ARECACEAE

PRINCIPES REPRODUCTIVE ARCHITECTURE

Hervé Rey, René Lecoustre, Sébastien Griffon, 2015

http://amapstudio.cirad.fr/soft/principes/start


Phoenix dactilifera :
Separate trees
Fruit
Spikelet
Steril zone
Fertil zone
Peduncle
Inflorescences
Peduncle
Bract
Stalk
Date

Elaeis guineensis : Separate inflorescences

Male Inflorescence

Female Inflorescence

Cocos nucifera : mixed inflorescences

PLANT PARAMETERS

PLANT Folder

Reproductive parameters

Principes_v2014c.xlsx - Microsoft Excel

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Compléments | Acrobat

A1 ^bck

PALM TREE

Version	Name	Age	Sex		Fronds Torsion		Pinnae Orientation
				Frequency	Direction	Exception	
	String	Nb of CU	Code	%	Code	%	Code
v2014c	PRINCIPES	100	1	5.00	1	50.00	1
	PalmTreeName	SimulationAge	PalmTreeSex	InflorescenceSex_1	PalmTreeDeviationDirection_1_2		PalmTreeLeafletChoice
			0 = Male 1 = Female 2 = M or F 3 = M & F	if Type = 2 F on Total	1 = clockwise -1 = counterc		1 = Induplicate = Phoenix -1 = Reduplicate = Elaeis

SIMULATION

Seed	Output	Reference	Mode	Complexity	Element Length Unit for geometry		
random	geometry	rank	simulation	simulation			
Nb	Nb of CU	rank	Code	Code	cm	cm	cm
567	100	17	0	1	30	20	10
SimulationSeed	SimulationOutputStep	SimulationStructureAge	SimulationMode	SimulationStructureComplexity		PalmTreeGeometryLengthUnit_1_2_3	
		Frond & Inflorescence	0 = structural 1 = Growth 2 = functional		Spear Frond Nervure Stump	Stalk Bract	Pinnae Spikelet

0 = Whole Palm-tree
1 = Whole Fronds
2 = Whole Inflos
3 = Stem
4 = One Frond 3D
5 = One Inflo 3D
6 = One Leaflet 3D
7 = One Spikelet 3 D
8 = One Frond 2D
9 = One Inflo 2D
10 = One Leaflet 2D
11 = One Spikelet 2D

COULEURS

	Frond_Nervure	Spear	Stem	Stump	Pinnae_1	Pinnae_2	Pinnae_3
R	122	28	127	153	50	28	28
V	160	228	102	102	200	228	228
B	0	28	0	51	50	28	28

	Inflo_Stalk	Bract	Spikelet	Female Flower	Male Flower	Fruit
R	255	115	255	255	255	223
V	179	105	179	255	255	40
B	0	79	0	153	153	3

IGAP | Principes_v2014c | Summary | PLANT | STEM_Geom | SPEAR | FROND_Prod | FROND_NERVURE_Geom | STUMP

Prêt | 90 %

Palm-Tree Sex

Cocos nucifera

Phoenix dactylifera

Elaeis guineensis

1- Phenomena

PLANT Folder

Palm-tree Sex

Palm-tree Sex code

Femele Bunches Ratio

Principes_v2014c.xlsx - Microsoft Excel

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A1 ^bck

bck

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10 = One Leaflet 2D
11 = One Spikelet 2D

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IGAP | Principes_v2014c | Summary | PLANT | STEM_Geom | SPEAR | FROND_Prod | FROND_NERVURE_Geom | STUMP

Prêt 90 %

2- Model

Palm-Tree Sex

Cocos nucifera

2

Male
&
Femele
Mixed
Inflorescence

0

Male
Palm
Tree

Phoenix dactylifera

1

Femele
Palm
Tree

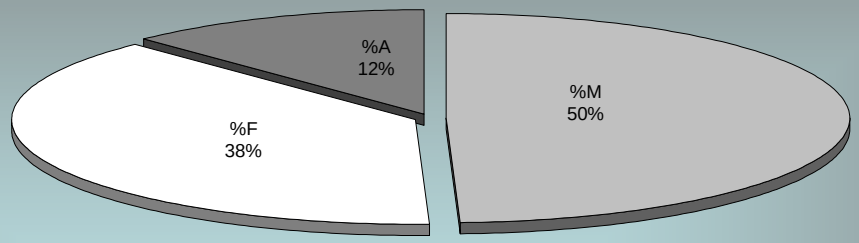
3

Male
&
Femele
Separated
Inflorescence

Elaeis guineensis

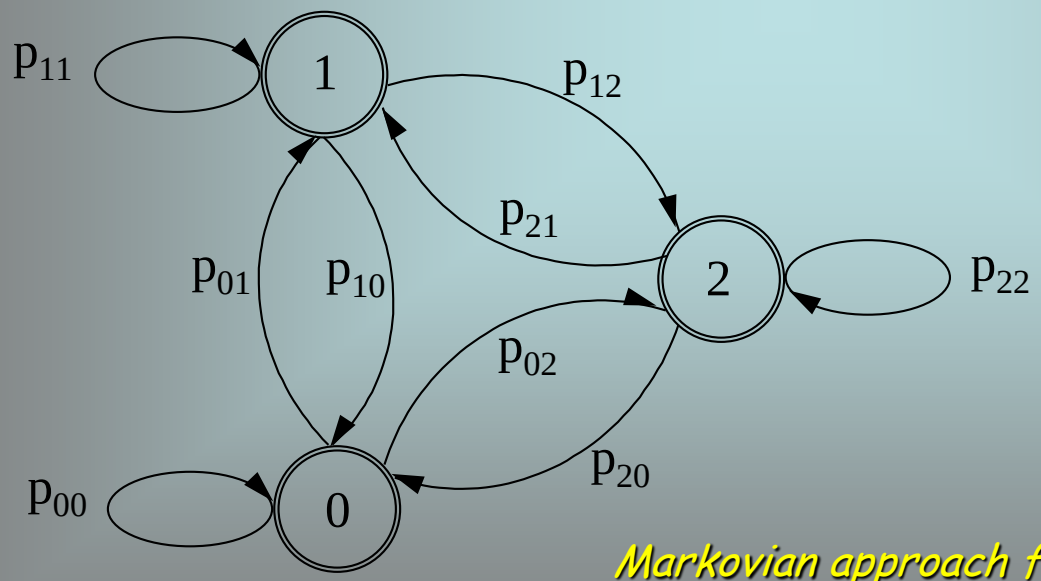
3- We observe

Inflorescence Sex Frequency



Rey & al, 1992

For Male & Femele Palm-tree with separated inflorescence



Elaeis guineensis

Markovian approach for sexualisation modelling

3- We observe

INFLORESCENCE PRODUCTION

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Compléments | Acrobat

A1 ^IGAP!A1

INFLO_Prod Folder

IGAP!A1

STIPE | BEARER | ORGAN | TIME

INFLORESCENCE on STEM DEVELOPMENT, LOCATION & INSERTION

	INFLORESCENCE DEVELOPMENT PHENOLOGY								INFLORESCENCES LOCATION		INFLORESCENCE AXIAL INSERTION ANGLE				
	INFLORESCENCE			FEMALE FLOWER				MALE FLOWER							
	Life Span		Anthesis	Life Span		Fructification Frequency		Life Span		Code		Final			Evolution
										0 = NO 1 = YES					
Item	Position	Mean	before Flowering	Mean	Position	Mean	STD	Mean	Position		Position	Mean	STD	Time	Growth
Interpolation		0	0	0		1	1	0		0		1	1		1
Nb Values		1.0	1.0	1.0		4.0	4.0	1.0		2.0		1.0	1.0		3.0
Variable Name		InfloLifeSpan_		FemaleFlowerLifeSpan_		FruitLocalisation_		MaleFlowerLifeSpan_	InflorescenceLocalisation_			StalkInsertionAngleEvol_			
Unit	Pos Stem	Phyllo	Phyllo	CU nb	Pos Bearer %	%	%	CU nb	Pos Stem	Code	Pos Stem	degree	degree	Phyllo	Ratio
1	1	36	20	10	0.00	0.00	0.00	22	1	0	1	70.00	0.05	1	0.01
2					20.00	80.00	1.00		40	1				20	0.10
3					50.00	90.00	3.00							36	1.00
4					100.00	100.00	5.00								
5															
6															
7															
8															
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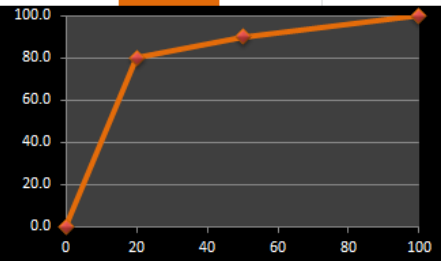
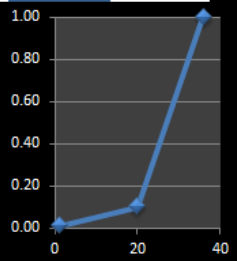
25															





Principes | PLANT | STEM_Geom | SPEAR | FROND_Prod | FROND_NERVURE_Geom | STUMP | PINNAE_Prod | PINNAE_Geom | INFLO_Prod | STALK_Geom | BRACT

Prêt | 90 %

For

INFLORESCENCE RADIAL INSERTION ANGLE

See

FROND_Prod Folder

In

PRINCIPES – Vegetative Presentation

Phoenix dactylifera

Elaeis guineensis

Cocos nucifera

Elaeis guineensis

1- Phenomena

Elaeis guineensis

1- Phenomena

1- Phenomena

1- Phenomena

Phoenix dactylifera

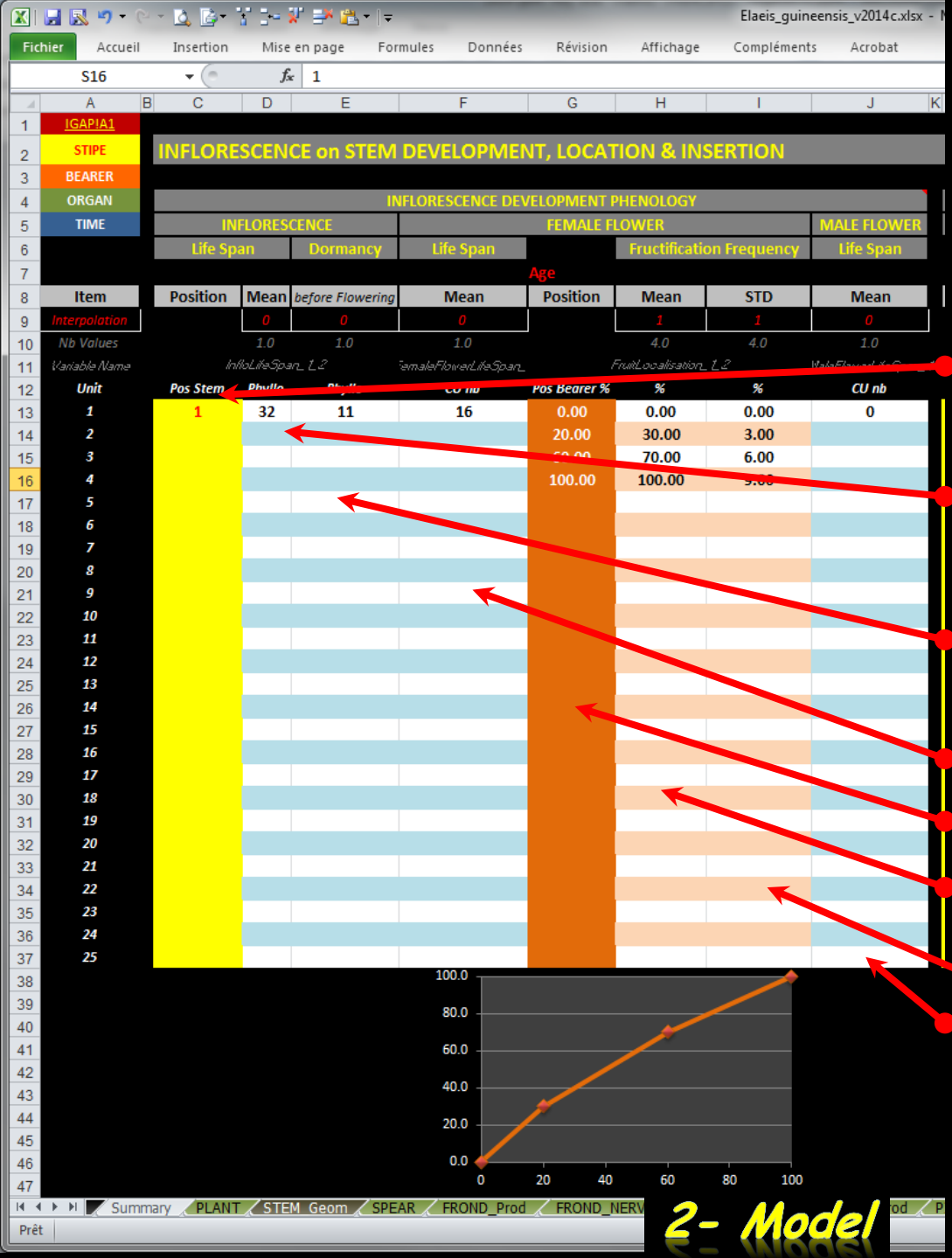
1- Phenomena

Cocos nucifera

1- Phenomena

INFLO_Prod Folder

Inflorescence Phenology



Absolut position of inflorescence on the stipe

Inflorescence life span (since initiation) before harvest

Inflorescence Dormancy (since initiation) before anthesis

Female Flower life span (since initiation)

Female Flower position on Spikelet

Female Flower Fructification frequency

Female Flower Fructification std of Freq

Male flower Life Span (since initiation)

Inflorescence Phenology

INFLO_Prod Folder

Elaeis_guineensis_v2014c.xlsx - Microsoft Excel

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Compléments | Acrobat

S16 | fx 1

IGAPIA1

STIPE

BEARER

ORGAN

TIME

INFLORESCENCE on STEM DEVELOPMENT, LOCATION & INSERTION

	INFLORESCENCE DEVELOPMENT PHENOLOGY								INFLORESCENCES LOCATION		INFLORESCENCE AXIAL INSERTION ANGLE				
	INFLORESCENCE			FEMALE FLOWER				MALE FLOWER							
	Life Span		Dormancy	Life Span		Fructification Frequency		Life Span		Code		Final			Evolution
				Age						0 = NO		YInsertionAngle			
Item	Position	Mean	before Flowering	Mean	Position	Mean	STD	Mean	Position	1 = YES	Position	Mean	STD	Time	Growth
Interpolation		0	0	0		1	1	0		0		1	1		1
Nb Values		1.0	1.0	1.0		4.0	4.0	1.0		2.0		6.0	6.0		4.0
Variable Name		InfloLifeSpan_L2		FemaleFlowerLifeSpan_		FruitLocalisation_L2		MaleFlowerLifeSpan_1	InflorescenceLocalisation_1			StalkInsertionAngleEvol_1			
Unit	Pos Stem	Phyllo	Phyllo	CU nb	Pos Bearer %	%	%	CU nb	Pos Stem	Code	Pos Stem	degree	degree	Phyllo	Ratio
1	1	32	11	16	0.00	0.00	0.00	0	1	0	1	0.00	0.00	1	0.10
2					20.00	30.00	3.00		70	1	70	35.00	0.35	12	0.40
3					60.00	70.00	6.00				160	30.00	0.30	17	0.55
4					100.00	100.00	9.00				320	27.00	0.27	32	1.00
5											400	25.00	0.25		
6											500	22.00	0.22		
7															
8															
9															
10															
11															
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15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															

1–11	Dormancy
12–16	Flowering
17–32	Fructification

100.0

1.00

2- Model

Inflorescences are labelled according to their corresponding palm

Phoenix dactylifera

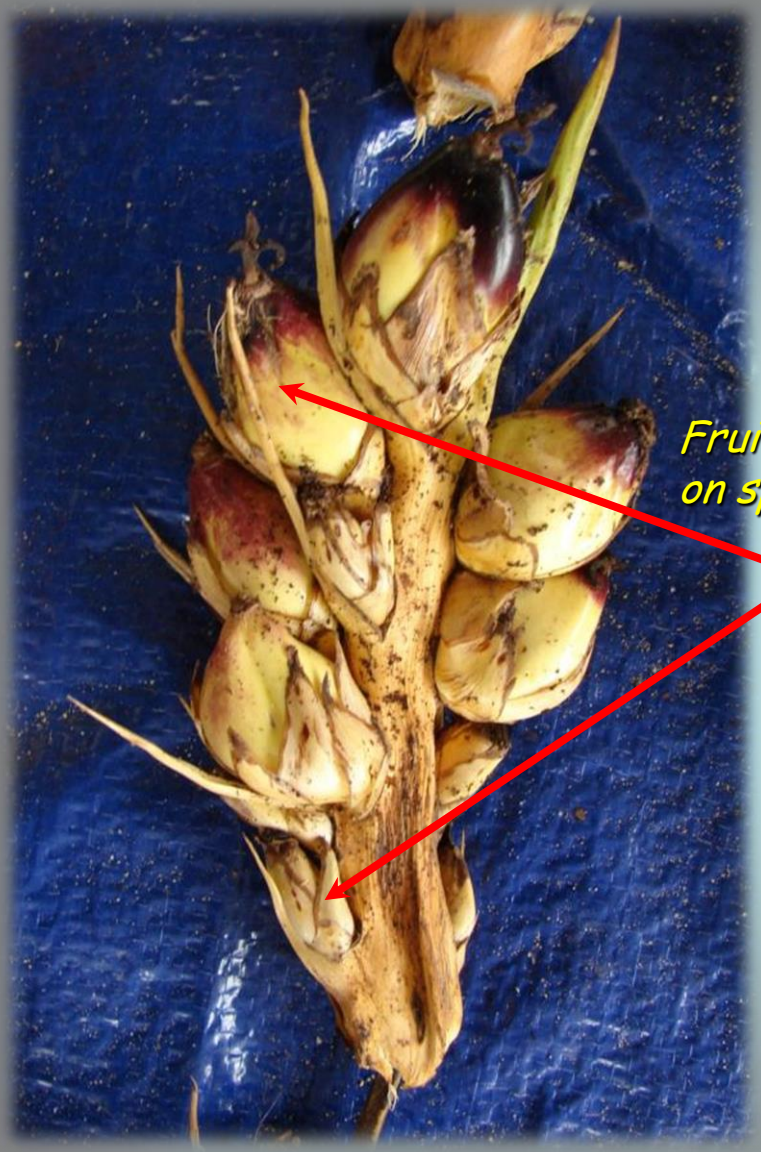
3- We measure

3- We measure

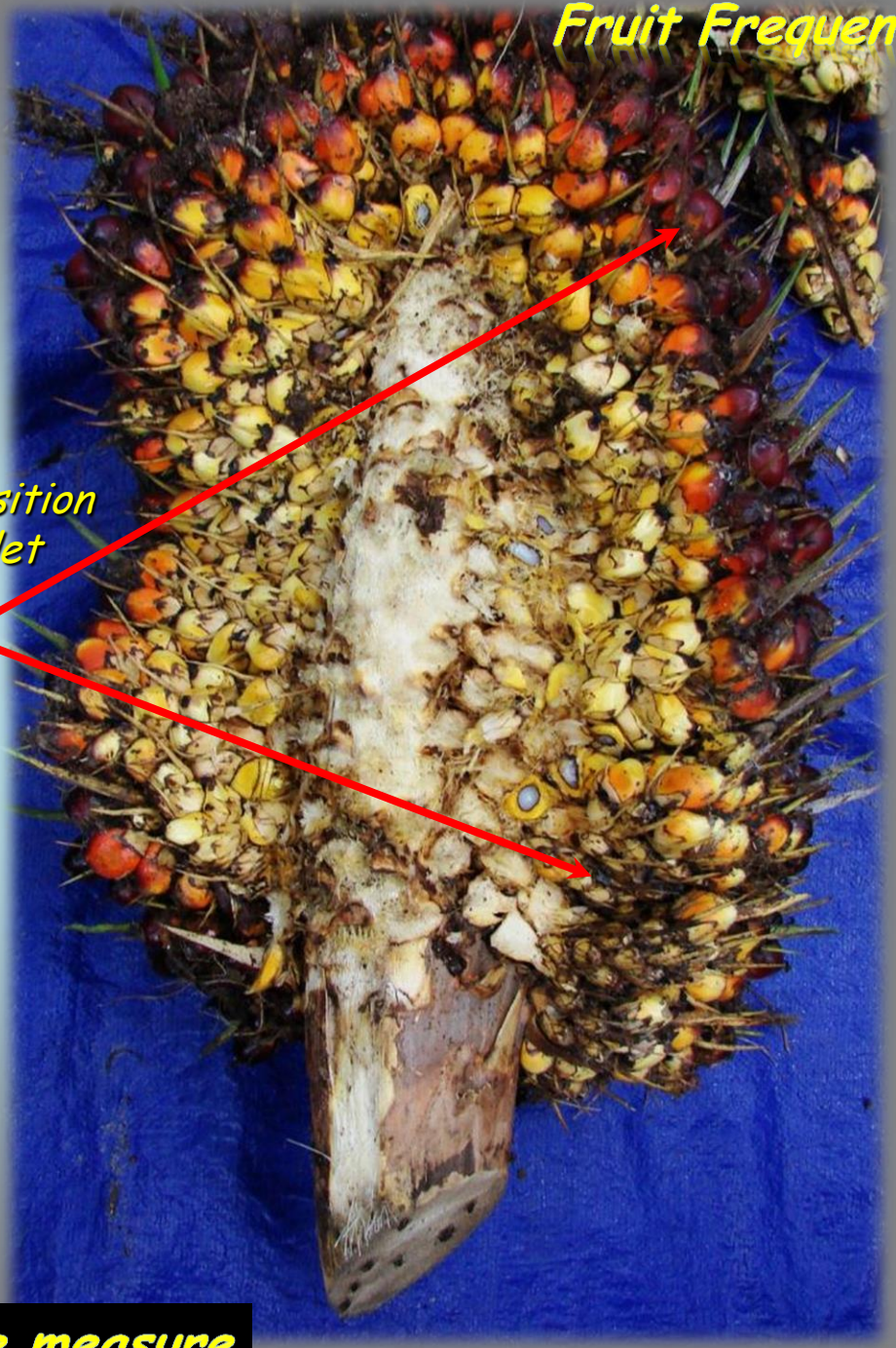

Inflorescence positions in the crown
Phoenix dactylifera

3- We measure

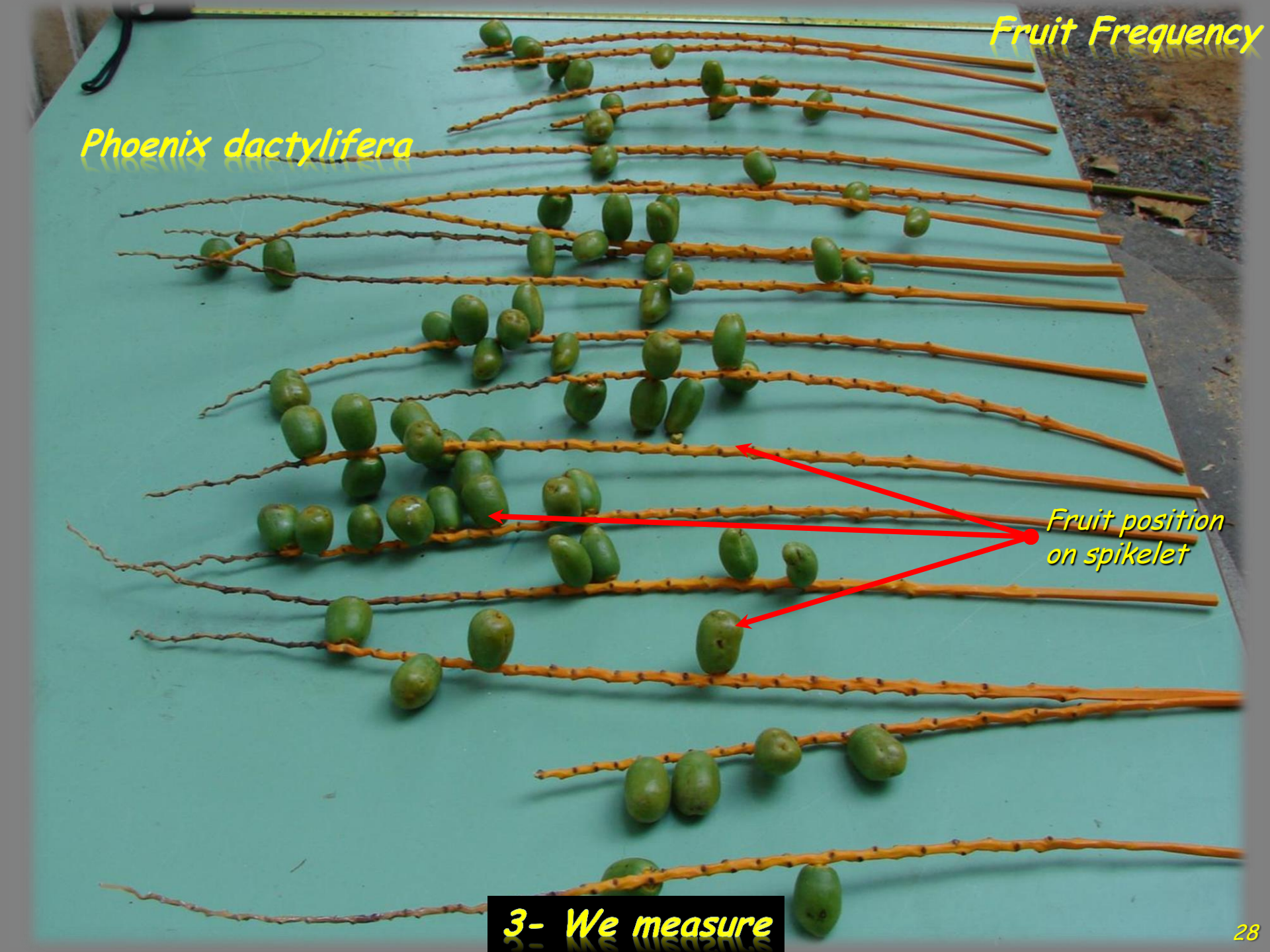
3- We measure



Elaeis guineensis



3- We measure


Fruit Frequency
Phoenix dactylifera
Fruit position
on spikelet
3- We measure

Fruit Frequency

Cocos nucifera

3- We measure

1- Determine inflorescence number (axillary frond)

2- Determine frond number before anthesis
-> « dormancy »

3- Determine lower frond number when harvesting
-> « Life Span »

4- Determine flower positions on spikelets

5- Determine fruit positions on same spikelets

6- Compute fruit occurrence as a function
of its relative length position on spikelet

4- Protocol

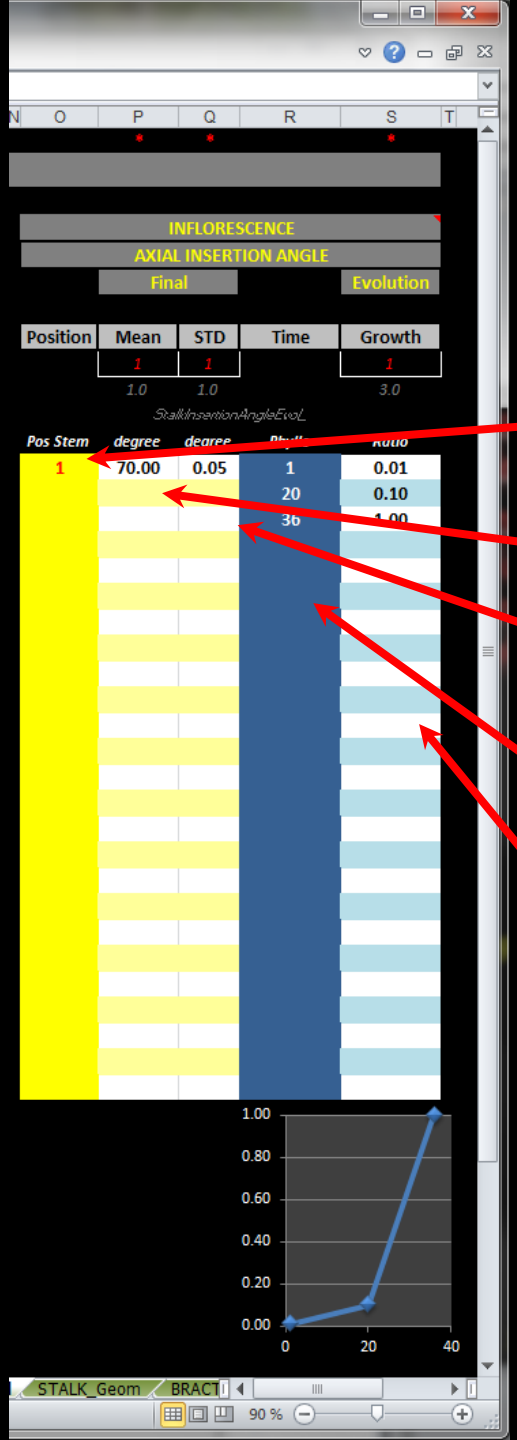
Stalk
Axial Insertion Angle

Cocos nucifera

1- Phenomena

INFLO_Prod Folder

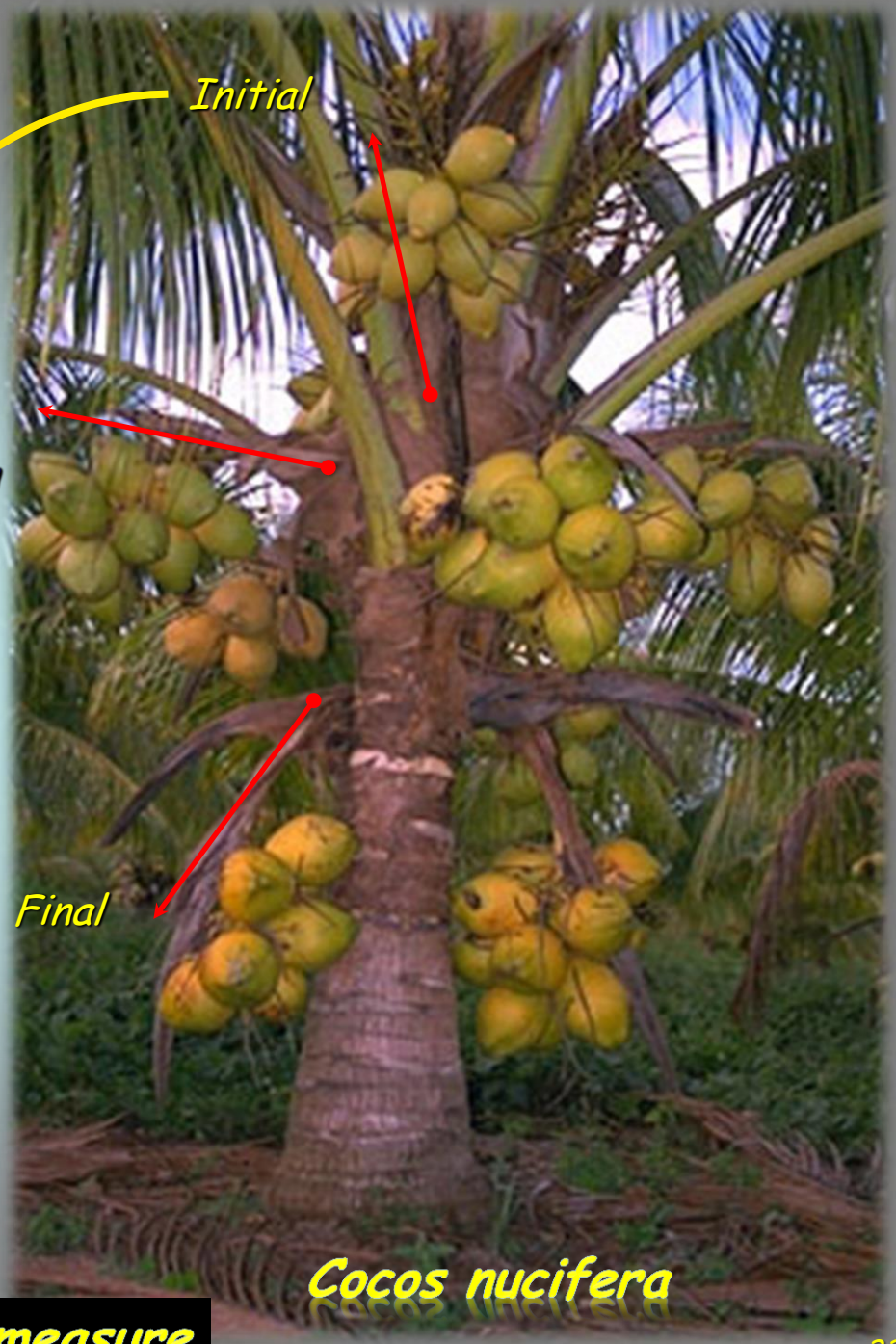
Inflorescence Axial Insertion Angle



- *Absolute position of inflorescence on the stipe*
- *Final Inflorescence insertion angle*
- *Final Inflorescence insertion angle standard variation*
- *Duration (in phyllochrones)*
  For axial insertion angle evolution
- *Ratio for axial insertion angle along time*

Stalk
Axial Insertion Angle

Evolution
Duration



3- We measure

Inflorescence Axial Insertion Angle

1- Determine inflorescence ranks
at least first and last ones

2- Measure corresponding stalk axial insertion angles (photo)

3- Keep last inflorescence as reference angle (final)

4- Stalks axial insertion angles are expressed
through a ratio of this final angle

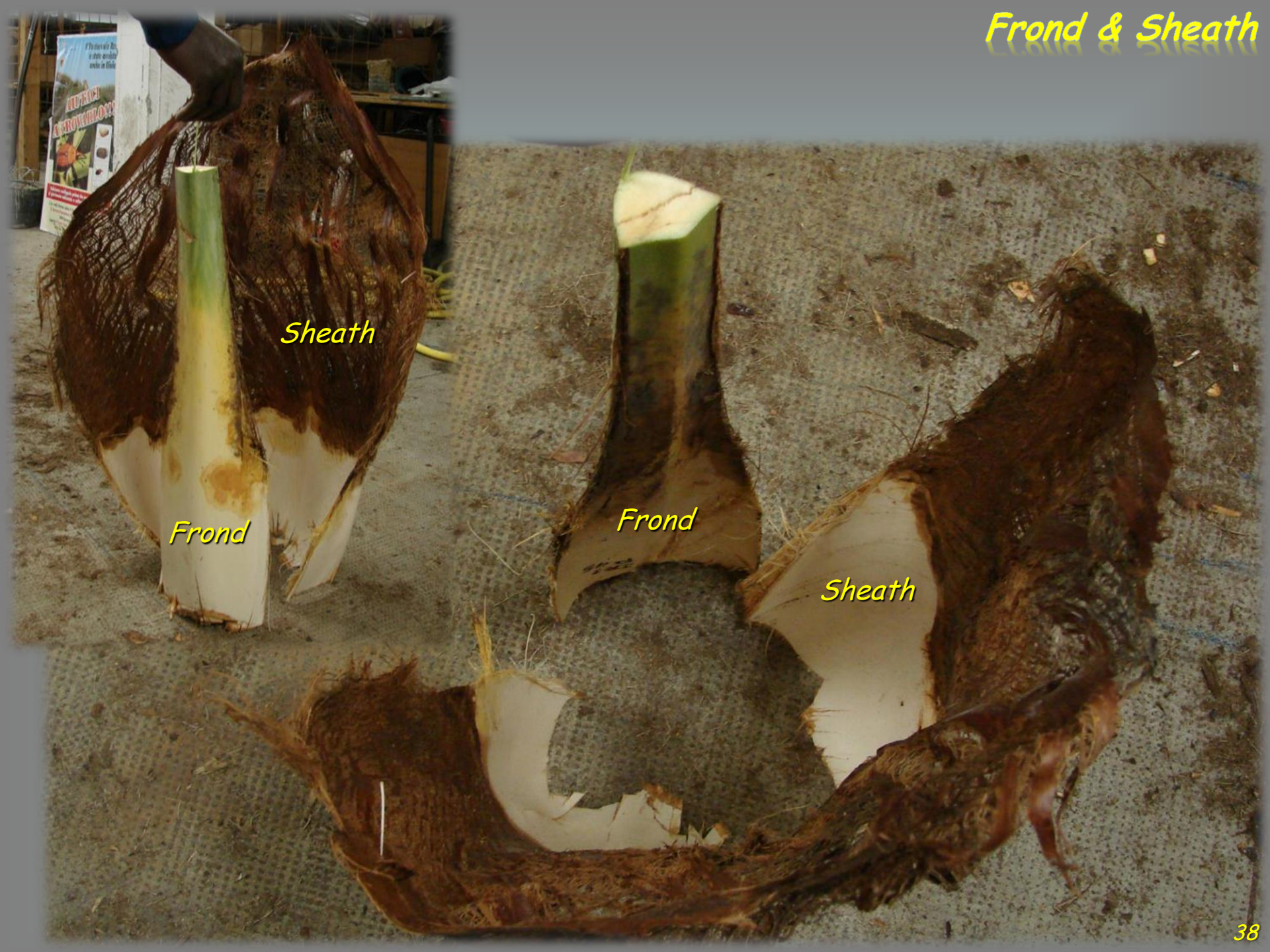
PHENOLOGY

Phoenix dactylifera

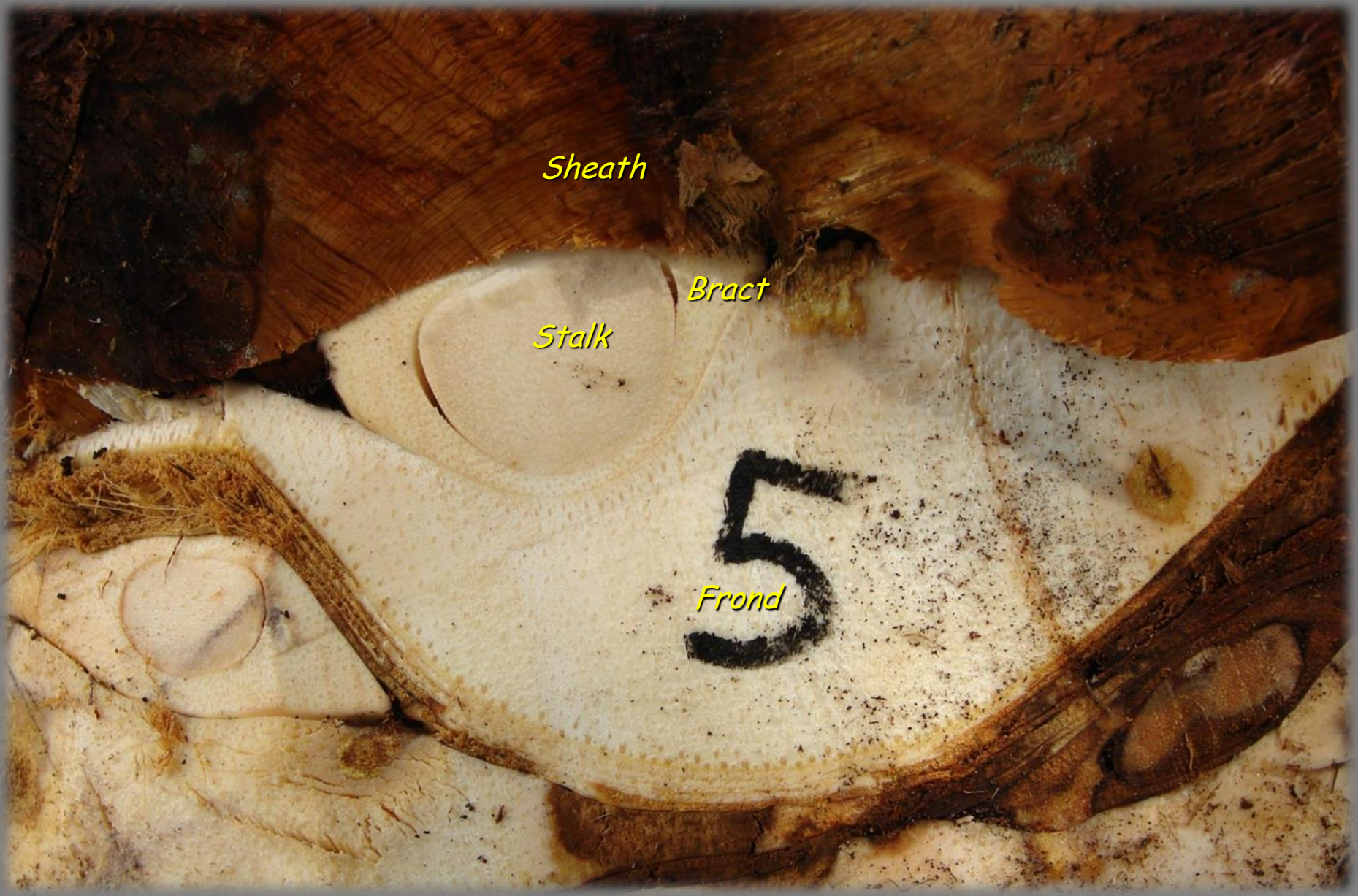

Frond & inflorescence

Fronds and axillary Inflorescences

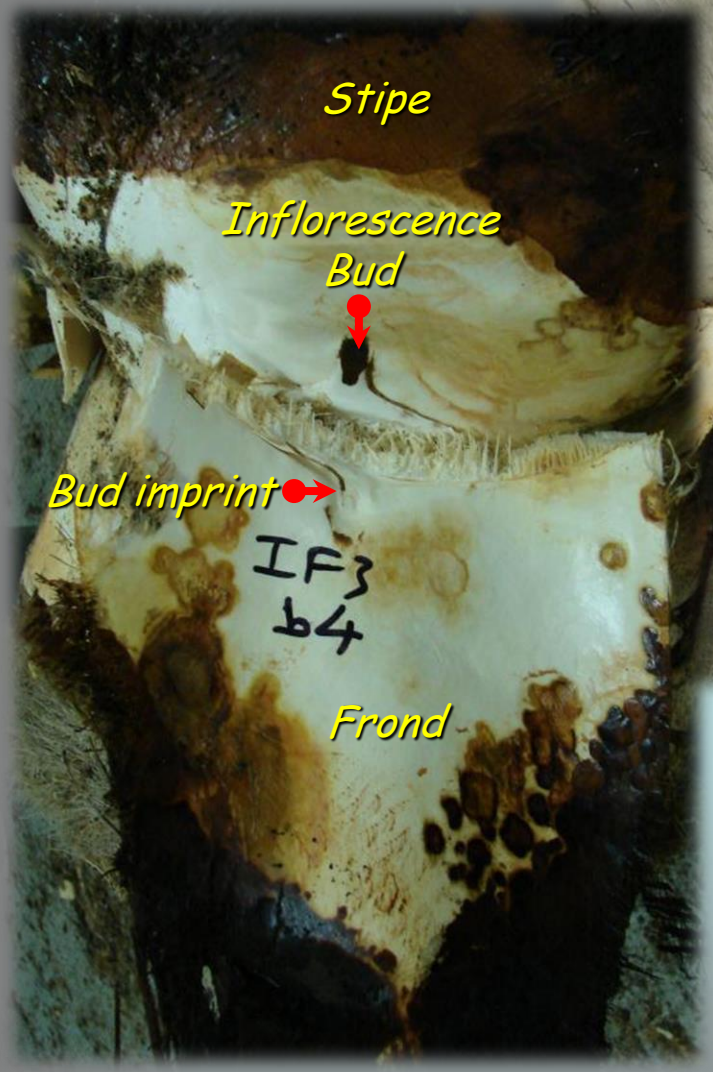
Frond & Sheath

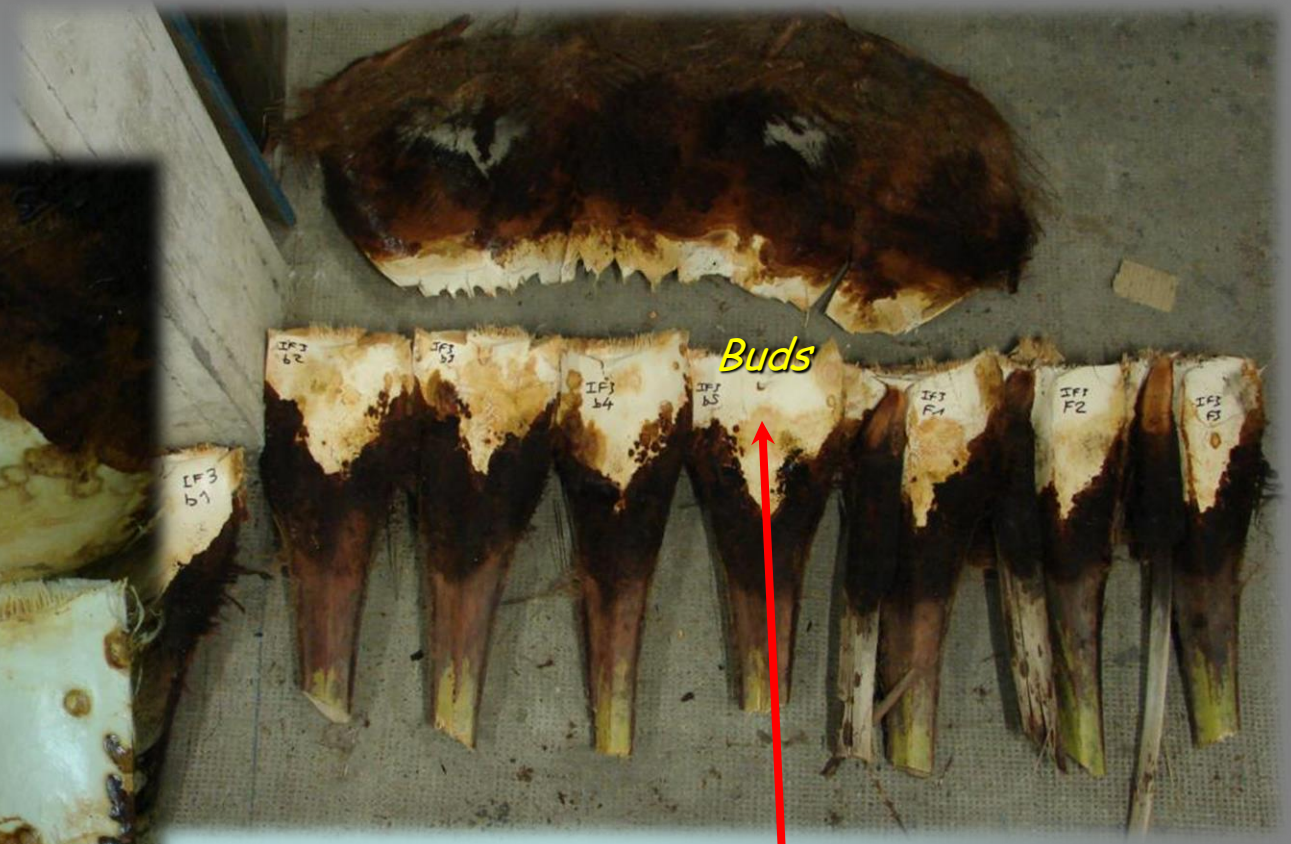


Frond, Bract, Stalk & Sheath



Frond & Sheath

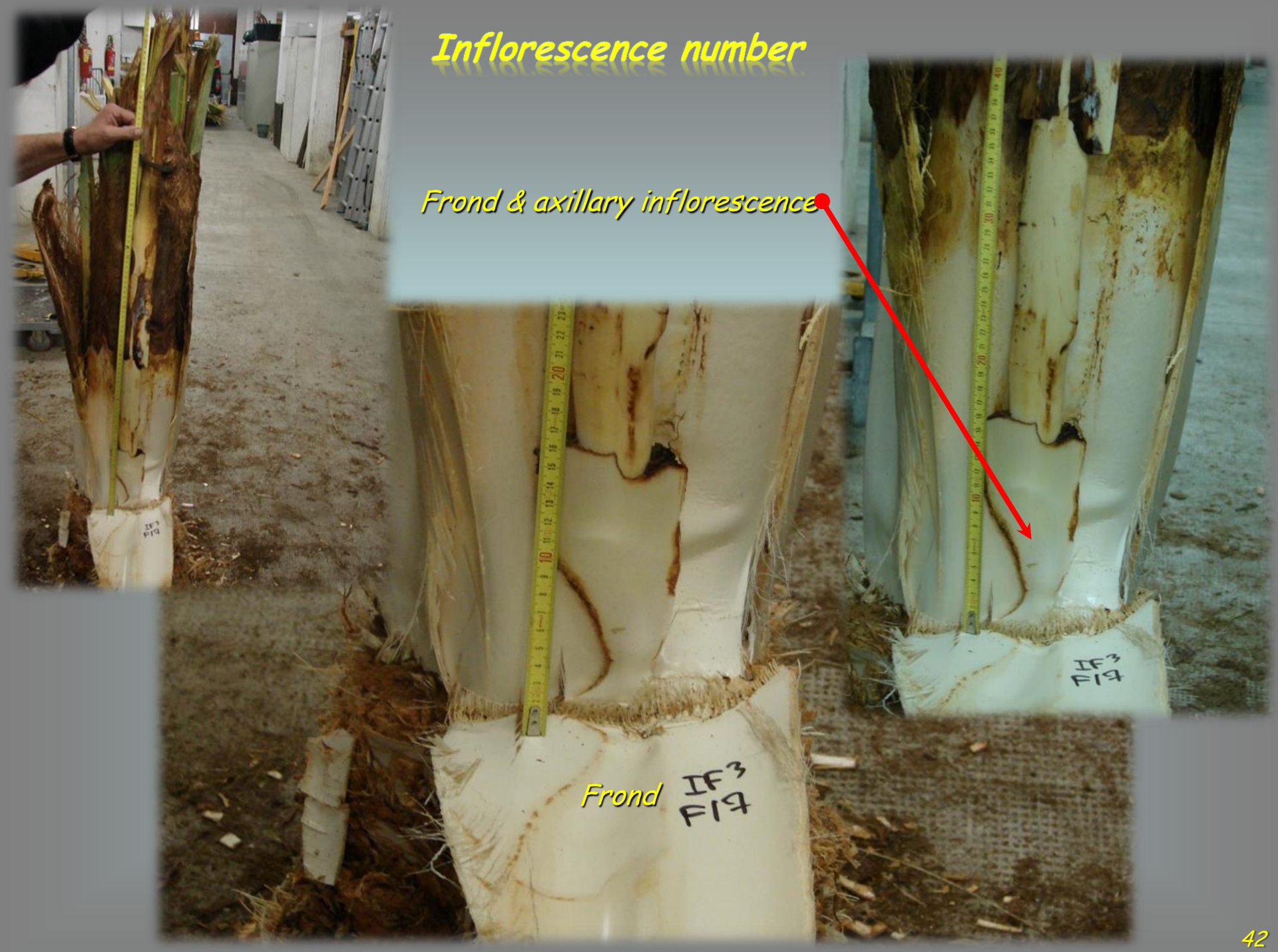




Fronds with aborted & not aborted inflorescence

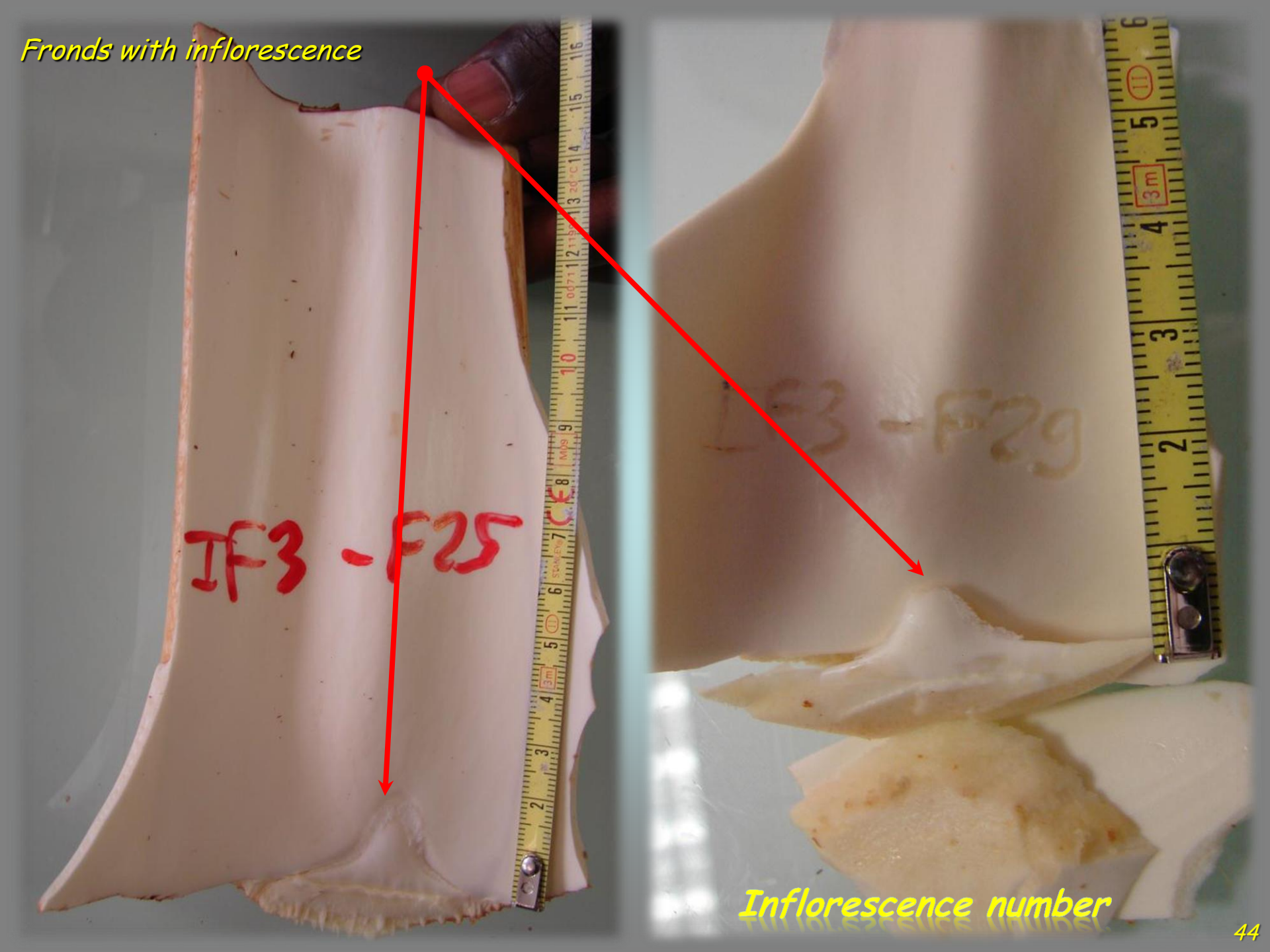
Inflorescence number

Inflorescence number



Inflorescence number

Frond & axillary inflorescence
Bract & petiole

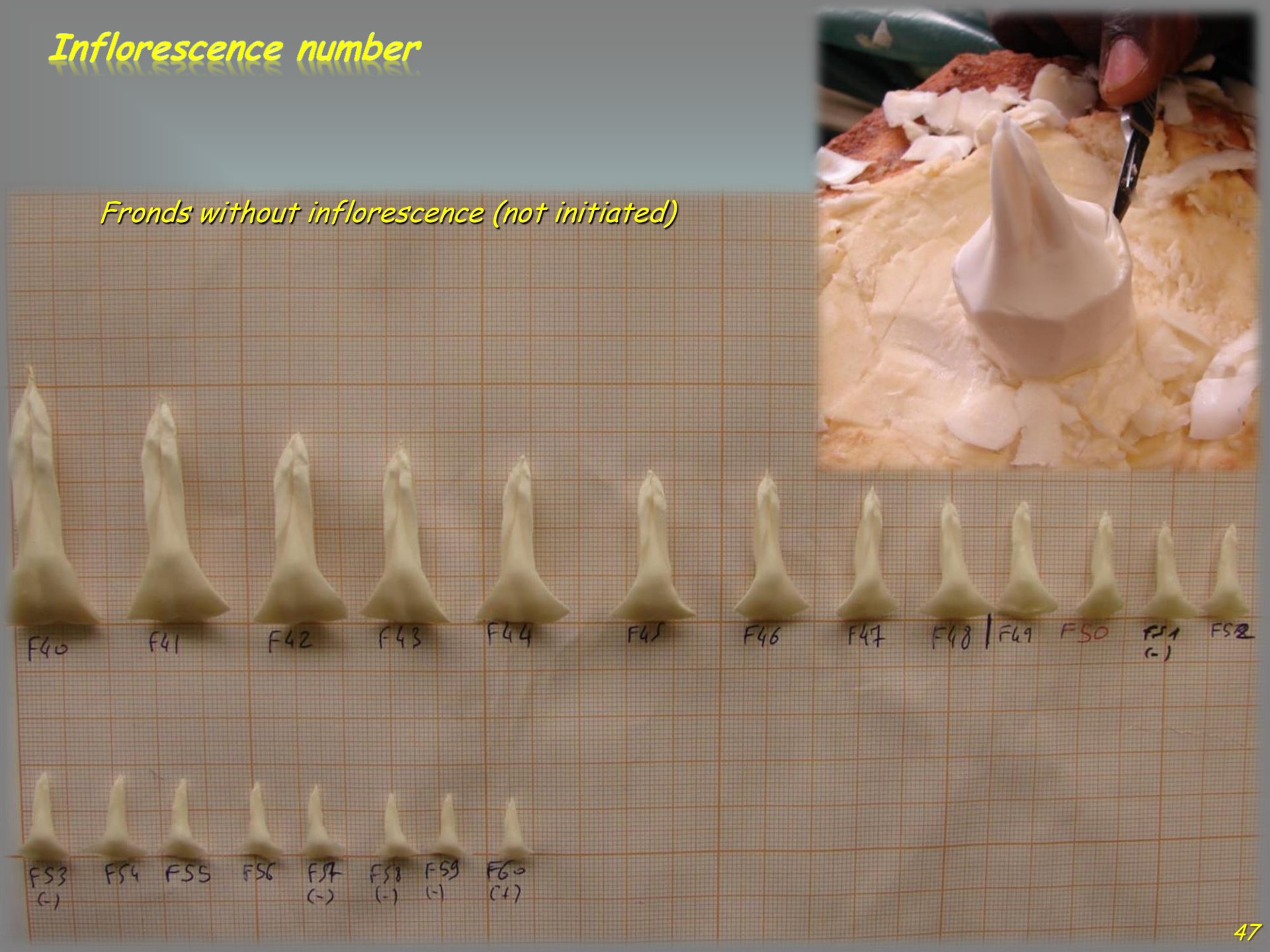

Fronds with inflorescence
IF3 - F25
IF3 - F29
Inflorescence number

Inflorescence number

Inflorescence number

Inflorescence number

Fronds without inflorescence (not initiated)



INFLORESCENCE GEOMETRY

STALK_Geom Folder

Elaeis_guineensis_v2014c.xlsx - Microsoft Excel

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A1 ^IGAP!A1

IGAP!A1 | STIPE | BEARER | ORGAN | TIME

STALK SIZE & GEOMETRY

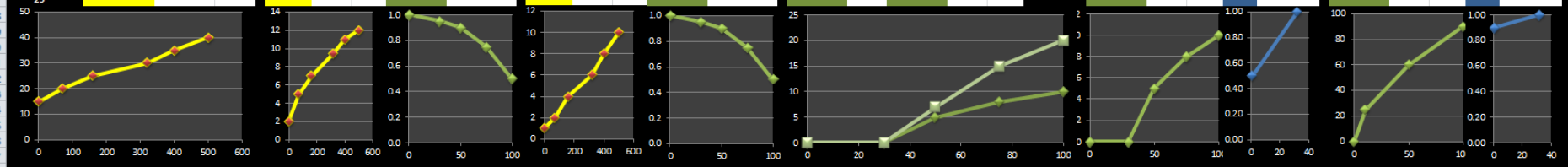
Item	STALK LENGTH Position	Length Final Mean	Length Final STD	STALK WIDTH Position	Width Max Mean	Width Max STD	Width Position	Width Shape Factor Shape
Interpolation		1	1		1	1		1
Nb Values		6.0	6.0		6.0	6.0		5.0
Variable Name		StalkLength_1_2			StalkWidth_1_2_3			
Unit	Pos Stem	cm	cm	Pos Stem	cm	cm	Pos Organ %	factor
1	1	15.00	1.00	1	2.00	0.30	0.00	1.00
2	70	20.00	3.00	70	5.00	0.80	30.00	0.95
3	160	25.00	4.00	160	7.00	1.20	50.00	0.90
4	320	30.00	4.20	320	9.50	1.50	75.00	0.75
5	400	35.00	4.30	400	11.00	1.60	100.00	0.50
6	500	40.00	4.50	500	12.00	1.70		

Item	STALK HEIGHT Position	Height Max Mean	Height Max STD	Height Position	Height Shape Factor Shape
Interpolation		1	1		1
Nb Values		6.0	6.0		5.0
Variable Name		StalkHeight_1_2_3			
Unit	Pos Stem	cm	cm	Pos Organ %	factor
1	1	1.00	0.10	0.00	1.00
2	70	2.00	0.50	30.00	0.95
3	160	4.00	0.80	50.00	0.90
4	320	6.00	1.00	75.00	0.75
5	400	8.00	1.10	100.00	0.50
6	500	10.00	1.20		

Item	STALK BENDING ANGLE (same nb of CP for Initial & Final) Position	Initial Mean	Orthotropy Position	Final Mean	Final STD	Evolution Duration	Phyllo
Interpolation		1		1	1	0	
Nb Values		5.0		5.0	5.0	1.0	
Variable Name			StalkBendingAngle_1_2_3_4				
Unit	Pos Organ %	degree	Pos Organ %	degree	degree		
1	0.00	0.00	0.00	0.00	0.00		32
2	30.00	0.00	30.00	0.00	0.20		
3	50.00	5.00	50.00	7.00	0.70		
4	75.00	8.00	75.00	15.00	1.50		
5	100.00	10.00	100.00	20.00	2.00		

Item	STALK TORSION ANGLE Position	Final Mean	Final STD	Evolution Time	Evolution Growth	Phyllo
Interpolation		1	1		1	
Nb Values		5.0	5.0		2.0	
Variable Name		StalkRotationAngle_1_2		StalkRotationAngleEvol_		
Unit	Pos Organ %	degree	degree	Phyllo	Ratio	
1	0.00	0.00	0.00	1	0.50	
2	30.00	0.00	1.00	32	1.00	
3	50.00	5.00	0.50			
4	75.00	8.00	0.80			
5	100.00	10.00	1.00			

Item	STALK LATERAL DEVIATION ANGLE Position	Final Mean	Final STD	Evolution Time	Evolution Growth	Phyllo
Interpolation		1	1		1	
Nb Values		4.0	4.0		2.0	
Variable Name		StalkLateralDeviationAngle_1_2		\LateralDeviationAngleEv		
Unit	Pos Organ %	degree	degree	Phyllo	Ratio	
1	0.00	0.00	0.00	1	0.90	
2	10.00	25.00	0.25	32	1.00	
3	50.00	60.00	0.40			
4	100.00	90.00	0.50			



Summary | PLANT | STEM_Geom | SPEAR | FROND_Prod | FROND_NERVURE_Geom | STUMP | PINNAE_Prod | PINNAE_Geom | INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom

Prêt | 80 %

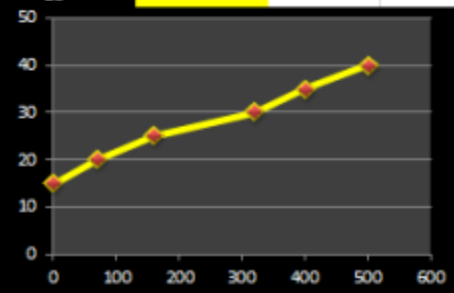

Stalk
Length
Tab. 53.
ELAIS melanococca.
1- Phenomena

Stalk Length : acrotony in the crown…

1- Phenomena

STALK_Geom Folder Stalk Length

	A	B	C	D	E	F
1	IGAP!A1					
2	STIPE		STALK SIZE & GEOMETRY			
3	BEARER					
4	ORGAN		STALK			
5	TIME		LENGTH			
6				Final		
7				Length		
8	Item		Position	Mean	STD	
9	Interpolation			1	1	
10	Nb Values			6.0	6.0	
11	Variable Name			StalkLength_L_2		
12	Unit		Pos Stem	cm	cm	
13	1		1	15.00	1.00	
14	2		70	20.00	3.00	
15	3		160	25.00	4.00	
16	4		320	30.00	4.20	
17	5		400	35.00	4.30	
18	6		500	40.00	4.50	
19	7					
20	8					
21	9					
22	10					
23	11					
24	12					
25	13					
26	14					
27	15					
28	16					
29	17					
30	18					
31	19					
32	20					
33	21					
34	22					
35	23					
36	24					
37	25					



- Absolut position of stalk on the stipe
- Average stalk length
- Standard deviation on stalk length

3- We measure

1- Determine stalk position on the stipe

2- Measure stalk nervure length

3- Do it for many frond in crown
to determine stalk acrotony in crown

4- Protocol

Stalk Width & Height Shape Factor

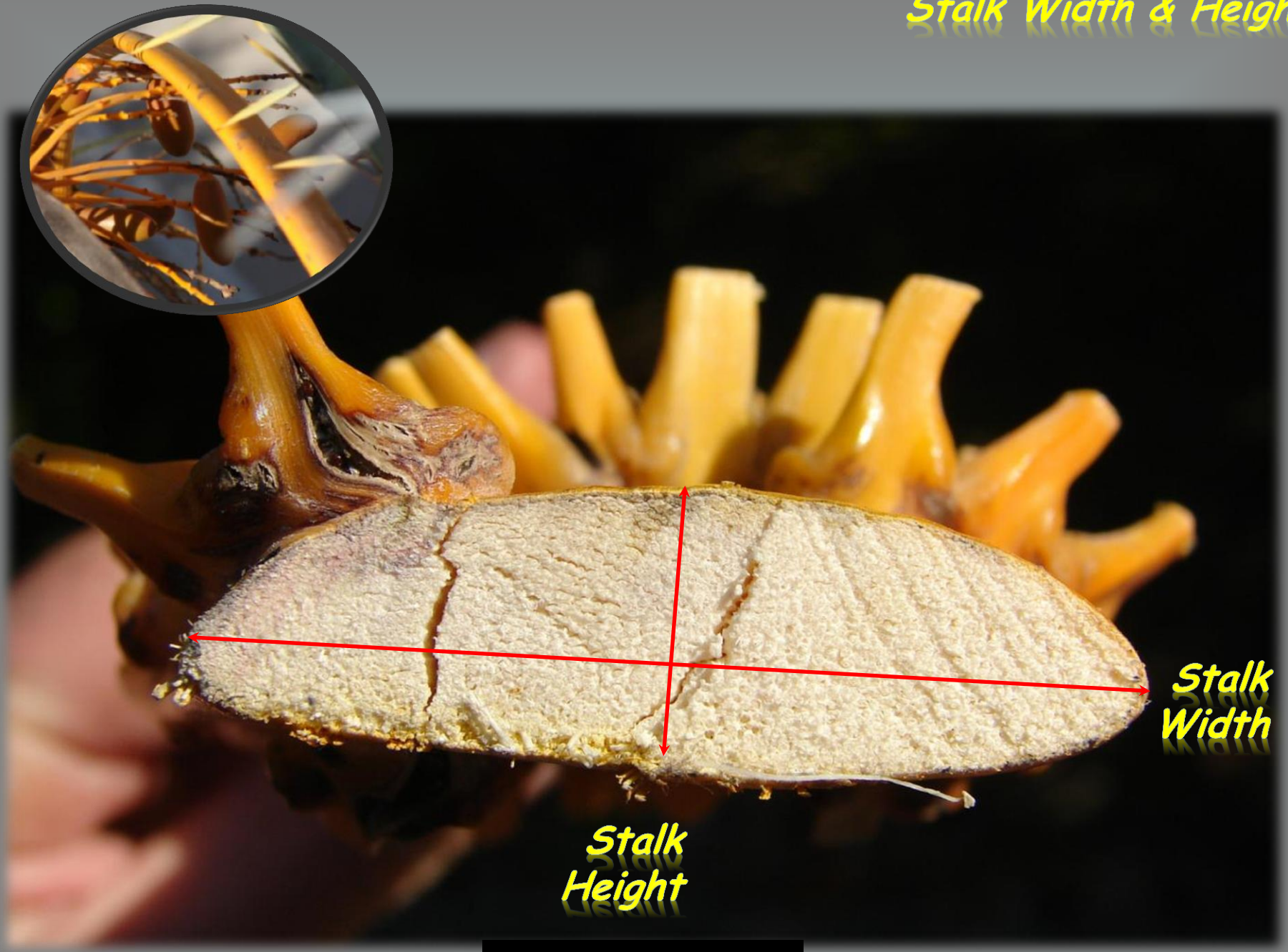
1- Phenomena

STALK_Geom Folder

Stalk Height Width

- *Absolut position of stalk on the stipe*
- *Average stalk height (width)*
- *Stalk height (width) standard deviation*
- *Relative length position on the stalk*
- *Shape factor according to relative length position*

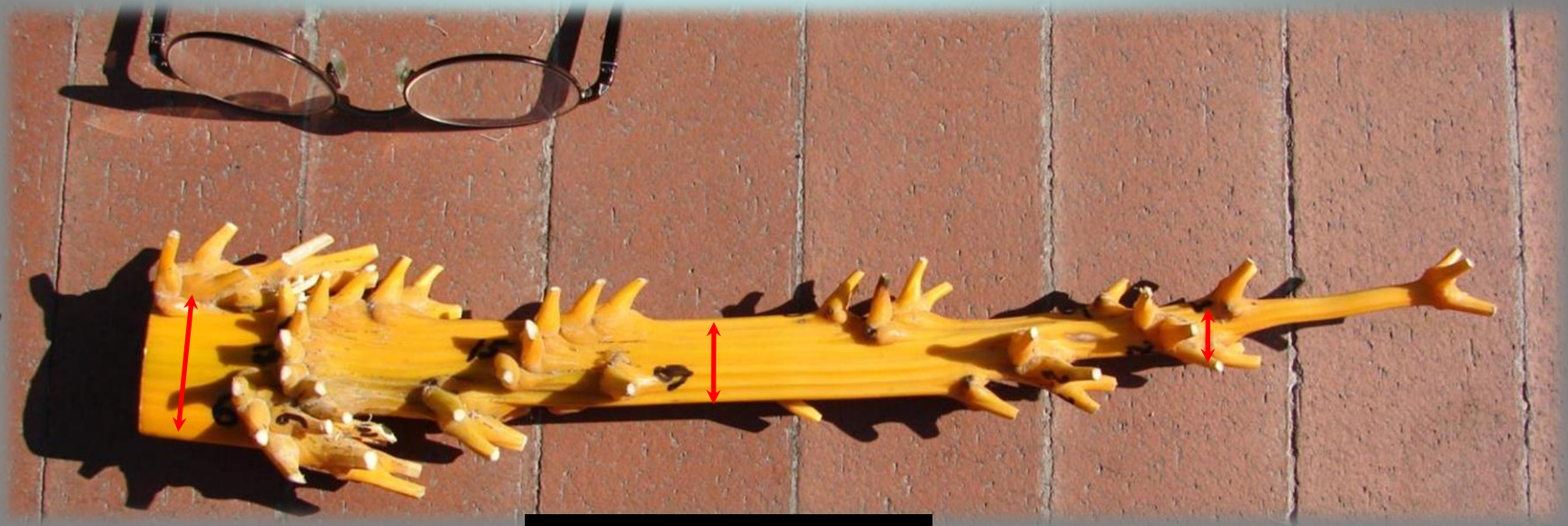
Stalk Width & Height



3- We measure

Stalk Width & Height Shape Factor

Shape Factor



3- We measure

1- Determine frond position on the stipe

2- Measure frond nervure length

3- Measure frond nervure widths & heights
4- Measure lengthes position at same time

5- Compute relative length positions
6- Express frond nervure shapes
by mean value (at « C » point for example)
and shape factors relatively to this mean value

Stalk Bending Angle

1- Phenomena

STALK_Geom Folder

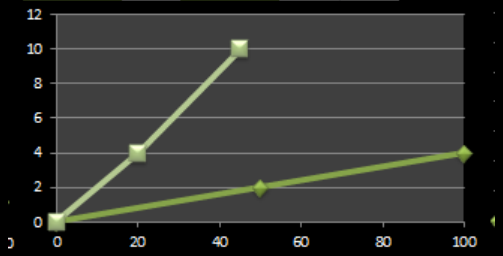
Stalk Bending Angle

xlsx - Microsoft Excel

STALK					
BENDING ANGLE (same nb of CP for Initial & Final)					
Initial		Final		Evolution	
Position	Mean	Position	Mean	STD	Duration
	1		1	1	0
	3.0		3.0	3.0	1.0

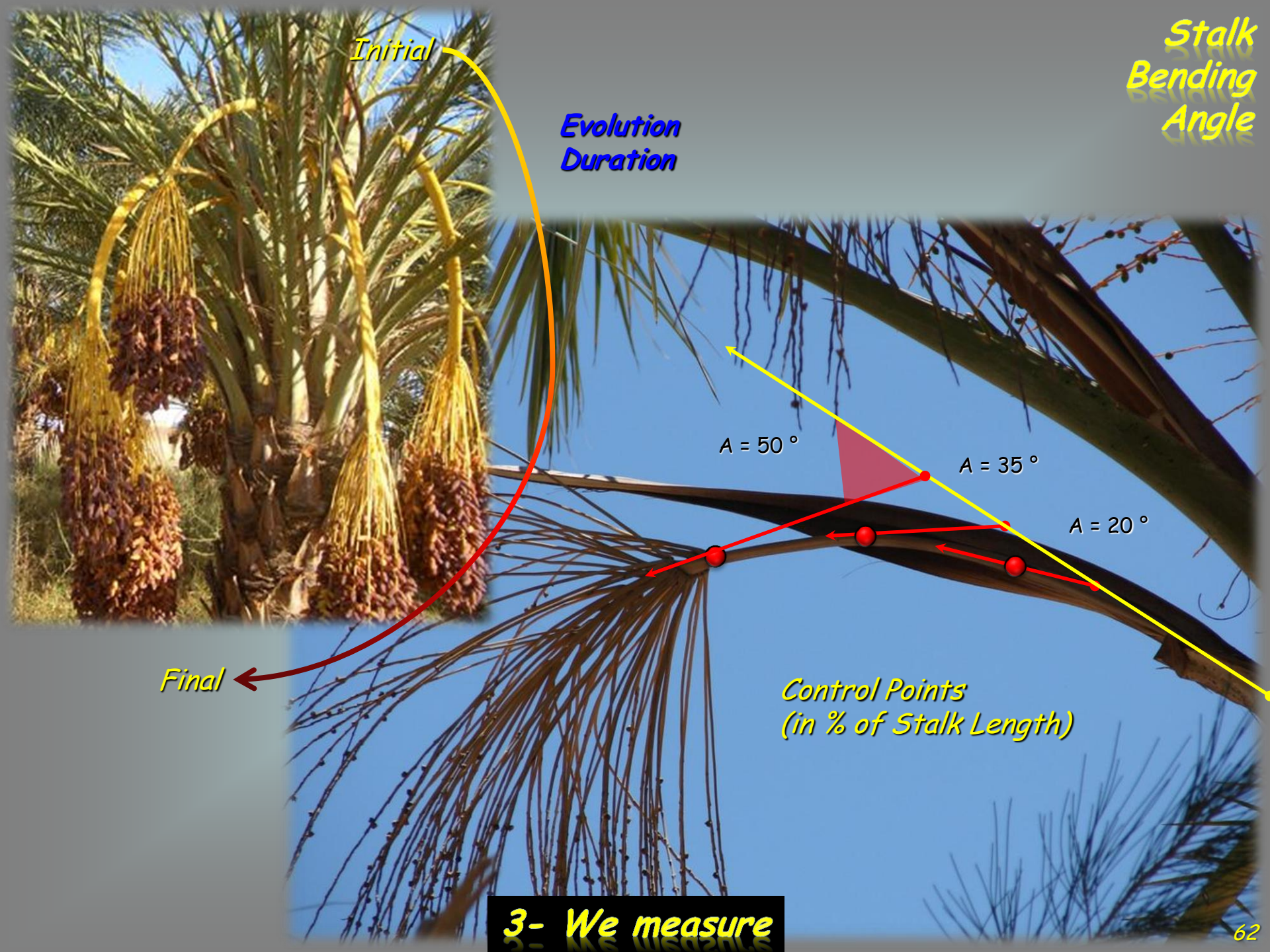
StalkBendingAngleExcl

Pos Organ %	degree	Pos Organ %	degree	degree	Phyllo
0.00	0.00	0.00	0.00	0.00	36
50.00	2.00	20.00	4.00	0.20	
100.00	4.00	45.00	10.00	1.00	



IFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_G

- Inflo number between initial & final angle
- Relative length position on the stalk
- Initial bending angle
- Relative length position on the stalk
- Final bending angle
- Final bending angle standard deviation


Stalk Bending Angle
Initial
Evolution Duration
Final
A = 50 °
A = 35 °
A = 20 °
Control Points
(in % of Stalk Length)

3- We measure

1- Take photos of palm crown

2- For upper and lower inflorescences

3- Use « mesurim » software to determine

bending angles and
corresponding relative length positions

4- Protocol

Stalk Torsion Angle

1- Phenomena

Stalk Lateral Deviation Angle

Control Points
(in % of Stalk Length)

1- Phenomena

STALK_Geom Folder

Stalk Torsion Lateral deviation Angles

- Relative length position on the stalk
- Torsion angle
- Torsion Angle standard deviation
- Lateral Deviation angle
- Lateral Deviation angle standard deviation
- Time (phyllochrones)
- Frond anlges evolution

Stalk Torsion Angle

Control Points
(in % of Stalk Length)

A = 70 °

3- We measure

Stalk Lateral Deviation Angle

Control Points
(in % of Stalk Length)

3- We measure

Stalk Lateral Deviation, Torsion & Bending Angles

3- We measure

Stalk Lateral Deviation, Torsion & Bending Angles

Elaeis guineensis

3- We measure

1- Take photos of palm crown
from face for torsion angle
from soil for lateral deviation angle

2- For upper and lower stalks

3- Use « mesurim » software to determine
torsion angles
lateral deviation angles
at some position
expressed by their
corresponding relative length positions

4- Protocol

Stalk values Data Sheet Folder

Template_2012-09-27.xlsx - Microsoft Excel

!GAP! A1	One STALK	FORM 07 d

Observer Name		Date (jj/mm/aaaa)		Localisation	
Plot		Palm Id. Number		Progeny	
Frond Rank		Inflorescence Sexe		Pheno Stage	
Stalk		Stalk Length		Stalk Insertion Angle	

	1	2	3	4	5	6	7	8	9	10	11
	Organ	Stalk sample	Stalk sample	Stalk sample	Stalk	Stalk	Stalk	Stalk	Stalk Sample	Stalk Sample	Stalk Sample
	Control Points	Length Position	Relative Length Position	Width	Height	Bending Angle	Lateral Deviation Angle	Rotation Angle	Volume	Fresh Weight	Dry Weight
Rank	Name	cm	%	cm	cm	degree	degree	degree	cm3	g	g
1	Insertion										
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											

02- Arrow_Guide | 03- Frond_Data | 03- Frond_Guide | 04- FrondNervure_Data | 04- FrondNervure_Guide | 05- FrondNervure&Pinnae_Data | 05- FrondNervu

Stalk values Protocol Sheet Folder

Template_2012-09-27.xlsx - Microsoft Excel

A2 ^IGAP!A1

IGAP!A1 **One STALK** — **FORM 07 p**

Step	Organ	Operating Protocole	Column Number	Observation Material	Model Parameter concerned
1	Stalk	Draw marks (control points) around Stalk with felt-tip pen (base, half sterile-zone, 1st pseudo-verticille, then each 10 cm for example).	1	Felt-tip (pen)	Control Point Name
2	Stalk	Measure length-position of each control points from Stalk base.	2	Measuring tape	Stalk Length
3	Stalk	Measure Stalk-width for each control point.	4	Calliper	Stalk Width
4	Stalk	Measure Stalk-height for each control point.	5	Calliper	Stalk Height
5	Stalk	Take pictures from Stalk according to 3 perpendicular planes (3D) (if not already done).		Photoscope	
6	Stalk	Measure of Stalk bending angles for choosen control points.	6	Mesurim software	Stalk Bending Angle
7	Stalk	Measure of Stalk lateral deviation angles for choosen control points.	7	Mesurim software	Stalk Lateral Deviation Angle
8	Stalk	Measure of Stalk rotation angles for choosen control points.	8	Mesurim software	Stalk Rotation Angle
9	Stalk	Cut Stalk at each mark into Stalk samples.		pair of secateurs	
10	Stalk sample	Measure Stalk sample volume.	9	""Archimede Principle"	Stalk Volume
11	Stalk sample	Measure Stalk sample fresh weight.	10	Weighing machine	Stalk Fresh density
12	Stalk sample	Dry Stalk sample (3 days at 60°C).		Drier (Oven)	
13	Stalk sample	Measure Stalk sample dry weight.	11	Weighing machine	Stalk Dry density

06- Pinnae_Data | 06- Pinnae_Guide | 07- Stalk_Data | 07- Stalk_Guide | 08- Bract_Data | 08- Bract_Guide | 09- Stalk&Spikelet_Data | 09- Stalk&Spikelet_Guide | 10- Spikelet_Data | 10- Spikelet_Guide

BRACT PRODUCTION

BRACT_Prod Folder

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Compléments | Acrobat

A1 ^IGAP!A1

IGAP!A1

STIPE | BEARER | ORGAN | TIME

BRACT on STALK LOCATION & INSERTION

	BRACT LOCATION Code			BRACT NUMBER	BRACT DISTANCE			BRACT RADIAL INSERTION ANGLE Phyllotaxy			BRACT AXIAL INSERTION ANGLE Final				BRACT AXIAL INSERTION ANGLE Evolution
		0 = NO	STD												
Item	Position	1 = YES	on position	Number	Position	Mean	STD	Position	Mean	STD	Position	Mean	STD	Time	Growth
Interpolation		0	0	0		1	1		1	1		1	1		1
Nb Values		3.0	3.0	1.0		2.0	2.0		1.0	1.0		1.0	1.0		2.0
Variable Name		BractLocalisation_		BractNumber_		BractDistance_			BractPhyllotaxy_			BractInsertionAngleEvol_			
Unit	Pos Bearer %	Code	%	Nb	Pos Bearer %	cm	cm	Pos Bearer %	degree	degree	Pos Bearer %	degree	degree	Phyllo	Ratio
1	0.00	0	0.00	1 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	1	0.50
2	2.00	1	0.00		100.00	0.00	0.00							32	1.00
3	2.10	0	0.00												
4															
5															
6															
7															
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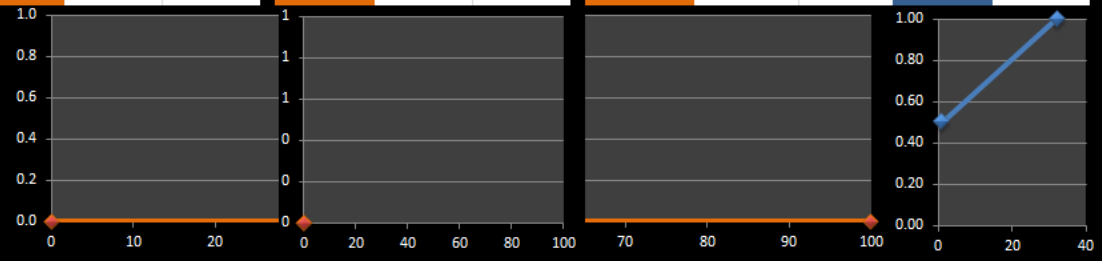

Principes | PLANT | STEM_Geom | SPEAR | FROND_Prod | FROND_NERVURE_Geom | STUMP | PINNAE_Prod | PINNAE_Geom | INFLO_Prod | STALK_Geom | BRACT_Prod | BR

Prêt | 90 %

Bract on Stalk Number & Location

1- Phenomena

BRACT_Prod Folder

Bract Number & Location

1Principes2014-5.xlsx

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Compléments

A1 ^IGAP!A1

IGAP!A1

STIPE | BEARER | ORGAN | TIME

BRACT on STALK LOCATION & INSERTION

	BRACT LOCATION Code			BRACT NUMBER		BRACT DISTANCE	
		0 = NO 1 = YES	STD on position				
Item	Position			Number	Position	Mean	STD
Interpolation		0	0	0		1	1
Nb Values		3.0	3.0	1.0		2.0	2.0
Variable Name		BractLocalisation_		BractNumber_		BractDistance_	
Unit	Pos Bearer %	Code	%	Nb	Pos Bearer %	cm	cm
1	0.00	0	0.00	1	0	0.00	0.00
2	2.00	1	0.00		100.00	0.00	0.00
3	2.10	0	0.00				
4							
5							
6							
7							
8							
9							
10							
11							
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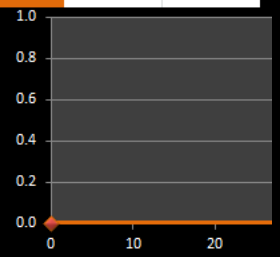
25							



Principes | PLANT | STEM_Geom | SPEAR | FROND_Prod | FROND_NERVUR

Prêt

- Bract number
- Bract Location
- Relative Length Position On Stalk
- Average Distance Between Bracts
- Standard deviation On distance Between Bracts

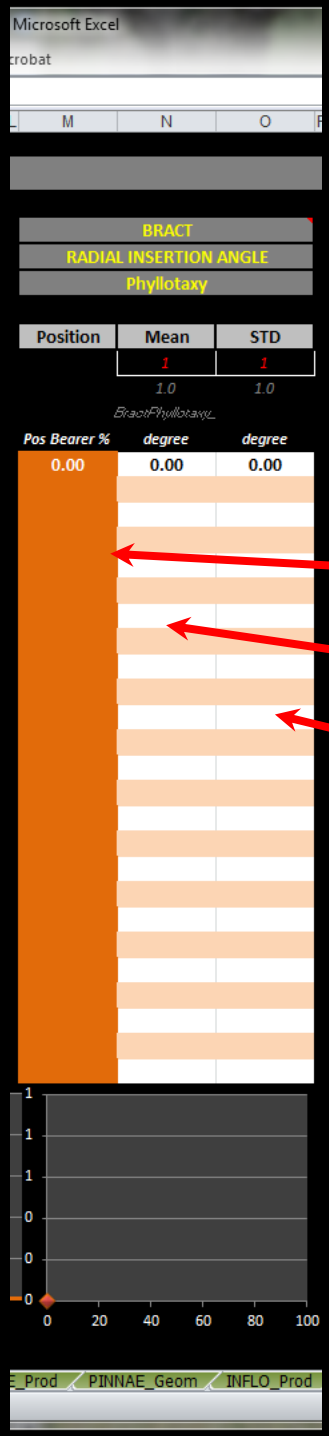
2- Model

Phyllotaxy

Bract on Stalk
Radial Insertion Angle

BRACT_Prod Folder

Bract Radial Insertion Angle



- Relative length position of bract on the stalk
- Average bract phyllotaxy (radial insertion angle)
- Standard deviation on radial insertion angle

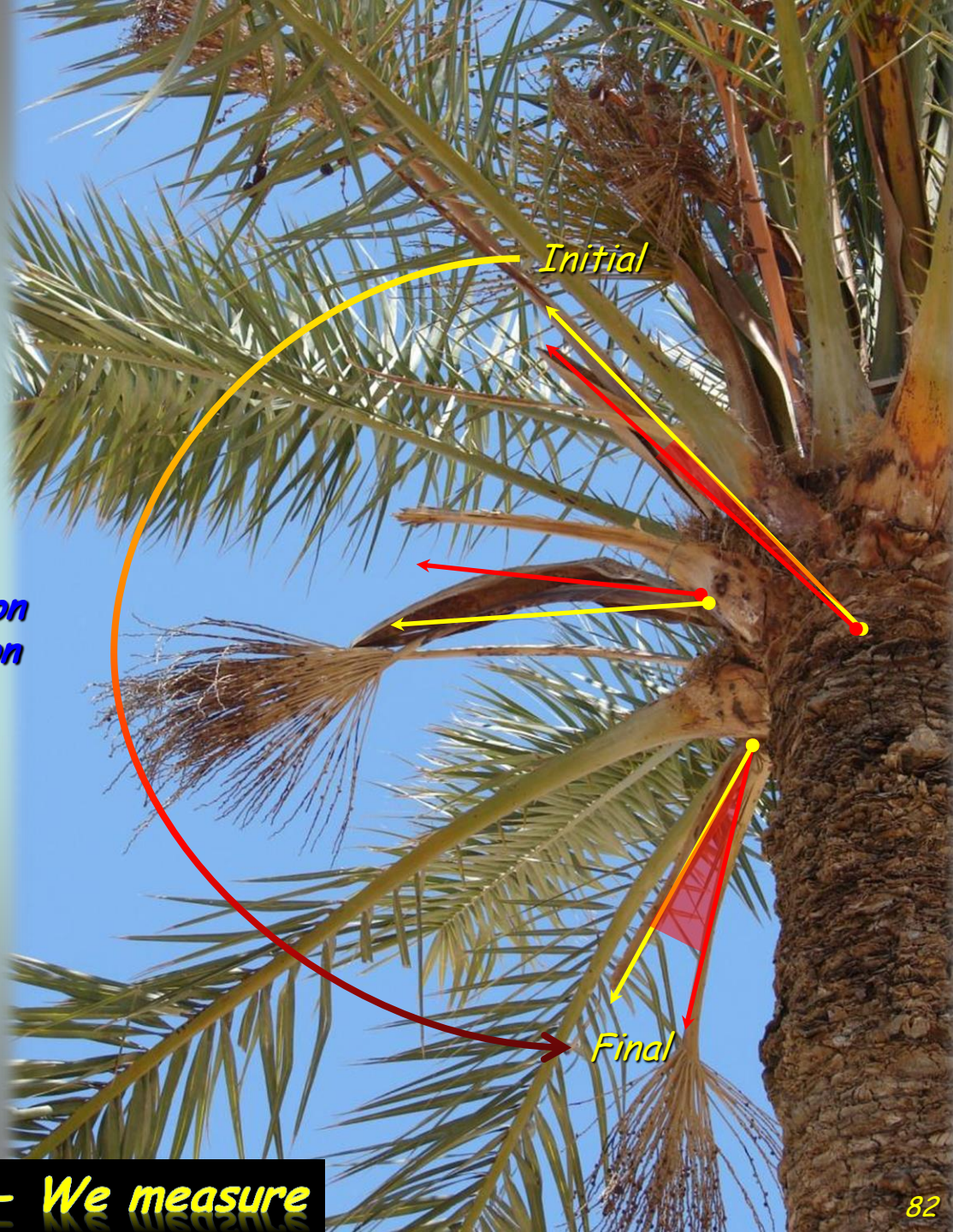
Bract on Stalk
Axial Insertion Angle

BRACT_Prod Folder

Bract Axial Insertion Angle

- Relative length position of bract on the stalk
- Average bract axial insertion angle
- Standard deviation on axial insertion angle
- Time (phyllochrones)
- Stalk axial insertion angle evolution

Bract on Stalk
Axial Insertion Angle



Evolution Duration

3- We measure

Stalk Axial Insertion Angle

1- Determine frond ranks
at least first and last ones

2- Measure corresponding stalk axial insertion angles (photo)

3- Keep last stalk as reference angle (final)

4- stalks axial insertion angles are expressed
through a factor of this final angle

BRACT GEOMETRY

Same parameters than for stalk size & geometry

BRACT_Geom Folder

1Principes2014-5.xlsx - Microsoft Excel

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Compléments | Acrobat

A1 ^IGAP!A1

IGAP!A1 | STIPE | BEARER | ORGAN | TIME

BRACT SIZE & GEOMETRY

	BRACT LENGTH					BRACT WIDTH					BRACT HEIGHT				
		FINAL			EVOLUTION		Max			Shape Factor		Max			Shape Factor
Item	Position	Mean	STD	Time	Growth	Position	Mean	STD	Position	Shape	Position	Mean	STD	Position	Shape
Interpolation		1	1		1		1	1		1		1	1		1
Nb Values		1.0	1.0		2.0		1.0	1.0		1.0		1.0	1.0		1.0
Variable Name		EbractLengthEvol_					EbractWidth_					EbractHeight_			
Unit	Pos Stem	cm	cm	Phyllo	Ratio	Pos Stem	cm	cm	Pos Organ %	factor	Pos Stem	cm	cm	Pos Organ %	factor
1	1	100.00	10.00	1	0.10	1	5.00	0.50	0.00	0.60	1	1.00	0.10	0.00	0.80
2				30	1.00										
3															
4															
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23															
24															
25															

	BRACT BENDING ANGLE &EVOLUTION						BRACT TORSION ANGLE					BRACT LATERAL DEVIATION ANGLE				
	Initial		Final (same nb				Final			Evolution		Final			Evolution	
Item	Position	Mean	Position	Mean	STD	Duration	Position	Mean	STD	Time	Growth	Position	Mean	STD	Time	Growth
Interpolation		1		1	1	0		1	1		1		1	1		1
Nb Values		1.0		1.0	1.0	1.0		2.0	2.0		2.0		2.0	2.0		2.0
Variable Name		EbractBendingAngleEvol_						EbractRotationAngleEvol_					EbractLateralDeviationAngleEvol_			
Unit	Pos Organ %	degree	Pos Organ %	degree	degree	Phyllo	Pos Organ %	degree	degree	Phyllo	Ratio	Pos Organ %	degree	degree	Phyllo	Ratio
1	0.00	0.00	0.00	0.00	0.00	32	0.00	0.00	0.00	1	0.10	0.00	0.00	0.00	1	0.10
2							100.00	10.00	1.00	36	1.00	100.00	20.00	2.00	36	1.00
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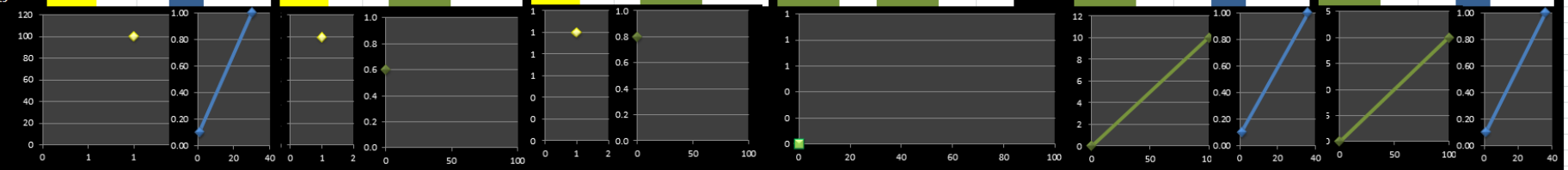


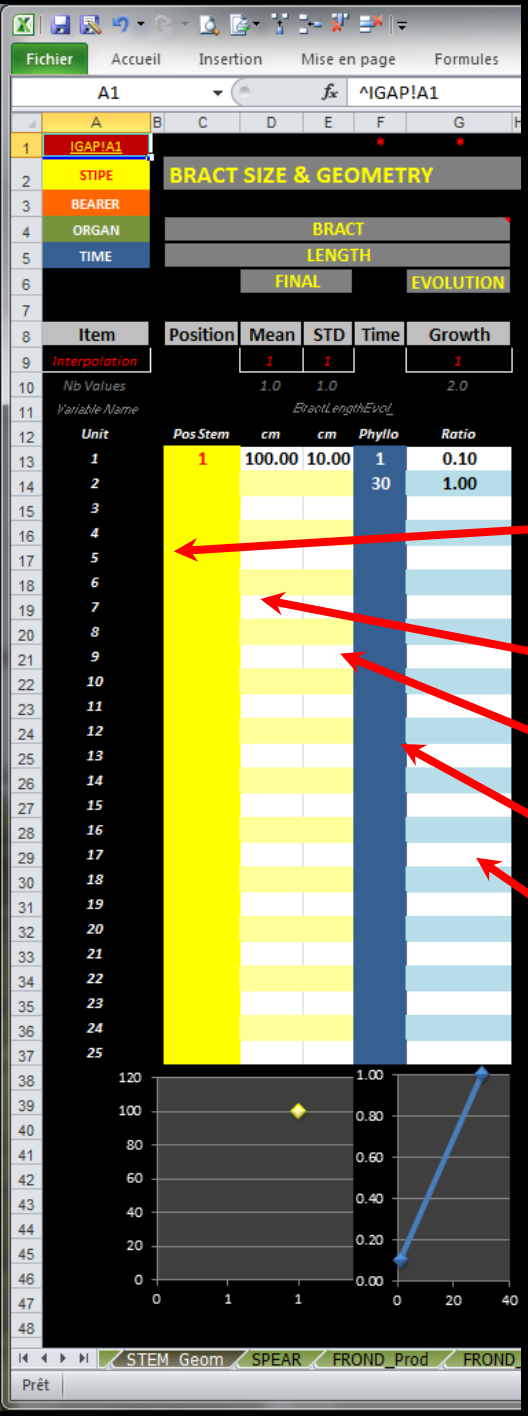
STEM_Geom | SPEAR | FROND_Prod | FROND_NERVURE_Geom | STUMP | PINNAE_Prod | PINNAE_Geom | INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEMALE_FLOWER_Prod | FEMALE

Prêt

Bract Length

BRACT_Geom Folder

Bract Length



- Absolut position on the Stipe
- Average Bract Length
- Bract Length standard deviation
- Time (phyllochrones)
- Stalk length evolution

Bract Length

3- We measure

1- Determine Inflorescence position on the stipe

2- Determine bract position on stalk

3- Measure bract length(es)

4- Determine bract length evolution accordin to Inflorescence position in the crown if necessary


Phoenix dactylifera
Bract
Height
Width
1- Phenomena

Bract
Height
Width

Phoenix dactylifera

1- Phenomena

BRACT_Geom Folder Bract Height Width

- Absolut position on the Stipe
- Average Bract Widt
- Bract Widt standard deviation
- Bract relative length position
- Bract shape factor according to Relative length position

The same for Height!

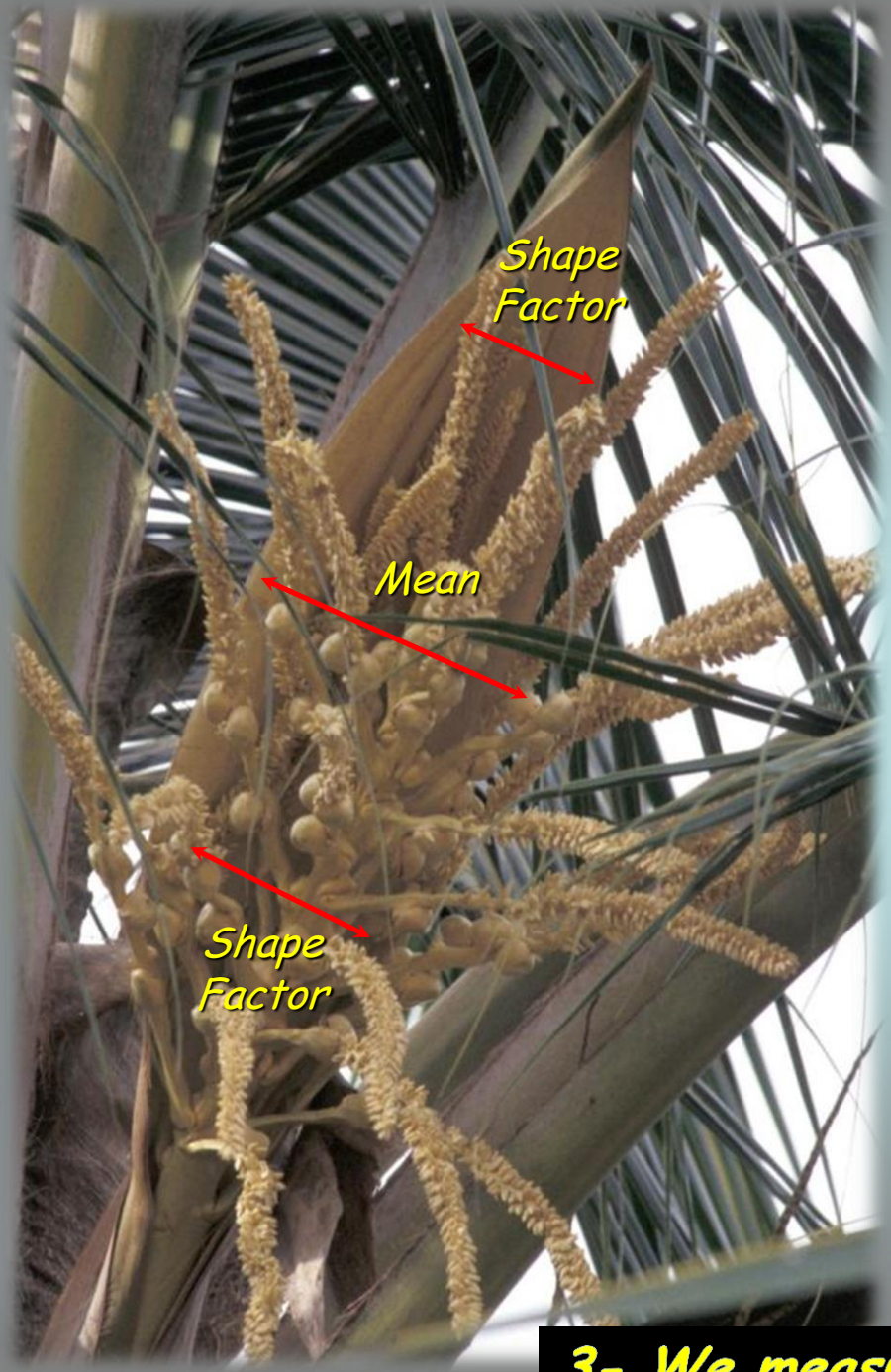
3- We measure

Bract
Height
Width

Cocos nucifera

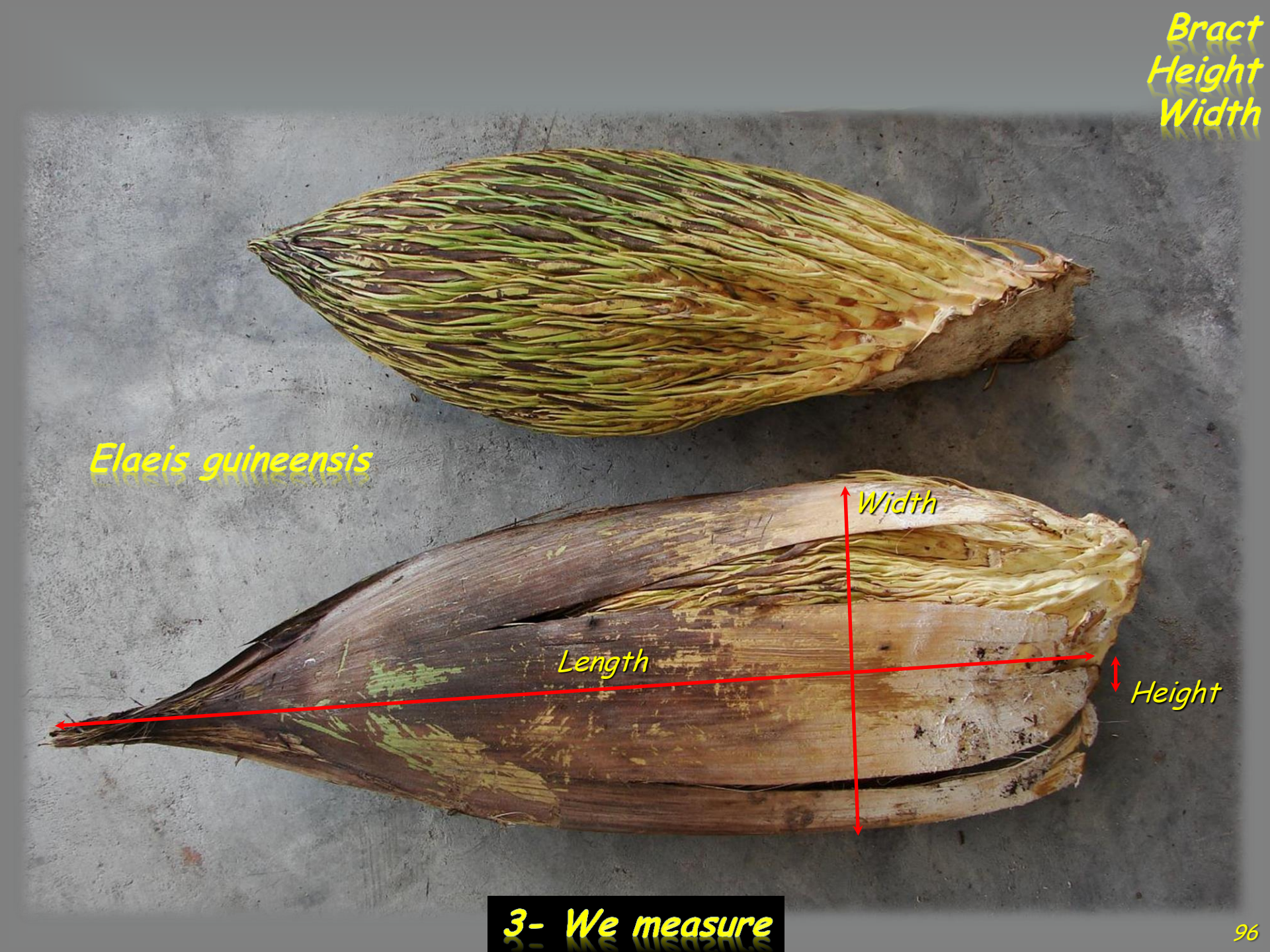
1- Phenomena

Bract
Height
Width



Cocos nucifera

3- We measure



3- We measure

1- Determine Inflorescence position on the stipe

2- Measure bract length

3- Measure bract widths & heights
4- Measure length positions at same time

5- Compute relative length positions
6- Express bract shapes
by mean value
and shape factors relatively to this mean value

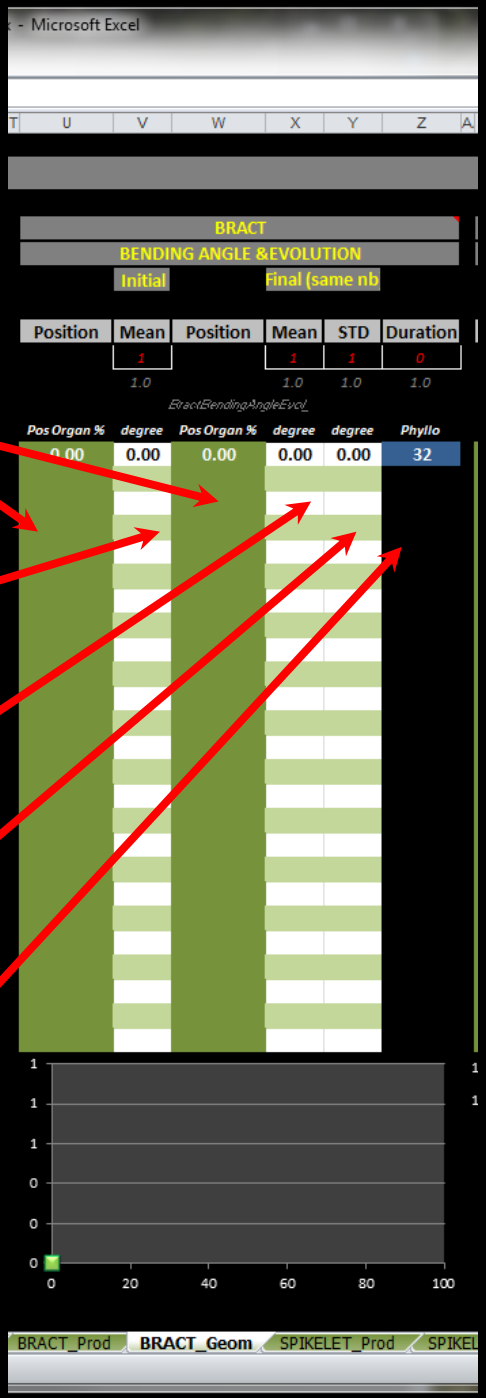
Bract Bending Angle

Phoenix dactylifera

1- Phenomena

Stipe
Bearer
Organ
Time

BRACT_Geom Folder Bract Bending Angle



Relative length position on the Bract

Initial bending angle

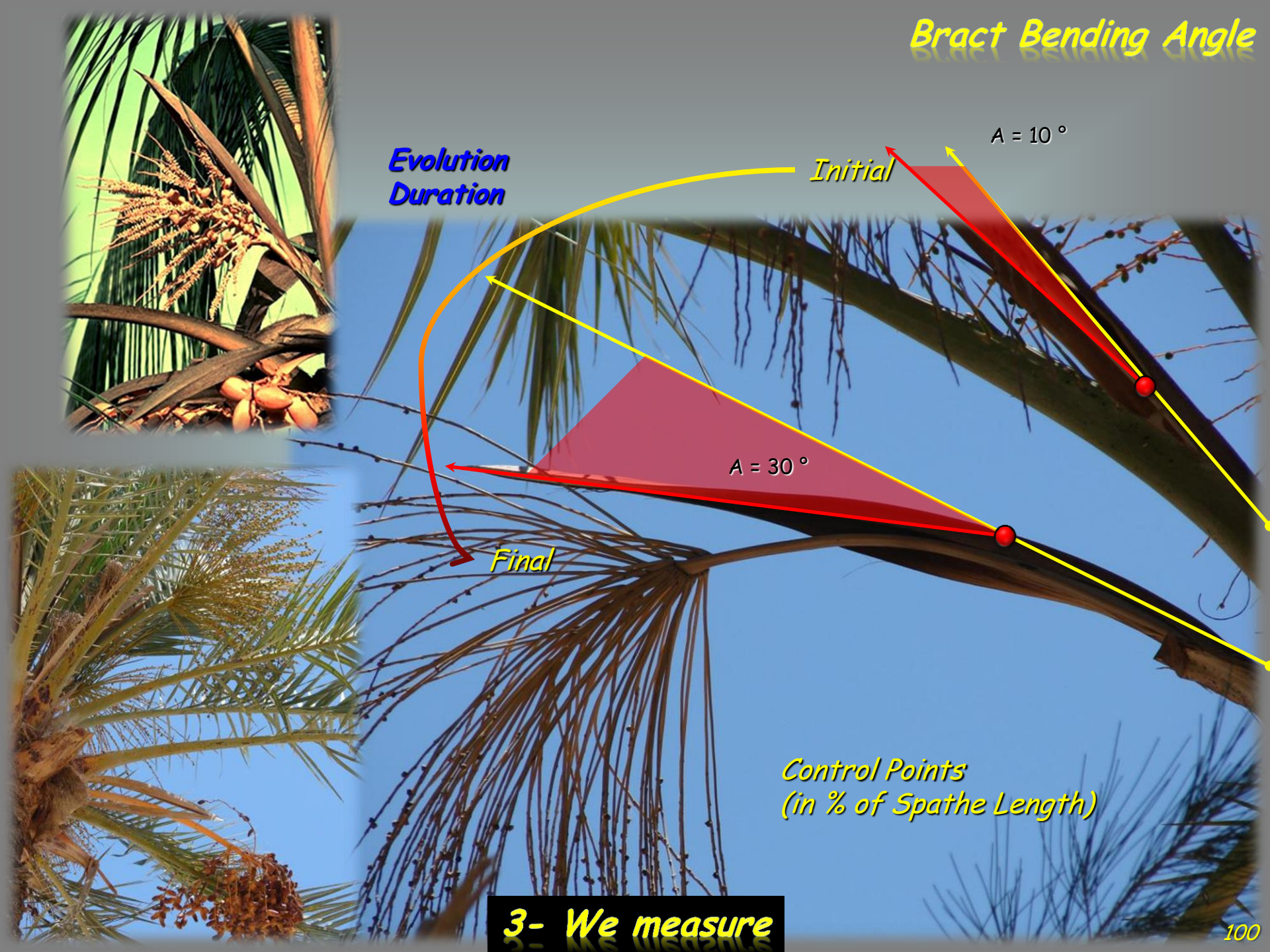
Final bending angle

Final bending angle standard deviation

Duration for Bending Angle

2- Model

Bract Bending Angle



3- We measure

1- Take photos of palm crown from side
in order to see correctly bending angles

2- For upper and lower inflorescences
determine inflorescence crown position
count frond number (duration)

3- Use « mesurim » software to determine
bending angles
at some stalk positions
expressed by their
corresponding relative length positions

4- Compute bending angles evolutions
between upper & lower inflorescences

4- Protocol

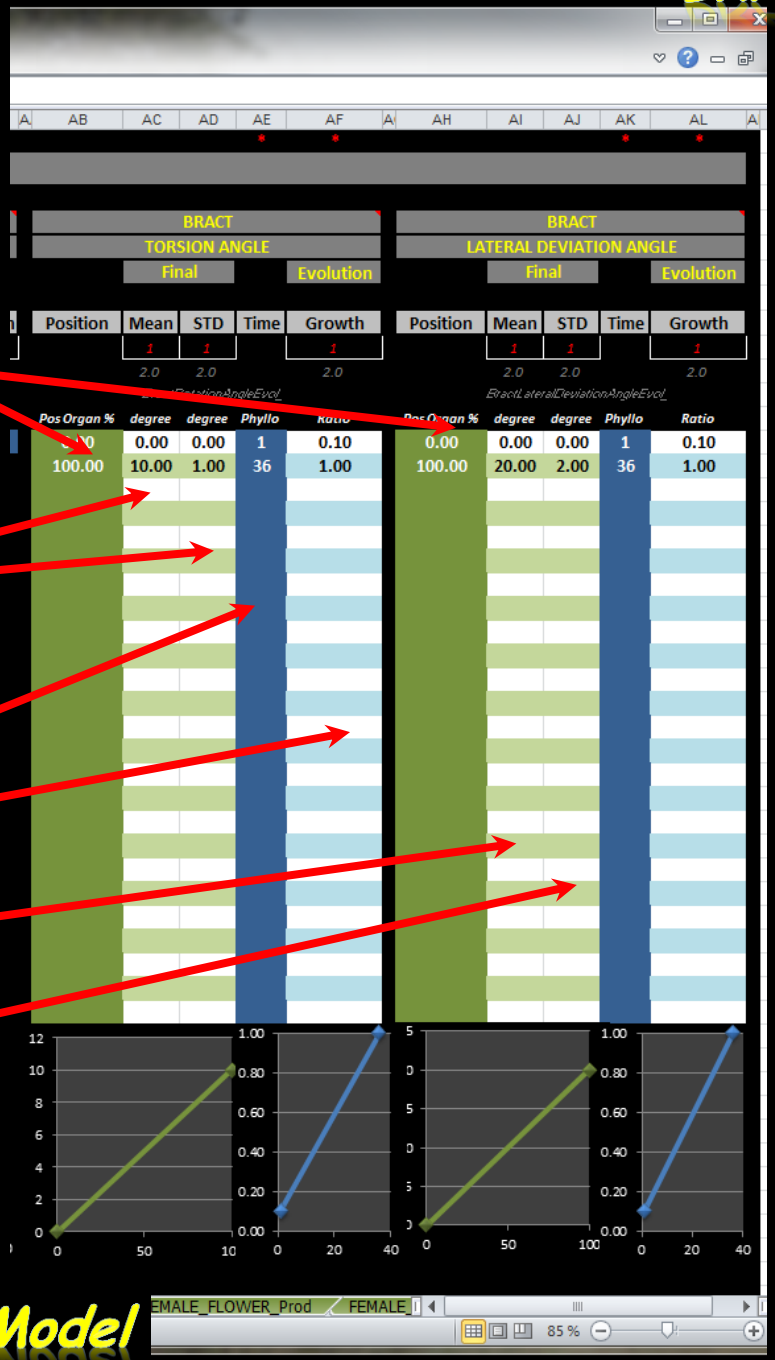
Bract Torsion Angle

2- Phenomena

Stipe
Bearer
Organ
Time

BRACT_Geom Folder

Bract Torsion & Lateral Deviation Angles



Relative length position on the Bract

Torsion Angle

Torsion Angle standard deviation

Time (phyllochrones)

Frond angles evolution

Lateral Deviation Angle

Lateral Deviation Angle standard deviation

1- Model

Bract Lateral Deviation & Torsion & Bending Angle

3- We measure

Bract Torsion & Lateral Deviation Angles

1- Take photos of palm crown
from face for torsion angle
from soil for lateral deviation angle

2- For upper and lower BRacts

3- Use « mesurim » software to determine
torsion angles
lateral deviation angles
at some bracts positions
expressed by their
corresponding relative length positions

4- Protocol

Bract values Data Sheet Folder

Template_2012-09-27.xlsx - Microsoft Excel

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Acrobat

A2 ^IGAP!A1

IGAP!A1

One BRACT

FORM 08 d

Observer Name		Date (jj/mm/aaaa)		Localisation	
Plot		Palm Id. Number		Progeny	
Frond Rank		Inflorescence Sexe		Pheno Stage	
Bracts Rank		Bract Length		Bract Insertion Angle	

	1	2	3	4	5	6	7	8	9	10	11
	Organ	Bract Sample	Bract Sample	Bract Sample	Bract Sample	Bract Sample	Bract Sample	Bract Sample	Bract Sample	Bract Sample	Bract Sample
	Control Points	Length Position	Relative Length Position	Width	Height	Bending Angle	Lateral Deviation Angle	Rotation Angle	Volume	Fresh Weight	Dry Weight
Rank	Name	cm	%	mm	mm	degree	degree	degree	cm3	g	g
1	Insertion										
2	P2										
3	P3										
4	P4										
5	P5										
6	P6										
7	P7										
8	P8										
9	P9										
10	P10										
1	Insertion										
2	P2										
3	P3										
4	P4										

05- FrondNervure&Pinnae_Guide | 06- Pinnae_Data | 06- Pinnae_Guide | 07- Stalk_Data | 07- Stalk_Guide | 08- Bract_Data | 08- Bract_Guide | 09- Stalk&Sp

Bract values Protocol Sheet Folder

IGAP!A1	One BRACT				FORM 08 p
Step	**Organ**	**Operating Protocole**	**Column Number**	**Observation Material**	**Model Parameter concerned**
1	Bract	Draw marks (control points) around Bract with felt-tip pen (base, half sterile-zone, 1st flower scar, then each 10 cm for example).	1	Felt-tip (pen)	Control Point Name
2	Bract	Measure length-position of each control points from Bract base.	2	Measuring tape	Bract Length
3	Bract	Measure Bract width for each control point.	4	Calliper	Bract Width
4	Bract	Measure Bract height for each control point.	5	Calliper	Bract Height
5	Bract	Take pictures from Bract according to 3 perpendicular planes (3D) (if not already done).		Photoscope	
6	Bract	Measure of Bract bending angles for choosen control points.	6	Mesurim software	Bract Bending Angle
7	Bract	Measure of Bract lateral deviation angles for choosen control points.	7	Mesurim software	Bract Lateral Deviation Angle
8	Bract	Measure of Bract rotation angles for choosen control points.	8	Mesurim software	Bract Rotation Angle
9	Stalk	Cut Bract at each mark into Bract samples.		pair of secateurs	
10	Stalk sample	Measure Bract sample volume.	9	""Archimede Principle"	Bract volume
11	Stalk sample	Measure Stalk sample fresh weight.	10	Weighing machine	Bract Fresh Density
12	Stalk sample	Dry Stalk sample (3 days at 60°C).		Drier (Oven)	
13	Stalk sample	Measure Stalk sample dry weight.	11	Weighing machine	Bract Dry Density

SPIKELET PRODUCTION

SPIKELET_Prod Folder

Elaeis_guineensis_v2014c.xlsx - Microsoft Excel

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F46

IGAP!A1

STIPE | BEARER | ORGAN | TIME

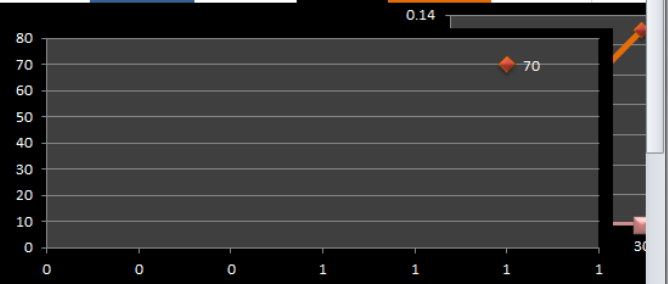
SPIKELET in PSEUDO-VERTICILLE on STALK LOCATION & INSERTION

SPIKELET ZONE LOCATION & EVOLUTION ON STALK

RELATIVE LENGTH OF SPIKELET ZONE ay FINAL STAGE (after evolution)

		PEDONCULE ZONE				SPIKELET ZONE					PSEU		
												Inter-Pseudo-Vert	
		Mean	STD		Evolution	Mean	STD		Evolution			Distancel	
Item	Position	Rel. Length	Rel. Length	Time	Growth	Rel. Length	Rel. Length	Time	Growth	Verif	Position	Mean	STI
Interpolation		0	0		1	0	0		1	total		1	1
Nb Values		1.0	1.0		2.0	1.0	1.0		3.0			3.0	3.0
Variable Name			SpikeletLocalisation_01_02_03				SpikeletLocalisation_11_12_13						SpikeletDistance
Unit	Pos Bearer %	Long Zone %	%	Phyllo	Factor	Long Zone %	%	Phyllo	Factor		Pos Bearer %	cm	cm
1	1	30.00	0.00	1	0.00	70	0.00	1	0.00	100.00	0.00	0.00	0.
2				12	0.30			12	0.30	0.00	30.00	0.13	0.0
3				36	1.00			36	1.00	0.00	100.00	0.13	0.0
4										0.00			
5										0.00			
6										0.00			
7										0.00			
8										0.00			
9										0.00			
10										0.00			
11										0.00			
12										0.00			
13										0.00			
14										0.00			
15										0.00			
16										0.00			
17										0.00			
18										0.00			
19										0.00			
20										0.00			
21										0.00			
22										0.00			
23										0.00			
24										0.00			
25										0.00			

Zone	=	Productions
Pedoncule	=	Without Spikelet
Spikelets	=	Spikelets



INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEMALE_FLOWER_Prod | FEMALE_FLOWER_Geom

Prêt

Spikelets Location on stalk

Peduncle zone

Spikelets zone

Phoenix dactylifera

1- Phenomena

Spikelets Location on stalk

Cocos nucifera

Spikelets Location on stalk

Elaeis guineensis

1- Phenomena

SPIKELET_Prod Folder Peduncle Spikelet Zone Location

Elaeis_guineensis_v2014c.xlsx - Microsoft Excel

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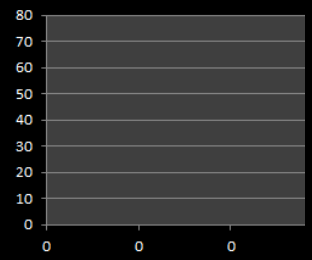
F46

!GAP!A1	
STIPE	SPIKELET in PSEUDO-VERTICILLE on STALK LOCATION & INSERTION
BEARER	
ORGAN	SPIKELET ZONE LOCATION & EVOLUTION ON STALK
TIME	RELATIVE LENGTH OF SPIKELET ZONE ay FINAL STAGE (after evolution)

		PEDONCULE ZONE				SPIKELET ZONE			
		Mean	STD		Evolution	Mean	STD		Evolution
Item	Position	Rel. Length	Rel. Length	Time	Growth	Rel. Length	Rel. Length	Time	Growth
Interpolation		0	0		1	0	0		1
Nb Values		1.0	1.0		2.0	1.0	1.0		3.0
Variable Name			SpikeletLocalisation_01_02_03				SpikeletLocalisation_11_12_13		
Unit	Pos Bearer %	Long Zone %	%	Phyllo	Factor	Long Zone %	%	Phyllo	Factor
1	1	30.00	0.00	1	0.00	70	0.00	1	0.00
2				12	0.30			12	0.30
3				36	1.00			36	1.00
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									

Zone	=	Productions
Pedoncule	=	Without Spikelet
Spikelets	=	Spikelets



INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIK | FEMA

Prêt

- Relative length position on bearer (stalk)
- Peduncle relative length (av.)
- Peduncle relative length (std)
- Peduncle zone lengthnening (time in phyllochrones)
- Peduncle zone lengthnening (growth in % of final length)

Same for Spikelet zone

2- Model

Spikelets must be :

1- Adjacents

&

2- in Same Plane at base

The smallest number of Pseudo-Verticille,
The BEST !!!

Pseudo-Verticille Determination

Phoenix dactylifera

1- Phenomena

Pseudo-Verticille Determination

Phoenix dactylifera

1- Phenomena

For Pesudo-verticilles determination
Spikelets must be :

1- Adjacents

&

2- in Same plane at base

So they are in same pseudo-verticille !...

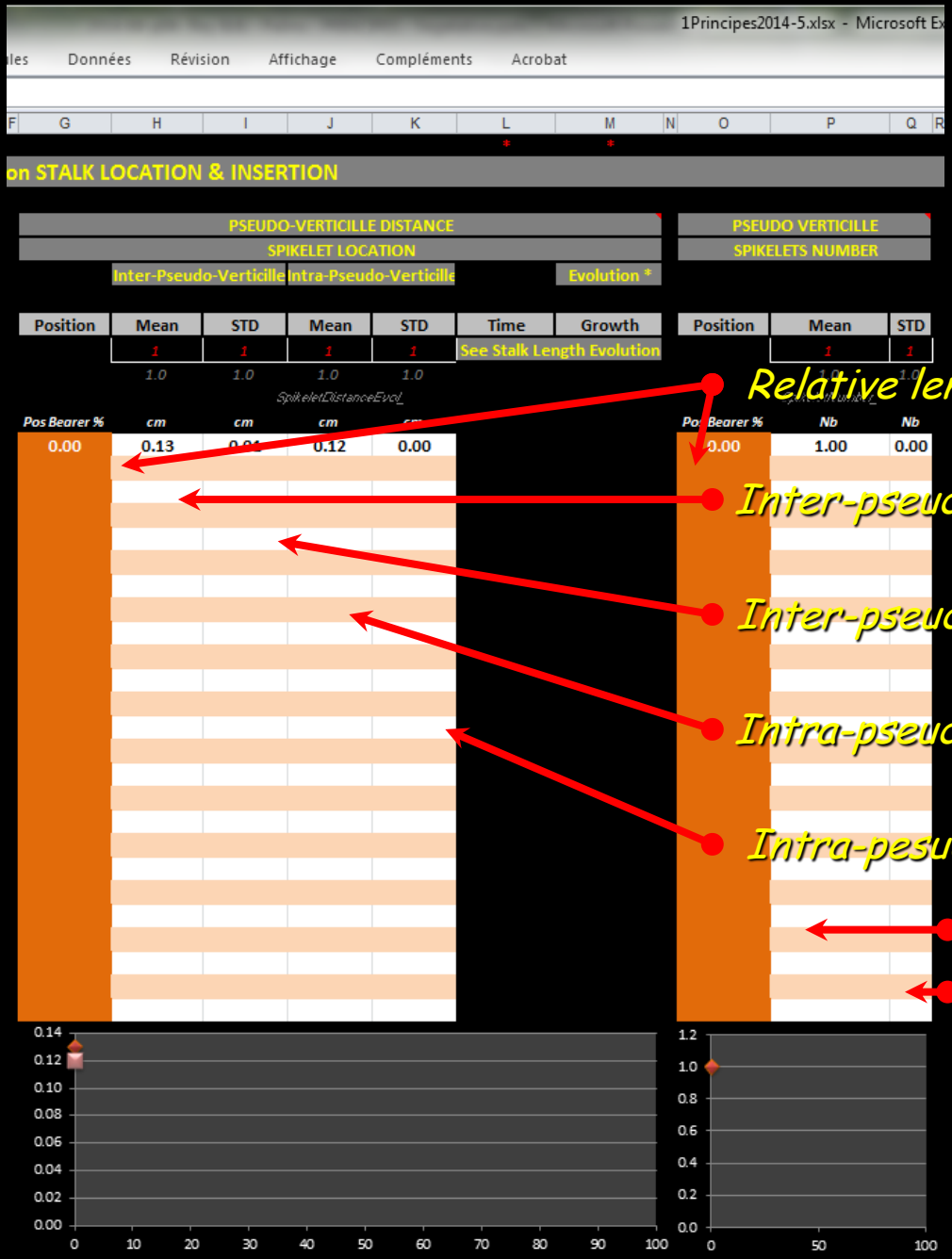
Inter Pseudo-Verticilles Distances

Phoenix dactylifera

1- Phenomena

SPIKELET_Prod Folder

Pseudo-Verticille Spikelet Distances



Relative length position on bearer (stalk)

Inter-pseudo-verticilles distances

Inter-pseudo-verticilles distance standard deviation

Intra-pseudo-verticilles distances

Intra-pesudo-verticilles distance standard deviation

Mean Spikelety number by pseudo-verticille

Standard devation on spikelet number

Inter Pseudo-Verticilles Distances

Inter Pseudo-verticilles Distance

Intra Pseudo-verticilles Distances

3- We measure

Inter Spikelets Distances

Cocos nucifera

3- We measure

Pseudo-Verticille Spikelets number

3- We measure

Pseudo-Verticille Spikelets number

3- We measure

Inter Spikelets Distances

3- We measure

Inter Pseudo-Verticilles or Inter Spikelets Distances

1- Measure stalk length

2- Determine spikelets groups (pseudo-verticilles)

3- Determine Pseudo-verticille insertion on stalk
4- Locate pseudo-verticilles by relative length position
5- Measure inter pseudo-verticilles distances

6- Number spikelets by pseudo-verticilles
7- Measure pseudo-verticille lengthes

8- Compute inter pseudo verticilles distances
9- Compute inter spikelets
in pseudo verticilles distance
by pseudo-verticilles locations

4- Protocol

Pseudo-verticille Radial Insertion Angle

Phyllotaxy
for Spikelets or Pseudo-verticilles
On Stalk ???

1- Phenomena

Spikelet Radial Insertion Angle

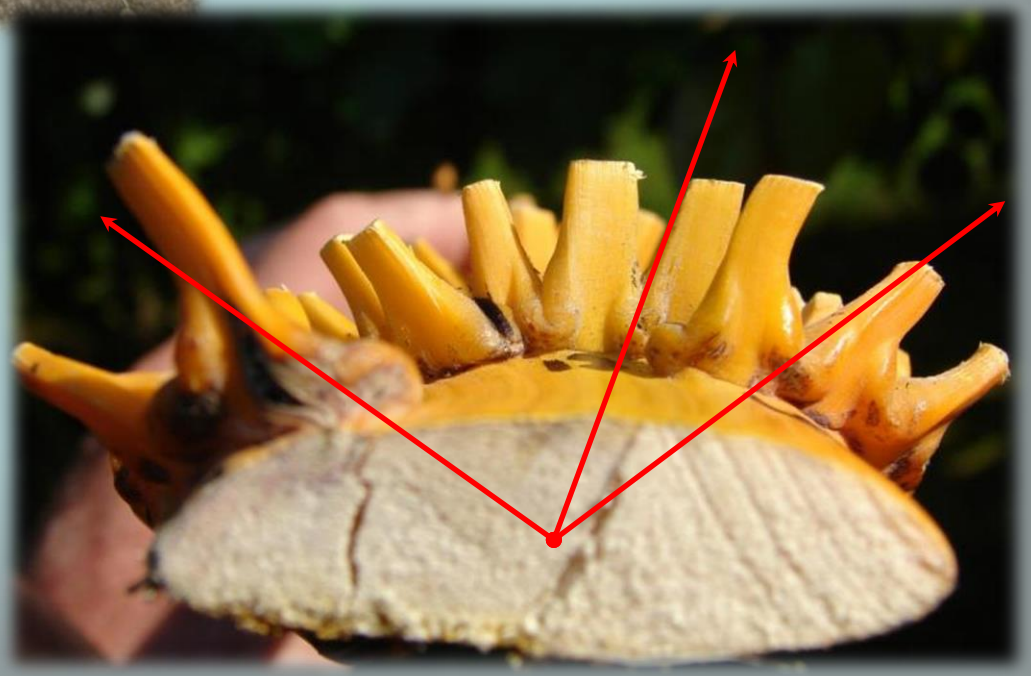
Elaeis guineensis

Spikelet
Radial Insertion Angle

Spikelet
Radial Insertion Angle

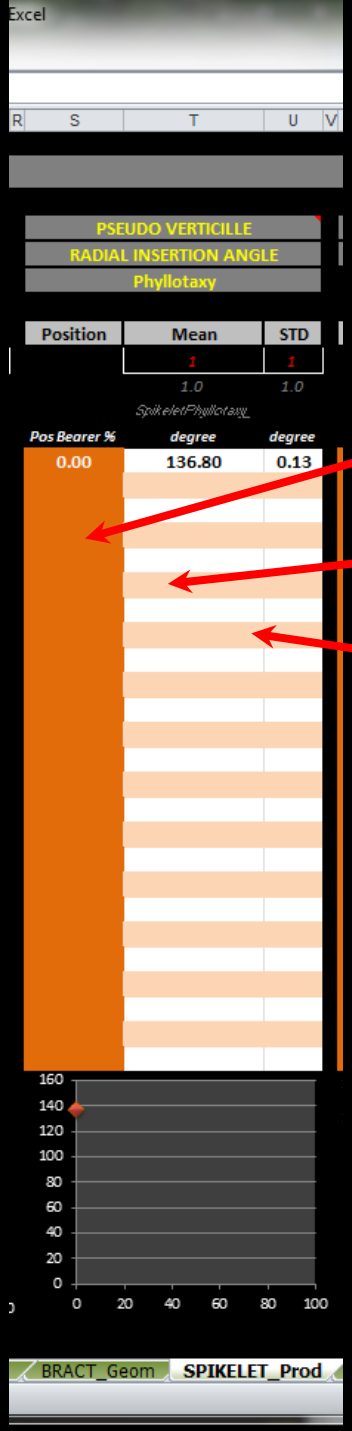
Cocos nucifera

Pseudo-verticille
Radial Insertion Angle



Phoenix dactylifera

SPIKELET_Prod Folder Pseudo-verticille Radial Insertion Angle



- Relative length position on bearer (stalk)
- Average radial insertion angle increment
- Radial insertion angle increment standard deviation

Pseudo-verticille
Radial Insertion Angle

3- We measure

1- Measure pseudo-verticilles position on stalk

2- Measure pseudo-verticilles radial angles

3- Calculate « phyllotaxy »
according to pseudo-verticilles
relative length position

4- Protocol

Pseudo-Verticille Axial Insertion Angle

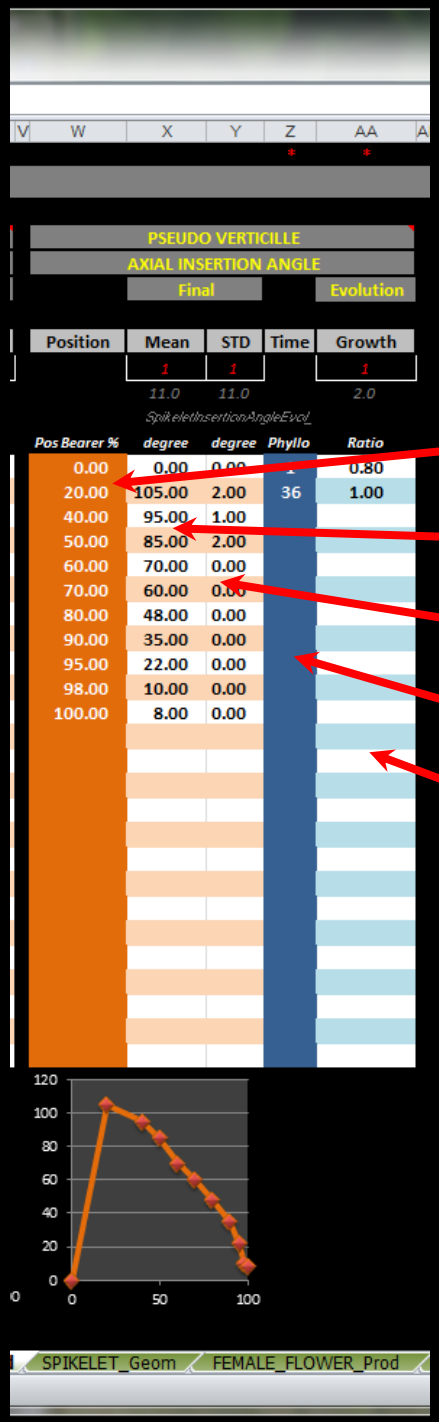
Spikelet Axial Insertion Angle

Cocos nucifera

Elaeis guineensis

1- Phenomena

SPIKELET_Prod Folder
Pseudo-verticille Axial Insertion Angle



PSEUDO VERTICILLE

AXIAL INSERTION ANGLE

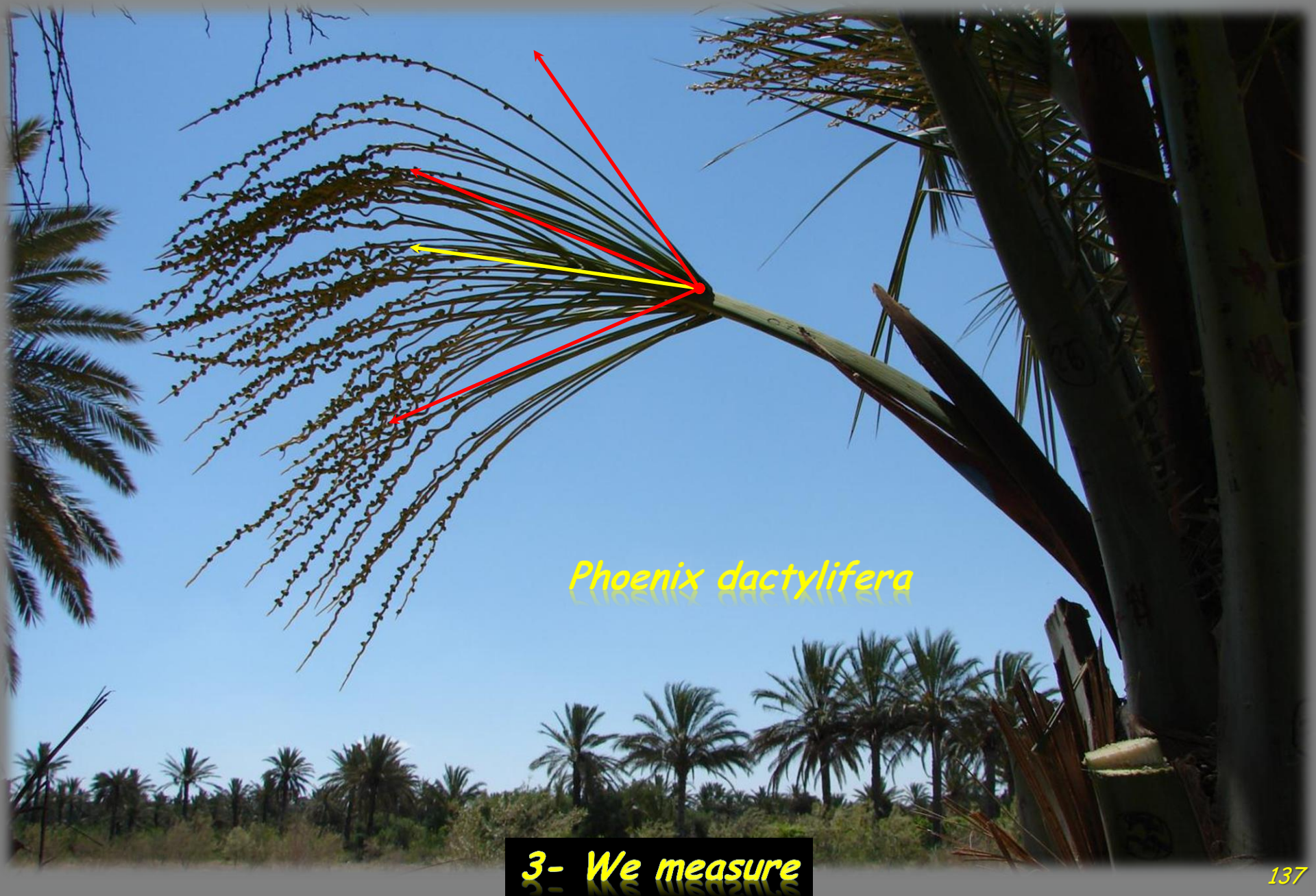
Final			Evolution
Position	Mean	STD	Time	Growth
	1	1		1
	11.0	11.0		2.0

SpikeletInsertionAngleEvol_

Pos Bearer %	degree	degree	Phyllo	Ratio
0.00	0.00	0.00	1	0.80
20.00	105.00	2.00	36	1.00
40.00	95.00	1.00		
50.00	85.00	2.00		
60.00	70.00	0.00		
70.00	60.00	0.00		
80.00	48.00	0.00		
90.00	35.00	0.00		
95.00	22.00	0.00		
98.00	10.00	0.00		
100.00	8.00	0.00		

- Relative length position on bearer (stalk)
- Average axial insertion angle
- Axial insertion angle standard deviation
- Time (phyllochrone)
- Axial insertion angle evolution

Pseudo-Verticille Axial Insertion Angle



3- We measure

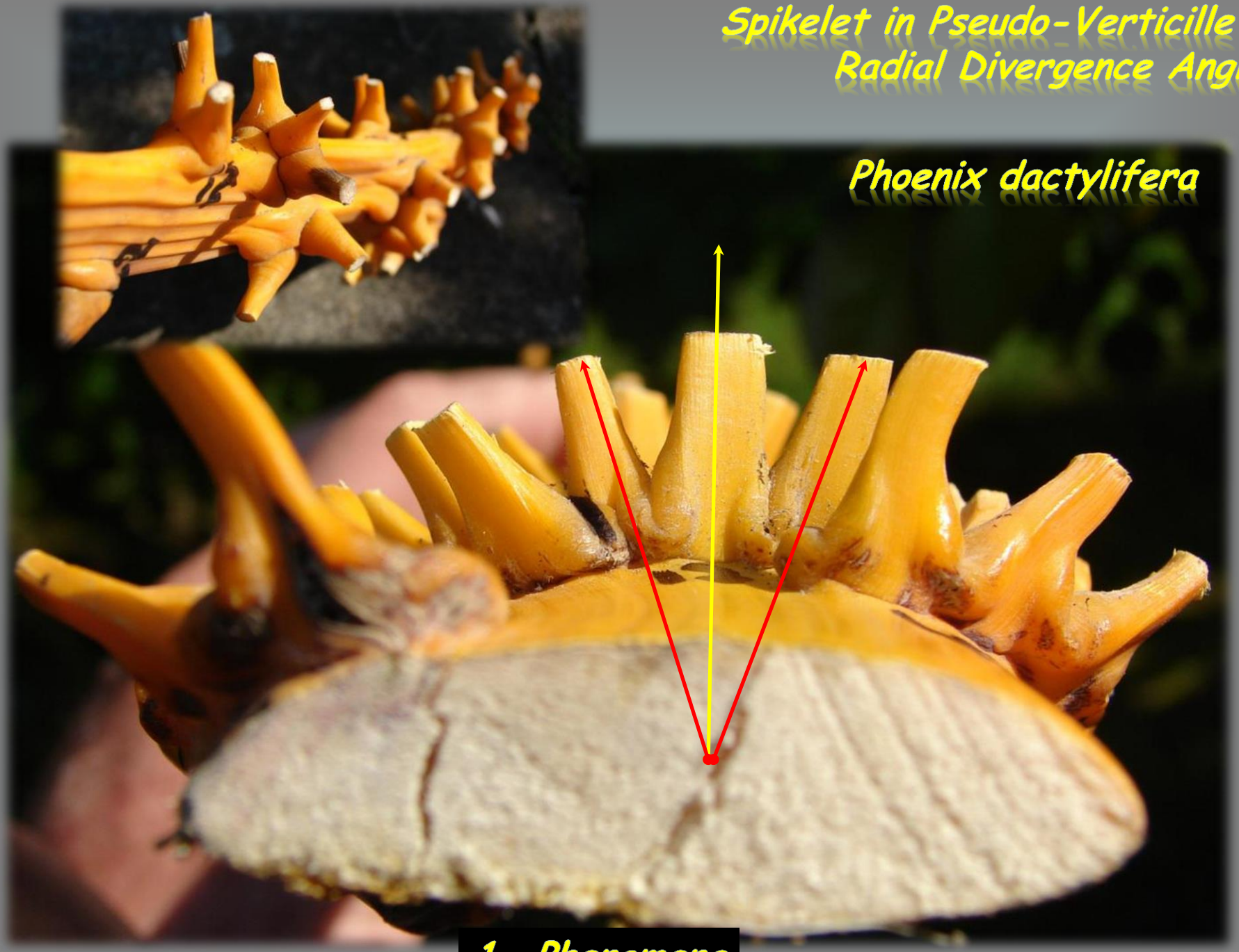
1- Locate pseudo-verticilles on stalk
with relative lenth position

2- Measure pseudo-verticilles axial angles

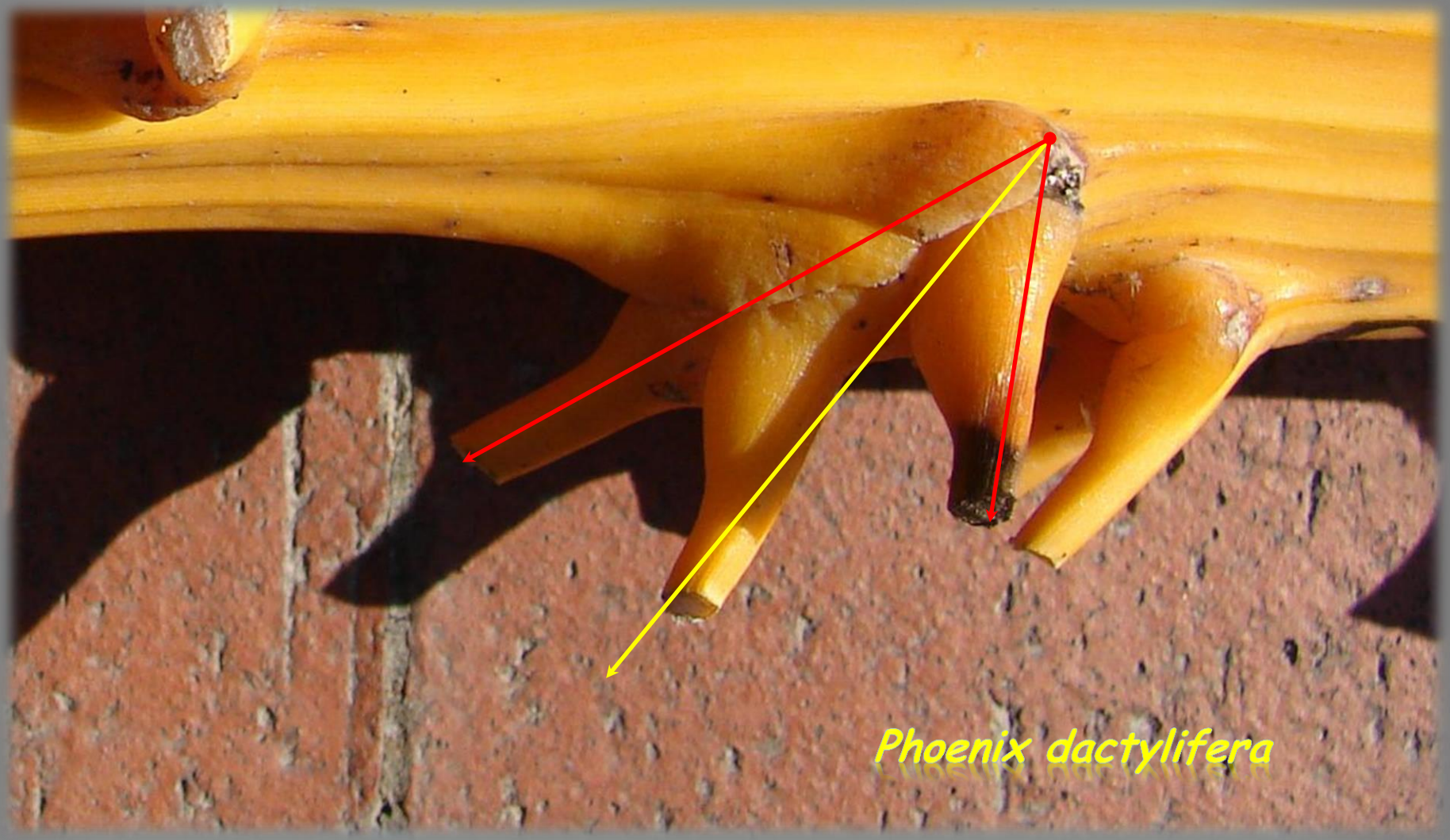
3- Calculate pseudo-verticilles axial angles
according to relative length position

4- Protocol

Spikelet in Pseudo-Verticille : Radial Divergence Angle



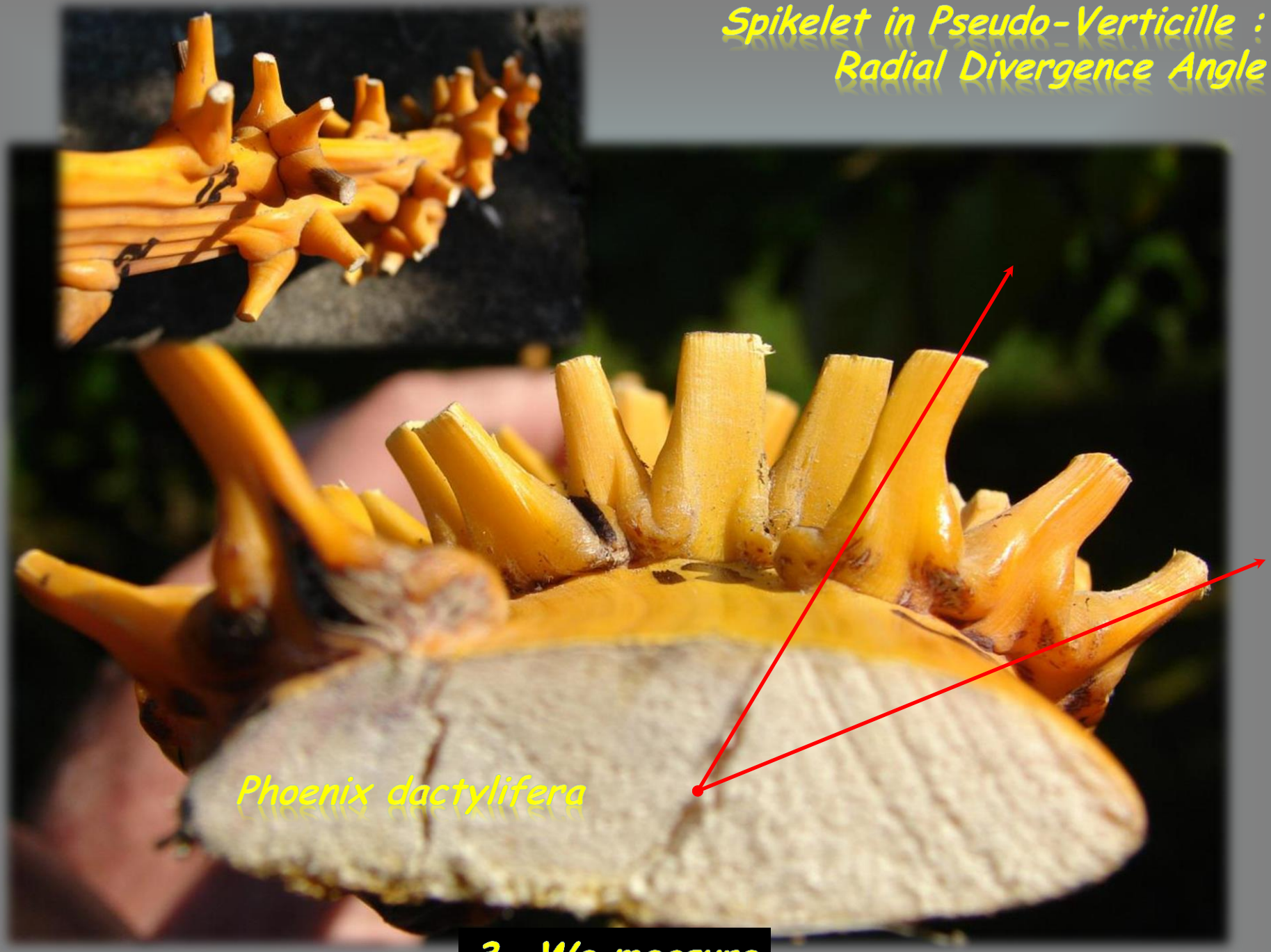
Spikelet in Pseudo-Verticille : Axial Divergence Angle



SPIKELET_Prod Folder Spikelets Radial & Axial Divergence Angles

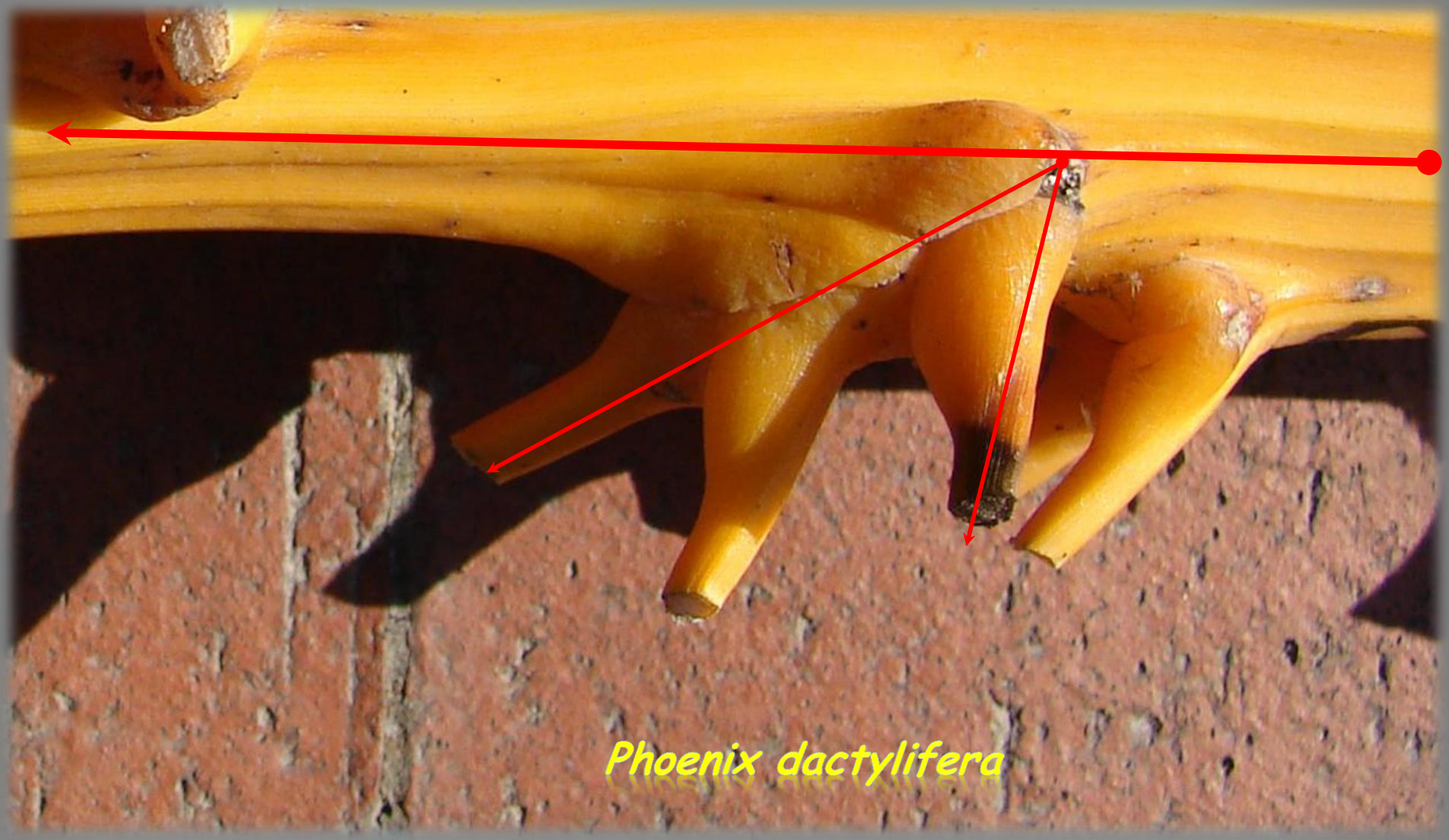
- Relative length position on bearer (stalk)
- Average radial divergence angle
- Radial divergence angle standard deviation
- Average axial divergence angle
- Axial divergence angle standard deviation
- Time (phyllochrone)
- Divergence angles evolutions

Spikelet in Pseudo-Verticille : Radial Divergence Angle



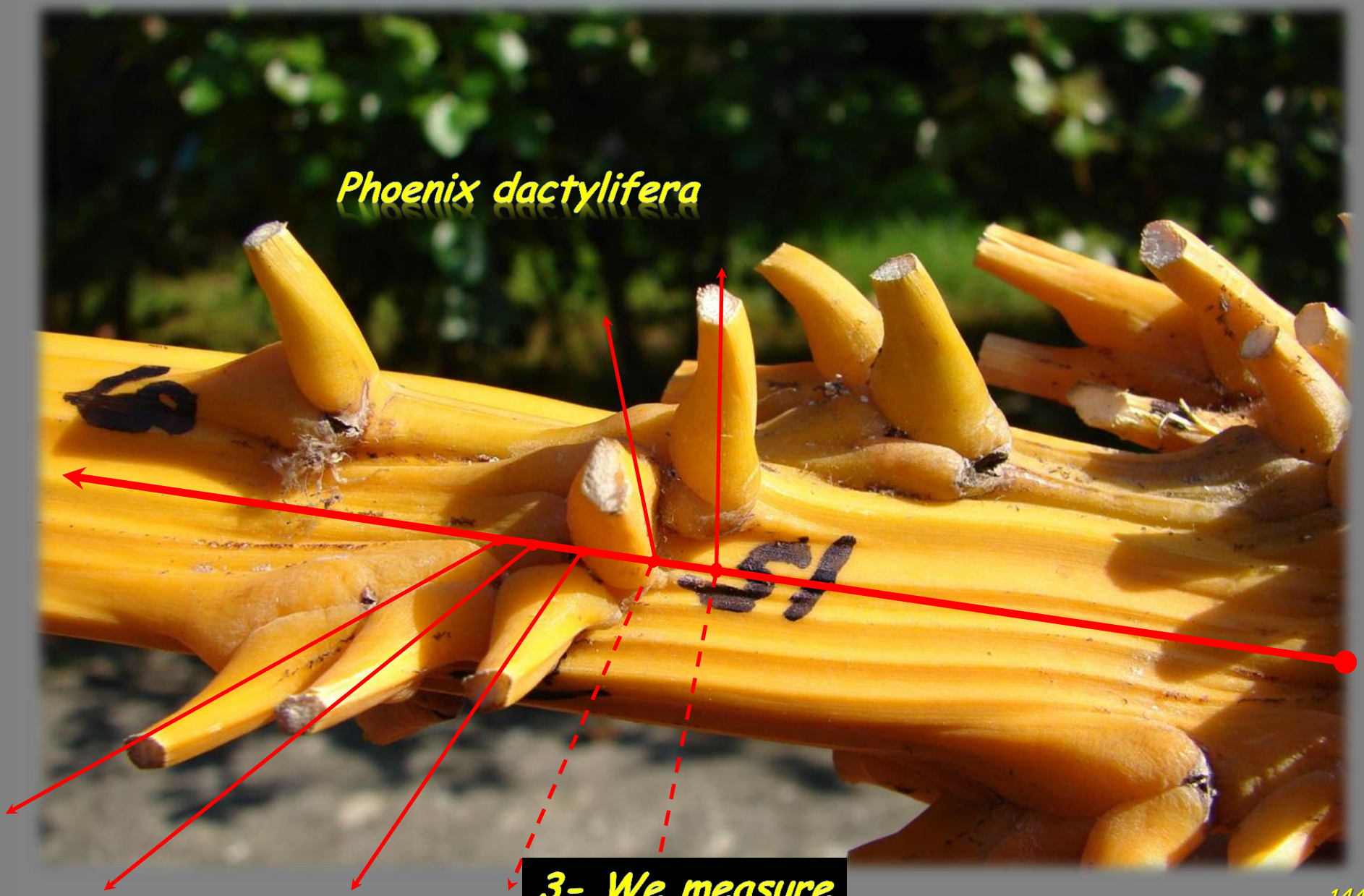
3- We measure

Spikelet in Pseudo-Verticille
Axial Divergence Angle



3- We measure

Spikelet in Pseudo-Verticille : Radial & Axial Divergence Angles



Spikelet in Pseudo-Verticille
Axial & Radial
Divergence Angles

Phoenix dactylifera

3- We measure

Spikelet in Pseudo-Verticille Axial & Radial Divergence Angles

1- Locate pseudo-verticilles on stalk with relative lenth position

2- Between extreme spikelets in each pseudo-verticille

3- Measure radial & axial divergence angles

4- Protocol

Pseudo-Verticilles values Data Sheet Folder

Template_2012-09-27.xlsx - Microsoft Excel

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A2 ^IGAP!A1

IGAP! A1

Many SPIKELETS on STALK

FORM 09 d

Observer Name		Date (jj/mm/aaaa)		Localisation	
Plot		Palm Id. Number		Progeny	
Frond Rank		Inflorescence Sexe		Pheno Stage	
Spikelets Number		Stalk Length		Stalk Insertion Angle	

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Organ	Pseudo-Verticille	Pseudo-Verticille	Pseudo-Verticille	Pseudo-Verticille	Pseudo-Verticille	Pseudo-Verticille	Spikelet	Spikelet	Spikelet	Spikelet	Spikelet	Spikelet	Spikelet	Spikelet
	Pseudo-Verticille Rank	Length Position	Relative Length Position	Radial Angle	Radial Div, Angle	Axial Angle	Axial Div, Angle	In Pseudo-Verticille	Rank	Length Position	Length	Sterile Length	Base Diameter	Flowers Nb	Fruits Nb
Rank	Name	cm	%	degree	degree	degree	degree	Nb	nb	cm	cm	cm	mm	nb	nb
1	Insertion														
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															

07- Stalk_Data | 07- Stalk_Guide | 08- Bract_Data | 08- Bract_Guide | 09- Stalk&Spikelet_Data | 09- Stalk&Spikelet_Guide | 10- Spikelet_Data | 10- Spikelet_Guide

Pseudo-verticilles values Protocol Sheet Folder

Template_2012-09-27.xlsx - Microsoft Excel

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A2 ^IGAP!A1

IGAP! A1 — **Many SPIKELETS on STALK** — **FORM 09 p**

Step	Organ	Operating Protocole	Column Number	Observation Material	Model Parameter concerned
1	Inflorescence	Take pictures of inflorescence (infrutescence) according to 3 perpendicular planes (3D).		Photoscope	Angles
2	Pseudo-verticille	Locate the first Pseudo-Verticille from the stalk-base (if pseudo verticille).	1	Eyes and fingers	Pseudo-Verticille localisation
3	Spikelet	Locate the first Spikelet from the first Pseudo-Verticille-base (or from the Stalk base if no Pseudo-Verticille).	8	Eyes and fingers	Spikelet Number in Pseudo-Verticille
4	Spikelet	Prune first Spikelet out of first Pseudo-Verticille.	9	Pruning shears	Spikelet Rank
5	Spikelet	Number first Spikelet of first Pseudo-Verticille (Peudo-Verticille-number_Spikelet-number).		Scotch + felt-tip	
6	Spikelet	Measure total-length of first spikelet.	11	Measuring tape	Spikelet Length
7	Spikelet	Measure steril-zone-length of first Spikelet (from Spikelet base to first Flower scar).	12	Measuring tape	Flower Localisation
8	Spikelet	Measure basis-diameter of first Spikelet.	13	Calliper	Spikelet Diameter
9	Spikelet	Count total number of Flowers on fertil zone of spikelet.	14	Eyes and fingers	Spikelet Flowers Nb
10	Spikelet	Count total number of fruits on fertil zone of spikelet.	15	Eyes and fingers	Spikelet Fruit Nb
11	Spikelet	Take pictures of Spikelet according to 3 perpendicular planes in case of SAMPLING this Spikelet.		Photoscope	SEE FICHE FICHE 10
12	Spikelet	GOTO STEP 4 for every Spikelet from first Pseudo-Verticille.	9	Secateurs	Spikelet Rank
13	Pseudo-verticille	GOTO STEP 2 for every Pseudo-Verticille on Stalk.	8	Eyes and fingers	Pseudo-Verticille Localisation
14	Stalk	RESULT of GOTO is that every Spikelet on Stalk has been pruned.			
15	Stalk	Take pictures from Stalk according to 3 perpendicular planes (3D).		Photoscope	SEE FICHE 07
16	Stalk	Stick measuring tape along stalk.			
17	Pseudo-verticille	Locate and measure position in length of every Pseudo-Verticilles from Stalk-base.	2	Measuring tape	Spikelet inter Pseudo-Verticille Distance
18	Spikelet	Locate and measure position in length of every Spikelet from Pseudo-Verticille OR Stalk base (you choose!).	10	Measuring tape	Spikelet intra Pseudo-Verticille Distance
19	Pseudo-verticille	Measure Radial divergence angle between external Spikelets from same Pseudo-Verticille.	5	Protractor	Spikelet Radial Divergence Angle
20	Pseudo-verticille	Measure Axial divergence angle between external Spikelets from same Pseudo-Verticille.	7	Protractor	Spikelet Axial Divergence Angle
21	Pseudo-verticille	Measure Axial insertion angle of Pseudo-Verticille main-direction on Stalk.	5	Protractor	Spikelet Insertion Angle
22	Stalk	Measure radial insertion angle of Pseudo-Verticilles main-direction on Stalk in order to compute phyllotaxy.	4	Trigonometric circle	Stalk Phyllotaxy

06- Pinnae_Data | 06- Pinnae_Guide | 07- Stalk_Data | 07- Stalk_Guide | 08- Bract_Data | 08- Bract_Guide | 09- Stalk&Spikelet_Data | 09- Stalk&Spikelet_Guide | 10- Spikelet_Data | 10- Spikelet_Guide

SPIKELET GEOMETRY

SPIKELET_Geom Folder

1Principes2014-5.xlsx - Microsoft Excel

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W13 | 2

IGAP!A1

STIPE

BEARER

ORGAN

TIME

SPIKELET SIZE & GEOMETRY

Item	SPIKELET LENGTH Position	Max	Position	Position Ratio	STD	Time	EVOLUTION * Growth
		Max		Position Ratio			EVOLUTION *
	*Applies to Flower Group Distance						
Interpolation		1		1	1		1
Nb Values		2.0		8.0	8.0		2.0
Variable Name			SpikeletLengthEvoL				
Unit	Pos Stem	cm	Pos Bearer %	ratio	cm	Phyllo	Ratio
1	1	8.00	0.00	0.00	0.00	1	0.80
2	200	25.00	12.00	0.00	0.10	36	1.00
3			30.00	0.90	4.00		
4			50.00	1.10	2.50		
5			70.00	1.00	1.20		
6			80.00	0.95	0.20		
7			90.00	0.80	0.00		
8			100.00	0.75	0.00		
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Item	SPIKELET DIAMETER Position	Max	Position	Position Ratio Ratio	STD	Position	Shape Ratio ratio
		Max		Position Ratio			Shape Ratio
Interpolation		1		1	1		1
Nb Values		2.0		8.0	8.0		5.0
Variable Name				SpikeletDiameter_1			
Unit	Pos Stem	cm	Pos Bearer %	ratio	cm	Pos Organ %	ratio
1	1	1.00	0.00	0.00	0.00	0.00	1.00
2	200	3.00	12.00	0.00	0.10	20.00	1.00
3			30.00	1.00	4.00	80.00	1.00
4			50.00	0.95	2.50	82.00	0.08
5			70.00	0.90	1.20	100.00	0.01
6			80.00	0.90	0.20		
7			90.00	0.85	0.00		
8			100.00	0.85	0.00		
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Item	SPIKELET STIFFNESS (Young Module Value) Position	Final Mean	STD	Time	Evolution Growth
		Final			Evolution
	100 = very soft (bending)		10 000 = very straight (no bending)		
Interpolation		1	1	1	0
Nb Values		3.0	3.0	3.0	3.0
Variable Name			SpikeletStiffnessEvoL		
Unit	Pos Bearer %	val	val	Phyllo	Factor
1	0.00	4000.00	1000.00	1	2.00
2	50.00	3500.00	1000.00	10	1.50
3	100.00	3000.00	1000.00	36	1.00
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Item	SPIKELET Zig Zag ANGLE Position	Mean	STD
Interpolation		1	1
Nb Values		1.0	1.0
Variable Name		SpikeletZigZagAngle_	
Unit	Pos Bearer %	degree	degree
1	0.00	3.00	0.30
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
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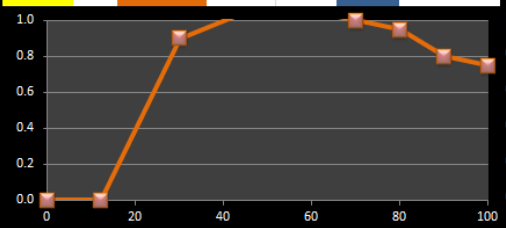
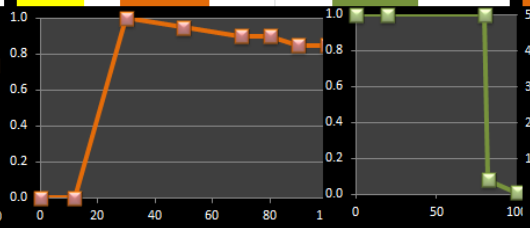
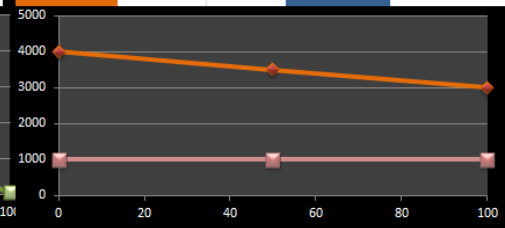
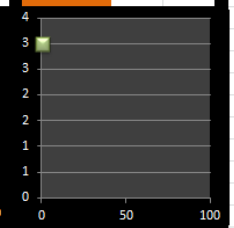
22			
23			
24			
25			









STEM_Geom | SPEAR | FROND_Prod | FROND_NERVURE_Geom | STUMP | PINNAE_Prod | PINNAE_Geom | INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEM

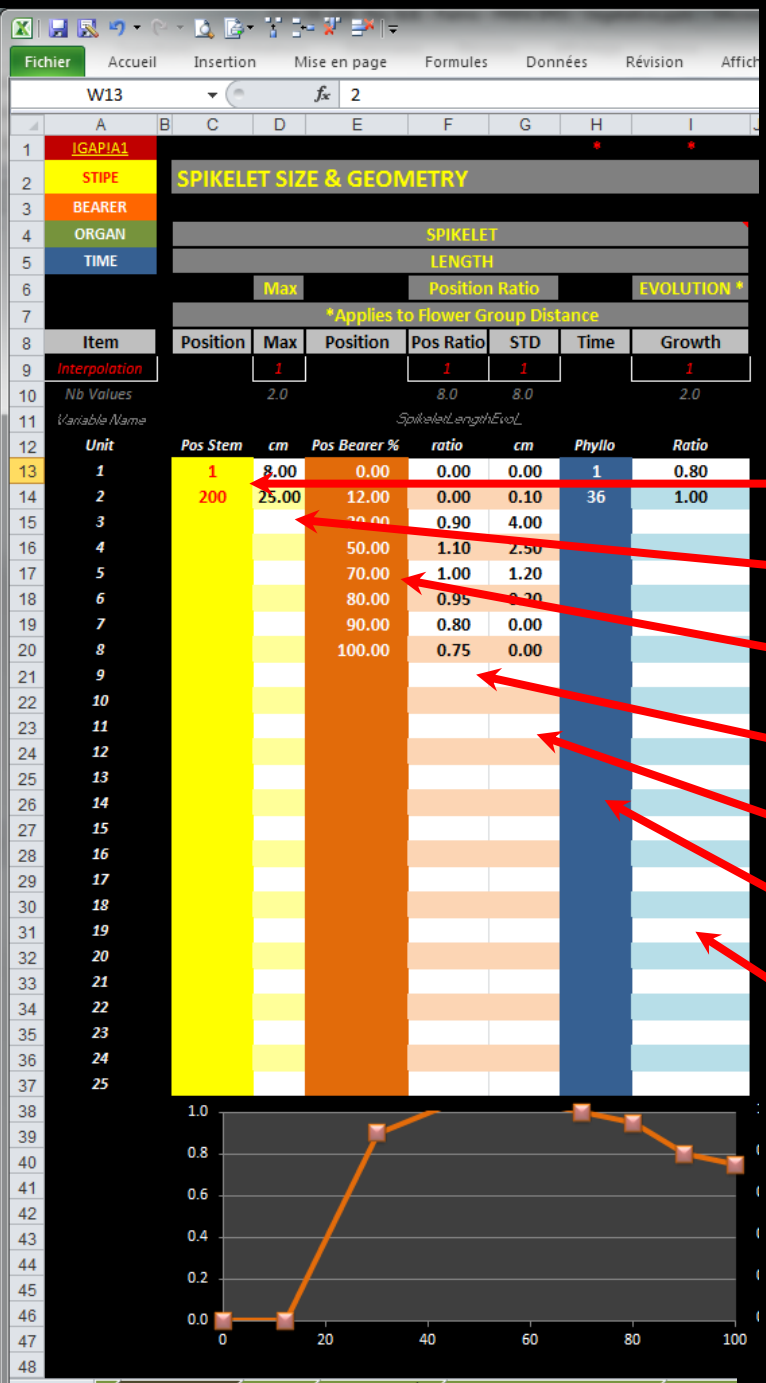
Prêt | 90 %


Phoenix dactylifera
Spikelet Length
1- Phenomena


Elaeis guineensis

Elaeis guineensis

SPIKELET_Geom Folder Spikelet Length

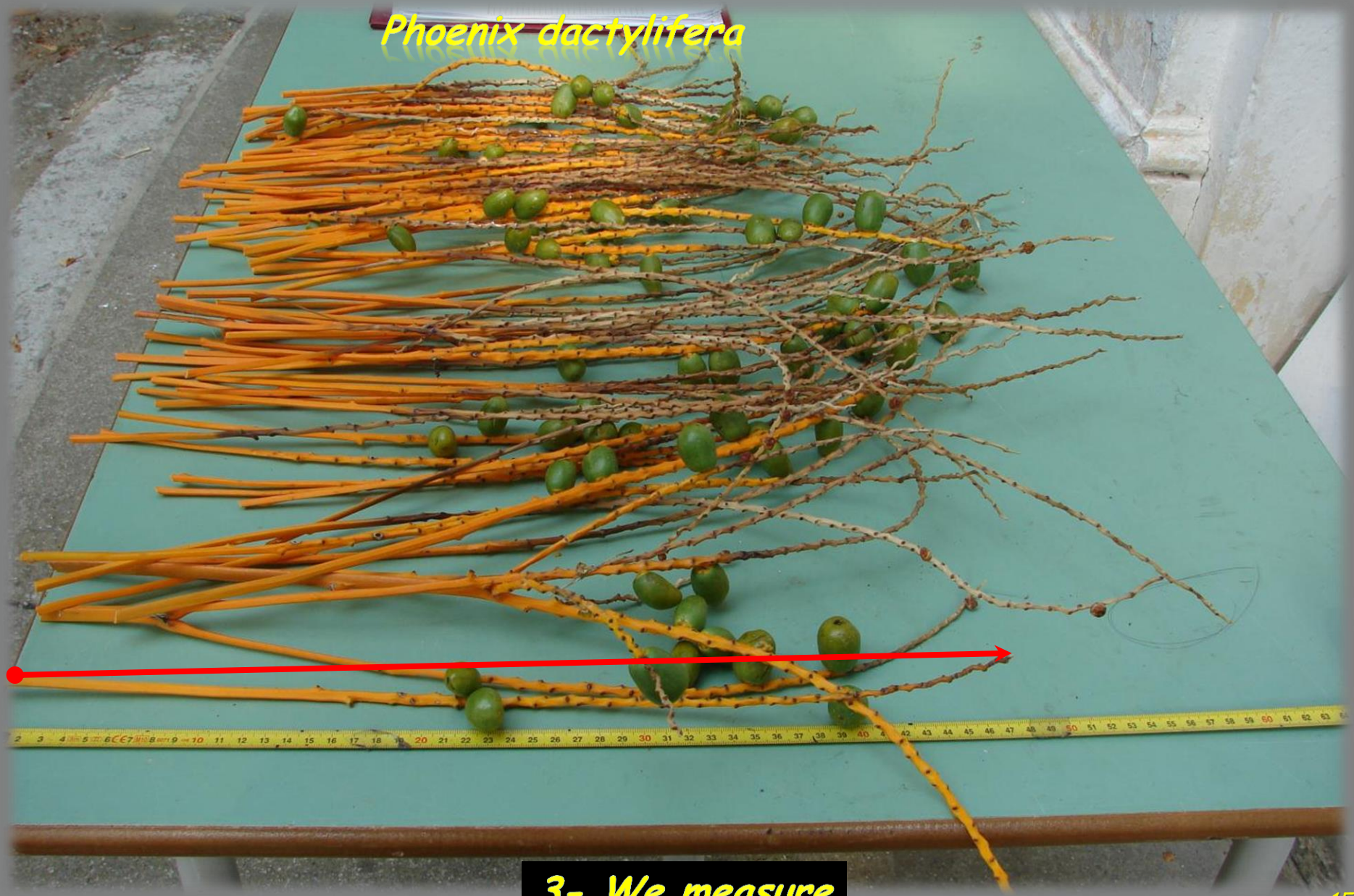


SPIKELET SIZE & GEOMETRY

Item	Position	Max	Position	Pos Ratio	STD	Time	Growth
Interpolation		1		1	1		1
Nb Values		2.0		8.0	8.0		2.0
Variable Name				SpikeletLengthEvol			
Unit	Pos Stem	cm	Pos Bearer %	ratio	cm	Phyllo	Ratio
1	1	8.00	0.00	0.00	0.00	1	0.80
2	200	25.00	12.00	0.00	0.10	36	1.00
3			[illegible]	0.90	4.00		
4			50.00	1.10	2.50		
5			70.00	1.00	1.20		
6			80.00	0.95	[illegible]		
7			90.00	0.80	0.00		
8			100.00	0.75	0.00		
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

- Absolut position of Inflorescence on the stipe
- Max length of Spikelet for Inflorescence
- Relative length position on Stalk
- Spikelet length as ratio on max length
- Spikelet length standard deviation
- Time (phyllochrone)
- Spikelet length evolution


Phoenix dactylifera
Spikelet Length
Maximum on Inflorescence
Position Ratio on Maximum
3- We measure



3- We measure

1- Determine Inflorescence position on the stipe

2- Measure Spikelet position on Stalk

3- Measure Spikelet length

4- Compute Spikelet relative length position on Stalk

5- Compute Spikelet max length for Stalk

6- Compute Spikelets lengthes ratios

Spikelet Diameter

Maximum on Inflorescence

Position ratio on Maximum

Shape Ratio

Phoenix dactylifera

3- We measure

SPIKELET_Geom Folder Spikelet Diameter

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age Compléments Acrobat

K L M N O P Q R

SPIKELET

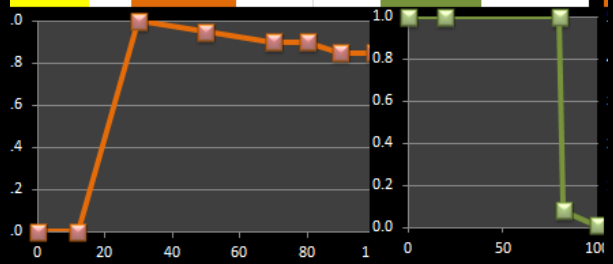
DIAMETER

Max | Position Ratio | Shape Ratio

Position	Max	Position	Ratio	STD	Position	ratio
	1		1	1		1
	2.0		8.0	8.0		5.0

SpikeletDiameter_1

Pos Stem	cm	Pos Bearer %	ratio	cm	Pos Organ %	ratio
1	1.00	0.00	0.00	0.00	0.00	1.00
200	3.00	[illegible]	0.00	0.10	20.00	1.00
		30.00	1.00	4.00	[illegible]	1.00
		50.00	0.95	2.50	82.00	0.08
		70.00	0.90	1.28	100.00	0.01
		80.00	0.90	0.20		
		90.00	0.85	[illegible]		
		100.00	0.85	0.00		



- Absolut position of Inflorescence on the stipe
- Max diameter of spikelet for Inflorescence
- Relative length position on stalk
- Spikelet diameter as ratio on max diameter
- Spikelet diameter standard deviation
- Spikelet relative length position
- Spikelet shape ratio

NNAE_Prod / PINNAE_Geom / INFLO_Prod / STALK_Geom

Spikelet Diameter

Elaeis guineensis

Maximum on Inflorescence

Position ratio on Maximum

Shape Ratio

3- We measure

1- Determine Inflorescence position on the stipe

2- Measure spikelet relative length position on stalk

3- Measure spikelet diameter with digital calliper

4- Compute spikelet relative length positions

5- Compute spikelet max diameter for stalk

6- Compute spikelet diameter ratios

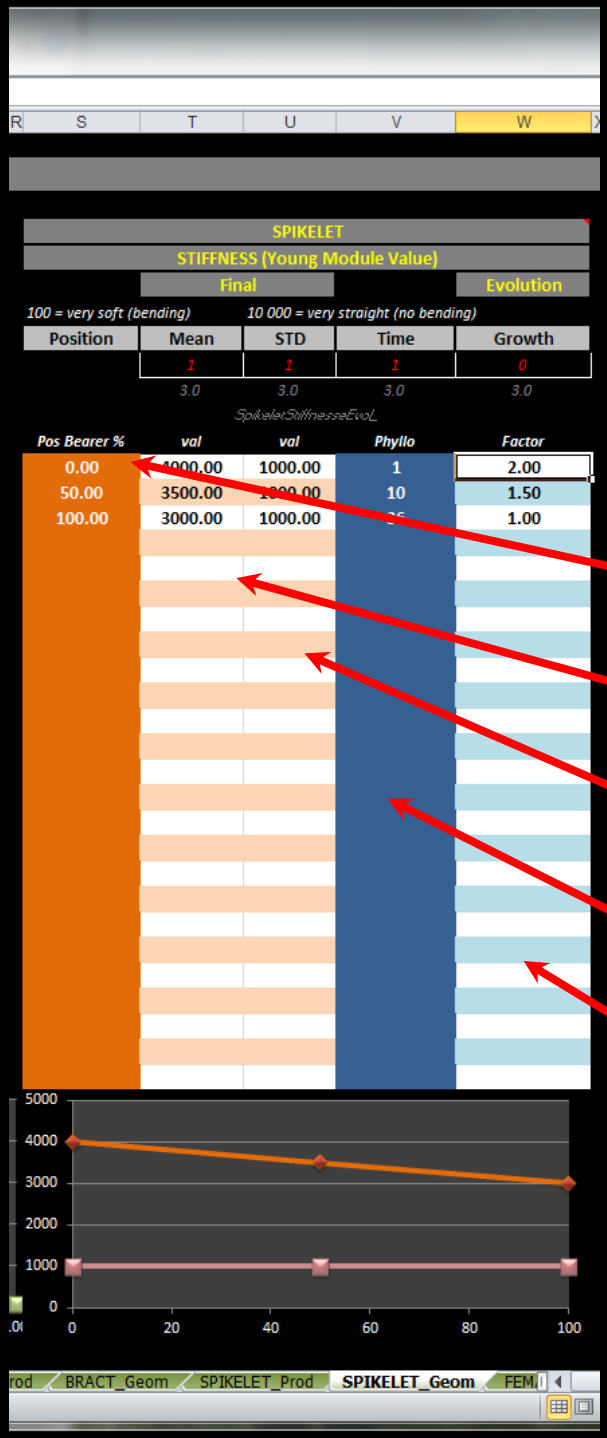
Spikelet Bending : Stiffness coefficient

1- Phenomena

Spikelet Bending : Stiffness coefficient

1- Phenomena

SPIKELET_Geom Folder Spikelet Stiffness



SPIKELET				
STIFFNESS (Young Module Value)				
	Final			Evolution
100 = very soft (bending)		10 000 = very straight (no bending)		
Position	Mean	STD	Time	Growth
	1	1	1	0
	3.0	3.0	3.0	3.0

SpikeletStiffnesseEvol_

Pos Bearer %	val	val	Phyllo	Factor
0.00	1000.00	1000.00	1	2.00
50.00	3500.00	1000.00	10	1.50
100.00	3000.00	1000.00	[illegible]	1.00

- *Relative length position of Spikelet on the Stalk*
- *Stiffness coefficient for old spikelets*
- *Stiffness coefficient for old spikelets standard variation*
- *Time*
- *Spikelet stiffness evolution (factor!...) To determine young spikelets stiffness*

Spikelet Bending : Stiffness coefficient

Ripening inflos

Phoenix dactylifera

3- We measure

Spikelet Bending : Stiffness coefficient

Evolution
Duration

Phoenix dactylifera

3- We measure

Spikelet Bending : Stiffness coefficient

Elaeis guineensis

3- We measure

1- Determine Inflorescence position in crown

2- Determine Spikelet position on stalk

3- Determine spikelet bending for many spikelets

4- Evaluate stiffness for spikelets of young and old inflorescences

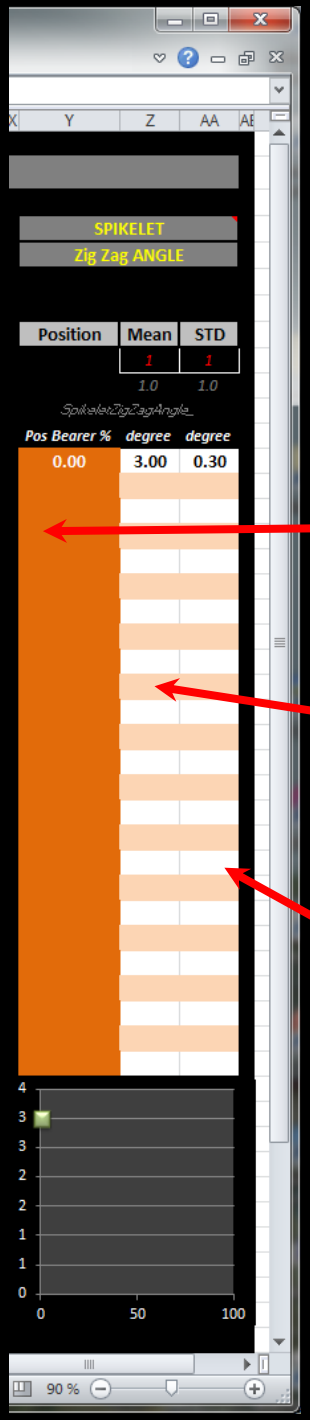
5- Determine factor evolution between young and old inflorescences

4- Protocol


Phoenix dactylifera

Elaeis guineensis

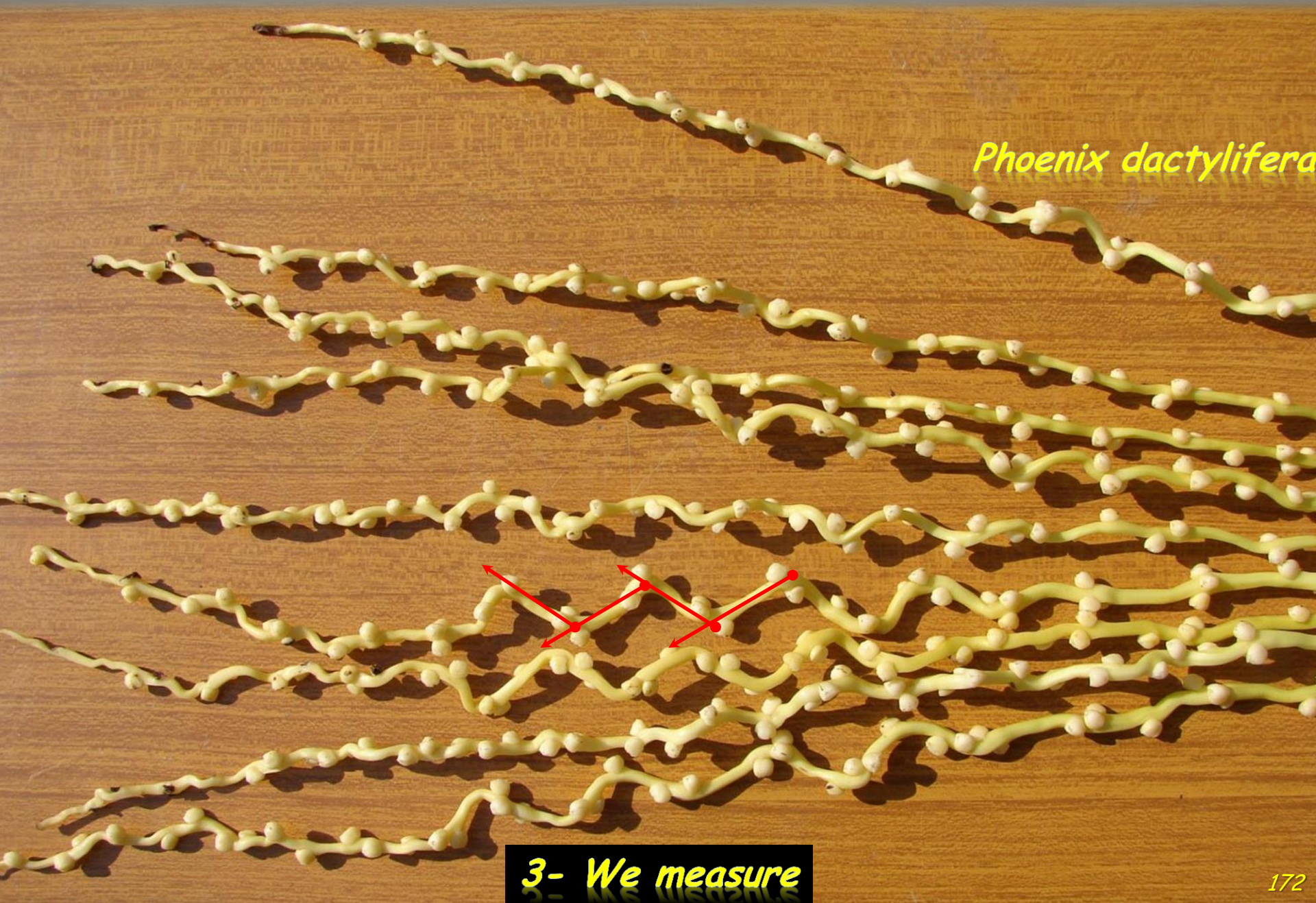
SPIKELET_Geom Folder Spikelet ZigZag Angle



Relative length position of the Spikelet

Spikelet deviation angle (« zig-zag »)
For each Elementary Length Unit,
Once Right, Once Left

Zig-zag angle standard deviation



3- We measure

1- Determine Inflorescence position in crown

2- Determine Spikelet position on stalk

3- Measure successive deviation (zigzag) angle on spikelets

4- Compute average and standard deviation zigzag angle

Spikelet values Data Sheet Folder

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A2 ^IGAP!A1

IGAP! A1

One SPIKELET

FORM 10 d

Observer Name		Date (jj/mm/aaaa)		Localisation	
Plot		Palm Id. Number		Progeny	
Frond Rank		Inflorescence Sexe		Pheno Stage	
Spikelet Rank		Spikelet Length		Spikelet sterile Length	

	1	2	3	4	5	6	7	8	9	10	11
	Organ	Spikelet Sample	Spikelet Sample	Spikelet Sample	Spikelet Sample	Spikelet Sample	Spikelet Sample	Spikelet Sample	Spikelet Sample	Spikelet Sample	Spikelet Sample
	Control Points	Length Position	Relative Length Position	Length	Diameter	Bending Angle	Lateral Deviation Angle	Rotation Angle	Volume	Fresh Weight	Dry Weight
Rank	Name	cm	%	cm	cm	degree	degree	degree	cm3	g	g
1	Insertion		%								
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											

07- Stalk_Data | 07- Stalk_Guide | 08- Bract_Data | 08- Bract_Guide | 09- Stalk&Spikelet_Data | 09- Stalk&Spikelet_Guide | 10- Spikelet_Data | 10- Spikele

Prêt

Spikelet values Protocol Sheet Folder

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A2 | ^!GAP!A1

Step	Organ	Operating Protocole	Column Number	Observation Material	Model Parameter concerned
!GAP!A1	One SPIKELET				FORM 10 p
1	Spikelet	Draw marks (control points) around Spikelet with felt-tip pen (base, half sterile-zone, 1st flower scar, then each 10 cm for example).	1	Felt-tip (pen)	Control Point Name
2	Spikelet	Measure length-position of each control points from Spikelet base.	2	Measuring tape	Spikelet Length
3	Spikelet	Measure Spikelet diameter for each control point.	4	Calliper	Spikelet Diameter
4	Spikelet	Take pictures from Spikelet according to 3 perpendicular planes (3D) (if not already done).		Photoscope	
5	Spikelet	Measure of Spikelet bending angles for choosen control points.	6	Mesurim software	Spikelet Bending Angle
6	Spikelet	Measure of Spikelet lateral deviation angles for choosen control points.	7	Mesurim software	Spikelet Lateral Deviation Angle
7	Spikelet	Measure of Spikelet rotation angles for choosen control points.	8	Mesurim software	Spikelet Rotation Angle
8	Spikelet	Measure Spikelet volume.	9	""Archimede Principle"	Spikelet volume
9	Spikelet	Measure Spikelet fresh weight.	10	Weighing machine	Spikelet Fresh Density
10	Spikelet	Dry Spikelet (3 days at 60°C).		Drier (Oven)	
11	Spikelet	Measure Spikelet dry weight.	11	Weighing machine	Spikelet Dry Density

06- Pinnae_Data | 06- Pinnae_Guide | 07- Stalk_Data | 07- Stalk_Guide | 08- Bract_Data | 08- Bract_Guide | 09- Stalk&Spikelet_Data | 09- Stalk&Spikelet_Guide | 10- Spikelet_Data | 10- Spikelet_Guide

FEMALE
MALE
MIXED

FLOWER
PRODUCTION

FEMALE_FLOWER_Prod Folder

1Principes2014-5.xlsx - Microsoft Excel

IGAPIA1 | STIPE | BEARER | ORGAN | TIME

FEMALE FLOWER on SPIKELET DEVELOPMENT, LOCATION & INSERTION

	FEMALE FLOWER LOCATION			FEMALE FLOWER GROUP FREQUENCY					FEMALE FLOWER GROUP DISTANCE						FEMALE FLOWER RADIAL INSERTION ANGLE			FEMALE FLOWER AXIAL INSERTION ANGLE		
	BEGINNING POSITION according to spikelet on stalk position									Inter-Group		Intra-Group		Evolution	Phyllotaxy					
	Spikelet	Mean	STD		1	2	3	4	Verif total											
Item	Position	Beginning	on Beginning	Position	Mean	Mean	Mean	Mean		Position	Mean	STD	Mean	STD		Position	Mean	STD	Position	Mean	STD
Interpolation		1	1		1	1	1	1			1	1	1	1	See Spikelet Evolution		1	1		1	1
Nb Values		2.0	2.0		3.0	3.0	3.0	3.0			3.0	3.0	3.0	3.0			3.0	3.0		3.0	3.0
Variable Name		FemaleFlowerLocalisation_			FemaleFlowerGroupFrequency_						FemaleFlowerDistanceEvol_						FemaleFlowerPhyllotaxy_			FemaleFlowerInsertionAngle_	
Unit	Pos Bearer %	Pos Organ %	%	Pos Bearer %	%	%	%	%		Pos Bearer %	cm	cm	cm	cm		Pos Bearer %	degree	degree	Pos Bearer %	degree	degree
1	0.00	40	1.00	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00		0.00	137.00	1.37	0.00	60.00	0.60
2	100.00	20	2.00	20.00	100.00	0.00	0.00	0.00	100.00	80.00	0.80	0.30	1.00	0.10		20.00	137.00	1.37	20.00	20.00	0.20
3				100.00	100.00	0.00	0.00	0.00	100.00	100.00	0.70	0.20	1.00	0.10		100.00	137.00	1.37	100.00	60.00	0.60
4									0.00												
5									0.00												
6									0.00												
7									0.00												
8									0.00												
9									0.00												
10									0.00												
11									0.00												
12									0.00												
13									0.00												
14									0.00												
15									0.00												
16									0.00												
17									0.00												
18									0.00												
19									0.00												
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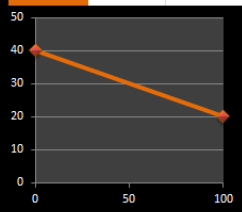
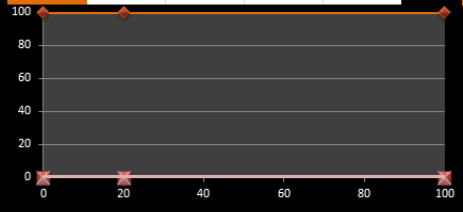
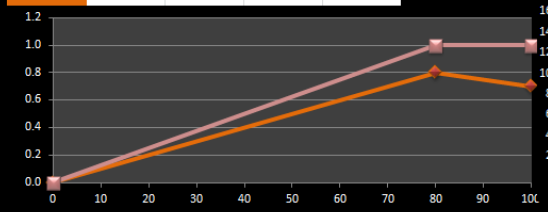
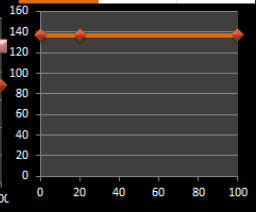
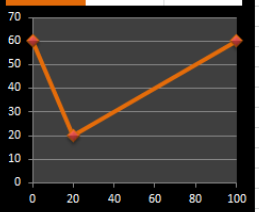
23									0.00												
24									0.00												
25																					











FROND_Prod | FROND_NERVURE_Geom | STUMP | PINNAE_Prod | PINNAE_Geom | INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEMALE_FLOWER_Prod | FEMALE_FLOWER_Geom

Prêt

MALE_FLOWER_Prod Folder

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IGAP!A1

STIPE | BEARER | ORGAN | TIME

MALE FLOWER on SPIKELET DEVELOPMENT, LOCATION & INSERTION

Item	MALE FLOWER LOCATION BEGINNING POSITION according to spikelet on stalk position: Spikelet Position	Mean Beginning	STD on Beginning	MALE FLOWER GROUP FREQUENCY: Position	1 Mean	2 Mean	3 Mean	4 Mean	Verif total
Interpolation		1	1		1	1	1	1	
Nb Values		1.0	1.0		1.0	1.0	1.0	1.0	
Variable Name		MaleFlowerLocalisation_			MaleFlowerGroupFrequency_				
Unit	Pos Bearer %	Pos Organ %	%	Pos Bearer %	%	%	%	%	100.00
1	0.00	0	0.00	0.00	100.00	0.00	0.00	0.00	0.00
2									0.00
3									0.00
4									0.00
5									0.00
6									0.00
7									0.00
8									0.00
9									0.00
10									0.00
11									0.00
12									0.00
13									0.00
14									0.00
15									0.00
16									0.00
17									0.00
18									0.00
19									0.00
20									0.00
21									0.00
22									0.00
23									0.00
24									0.00
25									

Item	MALE FLOWER GROUP DISTANCE: Position	Inter-Group Mean	Inter-Group STD	Intra-Group Mean	Intra-Group STD	Evolution
Interpolation		1	1	1	1	See Spikelet Evolution
Nb Values		1.0	1.0	1.0	1.0	
Variable Name		MaleFlowerDistanceEvoL				
Unit	Pos Bearer %	cm	cm	cm	cm	
1	0.00	0.00	0.00	0.00	0.00	
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Item	MALE FLOWER RADIAL INSERTION ANGLE Phyllotaxy: Position	Mean	STD	MALE FLOWER AXIAL INSERTION ANGLE: Position	Mean	STD
Interpolation		1	1		1	1
Nb Values		1.0	1.0		1.0	1.0
Variable Name		MaleFlowerPhyllotaxy_			MaleFlowerInsertionAngle_	
Unit	Pos Bearer %	degree	degree	Pos Bearer %	degree	degree
1	0.00	137.00	1.37	0.00	0.00	0.00
2						
3						
4						
5						
6						
7						
8						
9						
10						
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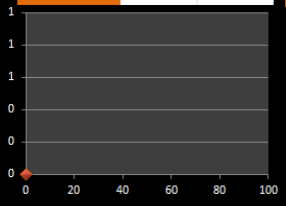

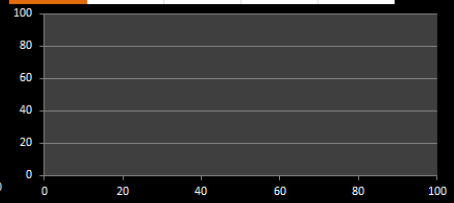

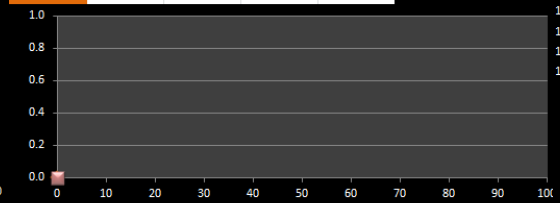

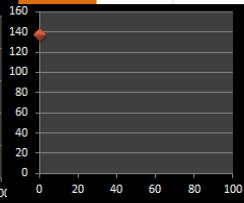

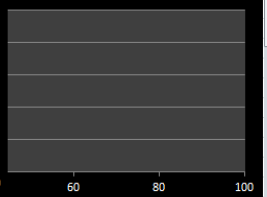

STUMP | PINNAE_Prod | PINNAE_Geom | INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEMALE_FLOWER_Prod | FEMALE_FLOWER_Geom | MALE_FLOWER_Prod | MALE_FLOWER_Geom

Prêt 90 %

MIXED_FLOWER_Prod Folder

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A1 ^IGAP!A1

IGAP!A1 | STIPE | BEARER | ORGAN | TIME

MIXED FLOWER on SPIKELET LOCATION & INSERTION (for Sex Code = 3, Male & Female flowers)

	MIXED FLOWER SEXUALISATION			MIXED FLOWER LOCATION BEGINNING POSITION			MIXED FLOWER GROUP FREQUENCY					MIXED FLOWER GROUP DISTANCE						MIXED FLOWER RADIAL INSERTION ANGLE			MIXED FLOWER AXIAL INSERTION ANGLE
	Femele on total frequency			according to spikelet on stalk position				1	2	3	4		Inter-Group		Intra-Group		EVOLUTION *	PHYLLOTAXY			See Female & Male Flowers
				Spikelet	Mean	STD															
Item	Position	Presence	STD	Position	Beginning	on Beginning	Position	Mean	Mean	Mean	Mean	Position	Mean	STD	Mean	STD		Position	Mean	STD	
Interpolatio		1	1		1	1		1	1	1	1		1	1	1	1	See Spikelet Evolutio		1	1	
Nb Values		1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0			1.0	1.0	
Variable Name		MixedFlowerLocalisation_			MixedFlowerLocalisation_			MixedFlowerGroupFrequency_					MixedFlowerDistanceEvol_						MixedFlowerPhyllotaxy_		
Unit	Pos Bearer %	%	%	Pos Bearer %	Pos Organ %	%	Pos Bearer %	%	%	%	%	Pos Bearer %	cm	cm	cm	cm		Pos Bearer %	degree	degree	
1	0.00	10.00	0.00	0.00	50	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	
2												0.00									
3												0.00									
4												0.00									
5												0.00									
6												0.00									
7												0.00									
8												0.00									
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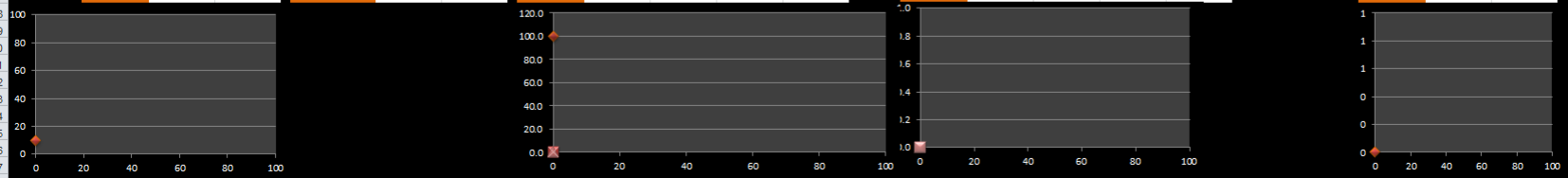
25																					



INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEMALE_FLOWER_Prod | FEMALE_FLOWER_Geom | MALE_FLOWER_Prod | MALE_FLOWER_Geom | MIXED_FLOWER_Prod | FRUIT

Prêt

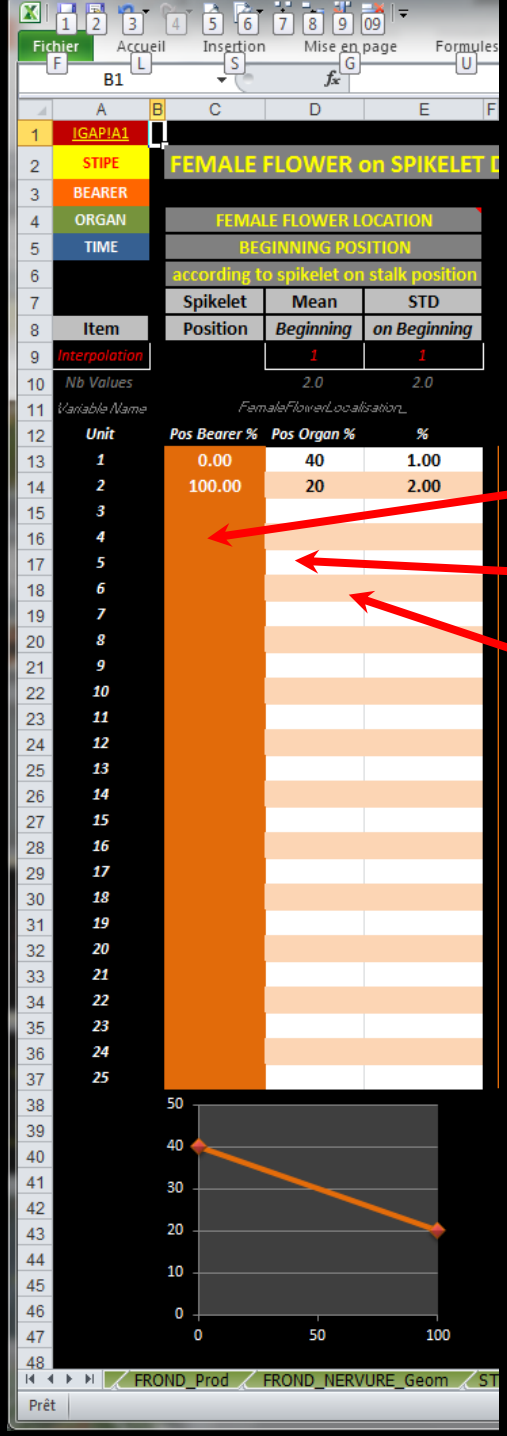

Female Flower Location
Phoenix dactylifera
1- Phenomena

Male Flower Location

Male or Female Flower Location

Elaeis guineensis

FLOWER_Prod Folder Flower Location



- Relative length position of spikelet on the stalk
- Relative length position of first flower on the spikelet
- Standard deviation of Relative length position of first flower on the spikelet

2- Model


Female Flower Location
Phoenix dactylifera
3- We measure

Male & Femele Flower Location

3- We measure

1- Determine Inflorescence position in crown

2- Determine Spikelet position on stalk

3- Measure First flower length position on spikelet

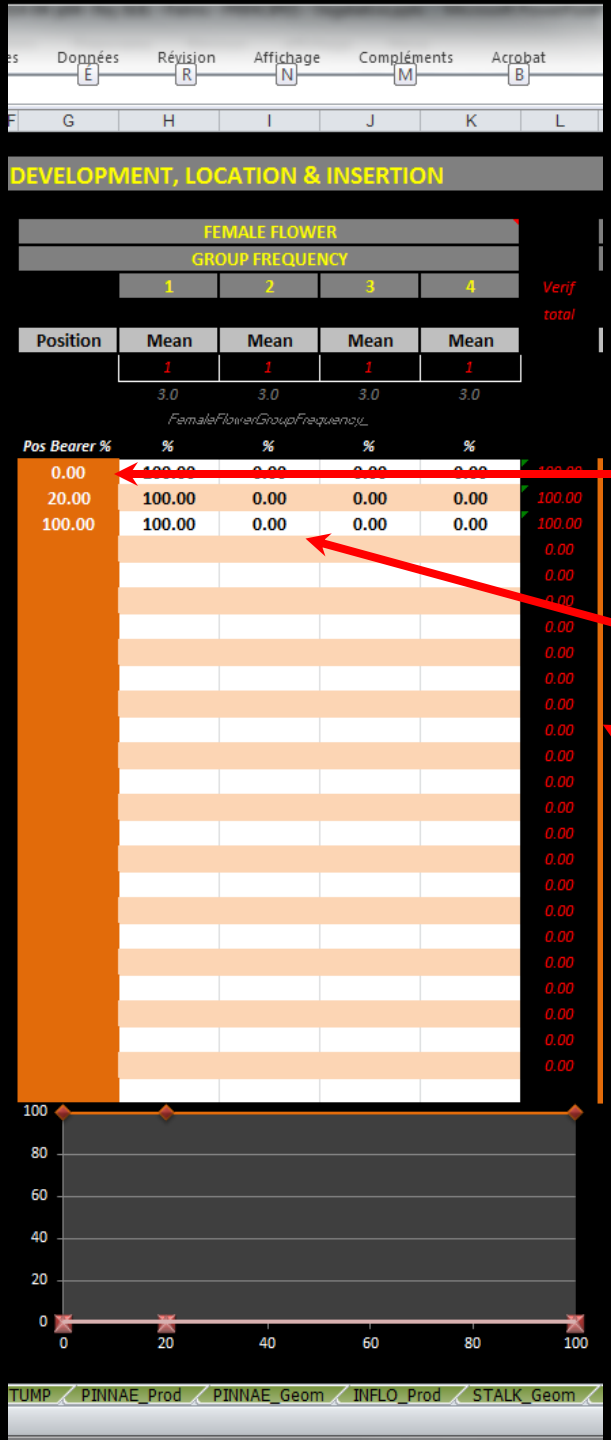
4- Do it for many spikelets at many positions on stalk

5- Compute average and standard deviation
first flower position on spikelet
as a function of position of spikelet on stalk.

4- Protocol

1- Phenomena

FLOWER_Prod Folder Flower Group Frequency



Relative length position of flower on the spikelet

Group frequency
(for 1, 2, 3 or 4 flowers per group)

Total must be 100% !...

1- Measure Spikelet length

2- Determine flower group type (1, 2, 3 or 4 flowers)

3- Locate group in relative length position on spikelet

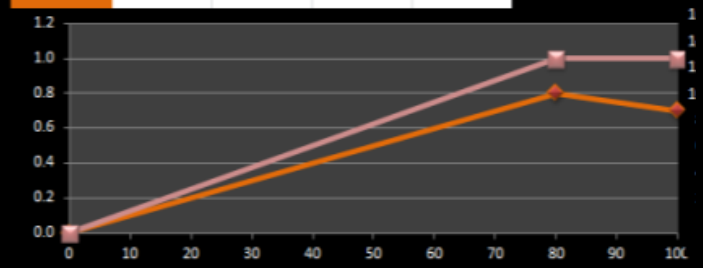
4- Compute flower group frequency by location

FLOWER_Prod Folder

Flower Group Distance

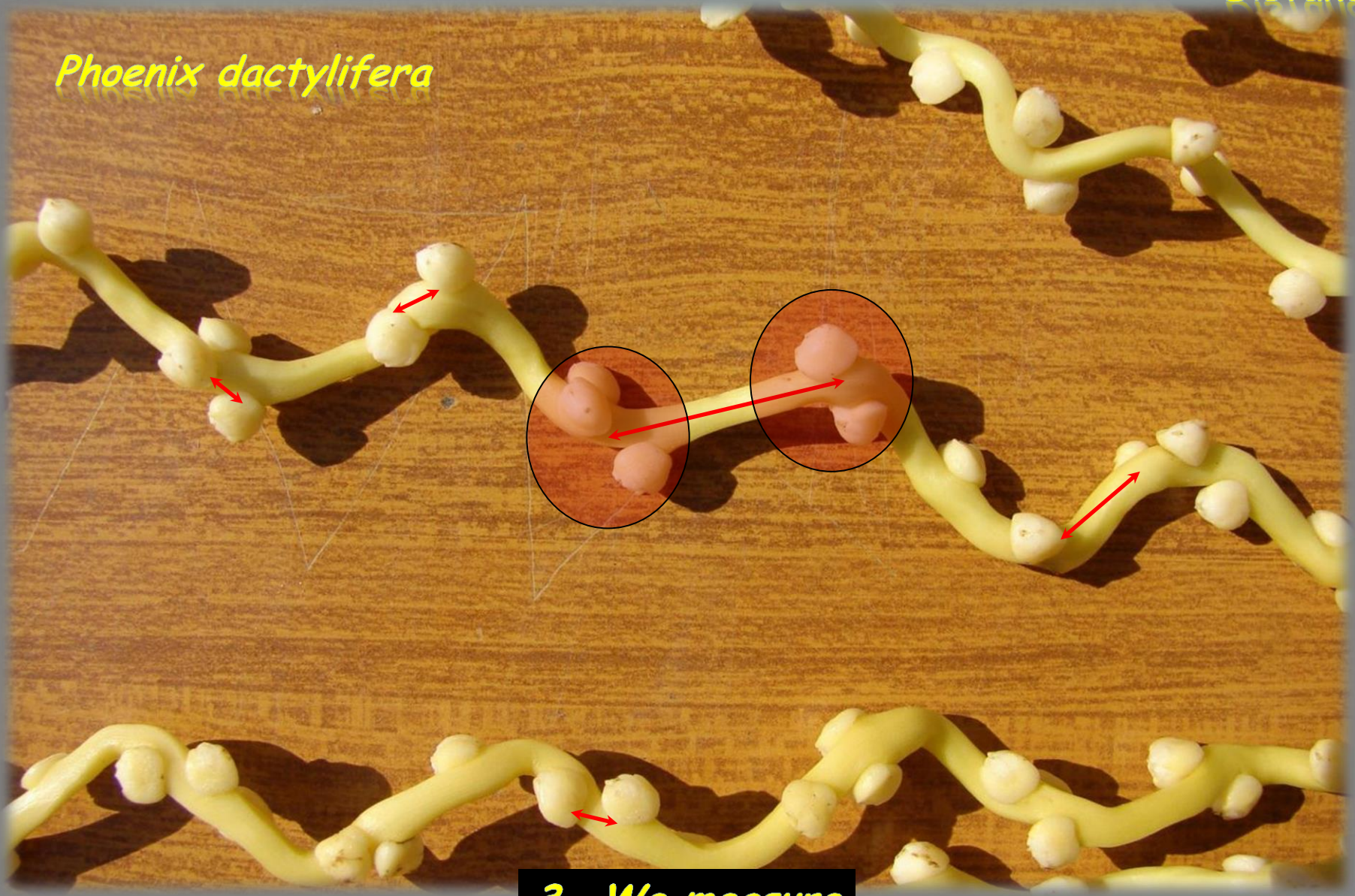
1Principes2014-5.xlsx - Microsoft Excel

FEMALE FLOWER					
GROUP DISTANCE					
	Inter-Group		Intra-Group		Evolution
Position	Mean	STD	Mean	STD	
	1	1	1	1	See Spikelet Evolution
	3.0	3.0	3.0	3.0	
	FemaleFlowerDistanceEvoL				
Pos Bearer %	cm	cm	cm	cm	
0.00	0.00	0.00	0.00	0.00	
80.00	0.80	0.30	1.00	0.10	
100.00	0.70	0.20	1.00	0.10	



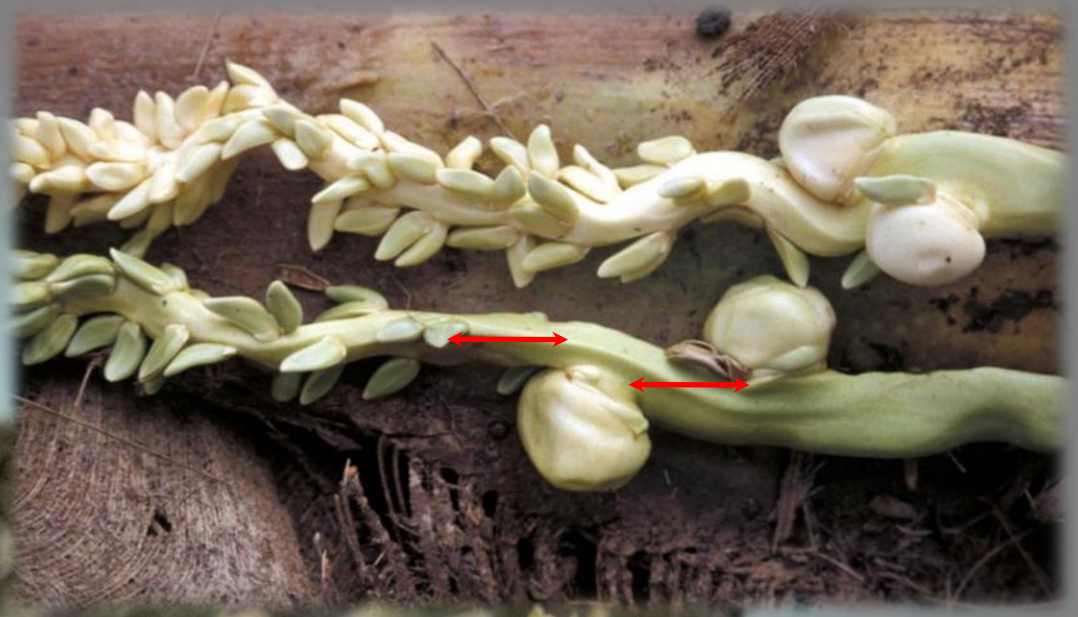
BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEMALE_FLOW

Flower Group Distance



3- We measure

Group Frequency & Distance



Cocos nucifera

3- We measure

Elaeis guineensis

3- We measure

1- Measure Spikelet length

2- Determine flower group type (1, 2, 3 or 4 flowers)

3- Measure inter & intra group distances

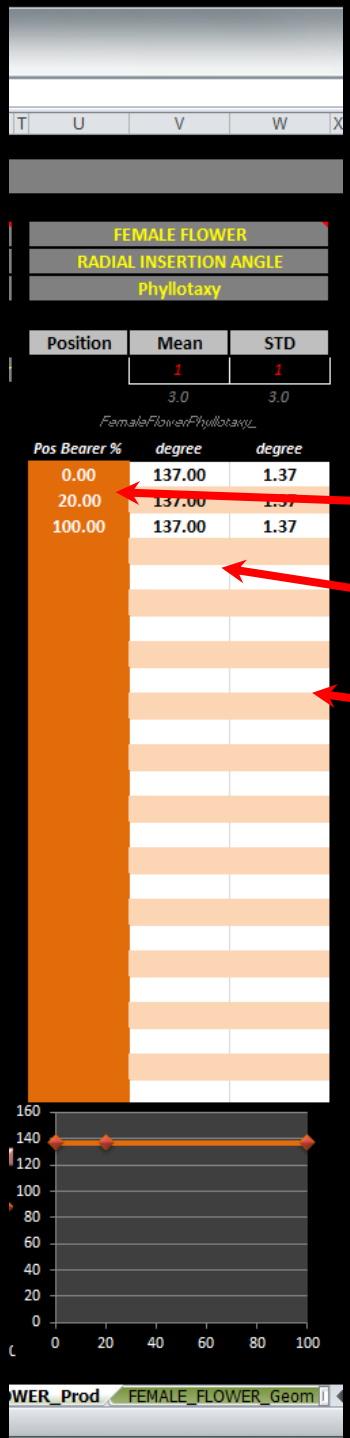
4- Locate group in relative length position on spikelet

5- Compute flower inter & intra groups distances by location

Flower Radial Insertion Angle : Spikelet Phyllotaxy?

Phoenix dactylifera

FLOWER_Prod Folder Flower Radial Insertion Angle



FEMALE FLOWER
RADIAL INSERTION ANGLE
Phyllotaxy

Position	Mean	STD
	1	1
	3.0	3.0

FemaleFlowerPhyllotaxy_

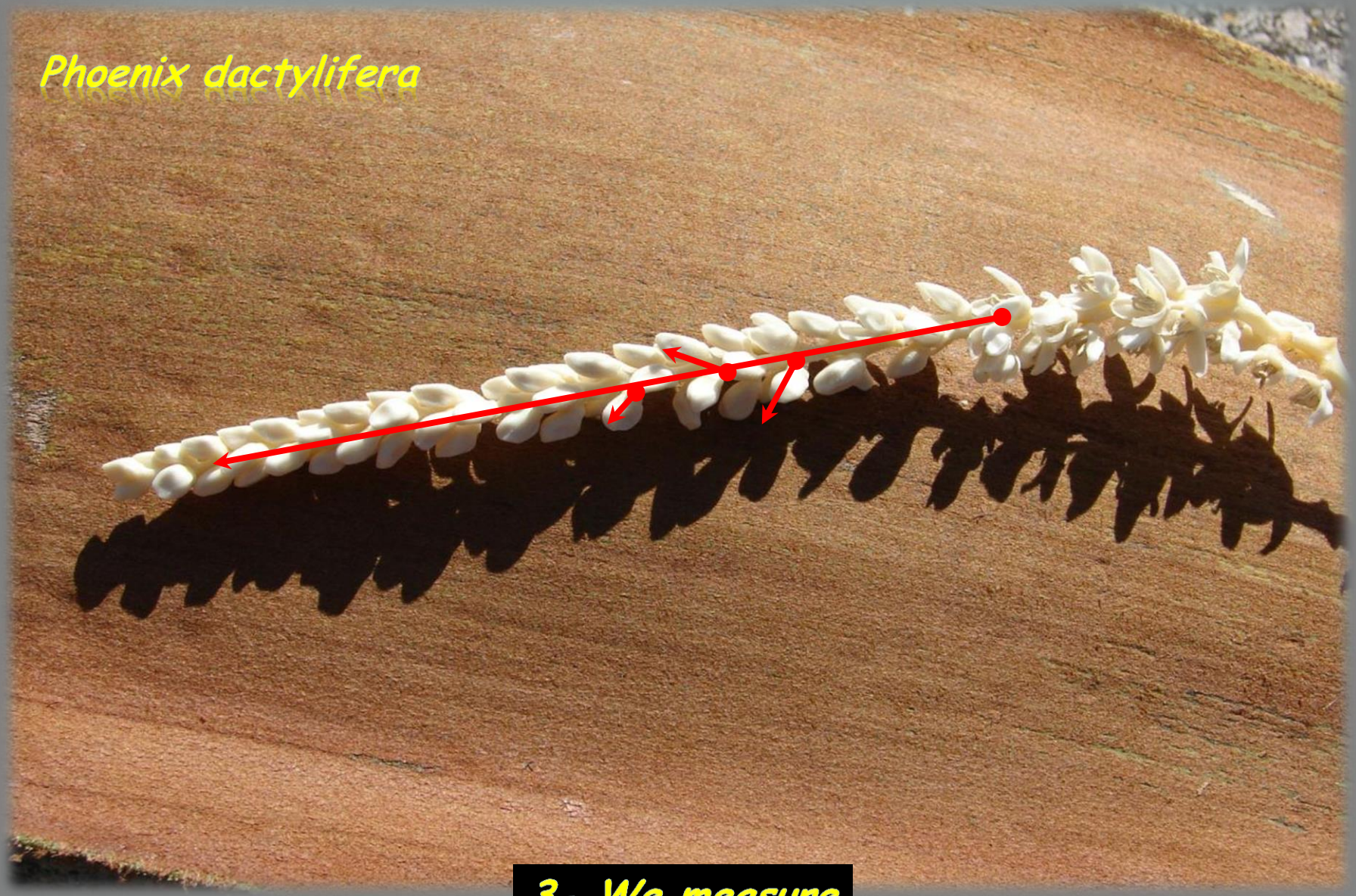
Pos Bearer %	degree	degree
0.00	137.00	1.37
20.00	137.00	1.37
100.00	137.00	1.37

Relative length position of flower on the spikelet

Flower radial insertion angle

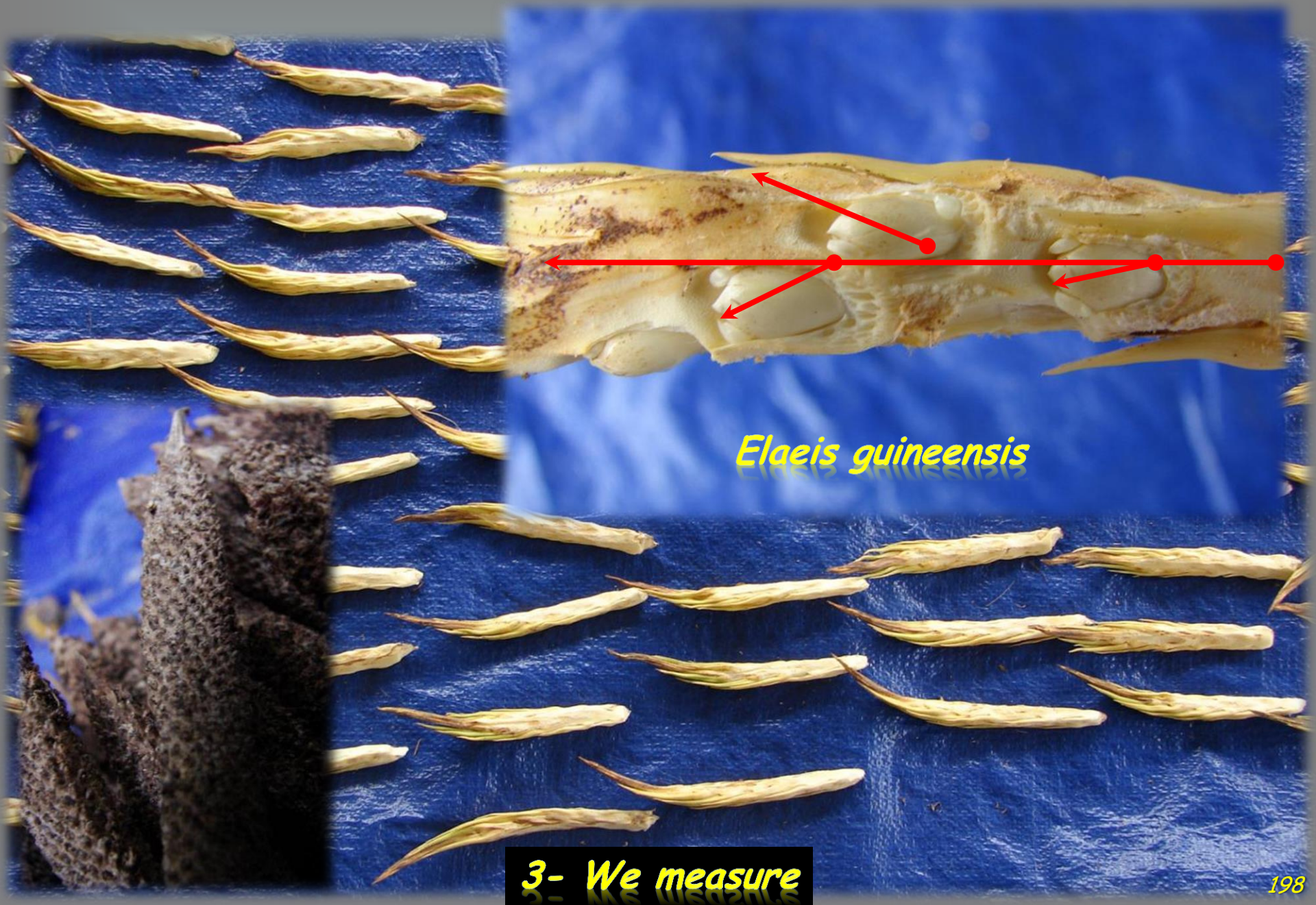
Flower radial insertion angle standard deviation

Male Flower Radial Insertion Angle



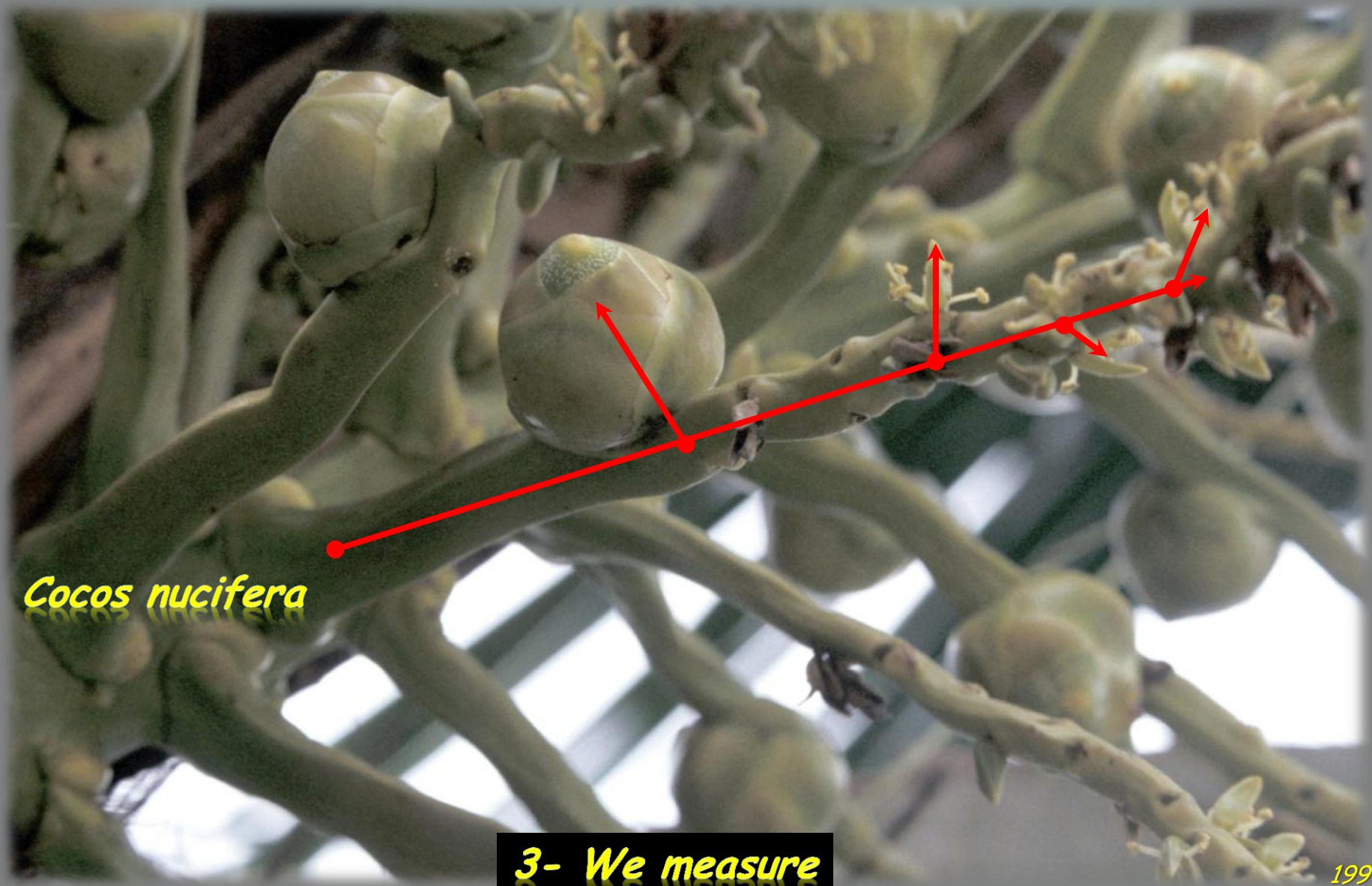
3- We measure

Female or Male Flower Radial Insertion Angle



3- We measure

Female & Male Flower Radial Insertion Angle



3- We measure

1- Measure Spikelet length

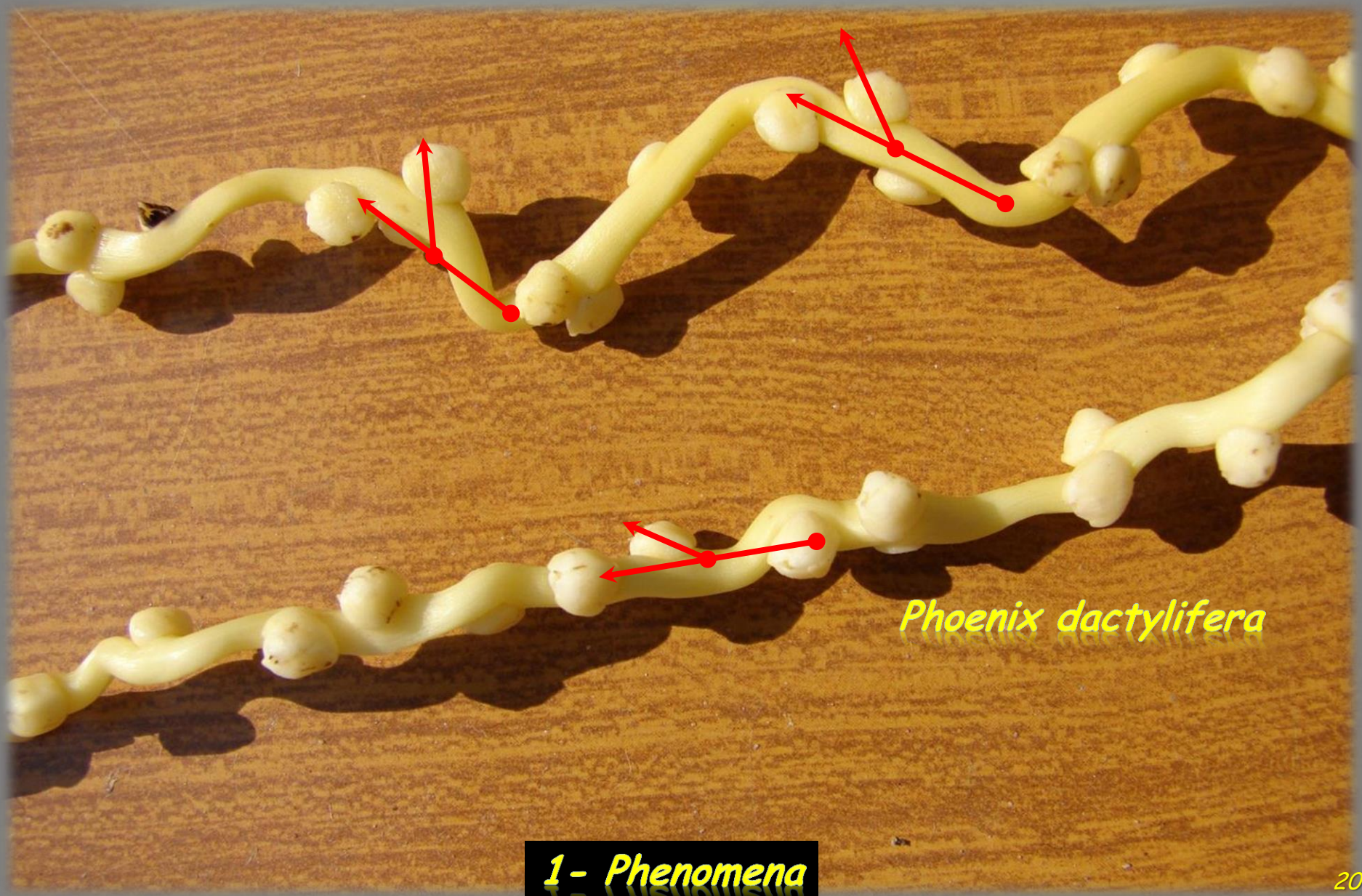
2- Determine flower group type (1, 2, 3 or 4 flowers)

3- Measure successive Flower's radial insertion angles

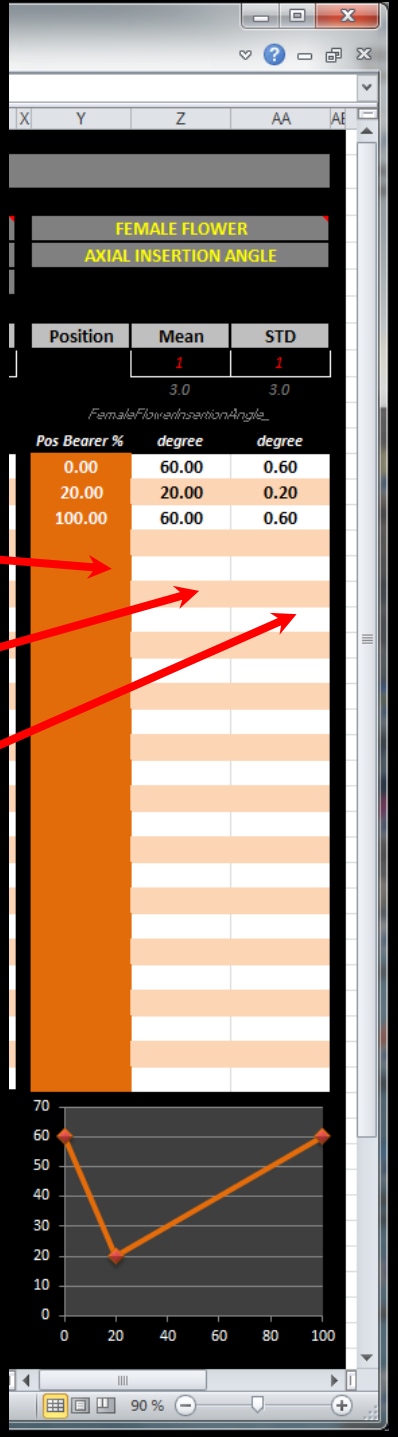
4- Determine if phyllotaxic angle can model radial angles

4- Protocol

Female Flower Axial Insertion Angle



FLOWER_Prod Folder Flower Axial Insertion Angle

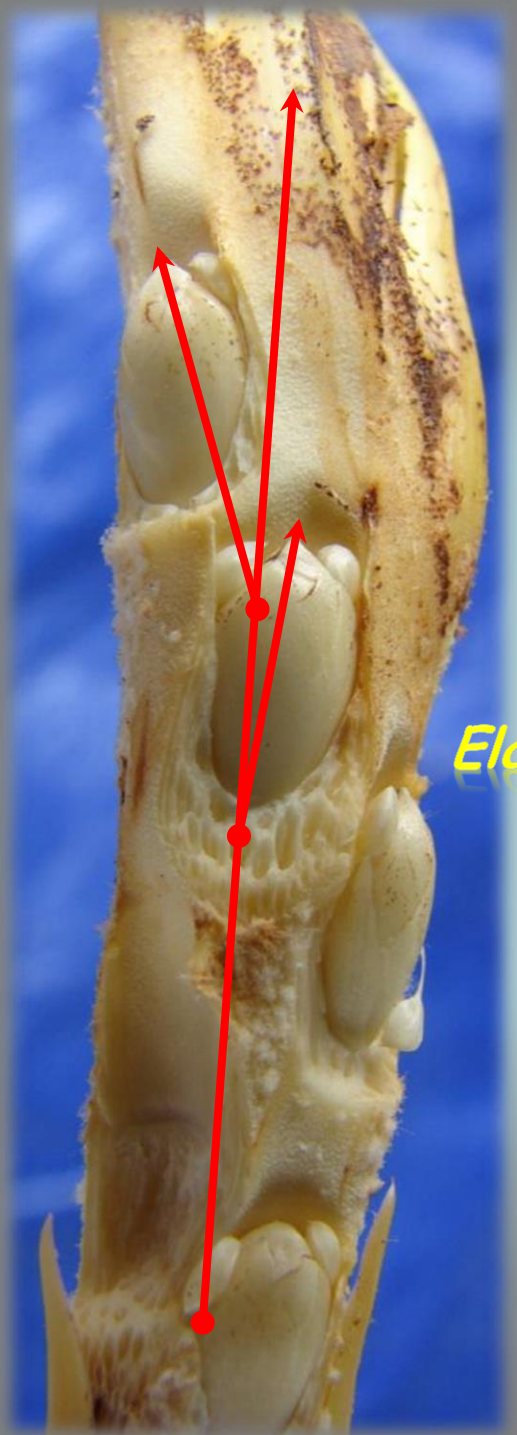


Relative length position of flower on the spikelet

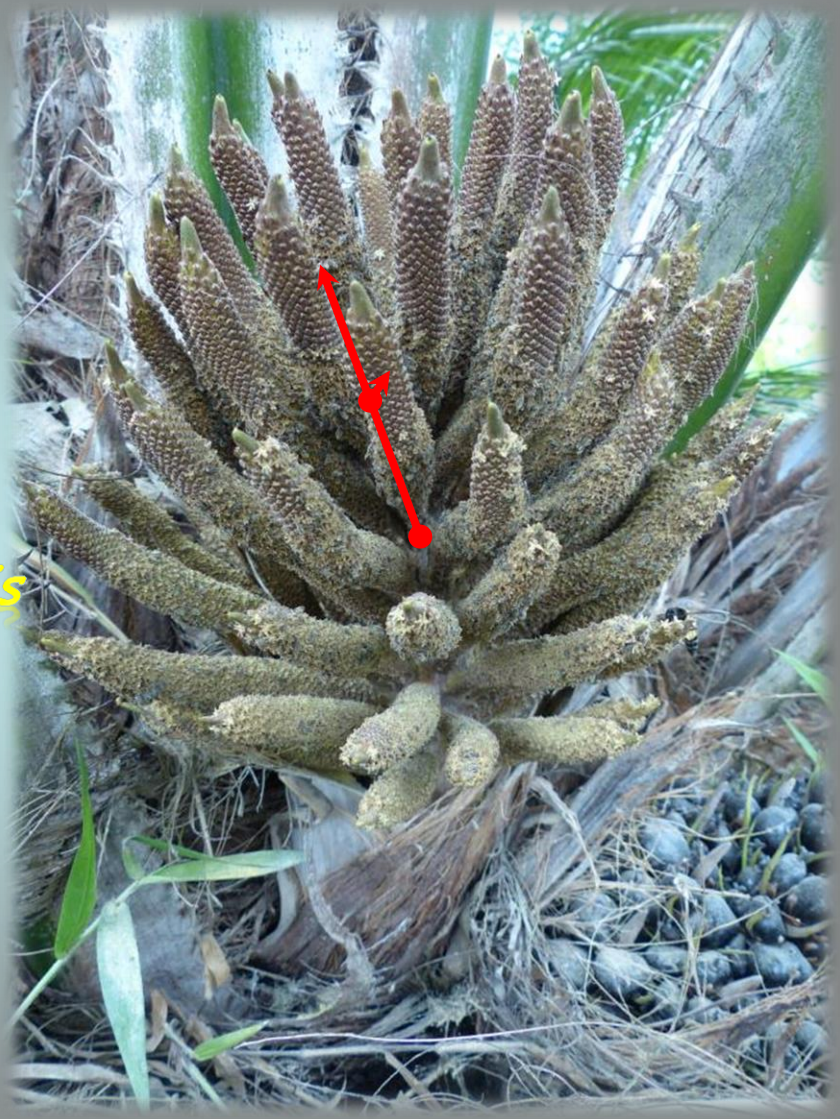
Flower axial insertion angle

Flower axial insertion angle standard deviation

Male & Female Flower Axial Insertion Angle

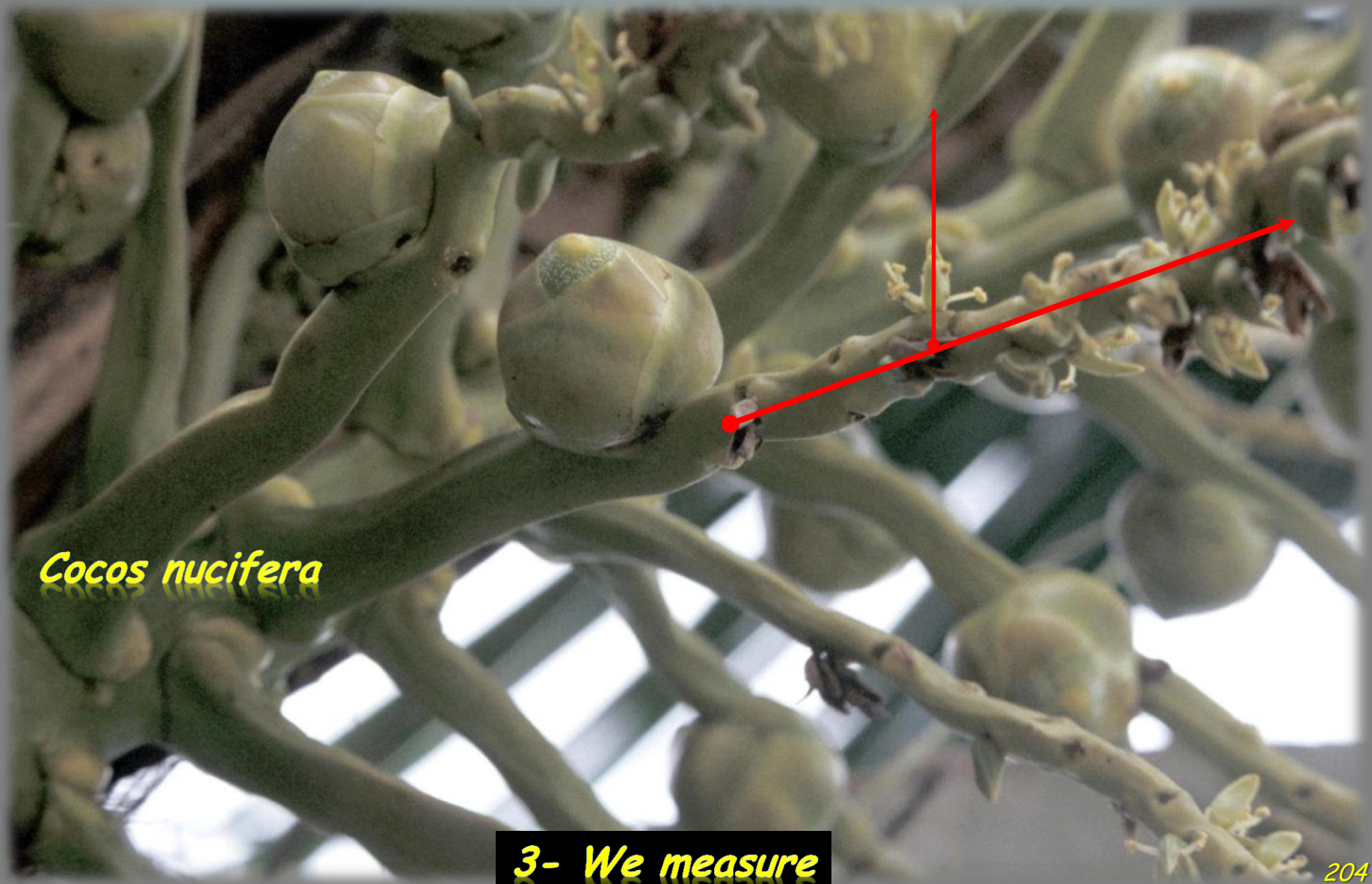


Elaeis guineensis



3- We measure

Femele & Male Flower Axial Insertion Angle



3- We measure

1- Measure Spikelet length

2- Determine flower group type (1, 2, 3 or 4 flowers)

3- Measure successive Flower's axial insertion angles

4- Protocol

FEMALE
MALE
MIXED
FLOWERS

FRUITS

Elaeis_guineensis_v2014c.xlsx - Microsoft Excel

Fichier | Accueil | Insertion | Mise en page | Formules | Données | Révision | Affichage | Compléments | Acrobat

J16

IGAP!A1

STIPE

BEARER

ORGAN

TIME

FEMALE FLOWER Then FRUIT SIZE (according to phenology)

	FEMALE FLOWER & FRUIT LENGTH					FEMALE FLOWER & FRUIT DIAMETER				
		FINAL			EVOLUTION		FINAL			EVOLUTION
		Length					Width			
Item	Position	Mean	STD	Time	Growth	Position	Mean	STD	Time	Growth
Interpolation		1	1		1		1	1		1
Nb Values		3.0	3.0		6.0		3.0	3.0		6.0
Variable Name	FemaleFlowerLength_L_2			FruitLengthEvoL_1		FemaleFlowerDiameter_L_2			FruitDiameterEvoL_1	
Unit	Pos Bearer %	Nb	%	Phyllo	Ratio	Pos Bearer %	Nb	%	Phyllo	Ratio
1	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00	1	0.00
2	20.00	3.50	0.35	11	0.00	20.00	2.50	0.10	11	0.00
3	100.00	4.00	0.40	12	0.10	100.00	3.00	0.12	12	0.10
4				17	0.20				17	0.20
5				22	0.90				22	0.90
6				32	1.00				32	1.00
7										
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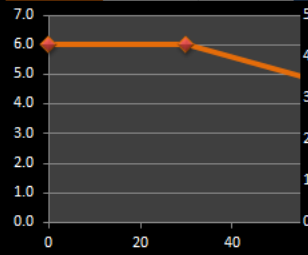

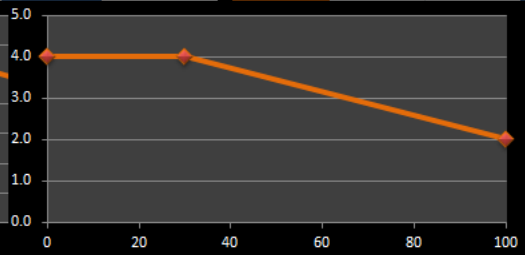

INFLO_Prod | STALK_Geom | BRACT_Prod | BRACT_Geom | SPIKELET_Prod | SPIKELET_Geom | FEMALE

Prêt

90 %

1Principes2014-5.xlsx - Micro...

A1

^IGAP!A1

FLOWER_Geom Folder

MALE FLOWER SIZE

	MALE FLOWER LENGTH			MALE FLOWER DIAMETER		
Item	Position	Mean	STD	Position	Mean	STD
Interpolation		1	1		1	1
Nb Values		3.0	3.0		3.0	3.0
Variable Name	FemaleFlowerLength_1			FemaleFlowerDiameter_1		
Unit	Pos Bearer %	Nb	%	Pos Bearer %	Nb	%
1	0.00	0.00	0.00	0.00	0.00	0.00
2	20.00	0.50	0.05	20.00	0.30	0.03
3	100.00	0.30	0.03	100.00	0.20	0.02
4						
5						
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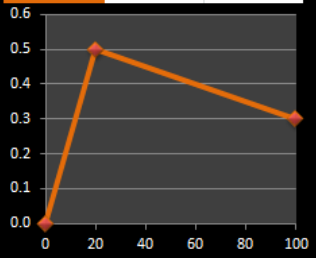
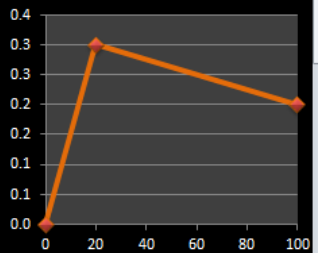




MALE_FLOWER_Prod | MALE_FLOWER_Geom | MIXED_FLOWER_F

90 %

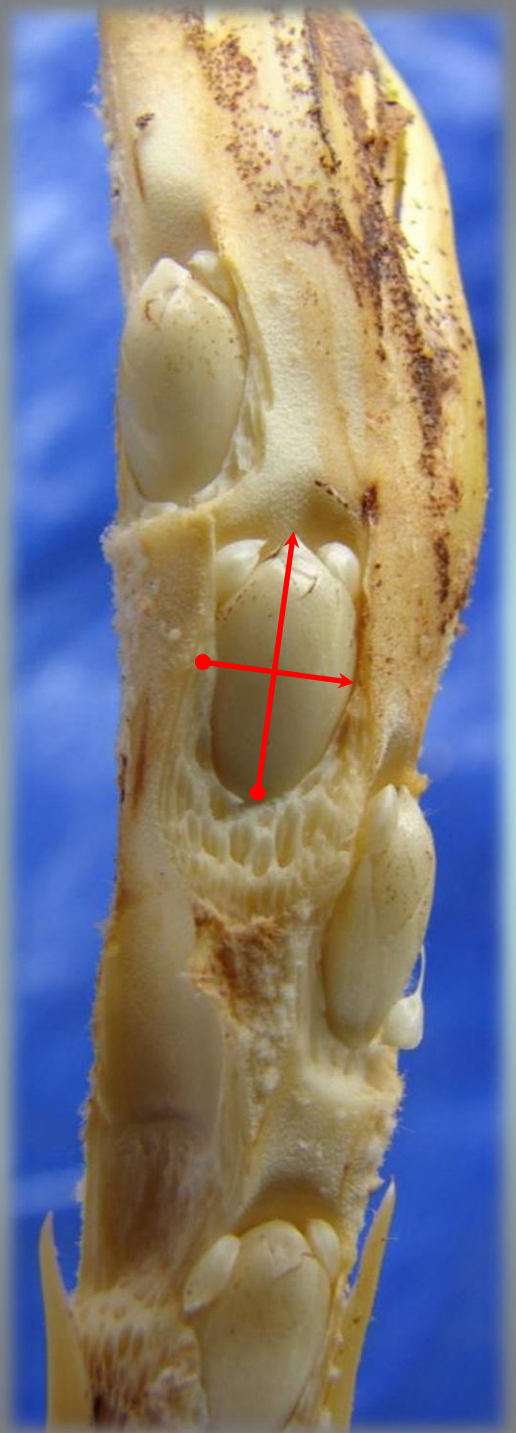
Phoenix dactylifera

Flower Length & Diameter

Flower Length & Diameter

Fruit Length & Diameter

Flower Length & Diameter

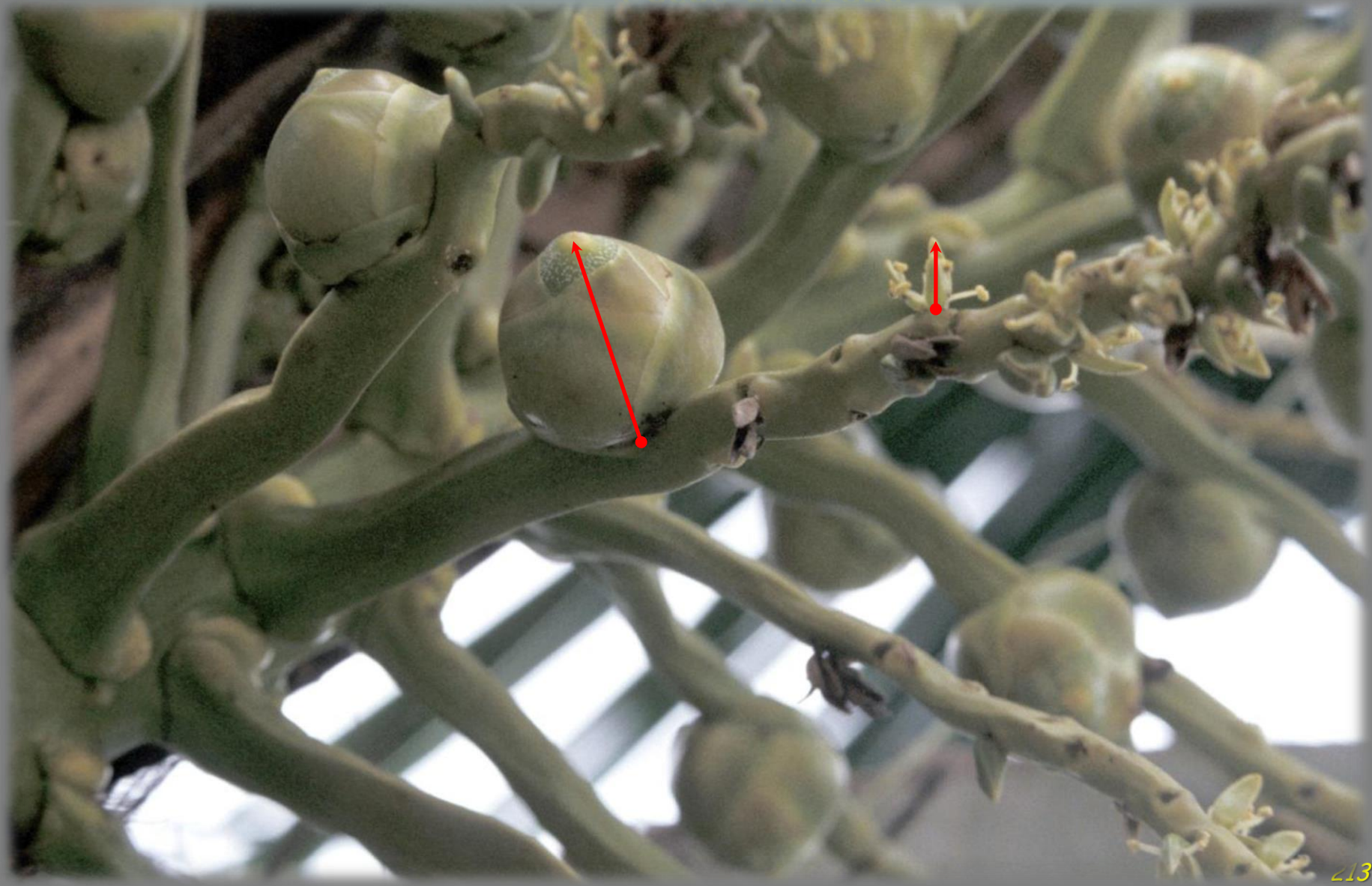


Elaeis guineensis

Fruit Length & Diameter

Flower Length & Diameter

Cocos nucifera



Fruit Length & Diameter

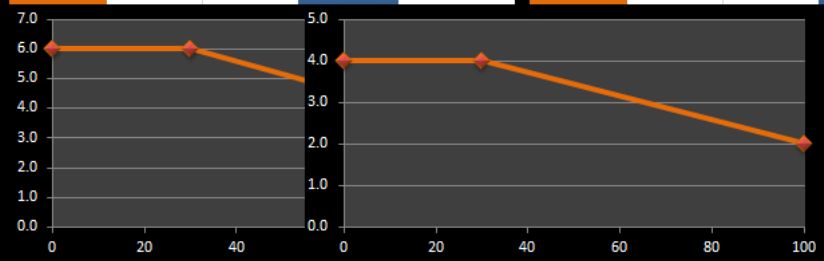
FLOWER_Geom Folder

Flower Fruit Length Diameter

Elaeis_guineensis_v2014c.xlsx - Microsoft Excel

FEMALE FLOWER Then FRUIT SIZE (according to phenology)

Item	Position	Mean	STD	Time	Growth	Position	Mean	STD	Time	Growth
	FEMALE FLOWER & FRUIT LENGTH					FEMALE FLOWER & FRUIT DIAMETER				
		FINAL Length			EVOLUTION		FINAL Width			EVOLUTION
Interpolation		1	1		1		1	1		1
Nb Values		3.0	3.0		6.0		3.0	3.0		6.0
Variable Name	FemaleFlowerLength_L2			FruitLengthEvoL1		FemaleFlowerDiameter_L2			FruitDiameterEvoL1	
Unit	Pos Bearer %	Nb	%	Phyllo	Ratio	Pos Bearer %	Nb	%	Phyllo	Ratio
1	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00	1	0.00
2	20.00	3.50	[illegible]	11	0.00	20.00	2.50	0.10	11	0.00
3	100.00	4.00	0.40	12	0.10	100.00	[illegible]	[illegible]	12	0.10
4				17	0.20				17	0.20
5				22	0.90				22	0.90
6				32	1.00				32	1.00



Relative length position of flower then fruit on the spikelet

Fruit length

Fruit length std

Time (phyllochrones)

Fruit growth (from flower initial size)

Same for diameter

2- Model


Fruit Length & Diameter
3- We measure

1- Measure Spikelet length

2- Measure flower/fruit position on spikelet

3- Measure flower/fruit length & diameter

4- Compute flower/fruit length & diameter
according to fruit location
and flower size initial conditions

Flowers & Fruits values Data Sheet Folder

Template_2012-09-27.xlsx - Microsoft Excel

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A2 ^IGAP!A1

[IGAP!A1] **Many FLOWERS & FRUITS on SPIKELET** — **FORM 11 d**

Observer Name		Date (jj/mm/aaaa)		Localisation	
Plot		Palm Id. Number		Progeny	
Frond Rank		Inflorescence Sexe		Pheno stage	
Spikelet Rank		Spikelet total Length		Spikelet sterile length	

	1	2	3	4	5	6	7	8	9	10	11
	Organ	Flower	Flower	Flower	Fruit	Flower/Fruit	Flower / Fruit	Flower / Fruit	Flower / Fruit	Flower / Fruit	Flower / Fruit
	Control Point	Length Position	Relative Length Position	Phylotaxy on spikelet	Rank	Insertion Angle	Length	Diameter	Volume	Fresh Weight	Dry Weight
Rank	Char	cm	%	degree	nb	degree	mm	mm	cm3	g	g
1	Insertion										
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											

08- Bract_Guide | 09- Stalk&Spikelet_Data | 09- Stalk&Spikelet_Guide | 10- Spikelet_Data | 10- Spikelet_Guide | 11- Spikelet&Flower&Fruit_Data | 11- Spik

Flowers & Fruits values Protocol Sheet Folder

Template_2012-09-27.xlsx - Microsoft Excel

A2 ^IGAP!A1

Step	Organ	Operating Protocole	Column Number	Observation Material	Model Parameter concerned
IGAP! A1	Many FLOWERS & FRUITS on SPIKELET				FORM 11 p
1	Spikelet	Select one Spikelet : Spikelet SAMPLING		Eyes	SEE FICHE 09
2	Spikelet	Take pictures of Spikelet according to 3 perpendicular planes after pruning from Stalk.		Photoscope	
3	Spikelet	Stick measuring tape along Spikelet.		Measuring tape	
4	Flower	Locate the first Flower scar (sterile zone length).	1	Eyes and fingers	Flower localisation
5	Flower	Measure length-position from Spikelet-base for every Flower scar along Spikelet.	2	Measuring tape	Flower distances & groups
6	Fruit	Number rank-position from Spikelet-base for every Fruit along Spikelet.	5	Scotch + feutre	Fruit probability
7	Spikelet	Measure radial insertion angle of Flower main-direction on Spikelet in order to compute phyllotaxy.	4	Trigonometric circle	Spikelet phyllotaxy
8	Flower / Fruit	Measure axial insertion angle of Flowers / Fruits on Spikelet.	6	Protractor	Flower insertion angle
9	Flower / Fruit	Measure successive Flowers / Fruits on Spikelet from Spikelet-base.		Fingers	
10	Flower / Fruit	Measure Flower / Fruit length.	7	Calliper	Flower length
11	Flower / Fruit	Measure Flower / Fruit diameter.	8	Calliper	Flower diameter
12	Fruit	Measure Fruit volume.	9	""Archimede Principle"	Fruit volume
13	Fruit	Measure Fruit fresh weight.	10	Weighing machine	Fruit Fresh Density
14	Fruit	Dry Fruit (3 ? days at 60°C).		Drier (Oven)	
15	Fruit	Measure Fruit Spikelet dry weight.	11	Weighing machine	Fruit Dry Density

08- Bract_Data / 08- Bract_Guide / 09- Stalk&Spikelet_Data / 09- Stalk&Spikelet_Guide / 10- Spikelet_Data / 10- Spikelet_Guide / 11- Spikelet&Flower&Fruit_Data / 11- Spikelet&Flower&Fruit_Guide


Danke
Gracias
Grazie
Hvala
Mersi
Obrigado
Sheshe
Shoukran
Spassiba
Terimah Kasih
Thank you