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Elucidation of the physiological basis related to high photosynthetic capacity of soybean local variety, 'Peking'.

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Abstract

The enhancement of leaf photosynthetic capacity can have the potential to improve the seed yield of soybean. Key targets for the increase of leaf photosynthetic capacity remains unclear in soybean. Peking, Chinese local variety, has been the useful material for soybean breeding since it shows various resistances against biotic and abiotic stress. Sakoda et al., 2017 reported that Peking had the higher capacity of leaf photosynthesis than Enrei, Japanese elite cultivar. They identified the genetic factors related to high photosynthetic capacity of Peking. The objective of this study is to elucidate the physiological basis underlying high photosynthetic capacity of Peking. Peking and Enrei were cultivated at the experimental field of the Graduate School of Agriculture, Kyoto University, Kyoto, Japan. The sowing date was July 4, 2016. Gas exchange parameters were evaluated at the uppermost fully expanded leaves on 43, 49, and 59 days after planting (DAP) with a portable gas exchange system, LI-6400. The leaf hydraulic conductance, K_{leaf}, was determined based on the water potential and transpiration rate of the uppermost fully expanded leaves on 60 DAP. The morphological traits related to leaf photosynthesis were analyzed at the same leaves with the gas exchange measurements. The light-saturated CO_2 assimilation rate (A_{sat}) of Peking was significantly higher than that of Enrei at 43 and 59 DAP while the stomatal conductance (g_s) of Peking was significantly higher at all the measurements ($p < 0.05$). It suggested that high A_{sat} was mainly attributed to high g_s in Peking. g_s is reported to be affected by the morphological traits and water status inside the leaf, represented by K_{leaf}, in crop plants. The tendency of the variation of the stomatal density between two cultivars was not consistent throughout the measurements. On the other hand, K_{leaf} of Peking was 59.0% higher than that of Enrei on 60 DAP. These results imply that high g_s might be attributed to high K_{leaf} in Peking. Further research is needed to reveal the mechanism to archive high g_s on the basis of water physiology in Peking. The knowledge combining the genetic and physiological basis underlying high photosynthetic capacity of Peking can be useful to improve the biomass productivity of soybean.

Keywords: Soybean, leaf photosynthesis, stomatal conductance, leaf hydraulic conductance

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