2 Starch Biosynthesis in Guard Cells But Not in Mesophyll Cells Is Involved in CO2-Induced Stomatal Closing.

Azoulay-Shemer T, Bagheri A, Wang C, Palomares A, Stephan AB, Kunz HH, Schroeder JI

show author affiliations

Plant Physiol. 2016 Jun; 171(2):788-98

Recommendations:

Very Good 06 Jul 2016

Wagner Araujo

F1000 Plant Biology

Universidade Federal de Viçosa, Viçosa, MG, Brazil.

GOOD FOR TEACHING | INTERESTING HYPOTHESIS | NEW FINDING

DOI: 10.3410/f.726399363.793520355

It is well known that the regulation of both stomata movements and development are highly sensitive to modifications in the surrounding environment {1,2} and therefore stomata play a significant role in mediating plant-environment interactions.

In this outstanding research the group around Julian Schroeder has provided evidence for a functional role of guard cell metabolism in CO2-induced stomatal movements.

By analyzing the stomatal responses to changes in [CO2] coupled with net CO2 assimilation rates in different tissue-specific starch accumulation mutants, Azoulay-Shemer and colleagues were able to suggest that starch biosynthesis in guard cells is involved in CO2-induced stomatal closing rather than in mesophyll cells.

Although compelling evidence has demonstrated that mesophyll tissues produce a diffusible signal involved in stomatal responses to CO2 changes {3,4}, the results obtained by Azoulay-Shemer and colleagues indicate that this signal is not directly connected with mesophyll starch. Further research is clearly required to ascertain the importance of both guard cell and mesophyll metabolism in the regulation of stomatal movements.

References

1. **Environmental regulation of stomatal development.**
Casson SA, Hetherington AM. Curr Opin Plant Biol. 2010 Feb; 13(1):90-5
PMID: 19781980 DOI: 10.1016/j.pbi.2009.08.005
2. **Mechanisms of abscisic acid-mediated control of stomatal aperture.**
Munemasa S, Hauser F, Park J, Waadt R, Brandt B, Schroeder JI. Curr Opin Plant Biol. 2015 Nov 18; 28:154-162
PMID: 26599955 DOI: 10.1016/j.pbi.2015.10.010
3. **Apoplastic mesophyll signals induce rapid stomatal responses to CO2 in Commelina communis.**
Fujita T, Noguchi K, Terashima I. New Phytol. 2013 Apr 8;
PMID: 23560389 DOI: 10.1111/nph.12261
4. **Is the signal from the mesophyll to the guard cells a vapour-phase ion?**
Mott KA, Berg DG, Hunt SM, Peak D. Plant Cell Environ. 2014 May; 37(5):1184-91
PMID: 24313673 DOI: 10.1111/pce.12226

Disclosures

None declared

Abstract:

ABSTRACT

Starch metabolism is involved in stomatal movement regulation. However, it remains unknown whether starch-deficient mutants affect CO2-induced stomatal closing and whether starch biosynthesis in guard cells and/or mesophyll cells is rate limiting for high CO2-induced stomatal closing. Stomatal responses to [CO2] shifts and CO2 assimilation rates were compared in Arabidopsis (Arabidopsis thaliana) mutants that were either starch deficient in all plant tissues (ADP-Glc-pyrophosphorylase [ADGase]) or retain starch accumulation in guard cells but
are starch deficient in mesophyll cells (plastidial phosphoglucose isomerase [pPGI]). ADGase mutants exhibited impaired CO2-induced stomatal closure, but pPGI mutants did not, showing that starch biosynthesis in guard cells but not mesophyll functions in CO2-induced stomatal closing. Nevertheless, starch-deficient ADGase mutant alleles exhibited partial CO2 responses, pointing toward a starch biosynthesis-independent component of the response that is likely mediated by anion channels. Furthermore, whole-leaf CO2 assimilation rates of both ADGase and pPGI mutants were lower upon shifts to high [CO2], but only ADGase mutants caused impairments in CO2-induced stomatal closing. These genetic analyses determine the roles of starch biosynthesis for high CO2-induced stomatal closing.

DOI: 10.1104/pp.15.01662

Comments:

COMMENTS add a comment