MRI in Plant Research: Unlocking the Hidden Life of Seeds

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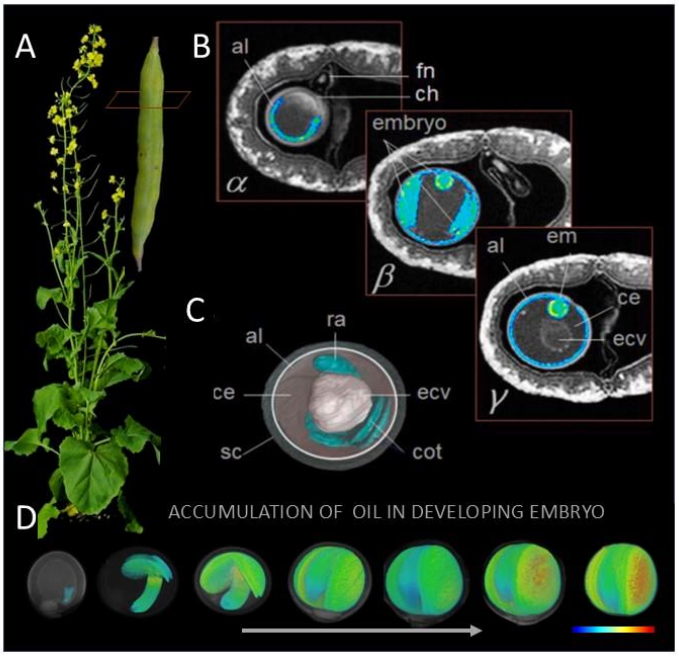
Magnetic Resonance Imaging (MRI), long established as a cornerstone of medical diagnostics, is increasingly recognized as a powerful tool for exploring the inner life of plants through *in vivo* imaging. What drives the adoption of MRI in plant research, and what obstacles must be addressed to fully realize its potential in this emerging field?

This presentation showcases how in vivo MRI, enabled by the newly established plant MRI platform at IPK [1], is opening new avenues for investigating the inner life of plant seeds. MRI now enables detailed investigations into embryogenesis and seed formation, the role of mechano-sensing, and the spatial and temporal dynamics of storage product partitioning in seeds [2,3, 4]. We've also developed method for the non-invasive visualization of sugars and amino acids in complex "sink organs" like fruits, taproots, and tubers, focusing on crops like maize, potato, and sugar beet [5].

Our new approach integrates deep learning algorithms with MRI to automate data analysis—exemplified by our MRI-Seed-Wizard [6], a tool that enables breeders to quantify more than 20 seed traits. Many of these traits cannot be measured using conventional methods, including X-ray computed tomography. Finally, I would like to share my vision of how MRI in plant science is evolving, highlight the need for closer collaboration between physicists and plant scientists to facilitate progress in the field [7].



MRI-based visualization of tissue-specific lipid storage in developing embryo of oilseed rapeseed (*Brassica napus*). **(A)** Optical image of rapeseed plants and a typical silique, which contains seeds. **(B)** Virtual cross sections through the silique at mid cotyledon stage of development; lipid detected in the aleurone layer of endosperm and in the embryo proper. **(C)** schematic representation of the seed organs; **(D)** the developmental sequence of oil deposition in embryo. Abbreviations: al – aleurone; ce – cellularized endosperm; ch – chalazal region; cot – cotyledon; ecv – endosperm central vacuole; em – embryo; en – endosperm; fn – funiculus; ps – pseudoseptum; ra – radicle; sc – seed coat; se – seed; va – valve.

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