YOUNG KOUNG LEE

INVITED TALK 6

The Transcriptional Regulation of Plant Growth by Plasma-Activated Water

Young Koung Lee[1,3]*, Hong Kwan Beak[1,2] and Ryza A. Priatama[1]

[1] Institute of Plasma Technology, Korea Institute of Fusion Energy, 54004, Republic of Korea
[2] Department of Biology, College of Natural Science, Wonkwang University, 54538, Republic of Korea
[3] Department of Plasma and Nuclear Fusion, University of Science and Technology, Republic of Korea

***Corresponding author:** leeyk@kfe.re.kr

Abstract

Cold atmospheric-pressure plasma technology (CAP) has emerged as a promising tool in biotechnology field, demonstrating its ability to enhance seed germination, plant growth, biomass and yield. Plasma-activated water (PAW), produced using a surface dielectric barrier discharge (SDBD) device, has recently been applied to improve biomass in plants, Arabidopsis, as a model plant, and crops, tomato, and sorghum. However, the molecular mechanisms underlying biomass improvement following plasma treatment remains largely uninvestigated in even in well-studied plant Arabidopsis. In this study, we analyzed the molecular role of PAW which plays a role in Arabidopsis and sorghum cultivation. Phenotypic analysis in sorghum seedlings revealed significant growth due to the enhancement of stem thickness. In sorghum seedling, primordia tissue, leaf sheath (LS1), LS2 area and stem tissue area were all enlarged in the PAW-treated group compared to the control group. Furthermore, transcriptome data showed that 1253 genes out of 1610 Differentially expressed genes (DEGs), 78%, were upregulated after plasma cultivation. Gene ontology (GO) term analysis revealed that PAW treatment predominantly upregulates genes involved in transmembrane transport, light response, oxidoreductase activity, transcription factor activity, and cell wall expansion. These findings highlight the potential of PAW as a novel agricultural tool for enhancing biomass production in Arabidopsis and sorghum, offering new avenues for improving crop yield through plasma technology.

Keywords: Transcriptional regulation, Plant growth, Plasma-activated water, Sorghum, Arabidopsis

CURRICULUM VITAE

Name:	Young Koung Lee
Academic positions:	Principle researcher /Professor
Workplace:	KFE (Korea institute of fusion energy)/ UST (University of Science and Technology)
Address:	37 Dongjangsan-ro, Gunsan-si, Jeonbuk-do, 54004, Republic of Korea
Email:	leeyk@kfe.re.kr
Expertise:	Plant molecular biology, Plasma application in plant, System biology

Education History

[Doctorate]	2006	Department of Biological science, KAIST
[Master]		Department of Agronomy, Kyungpook National University
[Bachelor]		Department of Agronomy, Kyungpook National University

Professional Background

Post-doc.	Post-doc., KAIST & Cold Spring Harbor Lab.
Research professor	Research professor, Wonkwang University

Selected Awards and Honors

1. 2023 Jeollabuk-do Governor's Award for Contributions in the Agri-Food and Bio Session.

Selected Publications

1. Beak H.K., Priatama R.A., Han S.I., Song I., Park S.J. and **Lee Y.K.** (2024) Biomass enhancement and activation of transcriptional regulation in sorghum seedling by plasma activated water. *Front. Plant Sci.* 15:1488583.
2. Lee, E.S., Heo, J., Choo, Y-K., Bae, J.H., Kim, C.M., **Lee, Y.K.,** *et al.,* (2023) Engineering homoeologs provide a fine scale for quantitative traits in polyploid. *Plant Biotechnol. J., 1(12):2458-2472.*
3. Priatama R.A., Pervitasari A.N., Park S., Park S.J., **Lee Y.K**. (2022) Current Advancements in the Molecular Mechanism of Plasma Treatment for Seed Germination and Plant Growth. *Int. J. Mol. Sci. 23*, 4609.
4. **Lee Y.K**., Kumari S., Olson A., Hauser F., Ware, D. (2022) Role of a ZF-HD Transcription Factor in miR157- Mediated Feed-Forward Regulatory Module That Determines Plant Architecture in *Arabidopsis*. *Int. J. Mol. Sci.* 23, 8665.
5. Song I.* and **LEE Y.K.*** *et al.,* (2021) Effect of an Endoplasmic Reticulum Retention Signal Tagged to Human Anti-Rabies mAb SO57 on Its Expression in Arabidopsis and Plant Growth. *Mol. Cells* 44(10): 770-779