## Research Update: Does Rootstock Propagation Method Influence Citrus Tree Growth?

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#### **Seed propagation**







#### **Nucellar embryony**

Genetically identical embryos develop from the nucellar tissue

# Why change?

- Many seed source trees are located outside and are exposed to diseases.
- Demand for seed for the most popular rootstocks exceeds the available supply.
- No seed source trees for many of the newest rootstock varieties.

## Alternatives to seed propagation

Cuttings propagationTissue culture propagation

Like seed propagation, both methods will produce genetically uniform plants.

#### **Cuttings propagation**



Typically, single node stem cuttings are used (certified disease-free).

#### **Tissue culture (TC) propagation**



Starting material: Nucellar embryos or buds from disease-free, true-to-type plants (DPI).

## Advantages of TC propagation

- Rapid propagation of large numbers of plants.
- Plants can be propagated year-round without seasonal restrictions.
- Plants are very uniform and pathogen-free.



Major propagation tool for many fruit and nut tree rootstocks (apple, pear, cherry, peach, almond, etc.)

### **Root system differences**



#### Tap root system

#### Adventitious-type root system



# Nursery and field performance



- Inferior root system
- Excessive sprouting
- Epigenetic effects
- Higher costs

- Early year survival
- Susceptibility to windinduced uprooting
- Water & nutrient uptake



### **New budwood report information**

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ADAM H. PUTNAM COMMISSIONER	Florida Department of Agriculture and Consumer Services Division of Plant Industry SOURCE TREE BUD CUTTING REPORT Section 581.031 (3), F.S. / Rules 5B-62.005, .011(3), .012(1)(3)(7), .016, .017(1)(2)(5), .019(3), F.A.C. Section 581.031 (3), F.S. / Rules 5B-62.005, .011(3), .012(1)(3)(7), .016, .017(1)(2)(5), .019(3), F.A.C.													
Source Record	Source Tree Information Budding Record (Fill out at time of budding)									g)				
Variety – Clone	Scion		Increase	B/W Cutting	Rebuds	Topwor	Rootstock Information			Location of Use			Trees Produced	
	Location	ID #	BCR #	# Buds	`	>	Rootstock	✓ Seedling			ł	Block/House	Row/Bench	# Budded
											$\square$			
					$\square$									
					$\square$						-			
					$\vdash$	-			$\left  \right $		+			
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									$\square$		+			
					$\square$				$\square$		+			

## **Objectives**

- Study effect of propagation method on plant traits during the nursery stage
- Evaluate field performance during the early years and throughout the productive years.

## **Plant material**

Rootstock	SD	СТ	TC1	TC2
Cleopatra	$\checkmark$	$\checkmark$		
Swingle	$\checkmark$	$\checkmark$	$\checkmark$	
US-1516	$\checkmark$	$\checkmark$	$\checkmark$	
US-802	$\checkmark$	$\checkmark$	$\checkmark$	
US-812	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
US-897	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
US-942	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
X-639	$\checkmark$		$\checkmark$	$\checkmark$

## **Nursery stage**



#### Grafted field-ready plants (Valencia)

## **Root architecture**

#### Young non grafted plants



Traits assessed:

- Number of primary roots (P)Number of lateral roots (L)
- Specific root length (m/g)

## **Root architecture**

- Seed propagated rootstocks produced mostly one well-defined taproot.
- TC plants and cuttings produced many primary/ adventitious roots (4-8).
- TC plants and cuttings produced a considerably larger number of lateral roots (30-120% more) than seedlings.
- TC plants and cuttings had a higher specific root length (m/g) than seedlings.

## **Rootstock effect**

#### Young non grafted plants



## Root to shoot ratio

#### Young non grafted plants



Significant differences between plants propagated by seed, cuttings, and TC.

## What does this mean?

- Plants with a smaller root to shoot ratio and higher specific root length are generally considered very efficient in taking up nutrients and water.
- Commercial nurseries may have to adjust their management practices based on the method by which rootstock liners are produced.

#### **Field-ready Valencia trees**

Bud date: April 2017 – Analysis: Nov 2017



## Leaf area (cm<sup>2</sup>)

**Field-ready Valencia trees** 



Leaf area differences were not correlated with rootstock propagation method, but leaf area differed among trees on different rootstock varieties.

## Root to shoot ratio

#### Field-ready Valencia trees



Root to shoot ratio differences were not correlated with the propagation method, but root to shoot ratios differed among trees on different rootstock varieties.

#### **Rootstock trunk diameter**

#### Field-ready Valencia trees



# Trunk diameters differed more among trees on different rootstock varieties.

### **Field-ready Valencia trees**



### **Root size distribution**

#### Field-ready Valencia trees



Root size distribution varied with propagation method. How does this affect root anchorage?

# What are the possible implications for field performance?



#### Trees 8 months after planting (US-942)

Trees not yet affected by HLB









### Tree height (6 months)



# Tree height is larger for trees on seed propagated rootstocks in some rootstocks.

#### **Rootstock trunk diameter (6 months)**



# Rootstock trunk diameter is larger for trees on seed propagated rootstocks in some rootstocks.

#### **Rootstock trunk diameter (6 months)**



But, rootstock trunk diameters also differed among rootstock varieties.



# Root imaging with rhizotrons



#### Image analysis to assess root growth



#### **Root growth over 6 months**



Root length differs among some rootstocks.

#### **Root growth average**



Root length and growth were similar whether rootstocks were propagated by seed or tissue culture.

#### Sap flow measurement

#### 3 needle sap flow sensor







#### Ferrarezi et al.

#### Sap flow measurement



#### Ferrarezi et al.

#### **New field trials**

<u>April 2018</u> Two new field trials under commercial operation planted in Hendry County (492 trees) and in Polk County (472 trees)

## Thank you



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## Thank you



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