UNRAVELING GRAFT COMPATIBILITY OF SCION/ROOTSTOCK INTERACTIONS IN PEPPER

Consuelo Penella, Ana Pina, Alberto San Bautista, Salvador López-Galarza, Ángeles Calatayud

penella_con@gva.es

Instituto Valenciano de Investigaciones Agrarias (IVIA)
1. INTRODUCTION

Why grafting technique in pepper?

- It could allow to combine desired shoot characteristics with root features to overcome environmental stresses
- It can be an adaptation environmentally-friendly strategy in agricultural production systems

**SCION**
*Capsicum spp. (annuum)*
- Commercial cultivars with desired fruit characters
- Traditional cultivars

**ROOTSTOCK**
*Capsicum spp.*

Robust rootstock
- Tolerant to environmental stresses
Handicaps

- This practice is still limited in grafted peppers plants because:
  - There are very few commercial pepper rootstock available
  - They usually are not designed to cope with abiotic stresses
  - Capsicum plants are “special” (only itself)
1. INTRODUCTION

Previous works

- More than 50 pepper genotypes were evaluated
- Accessions: A5, A25, B14 and C12 were selected through physiological measures

Penella et al., 2013. JFAE. 11, 1101-1107
Penella et al., 2014. Hort. Sci. 4, 192-200
Penella et al., 2015. Plant Sci. 230, 12-22
1. INTRODUCTION

Previous works

• More than 50 pepper genotypes were evaluated (from germplasm bank)
• Accessions: A5, A25, B14 and C12 were selected through physiological measures
• Yield experiments
1. INTRODUCTION

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Compatibility/Incompatibility?

Compatibility
- Successful graft union
- Survival and proper functioning of rootstock/scion

Incompatibility
- Failure graft union
- Lack of vascular connection
- or not fully functional connection
1. INTRODUCTION

Characterization of incompatibility

It is not a simple process

- Initial success
- Incompatible symptoms with time could be presented
  - limited vascular connection
  - development of abnormal growth patterns
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Could we characterize incompatibility? And predict it?
1. INTRODUCTION

CFI (Chlorophyll Fluorescence Imaging)

Grafting
Causes stresses

1. INTRODUCTION

CFI (Chlorophyll Fluorescence Imaging)

Grafting

Causes stresses

Cell deaths
Loss of water and solute
Disruption of the vascular system

Mechanical wounding
1. INTRODUCTION

CFI (Chlorophyll Fluorescence Imaging)

Grafting Causes stresses Mechanical wounding Cell deaths Loss of water and solute Disruption of the vascular system Activation repair mechanisms High metabolic demand

1. INTRODUCTION

**CFI (Chlorophyll Fluorescence Imaging)**

- **Grafting**
  - Causes stresses
  - Mechanical wounding:
    - Cell deaths
    - Loss of water and solute
    - Disruption of the vascular system
  - Activation repair mechanisms
  - High metabolic demand

- **Changes Photosynthesis activity**

- **Variations Fluorescence parameters**

1. INTRODUCTION

CFI (Chlorophyll Fluorescence Imaging)

1. INTRODUCTION

AIM

Evaluate the potential of CFI
• To predict compatibility/incompatibility

Connecting values of CFI
• To histological studies

Demonstrate if CFI reflects
• Morphological
• Anatomical development
PLANT COMBINATIONS

Adige/Adige (A/A)
Eggplant/S. torvum (EGG/ST)
Adige/S. torvum (A/ST)
Adige/Tomato (A/BEU)
Adige/A5 (A/A5)
Adige/C12 (A/C12)
Adige/B14 (A/B14)
Adige/A25 (A/A25)
MATERIAL AND METHODS

PLANT METHODS

Grafting

30 DAG

CFI

- Fv/Fm → indicator plant stress
- Φ_{PSII}
- NPQ
- q_p
Fv/Fm: reflects the maximal efficiency of excitation capture of dark-adapted plants and is correlated with the number of functional PSII
MATERIAL AND METHODS

PLANT METHODS

Grafting

30 DAG

CFI

• Fv/Fm
• Φ_{PSII}
• NPQ
• q_p

• Callus formation
• New cambium
• Vascular connections
RESULTS AND DISCUSSION

A/A
• Necrotic layer was absorbed
• Callus cells are clustering resembling symplastic domains

• Mean values about 0.76
RESULTS AND DISCUSSION

EGG/ST
RESULTS AND DISCUSSION

EGG/ST

- Well developed vascular graft union
- Mean values about 0.78
RESULTS AND DISCUSSION

A/A25
RESULTS AND DISCUSSION

A/A25

- Well developed vascular graft union
- Necrotic layer absorbed
- High cell proliferation at the graft interface

- Mean values about 0.78
RESULTS AND DISCUSSION

A/C12
RESULTS AND DISCUSSION

A/C12

- Well developed vascular graft union
- But with less vascular differentiation
- Mean values about 0.75
RESULTS AND DISCUSSION

A/B14
RESULTS AND DISCUSSION

A/B14

- High cellular activity
- But with less elongated cells
- Not completely vascular reconnection

- Mean values about 0.75
RESULTS AND DISCUSSION

A/A5
RESULTS AND DISCUSSION

A/A5

- Discontinuous xylem elements
- Necrotic layer

- Mean values about 0.70
RESULTS AND DISCUSSION

A/BEU

- Gaps at the graft interface
- Mean values about 0.55
RESULTS AND DISCUSSION

A/ST
RESULTS AND DISCUSSION

A/ST

- Weak unions
- Mean values about 0.42
RESULTS AND DISCUSSION

4 plants combinations were significant different:
- A/A, EGG/ST, A/A25 (a)
  - A/B14, A/C12 (b)
  - A/A5 (c)
  - A/BEU, A/ST (d)

3 plants combinations could be set up:
- A/A, EGG/ST, A/A25
  - A/B14, A/C12
  - A/A5, A/BEU, A/ST
CONCLUSIONS

CFI

Provided information on the union and represents a quick and non-invasive technique for screening (in)-compatible union in pepper

Image permits large areas of graft zones to be viewed, scion and rootstock too

It does not require sample preparation and it is not destructive or invasive

Allows the evaluation of the graft union development along the time

However, this technique does not replace systematically classical histology (in terms of understanding morphological and anatomical developments at graft interface)
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THANKS FOR YOUR ATTENTION