Evaluation of nanometric growth dynamics of plants under the influence of auxin using statistical interferometric technique

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1. Introduction

In general, the plant growth is very complex and dynamic and dependent on its environmental changes. In our study, leaf expansion measurements using Statistical Interferometry Technique (SIT) that is a highly sensitive interferometric technique with a subnanometric accuracy at a temporal scale of second found the presence of characteristic nanometric intrinsic fluctuations (NIF) in a short term growth of plant. It was demonstrated in our previous studies that NIF was highly dependent on environmental stresses for plant, for example ozone in atmosphere and heavy metals in soil. Therefore, NIF got attention because this phenomenon can reflect a biological activity and be a measure for the plant stress. However, the origin of NIF hasn't been fully clarified. In this study, we monitor the influence of auxin, one of the basic phytohormone, on the NIF to figure out the origin of NIF. Function of the auxin depends on the concentration and parts of plant. Auxin is also integral factor to control another phytohormone, for example, gibberellin. Thus auxin is important factor when analyzing plant growth state.

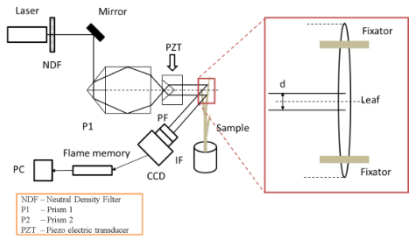


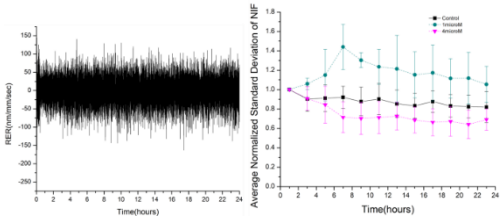
Fig.1 Schematic of experimental system

2. Experiments and results

In this study, the growth behavior of rice (*Oryza sativa*) under auxin exposure was observed. In SIT measurements, short-term growth rate was measured over 5 sec., in measurements of the in-plane expansion of the leaf and its standard deviation (SD) can be a measure of the plant healthiness. Figure.1 shows the experimental system of SIT. A He-Ne laser beam of wavelength 633nm is divided into two beams by a specially designed prism. From two illuminating points on the leaf, two independent random speckle fields are generated and randomly interfere each other on the observation plane. The random interference patterns are acquired by a CCD camera. The effects of Auxin on plant growth and NIF of growth rate were observed for 24 hours by exposing their root to 2,4-dichlorophenoxyacetic acid (2,4D) solution. Figure 2(a) is NIF under no auxin exposure. Figure 2(b) shows the results of averaged normalized SD (ANSD) of growth rate for 24 hours, where SDs were normalized by those before exposure. There were significant increment of 56.4% for 1μM and reduction of 24.3% for 4μM compared with control. The plant height measurement showed significant increment for 0.45μM, 1μM and 2μM, and significant reduction for 4μM.

3. Conclusion

For a proper concentration of auxin, the promotion of plant growth and the increment of NIF due to auxin were well coincide. One of the function of auxin is the cell wall loosening and this may lead to the increment in the NIF. Therefore, the experimental results suggested that the origin of the NIF is deeply related with the cell wall



(a) (b)

Fig.2 NIF and Normalized Standard deviation of NIF

loosening and swelling of the cell although further studies are needed.

References

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