Somaclonal variations in Date Palm Tissue Culture



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Abu Dhabi UAE, 18 / 07 / 2022

Somaclonal variations

Genetic variations in plants that have been produced by plant tissue culture & can be detected as genetic or phenotypic traits

Mechanism of Somaclonal variations

1- Genetic (Heritable Variations)

- Pre-existing variations in the somatic cells of explant
- Caused by mutations & other DNA changes
- Occur at high frequency

2- Epigenetic (Non-Heritable Variations)

- Variations generated during tissue culture
- Caused by temporary phenotypic changes
- Occur at low frequency

Various types of mutations have been described in somaclonal variants, including point mutations, gene duplication, chromosomal rearrangements, and chromosome number changes. Transposable element movement and changes in DNA methylation have also been implicated as possible mechanisms behind some somaclonal variation.

Somaclonal variations in date palm plants can be permanent (genetic stable variations) or temporary (epigenetic variation).

While the genetic variations in plants are fixed and difficult to be changed, epigenetic variations are unstable and mostly result from physiological changes.

Plants with epigenetic variation normally recover with time once the causes of these physiological changes are removed

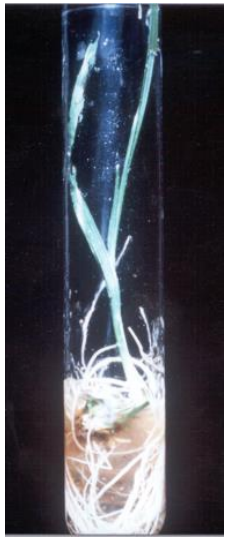
Several factors may contribute to the occurrence of somaclonal variations in tissue cultured date palm, namely:

Somaclonal Variation

- genotypical nature of plants
- type of explants used in in vitro process **Callus ?**
- conditions of regeneration of the vitro plants (Mother material, production protocol, personnel capacity, laboratory conditions …
- **Growth Regulators Auxins (2,4 D…)**
- **Long period in the lab & High number of subcultures**
- length of duration cultured tissues are kept

Date Palm Propagation

Propagation Offshoots / in vitro



Conform/True to type

Seed

No Conformity

Tissue Culture Techniques

Offshoot

Immature Inflorescence

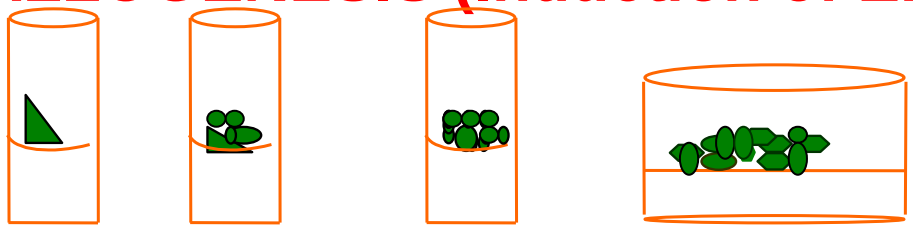
Apical Zone

Somatic Embryogenesis

Organogenesis

Somatic Embryogenesis

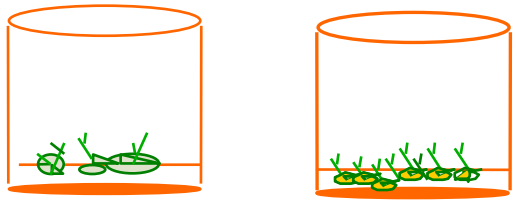
1. CALLOGENESIS (Induction of Embryogenic Callus)



4 à 5 Subcultures (6 m)

- Initiation Media : 2,4D + Activated Charocal
- Period of introduction of explants

2. GERMINATION somatic Embryos

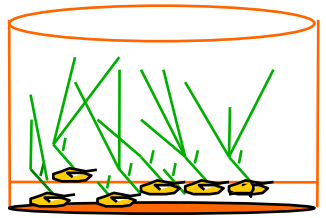


Subcultures /month

(8 à 10 months)

- Optimisation + Activated Charocal
- ANA-BAP & IPA

3. PRE-ACCLIMATATION *IN VITRO*

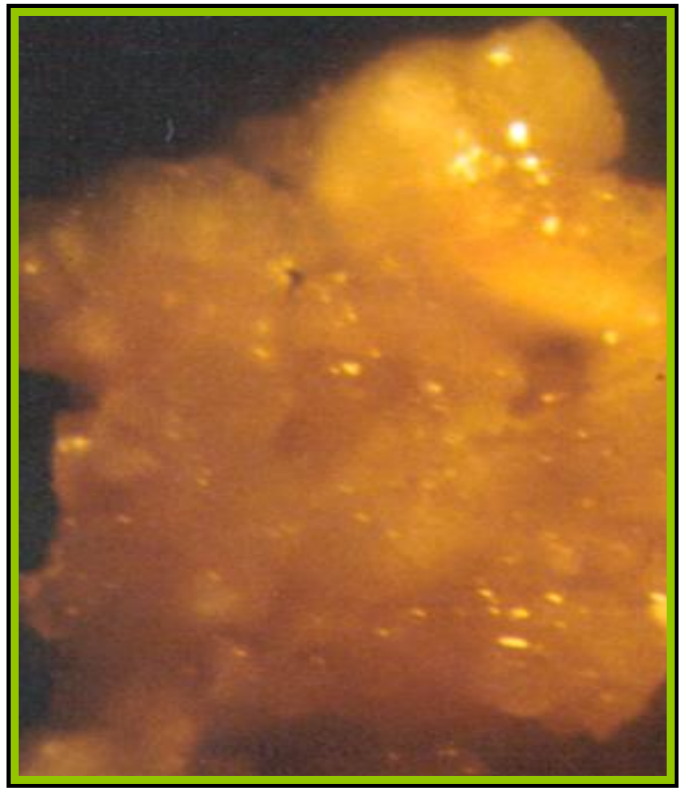


3 months

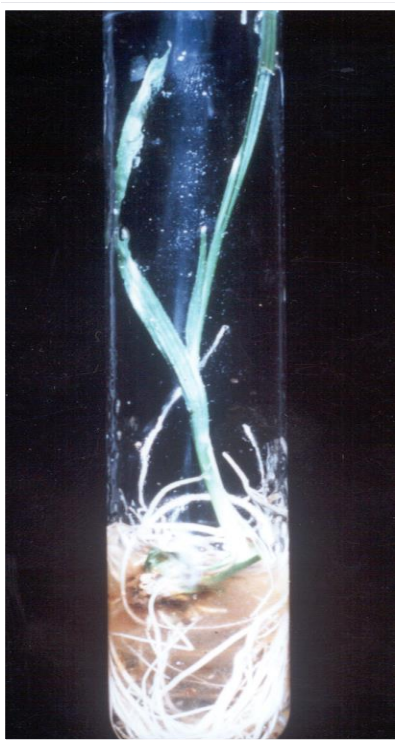
- Liquid Media + Ch.Activ + IBA
- Increase Rooting

+ - 19 months

Types of callus : Stability of date palm ?



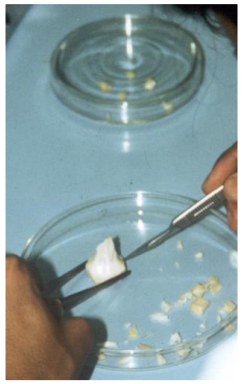
Somatic Embryogenesis (Direct & Indirect)



+ - 19 months

Organogenesis

Offshoot



Apical Zone

Devlpt Axillary buds

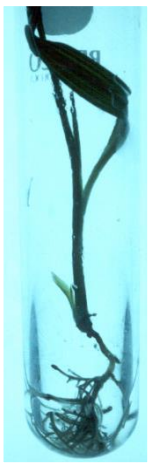
12- 8 months

multiplication

12- 14 months

Elongation

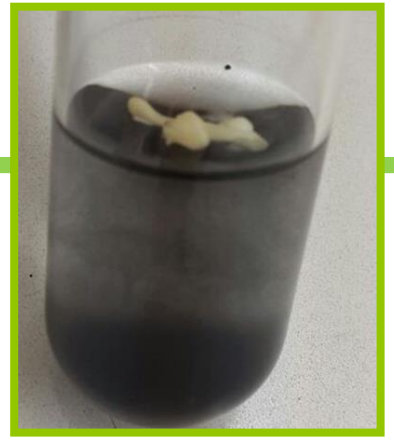
3 months



Rooting phase

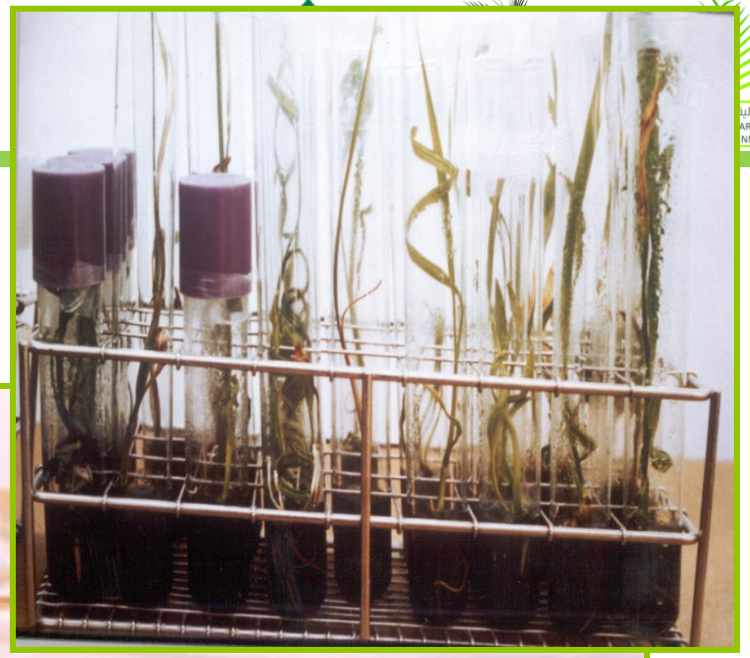
29-30 months

Immature inflorescences



Somatic Embryogenesis

Propagation



Somaclonal variation Study in Namibia

Realized when I was Chief Technical Advisor of FAO Project :

Namibia Date Production Support Programme

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Production of Barhee dates

Export of Barhee dates

Date palms from 5 tissue culture laboratories (L1 – L2 – L3 –L4 & L5) were studied

Results

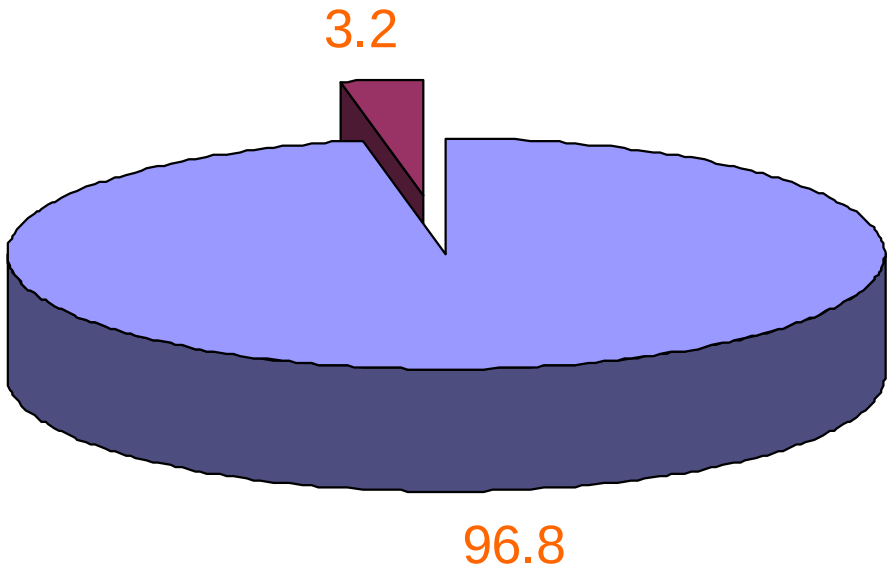
Barhee :

- All Barhee date palms morphologically analysed (1600) are coming from two laboratories (L1 and L2)

Mejhoul :

- 2700 date palms were morphologically analysed palm per palm
- 1846 Mejhool date palms were morhologically analysed coming from 5 laboratories L1 – L2 – L3 – L4 – L5

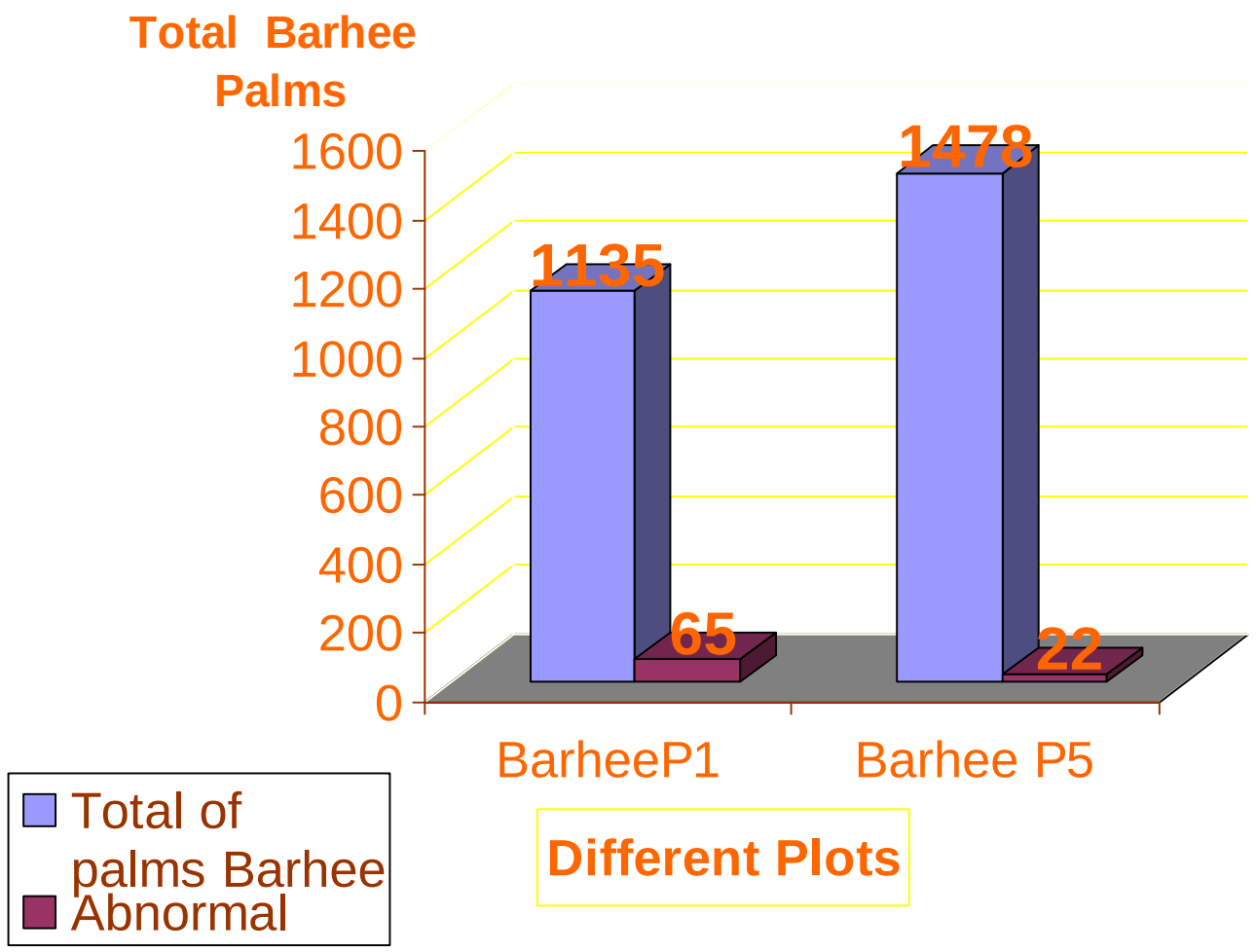
% 3.2 Genetic Variation



***low variation**

Low Economic Impact

Abnormalities of Barhee Palms analyzed



Somaclonal variation “Mejhool”

11,86%

It is to be mentioned that in Mejhool plot there was also a mixture of varieties received as Mejhool.

Results

(Laboratories : L1- L2- L3- L4- L5)

L1 (Embryogenesis) : very low Variation (< 2 %)

L2 (Embryogenesis) : Low Variation (< 3 %)

L3 (Embryogenesis) : Less than 15 %

L4 (Organogenesis) : More than 15 %

L5 (Organogenesis) : Low varaiation (< 3 %)

In Sudan & during our visits as Scientific committee of khalifa Award Festival, we estimated the somaclonal variation observed in some plantations around Khartoum to more than 20 %, especially in Mejhool plantations

RESULTS

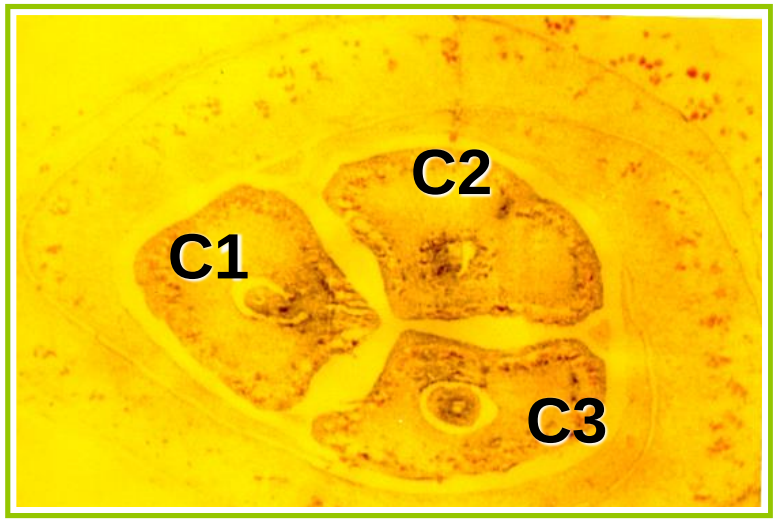
Types of Somaclonal Variation

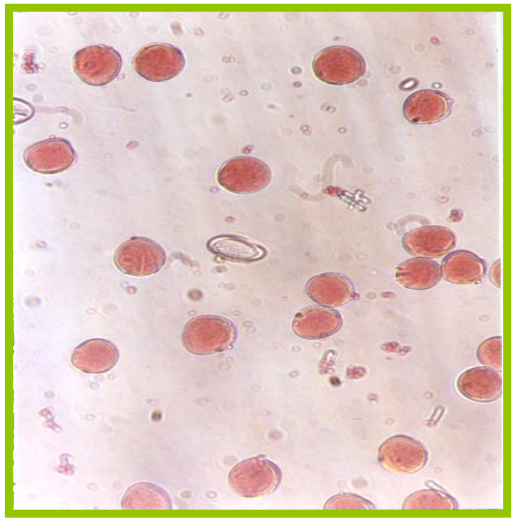
1. Failure of fruit set (Genetic variation)

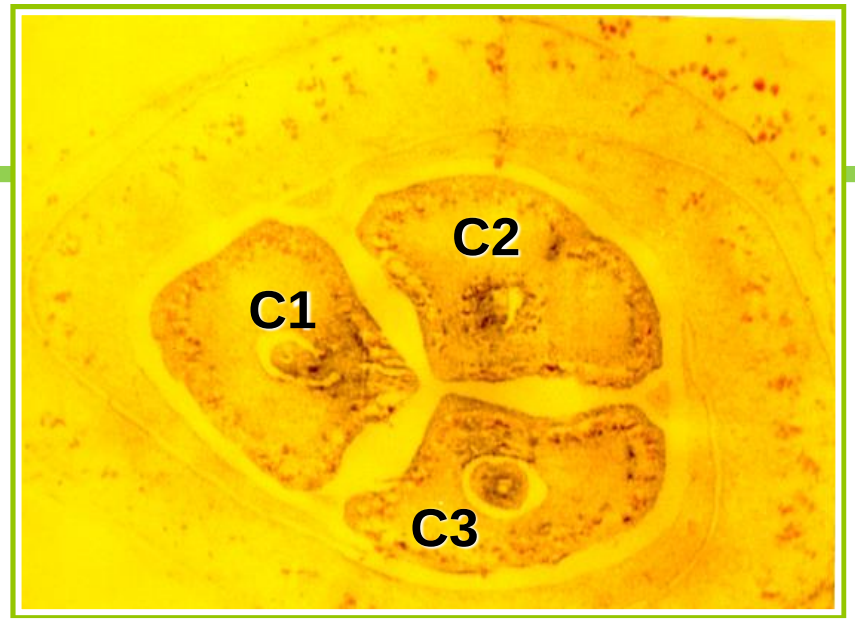
Failure of fruit set

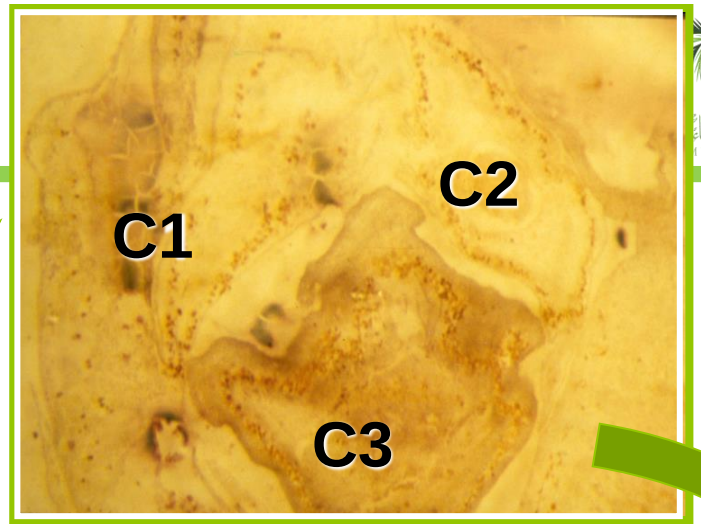
Sish – Parthenocarpic Fruits

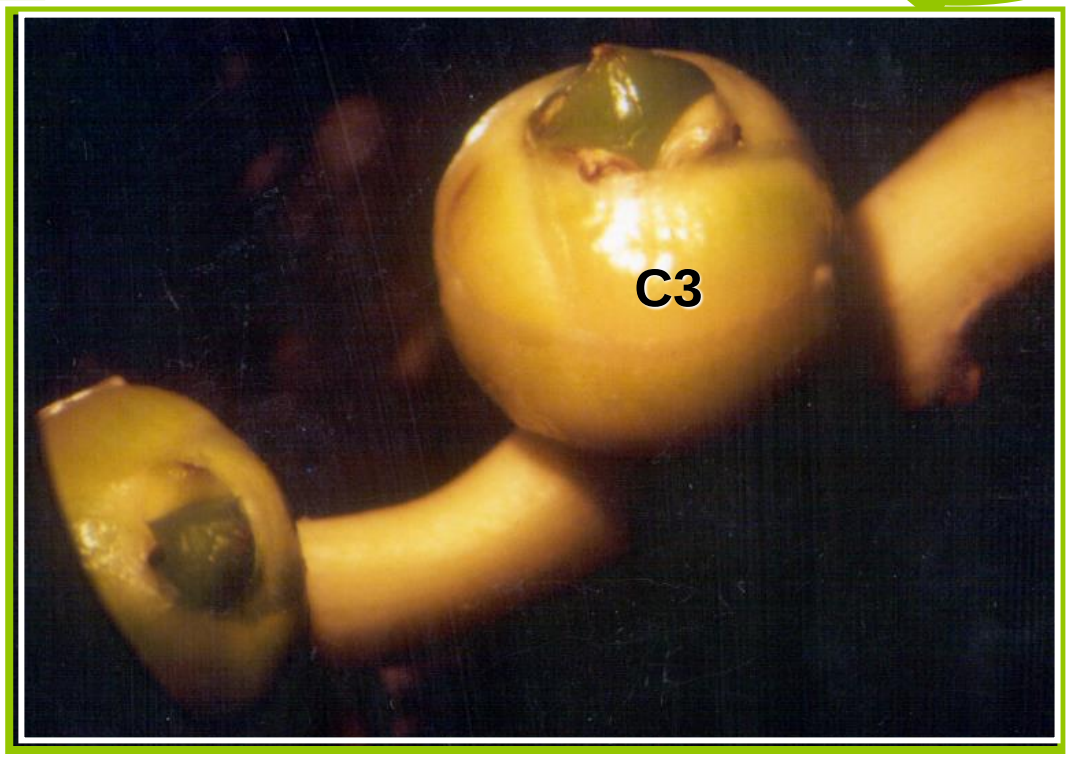
delayed flowering time

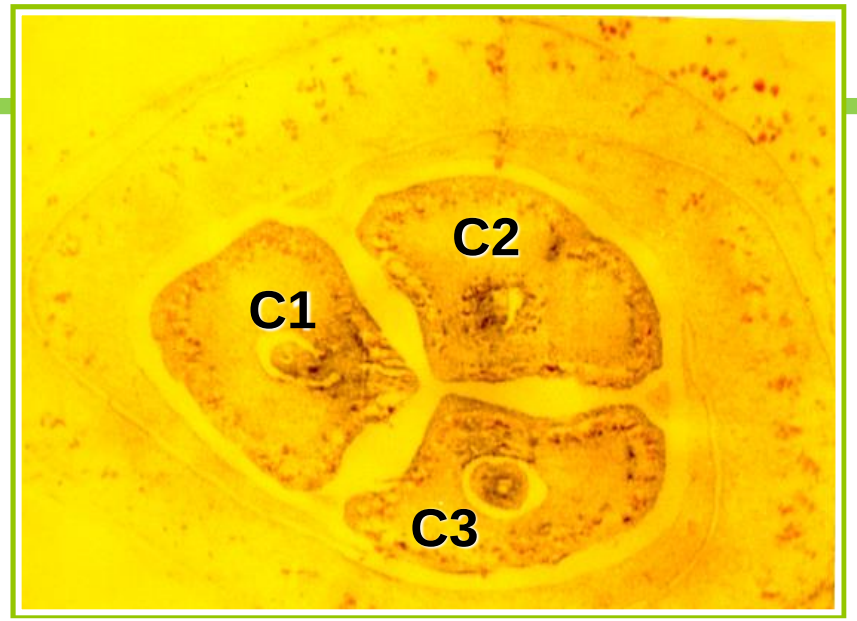

C2
C1
C3




C2
C1
C3


C1
C2
C3


C3


C2
C1
C3

1 carpel developed

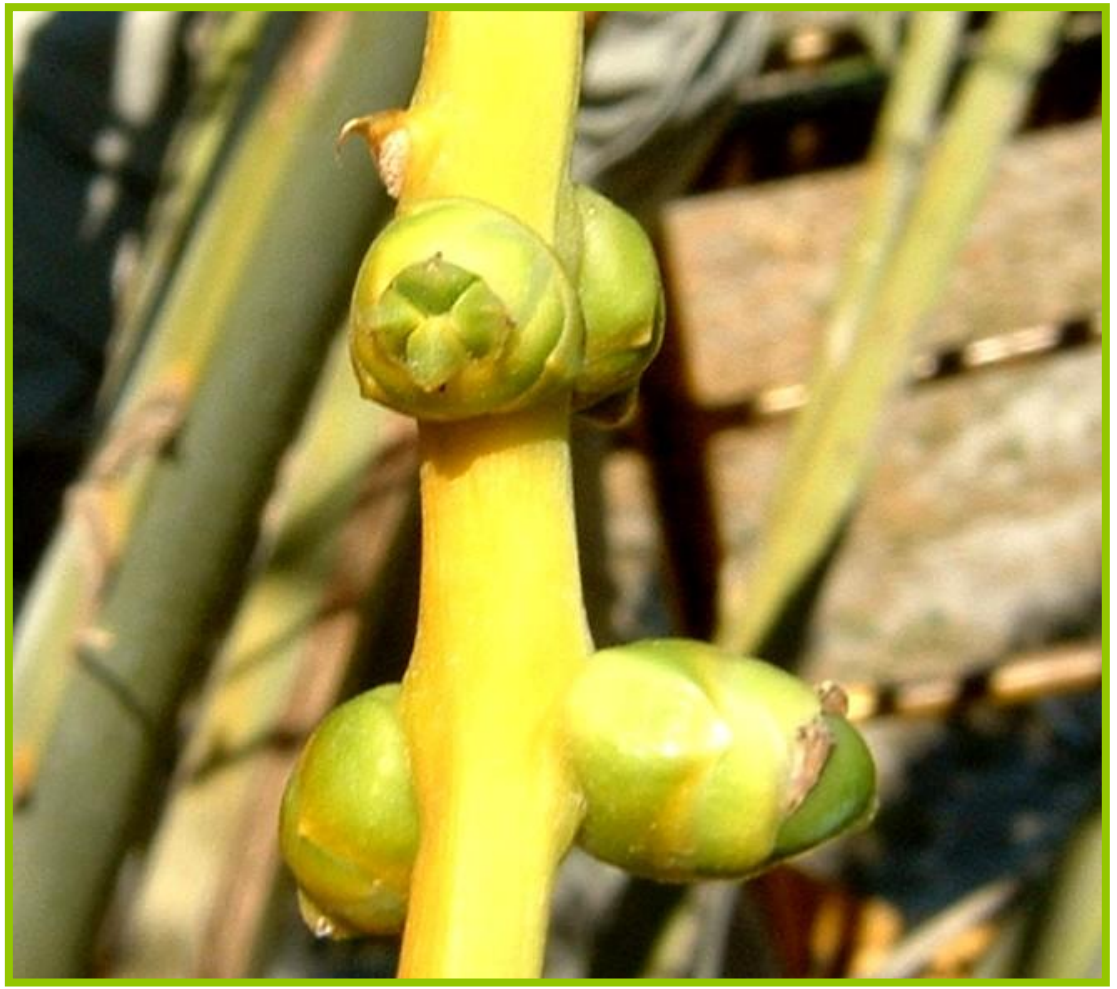
2 – 3 carpels developed

Good fruits

Parthenocarpic Fruits SISh

Multiple carpels : 3, 4, 5, 6 Carpels

Multiple carpels



Abnormal growth, size & development of leaves

Low production (Epigenetic)

Abnormal leaves

Abnormal Growth & devlopment of leaves (Genetic variation)

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No production

4 - Dwarfism

Dwarfism

Terminal bud bending

Dryness of apical bud

Off-types carrying symptoms similar to "Black Scorch" disease of Medjool cv

Albinism of leaves

high number of offshoots without inflorescence ?

twisted inflorescence

Somaclonal variation occurs because of :

-First / Laboratory & Personnel (Protocol , Errors , Nature of the explant, Lab Conditions), techniques comes in a second level

Most of commercialized date palm vitro-plants are coming from Somatic Embryogenesis, Somaclonal variation was not really explored for Organogenesis

the abnormalities of tissue culture-derived date palms are in general of a small incidence (Most of the case less than 5 % but for some laboratories more than 15%).

With the worldwide increase of potential countries coming into commercial cultivation of date palm, tissue culture is certainly the most appropriate tool to provide these countries with their needs of date palm plants.

It is highly recommended that all enterprises working with this commodity develop a safe tool that grantee a safe product to the end user (Microsatellite technique is one of the best for the moment) .

One of the important recommendation of the last workshop in Morocco was to continue the survey approach in order to well assess these abnormalities and also to carry out an international field evaluation !

After 17 years & planting of thousands/Millions of tissue culture date palm we really need to think about an international field evaluation !

References

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Thank you شـــكراً