



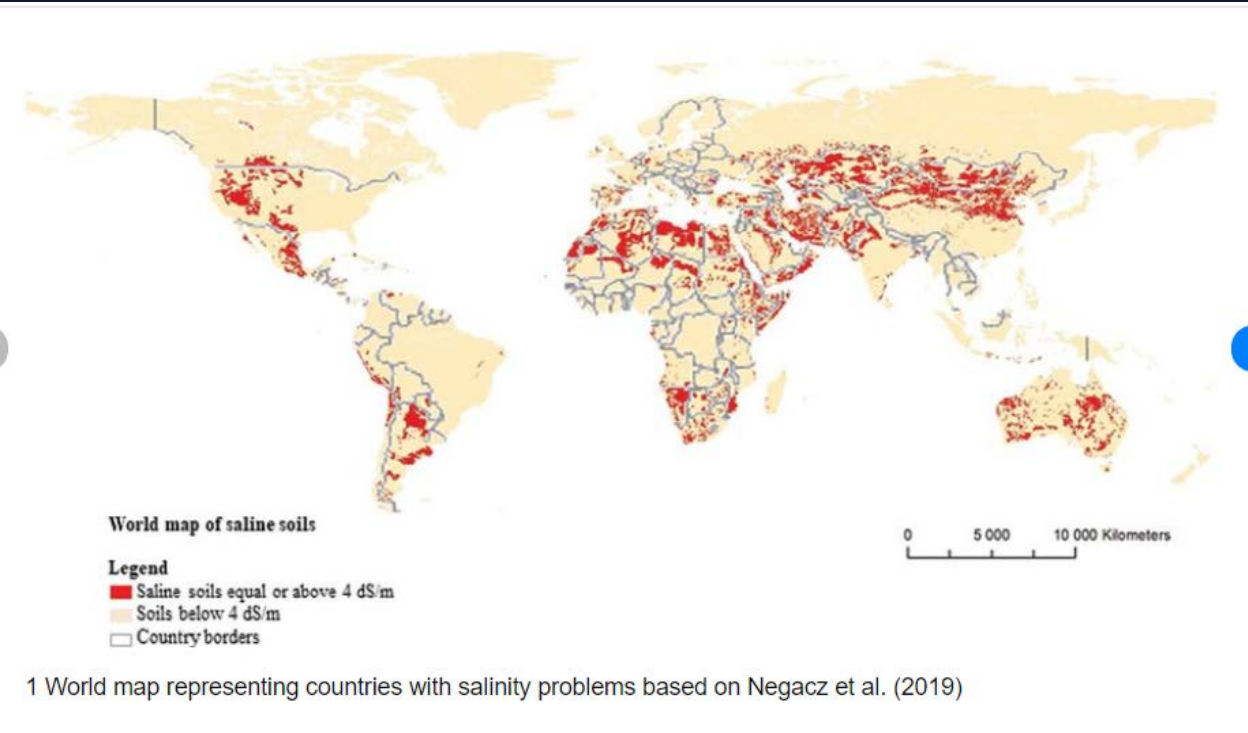
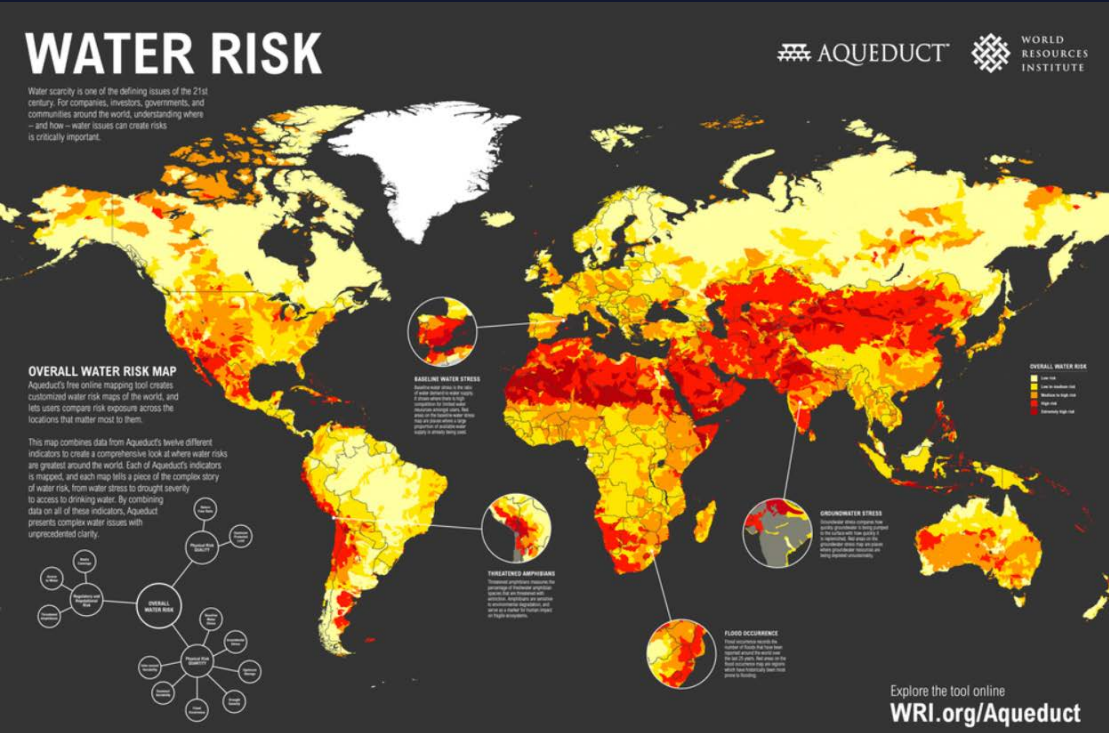
AQUA4D<sup>®</sup>

[ Swiss efficiency. ]

**Sustainable Avocado Production:  
Managing Salinity While Boosting Water  
Efficiency**

**Manejo de la Salinidad mientras se  
Aumenta la Eficiencia del  
Agua**

**Enrique Rebaza**  
Chief Agronomist, AQUA4D







**AQUA4D®: a unique technology that makes it possible to irrigate with saline water and restore salt-saturated soils while using less water.**

## Our technology

### Customized Technology as a Service (TaaS) for Agriculture 4.0

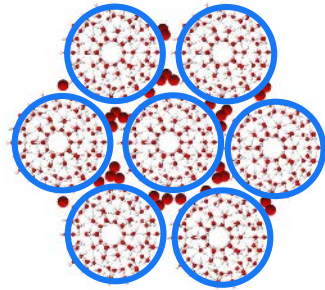
Quantifying and adjusting is integral to maximizing the impacts of our technology: If you cannot measure it, you cannot manage it.

Our technical teams use the latest monitoring and IoT tools to track on-field developments in real time, then suggest adaptations to increase efficiencies and achieve the best results.

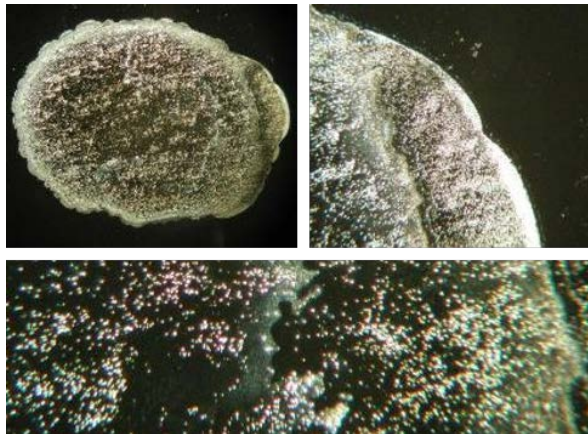




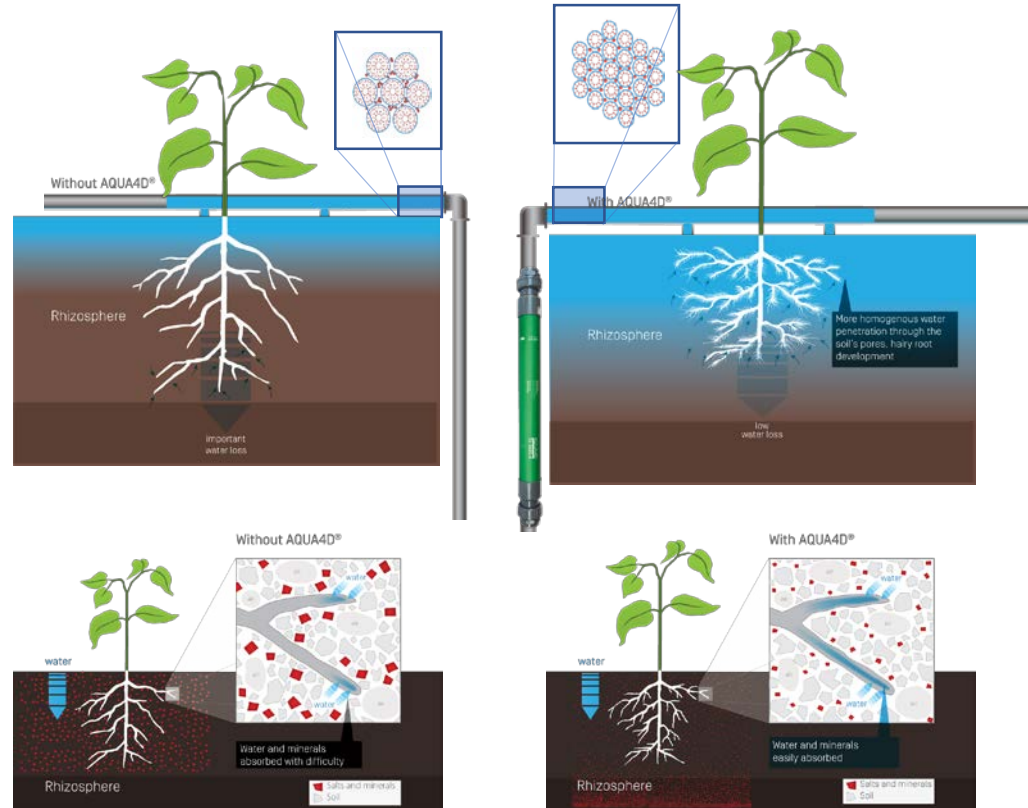
Non-treated water



Irregular border, irregular coarse distribution, tendency to coagulate



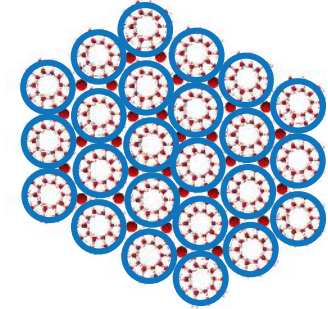
Improve water penetration & retention of irrigation water



Water-Smart Swiss Efficiency

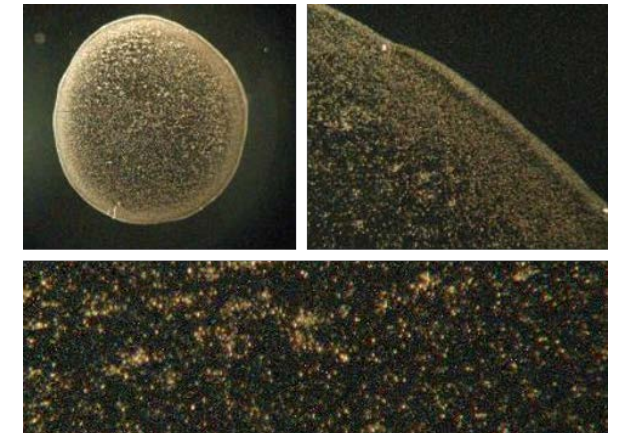


Treated water

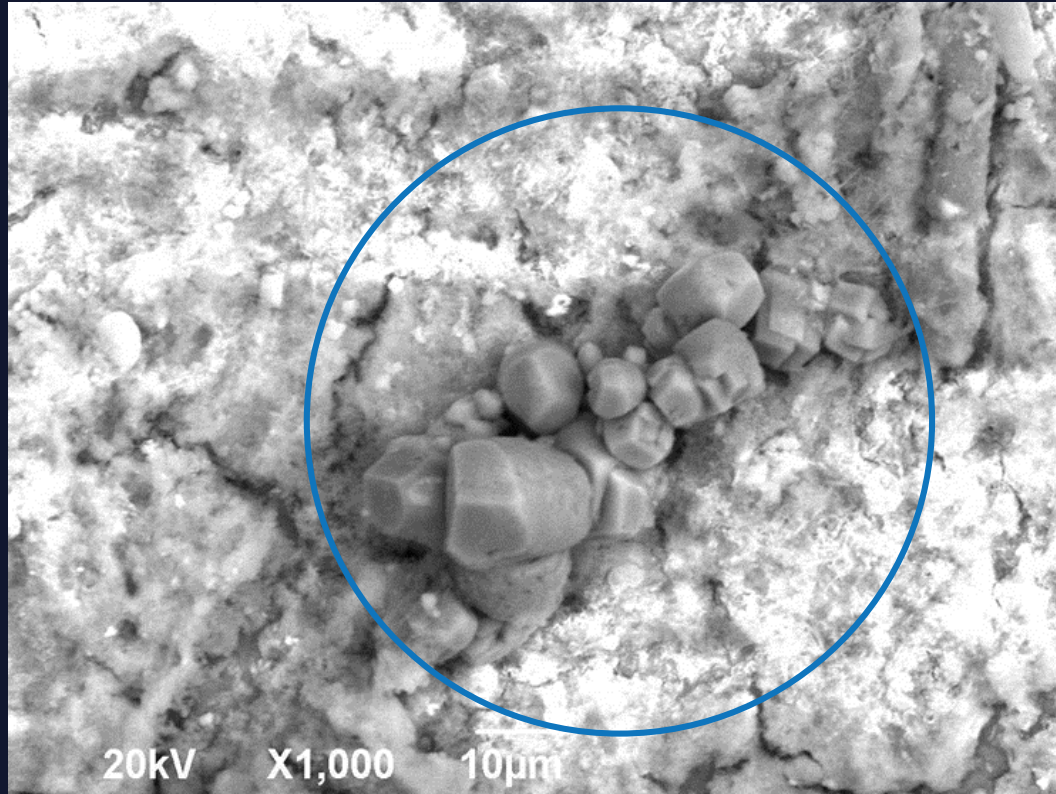


Improved water properties

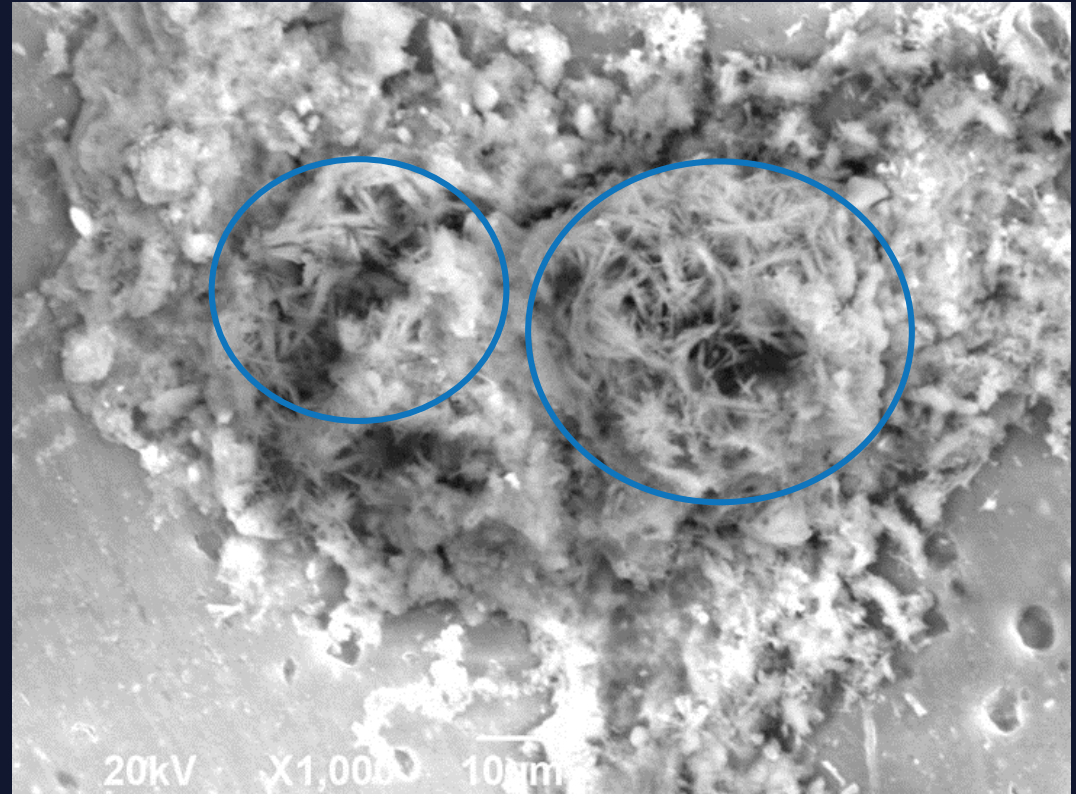
Different molecule structure



Calcium carbonate example (microscopic observation)



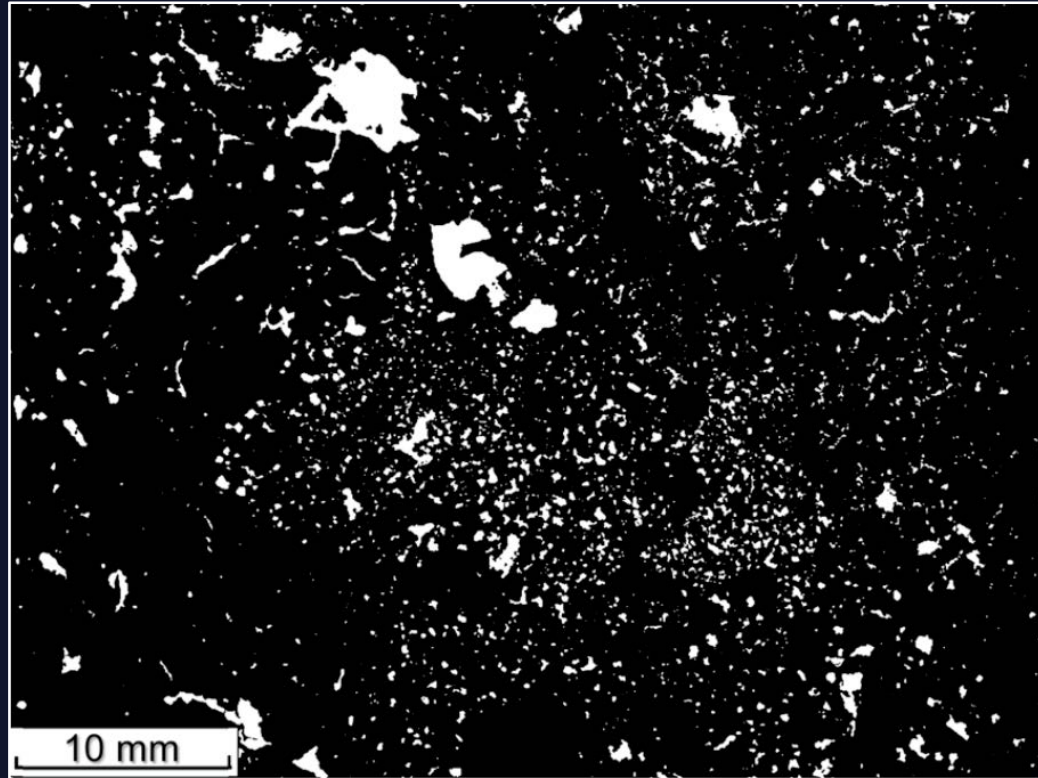
**Calcite crystals : Cubic shape**  
Without AQUA4D®



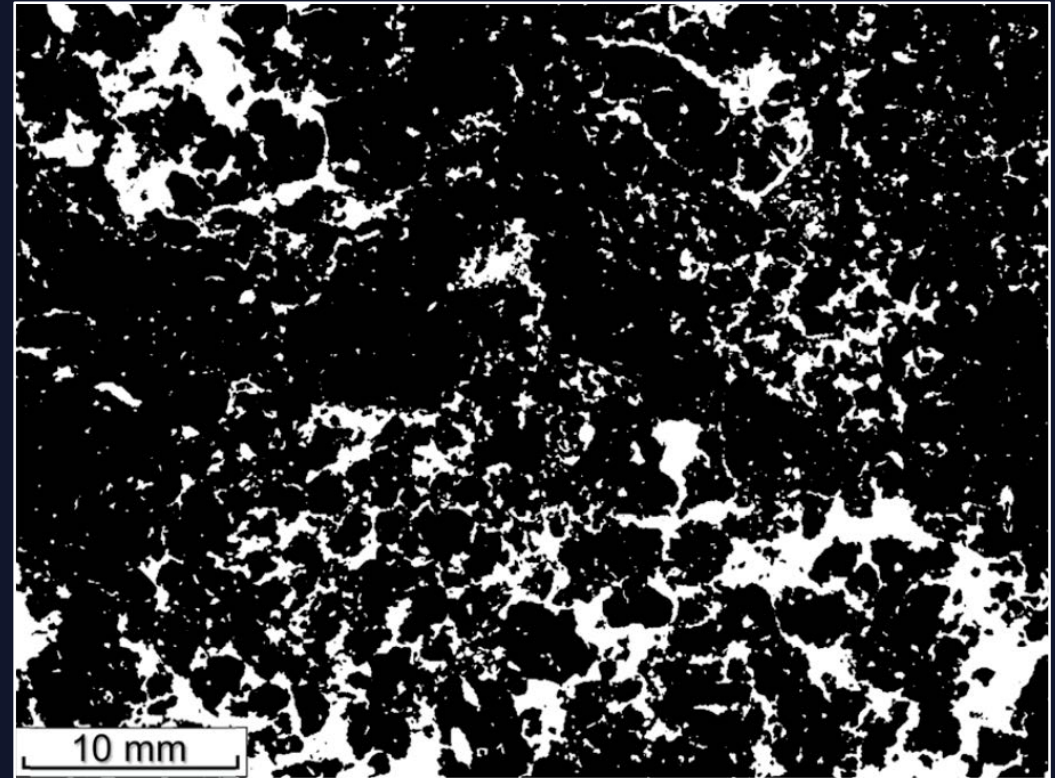
**Aragonite crystals : needles**  
With AQUA4D®



Images of soil porosity at the **macroscopic** scale



**Control group**



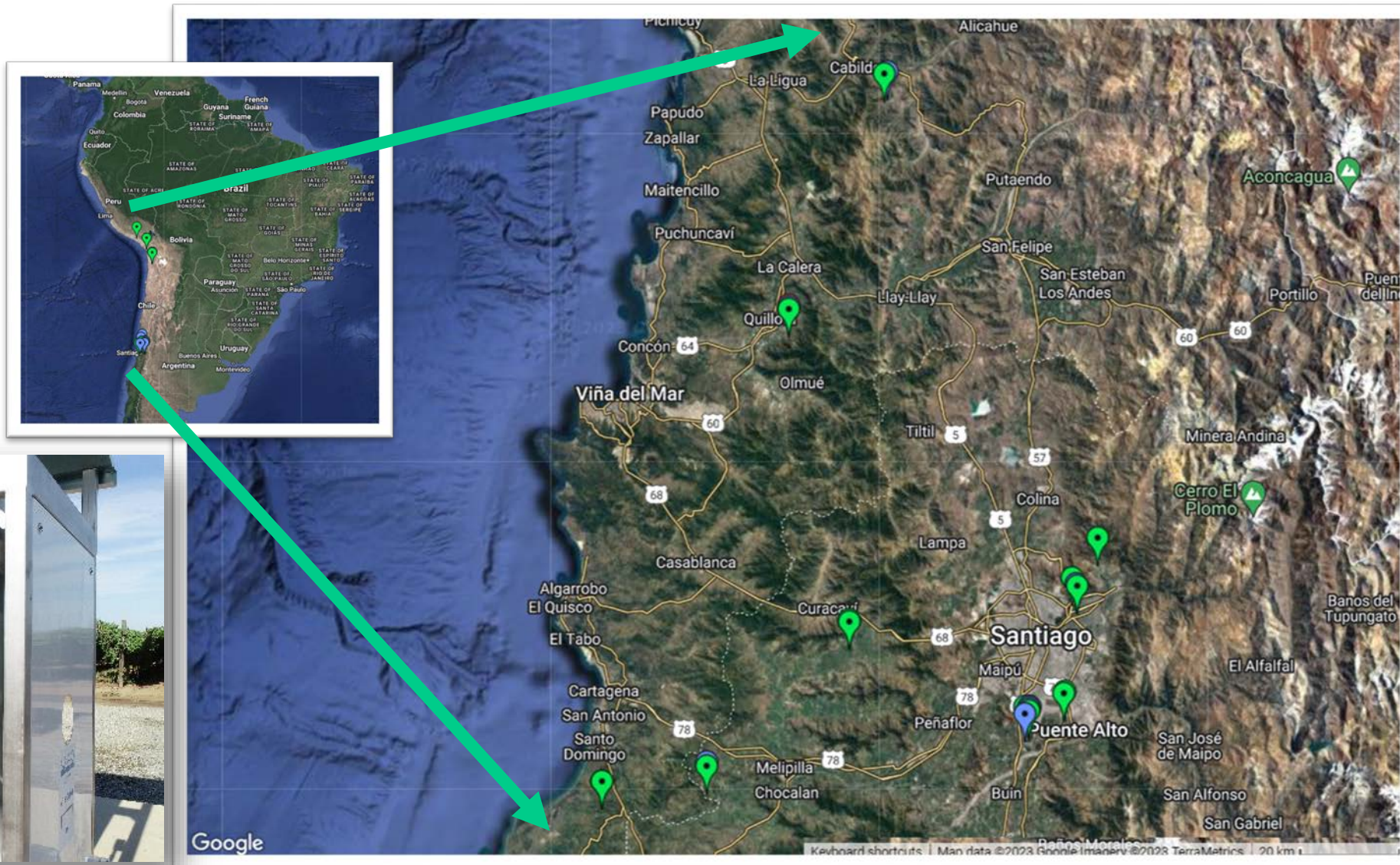
**AQUA4D® treated irrigation**



## Water-efficient avocado production

### Locations:

- Perú - Chinchá
- Chile - Cabildo, Quillota, Melipilla, Santo Domingo



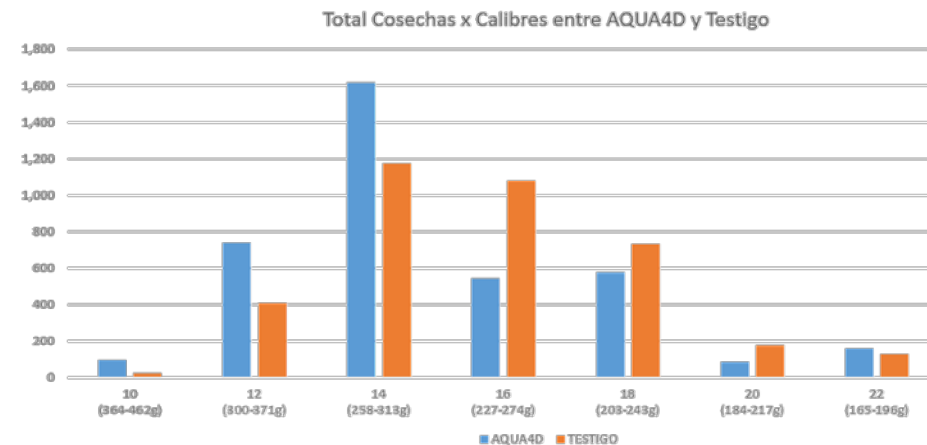
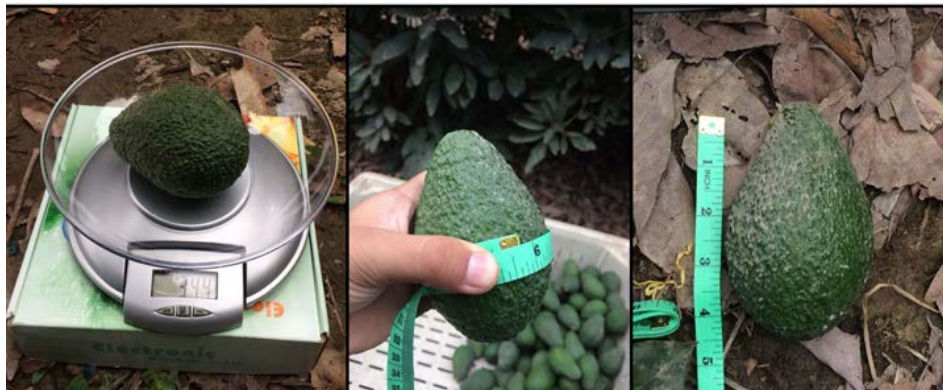


- Hass / rootstock Topa Topa (mexicano) grown in sandy soil on “Camellones” (humps),
- 4 driplines per tree row in a soil with initial EC 2.8 ds/m.
- Facing a fast yield drop compared to the farm average (6 vs 17 ton/Ha.- 2016);
- 2017-2018 season was watered with 13000 m<sup>3</sup>/Ha and a sector was installed with AQUA4D®:



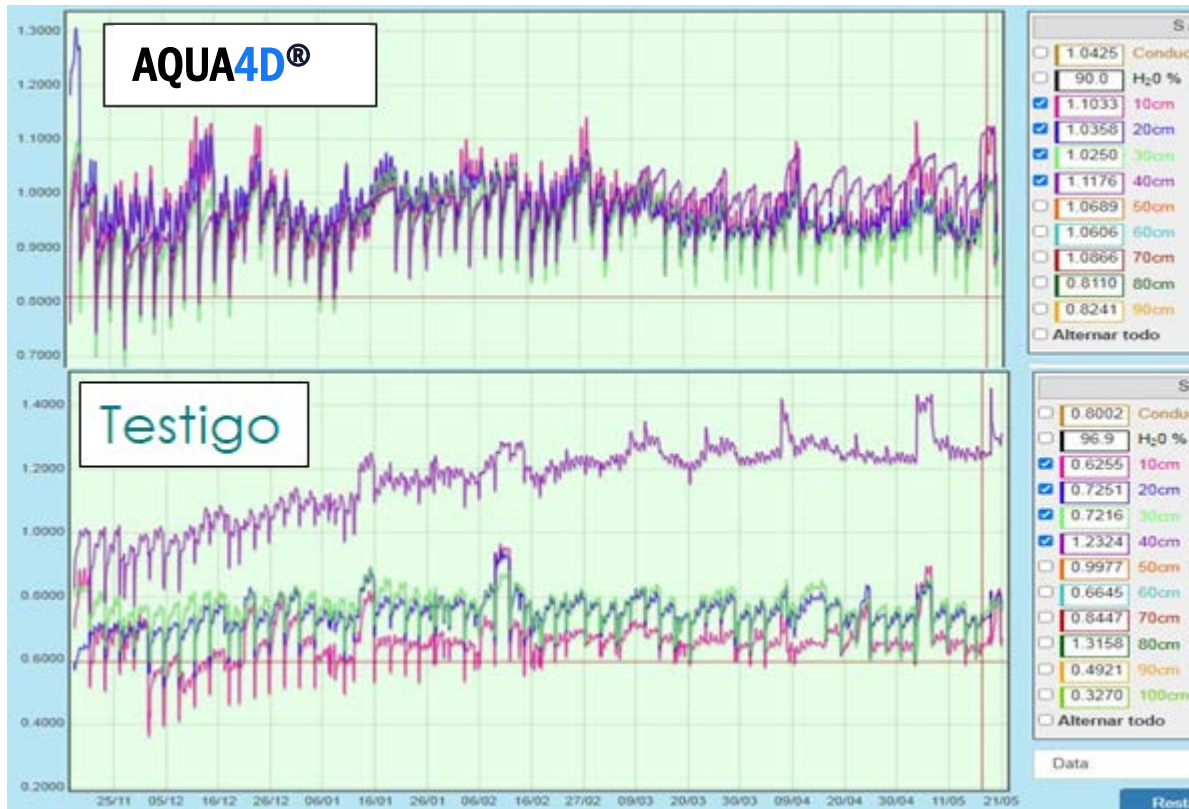
At end of 2018 season (June harvest) our comparative data showed the field irrigated with AQUA4D®:

- Registered lower EC at levels close to the surface and higher EC at deeper levels compared to the control.
- Irrigation uniformity of the drippers with AQUA4D® was 87% and of the control plot was 67%.
- Soil analysis showed nitrogen and phosphorus were more available and foliar analysis showed uptake of nitrogen, potassium, magnesium, calcium and iron were higher than the control.
- Visual observation showed trees with better growth and better branches for 2019.
- Fruit weight: Sampling showed that the field irrigated with AQUA4D® had fruit weighing 16% more on average, 5% greater circumference, 9% greater height or length, and 5% better export-quality fruit, as well as less discarded fruit.





*Given previous successes and the drought situation in Chile, we started a series of work in different fields, such as in Quillota in a Hass/Mexicola avocado (PRJ#00888-2020) with monitoring via soil probes and calicatas.*



- The problem: salt accumulation at 40 cm and poor irrigation and moisture distribution.
- Since November 2020 we started the monitoring and management of salts with an **AQUA4D®** batch and a control, using drip irrigation and focus on the active root system, irrigations in equal frequency and volume.
- In a few weeks and for 7 months the EC recorded with **AQUA4D®** irrigation shows no salts accumulation in the first 40 cm (0.8 dS/m at present).
- We reduced by 20% the volume of irrigation water based on good field moisture: Higher water content in the soil profile compared to the control in the active root zone.

- We worked from September 2020 to March 2022 on clay to silty soils, with stoniness up to 50% and slopes up to 50°.
- The objective was water efficiency of the irrigation system by increasing the size of the irrigation bulb with **AQUA4D®** with equal or less water volume (PRJ#00856):



Imagen 3: Ubicación geográfica zona de trabajo AQUA4D





As of March 2021 the field PRJ#00856, within 7 months the following successes:

- Surface moisture: + homogeneity / - runoff
- Manual moisture and EC measurements: + Moisture / - EC
- Roots and infiltration in calicatas: more roots / better Infiltration
- Plant development: Better foliage



Imagen 1: Zona AQUA4D®



Imagen 2: Zona Testigo

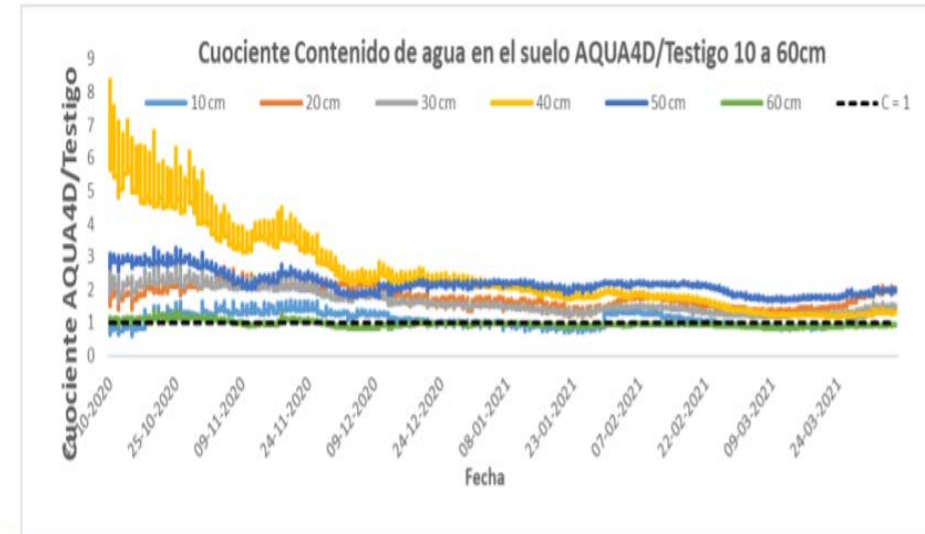


Figura 3a: Muestras del 29 de Enero (a) Follaje, (b) zona radical y sales superficiales en bulbo(c) con tratamiento AQUA4D y (d) Follaje, (e) zona radical y sales superficiales en bulbo(f) con tratamiento Testigo .

Project #00856 compared soil moisture at different depths (10 to 60 cm), with equal irrigation, there was always more moisture in Summer 2021 with AQUA4D® irrigation vs. the control.

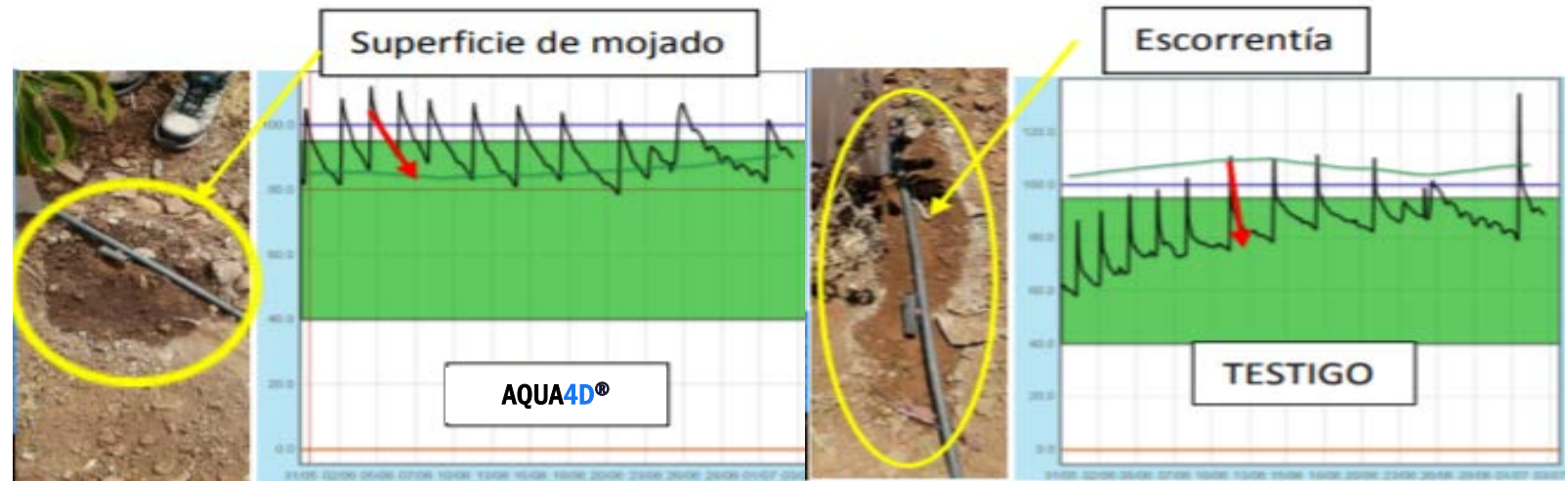


Figura 3b: Muestras del 25 de Marzo (a) Follaje y sales superficiales en bulbo(b) con tratamiento AQUA4D y (c) Follaje y sales superficiales en bulbo(d) con tratamiento Testigo .





- In the first half of 2021, at the same irrigation volume, the moisture content at 10/20/30 cm is **higher with AQUA4D®**.
- Increased moisture of **+72%**, **+20%** and **+17%** compared to the control sector.
- Runoff and evaporation are avoided.
- In the second semester, it was decided to **reduce the irrigation time by 17%**, based on the irrigation bulb needed in the PRJ#00856 project.



1: Zona radical activa, monitoreo de riego y colud sector AQUA4D® (izquierda) y Testigo (derecha) desde el 31 de Mayo de Julio 2021.

Cuadro 1: Diferencias promedio de porcentaje de humedad de 10 a 30 cm de profundidad entre el sector AQUA4D® y Testigo desde el 31 de Mayo 2021 al 09 de Septiembre 2021.

Junio- Septiembre	10 cm	20 cm	30 cm
TESTIGO	40,075	57,428	58,886
AQUA4D	68,949	68,949	68,949
Diferencia	↑ 72%	↑ 20%	↑ 17%

- With the monitoring the second semester, 2021 proceeded with **25% less irrigation**: good **moisture** in the root zone.
- Without flushing irrigation in the **AQUA4D®** sector, a lower electroconductivity was recorded in the different profiles between **10-60cm** of the PRJ#00856 project.

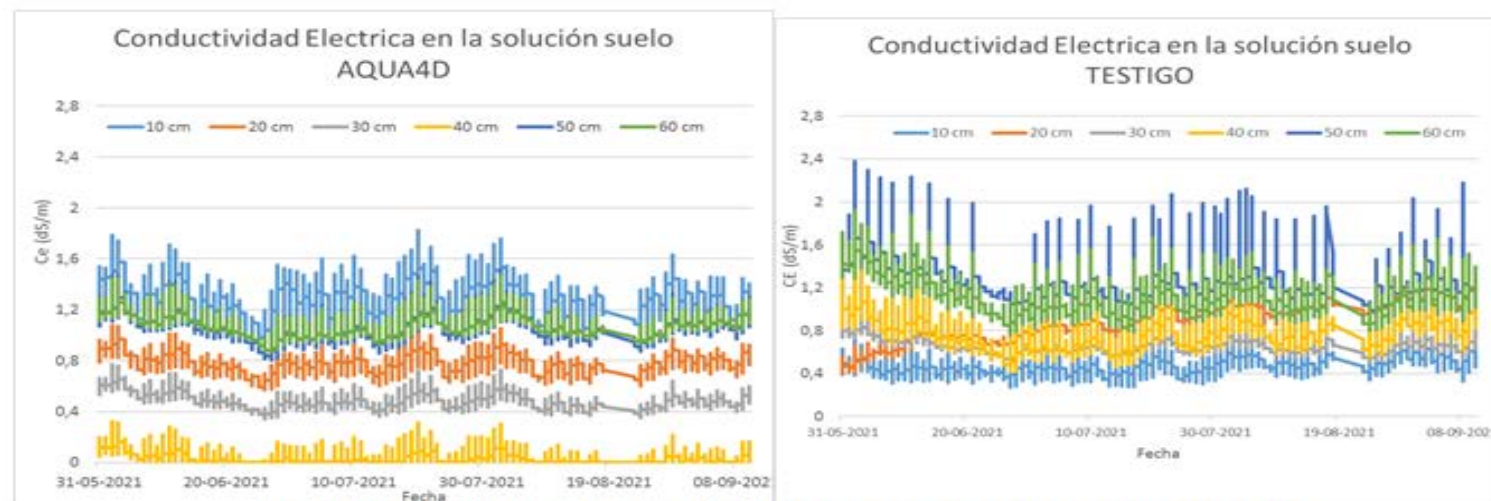


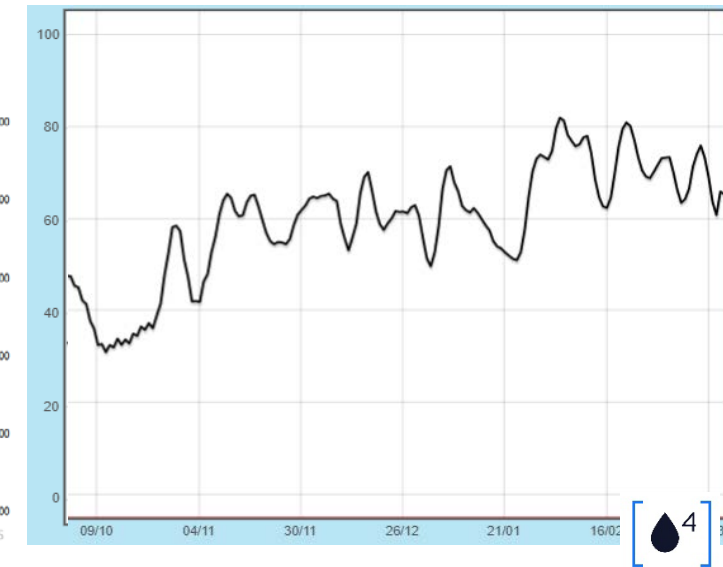
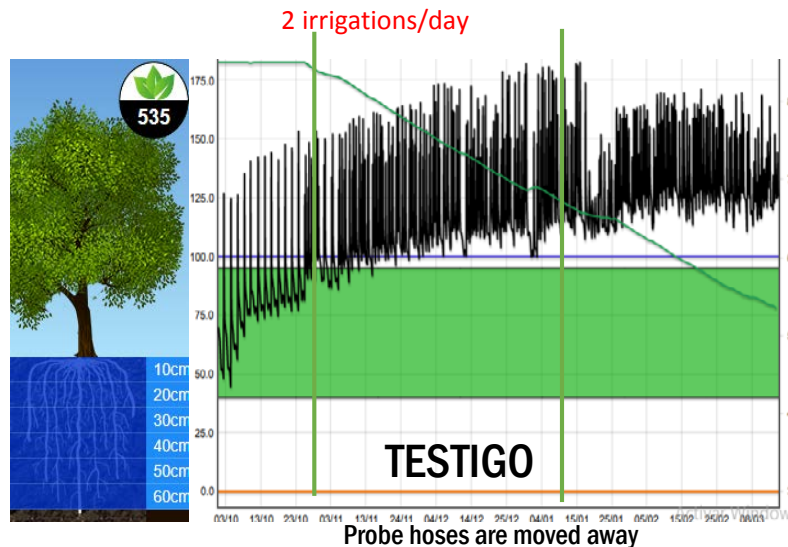
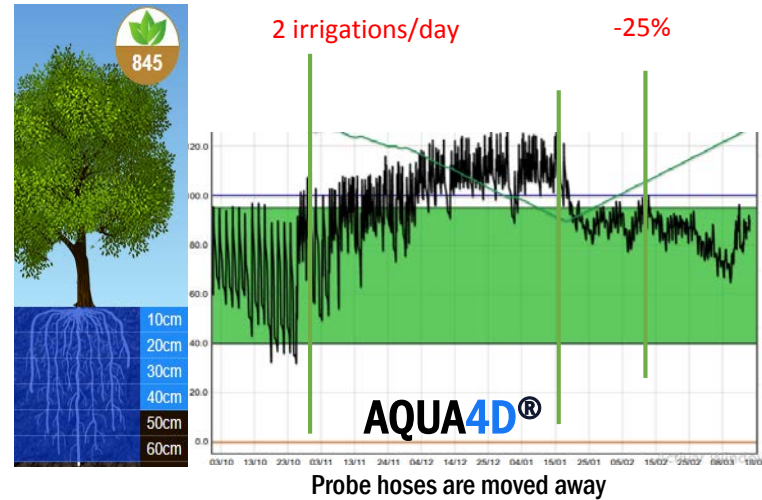
Figura 3. Comportamiento de las sales en Aqua4D (izquierda) y Testigo (derecha)

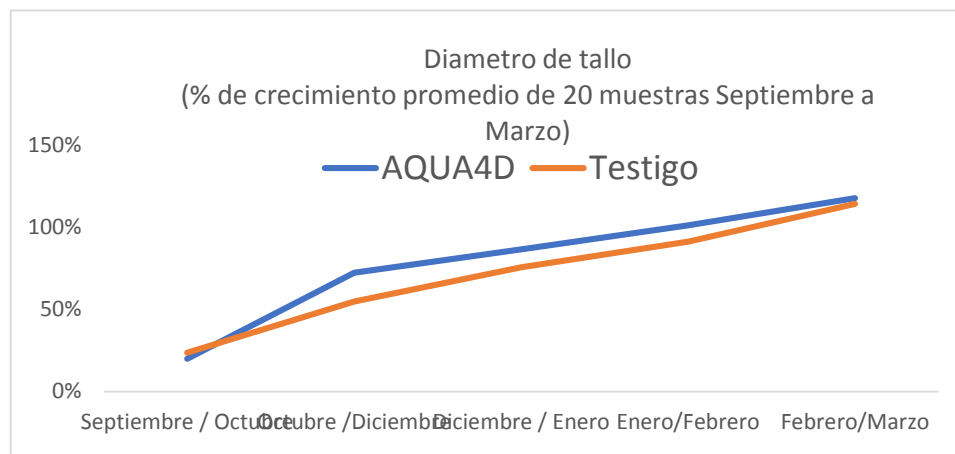




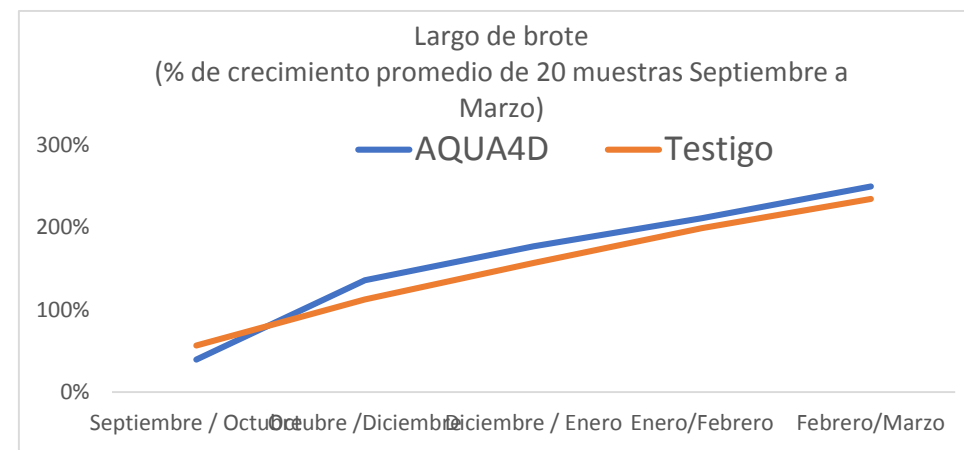
## Irrigation and EC monitoring during Spring 2021 and Summer 2022.

- The field with AQUA4D® responds to the 2 daily irrigations with an increase in uptake by the tree.
- The 25% reduction in irrigation volume in the AQUA4D® sector allows maintaining a better water-air ratio in the soil than the control.
- The plant activity index increases (monitoring of root growth and water uptake) compared to the control, which does not respond with growth.





Diámetro de tallo (variación promedio de 20 muestras acumulada %)					
Tratamiento	Septiembre / Octubre	Octubre / Diciembre	Diciembre / Enero	Enero / Febrero	Febrero / Marzo
AQUA4D	20%	72%	86%	101%	118%
Testigo	23%	55%	76%	91%	114%



Largo de brote (variación promedio de 20 muestras acumulada %)					
Tratamiento	Septiembre / Octubre	Octubre / Diciembre	Diciembre / Enero	Enero / Febrero	Febrero / Marzo
AQUA4D	40%	136%	177%	212%	250%
Testigo	56%	113%	157%	199%	235%

- As of March 2022: Both the cumulative variation in stem diameter and the cumulative variation in shoot length in **AQUA4D®** are greater than the Control, with the greatest difference occurring in the periods October 2021-December 2021 and December 2021-January 2022.
- By March 2022, irrigation with **AQUA4D®** and 25% less water allows for greater growth vs. the control. We do not generate stress to the trees.



- **AQUA4D®** achieves **greater infiltration** into the soil with the **same volume of water**.
- **AQUA4D®** keeps the irrigation water **longer in the soil**, with a **good air-water balance** after irrigation and with **good levels of water consumption** by the roots monitored every 10 cm.
- In a management without flushing irrigation, **AQUA4D®** manages to **keep salts constant and low** with less irrigation water, equivalent to a **25% reduction compared to the control**.
- **AQUA4D®** has a **41% higher moisture content** than the control with a wider irrigation bulb up to 40 cm from the center of the tree.
- **AQUA4D®** maintains moisture in the soil for a longer period of time, more **stable moisture at high temperatures** during the summer, **less stress** in the root zone.
- The cumulative variation of stem diameter and the cumulative variation of shoot length in plants irrigated with **AQUA4D®** is greater than the control, the greatest difference being in the October-December and December-January periods when temperatures are higher: less stress to the avocado tree.