



**XX OIL PALM**  
International Conference

THE TRANSFORMATIVE  
POWER OF OIL PALM

## Translating Genetic Discoveries into Elite Oil Palm Planting Materials in Sime Darby Plantation

Chee-Keng Teh, PhD. (Sime Darby Plantation R&D)

## Understanding the limitation...

# Conventional breeding programme



*Dura* ( $Sh^+Sh^+$ )

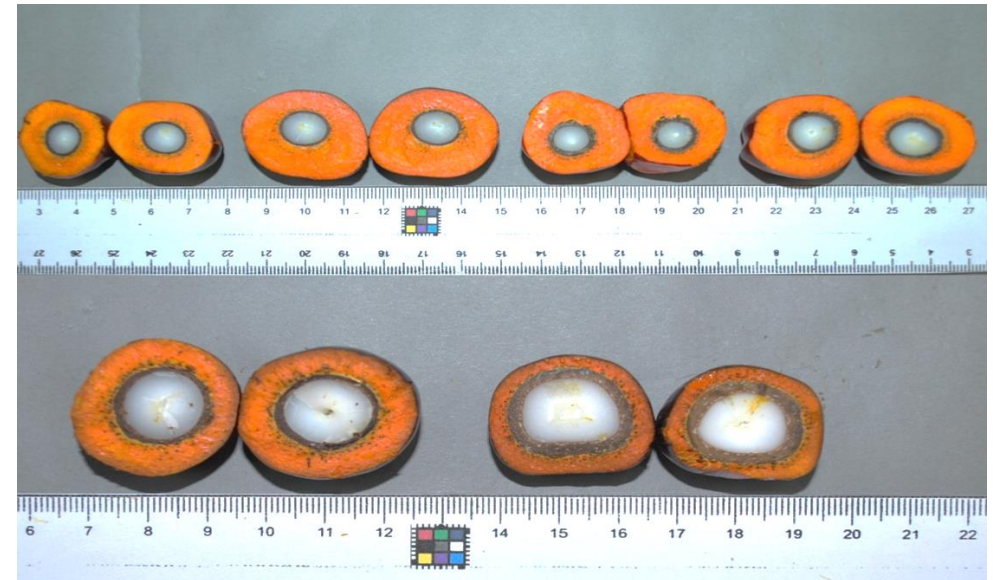


*Pisifera* ( $Sh^-Sh^-$ )  
**Female sterile**



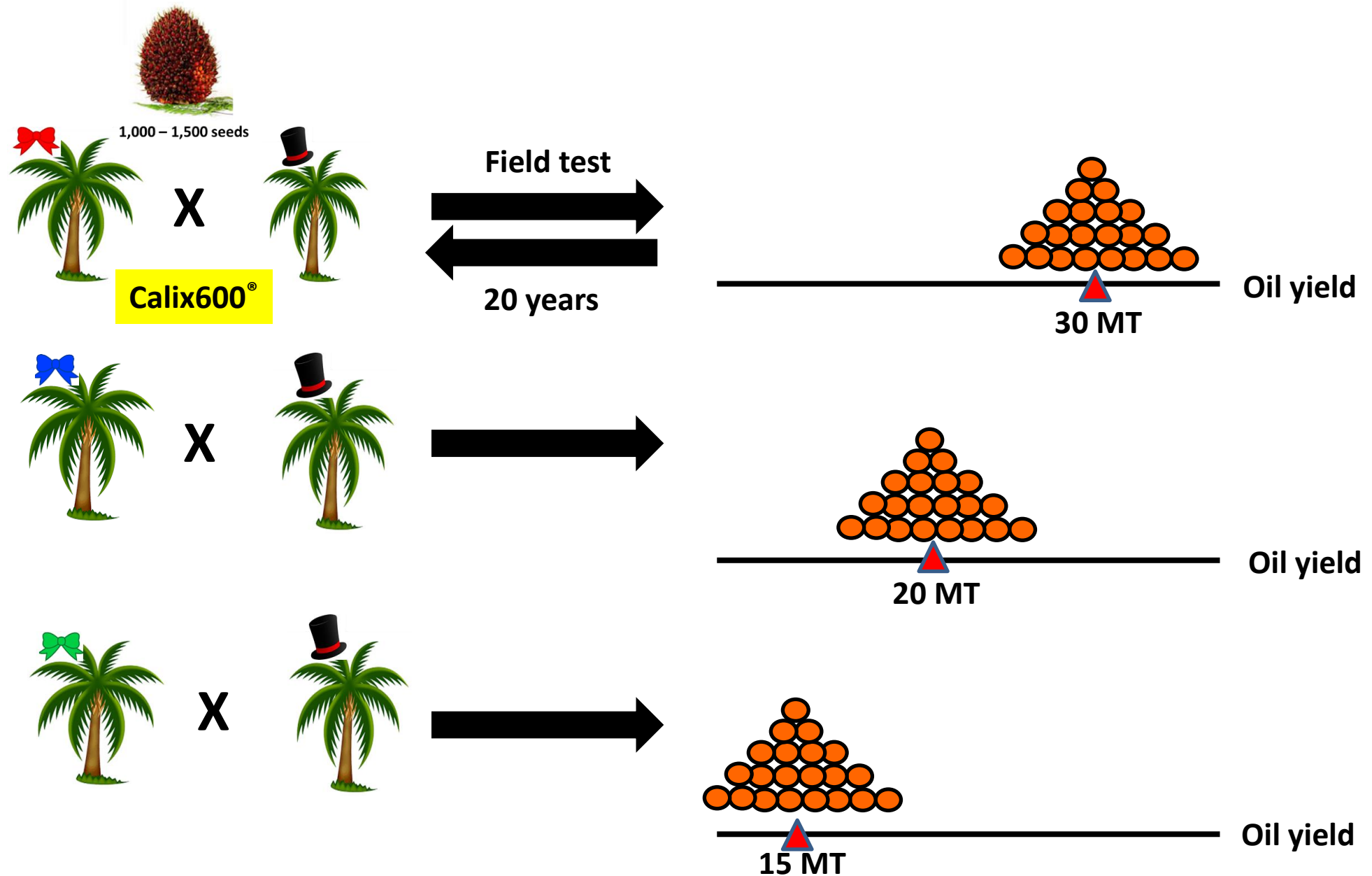
*Tenera* ( $Sh^+Sh^-$ )

**30% more oil**  
**Fertile**

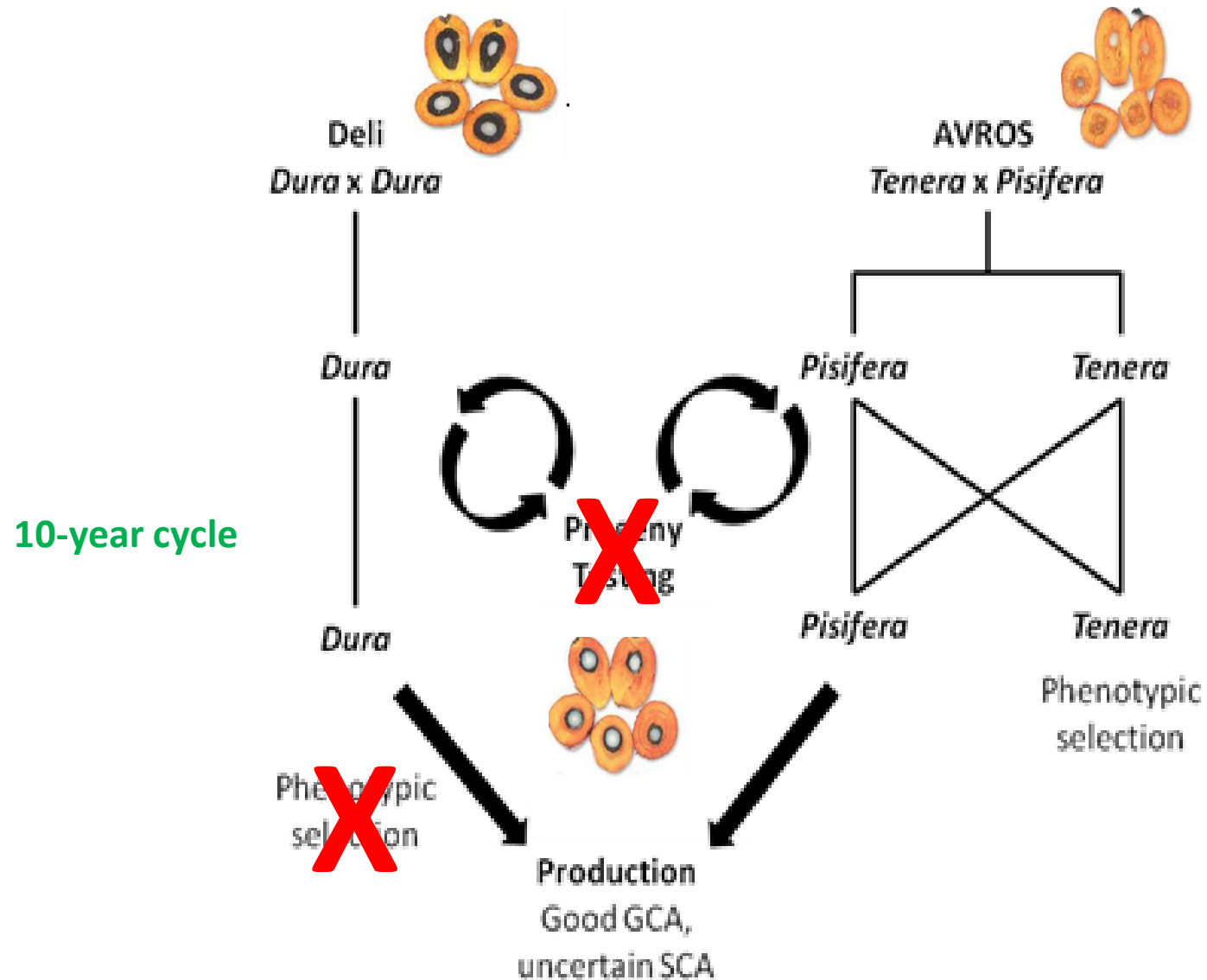


*All tenera, but...*

# Conventional breeding programme



# Conventional breeding programme

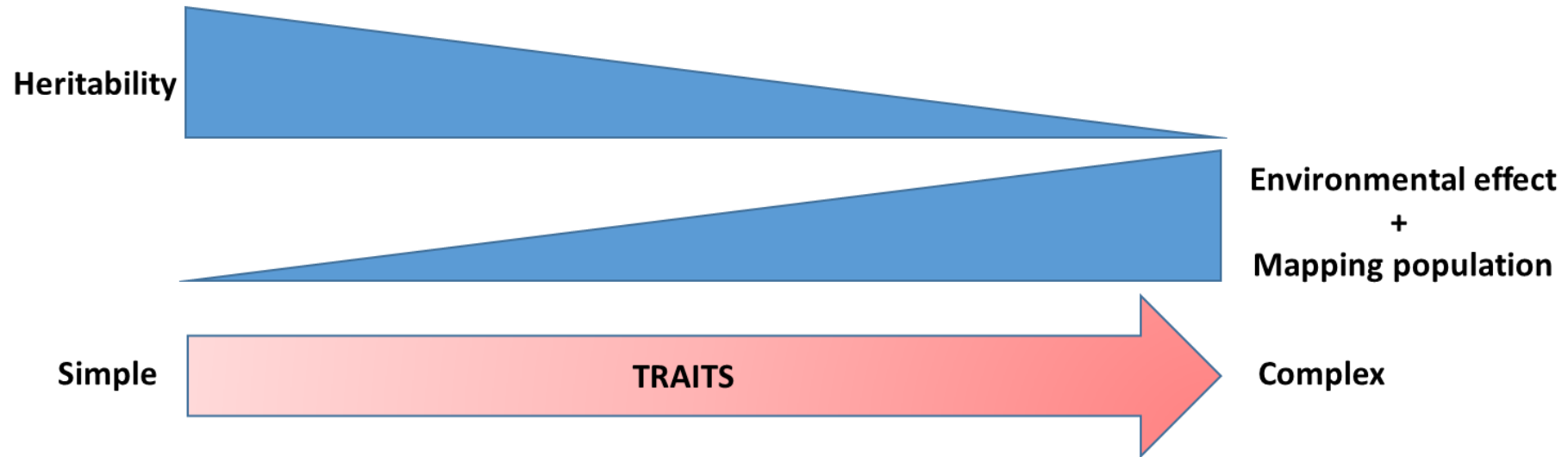


We have to accelerate the breeding progress using DNA marker technology.

## Discovery Phase: Genetic modelling for oil palm traits



# What are we pursuing?



Shell  
Virescens



S/F, M/F, K/F  
Dwarfism  
Oil quality



Disease resistance  
Stress resistance



Oil yield (O/P, FFB)



# Understand the control and then predict



Plant cell



Genome



ATCGGTCGAGAGAGAATGAT

TAGCCAGCTCTCTTACTA



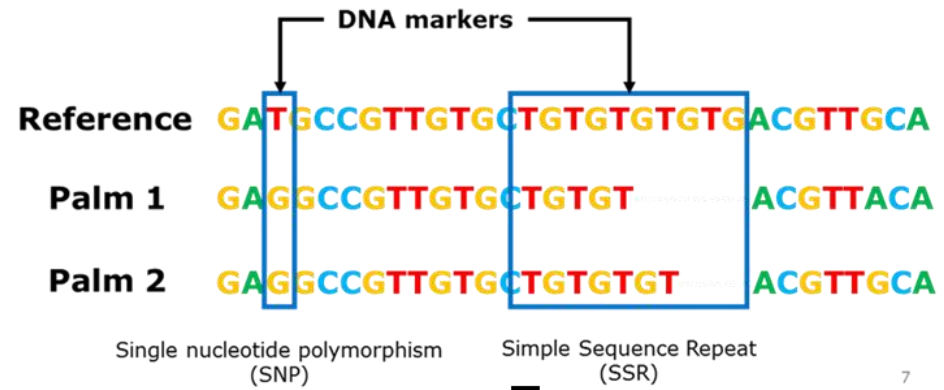
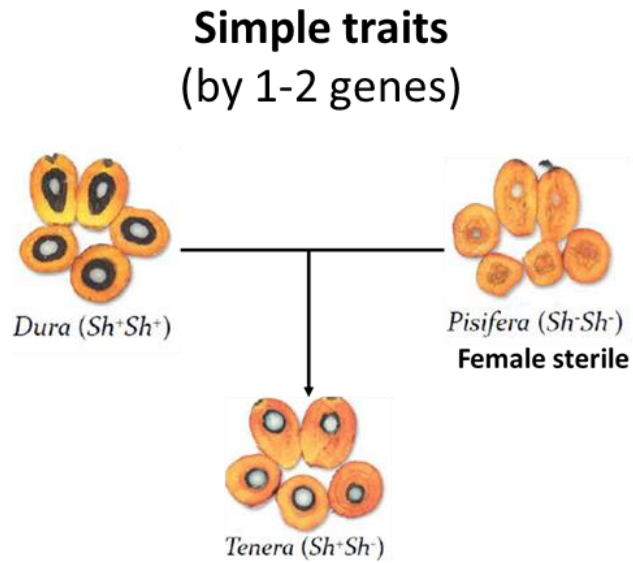
Human Genome  $2n=46$



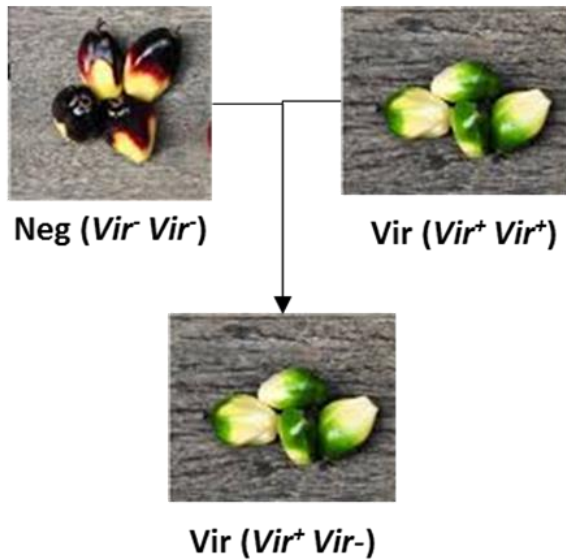
- ❖ Sequencing the genome is just the first step!
- ❖ Keep on placing missing puzzles



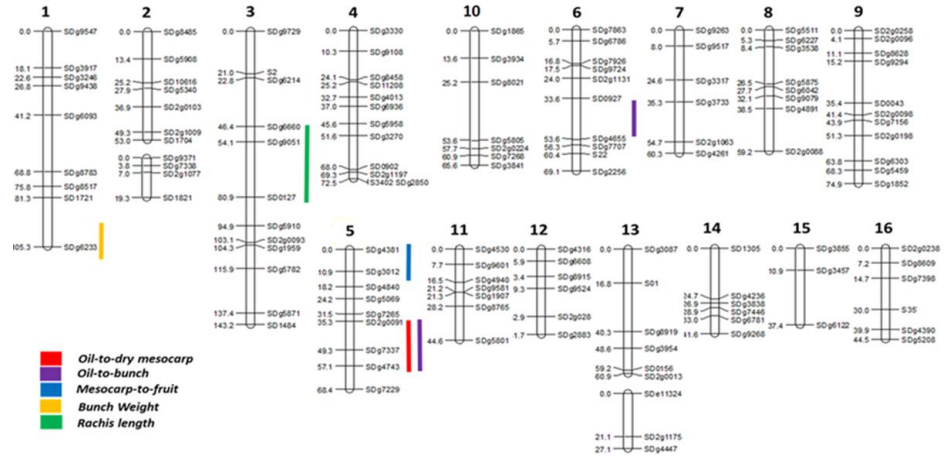
# Understand the control and then predict



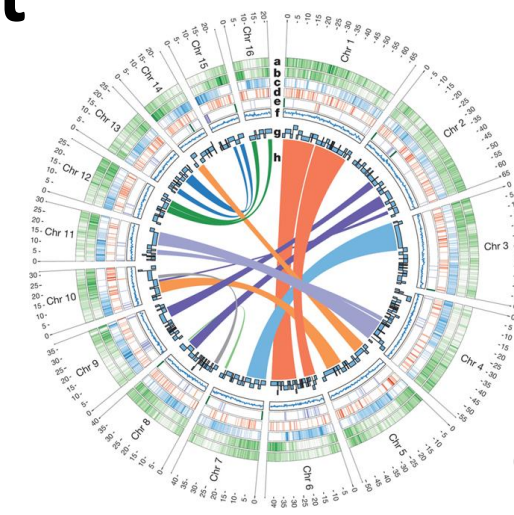
**Complex traits**  
(by many genes)



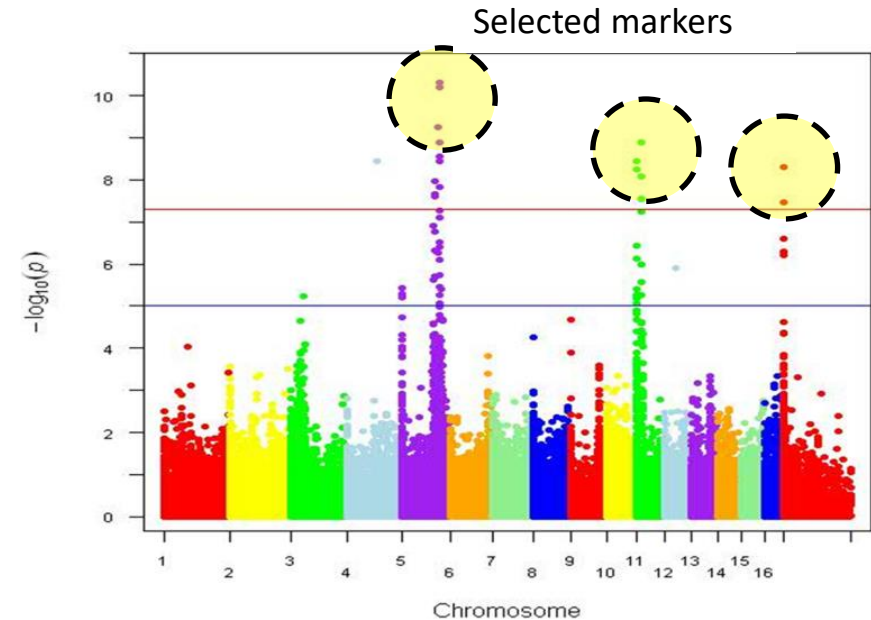
# Understand the control and then predict



Family-based linkage map

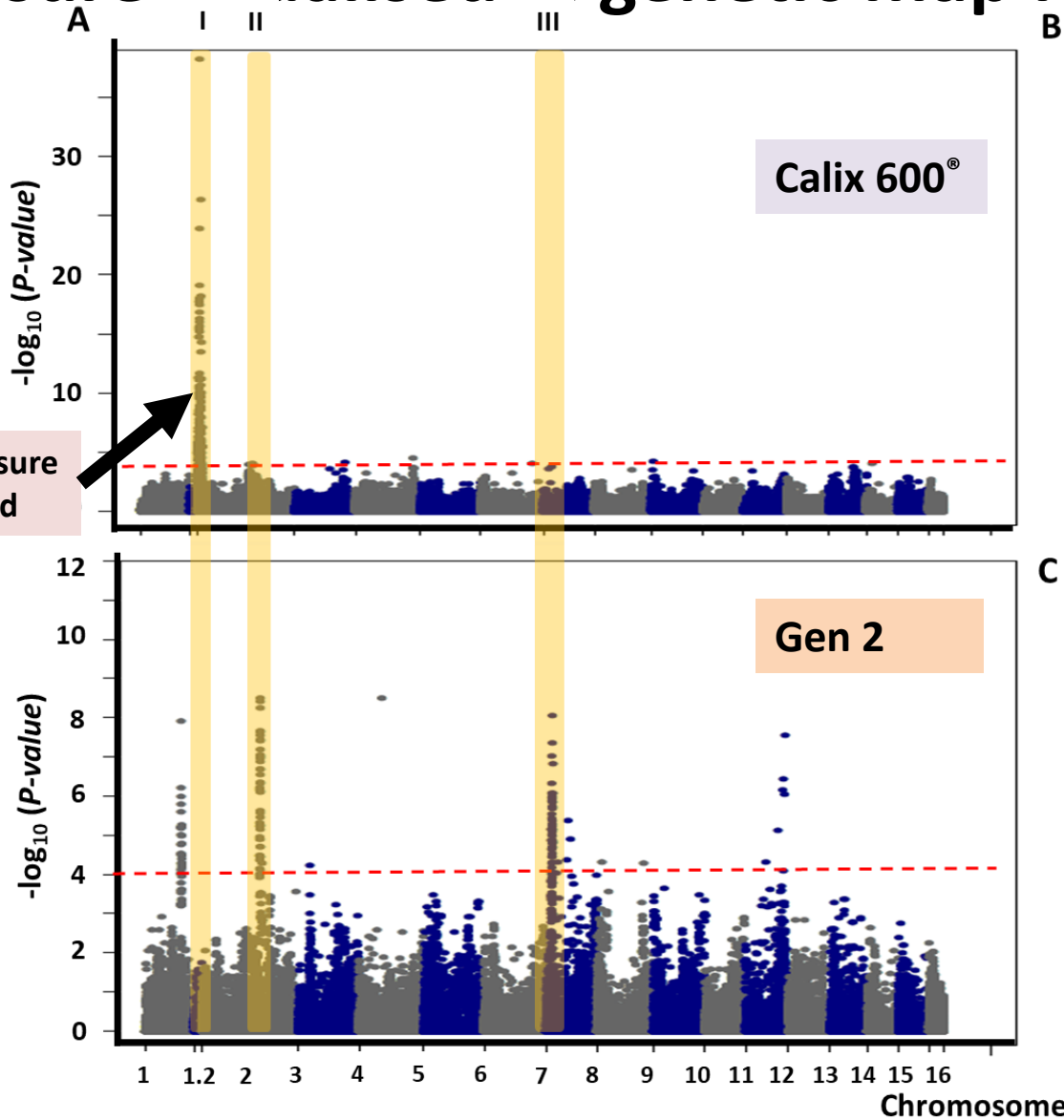


Oil Palm Genome, P5-build (Singh et al. 2013)

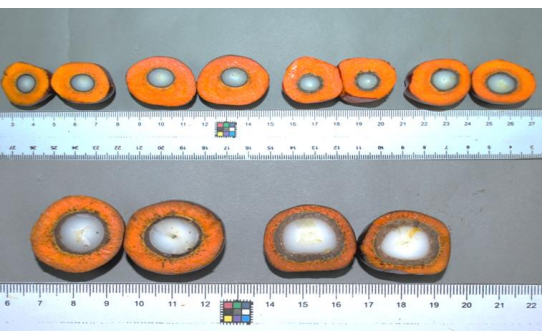
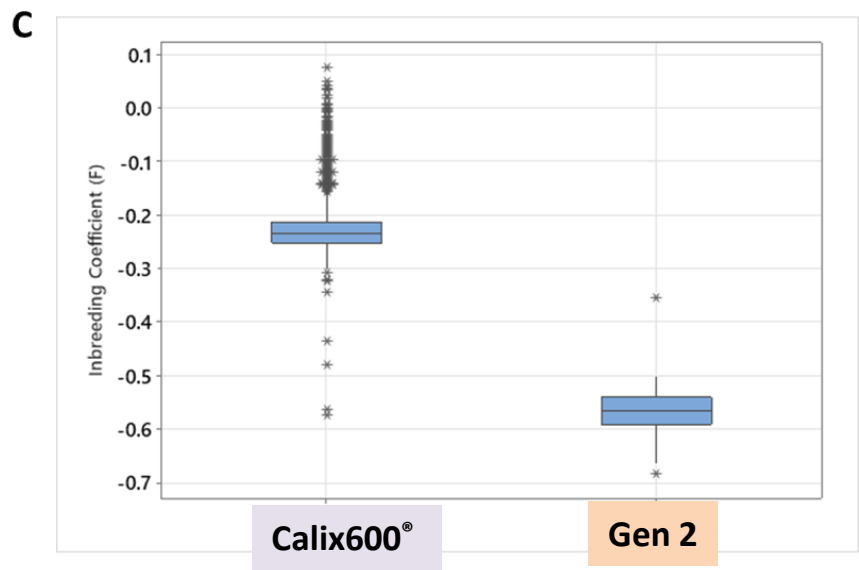
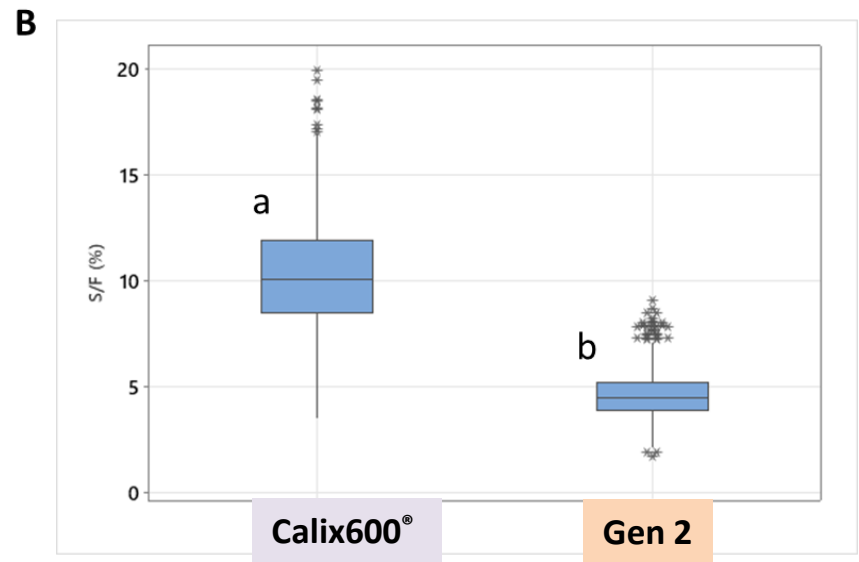


Genome-wide association study (Teh et al. 2016)

# Selection pressure visualised in genetic map for the first time



Major selection pressure  
Major QTL diminished



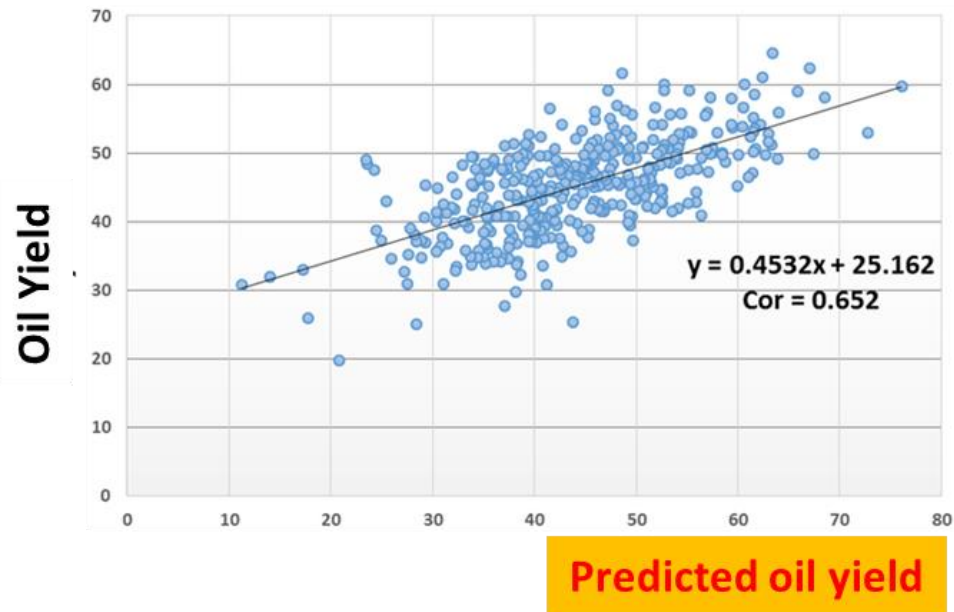
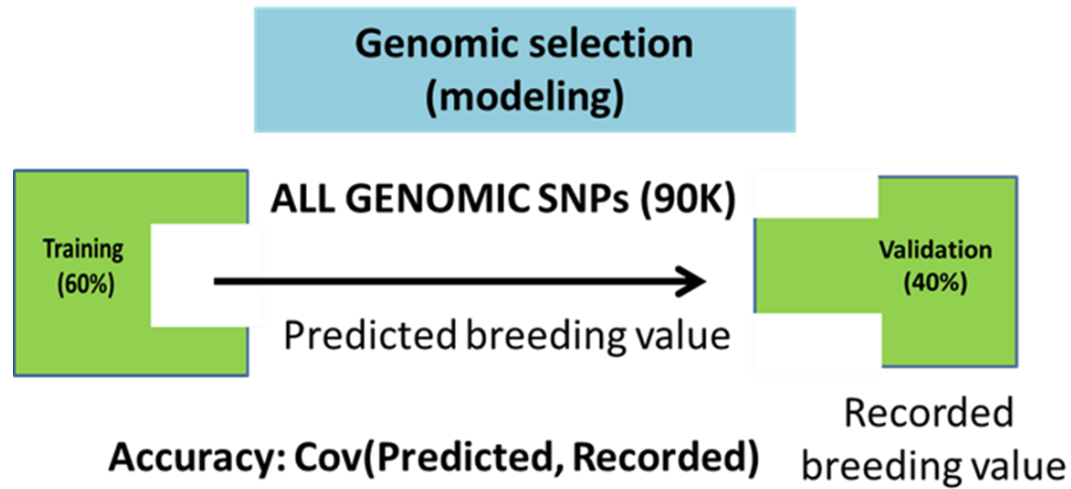
Shell/Fruit in *Tenera*

Selection pressure on Shell/fruit and allele fixation on Chromosome 2 observed

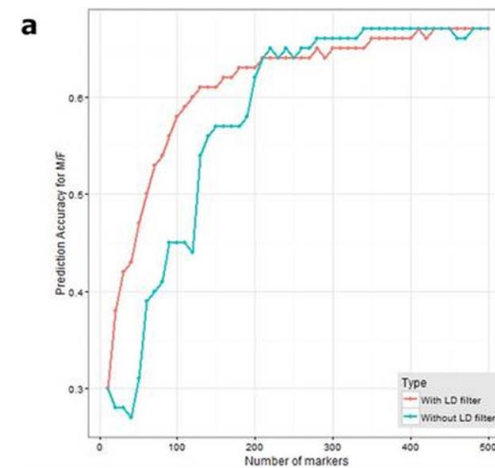
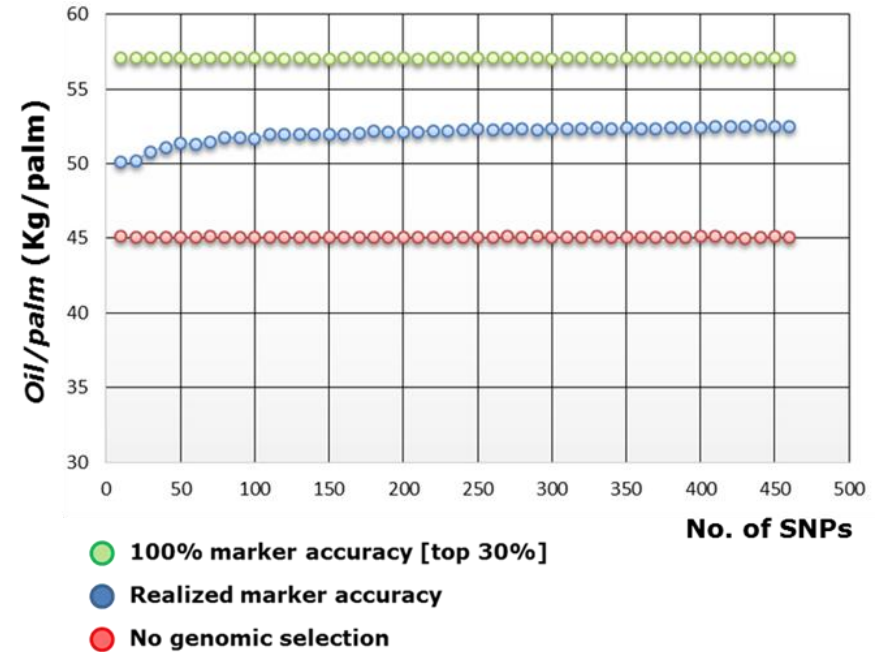




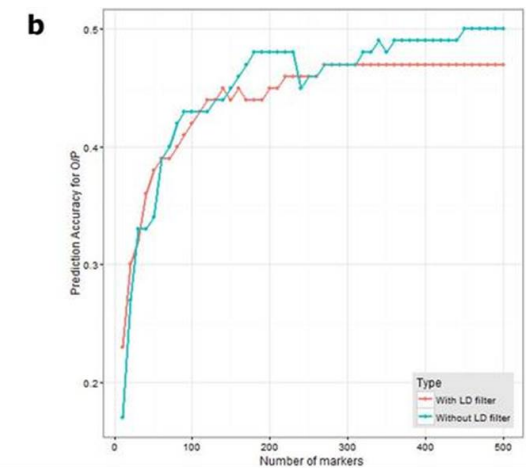
# Maximising the whole genome effect



**Prediction accuracy**



**Higher heritability**



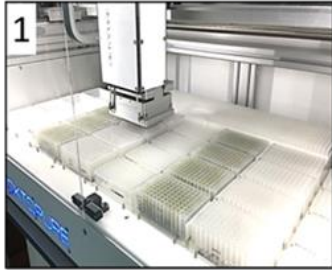
**Lower heritability**

Better result in heritable trait with QTL ranking (Kwong et al. 2017)

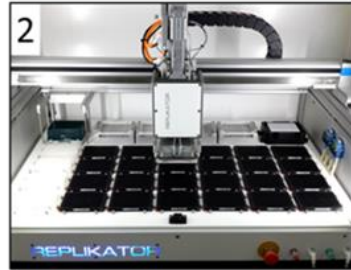


## Deployment and Validation: GenomeSelect™

# Throughput and robust genotyping platform is key



**1 DNA extraction**  
❖ 30,000 samples/month



**2 DNA dispensing**  
❖ Automated liquid handling



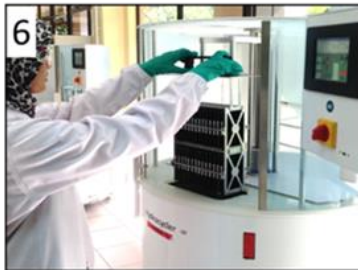
**3 Plate drying**  
❖ Drying of plates in oven



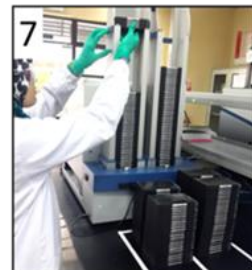
**4 Assay dispensing**  
❖ 5,000,000 data points/month



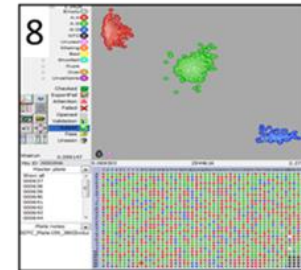
**5 Plate sealing**  
❖ Thermal and laser sealing of plates



**6 DNA amplification**  
❖ Water-based thermal cycler



**7 Plate reading**  
❖ Fluorescence based detection



**8 Genotype scoring**  
❖ 5,000,000 data points/month



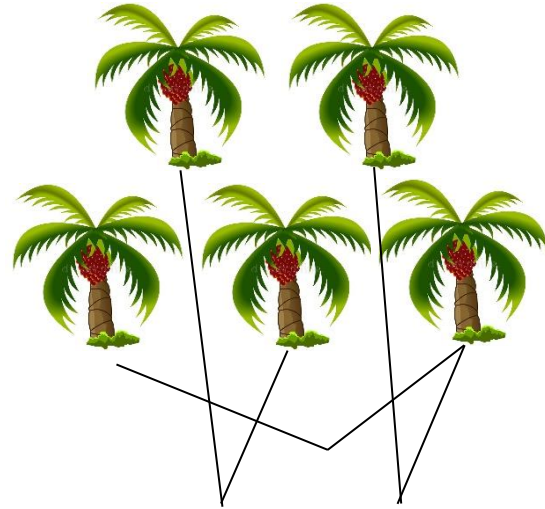
**Robust and high-through genotyping system (LGC Genomics)**

**SNP arrays for routine screening:**

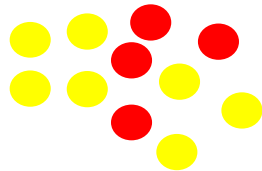
- ❖ OP200K
- ❖ GS1000™
- ❖ Legit100™
- ❖ Legit200™

# Cost reduction

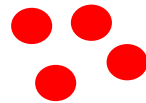
GenomeSelect™ version 1



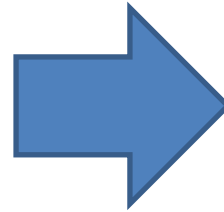
Test 6M seeds



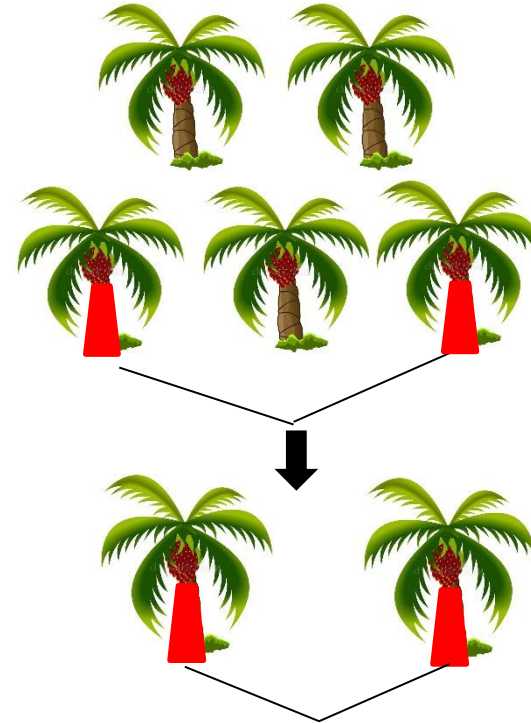
Select best seeds  
(+16% oil yield)



Plant 2M GS seeds



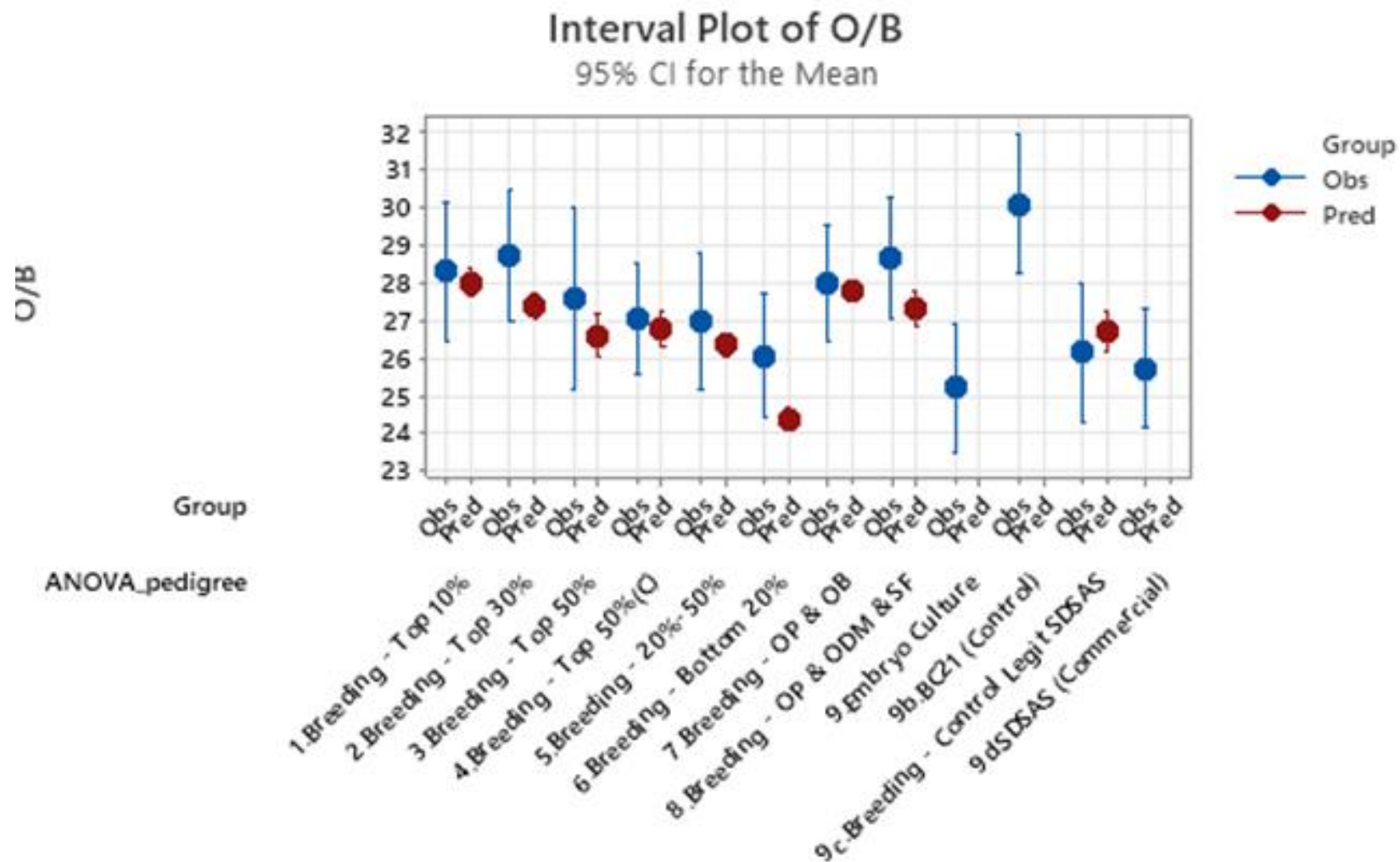
GenomeSelect™ Version 2



Reduced 99% production cost!



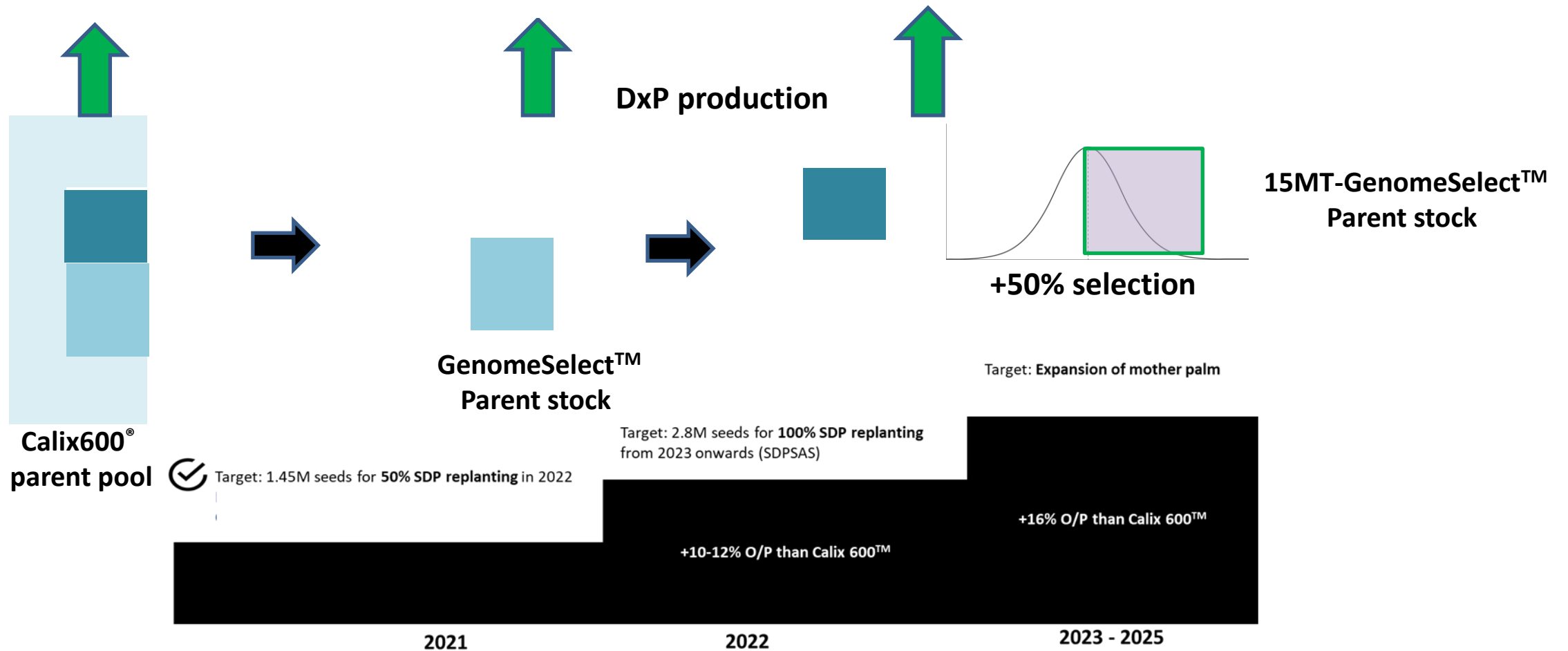
# Recording and prospective validation ongoing



*Individual standard deviations are used to calculate the intervals.*

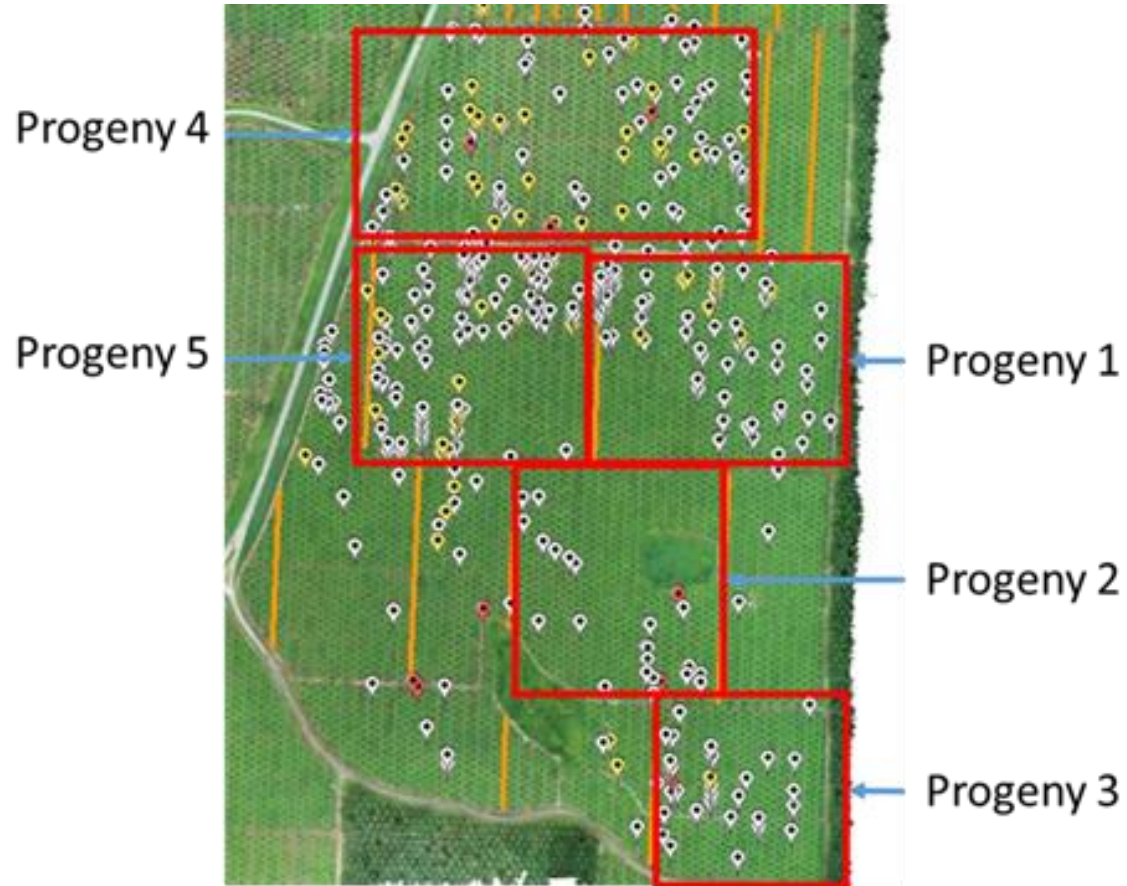
**Pred – GS prediction vs. Obs – field data**

# Recording and prospective validation ongoing





# Recording and prospective validation ongoing

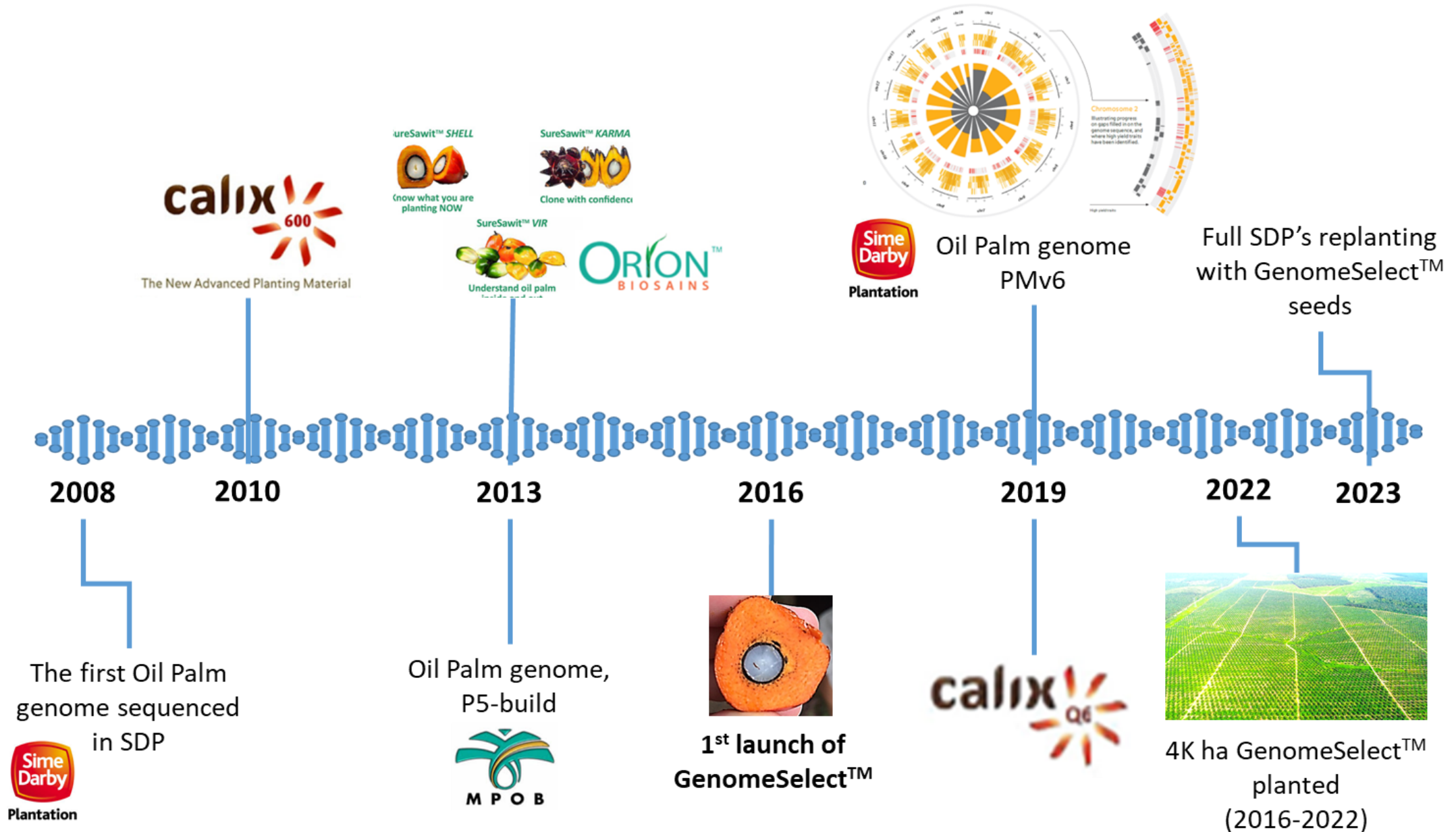


GPS-tagged commercial planting (by progeny)



- ❖ Combining trial and commercial planting
- ❖ New opportunity for other traits (Crown disease, P&D)
- ❖ Genetics x Environment interaction

# Seed production and upscale





# Future-proofing oil palm planting materials



100% external sales

The New Advanced Planting Material



+15% total oil/palm



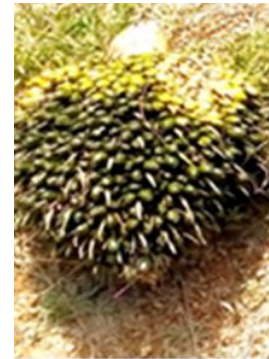
GenomeSelect™

Calix600®

Uniform thin shell and kernel size by

**GenomeSelect™** fixating S/F loci

100% SDP Replanting



Virescens



Loose fruit

**SD900 Programme**



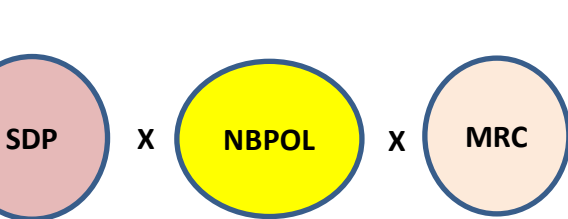
Ganoderma susceptibility



Crown disease



Drought susceptibility



Breeding materials & germplasm  
Multi-location evaluations

**Integrated Breeding**



Long stalk



Short palm



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Thanks