Epigenetic regulation of flower development in the oil palm

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Why studying the oil palm at all?

• Because it is the 1\textsuperscript{st} world source of vegetable oil and consumption for food and energy can only rise with increasing population.

• Because its \textit{mantled} floral phenotype provide an original model where agro-economical interests fuel the search for basic knowledge in a tropical perennial.
Characteristics of the *mantled* phenotype

- Somaclonal variation: arises from *in vitro* cloning
- Alteration of floral organs: poor oil accumulation, infertility, *visible in adult trees only*
- Highly heterogeneous: frequency, severity, genotype effect
- Unstable: spontaneous reversion
Dealing with *mantledness* from both ends of the cloning process

- Working on adult palms to understand the molecular origin of the floral phenotype
- Working on *in vitro* cultures to test potential markers for early detection
A few things we know about *mantled*

- No genetic/cytologic alteration
- Non-mendelian inheritance
- Hypomethylated genome
  
  ![Chemical flasks](image1)
  
  ![Plant](image2)
  
  -19.3%
  
  -7.4%

- Altered gene transcription

- Phenotype: stamen converted into carpels, reminiscent of B-class MADS-box gene mutants

![Wildtype flower](image3)

![B mutant flower](image4)
The hypothesis

• Epigenetic mechanisms regulating gene expression are perturbated by the cloning process (hormones, re-programming)
• Most of these alterations have no detectable impact on the phenotype and/or subside
• The pathway governing floral organ formation remains affected in the adult stage (sensitivity shared amongst Palms?)
The strategy

• *In vitro* material: investigating the genomic and epigenetic stability during the tissue culture process

• Adult (inflorescence) material: exploring the epigenetic regulation of flower development
The strategy

- *In vitro* material: investigating the genomic and epigenetic stability during the tissue culture process

  Follow-up on the phenotypic stability in the field

- Adult (inflorescence) material: exploring the epigenetic regulation of flower development
The strategy

- *In vitro* material: investigating the genomic and epigenetic stability during the tissue culture process

- Adult (inflorescence) material: exploring the epigenetic regulation of flower development

  Tracing back the origin of the *mantled* phenotype
Investigating the stability of cell cultures

Seed-derived palm

Cloning 1

Normal regenerant

Mantled regenerant
Investigating the stability of cell cultures

Seed-derived palm

Cloning 1

Normal regenerant

Cloning 2

« Normal » cell lines

Mantled regenerant

Cloning 2

« Mantled » cell lines

Propagation over 1 year, periodical samplings for DNA/RNA extractions
Exploring the epigenetic regulation of flower development

Floral MADS-box genes

Chanderbali et al., 2010
Exploring the epigenetic regulation of flower development

Polycomb-group genes

Floral MADS-box genes

Transposable Elements

Transcription factors

Chanderbali et al., 2010
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Floral MADS-box genes

Polycomb-group genes

Different epigenetic marks in mantled flowers?

Transposable Elements

Different mRNA/sRNA levels in mantled flowers?

Transcription factors

Bisulfite, ChIP

RNAseq, Q-PCR

Chanderbali et al., 2010
« Things written in pen you can’t change. That’s DNA. But things written in pencil you can. That’s epigenetics »

Danielle Reed, geneticist
*National Geographic, January 2012 issue*

Thank you for your attention