Department of Biochemistry

Fall 2015 Seminar Series
Beach Distinguished Lectures

Presented by

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Monday and Tuesday, November 16 & 17 at 3:30

Deans Auditorium (PFEN 241)

Translational Biotechnology: Improving Rice and Cassava Nutritional Quality

Newest projections expect that the world population will grow to more than 9 billion people by 2050. To provide sufficient and nutritious food for these people requires an increase in crop production by at least 50% and micronutrient improvement of staple crops. Major crops such as maize, wheat, rice, potato and cassava are rich in starch and together they provide more than 85% of the carbohydrate calories consumed worldwide. People for whom these crops are the primary staple food receive enough calories but they are often malnourished because the seeds, tubers and roots of these plants do not contain enough of the necessary vitamins and minerals such as iron for a healthy diet. For example, 1.6 billion people worldwide suffer reduced productive capacity due to iron-deficiency anemia [1]. Utilizing the genetic potential of the diversity available in seed banks around the world for crop improvement is often not possible because high micronutrient target traits are not available in breeding germplasm. We are employing gene technology strategies to increase the iron and vitamin content of rice, cassava and wheat, which would not be possible by conventional breeding. Increasing iron in wheat and polished rice endosperm includes genes encoding proteins for FeII (IRT1) and FeIII (NAS) uptake and transport, storage (ferritin) and bioavailability (phytase), either alone or in combination [2,3,4]. This has allowed us to increase iron content up to 11-fold over levels typically present in polished rice grains, approaching the recommended daily allowance (RDA). Results for wheat are similar. Using genes encoding enzymes for the key steps of vitamin B6 biosynthesis (PDX1 and PDX1) we have increased bioavailable vitamin B6 content in cassava storage roots and leaves to RDA levels [5]. This will be especially helpful for reducing the vitamin B6-related epilepsy disease in populations of Eastern Africa for whom cassava is a staple diet. Engineered target micronutrient improvements can now be combined into single locus traits to further optimize the micronutrient content of major staple crops.

What does it take to become a productive plant leaf?

The plant leaf is among the primary producers of biomass on earth and the plant organ most exposed to interactions with the biotic and abiotic environment. Understanding leaf development from its inception at the apical meristem to its mature photosynthesis production stage is therefore key for improving crop production and utilization of plants as feedstock for numerous industrial processes. While much has been learned about shaping the axial and abaxial anatomy of the mostly flat leaf, we have less comprehensive knowledge about the cellular, molecular and physiological mechanisms that drive leaf growth and expansion and that control its diurnal activities and responses to the environment. In my presentation I will review progress we have made in understanding the systems behavior of leaf development in response to circadian control and environmental conditions from integrating phenotypic information with quantitative cellular and molecular data. Most of the work has focused on Arabidopsis leaf number six, which is the first adult leaf, but it is likely that principles apply to leaves more broadly.

About the Beach Lectures:

David W. Beach was born in 1925 in London, England. Following service in the Royal Navy, he married Doris Holmes and began his career as a Chartered Accountant. Feeling the urge to expand his horizons, he moved to Canada and began a series of jobs in the aluminum industry that included General Manager of Kawneer, Canada and Vice-President of Kawneer, Inc. As Vice-President of ALUMAX Aluminum Corporation he was instrumental in making it one of the largest and most profitable aluminum companies in the world, prior to his retirement. Inspired by his son's enthusiasm for science, he has chosen to share his good fortune by supporting this biochemistry graduate program. This long-term support is intended to promote intellectual curiosity, a commitment to excellence, and an appreciation of science in all those involved.