. The accumulation of salt in the root area causes a decrease in the ability of plants to absorb water. In addition, the absorption of excess salt making up elements will cause poisoning to plants. Salinity combined with poor water conditions can permanently eliminate soil fertility[3]. Efforts to increase production under stress conditions carried out by means of crop improvement were largely unsuccessful, mainly because of multigenic (characteristics controlled by many genes) from the origin of the adaptive response (a suitable influence). Therefore, a focused approach combining physiological, biochemical and metabolic aspects of salt tolerance molecules is very important for developing tolerant plant varieties. Studying suitable ameliorant is one of the tasks of plant biologists. In the past few decades exogenous protectors such as osmoprotectants (proline, glycinebetaine, trehalose, etc.), plant hormones (gibberellic acid, jasmonic acid, brassinosterioids, salicylic acid, etc.), antioxidants (ascorbic acid, glutathione, tocopherol, etc.), plant hormones (gibberellic acid, jasmonic acid, brassinosterioids, salicylic acid, etc.), antioxidants (ascorbic acid, glutathione, tocopherol, etc.), signaling molecules (signaling acid nitric oxide, hydrogen peroxide, etc.), polyamine (spermidine, spermine, putresin), trace elements (selenium, silicon, etc.) have been found to be effective in reducing salt due to damage to plants[4]. This protector shows the ability to increase plant growth, the results are as good as stress tolerance under salinity. Salicylic acid has the effect of protecting the development of antistress programs and accelerating the process of growth normalization after removing stress factors[5]. Several studies have shown that the application of salicylic acid (0.5 mM) can promote the formation of ROS in photosynthetic tissue and increase oxidative damage during salt stress and osmotic pressure.[6] However, the role of salicylic acid has a disadvantage because ascorbic acid is more involved in neutralizing oxidative stress. The above description becomes the background of the importance of this research.

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MATERIALS AND METHODS

The study was conducted in the greenhouse Growth Center Kopertis Region I of North Sumatra in February 2019 to June 2019. This study used a factorial Randomized Block Design (RBD) with two factors examined, namely: V_1 = Inpago 9, V_2 = Inpago 10 dan V_3 = Situ Bagendit. Then, Salicylic Acid concentration have four levels, e.i: A_0 = 0 mM, A_1 = 1 mM, A_2 = 2 mM dan A_3 = 3 mM.

RESULTS AND DISCUSSION

This study examines two things, namely the growth character and biochemical character of three upland rice varieties in saline soil growing media. Plants grown in saline soil media will experience salinity stress. Based on the results of the study it can be seen that salinity stress resulted in a decrease in the growth and biochemical character of three upland rice

varieties. The relationship between plant height of three upland rice varieties in saline soil and salicylic acid application can be seen in Figure 1.

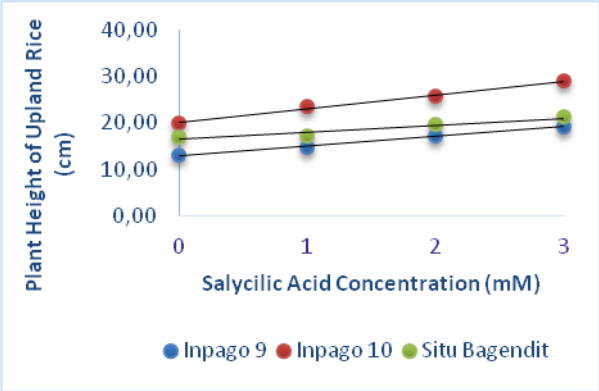

Figure 1. *Relationship between Application of Salicylic Acid to Plant Height of Three Upland Rice Varieties in Salinity Stress*

The results of the analysis of variance showed that upland rice varieties and antioxidant applications through leaves significantly affected plant height, number of tillers and leaf area of three upland rice varieties in saline soil. In Figure 1, it can be seen that salinity stress affects the growth of three upland varieties. The Inpago 10 variety shows the best and most adaptive response to salinity stress.

b. Leaf Area

Based on statistical analysis, it was found that varieties and types of antioxidants significantly affected leaf area of upland rice in saline soil.

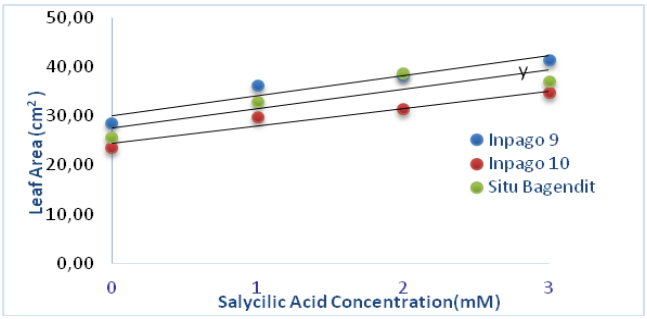

Figure 2*. Relationship Between Leaves Area of Three Varieties*

Upland Rice In Land Copy with Applicatio Salicylic Acid

c. Total Number of Tiller (Tiller)

The number of tillers of upland rice varieties in saline soils tends to be higher if salicylic acid is applied. the relationship between the total number of tillers of three upland rice varieties in saline soil and the application of salicylic acid can be seen in Figure 3.

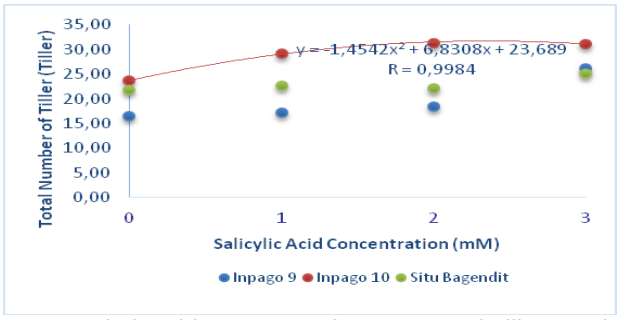

Figure 3*. Relationship Between the Amount of Tiller Total of* Three Varieties of Upland Rice in Saline Soil with Salicylic Acid Application

Figure 3 shows that the same tendency that the total number of tillers tended to increase with the administration of salicylic acid to three varieties of upland rice in saline soil. Inpago 10 is the most adaptive variety in saline soils. Furthermore, the number of Productive tillers tends to increase with increasing concentrations of salicylic acid.

d. Productive Tiller (tiller)

The relationship between the number of productive tillers of three upland rice varieties and the administration of salicylic acid in salinity stress can be seen in Figure 4.

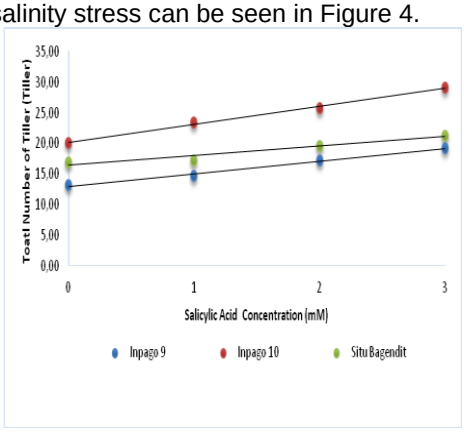

Figure 4. *Relationship Between Number of Productive Tilles of*

Three Varieties Upland Rice in Saline Soil with Salicylic Acid Application

Figure 4 shows the relationship between the number of productive tillers of three upland rice varieties in saline soil with the administration of salicylic acid. As the concentration of salicylic acid increases, the number of productive tillers increases and the Inpago 10 variety is most adaptive to salinity stress by having the highest number of productive tillers. The relationship between the amount of chlorophyll three varieties of upland rice in saline soil with the application of salicylic acid can be seen in Figure 5.

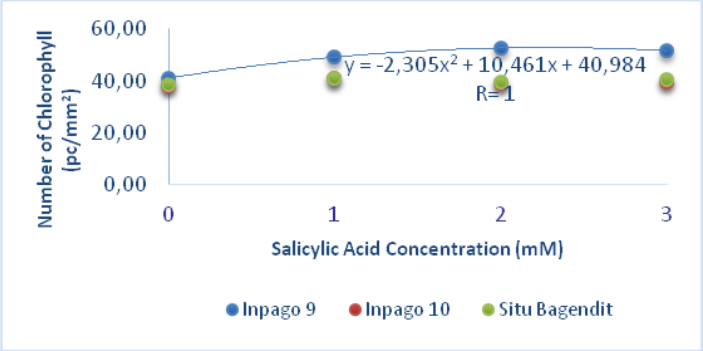

***Figure 5**. Relationship Between The Chlorophyll Number of Three Varieties of Upland Rice in Saline Soil with Salicylic Acid Application*

Figure 5 showed that the highest amount of chlorophyll is found in the Inpago 9 variety and in general shows that the application of salicylic acid to three upland rice varieties tends to increase the amount of chlorophyll.

e. Content of Prolin

Based on the results of the statistical analysis it was found that the variety significantly affected the proline content. Inpago 9 variety has the highest proline content compared to other varieties. Average different test results for the parameters of proline content can be seen in Table 4.

***Table 4**. Proline Content of Three Gogo Rice Varieties by Providing Salicylic Acid in Salinity Stress*

Variety (V)	*	
Inpago 9	173,31	a
Inpago 10	87,31	c
Situ Bagendit	131,37	b

Furthermore, the histogram of Proline content of three upland rice varieties in deep saline soil can be seen in Figure 6.

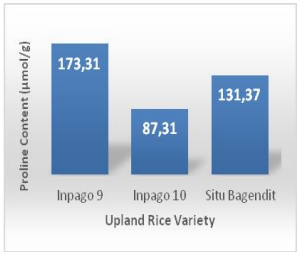

***Figure 6**. Proline Content of Three Upland Rice Varieties in Salin Soil with Application of Salicylic Acid*

Discussion

Based on the results of the study, it was found that three varieties of upland rice which experienced salinity stress, found a tendency to decrease growth. The application of salicylic acid to three upland rice varieties significantly affected the growth of upland rice in saline soils based on observations of vegetative components namely plant height, total number of tillers and leaf area. The results also showed that the Inpago 10 variety and salicylic acid concentration at 6 dm (A_3) would increase the tolerance of three upland rice varieties to plant height, number of tillers and leaf area compared to control (A_0) and (S_0). Soil salinity in the planting media causes depressed growth and upland rice production, this is indicated by differences in morphological characteristics of rice plants, both Inpago 9, Inpago 10 or Situ Bagendit varieties. Salinity tolerant paddy fields show better ability to grow and produce in saline land. This can be seen based on plant height, total number of tillers and leaf area. The results showed that plant height and total number of tillers, whereas tolerant varieties would have a narrower leaf area than non-tolerant varieties. The combination of PK fertilizer application through leaves and ascorbic acid in lowland rice planted in saline soil can significantly improve the character of vegetative components, total number of tillers and leaf area. This shows that Ascorbic Acid can help plants overcome physiological disorders caused by the presence of free radicals that can interfere with enzyme activity and plant metabolic processes and slow down the aging process. As reported by [7][8][9] that ascorbic acid influences various physiological processes including regulation of growth, differentiation and plant metabolism in salt stress. In addition, ascorbic acid protects metabolic processes against the presence of H_2O_2 free radicals 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. In line with [10] and [11] found that antioxidants can stimulate cell division and enlargement which in turn increases plant growth. Therefore it can be said that due to the stimulation of cell division and enlargement results in an increase in growth and development of the morphological character. [12]reported that salicylic acid (SA) is a phenolic phytohormone which acts as a signaling and tolerance molecule for abiotic pressure. It plays an important role in the response of plants to adverse environmental conditions similar to salinity. Soil salinity is a major problem of food production because it limits crop yields and limits land use that was not previously processed. It plays an important role in plant growth, ion absorption and transportation, preventing oxidative damage to plants by detoxifying super oxide radicals, which are produced as a result of salinity. This review provides evidence that supports the role of SA during plant growth and development is reviewed by comparing various experiments conducted by applying SA under salt pressure conditions. Meanwhile, the application of salicylic acid through leaves which synergizes with Ascorbic Acid will result in an increase for the vegetative component observed, namely plant height, total number of tillers and leaf area. As it is known that, salinity stress (salt) can cause nutrient deficiency (ion cytotoxicity and specific ion stress), osmotic stress and oxidative stress)[13]. The ionic stress results in inhibited the absorption of potassium and phosphorus nutrients. The salinity effect results in a lack of availability of K and P nutrients, as well as a low K^+Na^+ ratio. Soil salinity significantly reduces the absorption of mineral nutrients, especially phosphorus (P), because Phosphate ions precipitate with Ca^{2+}, Mg^{2+} and Zn^{2+} ions in saline soils and become unavailable to plants. In conditions of salinity gripping, absorption of nutrients through the root will be inhibited, namely P and K. nutrients The presence of Na + at higher concentrations in the xylem will limit the translocation of K + from root to shoot[14] which results in lower K +. Through leaf fertilization is expected to increase plant tolerance to salinity by compensating for nutrient deficiencies in plant tissue.[15][16] The interaction of upland rice (varieties), application of salicylic acid and ascorbic acid has increased plant height, total number of tillers and leaf area. In general the highest value for the vegetative component is the number of tiller.

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