

Vegetative development, productivity and quality of the fruits of grafted, own-rooted and micropropagated plants from transplanting to the fifth year in field

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BACKGROUND

Hazelnut (*Corylus avellana* L.) propagation:

- Rustic species, widely cultivated in temperate regions
- **Top producers:** Turkey, Italy, Azerbaijan, USA, Chile, Georgia, China (FAOSTAT 2022).



Traditional technique

☐ Stump Layering

Easy but unreliable: unclear varietal identity, susceptible to disease risk, excessive suckering



Propagation methods

Recent techniques

- ☐ **Grafting** (English double cleft winter grafting on *Corylus colurna* L. rootstock) : no suckers, stronger roots
- ☐ **Micropropagation**: uniform, healthy, large-scale plants



OBJECTIVES

Why this study?



The main question is whether micropropagated plants behave differently, from a vegetative and productive point of view, from grafted plants and ownrooted plants, and whether they may affect the quality of the hazelnuts.

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Evaluate and compare

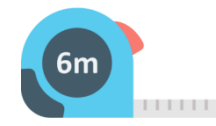
- Vegetative growth
- Productivity

Identify

- Suitable and sustainable plant types for modern hazelnut cultivation

Measurements:

- Vegetative growth
 - Plant height
 - Trunk diameter
 - GR
 - Canopy volume
- Productive performance
 - Yield
 - Kernel quality



EXPERIMENTAL SITE & SETUP



Orchard characteristics:

- 714 trees/ha, 4.0 m × 3.5 m spacing
- Single-trunk training

Management:

- Irrigated, fertilized based on crop needs and soil properties

HAZELNUT ORCHARD AT FIRST YEAR OF PLANTATION



Orchard SPLIT PLOT DESIGN

Plant number	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7
P. 25	Segorbe M. p 1	Segorbe M. p 2	Segorbe M. p 3	Segorbe M. p 4	Segorbe M. p 5	Segorbe M. p 6
P. 24	Fertil d. C. MICROPROPAGATED	Fertil d. C. OWNROOTED	T Giffoni MICROPROPAGATED	T Giffoni OWNROOTED	T Giffoni MICROPROPAGATED	T Romana GRAFTED
P. 23						
P. 22						
P. 21						
P. 20	Nocchione MICROPROPAGATED	Nocchione GRAFTED	T Gentile delle Langhe MICROPROPAGATED	T Gentile delle Langhe OWNROOTED	T Gentile delle Langhe MICROPROPAGATED	T Gentile delle Langhe GRAFTED
P. 19						
P. 18						
P. 17						
P. 16	Camponica MICROPROPAGATED	Pautet OWNROOTED	T Francescana MICROPROPAGATED	T Francescana OWNROOTED	T Francescana MICROPROPAGATED	T Francescana GRAFTED
P. 15						
P. 14						
P. 13						
P. 12	T Francescana GRAFTED	T Francescana OWNROOTED	T Francescana MICROPROPAGATED	T Gentile delle Langhe MICROPROPAGATED	T Gentile delle Langhe GRAFTED	T Gentile delle Langhe OWNROOTED
P. 11						
P. 10						
P. 9	T Romana GRAFTED	T Romana OWNROOTED	T Romana MICROPROPAGATED	T Francescana MICROPROPAGATED	T Francescana GRAFTED	T Francescana OWNROOTED
P. 8						
P. 7						
P. 6	T Gentile delle Langhe GRAFTED	T Gentile delle Langhe OWNROOTED	T Gentile delle Langhe MICROPROPAGATED	T Giffoni MICROPROPAGATED	T di Giffoni GRAFTED	T Giffoni OWNROOTED
P. 5						
P. 4						
P. 3	T di Giffoni GRAFTED	T Giffoni OWNROOTED	T Giffoni MICROPROPAGATED	T Romana MICROPROPAGATED	T Romana GRAFTED	T Romana OWNROOTED
P. 2						
P. 1						

The experiment followed a **split-plot design** with two experimental treatments:

Main thesis (first treatment):

Three types of plant material:

- OWNROOTED plants
- GRAFTED plants
- MICROPROPAGATED plants

Second thesis (second treatment):

Three Italian hazelnut cultivars:

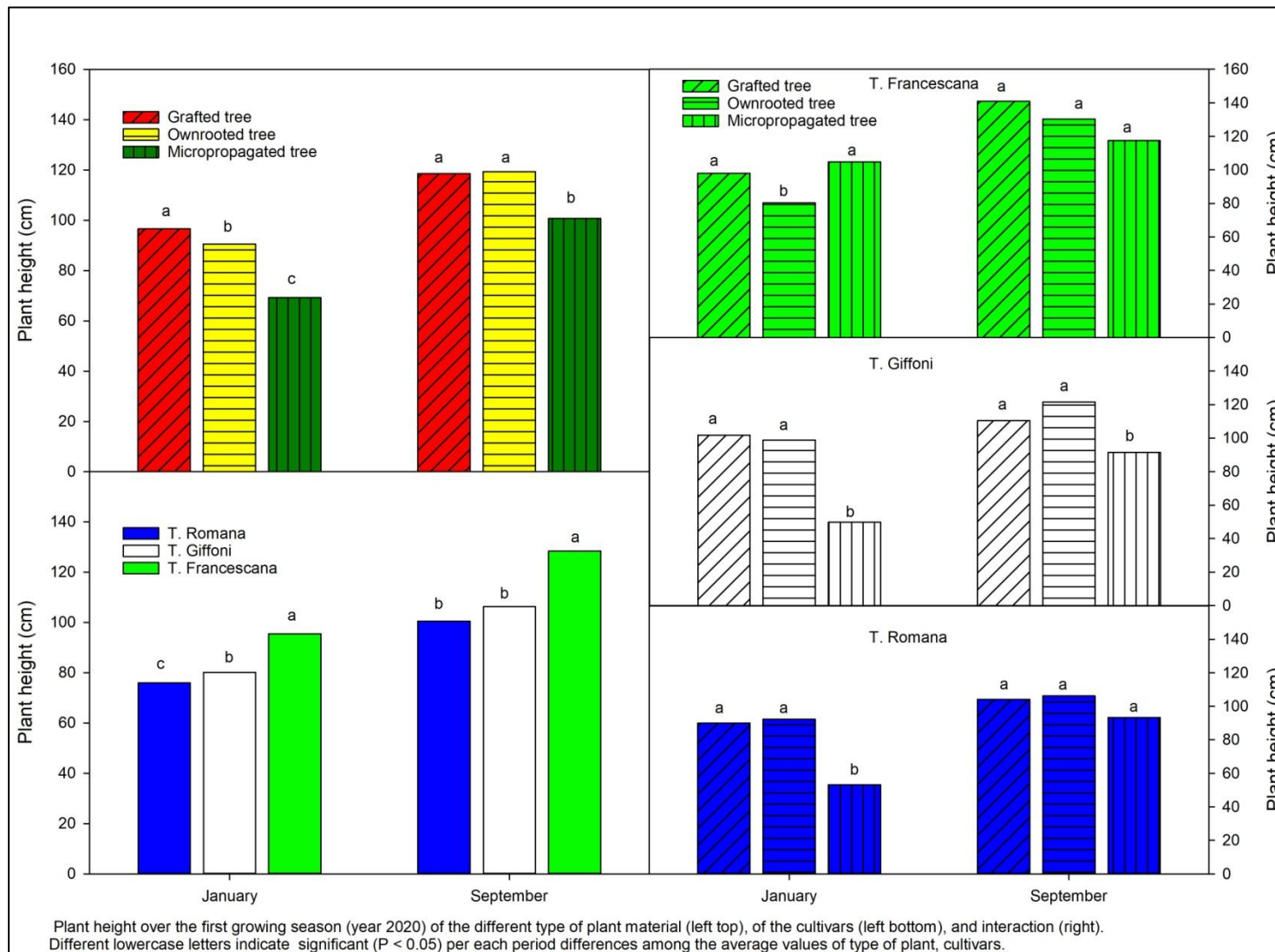
- ▶ Tonda di Giffoni
- ▶ Tonda Romana
- ▶ Tonda Franciscana®



The pollinators and the Tonda Gentile delle Langhe cultivar were not considered in the study

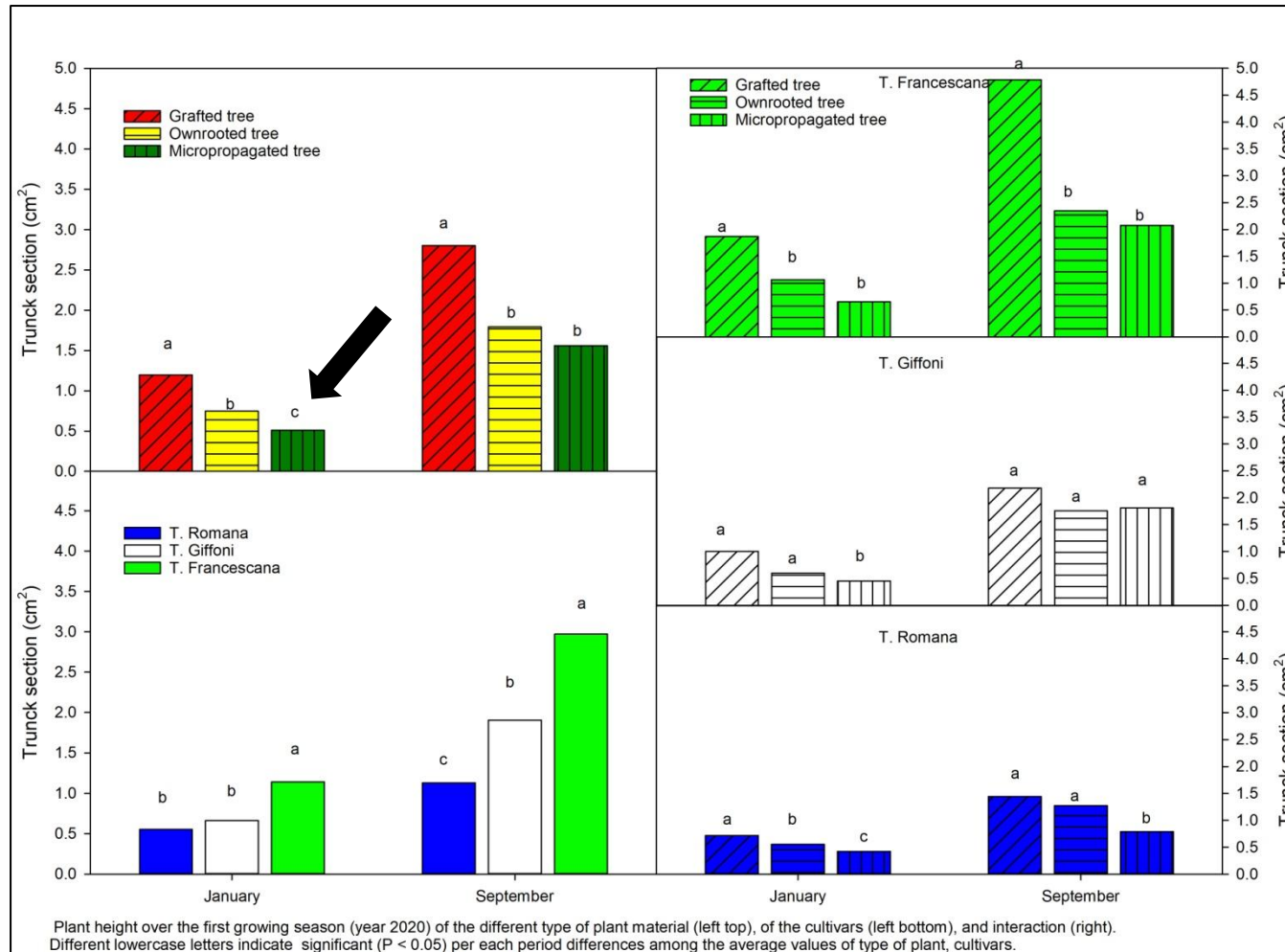


Results: PLANT HEIGHT FIRST YEAR



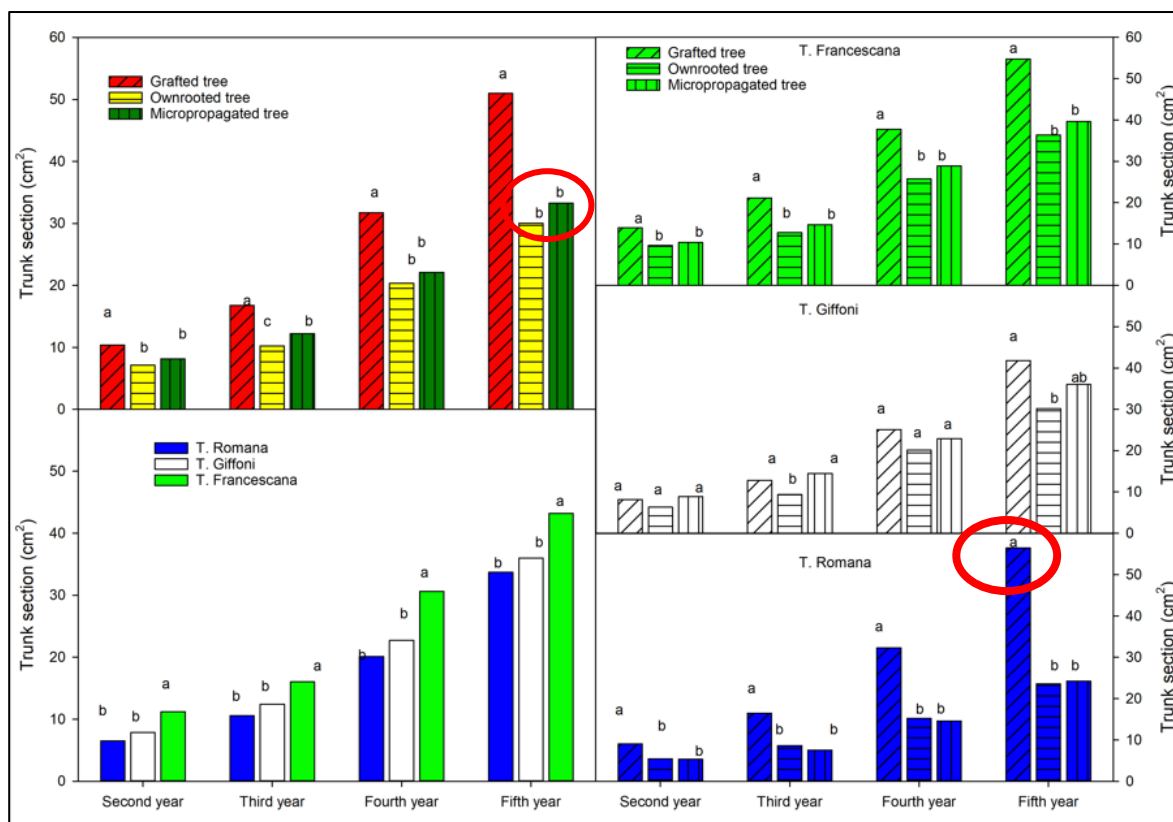
The micropropagated plants were initially smaller at the time of planting, but by the end of the first year they had caught up in height, reaching the same size as the others

Results: TRUNK DIAMETER FIRST YEAR

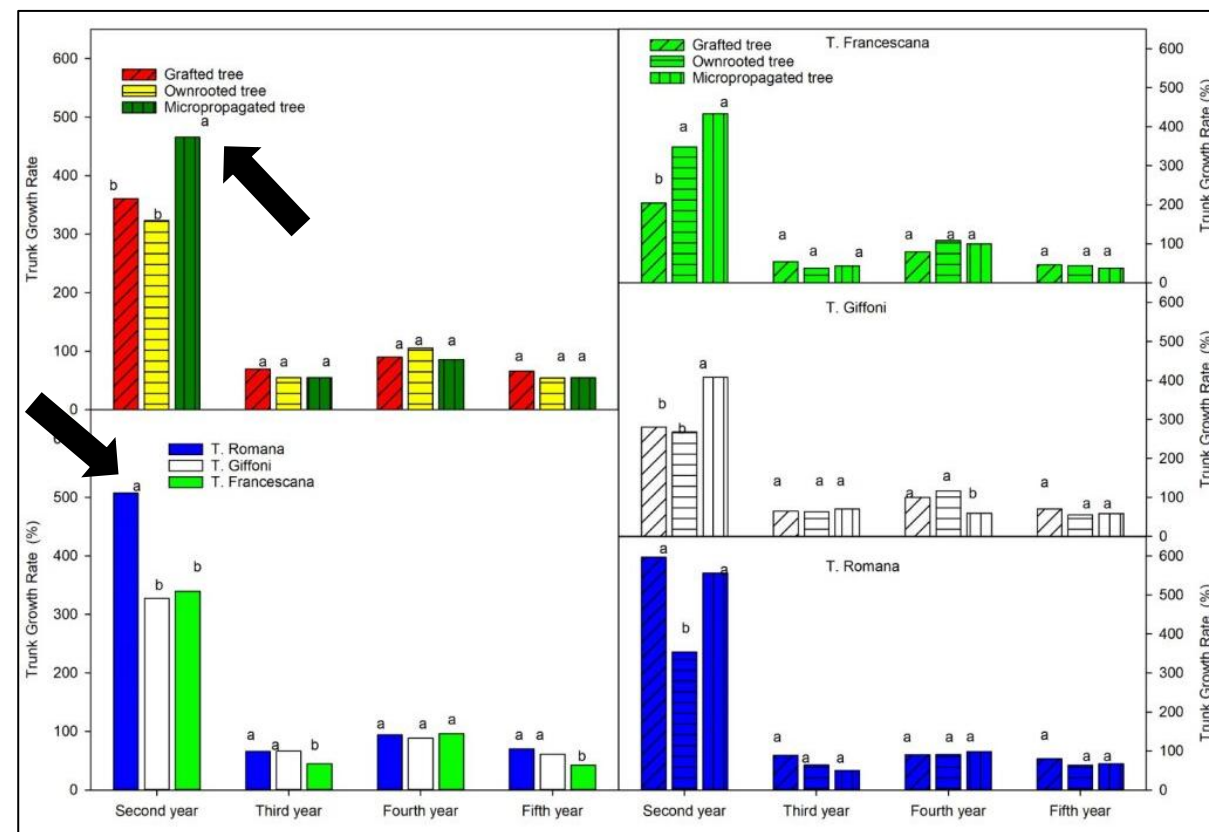


At the end of the first year, the micropropagated plants had dimensions similar to those of the other plant types

Results: TRUNK DIAMETER AND TRUNK GROWTH RATE

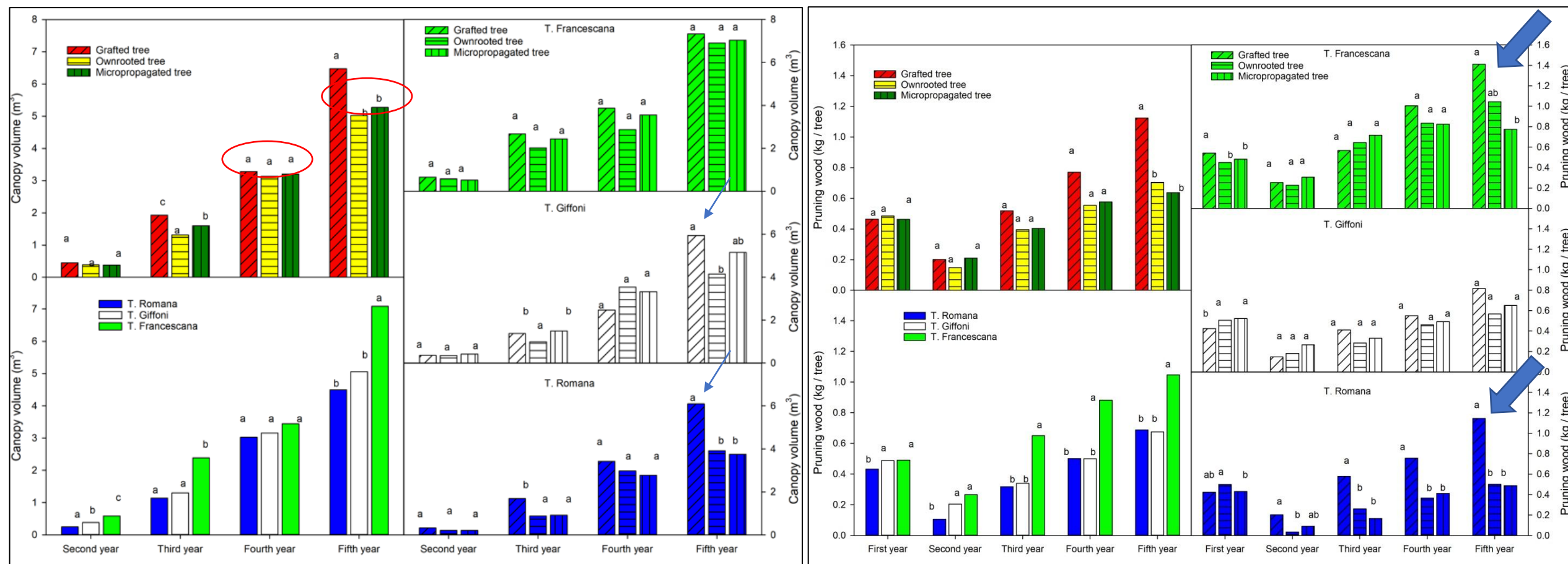


At the end of the fifth year, the trunk diameter does not show statistically significant differences between the micropropagated and own-rooted plants;



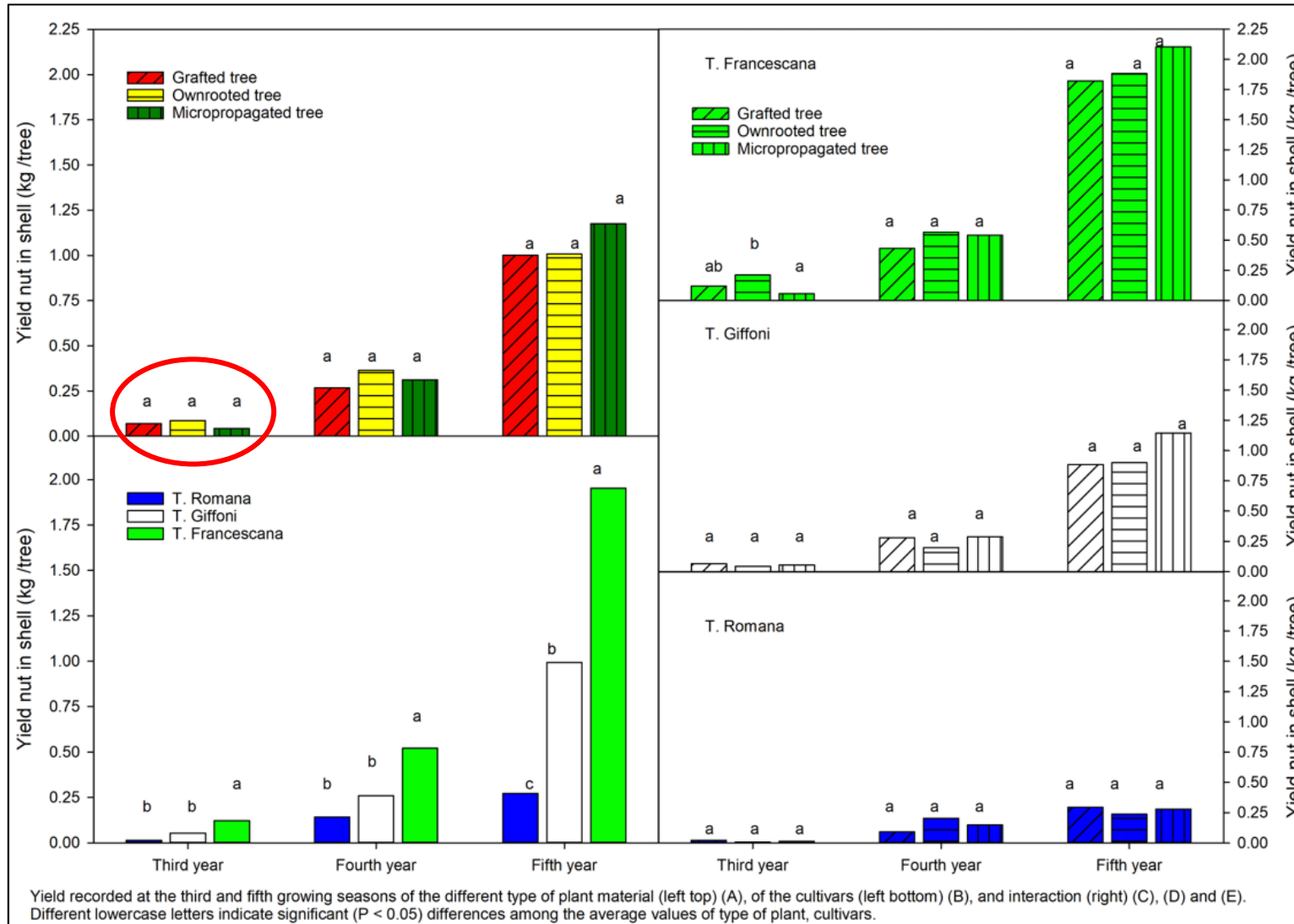
The trunk growth rate did not show significant differences, as it is identical across all plant types

Results: CANOPY VOLUME AND PRUNING WOODS

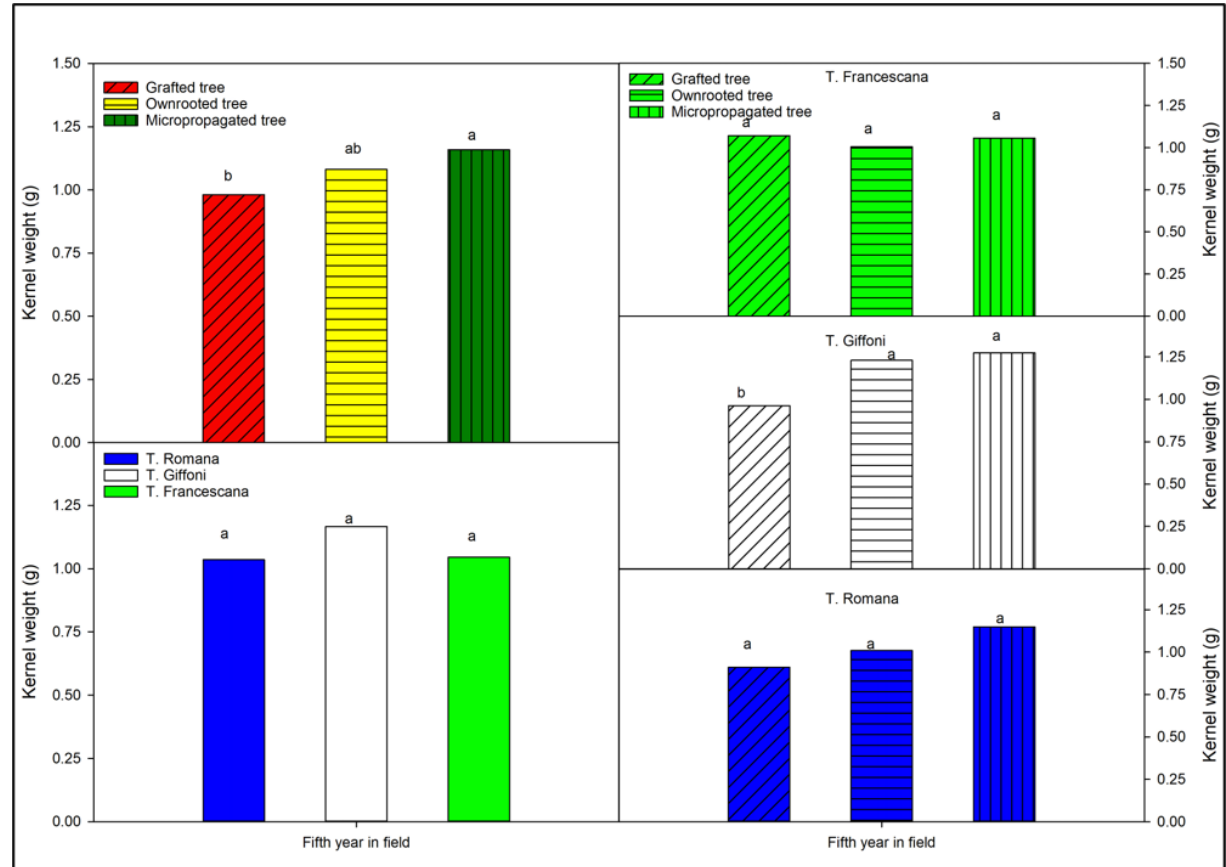
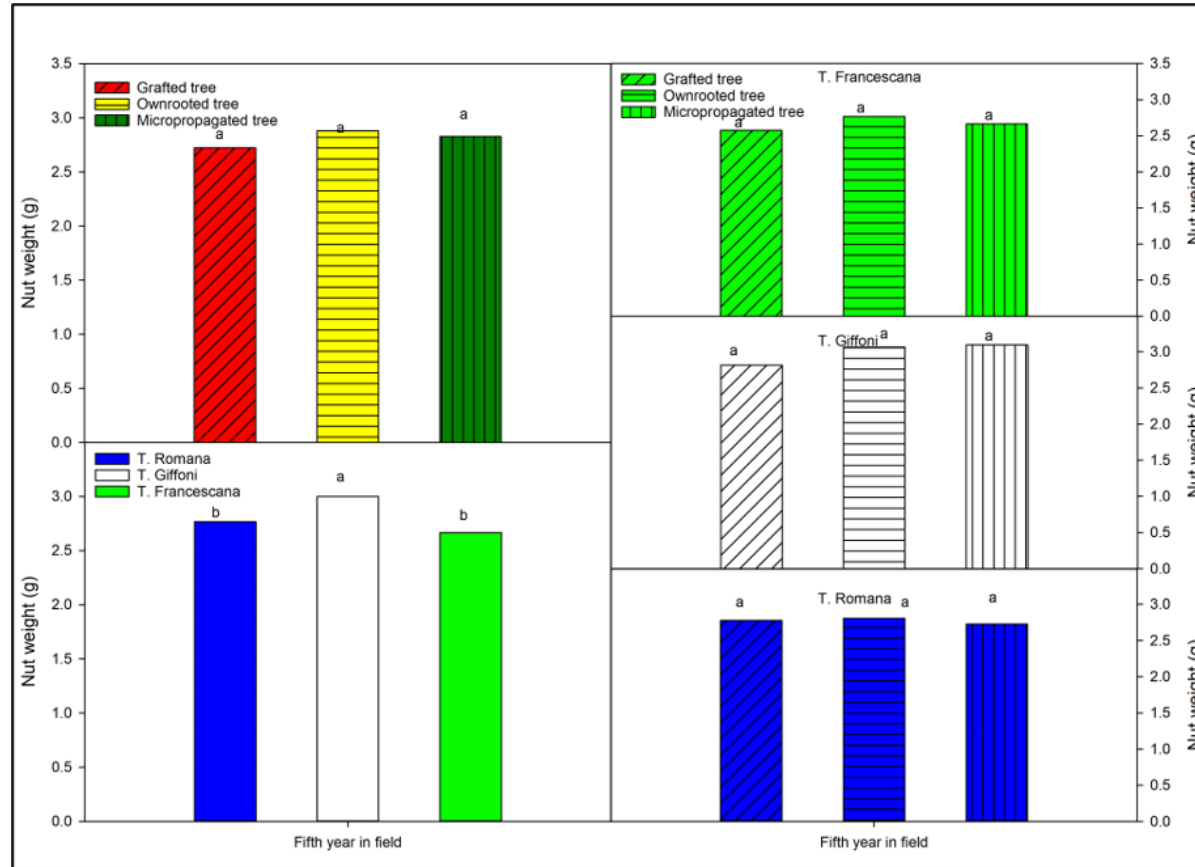


At the end of the fifth year, the canopy volume was similar in micropropagated and ownrooted plants, and biggest in grafted plants.

Results: YIELD FROM THE THIRD AND FIFTH YEAR

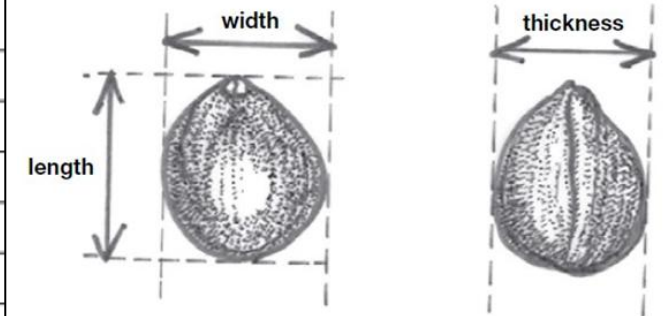


Results: NUT AND KERNEL WEIGHT



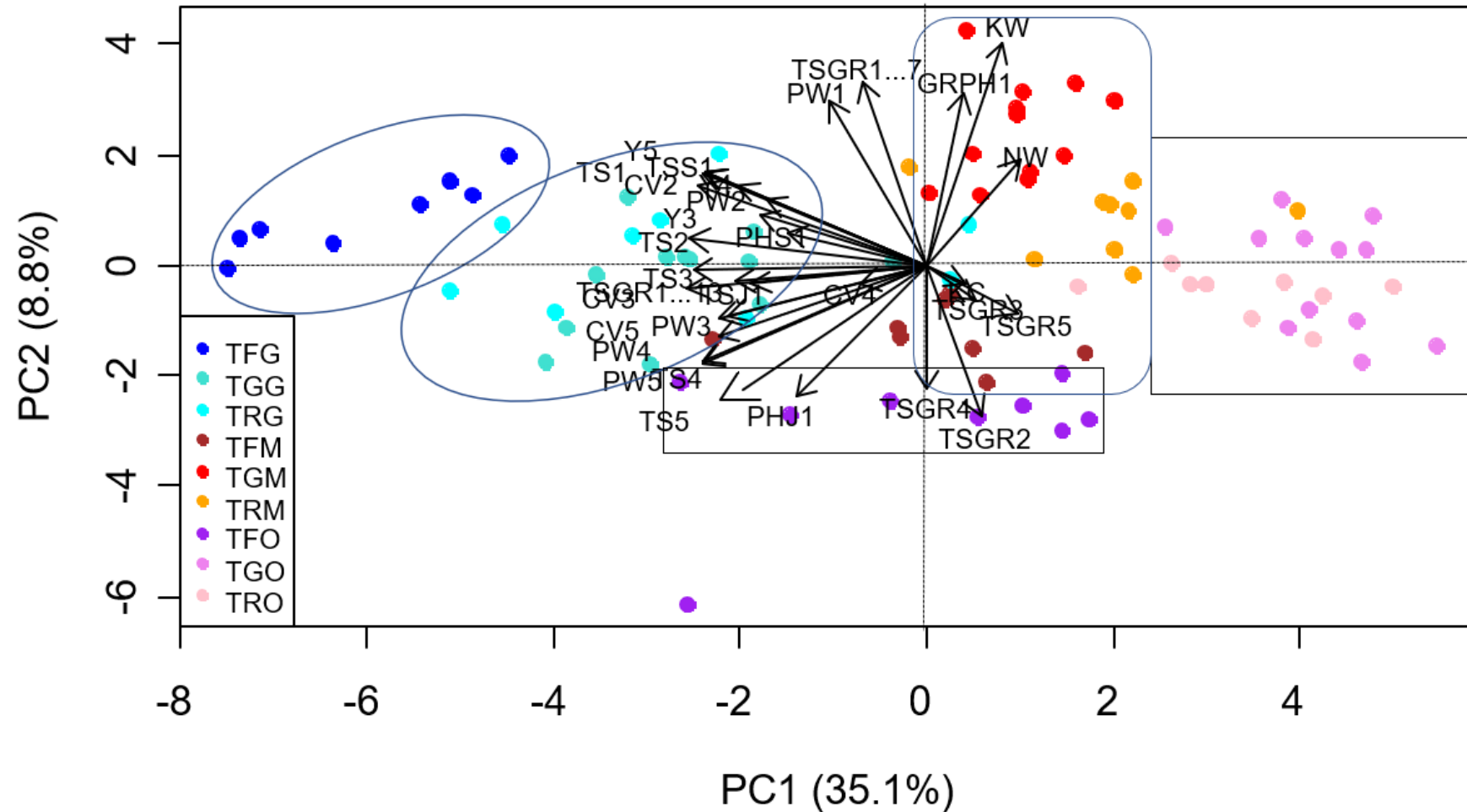
Results: NUT AND KERNEL QUALITATIVE ATTRIBUTES

Plant types	Nut width (mm)	Nut tickness (mm)	Nut length (mm)	Nut Roundness index	Kernel width (mm)	Kernel tickness (mm)	Nut length (mm)	Nut Roundness index
Grafted plant	18.8 a	17.8 a	19.3 a	0.94 a	13.6 a	13.1 a	16.6 a	1.16 a
Own-rooted plant	18.7 a	17.0 a	19.8 a	0.90 a	13.5 a	13.3 a	15.1 a	1.08 a
Micropropagated plant	18.9 a	17.2 a	21.0 a	0.91 a	13.7 a	13.9 a	15.3 a	1.09 a
T. Francescana	18.5 b	16.7 a	19.1 a	0.93 a	13.2 b	12.7 a	15.1 a	1.11 a
T. Giffoni	19.1 a	17.7 a	21.3 a	0.91 a	14.2 a	13.9 a	16.5 a	1.16 a
T. Romana	18.8 ab	17.5 a	19.9 a	0.91 a	13.4 b	13.7 a	15.3 a	1.05 a



Plant types	calibre <11 mm (%)	calibre 11 mm (%)	calibre 12 mm (%)	calibre 13 mm (%)	calibre 14 mm (%)	calibre 15 mm (%)	calibre 12-15 mm (%)
Grafted plant	1.3 a	7.7 a	20.3 b	38.0 a	23.0 a	9.8 a	91.1 a
Own-rooted plant	1.9 a	9.0 a	30.3 a	24.1 a	25.3 a	9.4 a	89.1 a
Micropropagated plant	2.6 a	8.5 a	15.2 b	32.7 a	28.9 a	12.1 a	88.9 a
T. Francescana	3.5 a	10.7 a	29.1 a	31.6 a	19.4 b	5.7 b	85.8 a
T. Giffoni	0.6 a	4.2 a	11.5 b	26.6 a	34.3 a	22.7 a	95.0 a
T. Romana	1.7 a	10.0 a	25.2 a	36.7 a	23.5 b	2.9 b	88.3 a

PCA ANALYSIS



TS = Trunk Section
 CV= Canopy Volume
 TSGR= Trunk Section Growth Rate
 PH= Plant Height
 PW= Pruned Wood
 Y= Yield
 KW= Kernel Weight
 NW= Nut Weight

1. The "Tonda Franceseana" responds better to grafting in terms of growth and yield.
2. The micropropagated Tonda Romana has a lower yield.
3. Grafted plants have a larger canopy volume, higher yield, and greater vigor, and are therefore different from other types of plants.
4. Micropropagated plants show greater growth in the first year.
5. Self-rooted plants differ in plant height and trunk growth rate in the second and fourth year.

TONDA DI GIFFONI

GRAFTED PLANT



OWNROOTED PLANT



MICROPROPAGATED PLANT



TONDA ROMANA

GRAFTED PLANT



OWNROOTED PLANT



MICROPROPAGATED PLANT



TONDA FRANCESCANA

GRAFTED PLANT



OWNROOTED PLANT



MICROPROPAGATED PLANT



Conclusions

1. Growth and Uniformity

- Micropropagated plants showed lower variability and higher initial growth rates.
- By year 4, all plants had similar canopy volumes; by year 5, grafted plants surpassed the others.

2. Tree Size and Yield

- Yield differences were linked to tree size, especially in early years.
- Similar patterns have been observed in peach between grafted and own-rooted trees.

3. Early Production and Juvenility

- Micropropagated plants showed no delays in flowering and no juvenile effects.
- This confirms their suitability for establishing uniform, high-performing orchards from the start.



THANK YOU FOR YOUR ATTENTION!

Chiara Traini, PhD student