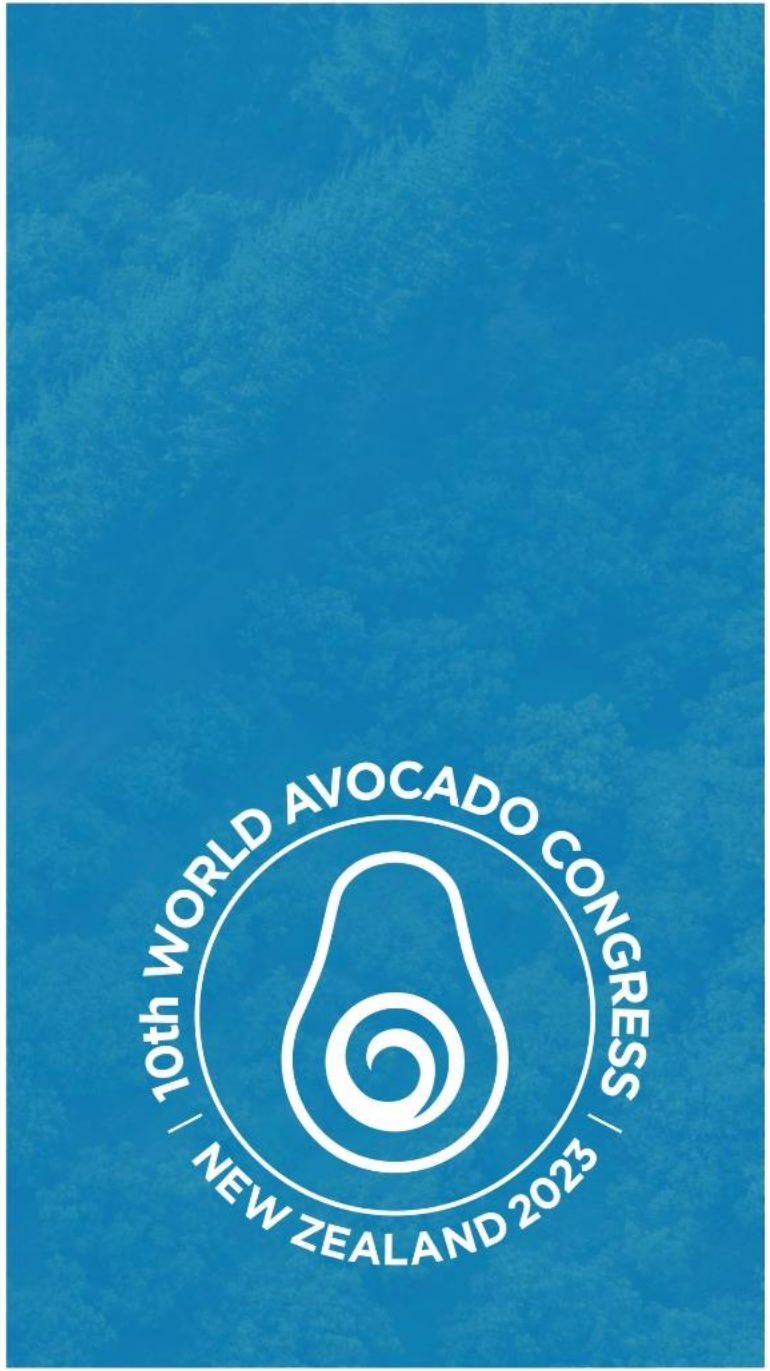
Growing Avocados in Challenging Times

Francisco Mena Völker
GAMA - Chile



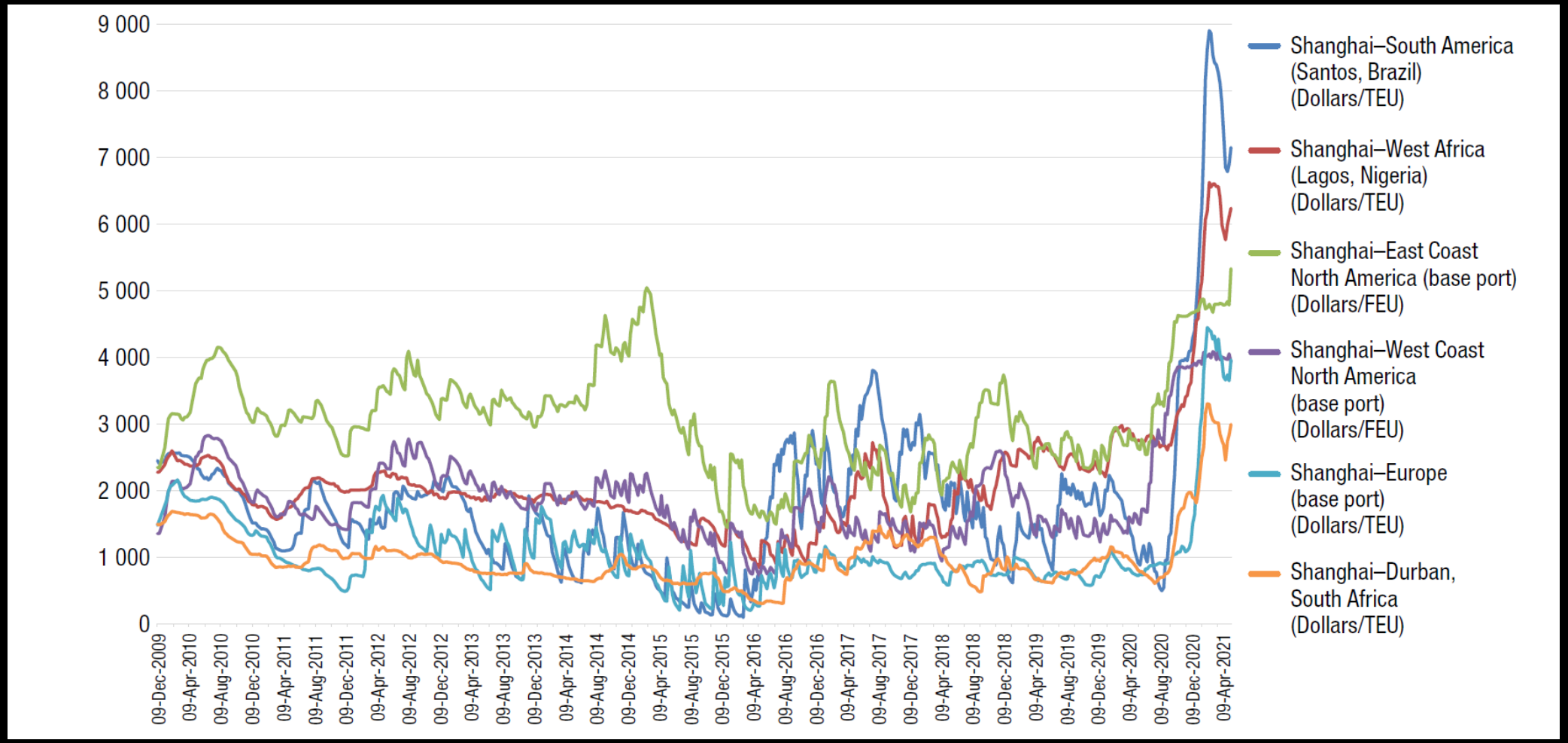
What has been so Challenging in the past Years?

- Production costs have Skyrocket.

Urea Monthly Price USD/ton

https://www.indexmundi.com

Shanghai containerized freight index, weekly spot rates, 18 December 2009–9 April 2021



Abbreviations: FEU, 40-foot equivalent unit; TEU, 20-foot equivalent unit.
Source: UNCTAD calculations, based on data from Clarksons Research, Shipping Intelligence Network Time Series.

What has been so Challenging in the past Years?

- **Production costs have Skyrocket.**
- **Shortage of Materials and Supplies.**

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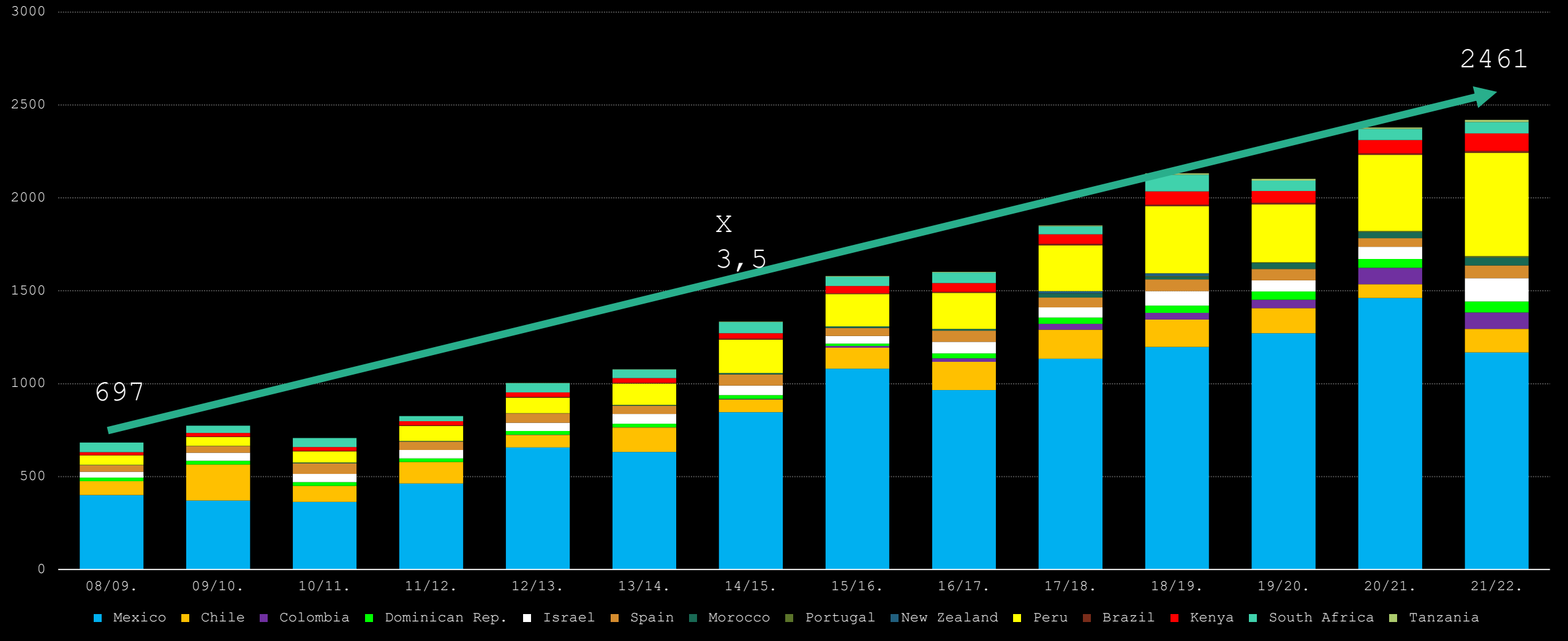
What has been so Challenging in the past Years?

- Production costs have Skyrocket.
- Shortage of Materials and Supplies.
- Logistics Problems (Delays).
- Availability and quality of labor.
- Climatic Uncertainty.
  - Drought.
  - Freeze.
  - Heatwaves.
  - Rain – Storms.

What has been so Challenging in the past Years?

- Production costs have Skyrocket.
- Shortage of Materials and Supplies.
- Logistics Problems (Delays).
- Availability and quality of labor.
- Climatic Uncertainty.
- Raise in Volumes

World Avocado Exports by Exporting Country (tonnes x 1000) Source: FruiTrop 283)



¿What´s left for us to do in this scenario?

- We can´t change the price of supplies.
- We can´t manage the fruit price in final markets.
- We can´t modify the price of shipping.
- We can´t control consumption,

¿What´s left for us to do in this scenario?

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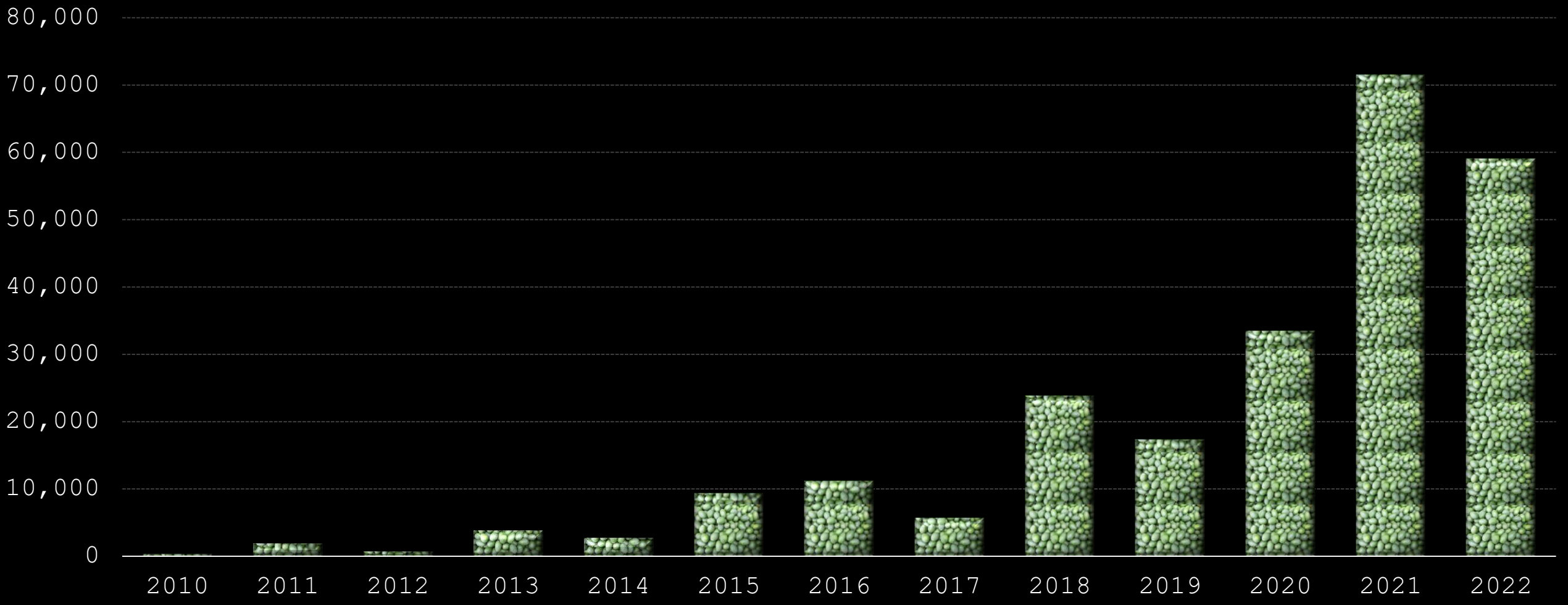
Avocado Imports Chile 2010-2022



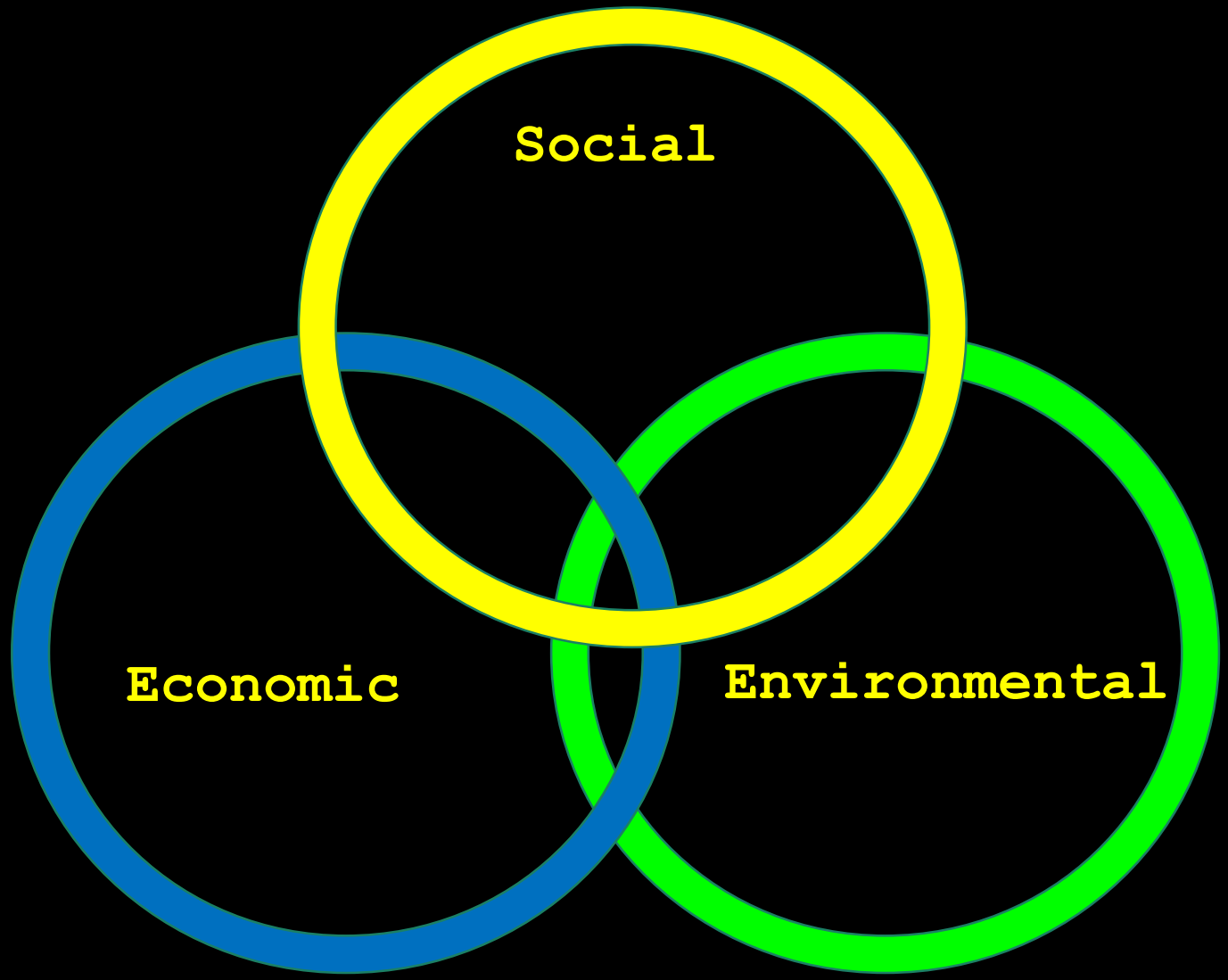
Source: odepa

¿What´s left for us to do in this scenario?

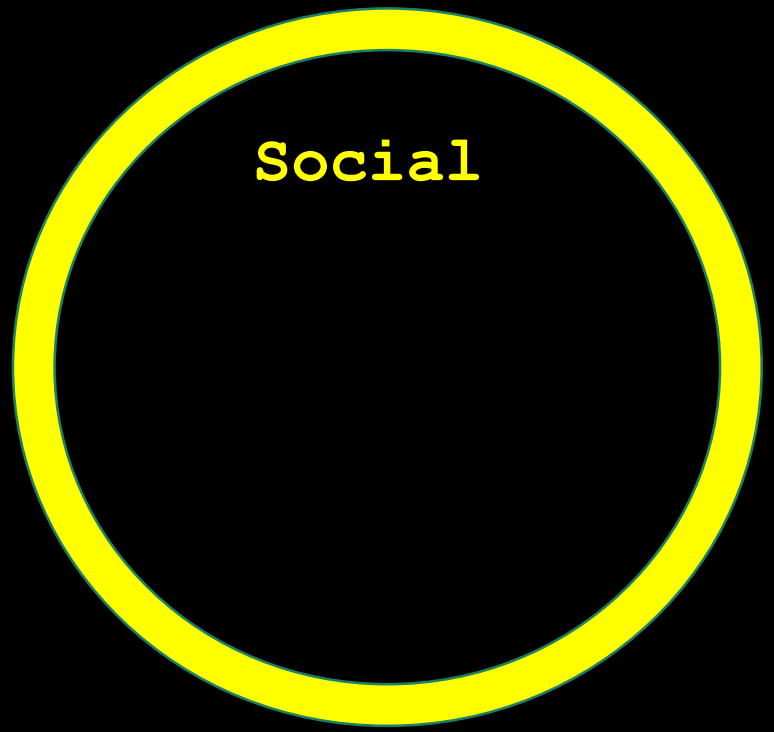
- We can´t change the price of supplies.
- We can´t manage the fruit price in final markets.
- We can´t modify the price of shipping.
- We can´t control consumption, but we work with the most sustainable crop and that will keep on improving consumption.
- Efficient use of resources:
  - Water
  - Fertilizers
  - Pesticides
  - Fuel
  - Energy
  - Labor

Relation Sustainability / Cost effectiveness

Sustainable Development



Sustainable Development



How we design our Orchards.

Worker friendly Orchards

Gama

Why did we go with High Densities?

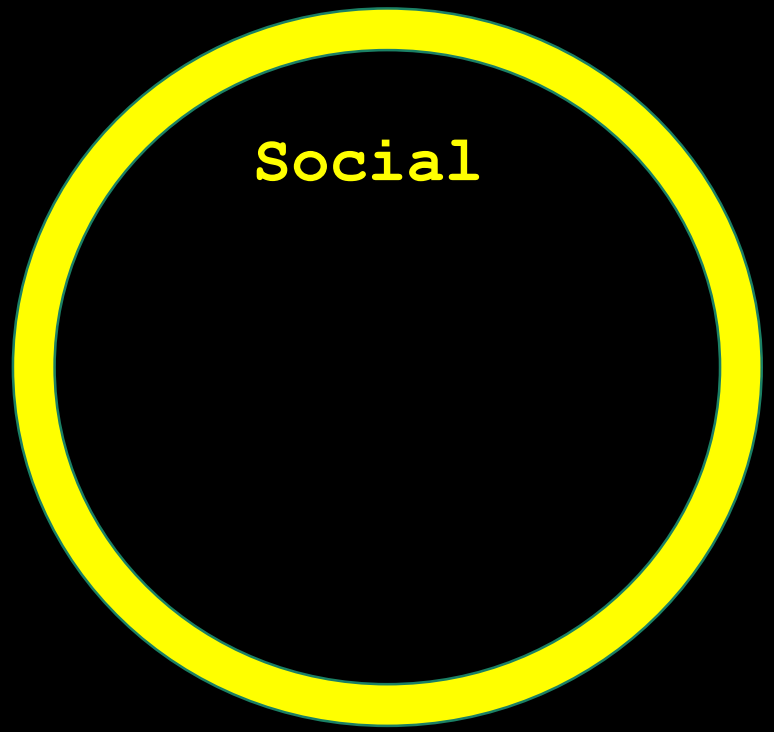
- Small Trees more attractive and Safer for Labor.
- Faster return of investment.
- Higher productions.
- Lower Picking costs.
- Better Picking Quality (Size picking).
- Easier canopy management.
- Lower water consumption/Kg.
- No option for mechanization on the hills and/or no need for applications/machinery transit in the Orchards.

Gama

Higher Densities

- Not only means more trees/ha.
- Commitment with light interception.
- “Rules of engagement”
- Soil and climatic considerations.
- Fruit is essential.
- Development of Soil applied PBR’s.

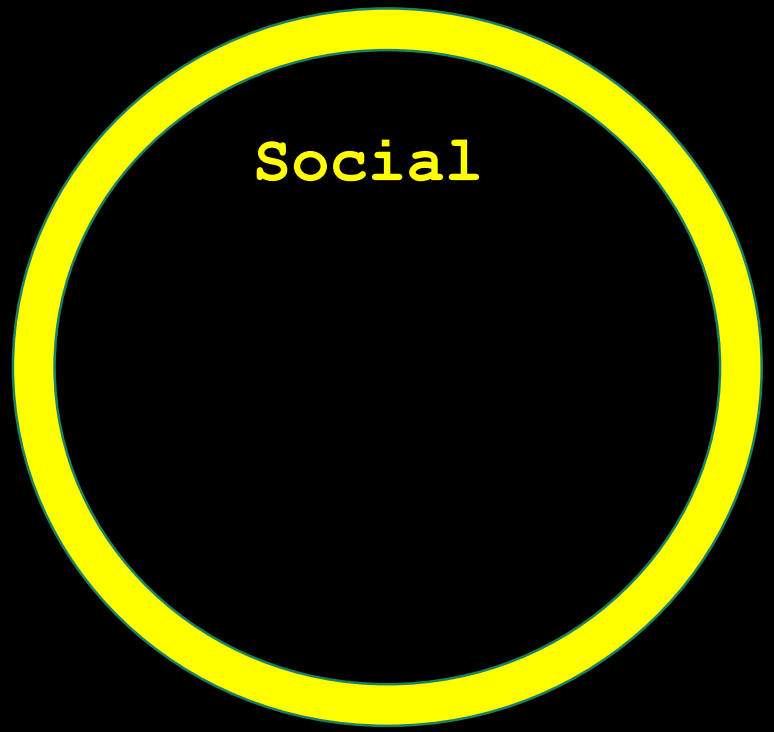
Sustainable Development



How we design our Orchards.
Reducing the use of Pesticides - Natural Enemies when possible.

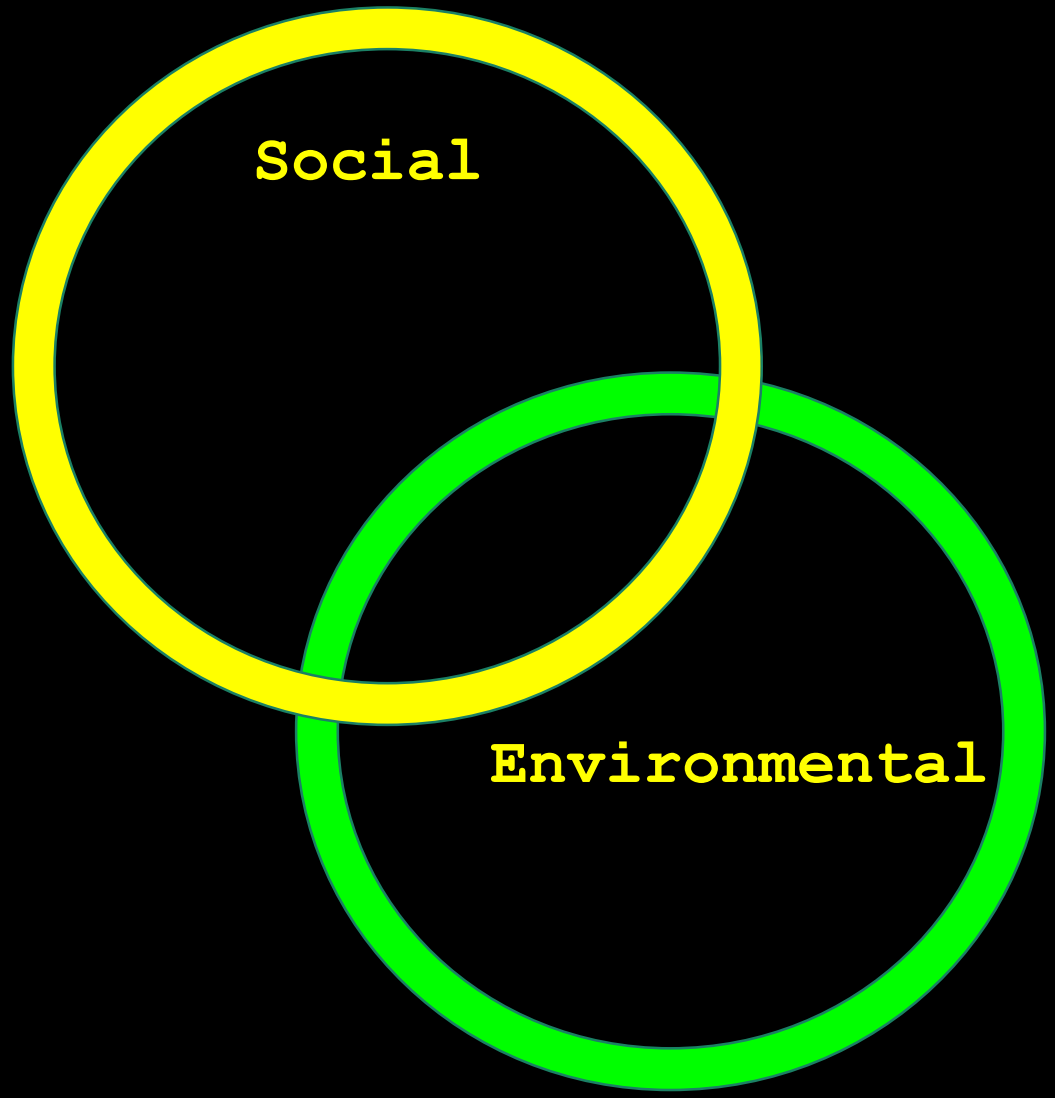

AMERICANO
QUIMICAMENTE
PURO
ALGODON HIDROFILO
25
37

Sustainable Development



How we design our Orchards.
Reducing the use of Pesticides - Natural Enemies when possible.
Benefits for Human health.

Sustainable Development



RESUMEN EJECUTIVO

ESTUDIO "HUELLA DE CARBONO EN PRODUCTOS DE EXPORTACIÓN AGROPECUARIOS DE CHILE"

FIA EST-2009-0270

Estudio co-ejecutado por:

Instituto de Investigaciones Agropecuarias (INIA)
y
Servicios de Ingeniería DEUMAN Ltda.

DEUMAN

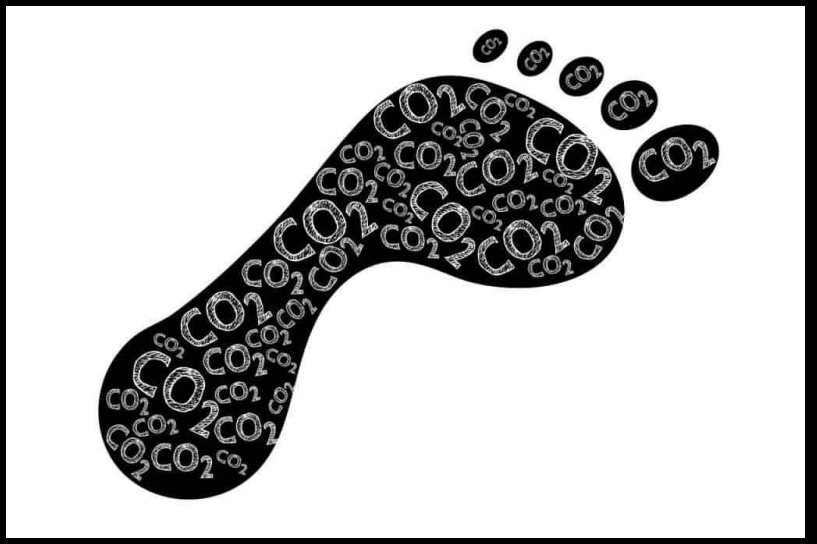
Mayo, 2010

FUNDACIÓN PARA LA INNOVACIÓN AGRARIA (FIA)

INSTITUTO DE INVESTIGACIONES AGROPECUARIAS (INIA)

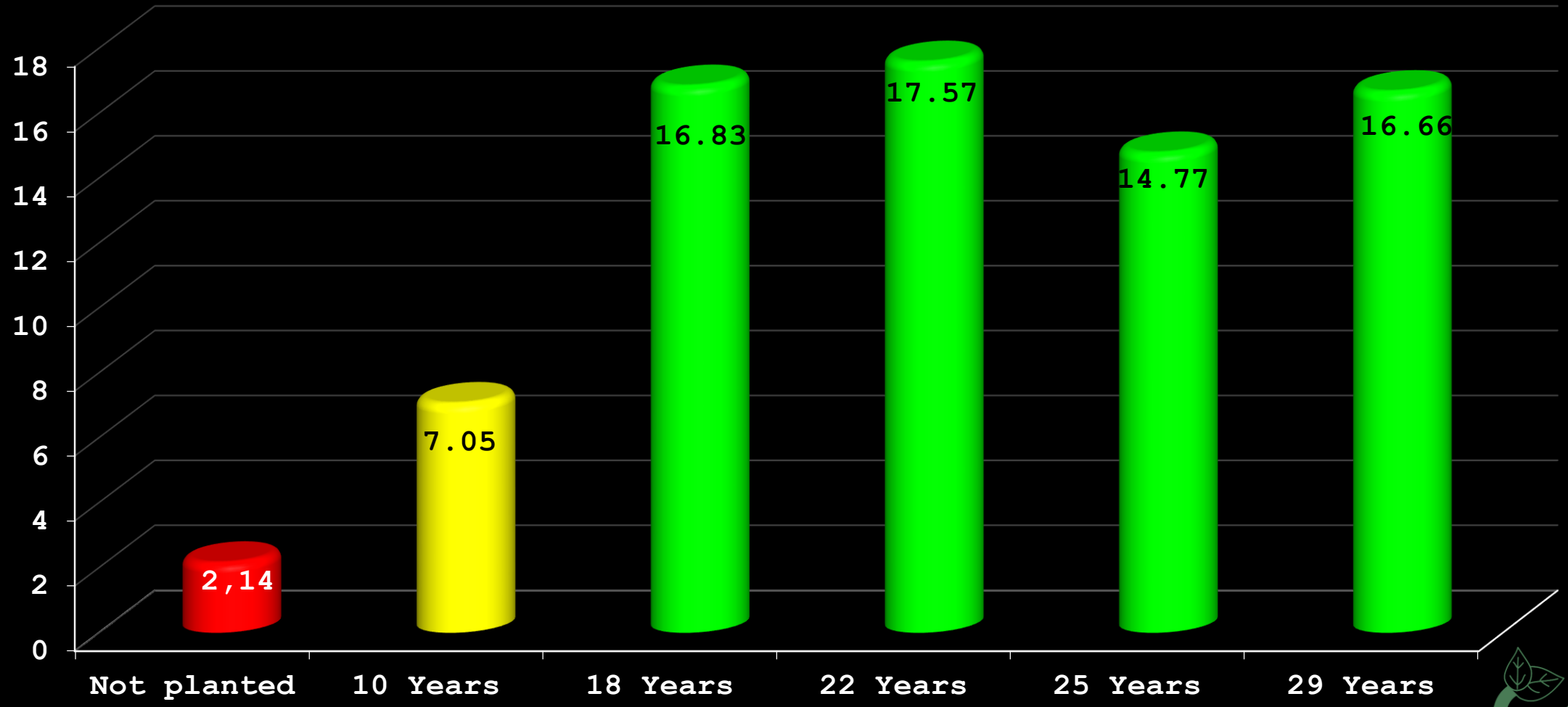
INIA LA PI ATINA

CHILE
POTENCIA ALIMENTARIA Y FORESTAL

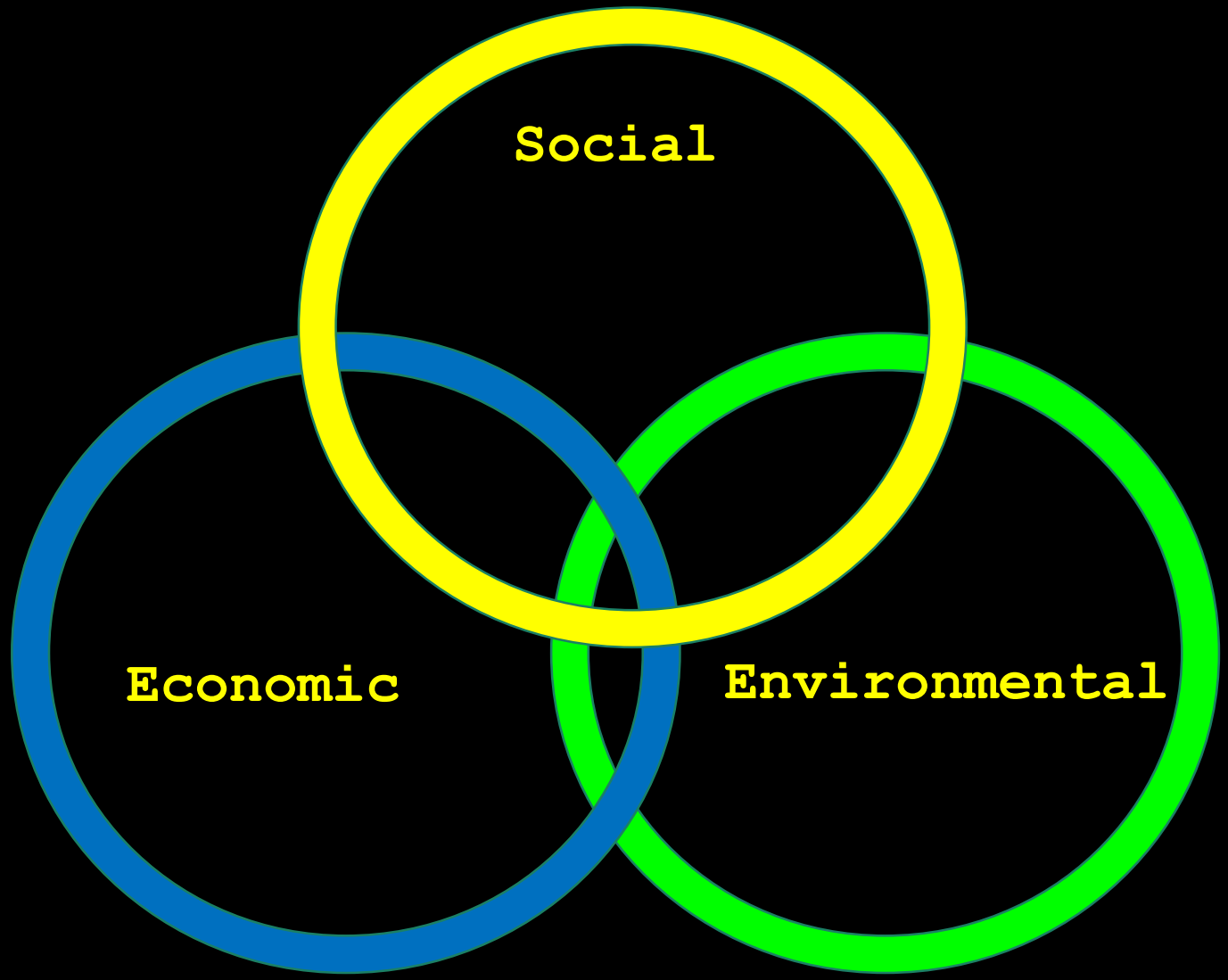


Si la huella de carbono incluye transporte marítimo, los rangos de valores de los productos vegetales fluctuaron para los envíos a EUA entre -0.04 kg CO_2e unidad funcional^{-1} (valor mínimo de palta Hass-laderas) y 2,93 kg CO_2e unidad funcional^{-1} (valor máximo de vinos); si el envío es a Europa, el rango quedó comprendido entre 0,01 y 2,97 kg CO_2e unidad funcional^{-1}, para los mismos productos. Fue evidente que la inclusión del cambio de uso para paltas del interior de la Región de

Soil (0 – 10 cm) Organic Matter Content under different ages of Avocado plantings - 2019



Sustainable Development



Factors that influence Avocado Production

Soil

- Homogeneous
- Complicated Soils:
  - Depth
  - Texture
  - Irrigation planning

Climate

- Freeze
- Fruit Set Temperatures
- Heat Waves
- Drought
- Rain

Water

- Availability
- Quality


TOXICO
NO BEBER
AGUA
DE RIEGO

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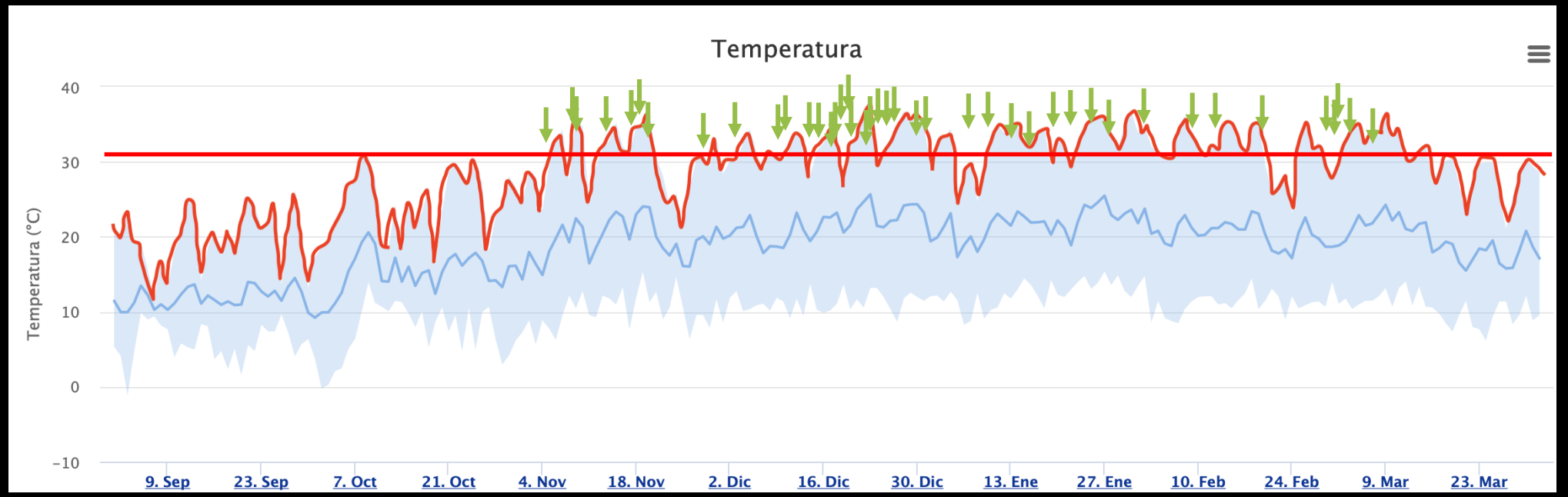
Temperatures 2019/2020: Peumo



42 days above 33° C up to March 31st

Gama

Heatwaves management on Avocados

- Overhead sprinklers.
  - Silit, L. *et al.* (2022)
    https://www.nature.com/articles/s41598-022-16839-3

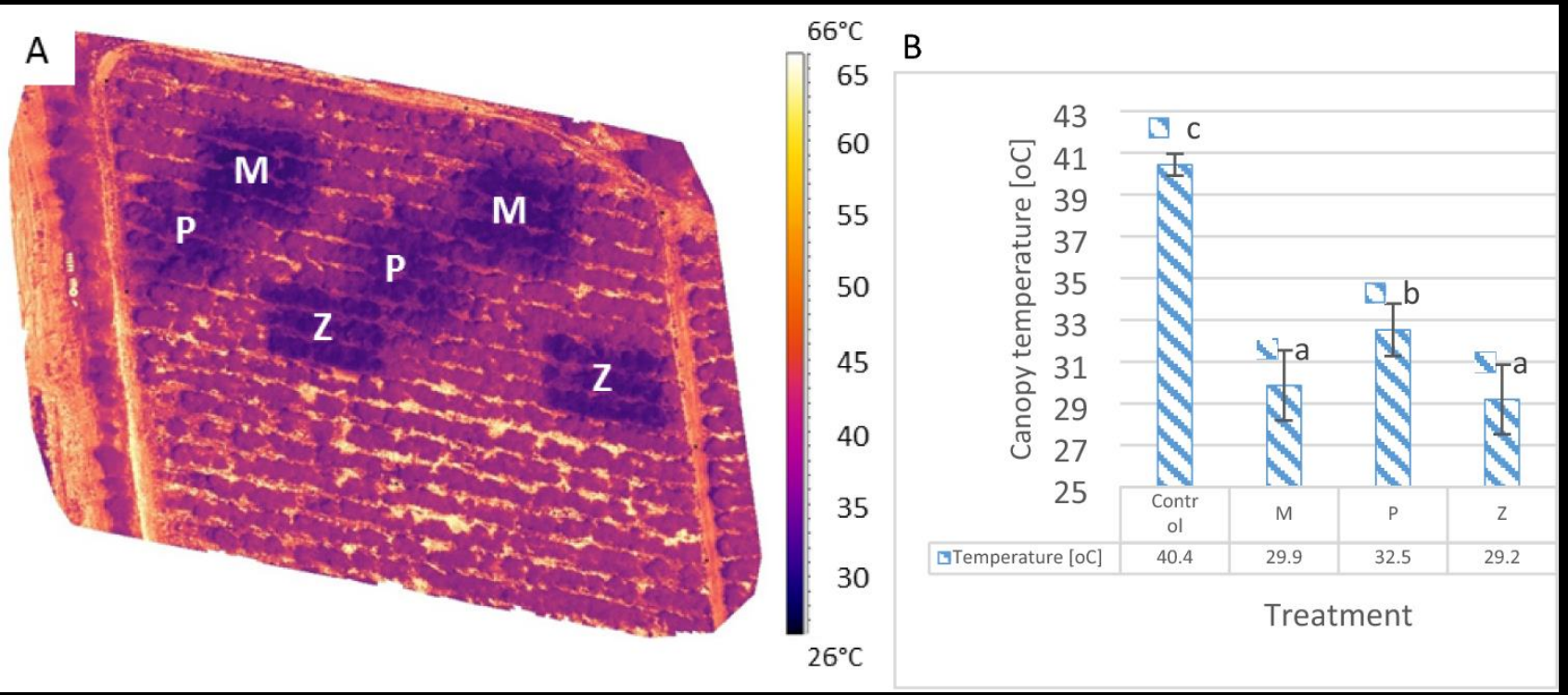
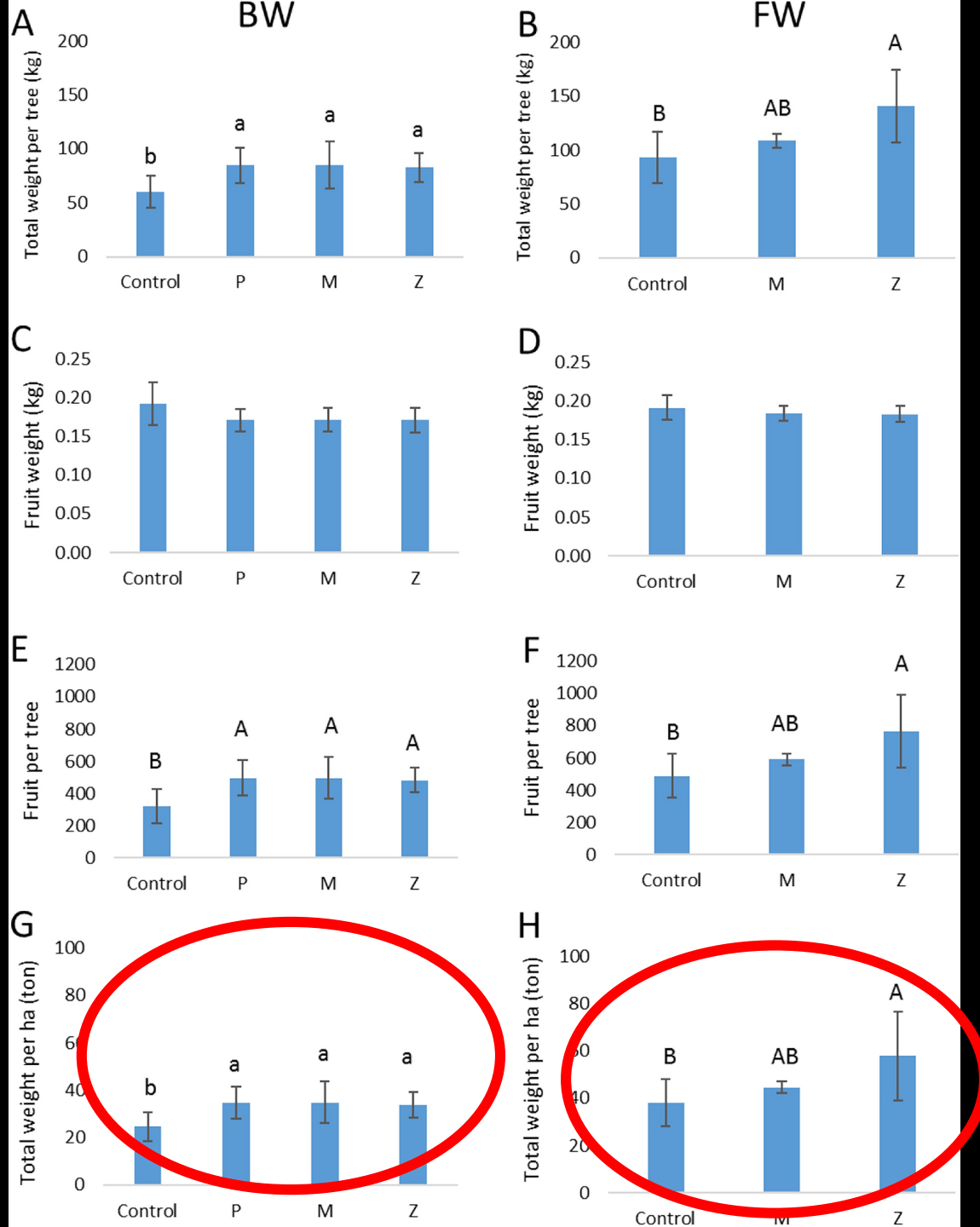


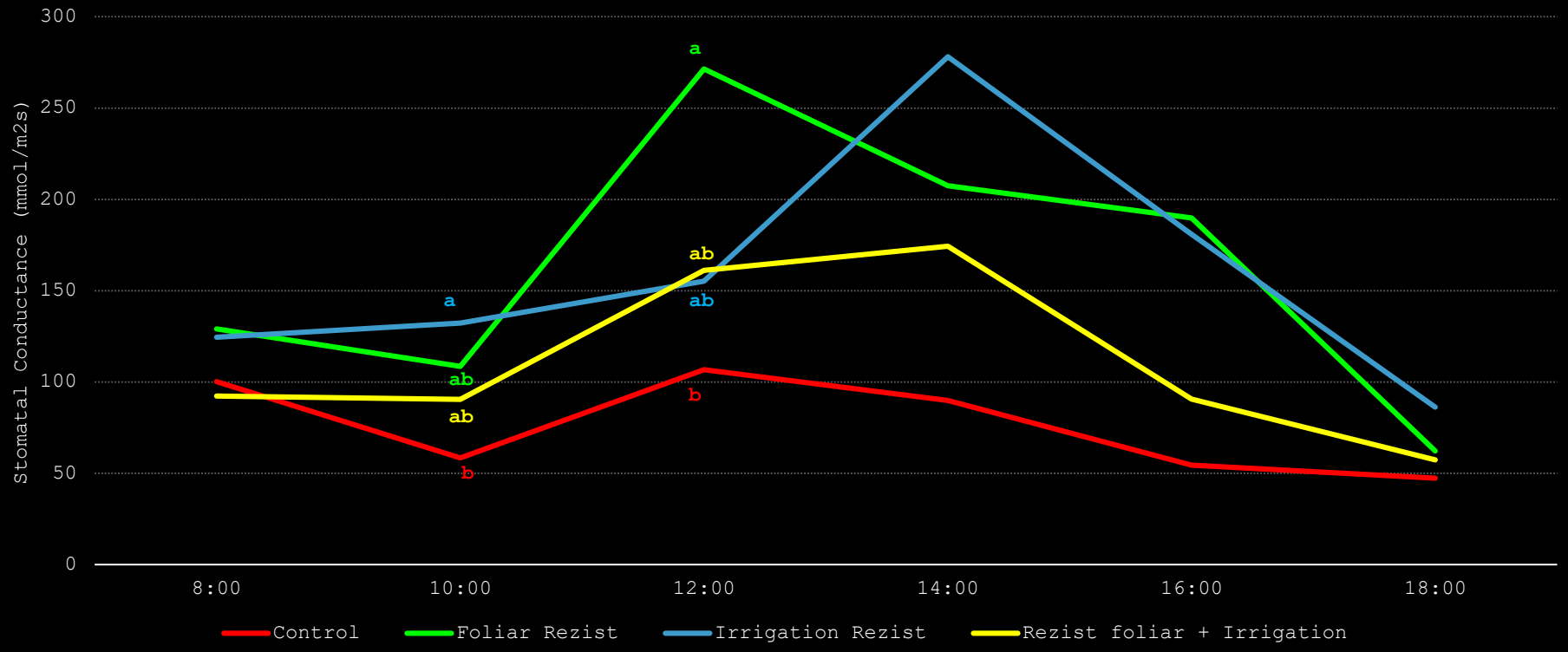
Figure 3. Canopy temperature in the orchards during the heatwave. (**A**) Above-canopy thermal imaging of the Gevim orchard with six experimental plots to which different treatment types were applied. P: sprinklers pulses (irrigation rate of 17 m3/h/ha). M: sprayers (21 m3/h/ha). Z: sprinklers (31 m3/h/ha). (**B**) Mean values of the tree's canopy temperature (taken from **A**). Different letters represent significant ($p \leq 0.05$) differences between treatments. Bars are SD values.

Yield indices in Hass avocado trees, as affected by several methods of canopy cooling. (**A**,**C**,**E**,**G**) Brackish water, Gevim orchard. (**B**,**D**,**F**,**H**) fresh water, Sa'ad orchard. P: sprinklers in pulses (irrigation rate of 17 m^3/h/ha). M: sprayers (21 m^3/h/ha). Z: sprinklers (31 m^3/h/ha). Different capital letters represent significant ($p \leq 0.05$) differences between treatments. Different lower-case letters represent significant ($p \leq 0.07$) differences between treatments. Bars are SD values.



Stomatal Conductance Curve

February 3rd 2021



Treatment	Stomatal Conductance					
	8:00	10:00	12:00	14:00	16:00	18:00
Control	100,2 ± 90,0	58,4 ± 16,4 b	106,7 ± 57,2	89,8 ± 35,8	54,47 ± 13,34	47,3 ± 30,0
Foliar Rezist	129,1 ± 37,1	108,6 ± 25,2	271,5 ± 97,2	207,4 ± 88,1	189,8 ± 90,8	62,27 ± 10,05
Irrigation Rezist	124,5 ± 27,3	132,3 ± 52,6 a	155,2 ± 51,1	278,1 ± 130,0	180,9 ± 146,9	86,3 ± 51,6
Rezist foliar +	92,3 ± 36,5	90,47 ± 7,30	161,2 ± 38,0	174,4 ± 57,9	90,7 ± 24,1	57,3 ± 19,5
P Value	0,8	0,088	0,071	0,133	0,234	0,521
Test de Tukey		90%	90%			

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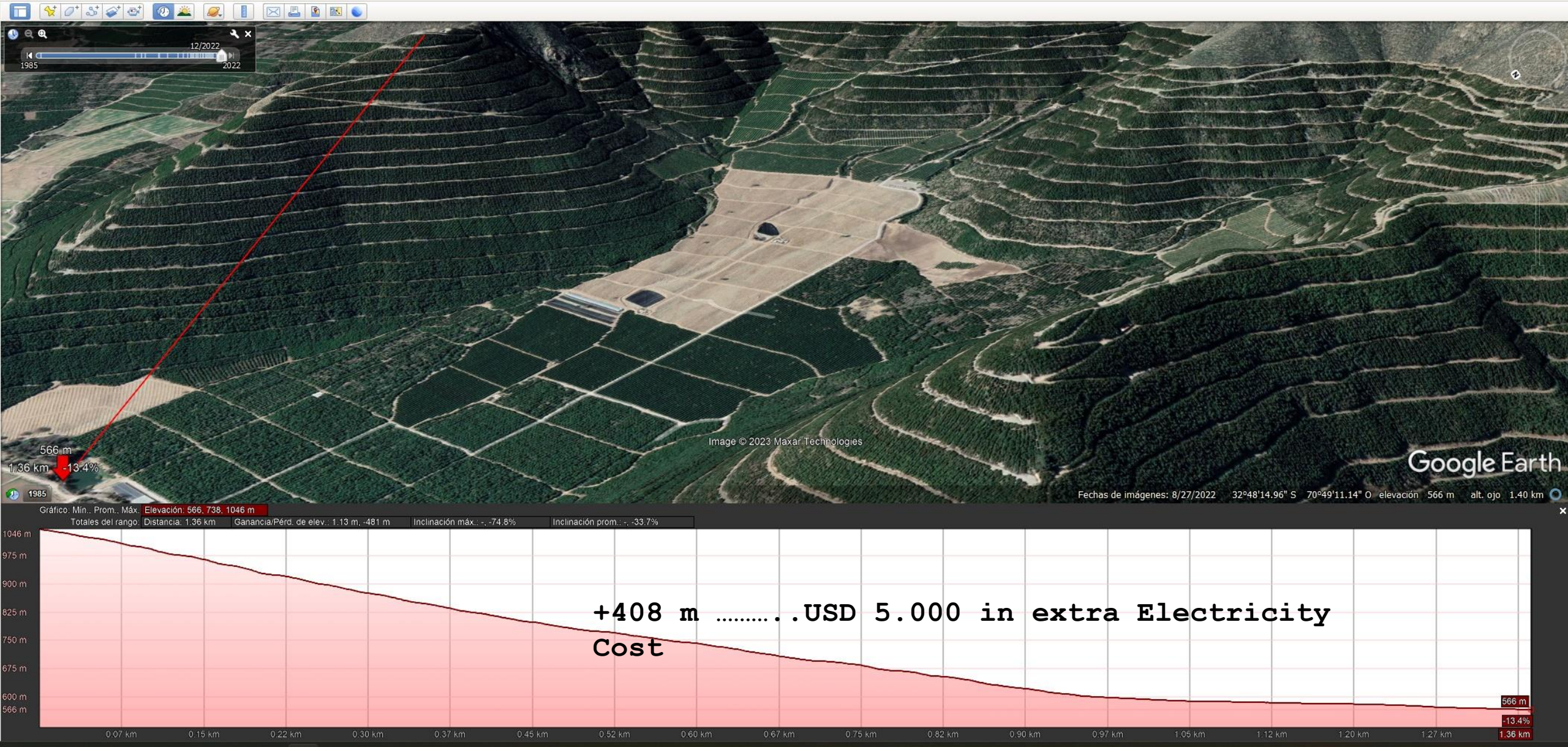
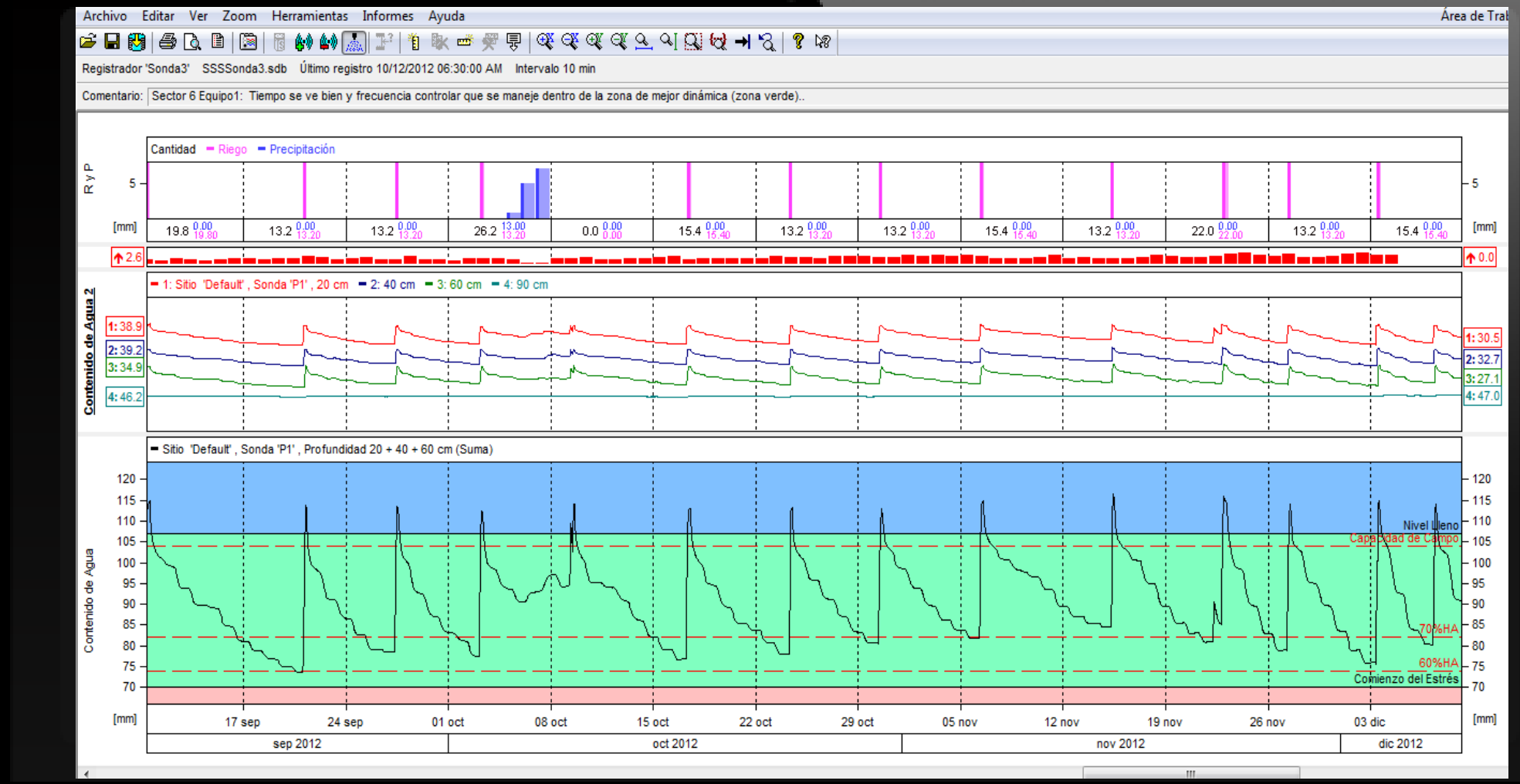
Efficient use of Water




Archivo Editar Ver Zoom Herramientas Informes Ayuda
Registrador 'Sonda3' SSSSonda3.sdb Último registro 10/12/2012 06:30:00 AM Intervalo 10 min
Comentario: Sector 6 Equipo1: Tiempo se ve bien y frecuencia controlar que se maneje dentro de la zona de mejor dinámica (zona verde)..
R y P
Cantidad Riego Precipitación
[mm]
19.8 13.2 13.2 26.2 0.0 15.4 13.2 13.2 15.4 13.2 22.0 13.2 15.4
Contenido de Agua 2
1: Sitio 'Default' , Sonda 'P1' , 20 cm 2: 40 cm 3: 60 cm 4: 90 cm
1: 38.9
2: 39.2
3: 34.9
4: 46.2
1: 30.5
2: 32.7
3: 27.1
4: 47.0
Contenido de Agua
Sitio 'Default' , Sonda 'P1' , Profundidad 20 + 40 + 60 cm (Suma)
Nivel Lleno
Capacidad de Campo
70%HA
60%HA
Comienzo del Estrés
17 sep 24 sep 01 oct 08 oct 15 oct 22 oct 29 oct 05 nov 12 nov 19 nov 26 nov 03 dic
sep 2012 oct 2012 nov 2012 dic 2012

Gama

Saturas
InTree™ Intelligence


Estrés Hídrico
(24 de marzo de 2020)
Estrés Hídrico
<= -0.9 (Superavit)
-0.9 a -0.75 (Óptimo)
-0.75 a -0.6 (Déficit)
>= -0.6 (Déficit Severo)

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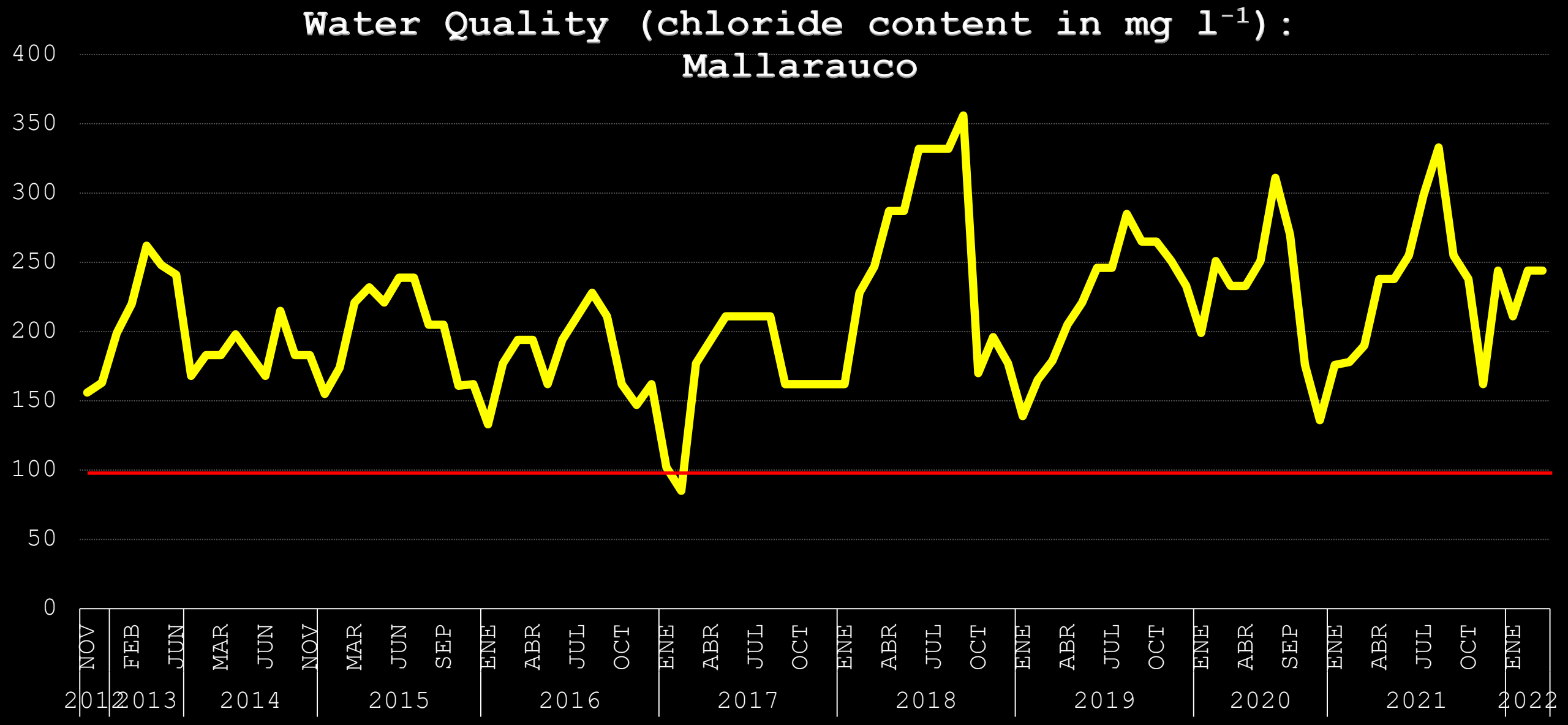

Effect of Rootstock on Production of Hass and GEM, AT Agricola, Chile

	K/tree									
	2015	2016	2017	2018	2019	2020	2021	2022	TOTAL 8	Avg K/ha
HASS/DUKE 7	5	6	16	4,76	2,97	5,14	17,66	12,89	70,42	8,80
HASS/DUSA	8	3	19	4,14	2,12	7,39	32,08	16,18	91,91	11,49
HASS/NABAL	7	7	20	8,75	4,17	18,81	23,44	31,75	120,92	15,12
GEM/DUKE 7	16	20	14	13,96	5,49	29,43	38,08	18,9	155,86	19,48
GEM/DUSA	7	17	15	15,4	1,88	26,5	30,35	19,12	132,28	16,54
GEM/NABAL	27	25	12	22	8,25	26,63	32,24	39,63	192,75	24,09

Irrigation Water 150 ppm of Chlorides

Hass: H/N: +71% H/D7

GEM: G/N: +23%

G/D7

+ 31% H/Du

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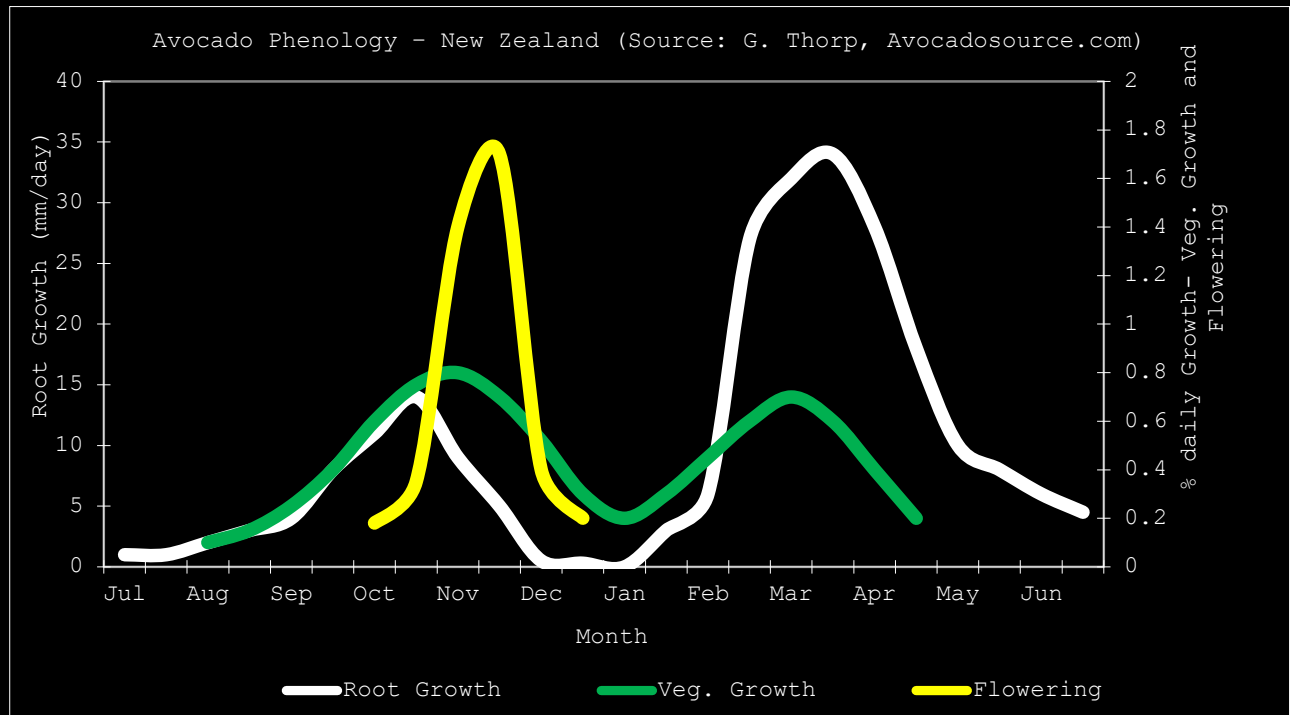
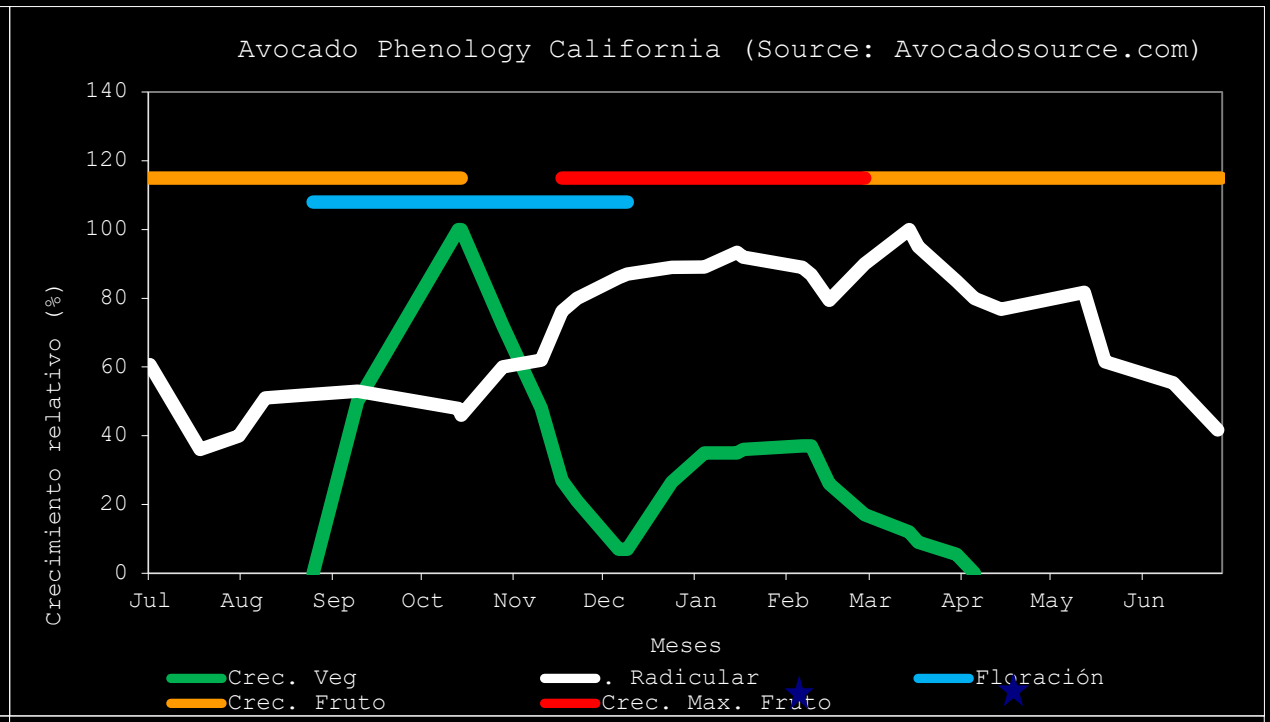
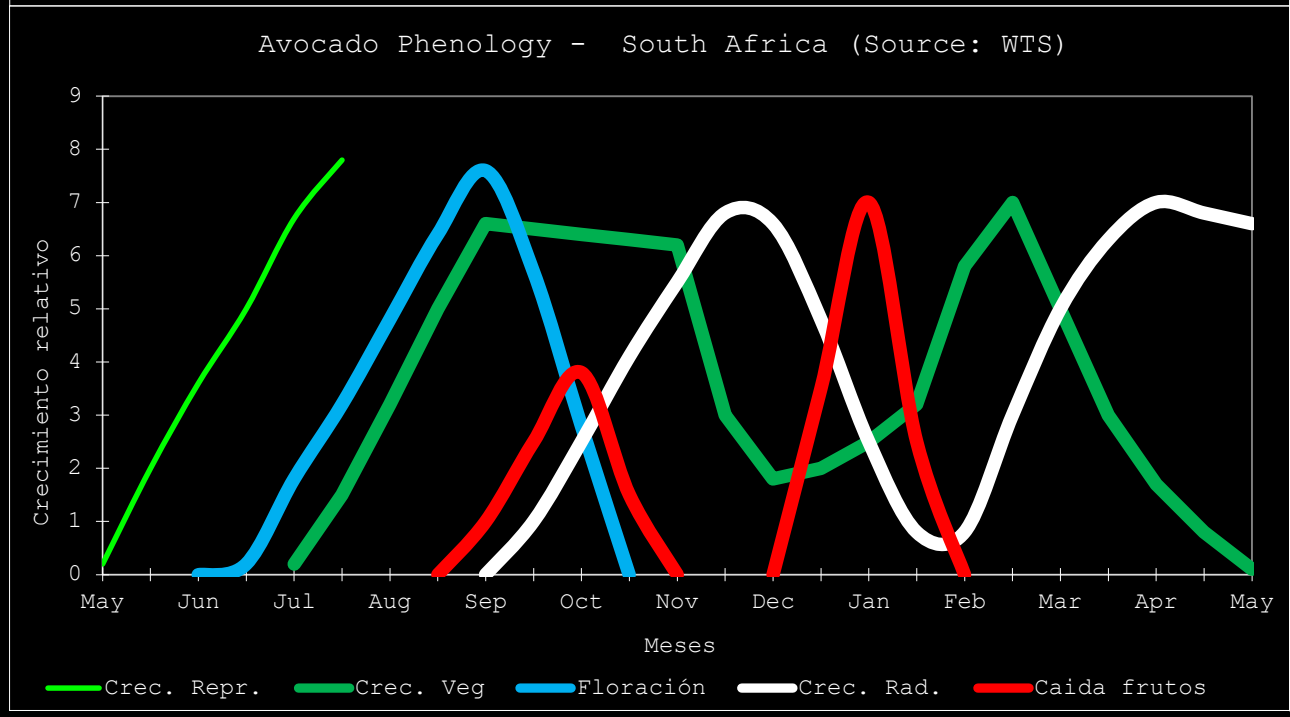
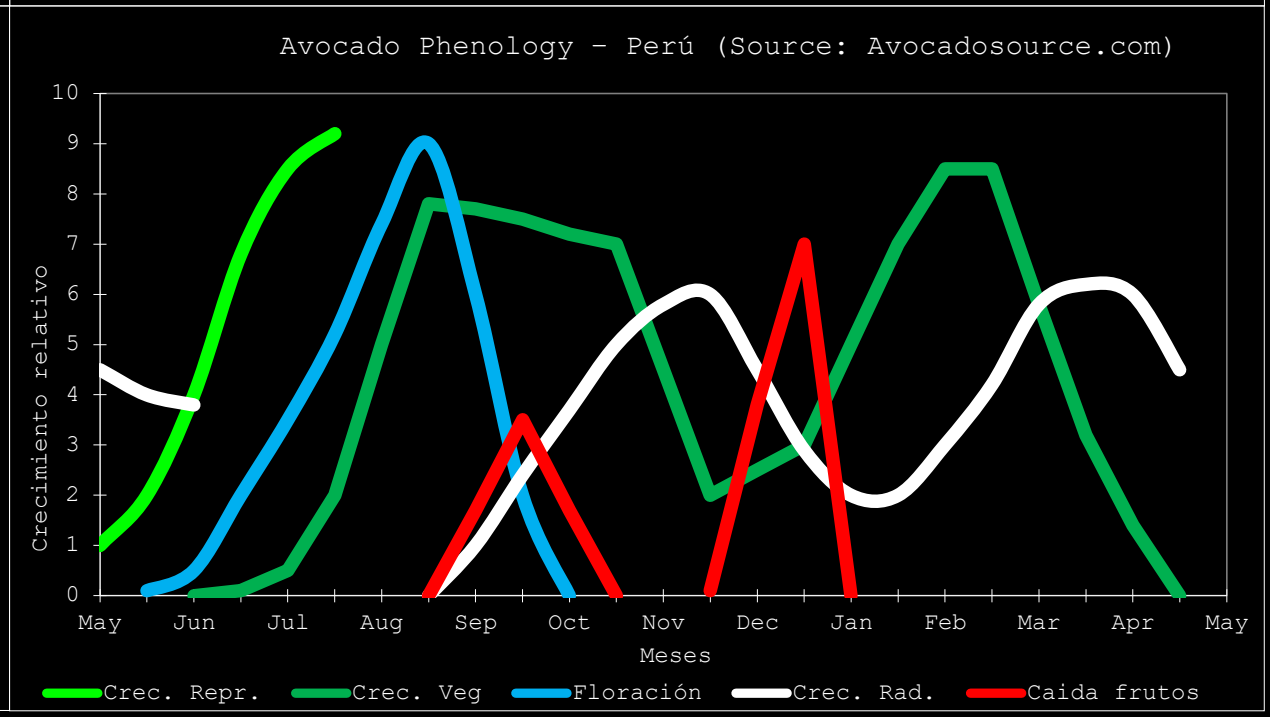
Management


Avocado Phenology - New Zealand (Source: G. Thorp, Avocadosource.com)
Root Growth (mm/day)
% daily Growth- Veg. Growth and Flowering
Month
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun
Root Growth
Veg. Growth
Flowering


Avocado Phenology California (Source: Avocadosource.com)
Crecimiento relativo (%)
Meses
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun
Crec. Veg
. Radicular
Floración
Crec. Fruto
Crec. Max. Fruto


Avocado Phenology - South Africa (Source: WTS)
Crecimiento relativo
Meses
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May
Crec. Repr.
Crec. Veg
Floración
Crec. Rad.
Caida frutos


Avocado Phenology - Perú (Source: Avocadosource.com)
Crecimiento relativo
Meses
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May
Crec. Repr.
Crec. Veg
Floración
Crec. Rad.
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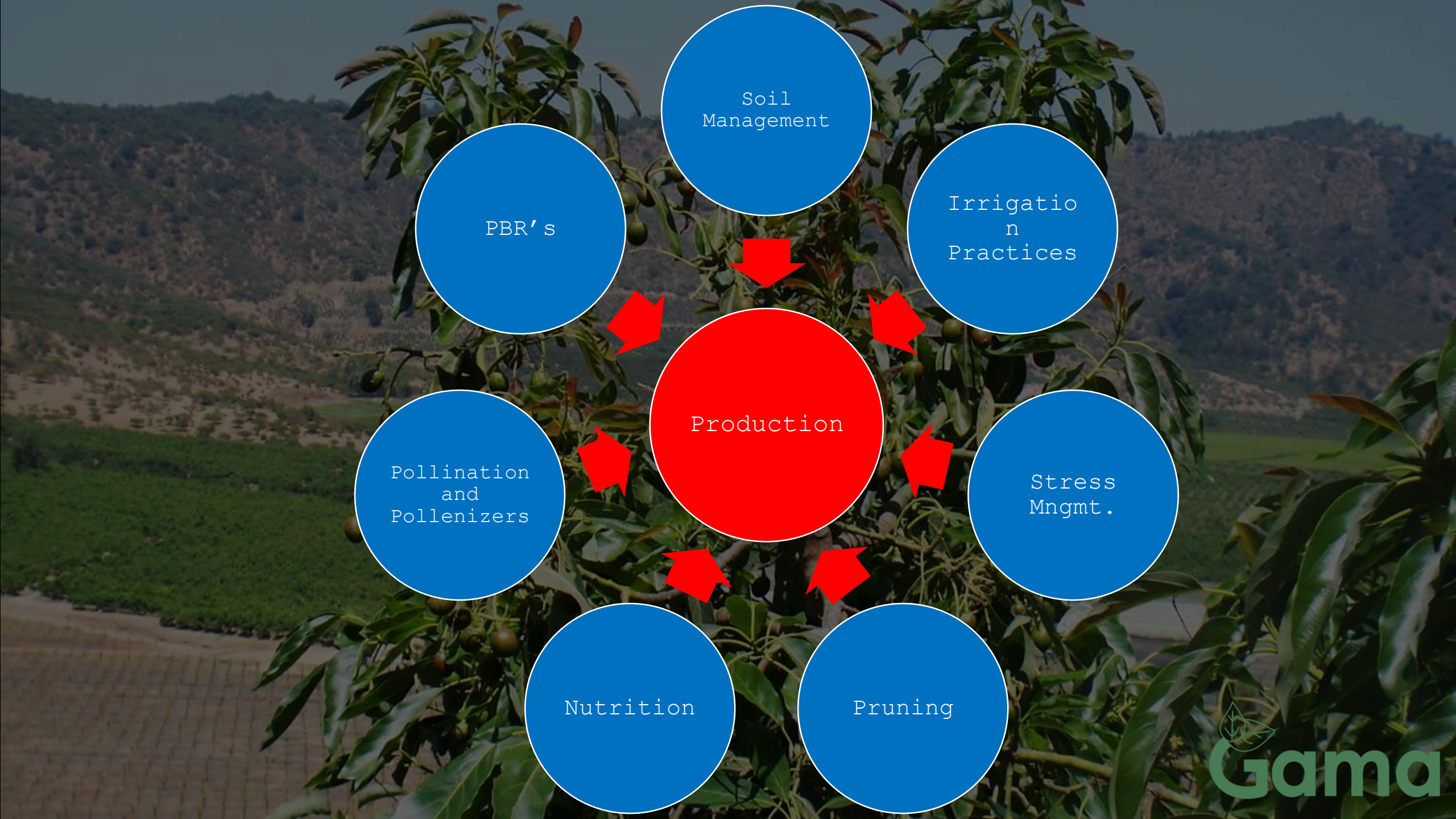
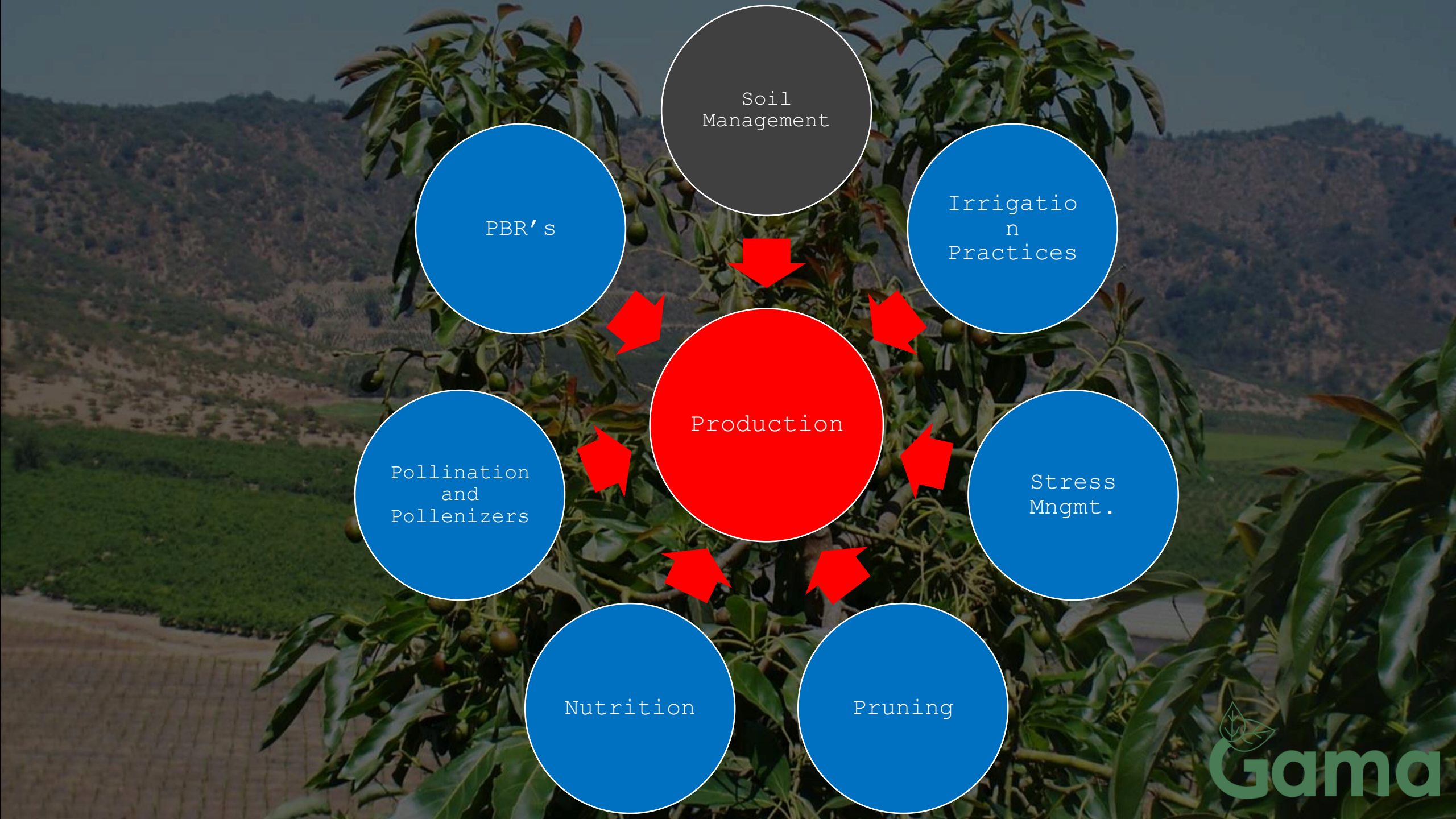

Soil Management
Irrigation Practices
Stress Mngmt.
Pruning
Nutrition
Pollination and Pollenizers
PBR's
Production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Nutrition
Pruning

Effect of Bioamino-L on Avocado Productivity

- Hass/Mexícola
- Edranol 11%
- 3 x 3 m
- 2009

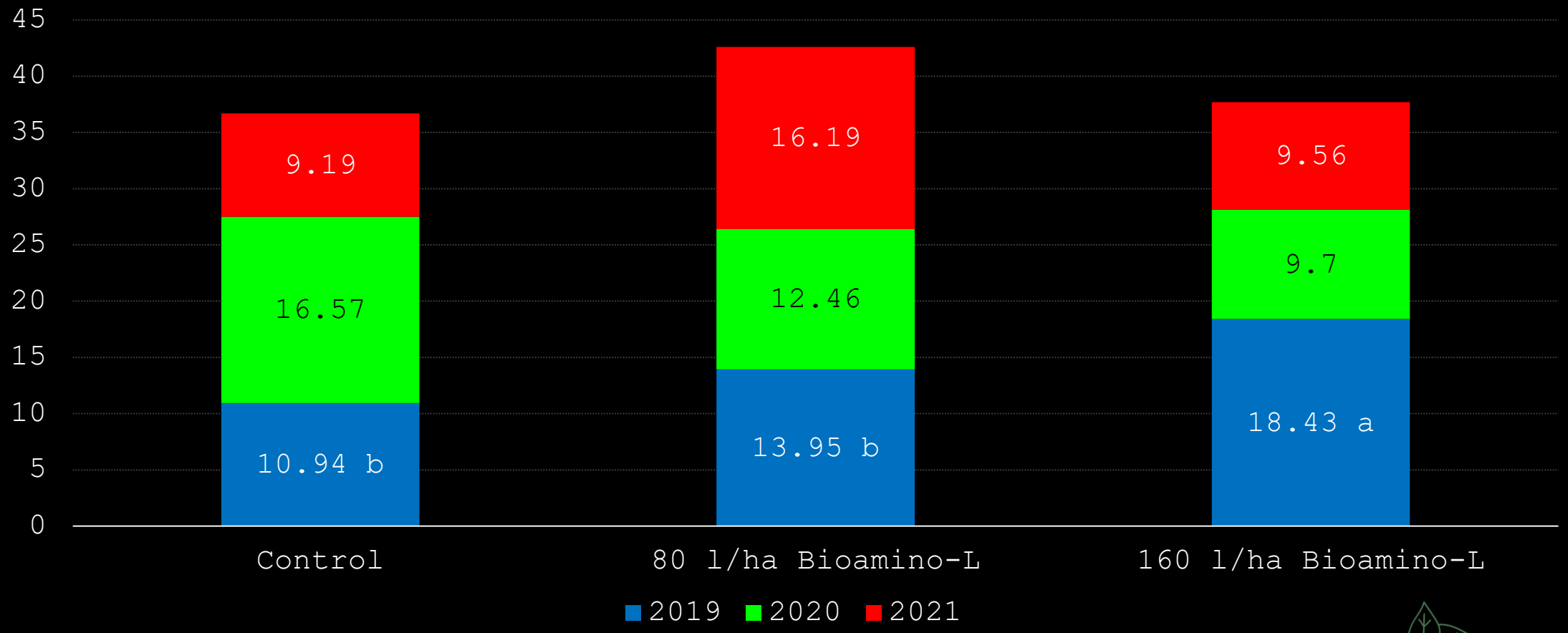
Tratamiento	Descripción
0	Testigo
1	Bioaminol 160 L/ha Season (80 Oct y 80 Mar)
2	Bioaminol 80 L/ha Season (40 Oct y 40 Mar)

Dates of Application:

08/11/2018 06/03/2019	First Season
18/11/2019 09/03/2020	Second Season
04/11/2020 12/03/2021	Third Season

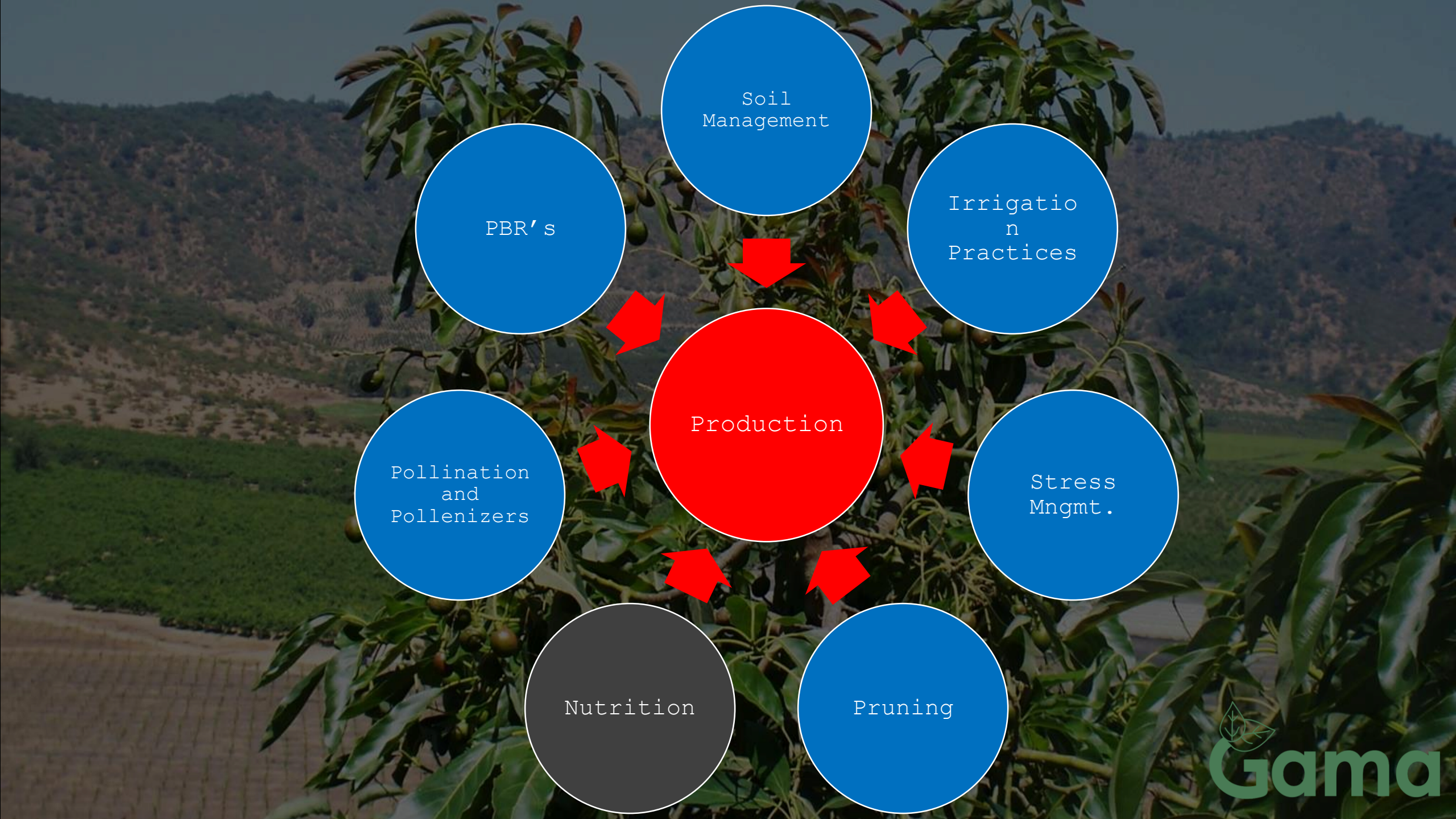
Gama

Effect of Bioamino-L on Avocado Productivity



Application of Bioaminol and reduction of the nitrogen supply in a Hass avocado orchard (Persea americana Mill.)

TTO	DESCRIPTION	Total N Supply
1	Regular fertilization+Bioaminol 120 (L/ha)	276
2	20% N reduction + Bioaminol 120 (L/ha)	221
3	40% N reduction + Bioaminol 120 (L/ha)	166
4	60% N reduction + Bioaminol 120 (L/ha)	110
5	80% N reduction + Bioaminol 120 (L/ha)	55
6	80% N reduction + Bioaminol 240 (L/ha)	55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Production

Effect of UREA + DMP application on differents dates.”

- Santa Blanca (Panquehue)
- Hass on Seedling Mexícola at 3,0 x 3,0 m. Edranol pollinator at 11%. Planted on 2004.
- First year of treatment: 2018

“Effect of UREA + DMPP application on differents dates. Santa Blanca. 2018-2021.”

Mes	T0
Aug	
Sept	
Oct	240
Nov	
Dec	
Jan	120
Feb	
Mar	
Apr	240
Total	600

“Effect of UREA + DMPP application on differents dates. Santa Blanca. 2018-2021.”

Mes	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Aug		100									66,6
Sept			100								66,6
Oct	240	200	200	300	200	200	200	200	200	200	66,6
Nov					100						66,6
Dec						100					66,6
Jan	120	100	100	100	100	100	200	100	100	100	66,6
Feb								100			66,6
Mar									100		66,6
Apr	240	200	200	200	200	200	200	200	200	300	66,6
Total	600	600	600	600	600	600	600	600	600	600	600

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“Effect of UREA + DMPP application on different dates. Santa Blanca. 2019-2021.”

Treatment	Fruits 19-21	Kilos 19-21	Fruit weight 21
T0	166,3	29,13	169,6 e
T1	158,3	28,59	175,2 c
T2	172,1	30,46	172,0 cde
T3	184,7	+17,2% 34,16	183,7 b
T4	188,8	+21% 35,43	184,6 b
T5	161,6	29,15	174,8 cd
T6	144,4	27,85	190,7 a
T7 O:200+J:100+F:100+A:200	162,6	29,40	174,5 cd
T7 O:200+J:100+M:100+A:200	195,0	+19,8% 34,92	170,0 e
T8	178,6	32,28	175,4 c
T10	143,0	24,70	171,3 de

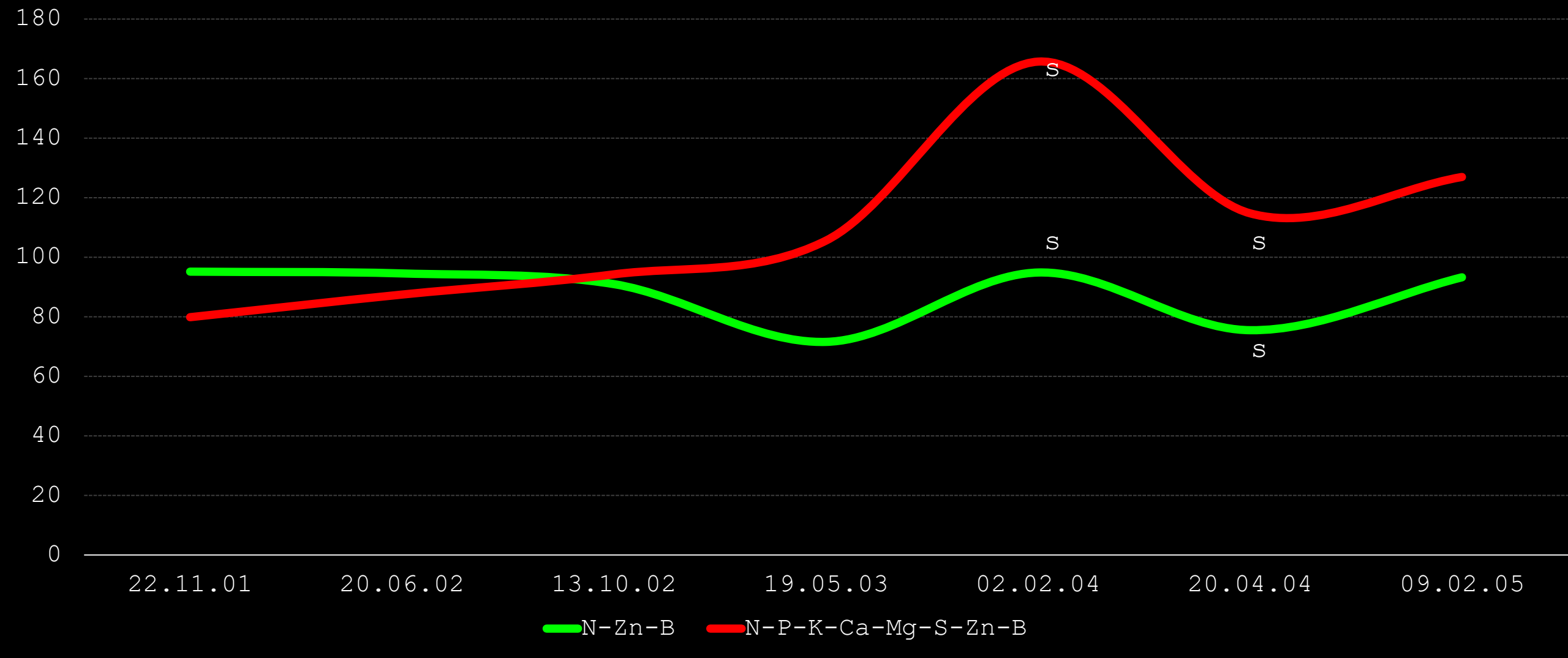
What about Potassium?

- There is still discussion regarding Potassium effect on Avocado Production.

Effect of N, P, K, Ca, Mg, S, Zn y B on Productivity of Hass Avocados

- T1: Nitrogen, Zinc and Boron
- T2: Nitrogen, Phosphorus, Potassium Calcium, Sulfur, Magnesium, Zinc, Boron
- Location:
  - Llay Llay
  - 4 years (2.000-2001 to 2.004-2005)

Evolution of Soil K content



Total Production

	Total Crop (K/Tree)		fruit Size (g/fruit)	
	T1	T2	T1	T2
2002	63,1	67,0	230,9	231,7
2003	30,3 s	14,4 s	298,8	289,5
2004	70,8	82,0	207,9 s	226,3 s
2005	0,6 s	9,4 s	279,12	261,83
Total	165	173	235,8 s	249,0 s

(T-Student, P<0,05).

T1 (N-Zn-B)

T2 (N-P-K-Ca-Mg-S-Zn-B)

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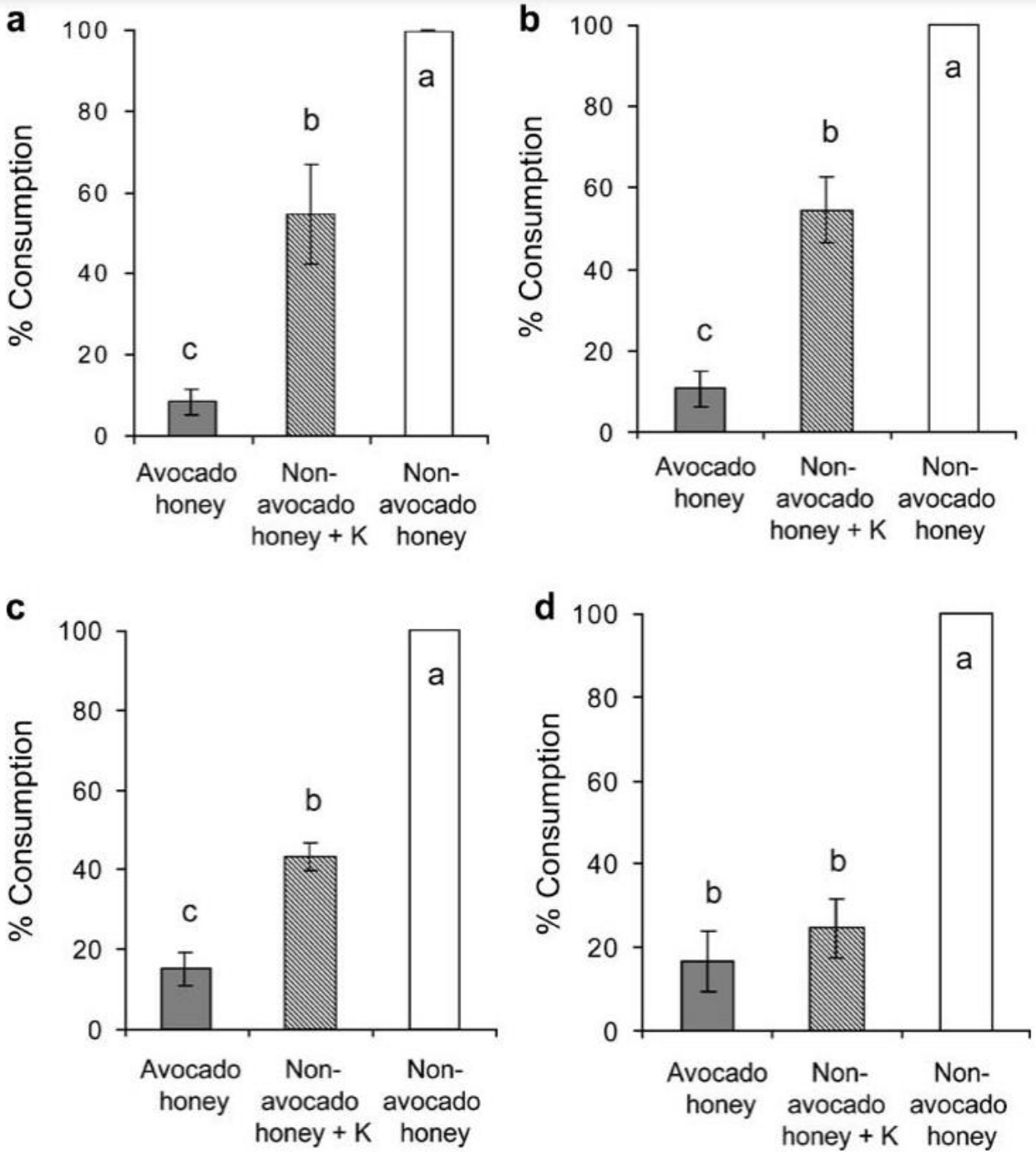


J Chem Ecol (2006) 32: 1949–1963
DOI 10.1007/s10886-006-9120-1

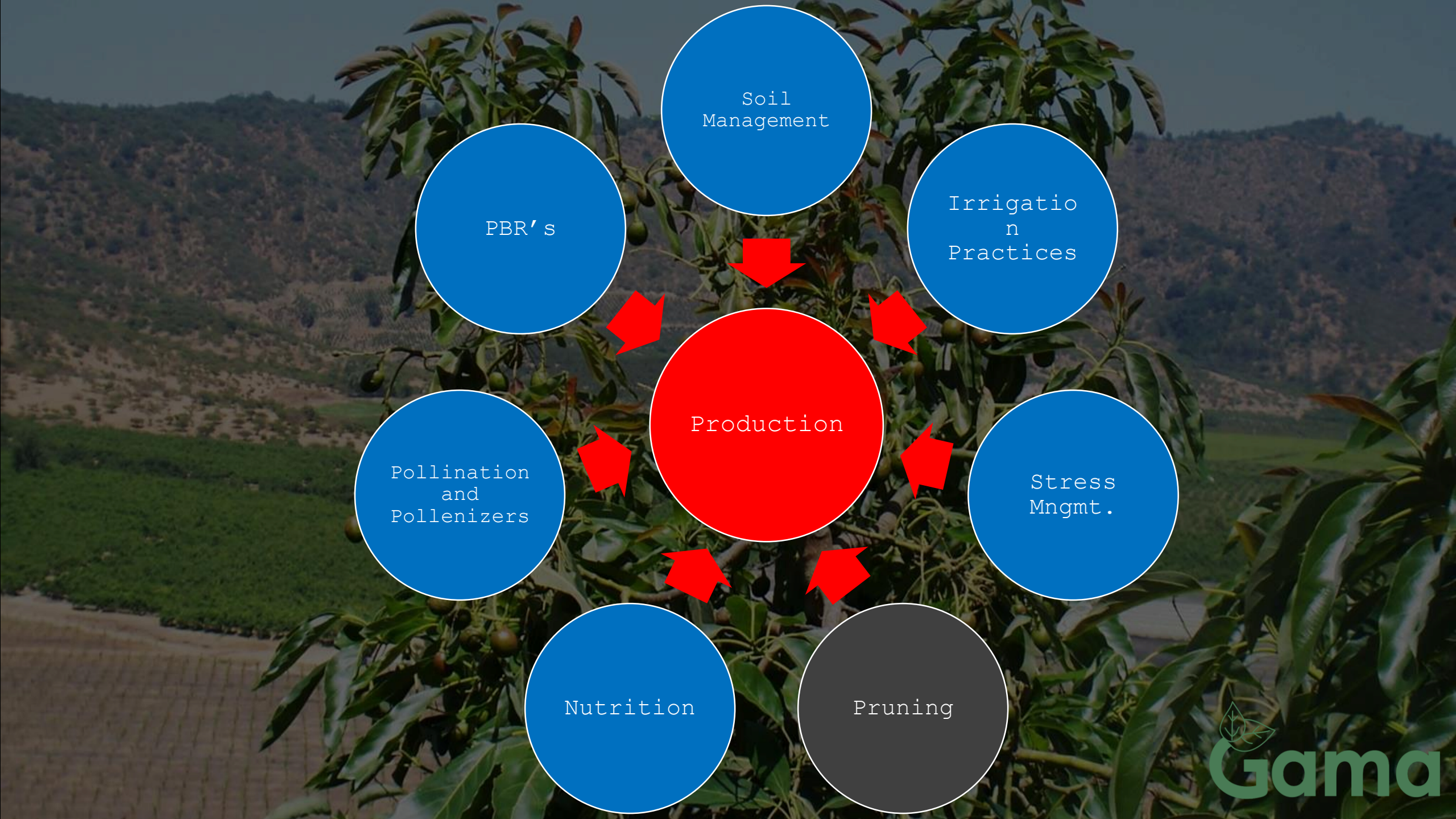
Analyses of Avocado (*Persea americana*) Nectar Properties and their Perception by Honey bees (*Apis mellifera*)

O. Afik · A. Dag · Z. Kerem · S. Shafir

- Bees' mean (±S.E.) relative consumption of solutions containing avocado honey, non-avocado honey, and non-avocado honey enriched with different potassium salts:
- **(a) KCl**
- **(b) K-gluconate**
- **(c) K3-citrate**
- **(d) K2-phosphate.**
- Different letters indicate significant differences between treatments with $P < 0.05$

Crowley 2022, Avocado Café

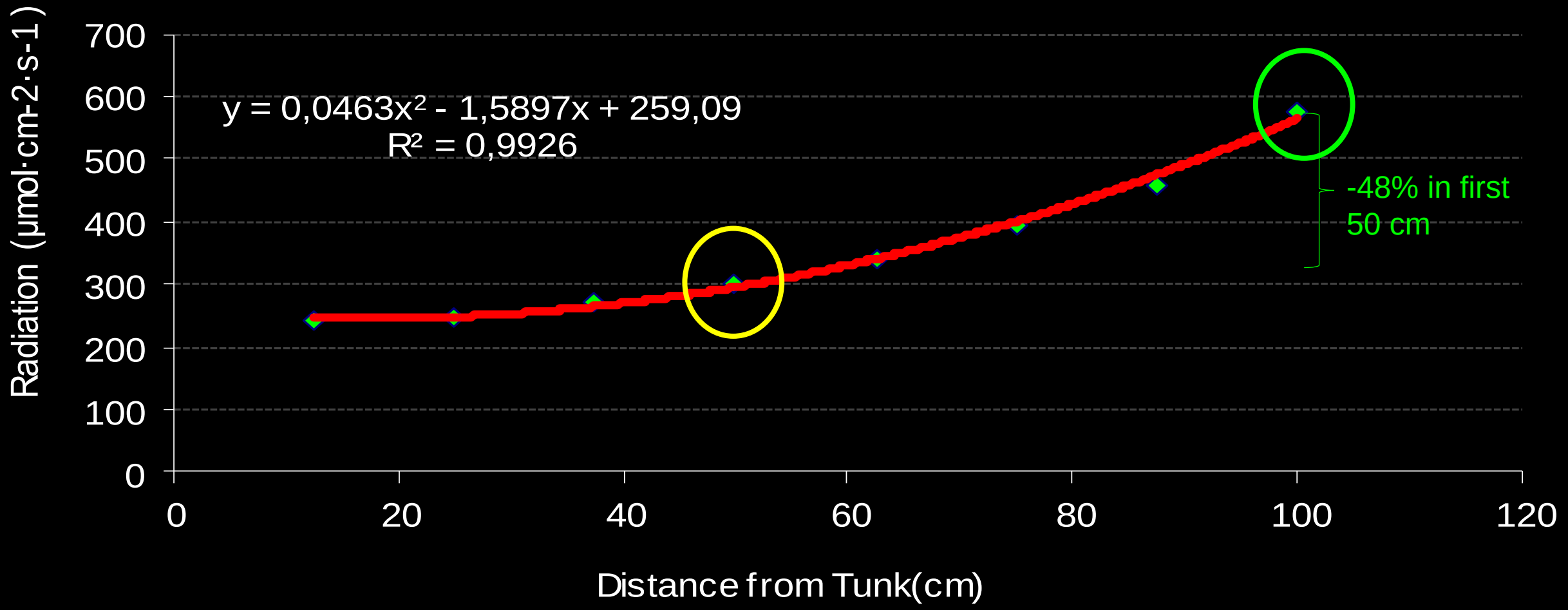
- Above 1% foliar K, lost yield potential.
- Leaf standard 0,7 - 0,9%.
- 0,8% leaf K : 18% of trees are non-bearing
- 1,4% leaf K: 36% of trees are non-bearing
- In California 20% of Orchards are over fertilized with Potassium.


Soil Management
PBR's
Irrigation Practices
Production
Pollination and Pollenizers
Stress Mngmt.
Nutrition
Pruning

Pruning in Avocados

- Need for pruning is not more an issue.

Relation Between distance from the trunk and solar radiation.



Torres, J. 2008 - GAMA


1 m

What are the rules of engagement?

- Pruning intensity.
- Pruning date.
- Flower induction and differentiation (Irreversible commitment to flowering)

Flower differentiation

Effect of different dates of fruit removal on next season's flowering.

- ✓6 dates of total fruit removal in ON cropping trees (3 trees per treatment).
- ✓Location: Santa Blanca, Panquehue

Table 1. Mean number of removed fruits per treatment in Hass Avocados, 2013

TMT	Month	Fruits removed
0	Removal at normal Harvest date	138,33 ± 50,30 a
1	1st week of February	165,67 ± 86,49 a
2	1st week of March	198,00 ± 31,05 a
3	1st week of April	108,00 ± 27,54 a
4	1st week of May	108,00 ± 18,68 a
5	1st week of June	117,00 ± 21,00 a
6	1st week of July	157,67 ± 69,97 a

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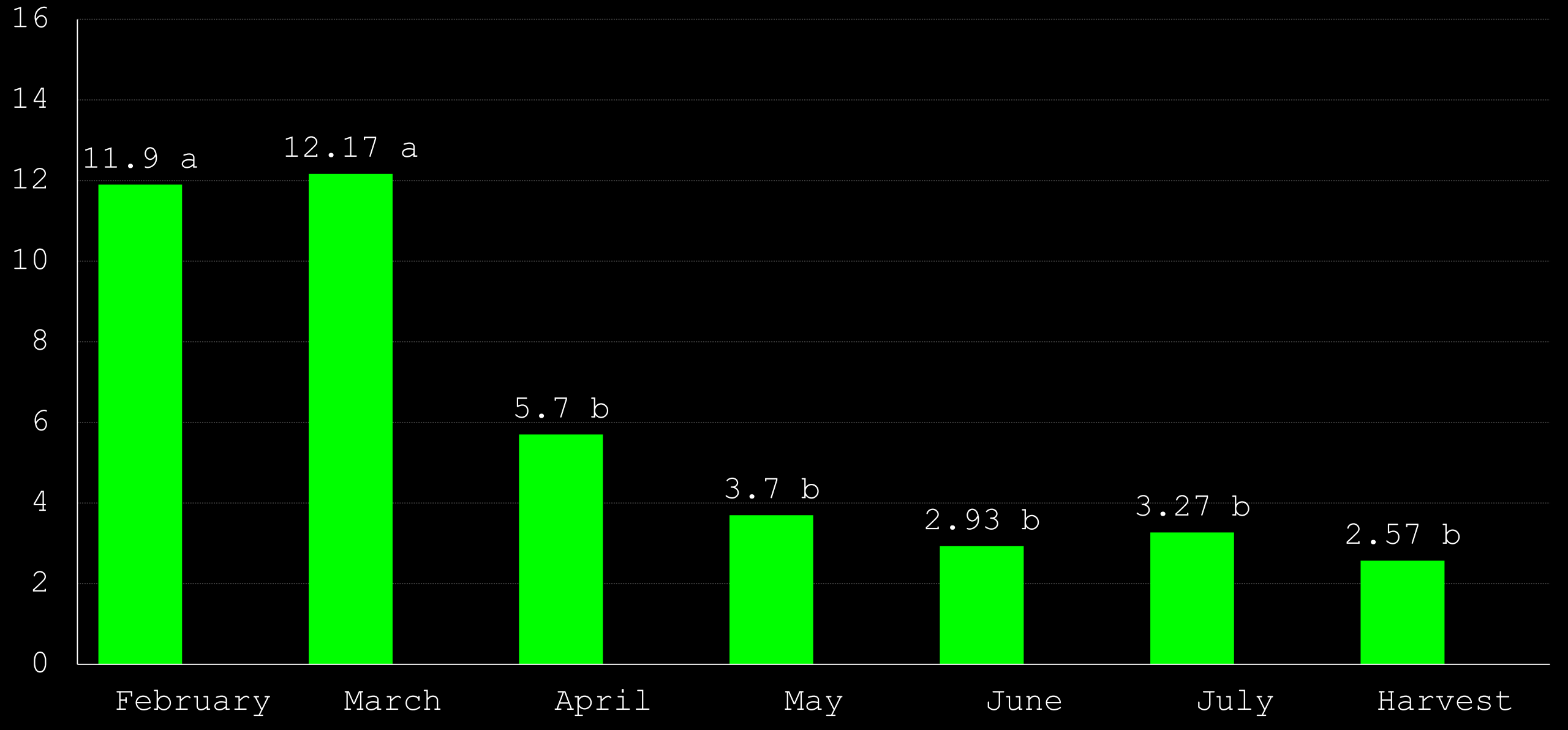
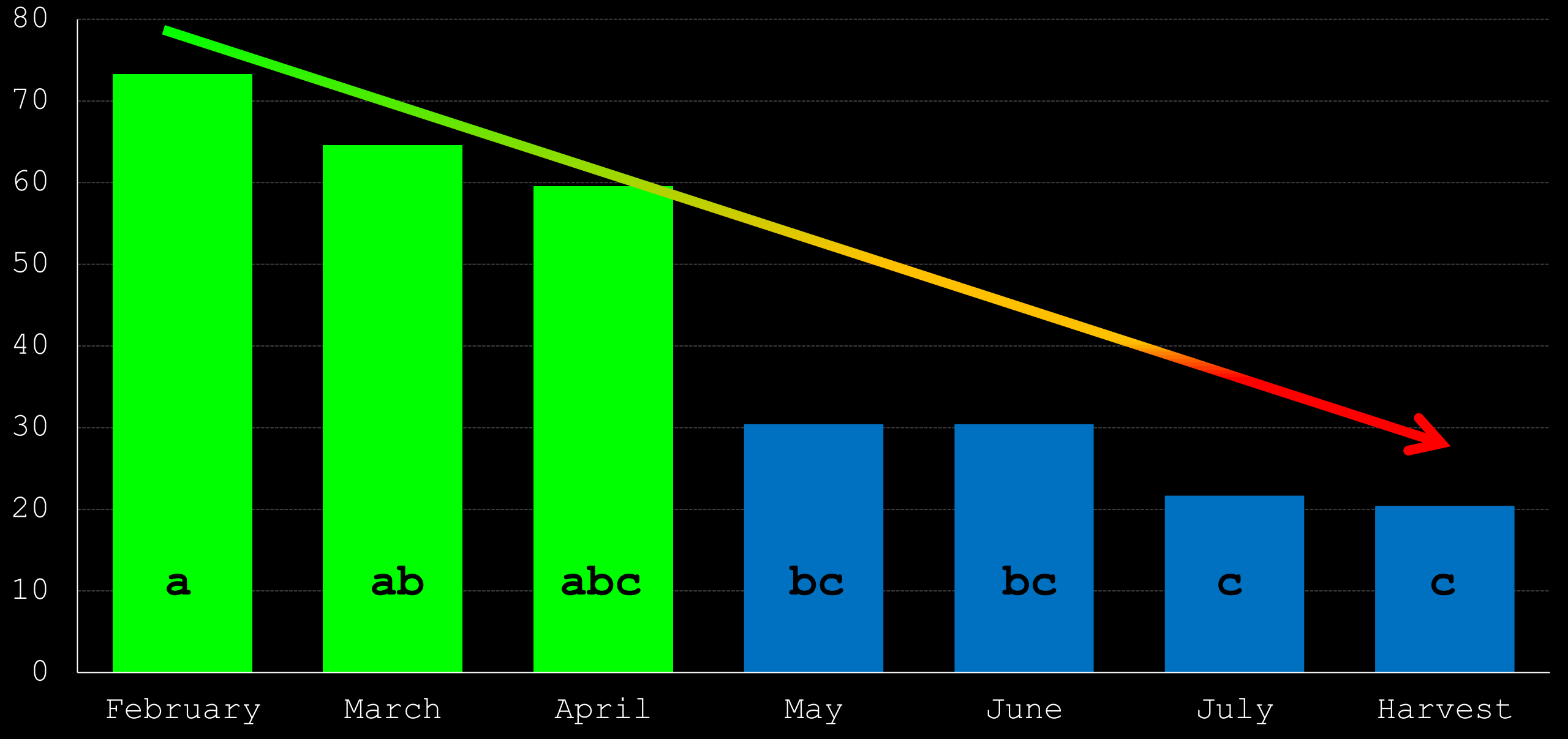
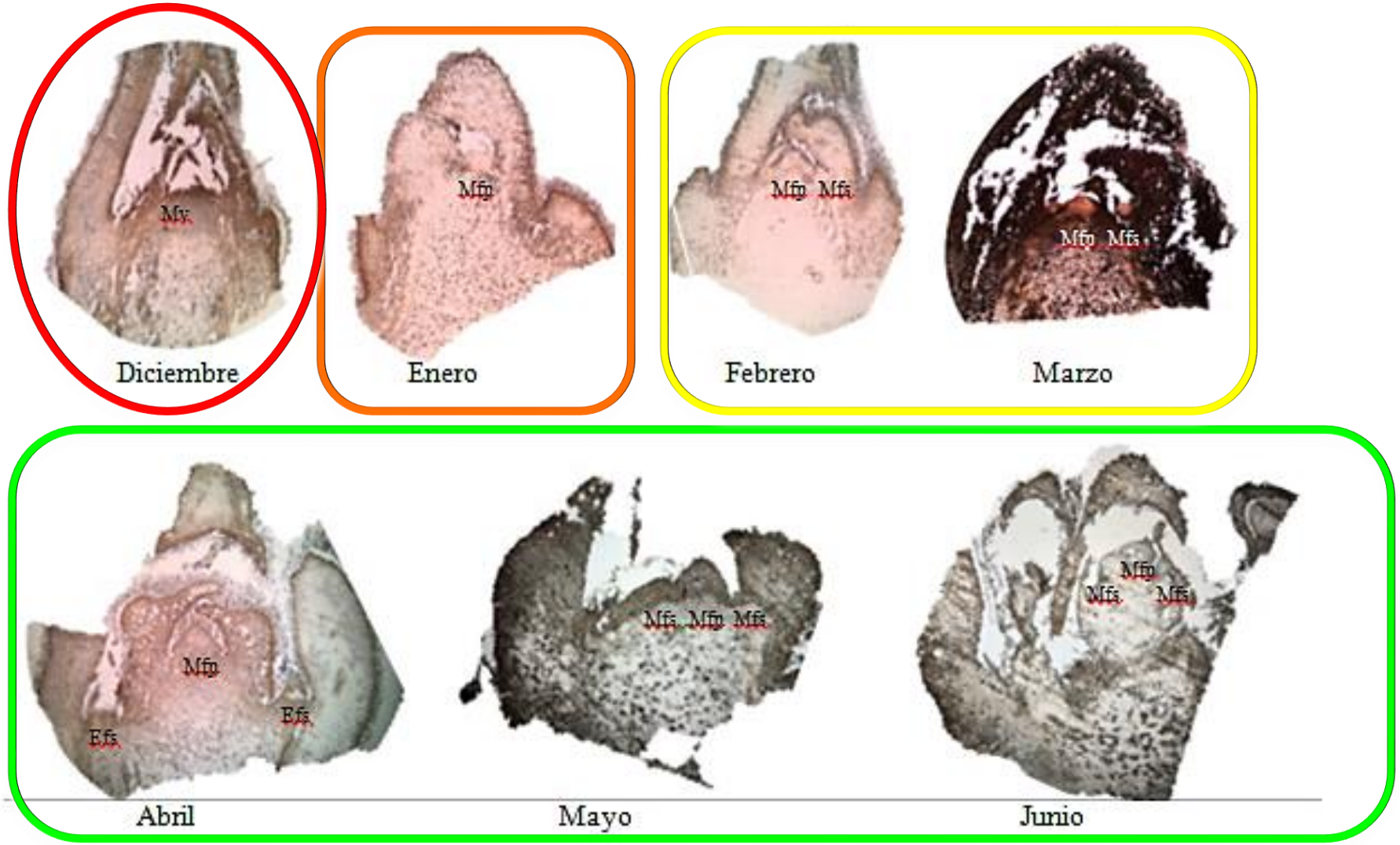
Average Number of floral buds per treatment. August, 2013.



% of Canopy Volume with Flowers. October, 2013.





Evolution of avocado buds form December 2013 to June 2014, before the application of 300 ppm of GA3. Abbreviations: Mv, vegetative meristem; Mfp, primary floral meristem; Mfs, secondary floral meristem; Efs, secondary floral axis. (Torres, J. , 2017)


https://plantbasedjuniors.com

Producing Great Fruit

- Not only Volume.
- Not only Fruit Size.
- Not only Nutrition.
- Not only Pest Free.
- Not only Fungicide applications.
- **IS TAKING CARE OF THE WHOLE PROCESS:**
  - **Loosing fruit at destination is a really bad business**

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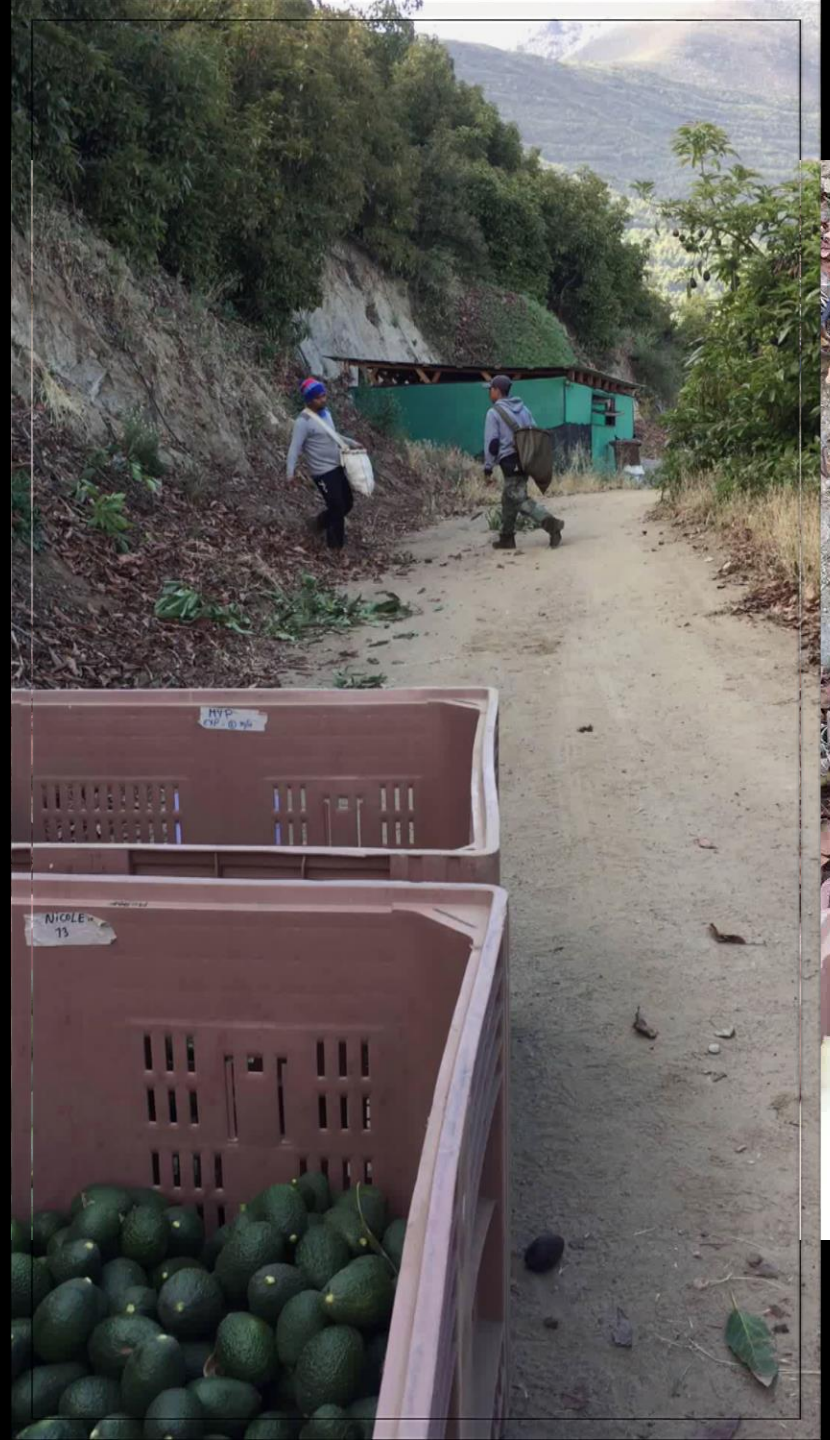

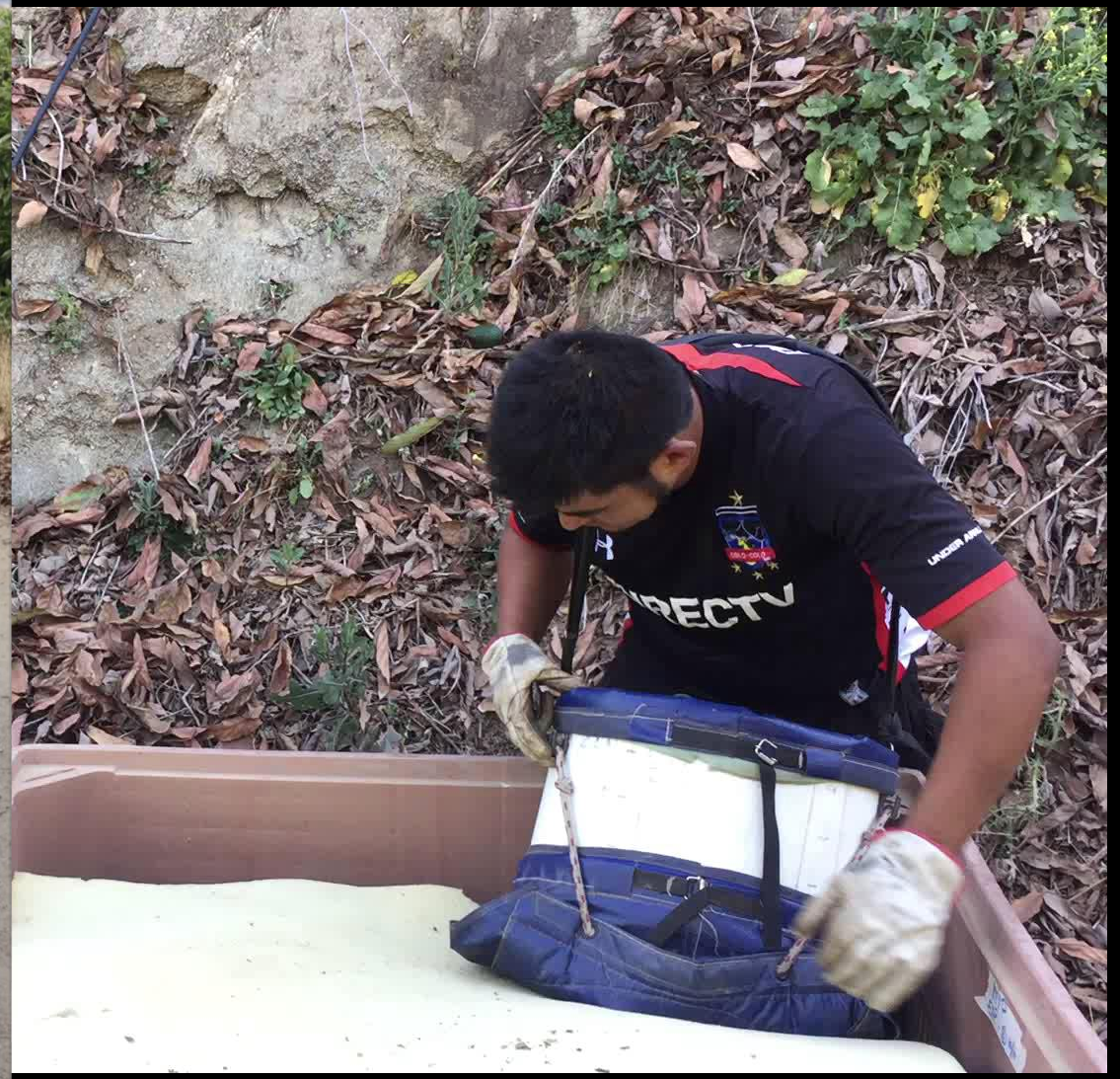

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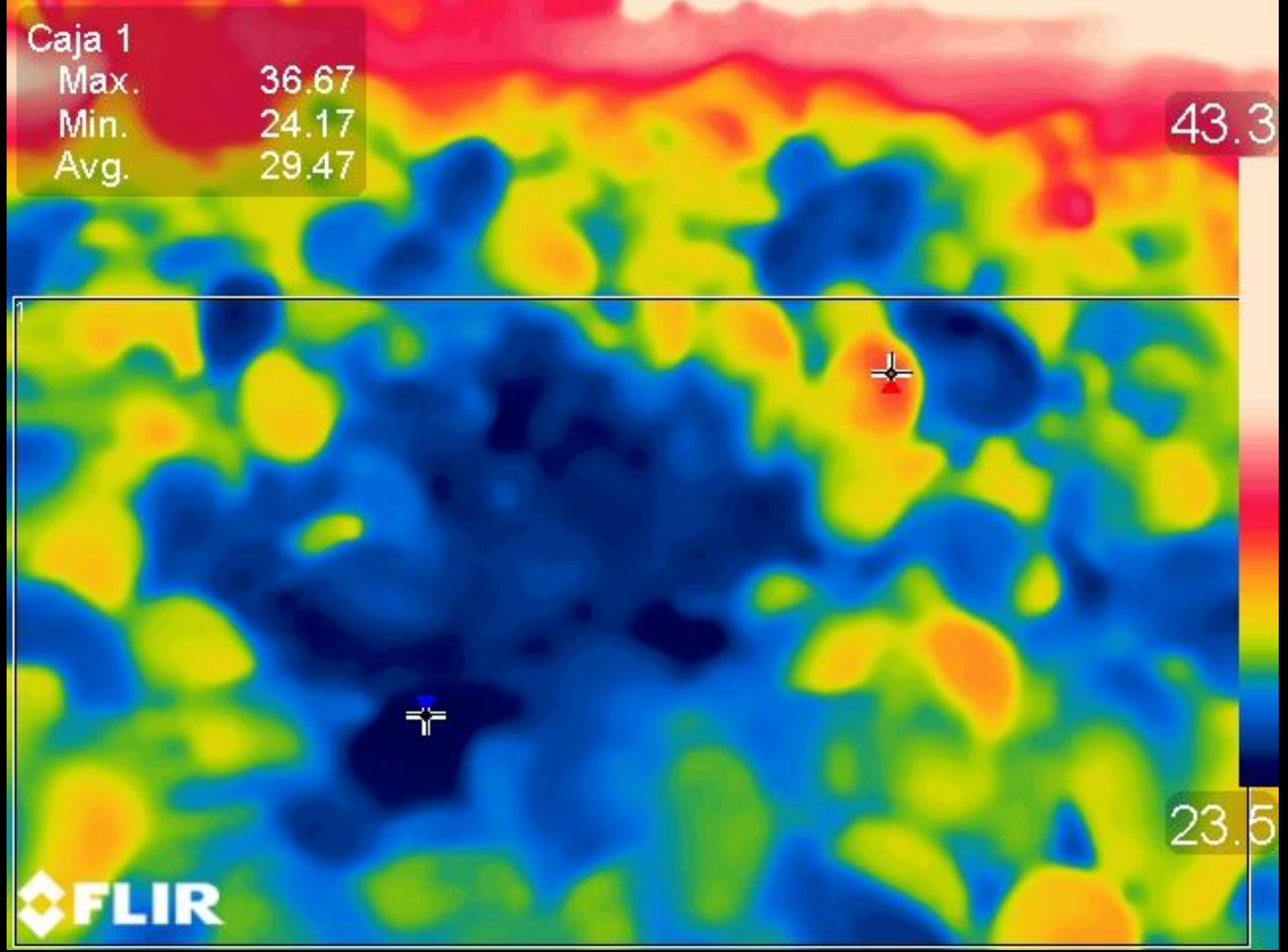
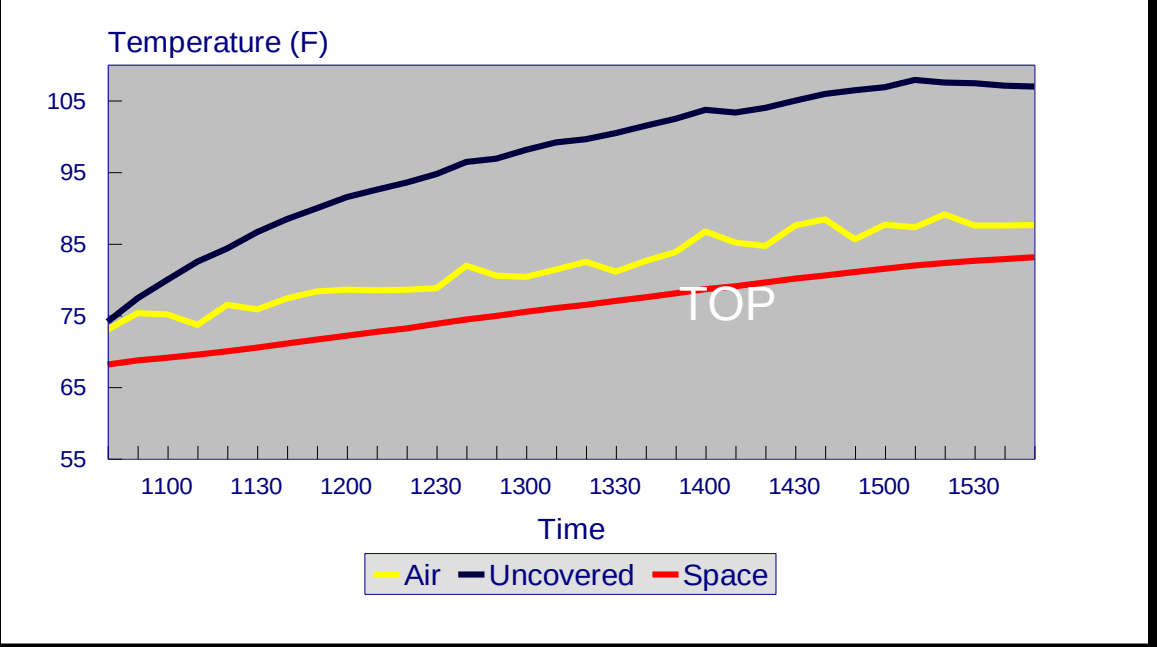
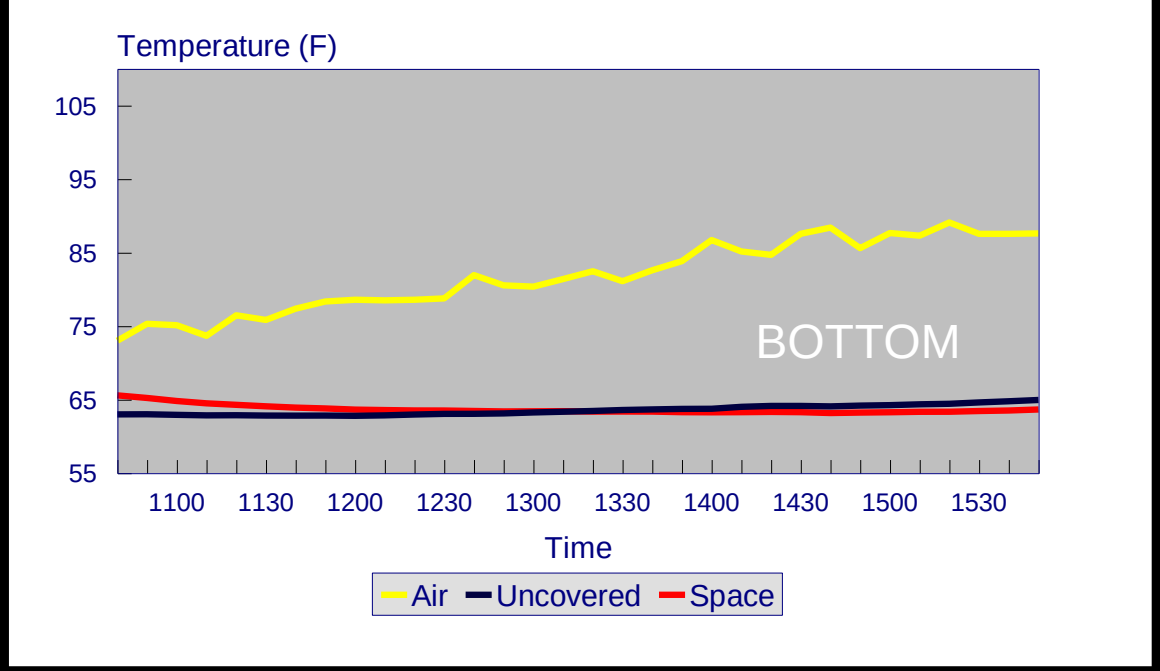
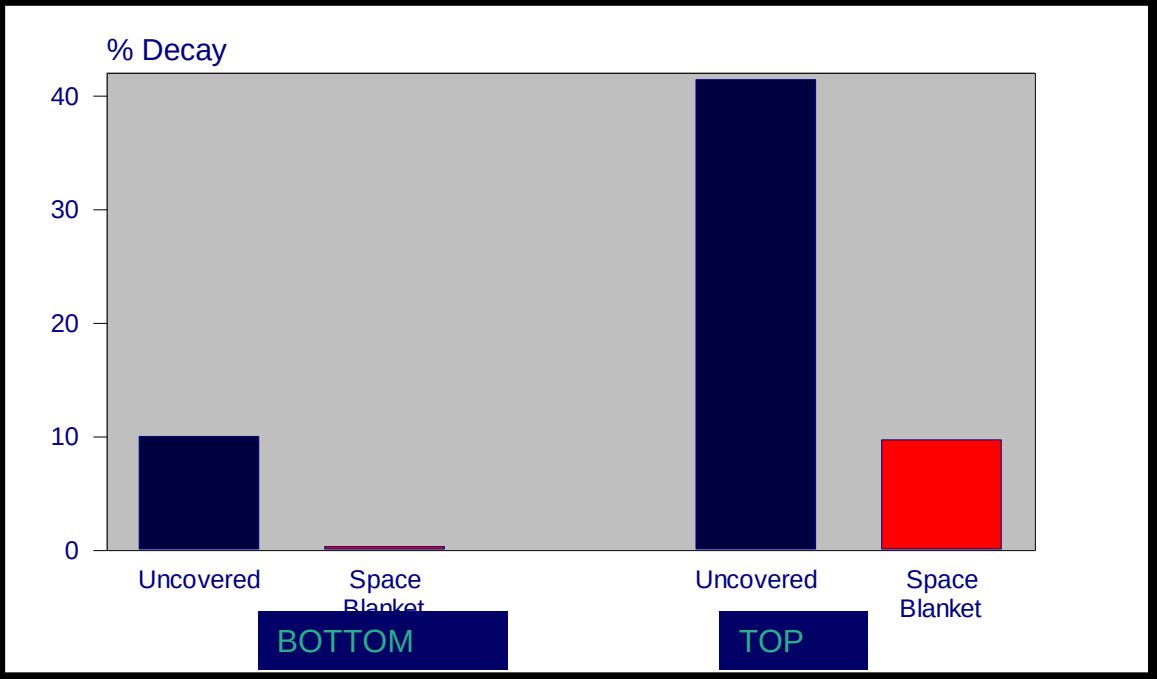
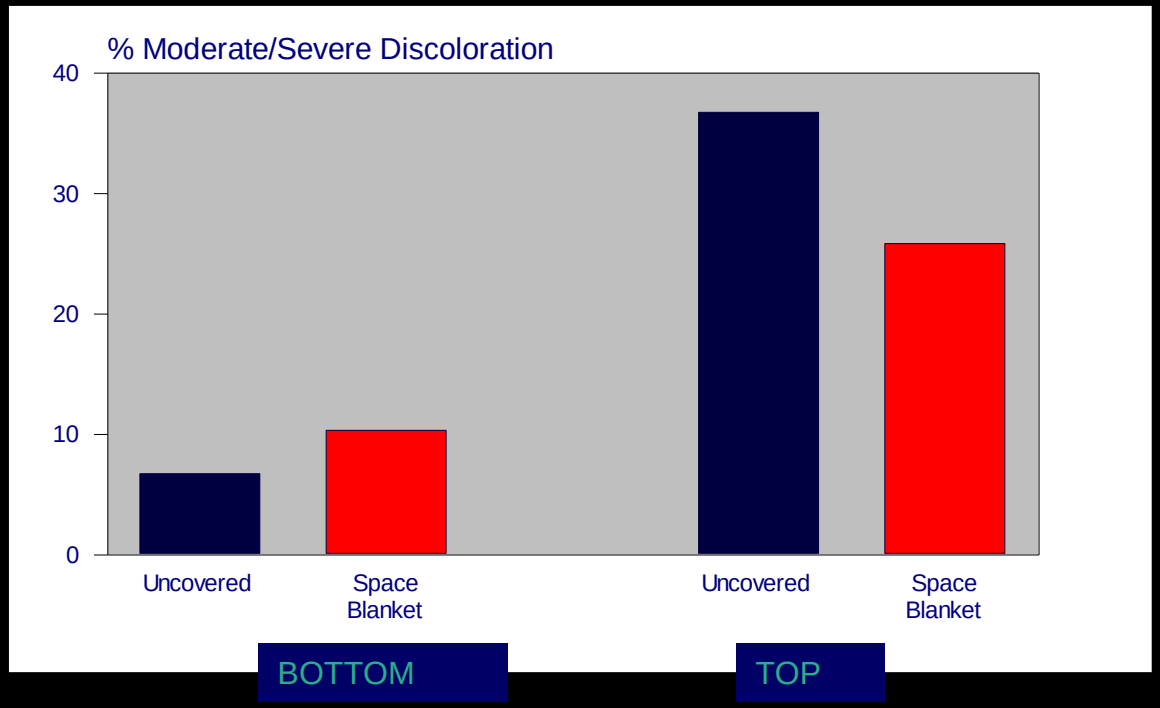

Caja 1
Max. 36.67
Min. 24.17
Avg. 29.47
43.3
23.5
FLIR









Source: Arpaia, M. L., 1994; 'Hass' fruit harvested from Riverside county.

Acknowledgments

To the growers who help finance GAMA's R+D program.

Our Team












Mauruuru koe !!!!!
Muchas Gracias !!!!!
Thank You !!!!!

Francisco Mena Völker
GAMA - Chile