Identification and Elimination of Yield Gaps in Oil Palm

Speaker: Thomas Fairhurst

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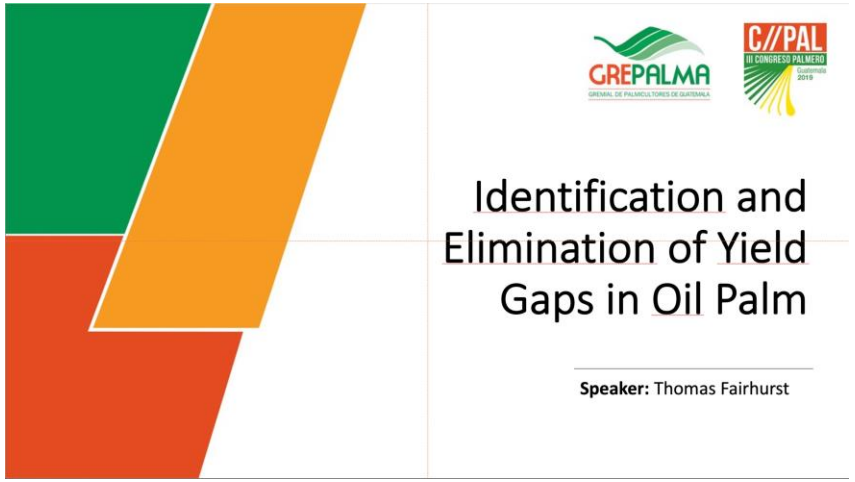


Definition of a ‘yield gap’

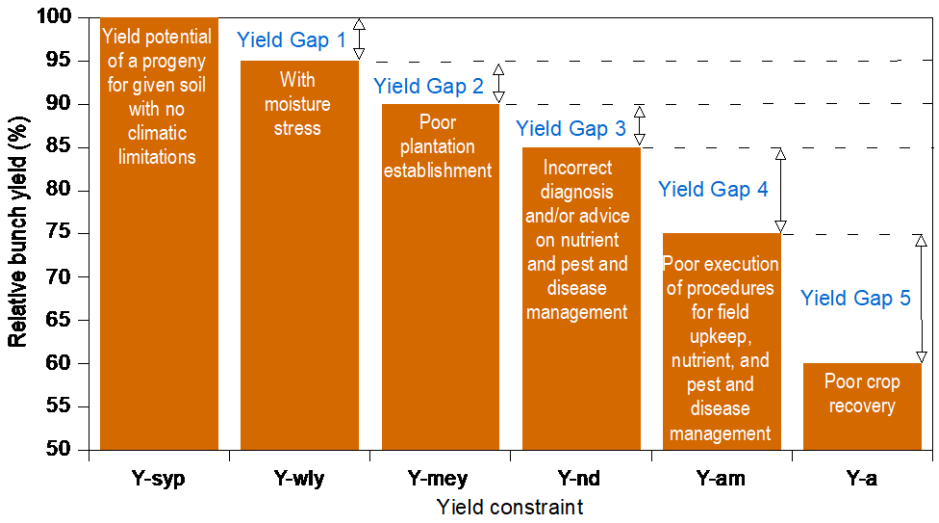
- **Difference** between **site yield potential** (defined in fertilizer trials, best management practice blocks, literature).

and

- **Actual yield.**
- Can be measured as yield of fruit bunches or crude palm oil or palm products (crude palm plus kernel oil).
- May be due to different factors:
  - Poor crop recovery.
  - Nutritional deficiencies.
  - Poor agronomic management and pests and diseases.
  - Moisture stress.
- Can be measured at national, company, farm, block, soil type or planting material.

Yield gap analysis

- Is there a gap between actual yield and site yield potential?
- What are the causes of yield gaps?
- Each yield gap cause requires different remedial measures.
- Make a plan to eliminate identified yield gaps:
  - '**Yield Taking**' (Yield Gap 5).
  - '**Yield Making**' (Yield Gap 1, 2, 3 and 4).



‘Yield Taking’

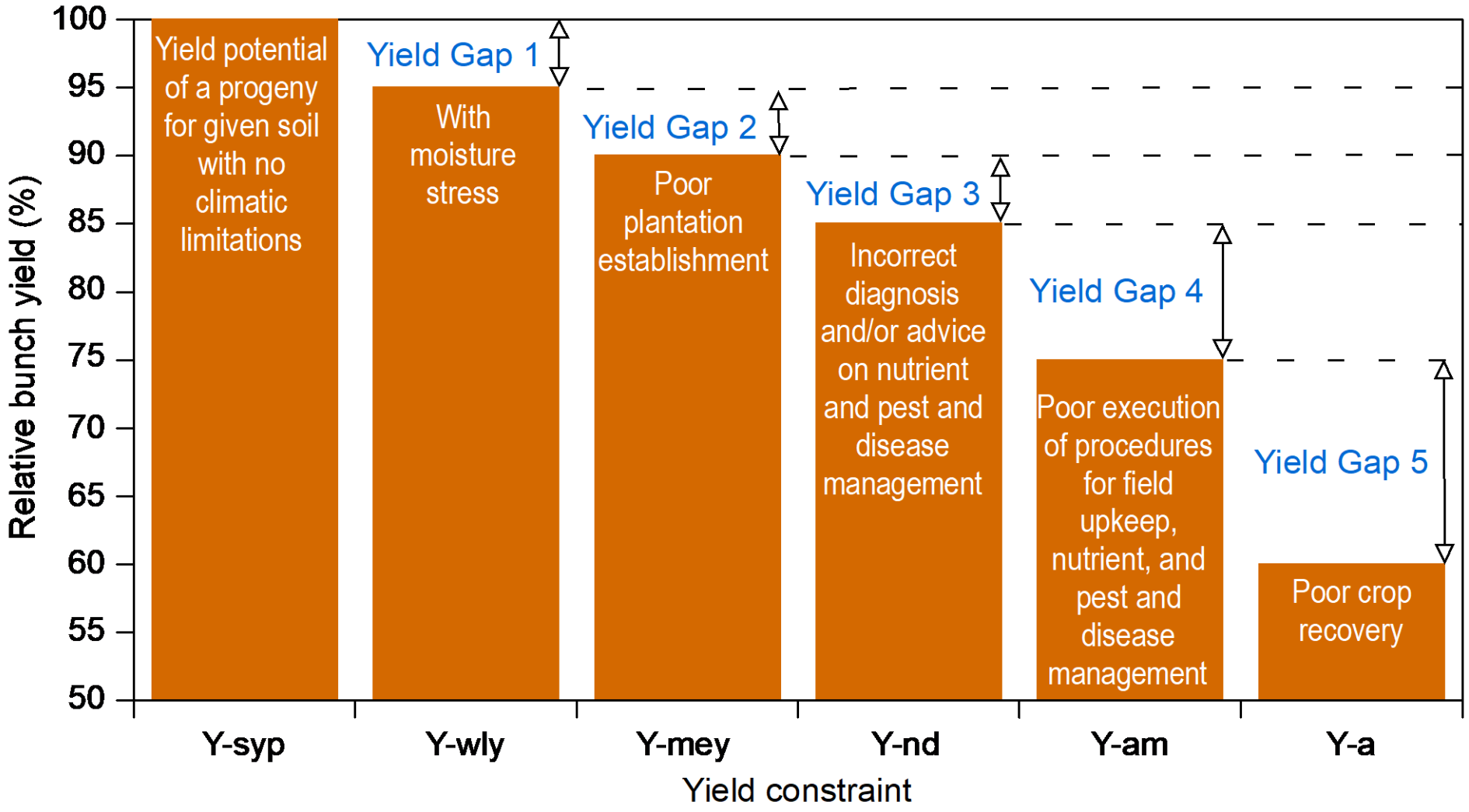
Getting the crop from the palms to the mill.

Logistics not agronomy.

Immediate results.

Yield Gap 5

Yield Gap 5 due to incomplete crop recovery



Remedial action on crop recovery

Short term results from remedial action:

1. Review milling capacity, adequacy of transport system and labour supply, and field drainage (vehicle access).
2. Install adequate field access from mill to palm (roads, paths, pruning, drainage).
3. Implement tightly controlled ten day harvest intervals with zero crop loss.
4. Implement the correct ripeness standard (≥5 loose fruit on the ground before bunch harvest).
5. Check fruit quality in field, at the ramp and in the lab.
6. Check mill losses.

‘Yield Making’

Putting more fruit bunches onto the palms.

Agronomic skill required.

Time lags of ≤4 years between implementation and results.

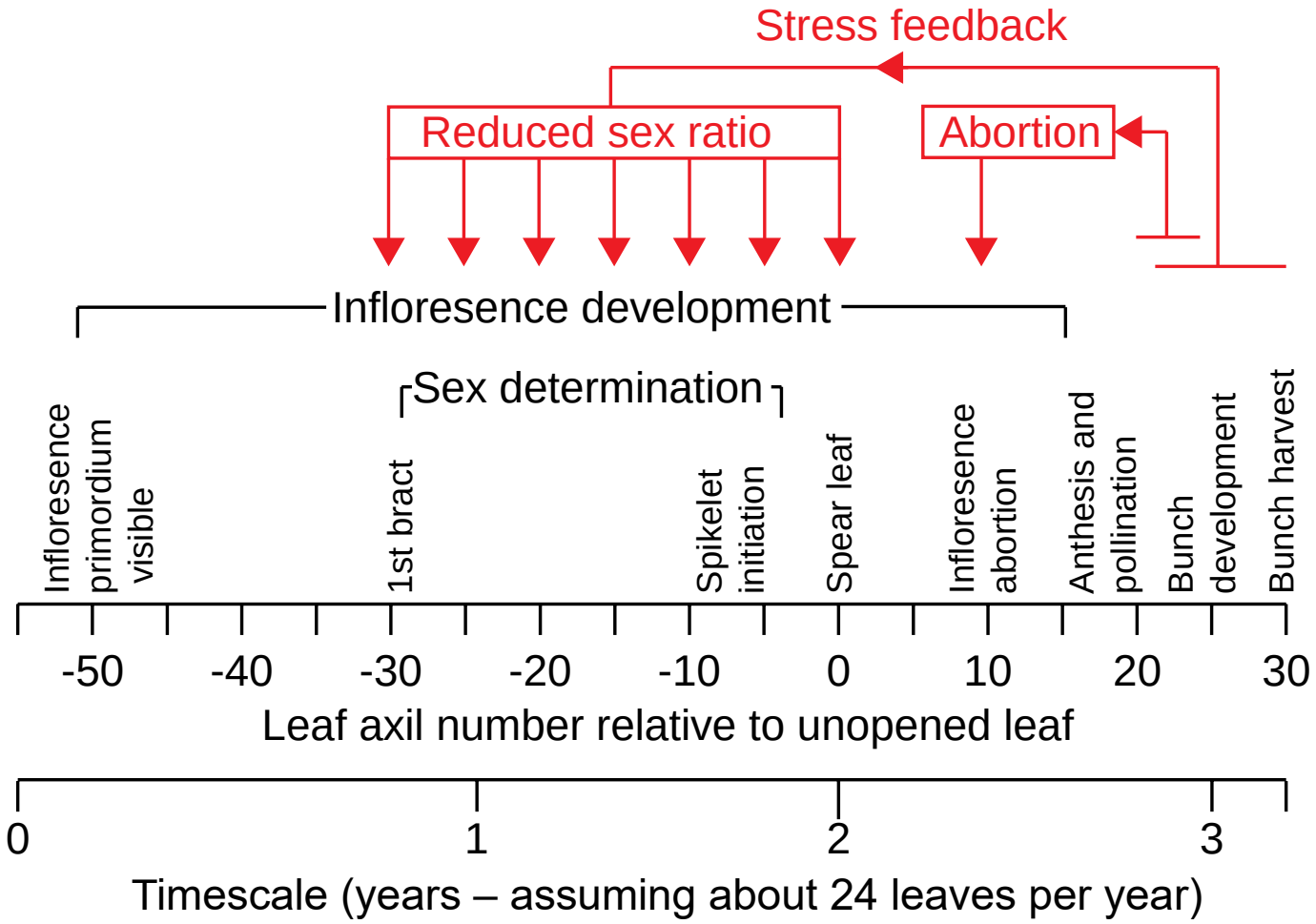
Yield Gap 1, 2, 3 and 4.

24–28 months from flower to bunch!

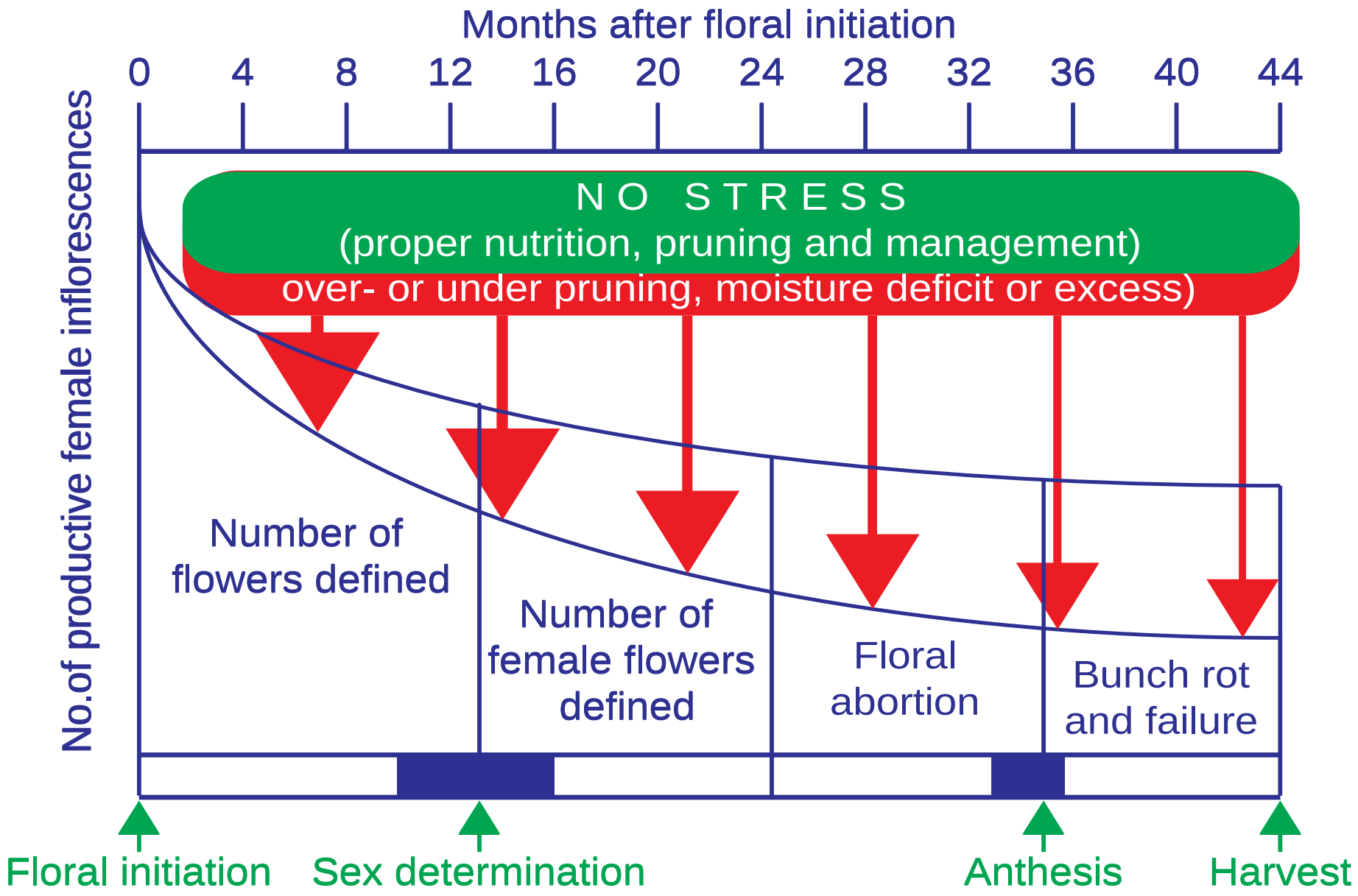
Female flower

Fruit bunch

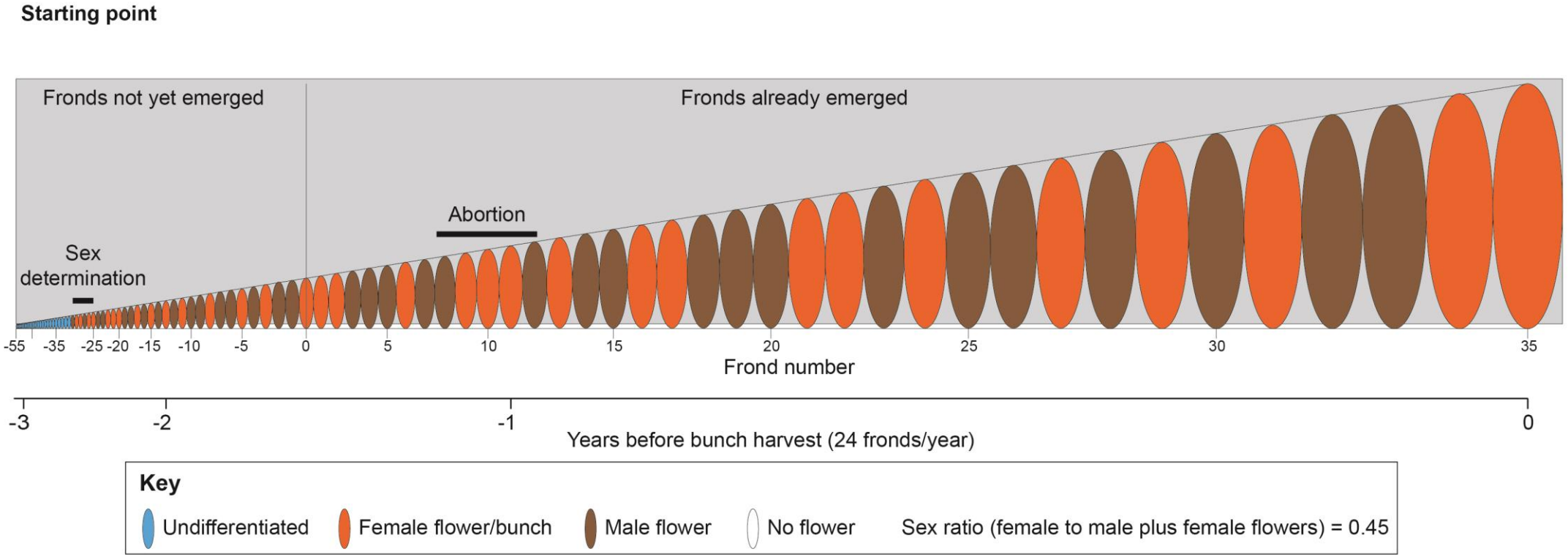
There are significant time lags between a stress event and its effect on yield



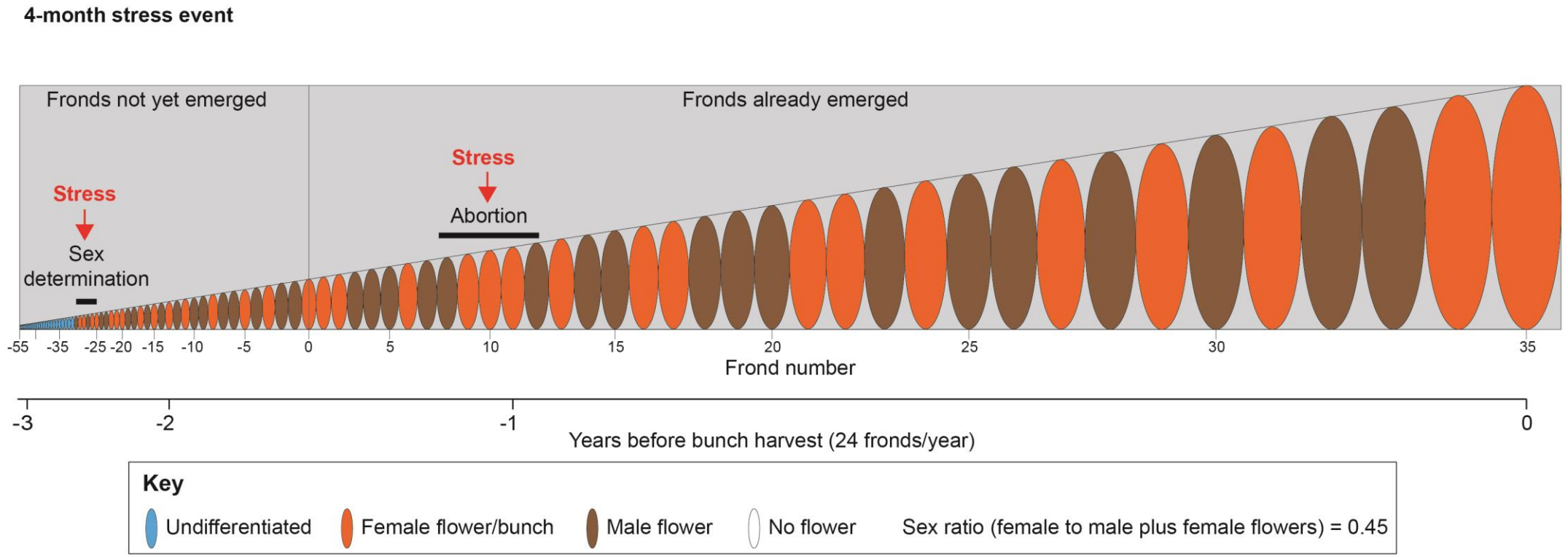
Jones, 1997


Months after floral initiation
0
4
8
12
16
20
24
28
32
36
40
44
No.of productive female inflorescences
NO STRESS
(proper nutrition, pruning and management)
over- or under pruning, moisture deficit or excess)
Number of flowers defined
Number of female flowers defined
Floral abortion
Bunch rot and failure
Floral initiation
Sex determination
Anthesis
Harvest

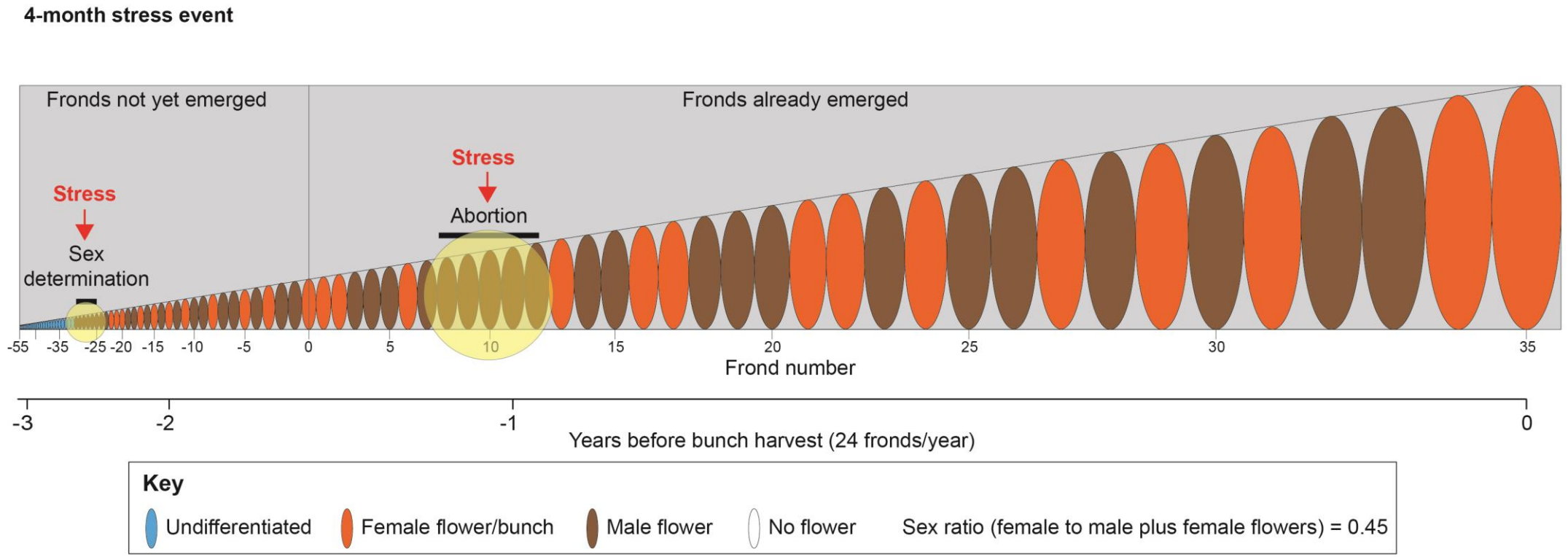
Starting point in a containing male and female flowers



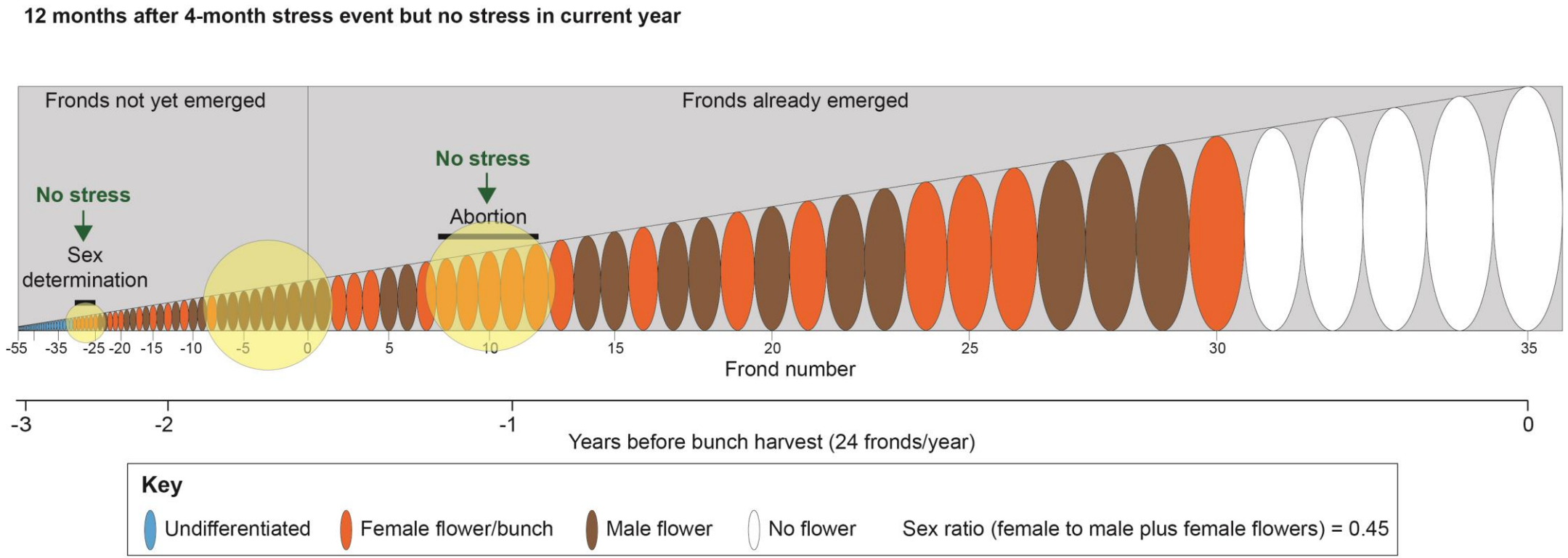
Stress event (e.g. drought, over-pruning or under-pruning, pest outbreak)



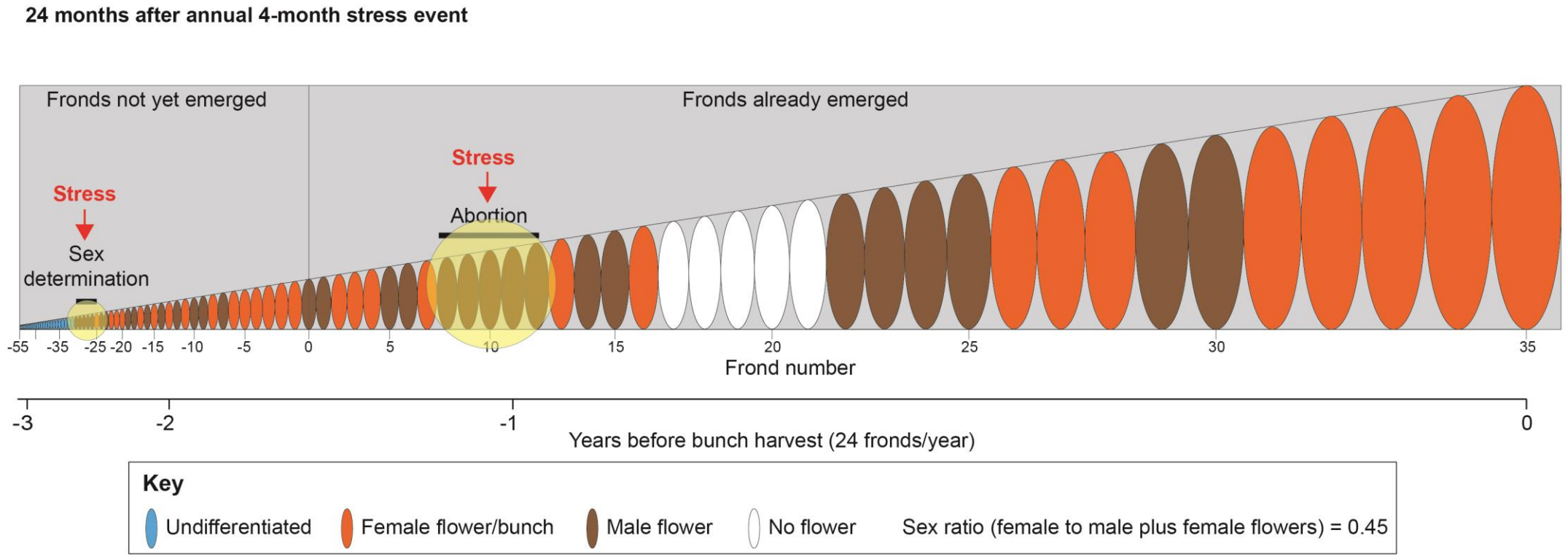
Very young flowers become male and some female flowers abort



12 months later there are a number of empty fronds at pre-emergence and from Frond 31–35. No stress this year!



24 months after starting point empty fronds detected mid-crown.

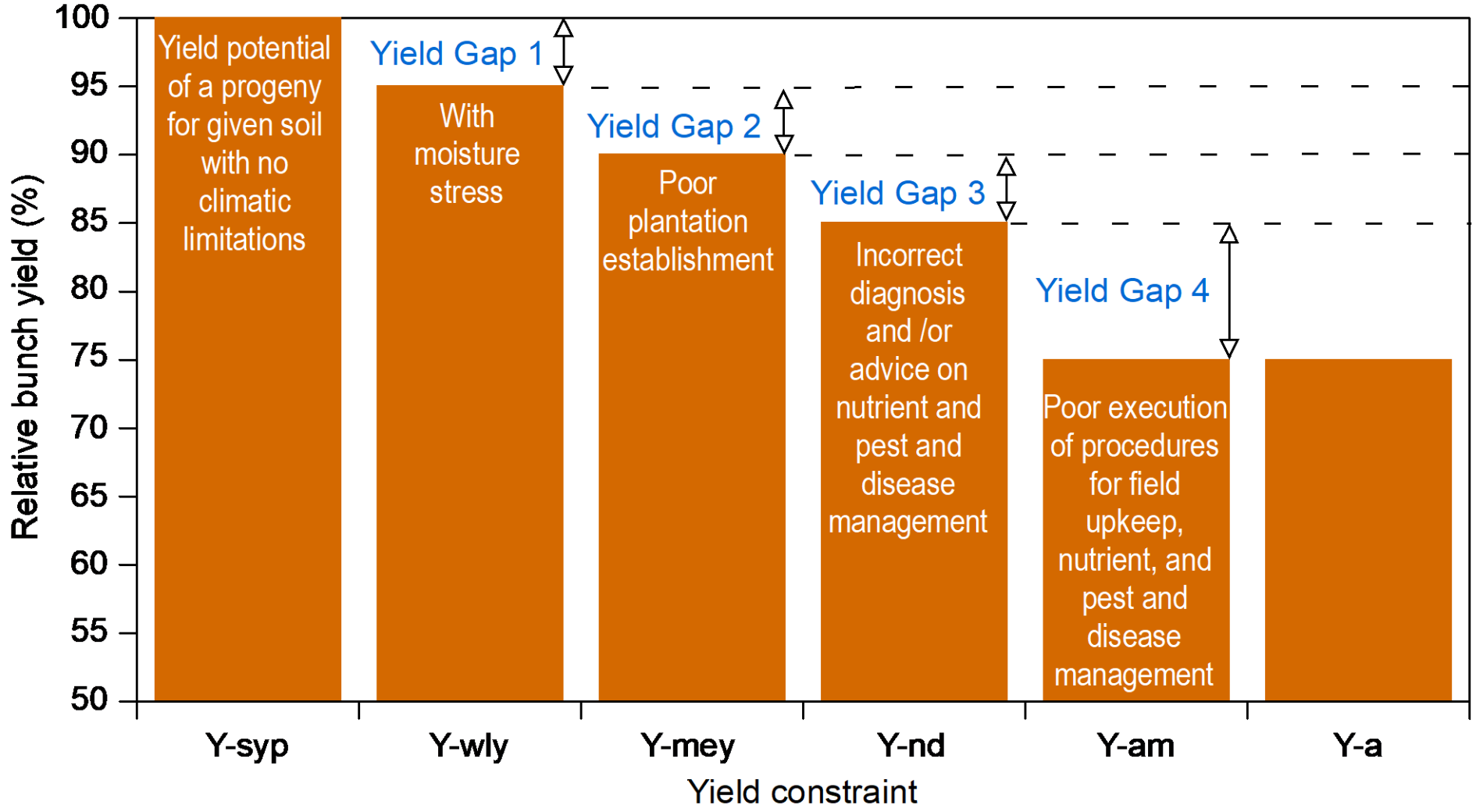


Must think and plan for long term

Long term results from remedial action:

- Twenty five year plan (crop, field budget, capex plan).
- Plan based on reasonable price assumptions (CPO, labour, fertilizer fuel) and interest rates.
- Stress tested business model.
- Financial planning to cope with price peaks (store) and troughs (spend).
- Don’t cut fertilizer!
- Investment capex related to price?
- Even James Fry struggles to predict the price accurately so don’t try and guess the market!
- ‘High yield producers’ can weather low prices better the ‘price guessers’!

Yield Gap 4 due to poor field practices



Verify that all field practices are being implemented correctly and cost-efficiently

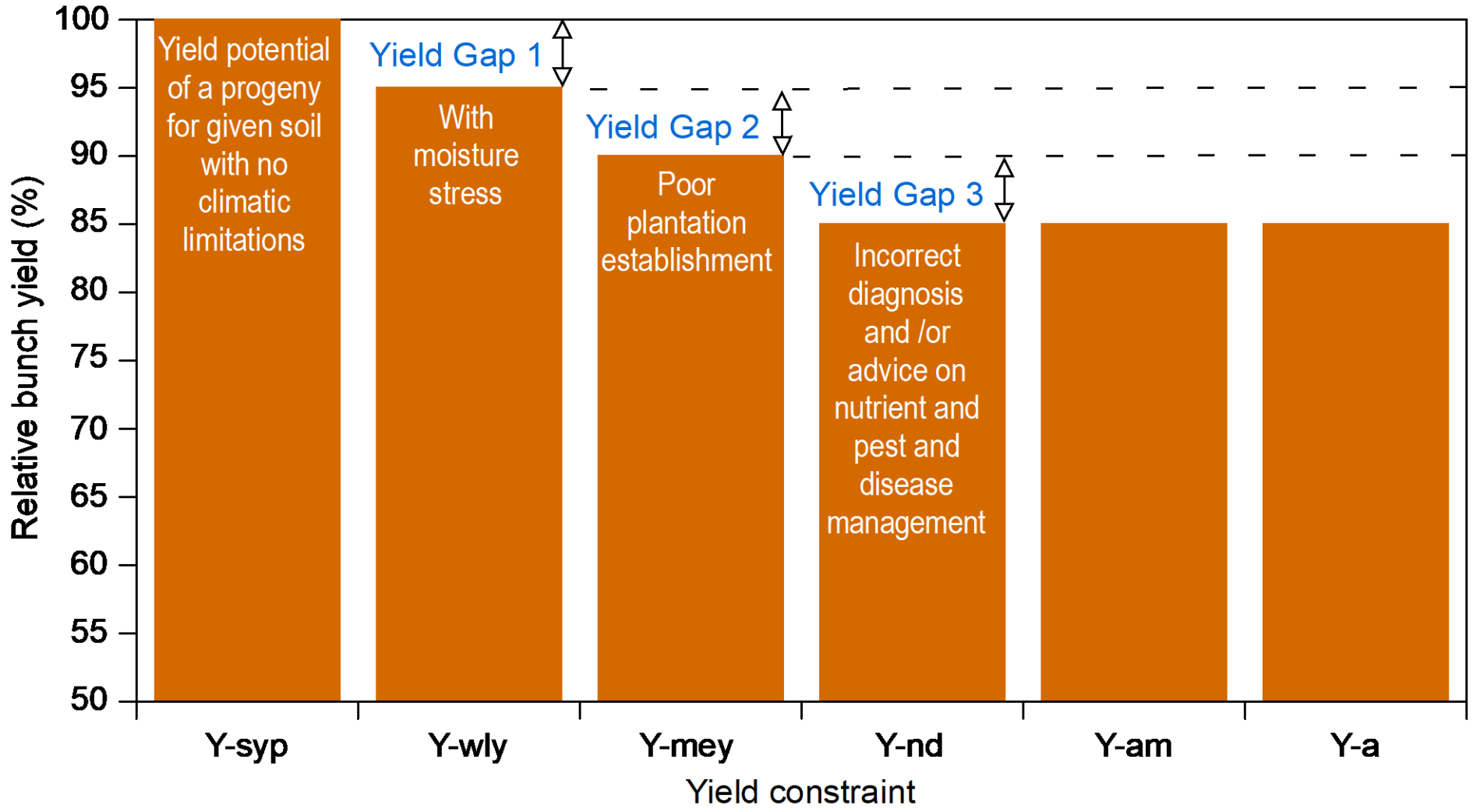
- Drainage
- Ground cover management
- Pruning
- Abnormal palm removal
- Pest and disease early warning system
- Pest management
- Disease management
- Fertilizer programme implementation

Evaluate field **costs** with reference to field **standards**

		Field upkeep standards (audits)	
		Poor	Good
Field costs (USD/ha)	High	Poor field standards and high costs. Time lags!	Good field standards and high costs. Find ways to reduce costs and maintain high standards
	Low	Poor field standards and low costs. Invest in field improvements	Good field standards and low costs. The ultimate goal.

- Field audits required to make a formal assessment of standards.
- Compare field standards with cost data.

Yield Gap 3 due to incorrect diagnosis



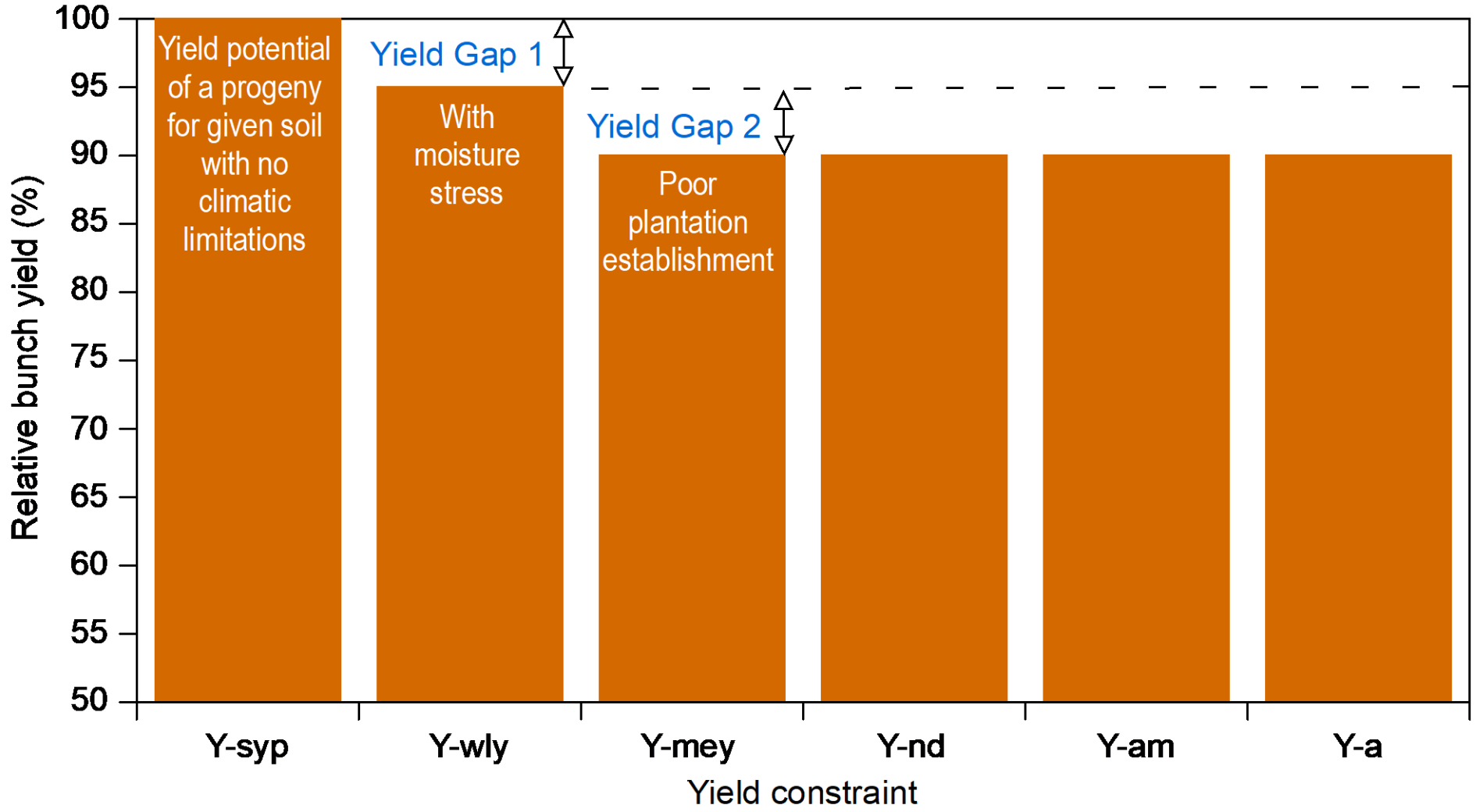
Verify that diagnostic work is being done properly and recommendations are correct

- Fertilizer recommendations are cost effective.
- Properly designed pest and disease early warning system.
- Appropriate integrated pest management practices.
- Appropriate integrated disease management practices.
- Proper standard operating procedures compiled and issued to all staff.
- Staff trained in the correct practices.
- Staff trained in basic oil palm physiology.

Fertilizer Planner™

- New software
- Interrogates data in OMP:
  - Leaf and soil analysis
  - Yield data
  - Field conditions
- Determines the least costly source of mineral fertilizers.
- **Glass box not a black box (all assumptions declared and transparent)**
- For more information, agrisoft-systems.com

Yield Gap 2 due to poor planting technique

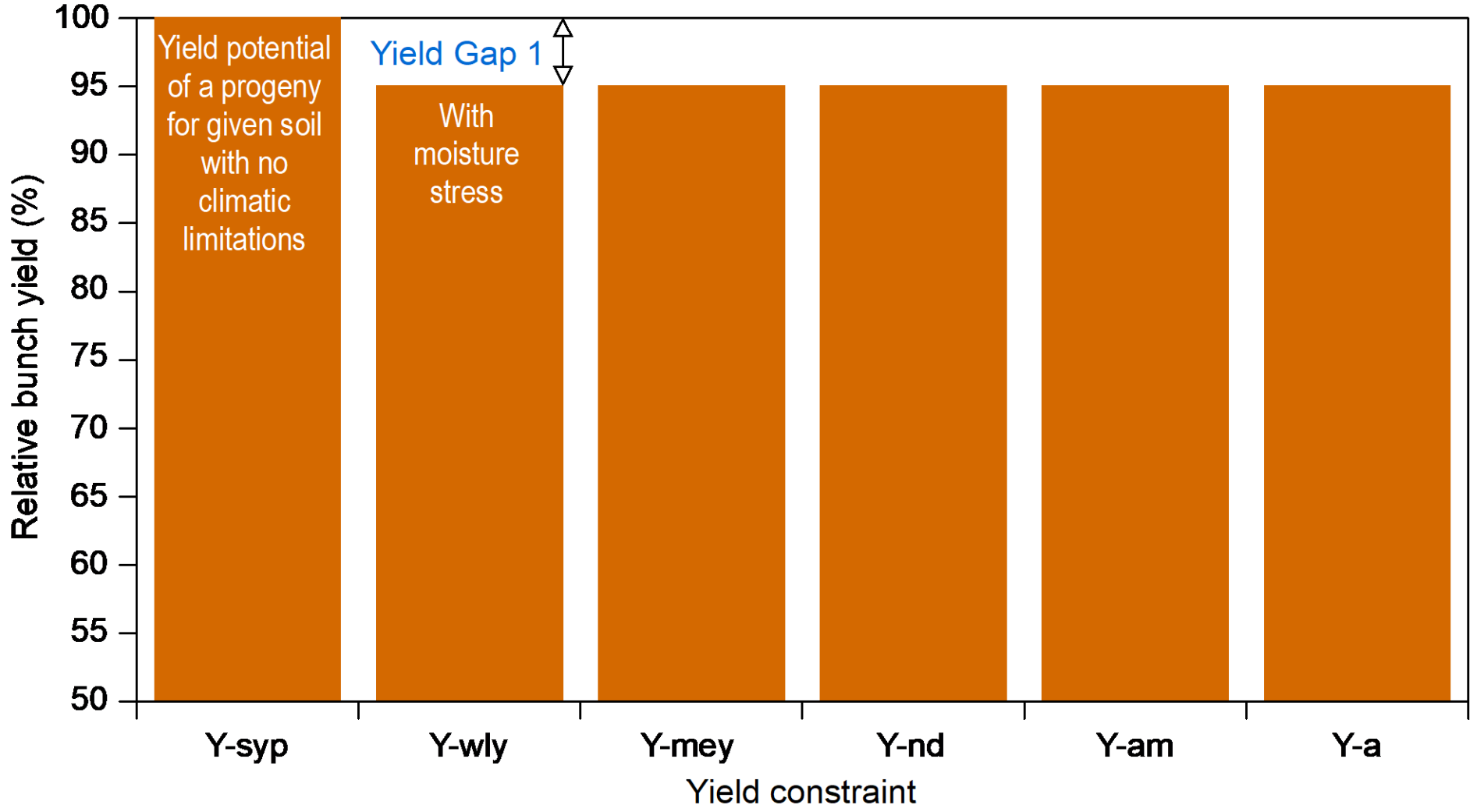


Verify that the correct planting and replanting techniques are used

Long term results from remedial action:

- High quality seed source.
- Excellent nursery.
- Strict culling.
- Proper land preparation (drainage, cambered beds).
- Road system.

Yield Gap 1 due to moisture stress

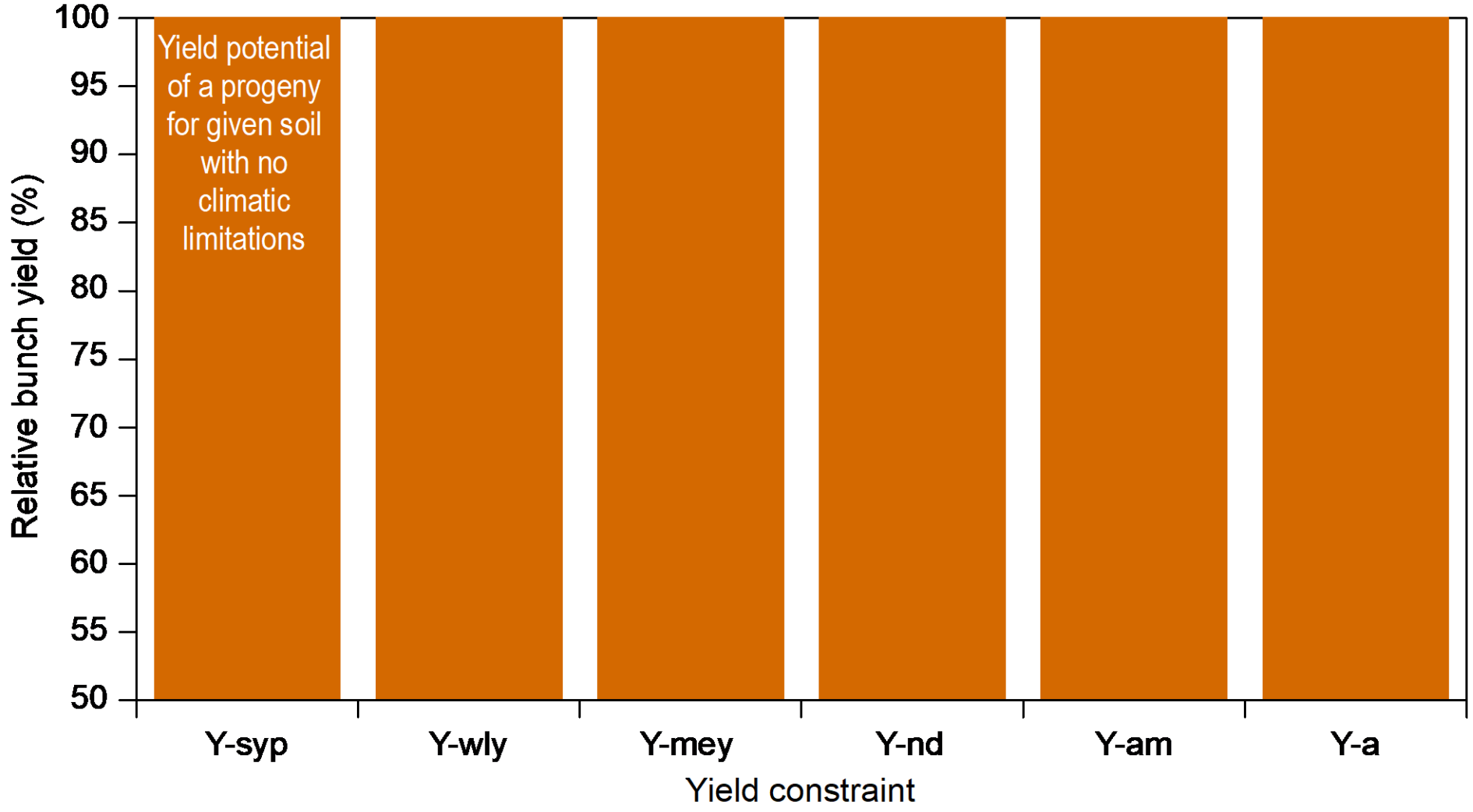


Implement water management practices

Long term results from remedial action:

- Measure water stress
- Soil moisture conservation (use of mill residues, platforms, terraces, frond stacking).
- Investigate cost effectiveness of irrigation.
- If water supply is sufficient, consider irrigation.

No yield gaps –site yield potential achieved!



Field visits, armed with the facts!

Division: D1-S01 Field: Desquite Block: 1002 *Printed: 18-Sep-17*

Area: 21.24 ha YOP: 2000 mYOP: 7 Palm age: 17 yr Planting material: Avros+Nig Density: 143.0 p/ha Seedling age at planting: mt

Land class: Palenque Previous land use: Potrero Land clearing: Quimico Trunk diameter: m DFH: 01/01/2004 MFH: 42 mt

Soil type: Palenque Soil texture (obs.): FAa/Fa Soil deficiency scoring: N P K Mg

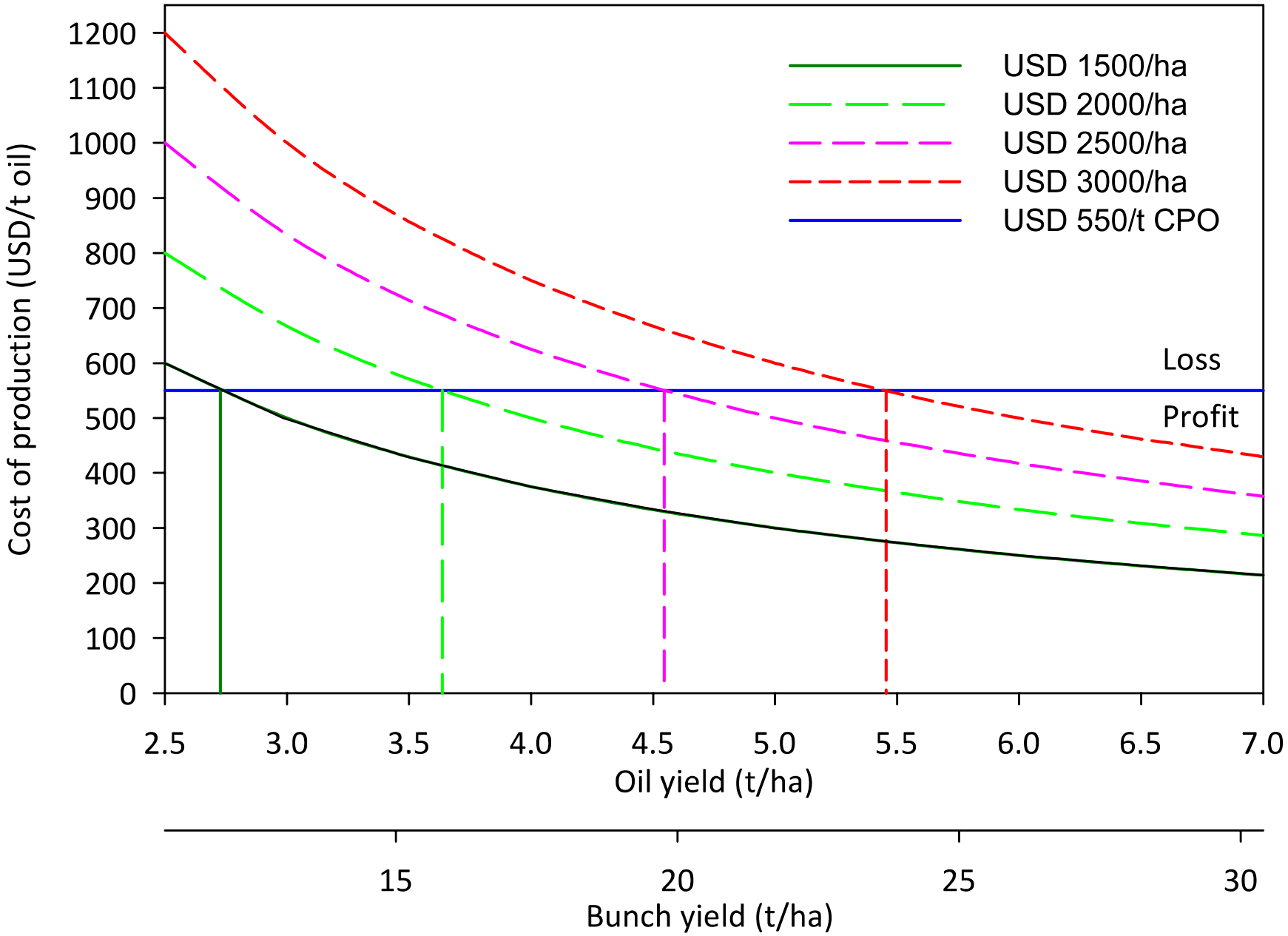
Topography: Plano Soil acidity status:

Drainage: Bueno Erosion: Ligera Soil consv. meas.: Soil consv. status: Field Marker: Comercial

Ground cover: 0 Pruning: Harvester access: Bueno Crop recovery: Growth Marker: Comercial

		Production data						Inorganic fertilizer inputs [kg/p]										Crop residues [t/ha]						Leaf analysis [% DM, mg/kg]; Deficiency scores																	
Yr	Age	Yield			BW	BN	HR	N		P2O5		K2O		MgO		B		EFB		Pome		Fibr		N			P			K			Mg			B		PCS	PH	SPH
		Pot	Act	Gap				A	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	L	Rc	D	L	Rc	D	L	Rc	D	L	Rc	D	L	D			
	yr	t/ha	t/ha	t/ha	kg																																	cm²	m	p/ha
2017	17	30.0	10.1	-19.9	28.0	3	22	0.4	1.0	0.3	0.4	1.0	1.1	-	-	0.016	0.015							2.49		-	0.176	0.11	-	0.98	2.16	-	0.29	0.09	-	33	-	50		139
2016	16	30.0	26.6	-3.4	24.9	8	26	0.2	0.5	0.1	0.1	0.3	0.9	0.1	0.1	0.030	0.030		-	-	-	-	40	2.45	0.31		0.156	0.08		0.98	2.02		0.30			22		41		139
2015	15	30.0	14.0	-16.0	24.7	-	-	0.8	0.8	-	-	0.6	0.6	0.2	0.1	0.036	0.036		-	-	-	87	-	2.57	0.39		0.171	0.11		0.98	1.83		0.32			12				-
2014	14	30.0	24.0	-6.0	23.8	-	-	1.5	1.1	0.3	-	0.8	-	0.1	-	0.029	0.020							2.72	0.43		0.150	0.10		0.90	2.01		0.32			11				-

Complete, up-to-date history of each block's agronomic background on yield, fertilizer history, leaf analysis, vegetative growth and palms stand.


Cost of production (USD/t oil)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
USD 1500/ha
USD 2000/ha
USD 2500/ha
USD 3000/ha
USD 550/t CPO
Loss
Profit
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
Oil yield (t/ha)
15
20
25
30
Bunch yield (t/ha)

Some conclusions……

- Significant yield gaps in Guatemala.
- Short term goal to eliminate crop losses (Yield Gap 4).
- Longer term goal to optimize field practices (Yield Gap 3).
- Make sure nutrient and pest and disease diagnosis and recommendations are appropriate and cost effective (Yield Gap 2).
- Raise high quality seeds in an excellent nursery and prepare land properly for new plantings (Yield Gap 1).
- Planters are price takers and field practice implementers.
- Triple bottom line benefit of yield intensification.

TCCL handbooks

- 20 box sets available at the conference.
- USD 125 per box set.