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SUMMARY TRIAL REPORT

Research carried out by
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TerraCottem®'s effect on biomass production in vermiculite and perlite tomato seedbeds and on the WRC of these seedbeds.

At the Institute for Mediterranean and Subtropical Horticulture "La Mayora" (IHSM-CSIC), a research station from the University of Málaga, Spain, trials were carried out on vermiculite and perlite tomato seedbeds. Professor María Remedios Romero Aranda says: "*These substrates are used because they are inert and nutrition and development of plants can be perfectly controlled, but have a serious problem which is that over time are compacted and lose air content and water retention capacity. That's why I wanted to test the behaviour of TerraCottem® on these substrates*." Prof. Aranda was a bit sceptical about the fact that hairs from the plants roots would be strong enough to penetrate the polymers and access their water content.

Trial work done at La Mayora

1. Trial set-up

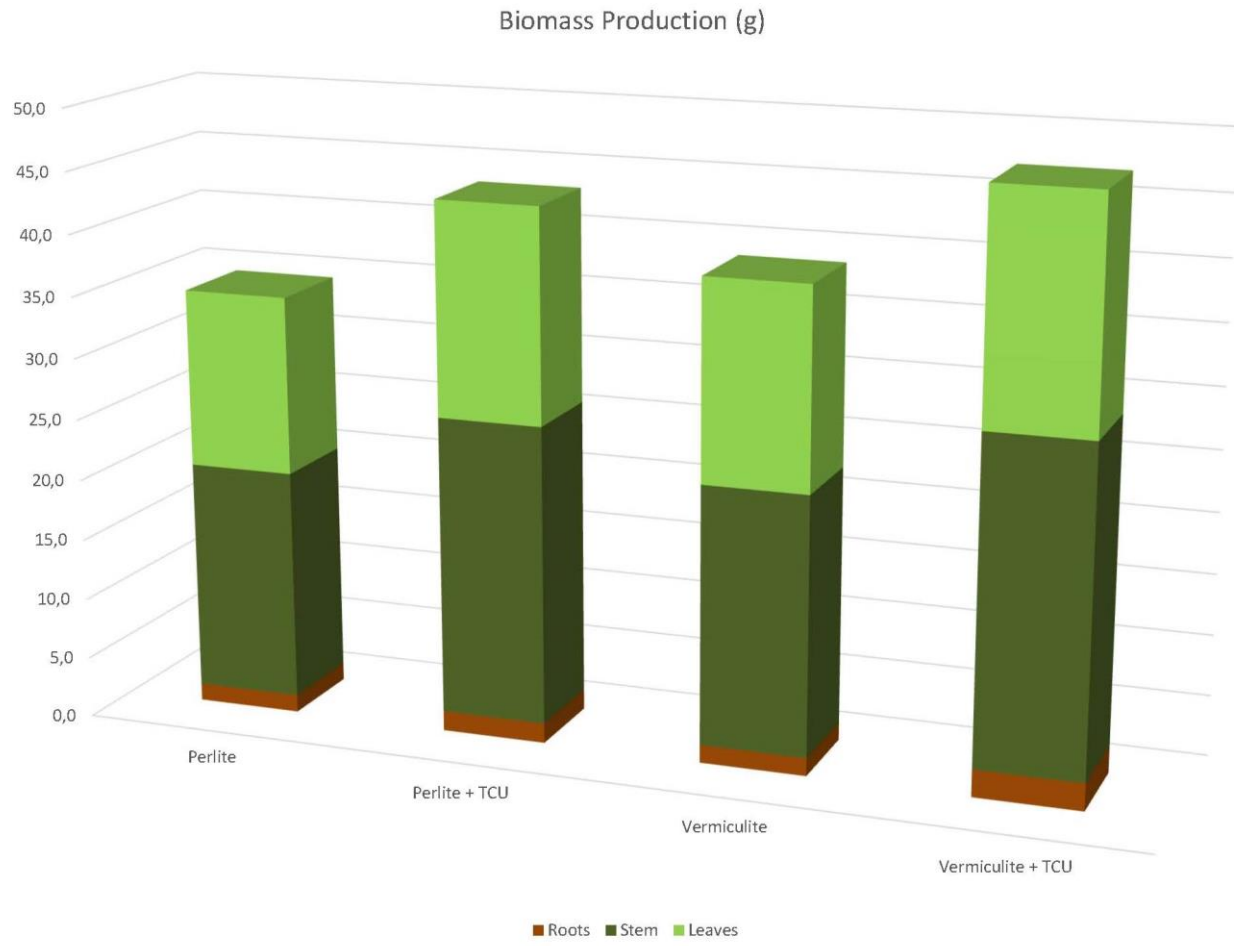
- 4 treatments, with 5 replicates each = a total of 20 containers:
  - Vermiculite;
  - Vermiculite + TerraCottem® Universal;
  - Perlite;
  - Perlite + TerraCottem® Universal;
- Containers: Ø18cm – Volume 3.7l
- TerraCottem® Universal application rate: 6g/l or 18g/container;
- Tomato seeds:
  - cv *moneymaker*;
  - Pre-germination at 25 ºC: April 5th 2016;
  - Transplant to containers: April 13th 2016;
- Timing:
  - Start: April 13th 2016;
  - End: June 23rd 2016;

2. Objectives

- ✓ To study the effect on biomass production (leaves – stem – roots) of TerraCottem® Universal in the vermiculite and perlite substrate.
- ✓ To analyse the water retention capacity in 2 substrates (vermiculite and perlite), with and without TerraCottem® Universal.
- ✓ To confirm the claim that the root hairs are able to penetrate the hydroabsorbant polymers and access the stored water.

3. Results

3.1 Biomass production



The addition of TerraCottem® Universal resulted in an increase in biomass production in both the vermiculite and perlite substrate. This increase was observed in both the underground (roots) as in the above-ground growth (leaves and stem):

	Leaves	Stem	Roots
Perlite	**+20,1%**	**+29,6%**	**+15,4%**
Vermiculite	**+13,7%**	**+25,4%**	**+52,1%**

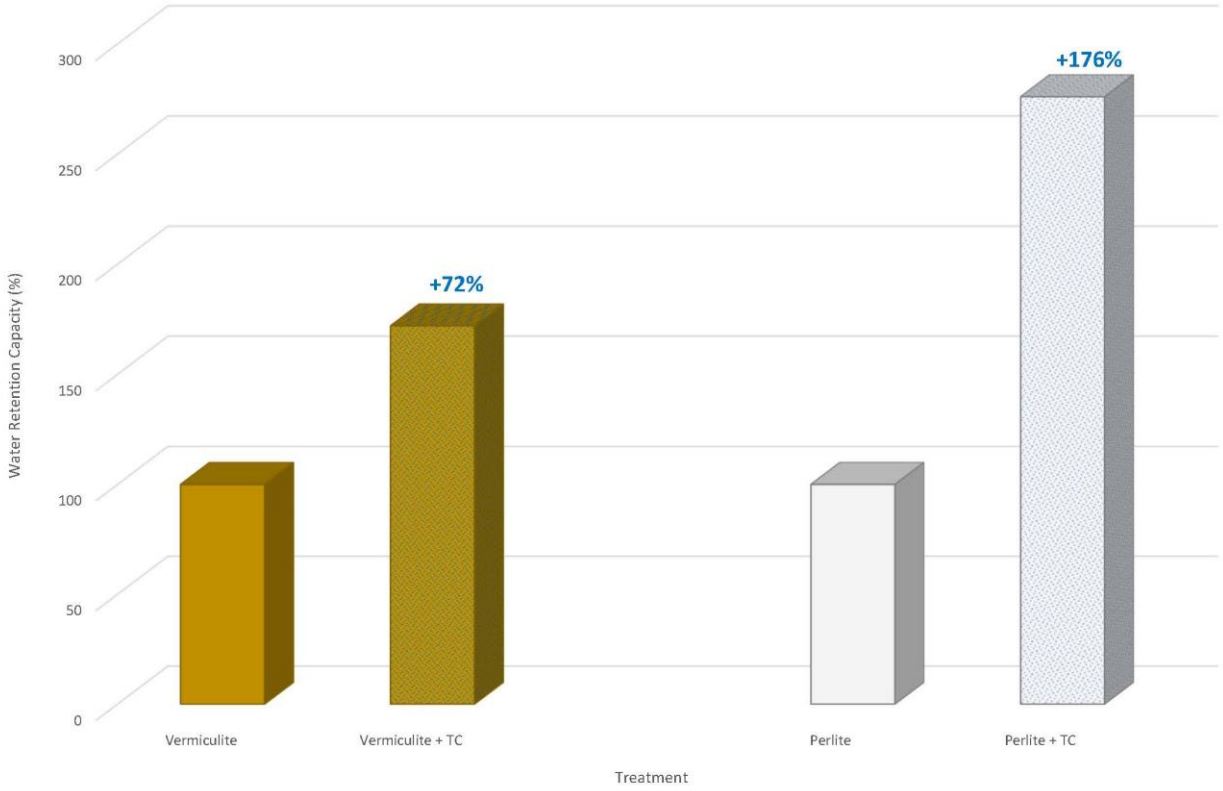
Professor María Remedios Romero Aranda:

The results show a significant effect on leaves and stems development.

Fig. 1 *Biomass development without (left) and with (right) TerraCottem® Universal*

"It would be of great relevance for the production sector, to determine the impact of the amendment on the yield and quality of the harvest, since more than 95% of the fresh weight of the tomato fruits is water. It is expected, that a plant with better leaf water status will be better able to cope with the high evaporative demands in times of high radiation and high temperatures typical inside the Mediterranean greenhouses."

3.2 Water Retention Capacity



<u>Professor María Remedios Romero Aranda</u>:

"*Based on previous studies, we started from the knowledge that the water retention capacity is higher in vermiculite than in the perlite.*

Pots were irrigated abundantly to ensure a water supply greater than the field capacity of the substrate. Once all the excess water provided in the irrigation had been drained, the pots were weighed at 24, 48 and 72 hours.

> *The results obtained show that 3 days after the irrigation, the amount of water in both substrates with TerraCottem® amendment, was about 60% higher than the amount of water retained in the substrates without amendment.*

On the other hand, versus controls, TerraCottem® Universal increases by 72% the water content of the perlite substrate and by 176% when the amendment is applied to the vermiculite substrate.

Therefore, the effectiveness of the amendment in retaining water depends on the characteristics of the substrate. In the future, a comparative study of the water retention capacity of different substrates subjected to the amendment could be addressed. With continuous recording probes (GS3 type), the evolution of the volumetric water content in the different substrates subject to amendment would be recorded. This information would allow to determine the most appropriate irrigation regime for each crop, considering measures of physiological variables related to the plant water status (leaf water potential, stomatal conductance to water vapour, foliar transpiration rate)."

3.3 Penetration of hydroabsorbant polymers

At the end of the trial, the roots were washed and subsamples were taken at random. These were stained with 5% toluidine blue. The images were taken using a stereomicroscope (Leica, model IC80 HD) connected to a PC that allowed digital capture of the images.

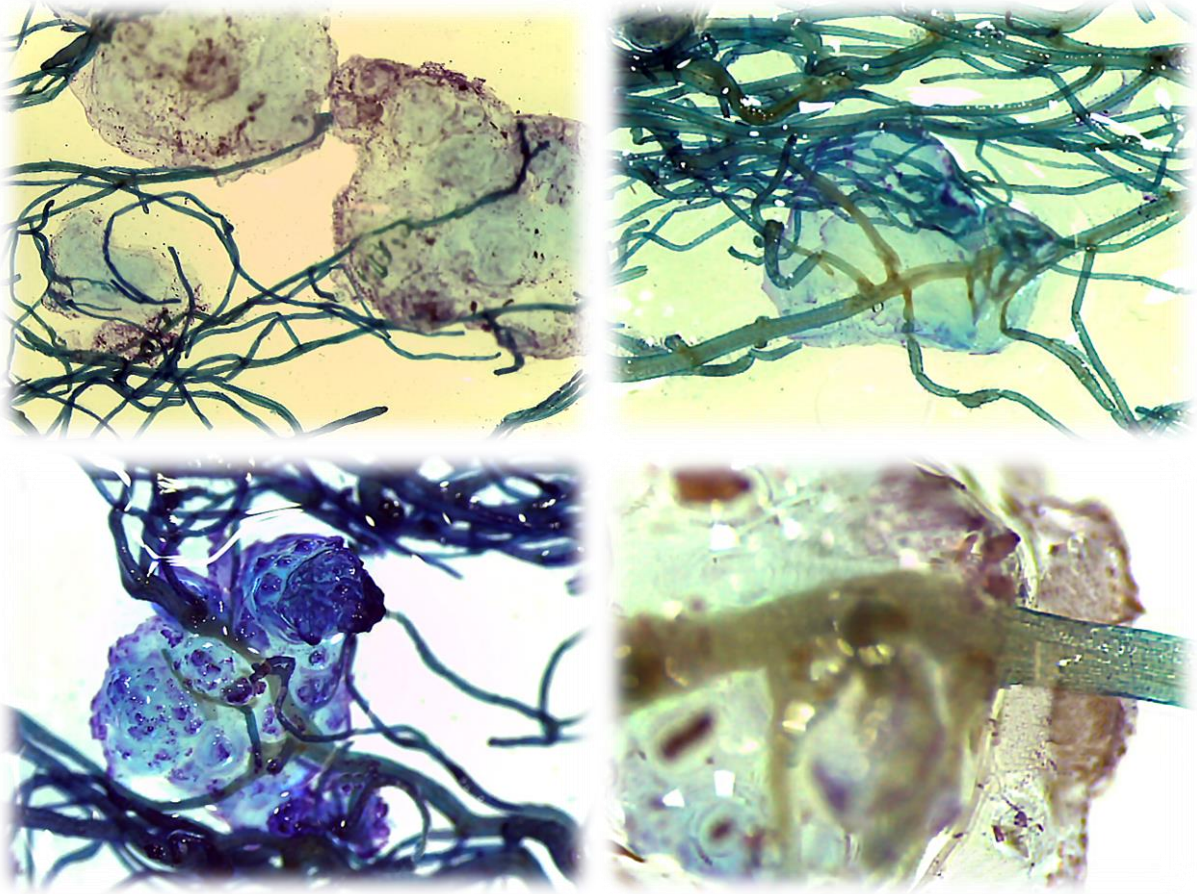


Fig. 2 *Microscopic view of tomato roots penetrating TerraCottem® Universal's hydroabsorbant polymers*

Professor María Remedios Romero Aranda:

> ***Figure 2 shows that the roots penetrate into the hydrogel, so that the root hairs are surrounded by a highly hydrated material.***

"In the future, the impact of the amendment on the root hydraulic conductivity and on xylem composition should be determined. This information would allow to know if the hydrogel interferes with the capture of essential nutrients such as K, which is widely recognized for its role as an osmotic agent in situations of water stress. In addition, both the root hydraulic conductivity and the content of K in the xylem are determining factors of the yield and quality of the tomato crop."

4. Overall conclusion

Professor María Remedios Romero Aranda:

"*The nutrition and development of plants can be perfectly controlled in these inert substrates, however over time they become compacted and lose aeration and water retention capacity. That's why we wanted to test the behaviour of TerraCottem® Universal on these substrates.*"

The addition of TerraCottem® Universal resulted in a rise of the water retention capacity in both the perlite and vermiculite substrate and an increase in biomass production for both the underground (roots) as the above-ground growth (leaves and stems).

Personally I was keen to see if the root would penetrate inside the polymers contained in TerraCottem® Universal. The pictures I took, with a stereomicroscope, of the tomato root hairs speak volumes.