A presentation by Dr. Yoseph Shoub - October 2018

about managing irrigation according to the plant's activity,

and not according the predefined irrigation programs.

Gerbera Breeding Ltd. Israel www.gerberaisrael.com

is a user of the AutoAgronom since 2005.

The photos were taken by the author.

AutoAgronom Israel Ltd.

www.autoagronom.co

Throughout 2016 season we observed in our Gerbera breeding-greenhouse, more than 80 agricultural Specimen under growing conditions, automatically controlled in real time - 24h a day - by an 'AutoAgronom' irrigation control system ('AA').

All the plants, as our gerbera plants do, grew in Coco peat in 4 liter 'Rosier' containers', dripped and fertigated via Micro-irrigation system, nourished with the same low concentration of the same feeding-formula.

The 'AA' irrigation short pulses, are of small quantities *(15 - 60cc / pulse),* replacing the soil-solution volumes, absorbed and used by the plants, while they perform their physiological activities.

We evaluated the plant's physiological activities value, as equivalent to the micro-changes of the 'water-tension values' occur in the roots' media, as a result of the soil-solution absorption by the roots. The micro-changes are measured by the 'AA' tensiometer in the roots volume of a chosen 'Leader-Plant'.

As long as the trials cycles continued, it became clear that the 'growth-habits' of all the specimens were almost the same, regarding theirsecondary roots' structure and their growth rates, and the qualities of the above-soil organs.

The obvious conclusions are - Irrigations managed according to the physiological activities of plants having high production potential, are highly accurate. While predefined irrigation programs do not preserve the desirable optimal growing conditions for the roots activities of such plants.

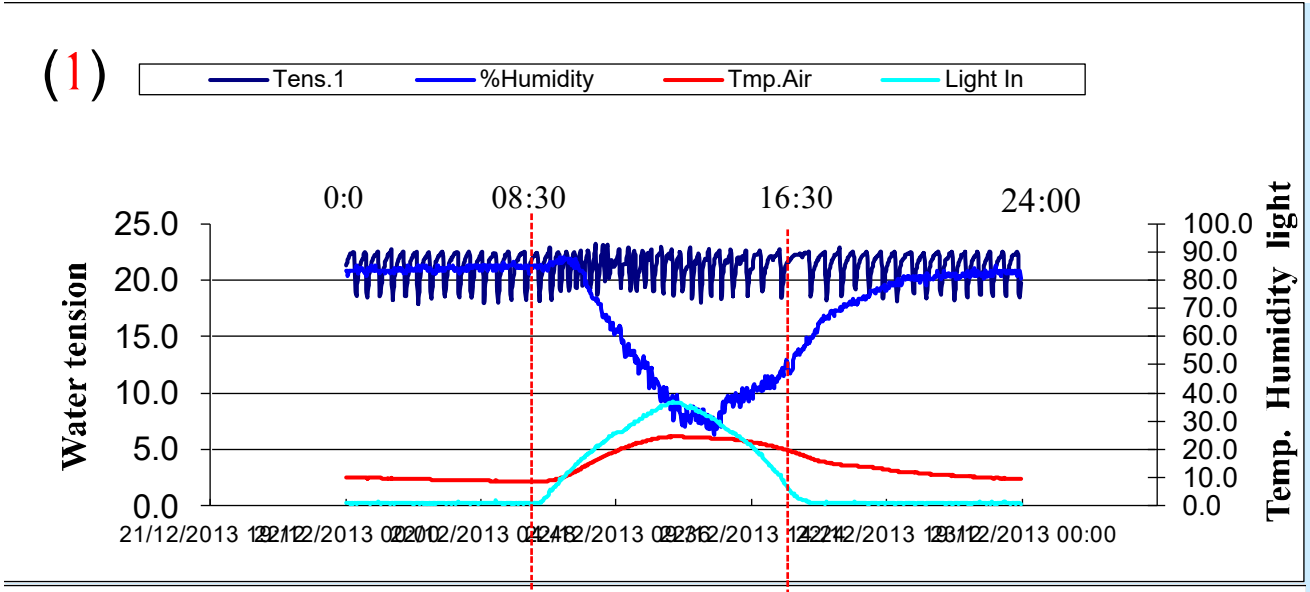
Our gerberas are successfully controlled in our greenhouse, for almost 13 years, by an ‘AutoAgronom’ system.

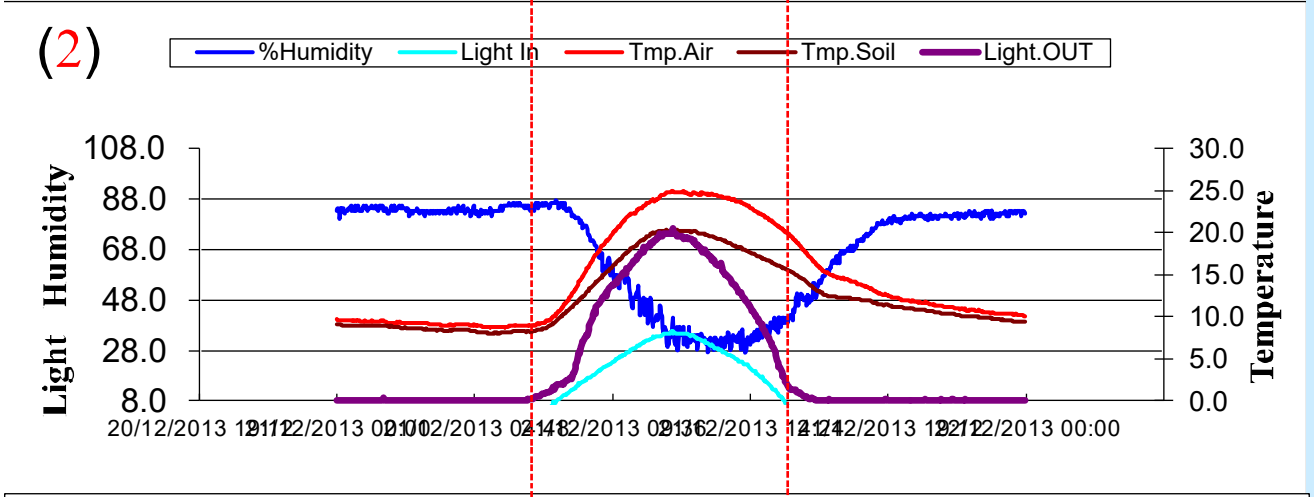
The ‘AA’ Tensiometer –

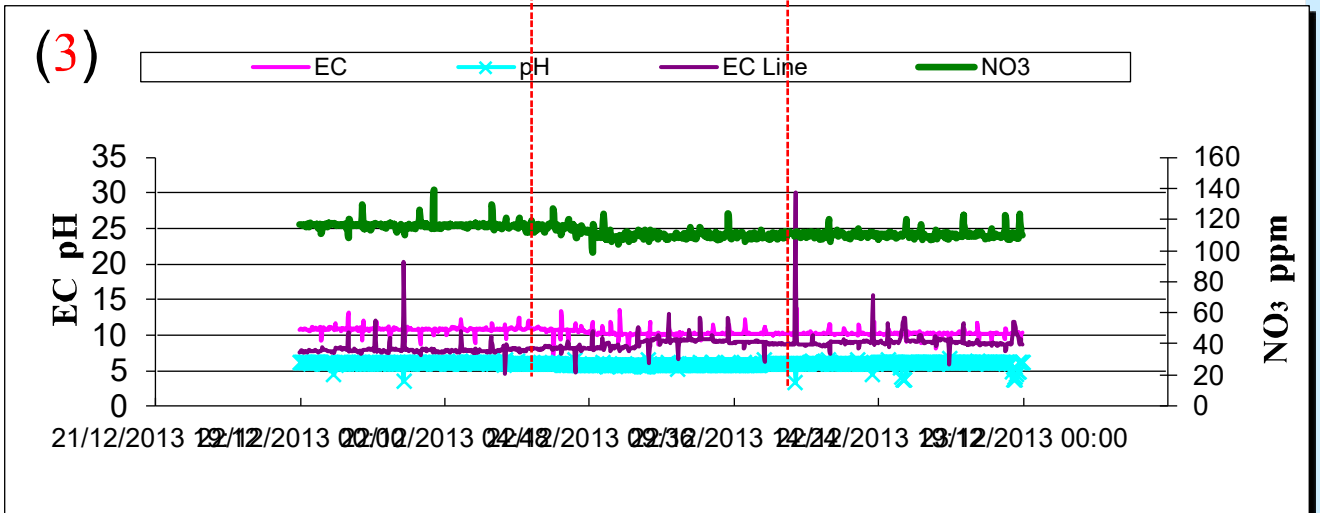
The AutoAgronom Tensiometer react continuously to the micro-changes of the ‘Water tension values’, occur in the root’s media, while the plants absorb the ‘Soil-solution’ for executing their physiological activities.

It synchronize with the plants’ actions, as it send the information in real time to the AutoAgronom computer, and controls the optimal water tensions values, and the optimal soil solution qualities, by supplying back the optimal feeding solution to the sites from where the soil solution was taken by the plants.

The high accuracy of the ‘AA’ sensors, allows it to maintain almost: 'Hydroponic conditions values - in the solid media’.







Growing conditions values controlled by the 'AA'.

Gerbera Breeding Ltd, Israel,
21.12.2013

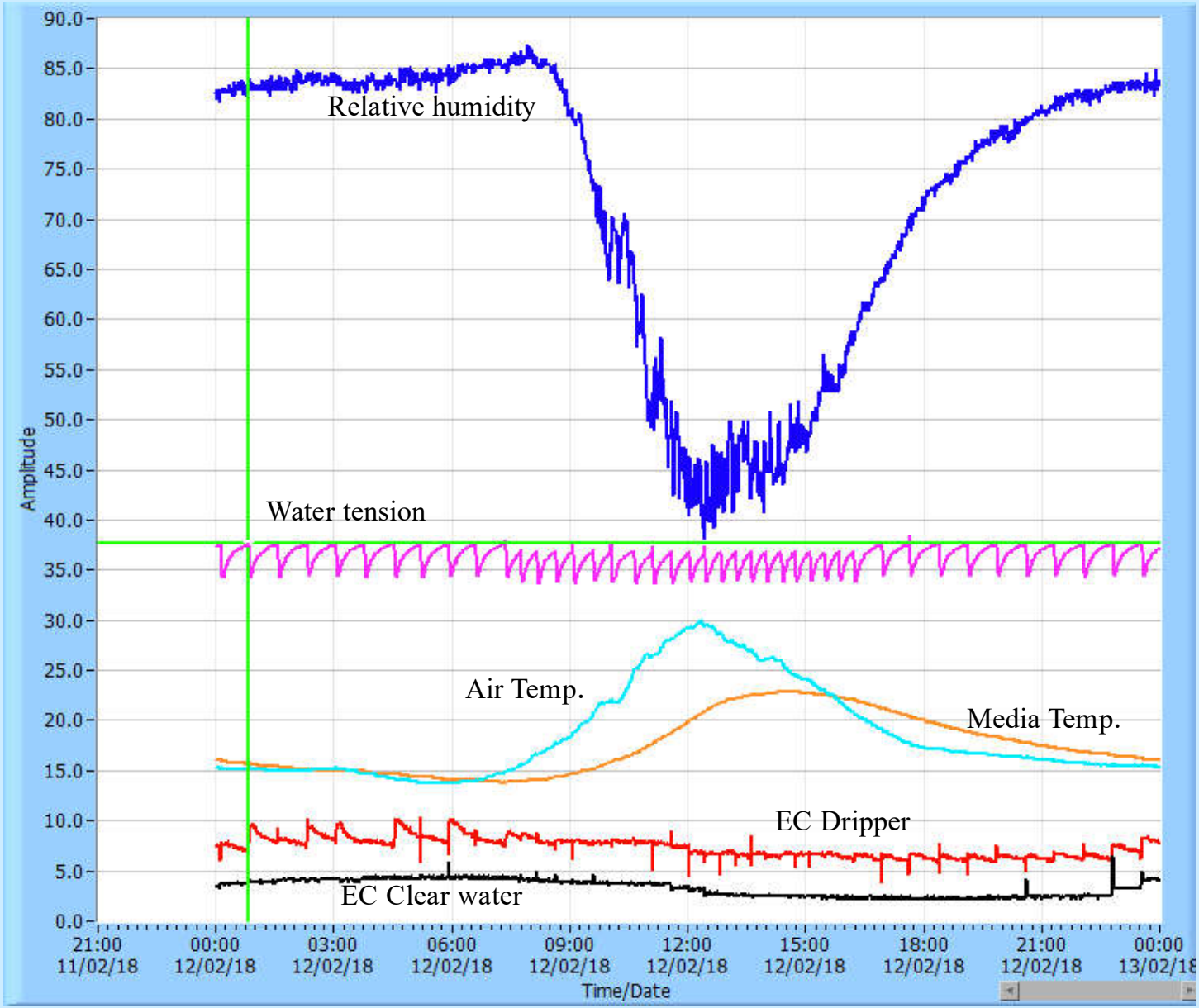
(1, 2) 6 Physical values

Water tension
Relative humidity (%)
Air Temperatures (c)
Media Temperatures (C)
light out (1000 lux)
Light in (1000 lux)

(3) 4 Chemical values

NO_3 - drainage (ppm)
EC - drainage (mS/cm)
EC - feeding solution (mS/cm)
pH - feeding solution

A day in the breeding greenhouse: 00:00 —> 24:00 02.12.2018



List of common agricultural specimens - controlled by AutoAgronom,
in the breeding greenhouse, December 2015 ⟷ October 2018,

Gerbera - Seedlings and Selected varieties (tenth thousands yearly).

Vegetables - Broccoli, Fennel, Beet, Lettuce, Kohlrabi, Mangold, Kale, Parsley, Spring Onion, Strawberries, Tomatoes, Potatoes, Eggplants, Cabbage, Cauliflower, Carrot, Spinach, Pea, Celery, Pepper, Pumpkin, Chives.

Spicing plants - Basil, Mint, Rosemary, Sage, Coriandrum, Thyme.

Field crops - Wheat, Corn, Melon.

Trees and Bushes - Roses, Figs, Vine, Avocado, Apples, Quercus Ithaaburensis, Papaya, Rhus crenata.. *(Lemon and guava outdoors),* Adenium. Ananas, Ginger.

Flowers - Roses, Lilies, Hippeastrums, Carnations, Chrysanthemums, Geraniums, Cyclamen, Strelizia (bird of paradise).

Gardening plants - Various kinds (about 40, *including the Adenium*).

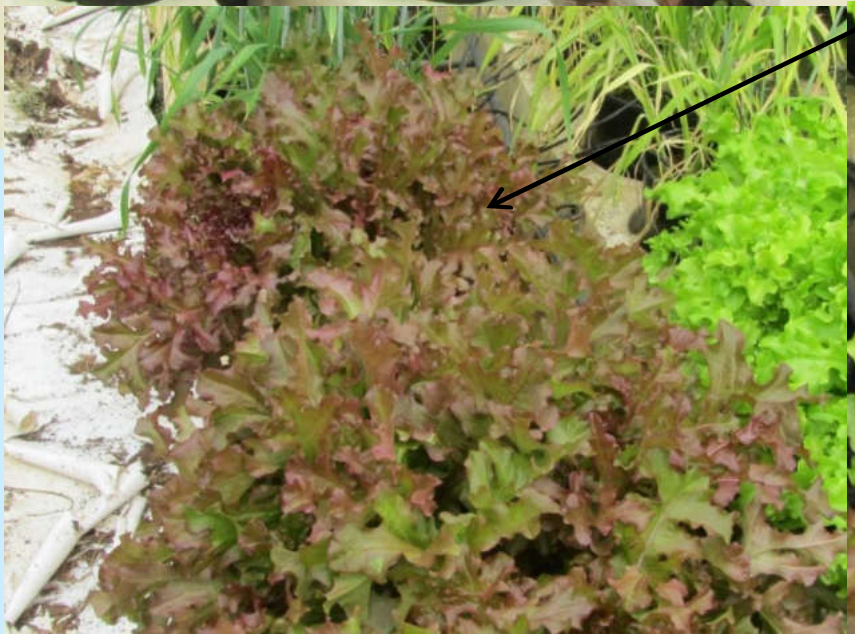
Vegetables specimens -

Fennel 30 days after planting

Beets 30 " "

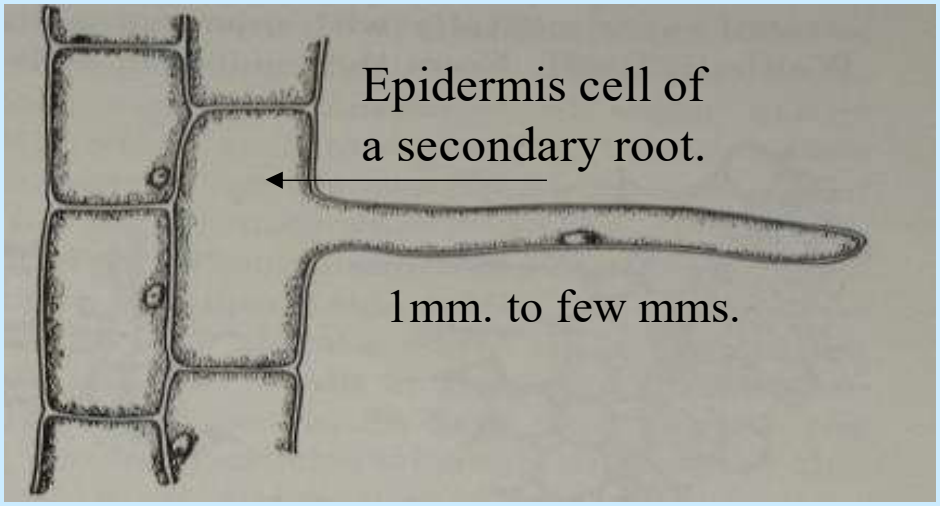
Lettuce 42 " "

60 " "



The ‘Root-hairs’ do the work.

Root hairs are elongated epidermis-cells located on the Secondary roots.
Their function is to absorb the soil-solution (*water, oxygen and minerals)* into the plant’s vascular system.



A scheme of a root hair

The productivity of intensive crops depends, to a great extent on the vital activity of the root-hairs.

‘AA’ Allium schoenoprasum, secondary roots
3 years after planting. May 2010.

Close up of 'AA' apple's secondary root covered with countless root-hairs, Dec. 2010.

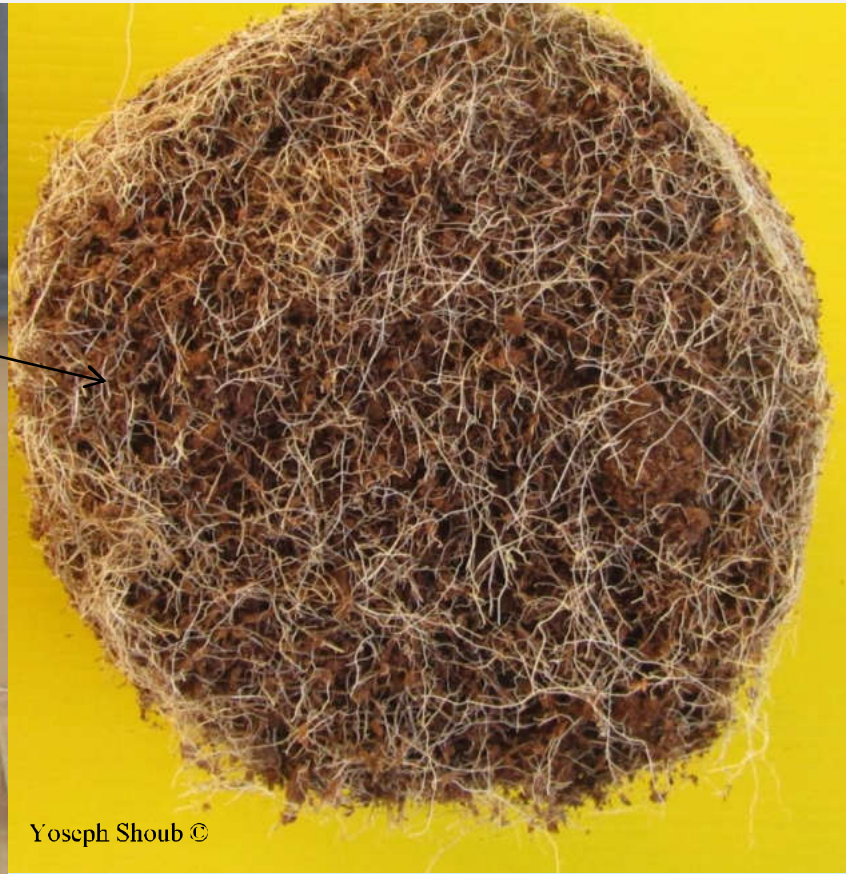
The root hairs are vital organs of the plants, yet they are very sensitive to the growing conditions in the root's media, as they are physically exposed and are not protected like the other organs.

Root hairs of intensive crops are highly influenced by the oxygen / water ratios. They will develop in the upper soil layers on condition that these ratios are kept optimally for their growth. The 'AA' tensiometer detects and controls the optimal water tensions, and the optimal oxygen / water ratios for the roots' development.

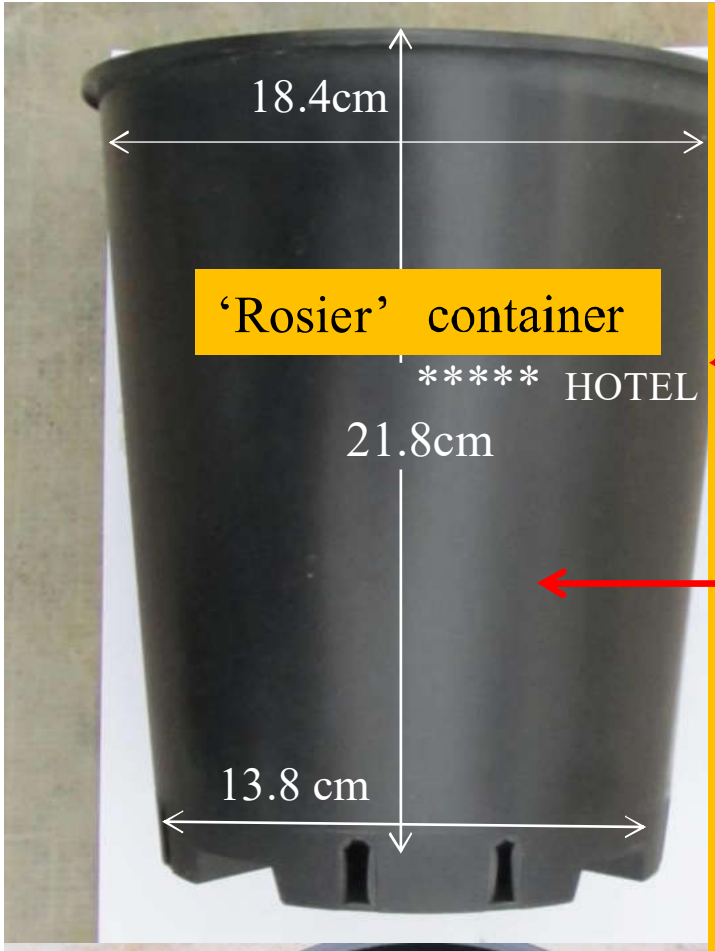
‘AA’ Kale - secondary roots.

The external secondary roots keep the container shape.
The outer appearance represents reliably the root’s vitality in the entire root’s volume.

Cross section 8 cm below the surface, 123 days after planting.



A comparison between Container versus Pot



4 Liter

5.5 liter

$$1.35 = \frac{\text{height}}{\text{average width}} = 1.06$$

draining efficiency
(speed & uniformity)

Total surface of drainage holes*

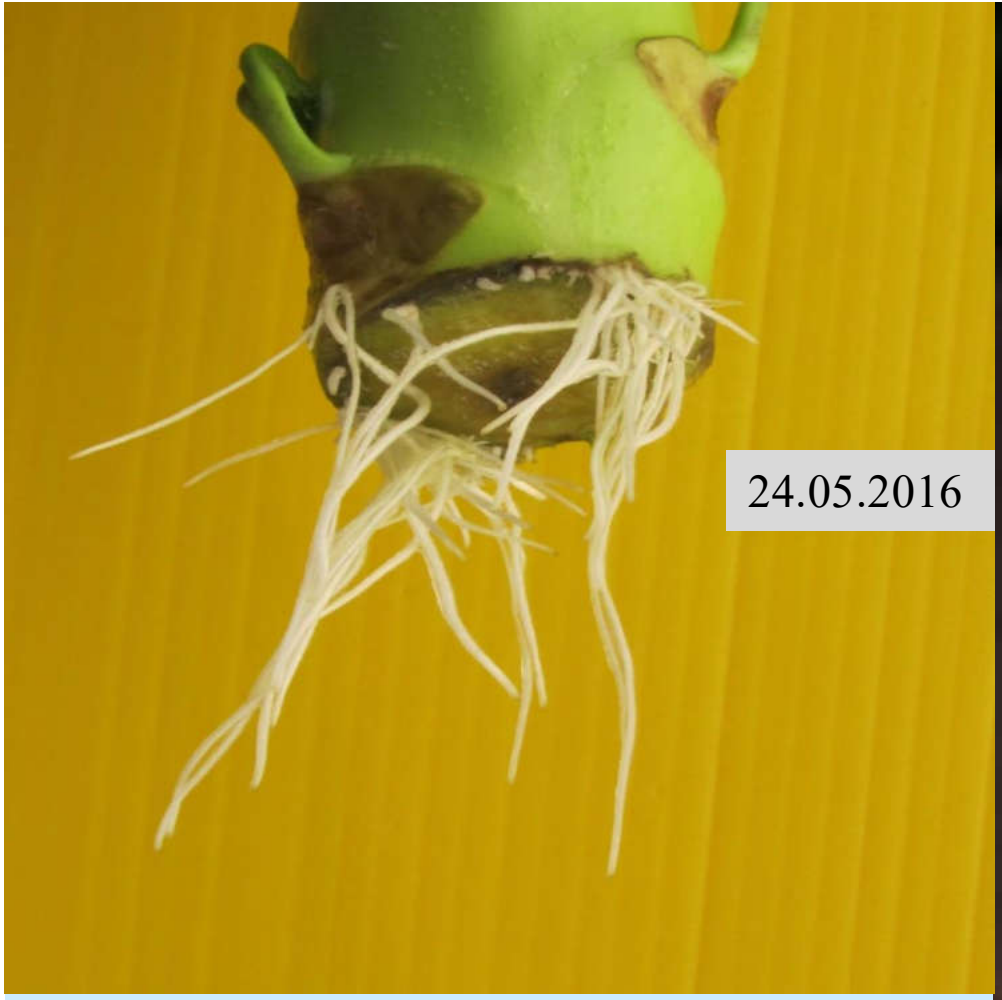
3040 mm

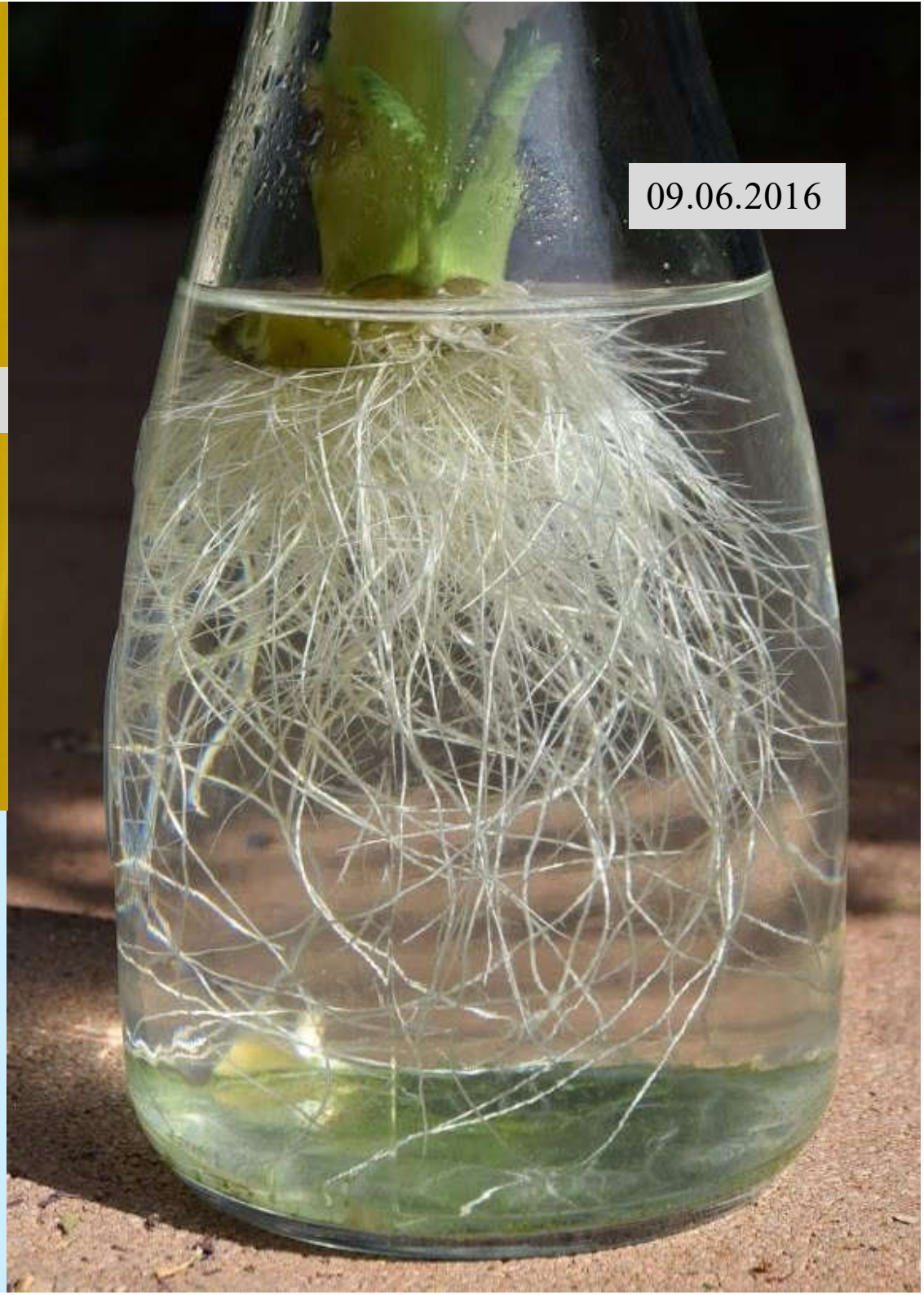
1060 mm

* The drainage movement acts as air pump.

Yoseph Shoub ©

External appearance of ‘AA’ Broccoli roots, developed in 4 Liter ‘Rosier’ container, 5 months after planting.





Adventitious roots of Broccoli develop easily in water.

Broccoli cluster ready to be picked 80 days after planting, (April 2016).

63 days after planting

Mangold

52 days after planting

Kohlrabi

115 days after planting

Kohlrabi - the final product 63 days after planting.

External appearance of the roots' system that did the work.

Wheat seedlings, var. Rotem, sown on 23.12.2015 photographed on 13.01. 2016.

The wheat seedlings 24.03.2016 24.05.2016

Wheat roots, April 2016

after shaken-out the coco media.

at the container's bottom.

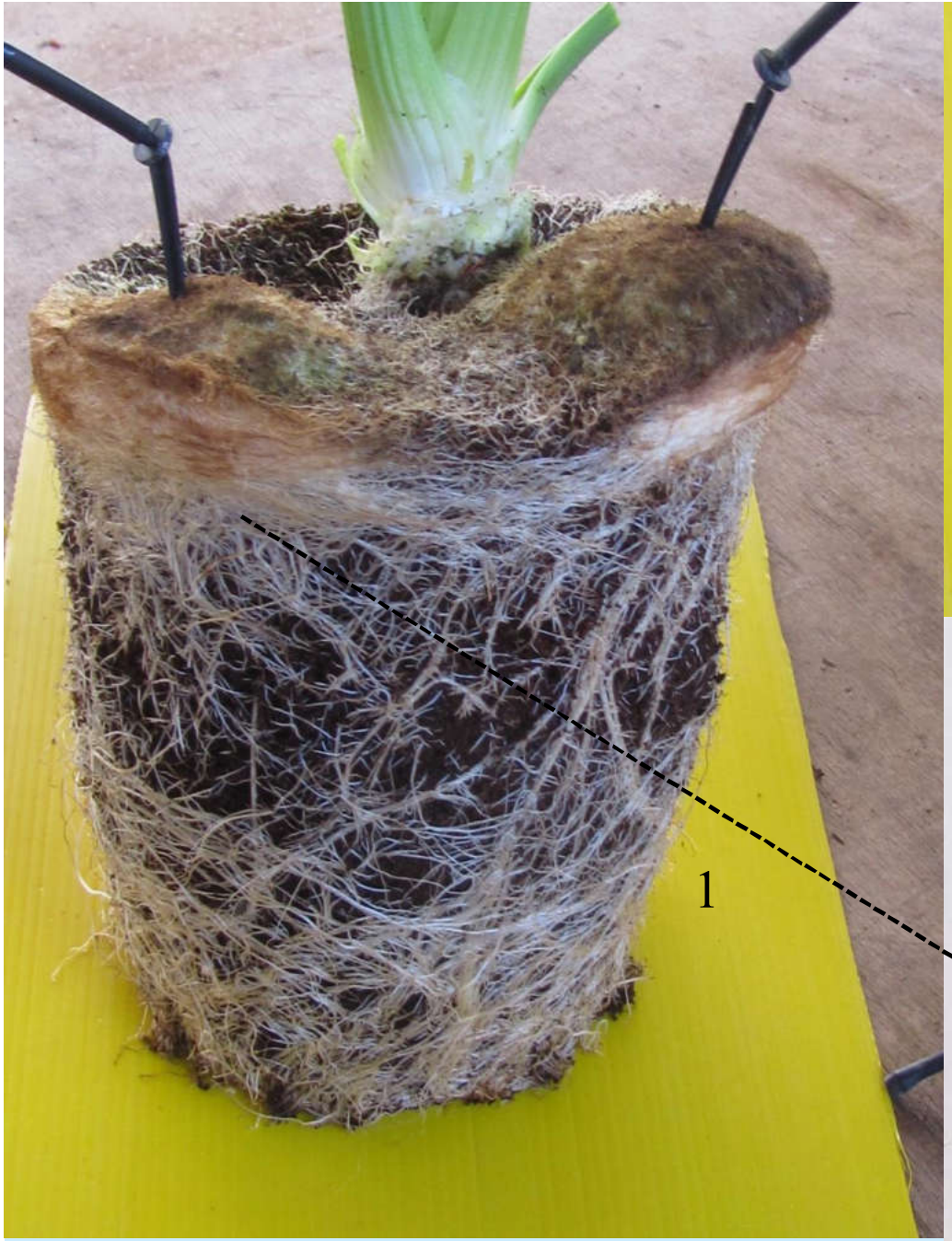
Popcorn 34 days after sowing.

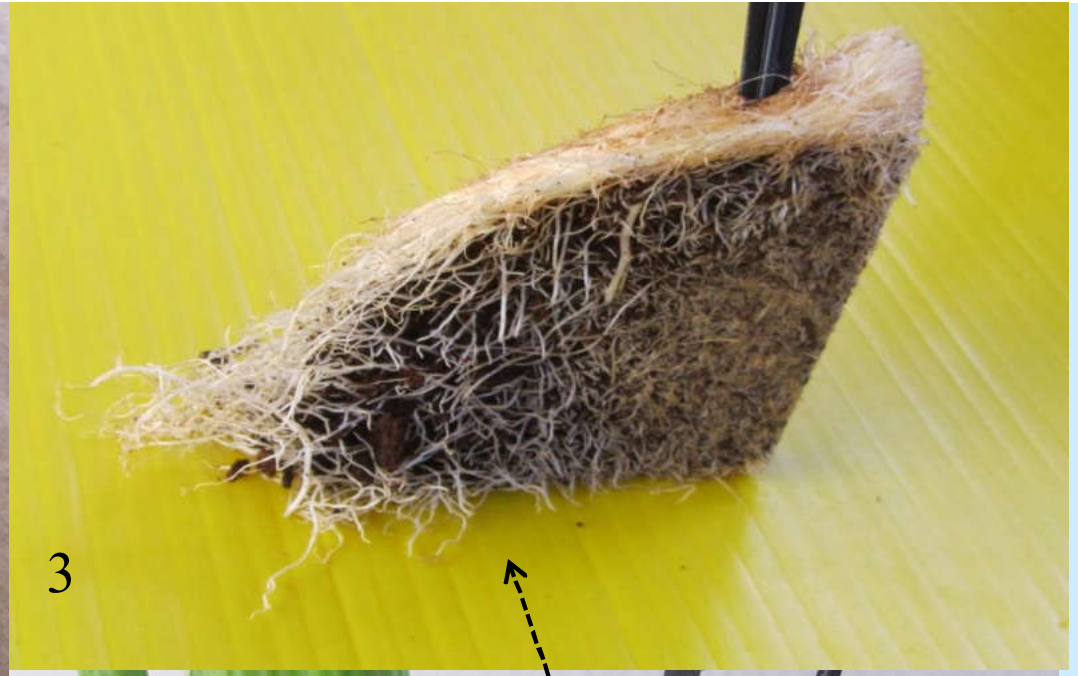
Popcorn -
root's system
on harvesting day,
152 days after
sowing.

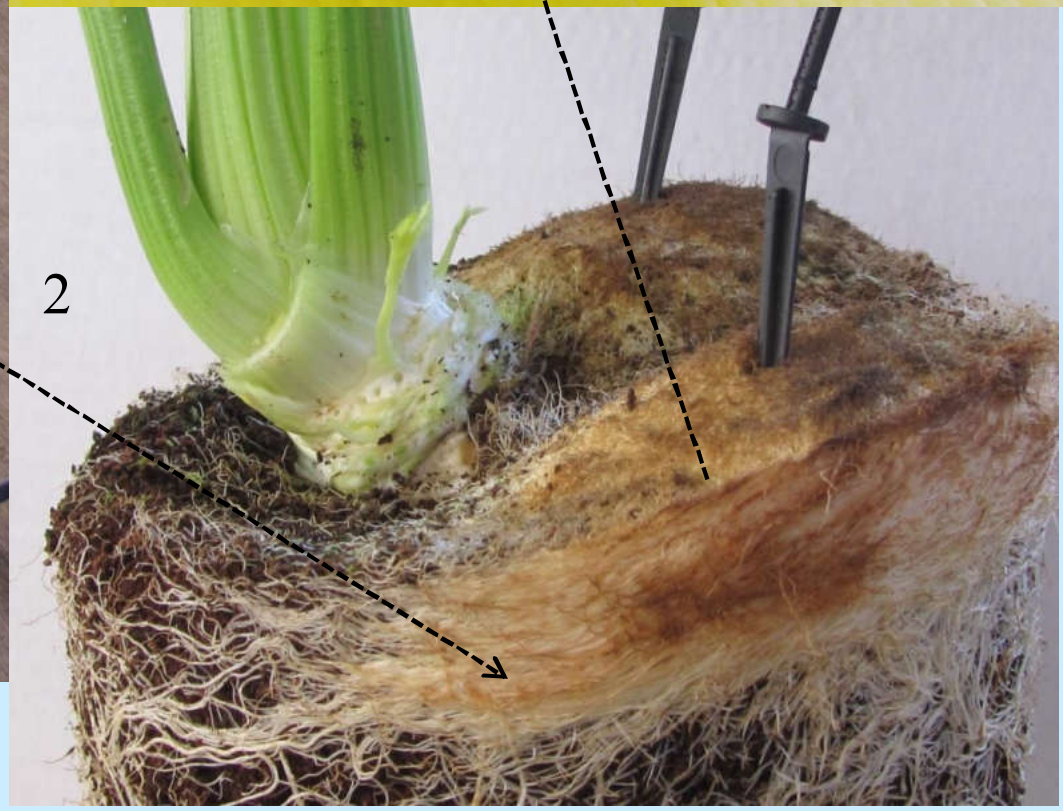
Longitudinal
section of the
root system.

Celery 02.04.2016,
100 days after
planting.

Water regulator,
2 per container.







Celery root's system 1 - 5

4

Cross section of the celery roots system, 8 cm below the media surface.

5

at the container's bottom

Cross section of the root system,
8 cm below the media surface.

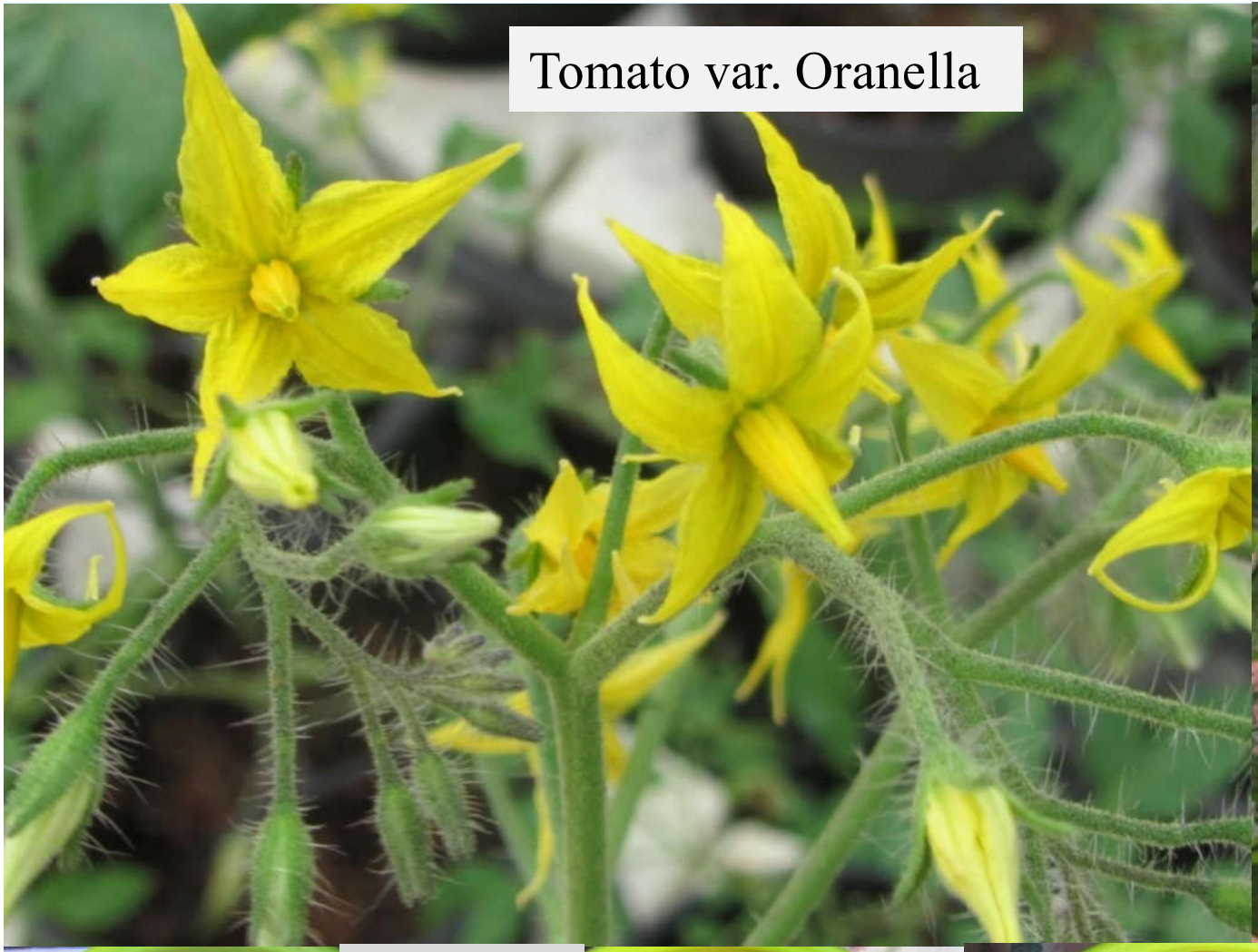
Coriandrum 80 days after planting

Roots system of Spring Onion 69 days after planting.

Strawberry, var. Malach April 2016

Root's system of Strawberry, var. Malach
127 days after planting

Tomato var. Oranella



01.08.2016

Cross section 8 cm below the media surface.

Root's system of Tomato var. Oranella, 185 days after planting, August 2016.

Leaves

Roots system

Cross section 8cm. below the surface.

September 2016

Pepper var. Tolemeo, 23 weeks after replanting, (planted on salad-Beets remnants).


Yoseph Shoub ©
Tomato
Spring onion
Celery
Kohlrabi
Broccoli
Coriandrum
Celery
Celery
Wheat
Kale
The roots do the work!
No matter to whom they belong, they all
do the same work, they are built for it.
So let them do it the easy way ! Yoseph Shoub ©
Tomato
Spring onion

The roots do the work - conclusive evidence.

'AA' systems combined with Micro-irrigation, create and control in the roots' volume the optimal conditions for the secondary roots and the root-hairs activities.

Cauliflower roots, 60 days after planting.

Washed eggplant roots, 18 months after planting.

March 2015


Parsley
The main root
. Carrot
Secondary roots
March 2015
Yoseph Shoub ©

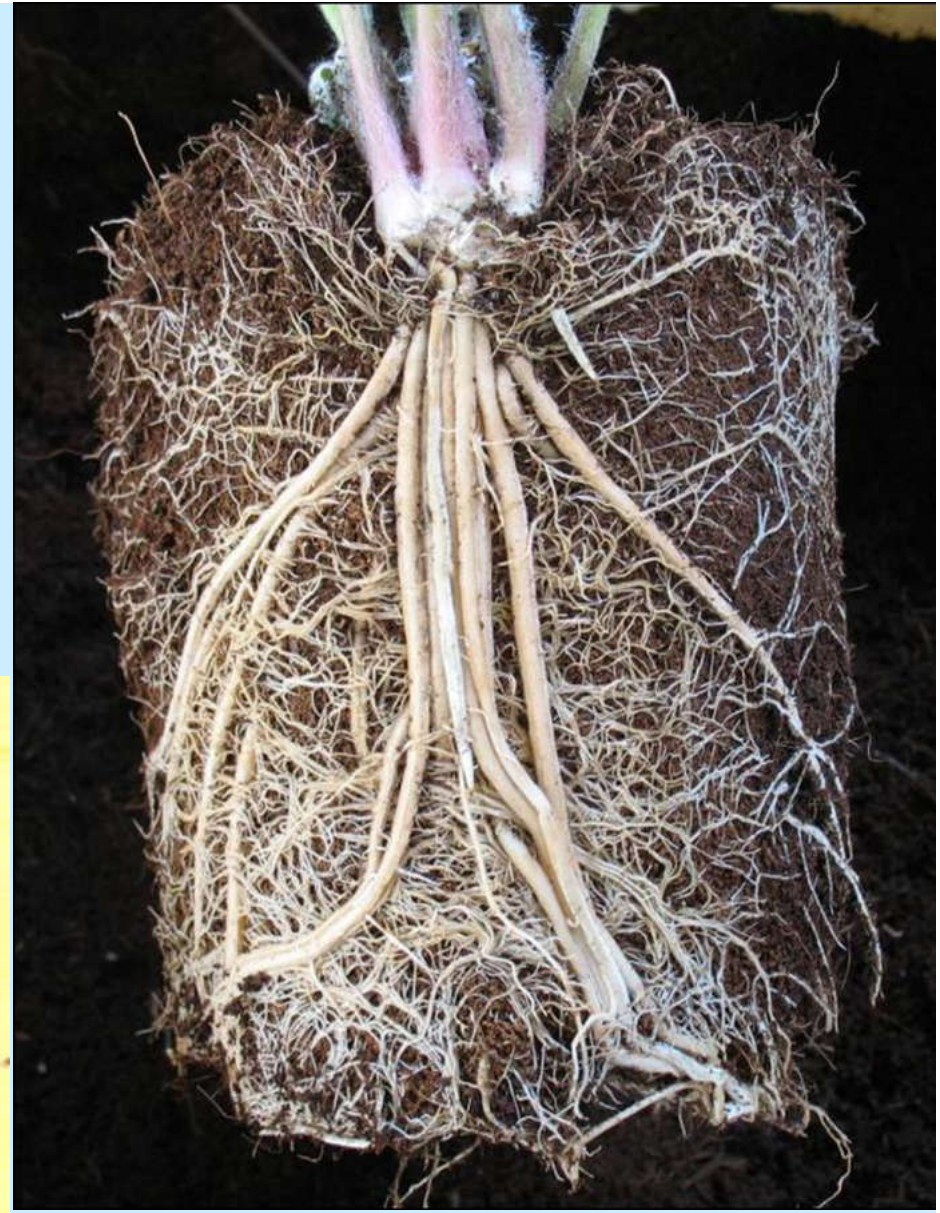
Gerbera seedlings
in 4 L. ‘Rosier’ container.

on planting day (15.02.2016)
and 77 days later, (03.05.2016)

Adventitious roots
Secondary roots

21.8 cm

Close-up of well rooted ‘AA’ gerbera seedling.



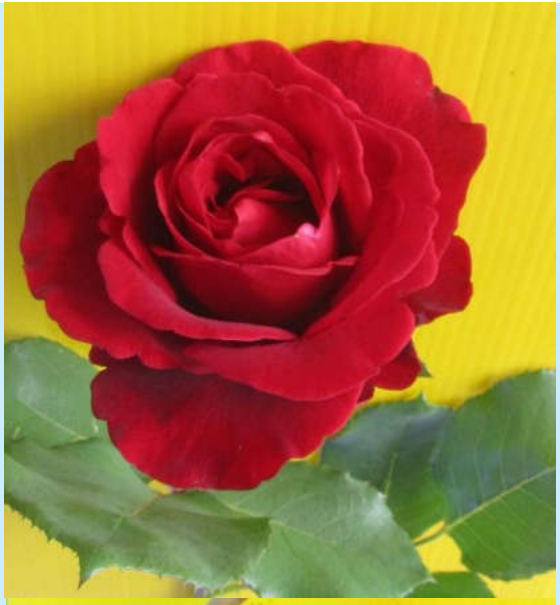
‘AA’ Papaya seedlings 9 weeks from germinating *(1.6 cm / day = 100 cm)*. Yoseph Shoub ©

Rooted ‘AA’ Figs cuttings,
107 days after planted as
leafy branches, April 2016.

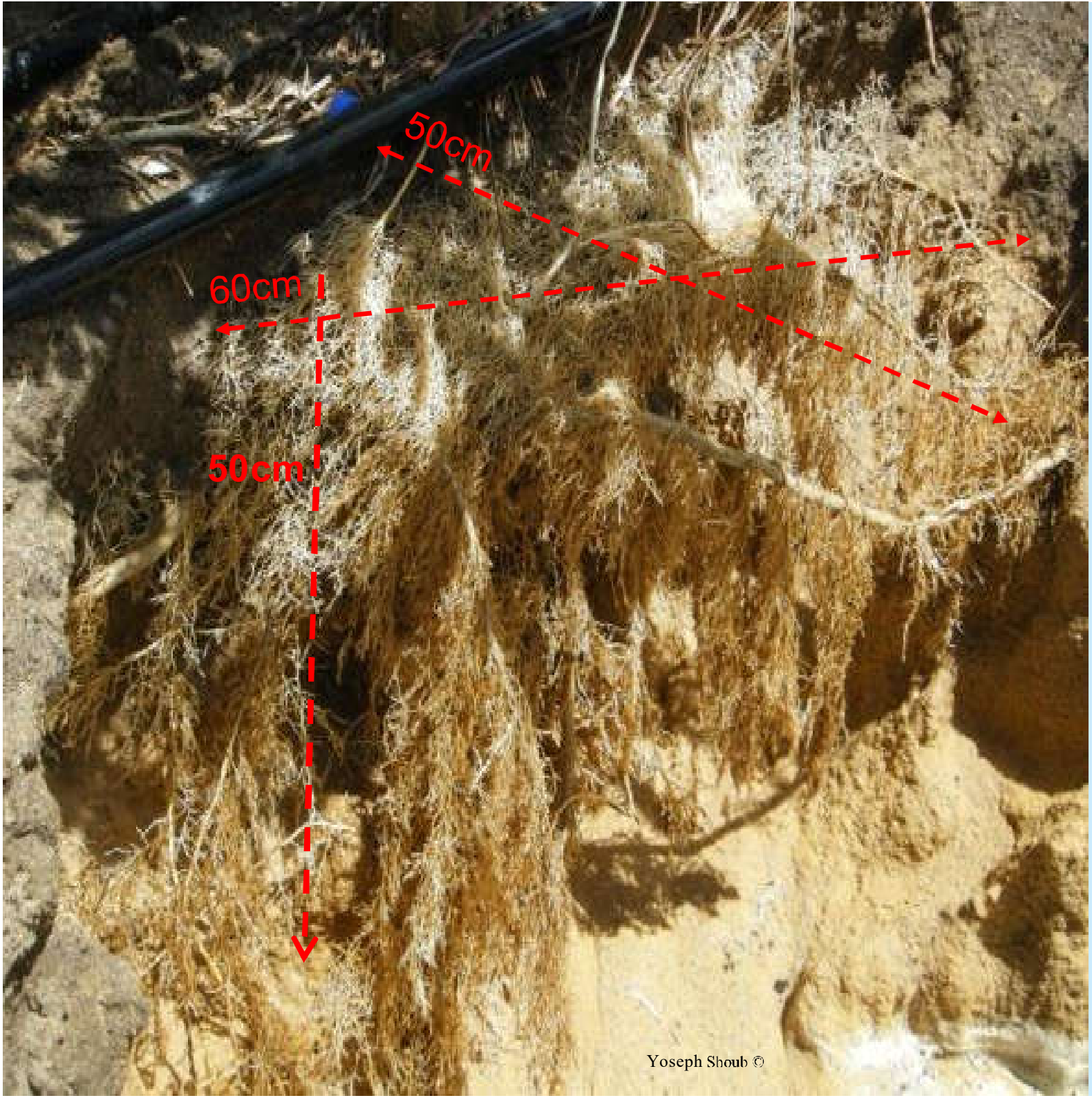
Rooting woody cuttings (without fogging)

Rooted ‘AA’ Vine cuttings 140 days after planted as senesced branches, May 2016.

A Developed ‘AA’ Fig tree
controlled by a gerbera plant,
14 months from planting.
It remained all that time in the
same container, July 2016.



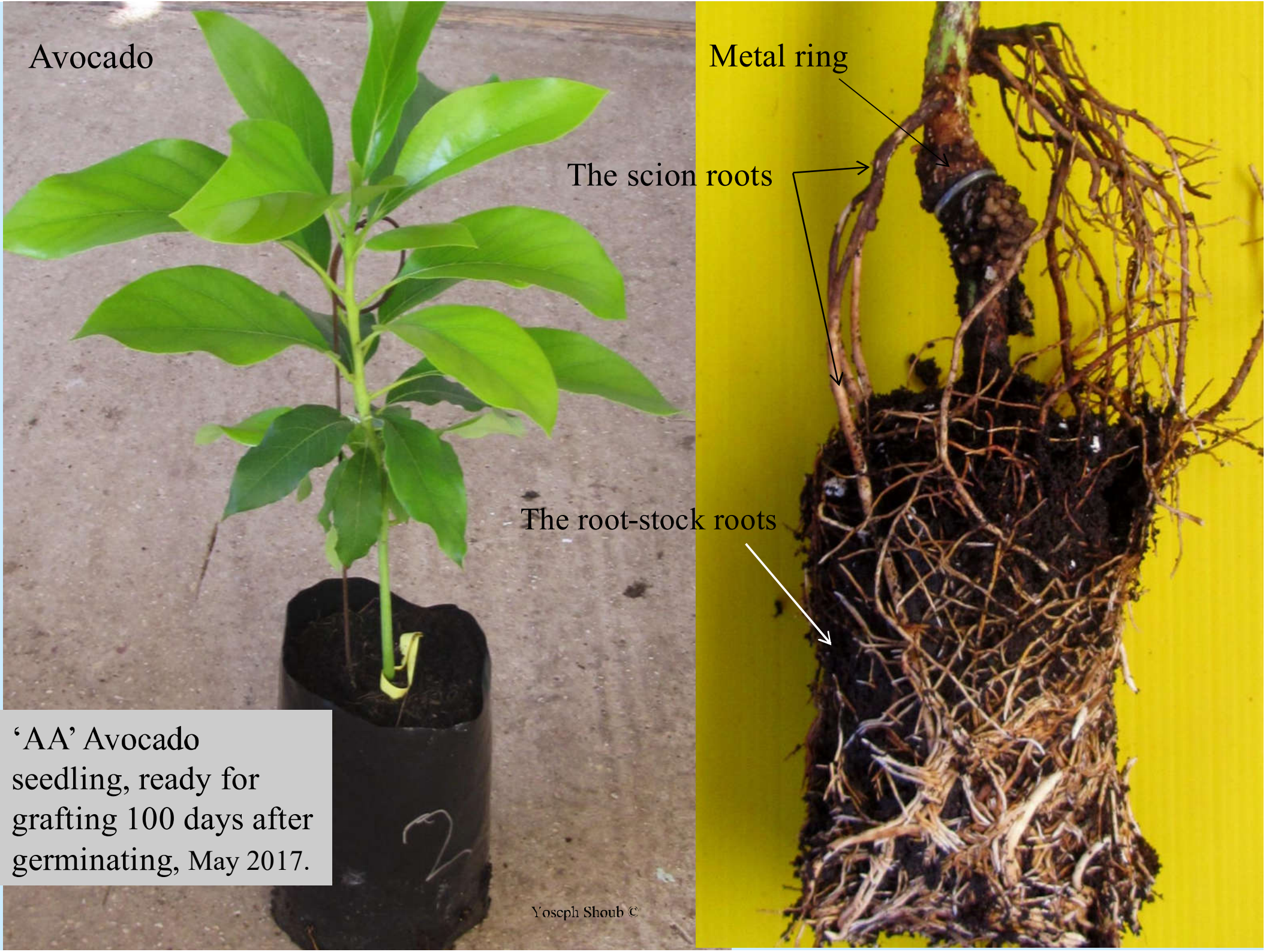
Root system of ‘AA’ Rose var. Don Juan, 34 weeks after planted as cutting, April 2016.



Secondary roots of 3-year-old citrus tree in soil controlled by 'AA' system.

Australia,

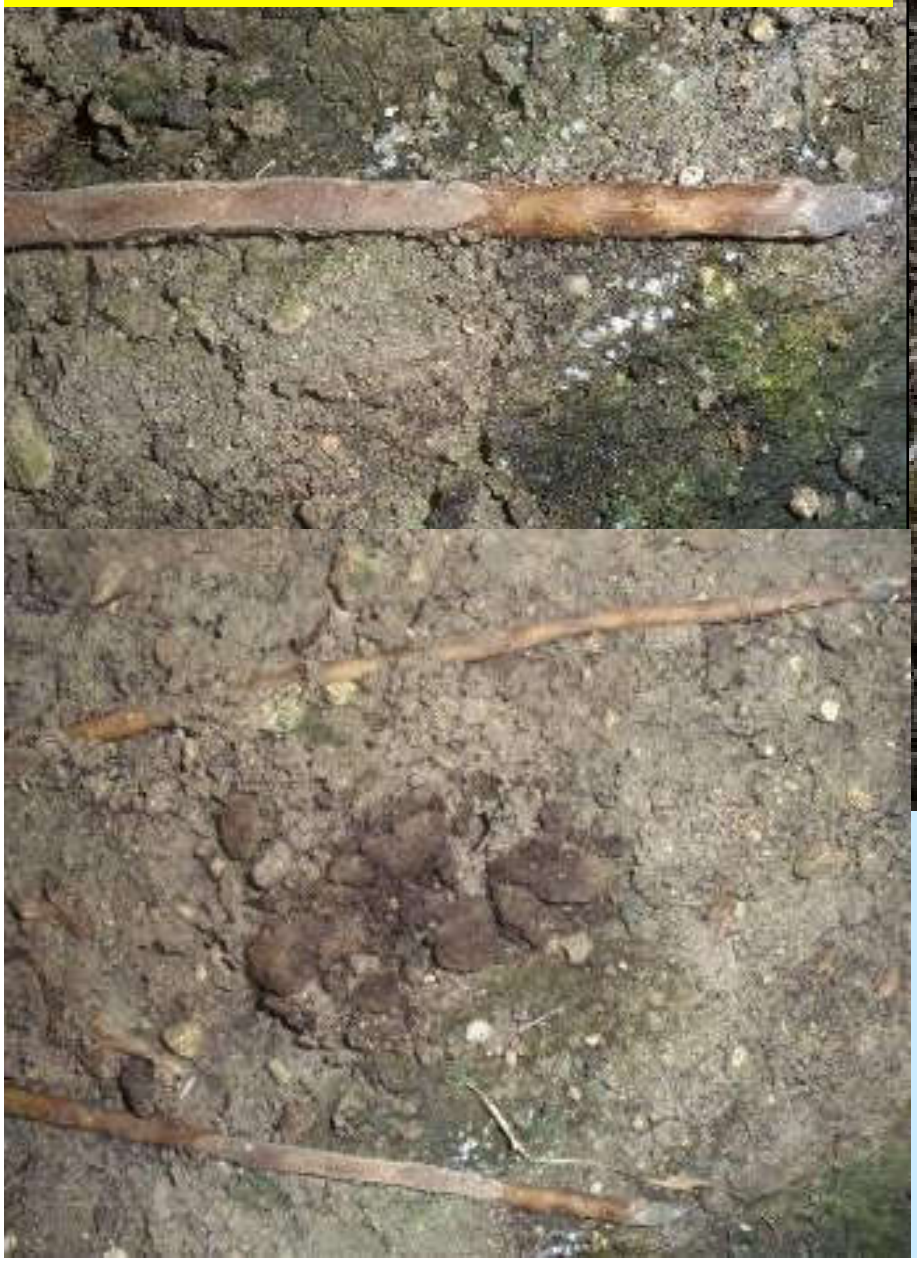
January 2010.



‘AA’ Avocado seedling, ready for grafting 100 days after germinating, May 2017.

Bananas' secondary-roots' performance in clay soil, the Jordan Valley, Israel October 2010.

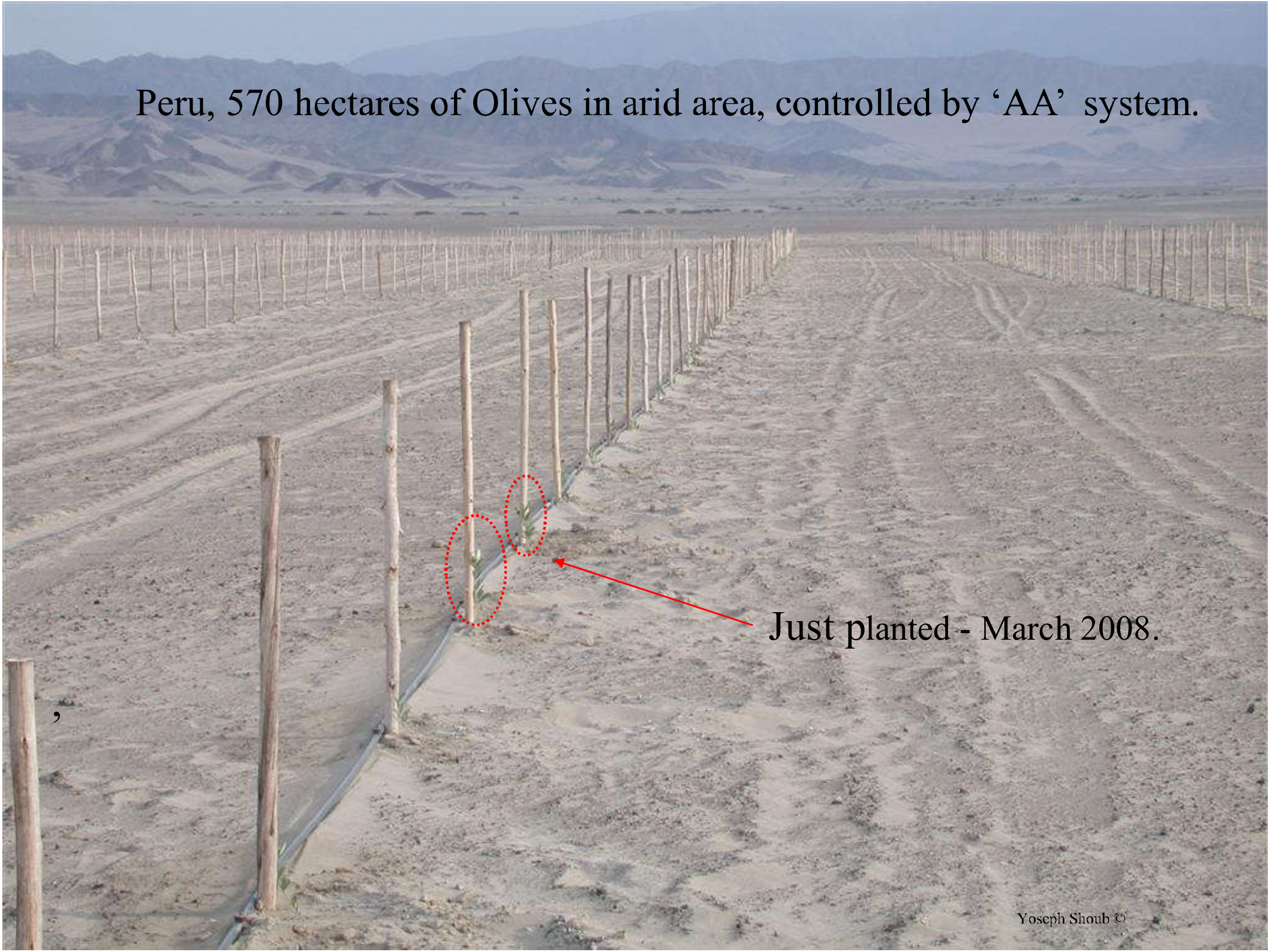
Under Conventional irrigation program.



Under AutoAgronom system.

It looks clearly that the roots of the Bananas grown in the same clay soil, but irrigated differently, develop their absorbing system differently.

"The plant is interested in the soil-solution.
The soil type is the growers' concern."


Peru, 570 hectares of Olives in arid area, controlled by ‘AA’ system.
Just planted - March 2008.
Yoseph Shoub ©

The same olives trees a year later - May 2009

The olive roots - July 2010

Chlorophytum comosum ‘Variegatum' under ‘AutoAgronom’ conditions Feb. 2017.

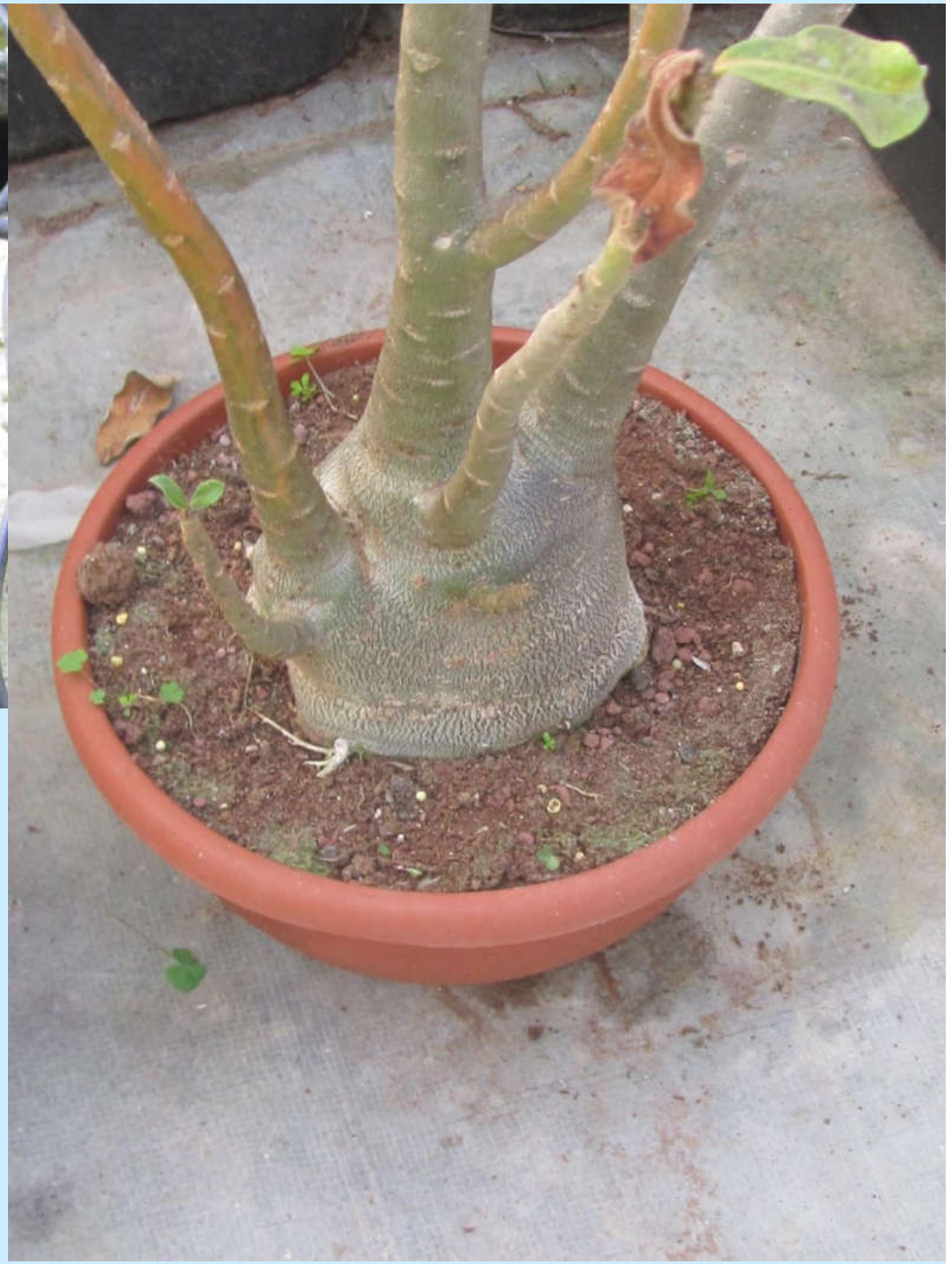
Numerous of ‘AA’ ‘Gardening plants’ at different ages, in different pots.

Thus, one can say - The plant is interested **only** in the soil solution!
The growing media is a physical factor, and it is the **grower's concern!**

We believe that the AutoAgronom is an efficient tool for roots-research.

We also assume; that roots' systems of various plants **do not reject *** to develop under the 'AA' optimal growing conditions.

* (*Even the Adenium arabicum)*



Adenium arabicum
"Desert Rose"
A succulents desert plant,
under 'AA' conditions,
January 2018.

For more information:

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www.gerberaisrael.com
www.selectaworld.com
www.autoagronom.com

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The end
Yoseph Shoub ©