Food and Agriculture Lecture Series

Exploiting the engine of C4 photosynthesis in crop plants to better serve humanity

Professor Rowan Sage
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Date: Wednesday, 3 November 2010
Time: From 4-5pm
Place: Molecular and Chemical Sciences Lecture Theatre (G33), UWA, (Fairway, Entrance No. 4, Car Park 14 and 21)

Most land plants use the C3 photosynthetic pathway, where the CO₂ fixing enzyme Rubisco incorporates atmospheric CO₂ into three carbon (C3) organic acids. At current atmospheric CO₂ levels and warmer temperatures (>20°C to 30°C), Rubisco is significantly inhibited by atmospheric oxygen, leading to the wasteful reactions of photorespiration. To compensate for this, the CO₂ concentrating mechanism termed C4 photosynthesis evolved. Most productive crops use the C4 pathway. Despite their relatively few numbers (3% of all land plants), C4 plants account for 25% of all land plant productivity. Humans have been studying the physiology of C4 plants in order to enhance crop yield while reducing water and fertilizer inputs. The challenge for C4 plant biologists is to engineer the C4 pathway into C3 crops of warm and/or dry climates. This lecture will discuss some of the initial efforts of studying the feasibility of engineering the C4 pathway into rice, and look at current trends to identify genetic controls over the expression of C4 photosynthesis, and to develop transformation technologies that can support the introduction of large numbers of foreign genes into rice.

Prof Rowan Sage is a Professor of Botany in the Department of Ecology and Evolutionary Biology, University of Toronto, St. George Campus, Toronto, Ontario, Canada. He received his PhD in 1986 from the University of California, Davis. His PhD dissertation addressed the nitrogen use efficiency of C4 photosynthesis in the ecologically similar weeds Chenopodium album (C3) and Amaranthus retroflexus (C4). In 1993, he joined the faculty at the University of Toronto, where he reactivated his C4 research. His work on C4 evolution led to his participation in the C4 Rice engineering project, which was initiated by John Sheehy at the International Rice Research Institute in 2006. Prof Sage’s current research includes the evolution and engineering of C4 photosynthesis, the impact of temperature and CO₂ variation on the biochemical processes governing C3 and C4 photosynthesis, and cold-tolerance in high-yielding C4 grasses such as Miscanthus. This last project is geared toward developing a bioenergy economy in Canada based on high-yielding C4 plants. In addition to his research and teaching (of physiological ecology and global change ecology), he is a handling editor for Global Change Biology and Oecologia and serves on the editorial board of Plant, Cell and Environment, Plant and Cell Physiology, and Photosynthesis Research.