השקיה מדייקת בחממות מבוססת ליזימטרים

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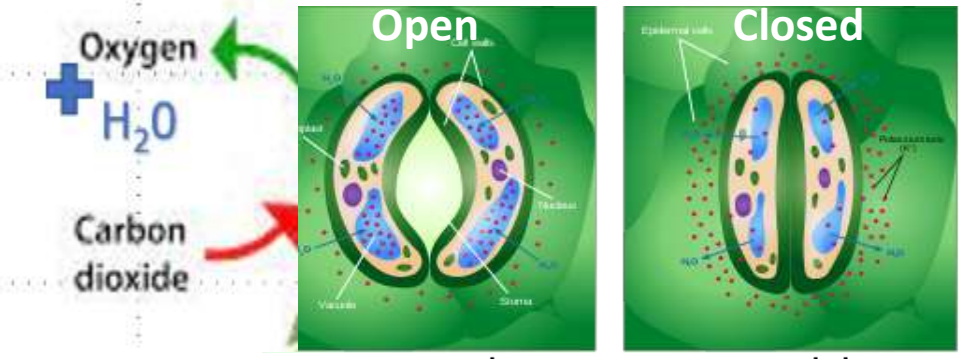
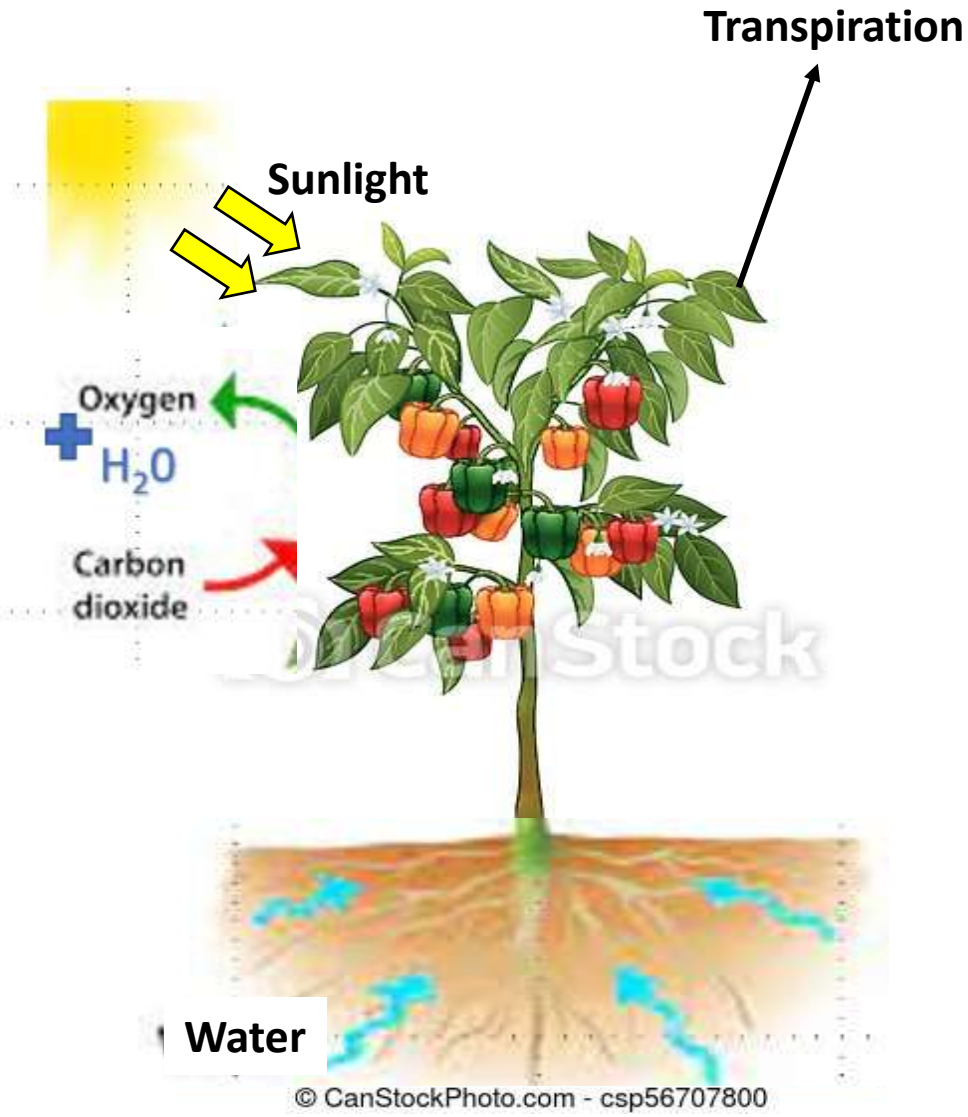
The Hebrew university of Jerusalem
The Robert H. Smith Faculty of Agriculture

הרצאה ביום עיון שרש דבר
במסגרת יום פתוח מו"פ ערבה
מרכז ויידור, תחנת יאיר 23/2/2022

Why to irrigate?

The plant uses only 5% of the water,
the rest (95%) is transpired to the atmosphere.





Why to irrigate ?

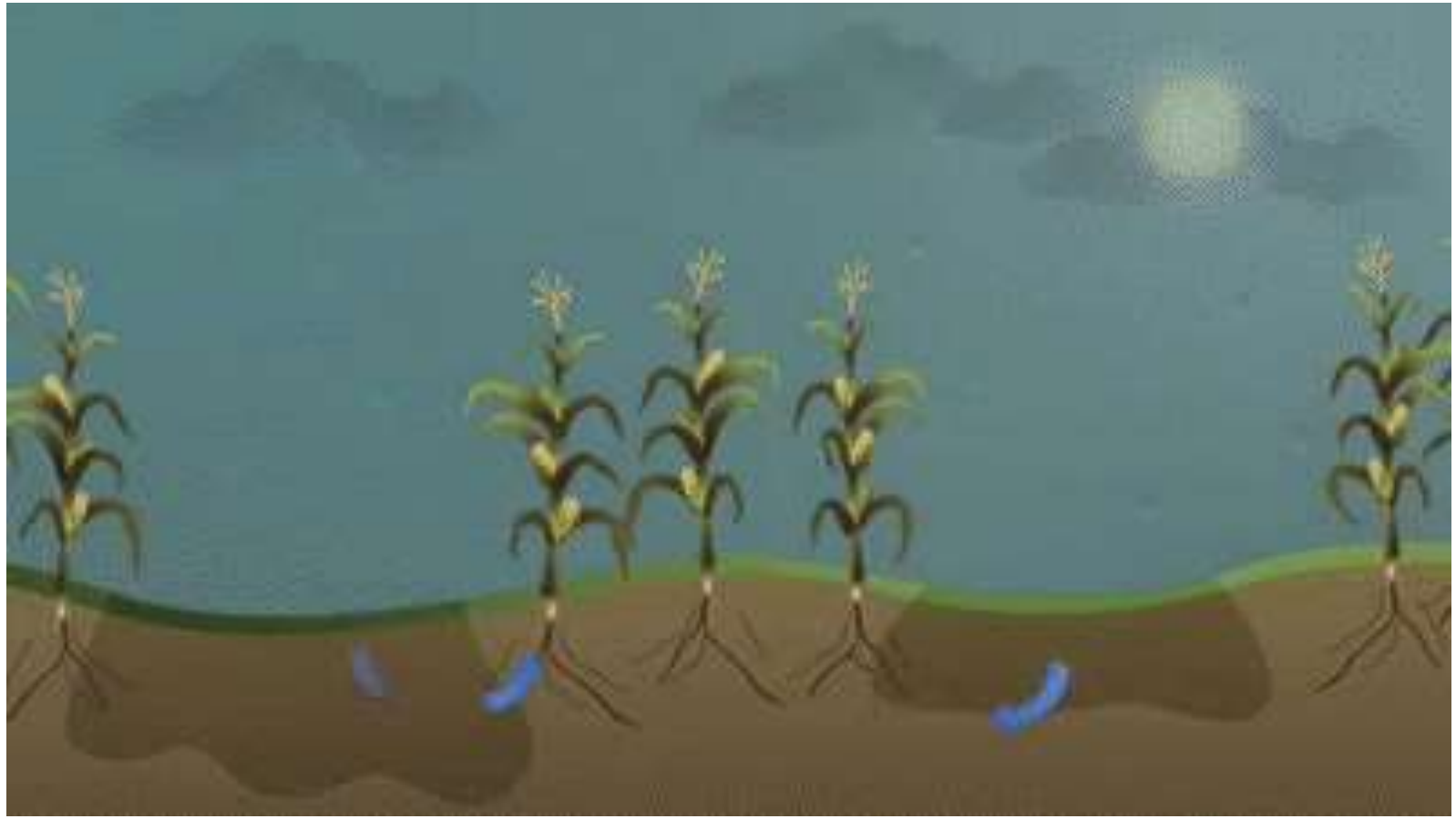
Average water loss for 1 plant **0.575** $\frac{L}{day}$

Maximum water loss for 1 plant **1.5** $\frac{L}{day}$

Total water loss(163 days) was 90-103 Litter (average 1 Plant)

Plant water loss

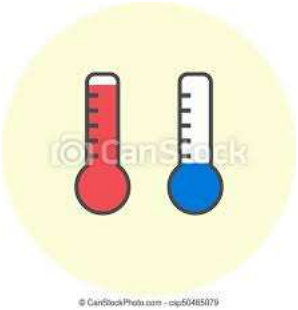
- Plant water demand is called **Evapotranspiration**
  - Evaporation – water loss from ground.
  - Transpiration – water loss from plant.



https://makeagif.com/i/xKdRFm

How much to irrigate ?

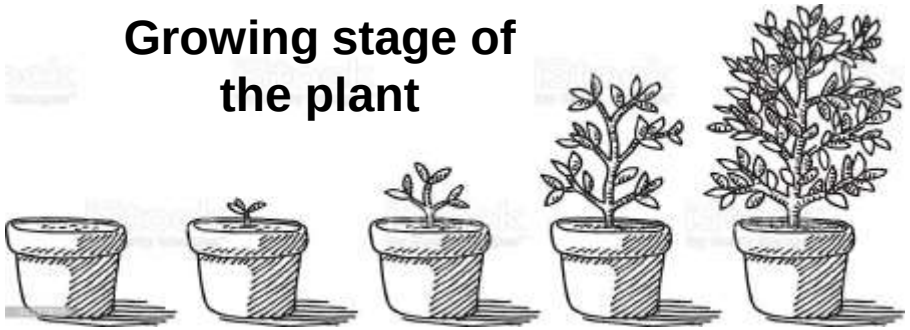
Temperature



Wind

Solar radiation

Growing stage of the plant



https://www.istockphoto.com/vector/potted-plant-growing-timelapse-drawing-gm472375179-31145776

Effects of over irrigation on the environment

- Overuse of water
- Crop damage and yield decreases
- Soil salinification and damages (erosion)
- Groundwater contamination

Solutions ?

https://www.mdpi.com/2073-4395/10/9/1238type=check_update&version=1

Alternative irrigation solution

The FAO-56 Penman-Monteith (FPME)

unit's: $\frac{mm}{day}$ or $\frac{m^3}{dunam} = \frac{1000\text{L}}{\text{dunam}}$

$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T+273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$

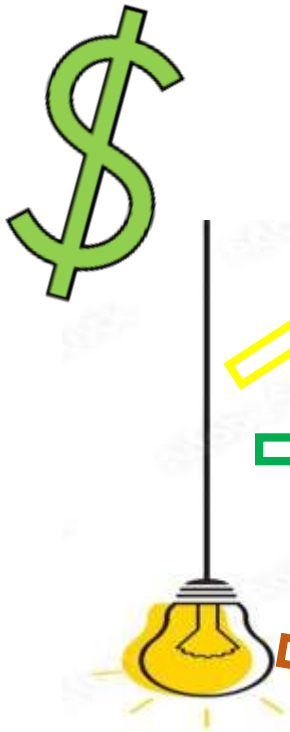
ET_0	reference evapotranspiration (mm day^{-1})
R_n	net radiation at the crop surface (MJ m^{-2} day^{-1})
S (or G)	soil heat flux density (MJ m^{-2} day^{-1})
T	mean daily air temp at 2 m height (°C)
u_2	wind speed at 2 m height (m s^{-1})
e_s, e_a	saturation and actual vapor pressure (kPa)
e_s-e_a	vapor pressure deficit, VPD (kPa)
Δ	Slope of vapor pressure curve (kPa °C^{-1})
γ	Psychrometric constant (kPa °C^{-1})

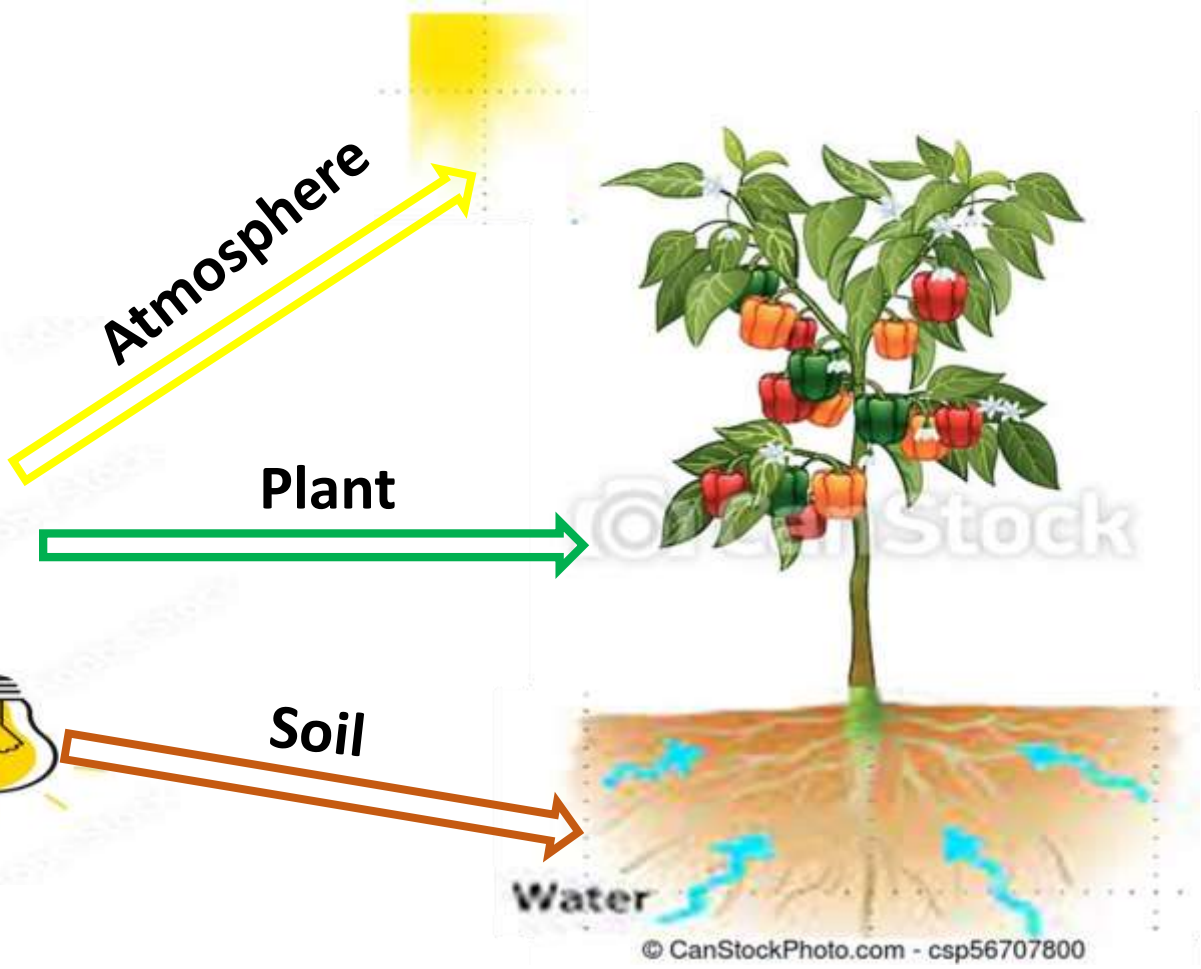
Consider special and temporal differences ?

https://www.mdpi.com/2073-4395/10/9/1238type=check_update&version=1

Alternative irrigation solutions

How to irrigate **precisely**?





Viridix

SupPlant
Unmute your Crops

Saturas
InTree Water Monitoring

Phytech

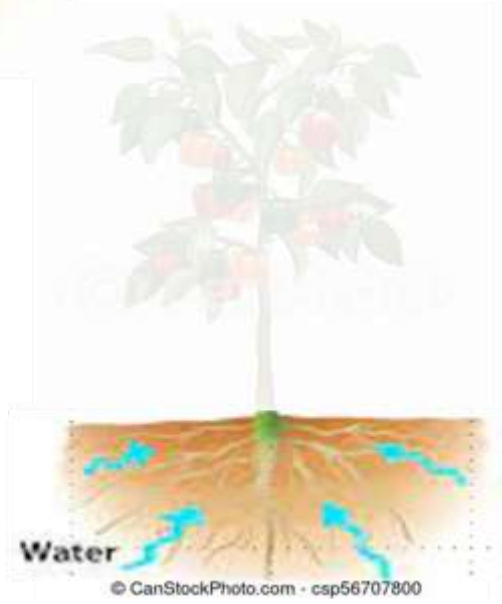
Tevatronic
AUTONOMOUS IRRIGATION

cropx

Alternative irrigation solution

Soil

Tensiometers and Soil Prob



Viridix

cropx

Tevatronic
AUTONOMOUS IRRIGATION

Alternative irrigation solution

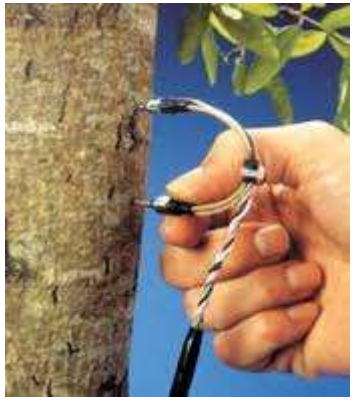
Plant

Dendrometers

SupPlant
Unmute your Crops

Phytech

Sap Flow



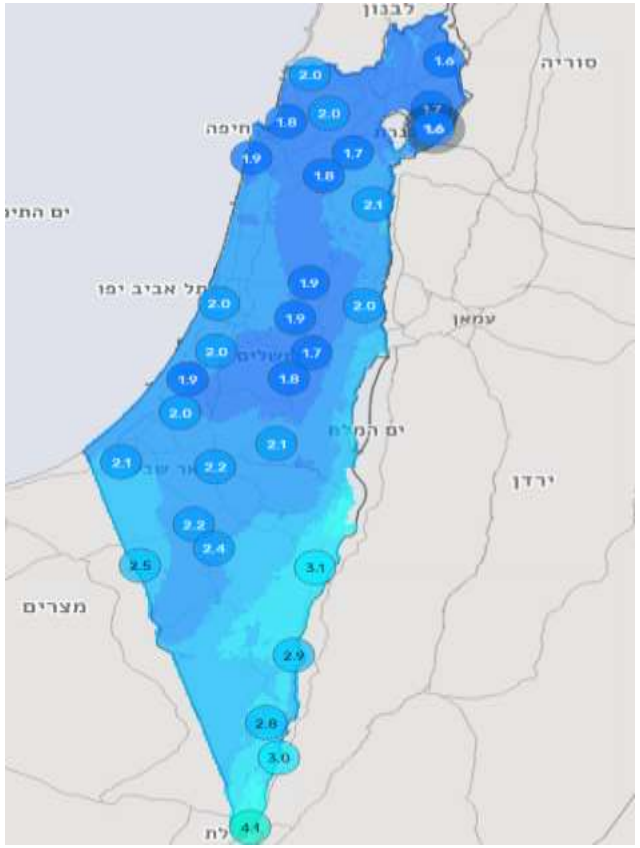
Stem Water Potential

Saturas
InTree Water Monitoring

http://www.concordscientificdevices.com/solor-science/fldl-sap-velocity-system.html

Alternative irrigation solution

Far sensing

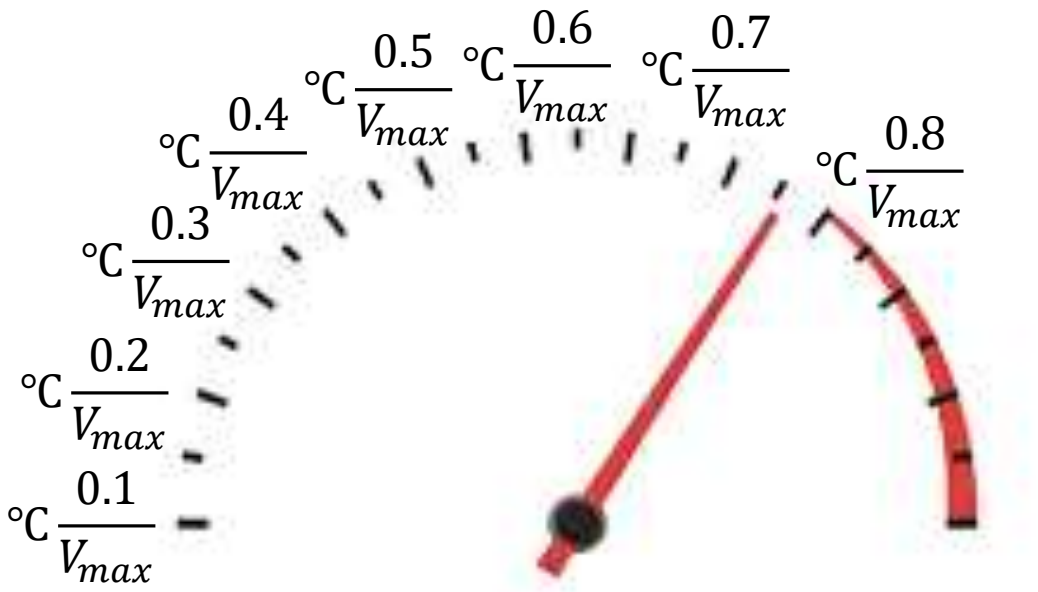


https://eos.com/blog/drones-in-agriculture-make-way-for-satellite-monitoring/

Precise irrigation

Most method will give you the **estimation** of the **evapotranspiration**

Car speedometer



THE HEBREW UNIVERSITY OF JERUSALEM

How to irrigate according to absolute plant demand ?

– how to measure absolute evaporation?

– what are the effects on plants physiological processes ?

– what is the effect on plant yield?

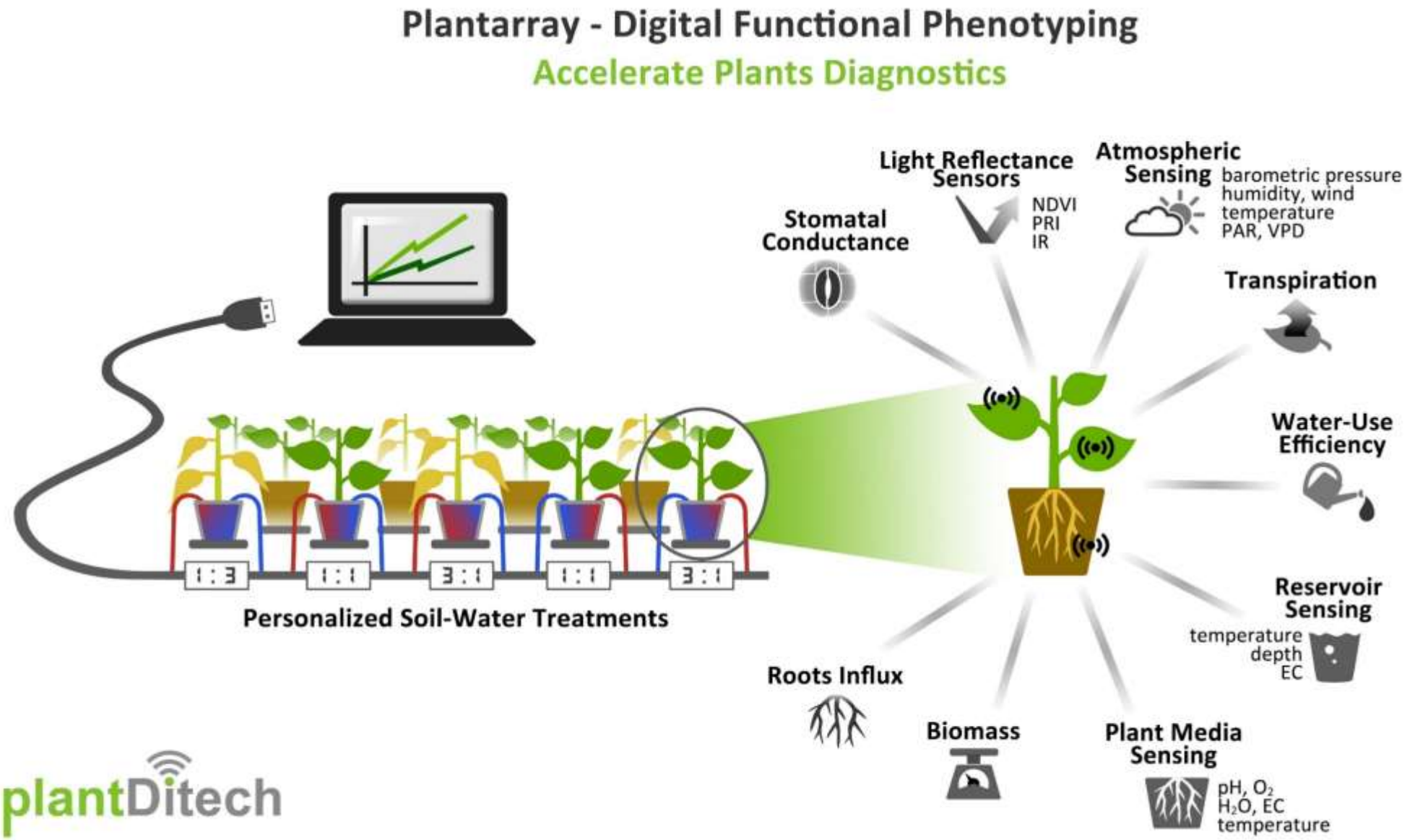
Precise irrigation – absolute measurements

Controller

Feedback irrigation system

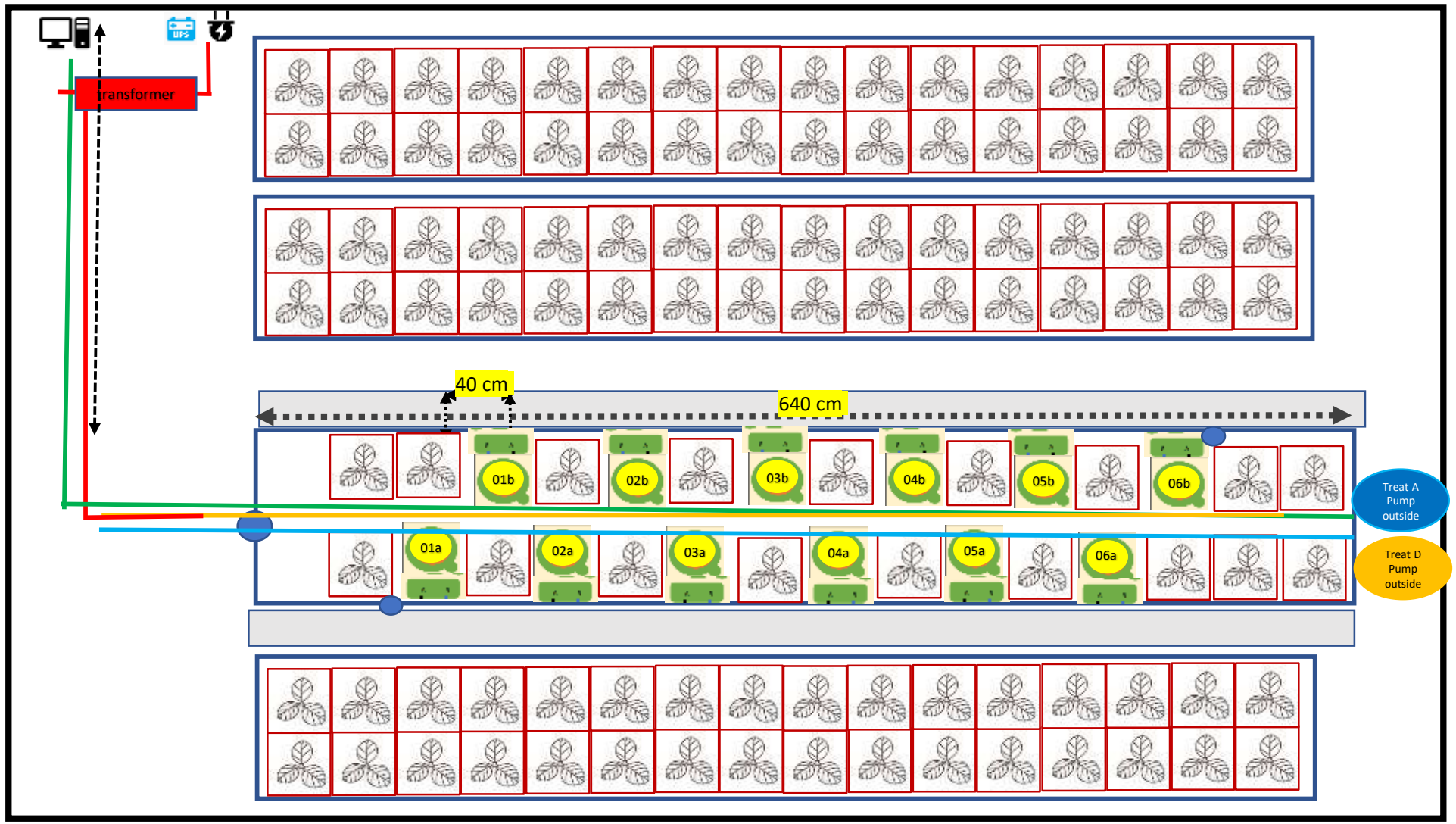
plantDitech

Precise irrigation – absolute measurements



http://www.plant-ditech.com/

My experiment setup –top view



Electricity point

Plant ditech pot + controller

Power supply to controller

transformer

UPS

Electricity, communication and Watch dog – שרוול

Pipe Treat D

Pipe Treat A

בזנט תחנה מטאורולוגית

עציץ מוגבה בשוחה
כ-16 עציצים בשורה * 2 שורות

תוספת 5 ס"מ כל צד לשלוחת
ליזימטרים – לצורך תחזוקה

Treat A – Fertilizer Stop 30 days

Treat D – No Fertilizer stop

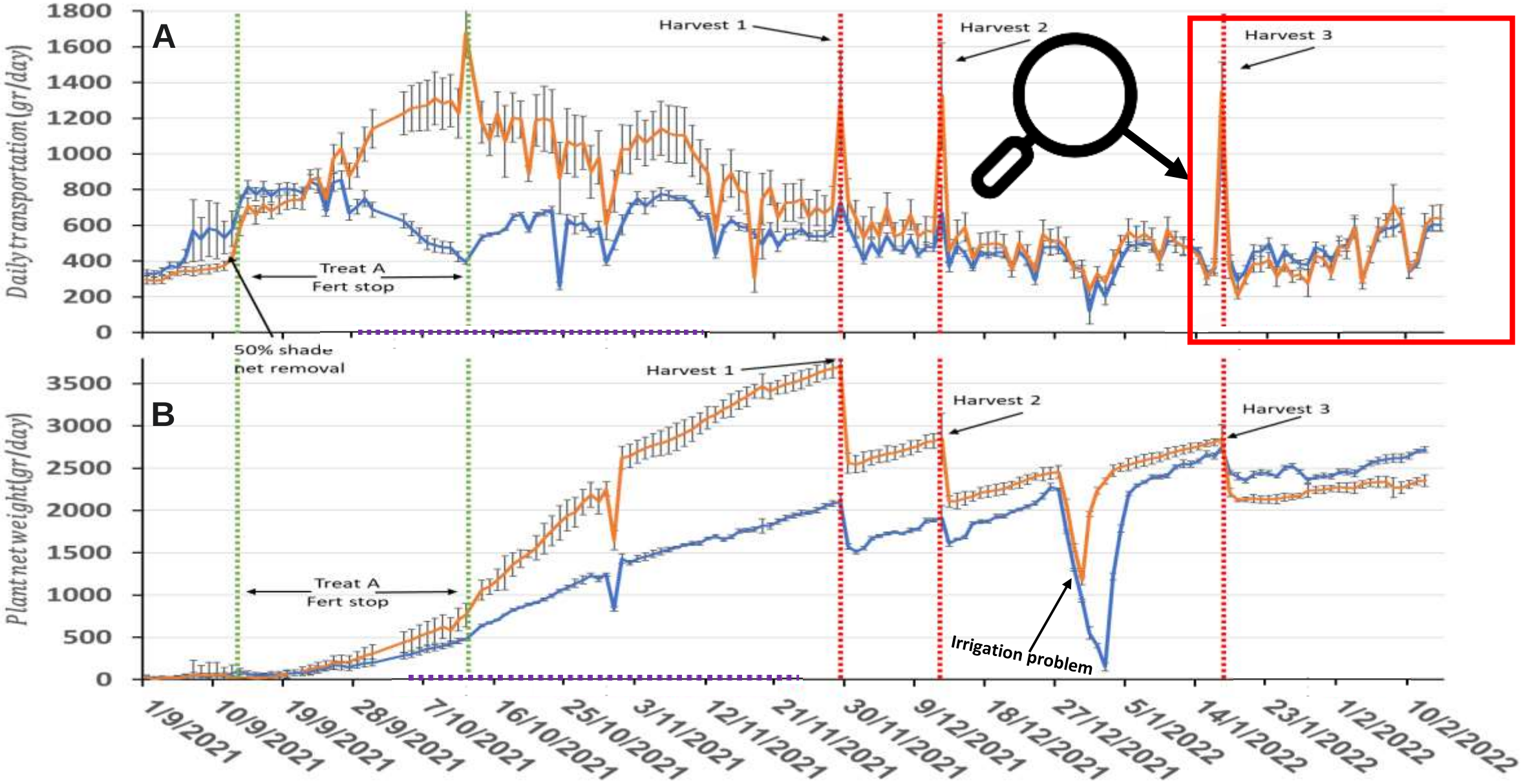
Plant demand absolute measurements

Lysimeter System

13.09.2021 14.12.2021 10.02.2022

Experiment Results - Plant

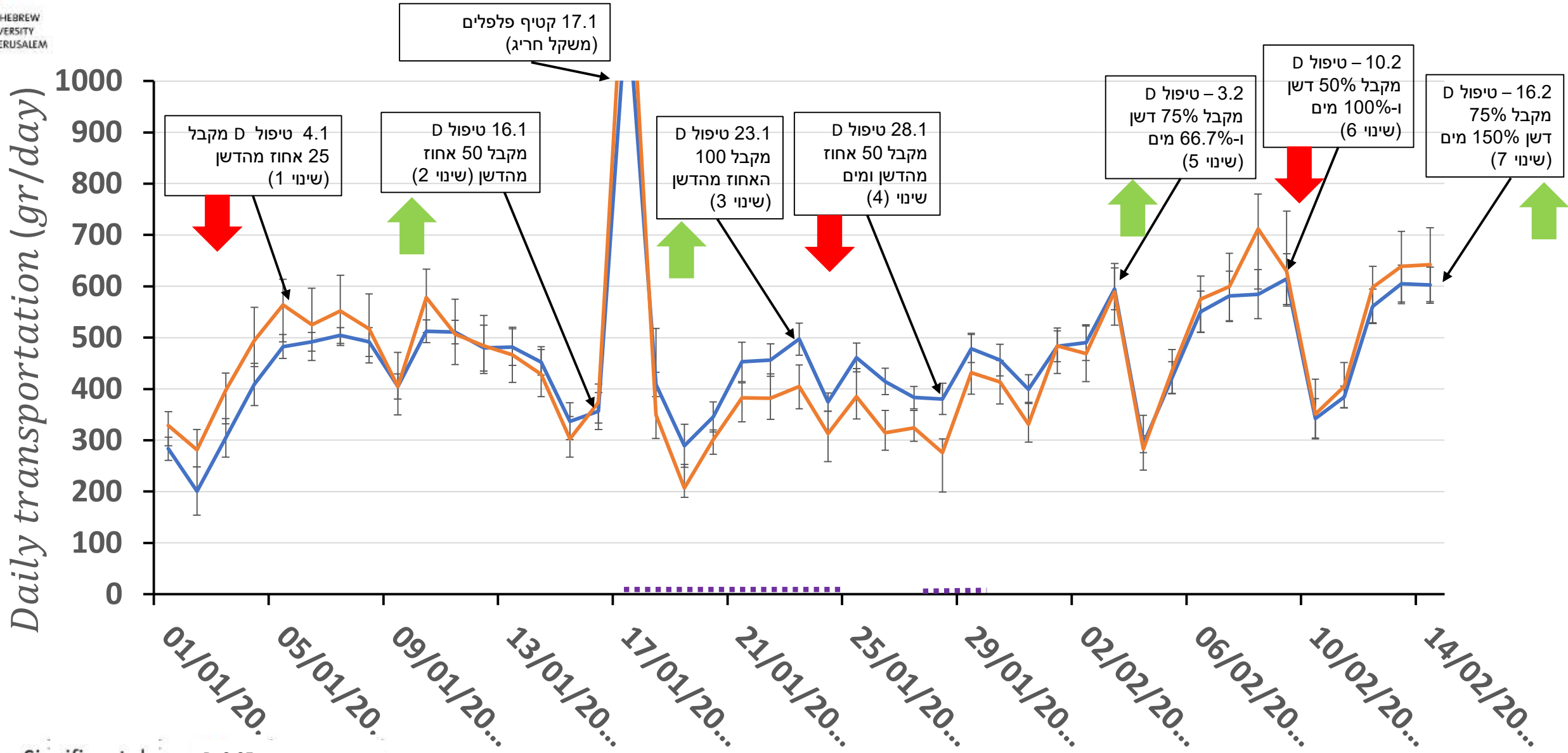
Ofer Dahan experiment



Significant days P<0.05

Treat A – Fertilizer Stop 30 days Treat D – No Fertilizer stop

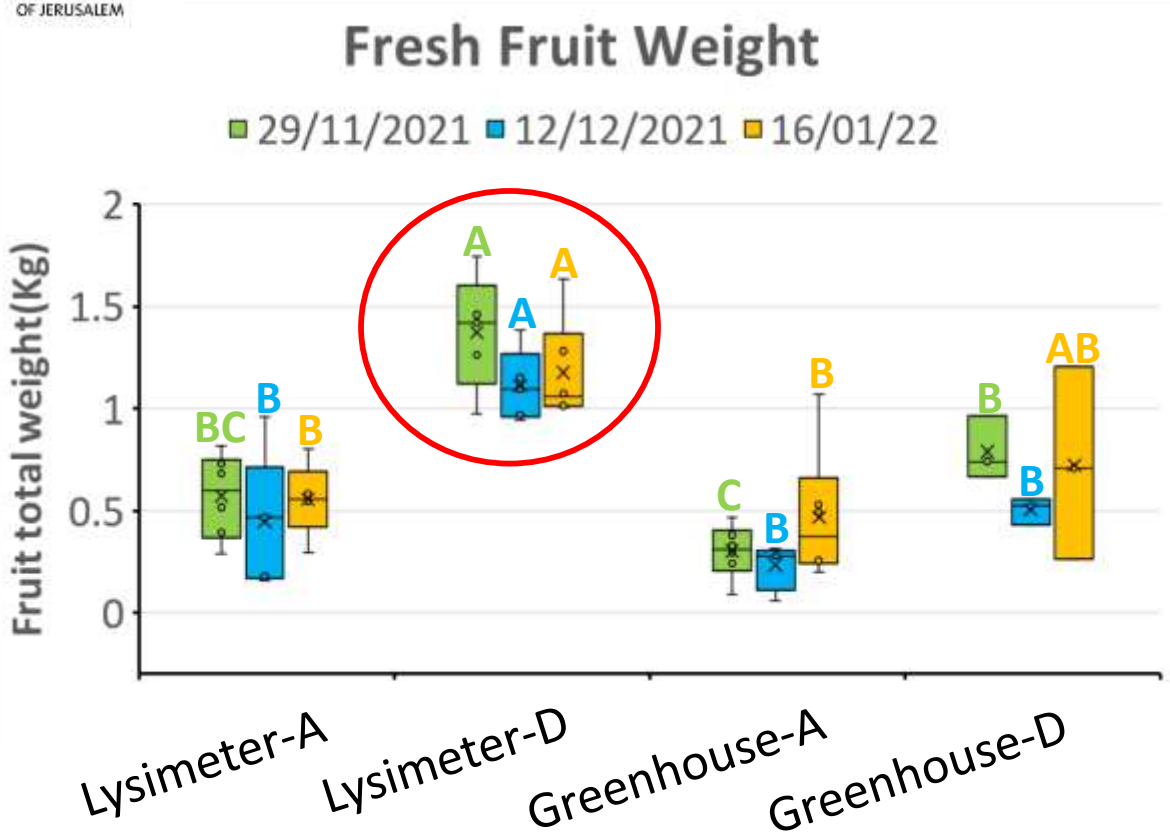
Ofer Dahan – “zoom in” - plant



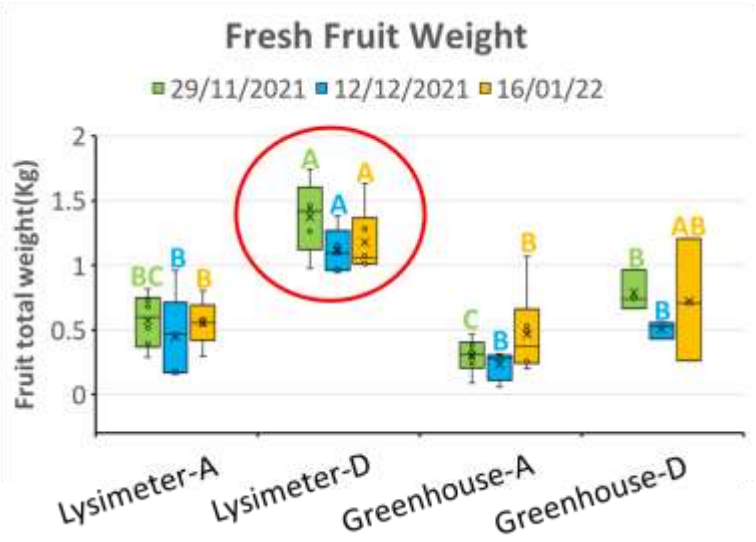
Significant days P<0.05

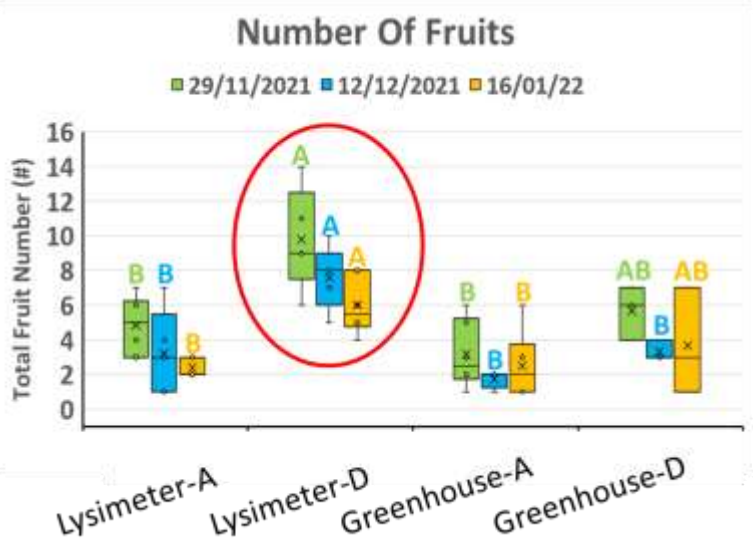
Treat A – Fertilizer Stop 30 days Treat D – No Fertilizer stop

Experiment Results - Fruits



Experiment Results - Fruits





		Average harvest weight(Kg)	Total harvest weight(Kg)	Total irrigation per plant(Litter)	Water per 1 Kg of average fruit weight $(\frac{Litter}{Kg})$	Water per 1 Kg of total fruit weight $(\frac{Litter}{Kg})$
Treat A	Greenhouse	0.789	5.528	~151.81	192.39	27.462
	Lysimeter	1.405	8.434	111.42	79.302	13.21
Treat D	Greenhouse	2.016	6.048	~151.81	75.29	25.10
	Lysimeter	3.246	19.456	124	38.2	6.373

Treat A – Fertilizer Stop 30 days Treat D – No Fertilizer stop

Results

- Lack of fertilizer causes stress to plants, effecting their physiological processes and fruit production.
- Irrigation by transpiration method produced higher yields per plant with less water per plant.
- Expanding the experiment to multiple greenhouses could allow to better understand how to irrigate plant precisely

Thanks

Roots of the Matter

Central & Morthen Arava-Tamar **R&D**

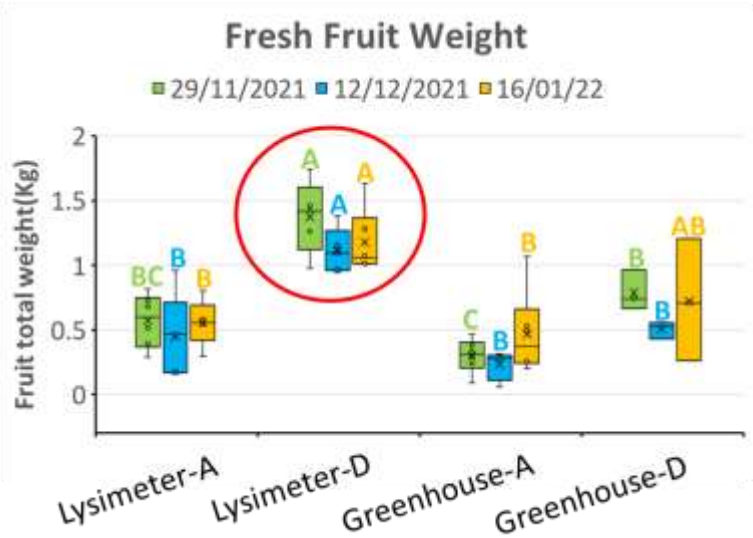
Plant Ditech Team

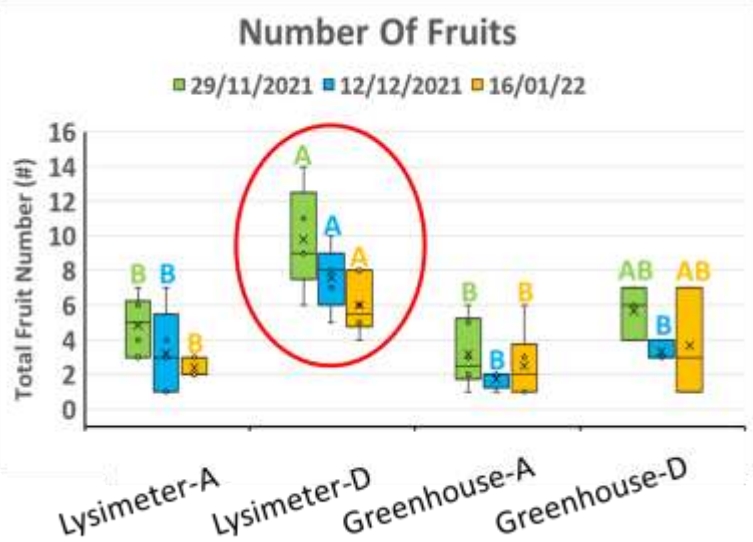
Noam Dacosta

Prof Moshelion lab members

Questions ?

Experiment Results - Fruits





תוצאות לא סופיות

	Average harvest weight($\frac{kg}{m^2}$)	Total harvest weight($\frac{kg}{m^2}$)	Total irrigation per plant(Litter)	Water per 1 Kg of average fruit weight ($\frac{Litter*m^2}{Kg}$)	Water per 1 Kg of total fruit weight ($\frac{Litte*m^2}{Kg}$)
Treat A					
Greenhouse	2.627	18.408	~505.527	192.39	27.462
Lysimeter	4.678	28.11	371.028	79.302	13.21
Treat D					
Greenhouse	6.173	20.139	~507.527	75.29	25.1
Lysimeter	10.809	65.088	412.92	38.2	6.373

Treat A – Fertilizer Stop 30 days Treat D – No Fertilizer stop