Sustainable intensification aiming for efficient fruit production combining genetics SHD/HD training systems & new technologies

AGROMILLORA
It's in our nature

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Agromillora Group

Sant Sadurní, 22th September 2023

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SUMMARY

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1.- The global context in fruit production

2.- Cost of production and growers prices: a challenge

3.- Sustainable intensification in fruit production:

The three pillars concept

4.- Present and futur orchards in different species:

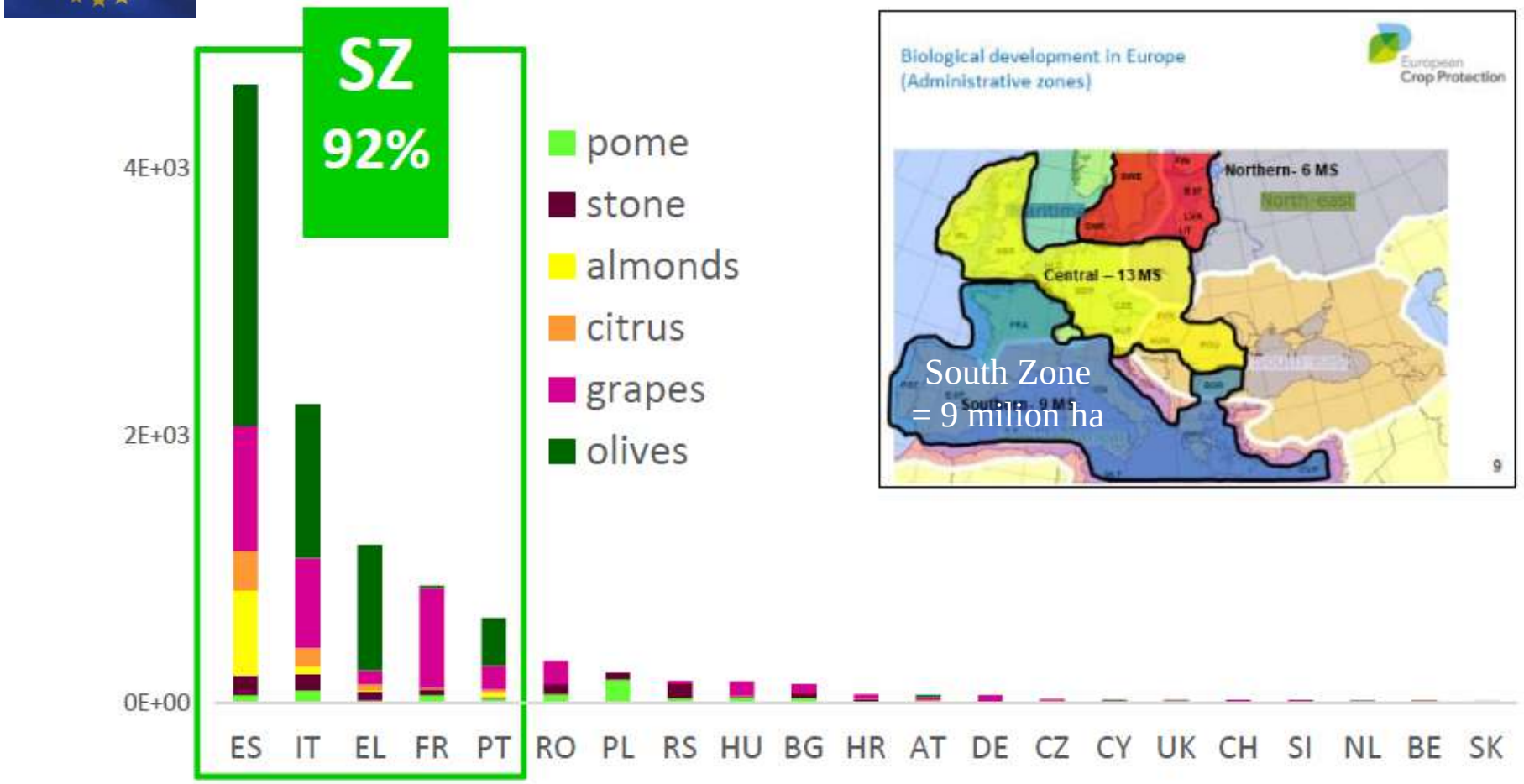
Apple, Pear, Peach, Almond and Pistachio

5.- Towards future fruit production 4.0

Surfaces and production of deciduous Fruit especies in SPAIN 2020

ESPECIE	Superficie-2020 (ha)	Producción-2020 (ton.)
Frutos secos		
Almendro (cáscara)	721.043	319.300
Pistacho (cáscara)	55.032	16.724
Nogal (cáscara)	16.335	21.383
Avellano (cáscara)	13.110	5.587
TOTAL FRTOS SECOS	828.520	360.494
Viña (hl)	957.857	40.948.621
Cítricos	307.343	6.138.540
Olivo	2.770.420	1.385.230
TOTAL FRUTA DULCE	183.959	2.486.170
TOTAL	5.050.099	-

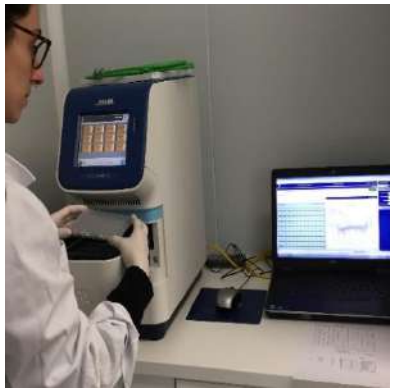
2017 - Production area for EU Member States (1000 ha)
Total 3D area: 10,8 Mha (Spain 4,6 Mha)



Last update	30.10.18
Extracted on	04.11.18
Source of data	Eurostat

We implement all the necessary procedures to ensure the genetic and health autenticity of our plant material.

Quality Assurance & Research Agromillora



Genetic authenticity. Real time PCR

Traceability. QR code

Quality Assurance in morfology

Health protocols in our facilities

Innovative Training Systems

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SUSTAINABLE & EFFICIENT SOLUTIONS · BY AGROMILLORA · SES

OLIVE

Innovative

ALMOND

Efficient

APPLE

Sustainable

CITRUS

FRUIT TREES

PLUM

370.000 has

https://youtu.be/unuJImvQnDU

Altissima densità o altissima sostenibilità?

THE CROSSROADS OF CHANCE
A DOCUMENTARY OF THE CREATIVE AGRICULTURAL REVOLUTION

AGROMILLORA 25th ANNIVERSARY SHD OLIVE GROVE

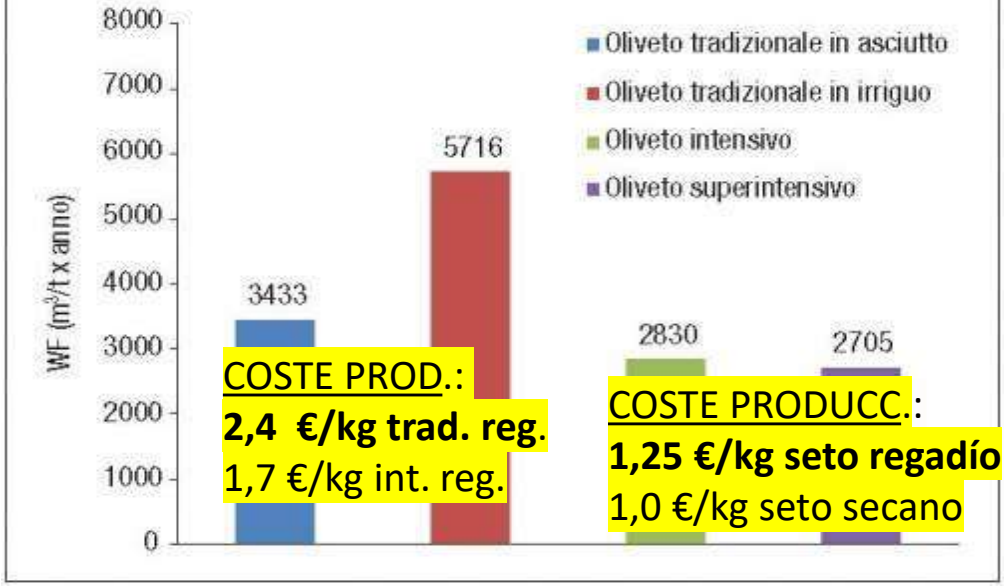
Altissima densità o altissima sostenibilità?

Prof. S. Camposeo

Di ***Salvatore Camposeo***
13 Gennaio 2020
Dipartimento di Scienze Agro-Ambientali e Territoriali
Università degli Studi di Bari Aldo Moro

Olivo e Olio n. 1/2020

Grafico 1 – Impronta dell'acqua (WF) per diverse tipologie di oliveto (per ton. d'olio)



COSTE PROD.:
2,4 €/kg trad. reg.
1,7 €/kg int. reg.

COSTE PRODUCC.:
1,25 €/kg seto regadío
1,0 €/kg seto secano

https://olivoeolio.edagricole.it/oliveto-e-frantoio/oliveto-superintensivo-altissima-densita-sostenibilita/

Environmental sustainability by LCA analysis of different soil managements in a high-density olive orchard

Giovanni Russo*, Gaetano A. Vivaldi, Bernardo C. De Gennaro, Salvatore Camposeo

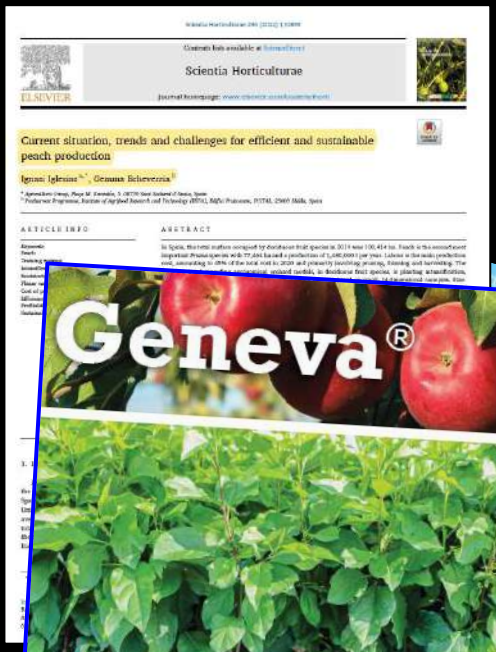
Giovanni R`, Vivaldi, G.A., DE GENNARO, B.C., Camposeo, S. 2015. Environmental sustainability of different soil management techniques in a high-density olive orchard. DOI:10.1016/j.jclepro.2014.06.064. pp.498-508. In JOURNAL OF CLEANER PRODUCTION - ISSN:0959-6526 vol. 107

Genetics: a fundamental pillar

Concerted activities with the main public and private research centers and universities


Lleida, 27 abril 2023
Organiza • Organitza:
50 anys
Escola Tècnica Superior d'Enginyeria Agrària
afrucat
Associació Empresarial de Fruita de Catalunya
AGROMILLORA
It's in our nature

Articles + papers + leaflets + books 2008-2023



Fondamentale aggiornare le varietà, i portinnesti per il controllo del vigore e le forme di allevamento, adottando quelle planari adatte alla meccanizzazione e all'uso efficiente della manodopera

GLOBAL CONTEXT FOR AN EFFICIENT PRODUCTION

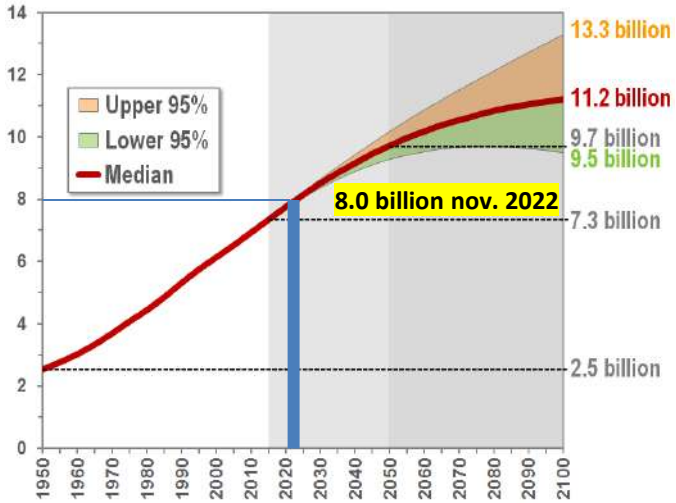
1. Biodiversity

Reduction of PESTICIDES: -50% in 2030, refered to 2020

Reduction of FERTILIZERS: -20% in 2030, refered to 2020

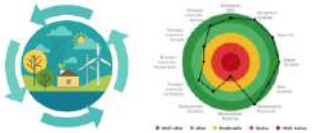
Increase of ORGANIC PRODUCTION: from 9% cultivated Surface UE in 2020, to 25% in 2030.

CLIMATE CHANGE



EFFICIENT USE OF INPUTS

ENVIRONMENTAL SUSTAINABILITY



PROFIT GROWER SUSTAINABILITY

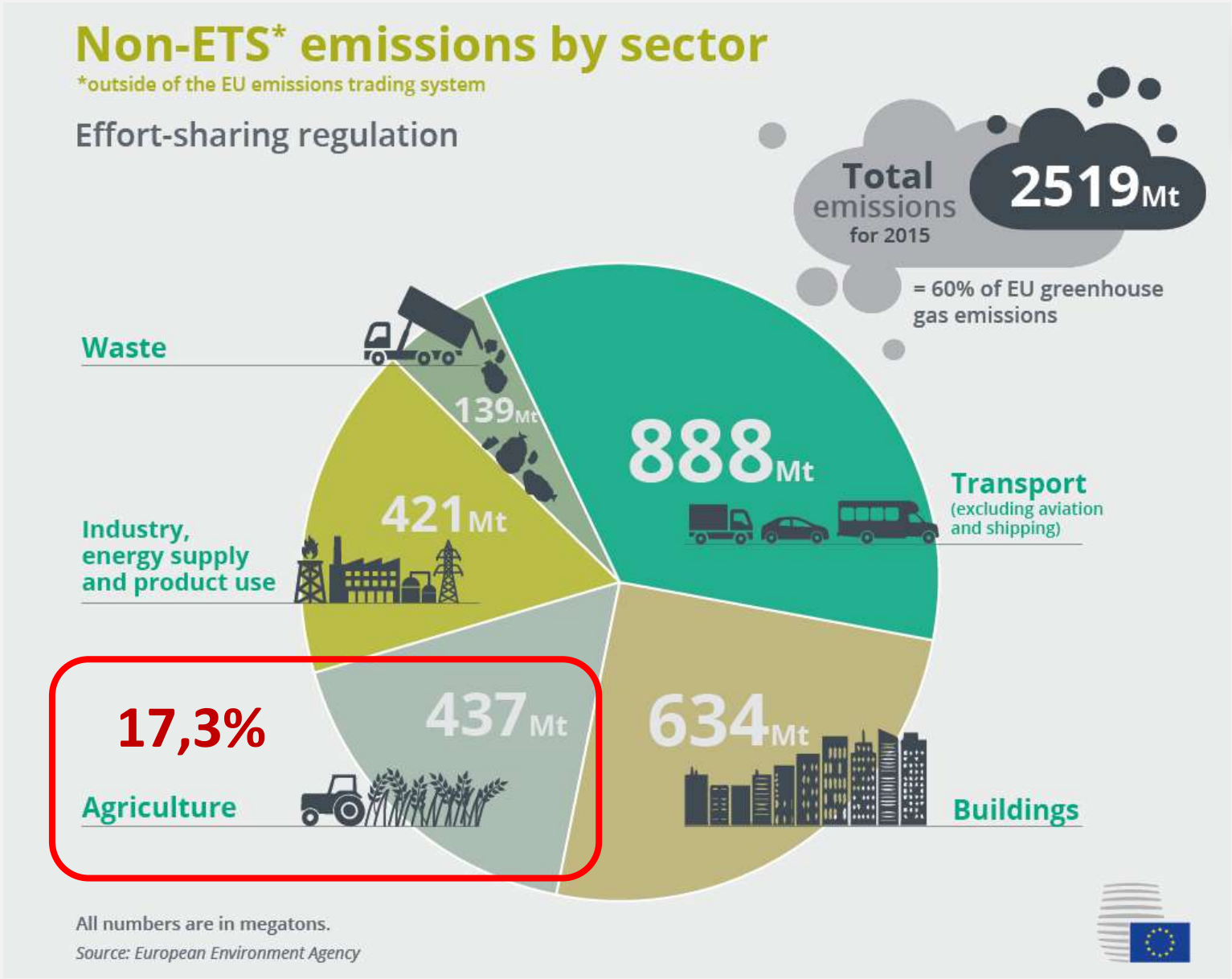
COSTS

SOCIAL SUSTAINA.

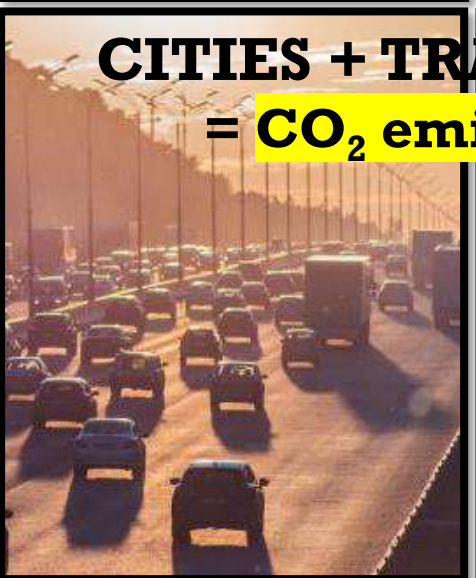
FOOD PRODUCTION

Increase of 30% in the next 30 years

NON-ETS emission by sector EUROPEAN UNION




INDUSTRY = CO_2 emissions

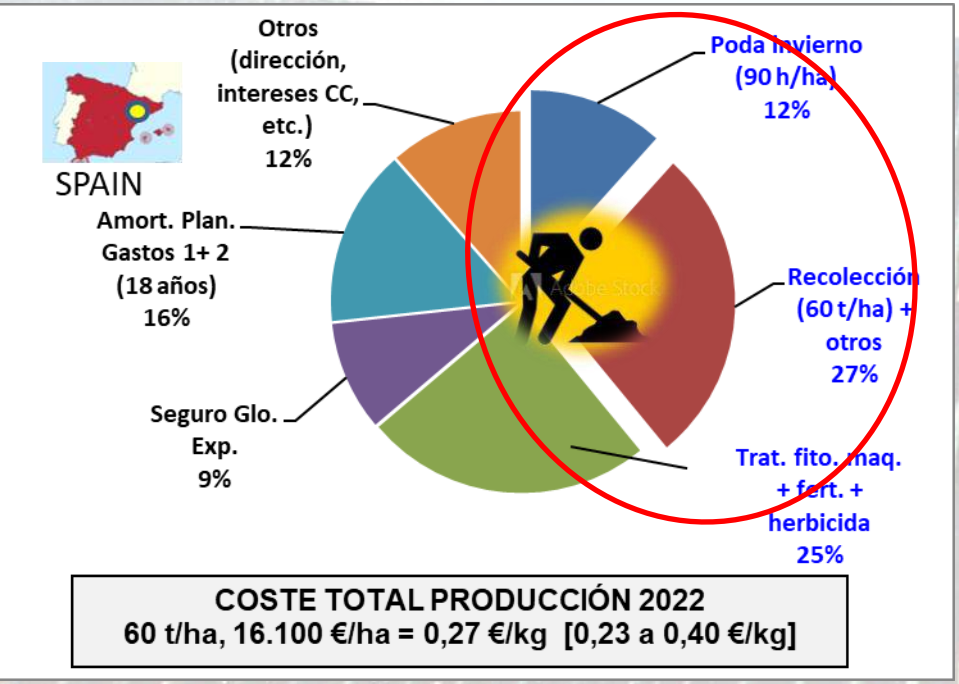

CITIES + TRANSPORT
= CO_2 emissions


ORCHARDS = Producing Fruit +
CO_2 sink

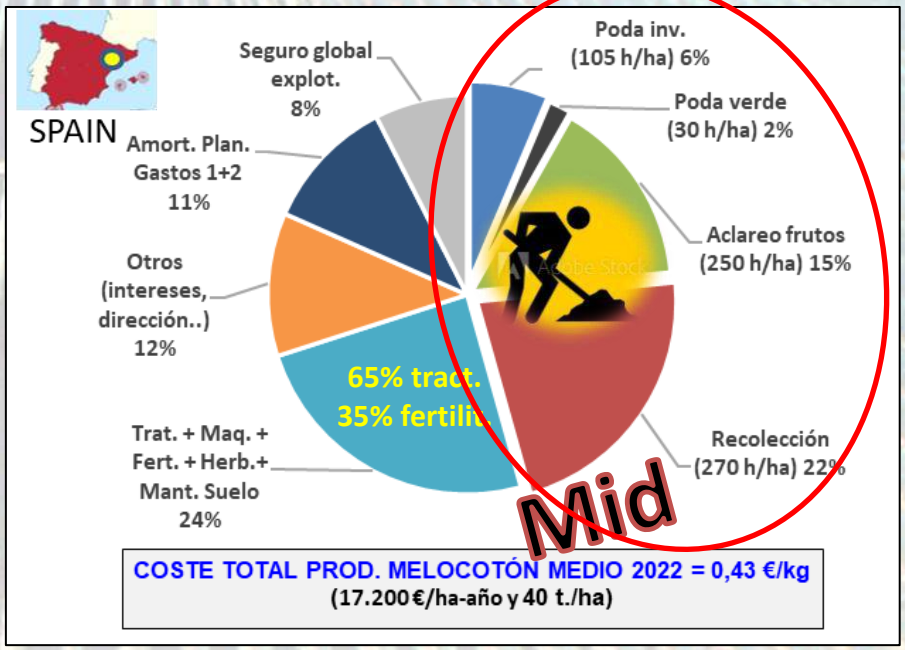
AGRIVOLTAICS (SEFRA, France)

17 June 2023

Production costs apple annd peach 2022 & maturity time



COSTE TOTAL PRODUCCIÓN 2022
60 t/ha, 16.100 €/ha = 0,27 €/kg [0,23 a 0,40 €/kg]



COSTE TOTAL PROD. MELOCOTÓN MEDIO 2022 = 0,43 €/kg
(17.200 €/ha-año y 40 t./ha)

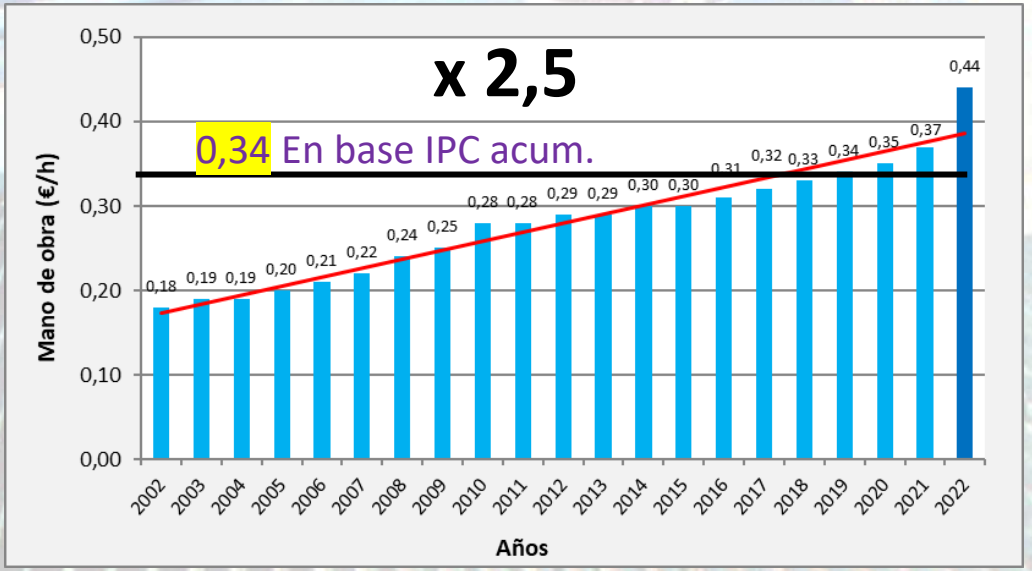




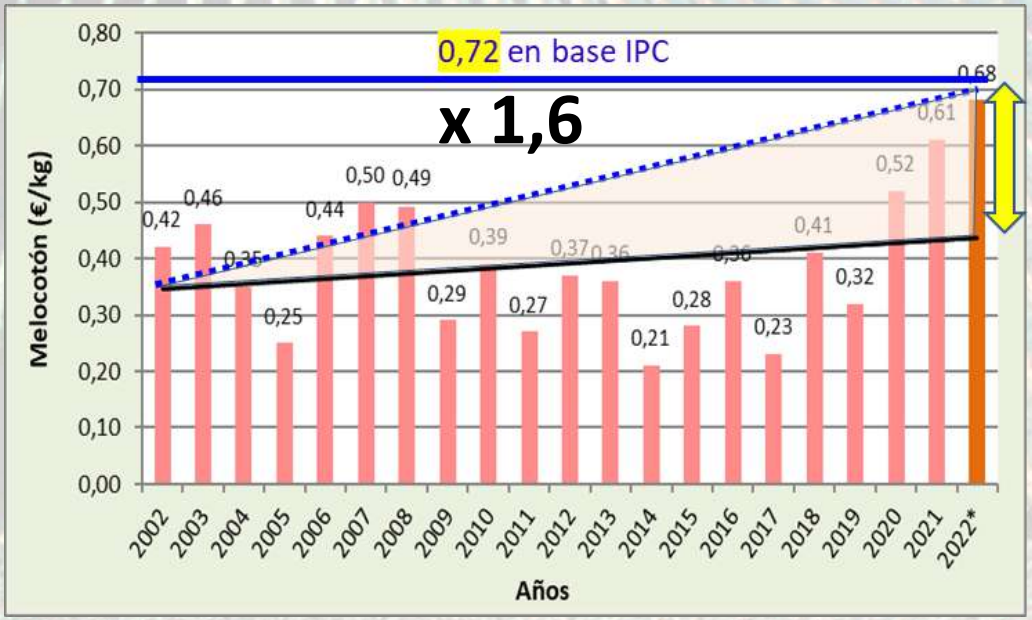

Evolution of cost of production and prices of growers for peach in the period 2002-2022

Evolución coste de producción melocotón 2002-2022 Zona de Lleida (a precios constantes)

SPAIN



Evolución precios al productor 2002-2022 Zona de Lleida (a precios constantes)



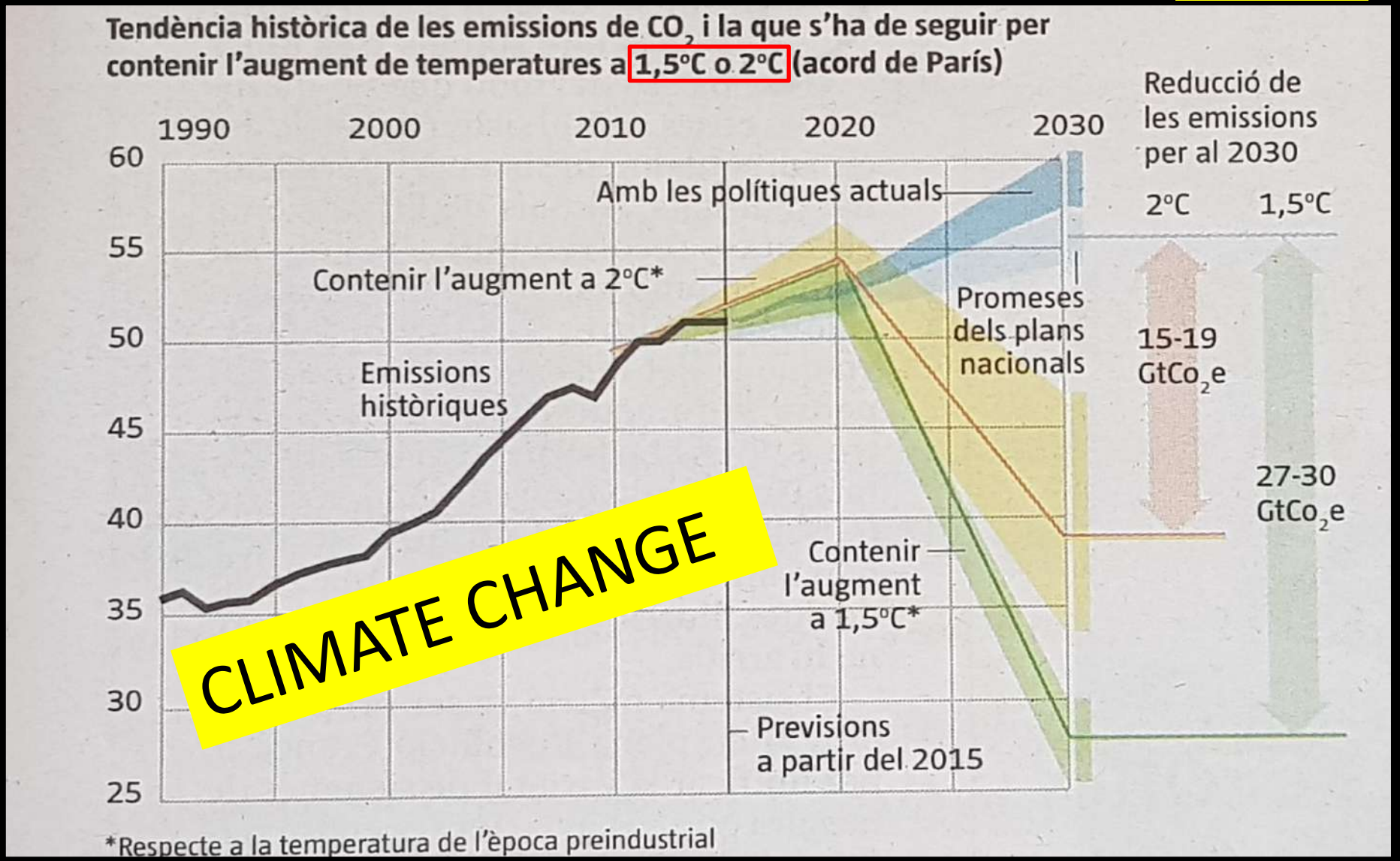
A FONDO

El cambio climático avanza y el mundo está “al borde del abismo”

9 agosto 2021

por Juan Ranchal

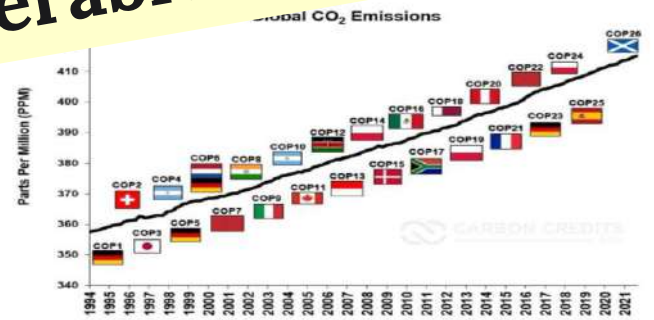
26. nov. 2019



ACUERDO DE PARIS (COP21) 2005: La intención del conjunto de naciones participantes, es que para el final de este siglo (2100), **la temperatura media global de la tierra no aumente más de 2º C respecto a valores pre-industriales**, aunque algunos países amenazados por la subida del nivel del mar proponen 1,5º C .

https://www.larazon.es/lr-content/20221123/5gv4ykesijavznaw7ohvbynmqa.html

COP27 Reaches Breakthrough Agreement on New "Loss and Damage" Fund for Vulnerable Countries

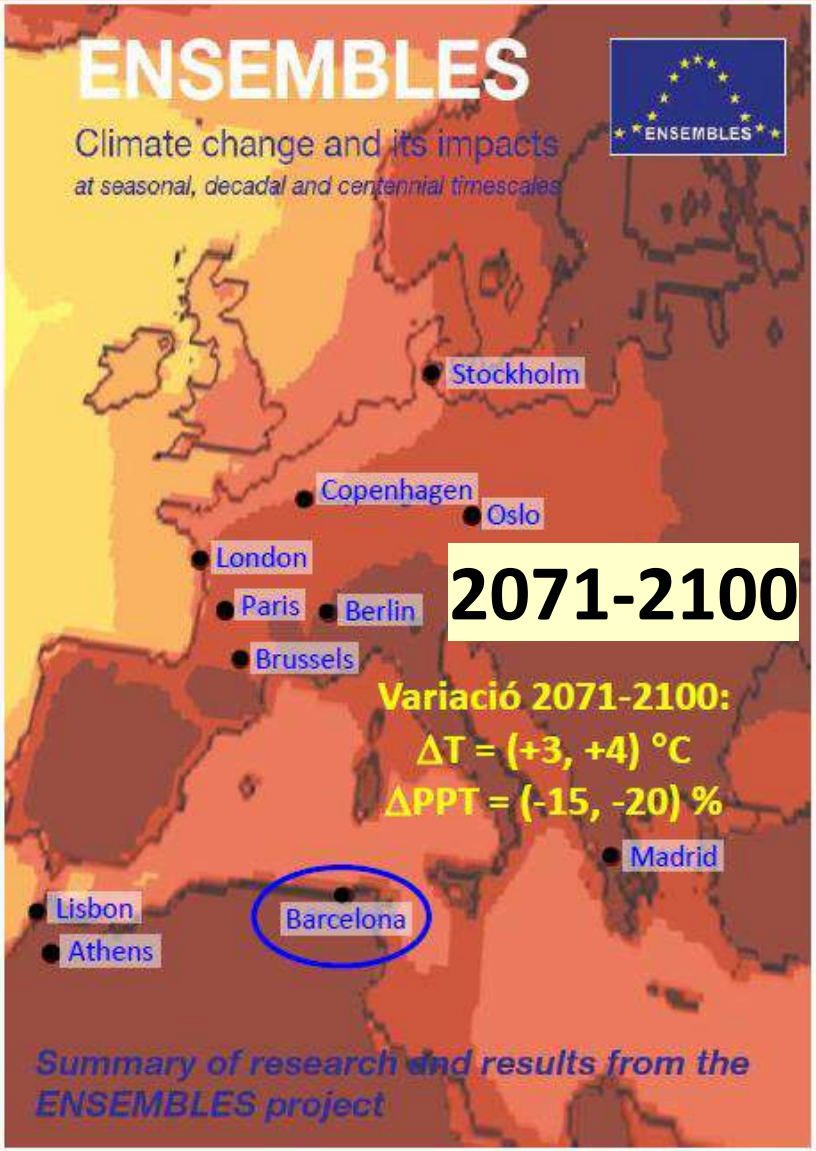


Conclusiones de la COP27: diez avances para seguir luchando contra el cambio climático

La COP-27 terminó por fin. El domingo se adoptó el acuerdo final que echó el cierre a más de dos semanas de negociaciones de la Convención de la ONU en Sharm el-Seij, Egipto. La principal conclusión es la siguiente: hay que seguir luchando contra el cambio climático. Esto no se ha acabado, ni mucho menos. No obstante, se ha logrado un abanico de avances que desligamos en diez puntos:

1. **Justicia climática para los más vulnerables**
2. **Cambio en el sistema financiero mundial**
3. **Posible acuerdo de reducción de las emisiones**
4. **Mercado de carbono**
5. **El objetivo de 1,5ºC no se tocó**
6. **Fortalecer la resiliencia de los sistemas energéticos**
7. **Acercamientos entre EEUU y China**
9. **Pactos por el agua y otros ámbitos**
10. **El papel de los bosques**

3. Projeccions climàtiques per al s. XXI



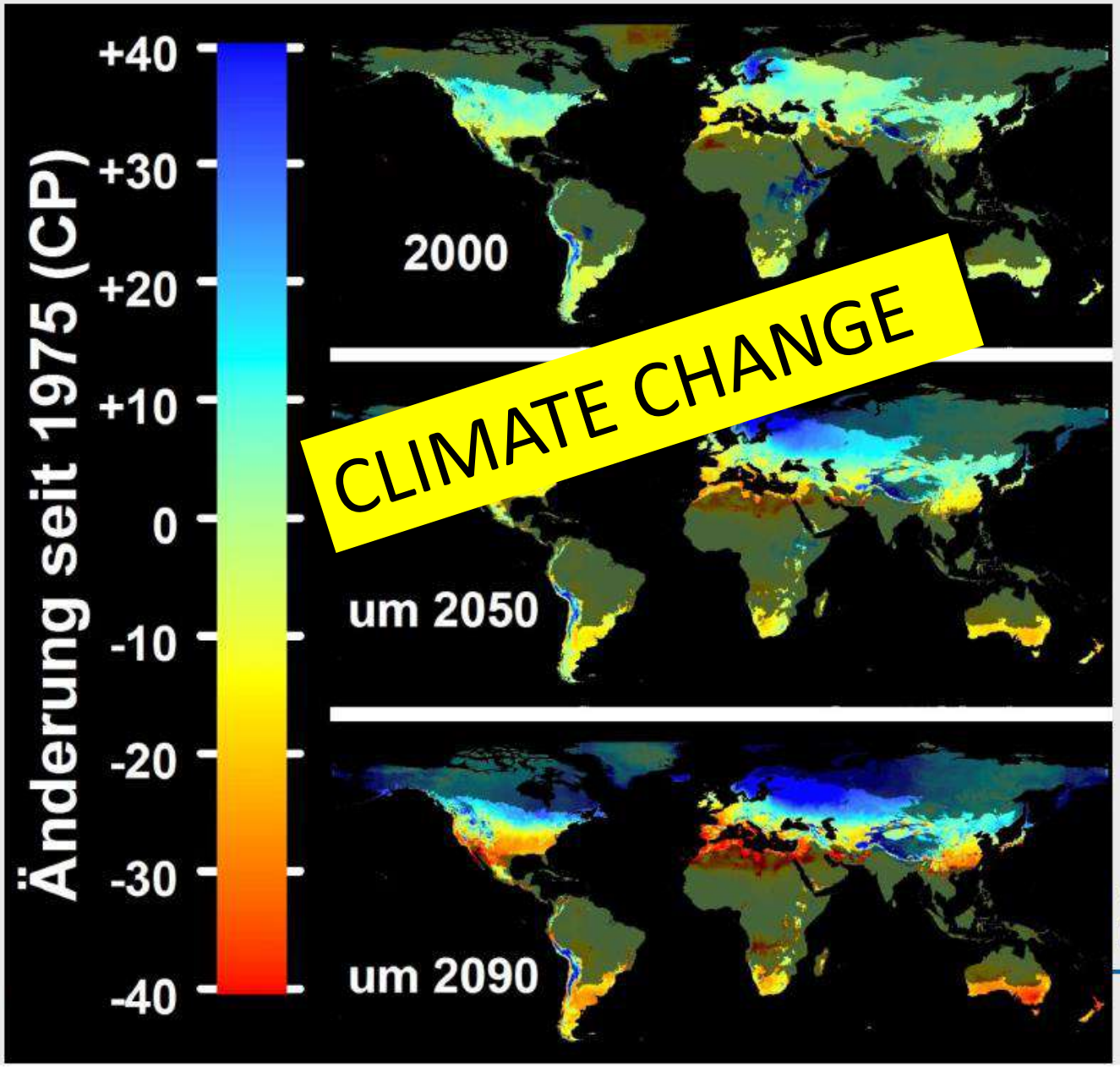
Portada de l'informe final del projecte europeu ENSEMBLES (2009)

Algunes ciutats europees ressituades a llocs on les condicions climàtiques "actuals" (període **1961-1990**) són les mateixes que les projectades per aquella ciutat en el període **2071-2100** (escenari A1B), tenint en compte en la comparació la temperatura, la precipitació i les característiques estacionals de cada ciutat per als dos períodes.

van der Linden, P. and J.F.B. Mitchell (eds.), 2009: *ENSEMBLES: Climate Change and its impacts. Summary of research and Results of the ENSEMBLES project*. Met Office Hadley Centre, Fitzroy Road, Exeter (UK), 160 pp.

http://ensembles-eu.metoffice.com/docs/Ensembles_final_report_Nov09.pdf

Prediction of lack of winter chill worldwide



LOW-MID CHILLING

Luedeling, Blanke et al. 2013:
Int J Biometerology 57, 679f

universitätbonn

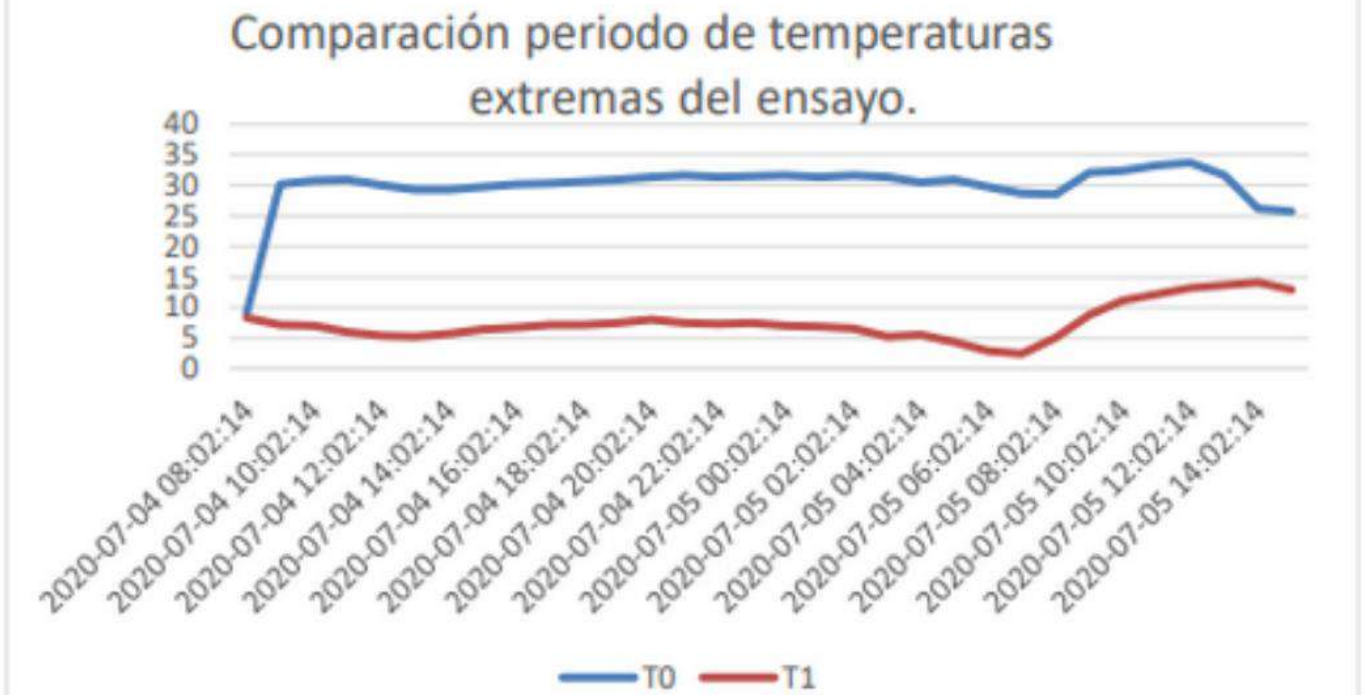
23-Febre.-2022

Impact on chilling hours in woody plants?

Agricooler

T0

Cómo mejorar la acumulación de horas frío en cerezos



Diferencia de temperatura medida en 30 horas, Agrícola El Carmelo.

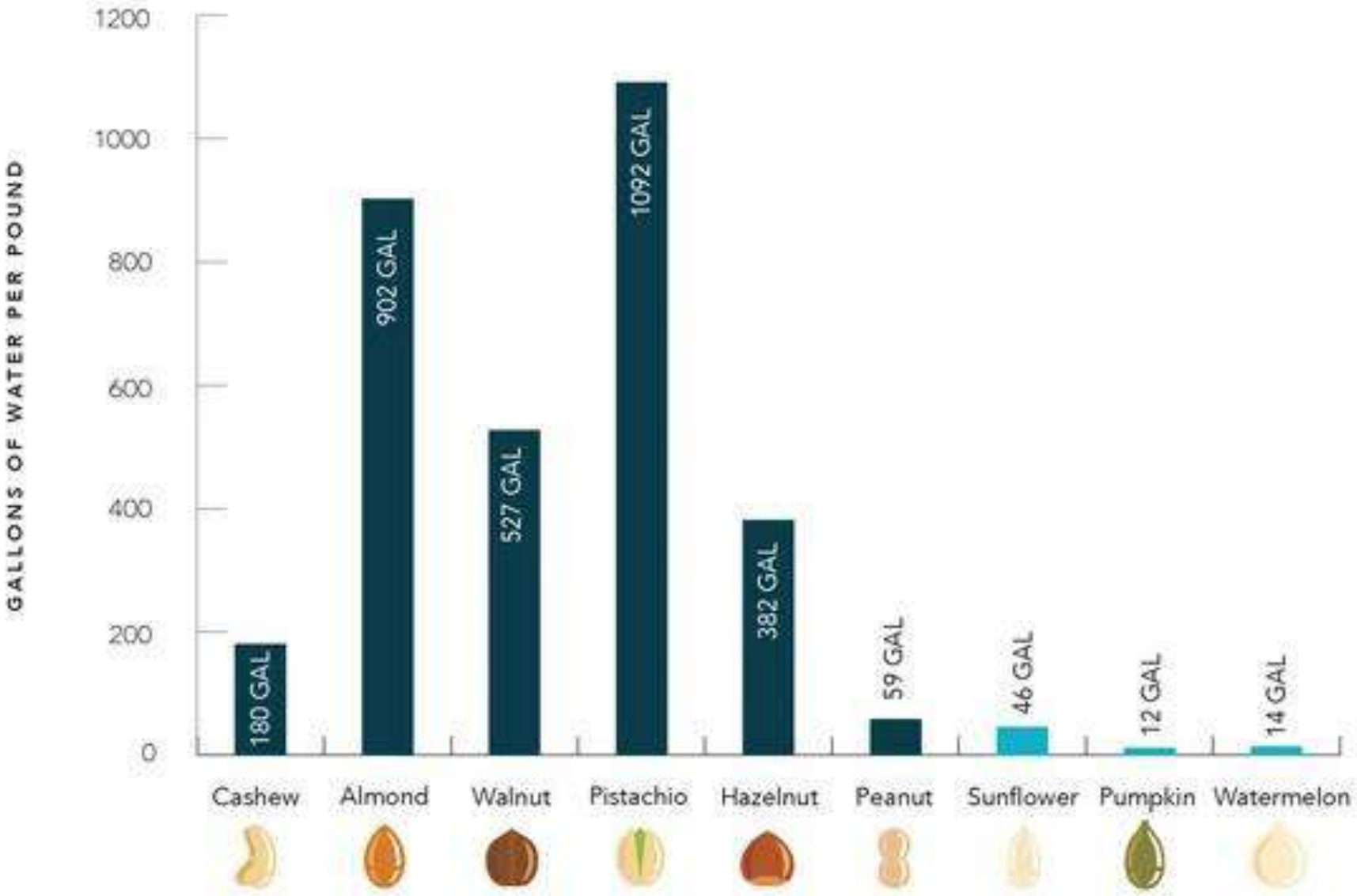
Agrícola El Carmelo,
Buin, Región Metropolitana de Chile.

5 April 2022

Sequía histórica en España, comienzan las restricciones: "Es un riesgo silencioso pero constante"

La sequía actual en España está comenzando a manifestar efectos en el campo y puntualmente está generando en algunas zonas déficit de abastecimiento urbano

WATER USAGE NUTS VS. SEEDS



APLICACIÓN DEL RIEGO POR ASPERSION EN EL ANCHO DE LA COPA

22 m^3/h-ha: AHORRO 50% del agua

2D

4 mm/h

0-1 mm/h

4 mm/h

3 April 2022

Selfrooted tres 3 years

DRY LAND

Almond genetics for future rootstocks for a better water efficiency

AVIJOR Plant. March 2021

Selfrooted tres
DRY LAND

Agosto-2022

A NEW CONCEPT FOR NEXT STEP IN AGRICULTURE TRANSFORMATION:

SUSTAINABLE INTENSIFICATION

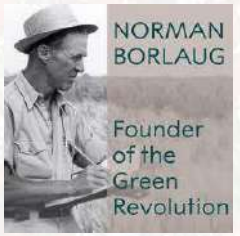
Technology
Knowledge
Science

INTENSIVE USE OF KNOWLEDGE
(Silva, 2017, FAO)

Sustainable intensification

Industrial farming

INTENSIVE USE OF INPUTS (NATURAL RESOURCES)
Green Revolution (NB)

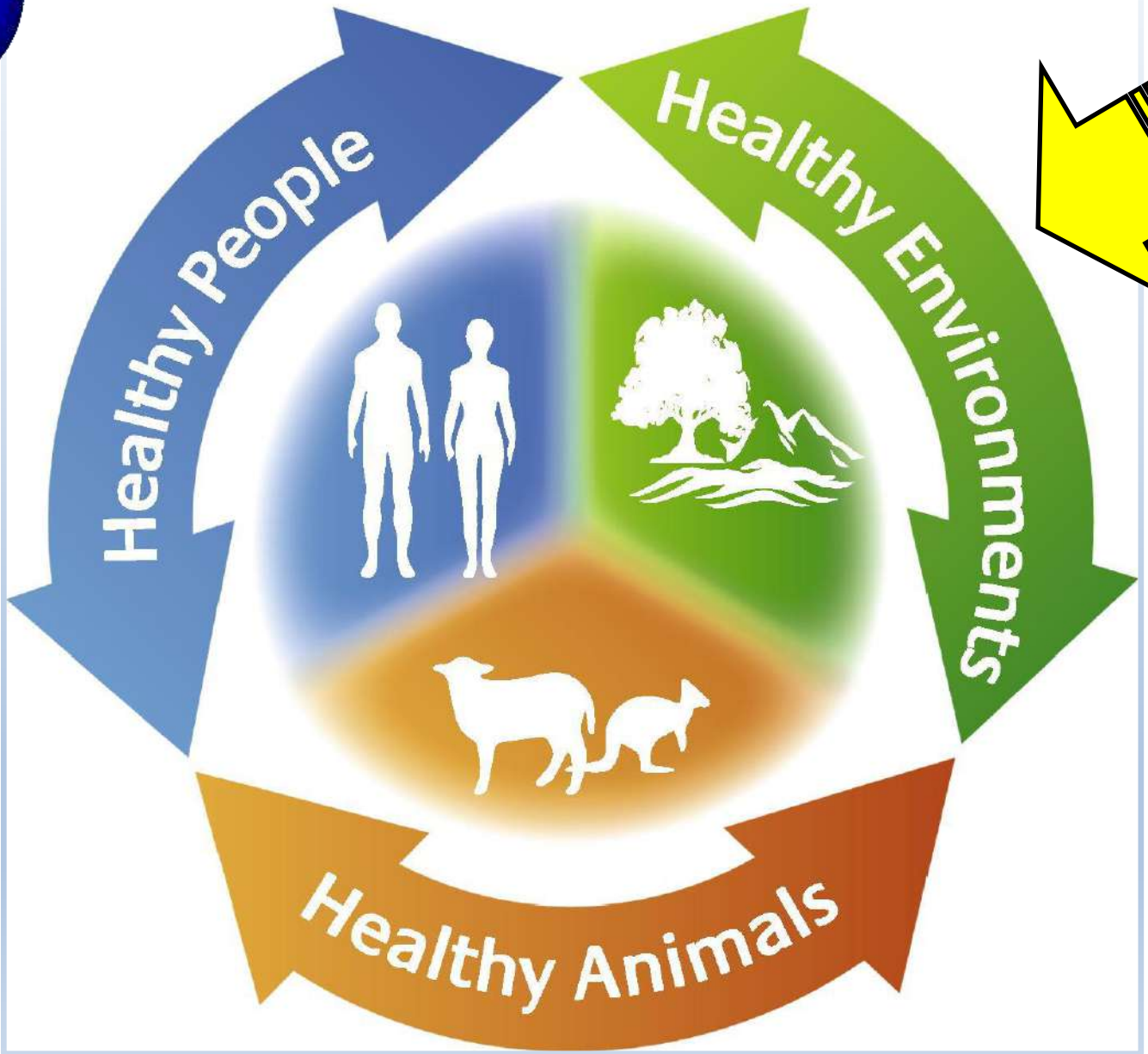


Pre-industrial Revolution agriculture

Resources

Adapted from **Louise Fresco**. On: *Feeding the whole world*. Ted Talks

The One Health Triad



Three pillars for efficient & sustainable orchards

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Variety & Rootstock

Training systems & canopy architecture

Production & Technology

1 Breeding + nursery prod.

2 Agronomical models

3 Technology

Iglesias, 2022

GALA GROUP-2022

Simmons Buckeye®
Fendeca
Galaval
Royal Beaut

Galaxy
Baigent Brookfield®
Gala Schnitzer Schniga®

Tenroy Royal Gala®
Mitchgla Mondial Gala®

Dark Baron®
T-Rex ®
Gala Fenzem
Devil Gala
Gala Briss
Gala Star ®
Bigbucks
Schnicored
DarkAnn ®

VIGOUR CONTROLLING ROOTSTOCKS ARE REQUIRED TO DEVELOP PLANAR CANOPIES OF INTENSIVE ORCHARDS

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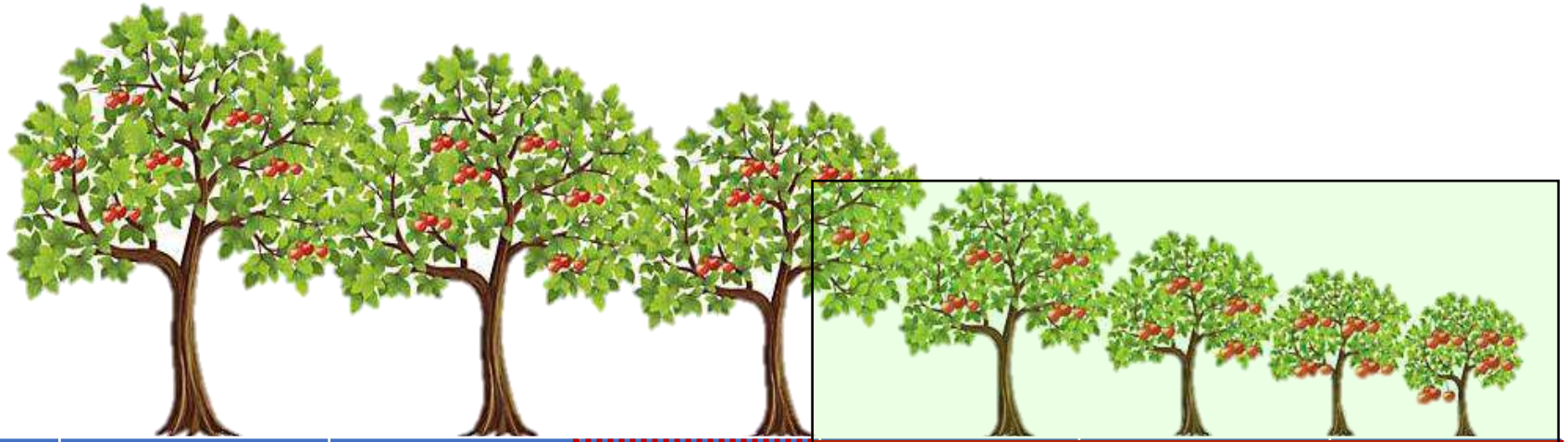


SPECIES	Very high	High	High-mid	Mid	Mid-low	Low
APPLE	Franco, M-25	M-4, M-793, MM-111	M-7, MM-106 G-257, G-969	M-26 G-41, G-213	M-9 EMLA o NAKB G-11	M-27, B-9 G-65
PEAR	Kirschensaler, BP-3, OHF-93	OHF-87, BP-1	BA-29 Pyrod	M-A	M-H	M-C
PEACH	GF-677 Garnen Nemaguard Atlas	Montclar,GF-305 Cadaman Lovell, Kuban	Rootpac-R Tetra Penta	Adesoto-101 Isthara Controller-6	Rootpac-40 MP-29 Intensia	Rootpac-20 Pilowred
CHERRY	F-12/1, Colt Sta. Lucia (SL-64)	Adara, Maxma-14 Gisela 12, PI-KU 1	Gisela-6 Weiroot-158	Gisela 5 Clinton	Gisela-3, Lake Cass, Crawford	Clare Damil
ABRICOT	Franco albaicoquero	Mirobolan 29C	Montclar, GF-305 AP-65	Adesoto-101 Isthara		
EUROPAN PLUM JAPANEES PLUM	Marianna 2624 Marianna GF 8/1	Mirobolan 29C Adara	Rootpac-R Tetra Penta	Isthara Adesoto-101 Miral 3278- AD		Rootpac-20
CITRUS	C. Carrizo Citrumelo- 4475	Ma. Cleopatra Naranjo amargo	USDA-942 FA-5	FA-517 UFR-6	USDA-897	CIVAC-19

INTENSIFICACIÓN EN LEÑOSOS

SARROCA, juliol 2018, 3r verde

3r year

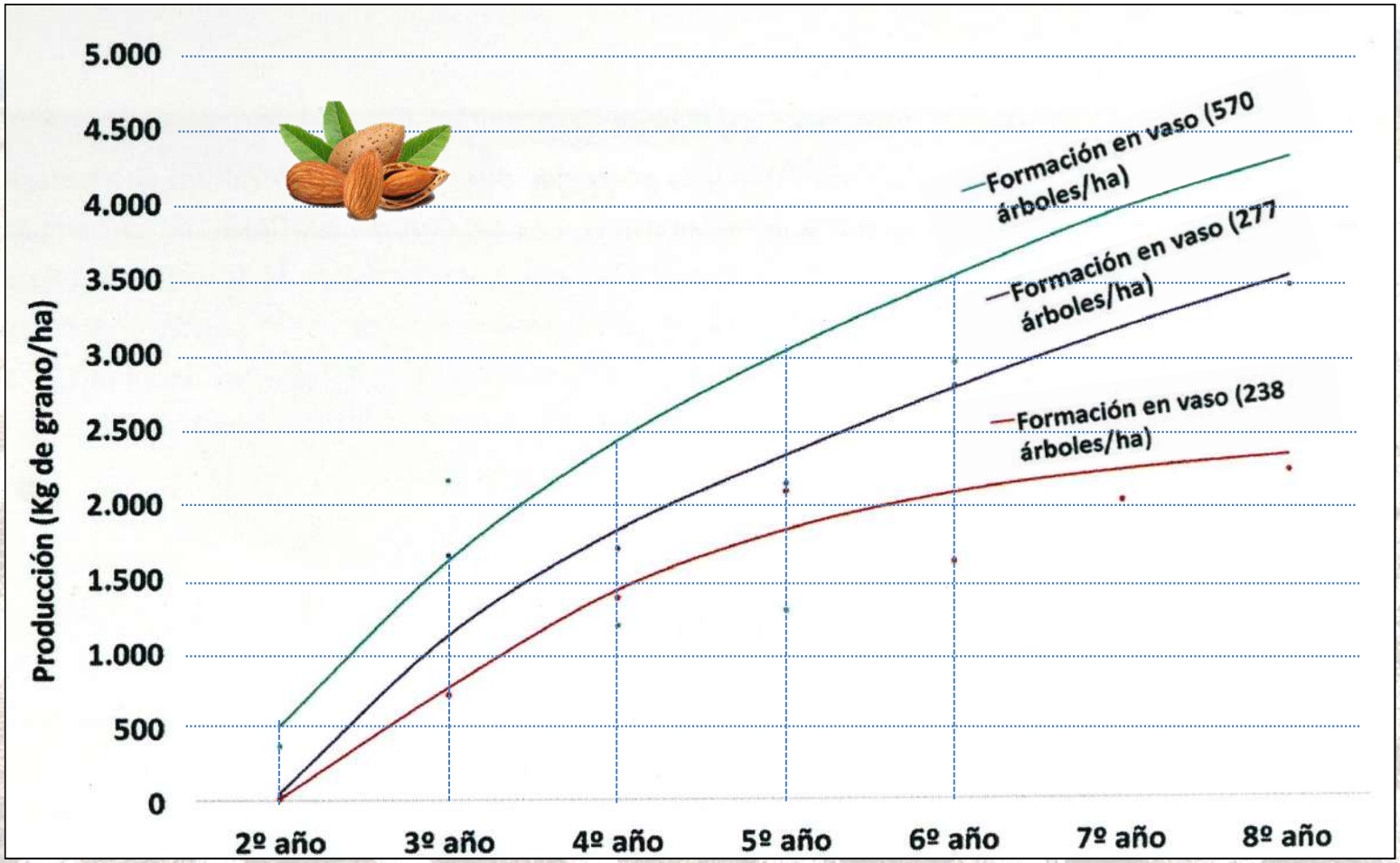
6 x 6 m 3r year

2003

Fecha de las imágenes: 7/23/2018

3,5 x 1,0 m, 3r year

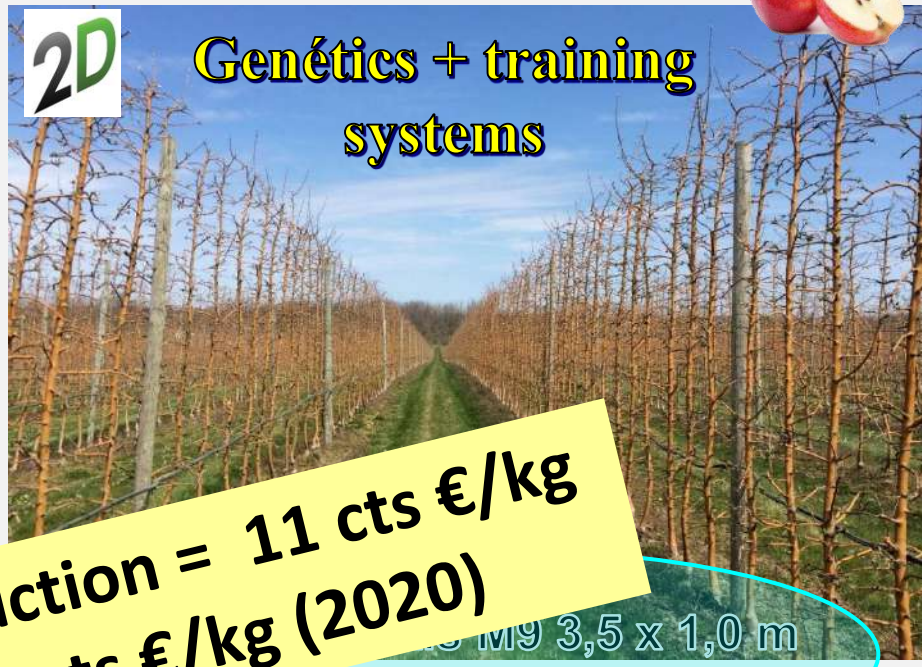
SPACING & YIELD IN ALMOND



(Miarnau et al., 2018)

IRTA
RECERCA I TECNOLOGIA AGROALIMENTÀRIES

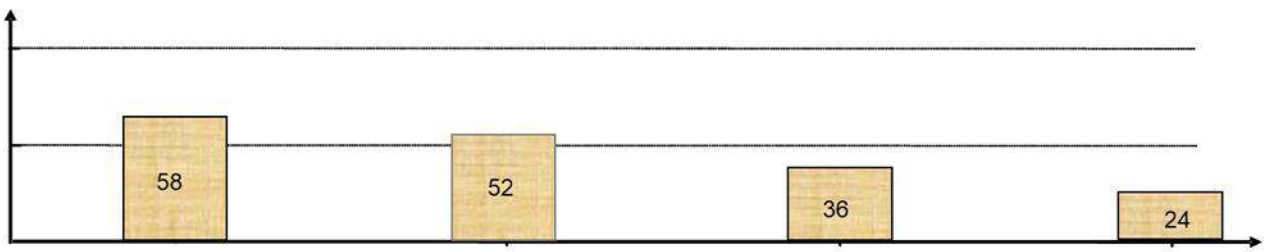
SUSTAINABLE INTENSIFICATION IN APPLE



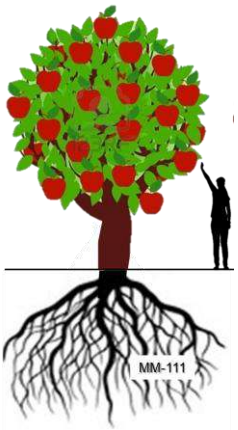
Σ Reduction cost of production = 11 cts €/kg (-40% cv 'Golden'): 27 cts €/kg (2020)

Transition to small trees = ECO sustainable intensification

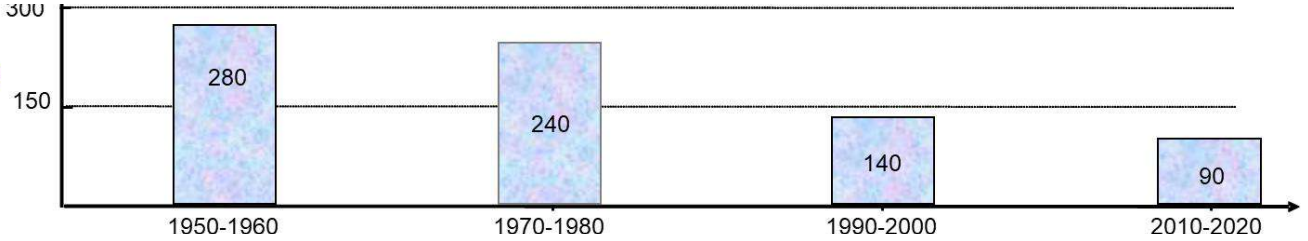
Deriva (%)



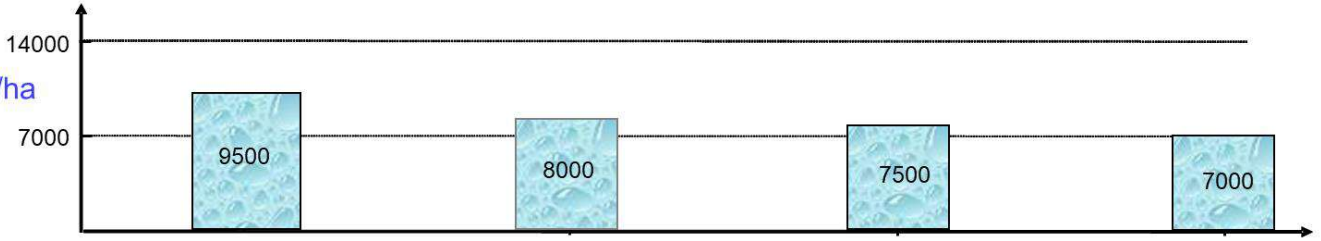
2D



UF N/ha



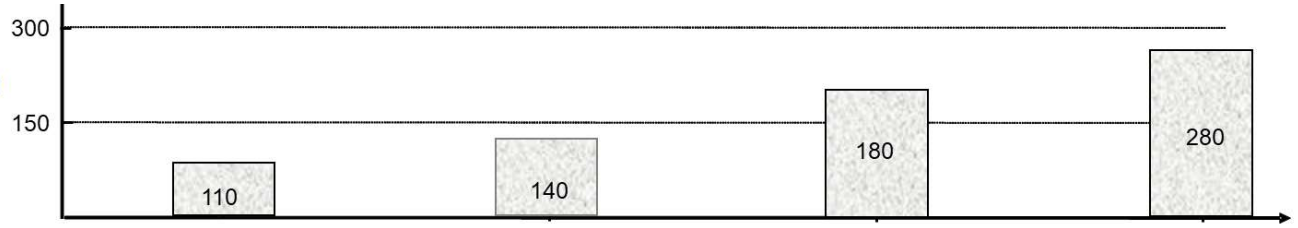
m³/ha



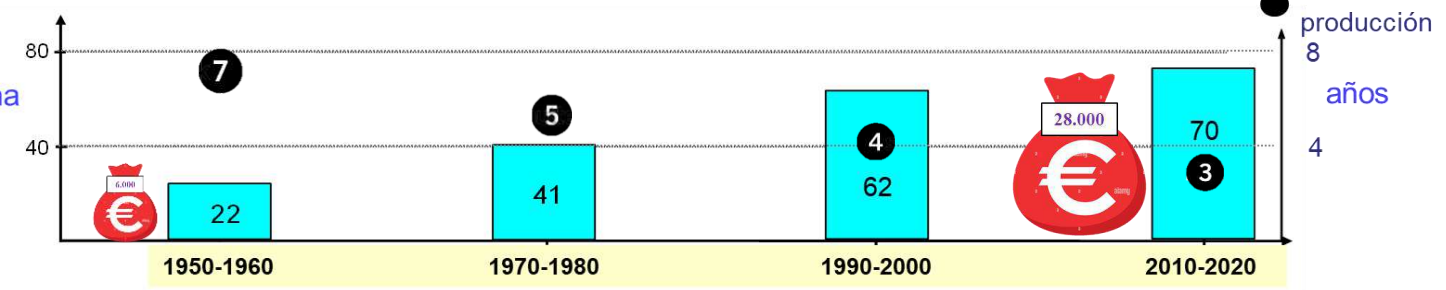
333 tre./ha

2,857 tre./ha

kg/h



t/ha



80% Plena producción

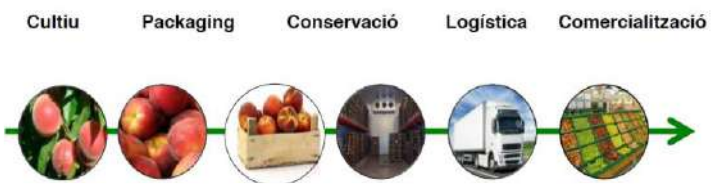
8 años

4

Iglesias, 2022

Life Cycle Assessment of apple and peach production, distribution and consumption in Mediterranean fruit sector

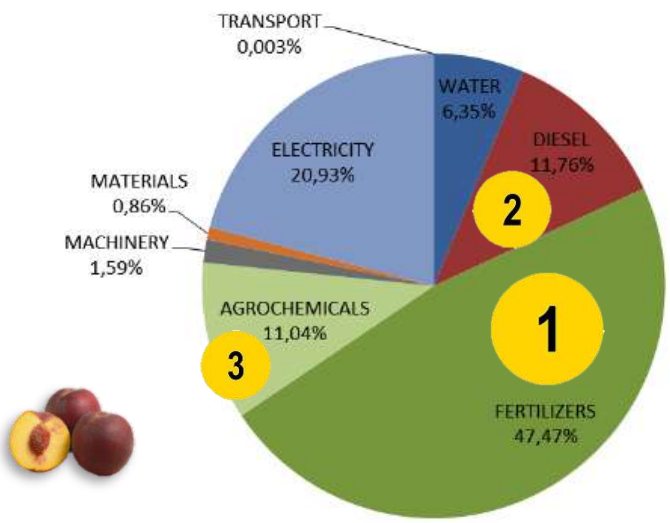
Elisabet Vinyes [a, *], Luis Asin [c], Simó Alegre [c], Pere Muñoz [a, d], Jesús Boschmonart [a, b], Carles M. Gasol [a, b]



Journal of Cleaner Production 149 (2017) 313–320

The LCA is defined by ISO standard (ISO14044:2010) as the compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle. LCA analysis considers four main steps: aim and scope, inventory analysis, impact assessment and interpretation of results. The end results are dependent on the systems' boundaries and the functional unit (FU), which is the unit to which the results of the LCA are related and is subsequently used for the communication of the LCA results.

Given the aim of this study, at according to 2 Section 2.1, only the CHG impact category was taken into account. The calculation method used was Recipe Midpoint H. Calculations were performed with the SimaPro 8.1 software, together with the ecoinvent Centre database 3.1. According to Milà i Canals et al. (2006) and Cerutti et al. (2011a), a mass-based functional unit is adequate when analysing only the agricultural stages of the life cycle of fruit for descriptive purposes. Therefore, in this study the functional unit was defined as "cultivation of 1 kg of apple".



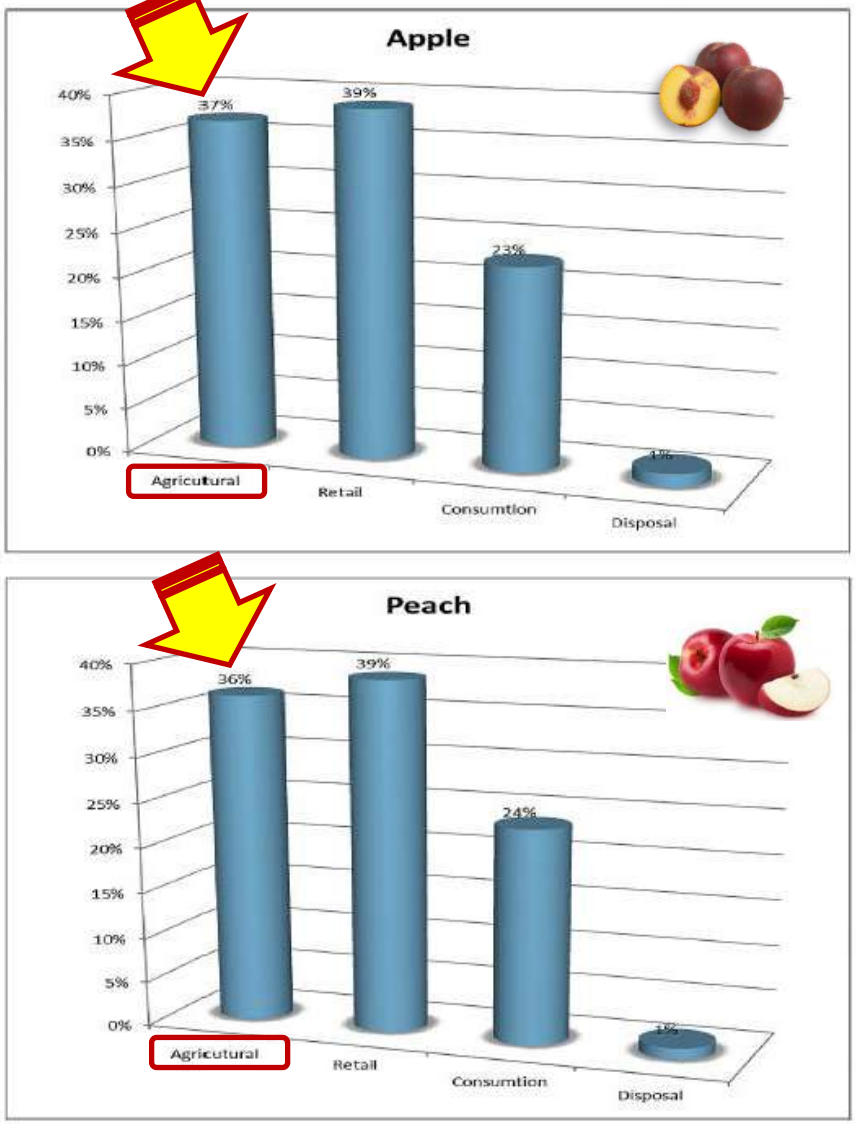
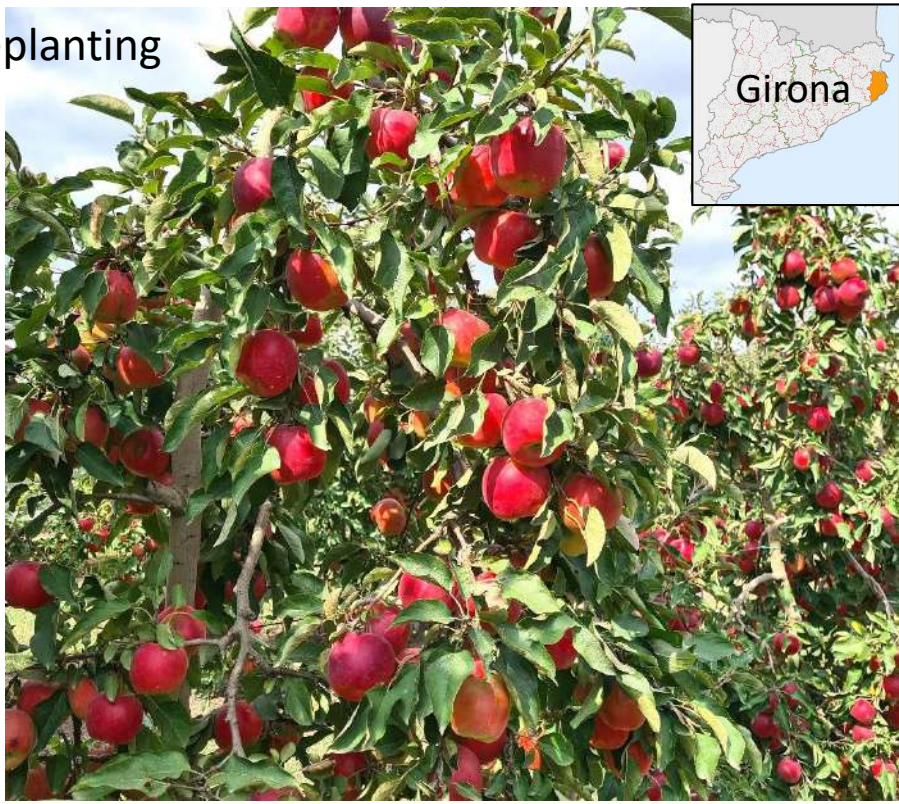


Fig. 3. Contribution percentage to CO_{2eq} emissions of the production stages considered.

GROUND COVER OPTIONS

Eco-sustainable intensification
AGROECOLOGY

STORY/G41 8th year Replanting



RESISTANCE TO PESTS AND DISEASES OF ROOTSTOCKS AND VARIETIES

M.9

G. 41

STORY

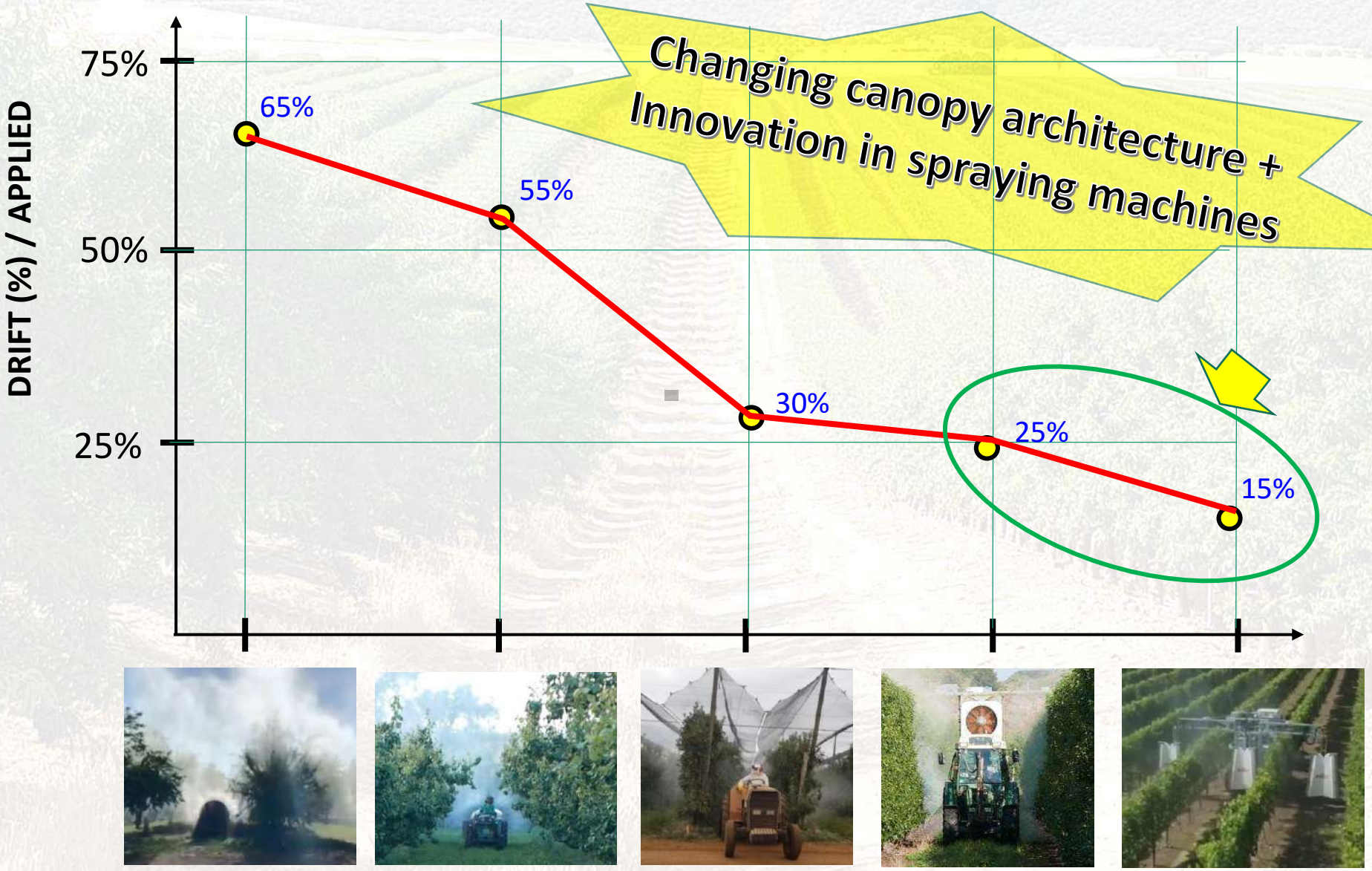
- 27% COST CROP PROTECTION

GALA

LIBERTY

GOLDEN

DRIFT (%) AFFECTED BY THE TRAINING SYSTEM AND SPRAYING EQUIPMENT

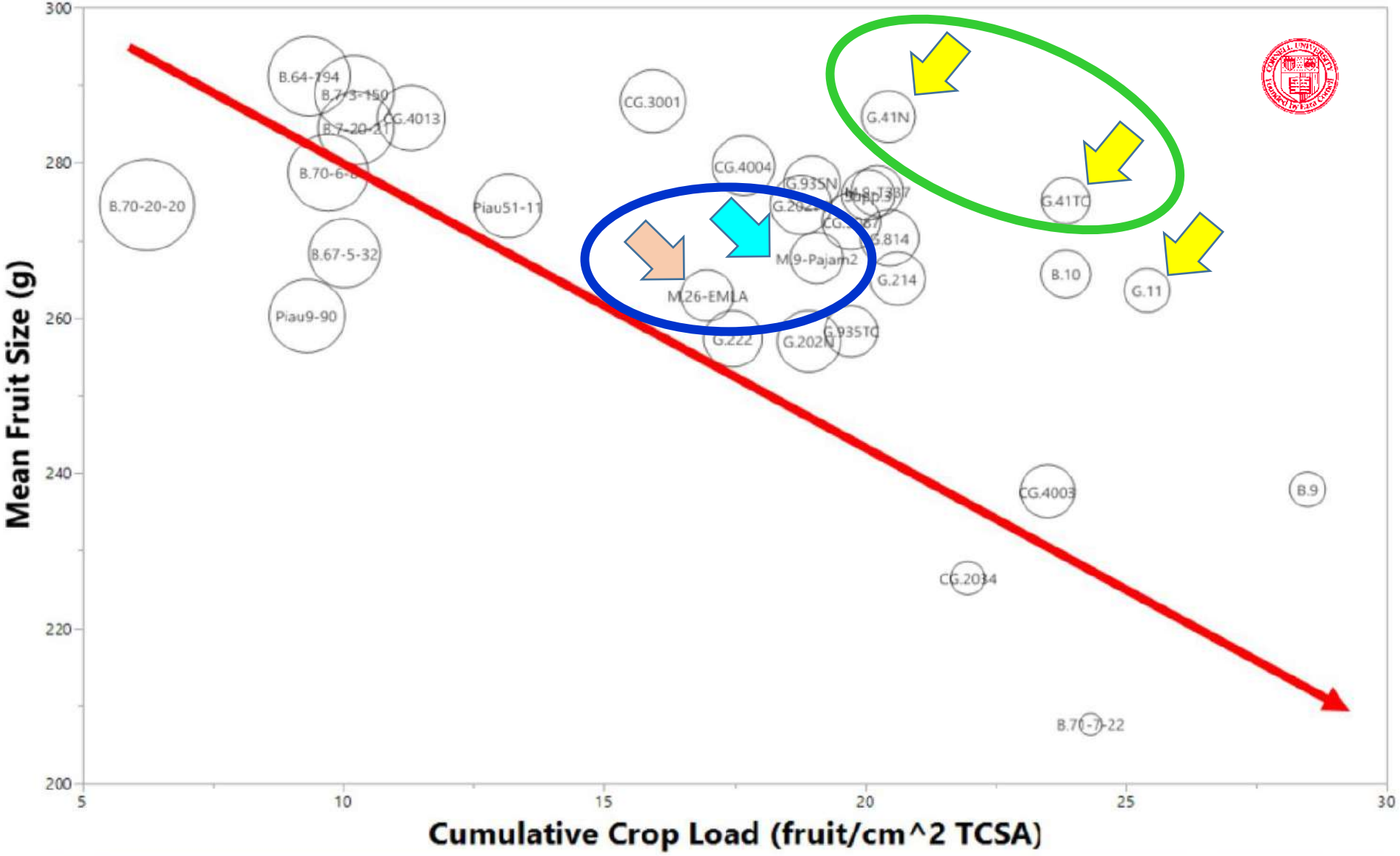


Iglesias 2021

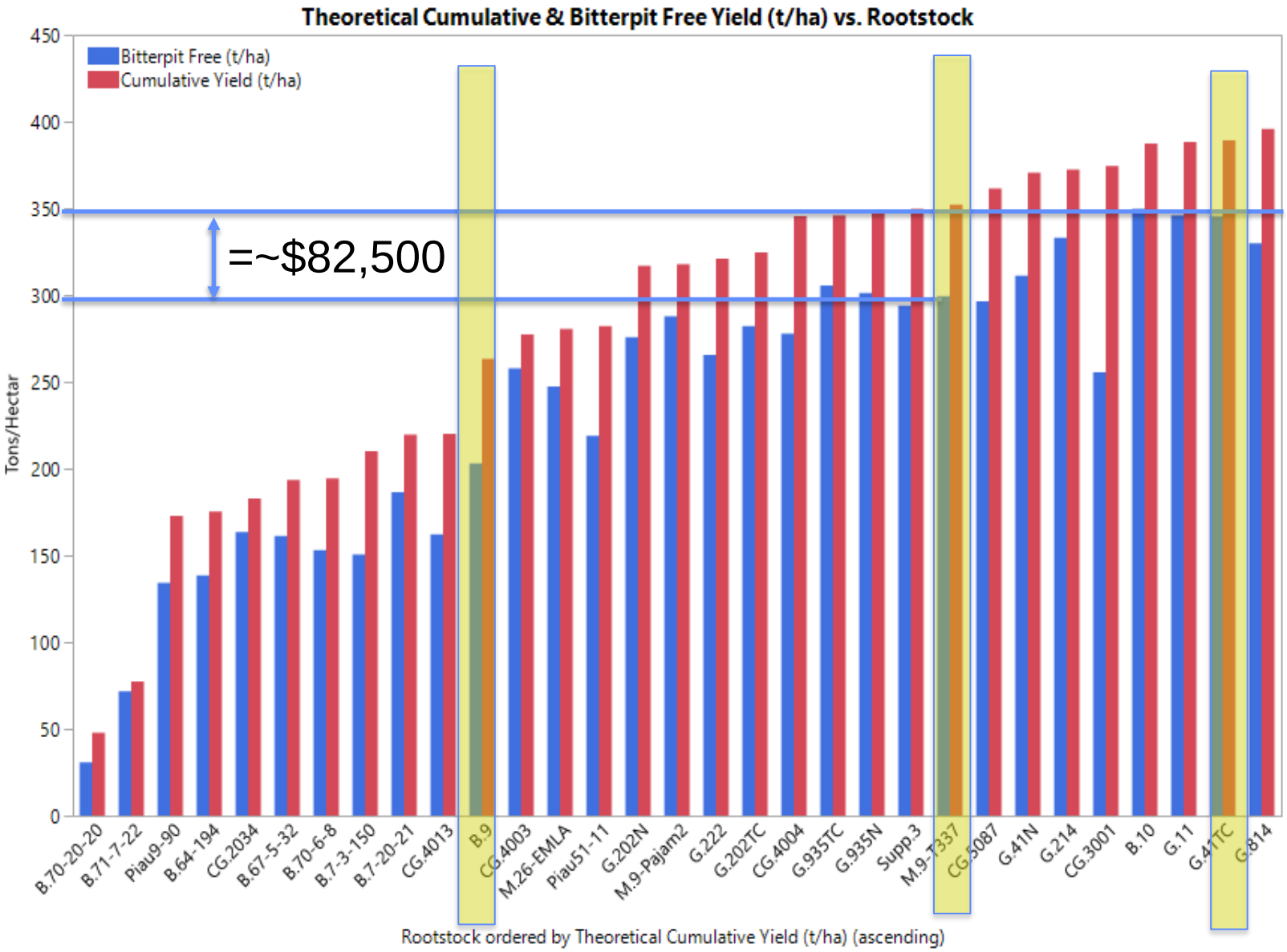
8-Octob.-2019

MANDALINE (EARLY PINK LADY) /M9337, 6th year 147 t/ha (3,6 x 0,6 m)

Bubble Plot of Honeycrisp Mean Fruit Size by Cumulative Crop Load Sized by Trunk Cross Sectional Area for 31 Rootstocks



Cumulative 8 year yields of ‘Honey Crisp’ and grower return



Robinson, 2019

PEACH

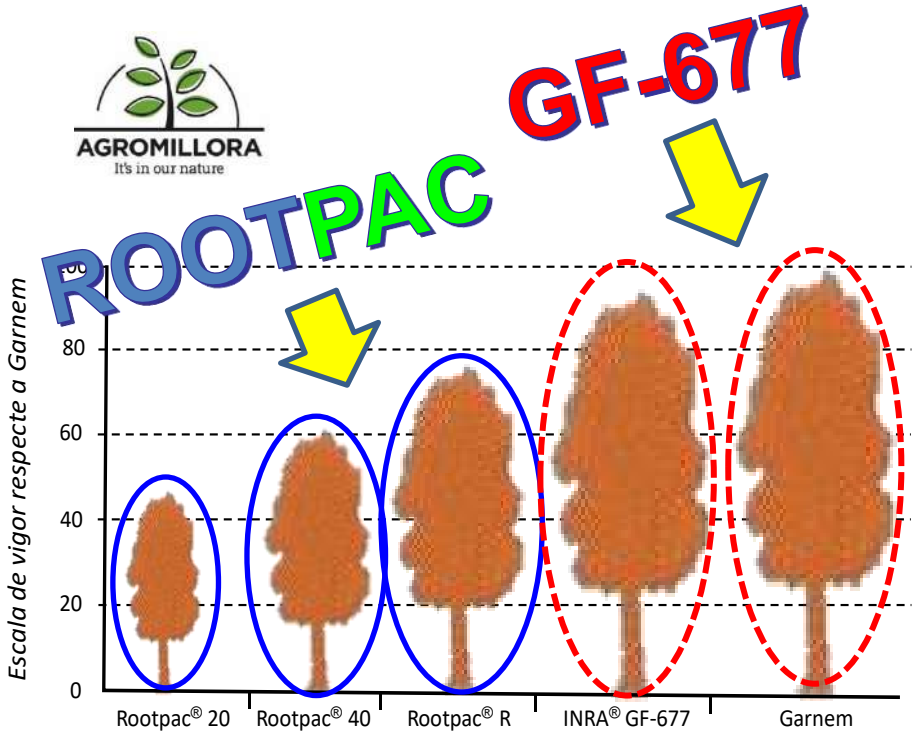
CONTROLLING SIZE ROOTSTOCKS

PRUNUS ROOTSTOCKS

ROOTPAC®

ROOTPAC 20 ROOTPAC 40 ROOTPAC R

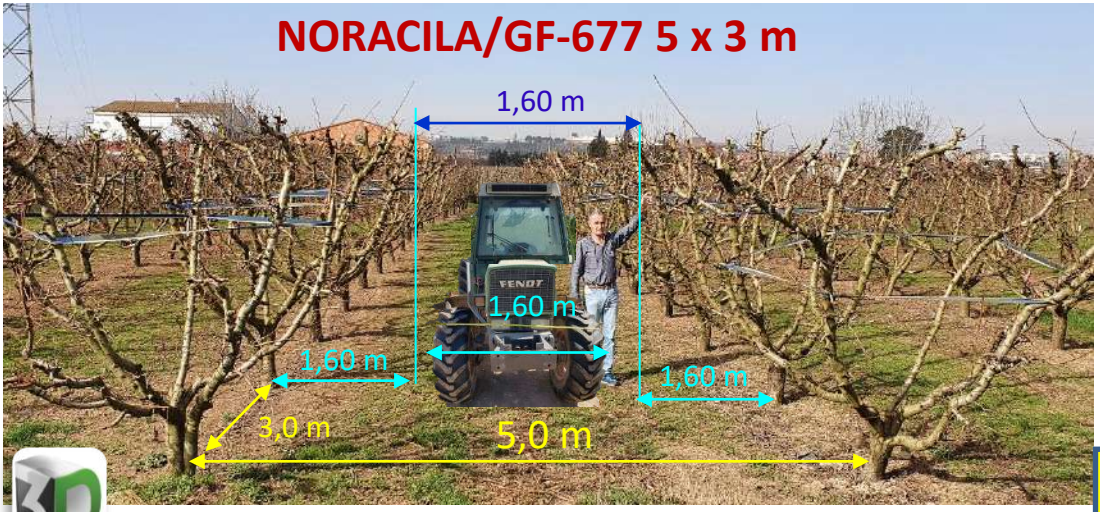
AGROMILLORA
It's in our nature

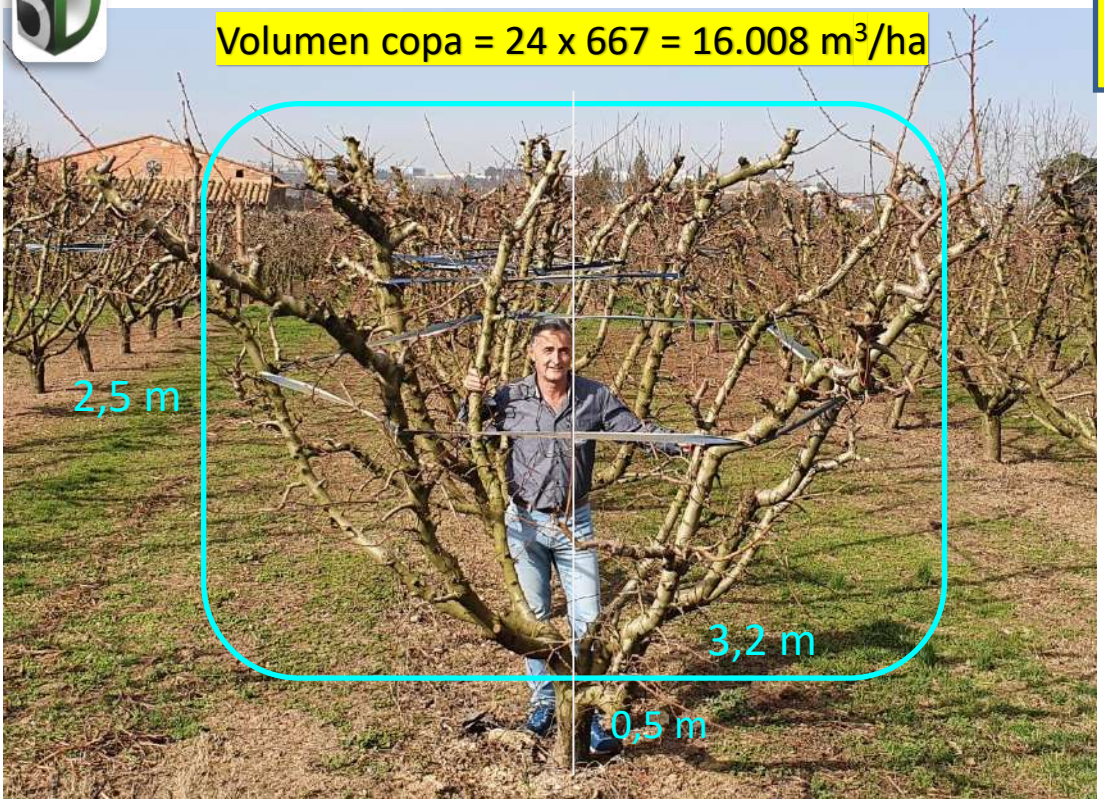


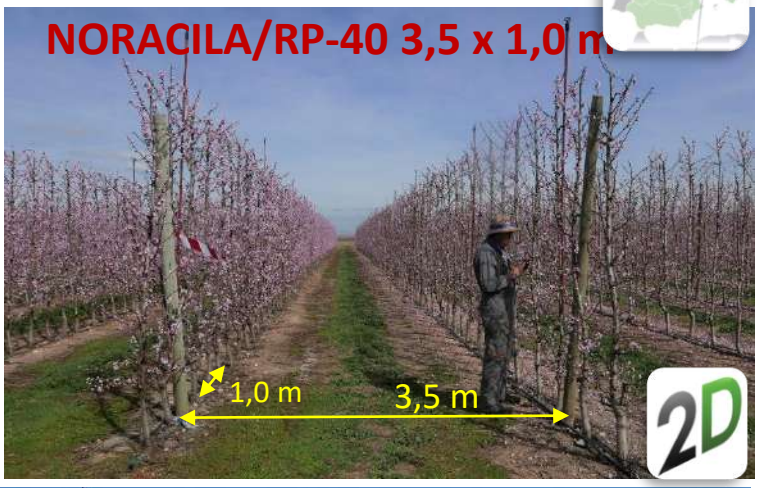

3D

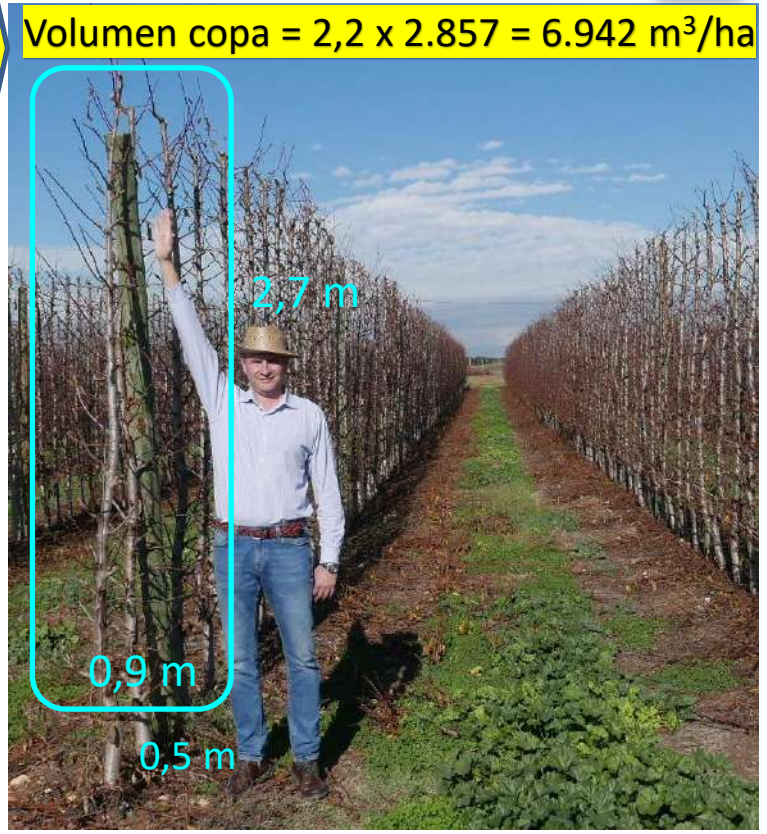

2D
23 marzo.- 2021

ARQUITECTURA DEL ÁRBOL Y ACCESIBILIDAD A LA COPA





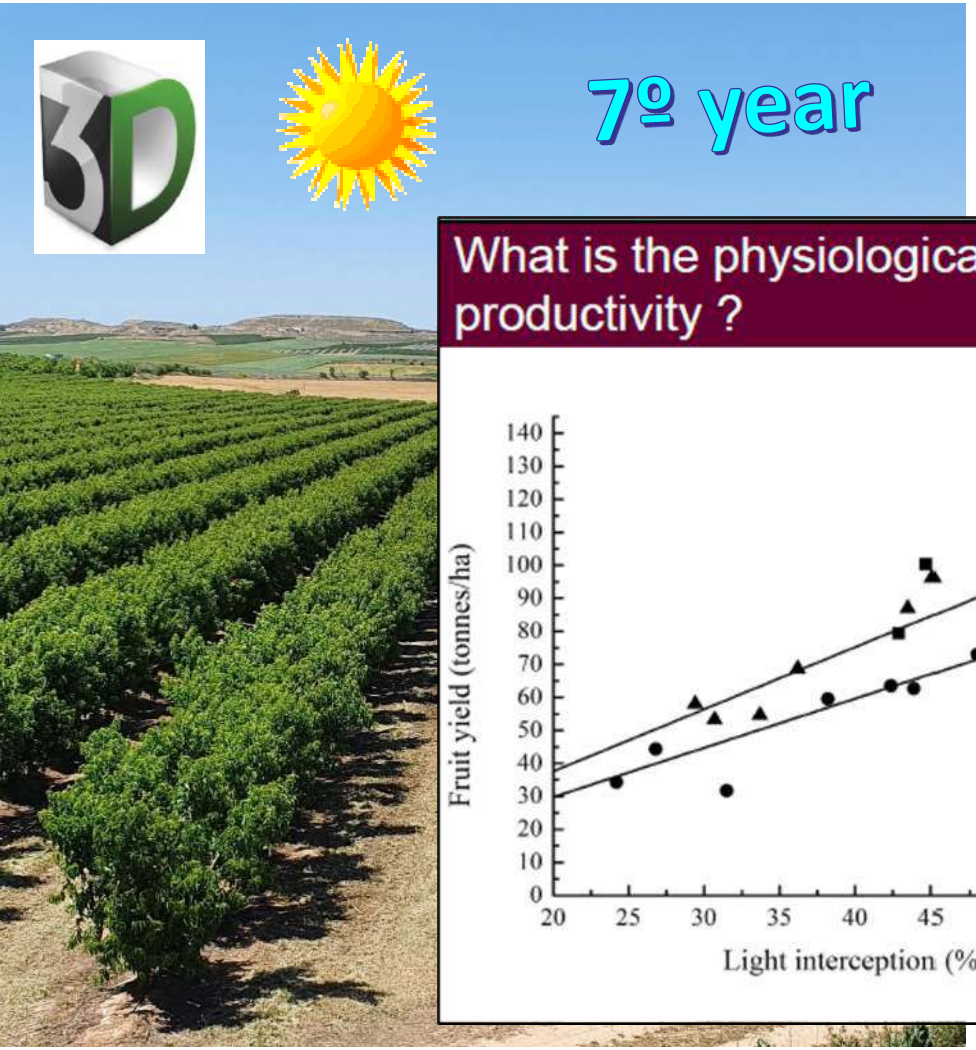


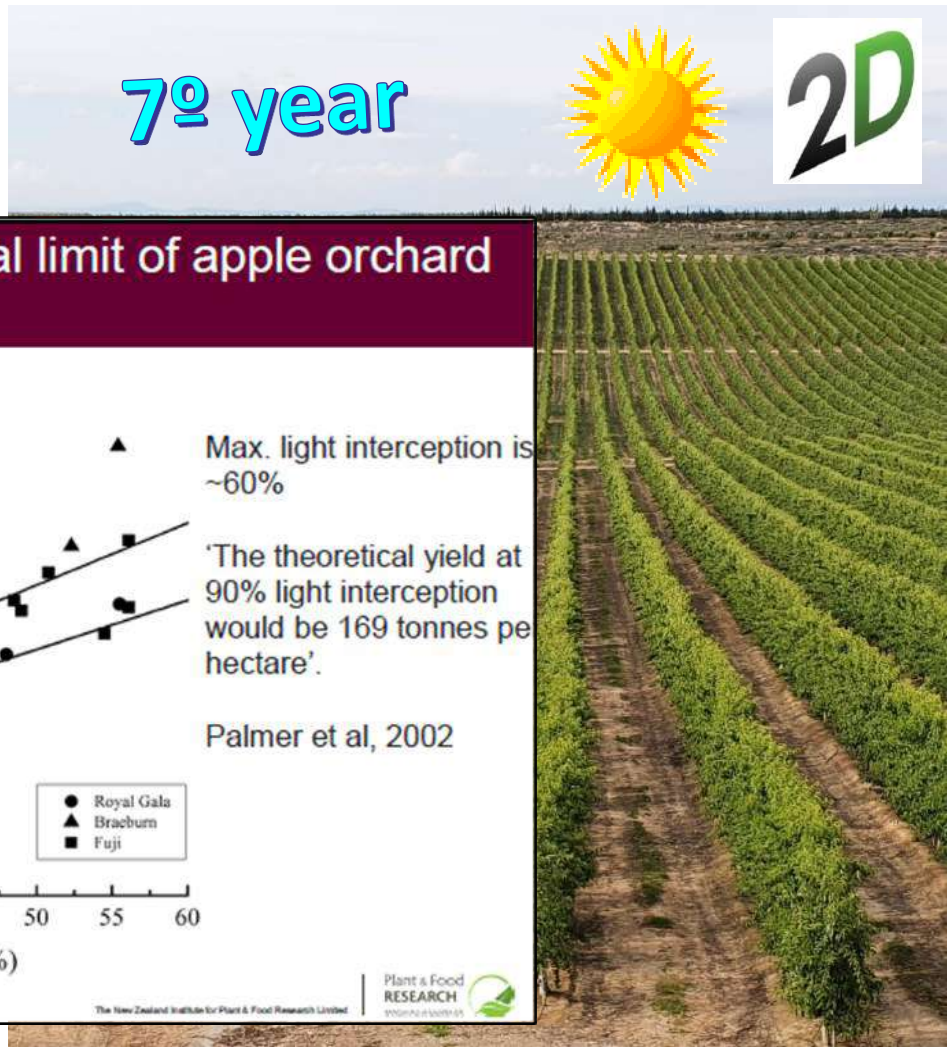


LIGHT INTERCEPTION AND YIELD AFFECTED BY CANOPY ARCHITECTURE: 3D vs 2D

Planted March 2011: 5 x 3 m

Planted March 2011: 3,5 x 1 m





What is the physiological limit of apple orchard productivity ?

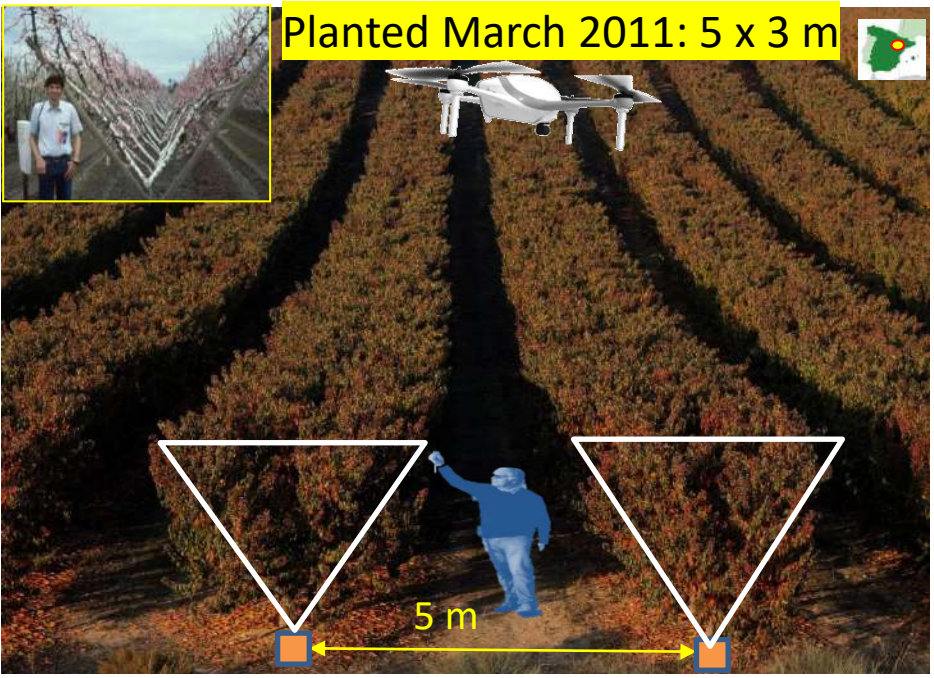
Max. light interception is ~60%

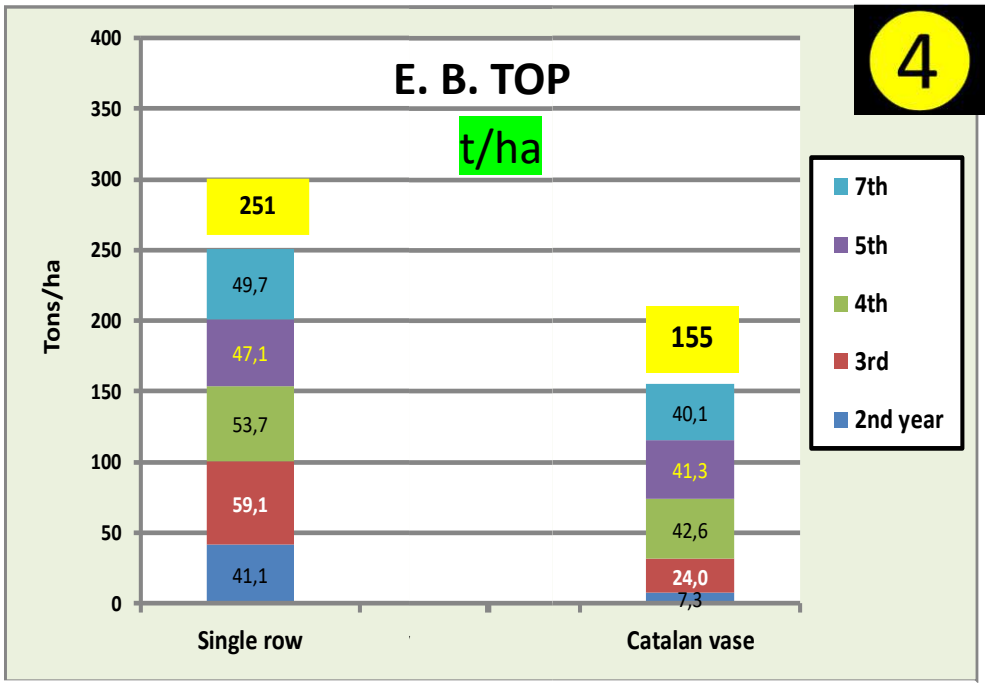
'The theoretical yield at 90% light interception would be 169 tonnes pe hectare'.

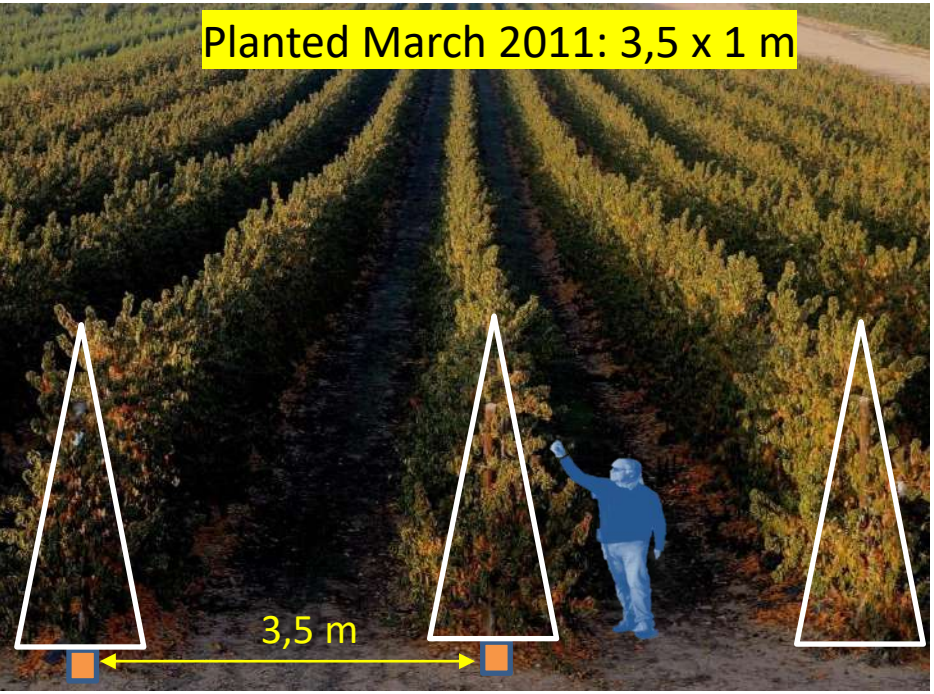
Palmer et al, 2002

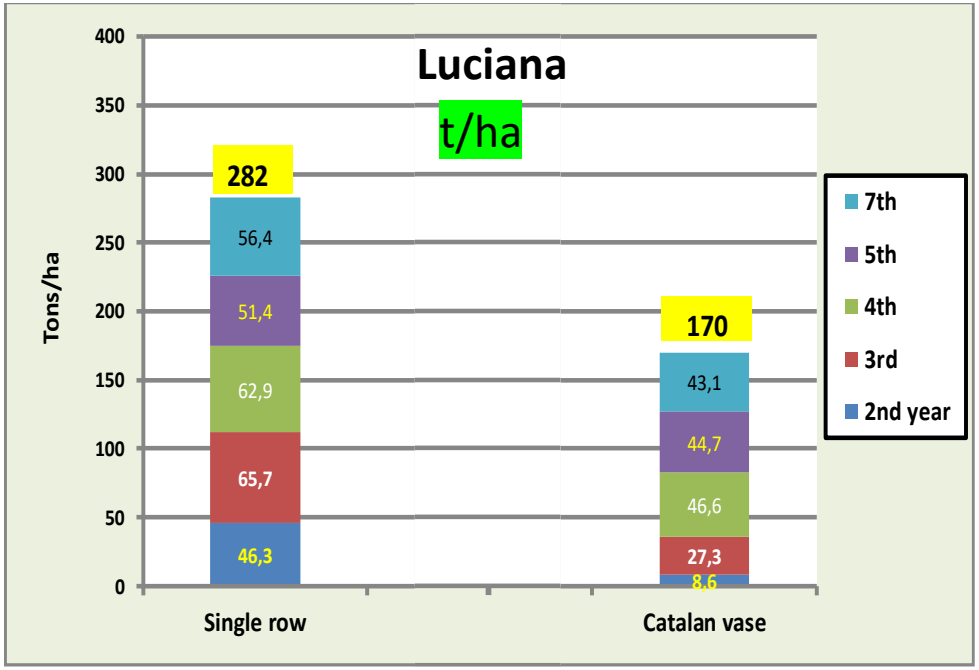
The New Zealand Institute for Plant & Food Research Limited

Plant & Food RESEARCH









Iglesias and Echeverría, 2022

ADAPTING CANOPY & EFFICENT MECHANIZATION

SUMMARY OF COSTS RELATED WITH TRAINING SYSTEM

SYSTEM	YIELD (kg/ha)	TOTAL+ COST (€/ha)	OTHER (€/ha)	PESTICIDES + FERTILIZERS* (€/ha)	WINTER PRUNING* (€/ha)	THINNING * (€/ha)	HARVEST* (€/ha)	TOTAL VAR. COST * (€/ha)
OPEN VASE	40,000	14,700	5,407	3,528 (2,293 pest.) (1,235 fert.)	920	1,785	2,975 €/ha 333 h (120 kg/h)	9,293
2D/AXIS	52,000	12,614	4,674	2,810 (1,885 pest.) (1,025 fert.)	750	836	2,078 €/ha 231 h 225 kg/h	6,474
DIFFERENCE	13,000	2,086	-	718	170	949	897	2,819

Labour NE-Spain: 8.5 €/h

(+): including annual amortization difference

OPEN VASE with AXIS = 714 €/ha

(*): variable annual cost

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ELSEVIER

Current situation, trends and challenges for efficient and sustainable peach production

Ignasi Iglesias [a,*], Gemma Echeverria [b]

[a] Agromillora Group, Plaça M. Raventós, 3. 08770 Sant Sadurní d'Anoia, Spain

[b] Postharvest Programme, Institute of Agrifood Research and Technology (IRTA), Edifici Fruitcentre, PCiTAL, 25003 Lleida, Spain

9 AÑOS

2D

INTENSIVE *vs* SHD SYSTEM IN ALMOND

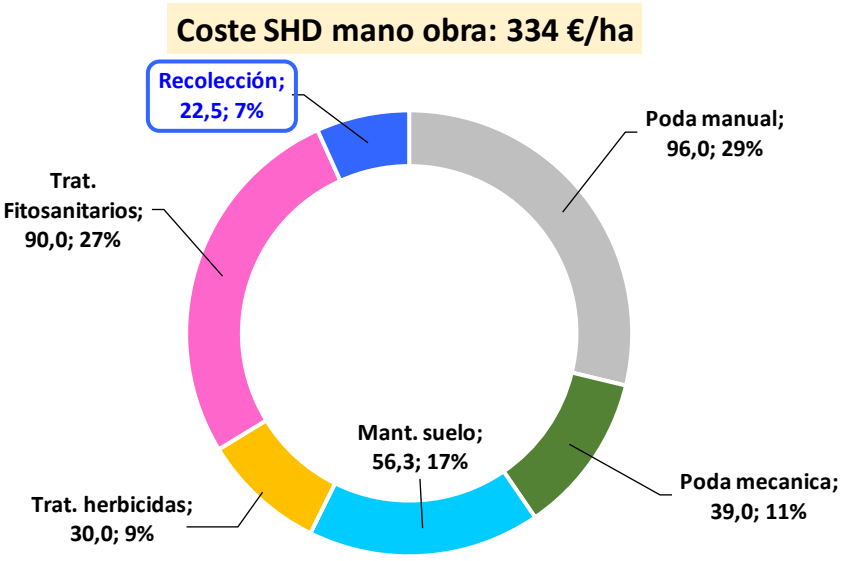
3D

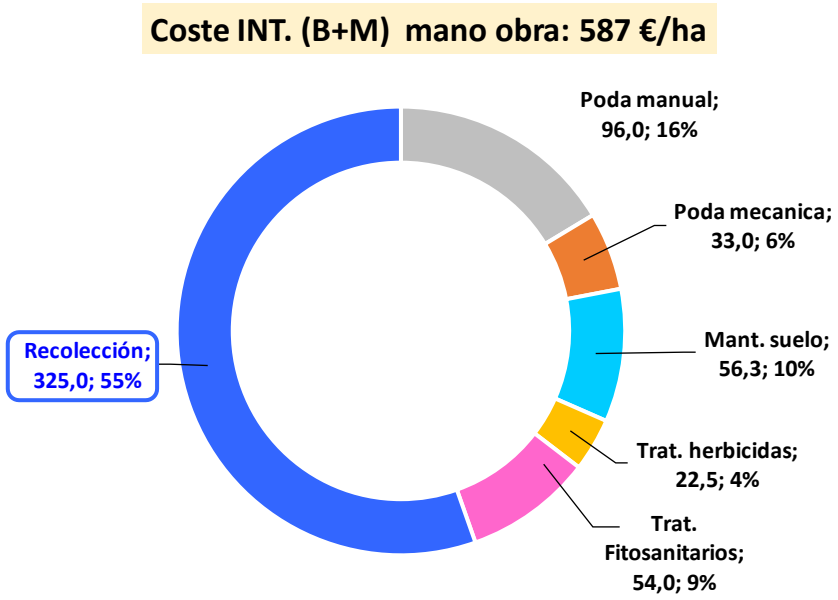
2D

AVIJOR/RP-20: Plant. NOV. 2017: 3,5 x 1,20 m (2.381 árb./ha)

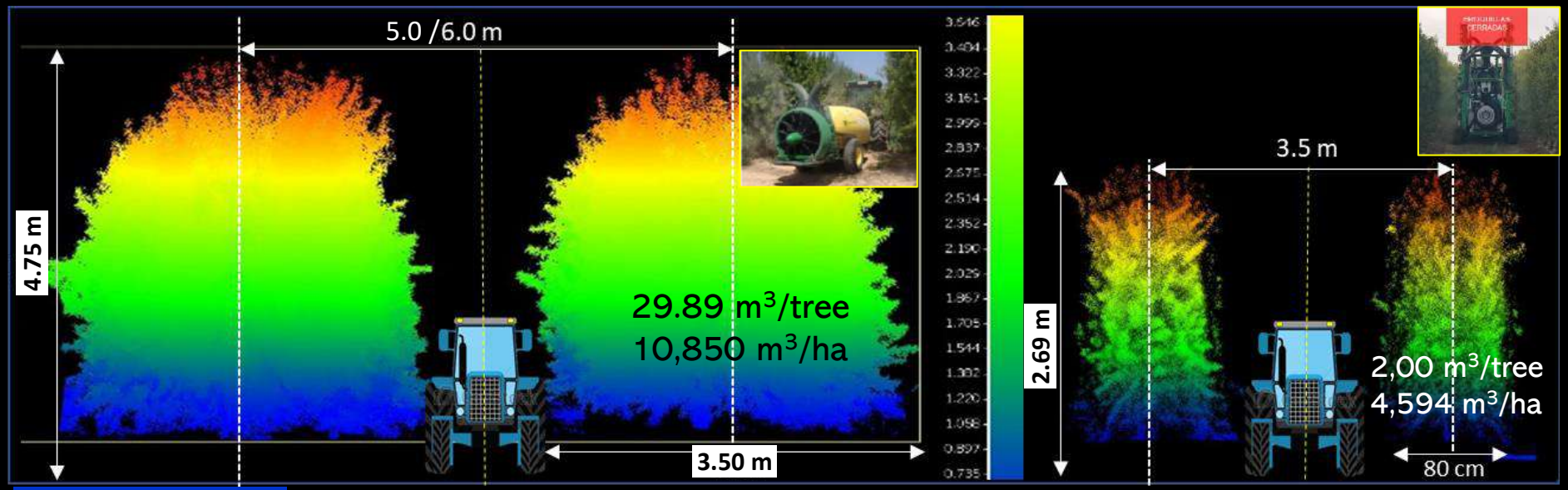
Coste total MANO DE OBRA y por conceptos SHD e INTENSIVO (M+B)-2020

AGROMILLORA
It's in our nature





EFFICIENCY OF TREATMENTS (2021 trial)



5th year of planting

FACTOR	INTENSIVE	SHD
Spacing (m) /density (tre./ha)	5.5 x 5 (363)	3.5 x 1.25 (2,285)
Canopy vol. (m³/ha)	10,850	5,720
Volum applied (l/ha)	1,130	745
Vol. applied (ml/m³ canopy)	104	131
Leaf deposition (%)	69 %	76 %
Drift (%)	29.3 %	16.6%
Cost treatments (€/ha-year)	1,014	716

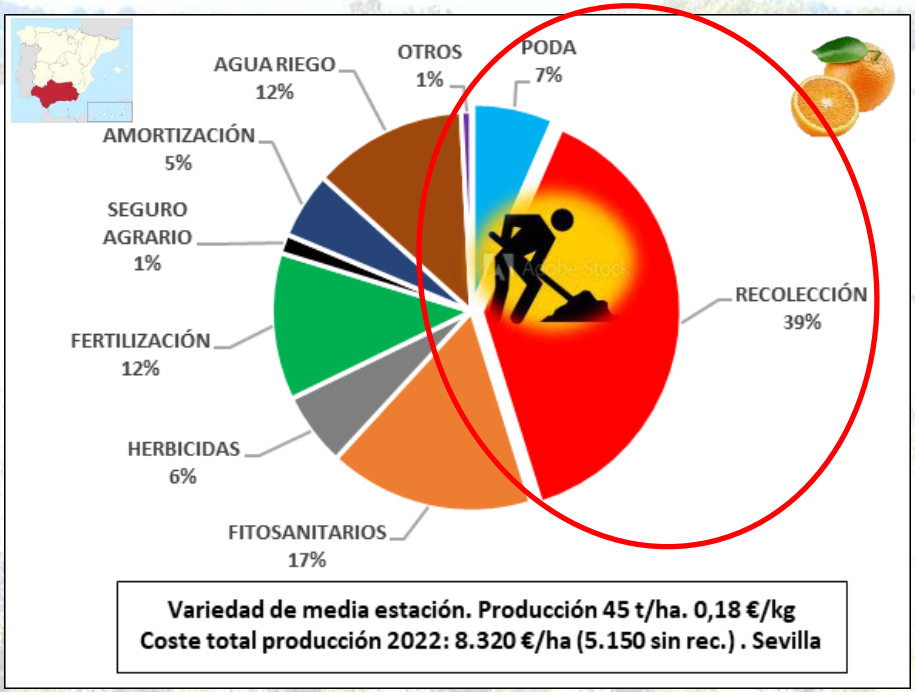
AGROMILLORA
It's in our nature

Grup de Recerca en AgroTICs i Agricultura de Precisió

In press 2022

CITRUS

COSTES DE PRODUCCIÓN Y PARTICIÓN EN MELOCOTONERO Y CÍTRICOS 2022



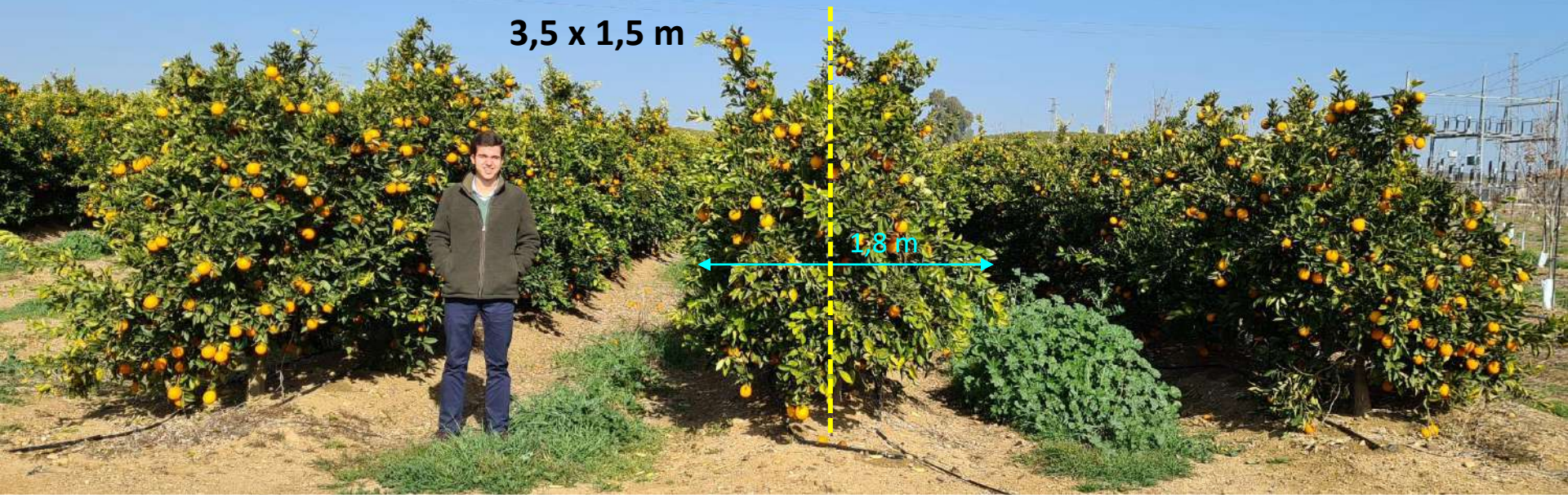
VASO TRADICIONAL: Sevilla (Spain)

7 x 6 m

9 febrer.- 2022

SETO EN ALTA DENSIDAD: Sevilla (SPAIN)

3,5 x 1,5 m



IFAPA
Junta de Andalucía

ALCALÀ DEL RÍO

(8º verde)

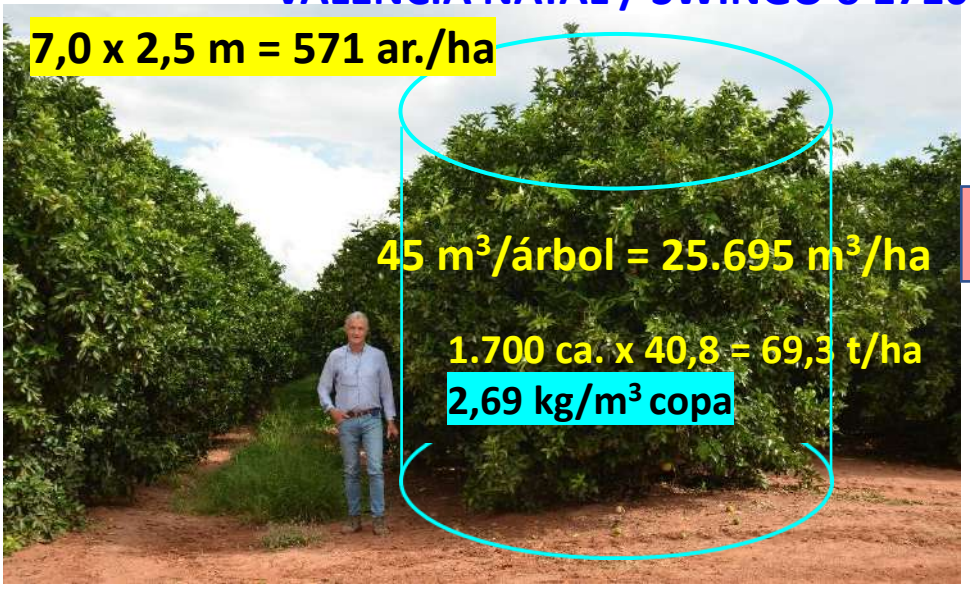
Plantación peatonal: 3r verde

Lane Late/C-35

TRADICIONAL <> HD

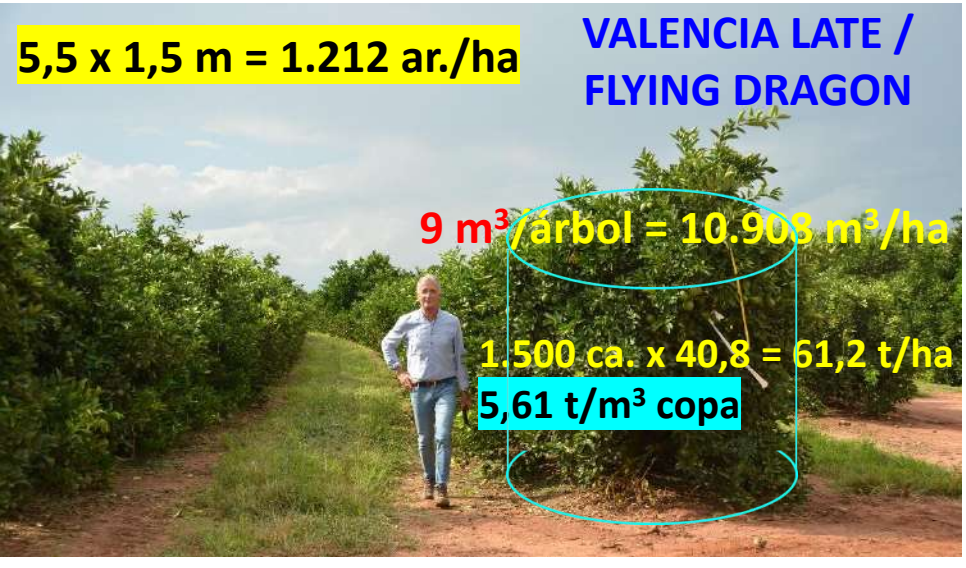
Embrapa Fundecitrus CAMBUHY

VALENCIA NATAL / SWINGO o 1710



11 años

13 abril.- 2023



WHAT'S NEXT?

Evolución de la Agricultura

1.0

Agricultura tradicional

Manual
Baja productividad

2.0

Revolución Verde

Mejora genética
Uso fitosanitarios y fertilizantes
Maquinaria Agrícola

3.0

Agricultura de precisión

GPS
Automatización
Biotecnología
Software de aplicación agrícola

4.0

Agricultura Inteligente

Computación nube
Conectividad
Sensores
Drones
Imágenes de satélite
Big Data
Apps móviles

5.0

Agricultura Inteligente

Inteligencia Artificial
Robótica
Biología Sintética
Agricultura vertical

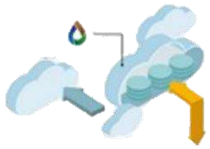
< 1950 — 1950 — 1990 — 2010 - ACTUALITAT




Futur Orchards Horizon 2030

DATA ADQUISITION OF SOIL + PLANT + CLIMATE

Mobile aerial adquisition
Vigor, uniformity, fertilisation



Monitoring and control
Web services

Electric orchard

Connected trap

Hail protection

Frost protection and excessive heat

4,3 m

5 wires

Connected camera
(beecam)

Pest resistant or tolerant variety

Probe No3 and K

Rootstock : G 11 and other

Drip irrigation (water blade)

Fertigation systems

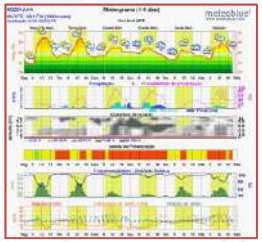
Biaxis plants

capacitive probes

Cement or iron posts
(30 year warranty)

Datacenter

Control
Monitoring
Modelling
Climate alert



0,5 to 0,7 m

Autonomus tractor
Darwin
Eclairvale®
Cutter Bar
Assistance platform
Leaf Stripper

Adapted cultivars & rootstocks

3,5 m to 3,8 m

1,25 m to 1,30 m between 2 plants

8 m to 9 m between 2 rows

Height > Width ≥1 & < 1,2)

Latitude : 44°50'25" Nord

3,2 m to 3,5 m

2 197 Tree/ha (4 395 axis/ha) to
2 500 Trees/ha (5 000 axis/ha)

Manual, robotic and mechanical harvesting :

Data analysis

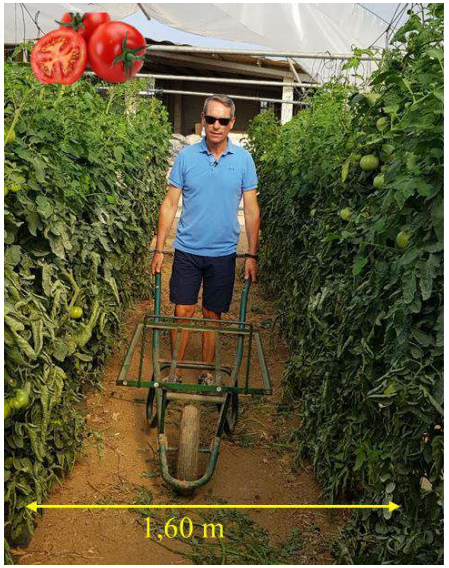
Transfering data to the laptop, smartphone, apps..)

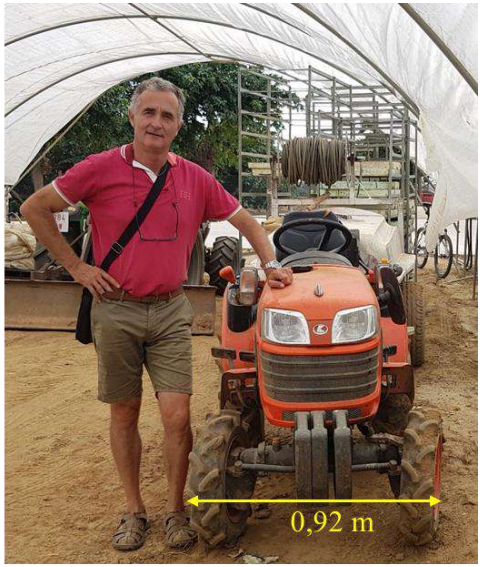
Land mobile acquisition :

- Floral card
- Tnining card
- Crop forecast
- Geolocation pests and diseases

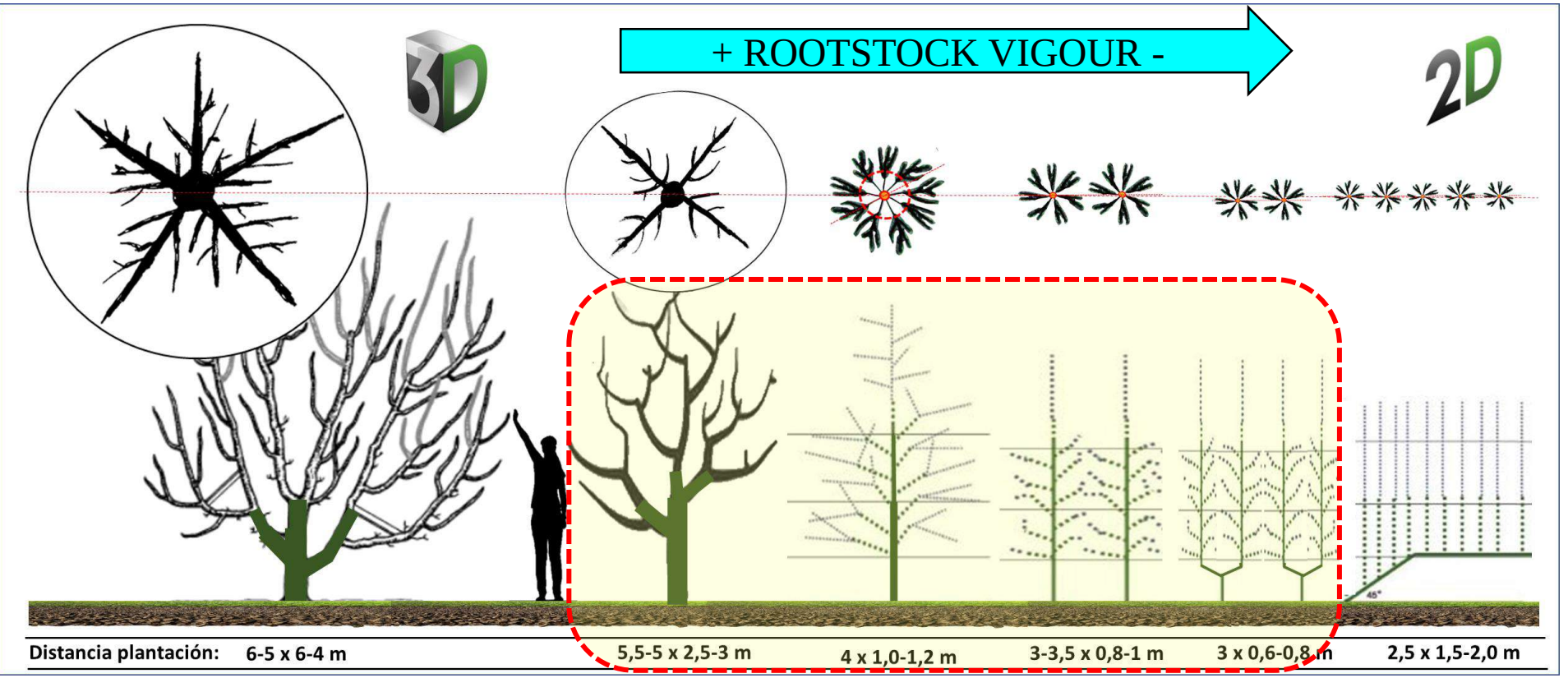
Horizontal OVER ROW (OR) system

Vertical OVER TREE ROW (OTR) system





CHANGING TREE ARCHITECTURE + DEVELOPMENT OF VIGOUR CONTROL ROOTSTOCKS IN PEACH



Iglesias & Echeverría, 2022

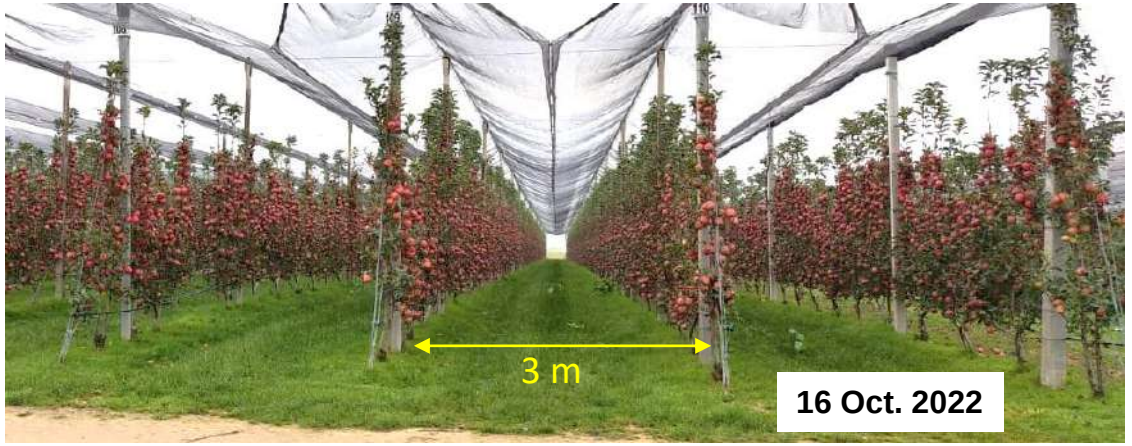
Mazzoni GROUP

18.750 ejes/ha

3rd year

2nd year = 26 t/ha
3rd year = 65 t/ha

MULTI-LEADER SYSTEM (8-10 leaders/tree) FROM BIBAUM TREES PINK LADY/M9



onfruit
precision counting

Appl... Forecast + Field View

agerpix
anticipating solutions

RGB + NIR (Camera)

GUSS

mini GUSS

WHAT'S NEXT?

2010

1945

2023


TEVEL
21 sept.- 2023

TEVEL

ADVANCED FARM

advanced.farm

30 apples/min


TEVEL

AGROMILLORA
It's in our nature

CONVINCED THAT THE BEST WAY TO PREDICT THE FUTURE IS TO CREATE IT

THANK YOU!!!

Dr Ignasi Iglesias
Tecnical Manager
Agromillora Group

iiglesias@agromillora.com