



Component 2

Multi-site trial
model assisted trait evaluation
for breeding

Agropolis CIRAD
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EMBRAPA

Field phenotyping

Consideration for GCP

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Debate: Difficulties of complex/fine trait phenotyping in the field. Usefulness of modelling. Lessons learned and perspectives.

- Different applications for phenotyping :
Physiology, Genetic studies and Selection per se
- Different needs, levels of comprehensive measurement, models
- A constant : what to measure, how, when, where ?
- Traits packages vs tests of hypothesis : which trait for which strategy ?

So, can modeling and heuristic approach in general contribute to better phenotyping protocol ? how can we reconcile the need for increasing throughput with the need to reproducible phenotype in the field ?



Modeling can help us to identify adaptation traits and to evaluate their impact on plant performance in TPE by :

- + Making a hierarchy of characteristics contributing to DT in a specific climatic scenario and then define ideotype
- + Making easier the analysis and interpretation of experiments or better designing experiment - “***using modeling as an analytical framework***”

What we still need to be done face to heterogeneity in field trials (soil, phenology, rooting depth,...) :

- *effectively characterize the environmental conditions*
- *manage the stress*
- *use appropriate germplasm*



Modeling is a tool to dissect variability for plant response to drought and access to process-based traits :

- + sort out hidden parameters (response curves, threshold or time course for response to state variables,...) with biological meaning: process-based traits
- + better access to relevant genetic factors
- + allow comparative studies and test of hypothesis

Field phenotyping for process-based traits is a challenge because we need to screen for and describe the genetic variance of thousand of progenies and accessions

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- We need to provide the breeders with high throughput methods , traits with high h^2 (no GxE interaction),...
- Thanks to new tools we can access to physiological traits :
IRT imaging / canopy temperature, transpiration rate
(visible=) remote sensing / NDVI (plant vigour, LAI, staygreen,...)
porometers / plant water status
- We have to capture the variance in multi-traits, multi-environments trials with appropriate statistical design



DEBATE :

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**Difficulties of fine trait phenotyping in the field. Usefulness of modeling
Lessons learned and perspectives.**

=> go back to the question : reach the breeder's demand

- What are the critical issues in field assessment ?
- Are there any new results (proof) for application in screening ?
- Which GCP field phenotyping platform for which applications ? Lessons from modeling ?
- Open questions...

MET, MSE
G x E x M



What are the critical issues in field assessment ?

- Tools for characterization of environmental conditions ?
- Identification of the nature of the limitations experienced by plants : which importance attaching to interaction between stresses (soil acidity, N limitation, high temperature & drought) ? (Biophysics vs *using probe genotypes* ?)
- How to account with heterogeneity (plant phenology, soil, root depth)?
- What do we expect from GIS, statistical design?
- How to move from unpredictable to managed stress environments ? Incidence of cropping practices ...
- Is genetic characteristics of tested germplasm a problem ? *Which perspectives on heterosis ?*

...ex DPN

MET, MSE
G x E x M



Are there any results for application in screening ?

- How promising is imaging (IRT, spectroradiometry,...) ?
- Do have new tools and modeling the same role ?
- How modeling, statistics can help to select traits related to GY architecture under drought and estimate GY stability across environments ?

MET, MSE
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- Desire for phenotyping support service : Which GCP field phenotyping platform for which applications ?
Lessons from modeling ?

- Interests and limits / breeders perspectives, GCP context, crop-physiologist and modelers concepts ?
- Phenotyping as a technique or as a scientific process per se?
...ex Rice project...

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=> go back to the question : reach the breeder's demand (session3)

- Are we closer to understand DT traits or to identify new traits ?
- Which trait for which genetic strategy ?
- Which model for which traits in the context of field phenotyping