PLENARY SESSIONS –

Thursday 7:45 –8:30 pm

Molecular Control of Host-Pathogen Interactions - Parasitizing the Weed

Jeff Dangl
University of North Carolina – Chapel Hill

8:30 –9:15 pm

Genes Controlling floret and inflorescence development in maize

Robert Schmidt

University of California – San Diego

Comparative studies of the molecular-genetic basis of plant development are providing insights into the evolution of plant form and function. As flower development represents one of the most dramatic examples of developmental change in plants, it has been the focus of intense research during the past decade. We and others have been comparing the degree to which the genes orchestrating floral organ and inflorescence development have been conserved in sequence and function between model eudicots and model grass species. To this end we have identified putative maize orthologues of eudicot floral organ and meristem identity genes. Through studies of their expression in developing maize spikelets, analyses of mutant phenotypes, and ectopic expression studies in transgenic rice and Arabidopsis, we have been elucidating the degree to which gene functions have been conserved. In addition, the cloning of maize genes that affect specific meristem fates during inflorescence development now opens the door for reciprocal investigations of the role of the orthologous genes in eudicot floral development. These comparative developmental genetic studies are providing new criteria on which to assess evolutionary relationships between grass and dicot floral organs and the process of floral organ specification. In spite of the morphological differences between grass spikelets and eudicot flowers, our results to date indicate that the genes orchestrating floral organ development and their respective activities have been largely conserved between the grasses and core eudicots.

Friday 7:30 – 8:15 pm

Towards nutritional optimization of a major staple: vitamins, iron, and essential amino acids.

Ingo Potrykus

Institute Plant Sciences/Swiss Federal Insitutue of Technology

The social and the scientific challenge. Malnutrition disorders are the cause for 24 000 deaths per day. Golden Rice represents a genetic engineering concept for development of nutrient-dense staple crops as contribution to reduction of malnutrition in developing countries. Major micronutrient deficiency disorders concern 1) protein/energy, 2) iron/zink, 3) vitamin A, and 4) iodine. These deficiencies are especially severe, where rice is the major staple crop. Traditional interventions such as distribution, fortification, dietary diversification, and measures against infectious diseases are helpful in reducing deficiency disorders, but they have not, and probably can not solve the problem. Statistics demonstrate that we are still faced with e.g. 2.4 billion iron-deficient women and children, and 400 million vitamin A-deficient children per year. Nutrient-dense staple crops offer the chance to complement the traditional interventions. Protein deficiency relates to the amount and the quality of dietary protein. Rice provides, with a typical daily diet of 300 g, only 10% of the required essential amino-acids. Asp-1, a synthetic gene, developed by Jesse Jaynes, and coding for an ideal storage protein, offered the opportunity to approach the otherwise difficult task of engineering appropriate amounts of nine amino-acids. The gene was placed under endosperm-specific control, and linked to an appropriate target sequence for the endosperm protein storage vesicles. A series of Asp-1-transgenic rice plants accumulate different amounts of the Asp-1 protein in their endosperm, thus providing the mixture of the essential amino-acids required. Iron deficiency caused by a rice diet is the consequence of 1) far too low amounts in rice of iron, 2) the presence of an extremely potent inhibitor of iron re-sorption, and 3)lack of any iron re-sorption-enhancing factors in a vegetative diet. Our engineering task for the endosperm was, therefore, to increase iron content, to reduce the inhibitor, and to add re-sorption-enhancing factors. Transgenic ferritin increased, so far, the iron content by two-fold; a transgenic metallothionin led to a seven-fold increase in re-sorption-enhancing cystein, and a transgene coding for a heat-stable phytase produced high inhibitor-degrading phytase activity.(P. Lucca et al. TAG 102: 392-396, 2001). Vitamin A-deficiency from a rice diet is due to the fact, that endosperm is totally devoid of any provitamin A. The introduction of transgenes for phytoene synthase, a phytoene / x-carotene double-desaturase, and lycopene cyclase completed the biochemical pathway to pro-vitamin A. Biochemical analysis of the polished rice kernels confirmed, that the yellow endosperm colour was due to varying amounts of provitamin A and further terpenoids of dietary interest. The concentration of 1.6mg/g may, according to experienced nutritionalists, be sufficient to prevent vitamin A-deficiency disorders from a daily diet of 200g of Golden Rice alone. Nutritional studies testing this hypothesis are in progress, but will require ca 18 months. (Xudong Ye et al., Science 287: 303-305, 2000). The challenge of free donation to developing countries. Golden Rice can contribute to relieve from malnutrition in developing countries only, if it reaches the poor free of charge and limitations. As the technology used to develop provitamin A-rice alone, made use of 70 IPR's, „freedom-to-operate for humanitarian use" became a major undertaking. The inventors solved the problem thanks to an alliance with the agbiotech industry. The rights for commercial use were transferred to industry which in turn supports the humanitarian project. "Humanitarian" is defined as income from Golden Rice per farmer or trader below $ 10 000 p.a. Thanks to this agreement the technology is now available via free licences to public research institutions for breeding and variety development. Transfer was, so far, to IRRI and PhilRice (Philippines), Department of Biotechnology, Delhi and Directorate of Rice Research, Hyderabad (India), Cuu Long Delta Rice Research Institute (Vietnam), Institute of Genetics, Academia Sinica, Beijing and National Key Laboratory of Crop Genetic Improvement, Wuhan (China), and Agency for Agricultural Research and Development, Jakarta (Indonesia). The challenge of safe technology transfer and variety development. To ensure proper handling of the GMO material, a "Humanitarian Board" has been set up, to supervise the choice of partners, to support further improvement, to overlook needs, availability, bio-safety, and socio-economic assessments, to coordinate the activities in the different countries, to support fund raising from public resources, to support deregulation, to facilitate exchange of information, and to mediate information of the public and general support for the humanitarian project. Members of the Board include G.Toenniessen, A.Dubock, W.Padolina, R.M.Russell, H.E.Bouis, G.Khush, K.Jenny, and the inventors P.Beyer and I.Potrykus. Variety development in the partner institutions is via backcrossing into or direct transformation of popular local varieties. Backcrossing requires ca. eight generations (or three years). Direct transformation may be faster and has already been achieved into a series of Indica varieties by the Vietnamese and Philippine partner institutions. Deregulation, of course, requires all the standard biosafety assessments for each single variety, and this again will take at least two years from the completion of the variety. The challenge of a radical GMO opposition and consumer acceptance. Golden Rice has, unfortunately, become a key topic in the fight between proponents and opponents of plant biotechnology in food production. A radical GMO opposition is the last major stumbling block, which might prevent that the poor in developing countries benefit from the project. Greenpeace and numerous other NGO's are determined to prevent success of Golden Rice, which they see as a "Trojan Horse", opening the road for the technology in developing countries. As the opposition has lost, with the Golden Rice case, all of their standard arguments used so far, and as the public and the media understand the moral dimension of the project, Greenpeace and the NGO's are trying to bypass a moral dilemma, by claiming that Golden Rice is useless anyhow, because children have to eat 9 kg/day. This is definitely wrong, but data to prove our view will, unfortunately, only be available in fall 2003.