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PLANT MAGNETORECEPTION: QUANTUM BIOLOGY OF LIFE BEYOND THE GEOMAGNETIC FIELD

Abstract

The quantum biology of plant magnetoreception delves into the still unknown ways in which plants perceive and respond to the Earth's magnetic field at the quantum level. Plant magnetoreception has long captivated scientists, challenging traditional notions of plant growth and development. As we contemplate space exploration and the potential for extraterrestrial agriculture, understanding how plants sense and respond to variability in external magnetic fields becomes crucial. In sum, the study of plant magnetoreception has tangible implications both for advancing basic research as well as for agricultural practices, in mitigating environmental stressors, enhancing resilience in the face of climate change, and ultimately in transfer to extraterrestrial environments. In this presentation I will briefly summarize the state of the art of quantum biology with particular reference to quantum coherence in photosynthesis, magnetic sensing mechanisms, the interplay between cryptochromes and iron-sulfur complex assembly, models and simulations as well as ongoing interdisciplinary studies. I will also try to answer to the following key questions: - what are the primary magnetosensors? - how many different magnetic field sensing mechanisms are there? - what are the primary magnetosensing mechanisms? - is there an ecological significance in magnetoreception? I will then focus of the next generation experiments involving dark/light-dependent reaction, the combined study of microgravity and hypo/hypermagnetic conditions and the role of reactive oxygen species in plant magnetoreception. As we stand at the nexus of quantum biology, plant physiology, and ecological interconnectedness, delving into this subject promises not only will deepen our understanding of the natural world but also will inspire innovative solutions for sustainable coexistence with our green companions on Earth and beyond.