D3A

Dipartimento di Scienze Agrarie, Alimentari ed Ambientali (D3A)

UNIVERSITÀ POLITECNICA DELLE MARCHE

Ricerca nella filiera frutticola e olivicola in risposta ai cambiamenti sociali e climatici

Davide Neri

Agricoltura

Alimenti

Ambiente

Agraria

Missione

conoscenza

innovazione

sostenibilità

Produzione e diffusione di conoscenze nell'ambito delle scienze agrarie, alimentari ed ambientali, produzione e trasformazione di prodotti, qualità e sicurezza dei prodotti alimentari, conservazione e valorizzazione delle risorse ambientali, della biodiversità e del paesaggio.

Ambiti disciplinari

Agronomia, agro-ingegneria e territorio, biochimica, biologia vegetale e forestale, chimica, colture arboree, genetica agraria, patologia vegetale, entomologia agraria, microbiologia alimentare, industriale e ambientale, scienze economiche nei sistemi agricoli e territoriali, scienze fisiche, scienze e tecnologie alimentari, scienze del suolo e produzioni animali.

DIDATTICA

CORSI DI LAUREA TRIENNALE

- Scienze e Tecnologie Agrarie (L-STA) Double degree
- Scienze e Tecnologie Alimentari (L-STAL)
- Scienze Forestali ed Ambientali (L-SFA)
- Sistemi Agricoli Innovativi (L-SAI) NEW

CORSI DI LAUREA MAGISTRALE

- Scienze Agrarie e del Territorio (LM-SAT)
- Food and Beverage Innovation and Management (LM-FABIAM)
- Scienze Forestali, dei Suoli e del Paesaggio (LM-FORESPA)

MASTER DI I LIVELLO *on line* in
"Gestione Qualità e HACCP nelle filiere alimentari"

CORSO DI DOTTORATO di ricerca in
"Scienze Agrarie, Alimentari ed Ambientali"

Corso di laurea magistrale interdipartimentale in
Management della Sostenibilità ed Economia Circolare (LM-MISEC)

Dipartimento di Scienze Agrarie, Alimentari ed Ambientali (D3A)

UNIVERSITÀ POLITECNICA DELLE MARCHE

DIDATTICA

University of Zadar

University of Debrecen

CORSI DI LAUREA TRIENNALE

- Scienze e Tecnologie agrarie
- Scienze e Tecnologie Viticoltura ed enologia
- Scienze Forestali ed Ambientali (L-SFA)
- Sistemi Agricoli Innovativi (L-SAI) NEW

CORSI DI LAUREA MAGISTRALE

- Agricoltura sociale
- Produzione e protezione delle colture
- Genomica, Biotecnologie e Biodiversità NEW
- Scienze Forestali, dei Suoli e del Paesaggio (LM-FORESPA)

MASTER DI I LIVELLO *on line* in
"Gestione Qualità e HACCP nelle filiere alimentari"

CORSO DI DOTTORATO di ricerca in
"Scienze Agrarie, Alimentari ed Ambientali"

Corso di laurea magistrale interdipartimentale in
Management della Sostenibilità ed Economia Circolare (LM-MASEC)

Dipartimento di Scienze Agrarie, Alimentari ed Ambientali (D3A)

UNIVERSITÀ POLITECNICA DELLE MARCHE

Soil fertility


Landscape


Peach orchard

Premise

«More weed less production»
we have to break this paradigma

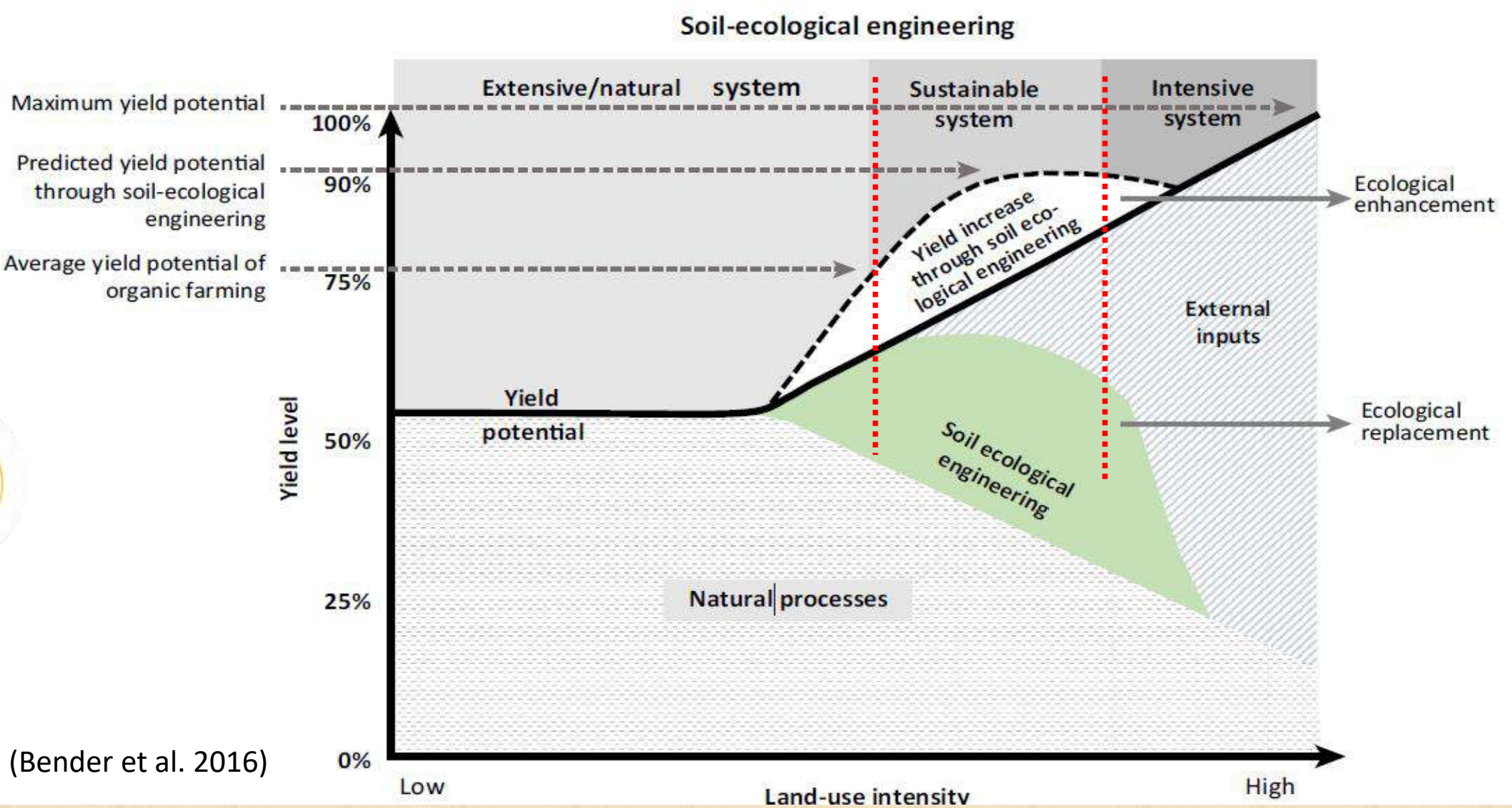
Agroecology in farming systems

Organic (ecologic, biologic) and integrated (conventional) agricultural systems

- Farming design for implementing circular economy. Multifunctionality and ecosystems services of the farming systems.

Biodiversity in agroecosystems. The importance of crop rotation and permanent consociation for sustainable agricultural systems.

- Root growth and behavior in relation to different organic residues and byproducts amendments and mulching.



(Bender et al. 2016)

Conceptual model showing the contribution of external resource inputs and natural biological processes to an ecosystem function, in dependence of land-use intensity

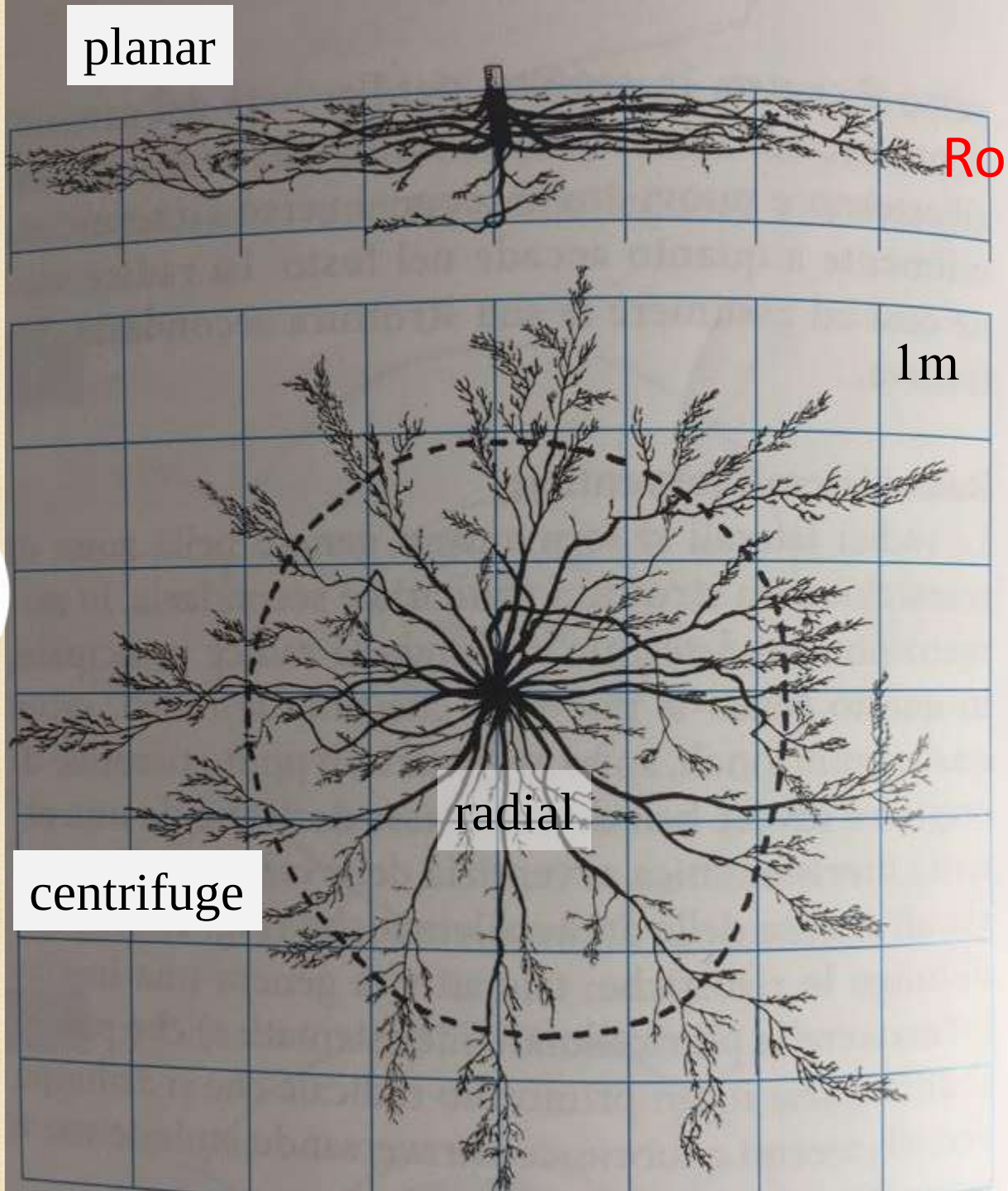
Where is the problem?

Prof Granatstain, Valdaso 2018

Soil sickness

difficulty in repeating a given crop over time on the same plot in single succession

First symptom of soil fertility degradation



Roots are very superficial

Root system in fruit trees

FROM Baldini 1985

Appena piantato

We hypothesise that a more diverse weed community will be less competitive

Sabine Zikeli research group
«Domino» CORE Organic

APRIFEL.COM
AGENCY FOR RESEARCH AND INFORMATION ON FRUIT AND VEGETABLES

Aprifel

Naturally occurring *Potentilla reptans* in apple orchard (Fibl 2020)

Biodiversity assessment

Aboveground Biodiversity:

- Pests occurrence
- Beneficial insects
- Weeds population

Belowground Biodiversity:

- Microbial metabolic activity (Biolog method)
- Bacteria and fungi populations (molecula biology)
- Nematodes trophic groups

InHort

Effect of row living mulches on weeds

51 species of weeds were determined in the orchard, among which:

LAMPU, TAROF, EQUAR, STEME, EROCI, ERICA, VIOAR, GERPU, BROMO, POAPR, CAPBP and Rumex sp.

occurred in all observations, regardless of the monitoring date.

LAMPU *Lamium purpureum*

TAROF *Taraxacum officinale*

EQUAR *Equisetum arvense*

STEME *Stellaria media*

EROCI *Erodium cicutarium*

ERICA *Erigeron canadensis*

VIOAR *Viola arvensis*

GERPU *Geranium pusillum*

BROMO *Bromus mollis*

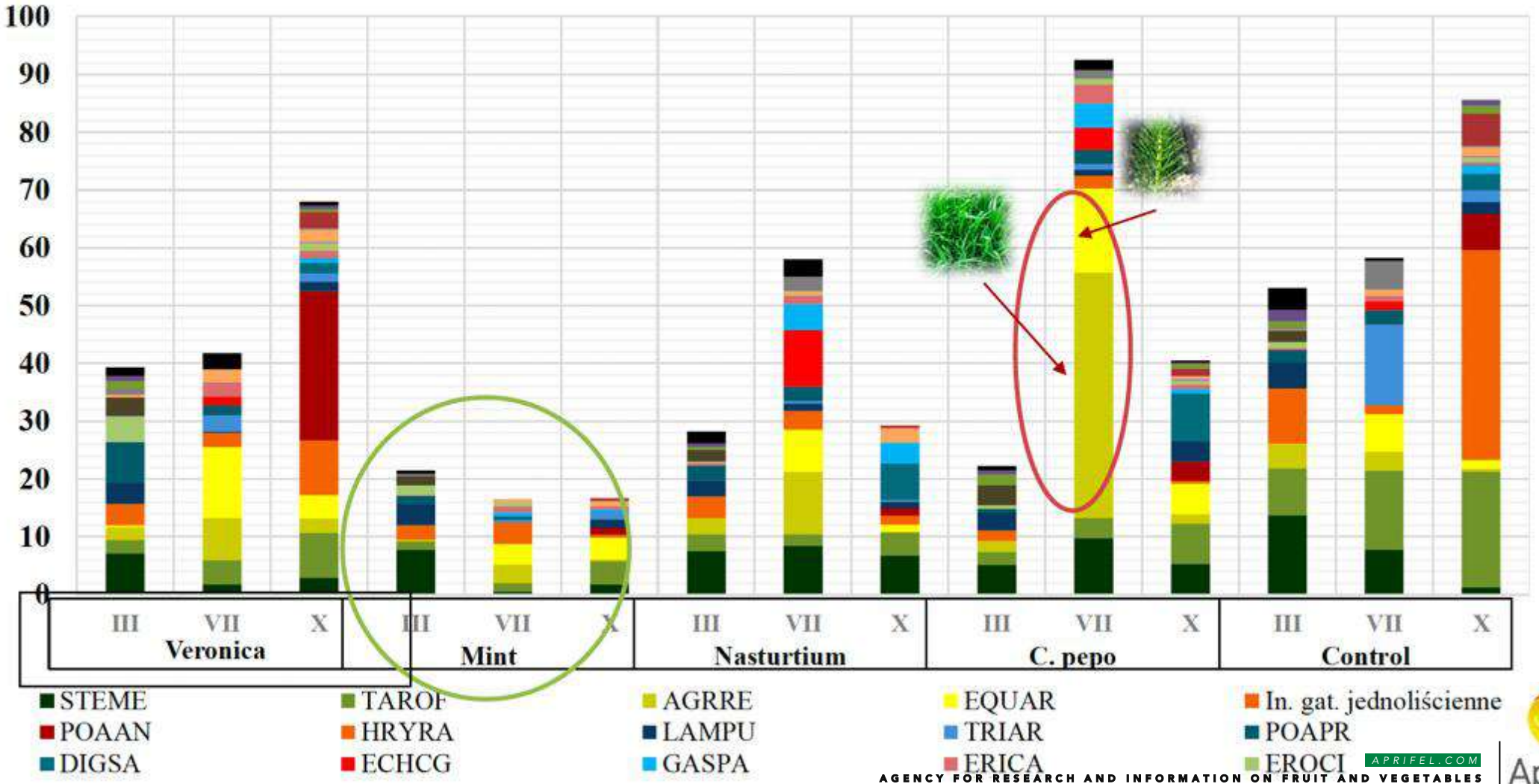
POAPR *Poa pratensis*

AGRRE *Agropyron repens*

Rumex sp.

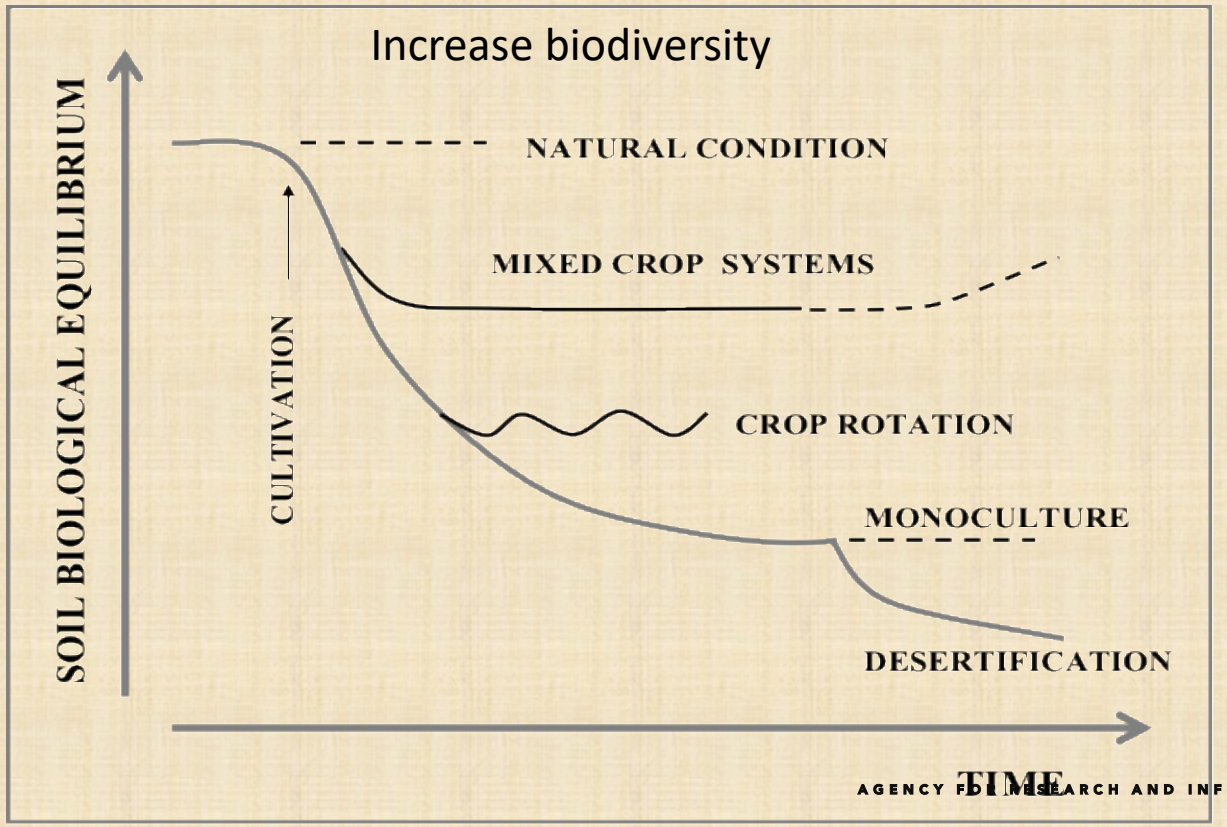
CAPBP *Capsella bursa-pastoris*

Soil coverage by weeds [%] in rows during vegetation period 2020



Rationale 1

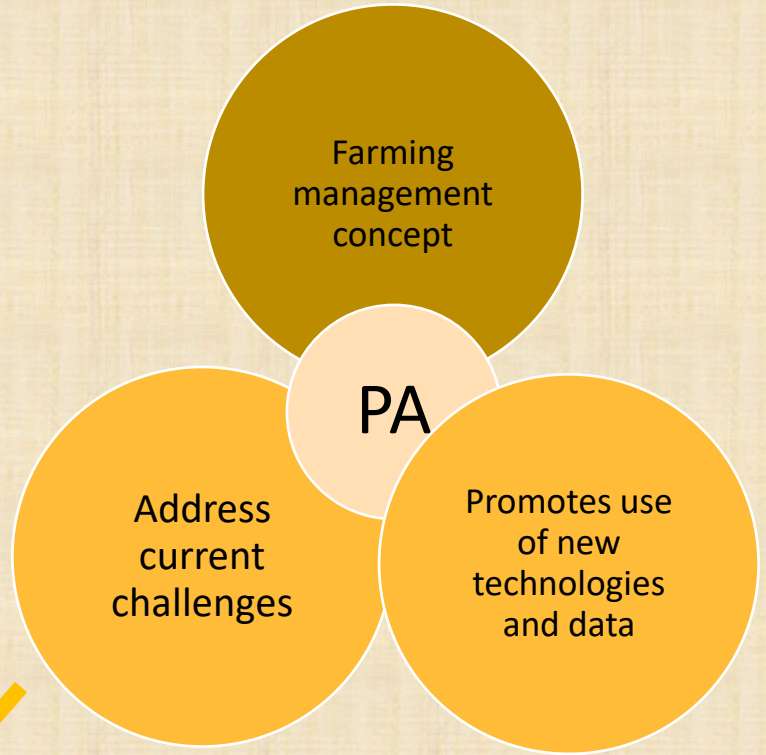
The DOMINO project aims to improve long-term sustainability of intensive organic orchard and vineyard by innovative strategies expected to increase biodiversity as a source of resilience for the agroecosystems, and to reduce the dependency on external inputs.

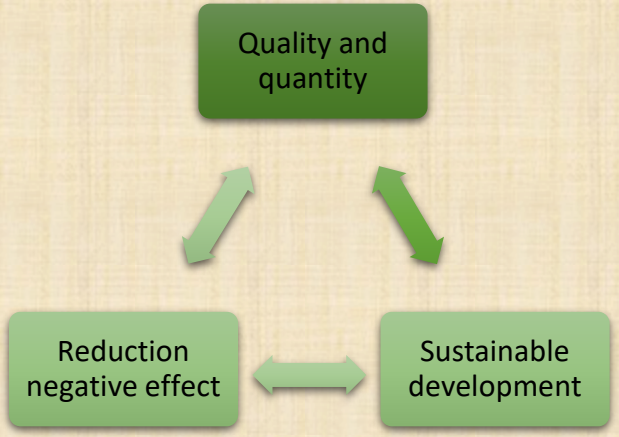


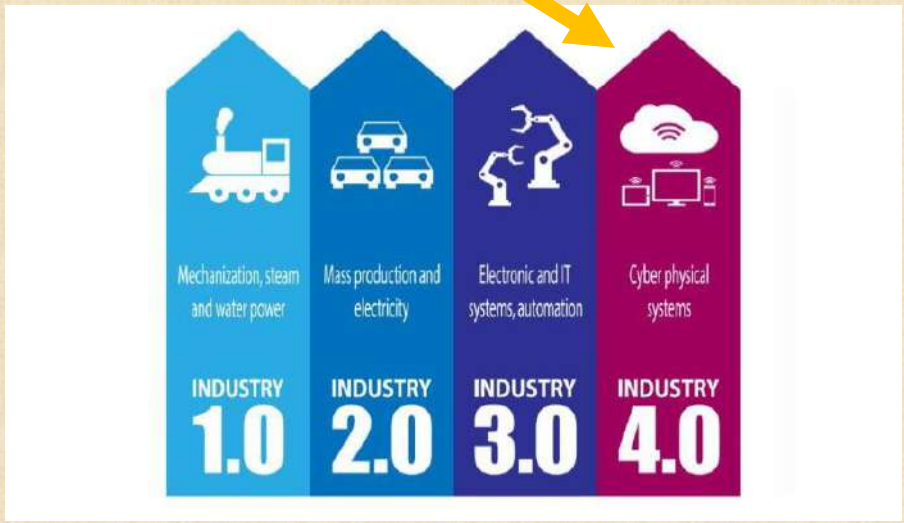
Modified from Zucconi, 1996

Precision agriculture (PA)

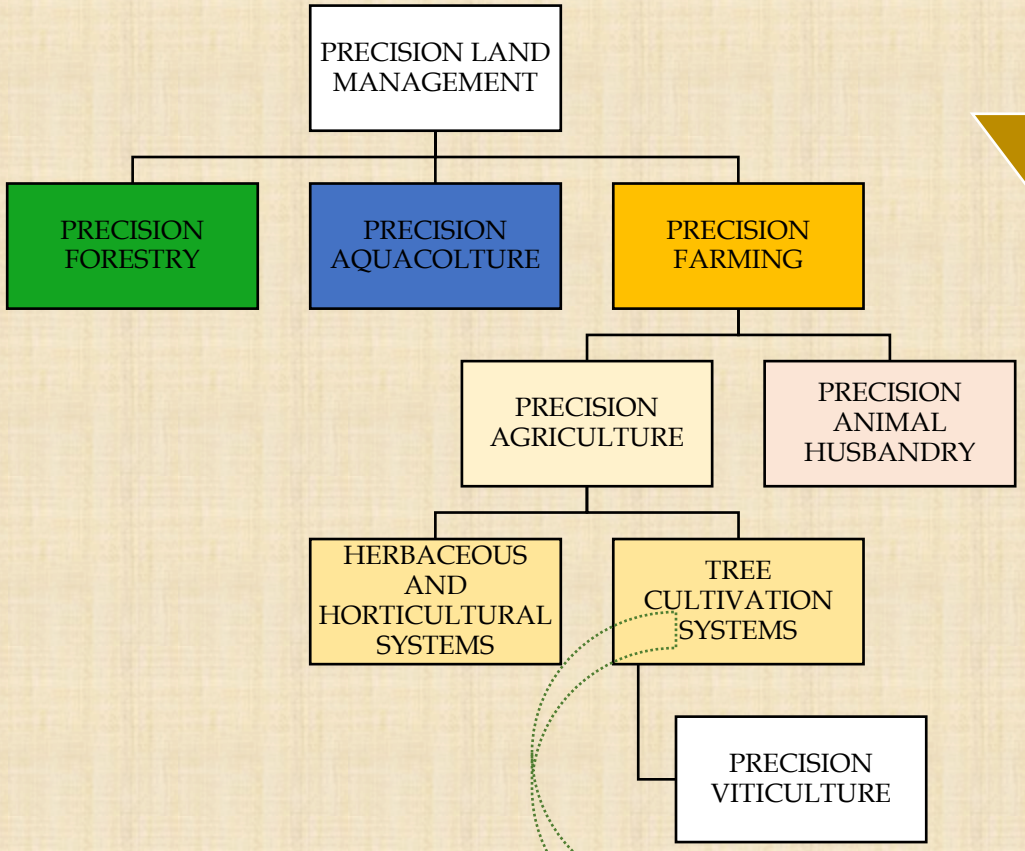
A. Koshravi

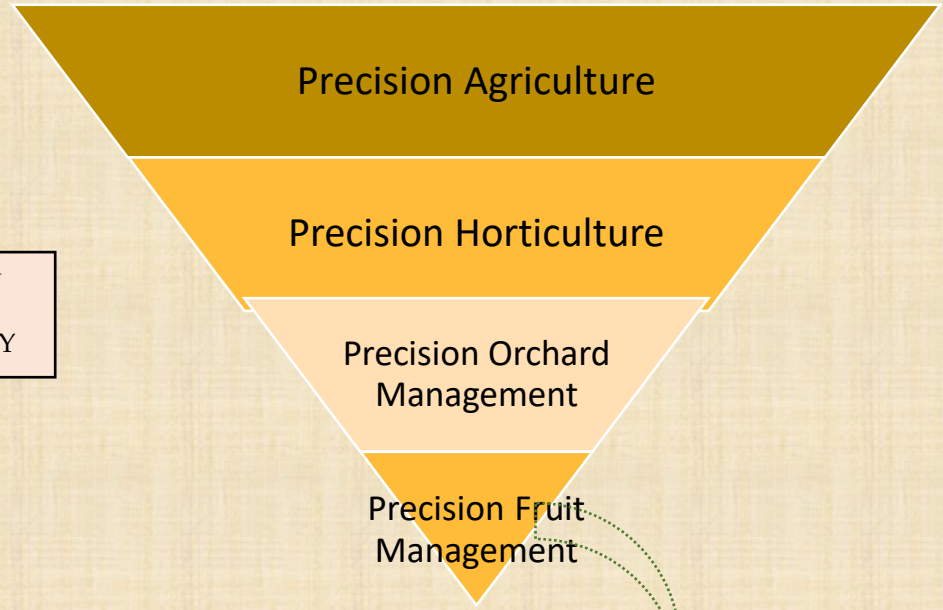






Precision agriculture in fruit and olive production



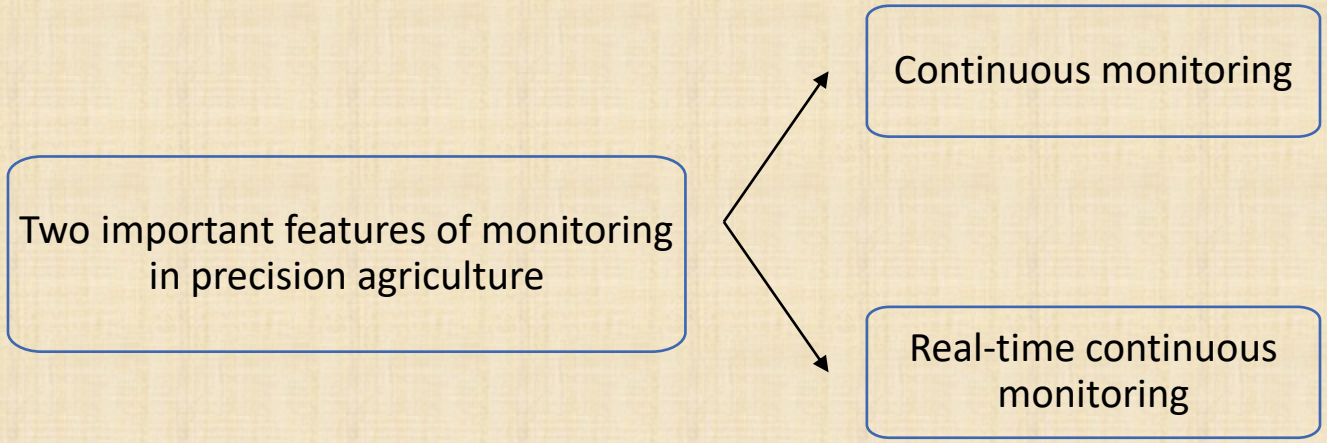


Smart fruit management through <u>real-time continuous monitoring</u> by a <u>proximal sensor</u>

(Auernhammer and Demmel (2016) in Q. Zhang (Ed.))

Fruit monitoring and outcomes

- Monitoring is systematic approach of supervision of activity along with regular collection and analyzing of data.



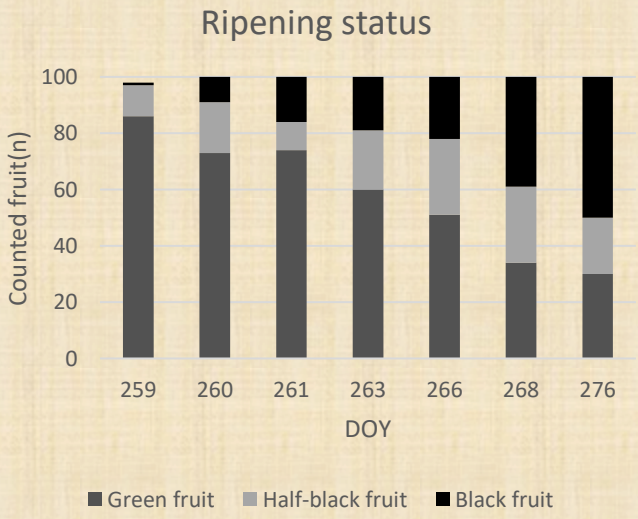
Severl outcomes of fruit monitoring
Fruit **load** determination
Fruit **size** estimation
Water status detection (Presicion irrigation)
Accurate detection of fruit **maturation**
Optimizing **harvesting** time
Pest and **disease** detection

(Manfrini et al., 2010), (Fernandes et al.,2018), (Hernández et al., 2018), (Conte et al., 2019), (Gucci et al., 2019).

proximal sensor , 1- rGB camera

- Camera

Custom video camera(Raspberry pi Foundation, Cambridge, UK)
5Mpix
RGB
S-mount camera lens
mini-CSI port
IP65 enclosures
powered by a 10W solar panel



The images from the camera were labeled using Labelbox platform (Labelbox Inc., San Francisco, CA, USA).

(Khosravi et al., 2021).

proximal sensor , 2- Extensimeter

- Extensimeter (synonym of fruit gauge) is plant-based sensor which measure fruit diameter. In most cases, a sensor, supported by a frame, is placed in contact with the epidermis of the growing fruit.

Provide accurate information on fruit growth
Response of the plant to the surrounding conditions
Integrating the soil and atmospheric water status
Reliable tool for making decision for management

- The most adopted sensors for extensimeters are
- *) Strain gauges
- *) Linear variable differential transducers (LVDTs)

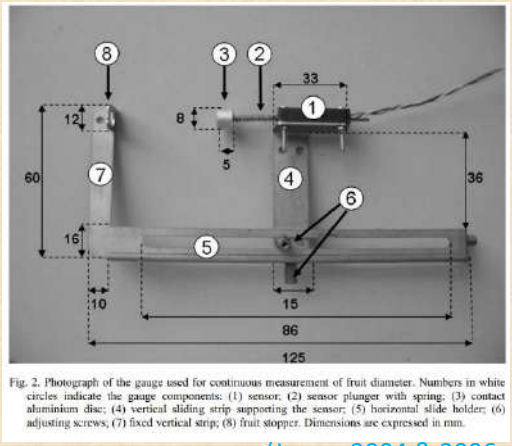
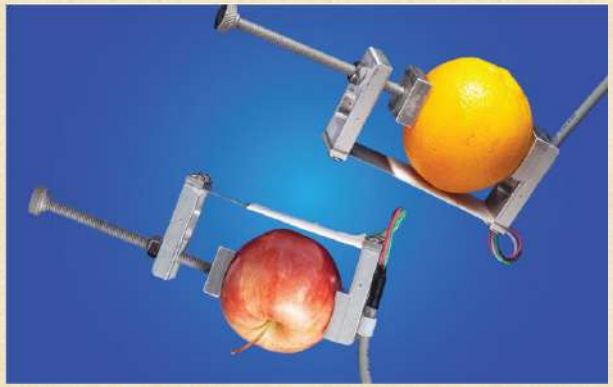


Fig. 2. Photograph of the gauge used for continuous measurement of fruit diameter. Numbers in white circles indicate the gauge components: (1) sensor; (2) sensor plunger with spring; (3) contact aluminium disc; (4) vertical sliding strip supporting the sensor; (5) horizontal slide holder; (6) adjusting screws; (7) fixed vertical strip; (8) fruit stopper. Dimensions are expressed in mm.



(Jones, 2004 & 2006; Morandi et al., 2007; Fernández, 2017; Scalisi et al., 2020; Zucchini et al.,2021; Khosravi et al., 2021; Dynamax.com)

IX International Olive Symposium
Davis, CA (United States of America)
SEPTEMBER
10-14, 2023

Organized and hosted by
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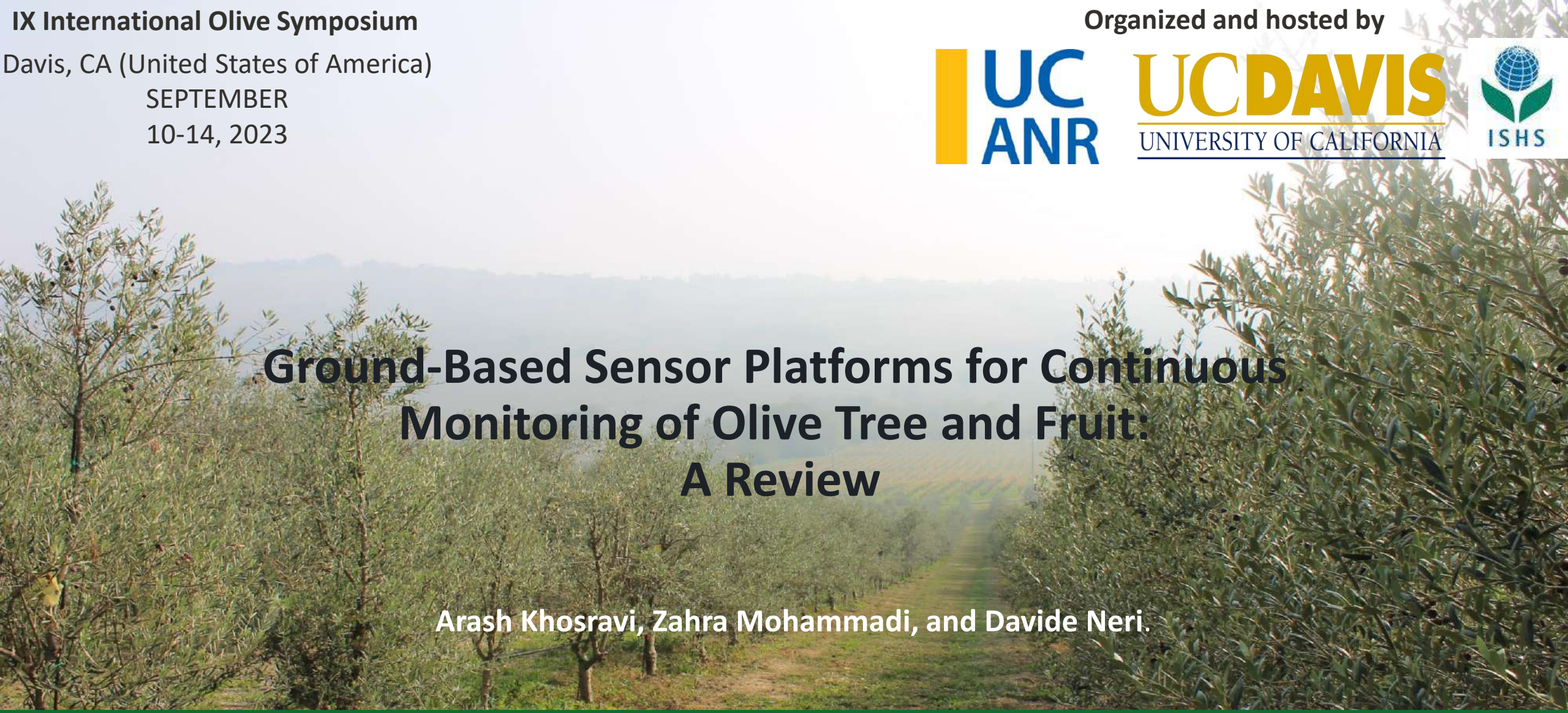

Ground-Based Sensor Platforms for Continuous Monitoring of Olive Tree and Fruit: A Review

Arash Khosravi, Zahra Mohammadi, and Davide Neri.

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AGRARIA
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Precision farming (PF) and continuous monitoring

PF is a farming management concept

Emphasizes the application of information technology

To collecting and using high-resolution data

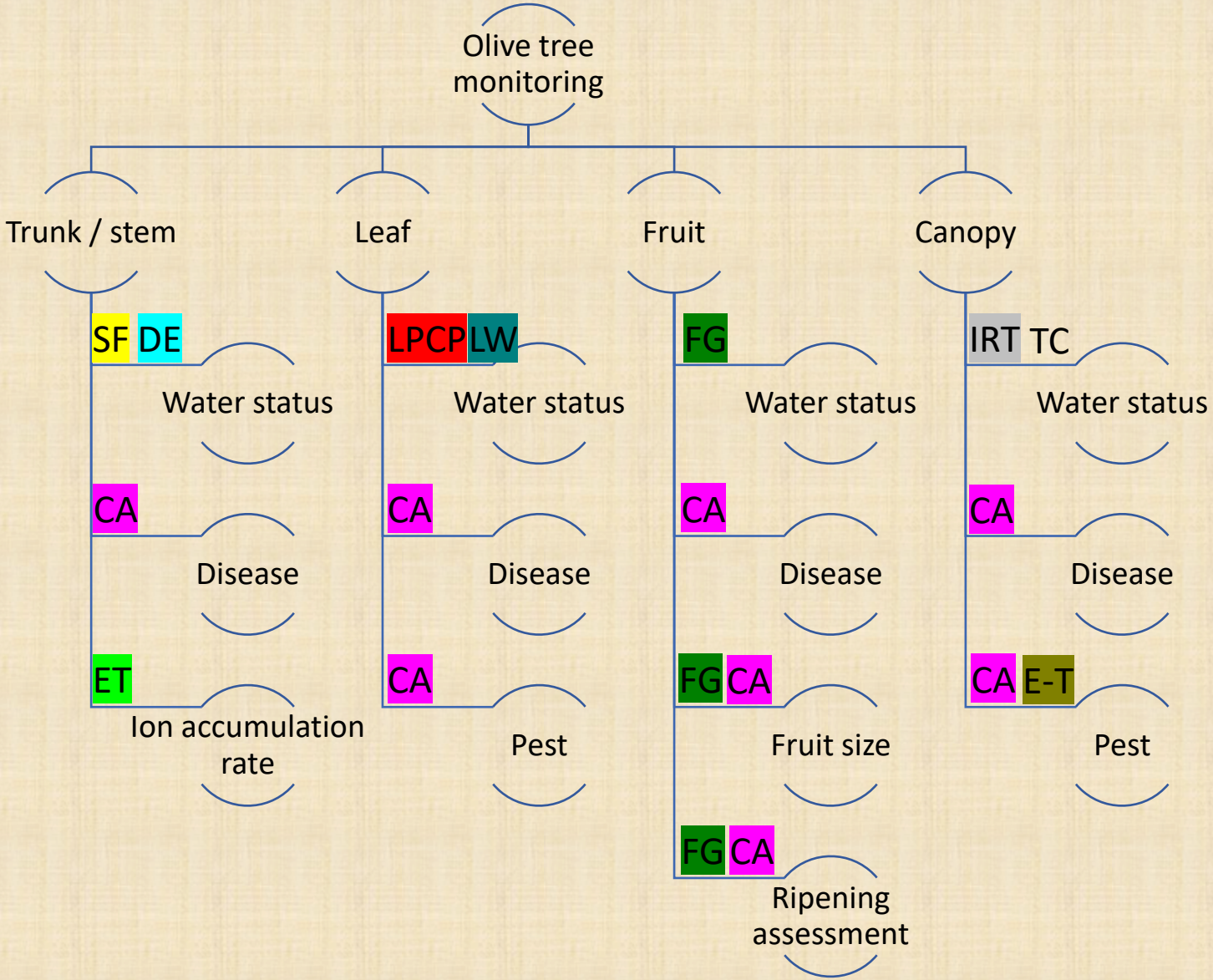
For on-time agricultural practices

Data collection (Monitoring)

- Range from seasonal period up to minute intervals
- Soil, Plant, Environment
- Satellite, Unmanned aerial systems, (Autonomous) tractors, Cranes or sliders on frame installation, stationary loggers

The aim of continuous monitoring in the olive orchard is to obtain orchard properties for real-time optimization of orchard performance.

Continuous monitoring (outcomes and sensors)



Sensor type
Sap Flow (SF)
Electrochemical transistor (ET)
Dendrometer (DE)
Camera-RGB multi and hyperspectral- (CA)
Leaf patch clamp pressure (LPCP)
Leaf water meter (LW)
Fruit gauge (FG)
E-trap (E-T)
Infrared temperature (IRT)
Thermal camera (TC)

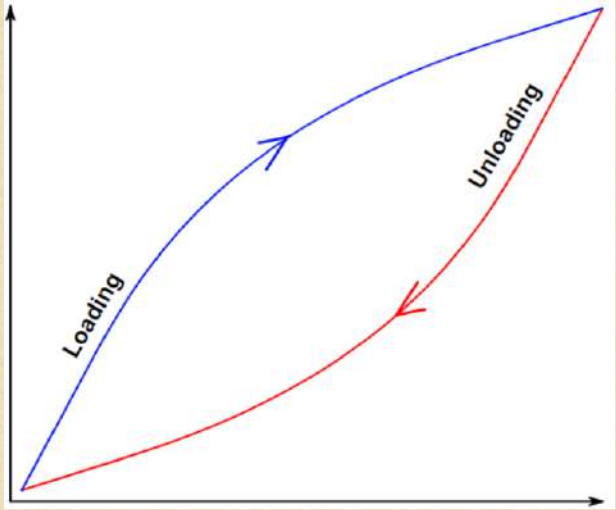
What is hysteresis

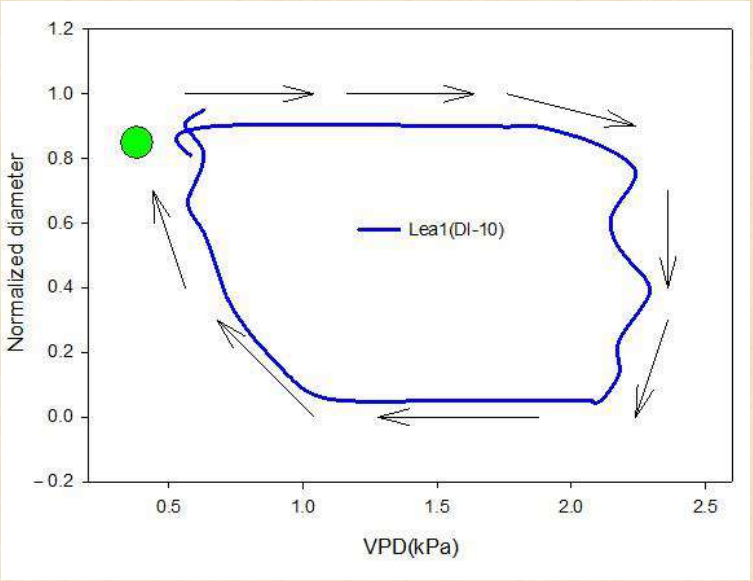
Hysteresis is a non-linear loop-like behavior that does not show affine similarity with respect to time.

It is a phase angle difference between input and output time series

We employed concept of hysteresis (fruit diameter vs Vapor pressure deficit (VPD))

Hysteresis in plant systems has been known for a long time, however, was not used for water status detection.





(Mayergoyz, 2003; Philips, 2003; O'Kane., 2005; Zhang et al., 2014; Bai et al., 2017; Khosravi et al., 2021, 2022)

Continuous monitoring of olive fruit growth by extensimeter

Cultivar	**Piantone di Falerone, Lea, Ascolana dura, Arbequina**
Tree age	**9**
Orchard	**Highly intensive (4×2)**
	Aguliano, Ancona, Italy
Extensimeter (Fruit gauge)	**Strain gauge & LVDT**
	DEX20, Winet
Year	**2021**
Irrigation treatment	**Without (DI-0), DI-10 and DI-20**
Growth phase	**III**

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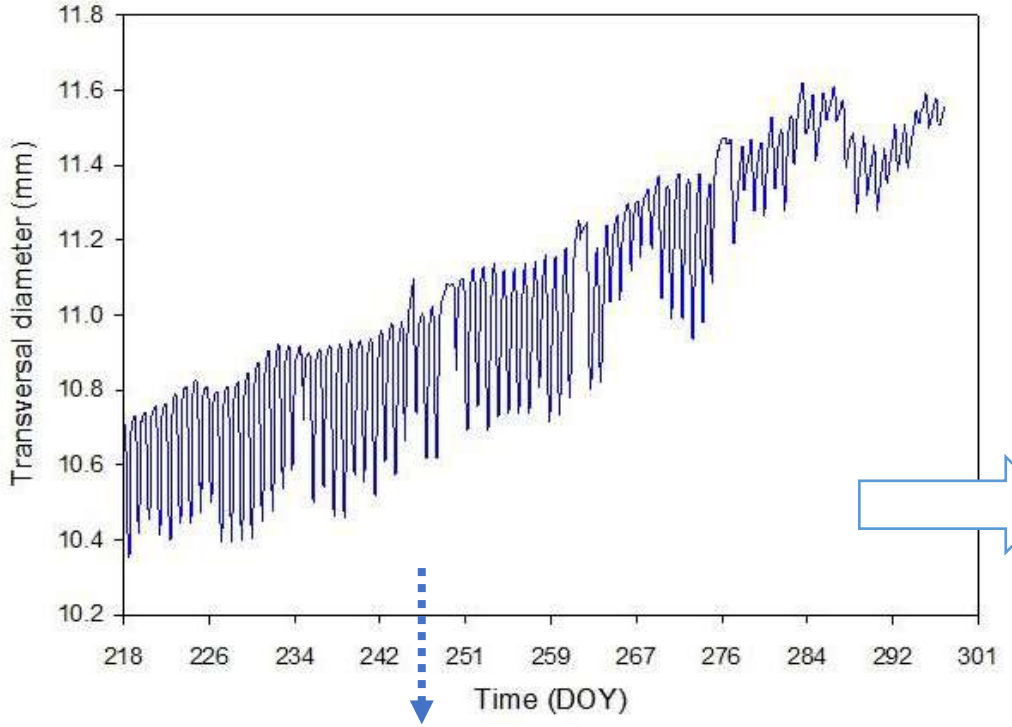
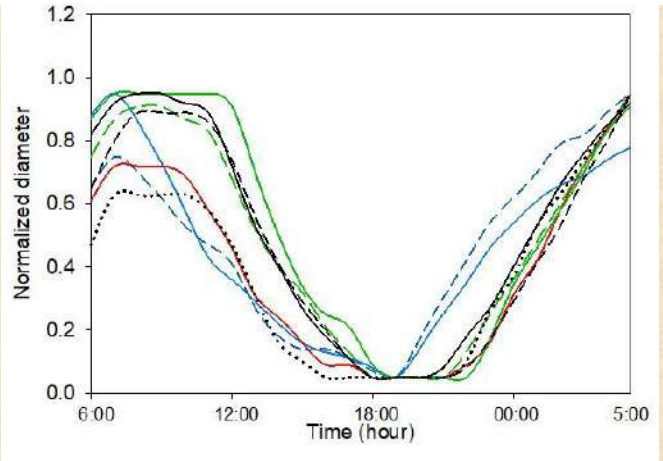
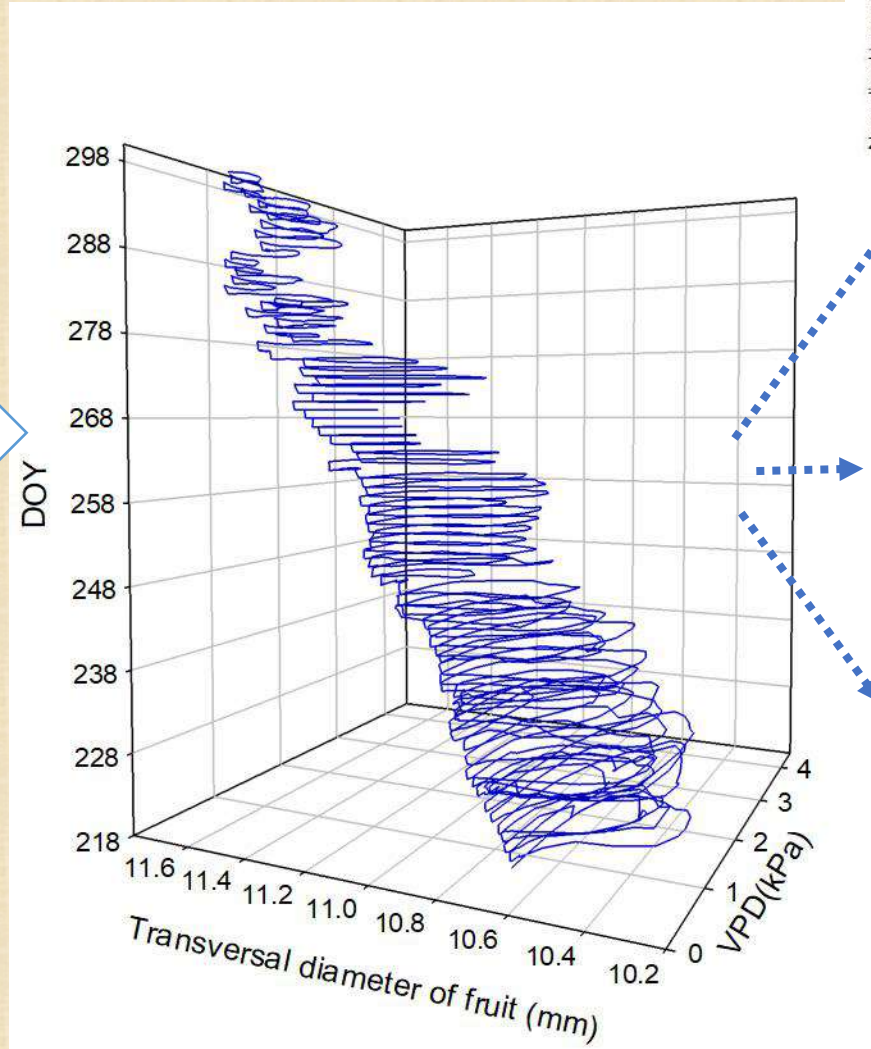
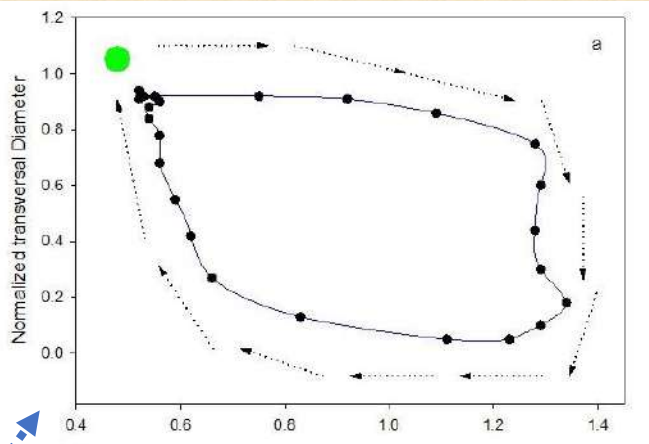
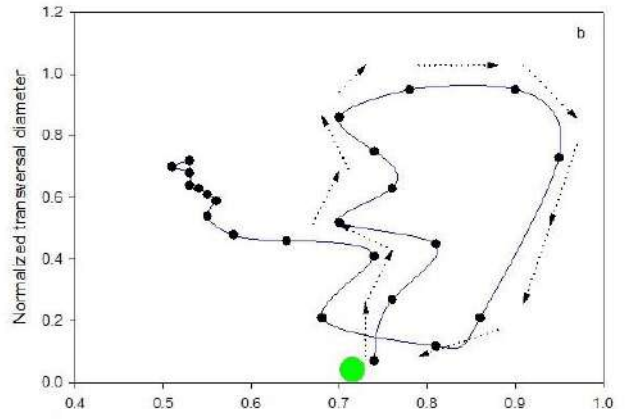
Hysteresis curve of fruit diameter versus VPD

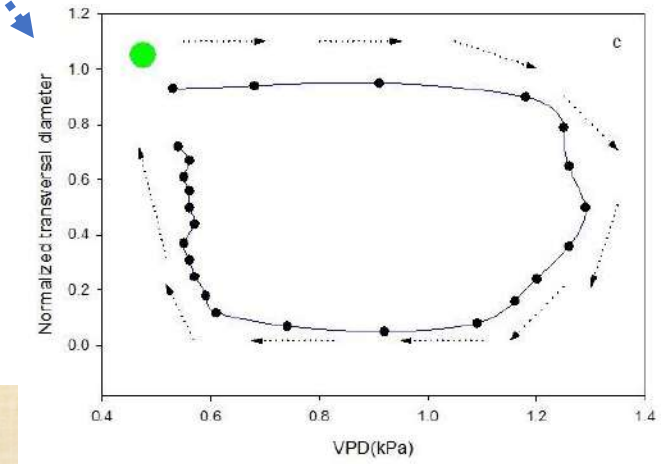




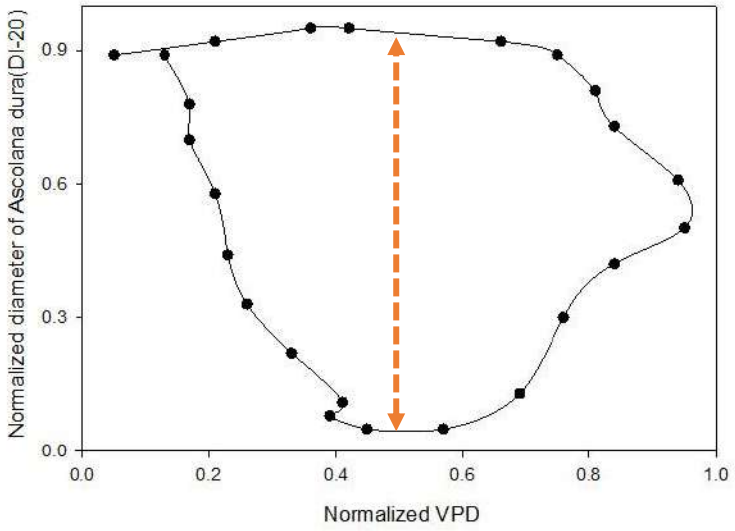


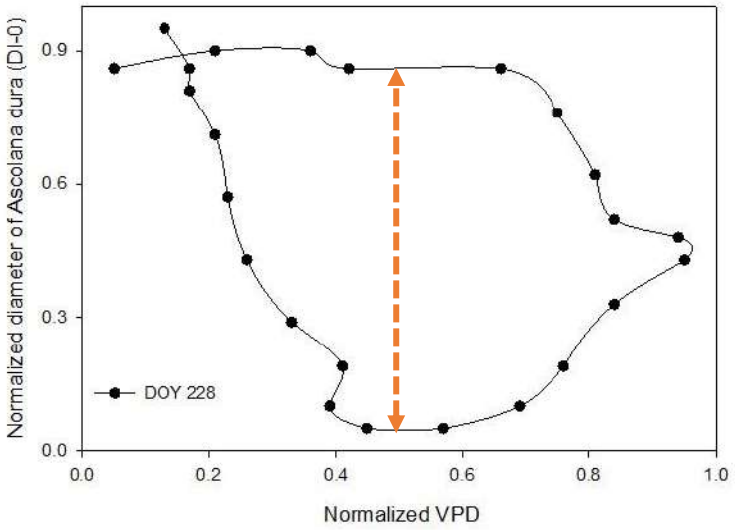




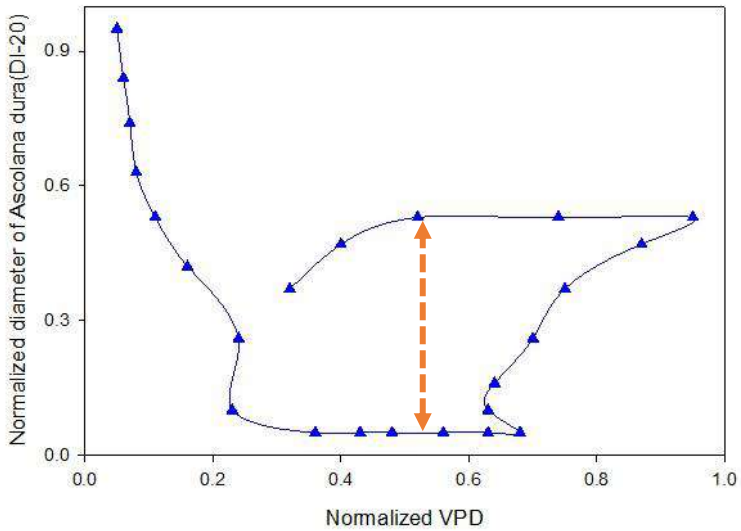


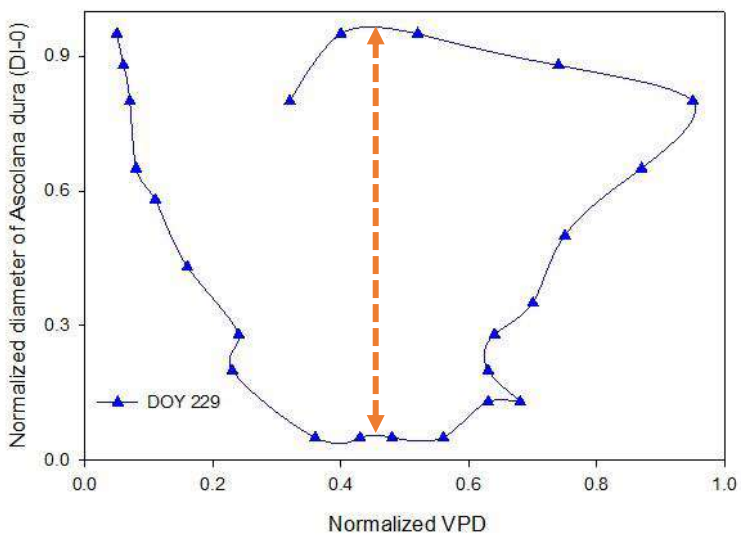
Water status index by hysteresis



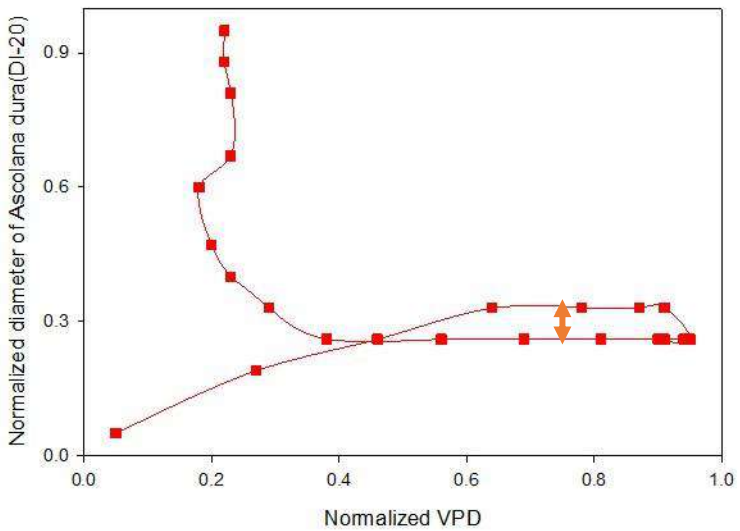


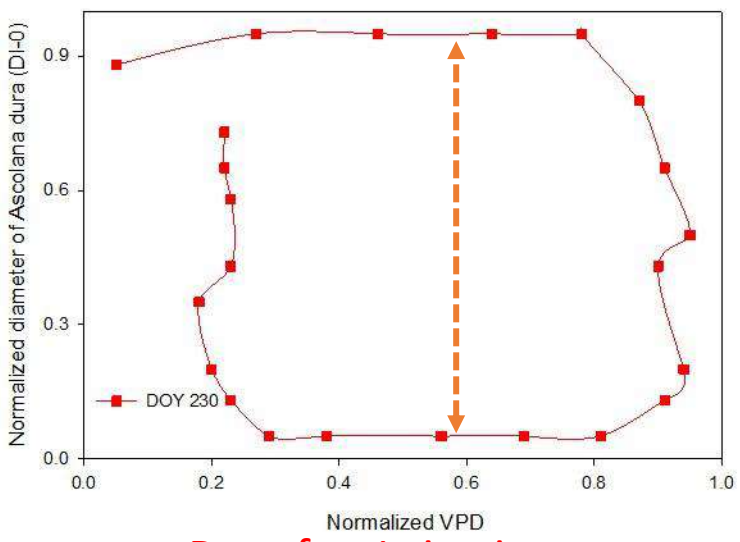
Day before Irrigation





Irrigation day





Day after Irrigation

Hysteresis magnitude changed employed as an index

L’analisi vibrazionale: un efficace strumento per ottimizzare la raccolta meccanizzata delle olive

Dott. Alessandro Annessi, *Prof*. Milena Martarelli, *Prof*. Paolo Castellini

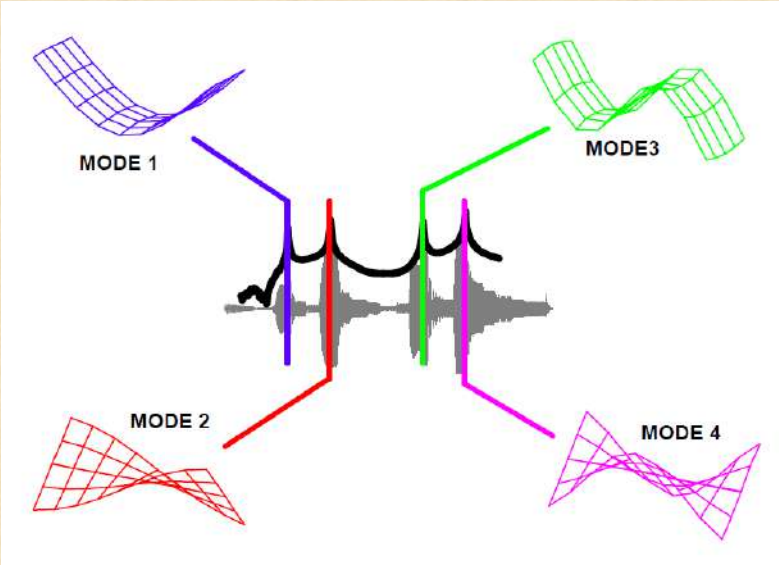
D3A – Dipartimento di Scienze Agrarie, Alimentali e Ambientali
DIISM - Dipartimento di Ingegneria Industriale e Scienze Matematiche

È TEMPO DI AGRICOLTURA
PSR MARCHE 2014-2022
Unione Europea / Regione Marche
PROGRAMMA DI SVILUPPO RURALE 2014-2022
FONDO EUROPEO AGRICOLO PER LO SVILUPPO RURALE: L'EUROPA INVESTE NELLE ZONE RURALI
Unione Europea
REGIONE MARCHE

Introduzione

Analisi vibrazionale

- Caratterizzazione dinamica dell'oliva
- Caratterizzazione dinamica dell'albero di olivo



- Ottimizzare il sistema di raccolta automatizzato delle olive tramite scuotimento meccanico (con particolare focus sulla varietà Ascolana tenera).
- Migliorare il macchinario nell'ottica dell'agricoltura di precisione.

Tecniche per la raccolta delle olive

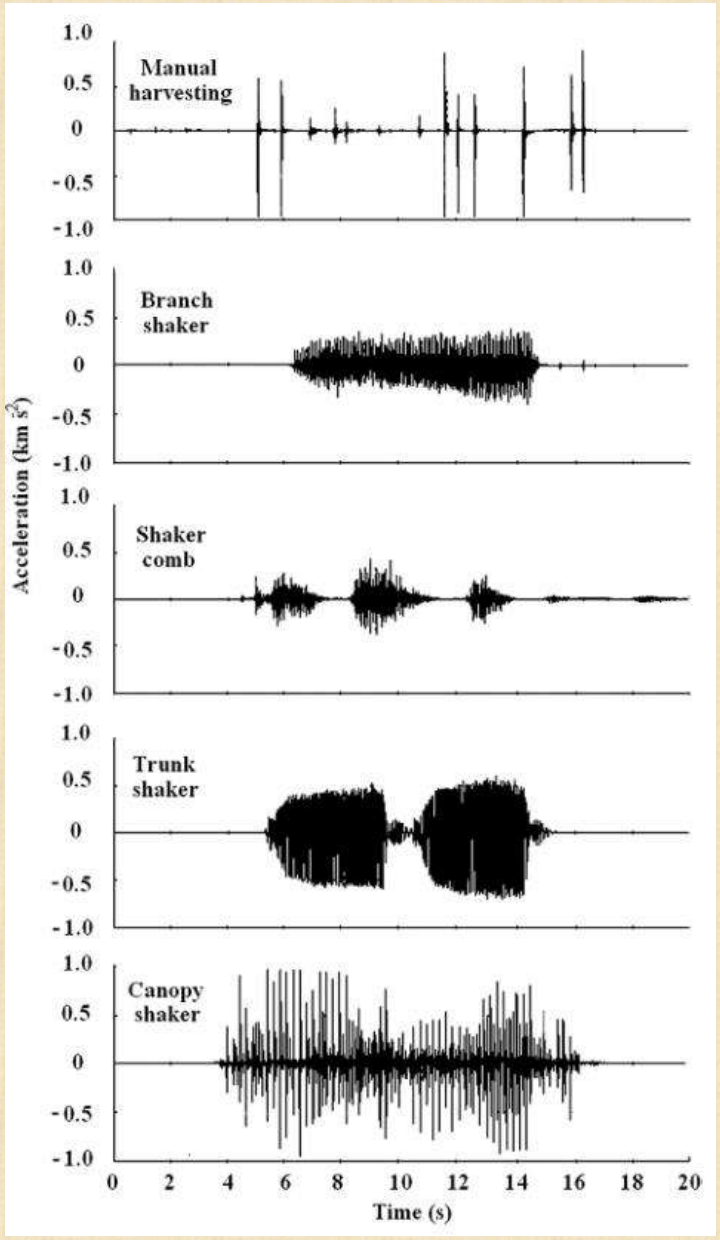
- Necessità di aumentare l'efficienza del sistema di raccolta e la qualità del prodotto, al fine di minimizzare i costi.
- Il costo della raccolta può essere maggiore del 40% del costo di produzione.
- Tecniche di raccolta:
  - raccolta manuale (15-25 kg h^{-1})
  - abbacchiatore (30-50 kg h^{-1})
  - scuotitore portatile del ramo
  - scuotitore del tronco (0.12-0.2 ha h^{-1})
  - scuotitore della chioma (0.36 ha h^{-1})





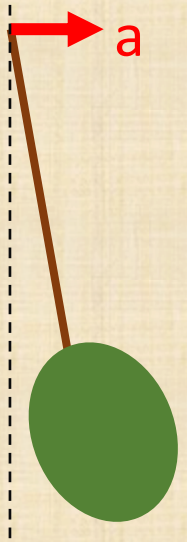

Tecniche per la raccolta delle olive

Sistema di raccolta	Frequenza (Hz)	Accelerazione media totale (ms^{-2})
Raccolta manuale	-	676±449
Scuotitore portatile del ramo	16.6±1.3	193.2±53.9
Abbacchiatore portatile	13.5±0.3	71.3±35.1
Scuotitore del tronco	24.2±1.0	343.1±139.0
Scuotitore della chioma	4.6±0.2	110.2±51.0

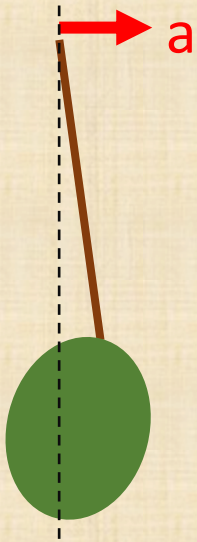


Caratterizzazione dinamica dell'oliva

- Il distacco dell'oliva è un fenomeno complesso in cui giocano forze d'inerzia, di trazione, flessione e torsione.
- Fattori rilevanti sono la fatica causata da cicli di stress e il danno cumulativo.
- Il distacco del frutto avviene grazie all'applicazione di un **accelerazione** (**a**) con determinata **ampiezza** ad una determinata **frequenza**. La combinazione dei due fattori è cruciale per ottenere il distacco senza rovinare il frutto, impiegando un tempo ragionevole.
- Durante lo scuotimento, i modi di vibrare del sistema peduncolo-oliva sono principalmente 2:
  - peduncolo e oliva si muovono in fase
  - peduncolo e oliva si muovono in controfase
- Il primo avviene ad una frequenza più bassa (intorno ai 25 Hz) del secondo (intorno ai 150 Hz)



Modo 1



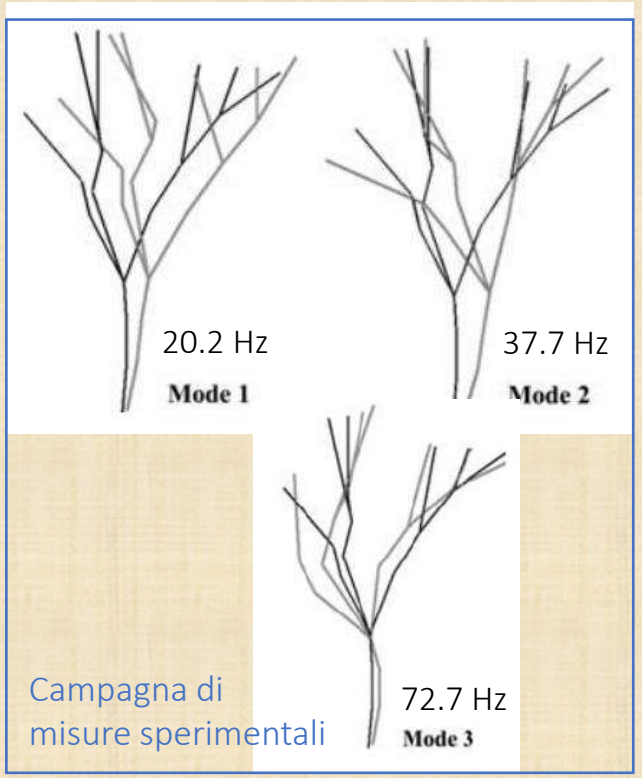
Modo 2

Rotazione e flessione dello stelo

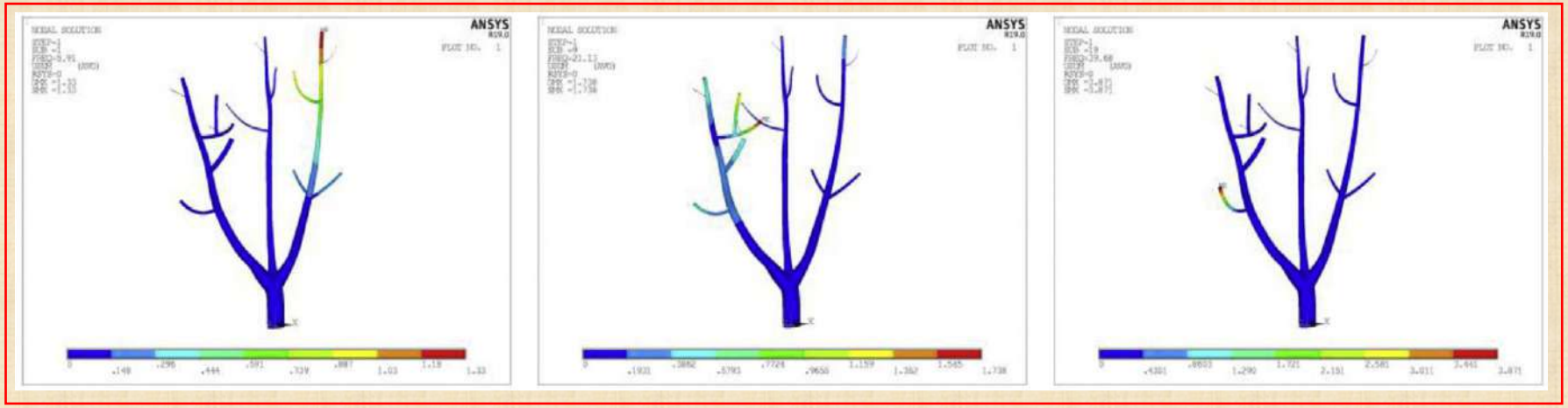
Flessione dello stelo e torsione attorno al rametto

Caratterizzazione dinamica dell'olivo

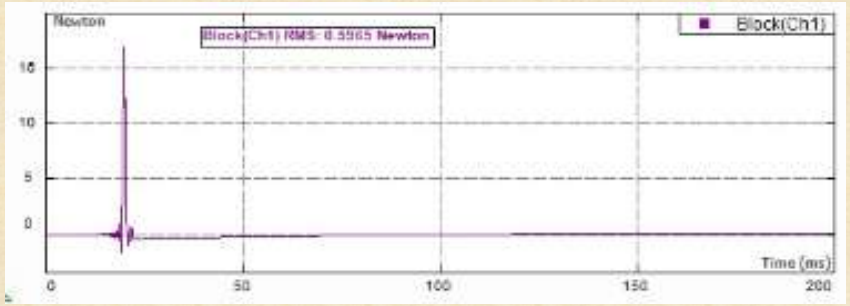
- Studiare la dinamica dell'olivo permette di conoscere la sua risposta quando sottoposto a eccitazioni note (di tipo impulsivo o oscillante)
- Valutare le frequenze di risonanza e i modi di vibrare dell'albero permette di progettare il sistema di scuotimento in modo intelligente
- I modi di vibrare di un olivo possono essere raggruppati in 3 classi in base alla deformazione:
    1. Modi che inducono vibrazioni del tronco (bassa frequenza)
    2. Modi interessano le branche principali
    3. Modi che interessano le branche secondarie (alta frequenza)

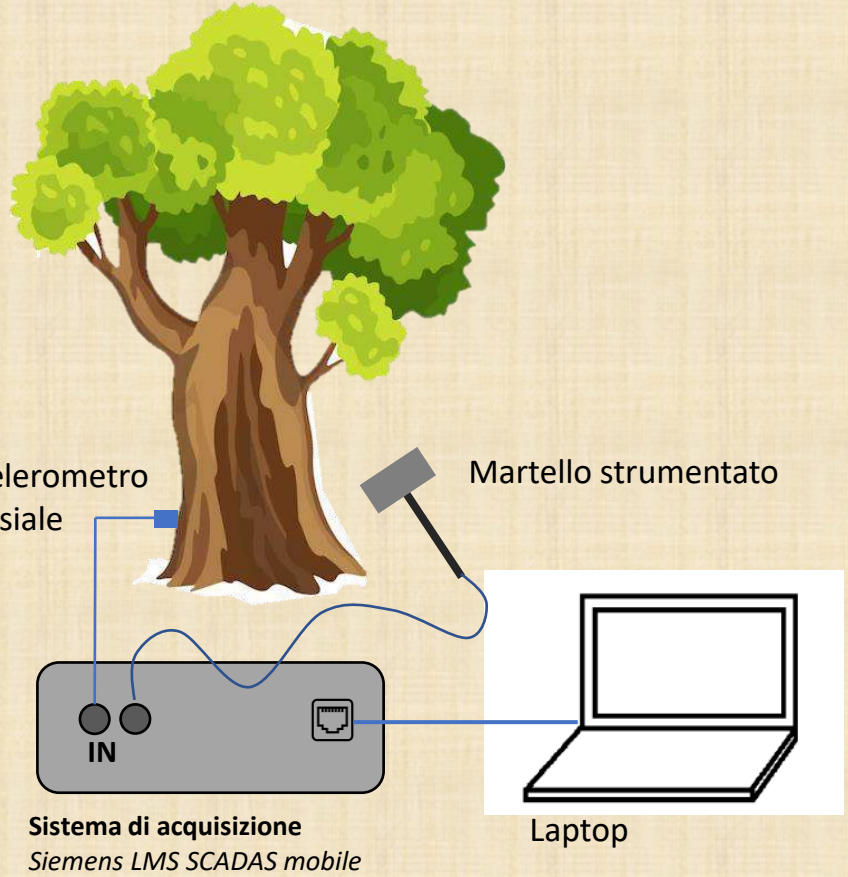


Simulazione numerica



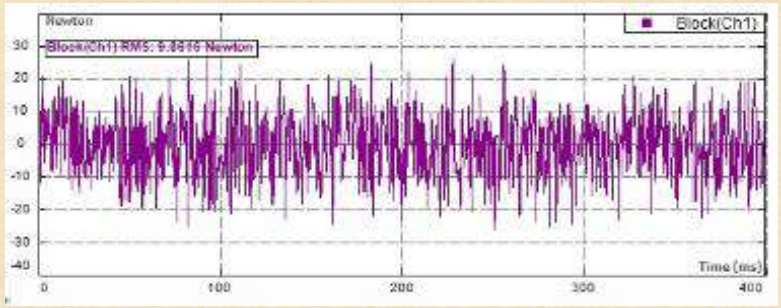
Caratterizzazione dinamica dell'olivo

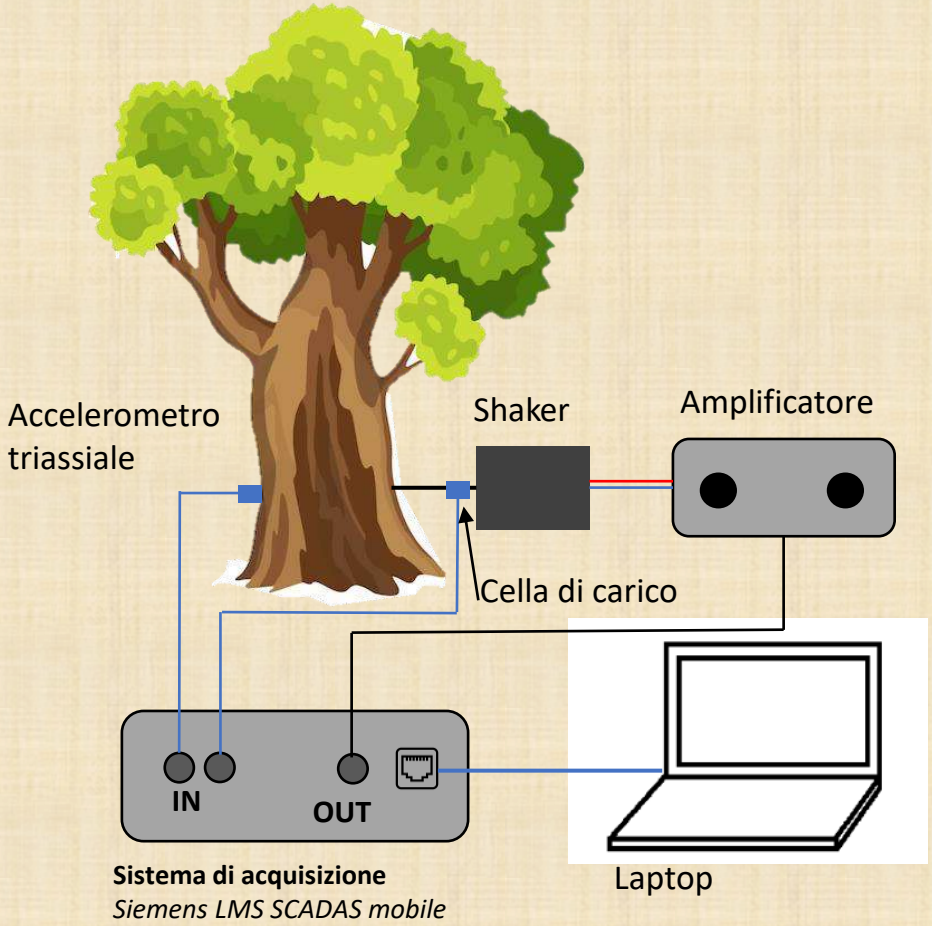




Sistema di acquisizione
Siemens LMS SCADAS mobile

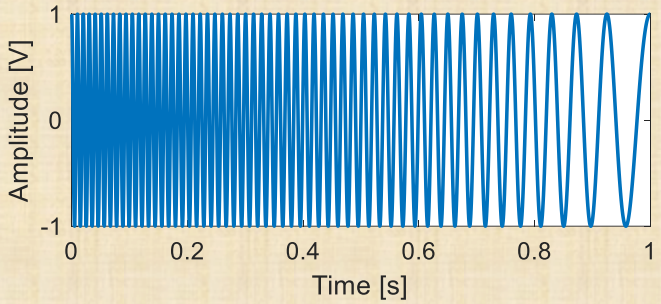
Caratterizzazione dinamica dell'olivo





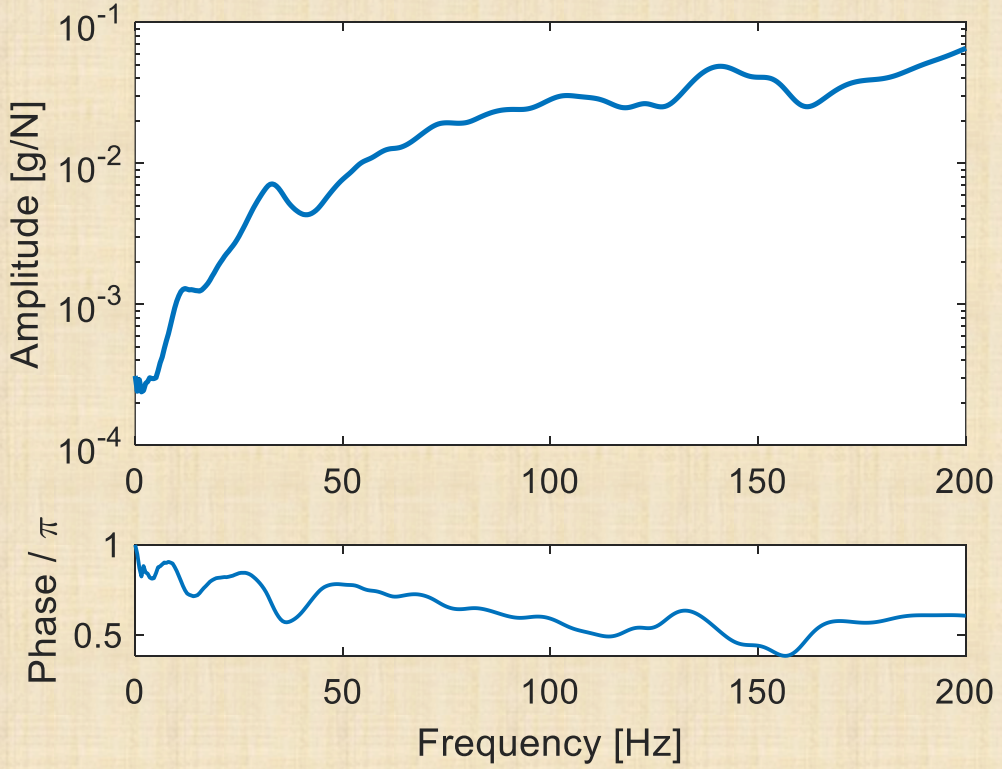
Sistema di acquisizione
Siemens LMS SCADAS mobile

Caratterizzazione dinamica dell'olivo



Funzione di Risposta in Frequenza (FRF)

$$FRF = \frac{Risposta\ [m/s^2]}{Eccitazione\ [N]}$$

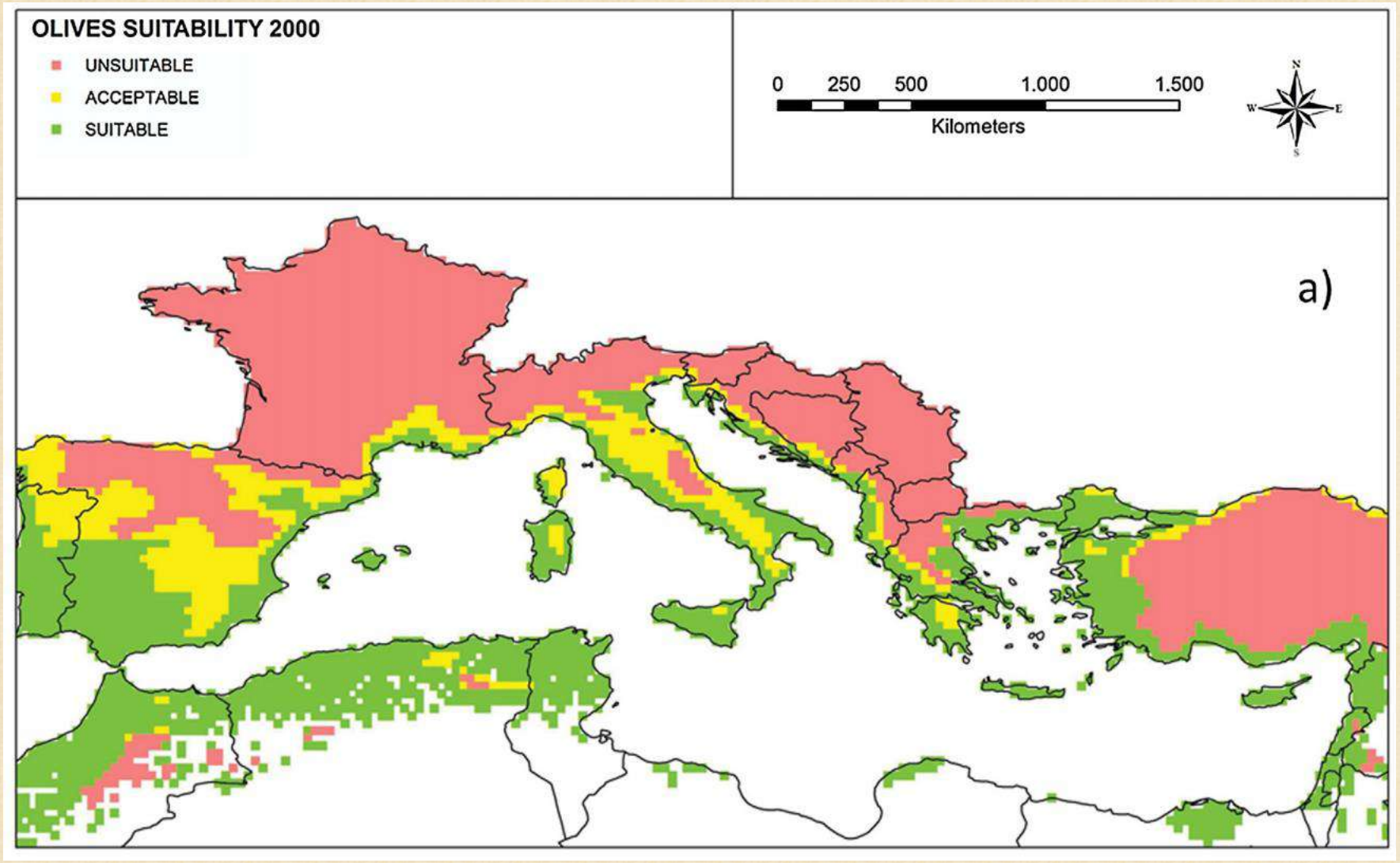


L’importanza della potatura

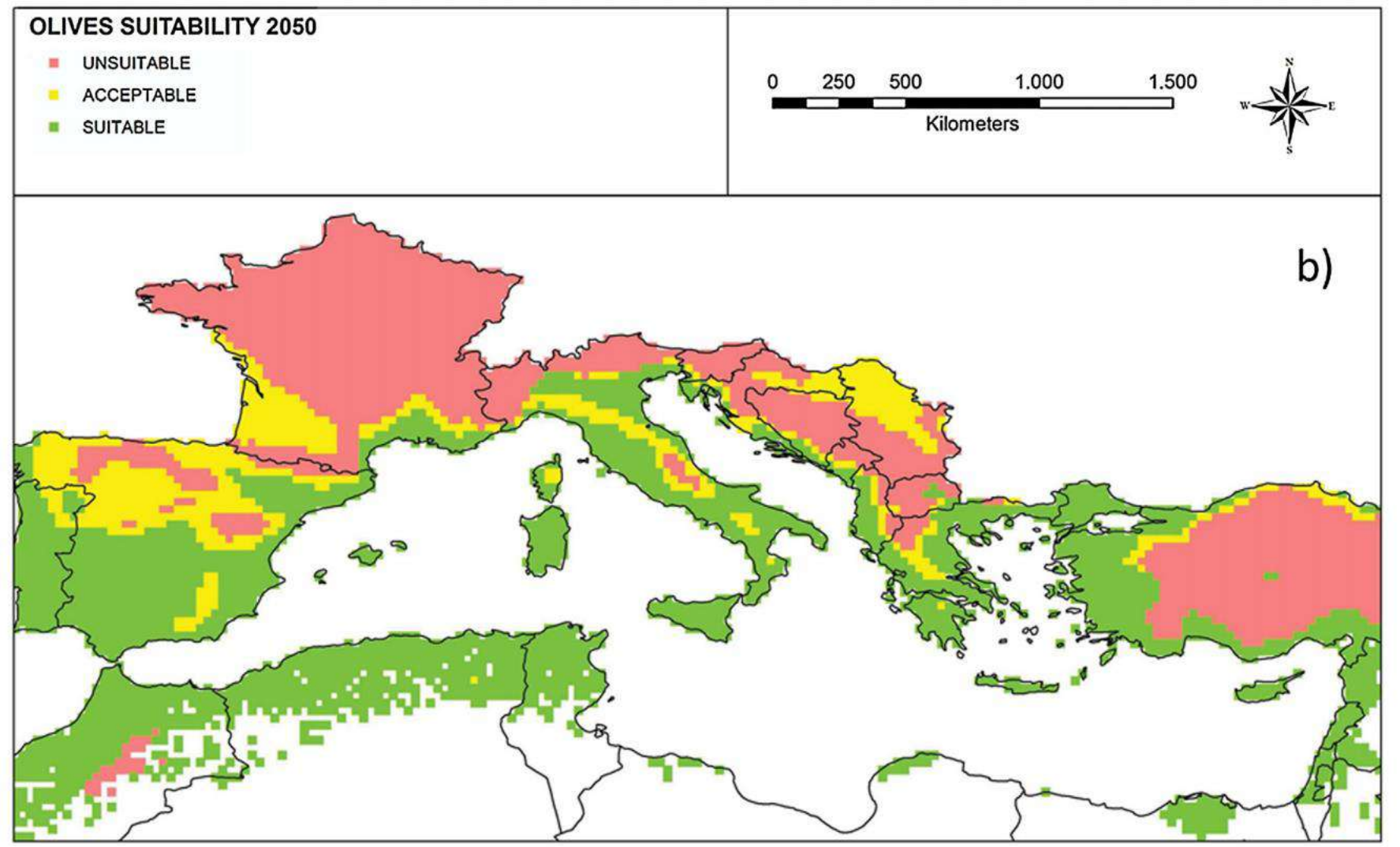
- Una potatura intelligente può aumentare in modo significativo la trasmissione delle vibrazioni alle branche finali
- La trasmissione delle vibrazioni è più efficiente nelle branche interne, più verticali e in linea con il tronco
- Una maggiore trasmissione porta ad un aumento dell’efficienza nella raccolta
- L’accelerazione che arriva al ramo terziario aumenta di un ordine di grandezza (da 0.1–1.0 m s^{-2} a 1.0–10 m s^{-2}) dopo la potatura
- L’energia fornita dallo shaker viene dissipata a causa di:
  - Complessa geometria dovuta alle ramificazioni
  - Presenza di succhioni
  - Attrito dovuto alle foglie
  - Attrito aerodinamico della chioma
  - Perdite interne al legno
  - Perdite al suolo attraverso l’apparato radicale

Global warming and climate change

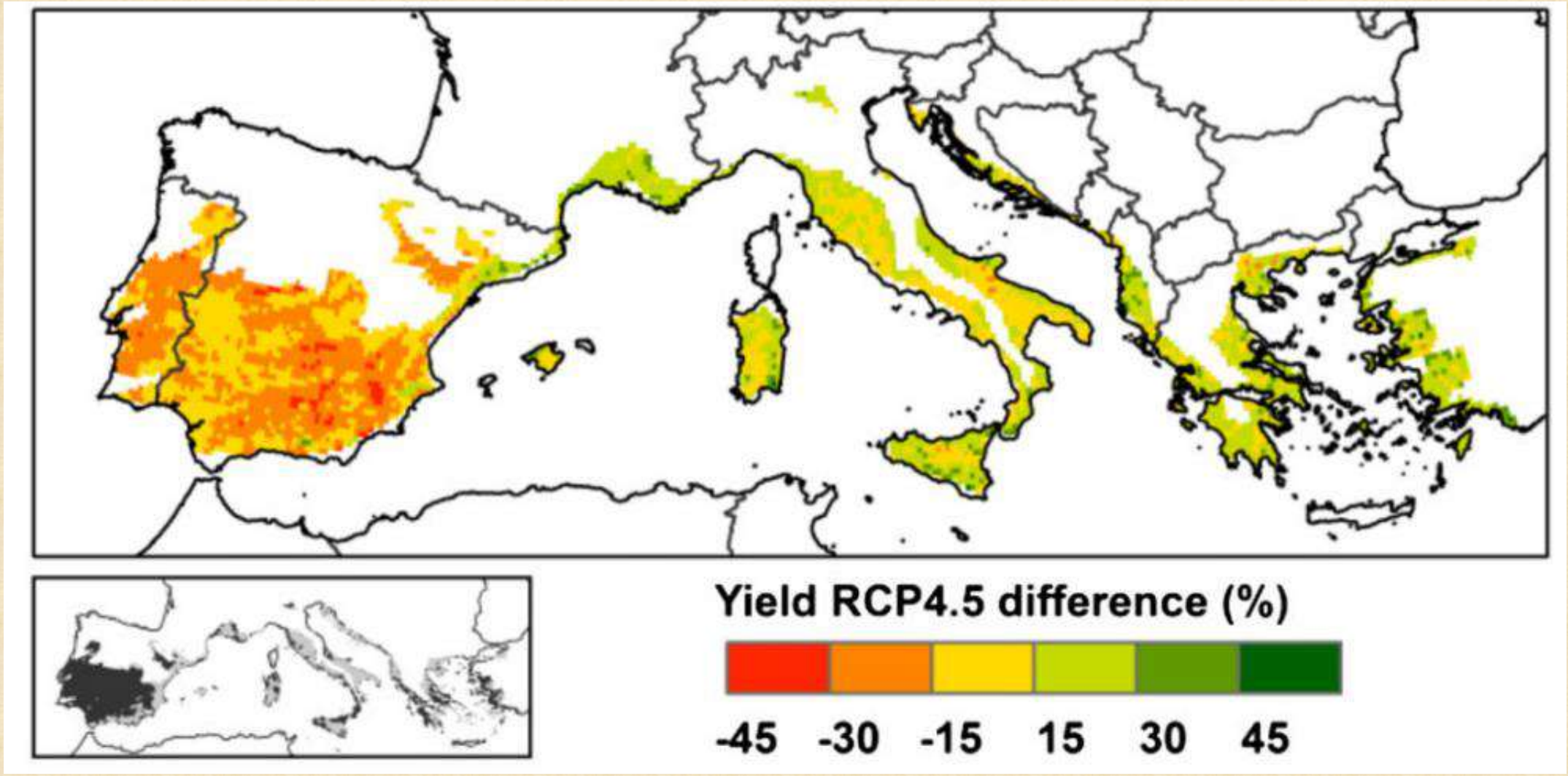
- It can change some factors that influences the olive flowering (Gabaldón-Leal et al., 2017; Lorite et al., 2018);
- It can increase the areas suitable for cultivation in Europe (Tanasijevic et al., 2014);
- It could change the yield of olive in Mediterranean area (Fraga et al., 2019; Cabezas et al., 2020);



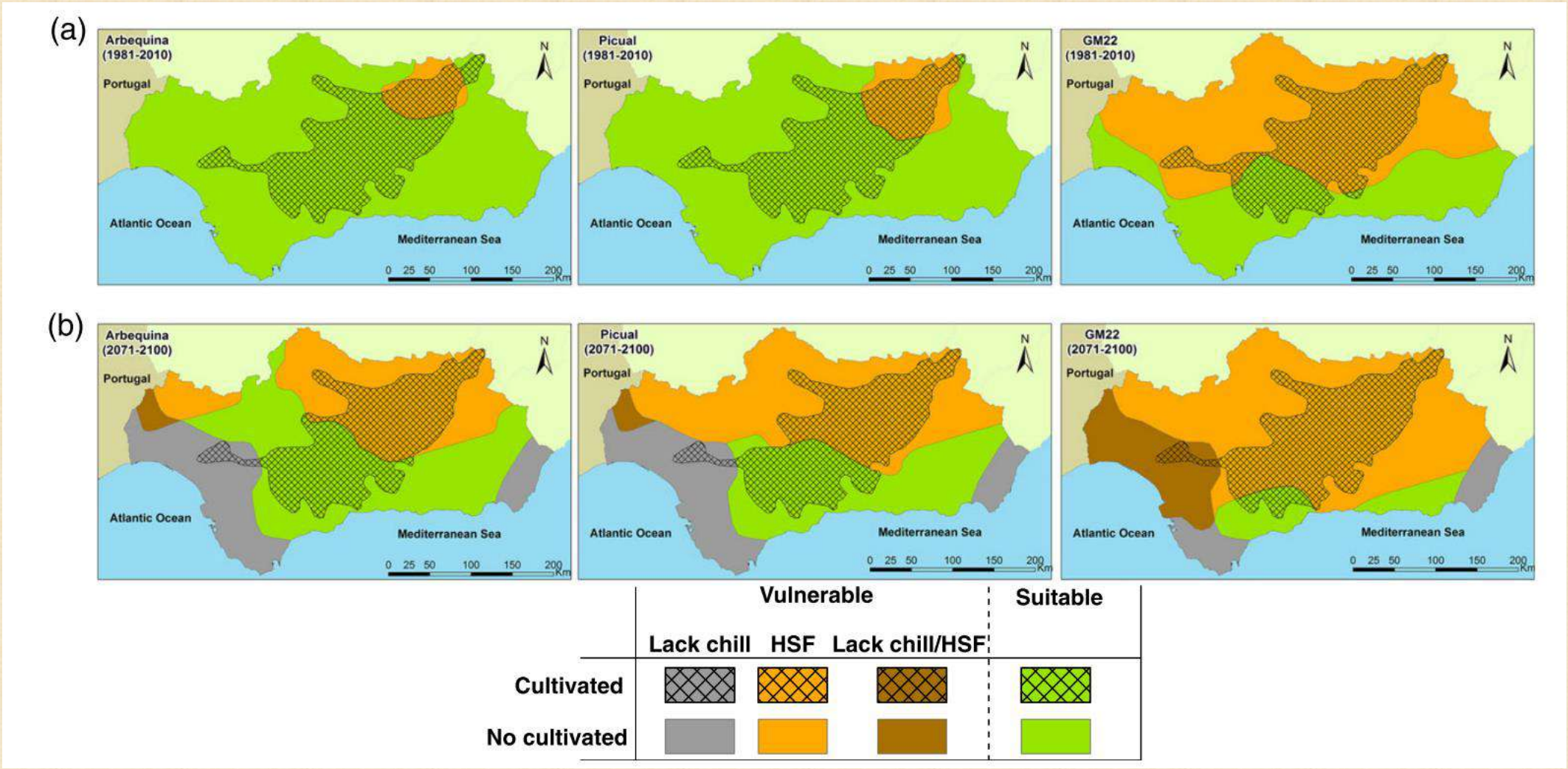
Tanasijevic et al., 2014



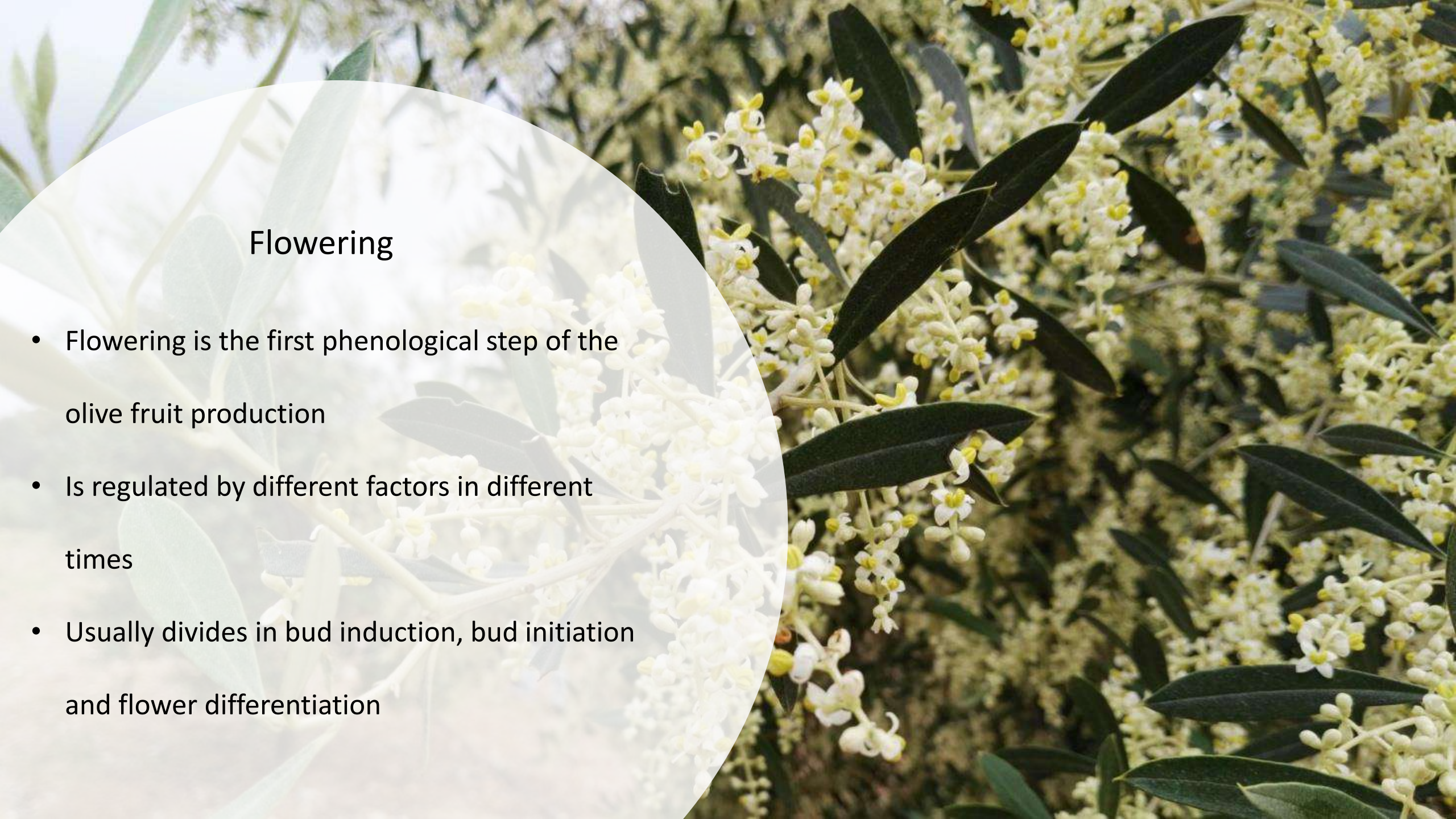
Tanasijevic et al., 2014



Expected differences in yield per hectare between the future (2041-2070) and the “present” (1989-2005) (Fraga et al., 2019)



heat stress during flowering (HSF), threshold 35◦ C
TU mean= 467 U (7.3◦ C as optimal temperature)
Gabaldón-Leal et al., 2017



Flowering

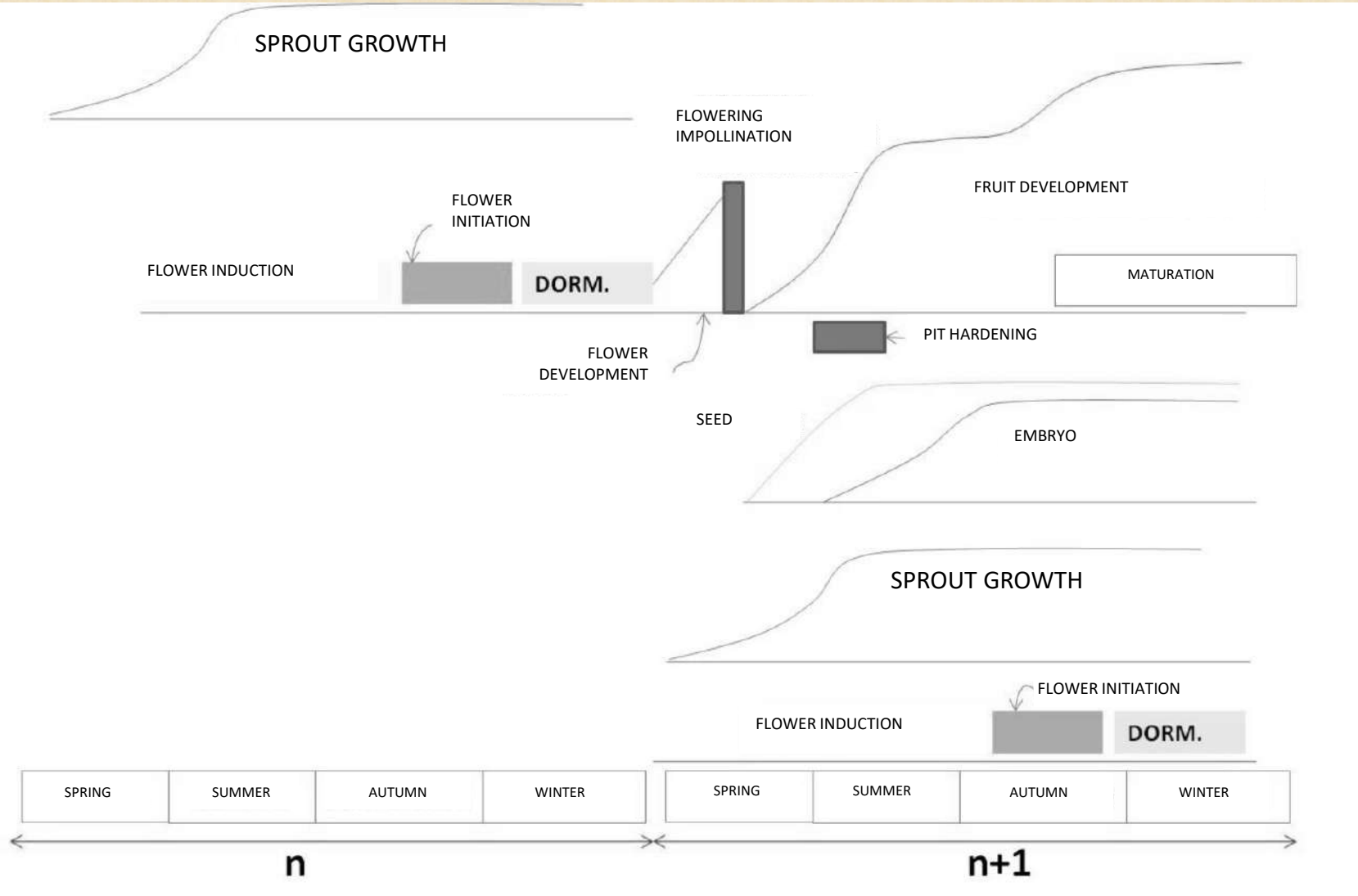
- Flowering is the first phenological step of the olive fruit production
- Is regulated by different factors in different times
- Usually divides in bud induction, bud initiation and flower differentiation

BUDS

VEGETATIVE

REPRODUCTIVE

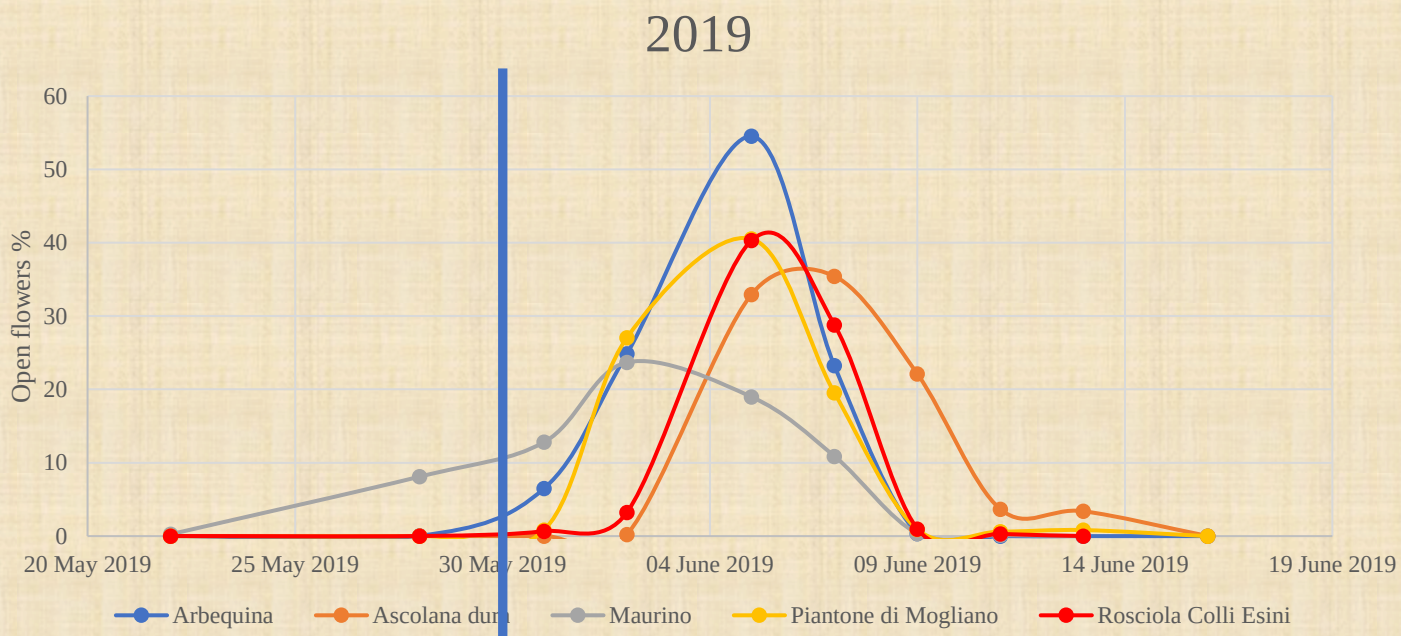
SEASONAL TREND OF THE PHASES

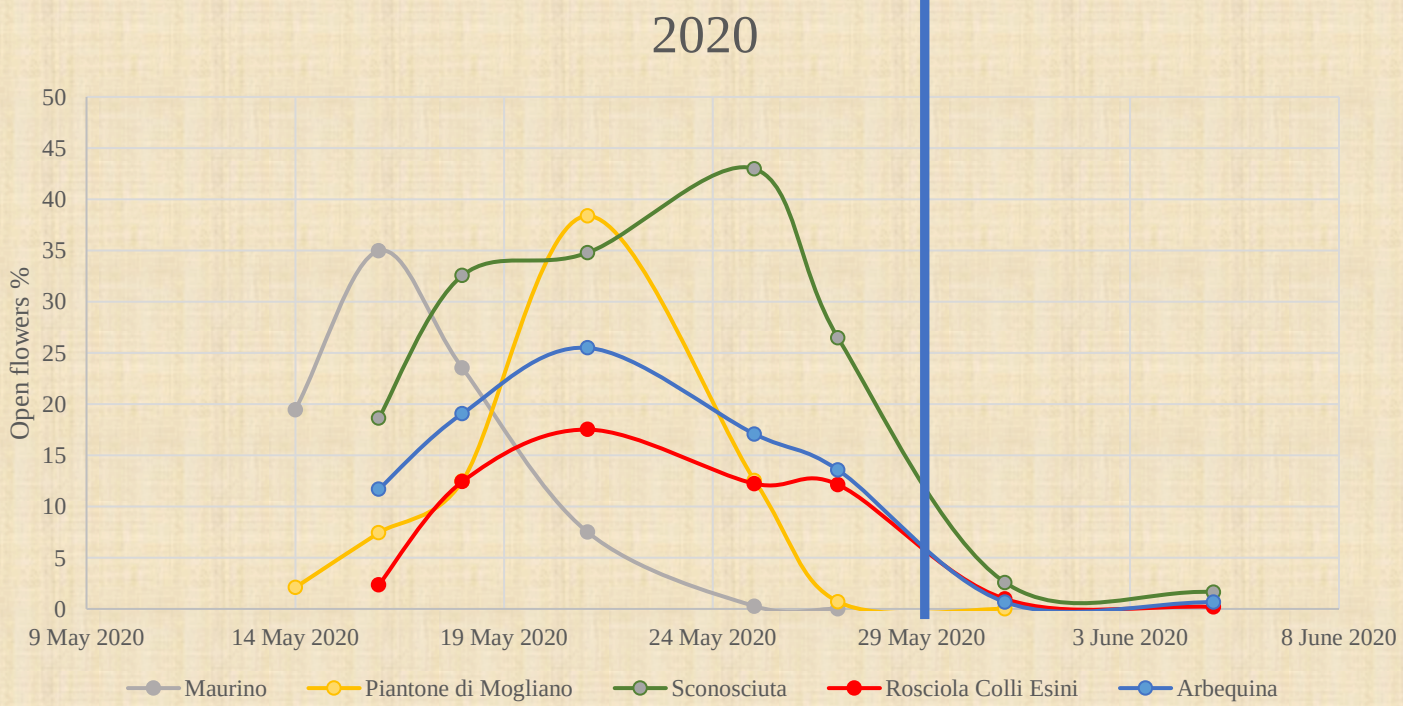


Gucci & Cantini, 2000; rielaborated by Tarragoni, 2014)

Piantone di Mogliano, Agugliano (AN) - Italy

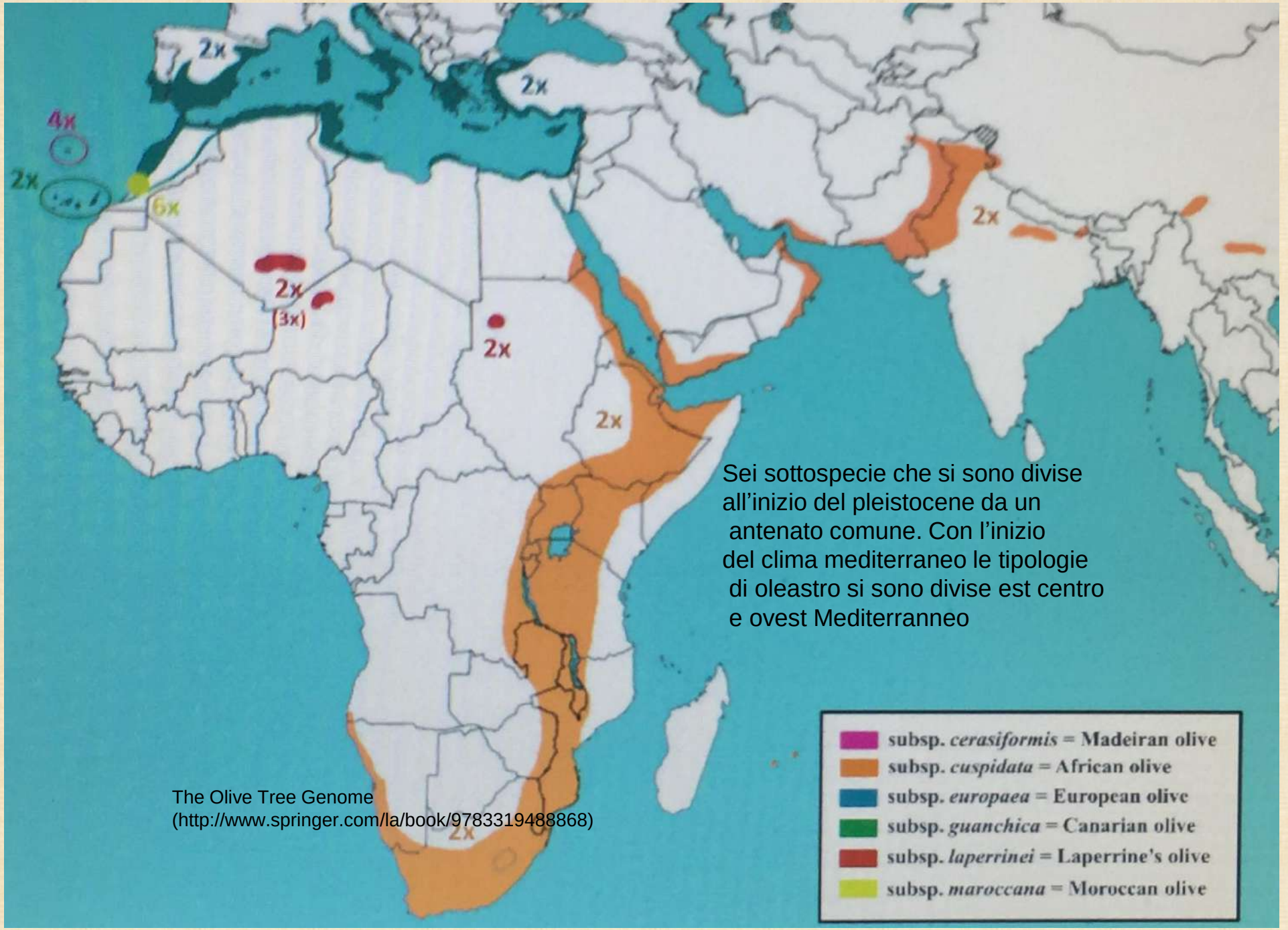
Time of flowering on different cultivars of olive in the Az. Didattico sperimentale «P. Rosati» of UNIVPM, Agugliano (AN)





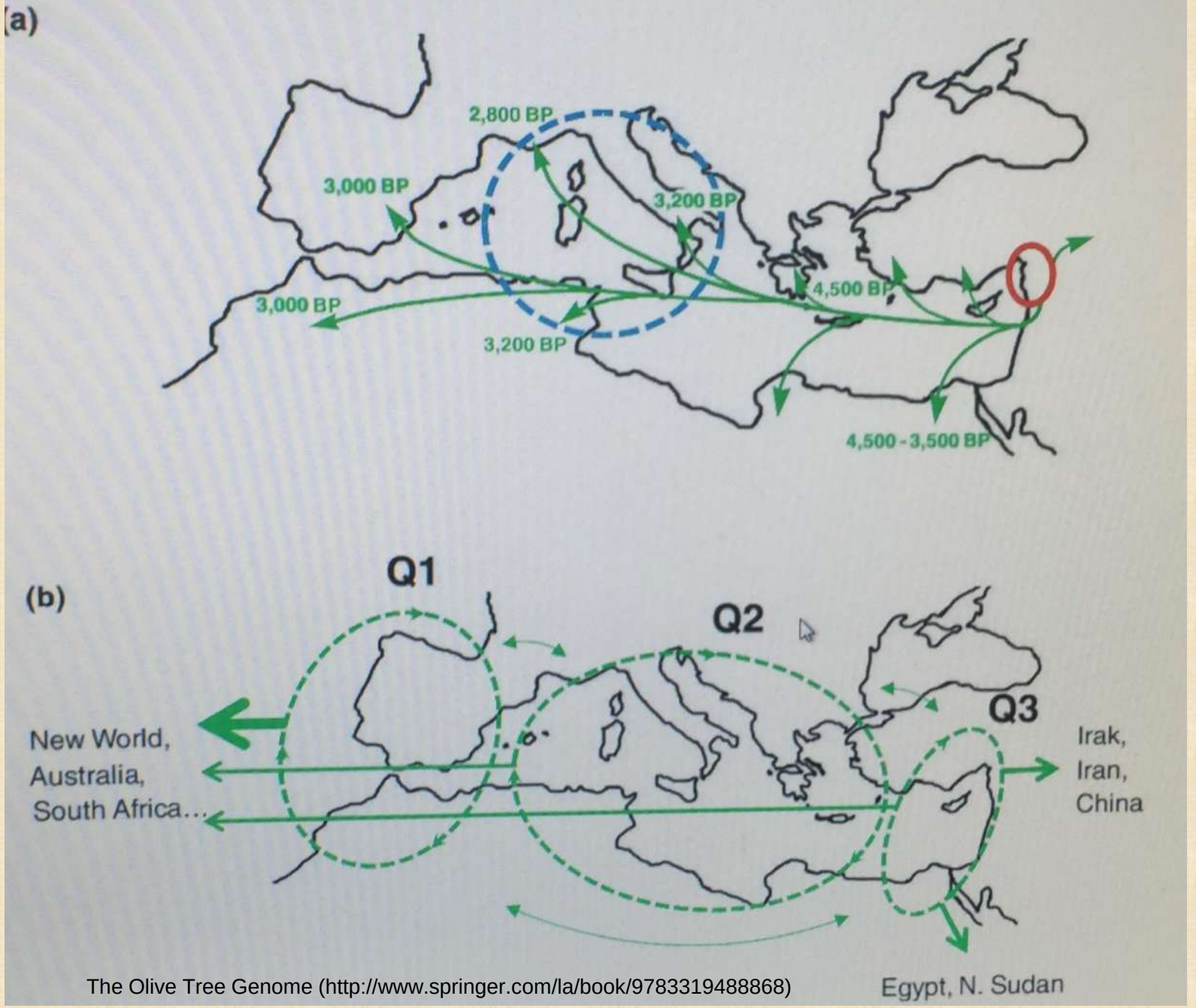
Varietà di passaggio fra olivastro e Moraiolo

Olivo di Sant'Emiliano, Trevi - (1830 anni)



Sei sottospecie che si sono divise all'inizio del pleistocene da un antenato comune. Con l'inizio del clima mediterraneo le tipologie di oleastro si sono divise est centro e ovest Mediterranneo

The Olive Tree Genome
(http://www.springer.com/la/book/9783319488868)


(a)
2,800 BP
3,000 BP
3,200 BP
3,000 BP
4,500 BP
3,200 BP
4,500 - 3,500 BP
(b)
Q1
Q2
Q3
New World,
Australia,
South Africa...
Irak,
Iran,
China
Egypt, N. Sudan

The Olive Tree Genome http://www.springer.com/la/book/9783319488868)

Linee plastidiali dell'olivo (E1, E2, E3)

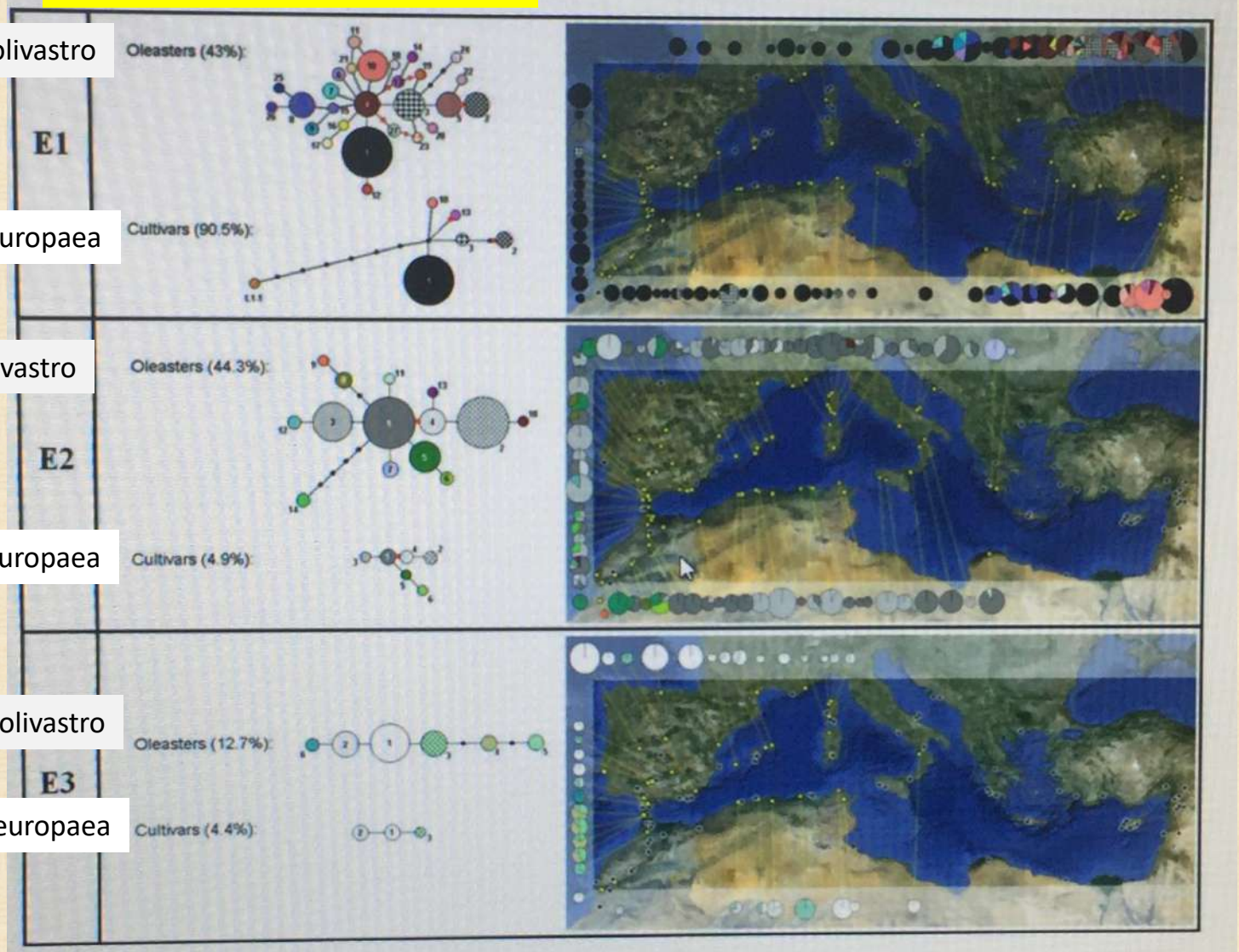
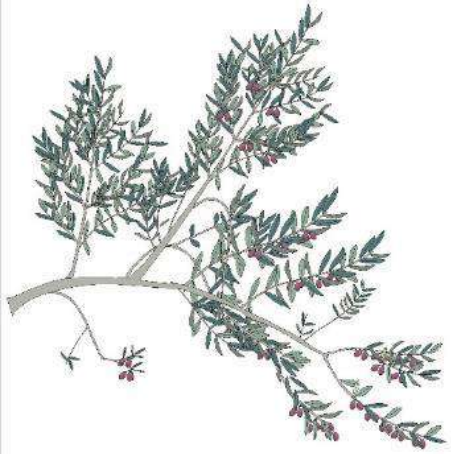


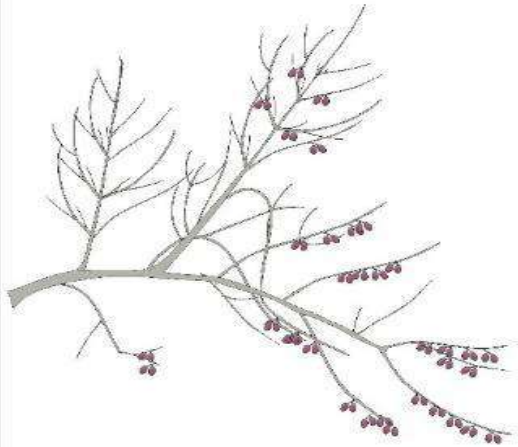
Fig. 2 Diversity of the three Mediterranean olive plastid lineages (namely E1, E2, and E3) reproduced from Besnard et al. (2013b). A total of 1797 trees (1253 oleasters and 534 cultivars) were characterized with 61 polymorphic plastid loci, especially multistate microsatel- nodes are indicated by *small black points*. The frequency of each lineage in oleasters and cultivars is indicated in *brackets*. On the right, the geographical distribution of chlorotypes in oleaster populations is given. The size of pie charts is relative to the number of trees analyzed per

Oliveto ad alta densità - Università Politecnica delle Marche
12 varietà: intrenazionali, nazionali e locali

Situazione iniziale

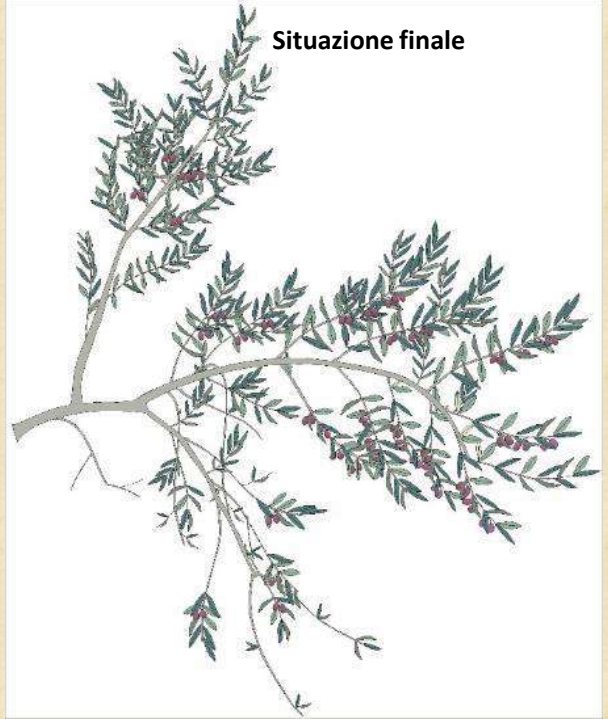


Situazione iniziale (posizione frutti)



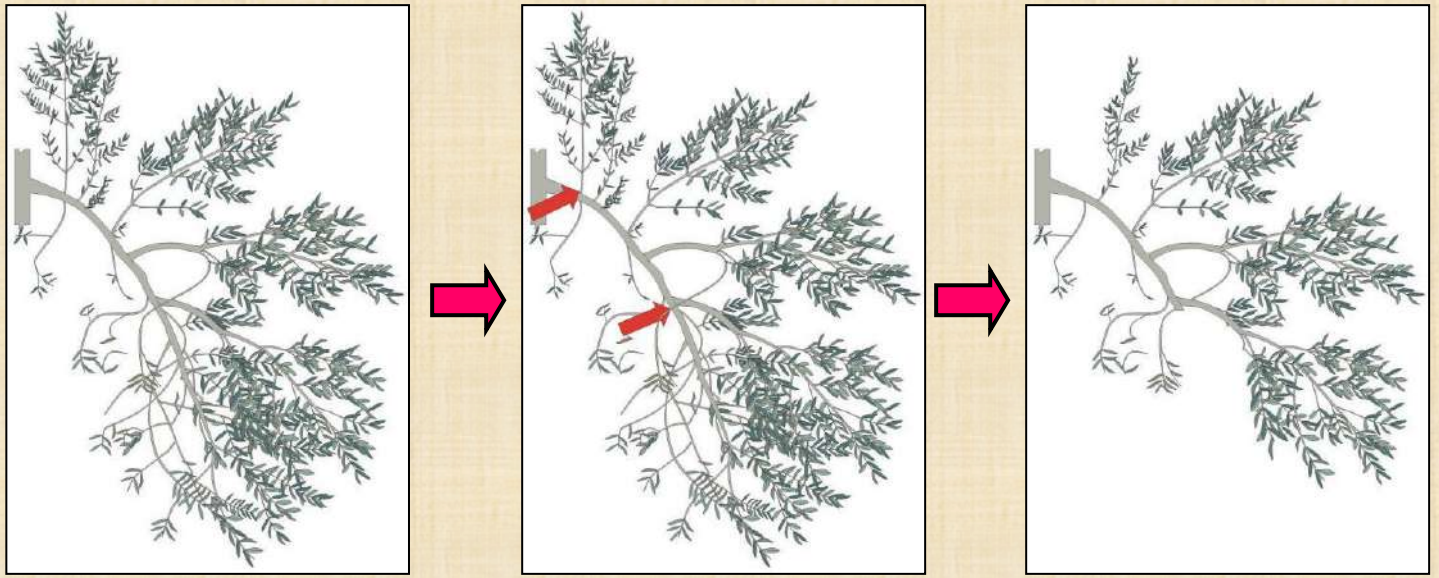
‘Leccino’

Situazione finale



E.M. Lodolini et al., 2005

Pruning of the fruiting branch



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V Convegno Nazionale dell'Olivo e dell'Olio
26-28 ottobre 2022 Alghero (SS)

APPLICAZIONE DI LASER SCANNER (LiDAR) IN OLIVICOLTURA

Davide Neri *, Veronica Giorgi , Stefano Chiappini, Mattia Balestra, Francesco Belluccini

Università Politecnica delle Marche UNIVPM, D3A

* d.neri@staff.univpm.it

È TEMPO DI AGRICOLTURA

PSR MARCHE 2014-2020 Unione Europea / Regione Marche
PROGRAMMA DI SVILUPPO RURALE 2014-2020
FONDO EUROPEO AGRICOLO PER LO SVILUPPO RURALE: L'EUROPA INVESTE NELLE ZONE RURALI

Unione Europea

MINISTERO DELLE POLITICHE AGRICOLE ALIMENTARI E FORESTALI

REGIONE MARCHE

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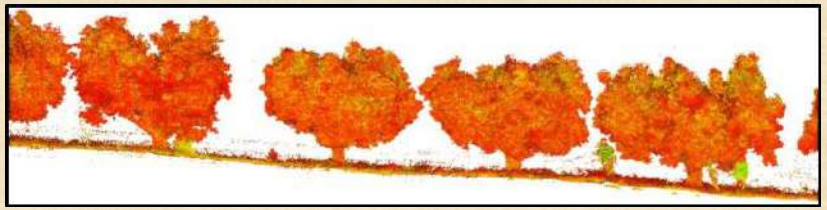
Necessità di ammodernare la tecnica colturale e adattarla ai cambiamenti climatici

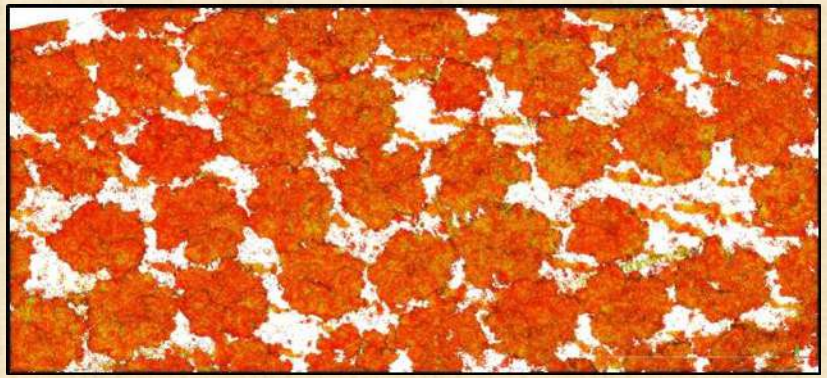
L'agricoltura di precisione strumento utile per meccanizzare e ridurre impatto ambientale

Fonte: Marinucci 1956

Fonte: https://olivoeolio.edagricole.it/oliveto-e-frantoio/cambiamento-climatico-ruolo-olivicoltura/

Vista laterale e dall'alto con LiDAR di un oliveto a Cartoceto (PU)





Kaarta Stencil 2 MLS

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Obbiettivi della sperimentazione

- Valutare effetti e differenze in chiome di alberi con **diverse modalità e intensità di potatura**

- Valutazione dell'**accuratezza della strumentazione LiDAR** nella determinazione dei volumi delle chiome e delle differenze **pre e post potatura** applicando diversi algoritmi

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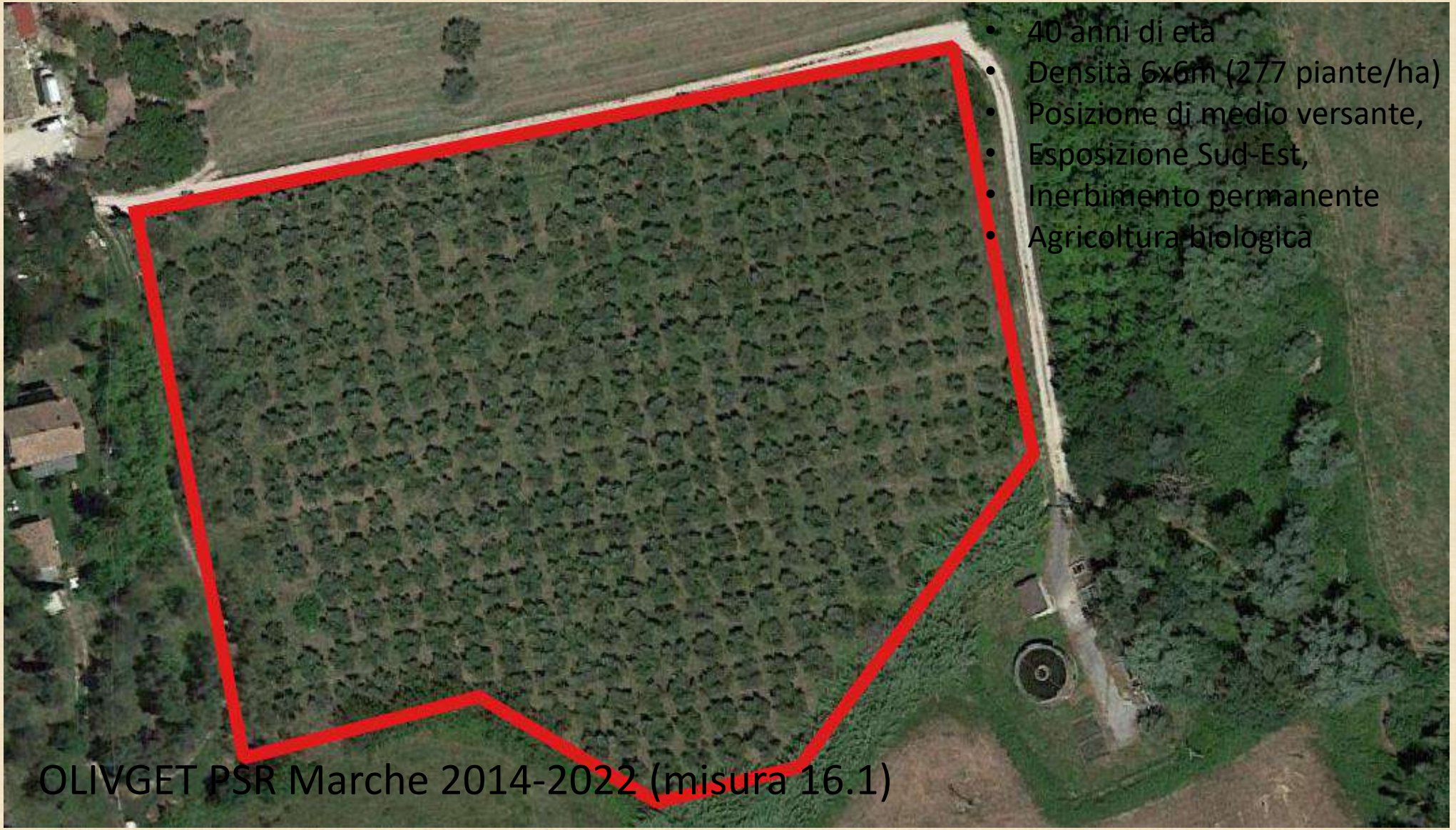
Area di studio



- 40 anni di età
- Densità 6x6m (277 piante/ha)
- Posizione di medio versante,
- Esposizione Sud-Est,
- Inerbimento permanente
- Agricoltura biologica

OLIVGET PSR Marche 2014-2022 (misura 16.1)

Azienda
Agricola Luvia
Cartoceto
(PU)

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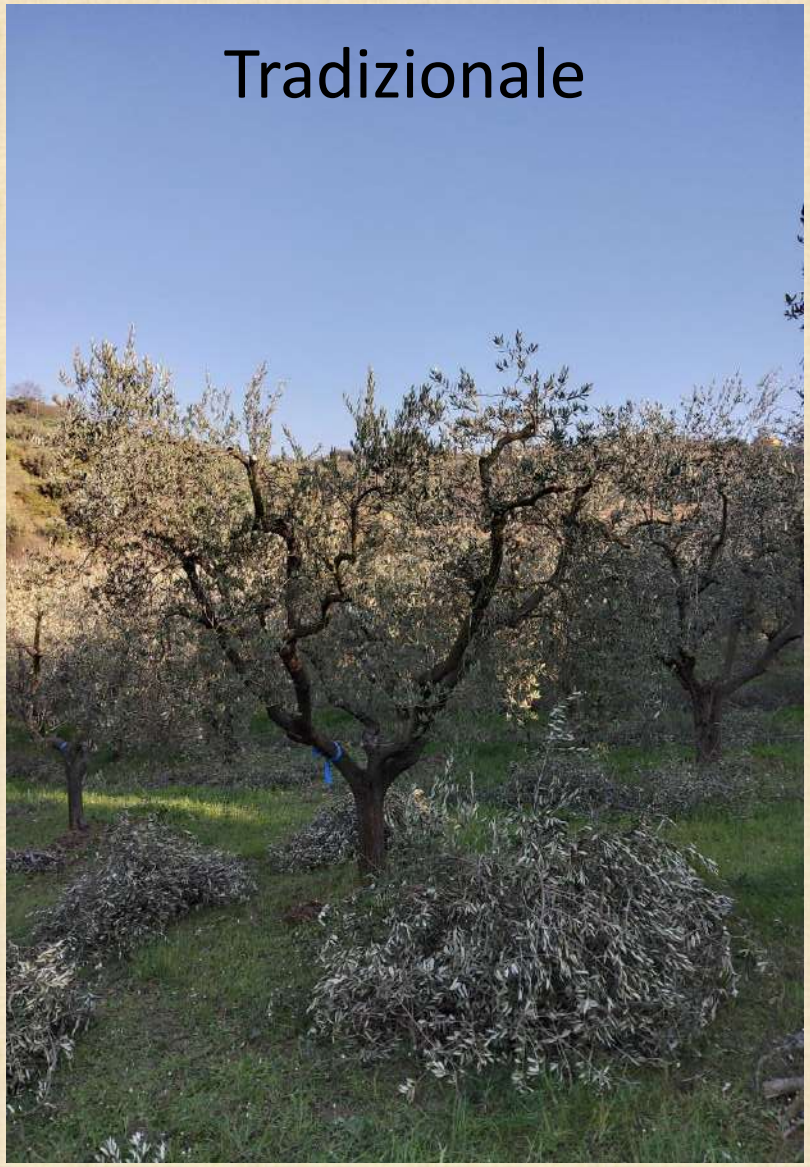
Prova di potatura



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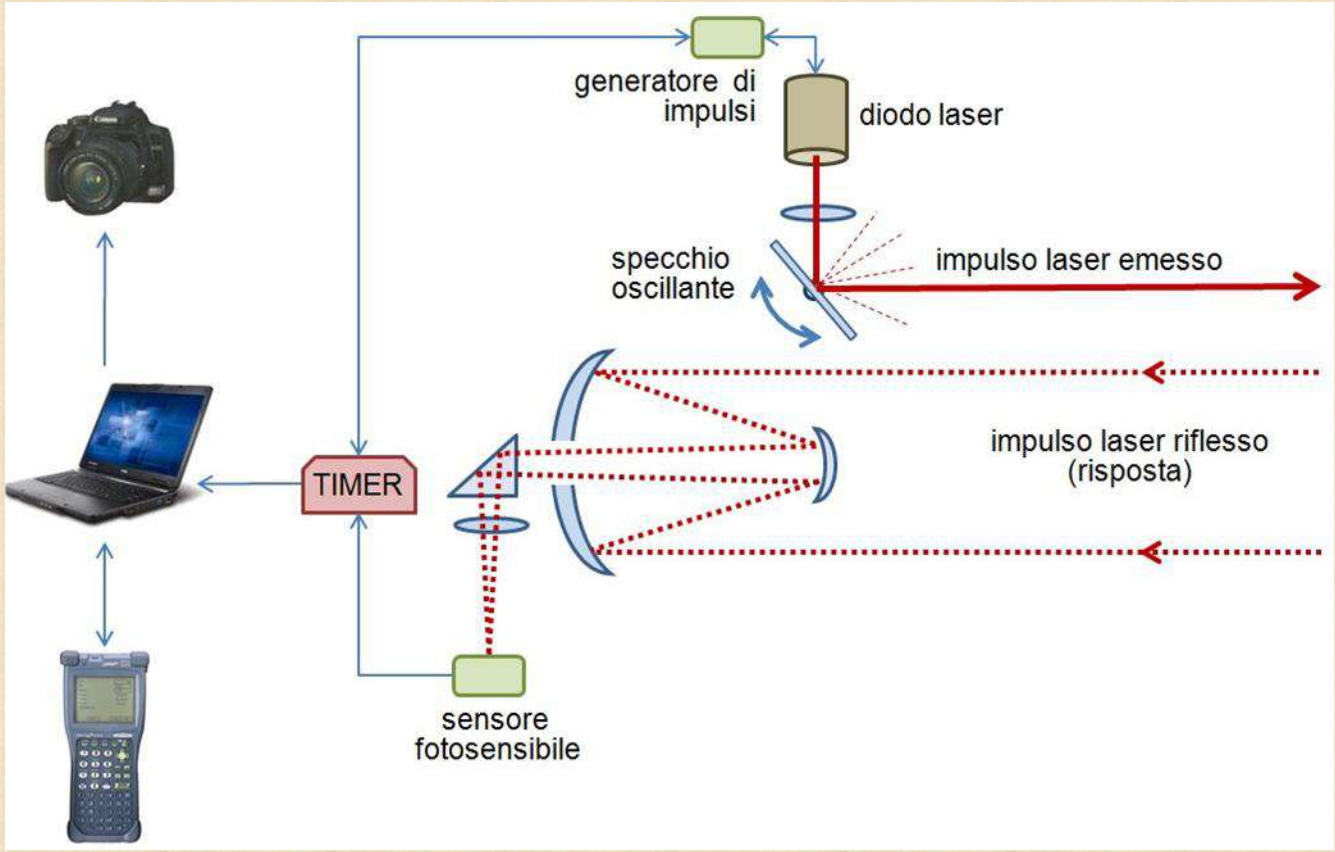
Il LiDAR Light Detection and Ranging

Permette di effettuare scansioni molto accurate dell'ambiente che ci circonda

Può essere portato manualmente, montato su veicoli terrestri o su droni (UAV) per rilievi aerei

È principalmente composto da:
Generatore di radiazioni
Computer
Sistema di archiviazione dei dati



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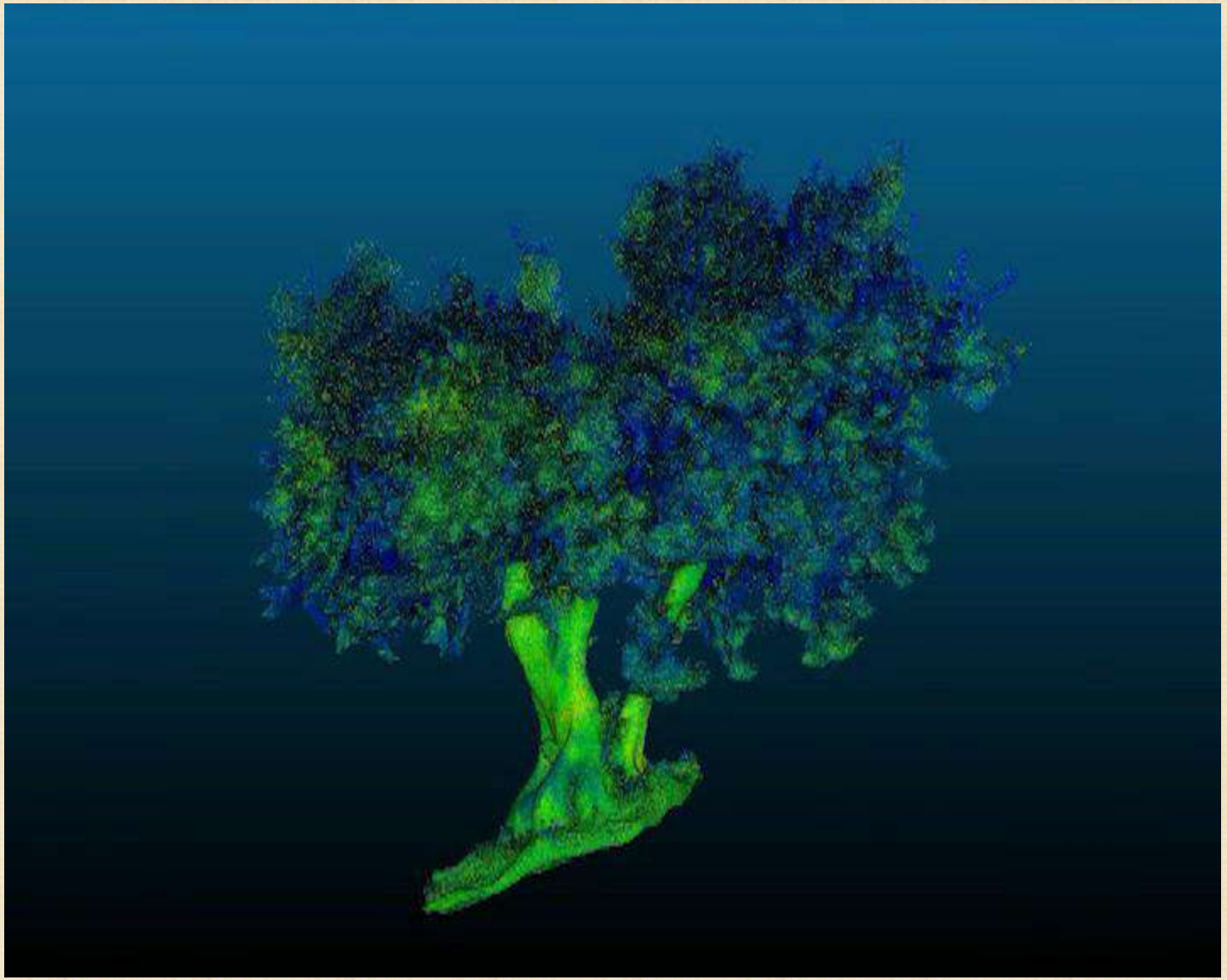
Nuvole di punti



Olivo storico di
Cartoceto PU

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Estrazione dei dati volumetrici dalle nuvole dei punti

- La nuvola dei punti grezza è stata elaborata tramite i software CloudCompare™ e MATLAB® → Separare il terreno dagli alberi e ottenere le nuvole delle singole piante

- È stato impostato un algoritmo tramite il software MATLAB® che permette di applicare quattro diverse funzioni: Alpha Shape, Convex Hull, la Triangolazione di Delaunay e il metodo Voxel Based

- Il sistema permette di ottenere il volume del risultato delle singole funzioni e la rappresentazione grafica

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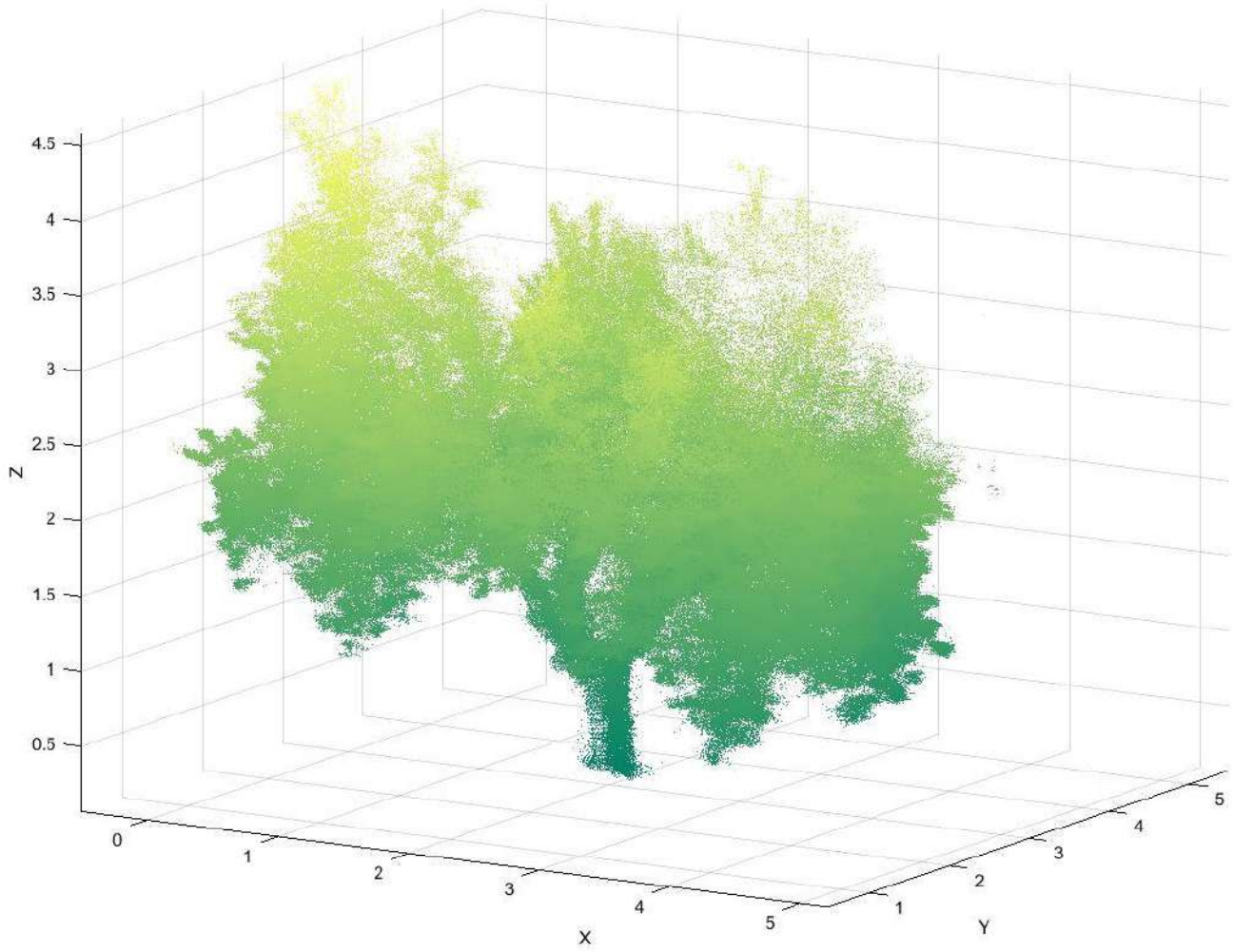
Nuvole di punti



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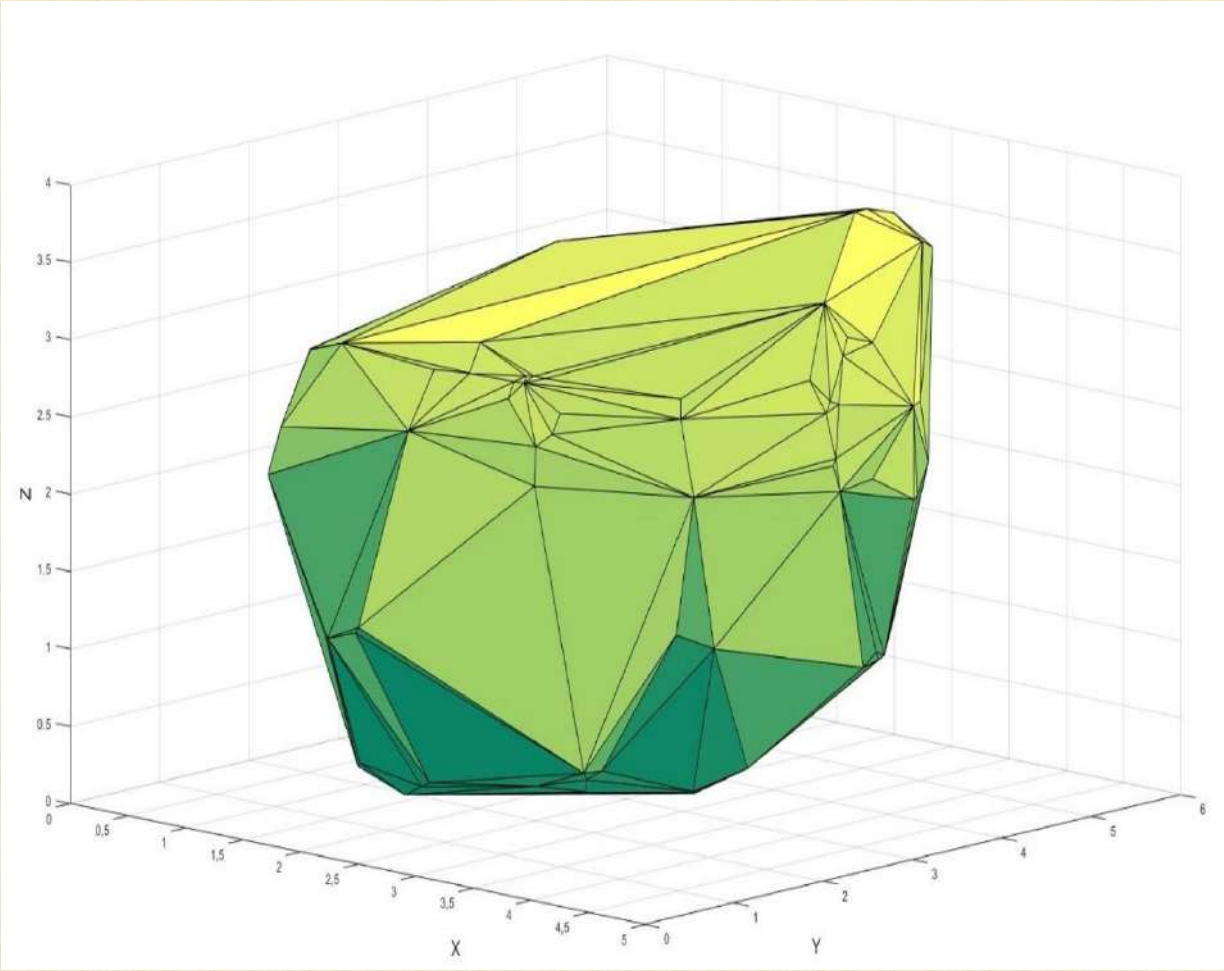
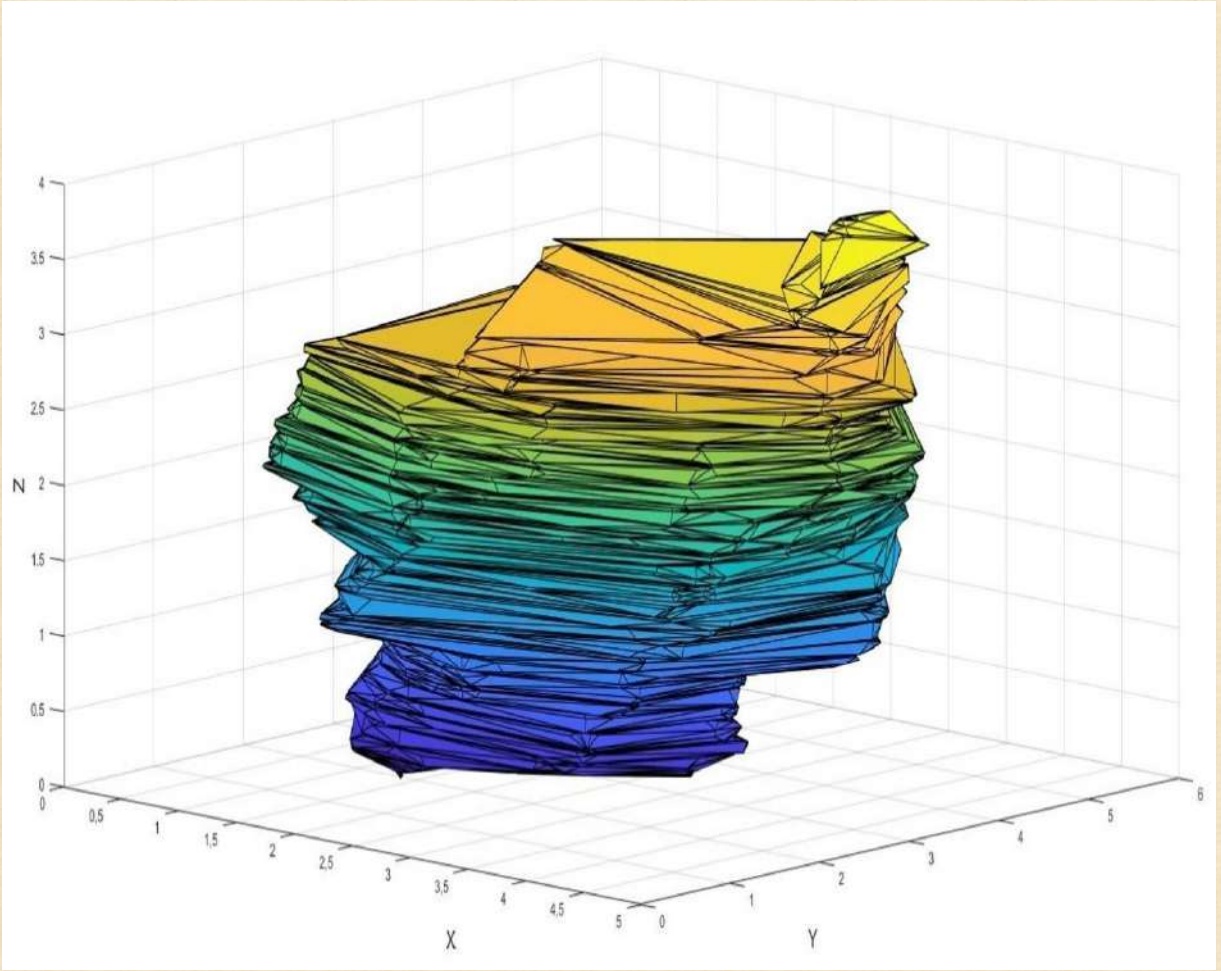
Elaborazione delle nuvole dei punti



Intero



Sezioni 0,1m

Convex Hull

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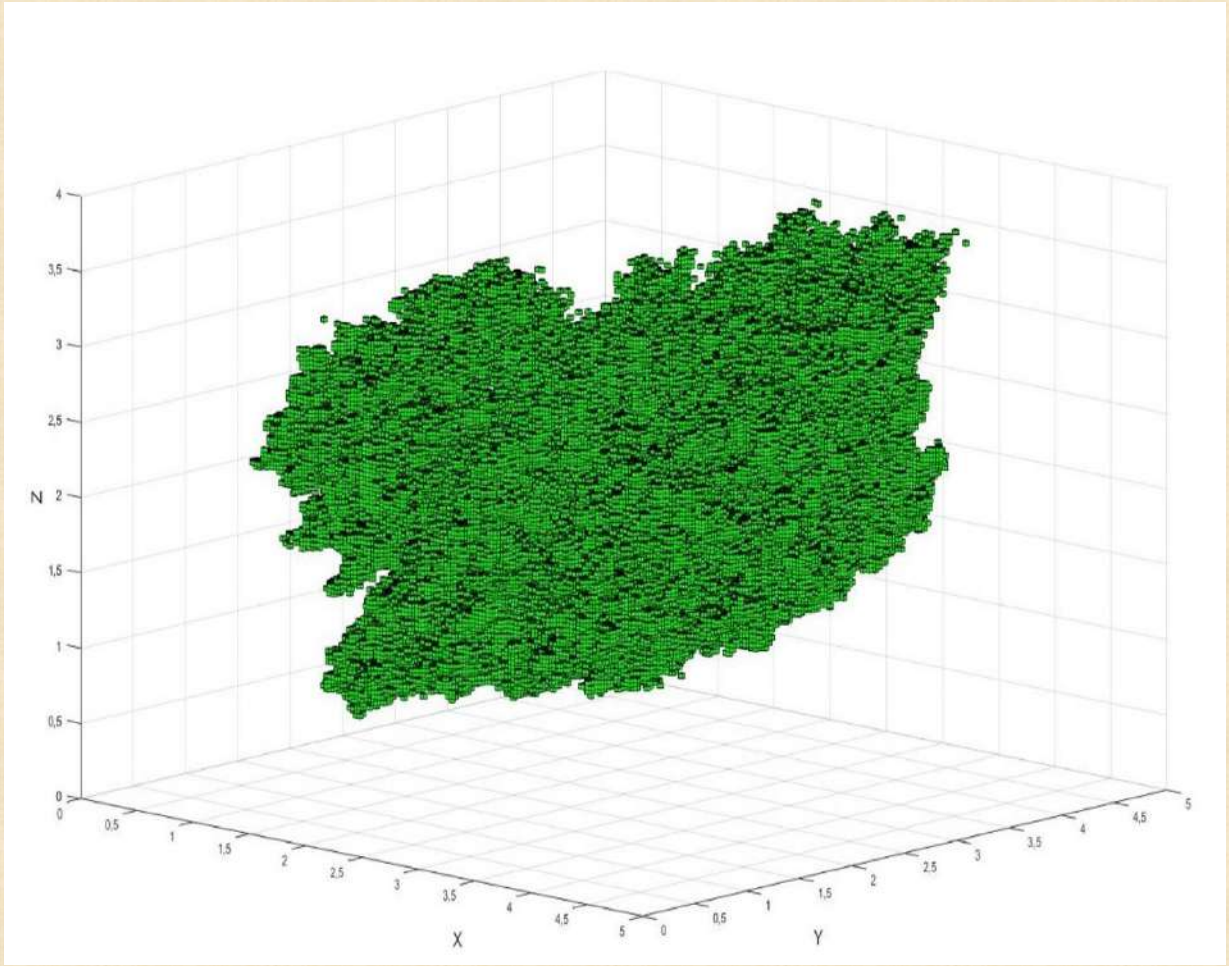
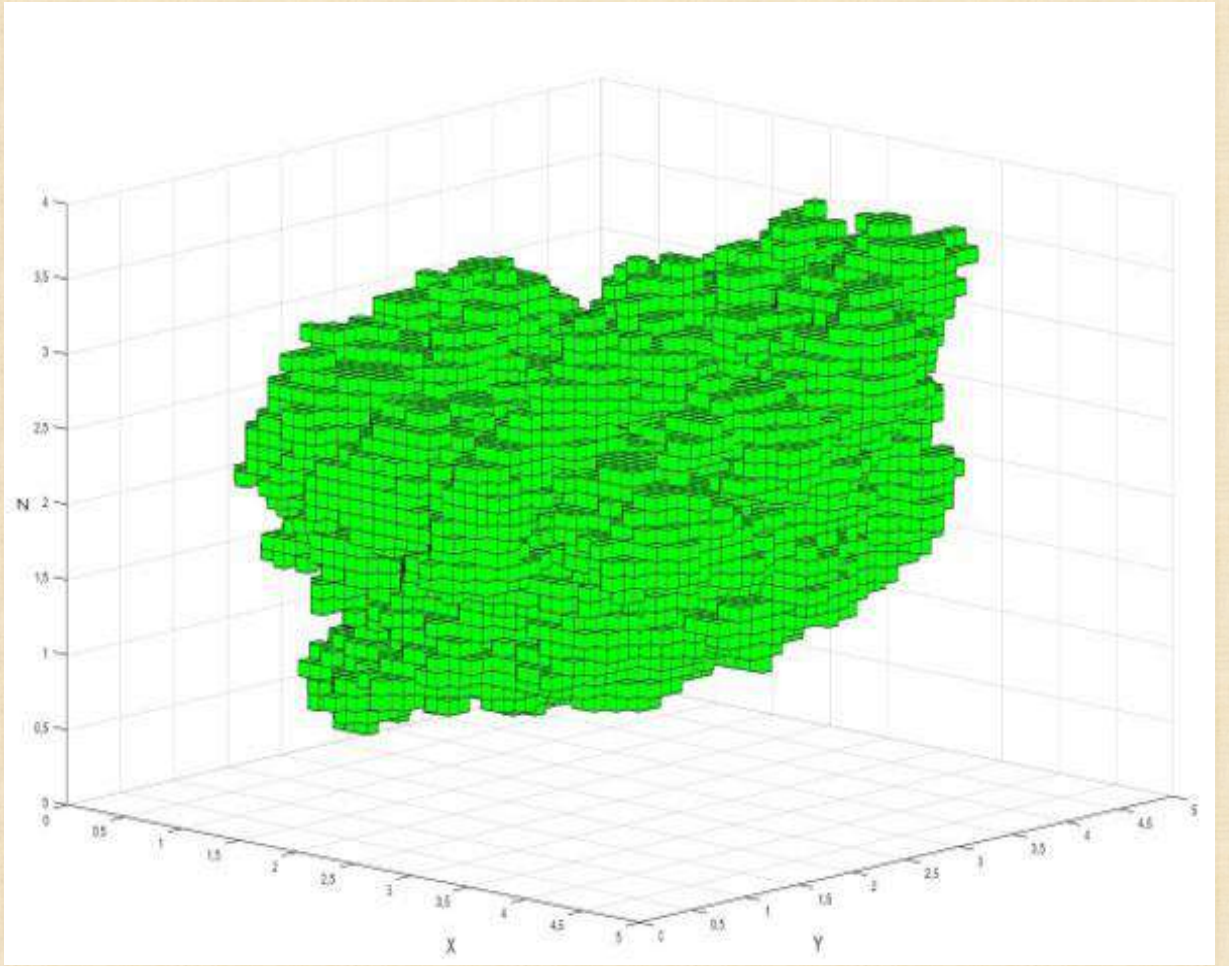
Elaborazione delle nuvole dei punti



l= 0,03m



l= 0,1m

Voxel

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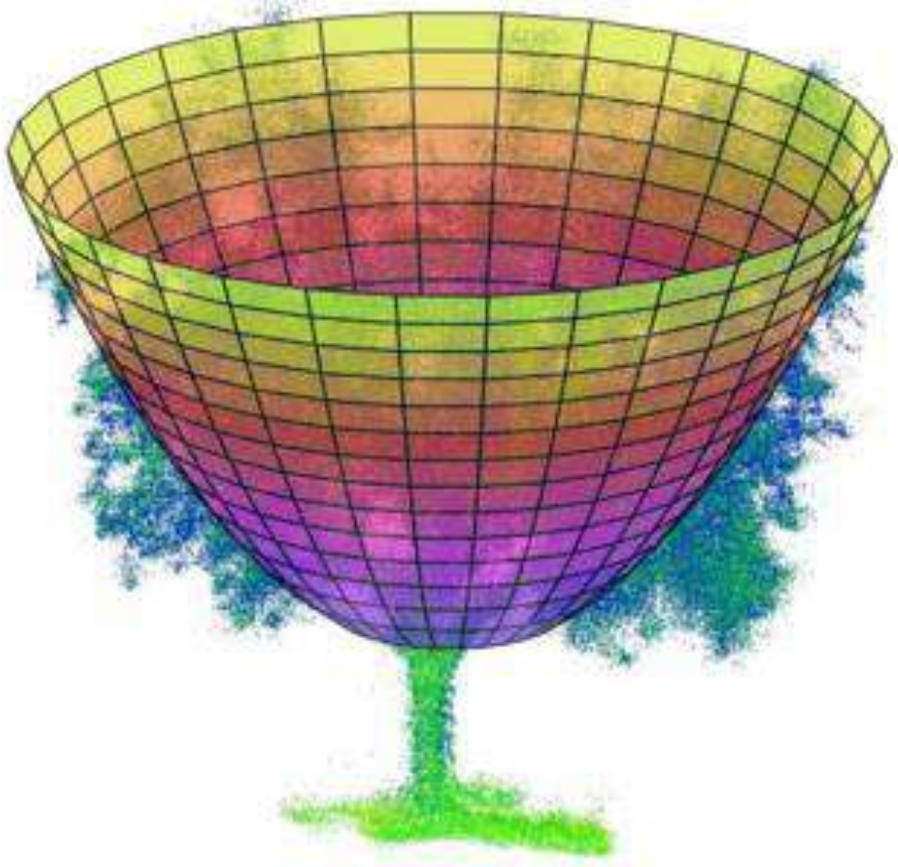
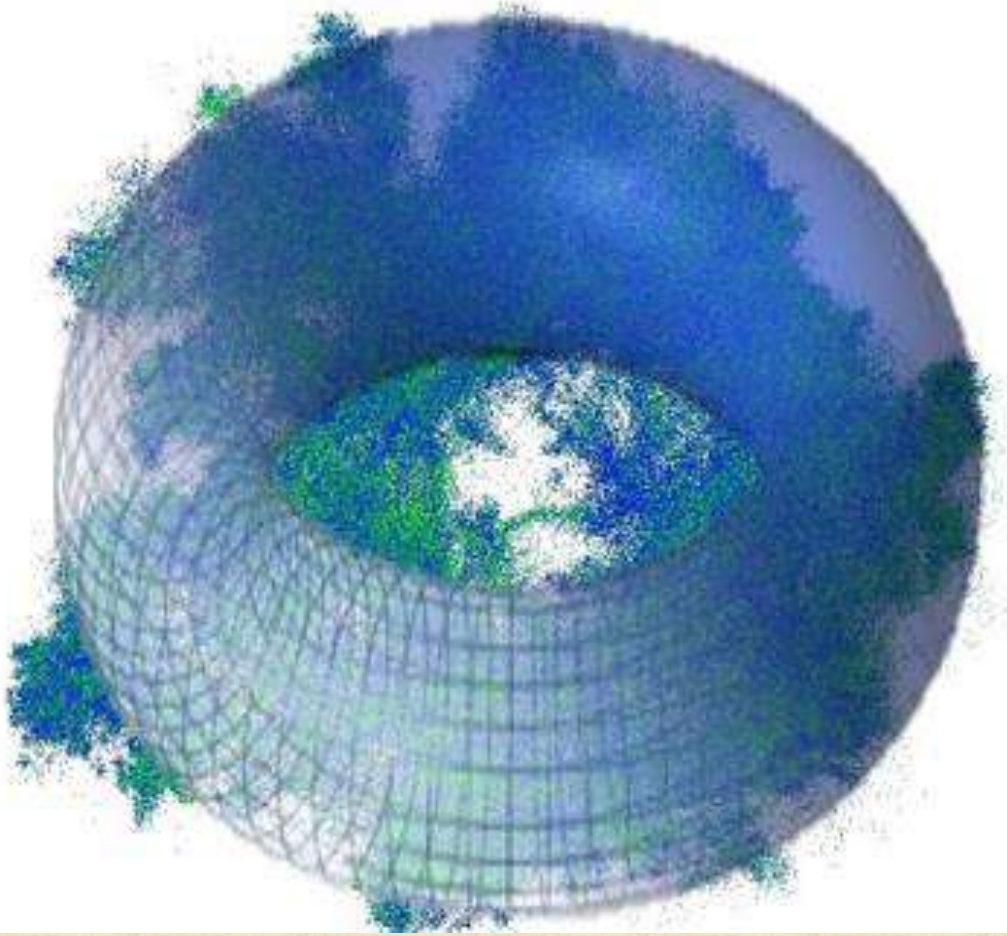
Calcolo del volume reale delle chiome



Paraboloide

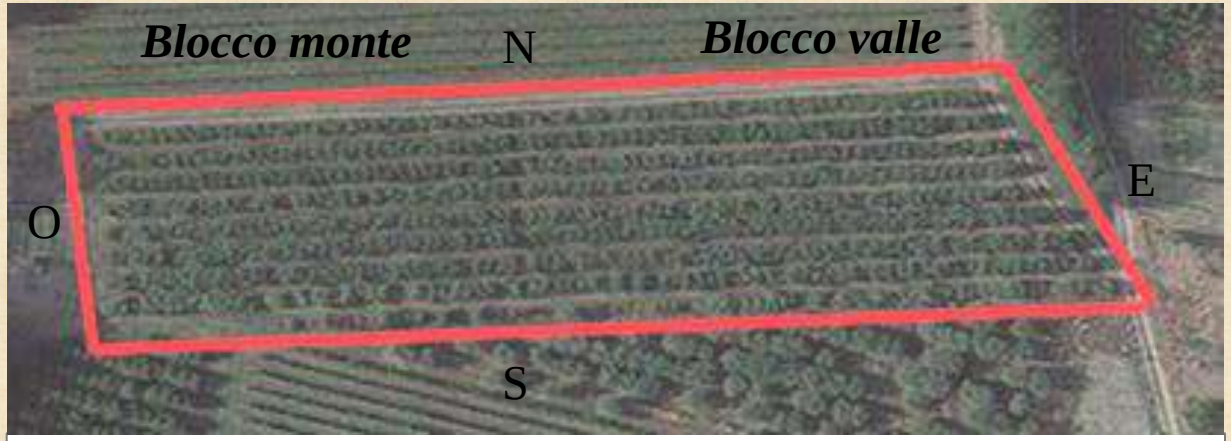
$$\frac{1}{2}\frac{\pi \cdot Dc^2 \cdot Hc}{4}$$



Toroidale

$$2\pi^2 \cdot Rr^2$$

Gestione della chioma in olivo ad alta densità



Nord

	1° filare	Arbequina	35 piante	FS-17	39 piante
	2° filare	Arbequina	35 piante	Tosca	48 piante
	3° filare	Tosca	35 piante	Don Carlo	46 piante
	4° filare	Piantone di Falerone	35 piante	Piantone di Mogliano	45 piante
Ovest	5° filare	Piantone di Mogliano	35 piante	Piantone di Falerone	44 piante
	6°filare	Ascolana tenera	35 piante	Rosciola laziale	45 piante
	7° filare	Rosciola laziale	35 piante	Ascolana tenera	47 piante
	8° filare	Maurino	35 piante	Sargano di Fermo	48 piante
	9° filare	Sargano di Fermo	35 piante	Maurino	39 piante

Sud — *Est*

- Varietà presenti in uno dei due blocchi
- Varietà presenti in entrambi i blocchi
- Varietà non considerate

Problematiche

- Oliveto non gestito dal 2017;
- Potatura non adeguata;
- Ombreggiamento dell'impianto con scomparsa dell'inerbimento;
- Diverse varietà nazionali e locali in fase di studio per gli habitus di crescita.

UNIVERSITÀ
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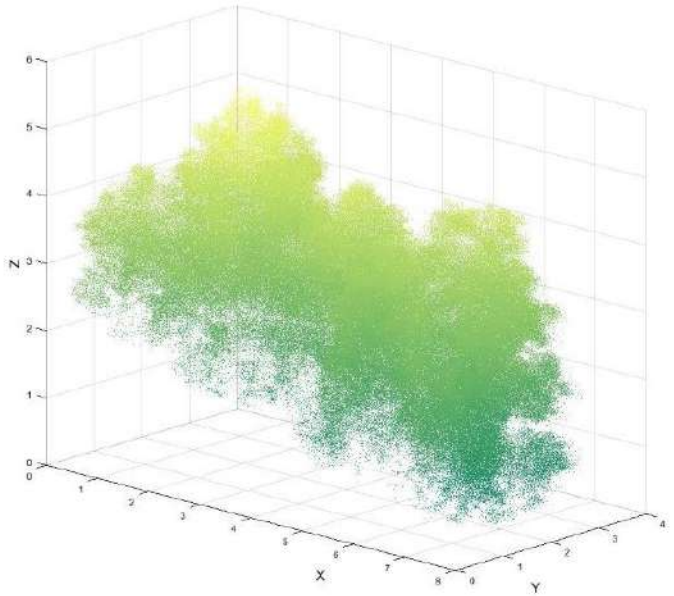
DELLE MARCHE

Potatura minima selettiva
Manuale

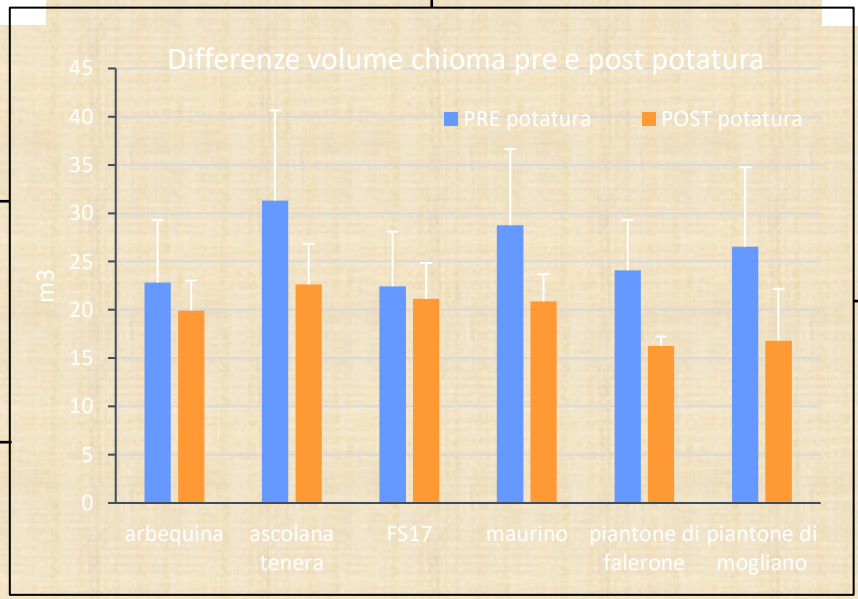
Gestione della chioma in olivo ad alta densità: Risultati

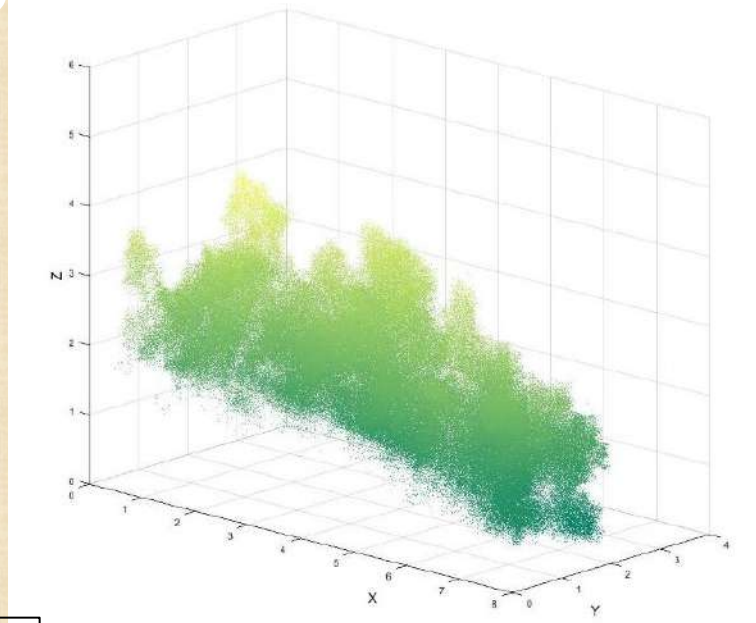
Differenze biometriche nel pre e post potatura
Dati LiDAR



Nuvola di punti chioma pre potatura

- I volumi si riferiscono a porzioni di vegetazione di 6 metri (3 piante circa)





Nuvola di punti chioma post potatura

- ***Barre blu***: chiome pre potatura, si notano le differenze nel naturale habitus delle varietà.
- ***Barre arancio:*** chiome post potatura, differenze che si appiattiscono, obiettivo di ricondurre le chiome a dimensioni simili.

- Variabilità (barre di errore) più accentuate nel pre potatura→ naturale sviluppo della varietà;
- Con le operazioni di taglio la variabilità si appiattisce→ potatura ridurre le differenze.

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Photovoltaic systems for fruit orchards

Davide Neri e Samuele Crescenzi

Dipartimento di Scienze agrarie, alimentari e ambientali

Università Politecnica delle Marche

1° point – «landscape»

- **Ground-mounted photovoltaic** (PV) arrays are the least-cost design solution
- The attention to their **impacts** in terms of **land-use** and land-transformation is growing,
- Concerns about **landscape** preservation and possible losses of ecosystem services.
- The **community acceptance** is often a barrier.
- The current design is generally aimed to **maximize energy generation**, given a certain land area.

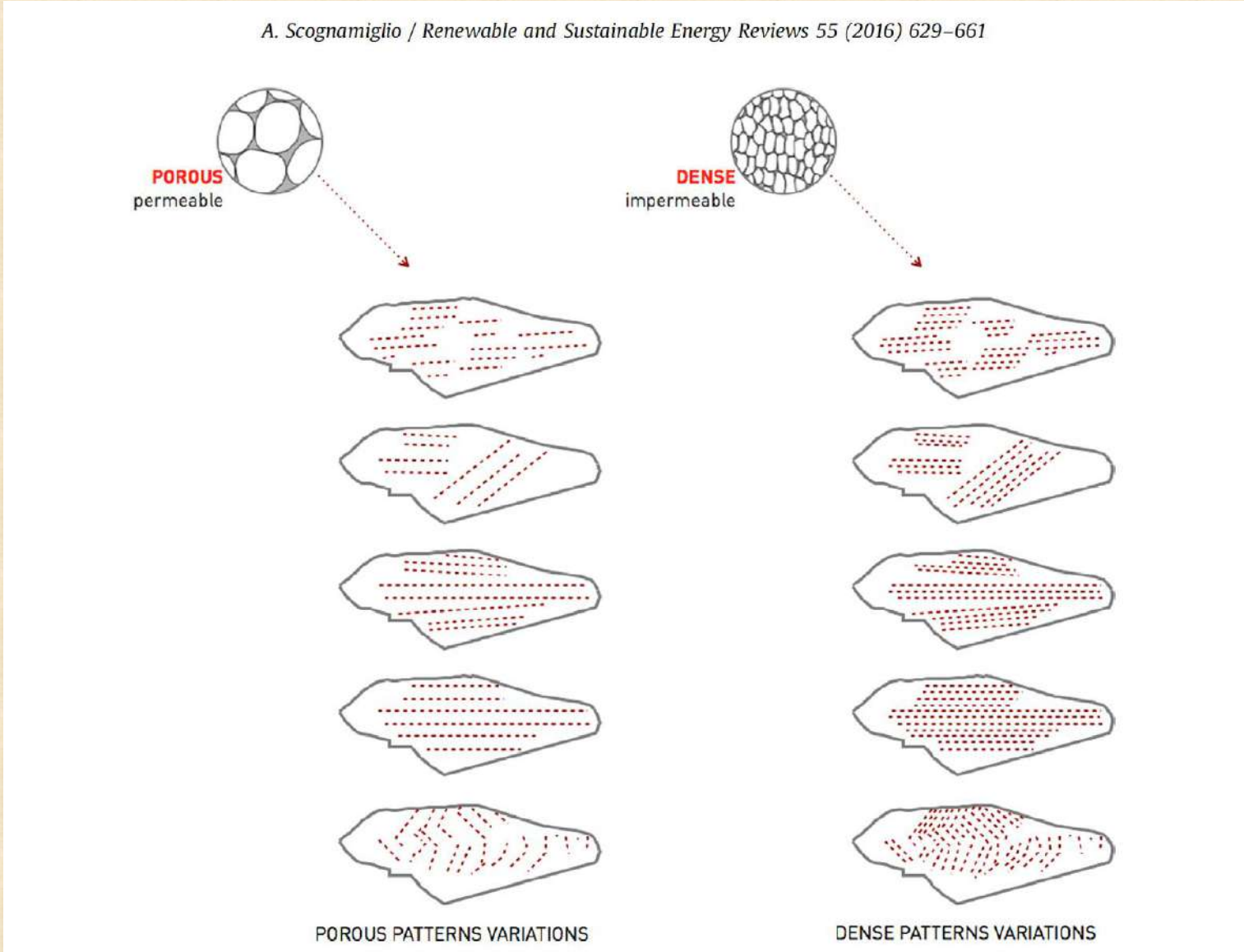
‘Photovoltaic landscapes’: Design and assessment. A critical review for a new transdisciplinary design vision
Alessandra Scognamiglio

Renewable and Sustainable Energy Reviews 55(2016)629–661

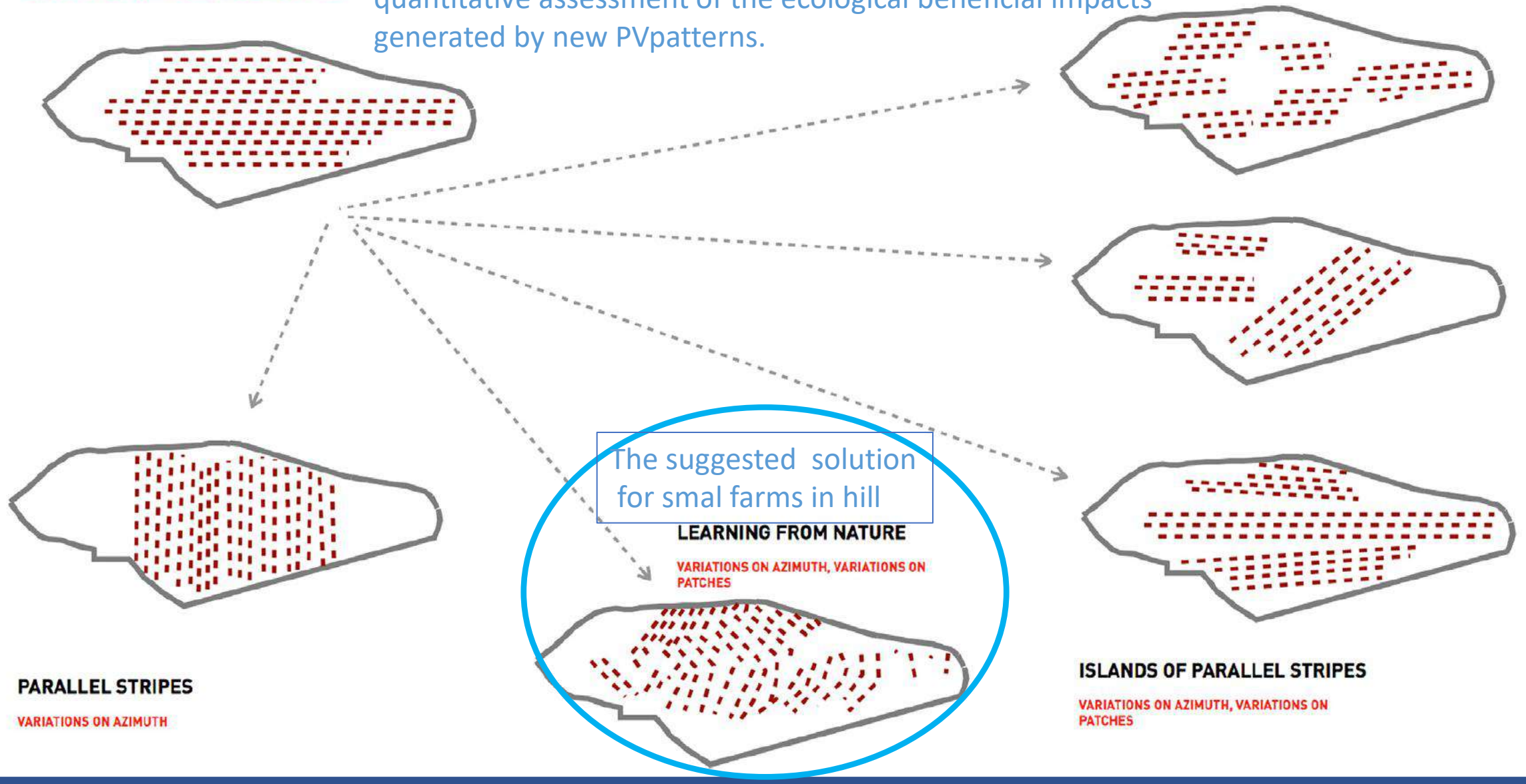
Porosity, or density, is a relevant attribute of a photovoltaic pattern. Porosity can be defined as the ratio between the total area of the installation and the area of the modules.

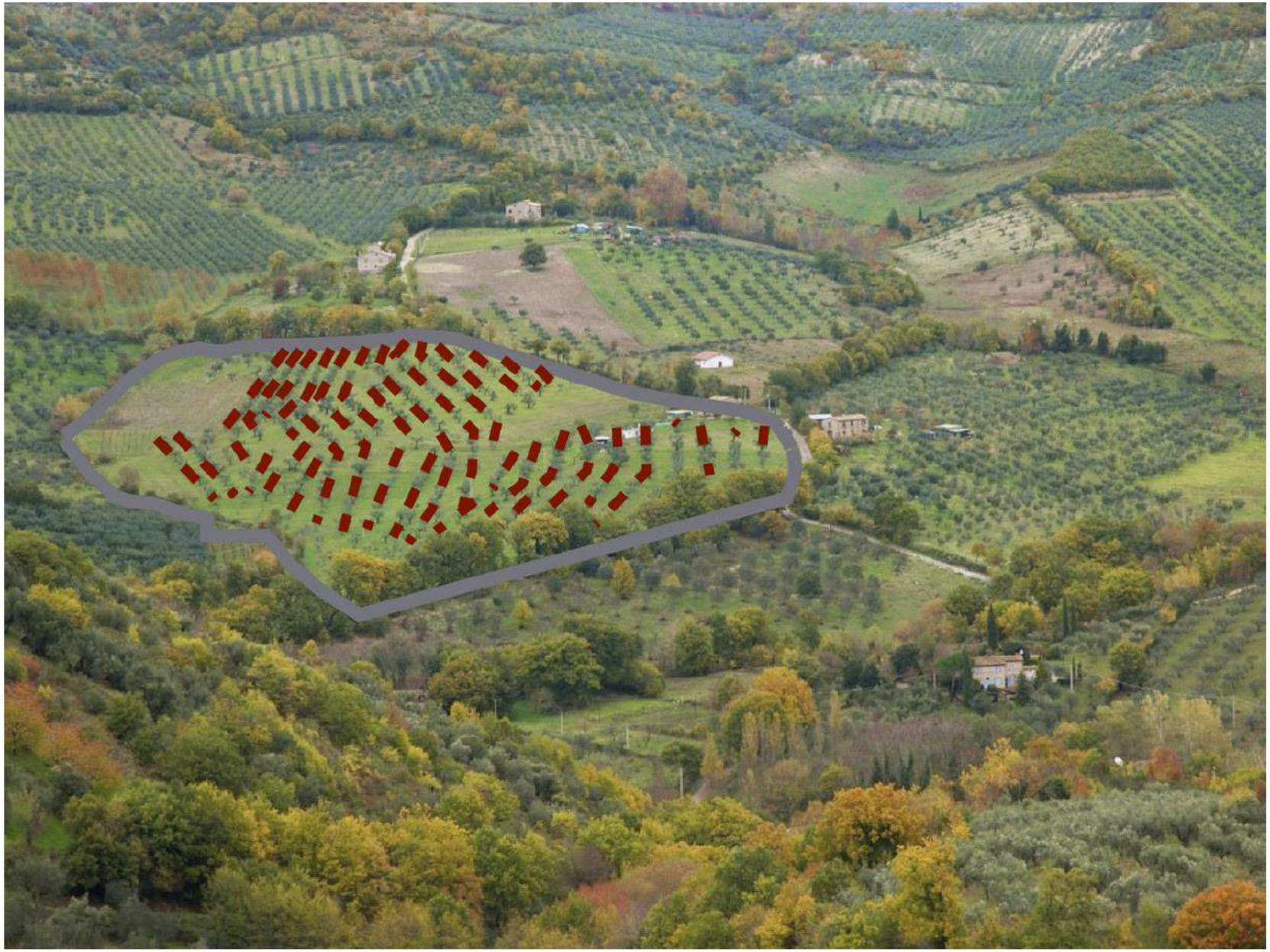
The space in which the phovoltaic pattern is arranged is a kind of “empty” space, that can be defined ‘pore’ space.

This is the space left in between the modules in a certain pattern. Patterns can be described as porous (permeable) or dense (impermeable). In the image variations on the degree of porosity are shown for some photovoltaic patterns



The study argues that new patterns would help in allowing a better ecological performance of the PV landscape, and the quantitative assessment of the ecological beneficial impacts generated by new PVpatterns.





The idea is that Pv systems should be designed as an element of the landscape they belong to

- according to an 'inclusive' design approach that does not focus only on the overall energy efficiency of the system,
- extends to other additional ecological and landscape objectives.

An original energy-design vision for on ground PV is advanced, rooted in an original concept of '**photovoltaic landscape**'.

Renewable and Sustainable Energy Reviews 55(2016)629–661

2° POINT – «FRUIT ORCHARDS»

Big two dimensional cherry ochard

Emilia Romagna, Portomaggiore (FE): ***Cherry*** Van

Anticracking hail net system with pearl Iridium®

Small two dimensional cherry orchard with multifunctional cover systems

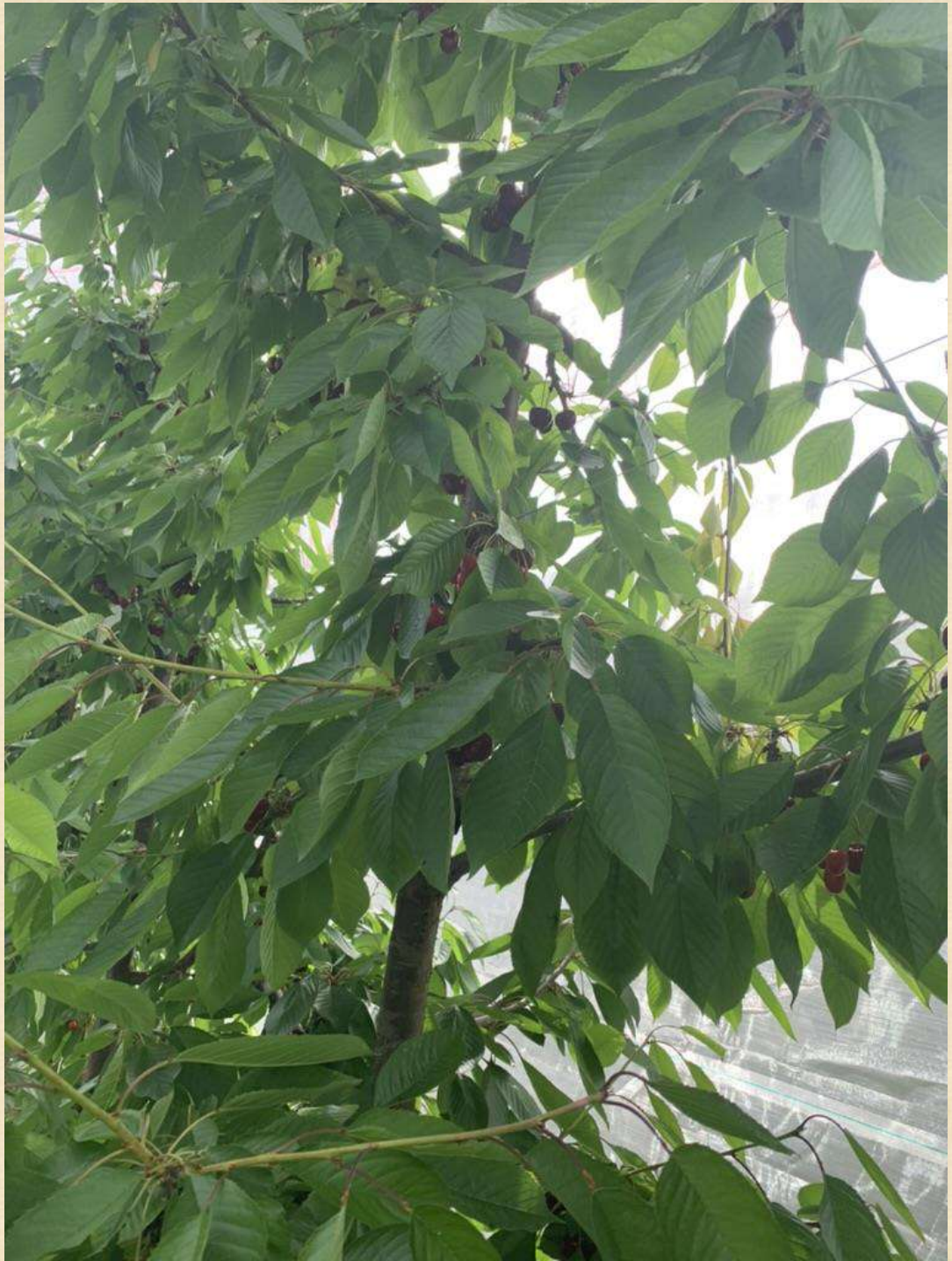
Small two dimensional cherry orchard with multifunctional cover systems

Emilia Romagna, Portomaggiore (FE): ***Cherry*** Van

Mechanization in two dimensional cherry orchard for harvest and pruning

Small two dimensional cherry orchard with multifunctional cover systems

Small two dimensional cherry orchard with multifunctional cover systems



(with less than 40% of total shade)

PROS

The net covers
the cherry fruit against:

Top: Rain (wagter proof)
Lateral:

- Hail
- Sunburn
- Wind
- Insect (Drosophila suzukii) (Rhagoletis spp) Halyomorpha halys

- Improve irrigation efficiency and photosynthesis during fruit maturation

CONS

The lateral cover must remain only up to 40-60 days (from 10 days after fruit set up to harvest).

- Longer periods will increase other pest damages (mites, fungal diseases …)
- In summer flower bud formation for the next year fruit production needs maximun available light

Small two dimensional cherry orchard with multifunctional cover systems

Top:
anti rain
water proof

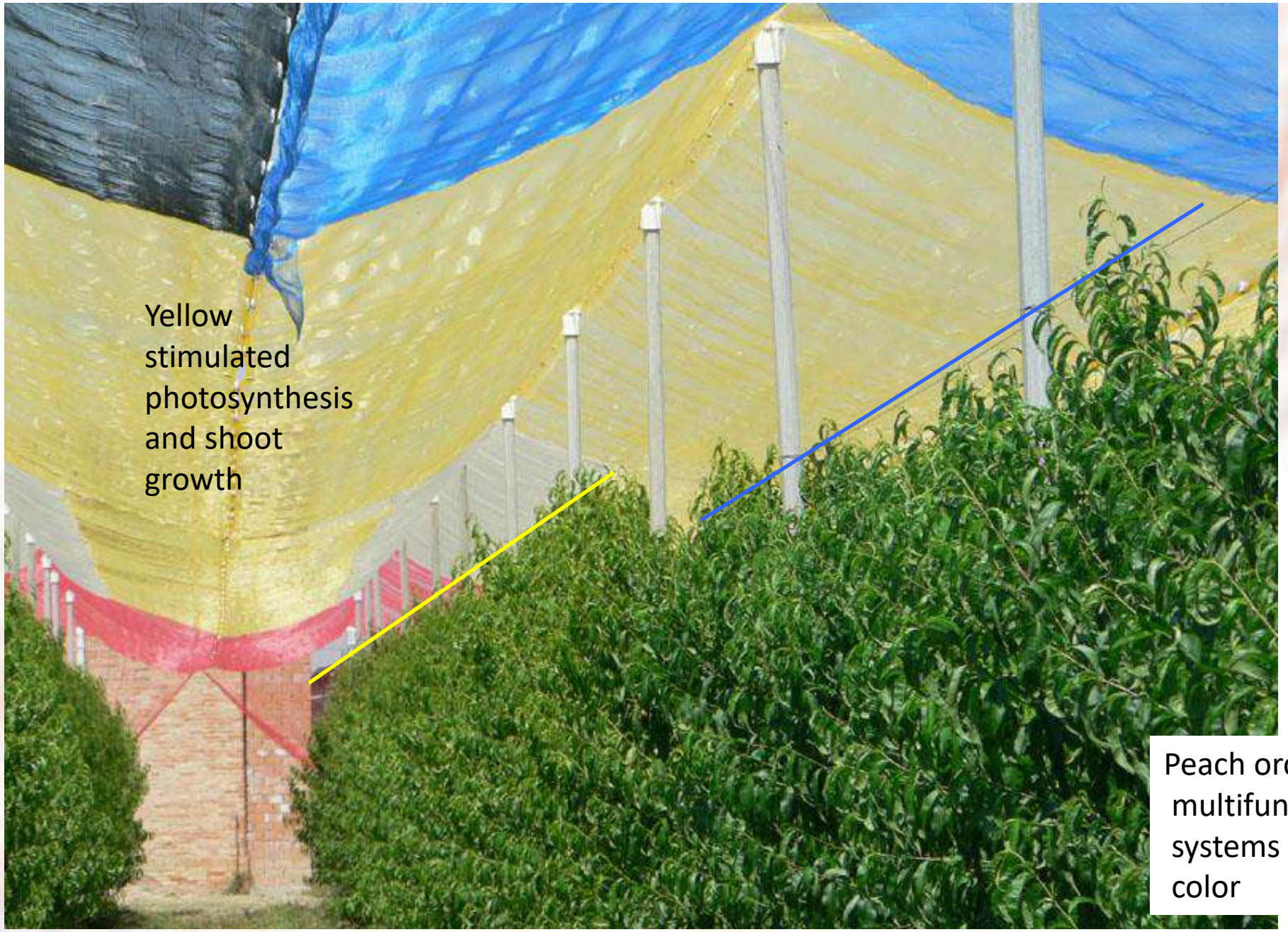
Lateral:
anti insect

Small two dimensional cherry orchard with multifunctional cover systems and PV /drawing)

Top:
anti rain
water proof
PV

Lateral:
anti insect

Emilia Romagna, Faenza: nectarine “Romagna 3000”



Blue induced more compact growth

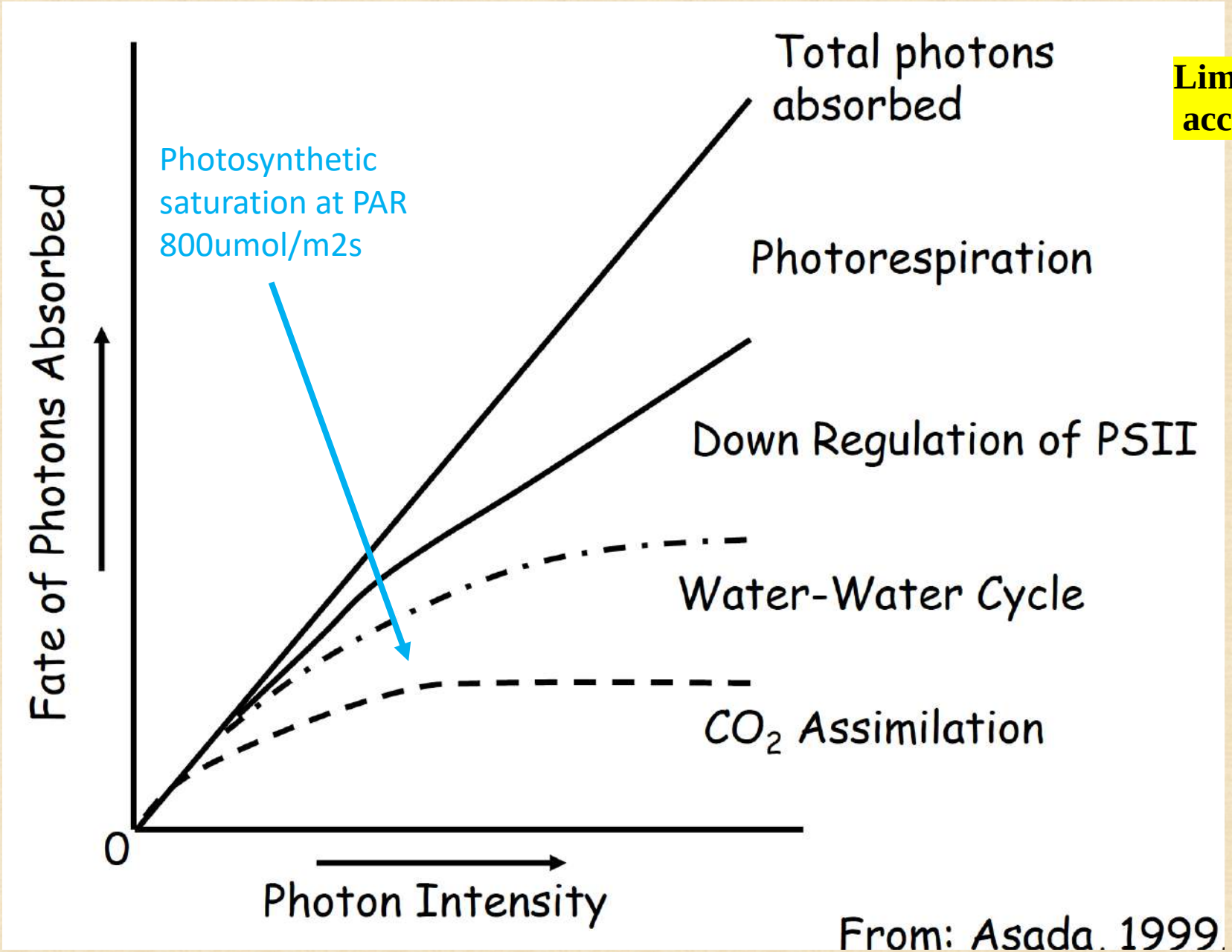
Peach orchard with multifunctional cover systems with different color

The need for photo-selective hail-nets and cover

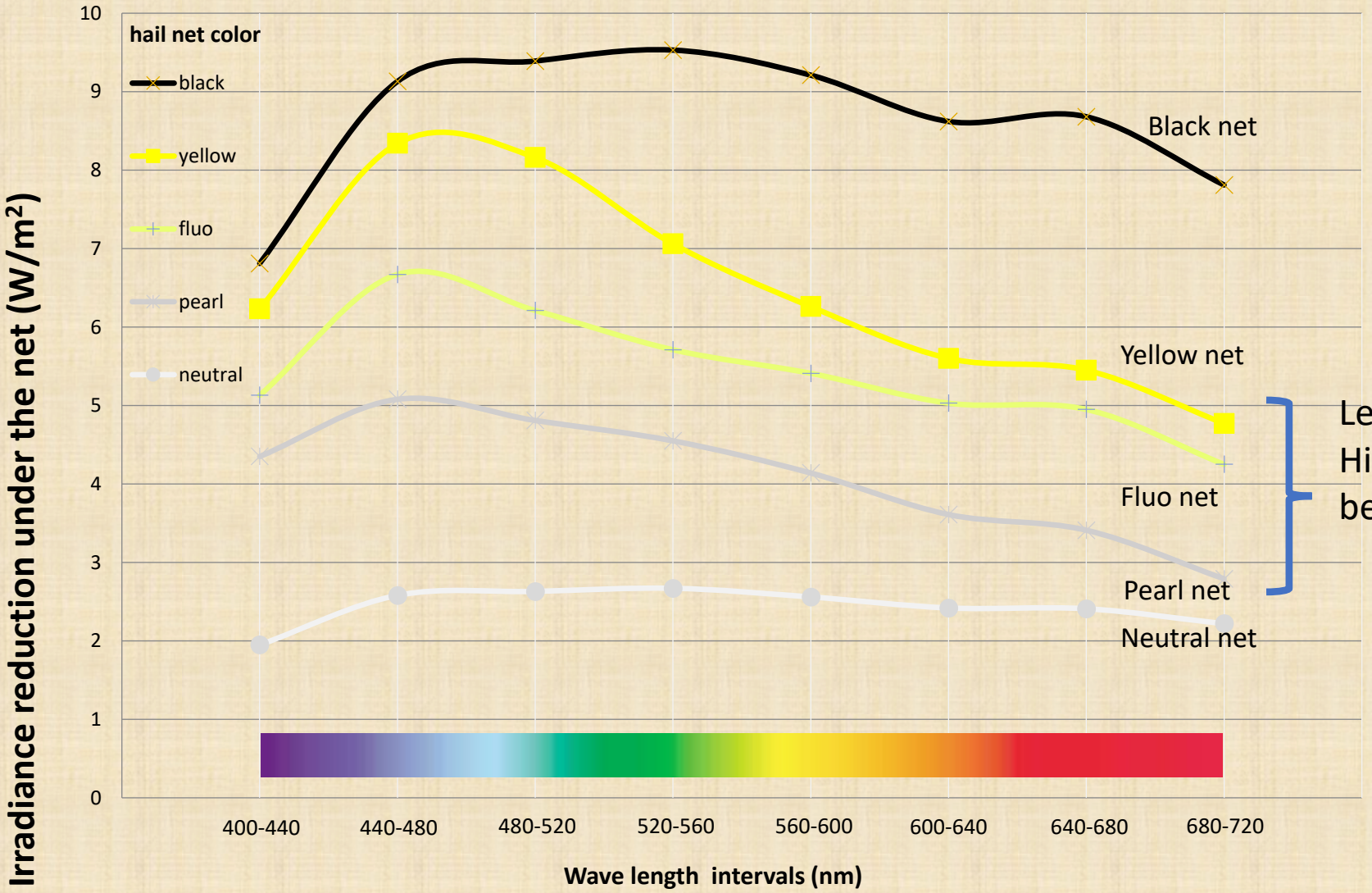
Table 1. Light quality modification by ColorNets. The relative change refers to the composition of the light transmitted through the plastic threads of each type of net, having the same shading factor (in PAR), relative to the natural sunlight measured at the same time. UV, ultra violet; B, blue; G, green, Y, yellow; R, red; FR, far red. Scattering refers to the scattered/direct light ratio under each net relative to natural sunlight at the time of measurement. For more details see Shahak et al. (2004a).

Net	Absorption	Transmittance	Scattering
Blue	UV+Y+R+FR	B+G	++
Red	UV+B+G	R+FR	++
Yellow	UV+B	G+Y+R+FR	++
White	UV	B+G+Y+R+FR	++
Pearl	UV	B+G+Y+R+FR	+++
Grey	all (+IR)	-	+
Black	all	-	0

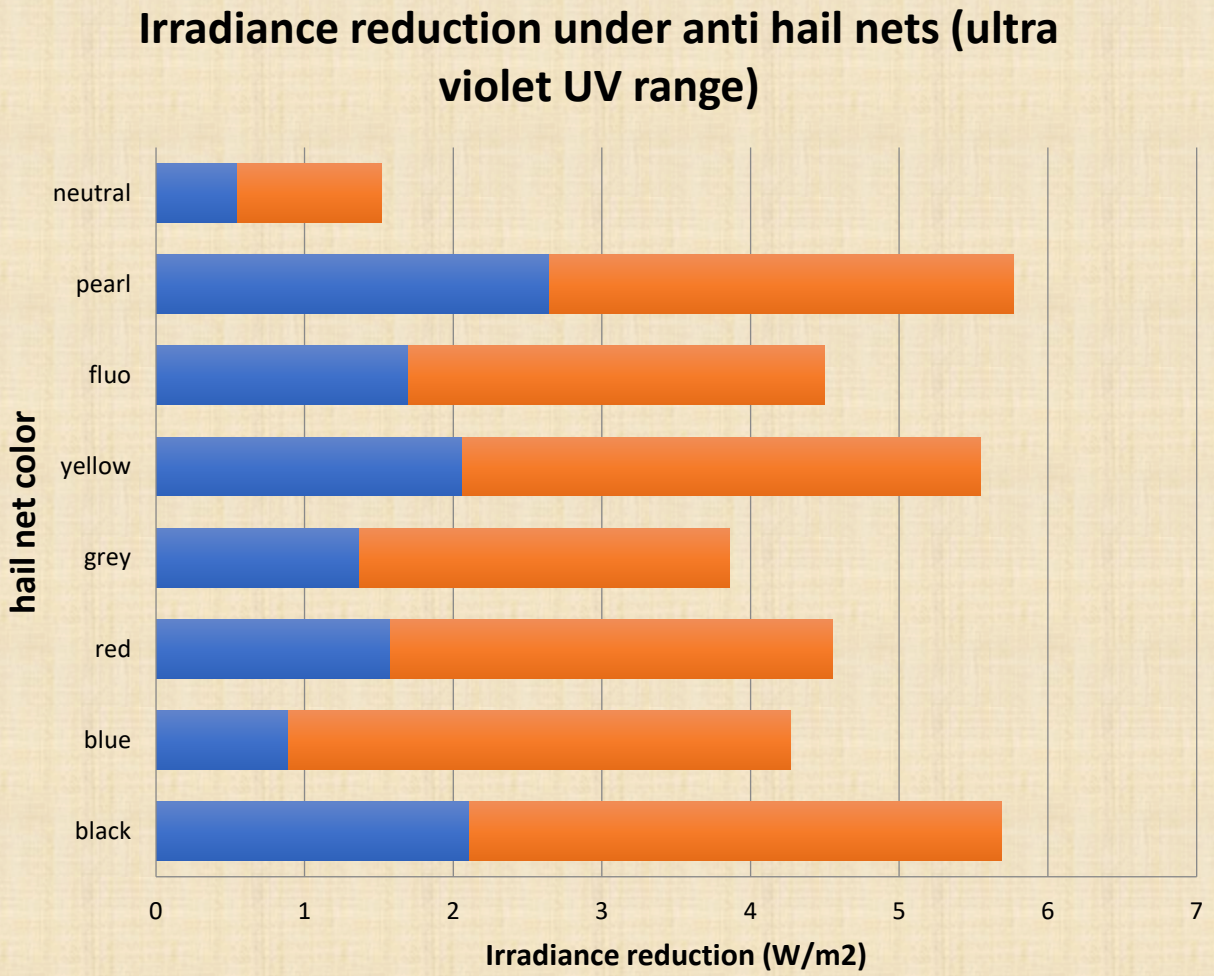
Limit of photosynthesis according to available light



Irradiance reduction under the net (W/m^2) according to the color



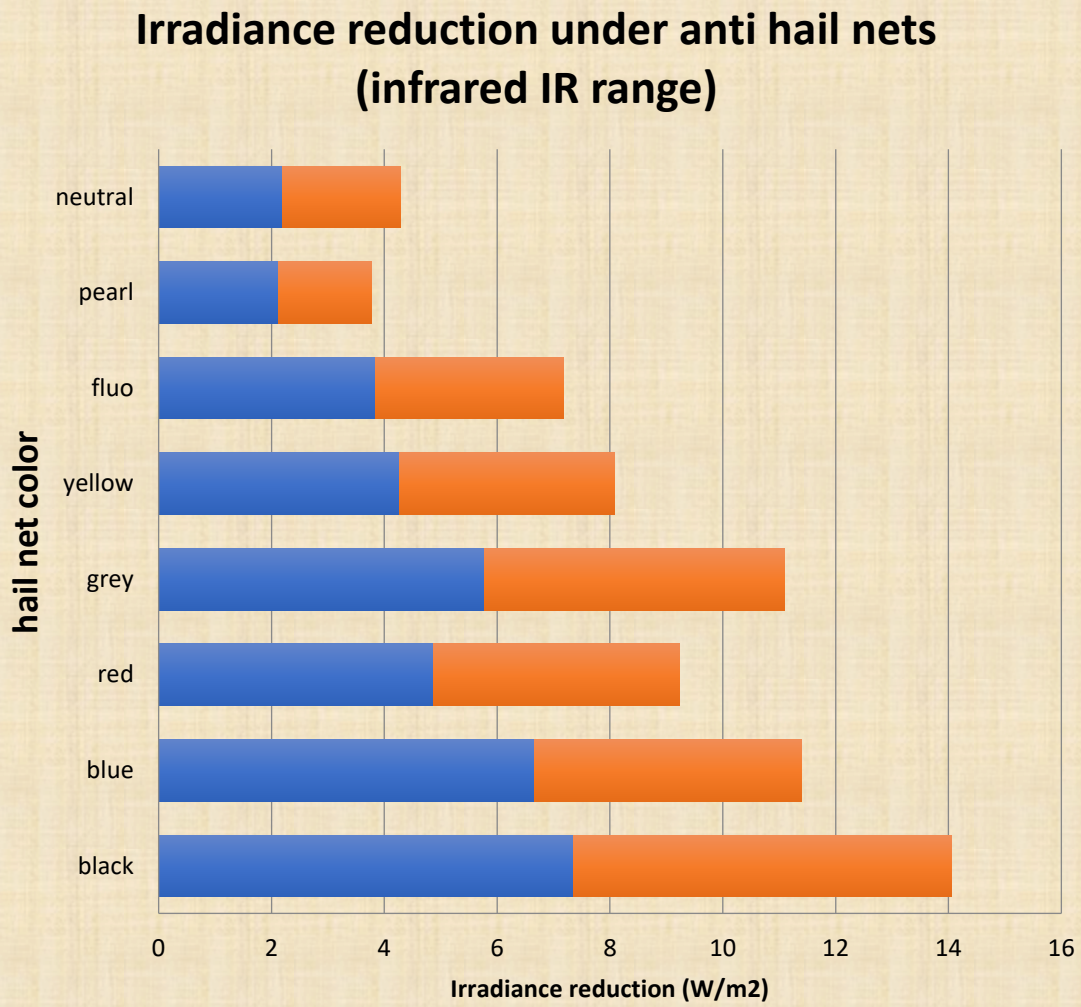
Light spectrum modifications under photo-selective hail-nets Neri et al 2021



UV reduction (%)

Net color	% reduction
Black	22.3
Blue	22.6
Grey	16.7
Red	19.1
Yellow	23.1
Fluo	18.1
Pearl	24.4
Neutral	6.3

Pearl showed more diffused light and less shade



IR reduction (%)

Net color	% reduction
Black	24.9
Blue	21.0
Grey	21.1
Red	16.4
Yellow	13.9
Fluo	12.8
Pearl	8.0
Neutral	7.7

Reduction of wind speed under the nets.

Under the net :
46% of reduction of average wind speed

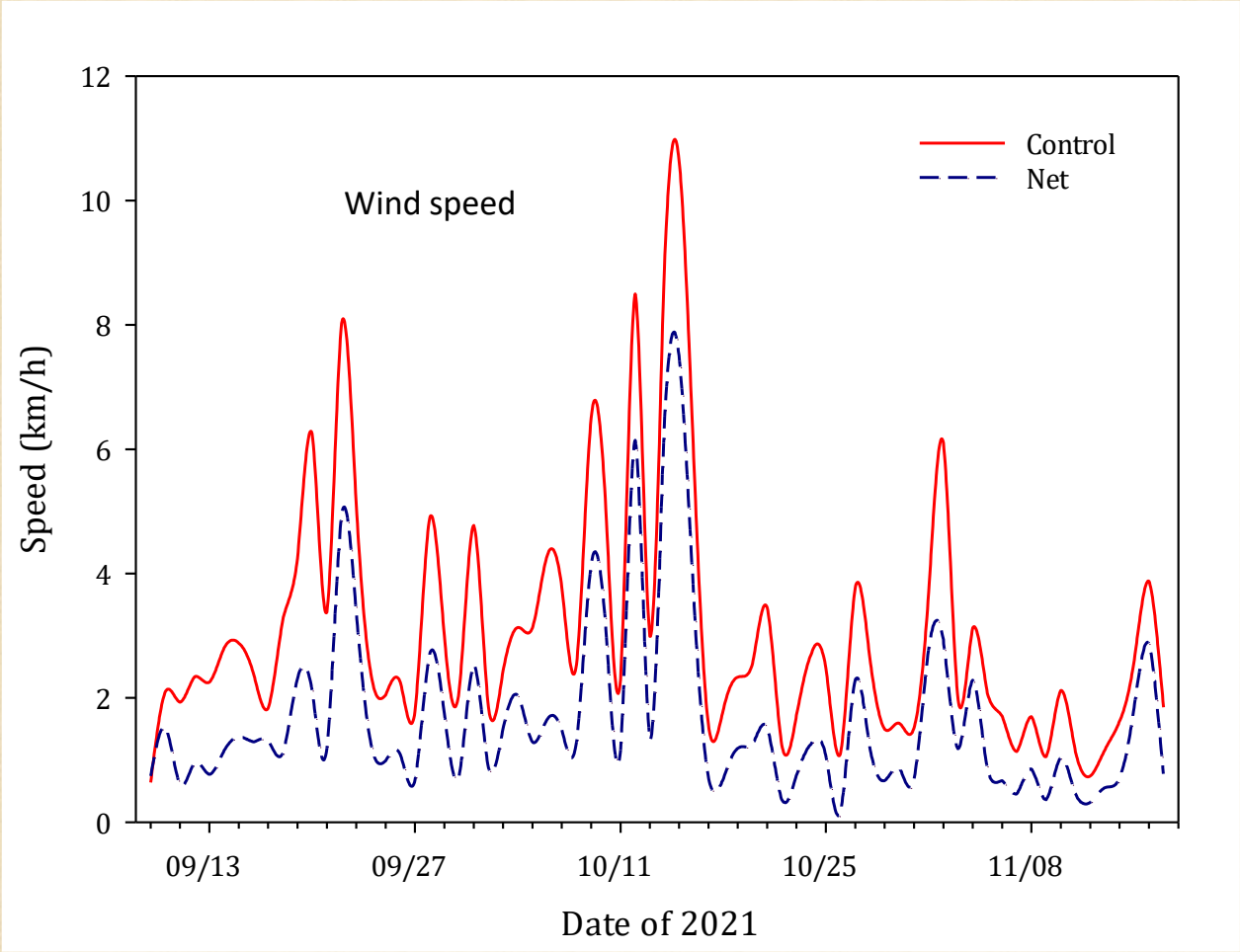
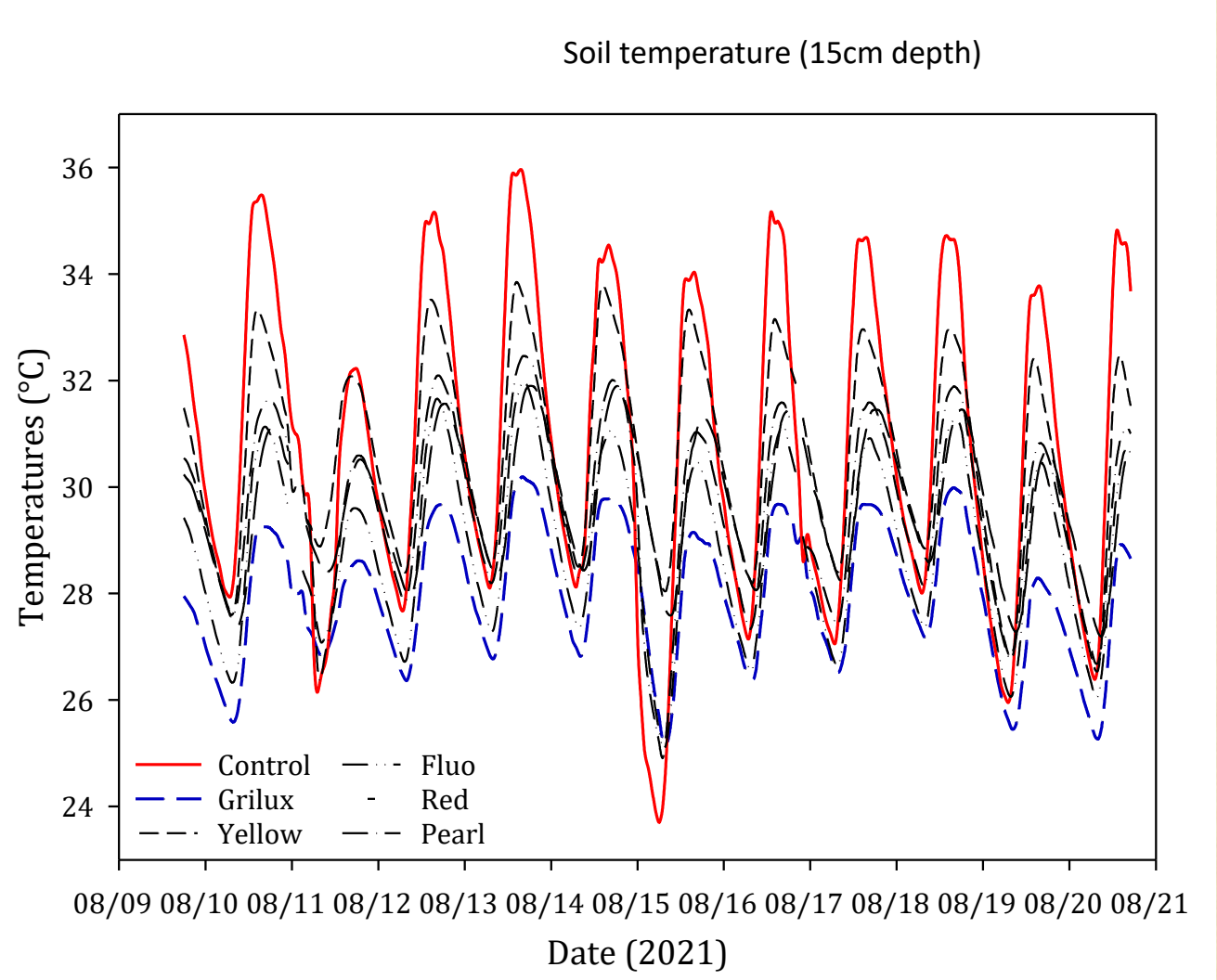


Photo-selective plastic nets in pomegranate orchards. 2022. S. Crescenzi, M. Zucchini, V. Giorgi, G. Vaccaro, D. Neri. ISHS Acta Horticulturae 1349:



Soil temperatures were lower under the nets. During the daylight only the yellow net showed soil temperatures close to the control.

Photo-selective plastic nets in pomegranate orchards. 2022. S. Crescenzi, M. Zucchini, V. Giorgi, G. Vaccaro, D. Neri. ISHS Acta Horticulturae 1349:

On flat agricultural farms

PV pannels large +-2 m, with a transparency of 40%

Inter row 3-4m

KU Leuven

40% trasparency

Cells 156mmx156mm 21% efficiency

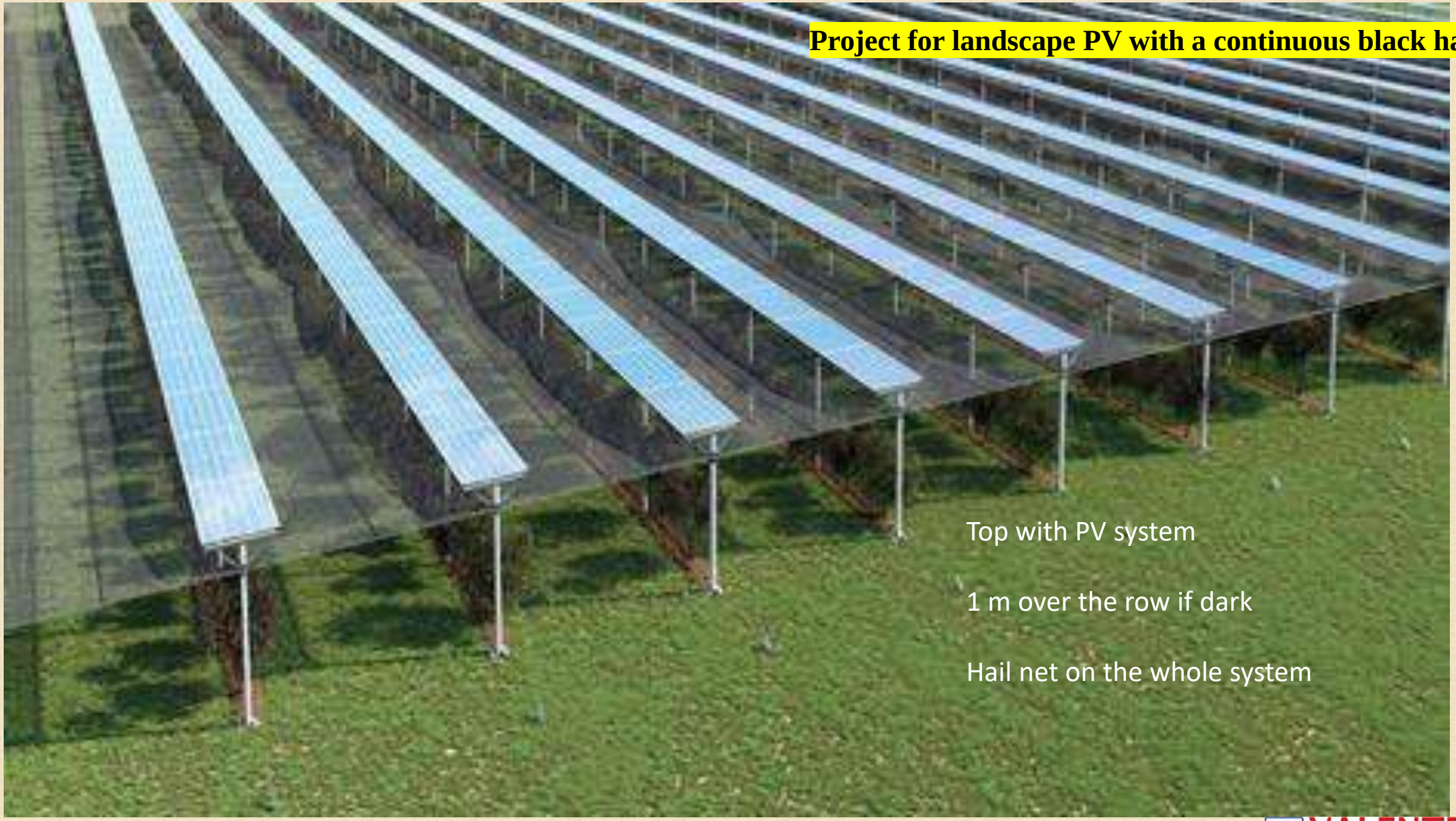
“There is always a tradeoff between the transparency level and the PV power,” Willockx said, noting that higher transparency levels will result in lower PV power density, and vice versa. “However, there is also a financial transparency limit: The needed PV power and energy returns must be calculated in function of the fixed structural costs to be financial attractive … This in combination with the needed transparency levels for the crop growth, explains the complex design of agriPV set ups.

KU Leuven

Project for landscape PV with a continuous black hail net

- Top with PV system
- 1 m over the row if dark
- Hail net on the whole system

Project for landscape PV with a continuous black hail net



Top with PV system

1 m over the row if dark

Hail net on the whole system

Top with PV system

1 m over the row if dark

Up to 2m if 40% transparent

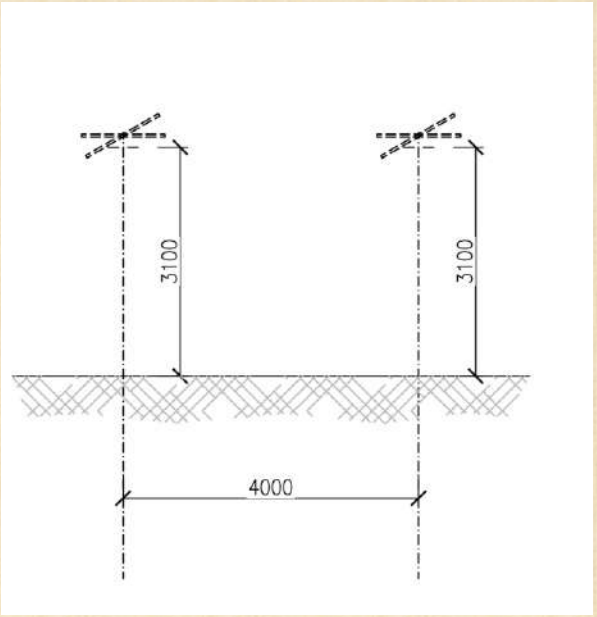
Olive

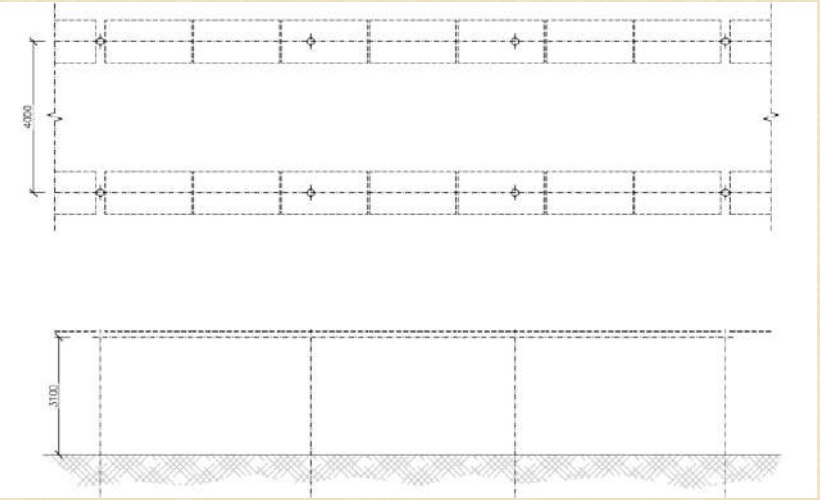
Rendering per il progetto Neri «pannelli e olivo da mensa»

Disegno: Davide Neri Monica Pantaloni e UNIVPM

Disegno: Davide Neri, Monica Pantaloni e UNIVPM

Modello di agrivoltaico e reti antinsetto - su filre di oliveto alta densità





Oleificio moderno,1901

Realtà supera fantasia