Breeding for Sustainable Palm Oil Production

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Introduction to Felda Global Ventures

VISION

To be the leading globally diversified integrated agri-business

MISSION

To be a global leader by:

- Creating value through our human capital
- Championing our locally invested culture
- Building an integrated value chain advantage
- Cultivating diversification in commodities and geography

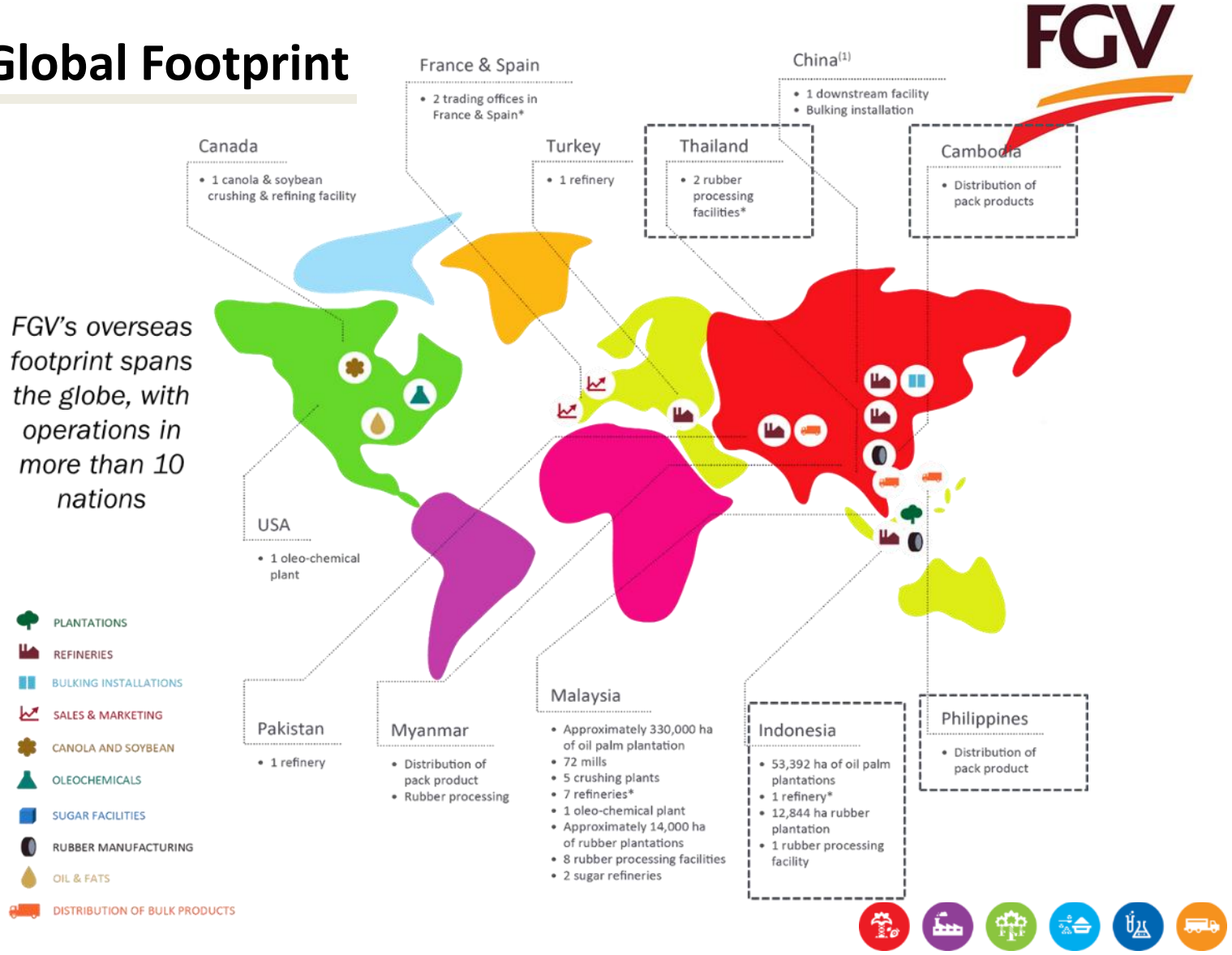
Felda Global Ventures Holdings Berhad (FGV) is a global, diversified and sustainable integrated agri-business leader, dynamically advancing to lead as a top 10 global player by 2020.

Incorporated in Malaysia in 2007, FGV progressed into a diverse agri-business company and rapidly established itself as Malaysia's leading global agri-business player.

Today we are the world's largest producer of crude palm oil (CPO), a leader in Malaysia's sugar industry and a pioneer of cutting edge green technologies, anchored by a 18,000 strong workforce and a global integrated supply chain able to add value to every endeavour.

Global Footprint

FGV's overseas footprint spans the globe, with operations in more than 10 nations



Our Overall Value Chain

Palm Upstream Cluster
+ The world's largest CPO producer
+ Forms the core of the company

Palm Downstream Cluster
+ Innovating new palm-based products
+ Processing of crude palm oil into refined oils & focuses on FMCG

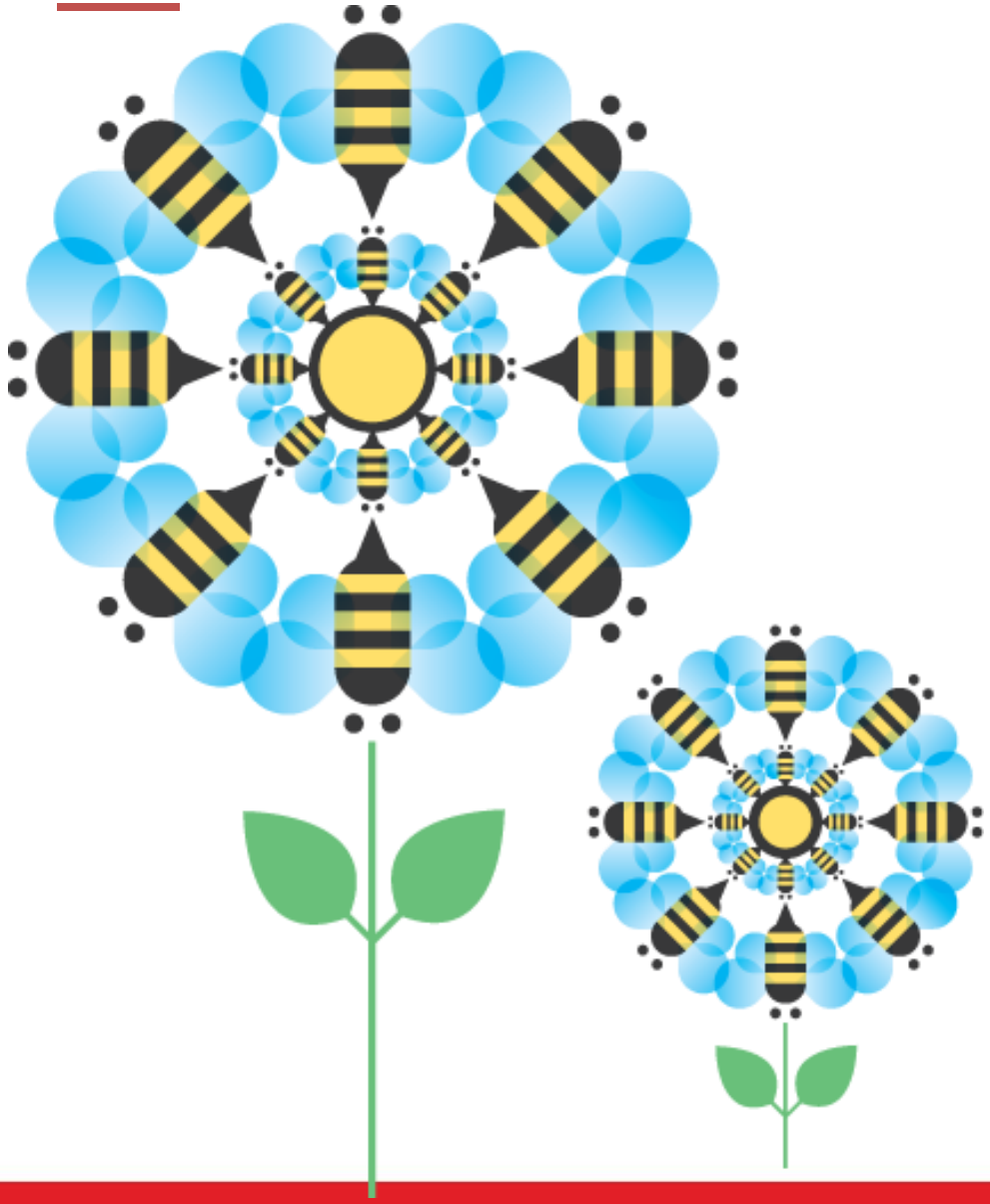
Sugar Cluster
+ Malaysia's leading refined sugar producer
+ Operated through MSM Malaysia Holdings Berhad, a listed company on Bursa Malaysia

Rubber Cluster
+ Top 5 global processed rubber player

Trading, Marketing and Logistics Cluster
+ Ensures FGV's integrated supply-chain support
+ World's largest bulking installation for vegetable oil
+ One of the global palm oil trading house

R&D and Agri-Services Cluster
+ Breeding disease-resistant, high-yielding oil palm
+ Improving the yield of selected agri-crops through breeding, tissue culture agronomy & crop protection

R&D and Agri-Services Cluster



Utilizing cutting-edge technologies across all facets of FGV

FGV's world class R&D and Agri-Services Cluster is anchored on four decades of research and development. The Cluster's key objective is to utilize cutting-edge agriculture technologies to enhance operational performance and commercial utilisation across all facets of FGV. The company's award-winning Yangambi oil palm planting material, which has 42 percent market share in Malaysia, is just one of R&D's innovative products.

Award-winning oil palm seeds

Seeds SOLD
24.1M

 # No.1 Market Share
42%

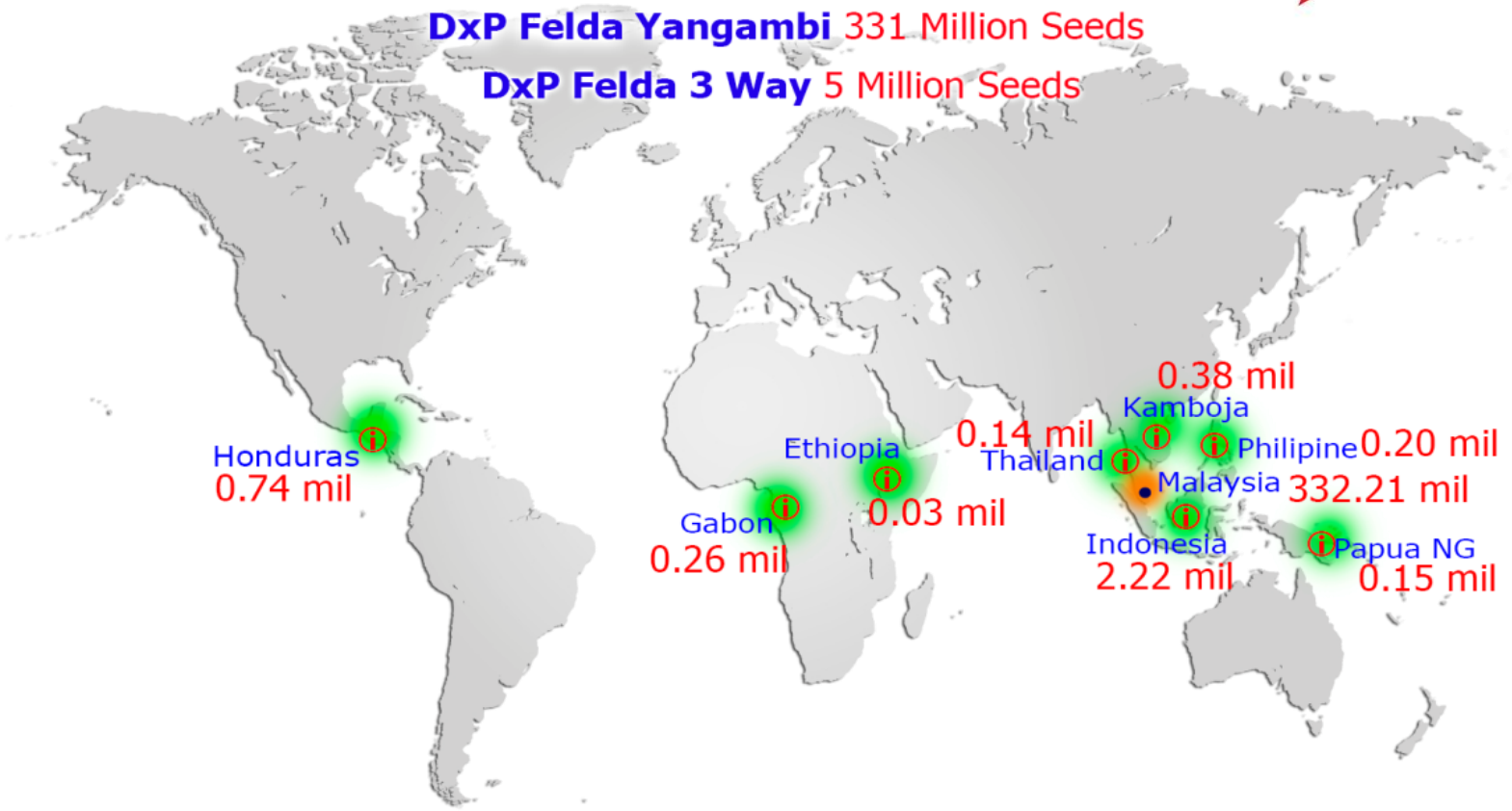
Malaysia, 2014

DxP Yangambi ML 161 Germinated Seeds Capacity	:	40.0 million p.a.
Ramet Clonal Seedlings Capacity	:	2.5 million p.a.

ALL THE WORLD 336 Million Seeds

DxP Felda Yangambi 331 Million Seeds

DxP Felda 3 Way 5 Million Seeds



OIL PALM BREEDING PROGRAMME

Existing Variety

SCREENING & SELECTION

CROSSING

TRIALS

PRODUCTION

Elite Variety

Wild or Improved Collection

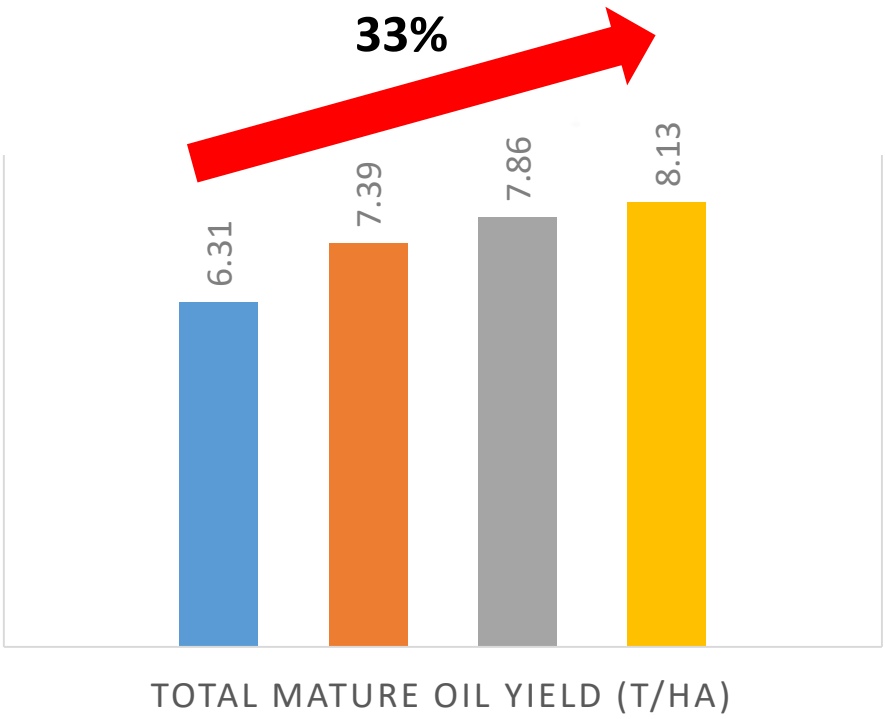
Phenotypic & statistical selection	Molecular breeding through marker selection

YIELD		
GANO. D. TOLERANT	HIGH DENSITY	DWARF
DROUGHT TOLERANCE	VIRESCENS	FERTIZER UPTAKE EFF.
HIGH IV, UNSATURATED	HIGH CAROTENE	*BUD ROT D. TOLERANCE
LOW LIPASE	DELAYED HARVESTING	LONG STALK

Type of Production		
DxP Seed	Clonal Seed	Ramet
		

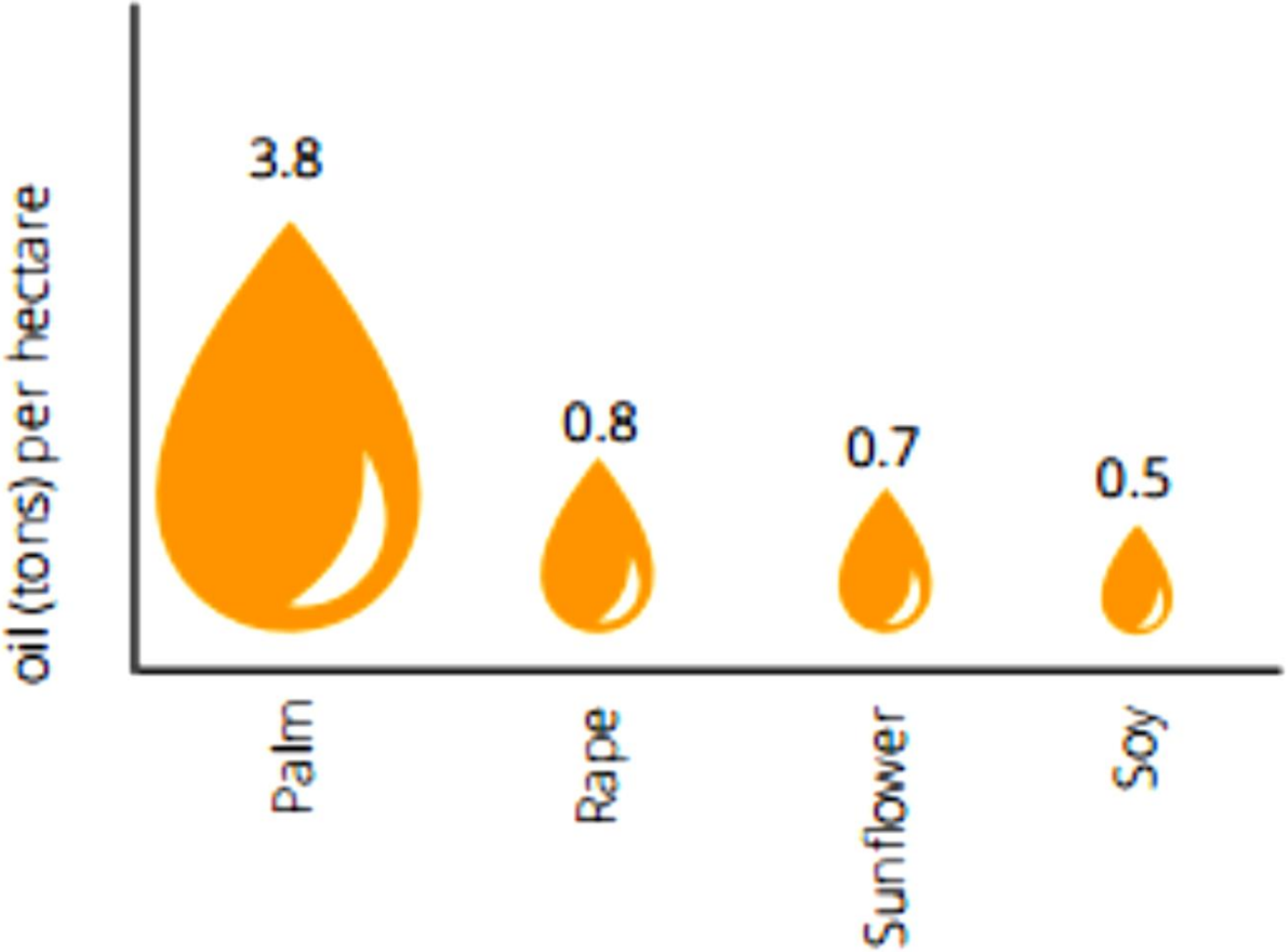
FGV OIL PALM PLANTING MATERIALS IMPROVEMENT PROGRESS

YEAR RELEASE	MATERIALS	TRAIT OF INTEREST
1980s	**La Me / AVROS / Yangambi**	Yield
1990s	**Yangambi**	Yield
2000s	**Yangambi (ML 161)**	Yield
2010s	**3 way-cross**	Yield + High density
2016	**GT1**	Ganoderma tolerance



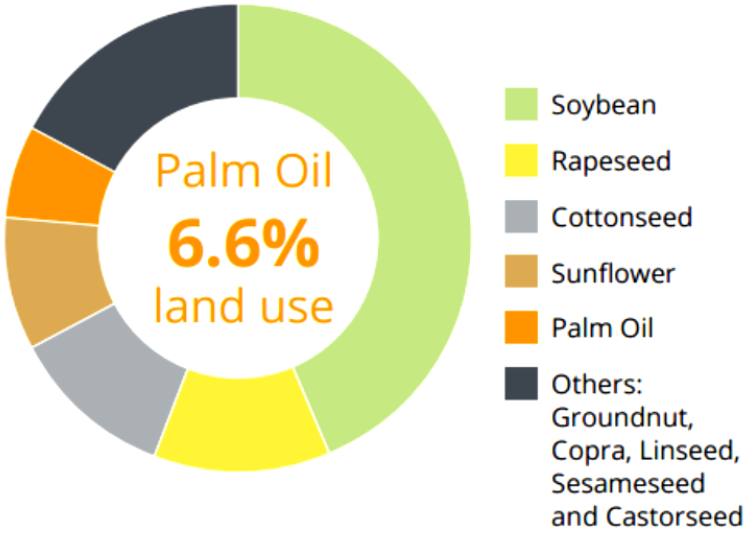
A highly efficient crop (Oil World 2016)

Highest Yield

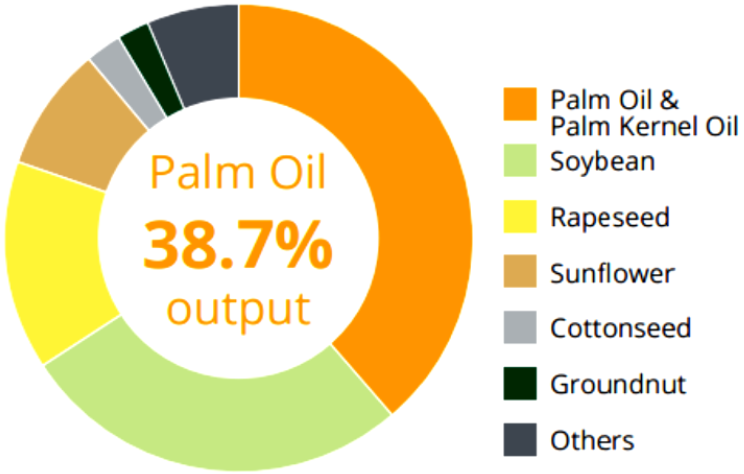


http://www.palmoilandfood.eu

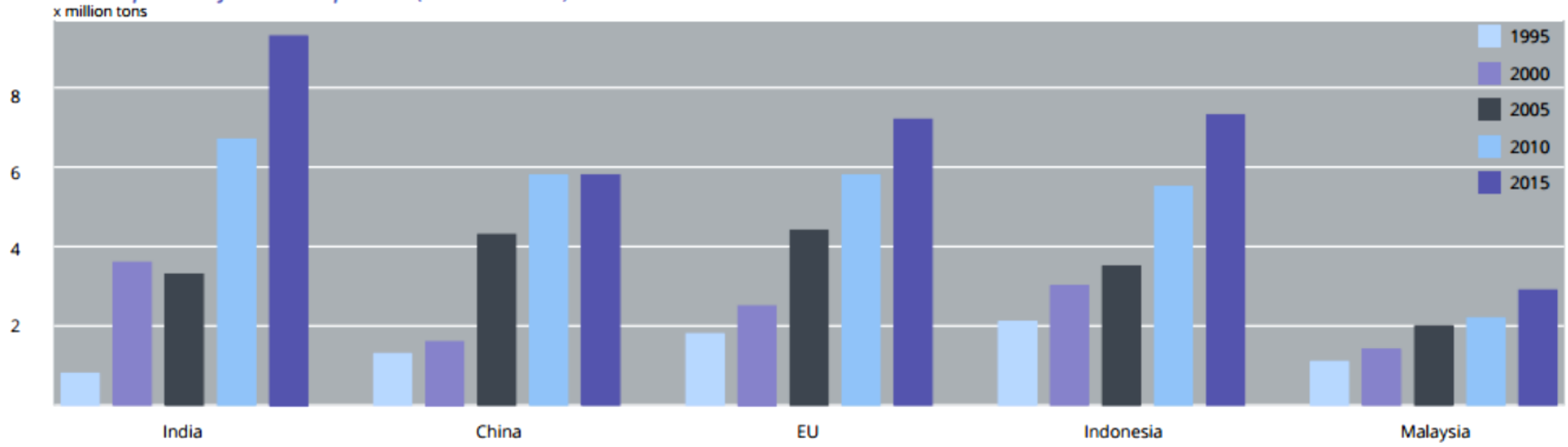
Major Oilseeds: Area in 2015 (Total is 274.4 million hectares) (Oil World 2016)



Global production of oils and fats in 2015 (Total is 179.6 million tons) (Oil World 2016)



Consumption major users of palm oil (Oil World 2016)

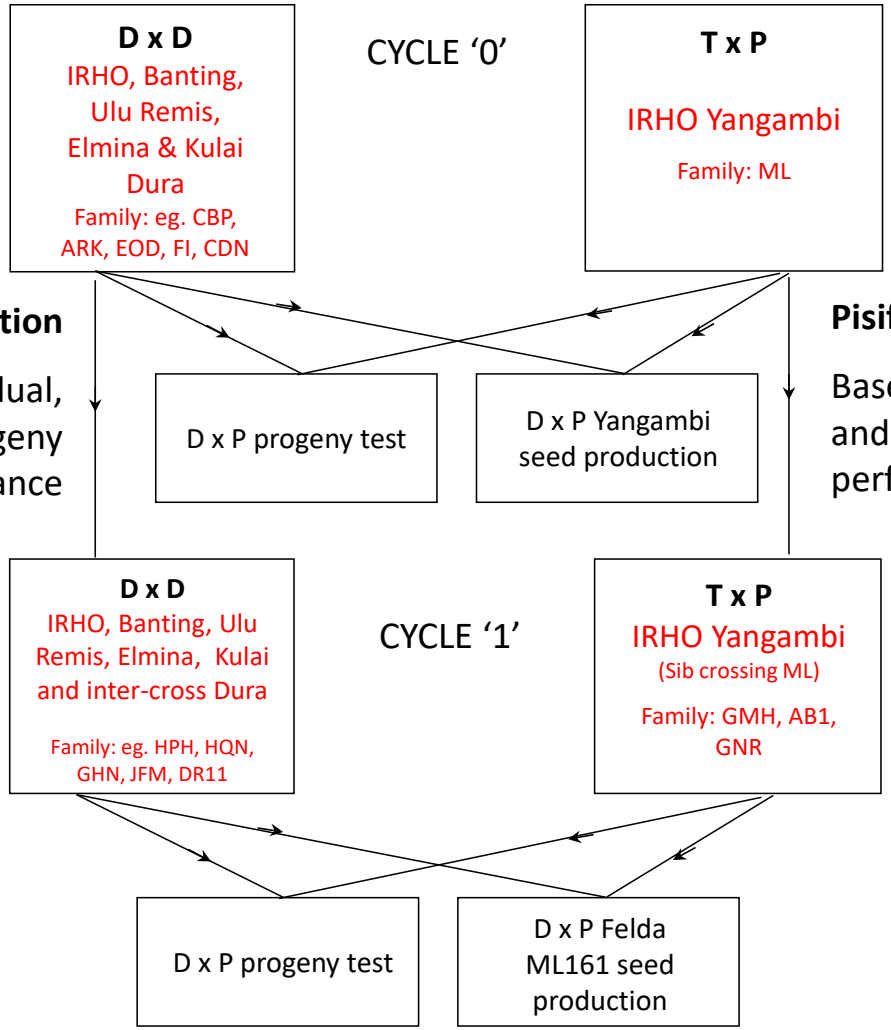


Strategy to increase productivity per ha of land

1. Higher yield per hectare
2. Higher palm stand per hectare
3. Palms tolerant to common disease
4. Ability to plant in environmentally challenged areas – drought tolerance
5. Shorter palms for longer economic lifespan

DxP Felda 3 Way

Selection method (Modified RRS)



Dura selection

Based on individual, family and progeny test performance

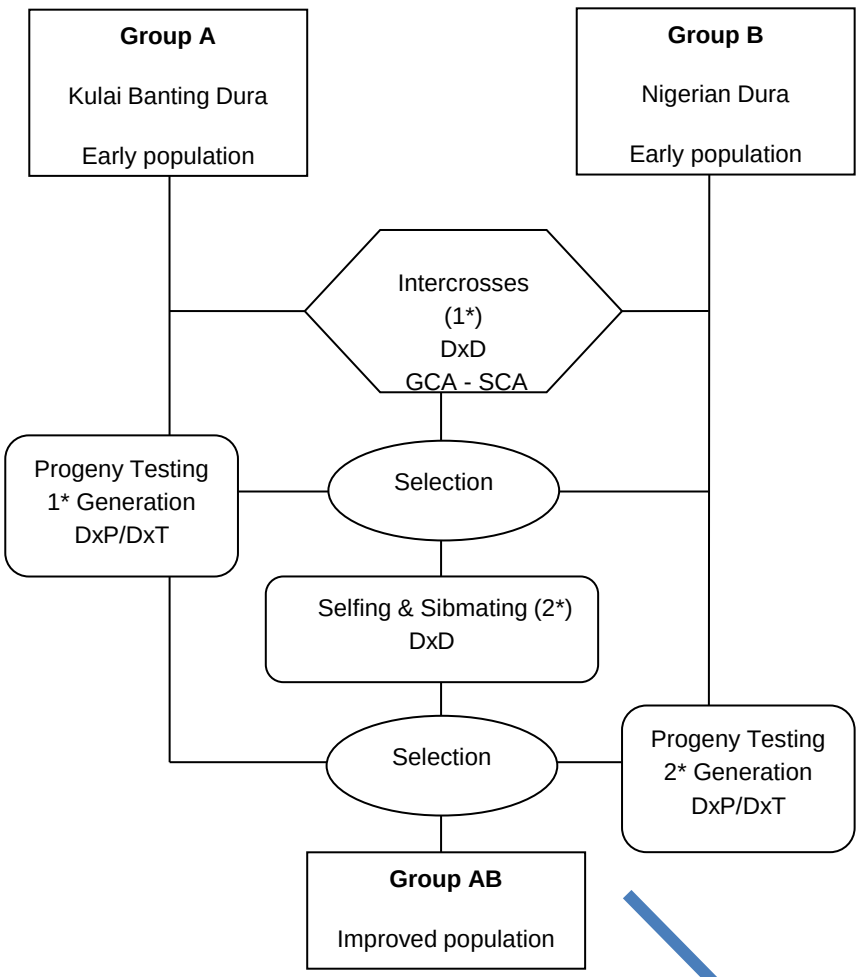
Pisifera selection

Based on tenera sib and progeny test performance

Tenera selection

Based on individual, family

Assembling DxP Felda 3 way



PISIFERA

IRHO Yangambi

L718P, L322P, L519P, L238P

T x P

IRHO Yangambi

Family: ML

T x P

IRHO Yangambi (Sib crossing ML)

Family: GMH, AB1, GNR

Pisifera selection

Based on tenera sib and progeny test performance

Tenera selection

Based on individual, family

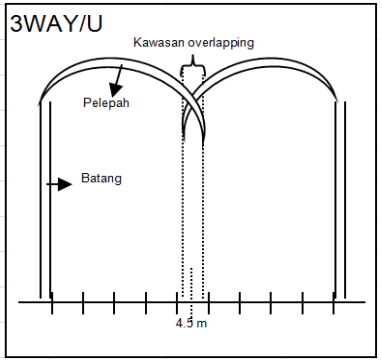
DxP FELDA 3 WAY

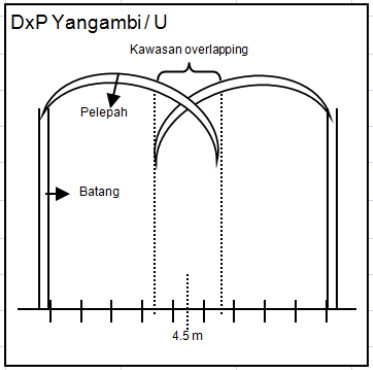
Summary Information About DxP Felda 3 Way

- The newest DxP FGV variety, a result of long breeding scheme and was released in 2008
- The variety comes from 3 breeding lines. The Dura line is a result of introgression of Dura Nigerian (MPOB) and Dura Deli Group. And the pisifera line comes from Yangambi ML 161 family.
- The advantages of Nigerian Dura is the small bunches with high number of bunches per year. And the advantages of Pisifera Yangambi ML161 is the high yield (CPO and kernel)
- High density interval planting 148 palms / ha to 160 palms/ha

Planting Material testing at Sahabat 6 Rachis length data at 7 year after planting		
DxP Yangambi P1	Mean	5.66
3Way P1	Mean	4.86

Results of density trial conducted on Felda 3Way





Trt	Density	BN	BW	ABW	T/ha
2011 (2nd YAH)					
T1	136	18.5	148.5	8	20.2
T2	148	23.6	198.3	8.4	29.4
T3	160	18.9	148.5	7.9	23.8
2012 (3rd YAH)					
T1	136	21.3	229.2	10.8	31.2
T2	148	26.5	251.9	9.6	37.3
T3	160	25.6	236.1	9.3	37.8
2013 (4th YAH)					
T1	136	24.8	299.6	12.1	40.7
T2	148	27	316.5	11.7	46.8
T3	160	26.9	316.8	11.8	50.7
2014 (5th YAH)					
T1	136	23.8	278.2	11.7	37.8
T2	148	23.2	262.1	11.3	38.8
T3	160	22.2	249.2	11.3	39.9

Economic gain through higher density planting

Palm stand /hectare	Mean fresh fruit bunch weight (tonne/hectare)	% gain over 136 palm/hectare planting
136	32.48	-
148	38.08	17.24
160	38.05	17.15

Additional USD 6,660/Ha in first 5 years of harvesting

Assumptions: OER: 25%; KER: 4.3%; CPO Price: USD 564/MT; Kernel Price : USD 496/MT

Oil Palm Improvement

Dura lines

D x D crosses = 100% D

↓

20 – 30% planted for evaluation

↓

Selected dura for seed production and/or progeny test

→ 70 – 80% lost opportunities due to resource shortage

Pisifera line

T X T or T X P

↙ 1D : 2T : 1P

↘ 1T : 1P

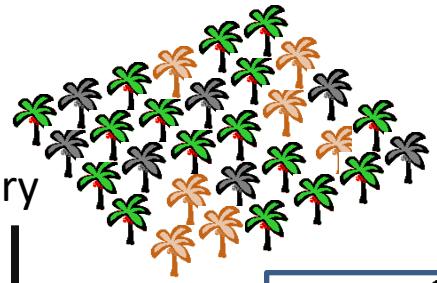
↓

30 – 40% planted for evaluation

???? Lost opportunity

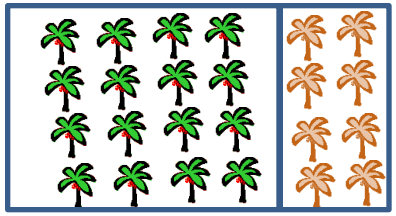
FGV

Breeding by Design: Marker-Assisted Selection in Pisifera improvement programme



Nursery

Marker screening



QTL enriched Advanced pisifera source without duras (from nursery screening) -25% of original population for field screening

Field evaluation (FFB-5yrs, BA-3x/palm (teneras only), VM-1x/palm)

DxP progeny testing (FFB-5yrs, BA-3x/palm, VM-1x/palm

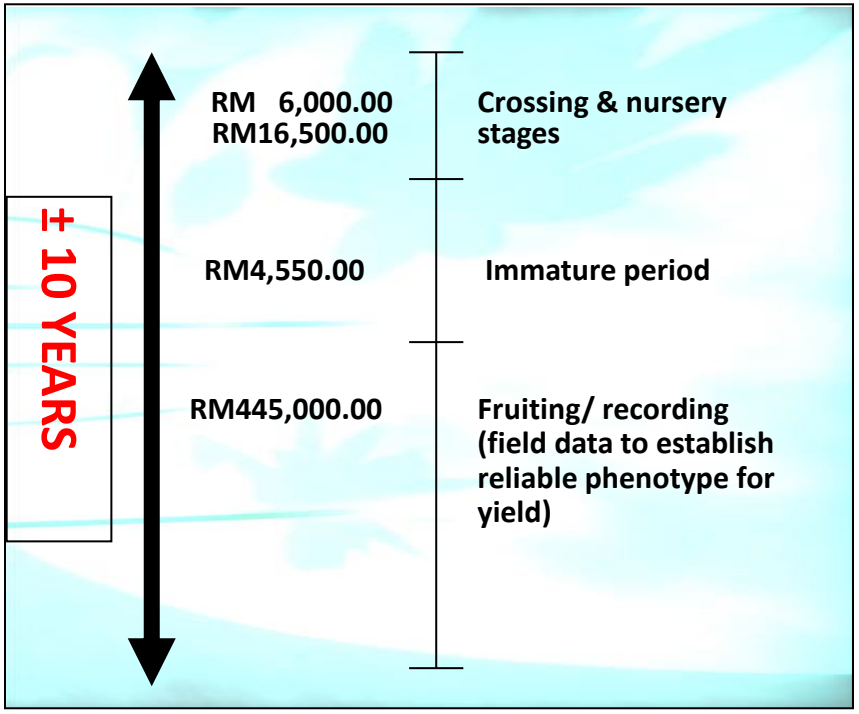
QTL enriched Pisifera selection – for progeny testing, tenera selection for next generation pollen source

TxT/P crosses for next cycle

Commercial DxP seed production

MAB = Reduced Oil Palm Breeding Costs

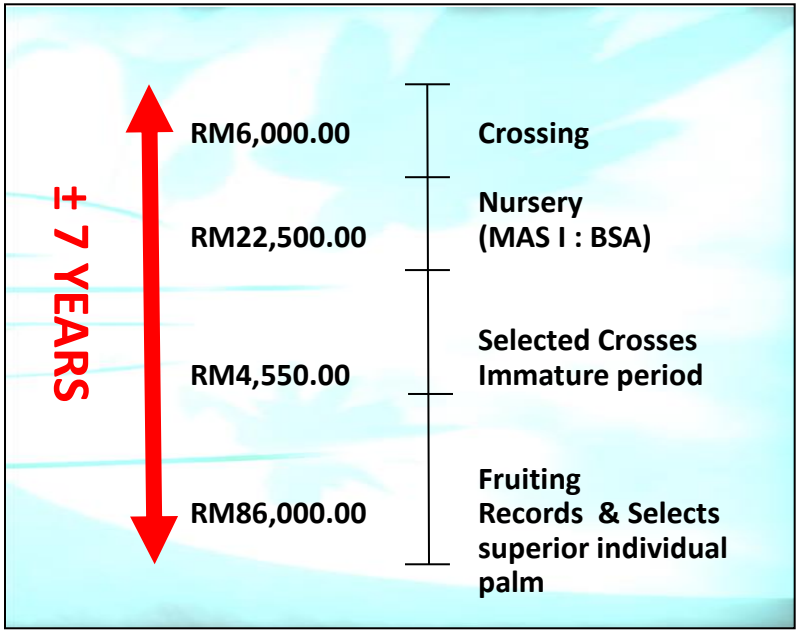
Conventional breeding



- 30 crosses, 100 plant/cross, RM200/cross (≈ 20 ha)
- RM5.5/seedling, RM6,000.00/ha (≈ 20 ha)
- ~ RM2,000/ha/yr (≈ 20 ha, 5 yrs)

RM472,050.00

MAS breeding



- 30 crosses, 100 plant/cross, RM200/cross (≈ 20 ha)
- RM5.5/seedling, RM6,000.00/ha (≈ 10 ha)
- ~ RM2,000/ha/yr (≈ 5 ha, 3 yrs)

RM119,300.00

R&D for SUSTAINABLE OIL PALM INDUSTRY

- **Convergence of breeding, biotechnology and genomics compliments each other to arrive at a common goal of producing high performing value-added planting materials.**
- **New oil palm varieties are aimed at sustainable production of palm oil across various environmental demands**
- **These development are of immense importance to the 3P principals (people, planet, profit) for sustainable palm oil production.**


THANK YOU