Palm Oil yield potential of oil palm (*Elaeis guineensis*) seeds developed by CIRAD and its partners.

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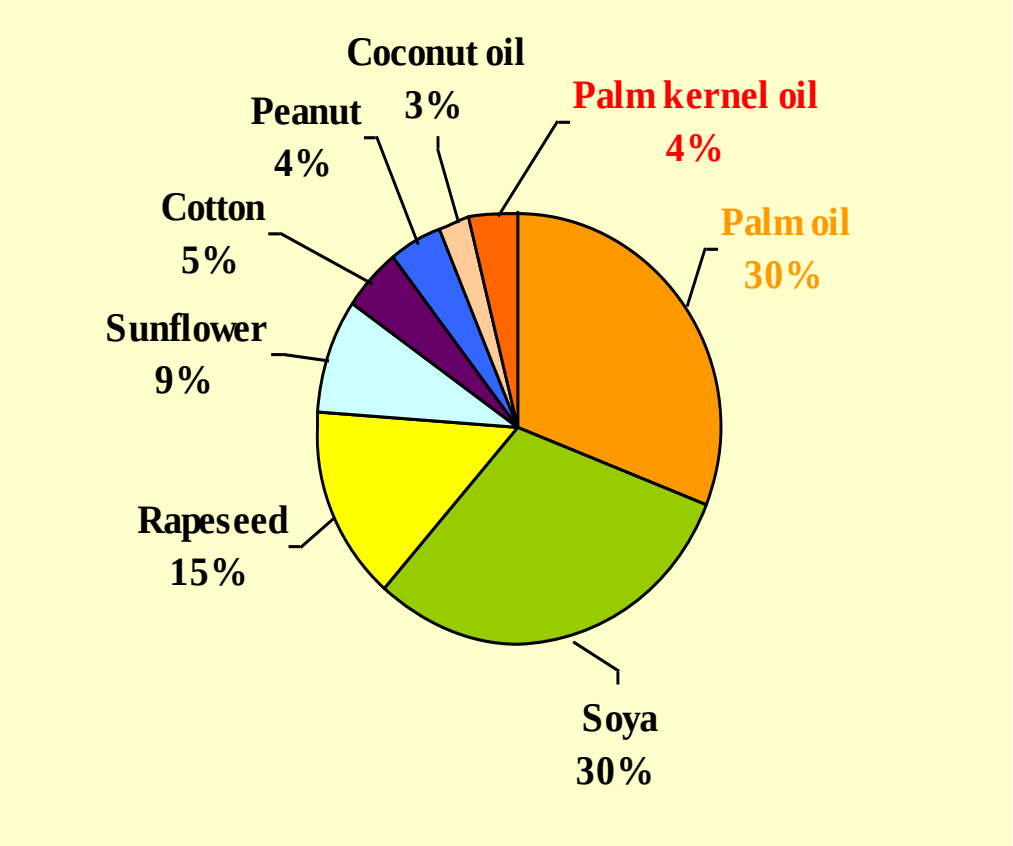
The main challenges
Oil and fat requirements

- 135 million tonnes of oils and fats consumed in 2005, including 115 million of vegetable origin.
- Oil palm supply around 37 million tonnes, Soybean around 34 Mt.
- In world average terms, oil palm yields are 6 to 10 times > soybean: 3 to 3.5 t/ha/year
- Oil and fat requirements are growing by 4.4% per year.
- Palm oil production is growing by **5.6**%.
- The contribution made by genetic improvement amounts to 1,2 %/ year (Cirad seeds).
- The rest comes from **extensions,** agronomic improvement and rehabilitation.

- … and bio diesel.

The most important height vegetable oils.



Breeders and global context

To <u>partly</u> meet these challenges:

⇒ **Sustainable intensification** of production over several cropping cycles will help to limit pressure on uncultivated areas, notably tropical forest. It will also have a positive economic impact for growers.

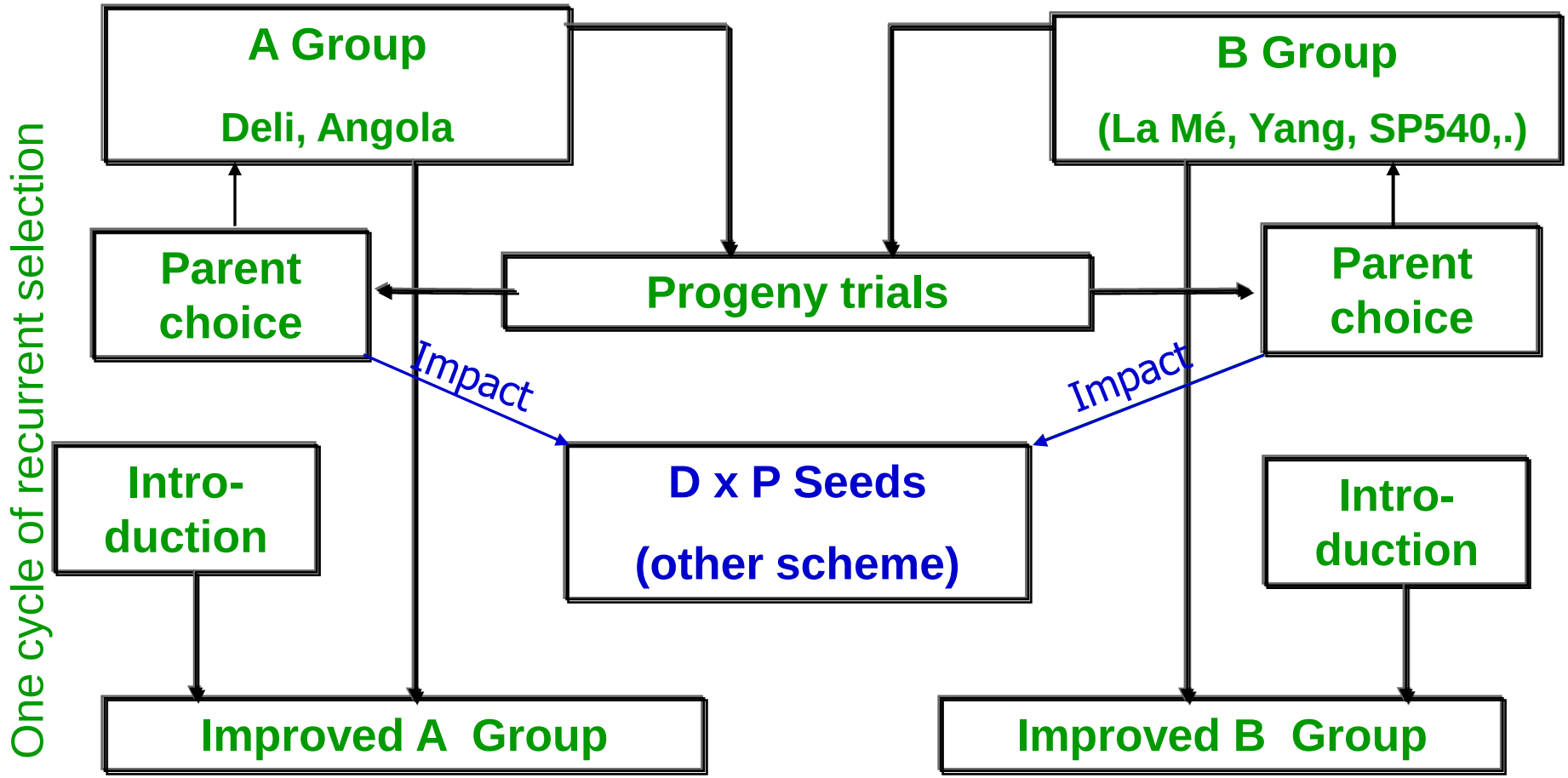
⇒ One of the prerequisites for achieving high yields is to provide growers with :

1 – high-yielding planting material.
2 – resistance to main deseases.

In this presentation we will focus on yield.

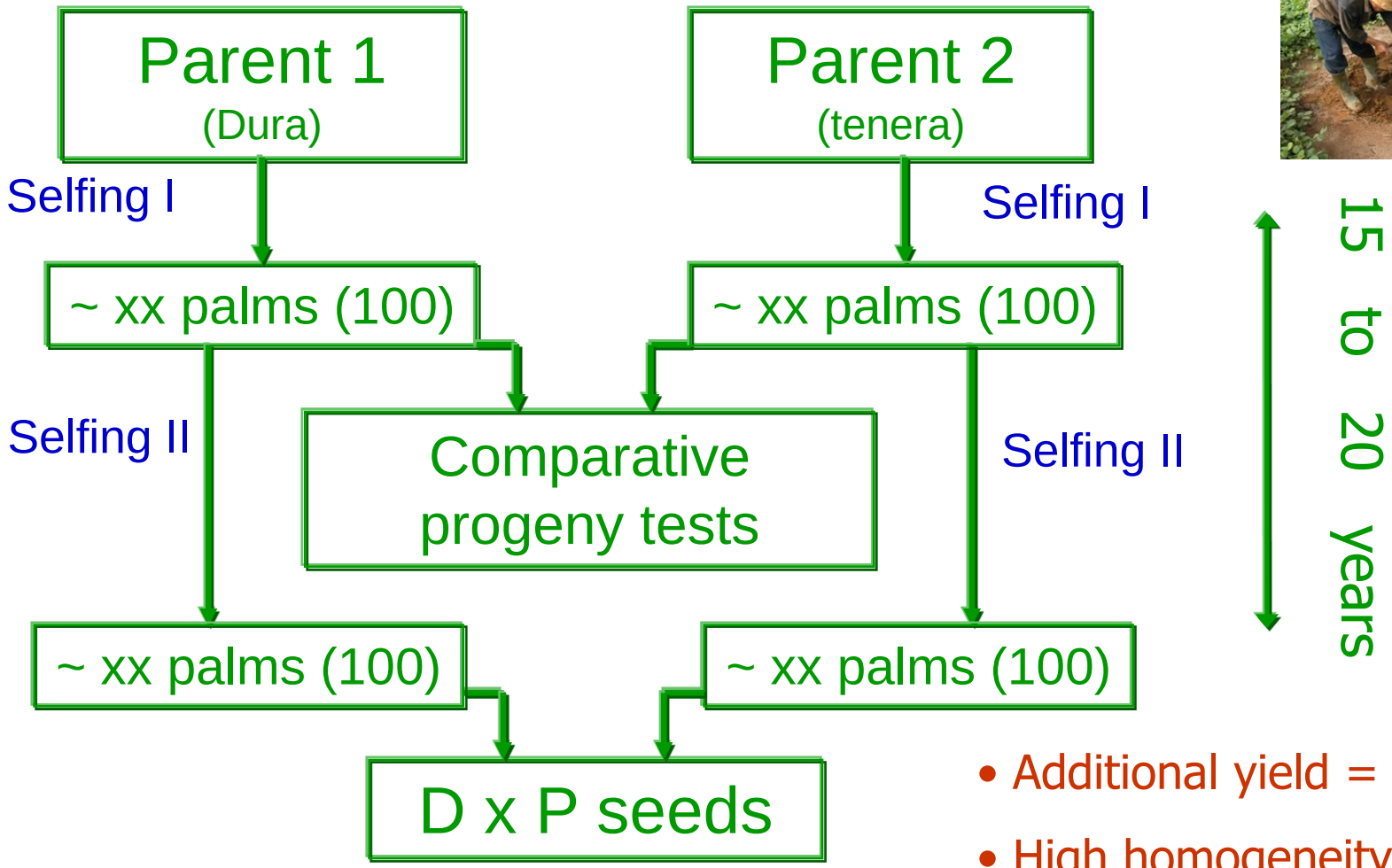
Breeding and seed production strategy

1 - SSR



One cycle = 20 years ; 3rd cycle on progress

2 – Scheme for D x P Seeds production: One cycle based on pedigree



- Additional yield = +12 %
- High homogeneity

Breeding and seed production strategy (cont…)

Selection and evaluation of parents

2 phases

- **1/ Pre-selection of parents for their inherent value**

  Only for **heritable traits :**

  Dura & Tenera Parents: growth rate
  % mesocarp/fruit
  % oil/mesocarp

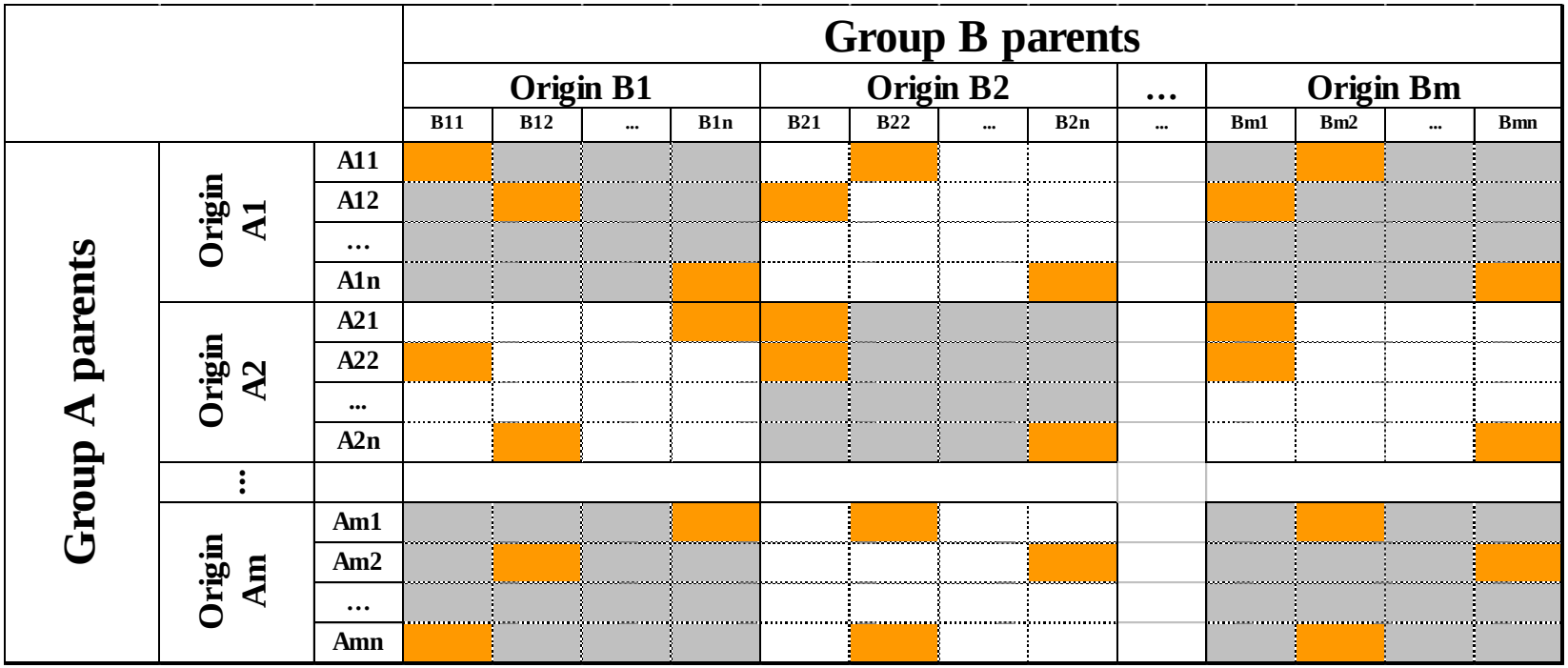
  Pisifera Parents: growth rate

- **2/ Selection of parents for their general combining ability (GCA)**

  Assessment of the average value of each parent when crossed with the parents of the other group for yield and growth rate.

Breeding and seed production strategy

General mating designs to evaluate GCA of parents



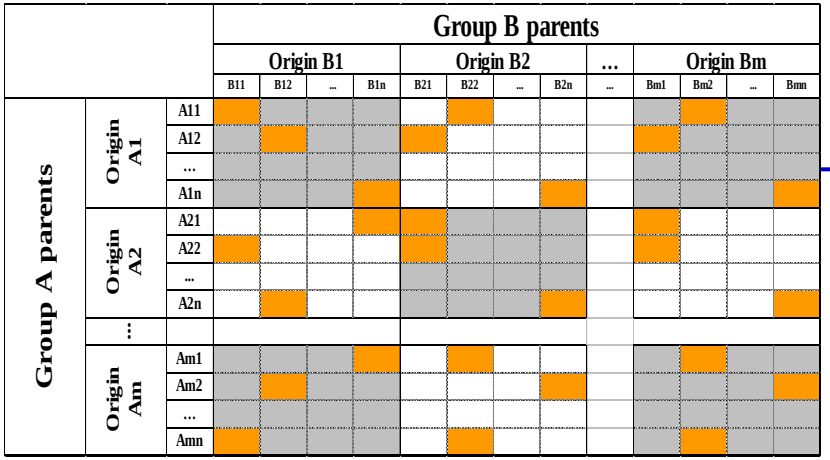
A genetic block

(set of progeny tests)

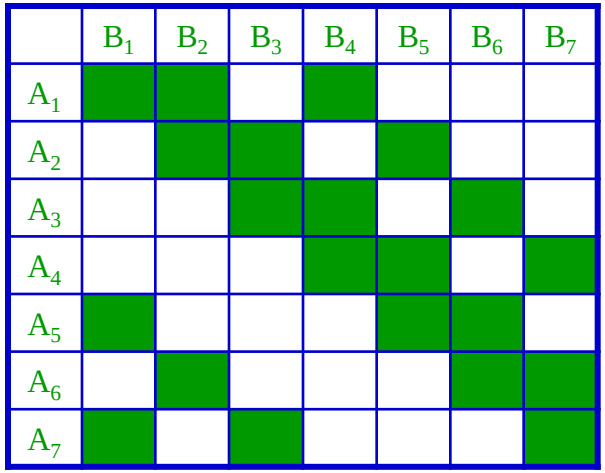
=

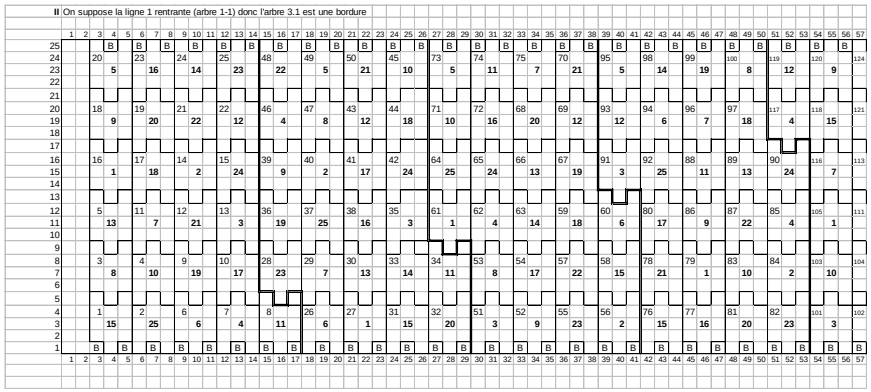
- **20 trials x 20 progenies = 400 crosses = 300 ha**
- **130 parents tested per group**
- **Each is tested three times …**

Field design



x 20





Breeding and seed production strategy

Example Aek Loba Timur Genetic Block
(P.T. Socfindo in Indonesia)

- Favourable ecological conditions
- 28 trials set up from 1995 to 2000 (25 prog test -3 clonal)
- 420 DxT or DxP crosses between
  - - 114 Dura Deli parents
  - - 112 Tenera or Pisifera parents (La Mé & Yangambi origins)

⇒ We will comment early data for 17 trials that have attained 8 years, 254 progeny, 83 Dura Deli and 104 LM ou YA palms

Origins tested in trials at Aek Loba Timur

A GROUP

- DA 5 D x DA 3 D (*)
- DA 10 D x DA 3 D
- DA 10 D x DA 115 D
- DA 115 D self
- DA 115 D self (*)
- DA 115 D x DA 3 D
- DA 300 D x DA 128 D
- DA 551 D x DA 767 D
- LM 269 D x DA 115 D
- LM 269 D x DA 128 D
- LM 404 D self
- LM 404 D x DA 3 D
- LM 404 D x DA 10 D

B GROUP

- LM 2 T self
- LM 2 T self (*)
- LM 2 T x LM 5 T
- LM 2 T x LM 9 T
- LM 2 T x LM 10 T
- LM 2 T x SI 10 T (*)
- LM 5 T self
- LM 5 T x LM 10 T
- LM 5 T x LM 311 P
- LM 9 T x LM 13 T
- LM 10 T self
- LM 13 T self
- LM 238 T x LM 511 P
- LM 718 T self
- LM 718 T x LM 238 T

(*) + one cycle of pedigree selection

RESULTS
Preliminary comments

FFB : the effective planting density is 143 palms/ha but we consider only 135 palms (road and non value palms)

FFB= observed yield * 0,944 (1)

OER : to estimate OER we consider mill loses and bias when sampling the bunches :

OER=O/B * 0,855 (2)

(1) x (2) = **0,807** ⇒ **- 20 %**

10,5 t/oil/ha observe in trials = 8,5 t/oil/ha effective in plantation

Mean of Aek Loba genetic block

After 2005 season

1 - Bunch analyses at 5 and 6 years (360 crosses)

% Fruit/ Bunch	% Mesocarp /Fruit	% Oil / Mesocarp	Oil/Bunch Lab.	OER
66.5%	82.5%	56.1%	30.8%	26.4%

2 - Yield of young and mature palms

Period	Crosses	BN x ABW	FFB t/ha/yr	Oil t/ha/yr
3-5 years	360	28.3 x 5.8	21.4	5.65
6-8 years	254	18.8 x 12.0	29.1	7.73

Aek Loba genetic bloc : extreme values (variability)

1 - Crosses tested (6-8 year period)

Number	OER	FFB	OIL
254 crosses classed	from 20.0 % to 31.6%	from 23.2 to 33.6	from 6.15 to 9.45

2 -GCA of parents tested (6-8 year period)

Number	OER	FFB	OIL
65 dura classed	from 23.6% to 29.8%	from 25.0 to 31.5	from 6.48 to 8.65
79 T or P classed	from 21.8 % to 29.5%	from 23.0 to 32.9	from 6.47 to 9.11

Aek Loba genetic bloc : Selection of progenies

6-8 year period	Ind. OER	FFB t/ha/yr	Oil t/ha/yr
Mean of ALT	26.4	29.1	7.73
Selected best 16 % (40 crosses)	27.6	30.8	**8.63**
% improvement	+ 4.6%	+6.0%	**+11.6%**
Selected best 8 % (20 crosses)	28.0	31.2	**8.85**
% improvement	+ 6.1%	+7.3%	**+14.5%**

Aek Loba genetic bloc : Selection of best parents based on GCA for Oil production

6-8 year period	Ind. OER	FFB t/ha/yr	Oil t/ha/yr
Mean of parents	26.2	29.1	**7.76**
GCA of the 16 % best Dura (10 palms)	+1.1 (27.3) + 4.1%	+1 (30.1) +3.6%	**+ 0.59 (8.35) + 7.7%**
GCA of the 16 % best T/P (13 palms)	+1 (27.2) + 3.9%	30.6 +5.6%	**+0.76 (8.52) +10.0%**
16% best D x 16% best T/P % improvement	28.3 + 8.0%	31.7 +9.2%	**9.13 +17.7%**

Reminder : 11.6 % -> 14.5 % -> 17.7 %

(…)

AL bloc : Selection of best parents based on GCA for Oil production

The expected value of crosses between selected palms for GCA on Oil production is attainable as we have observed:

6-8 year period	Ind. OER	FFB t/ha	Oil t/ha
PO 3360 D x PO 4982 P	29.6 %	31.5	9.45
PO 3174 D x PO 2766 P	29.1 %	31.1	9.22
PO 3600 D x PO 2762 P	30.5 %	29.8	**9.21**

(Expected : 9.13)

Correlations (R^2 : 0.9)

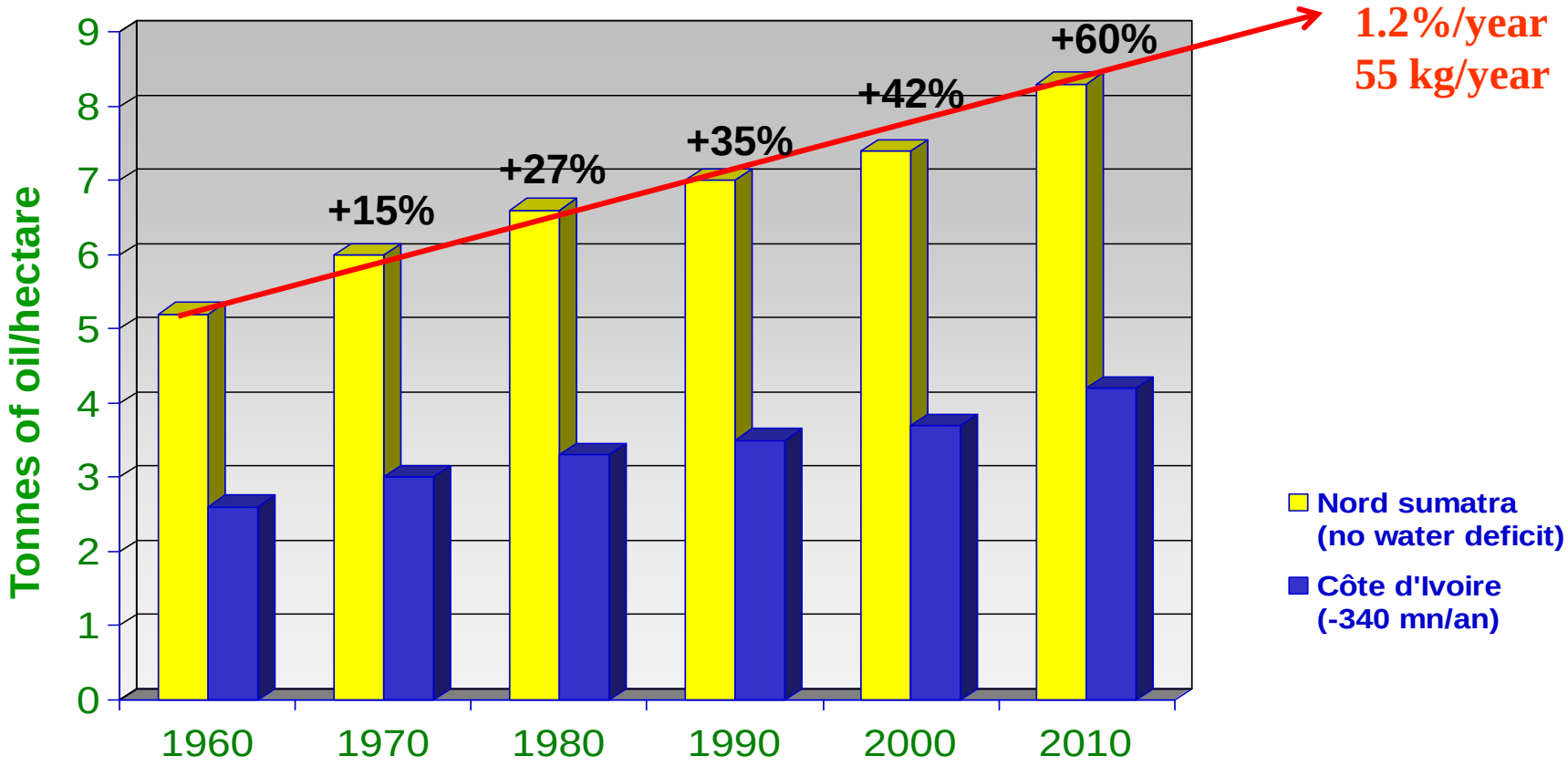
Cross	Rank	Observed values Oil t/ha/yr	Calculated values from GCA Oil t/ha/y
PO 3360 D x PO 4982 P	1	9.45	9.52
PO 3174 D x PO 2766 P	2	9.22	9.02
PO 3600 D x PO 2762 P	3…	9.21	9.25
PO 2580 D x PO 2980 T	25…	8.53	8.41
PO 3052 D x PO 2761 P	50…	8.28	7.75
PO 3062 D x PO 4740 P	75…	8.06	8.10
PO 3170 D x PO 3636 P	100…	7.90	7.92
PO 2995 D x PO 3277 T	125…	7.72	7.33
PO 3064 D x PO 3253 T	150…	7.60	7.60
PO 4840 D x PO 2972 T	175…	7.45	7.61
PO 4844 D x PO 3351 P	200…	7.31	7.21
PO 3127 D x PO 4799 P	225…	7.12	7.37
PO 3971 D x PO 3660 P	250	6.78	6.74

Genetic progress

- Both FFB and OER are moving :

Periode	1960	1970	1990	2010	Progress
OER %	21,5	23,5	25,8	27,8	+ 29,3 %
FFB t/ha	24,1	25,5	27,1	29,9	+ 24,1 %
Oil t/ha	5,2	6,0	7,0	8,3	+ 59,6 %

Evolution of Genetic Productivity



Conclusion : what production can be expected under Aek Loba-type ecological conditions?

- **FFB: 30 to 32 t/ha/yr** (31 to 34 t/ha/yr in trials)
- **Oil Extraction Rate: 26 to 29 %** (30 to 34 % in the lab.)
- **Yield: 8 to 9 t CPO/ha/yr** (10 to 11 t/ha/yr in trials)
- **Reasonable ABW: 22 to 24 kg for mature palms**
- **First harvest at 2 years**
- **Slow vertical growth: 40 to 60 cm/yr**
- **Iodine value over 55**

Conclusion

- The scheme proposed here allows an overall exploitation of the results.
- Value of crosses is estimated with high precision.
- It enable GCA calculations for the parents : this is of strategic importance as for the seed gardens and the recombinations for the next cycle.
- We estimate a greater genetic progress (> 17 %).
- Ongoing progress is a (welcome) result of our work.

Thank you

for your attention