Department of Applied Chemistry and Food Science

Key words Protein science, molecular biology, crop, environmental stress

Doctor of Pharmacology / Professor

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Education

Faculty of Pharmaceutical Sciences, Meiji Pharmaceutical University

Professional Background

Assistant Professor at Meiji Pharmaceutical University/ Team Director at National Institute of Agrobiological Sciences, MAFF/ Unit Director at National Institute of Crop Science, NARO/ Professor at University of Tsukuba/ Visiting Professor at University of Fukui

Consultations, Lectures, and Collaborative Research Themes

Lectures on “Response and tolerance mechanisms of crop under environmental stress”
Collaborative research on “Behavior and accumulation mechanisms of functional elements in crops”

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Main research themes and their characteristics

The world population has increased; and the accelerated global warming influences the yield and quality of crop. Food shortages are one of the most serious global problems in this century. It is important to increase the food production. Comprehensive analyses, which are proteomics, transcriptomics, and metabolomics, are used to identify the response and tolerant mechanism for important crop traits. Main research interests are within the key areas of crop proteomics, biochemistry and molecular biology with a special focus on signal transduction in cell.

「Proteomic analysis of the effect of inorganic and organic chemicals with silver nanoparticles on soybean under flooding stress」

Extensive utilization of silver nanoparticles (NPs) in agricultural products results in their interaction with other chemicals in the environment. To study the combined effects of silver NPs with nicotinic acid and potassium nitrate (KNO3), a proteomic technique was used. Root length/weight and hypocotyl length/weight of soybean were enhanced by silver NPs mixed with nicotinic acid and KNO3. Differentially changed proteins were predominantly associated with protein degradation and synthesis according to the functional categorization. Protein-degradation related proteins mainly consisted of the proteasome degradation pathway. The cell death was significantly higher in the root tip of soybean under the combined treatment compared to flooding stress. Accumulation of calnexin/calreticulin and glycoproteins significantly increased under flooding with silver NPs, nicotinic acid, and KNO3. Growth of soybean seedlings with silver NPs, nicotinic acid, and KNO3 was improved under flooding stress. These results suggest that the combined mixture of silver NPs, nicotinic acid, and KNO3 causes positive effects on soybean seedling by regulating the protein-quality control for the mis-folded proteins in the endoplasmic reticulum; and, it might improve the soybean growth under flooding stress.

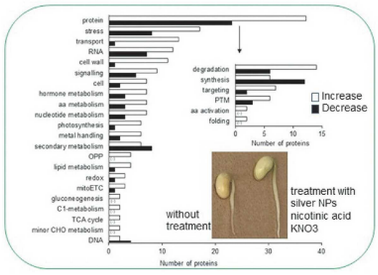

Fig.1 Functional categorization of proteins identified in flooding-stressed soybean treated with silver NPs/nicotinic acid/KNO3.

「Proteomic analysis of irradiation with millimeter waves on soybean growth under flooding conditions」

Improving soybean growth and tolerance under environmental stress is crucial for sustainable development. Millimeter waves are a radio-frequency band with a wavelength range of 1–10 mm that has dynamic effects on organisms. To investigate the potential effects of millimeter-waves irradiation on soybean seedlings, morphological and proteomic analyses were performed. Millimeter-waves irradiation improved the growth of roots/hypocotyl and the tolerance of soybean to flooding stress. Proteomic analysis indicated that the irradiated soybean seedlings recovered under oxidative stress during growth, whereas proteins related to glycolysis and ascorbate/glutathione metabolism were not affected. Immunoblot analysis confirmed the promotive effect of millimeter waves to glycolysis- and redox-related pathways under flooding conditions. Sugar metabolism was suppressed under flooding in unirradiated soybean seedlings, whereas it was activated in the irradiated ones, especially trehalose synthesis. These results suggest that millimeter-waves irradiation on soybean seeds promotes the recovery of soybean seedlings under oxidative stress, which positively regulates soybean growth through the regulation of glycolysis and redox related pathways.

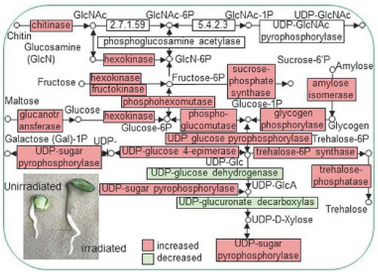

Fig.2 Mapping of differentially changed proteins related to sugar metabolism in soybean root irradiated with millimeter waves.

Major academic publications

(1)Komatsu S, Yamaguchi H, Hitachi K, Tsuchida K, Kono Y, Nishimura M. Proteomic and biochemical analyses of the mechanism of tolerance in mutant soybean responding to flooding stress. Int J Mol Sci, 2021, 22:e9046.

(2)Komatsu S, Maruyama J, Furuya T, Yin X, Yamaguchi H, Hitachi K, Miyashita N, Tsuchida K, Tani M. Proteomic and biological analyses reveal the effect on growth under flooding stress of chickpea irradiated with millimeter waves. J Proteome Res, 2021, 20:4718-4727.

(3)Sousa RHV, Carvalho FEL, Lima-Melo Y, Alencar VTCB, Daloso DM, Margis-Pinheiro M, Komatsu S, Silveira JAG. Impairment of peroxisomal APX and CAT activities increases protection of photosynthesis. J. Exp. Bot., 2019, 70:637-639.

(4)Rahiminejad M, Ledari MT, Mirzaei M, Ghorbanzadeh Z, Kavousi K, Ghaffari MR, Haynes PA, Komatsu S, Salekdeh GH. The quest for missing proteins in rice. Mol. Plant, 2019, 12:4-6.