1st AgroSpace-MELiSSA workshop – Rome, 16-18 May 2018

MULTI - TROP

AN EXPERIMENT FOR THE ISS

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YiSS – Youth ISS Science

MULTI-TROP goals

a) Education: to enhance secondary school students' interest in space biology;

b) Scientific: to disentangle the role of gravity from the other stimuli for root orientation;

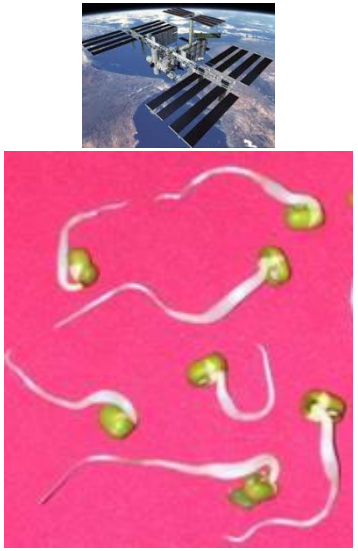
c) Applied: to address technical issues in the design of growth chambers for plant cultivation in microgravity.

Scientific Background

Root growth orientation depends on several external stimuli (tropisms)

On Earth, the effect of gravity on root orientation is considered dominant on other tropisms.

In microgravity roots grow in any direction



Aim

To investigate on the interactions between hydrotropism and chemotropism in root orientation without the dominant action of gravity.

Experiment Phases

Activities were organized in three phases:

1. **<u>Pre-flight phase</u> - including hardware refurbishment, selection of seed species , substrate type and nutrient solution components.**

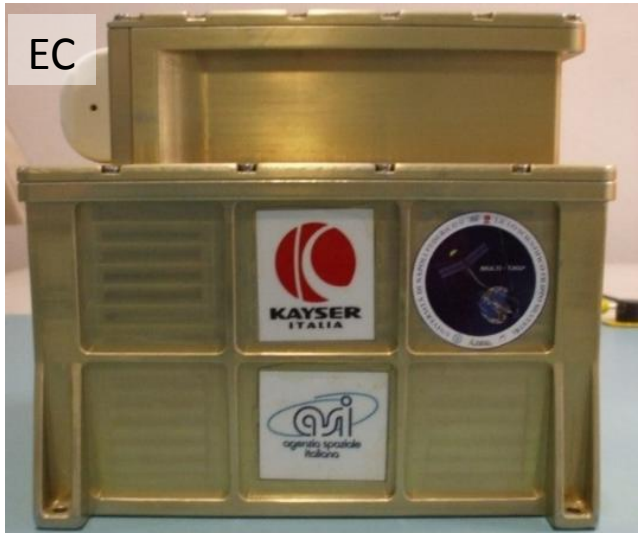
2. <u>Flight phase</u> - including experiment implementation at launch site, seed germination, root growth and experiment activation (fixative injection) on the ISS.

3. <u>Post-flight phase</u> - including a ground reference experiment, processing of plant samples, data analysis and modelling.

Hardware

- No new hardware was manufactured for MULTI-TROP.

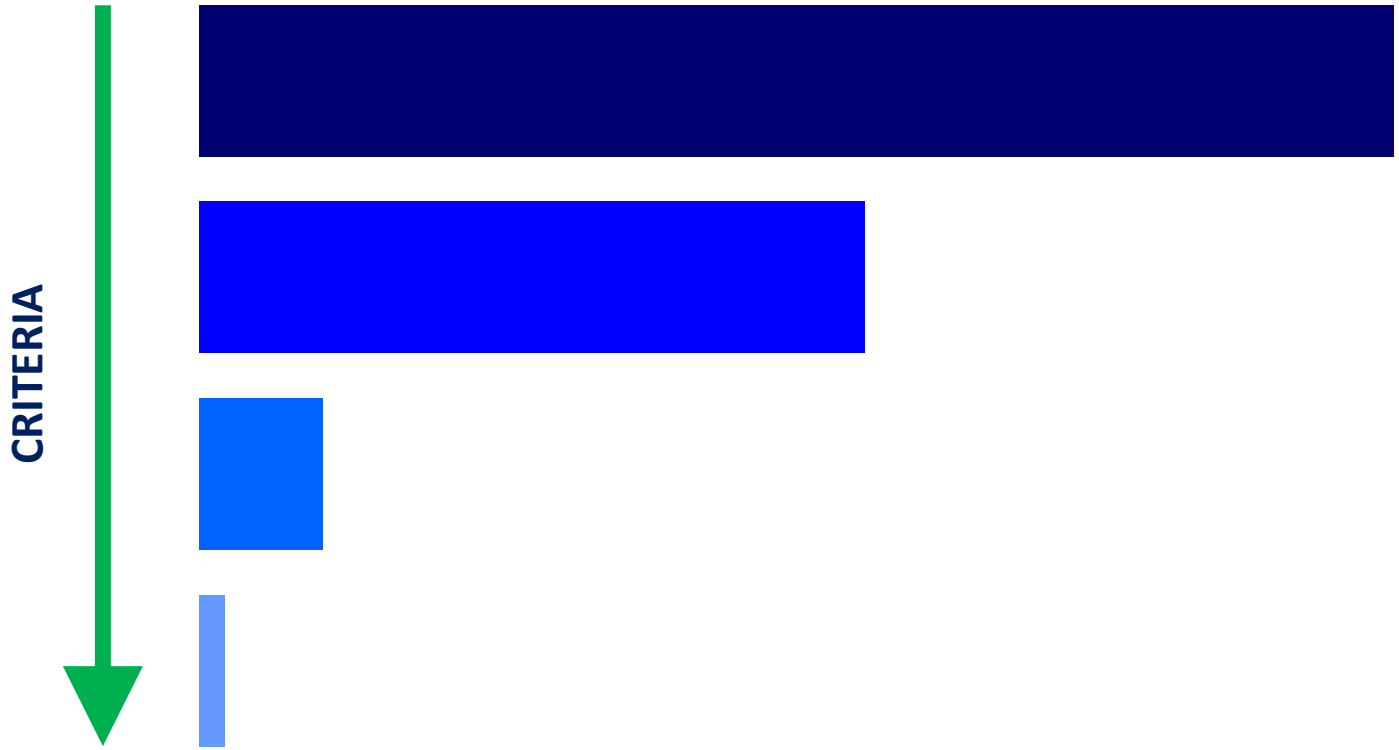
- The experiment is performed in a BIOKON container (EC) equipped with two YING-B2 Experiment Units (EUs) previously used for the Yeast In No Gravity (YING) experiment (2009, ISS Increment 20).



Seed selection: method

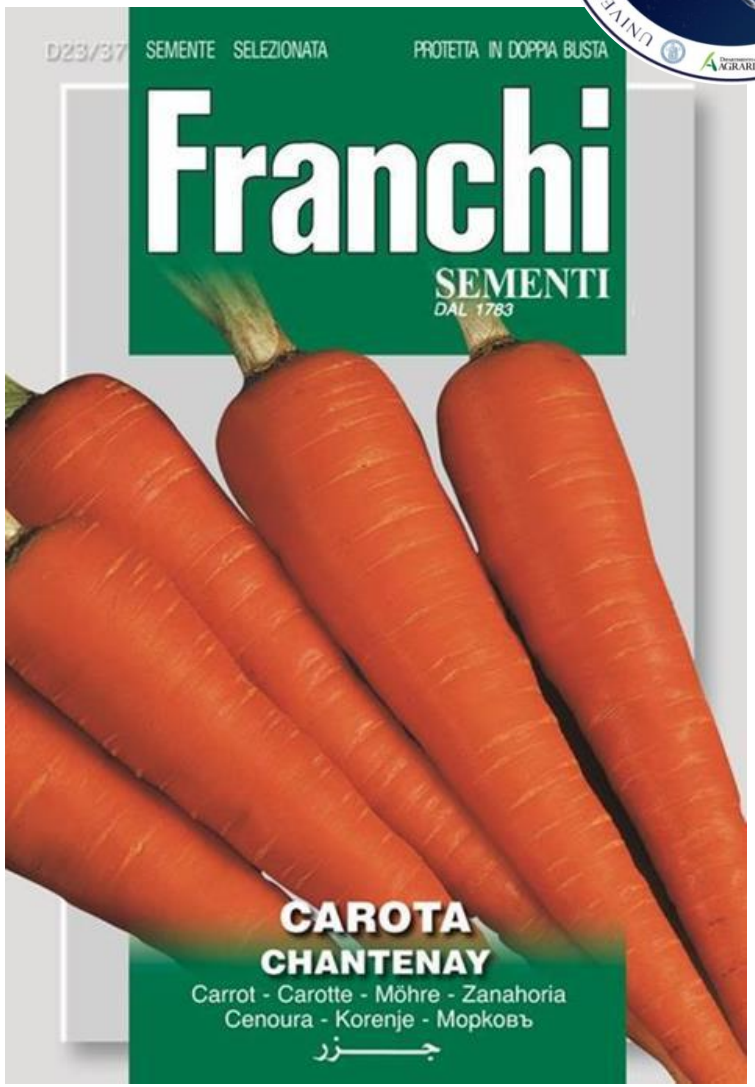
Subsequent exclusion criteria

Number of Species



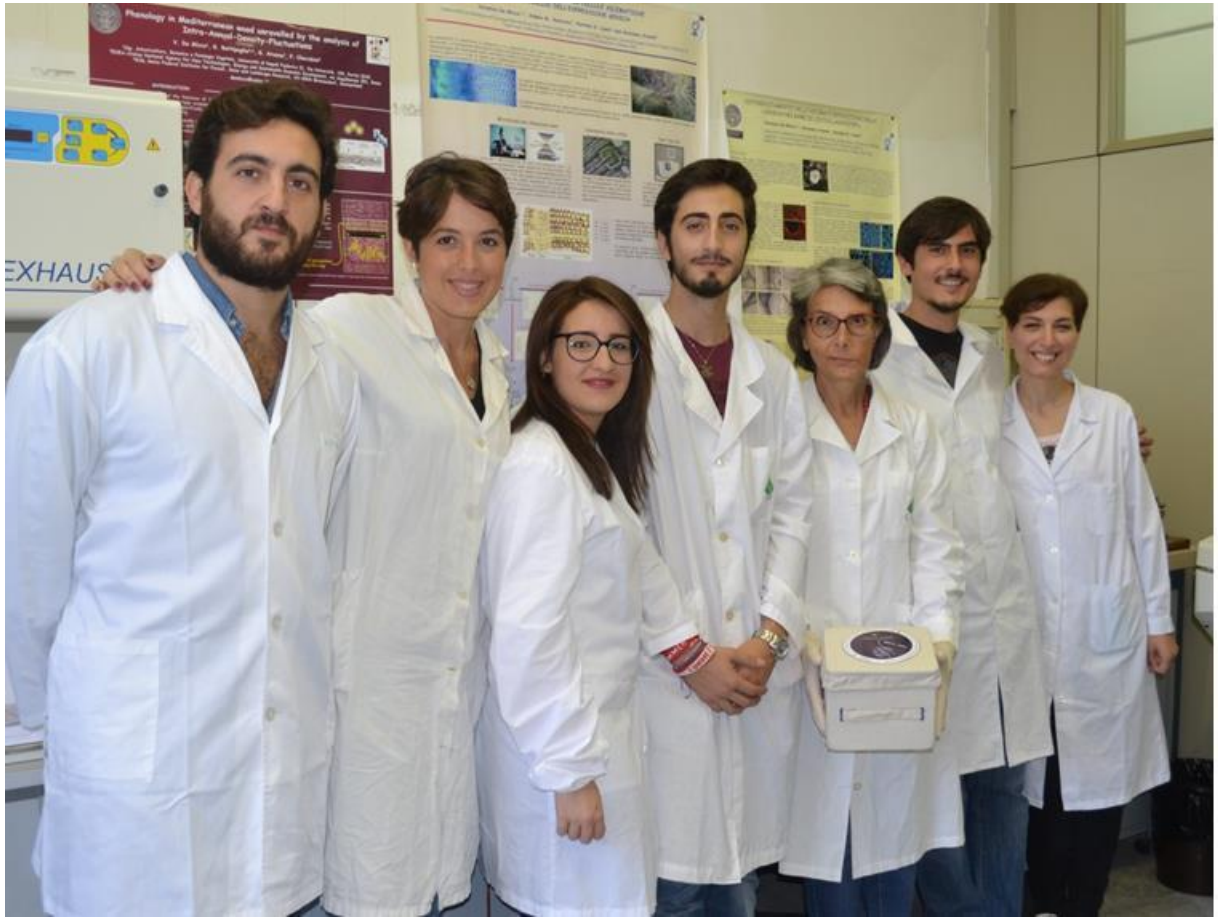
Selected seeds

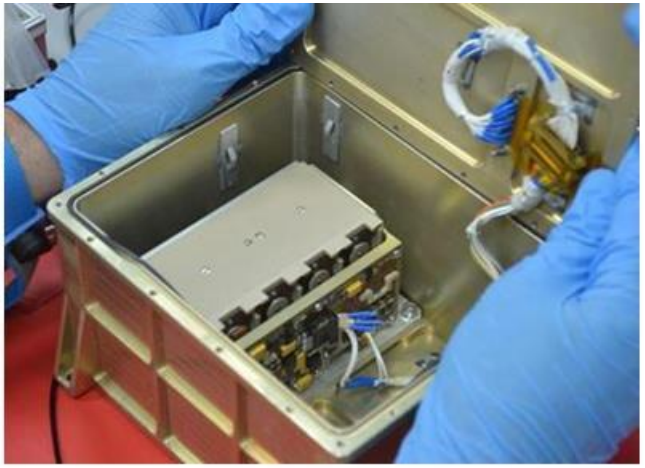
On the ISS for the MULTITROP experiment we used 32 carrot seeds (*Daucus carota*)



Experiment Simulation Test

Successful!





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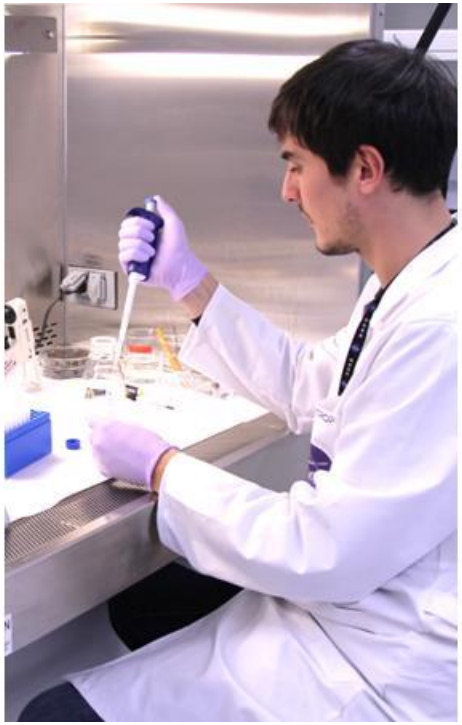
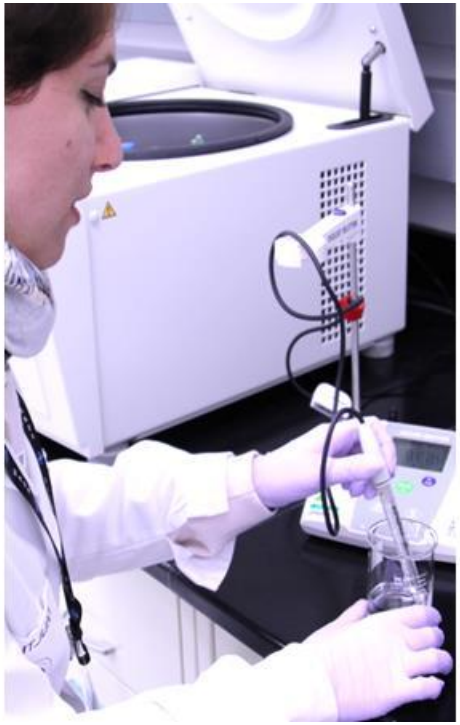
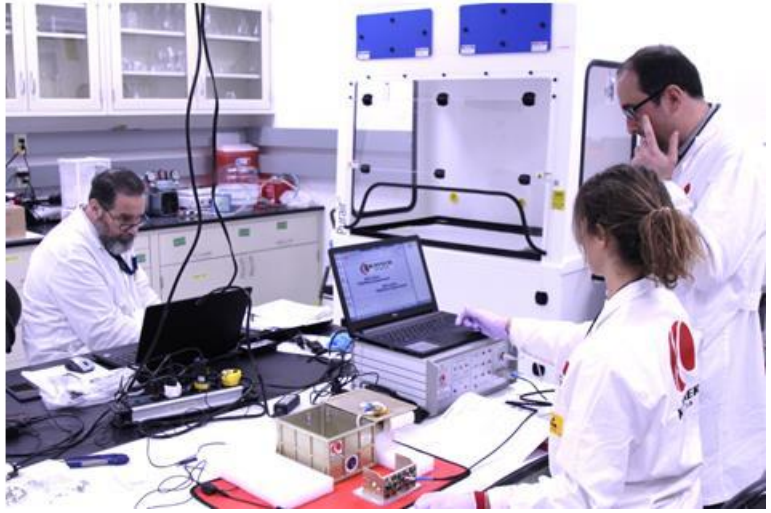
NASA - KSC - SSPF

Assembling/Disassembling





Assembling/Disassembling



Launch


CRS-13
SPACEX
FALCON 9
DRAGON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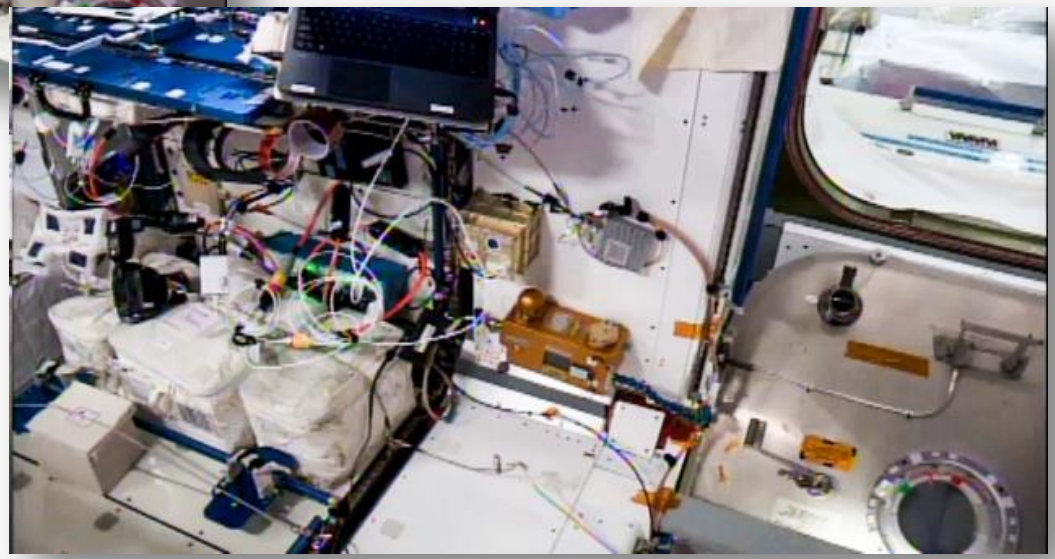
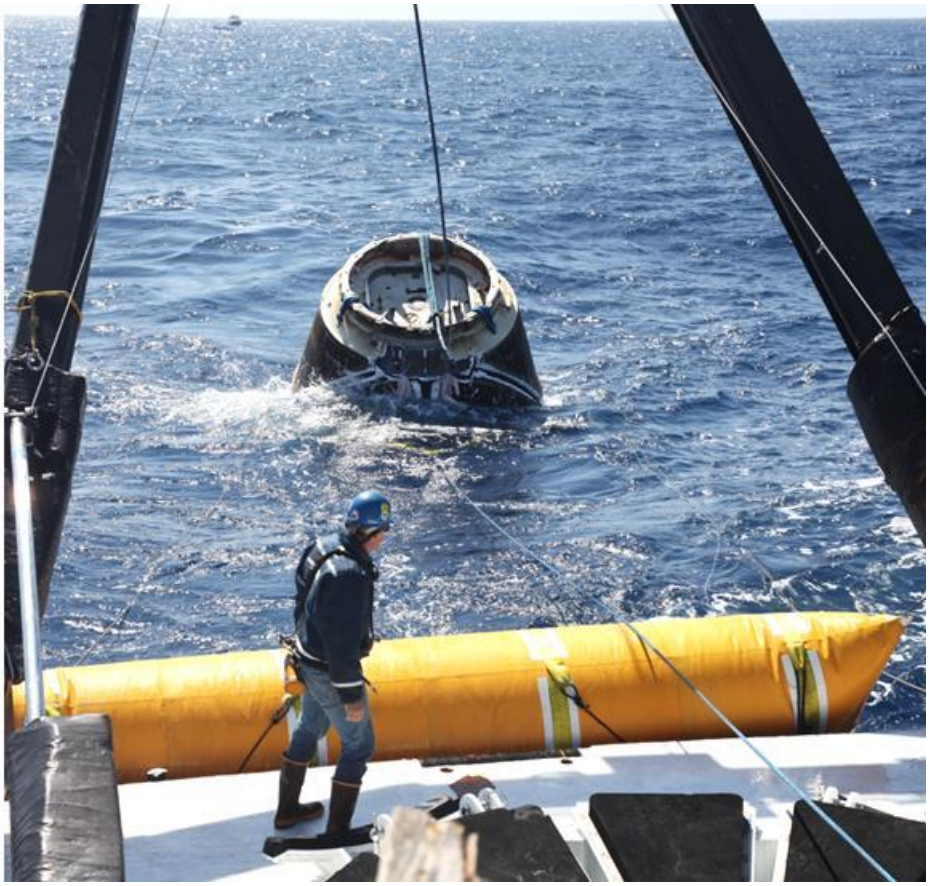
Berth

Activation and storage



Unberth

Splash down and retrieval



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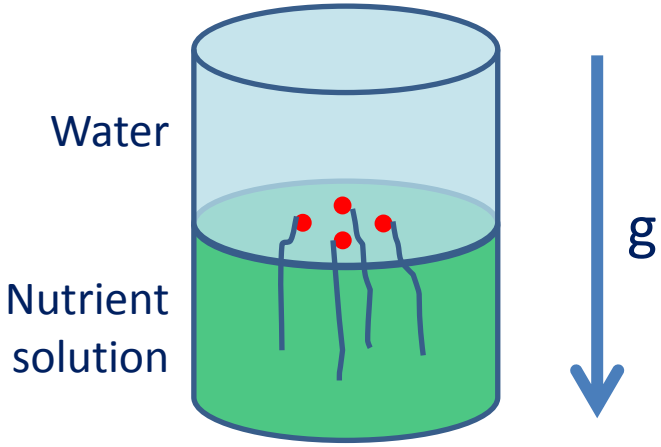
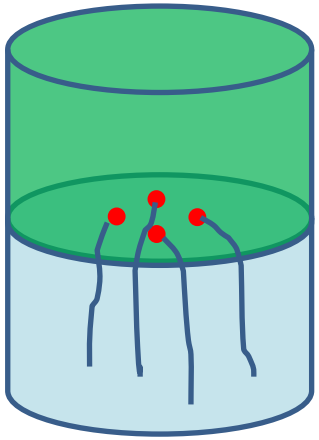
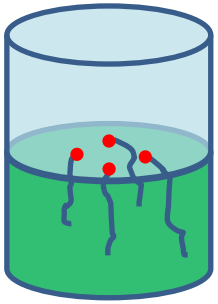
Germination on Earth



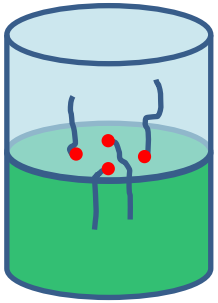


Gravitropism was dominant on other tropisms

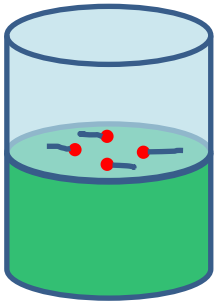
Germination on the ISS: hypotheses



1. If roots develop in the substrate with nutrient solution: chemotropism prevails on hydrotropism

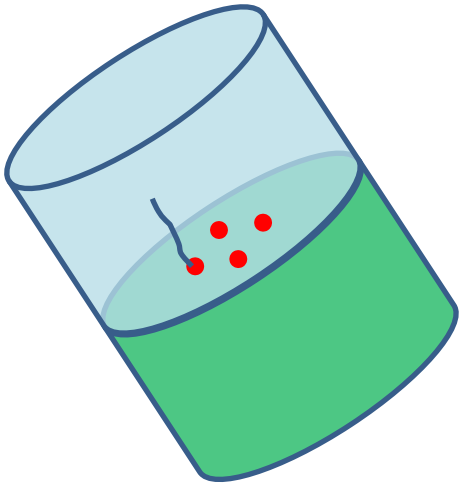


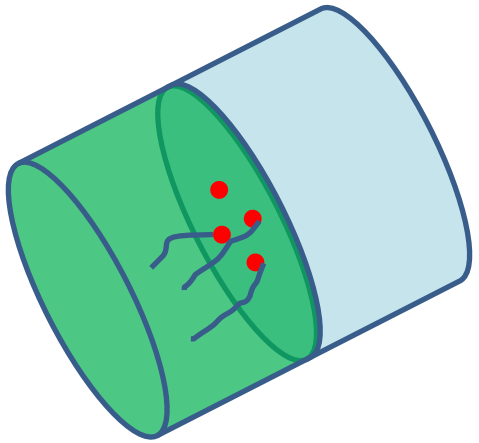
2. If roots develop equally in both substrates: hydrotropism prevails on chemotropism



3. If roots develop according to embryo axis: neither water nor nutrients act as directional stimulus.

MULTI TROP: preliminary results





In microgravity most carrot roots were attracted by the nutrient solution ($p<0,001$)

Work in progress …

- Ground Reference Experiment
- Biometric and anatomical analysis of the samples
- 3D and microscope digital image analysis
- Data analysis and modelling

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