ANTIOXIDANTS ACTIVITY OF LOCAL THAI RICE UNDER SALT STRESS

Author: Thaksapawn Aueaphiriyakul, Supervisor: Lect. Chutarat Puchkhon, Ph.D

Rice (*Oryza sativa* L.) exhibits various salt tolerance abilities among varieties/cultivars such as tolerant, intermediate-tolerant, and sensitive. Previous research on the salinity stress response in rice has been studied during the seedling stage. Therefore, this study shows the effects of sodium chloride (NaCl) on reactive oxygen species (ROS) scavenging activity in Gamfuang and Laimak compared to IR29 (standard salt-sensitive cultivar) and Pokkali (standard salt-tolerant cultivar). Rice were grown in a hydroponic system and treated with 120 mM NaCl for salt stress at 28 days after germination. Samples were collected 3 timings which are 0 (T1), 5 (T2) and 10 (T3) days after salt stress. T1 show trend of the increase in enzymatic antioxidants activities, including superoxide dismutase (SOD) and catalase (CAT). There were no significantly differences under salt stress compared to control in each cultivar, while Laimak show significantly increase in glutathione peroxidase (GPX) activity. At T2, all cultivars show trend of reduction of SOD, CAT and GPX activities. Laimak and Pokkali have a higher ascorbate peroxidase (APX) activity under salt stress condition. And T3 show the reduction of APX and GPX activity of all cultivars under salt stress, while SOD activity of Gamfuang is increase. Laimak and Pokkali also have a higher CAT activity under salt stress in this timing. Proline content of T1 shows similar in all cultivars. When subjected to salt stress at T2 and T3, Pokkali has the highest proline content in both timings. Laimak show the increase of proline content at the T2 and then decrease at the T3. For Gamfueng, proline content reduce at T2 and T3 after salt stress treatment. At T2 of all cultivars, the trend of DPPH scavenging activity under salt condition have higher than control. Moreover, Laimak and Pokkali have significantly higher than control at T2 under salt stress and still increasing at T3. All the results show trend of similarity enzymatic antioxidants activities and proline content in Laimak and Pokkali. It can be concluded that Laimak might have a tolerance ability similar to Pokkali.

Keywords: Salt stress, Rice, Antioxidant activitivity, Proline content, Oryza sativa L.

Introduction

Rice (*Oryza sativa* L.) is important carbohydrates source for Asian people. In Thailand, rice is not only food but it also being an economic plant. Northeast region of Thailand is a main seasonal rice cultivation field, but 2.85 million hectares of the northeast area effected by soil salinity problems. From previous research about physiological parameters and Na+/K+ ratio on Local Thai rice compared to standard salt-tolerance (Pokkali) and salt-sensitive (IR29) rice under salt stress by Khunpolwattana (2015) and Tantipirom (2016). They founded that Laimak has salt-tolerance ability similar to Pokkali and Gamfuang have salt-sensitive ability similar to IR29. The study of antioxidants activity on rice under salt conditions have reported that salt-tolerance have higher antioxidants ability than salt-sensitive.

The aim of this study is investigation of the effects of the sodium chloride (NaCl) on reactive oxygen species (ROS) scavenging enzyme activity.

Materials and methods

1. Gamfuang (GF), IR29 (IR), Pokkali (P) and Laimak (LM) were grew on hydroponics with modified WP No.2 nutrient solution.

2. All rice cultivars were germinated in distilled water for 7 days, then transferred to hydroponic tray filled with 8L. of ½ nutrient solution. At 14 days the nutrients were replaced with full solution. Salt treatment was started at 28 days after germination by adding 120 mM NaCl into nutrient solution. Samples in both control and salt treatment groups were collected at 0 day (T1), 5 days (T2) and 10 days (T3) after treatments.

3. Leaves of GF, IR, P and LM were used for crude enzyme extraction. Then, the supernatant were used for protein assay and enzymatic antioxidant activity. Proline content and antioxidant ability were measured the absorbance by using microplate reader.

4. Statistical analysis were performed using R software (R Core Team). Analysis of variance (ANOVA) was conducted to determine the effects of the experimental factors and their interactions. When significant differences were detected, mean comparisons were performed using Tukey's Honestly Significant Difference (Tukey's HSD) test at the 95% confidence level ($p < 0.05$).

Conclusion

The results of enzymatic antioxidants, DPPH scavenging activity and Proline content shows the NaCl responses of Laimak, the local Thai rice, similar to Pokkalii, the standard salt-tolerance rice.

References

Nontapon, J., Srihanu, N., Bhumiphan, N., Kaewhanam, N., Kangrang, A., Bhurtyal, U., KC, N., Kaewplang, S. and Huete, A. 2025. An Integrated Remote Sensing and Machine Learning Approach to Assess the Impact of Soil Salinity on Rice Yield in Northeastern Thailand. Geomatics 5(4): 80.

Khunpolwattana, N. 2015. Salt tolerant ability evaluation of local Thai rice seedlings and genome-wide association with salt tolerant traits. M.S. Thesis, Chulalongkorn University.

Tantipirom, N. 2016. soil salinity effects on Na+/K+ ratios in local thai rice oryza sativa l. and genome-wide association for prediction of genes involving in Na+ and K+ accumulation M.S. Thesis, Chulalongkorn University.

Result and discussion

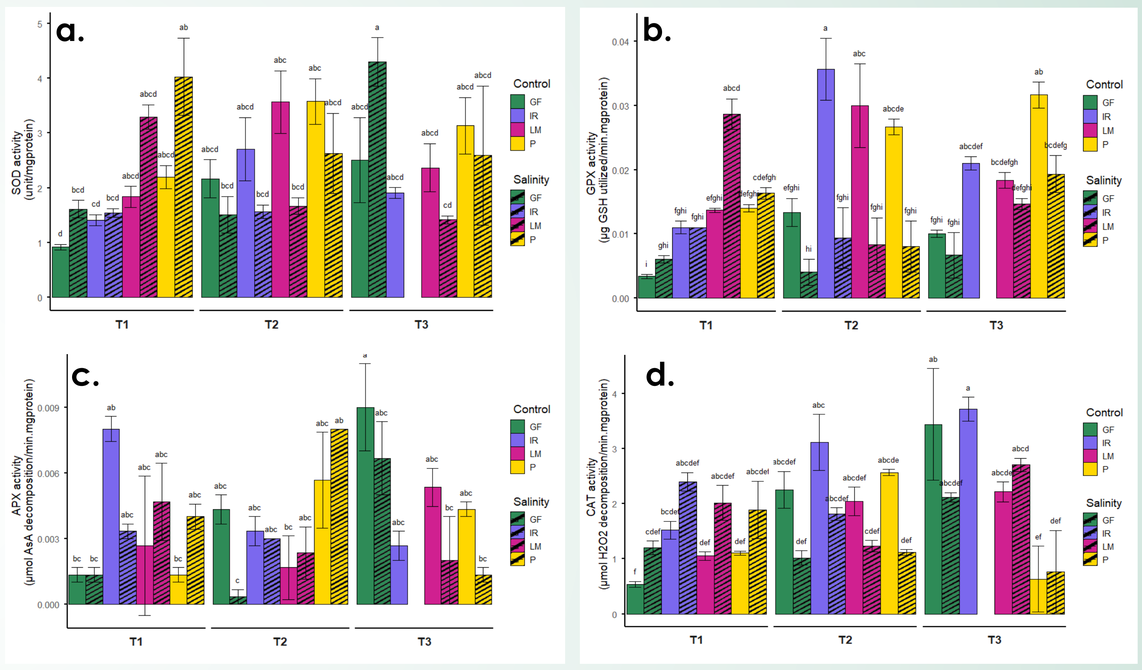


Figure 1: Enzymatic antioxidant activity (a.) SOD activity, (b.) GPX, (c.) APX activity and (d.) CAT activity

Trend of SOD activity and GPX activity in every cultivar under salt condition are lower than control and there are no different at T2 and T3, Except SOD activity in Gamfuang under salt at T3 that higher than control. Trend of Laimak and Gamfuang under salt condition, APX activity are higher than control at T2 and they show similar trend in CAT activity at T3 (Fig1). This results may assume that Laimak is a local-Thai ricewhich have salt-tolerance ability in term of enzymatic antioxidants similar to Pokkali.

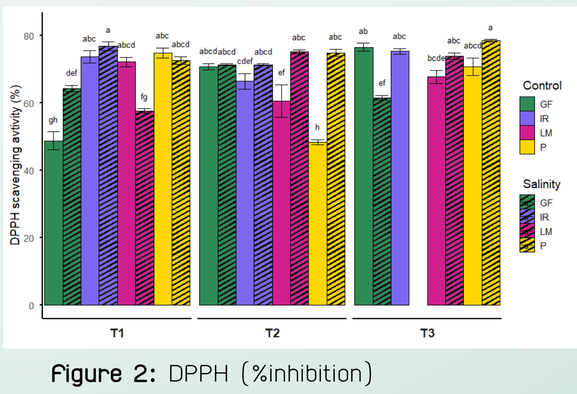


Figure 2: DPPH (%inhibition)

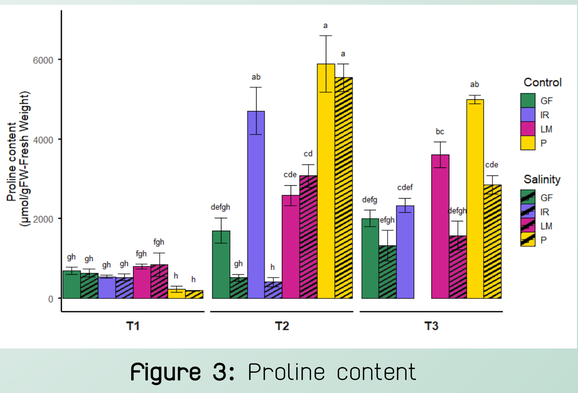


Figure 3: Proline content

The results of DPPH shows %inhibition of enzymatic antioxidants are increase in every cultivars under salt stress. Especially, in Laimak and Pokkali that show significantly higher than control. At T3, Gamfuang under salt stress is decreased from T2 while IR29 has already died, but Laimak and Pokkali still on the similar trend (Fig2).

For proline content, Laimak and Pokkali have high proline accumulated in cells at T2. Which means they may decrease water potential in cells. Which can help water uptake from environment better than Gamfuang and IR29 (Fig3).