The Avocado Industry in the next 20 years.

Francisco Mena Völker

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Introduction

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Sociedad Gardiazabal y Mena Ltda. is an organization established in 1994 that provides Consulting and Research In the Avocado and Citrus Industries.

LOCATION

- Our office is located in Quillota, Chile. This is the central and most productive area of our country.

SEMINARS

- GAMA is a common participant (presenting research work) in Avocado Brainstorming (UCR) and Avocado World Congress.

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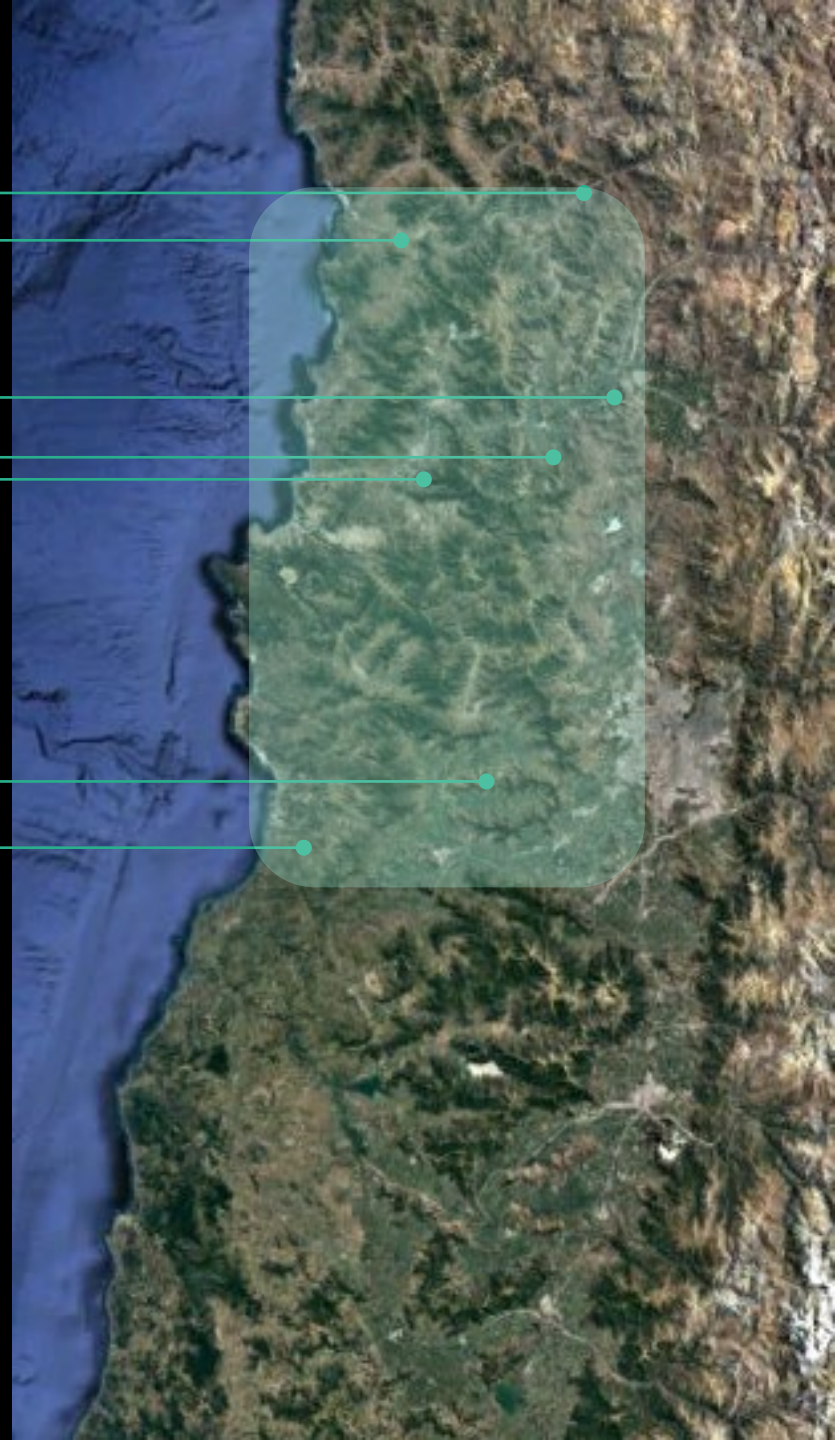
Research area

- More than 70 trials are running



Basis for Avocados R&D

- **Pursuit direct impact on Productivity (final outcome/ha)**
  - Enhance Production
  - Cost reduction
  - Ease of management
  - Improve Postharvest

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Basis for Avocados R&D

- **Pursuit direct impact on Productivity (final outcome/ha)**
  - Enhance Production
  - Cost reduction
  - Ease of management
  - Postharvest

- **Much of what we have done focuses on HD**
  - Planting distances.
  - PGR´s
  - Pruning
  - Nutrition
  - Alternatives to PGR’s

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Main Research in Past Years

1. Pollination and pollinators (UCR and Hofshi Foundation).
2. High Density and PGR´s.
3. Pruning timing .
4. Nutrition.
5. Irrigation (managing water requirements).
6. Bio stimulants for root growth and fruit production.
7. Salinity (reverse Osmosis).
8. Temperature Stress management.
9. Pre and Postharvest conditions influencing appearance of Black Spot (PUCV and INIA).

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Current research in Avocados

Total of 43 trials in Avocados

Subject	Trials
Soil Biostimulants	19
Nutrition	5
Solar Protectors	3
Pruning	2
Organic Matter Amendments	2
Foliar PGR's	2
Soil Biology	2
Soil PGR's	1
Nanobubbles	1
Harvest Timing	1
Rootstocks / Fruit Quality	1
Pollinators (Bombus)	1
Pests	1
Water efficiency	1
Foliar Bio stimulants	1

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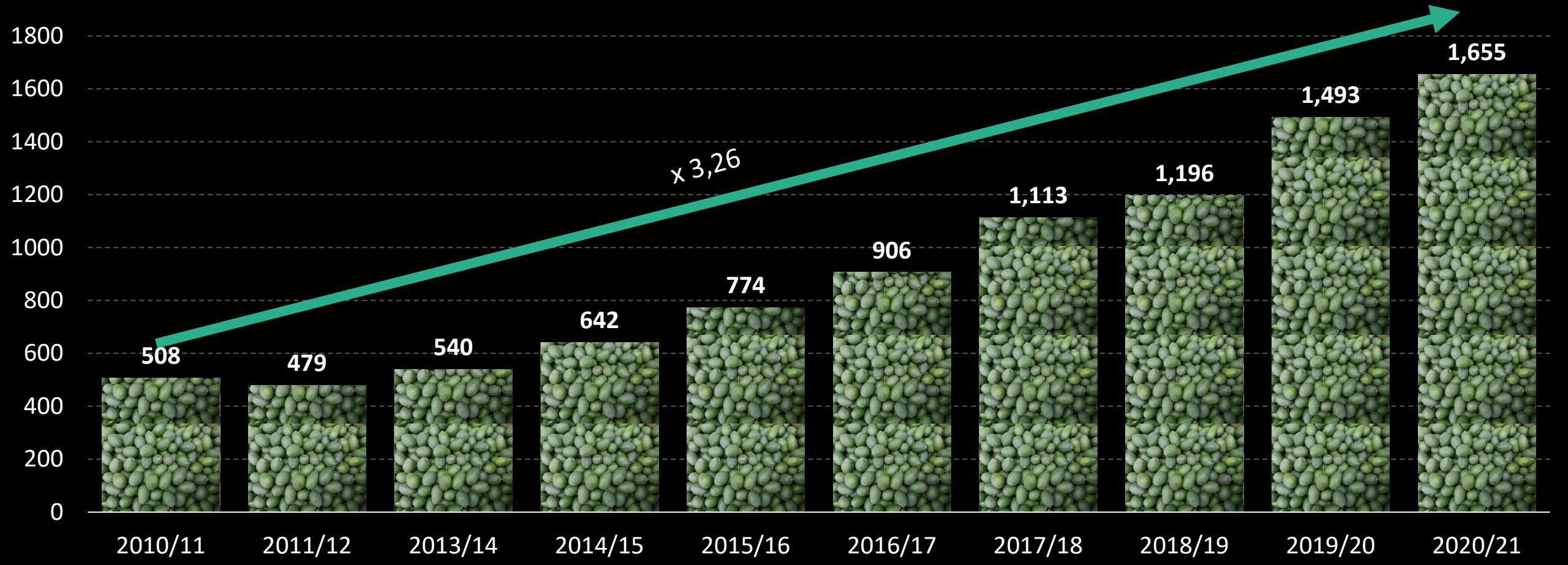
EU 27 + UK Avocado Imports (million lbs)



Source: Eurostat, FruiTrops

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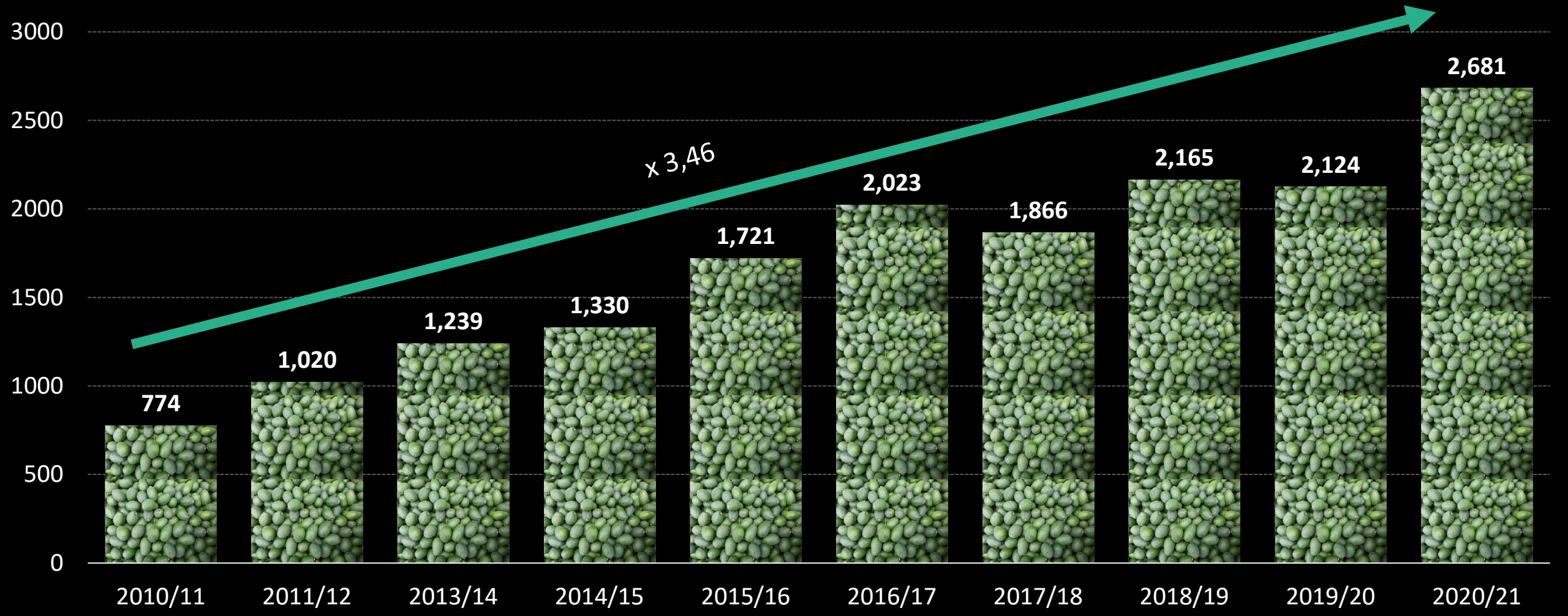
US Avocado Imports (million lbs)



Source: Eurostat, FruiTrops

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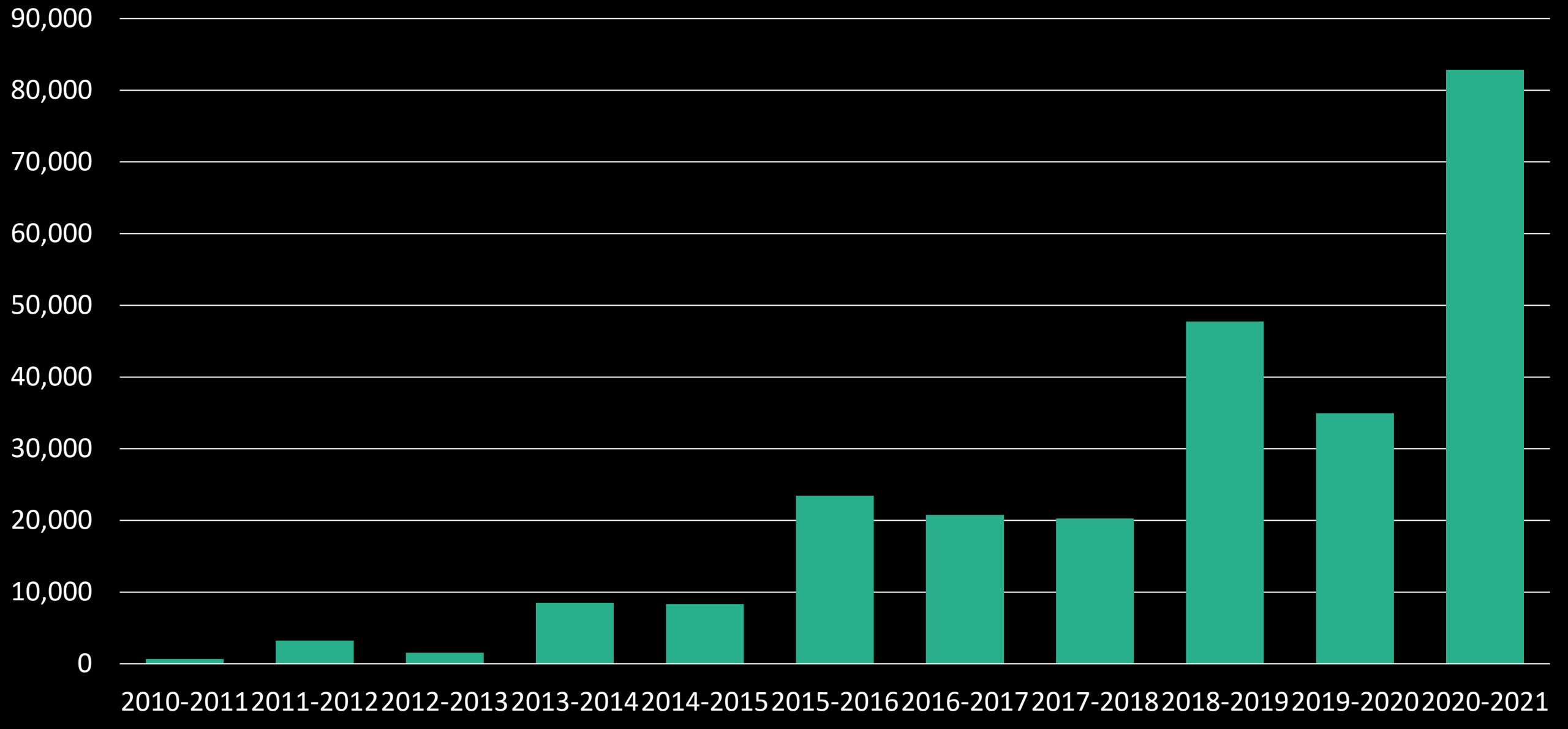
Avocado Consumption in Main destinations

Area	Lbs per capita
USA - California	17,3
USA - South Central	9,8
USA - West	9,1
USA	8,5
Norway - Denmark	6,4
USA - Northeast	6,4
Canad	6,3
USA - Southeast	5,3
Switzerland - Sweden	4,9
France	4,7
USA - Great Lakes	4,6
Spain	3,6
UK	3,5
Western Europe	3,3
Germany	2,8
Japan	1,4
Eastern Europe	1,1
Poland - Romania	1,1
Italy	1,0
Russia	0,7
South Corea	0,6
China	0,1

Sources: Comtrade, Eurostat

Evolution Of Avocado Imports in Latin America (000 lbs)

Evolution of Avocado Imports in Chile (000 lbs)



Avocados

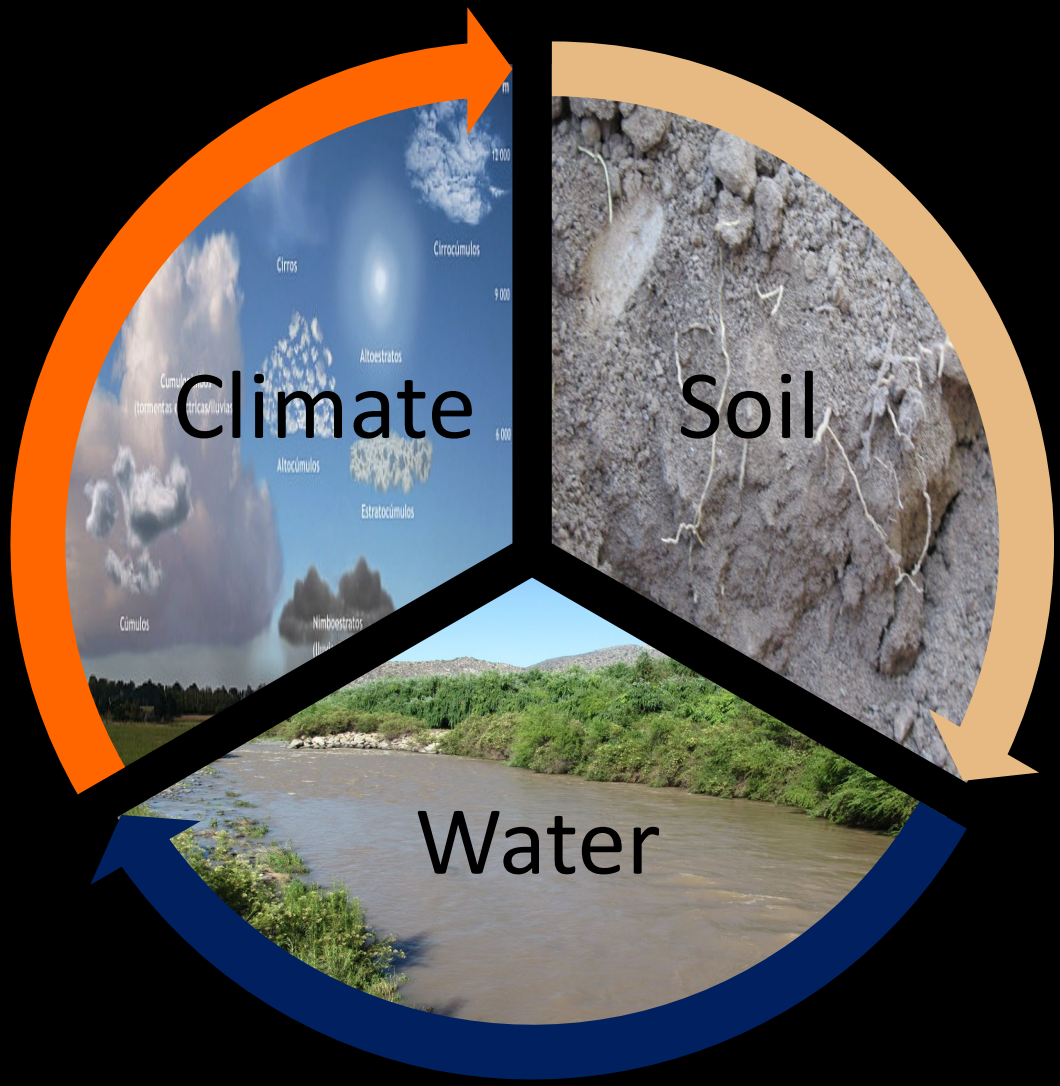
End of the avocado: why chefs are ditching the unsustainable fruit

Give peas a chance – as well as pistachios, fava beans and pumpkin seed paste. These are just some of the ingredients being used to replace one of the world's most popular fruits

Clare Finney

Mon 1 Nov 2021 12.00 GMT

Main Factors Affecting Avocado Production



Main Factors Affecting Avocado Production

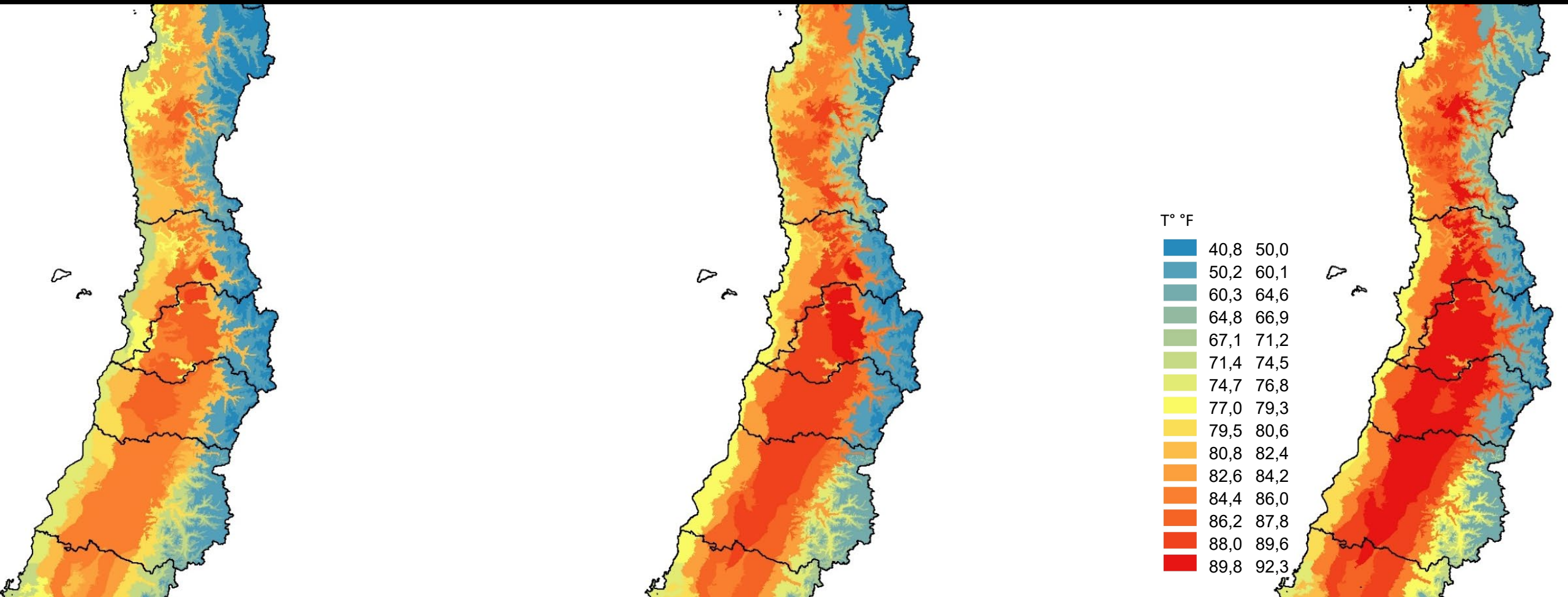
- **Climate:**
  - Changing or part of a Cycle?
  - Heat
  - Frost
  - ……Stress

Evolution of Maximum Temperature on January (Source: Agrimed U. Of Chile)

Actual Baseline

2050

2070

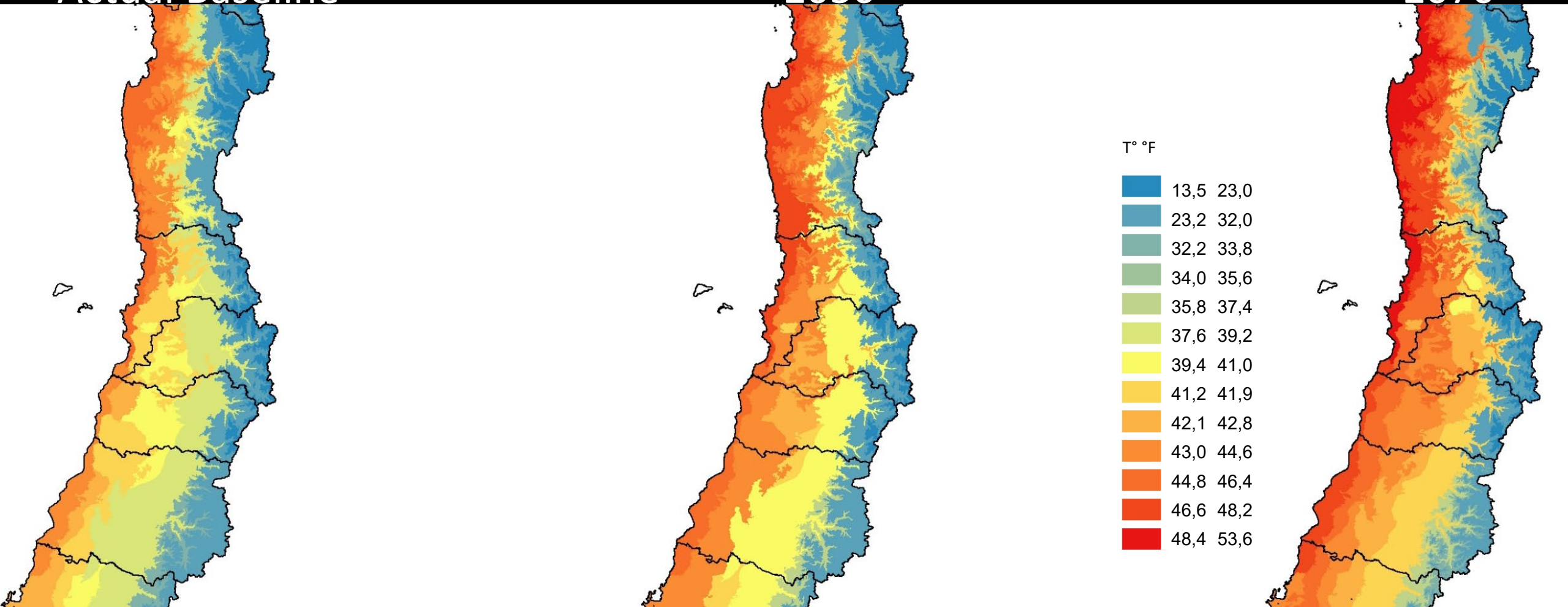


Evolution of Minimum Temperature in July (Source: Agrimed U. Of Chile)

Actual Baseline

2050

2070

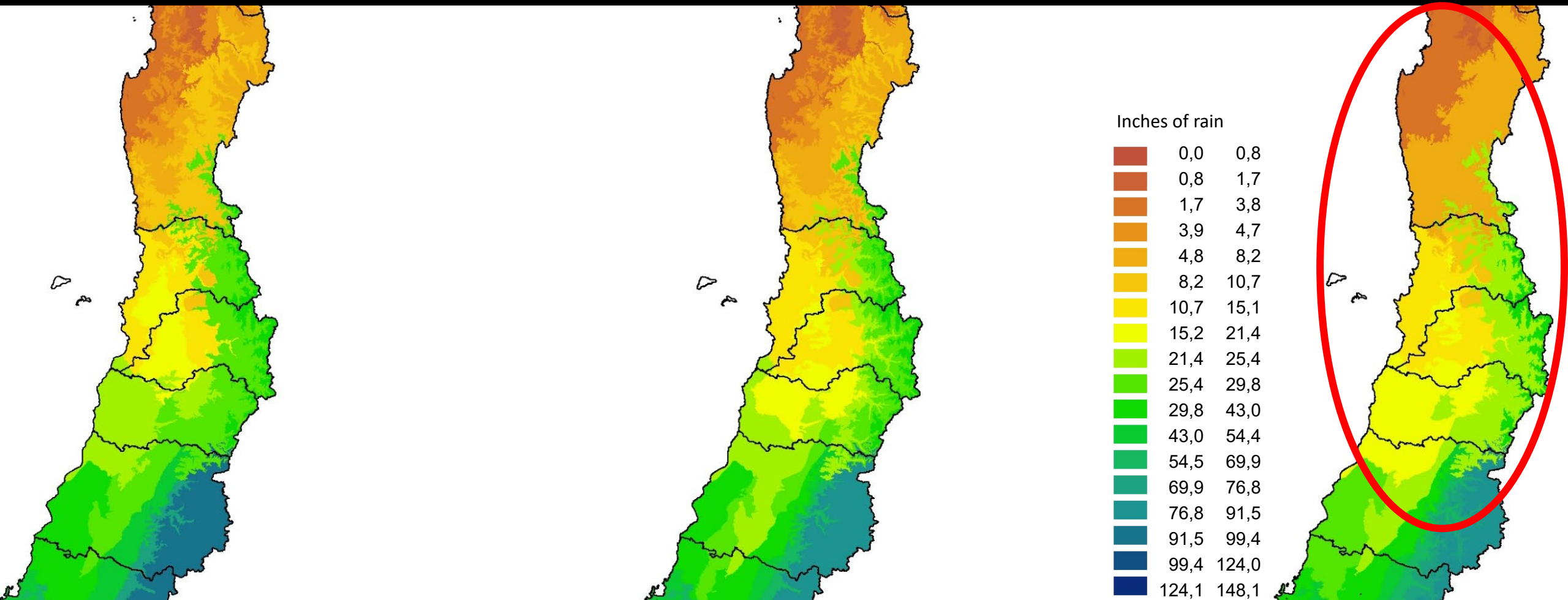


Evolution of Yearly Rainfall (Source: Agrimed U. Of Chile)

Actual Baseline

2050

2070

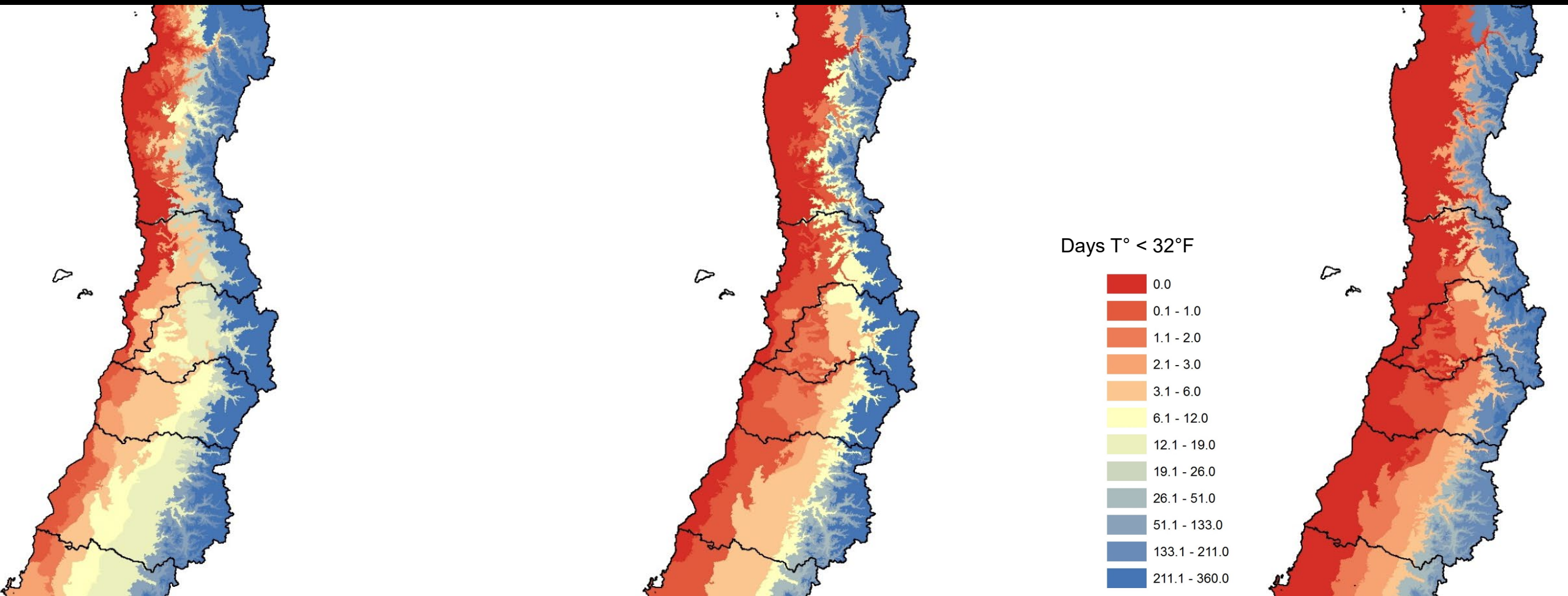


Evolution of days with Temperature below 0°C=32°F) (Source: Agrimed U. Of Chile)

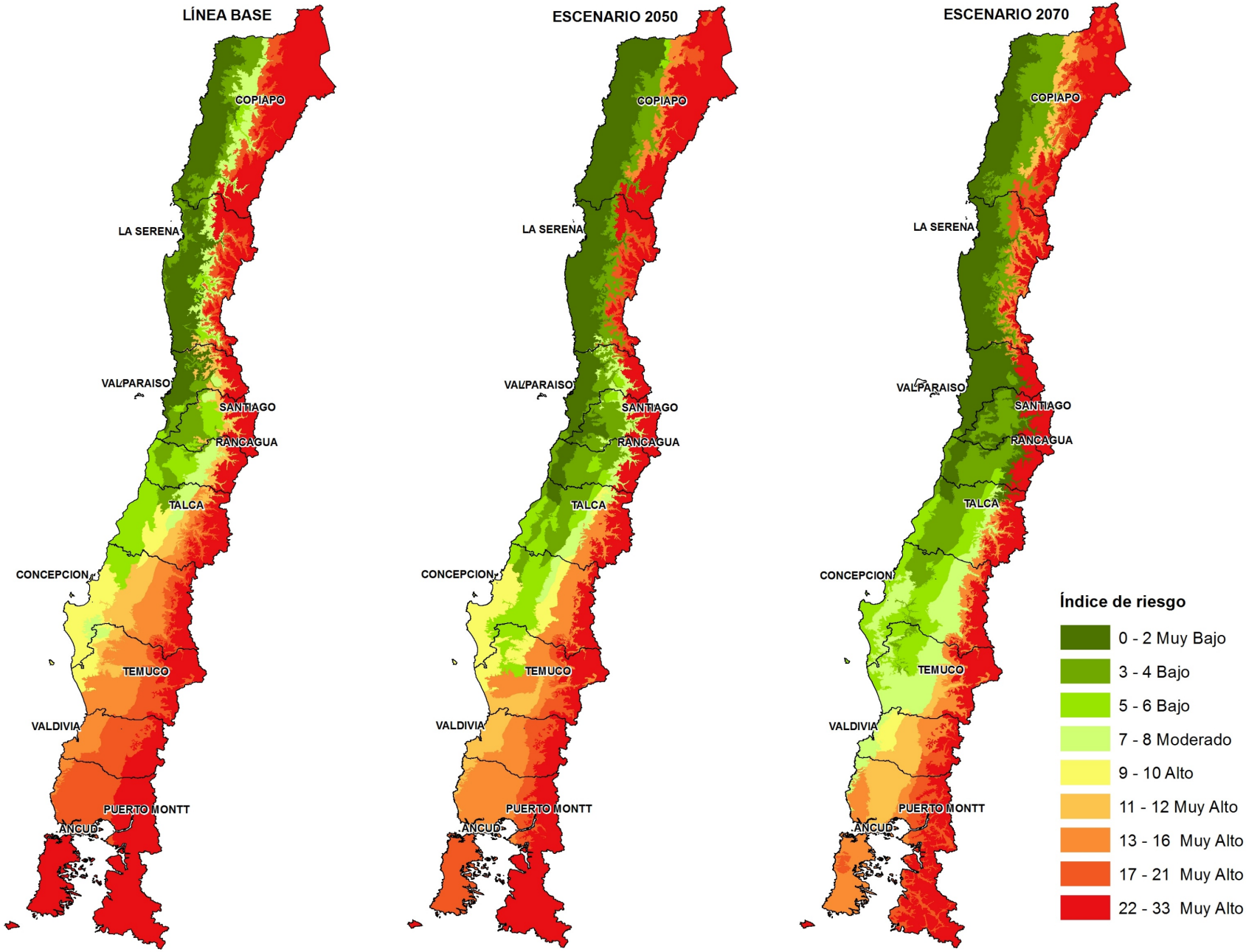
Actual Baseline

2050

2070

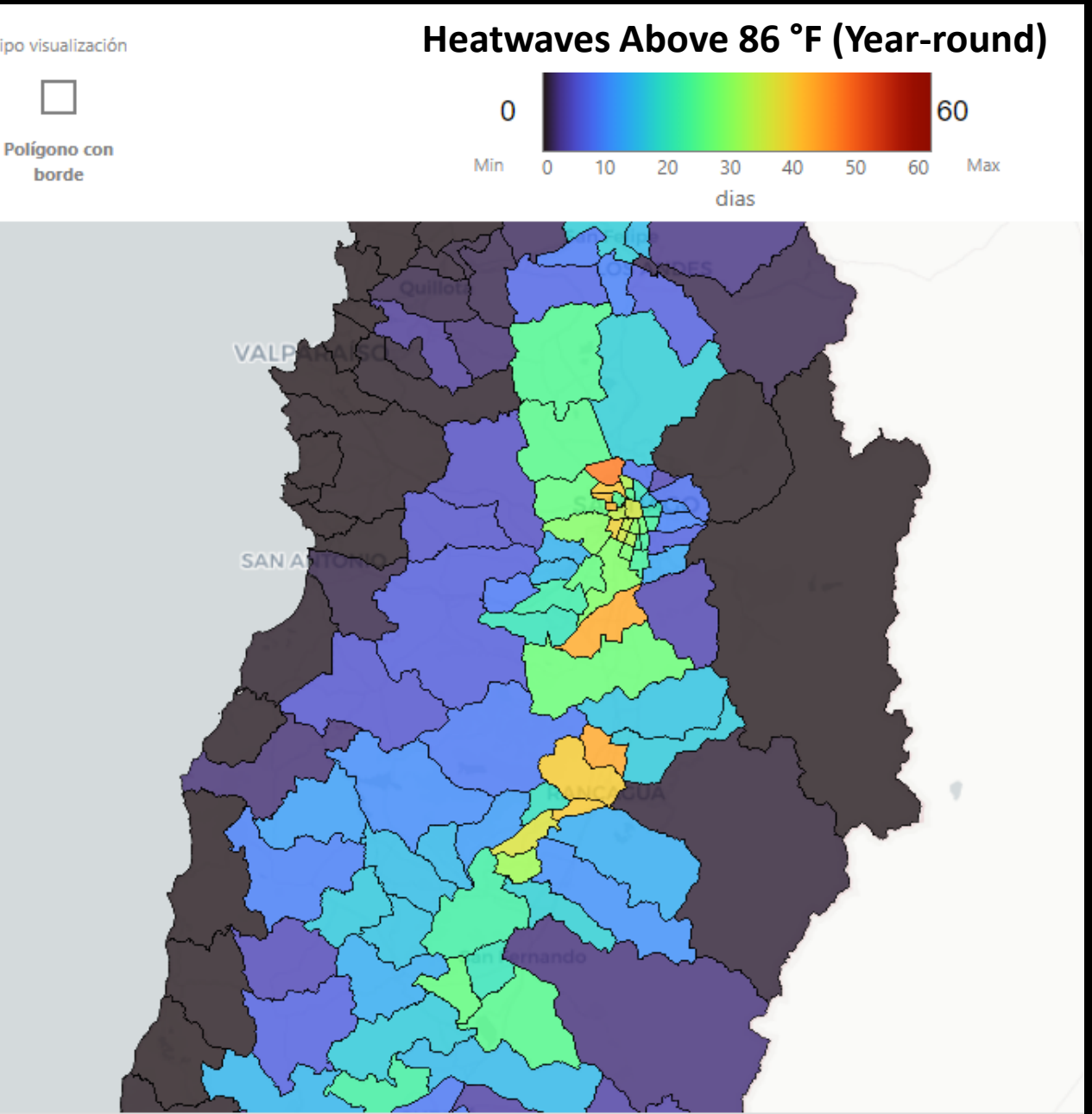


ÍNDICE DE RIESGO AGROCLIMÁTICO PALTO

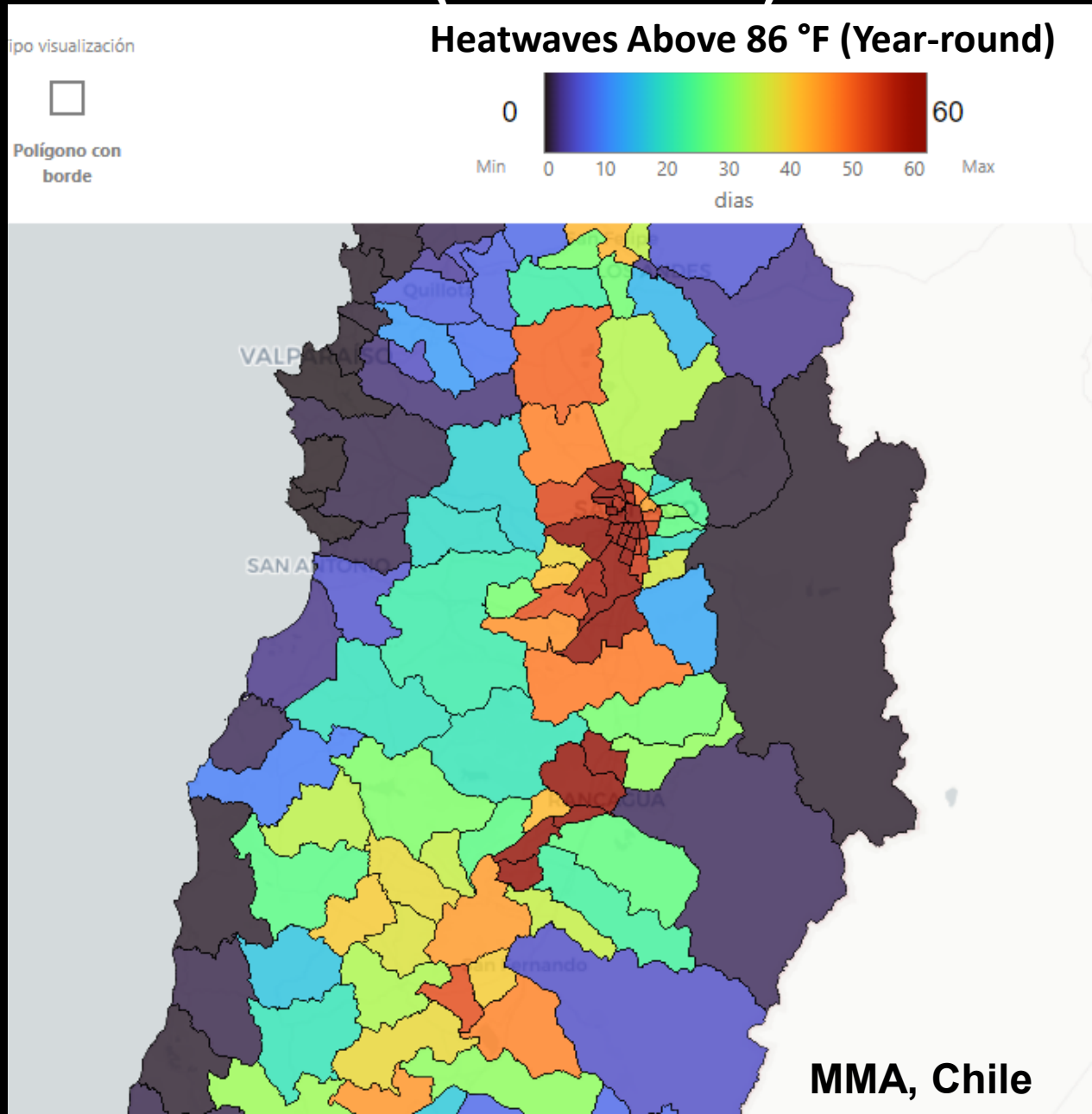


Heatwaves

Current



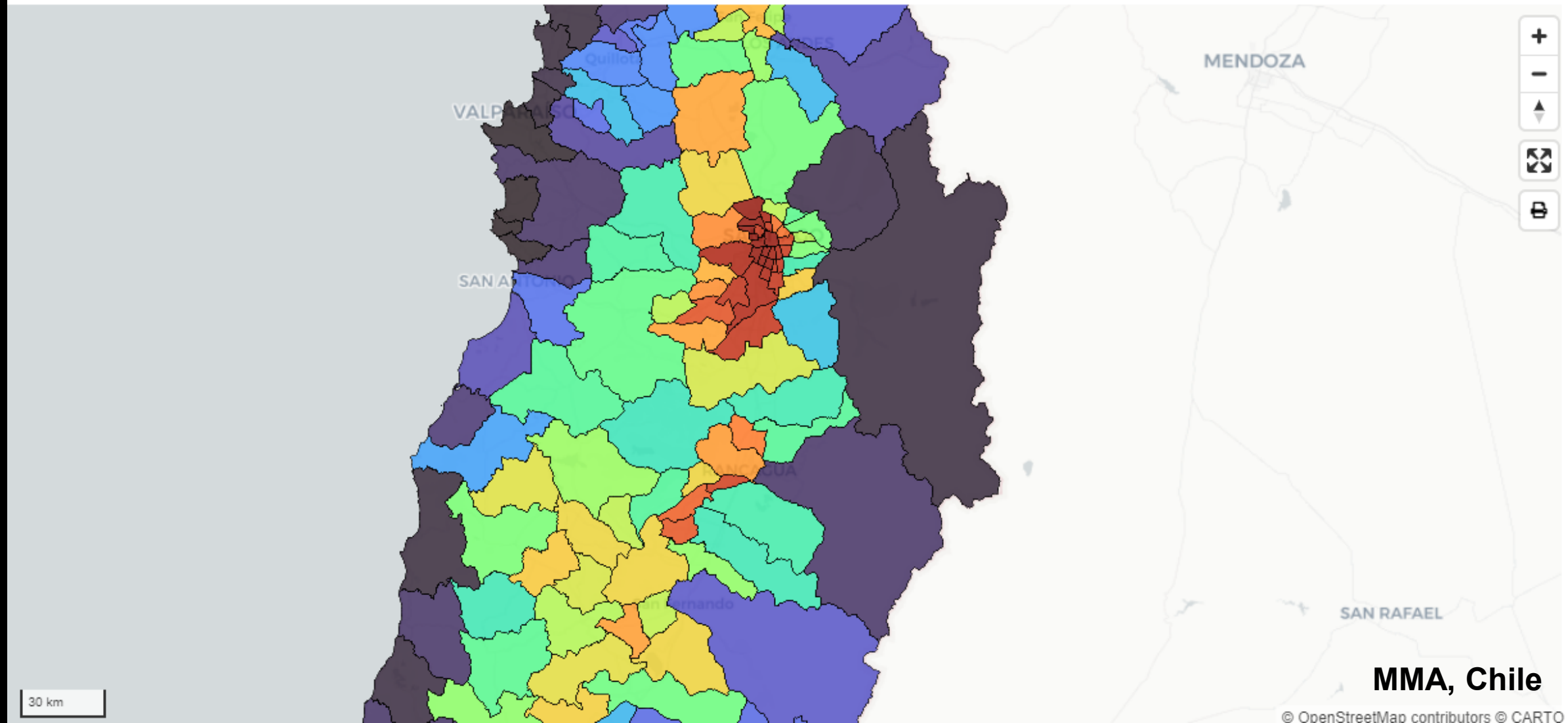
Future (2035-2065)



Tipo visualización

Polígono con borde

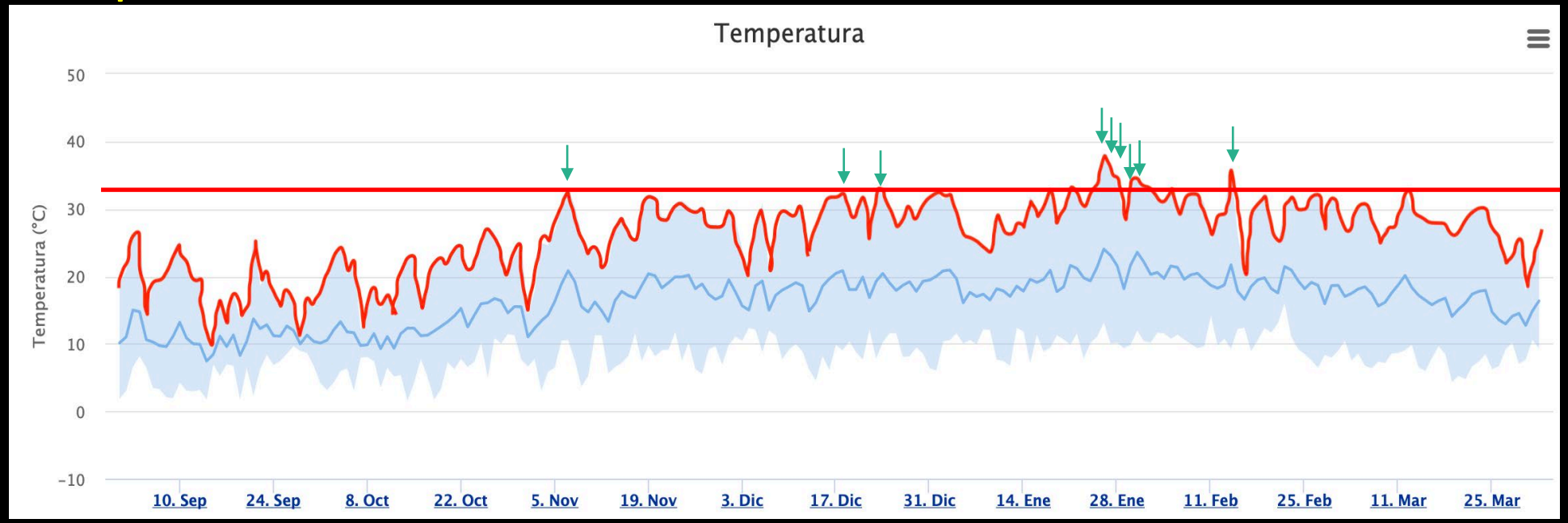
Increase in Days with temperature Above 86 °F (Year-round)



MMA, Chile

Factors influencing avocado production

Temperatures 2018/2019: Peumo



9 days above 91,4º F until march 31.

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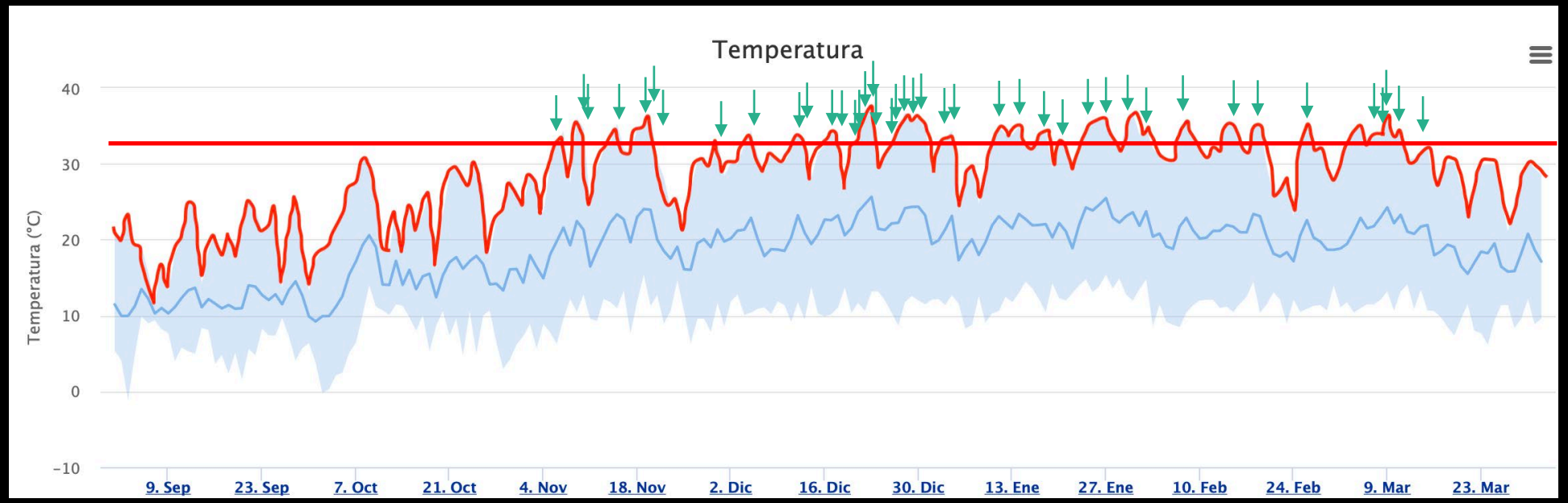
Factors influencing avocado production

Temperatures 2019/2020: Peumo



42 days above 91,4 °F until march 31.

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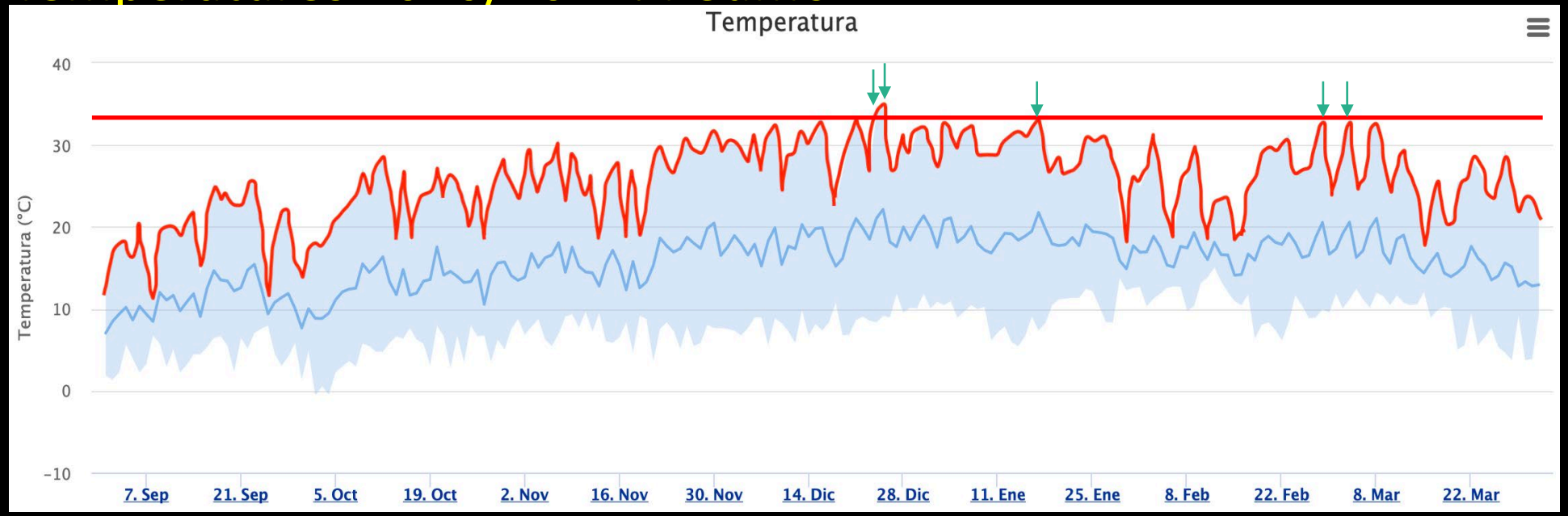
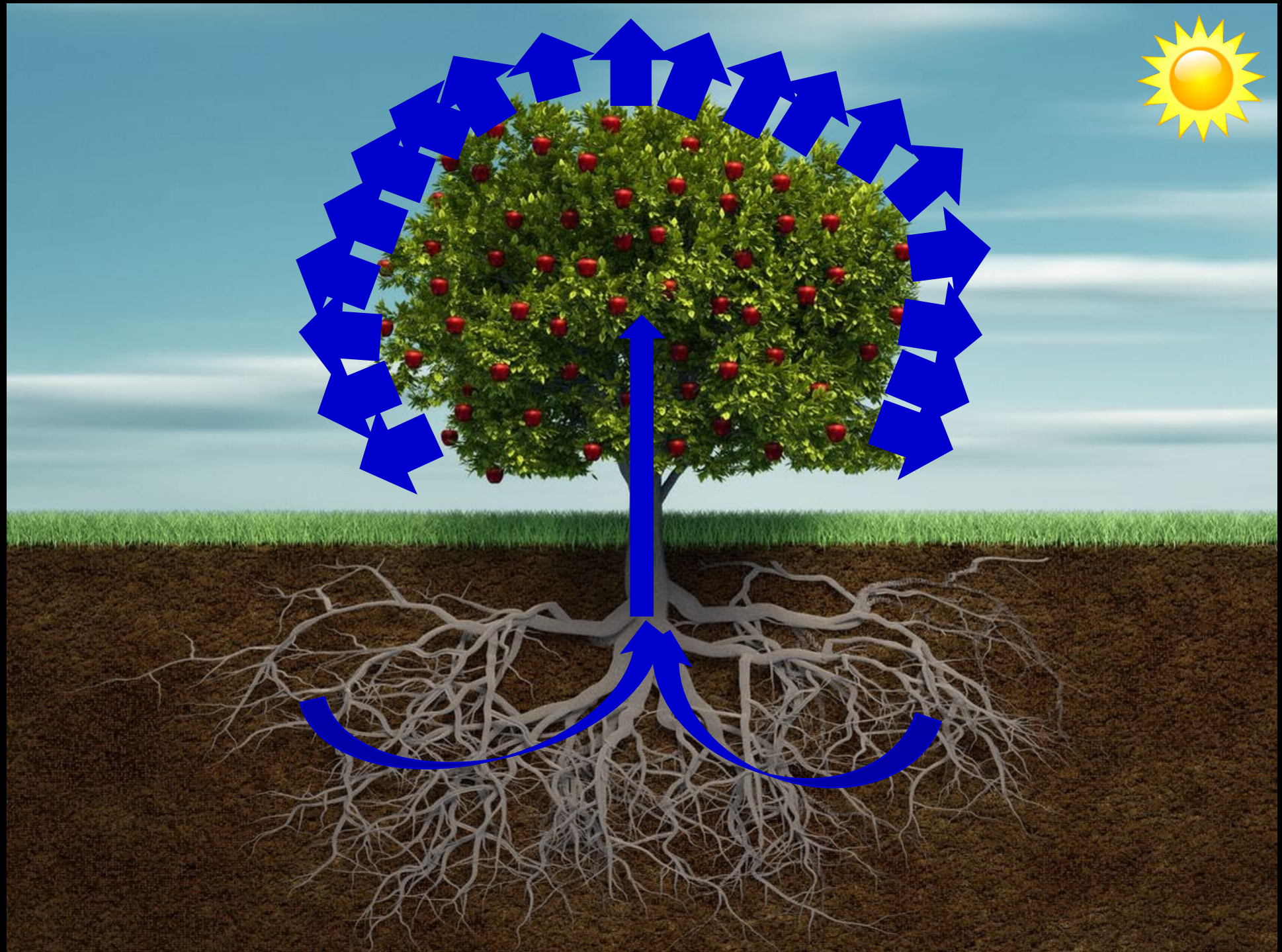
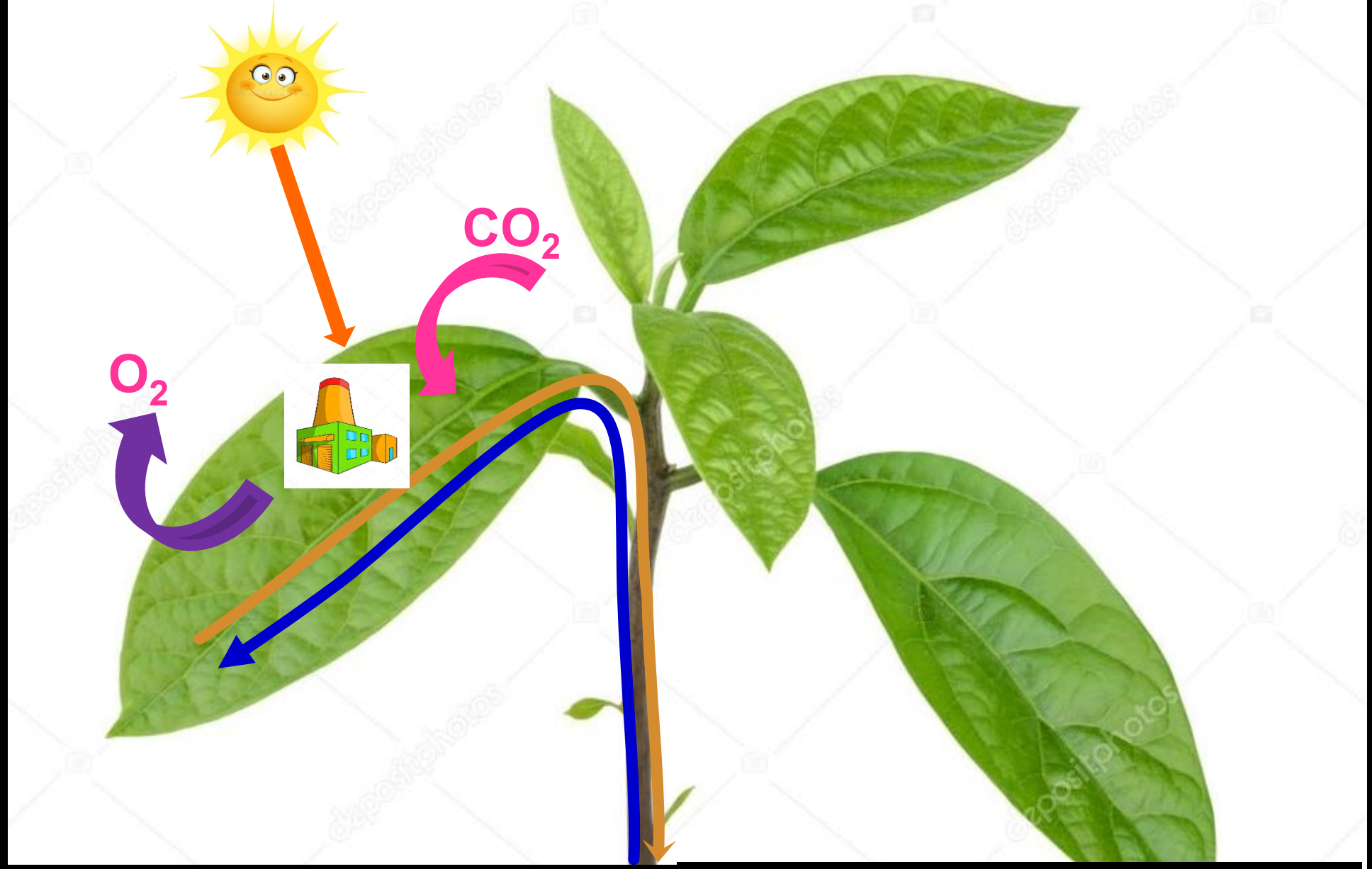
Factors influencing avocado production

Temperatures 2020/2021: Peumo

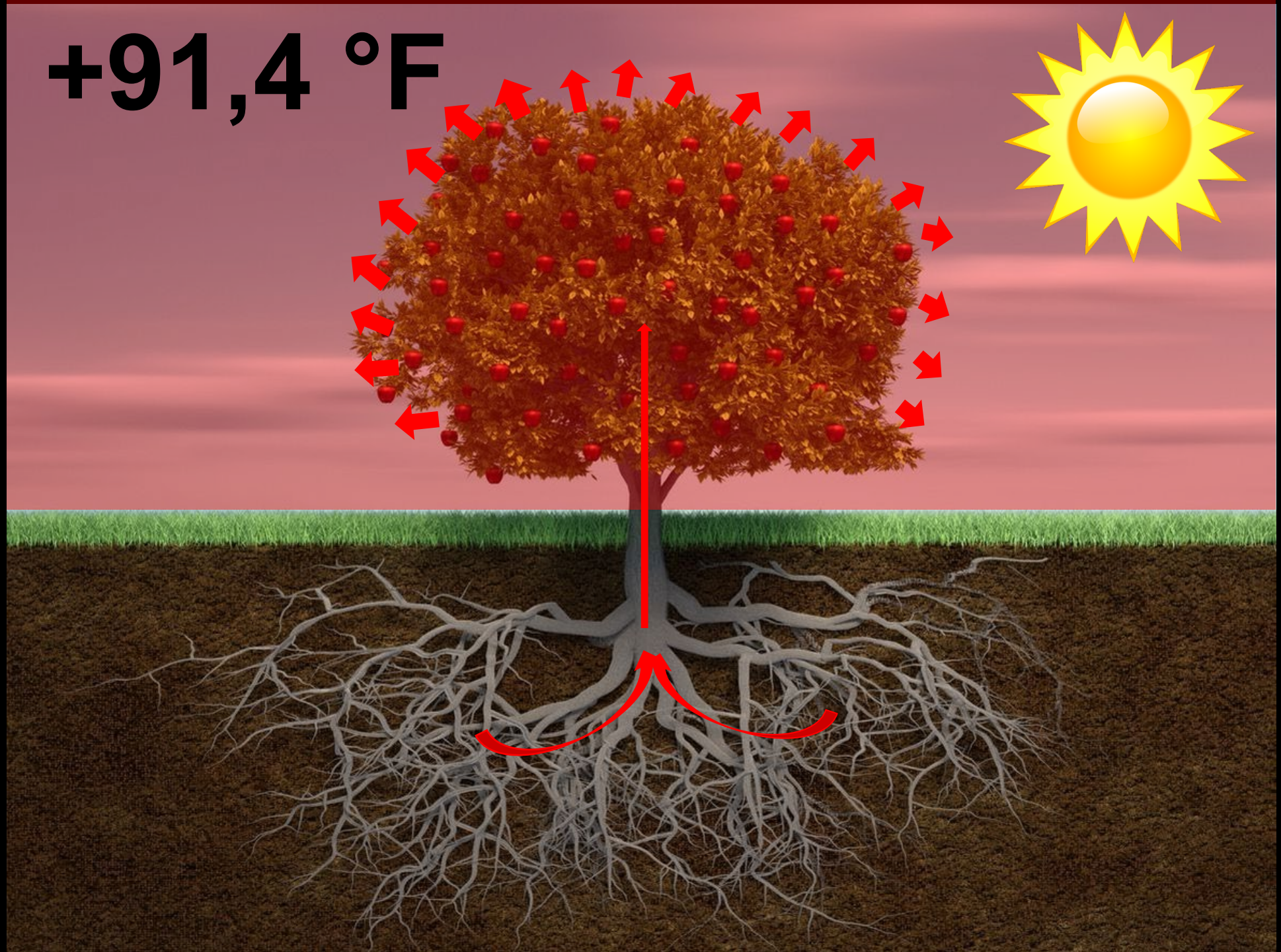


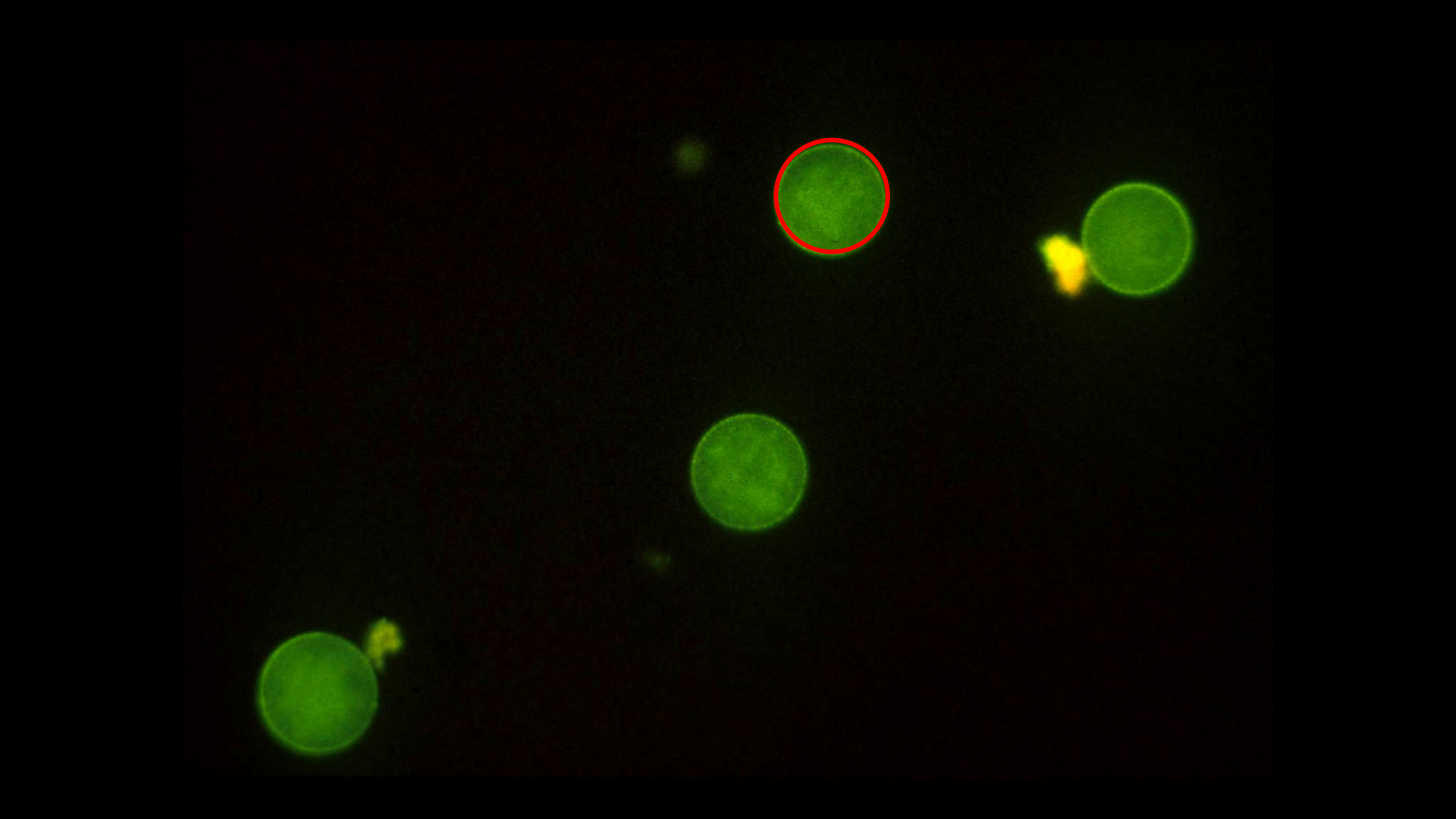
5 days above 91,4 °F until march 31.





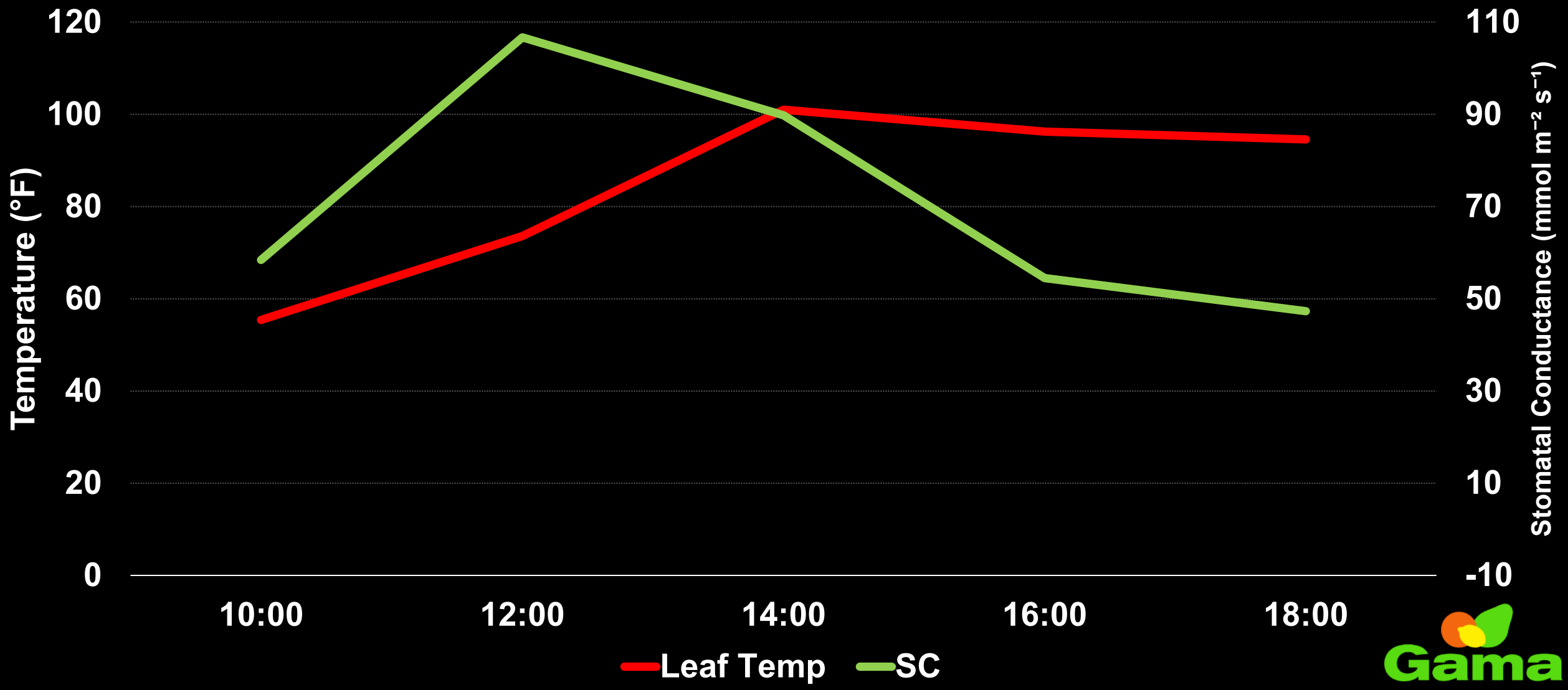
1. Water and Mineral Input
2. Sun Light and Energy
3. Atmospheric CO_2
4. Carbohydrate Production
5. O_2 Liberation
6. Transport of Produced Photosyntates


+91,4 °F




SC-1
LEAF POROMETER
METER
DESICCANT

Leaf Temperature and Stomatal Conductance in Avocados (Feb 3, 2021)



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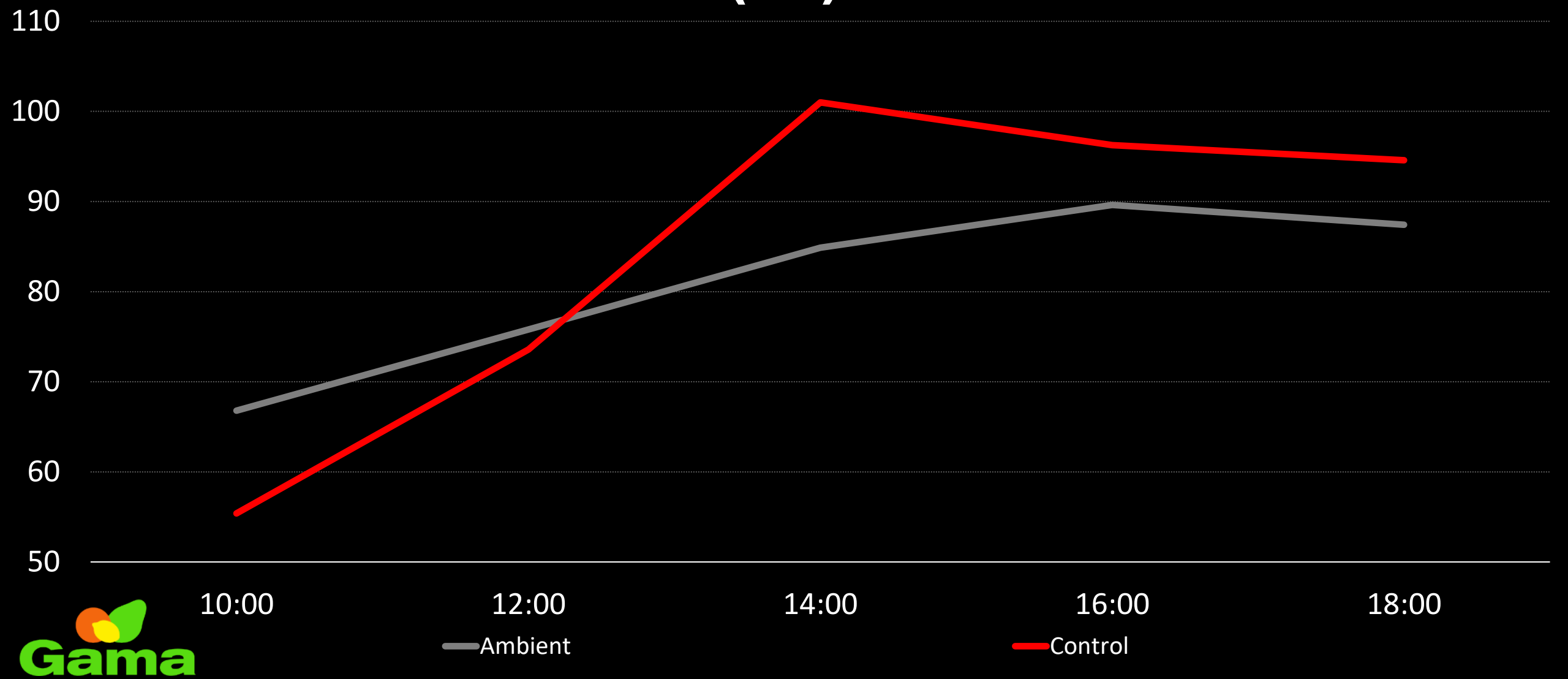
Leaf Temperature of Different Treatments (°F)



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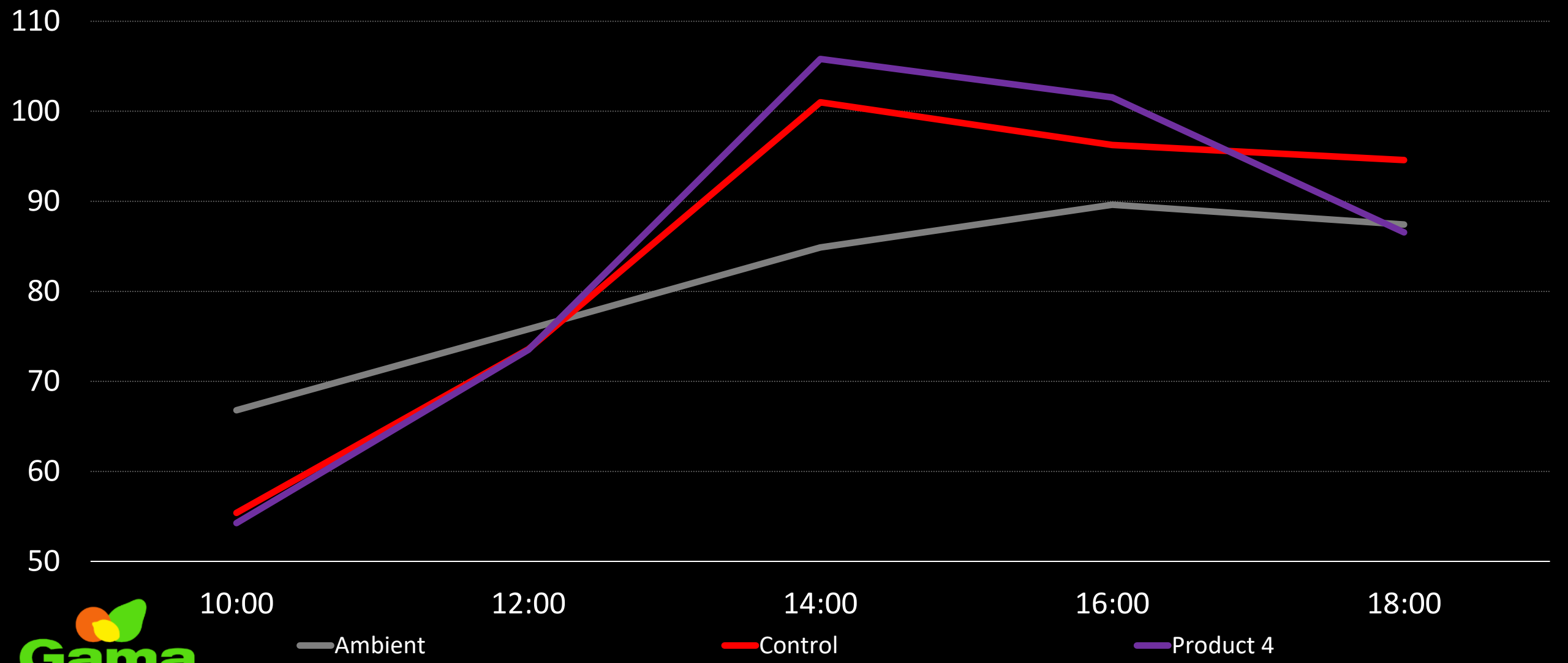
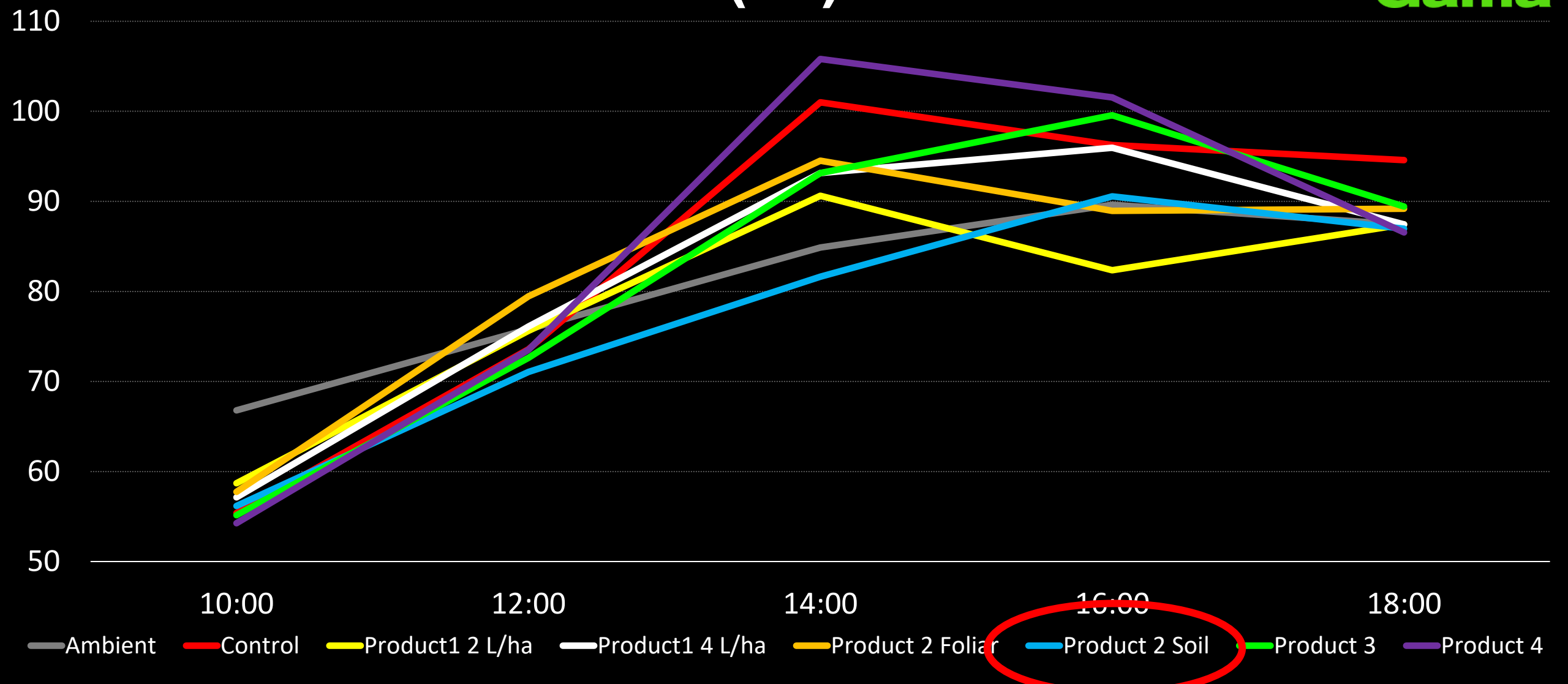
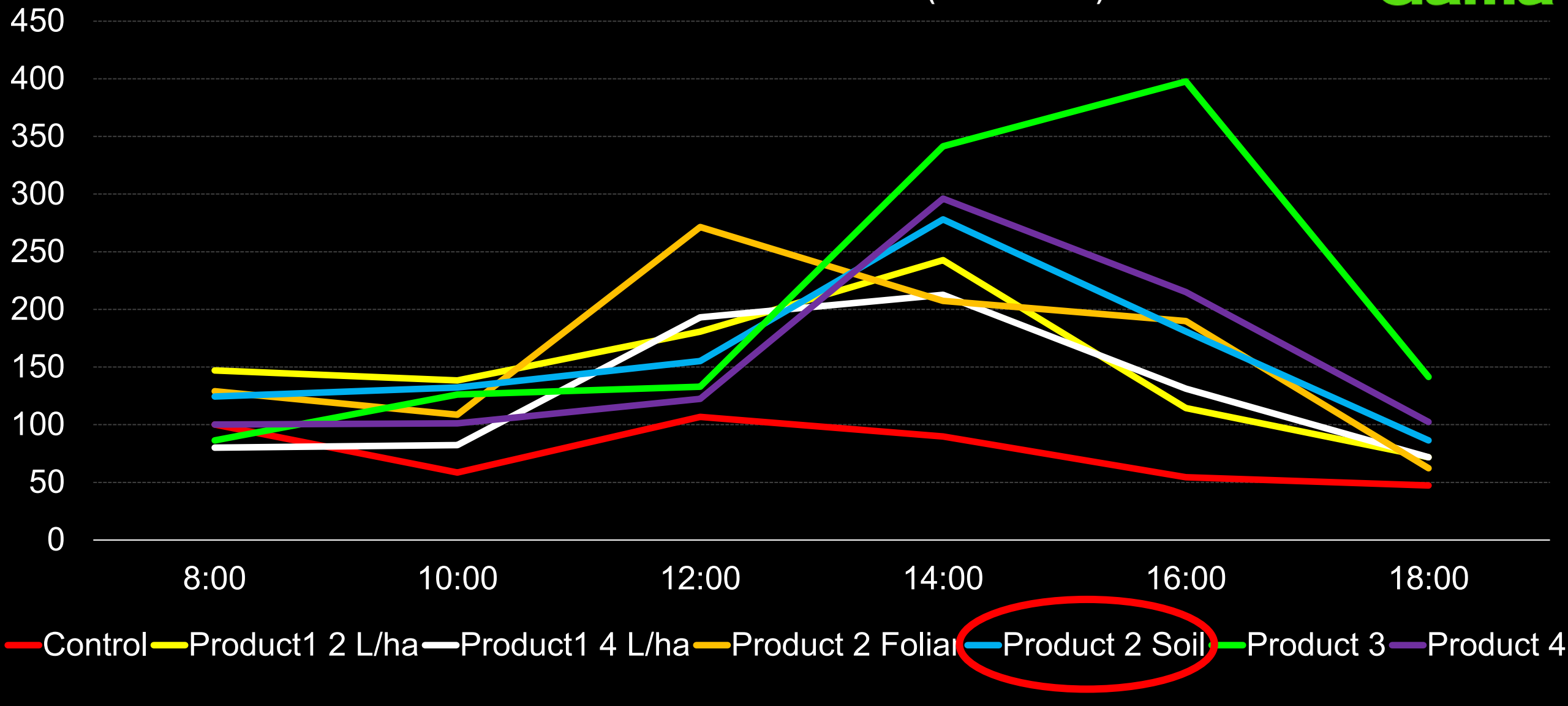
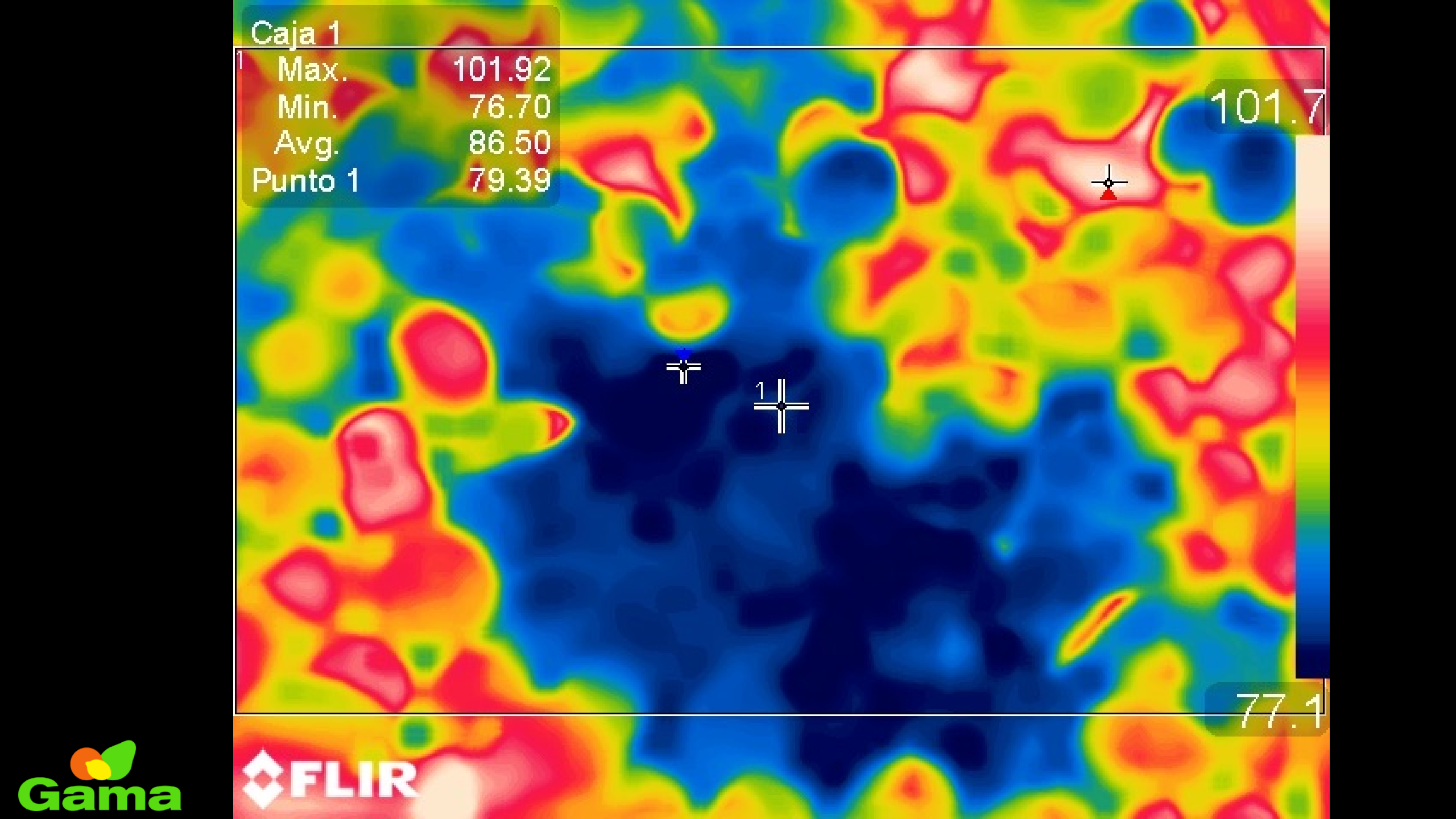


Leaf Temperature of Different Treatments (°F)



Effect of Different Treatments on Stomatal conductance (mmol m^{-2} s^{-1})




Caja 1
Max. 101.92
Min. 76.70
Avg. 86.50
Punto 1 79.39
101.7
77.1
FLIR

Main Factors Affecting Avocado Production

- Climate:
  - Changing or part of a Cycle?
  - Heat
  - Frost
  - ……Stress
- Water:
  - Availability
  - Quality
  - Irrigation Methodology depending on heat conditions

Water Availability - Salinity

- With a reduction in Snow availability, we have seen an increase in Chloride content in irrigation water in most Valleys,

Water Availability - Salinity

- With a reduction in Snow availability, we have seen an increase in Chloride content in irrigation water in most Valleys.
- Most of our rootstocks are Mexican race, which are very sensitive to Chlorides (38 ppm).
- Lahav (2003), Oster and Arpaia (2007), 12% of Potential production reduction for every 35,5 ppm (1 meq/L) in Chlorides.

Potential Avocado yield as Water Cl^- increases

Water Cl^- Content (ppm)	Potential Crop (lbs Acre)
38,0	13.500

Adapted from Lahav, 2003. Oster, J and Arpaia, ML

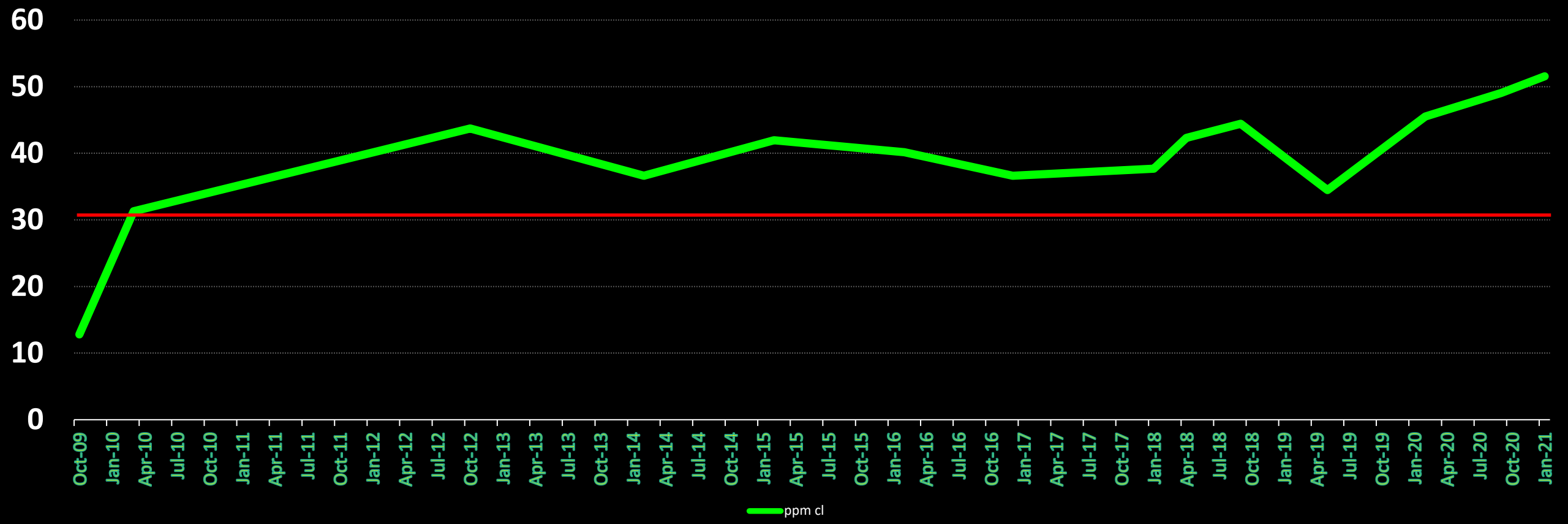
Potential Avocado yield as Water Cl^- increases

Water Cl^- Content (ppm)	Potential Crop (lbs Acre)
38,0	13.500
73,5	11.880
109,0	10.454
144,5	9.200
180,0	8.096
215,5	7.124
251,0	6.269

Adapted from Lahav, 2003. Oster, J and Arpaia, ML

Factors influencing avocado production

Chloride content (ppm): Peumo



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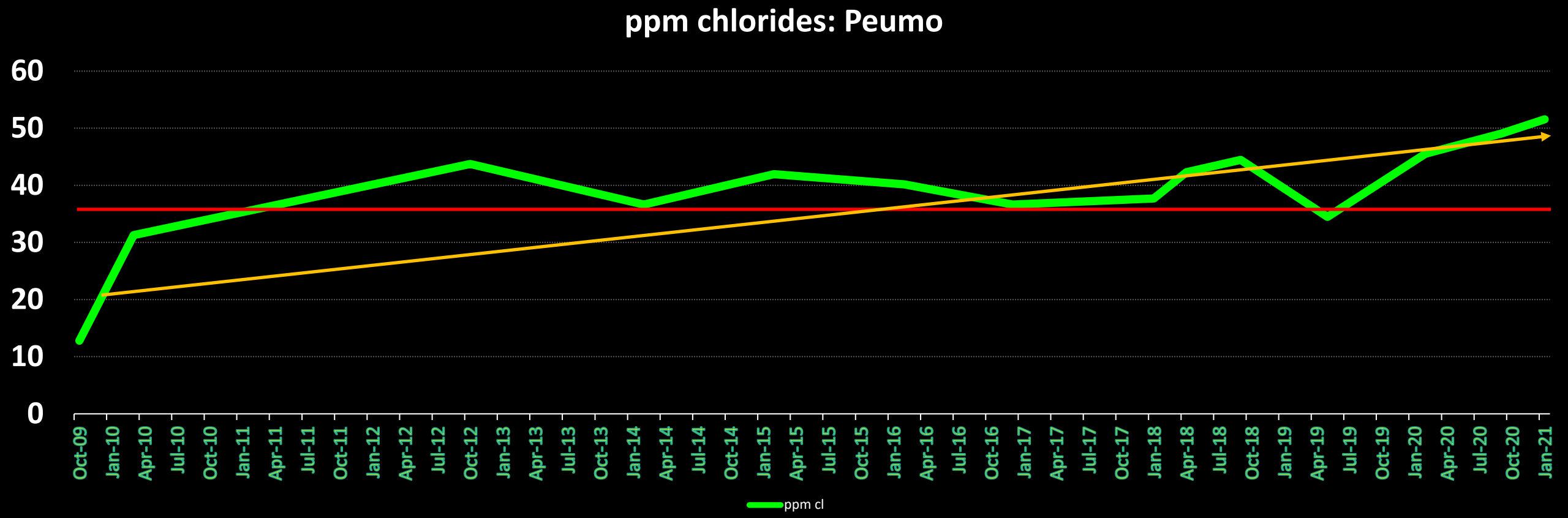
Factors influencing avocado production

Chloride content (ppm): Peumo



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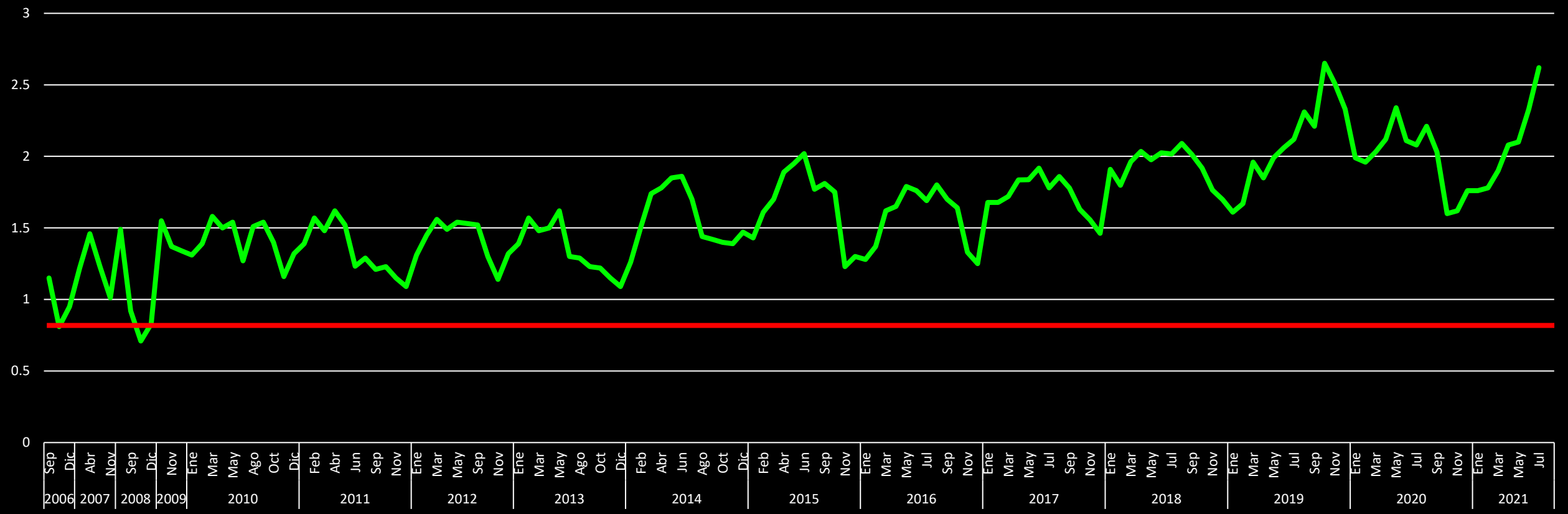
Factors influencing avocado production

- Water quality (Electric conductivity) Mallarauco



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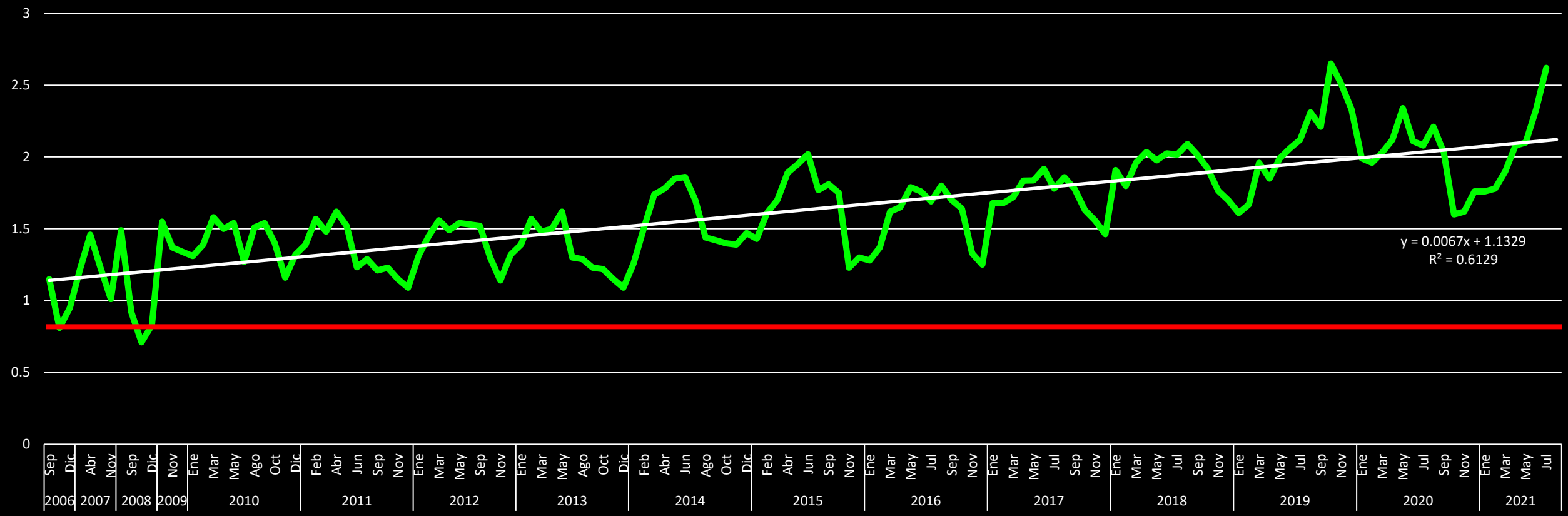
Factors influencing avocado production

- **Water quality (Electric conductivity) Mallarauco**



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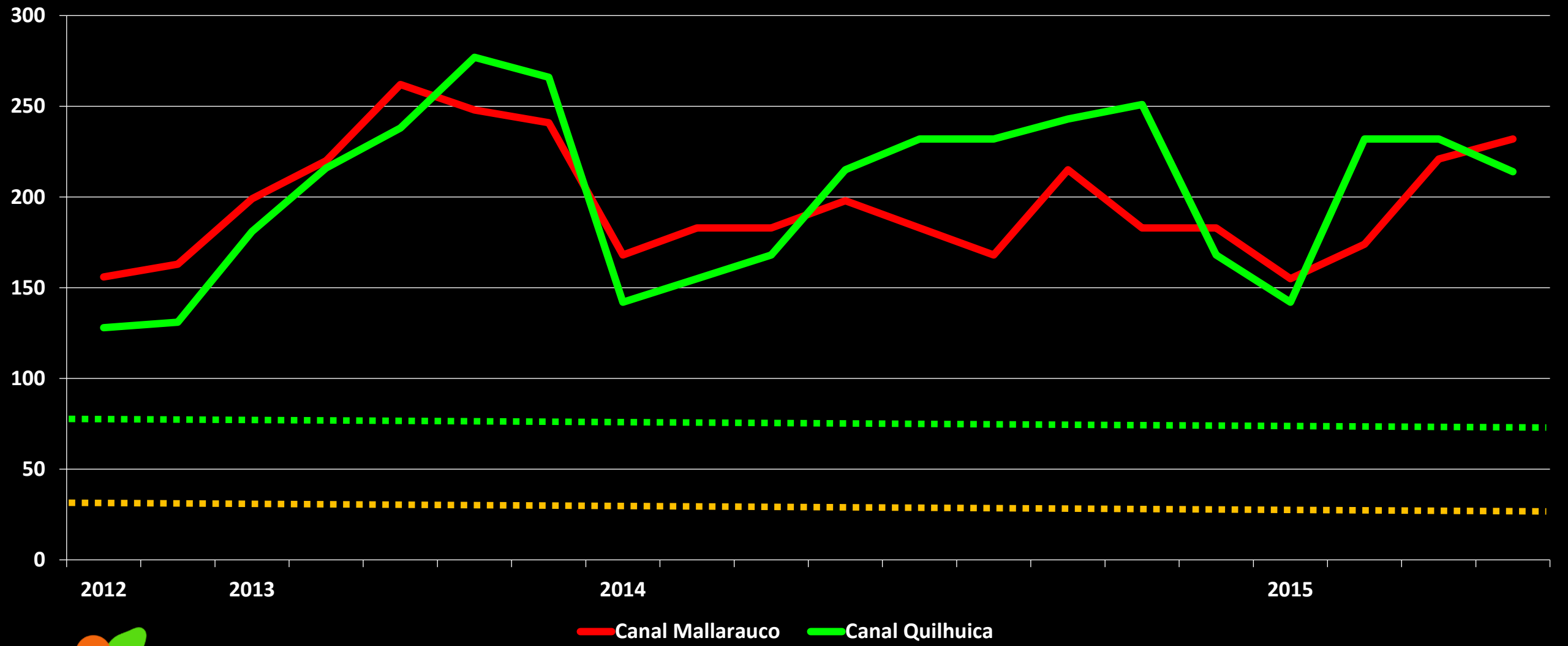
Water Chlorides Content – Mallarauco y Quilhuica AT Agrícola. 2012-15



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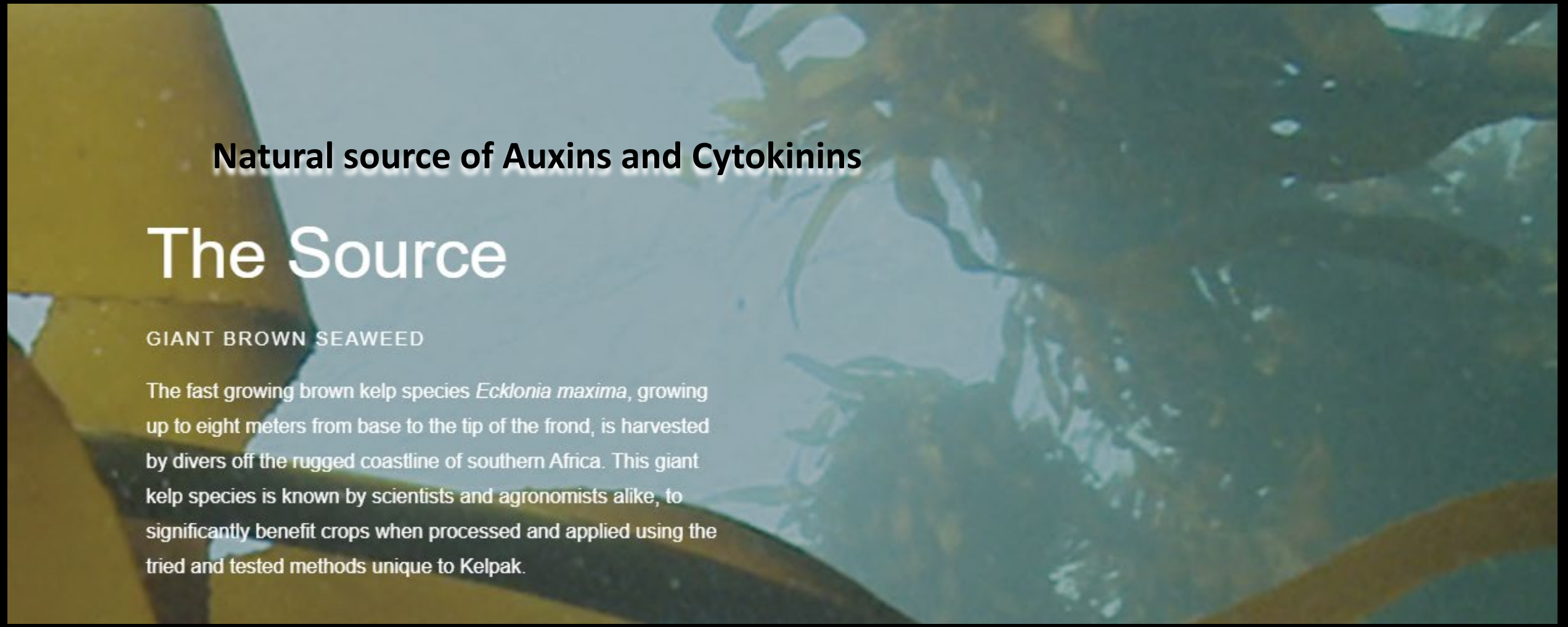
Benefits:

Increased nutrient absorption

Increased resistance to drought

Increased resistance to diseases

Increase the size and quiality of fruits



Soil applied KELPAK. Quilhuica 2016, 2017, 2018 & 2019.

- **Hass / Mexicola at 19,6 x 8,2 feet.**
- **Production years 2016, 2017, 2018 & 2019.**
- **Treatments:**

T0	Control
T1	Kelpak 1,6 gal/acre Nov
T2	Kelpak 3,2 gal/acre Nov
T3	Kelpak 1,6 + 1,6 gal/acre Nov + Mar
T4	Kelpak 3,2 + 3,2 gal/acre Nov + Mar

Applications: Spring and Summer

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Soil applied KELPAK. Quilhuica 2016, 2017, 2018 & 2019. Spring and Summer

Treatments	Sum fruits/tree 2016-2019	
T0 Control	204,7	
T1 K 1,6 gal Nov	262,6	+ 28,2%
T2 K 3,2 gal Nov	251,7	+ 22,9%
T3 K 1,6+1,6 gal Nov-Mar	258,8	+ 26,4%
T4 K 3,2+3,2 gal Nov-Mar	313,1	+ 52,9%

Different letters indicate that there are significant differences according to Tukey's Test

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Soil applied KELPAK. Quilhuica 2016, 2017, 2018 & 2019.

Treatments	Sum Lbs/tree 2016+17+18+19	
T0 Control	111,2	
T1 K 1,6 gal Nov	136,6	+ 22,7%
T2 K 3,2 gal Nov	134,2	+ 20,6%
T3 K 1,6+1,6 gal Nov-Mar	131,4	+ 18,1%
T4 K 3,2+3,2 gal Nov-Mar	164,6	+ 47,9%

Different letters indicate that there are significant differences according to Tukey's Test

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Soil applied KELPAK. Quilhuica 2016, 2017, 2018 & 2019.

	Lbs/Treatment				
Fruit Size	T0	T1	T2	T3	T4
Oversize	3,5	15,2	5,5	0,0	9,7
32	76,1	85,8	122,4	46,7	136,5
36	187,4	160,5	190,5	148,2	221,8
40	803,4	708,1	813,3	718,5	859,4
48	921,8	1215,0	1223,3	1181,5	1380,8
60	114,6	236,1	189,6	208,3	185,0
70	37,3	73,0	47,2	60,6	51,1
84	5,1	8,4	5,5	7,5	7,3
Undersize	8,4	9,3	3,3	4,2	6,4
SUM Lbs	2157,4	2511,3	2600,8	2375,3	2858,1
Size ≥ 48	1992,3	2184,6	2355,0	2094,6	2608,3
Size≤ 60	165,1	326,7	245,8	280,4	249,8

Treatments
T0 Control
T1 K 1,6 gal Nov
T2 K 3,2 gal Nov
T3 K 1,6+1,6 gal Nov-Mar
T4 K 3,2+3,2 gal Nov-Mar

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Soil applied KELPAK. Quilhuica 2016, 2017, 2018 & 2019.

Treatments	PCF 2016	PCF 2017	PCF 2018	PCF 2019
T0 Control	43,7 ab	43,3	3,676 b	48,3
T1 K 1,6 gal Nov	47,6 a	39,7	23,16 ab	48,9
T2 K 3,2 gal Nov	39,4 ab	46,3	13,95 ab	55,1
T3 K 1,6+1,6 gal Nov-Mar	28,2 b	28,8	21,5 ab	47,9
T4 K 3,2+3,2 gal Nov-Mar	37,6 ab	45,2	36,04 a	52,8

OFF YEAR

204% + production

Different letters indicate that there are significant differences according to Tukey's Test

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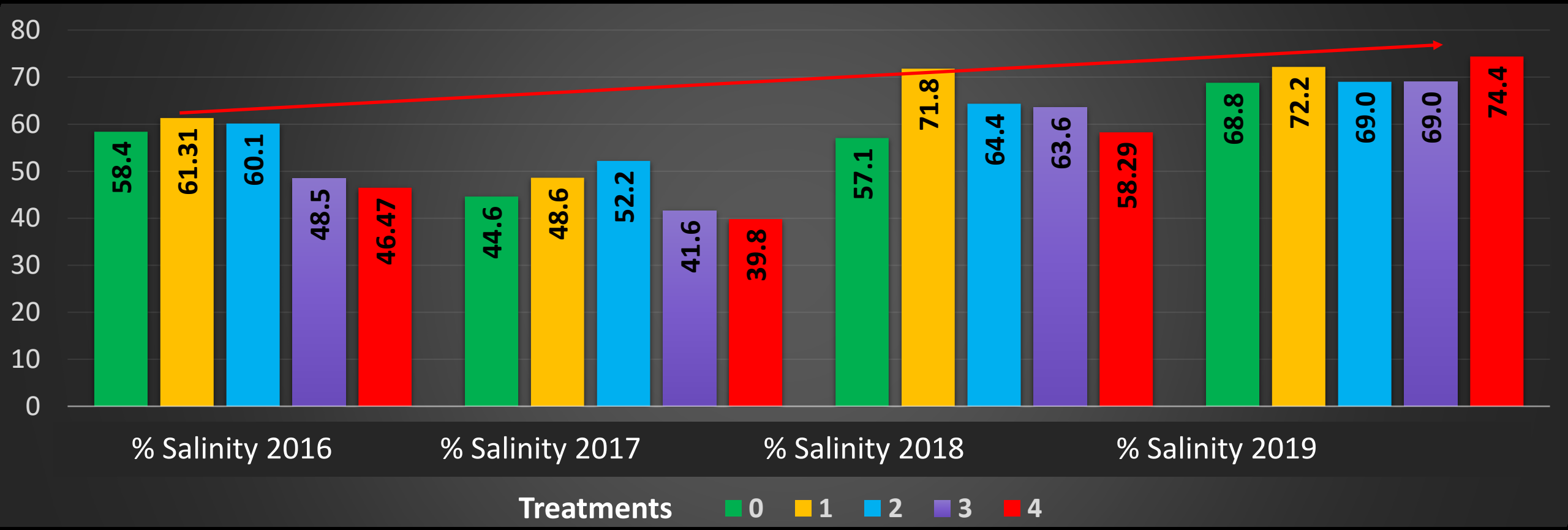
Soil applied KELPAK. Quilhuica 2016, 2017, 2018 & 2019. Leaf Salinity Damage



Treatments
T0 Control
T1 K 1,6 gal Nov
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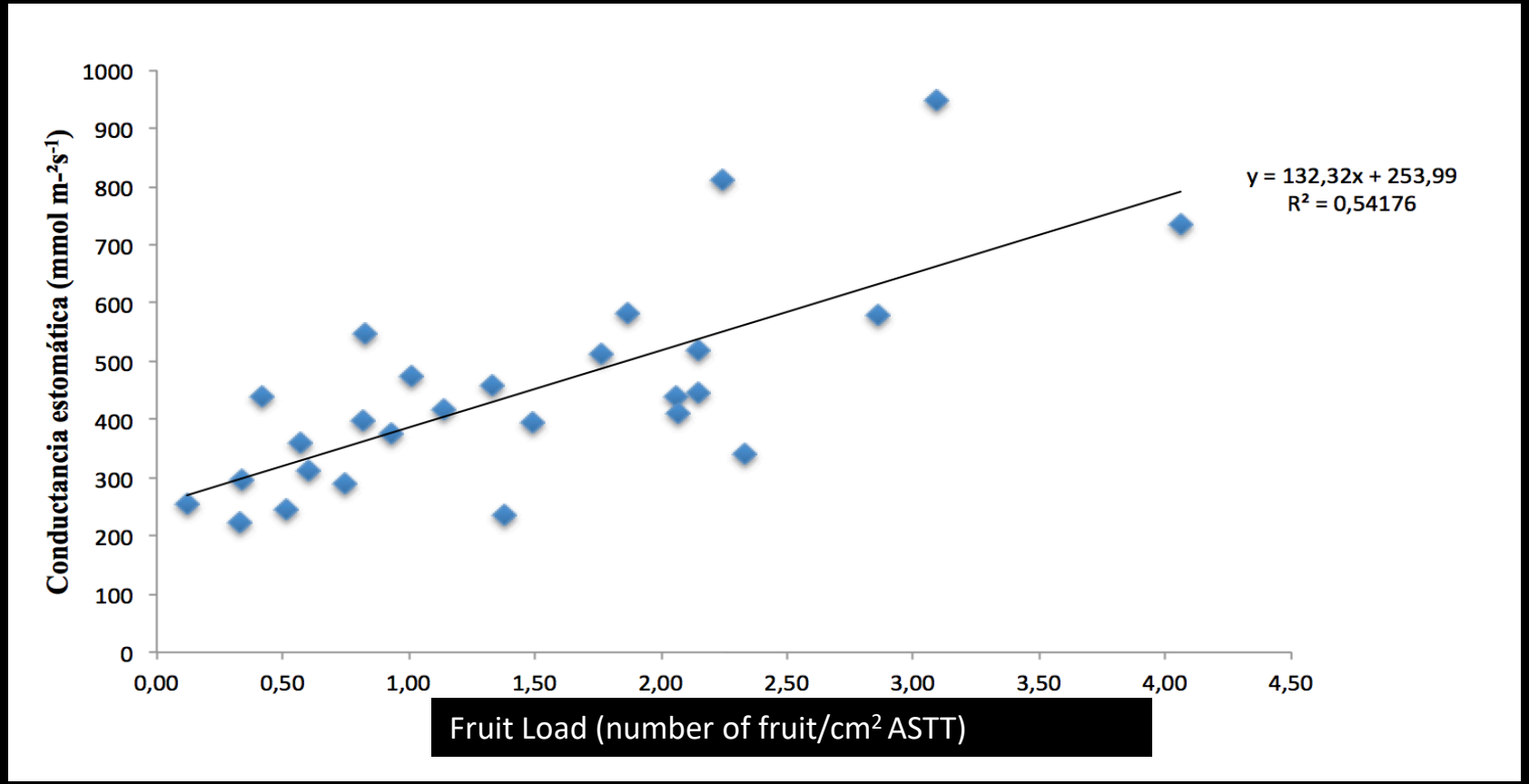

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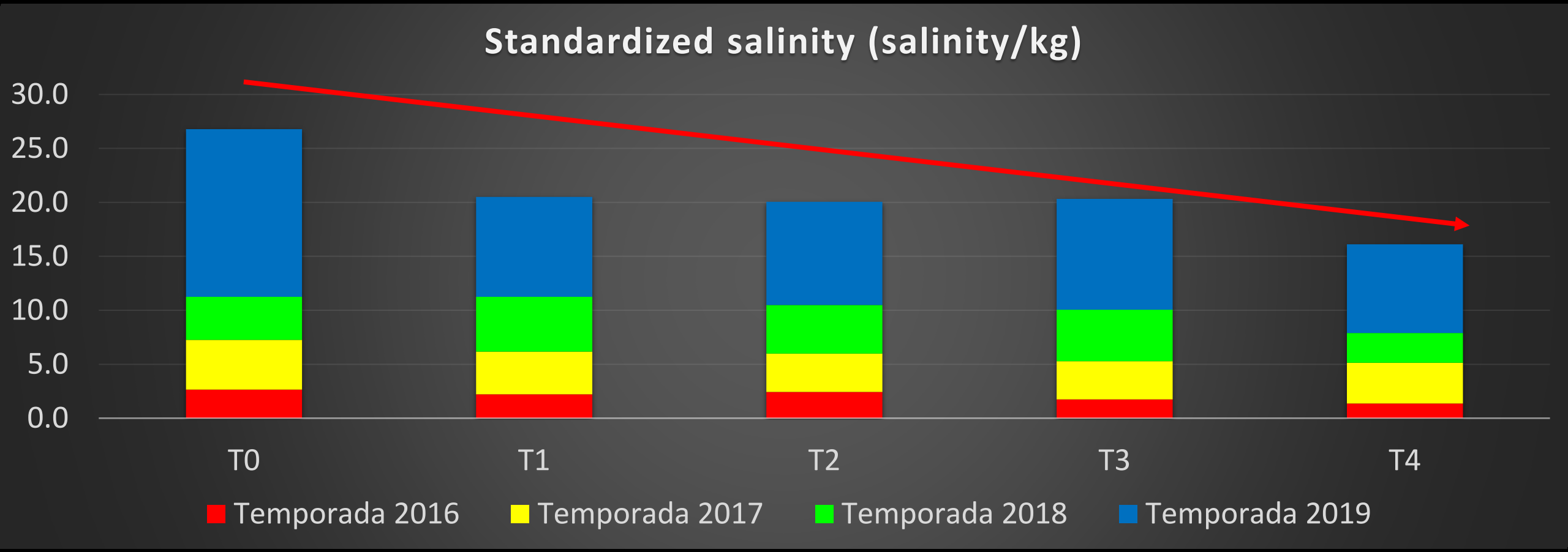

Treatments
T0 Control
T1 K 1,6 gal Nov
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T3 K 1,6+1,6 gal Nov-Mar
T4 K 3,2+3,2 gal Nov-Mar

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To Summarize

- Conditions are Changing and we need to adapt.
- Ambient conditions more prone to Stress.
- Several issues we need to focus in are:
  - How to prevent temperature caused stress.
    - Nets?
    - Water?
    - Sun Protectants
  - How to reduce salinity effects on productivity.
    - Root stimulators
    - Reverse Osmosis

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To Summarize

- Conditions are Changing and we need to adapt.
- Ambient conditions more prone to Stress.
- Several issues we need to focus in are:
  - How to prevent temperature caused stress.
  - How to reduce salinity effects on productivity.
- Many other things will change:
  - Pollinators.
  - Pests.
  - etc

we need to understand them in order to know what to look for in the orchards and adjust management.

- Stay Tuned to Avocado Cafe