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Biotic and Abiotic Stress Tolerance in Plants: the Challenge for the 21st Century

BOOK OF ABSTRACTS

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OPENING SESSION

OP01

The CIBA consortium

Cláudio J. Reis de Carvalho

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OP02

Embrapa Today and Tomorrow: R&D priorities

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Brazilian agriculture has faced many challenges in the past 50 years to be considered a case of success in tropical agriculture. Public policies, institutional building, growers entrepreneurship and technological inputs are key factors to explain this (re)evolution and will continue to play an important role in our future. Embrapa and all the other public and private institutions working for tropical agriculture are investing today in the science and technology that is going to be used tomorrow. Recognition that the current concept of 'agriculture' includes not only production systems, growers and arable land, but stretches from resource suppliers to consumers, is an important step to elect R&D priorities. Current R&D priorities include aiming at innovations for: the bioenergy sector; organic and agroecological-based systems; biological control; animal health; aquiculture; crop-livestock-forest integration; mitigation and adaptation to climate change; dynamics of land use; nitrogen biological fixation, native forest resources; automation and precision agriculture; alternative fertilizers; food, nutrition and health; biomass technology and green chemistry.

OP03

Population development to help resolve and move traits in genomics-assisted breeding

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Plant breeding programs evolve by developing a better understanding of genetic architecture of agricultural traits and making more use of it with minimal resource diversion from mainstream genetic gain accumulation. Thanks to new capacities for monitoring genome segregation, analytical approaches have evolved, shifting from specific experiments with ad hoc progenies to global analyses incorporated along the improvement process through new types of populations. An array of such populations is described here in order to illustrate current efforts at Cirad and IRD on a range of tropical crops. The leaders of these efforts and contributors of presentation materials are indicated in parentheses.

Annual crops allow quick constitution and management of novel populations which have specific features:

- Nested-Association-Mapping (NAM) populations in rice developed at CIAT and AfricaRice with IRD (Mathias Lorieux)
- Back-cross NAM (BCNAM) populations developed in sorghum at IER with CIRAD and ICRISAT (Jean-François Rami)
- Chromosome-segment substitution lines (CSSL) in groundnut developed at ISRA – CERAAS with Cirad, EMBRAPA and ICRISAT (Daniel Fonceka)
- Recurrent Selection populations in rice developed and used at CIAT with CIRAD for genomic selection (Cécile Grenier).

Vegetatively propagated fruit crops often find value in seedless types and often feature interspecific and intergenomic hybridization that fixed heterozygosity and sterility:

- banana and plantain improvement requires pre-breeding prior to sterility-generating combinations, leading attention to the causes for restriction to recombination and segregation distorsions (Angélique D'Hont).

Perennial crops often have a peculiar history that heavily impacted their population structure:

- sugarcane has a short breeding history featuring interspecific hybridization from a limited number of founders which led to strong linkage disequilibrium (LD) and allows genome-wide association studies
- cacao has a history of migrations and spontaneous hybridizations that resulted in admixture patterns enabling LD-based association mapping (Claire Lanaud).

All these examples suggest new modes of interaction between breeding programs. Exchanges of materials, when feasible, enable compilation of characterization efforts on the same materials, leading to a deeper understanding of biological variation. Exchanges of genotypic information enable linking geographically separated activities through identity by descent between haplotypes and its extension to genetic factors for agricultural traits. This is particularly important at a time of global changes and quick evolution of adaptive constraints.

OP04

The role of gibberellin in the response to drying soil

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Limitations in water supply constrain crop yields, leading to both economic losses and food insecurity. In order to develop crops that maintain productivity with less water it is necessary to understand the mechanisms by which plants regulate their responses to dry soils. There is accumulating evidence that gibberellins (GAs) mediate responses to environmental stress. We are investigating the role of GAs in response to drought in the model plant *Arabidopsis thaliana*, and the crop species wheat (*Triticum aestivum*). In Arabidopsis, mutants altered in GA metabolism and signal transduction were used to investigate the influence of GA signalling on morphological parameters and stress tolerance under drought. Transcriptional responses to progressive soil drying monitored by RNA sequencing and quantitative RT-PCR revealed changes in expression of a number of GA metabolism and signalling genes. The GA-inactivation gene *AtGA2ox1* and the DELLA gene *RGL3*, which encodes a GA-regulated growth repressor, were up-regulated by drought, while several GA-biosynthesis genes were down-regulated. In wheat, while *TaGA2ox3* is up-regulated in leaves during soil drying its expression is down-regulated in roots, consistent with a redistribution of growth in response to the stress. As well as limiting water and nutrient availability, drying soil becomes stronger, imposing a mechanical impedance to root growth, the severity of which depends on the soil type and degree of drying. Leaves of wheat seedlings growing in strong soil with normal water and nutrient availability were shorter than those on plants in weaker soil, and this restriction in leaf growth was fully rescued by application of GA to the soil. However, the applied GA further reduced root elongation and tiller numbers in strong soil, indicating that GA signalling does not mediate the effect of soil strength on these parameters. Strigolactones are shown to be candidates for mediators of the tillering response to strong soil.

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