



UNIVERSITY OF PADUA
FACULTY OF AGRICULTURE

**The sustainability of cultural practices on
veteran trees: a protocol for integrated
assessment and care**

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THE MONUMENTAL TREE

What is a monumental tree?, it is not only a beautiful tree, a survivor. He is a witness of the landscape and its evolution in the history of the men who through the generation have planted, tended and ruled, have enjoyed the benefits cease to be a tree to become the bridge between the past the present human history

Objectives of the research

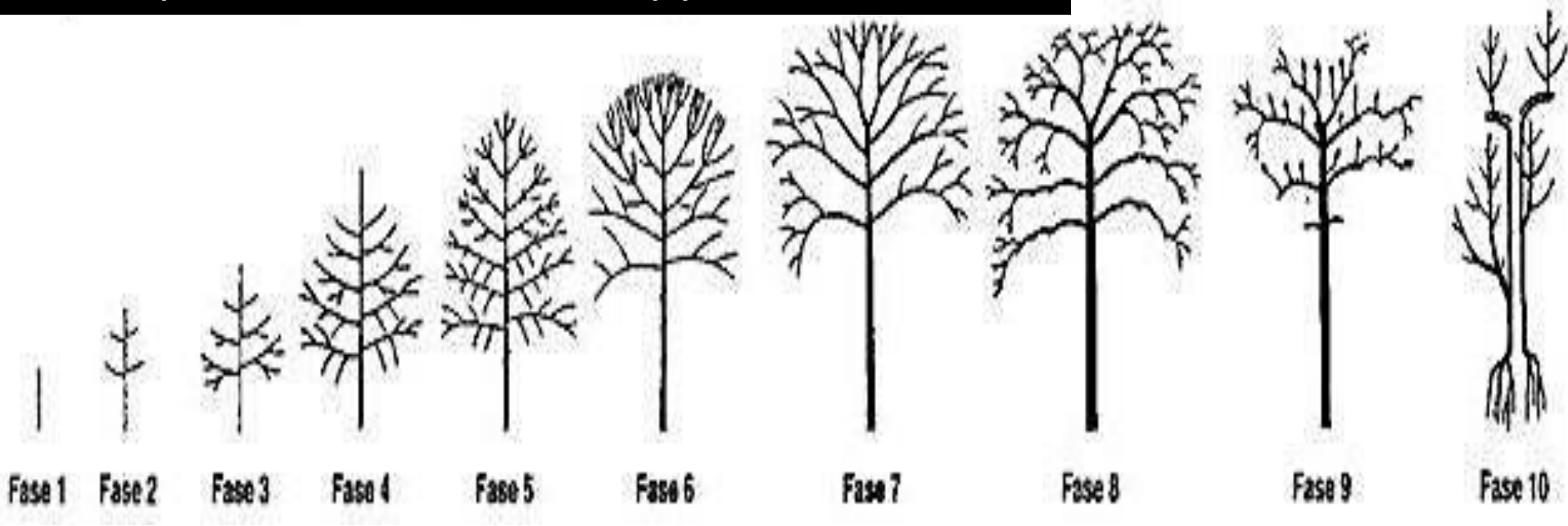
Safeguard measures and recovery must be anticipated by careful evaluations of arboreal specimens poring over vital and biomechanical parameters .

Only after you will be able to determine **the timing , the ways and tecchniques best suited** .

Becomes necessary, establish a protocol for evaluation and sustainability of possible cultural practicies

Senescence and Aging: Help you can apply these concepts to Tree?

Physiological and morphological stages of the development of the tree canopy



The age of the mother plant does not cause changes in the performance of branches that are taken from this and grow regardless of the facts.

Connor & Lanner (1990) and Lanner & Connor (2001) have tried to assess the possible symptoms of senescence in the oldest plants on the planet that is in specimens of *Pinus longaeva* of 4713 years (!) compared to plants "youth" of the same species (about 200 years).

We analyzed many parameters that usually are associated with aging such as pollen viability, seed germination, seed weight and also others such as the structure of xylem and phloem, length of castings annually. In none of these parameters we were able to observe certain age variations of individuals. Lanner & Connor (2001) conclude, therefore, that the concept of senescence of apical meristems or exchange can not be applied in the case of the species investigated because no type

So why the trees deteriorate, "Probably not perish because they are old."

The decay of the tree

- Assimilation does not seem to be the limiting factor in the growth of adult trees given that there **is no effect on growth in conditions of high CO₂**
- The concept of **size-related decline (stress progressive depending on the size)** would be replaced with a concept that could define **the optimal adjustment that is of permanence in a status optimum physiological during growth that is achieved with structural modifications of the conduction system** Anfodillo et al. (2006) could be delineated on the basis of some of the consequences that result from the model of West et al. (1999), verified empirically by Anfodillo et al. (2006), and some related work (Enquist, 2002; Enquist, 2003).
- Because the biological functions of the shaft are the same for the duration of life, the concept of senescence or old age for a tree is meant a substantially **slowdown the performance of such functions that involves a slowing of metabolic reality of the shaft and finally a less accumulation of biomass**

$$P < E$$

The concept of size-related decline (ie progressive stress in function of the size) would be replaced with a concept that could define the optimal adjustment that is of permanence in a status optimum physiological during growth that is achieved with structural modifications of the conduction system (Anfodillo et al., 2006)

METABOLIC PARAMETERS

crown and branches

Elongation of the apical jets

Rating transparency

Size of leaf

Presence and size of epicormic branches

Progress of the healing callus

dendrochronology

roots

Loss of roots

Number of lateral branches

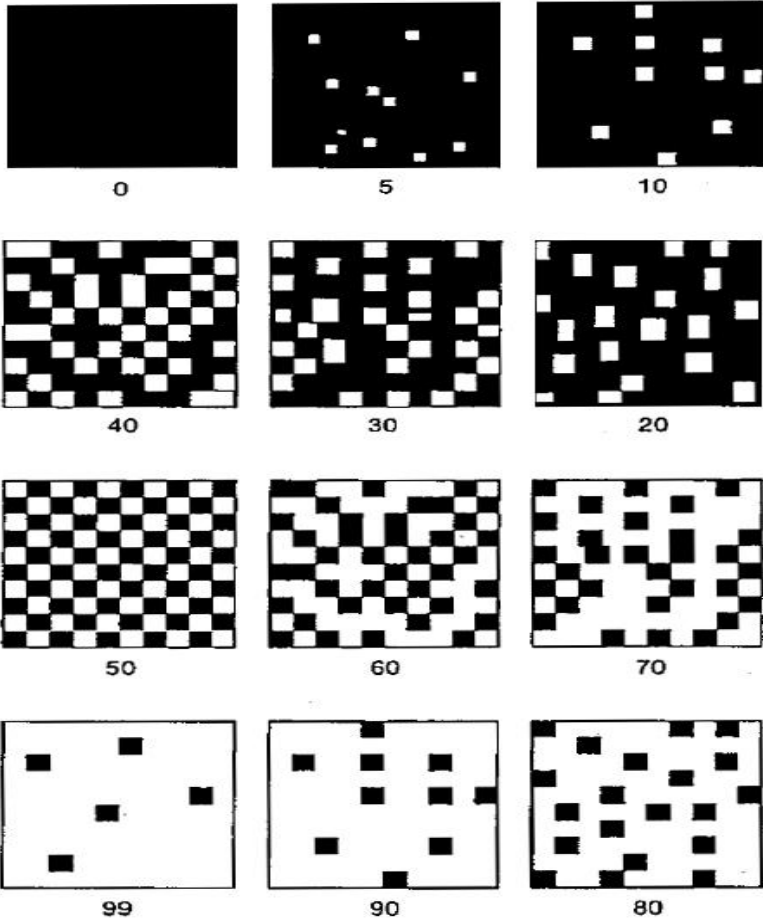
Length of root systems

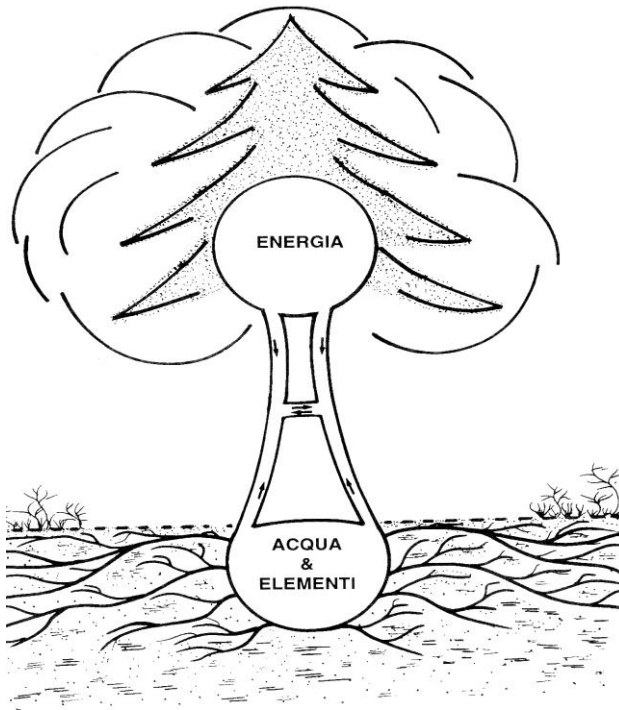
Evaluation of mycorrhization



Method of valuation adopted:

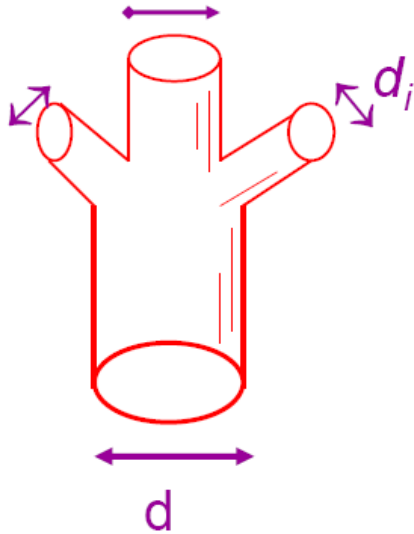
Scheme guide for the estimation of the transparency of the foliage (by Eichhorn et al., 1998)





The trees can be compared to a huge pump living. To maintain a high degree of functioning in a living system, requiring a continuous administration of energy. A high degree of order in the system means health. (From: The modern arboriculture, A. Shigo)

HYDRAULIC TAPER

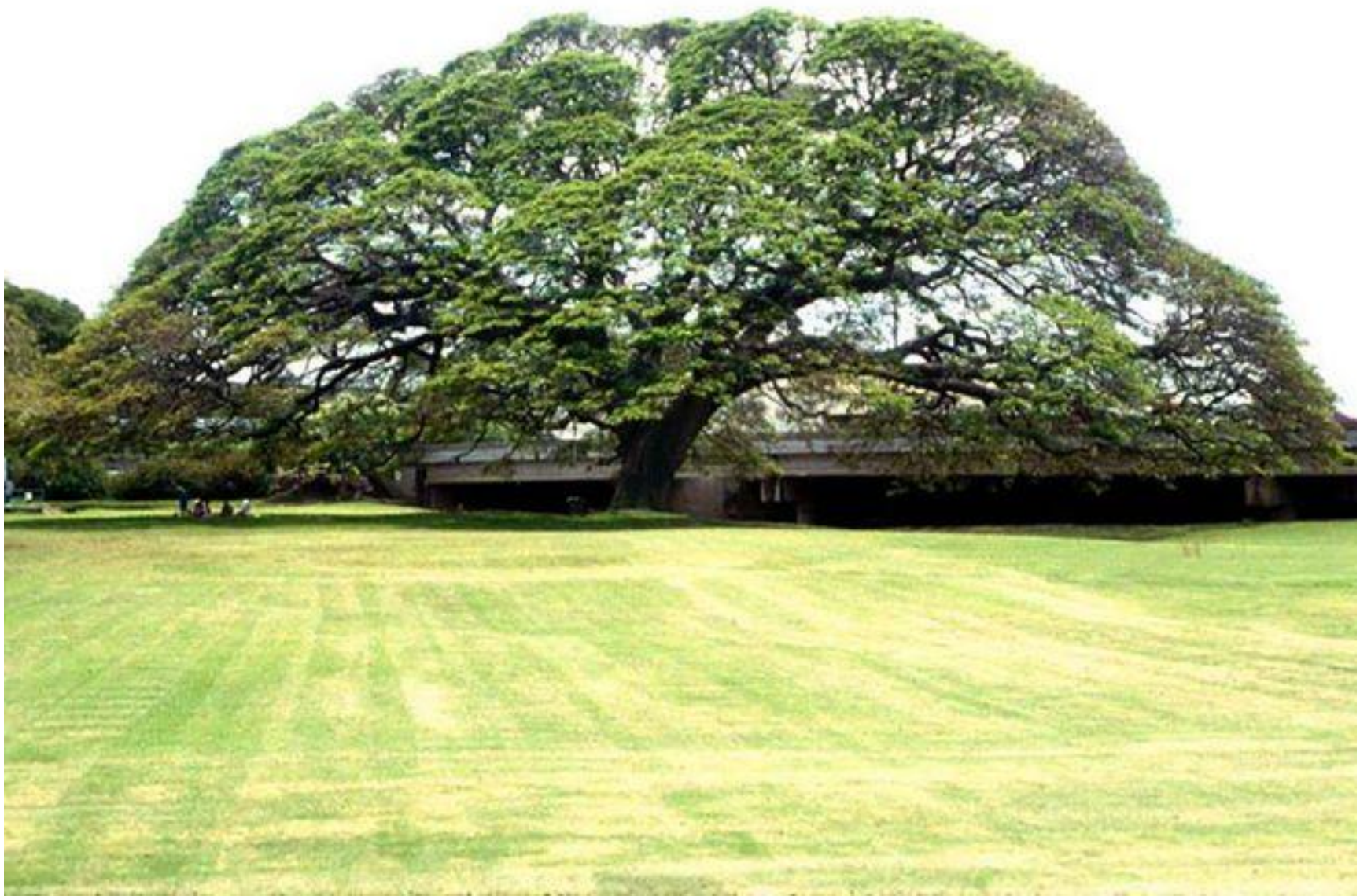


$$d^2 = \sum d_i^2$$

Rule of Leonardo

(Leonardo da Vinci (1452 - 1519))













15/08/2012













Many fail to understand - or do not think - as the physiology of trees is subject to and dependent wholly on energy balances and the principles of thermodynamics.

The plants are the largest living accumulator of solar energy that is then reused in part, to grow, to stand, to defend themselves and to reproduce. Every action performed by men or from the surrounding environment has an impact on these "batteries" natural. Just thinking in terms of energy you can thoroughly understand the trees

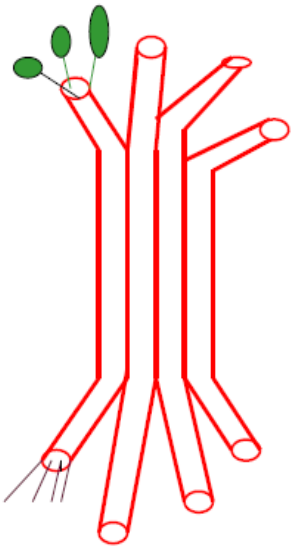
There are several theories about growth, including 3 main :

1. Needle mass theory (growth biometrically conditioned)
2. Constant stress theory (accretion mechanically conditioned)
3. Pipe model theory (accretion hydraulically conditioned)

The regeneration of the roots

“pipe model“

(SHINOZAKI et al. 1964) :



The model of the plant to the tubes (Unit pipe model of plant form) the tree is seen as a set of elementary units in the form of pipe each of which supports a unit leaves (Shinozaky et al.1964

According to this model a plant can afford a certain mass of leaves provided you have an adequate system to conducting

We can deduce that rebuilding a conduction system from the regeneration of the roots is possible to balance the leaf mass

Where the tree reiterates new roots?





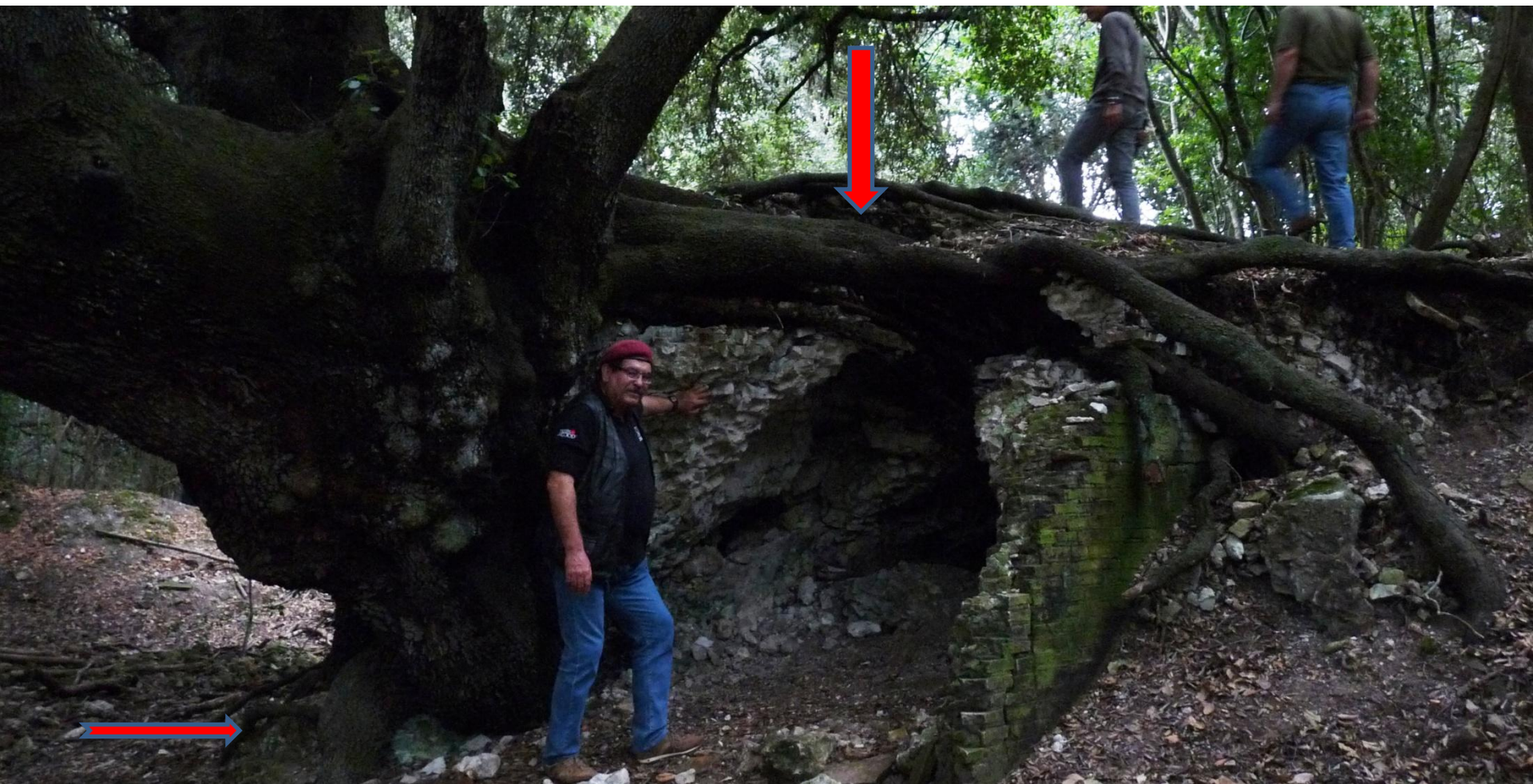


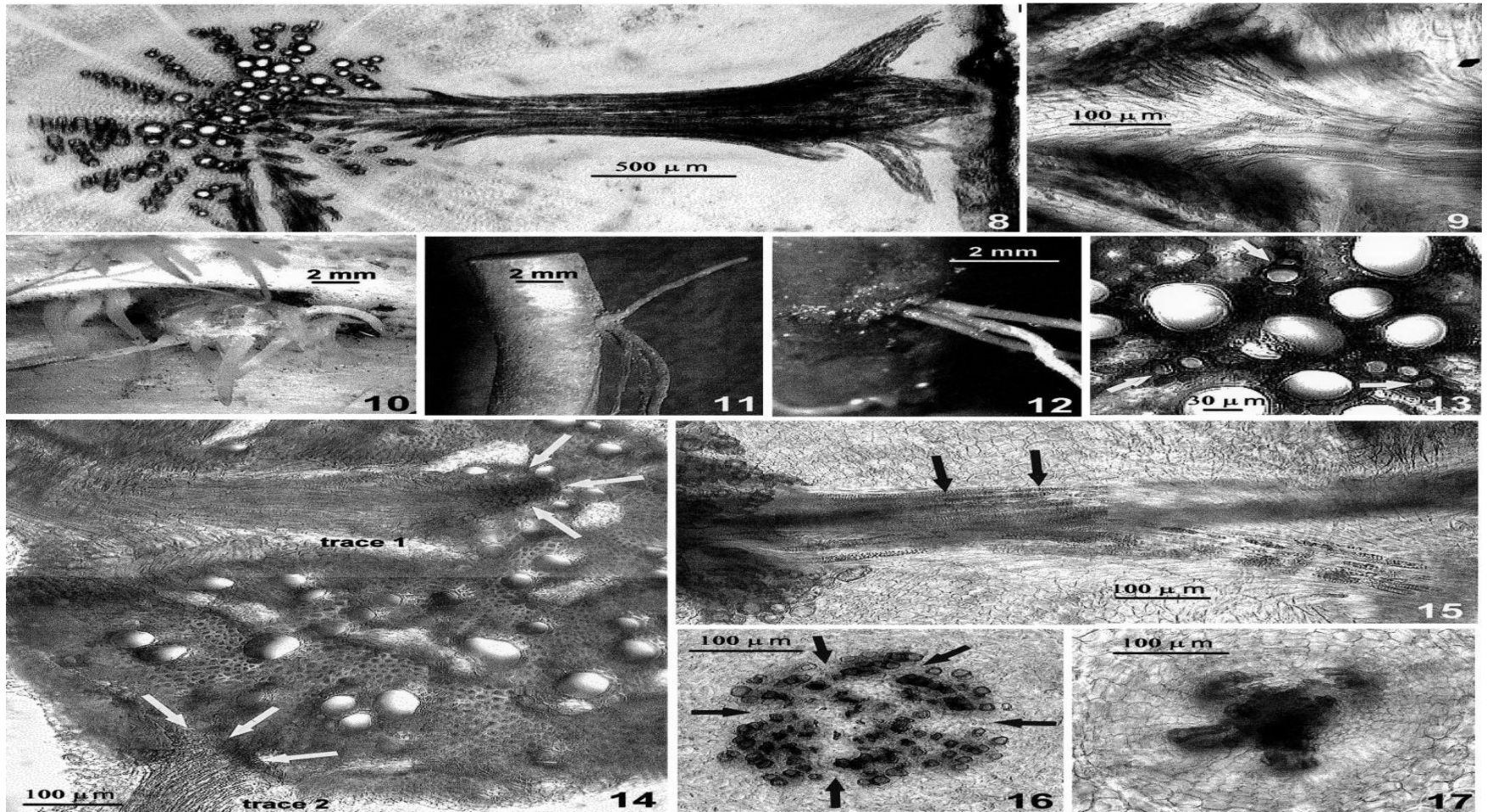










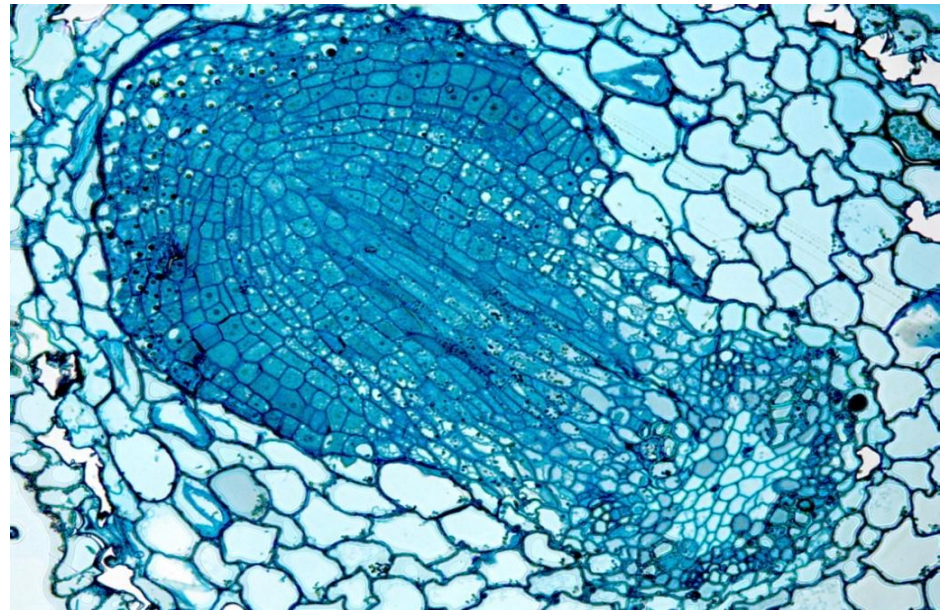
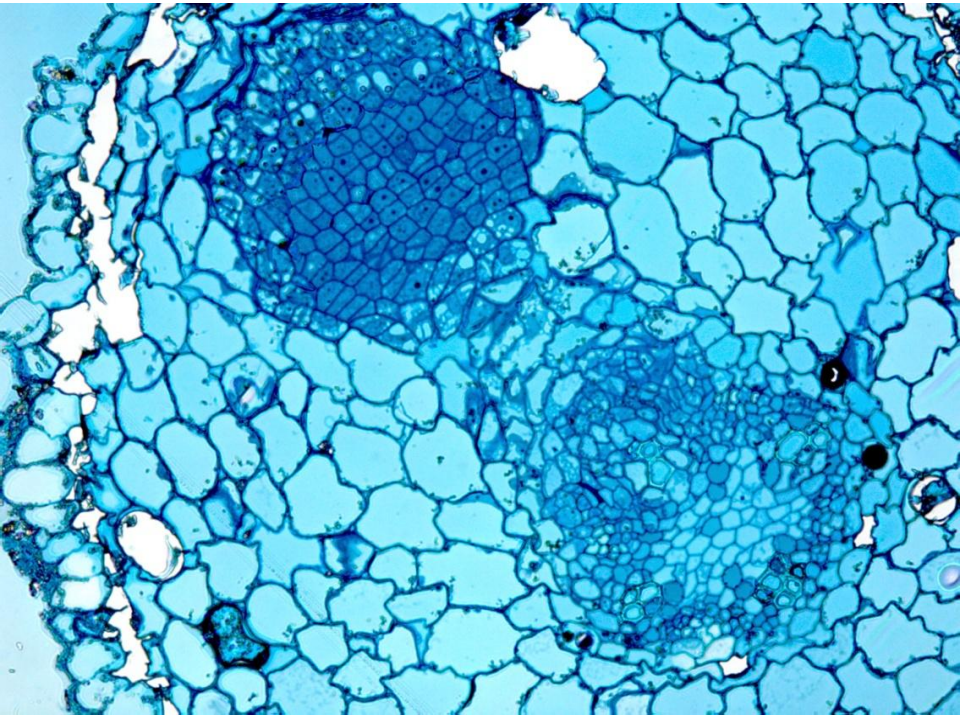
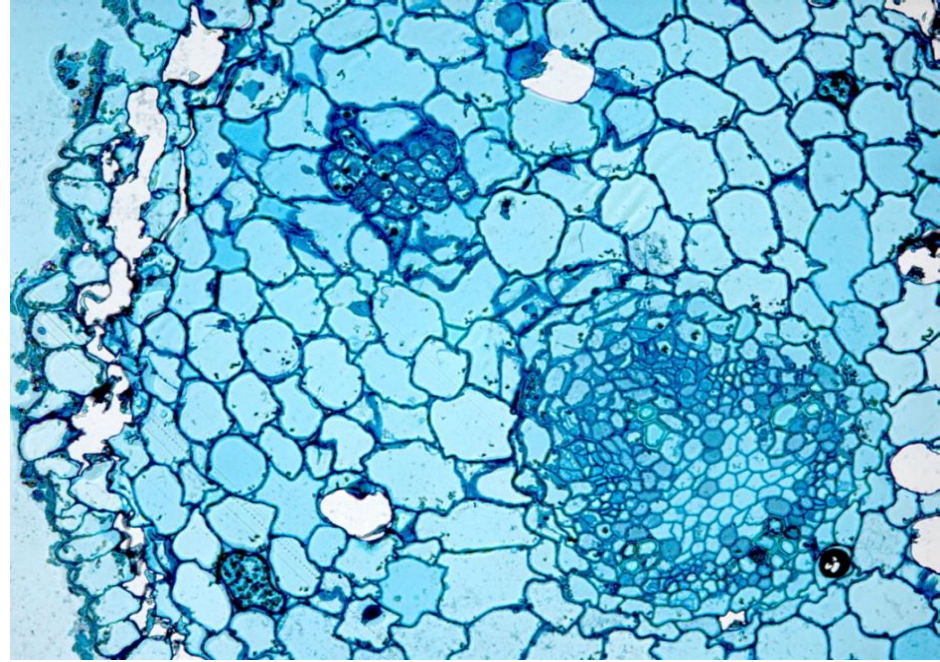
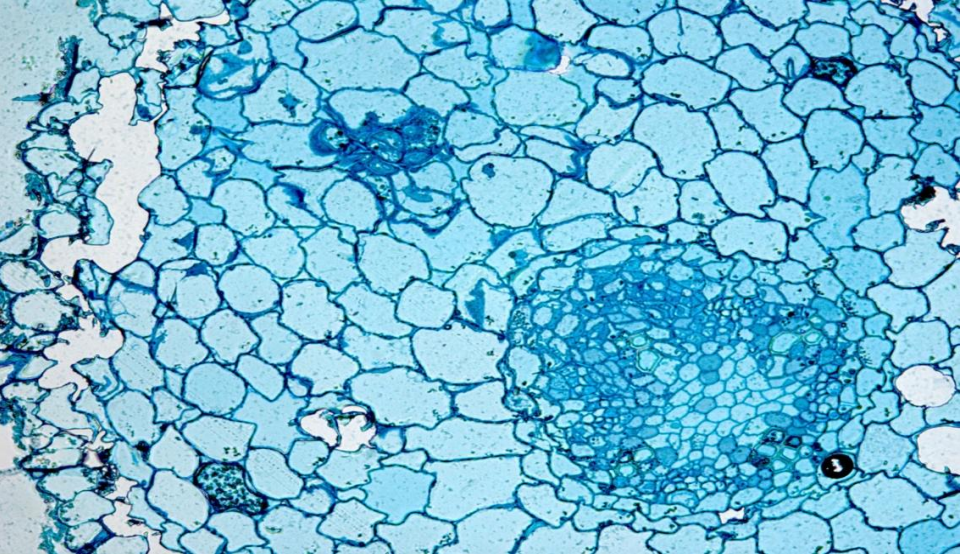


• When you form a lateral root of the trace can be observed up to the xylem from where it originated (Esau, 1965, Byrne, Pesacreta and Fox 1997; Fahn 1990)

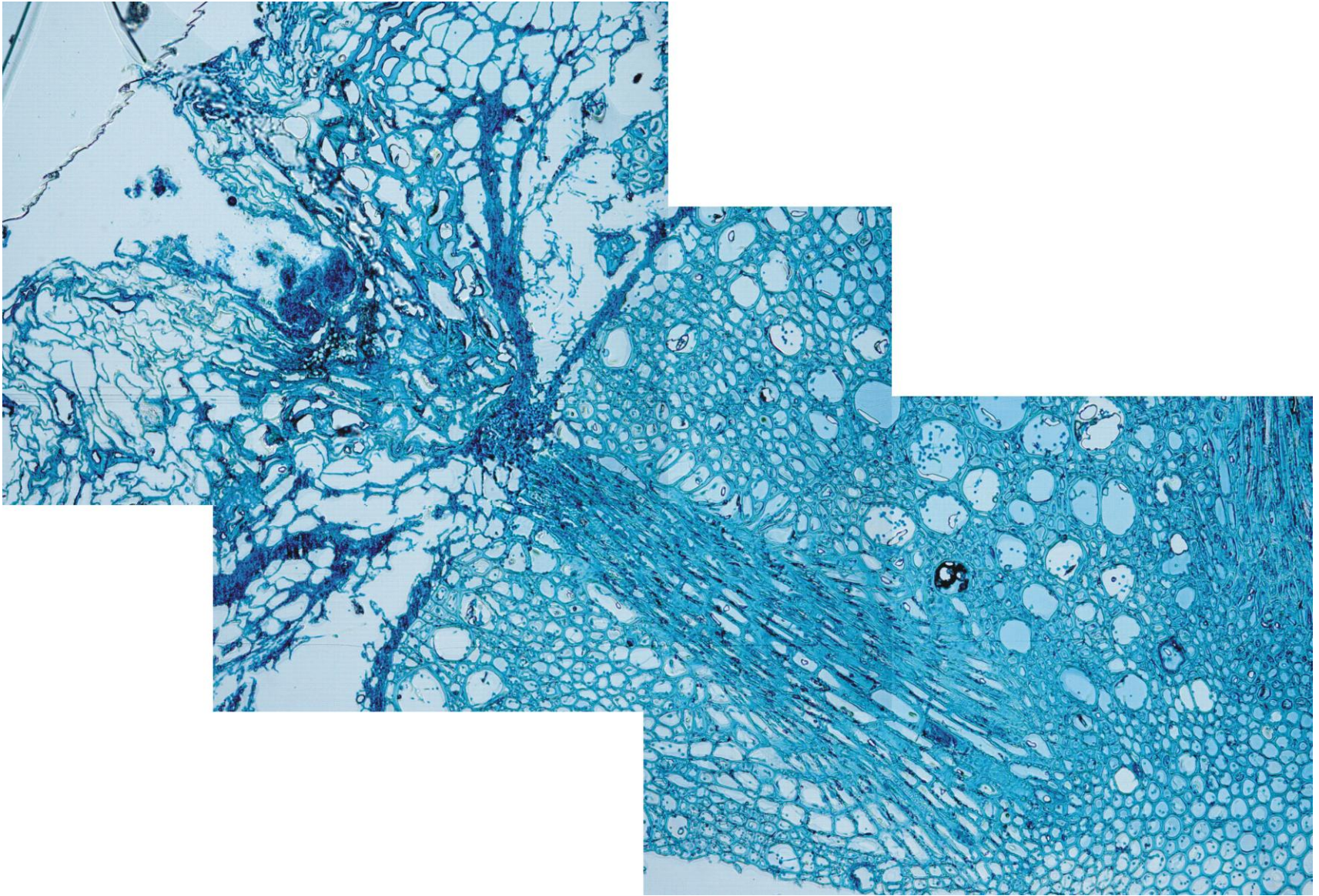
When a lateral root is inserted on parental axis its vascular system merges with the vascular system of origin (Byrne, Pesacreta and Fox, 1977), therefore, the stratification of a new growth maintains the connection with the change of the secondary vascular origin

There is the formation of roots in primary tissue starting from secondary roots much older; a root of this type can be defined and contrasted with accidental or adventitious root formation originating from primary tissues in the pericycle the importance of these roots is evident in the regeneration of new roots.

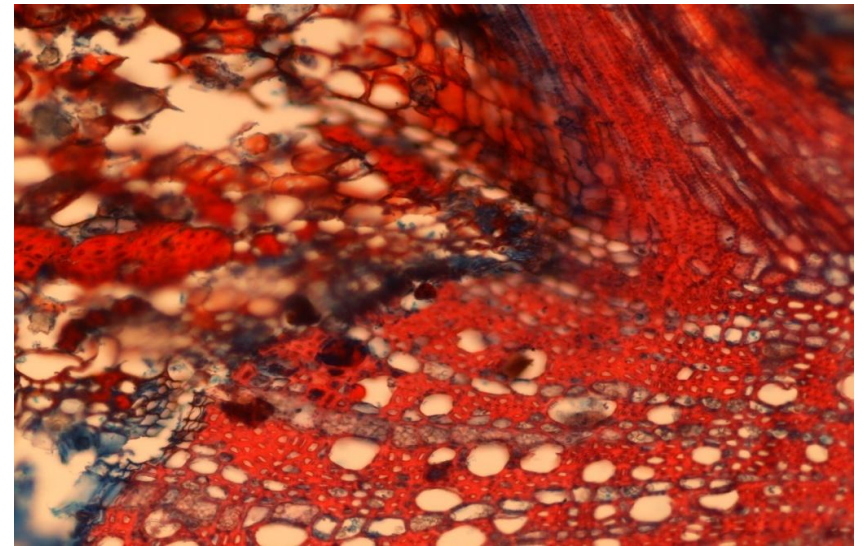
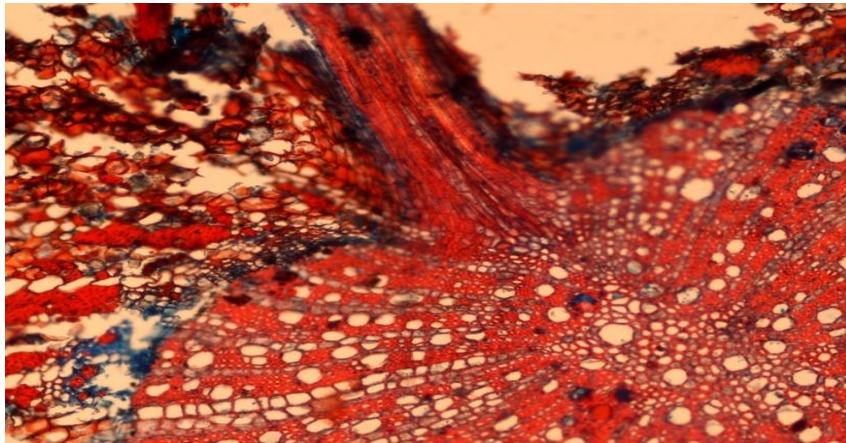
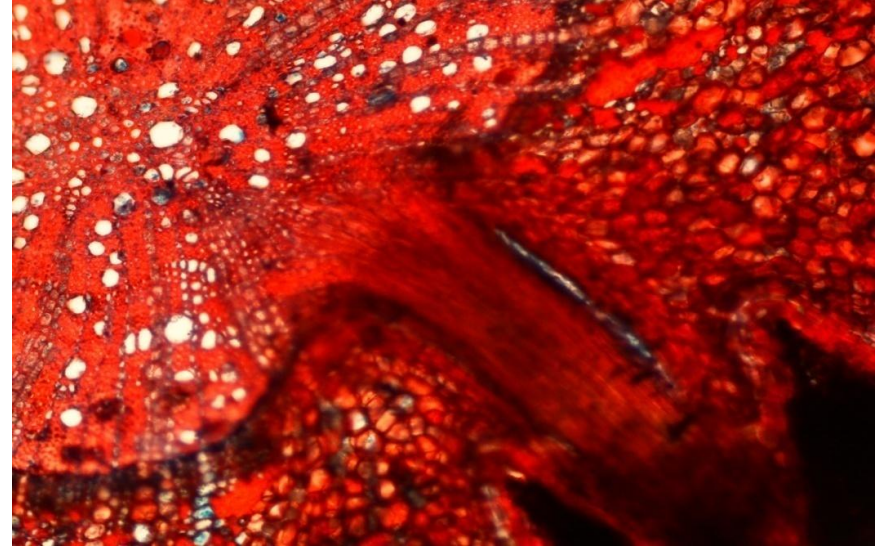
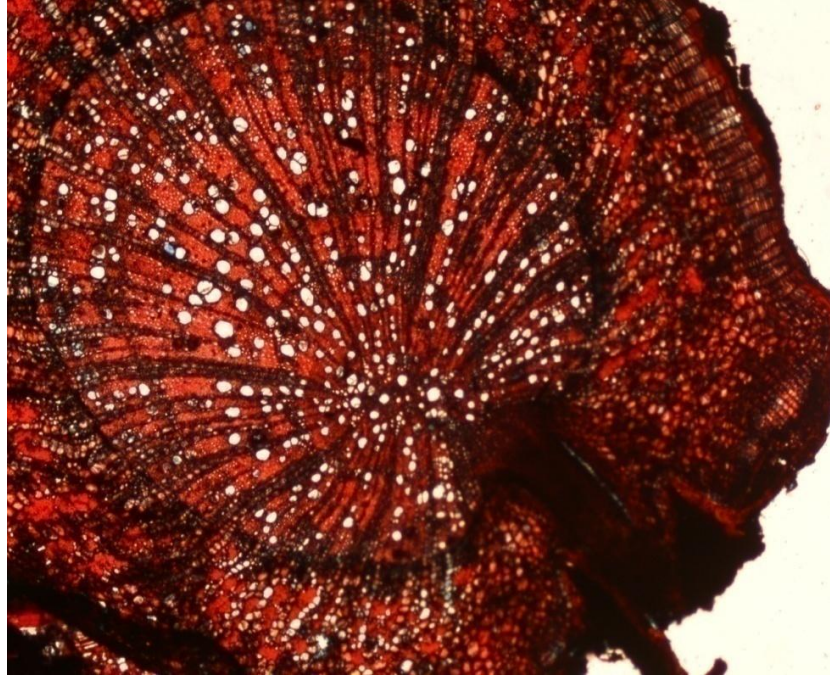
The presence of adventitious roots is largely underestimated because these roots provide a greater chance of absorption around the roots that are secondary growth.



Development of lateral root of the root in the primary structure, for cell proliferation pericycle, in correspondence of an ark xylem Primordio radical



Traces of lateral root from the wound strength (Fanchin jenny and Luigi Strazzabosco



Formation of adventitious roots: the root of cherry with track inserted in the parental secondary vascular tissue, with the addition of xylem tissues that are added along the track complex from the periphery to the secondary vascular system so the parental most peripheral parts until the xylem parental and integrating the vascular origin thus combining the peripheral parts of the vascular system parenting. (photo by A. Crivellaro and L. Strazzabosco).



17 cm e 130
reiterate
roots



the results





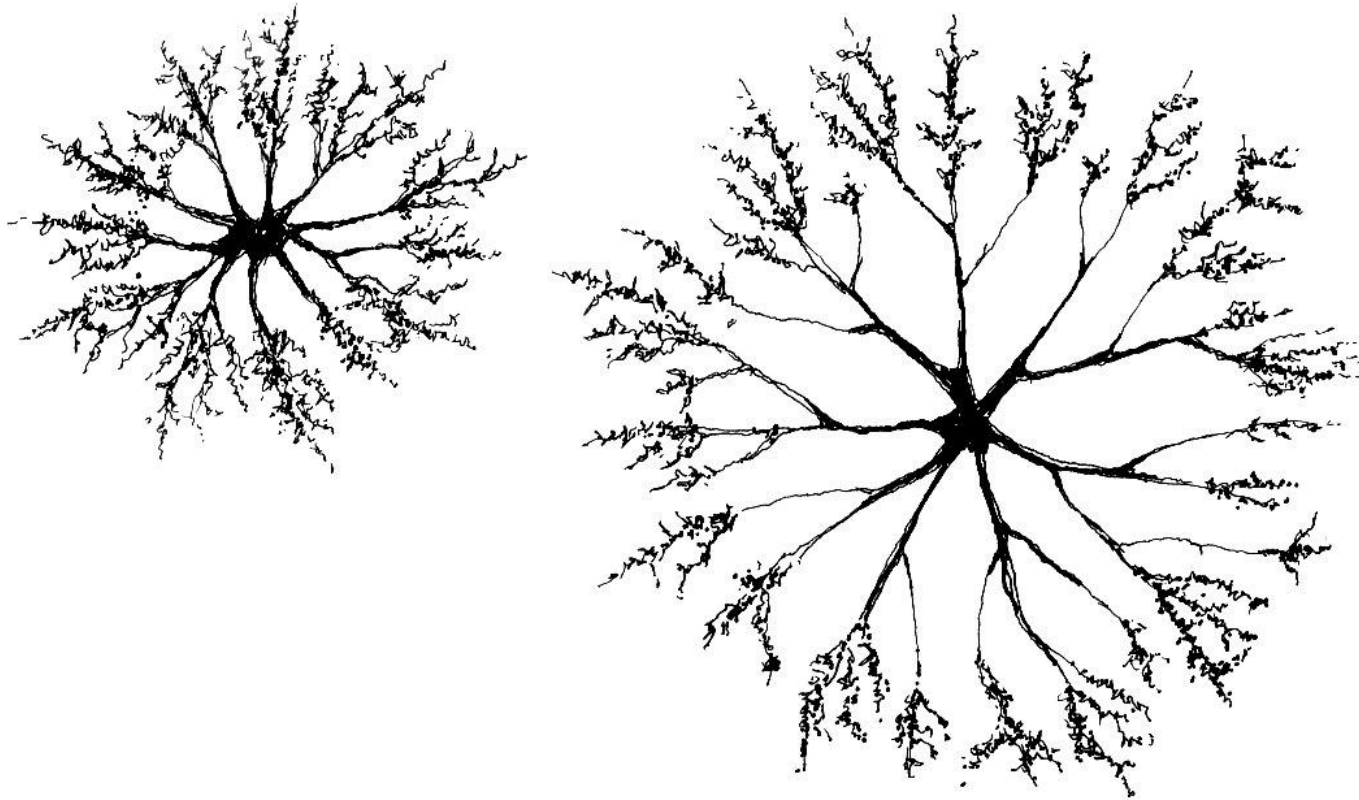
Root regeneration from calluses from wound

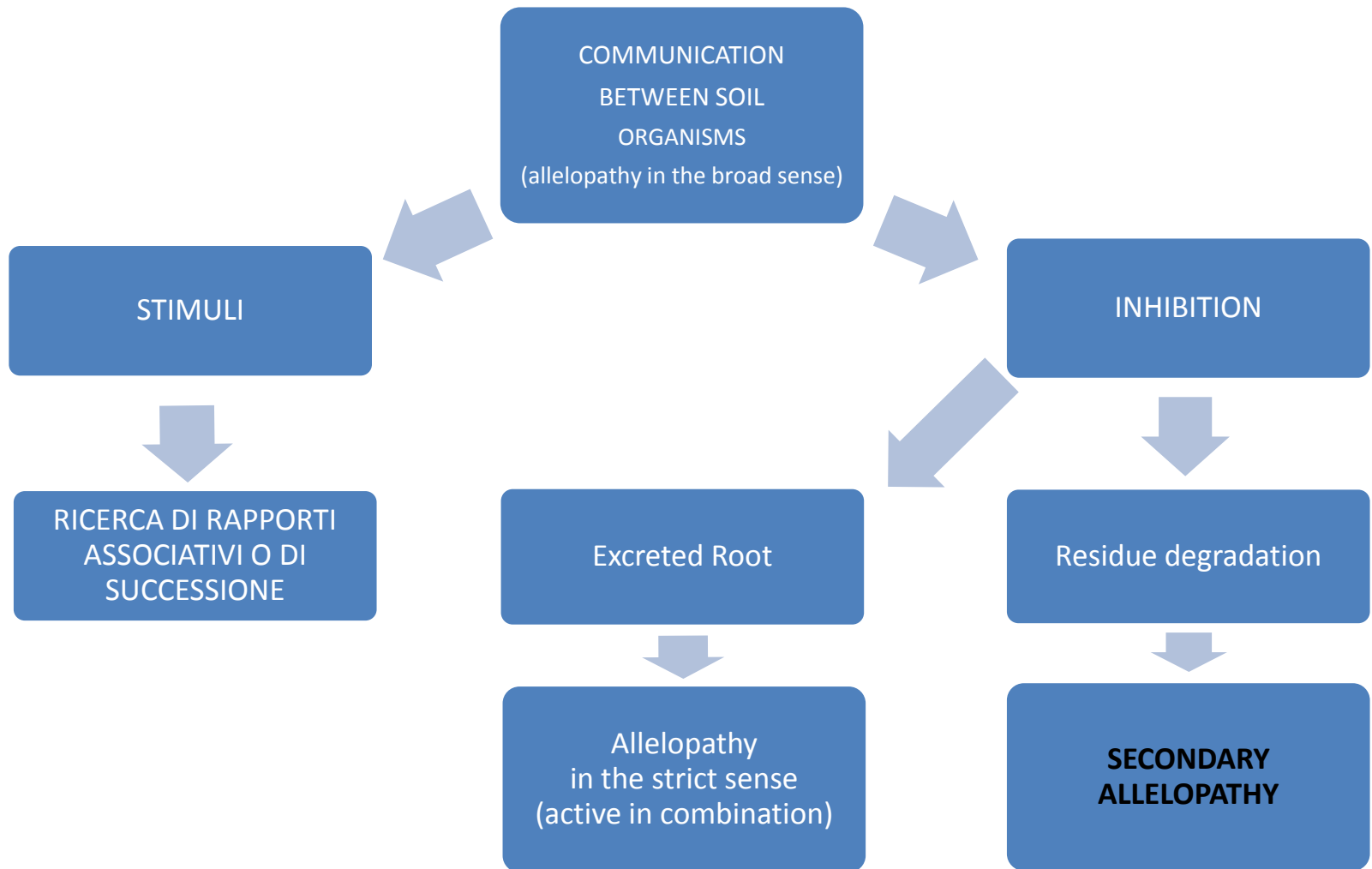


CAVITATION OF THE DISH ROOT

- When a root "explorer" enter into a free territory generates a network of capillaries that accompanies the extension of the absorbing surfaces
- to maintain a high absorption efficiency of the root must move.
- The result is the formation of a crown of absorbing roots, connected to the trunk by means of a radial roots skeletal.

CROWN AND ROOT CAVITES





SOIL RENEWAL AND ROOT REGENERATION

Allelopathy Secondary phenomena make unusable the soil inside the root dish

N.W.:. Soil replacement in the cavity determines the reiteration of plant root

The cavitation plate of the root so there is a tendency predetermined root

We know that the tree can form new root in absorbing whatever territory provided that it is favorable.

Only initially cavitation is caused by reduction of nutrient availability That the continuation of this situation is due to other

.

What is due to the release of metabolic catabolites that pervade the rhizosphere with soluble products. These activities exert toxic to the roots therefore we establish an allelopathy indirect that grows with the filling of the catabolic products that can be defined as **“Allelopathy Secondary Factors”** (Zucconi 1988).

But we know that renovating root the ground inside the cavitation will form new root absorbing roots in the primary structure .

EXPERIMENTAL TEST CONDUCTED

Of each segment were counted radical wounds of the absorbing roots of abscission and the possible radical regeneration in progress (if any masses of new root meristems). The samples, enclosed in petri dishes which have a limited substrate can ensure oxygenation and humidity (Laterlite); sealed boxes, the samples were stored in dark environment, at 20 ° C (+ a witness for each of the three species, outdoors, at room temperature). A distance of about 7 days, and then 15 days, observations were made, that is, the abutment on the possible response of the roots to the treatment.

REGENERATION IN OXYGENATION



EVALUATIONS



Acer c. root segment of the stereoscope:
the scars are obvious abscission of lateral
roots absorbent lost

Magnifying (detail) of a root primordium from a sample
of root magnolia, in response to treatment (are obvious
tissue cells radicals)







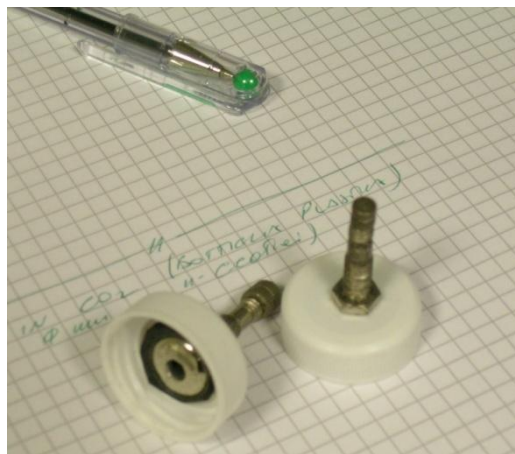
The results were analyzed with the Pearson correlation coefficient $R^2 = r^2$, on the axis of X has been put the diameter of the roots from 3 to 10 mm and the Y the response to oxygenation; The first analysis was carried out on 26-11-2011 and not significant correlation was observed between the diameter and the response to oxygenation $R^2 = 0.0136$ for *Taxodium distichum*, $R^2 = 0.0567$ for *Magnolia grandiflora* and $R^2 = 0.0092$ for *Acer campestre*.

The second analysis performed on 27-12-2011 gave a similar result for *Taxodium distichum* $R^2 = 0.0077$, $R^2 = 0.0076$ for *Magnolia grandiflora*, $R^2 = 0.1894$ for *Acer campestre*.

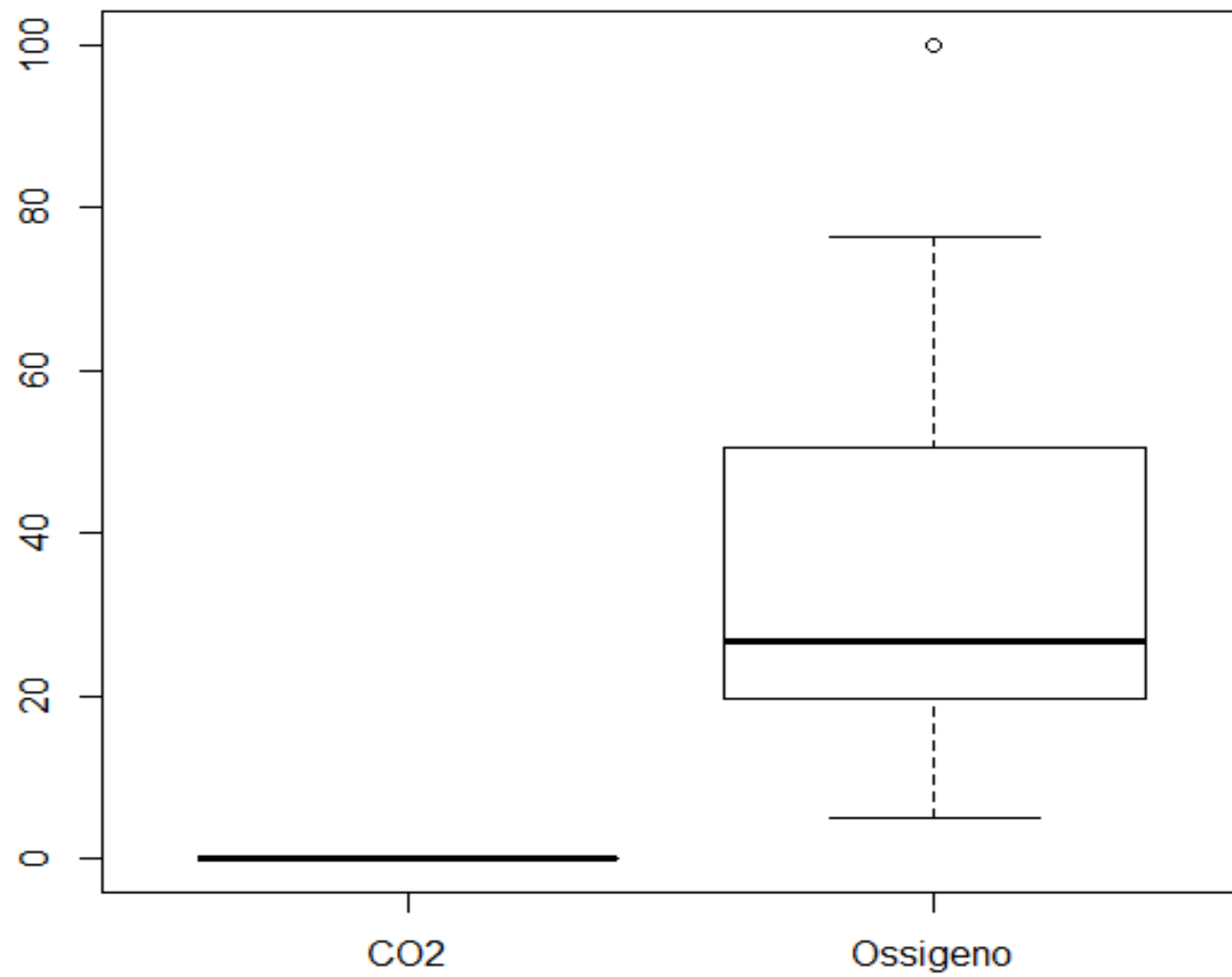
Therefore, even if carried out on a test powerful little we can say that the continuous relationship between diameter and response can not be correlated and that the period does not affect the response.

Another question is to test whether **oxygenation is related to the response of regeneration in the petri dish**, for We have **therefore carried out an evaluation with three replicates in blocks**, the same root was divided into two part placed in a petri dish for the oxygenation and the other half inside a bottle of pet moistened with the same amount of water and placed on a substrate of expanded clay, the bottle was removed and the air saturated with CO₂

They are evaluated for each of the three replicates the calli of old roots and lost after nine days were evaluated meristems of recurrence of the total measured. The answer only came in oxygenation while no response was observed in the bottles saturated with CO₂,







The stress response in the regeneration

All literature consulted and confirmations obtained with our experiments show that the regeneration of lateral axes in the primary structure of parental axes in secondary structure **is a response to a disturbance in the area of pronounced rhizosphere**

FEEDBACK AND CONFIRMATIONS

- **Scars of roots lost that maintain a visible trace for many years formed new roots also in secondary growth axes, these roots may represent a significant portion of the root system.**
- **The reiteration of roots occurs in response to stress but also to endogenous or exogenous stimuli such as hormonal stimuli, or in response to CO₂ reduction and the increase in O₂**
- **The regeneration of roots at the expense of the fitness of the roots**
- **The persistence of repeated roots is related to the permanence of the conditions in the rhizosphere for optimal functionality radical**

SUSTAINABILITY

In monumental trees stimulate recurrence within roots can absorb water means substantially prevent the reiteration of new roots from the collar retaining all the root system still present.

- We can say that the regeneration of radicii axes of parental care in secondary structure is a sustainable practice
- does not reduce the safety factor of the biomechanical
- But this is a "cure" that must be carefully evaluated invasive, and also requires a careful management plan

Evaluation of starch and correlation with response to oxygenation into Petri

Lately Chandra Bellasio ¹, Alessio Fini ², Francesco Ferrini ² have presented an improved method for the analysis of starch into wood, using commercial methods (Sigma STA 20 and Megazyme K-TSTA) used in the determination of the starch content into the wood. Il protocol used has proven to be fast (up to 35 samples per day with further improvements up to 50), more precise and stable compared to commercial methods employed, but has recovered 27% and 13% starch in more without increasing interference . **The proposed method has a good performance on standard where the error ranged between 0.16 and 0.35%.**

¹ Department of Plant Sciences, University of Cambridge, Downing Street, Cambridge CB2 3EA, UK;

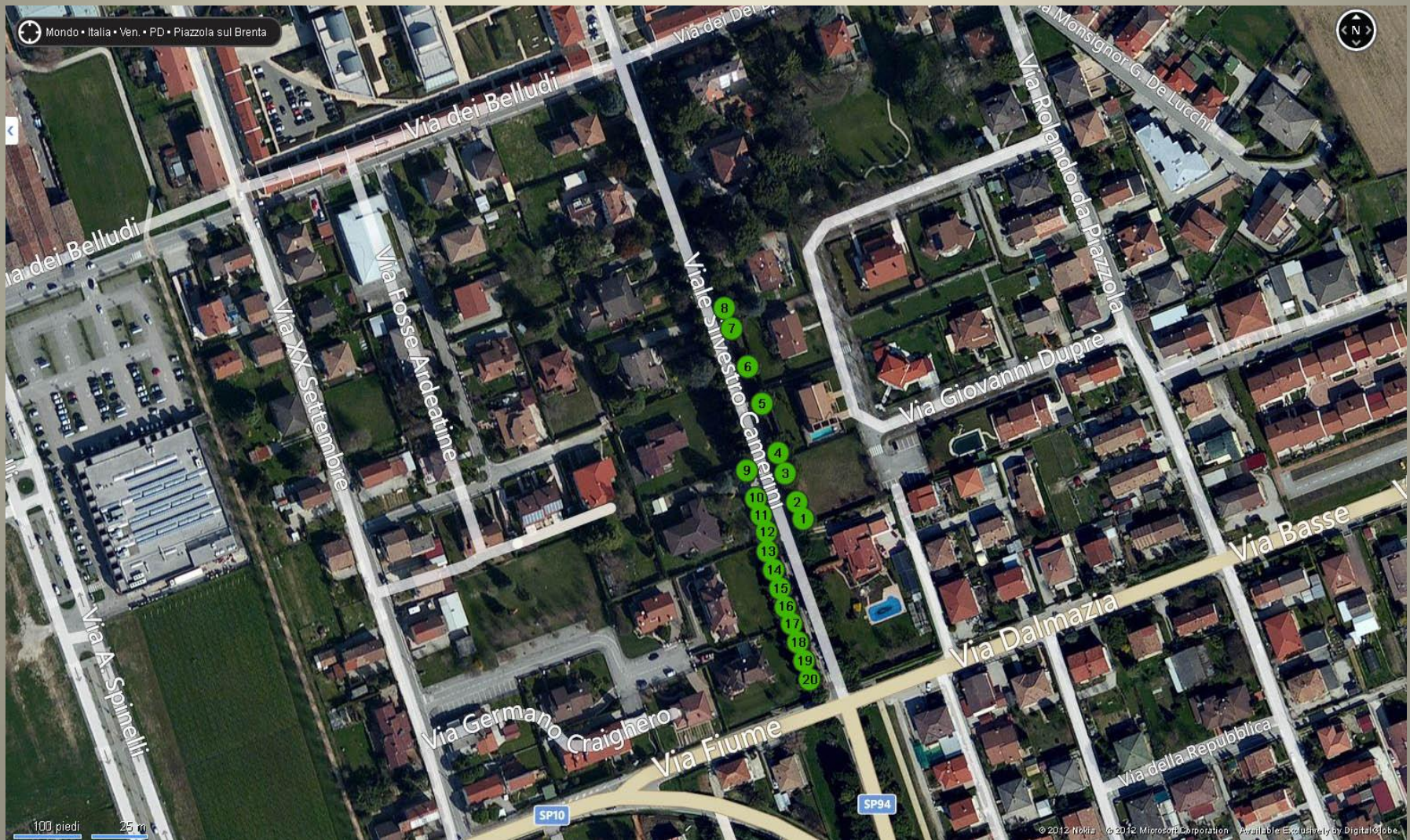
² Department of Plant, Soil and Environmental Science – University of Florence, viale delle Idee, 30, 50019, Fiorentino (FI), Italy;

Given the importance of this protocol for the determination of starch into woody tissues has formed a research group formed by Chandra Bellasio, Alessio Fini Luigi Strazzabosco, Francesco Ferrini, and Sergio Mutto Accprdi for the use of this method on roots woody. The goal of this research is to validate a protocol taking into account the color of the starch and response to regeneration into Petri able to demonstrate a linear relationship between starch and response to oxygenation

One species (magnolia) of which 20 have been chosen replicas on the same row in the town of Piazzola sul Brenta. Some roots were collected into the secondary structure of each magnolia at the same distance from the collar using the technique of the air spade, always by the same orientation.

The roots levied on every magnolia were divided into three by the same segment. A part in radial section was stained with iodine tincture and photographed, a part frozen to minus 15 ° and cut into pieces of about a cm, was sent for analysis by courier in 12 hours has delivered the frozen sample into Thermal box filled with ice for the analysis of the starch. One part was placed in Petri dishes for regeneration by assessing the percentage of meristems radicals produced on the streets of each segment.

Evaluation of the correlation experimental model





Codice 14

DATI RILEVAMENTO Rilevatore Luigi Strazzabosco Data 26/10/2012 ☒ Nuovo ☐ Aggiornamento

LOCALIZZAZIONE SOGGETTO

Tipo di area verde Verde pubblico stradale ☒ Centrale ☐ Periferica Tipo di impianto ☐ Isolato ☐ Gruppo ☒ Filare

CARATTERISTICHE DEL SOGGETTO

Specie (comune) Magnolia Specie (scien.) *Magnolia grandiflora* L.

Diametro Ad 1,30 M (cm) 77 Altezza (m) 19 Altezza 1° Palco (m) 4,5 Diametro della chioma (m) 6 Governo ☒ Monocormico ☐ Policormico

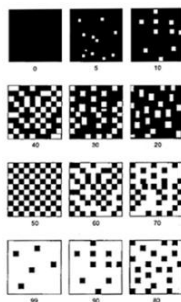
Posizione Sociale ☐ Dominante ☒ Codominante ☐ Dominato ☐ Sottoposto Struttura ☒ Forma naturale ☐ Forma obbligata ☐ Pianta capitozzata

TRASPARENZA DELLA CHIOMA



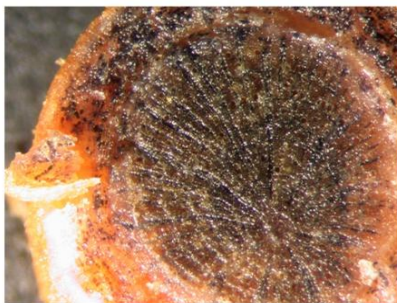
Trasparenza chioma rilevata
= 13 %

Metodo di valutazione adottato:
Schema guida per la stima della trasparenza del fogliame (da Eichhorn et al., 1998)



ANALISI DI LABORATORIO

Prova di colorazione all'amido



Risposta all'ossigenazione (%)
= 80 %

DOCUMENTAZIONE FOTOGRAFICA



NOTE



Codice 01

DATI RILEVAMENTO Rilevatore Luigi Strazzabosco Data 26/10/2012 ☒ Nuovo ☐ Aggiornamento

LOCALIZZAZIONE SOGGETTO

Tipo di area verde Verde pubblico stradale ☒ Centrale ☐ Periferica Tipo di impianto ☐ Isolato ☐ Gruppo ☒ Filare

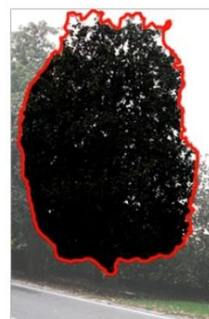
CARATTERISTICHE DEL SOGGETTO

Specie (comune) Magnolia Specie (scien.) *Magnolia grandiflora* L.

Diametro Ad 1,30 M (cm) 74,5 Altezza (m) 18,5 Altezza 1° Palco (m) 3 Diametro della chioma (m) 8 Governo ☒ Monocormico ☐ Policormico

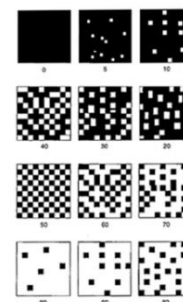
Posizione Sociale ☐ Dominante ☒ Codominante ☐ Dominato ☐ Sottoposto Struttura ☒ Forma naturale ☐ Forma obbligata ☐ Pianta capitozzata

TRASPARENZA DELLA CHIOMA



Trasparenza chioma rilevata
= 10 %

Metodo di valutazione adottato:
Schema guida per la stima della trasparenza del fogliame (da Eichhorn et al., 1998)



ANALISI DI LABORATORIO

Prova di colorazione all'amido



Risposta all'ossigenazione (%)
= 38 %

DOCUMENTAZIONE FOTOGRAFICA



NOTE



N° campione

1

rigenerazione

38 %



N° campione

9

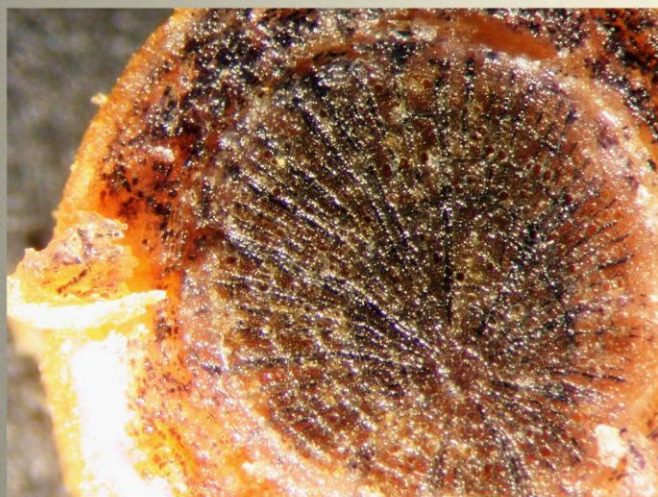
79%



N° campione

6

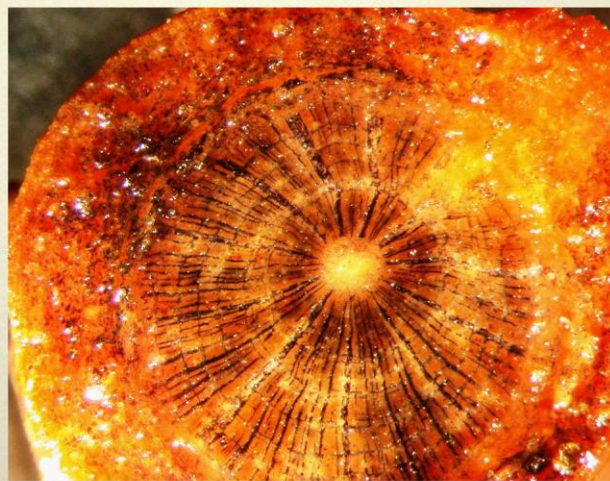
22%



N° campione

14

80%



N° campione

11

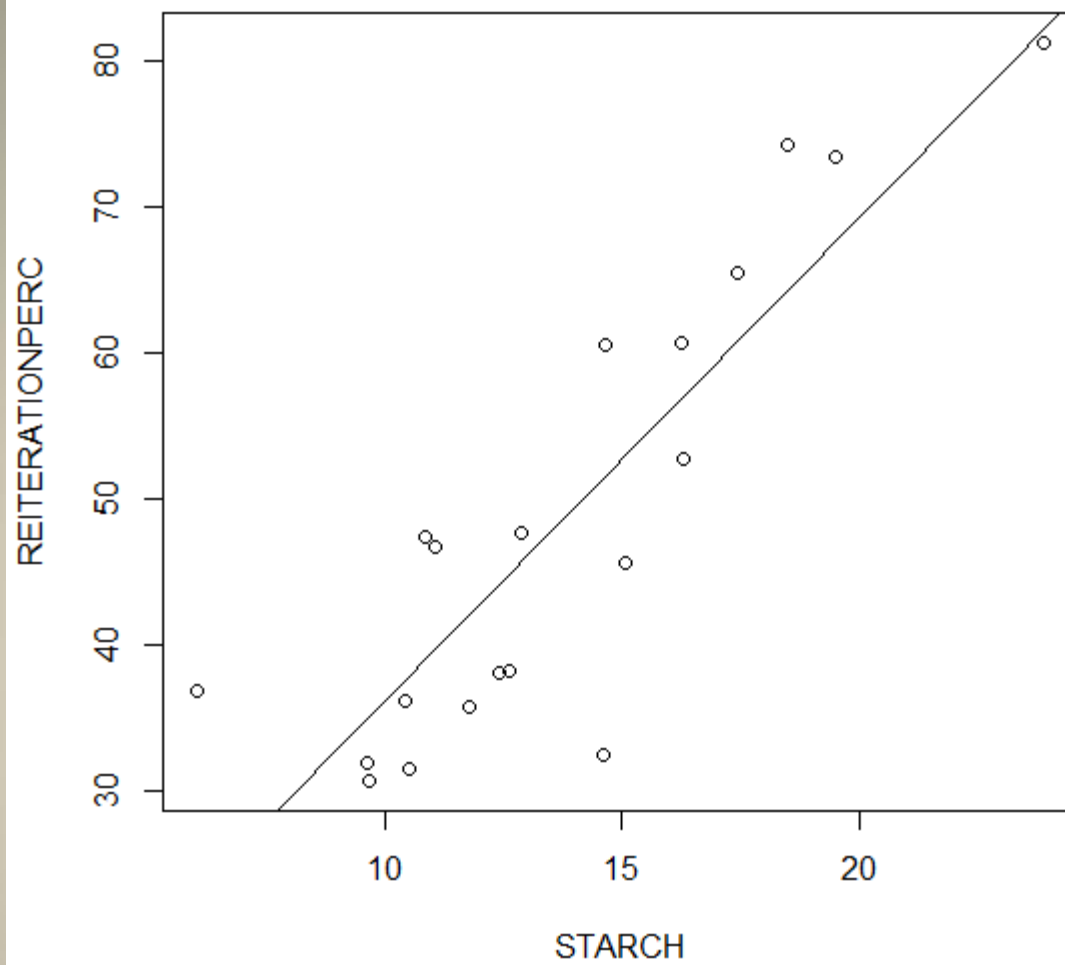
78%



N° campione

5

52%

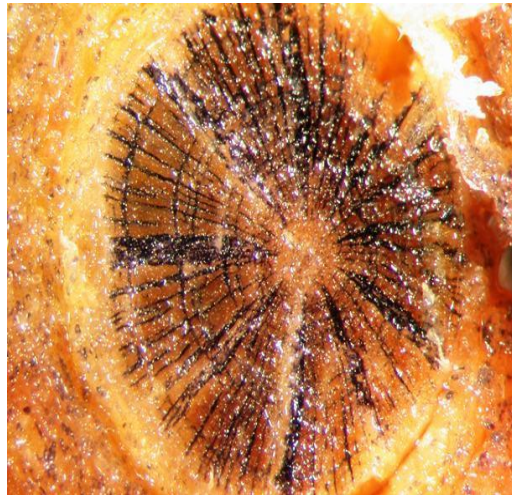


p-value: 7.5e-07
R-squared: 0.7519

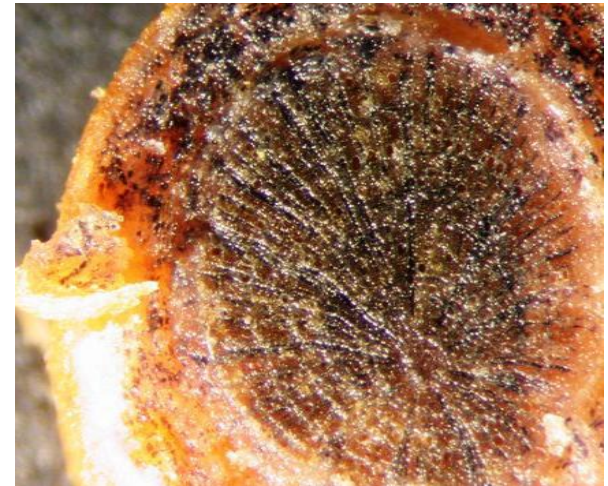
- class 1 : < 14.65 gr of starch over 100 gr of dry matter
- class 2: between 14.65 and 18 gr of starch over 100 gr of dry matter
- class 3 : > 18 gr of starch over 100 gr of dry matter



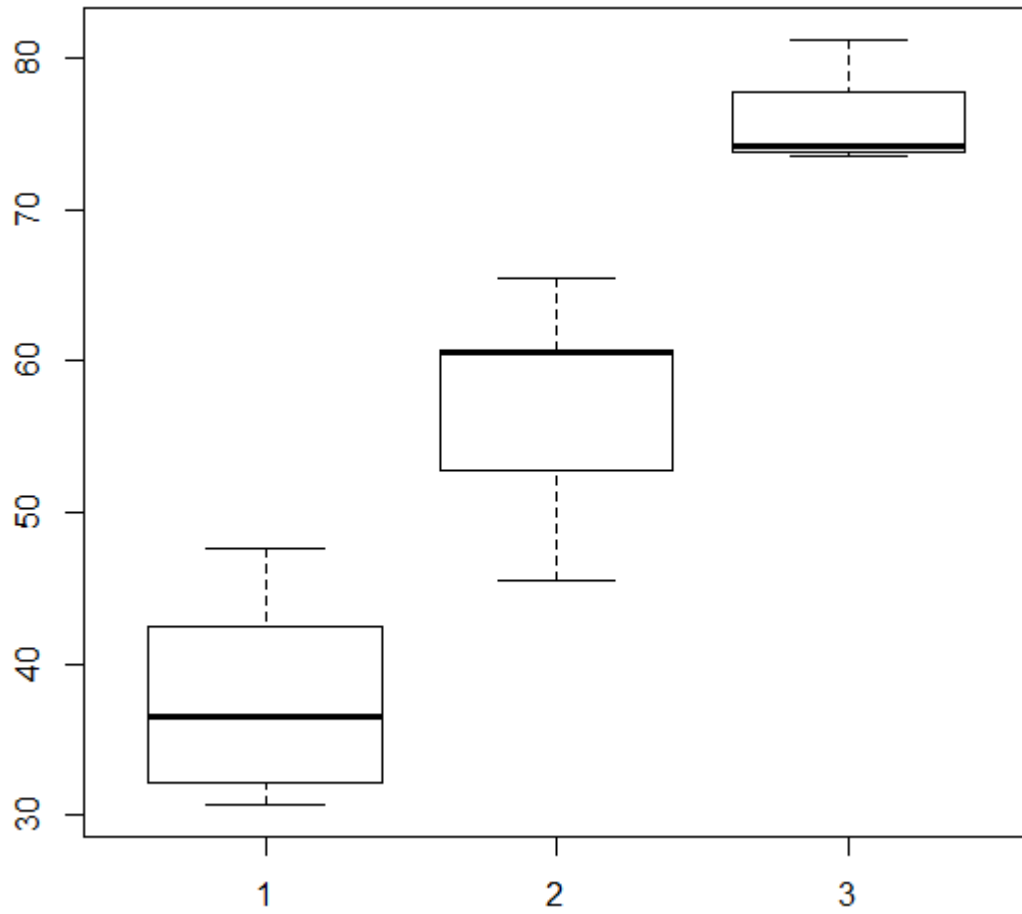
class 1



class 2



class 3



ANOVA (p-value 7.22e-09)

La valutazione biomeccanica









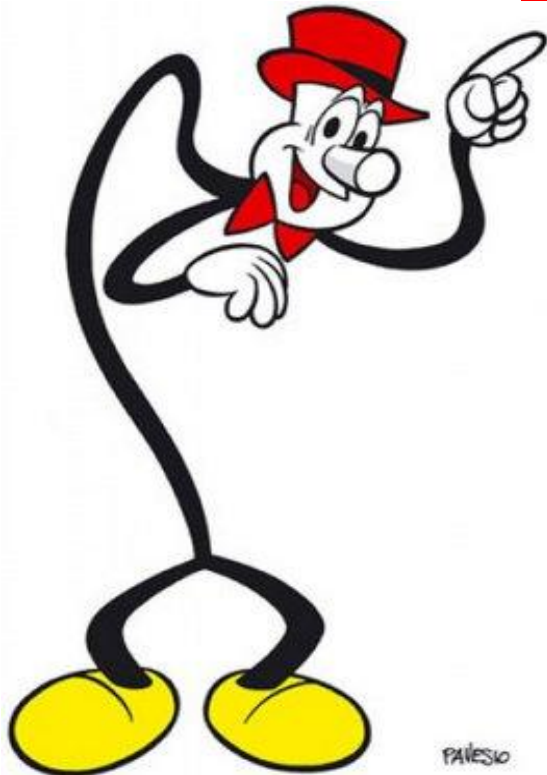


IL GRUPPO TIRAMMOLLA

LUIGI SANI

ENZO BLOTTA

LUIGI STRAZZABOSCO



will speak before long Luigi Sani

Il compendio Revedin – Bolasco

Castelfranco Veneto (TV)

Il Centro per il restauro, il recupero e la valorizzazione dei parchi storici e degli alberi monumentali



“ Il Centro verrà finanziato con fondi europei ottenuti attraverso la partecipazione ad un bando regionale.”

“ Sono previsti 3 laboratori di ricerca:

- giardini storici e paesaggio;
- salute e benessere delle piante;
- biomeccanica.

“ Sono previsti 1.000.000,00 Euro per il Centro, dei quali 344.100,00 per l'acquisto di attrezzature scientifiche, i rimanenti per il restauro delle strutture.

“ Il personale che sarà coinvolto nelle attività di ricerca del centro è già dipendente del Dipartimento TESAF (gruppo di lavoro TREB FITNESS LAB).

“ La documentazione è stata portata da: Prof. Maffeo Accardi, Prof. Semenzato, Prof. Mandecchia, Dott. Stoccolanca, Dott. Spig. La parte edilizia invece è stata curata dall'Ufficio Tecnico dell'Università di Padova.



la sala affrescata (5)
da adibire a nuova aula didattica



il salone delle feste (2)
da adibire ad aula magna/sala conferenze



la cucina (10)
a supporto di foresteria e servizi ristorazione e catering



**A special thanks to the collaboration
Dr. John Nalin and Dr. Genny Fanchin**