An Epigenetic Approach of Somaclonal Variation in the Oil Palm

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The oil palm is a non-model crop

- Oil palm is the 1\textsuperscript{st} source for vegetable oil
- Fat consumption for food and energy is increasing with growing population and living standards
- A vector for development and poverty alleviation
- A strategic crop in South East Asia
The oil palm is a non-model crop

- A tropical perennial Monocot
- Very limited genomic resources to date
- Research in genomics is scattered amongst National Institutions and private sector
- Three different Genome Sequencing Initiatives
- No genome sequence publicly available to date
... but it provides an amazing model!

- Large scale micropropagation has generated somaclonal variation
- Public/private partnership fuels the search for basic knowledge
- The *mantled* floral phenotype provides an original support for epigenetic studies
Things written in pen you can’t change.
That’s DNA.

But things written in pencil you can.
That’s epigenetics »

Danielle Reed
Geneticist
The **mantled** phenotype

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

- On adult clonal palms: understanding the molecular origin of the floral phenotype
- On *in vitro* cultures: generating and assessing potential markers for early detection
A few things we know

- No cytogenetic alteration
- Non-mendelian inheritance
- Hypomethylated genome

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

1. Epigenetic mechanisms regulating gene expression are affected by somatic embryogenesis.

2. Somatic embryogenesis driven by cycles of dedifferentiation / redifferentiation under the control of plant growth regulators.

3. The pathway governing the identity of flower whorls remains modified at the adult stage.
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
Investigating the stability of cell cultures

Global DNA methylation rates

S-Sap Analysis of Transposable Elements

Transcriptomics analysis, Q-PCR on target sequences
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

Chanderbali et al., 2010

Transcription factors
Exploring the epigenetic regulation of flower development

Polycomb-group genes

Floral MADS-box genes

Different epigenetic marks in *mantled* flowers?

Bisulfite sequencing, ChIP

Different mRNA/sRNA levels in *mantled* flowers?

RNAseq, Q-PCR

Transposable Elements

Transcription factors

Chanderbali et al., 2010
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Thank you for your kind attention

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