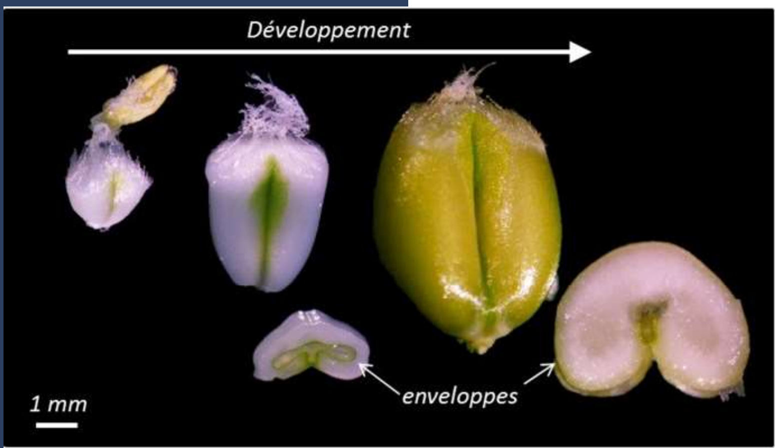
Figure (and photos) by Anne-Laure Chateigner-Boutin

Wheat grain growth is strangled by bonds between cell-wall polymers

The cells walls surrounding plant cells are composed of tightly-interwoven polymer networks whose composition and structure vary between species, developmental stage, tissue and organ. These polymers, led by the polysaccharides, find a host of food and non-food uses. Cell wall composition has been amply researched in wheat grain endosperm as it is key to bread flour quality, but scant attention has been paid to cell walls of the outer layers, much less in the developing grain.

▸ RESULTS

We used a multi-approach battery of imaging and biochemistry methods on hand-dissected tissue specimens to investigate the cell walls in the outer layers of the wheat grain (Recital cultivar) at a series of developmental stages. We also ran parallel monitoring to track growth in grain dimensions. On top of the known cell-wall polysaccharides, we also detected lignins much earlier than previously thought in developing wheat grain, long before it reaches full size. Our time–course tissue analysis strategy found that lignin and ferulic acid content rise in early developing grain but then fall away at later stages of maturity and in harvested grain. This time–course kinetics is explained by the creation of new resistant interunit covalent bonds that withstand the extraction conditions used to prep the samples for assay, and so late-growth-stage assays fail to capture lignin and ferulic acid. The turnaround, in the cultivar studied here, overlaps with the stage when grain growth comes to a halt. Our findings suggest that major structural cell-wall changes occur late into development in the outer pericarp and that these changes could be part of a system that arrests grain growth and thus determines grain size.



▸ FUTURE OUTLOOK

Our study thus brings unexpected results—(i) lignin found at very early growth stages, and (ii) changes in cell-wall properties likely due to covalent crosslinking between cell-wall polymers—and raises the idea that rigidifying wheat grain outer layers may work with other factors to arrest radial grain growth. To confirm this pattern of events, we will next evaluate the mechanical properties of the developing pericarp in wheat cultivars that share different growth kinetics.

Participants

IJPB INRA Versailles, GDEC INRA Clermont-Ferrand, IATE INRA Montpellier

Read more

Ferulate and lignin cross-links increase in cell walls of wheat grain outer layers during late development

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Chateigner-Boutin AL, Lapierre C, Alvarado C, Yoshinaga A, Barron C, Bouchet B, Bakan B, Saulnier L, Devaux MF, Girousse C, Guillon F

CONTACTS

Anne-Laure Chateigner-Boutin
anne-laure.chateigner-boutin@inra.fr
Fabienne Guillon
fabienne.guillon@inra.fr
Biopolymers, Interactions, Assemblies (BIA)