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Pruning trials to reduce the impact of *Dryocosmus kuriphilus* in chestnut orchards

MARIOTTI B., TANI A., POLI I., MALTONI A.

Department of Management of Food, Agricultural and Forest Systems - GESAAF. Università degli Studi di Firenze. Firenze, Italy

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mountain
traditional
heritage
multifunctional
CHESTNUT STANDS
too many adjectives for a simple management

Damage: galls on leaves, shoots, buds and flowers

main effect

Reduction

of photosynthetic surface

Loss of fruit production in terms of quantity and quality

Reduction of plant growth

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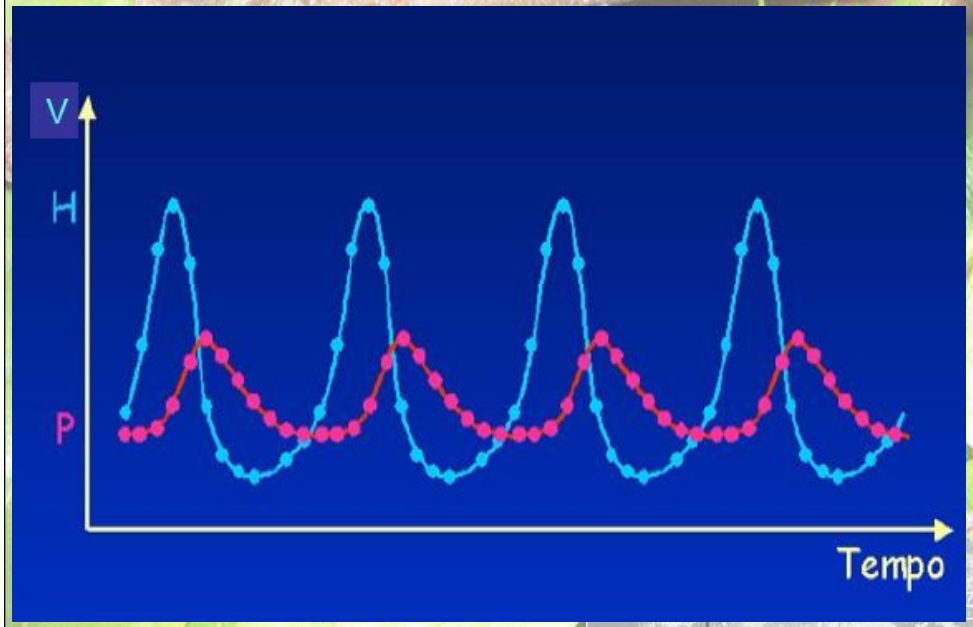
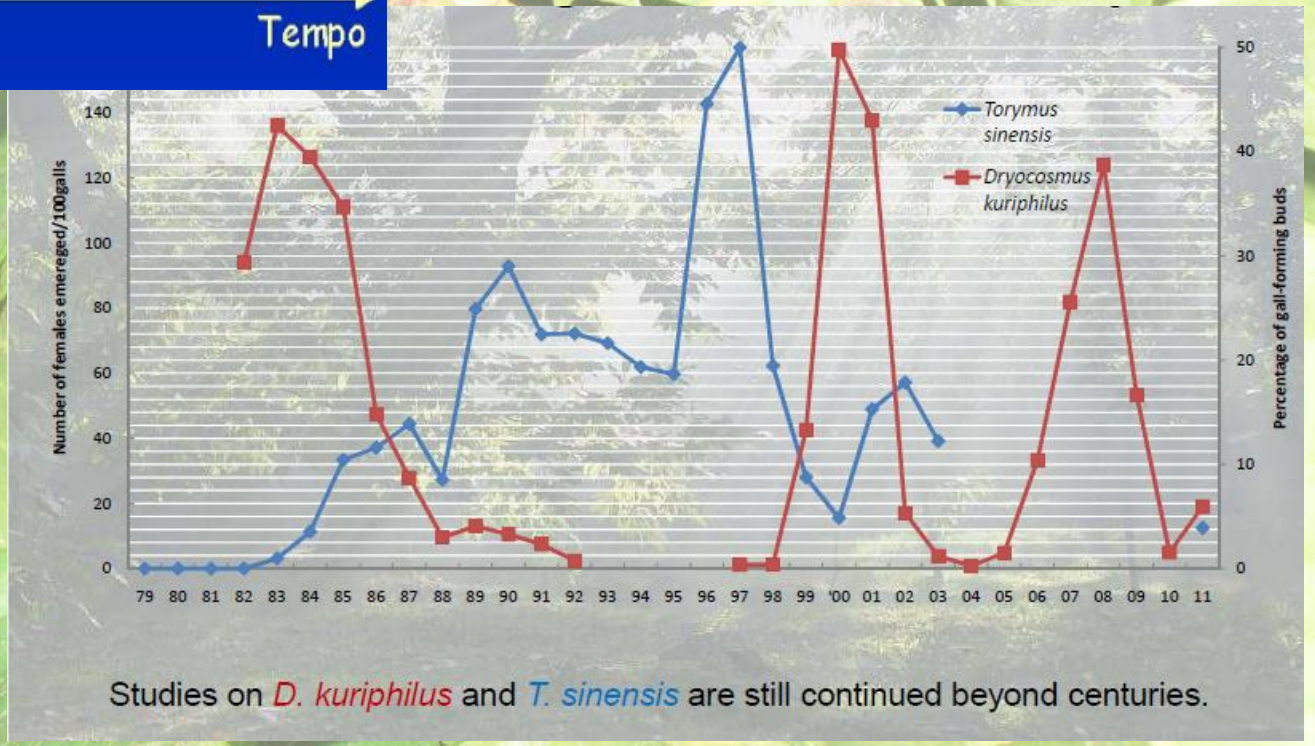
BIOLOGICAL CONTROL



***D. kuriphilus* control by *T. sinensis* will reach a steady state?**



Studies on *D. kuriphilus* and *T. sinensis* are still continued beyond centuries.

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Estimated **loss** in fruit production ???

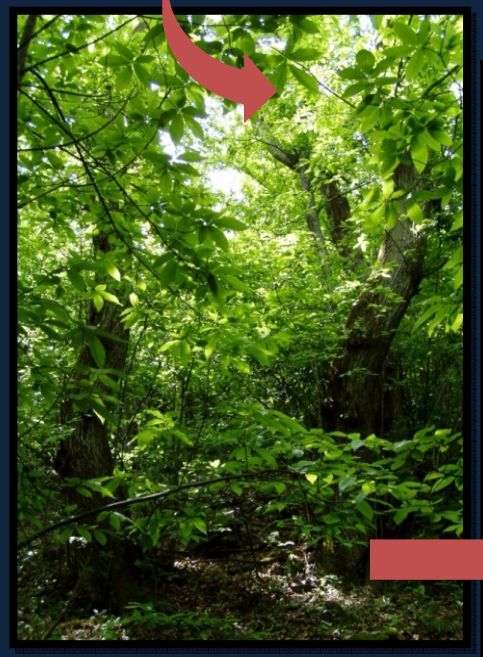
50-70% (CABI, 2011)

Abandonment of cultivation

High costs of restoring

LOST CHESTNUT ORCHARDS (as happened after chestnut blight)

?? €



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Integrate Defense Strategy

Biological control
(best effective
but in ?? years)
Focus: **D. kuriphilus**

Silvicultural practices
(effective in 1 year)
Focus: **plants in field**

Genetic selection
(effective in too much year)
Focus: **cultivars**

During the time gap to the effectiveness of biological control and genetic improvement, it is necessary to reduce the damage to avoid chestnut stands degradation and abandonment

Goal of silviculture practices

to reduce damages in order to maintain a good vegetative state of plants and an acceptable level of fruit production

Preliminary steps

to study the plant-insect interactions

Classification of damage in types (in terms of consequences on plant development)

Analysis of the damage types distribution on the plant

Analysis of the relationships between damage susceptibility and plant vigor

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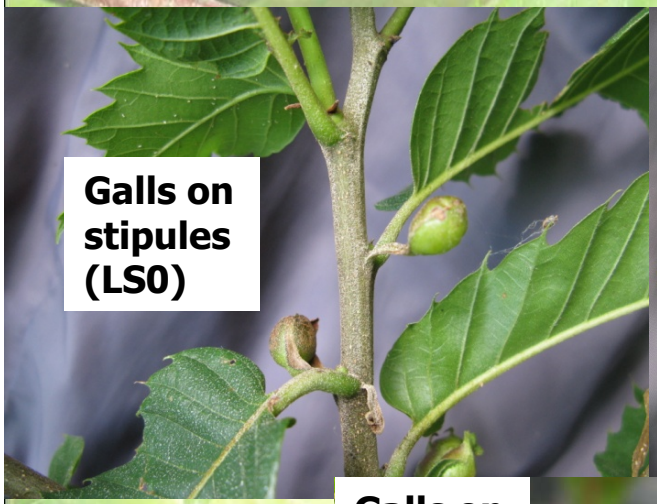
Classification of damage

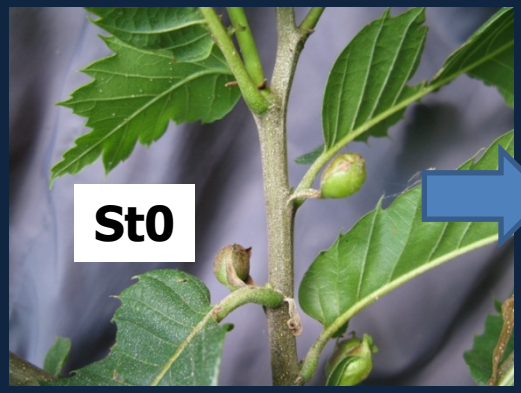
-ATTACKED ORGAN (Shoot, Leaf, Bud)
-EFFECT of the galls on abnormal development (degree of deformity)



(Maltoni et al., 2012)

Abnormal organ development involves a reduction of photosynthetic area causing different consequences according to the attacked organ and its position in the tree

Galls on leaves and stipules



Consequences on plant growth

	Current season	Following seasons
L0 / St0	No	No
L1	Very Very slight	No
L2	Very slight	No

Galls on shoots

S0

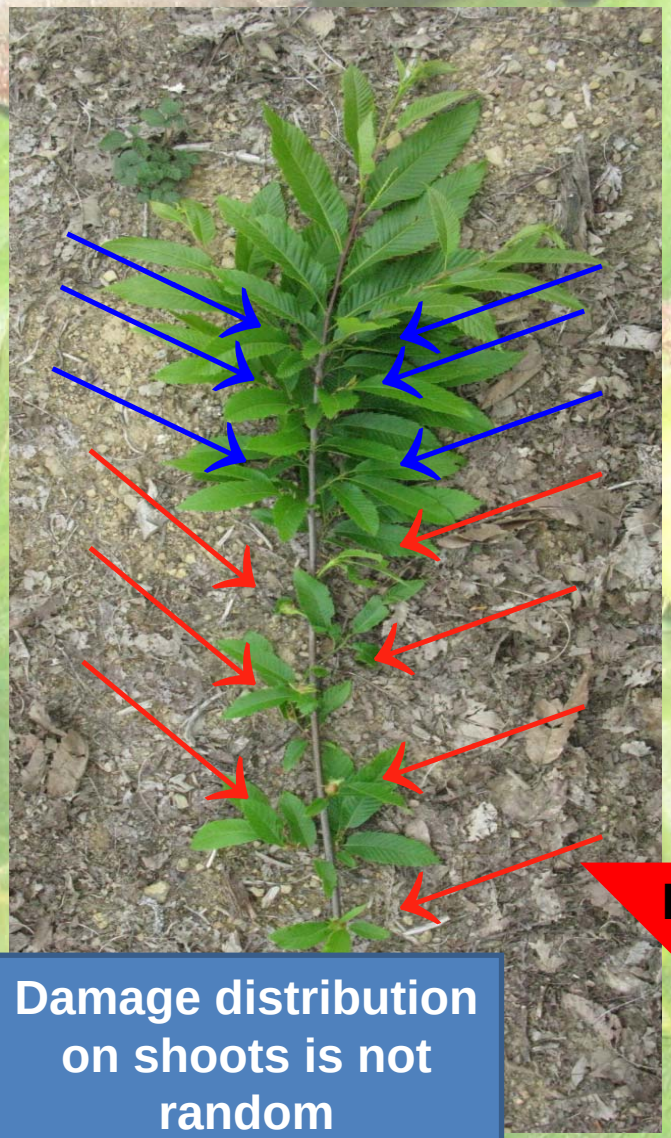
S1

S2

Consequences on plant growth

Current season	Following seasons
Normal shoot growth and development	No
Usually this damage causes a general reduction of the active photosynthetic area during the current growing season	Not predictable (in many cases it doesn't cause the death of the entire shoot) Possible reduction of new shoots
Heavy damage It compromises the shoot development and so the photosynthetic activity	Most severe damage It always causes the shoot death No new shoots

Analysis of the damage types distribution on the plant



Damage distribution on shoots is not random

Healthy nodes

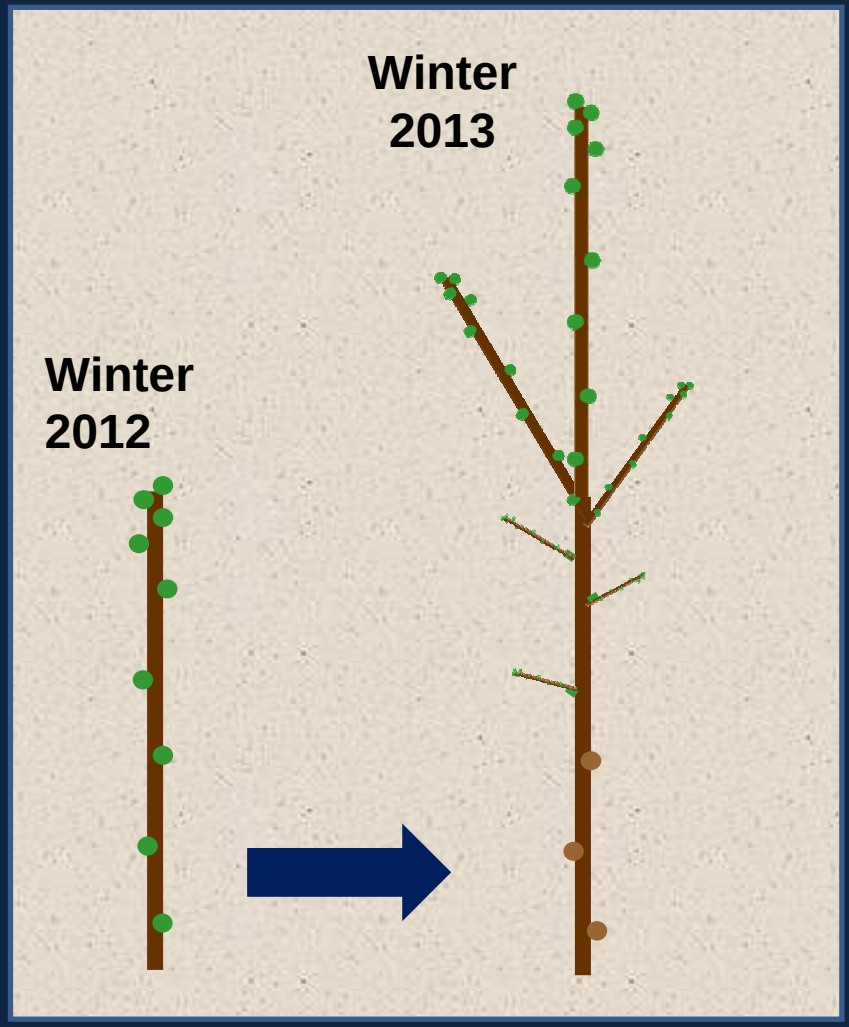
Damaged nodes

Relationship between damage susceptibility and plant vigor

Vigorous plants tend to have well developed and healthy (or slightly damaged) growing shoots in apical position

Relevance of damage position on shoots

The development of chestnut shoots



Rough assessment of the reduction of photosynthetic surface in terms of leaves number

	Apical part of the shoot → new shoots				Lower part of the shoot → brachiblasts			
	Y_0	Y_1	Y_2	$....Y_{10}$	Y_0	Y_1	Y_2	$....Y_{10}$
St0	0	0	0	0	0	0	0	0
L0	0	0	0	0	0	0	0	0
L1	1	0	0	0	1	0	0	0
L2	1	0	0	0	1	0	0	0
S0	0	0	0	0	0	0	0	0
S1	0-5	0-30	0-90	0-3000	0-3	0-3	0-3	0-3
S2	10	~35	>100	~4500	3	3	3	3
DB2					0	0-?	0-?	
F2	5	0	0	0	5	0	0	0

Relationships between damage susceptibility and plant vigor

Why is it important to investigate it?

If there is a relationship between the damage and plant vigor, it is possible to experiment with effective cultural practices focused on reducing the damages on the plant

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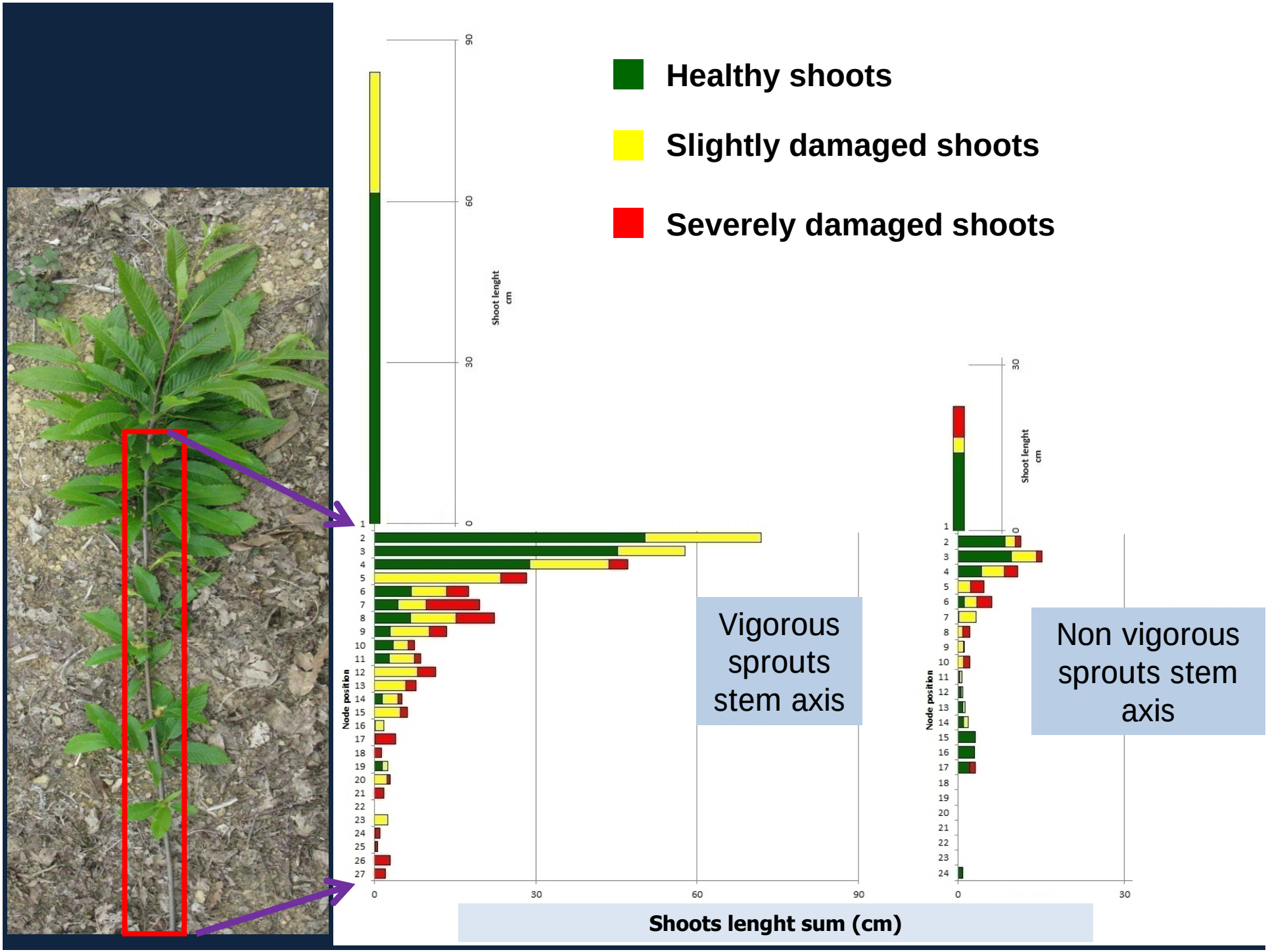
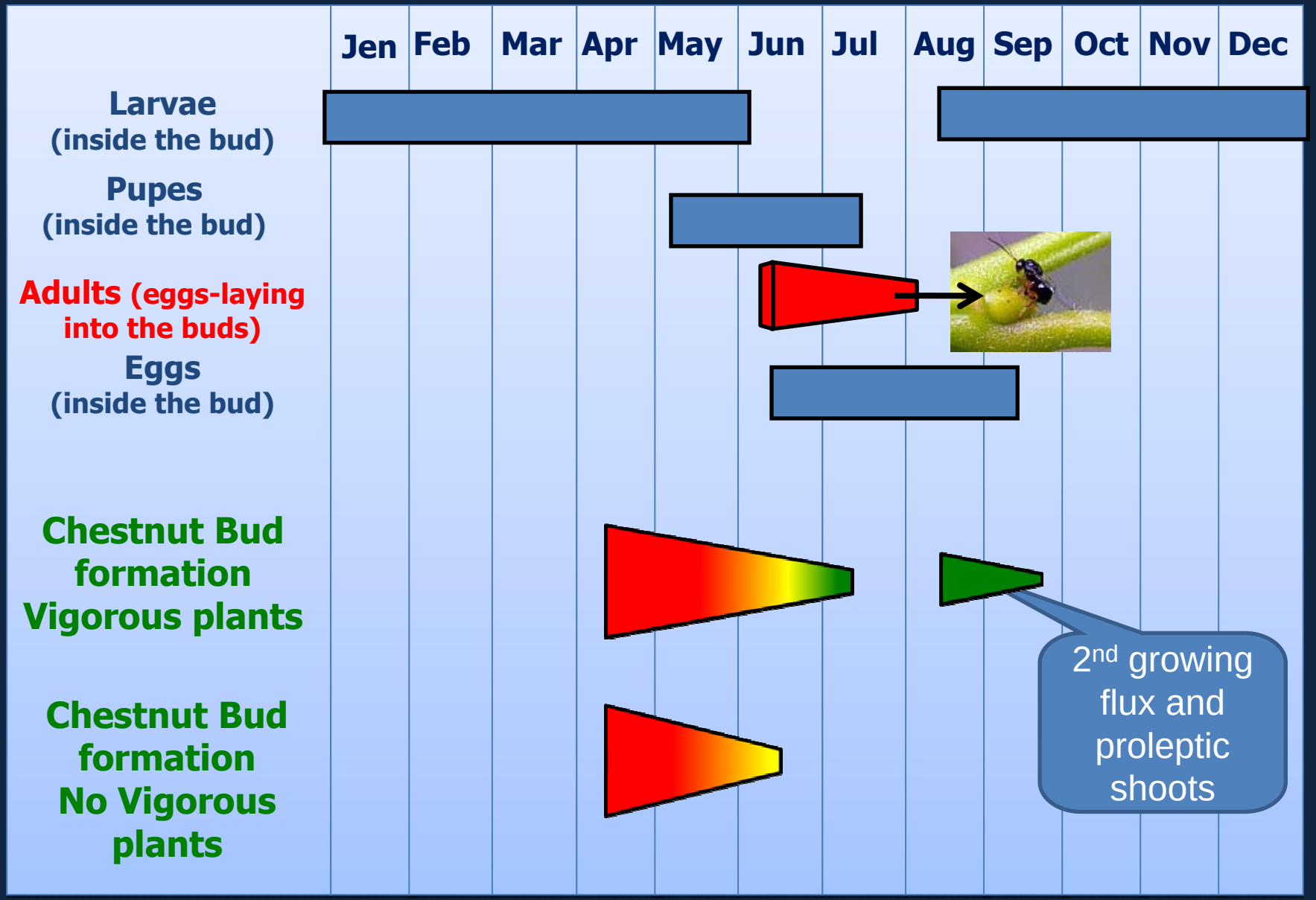

Healthy shoots
Slightly damaged shoots
Severely damaged shoots
Shoot lenght cm
Node position
Vigorous sprouts stem axis
Non vigorous sprouts stem axis
Shoots lenght sum (cm)

Results interpretation

Time of bud formation has effects on damage susceptibility

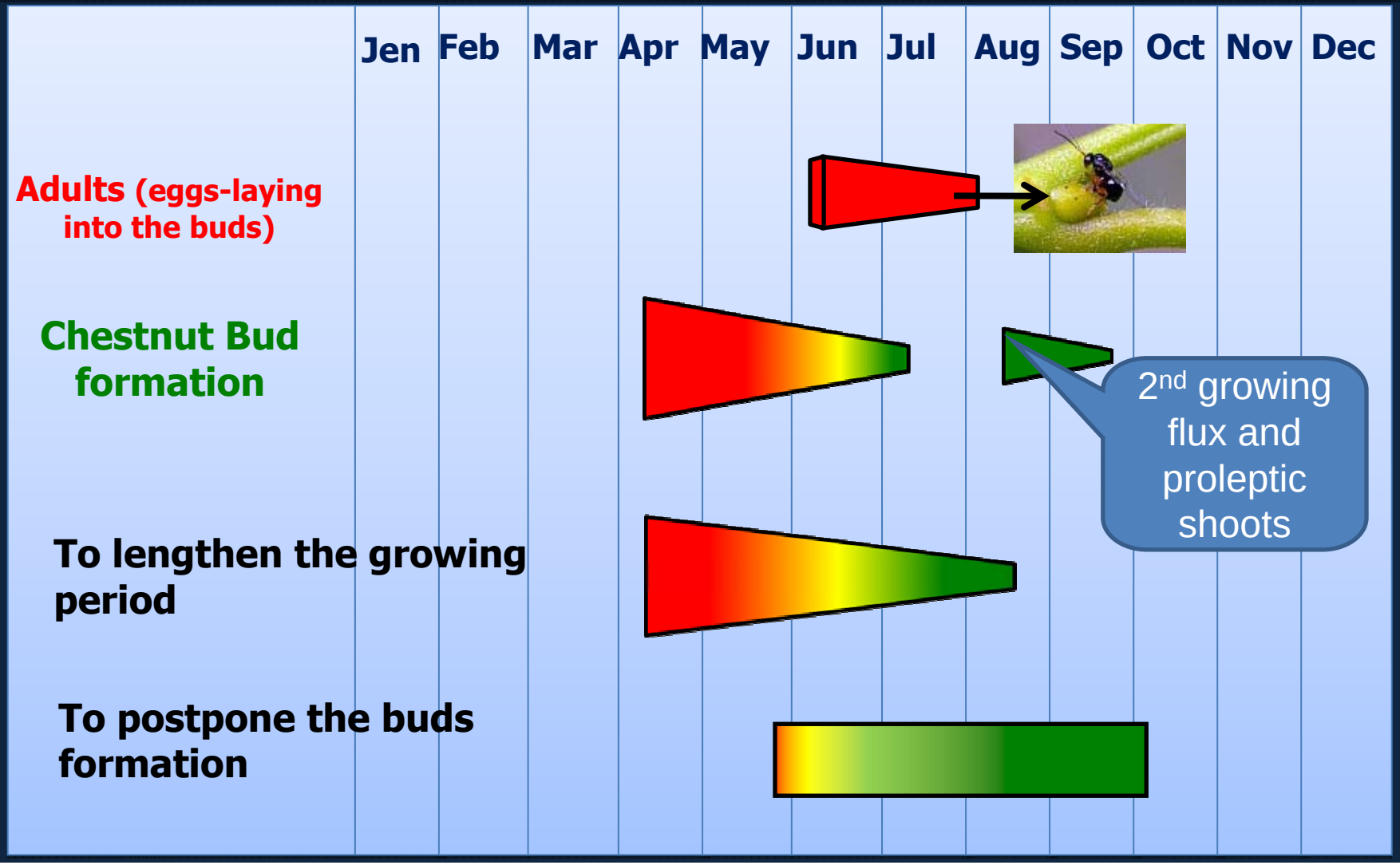


Hypothesis:

Two possible strategies to reduce the damage postponing buds formation

1) Promote the development of vigorous spring shoots

2) Postpone shoot formation



The shortest way to have clearer evidences that pruning can be effective

to postpone bud formation

Method: green pruning on growing shoots
GREEN^2 PRUNING

Stand: young coppice and young grafted plants (juvenile and reactive)

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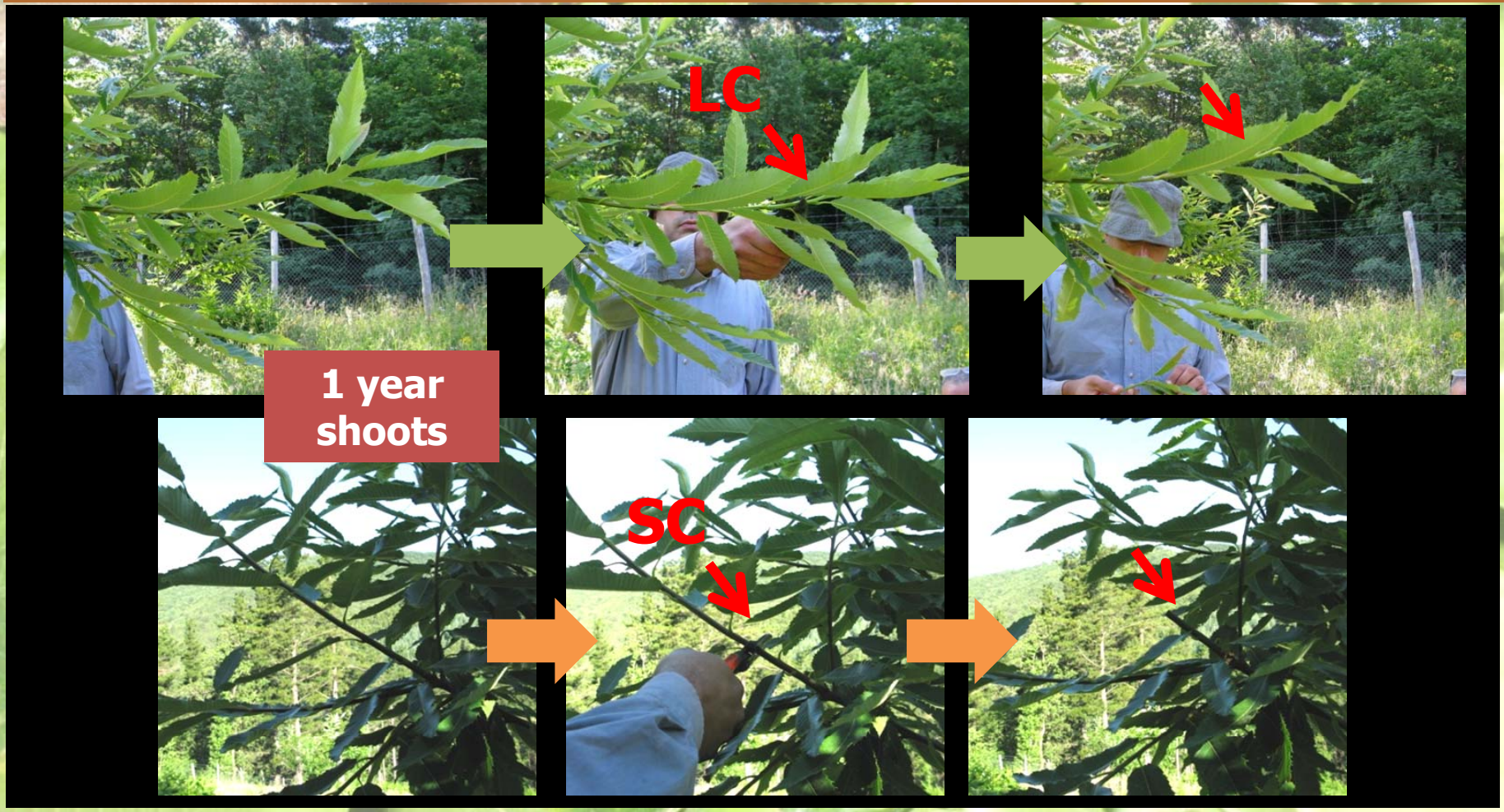
MATERIALS and METHODS

2 different pruning techniques: Short-cut (SC) and Long-cut (LC)



4 different pruning times (2010)

-the second half of May (M) - the second half of June (Jn)

-the middle of July (Jl) -the second half of August (A)

Key points……

- **How effective was the pruning method in limiting the attack?**
  - **Which was the most profitable pruning time to postpone bud formation?**
  - **Does the pruning technique have a significant role?**
  - **Which is the best combination between pruning time and pruning technique?**
- **What would have happened if the plants hadn't been pruned?**

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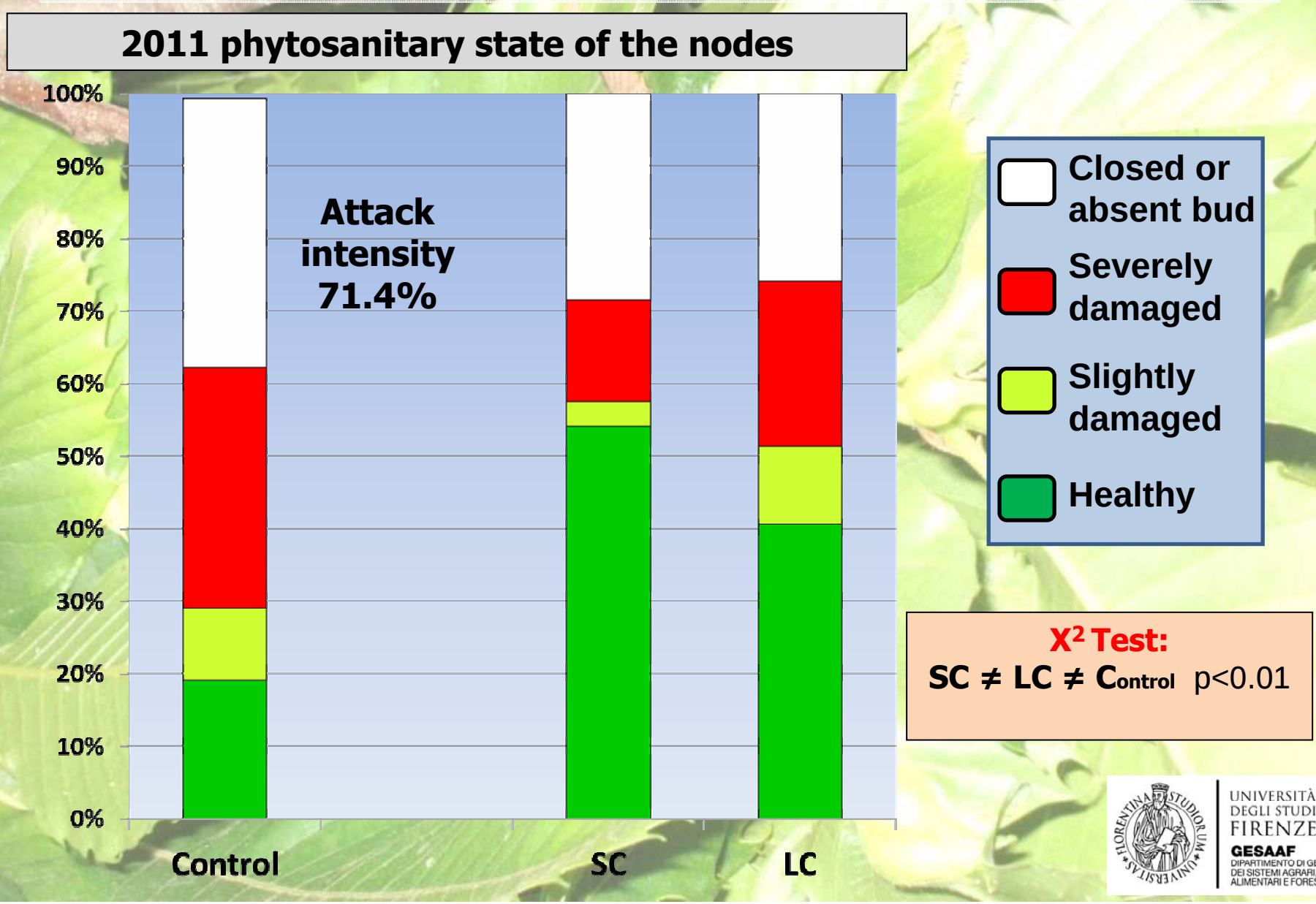
How effective was the pruning method in limiting the attack?



X^2 Test:

SC ≠ LC ≠ $C_{control}$ $p<0.01$

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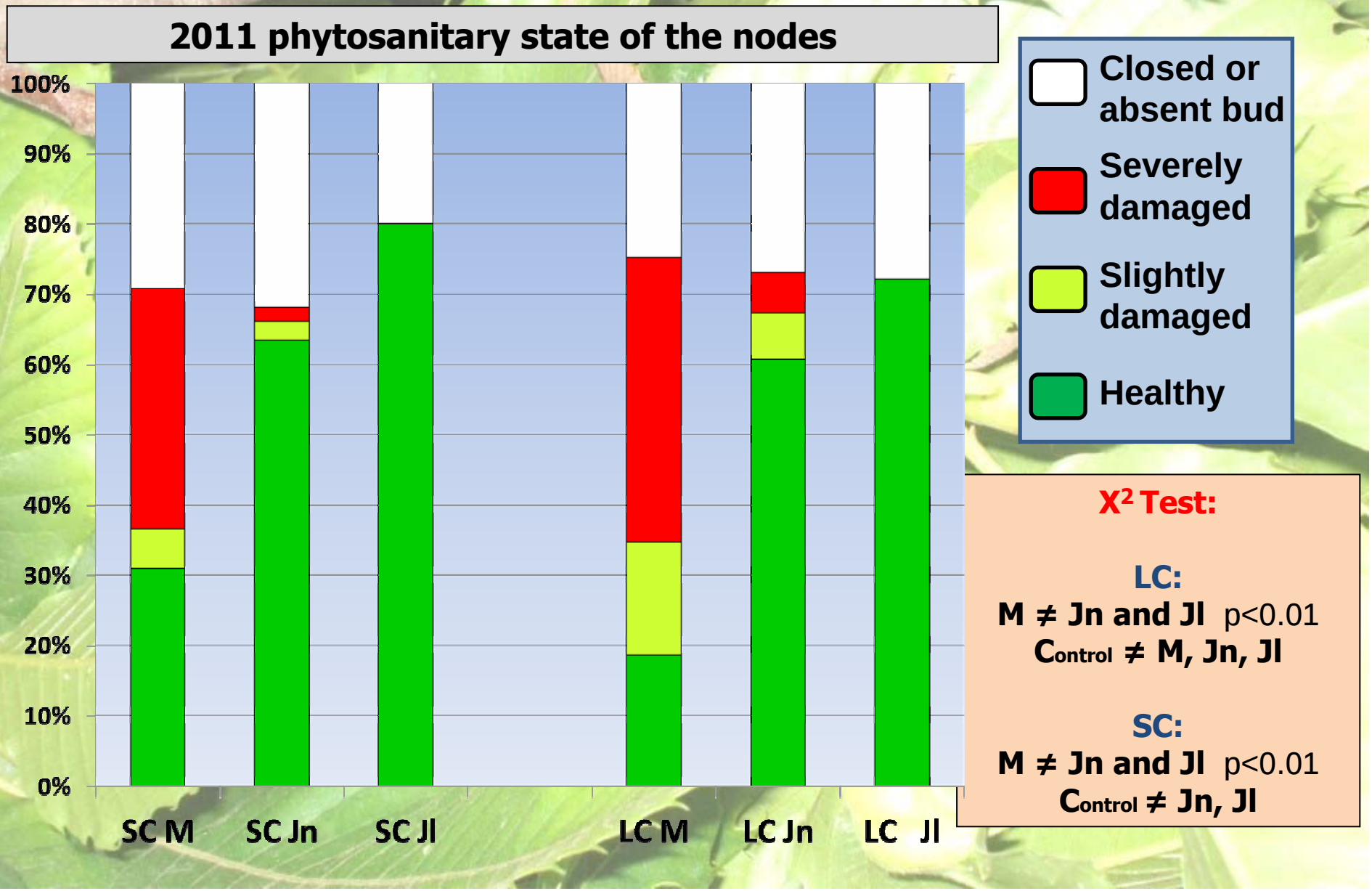
How effective was the pruning method in limiting the attack?



X^2 Test:

LC:

M ≠ Jn and Jl $p<0.01$

$C_{control}$ ≠ M, Jn, Jl

SC:

M ≠ Jn and Jl $p<0.01$

$C_{control}$ ≠ Jn, Jl

On young grafts or in intensively cultivated orchards

?

Traditional chestnut orchards (most spread)

To transfer the results in traditional chestnut orchards is difficult because of:
-lower reactivity of mature trees
-green pruning on 1 yr growing shoots is not practicable and unaffordable on mature trees

The "postponing" strategy is not suitable

That's why in traditional old chestnut orchards we decided to test

to lengthen the growing period

inducing the development of more vigorous shoots

Method: **pruning (winter and green) on branches**

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LI.DA.CI.PO. Project Funding by Regione Toscana

Rural Development Program PSR

Mis. 124 Dissemination Innovative Techniques

No strictly research activity

How and why green pruning can be applied in old traditional chestnut orchards depends from the expected effects

No shoot formation by dormant bud

To maintain fruit production

To not eliminate buds for the future

More longer (vigorous) shoots

To have less serious damages

To produce bigger fruit

To maintain production level (less fruit but bigger)

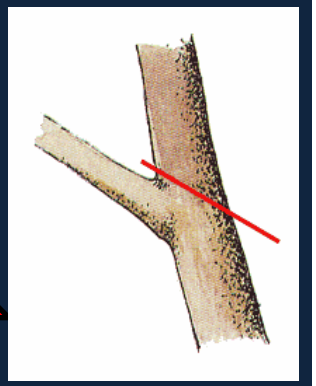
To elongate working period for tree-climbing

Possible criteria

Healthy shoots from dormant and adventitious buds

Healthy but too juvenile so not productive (fruit)
Not available for the future

To reinvigorate branches to obtain more vigorous spring shoots



Adopted tecnique

Pruning times:
(Winter as control) May, June, July (green pruning on woody organs)
10 to 15 cuts for plant

BEST RESULTS in May and in June

Shoots development: higher in pruned plants (but not statistically); + 4,5 cm and +2,3 buds in May; + 3,2 cm and + 1,8 buds in June.

Damage susceptibility: -7 % in May, - 5 % in June for heavy damage; not statistically significant results between pruned and non pruned plants (low presence of gall wasp? irrigation?)

New adventitious shoot formation: significantly reduced – 80 % for all time. Never considered before: very important for future plant life

Fruit production: no reduction in quantity and bigger nut size in pruned plants (but not statistically different); + 8-12 % depending on cultivar in May treatment

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The green² method (shortening cuts on 1 years old shoots) is suitable for young grafts in orchards.

It is possible to induce new healthy shoots. Time plays an important role.

Green pruning effects on old trees are positive but not significant (from a scientific point of view)
But are significant for old traditional chestnut growers
Pruning is necessary

Green pruning can interact negatively with the early stage of introduction of *Torymus sinensis*, so (in this phase) it have to be used in areas far from the introduction zones

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Considering that any **environmental condition** or **cultural practice** that **lengthens** the plant growth season reduces damages, probably high significant results can be reached testing the best effective combination of different cultural practices (pruning + fertilization and/or irrigation)

Silvicultural practices are complementary to biological control and helpful to solve the problem

More tests and studies are necessary

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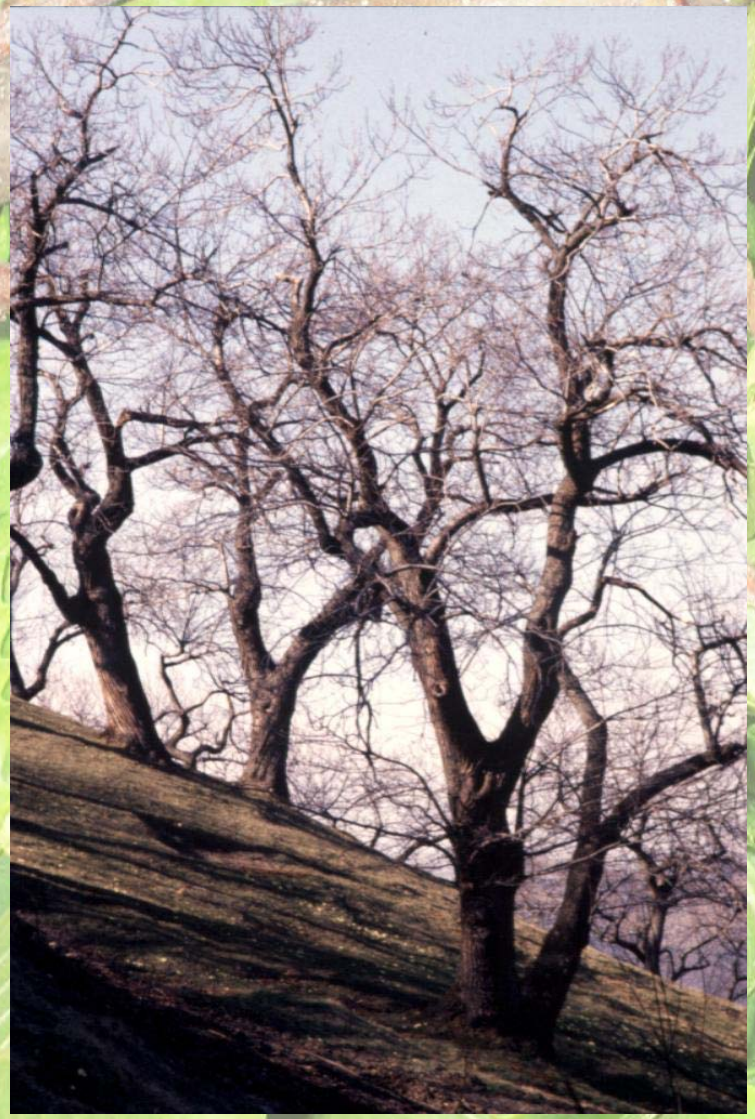

THANK YOU FOR YOUR ATTENTION!

alberto.maltoni@unifi.it

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