Abstract

Near infrared spectroscopy and aquaphotomics for soybean cultivar cold tolerance evaluation

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Introduction

Soybean has expanded its cultivation region far beyond the biological cold tolerance of the species due to its enormous economic importance. Conventional soybean screening methods for cold tolerance have failed due to their being destructive and not allowing real-time data acquisition on a molecular level. In this work, we present the use of a low-cost handheld type SW-NIR spectrometer for screening cold tolerant soybean based on real-time plant stress response acquired under in situ cold stress perturbation.

Materials and Methods

Five soybean cultivars that have different cold stress tolerance (Kitamusume (A), Toyoharuka (B), Toyocomachi (C), Toyomusume (D), Hokkaihadaka (E); twenty plants per group) were grown in phytothron at 27°C for 2 weeks. Then, all the plants were moved to 22°C phytothron for in situ cold stress perturbation for one week. A NIR spectrometer (FQA-NIR Gun; Shizuoka Shibuya Seiki, Hamamatsu, Japan), was used to acquire transflectance spectra of five leaves from each plant once after a week at 22°C (588-1025 nm at 2 nm steps). A SIMCA prediction model was constructed (Pirouette 3.11 Infometrix, Inc ® WA, USA) and validated by an independent validation set of 50 separate plants consisting of ten plants per cultivar.

Results and Discussion

SIMCA prediction model constructed was optimised for best results by using mean centered 2nd derivative spectra and 9 PC factors. The accuracy of cold tolerance prediction achieved based on a single leaf spectrum measured by handheld spectrometer was more than 92%. For the first time, we report that the most effective wavelengths (discriminating power in the optimised model) were located in the water absorbance band region at 896 nm, 932 nm, 956 nm, 998 nm.

Conclusion

Cold tolerance of soybean cultivars was successfully evaluated when using water absorbance spectral patterns of plant leaves analysed by a handheld spectrometer after exposure to cold stress.

Reference paper as:
B. Jinendra and R. Tsenkova (2012) Near infrared spectroscopy and aquaphotomics for soybean cultivar cold tolerance evaluation (abstract), in: Proceedings of the 15th International Conference on Near Infrared Spectroscopy, Edited by M. Manley, C.M. McGoverin, D.B. Thomas and G. Downey, Cape Town, South Africa, p. 360.