

Cold-Triggered Phase Separation Forms a Chloroplast Compartment Modulating RNA Processing

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Arabidopsis plants can produce photosynthetic tissue with active chloroplasts at temperatures as low as 4°C, and this process depends on the presence of the nuclear-encoded, chloroplast-localized RNA-binding protein CP29A. We demonstrate that CP29A undergoes phase separation in vitro and in vivo in a temperature-dependent manner, which is mediated by a prion-like domain (PLD) located between the two RNA recognition motif (RRM) domains of CP29A. The resulting droplets display liquid-like properties and are found near chloroplast nucleoids. The PLD is required to support chloroplast RNA splicing and translation in cold-treated tissue. Together, our findings suggest that plant chloroplast gene expression is compartmentalized by inducible condensation of CP29A at low temperatures, a mechanism that could play a crucial role in plant cold resistance.

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