Restoration of Salt-Affected Soils Utilizing Halophiles Retained in Rice Bran

*Shigetatsu Nishigai[1]

1. Sendai Nika Senior High School, Miyagi Prefecture

Salt damage has been a serious problem on a global scale due to drought and inappropriate use of irrigation water, and salt-induced land degradation is leading the world to a potential food shortage crisis. To cope with this problem and restore the productivity of farmlands, an innovative method must meet the following criterion; inexpensive, rapid, simple and non-invasive to plants.
In this research, we aimed to restore the salt-affected land to the level in which plants that are naturally cultivable in the region can be grown.
Fundamentally, salt concentrated environments need to be diluted to the level that Sodium Ion and NaCl concentration is low enough for plants to grow. Since it is impossible to degrade NaCl further into any elements, and our aim is to make it feasible for farmers to grow crops before rains push salt out of farmlands, we need to consider ways to prevent NaCl from dissolving in water absorbed by plant vessels.
I positively utilize the characteristic of halophiles such as yeast that generates organic acids by eating rice bran as bait. Here is our hypothesis, when we mingle salt-affected soils with halophiles retained in rice bran, organic acid effectively works, and reach out the salt adhering to soils. Next, when halophiles multiply in salt concentrated environment, it is considered that a certain amount of Sodium Ionare incorporated into the cell membrane, especially that of alkali/acidic halophile utilizing Sodium Ion instead of or in addition to proton to take in nutrition. Then, the Sodium Ion and NaCl concentration are expected to decrease.
To give scientific evidence to the hypothesis, I organized two sorts of experiments.
As the first step, we tried to observe if it is true that halophiles incorporated Sodium Ion ions to inside the membrane.
We centrifuged the sake lees and water mixed solution, blended the supernatant fluid with 4.4% salinity, pH5,6,8,9 adjusted LB liquid media, and incubated at 35℃. The salinity continuously got lower, especially in pH6 media it went down to 3.7% after five days of incubation. To prove that the changes are caused by halophiles, later we left the LB media at 10℃ environments for two days and determined that the salinity remained the same or got back higher. However it was still possible that the nutrient was insufficient, so I incubated them at 35℃ again for four days, and got the result that the pH6 media reached 3.2%, meaning the halophile incorporated Sodium Ion.
As the second step, we implemented our method to a practical stage; observed the germination rate of radish sprouts and the salinity decrease in salt-affected soils mixed with the halophiles retained in rice bran.
As for the experiment to observe the germination rate, we centrifuged the sake lees and water mixed solution, blended the supernatant fluid with 1.4% salinity, which is slightly beyond the range of radish sprouts optimum salinity. Then we grew 20 grains of radish sprouts in 20℃ on the three kinds of paper towel, the first one absorbed the distilled water, the second one, the 1.4% salinity water without halophiles, and the third one, the 1.4% salinity water with halophiles. After leaving them for a week, we observed the germination rate, how many grains have germinated out of 20. Judging from the data, it turned out that whether halophiles were added to the solutions or not resulted in three times of difference in germination rate.
As for the experiment to observe the salinity decrease in artificial salt-affected soils, we simply mixed soil with the halophiles retained in rice bran and measured the change in salinity and ppm. We prepared the

suspension of yeast and poured it to rice bran. Then I incubated them at 20 ℃ and got a result that the ppm of the salinity went down for 15% on average in the third day from the day started incubation.
From these experiment, it turned out that this method is effective in restoring the salt-affected lands to some degree, but there is strong need to improve the effectiveness and efficiency.
The deeper acknowledgment regarding the more specific mechanism of how the salinity decrease occurs and the prevention of recurrence of salt damage would provide further insight into the more efficient procedure of recovering salt-affected lands.

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