The Arboricultural Association's 49th National Amenity Conference

SUSTAINABILITY AND THE URBAN FOREST

20–23 SEPTEMBER 2015

THE UNIVERSITY OF WARWICK, COVENTRY CV4 7AL

www.trees.org.uk/The-Amenity-Conference

Main Quarantine diseases of amenity trees and their possible control through trunk injection methods

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The list of diseases in urban trees
is very long, due to both
native and "exotic" pests and parasites.

Main pathways are strictly
associated to **international trade**
i.e. **plants for planting**
(and wood packaging material, logs, bark, ….)

International, national and local efforts plus legislations help

Funded by the EU's LIFE programme

Forest Research · fera · Forestry Commission · National Trust · WOODLAND TRUST · Animal & Plant Health Agency · Department for Environment Food & Rural Affairs · Cyfoeth Naturiol Cymru Natural Resources Wales

Main “Emergencies” in the EU

		EU status	Presence in the EU	Presence in the UK
Asian longhorned beetle	*Anophophora glabripennis*	Quarantine	yes	yes
Horse chestnut leaf miner	*Cameraria ohridella*	-	yes	yes
Oak processionary moth	*Thaumatopoea processionea*	Quar.	yes	yes
Oriental chestnut gall wasp	*Dryocosmus kuriphilus*	Quar.	yes	yes
Pine processionary moth	*Thaumetopoea pityocampa*	-	yes	no
Red palm weevil	*Rhynchophorus ferrugineus*	Quar	yes	no
Pine wood nematode	*Bursaphelenchus xylophilus*	Quar.	yes	no
Citrus longhorned beetle	*Anoplophora chinensis*	Quar.	yes	no

Main “Emergencies” in the EU

		EU status	Presence in the EU	Presence in the UK
Fire blight	*Erwinia amylovora*	Quar.	Yes	yes
Horse chestnut bleeding canker	*Pseudomonas syringae* pv *aesculi*	-	Yes	yes
Ramorum blight	*Phytophthora ramorum*	EU Decision (since 2013)	Yes	yes
“Phytophthorae”	*Phytophthora* spp.	*	Yes	yes
Chalara dieback of ash	*Hymenoschyphus fraxineus*	-	Yes	yes
Dutch elm disease	*Ophiostoma novo-ulmi*	Quar.	Yes	yes
Chestnut blight* **	*Cryphonectria parasitica*	Quar.	Yes	yes
Canker stain of plane* **	*Ceratocystis platani*	Quar.	Yes	no
Thousand cankers disease* **	*Geosmithia morbida + P. juglandis*	**	Yes	no

* Usually not, but *P. lateralis* and *P. kernoviae* in the EPPO A2 list

** EPPO Alert list

*** Few slides on symptoms at the end of the Powerpoint

Just 2 mins for a personal warning on *Ceratocystis platani*

The London plane is YOUR tree
(Oxford Botanic Garden, ca. 1790).

Ceratocystis platani is lethal.
No effective cures are available.
EU Quarantine parasite.

Peculiar symptoms must be known.

Canker stain of Plane
Ceratocystis platani

It's a Quarantine pathogen in the whole EU with related compulsory eradication measures.

Pay attention to **fake information**, this is from a very well known website.

This is **not a canker by *Ceratocystis* !**

Simply, it's not a canker ...

Canker caused by *Ceratocystis platani* on a plane tree

Do not confuse it with *Phellinus punctatus*: a wood decayer.

It's a frequent mistake, but it's not a Quarantine pathogen, and this mistake can be <u>really embarrassing</u> ….

Lacking carpophores it looks similar, but you can see a centrifugal tentative compartimentalization.

There are a few additional slides on peculiarities at the end of the presentation.

Feel free to use those pictures.

No time to discuss them now, sorry.

We cannot treat all trees against all parasites

We can only treat

the “best” trees

against

the“worst” pests and pathogens.

In urban arboriculture
we need
the cheapest, easiest, safest
delivery system and pesticide.

The EU Directive 2009/128

24.11.2009 EN Official Journal of the European Union L 309/71

DIRECTIVES

DIRECTIVE 2009/128/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 21 October 2009

establishing a framework for Community action to achieve the sustainable use of pesticides

Article 1

Subject matter

This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.

(16) Use of pesticides can be particularly dangerous in very sensitive areas, such as Natura 2000 sites protected in accordance with Directives 79/409/EEC and 92/43/EEC. In other places such as public parks and gardens, sports and recreation grounds, school grounds and children's playgrounds, and in the close vicinity of healthcare facilities, the risks from exposure to pesticides are high. In these areas, the use of pesticides should be minimised or prohibited. When pesticides are used, appropriate risk management measures should be established and low-risk pesticides as well as biological control measures should be considered in the first place.

IPM approach

Article 14

Integrated pest management

1. Member States shall take all necessary measures to promote low pesticide-input pest management, giving wherever possible priority to non-chemical methods, so that professional users of pesticides switch to practices and products with the lowest risk to human health and the environment among those available for the same pest problem. Low pesticide-input pest management includes integrated pest management as well as organic farming according to Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products ([1]).

6. 'integrated pest management' means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms;

Aerial spraying is prohibited

(14) Aerial spraying of pesticides has the potential to cause significant adverse impacts on human health and the environment, in particular from spray drift. Therefore, aerial spraying should generally be prohibited with derogations possible where it represents clear advantages in terms of reduced impacts on human health and the environment in comparison with other spraying methods, or where there are no viable alternatives, provided that the best available technology to reduce drift is used.

CHAPTER IV

SPECIFIC PRACTICES AND USES

Article 9

Aerial spraying

1. Member States shall ensure that aerial spraying is prohibited.

2. By way of derogation from paragraph 1 aerial spraying may only be allowed in special cases provided the following conditions are met:

(a) there must be no viable alternatives, or there must be clear advantages in terms of reduced impacts on human health and the environment as compared with land-based application of pesticides;

(b) the pesticides used must be explicitly approved for aerial spraying by the Member State following a specific assessment addressing risks from aerial spraying;

(c) the operator carrying out the aerial spraying must hold a certificate as referred to in Article 5(2). During the transitional period where certification systems are not yet in place, Member States may accept other evidence of sufficient knowledge;

(d) the enterprise responsible for providing aerial spray applications shall be certified by a competent authority for authorising equipment and aircraft for aerial application of pesticides;

(e) if the area to be sprayed is in close proximity to areas open to the public, specific risk management measures to ensure that there are no adverse effects on the health of bystanders shall be included in the approval. The area to be sprayed shall not be in close proximity to residential areas;

(f) as from 2013, the aircraft shall be equipped with accessories that constitute the best available technology to reduce spray drift.

National Action Plans

Article 4

National Action Plans

1. Member States shall adopt National Action Plans to set up their quantitative objectives, targets, measures and timetables to reduce risks and impacts of pesticide use on human health and the environment and to encourage the development and introduction of integrated pest management and of alternative approaches or techniques in order to reduce dependency on the use of pesticides. These targets may cover different areas of concern, for example worker protection, protection of the environment, residues, use of specific techniques or use in specific crops.

DECRETO 22 gennaio 2014.

Adozione del Piano di azione nazionale per l'uso sostenibile dei prodotti fitosanitari, ai sensi dell'articolo 6 del decreto legislativo 14 agosto 2012, n. 150 recante: «Attuazione della direttiva 2009/128/CE che istituisce un quadro per l'azione comunitaria ai fini dell'utilizzo sostenibile dei pesticidi».

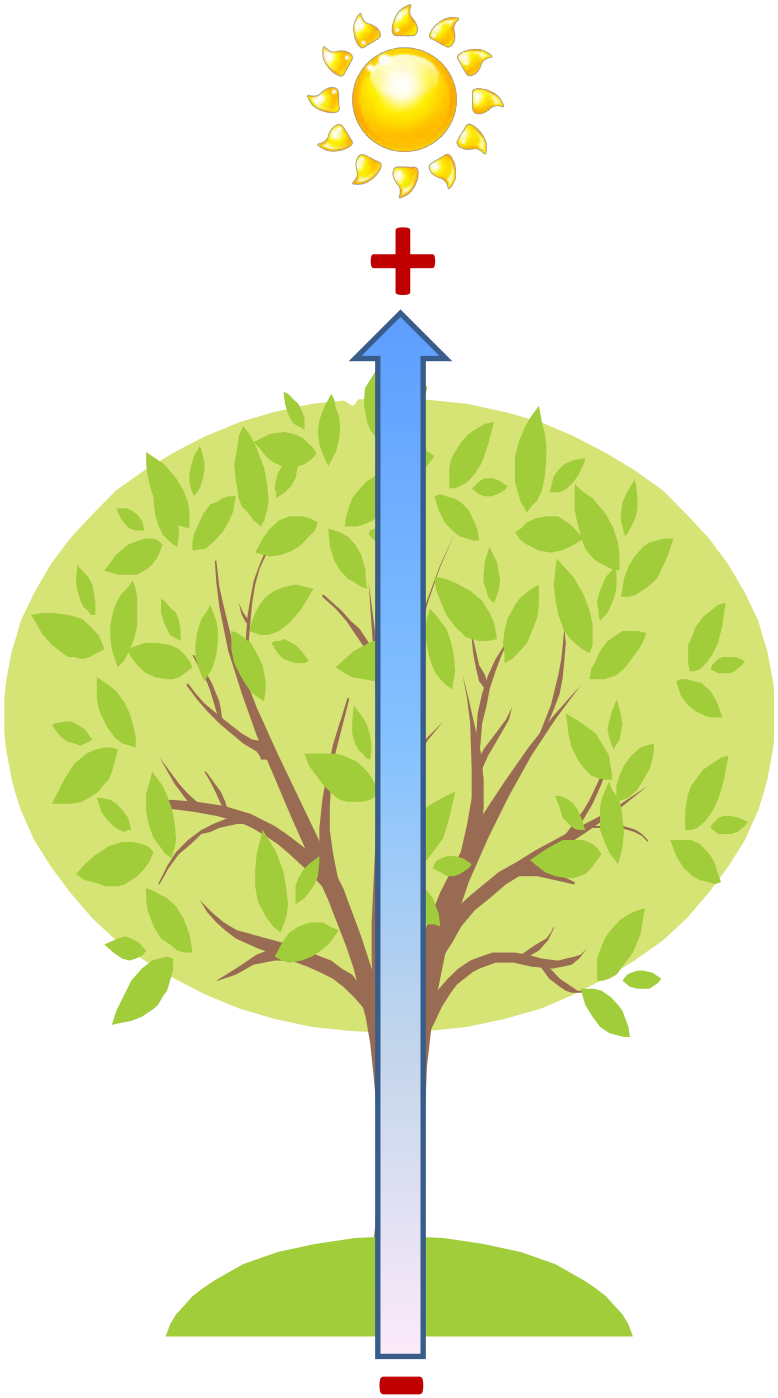
«Trunk injection»
fits such requirements
better than others.

What is trunk injection?

Xylematic sap moves up through the vessels according to a **depression difference** between water in roots and canopy.

Pressure changes with the features related to **leaves' transpiration**:

tree species, amount of active leaves, health, sun intensity, soil humidity, etc.

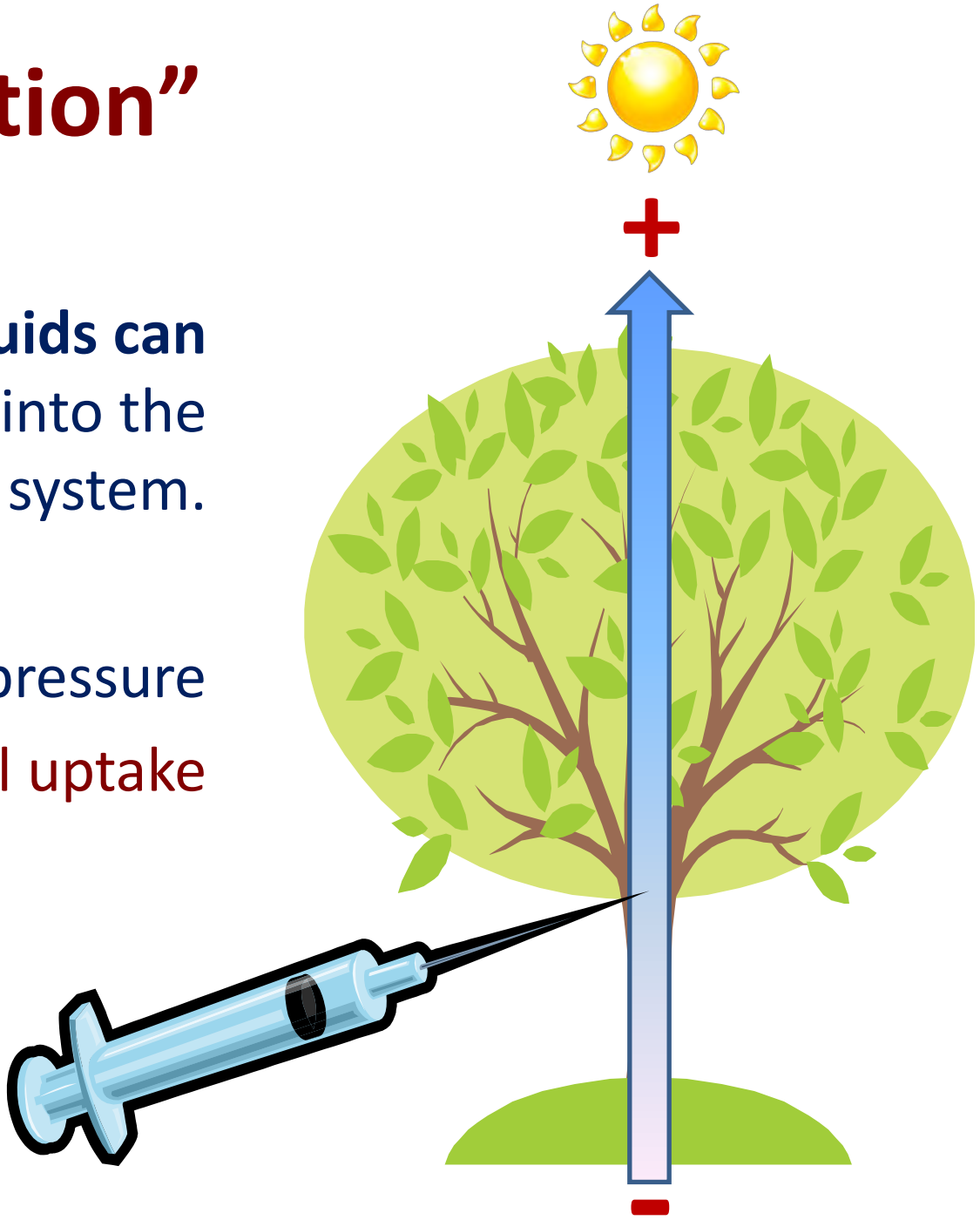


“injection”

Sap-compatible liquids can be “injected” into the xylematic system.

Injection: external pressure

Infusion: natural uptake



“Trunk injection”?
A tree is not a pole

The improvement of the tree health status
is our goal.

I’d prefer
“Tree endotherapy” or
“Xylematic injection”

“injection” is not a new method !

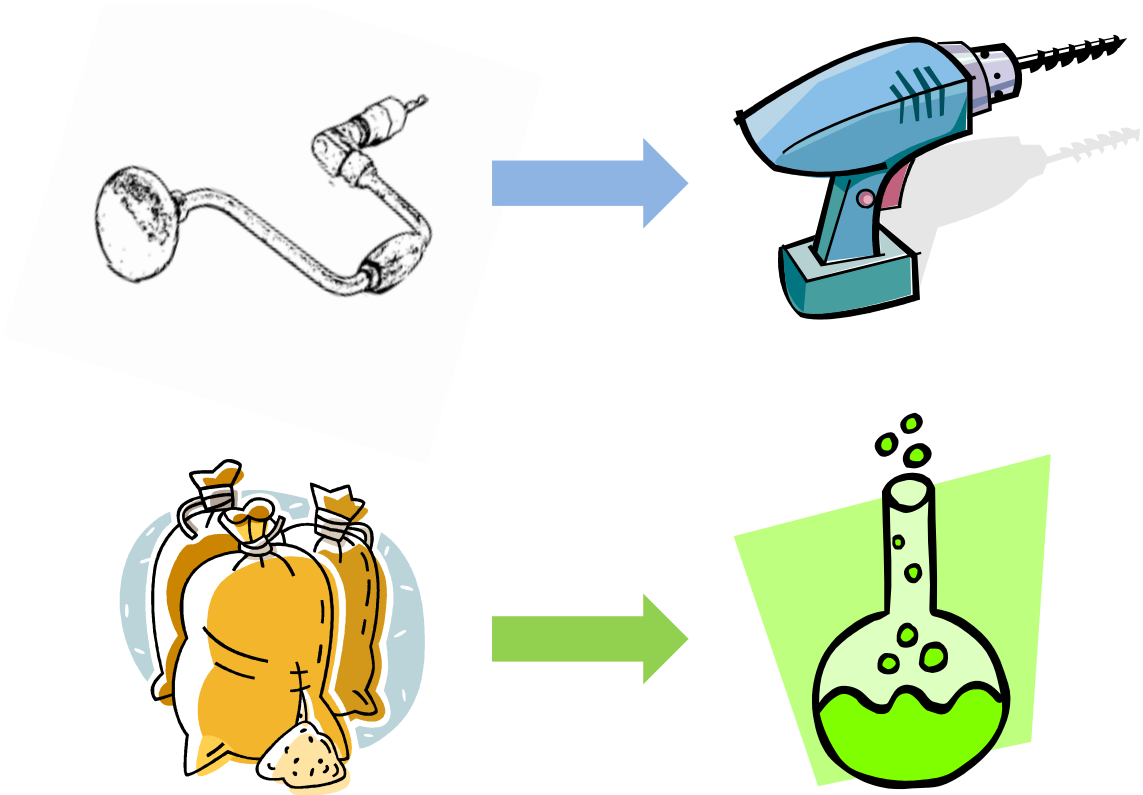
1478-1519: Leonardo da Vinci describes how he “injected” arsenic in a apple tree during vegetative period from a jar through a deep hole, then plugged.

“Boring **a hole in a tree with a gimlet** and inserting in it arsenic [...] dissolved in [...] water [...] the **hole must be large** and must go **right through the pit** [...].
[...] **when the sap is rising** in the trees [...] the poisonous liquid should be **squirted in from a jar** [...]

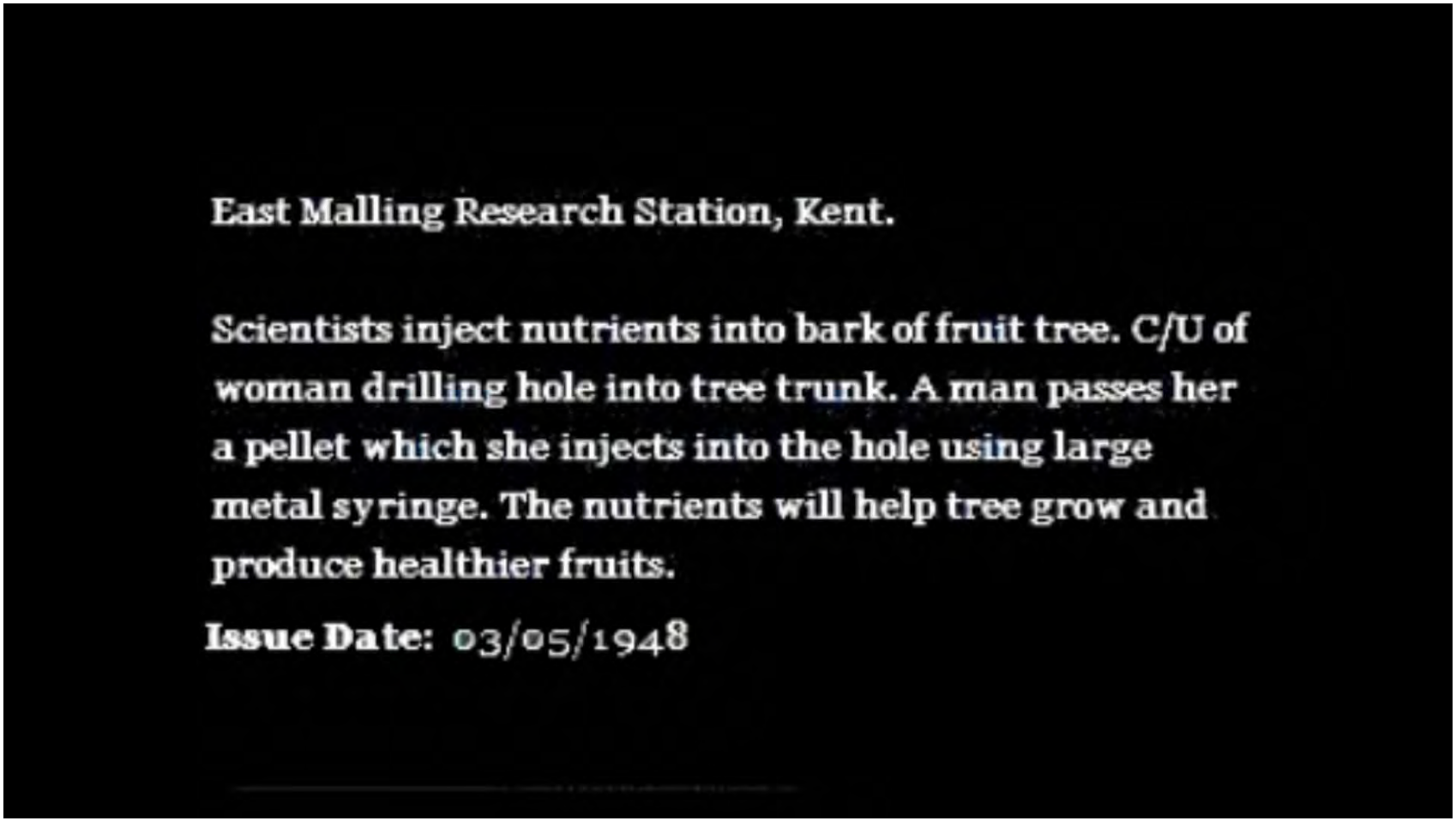
Codex Atlanticus, fol. 76 recto a; fol. 12 recto a.

Little has changed in 500 years

Methods remain the same, materials changed.

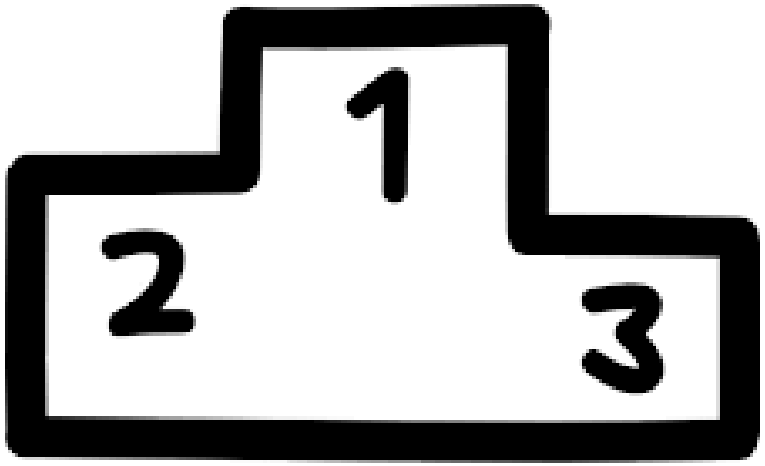


East Malling Research Station
Kent, 1948



What we need to inject a tree

1) Excellent Injectables
2) Good Knowledge and Experience
3) A suitable Device

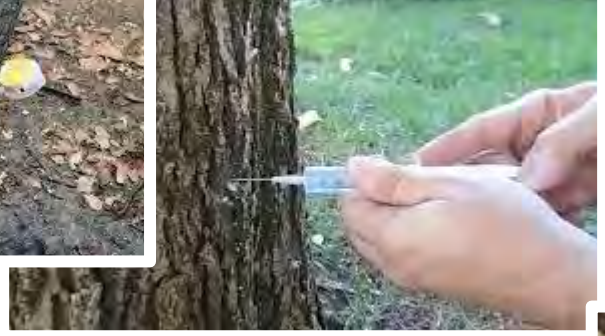


ALL devices work !

also a common syringe: just try

Differences concern

1) speed (= £),
2) real distribution into the tree,
3) side effects, sometimes worst than the pest.


Available tools are dozens

(all the pictures from internet)



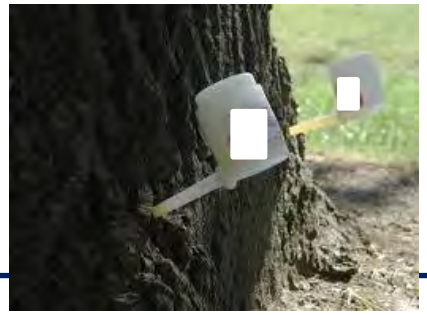






All in all, they work in this way

Drill a hole every 20 cm along the circumference



Insert a pre-pressurized capsule (ca. 15 ml).

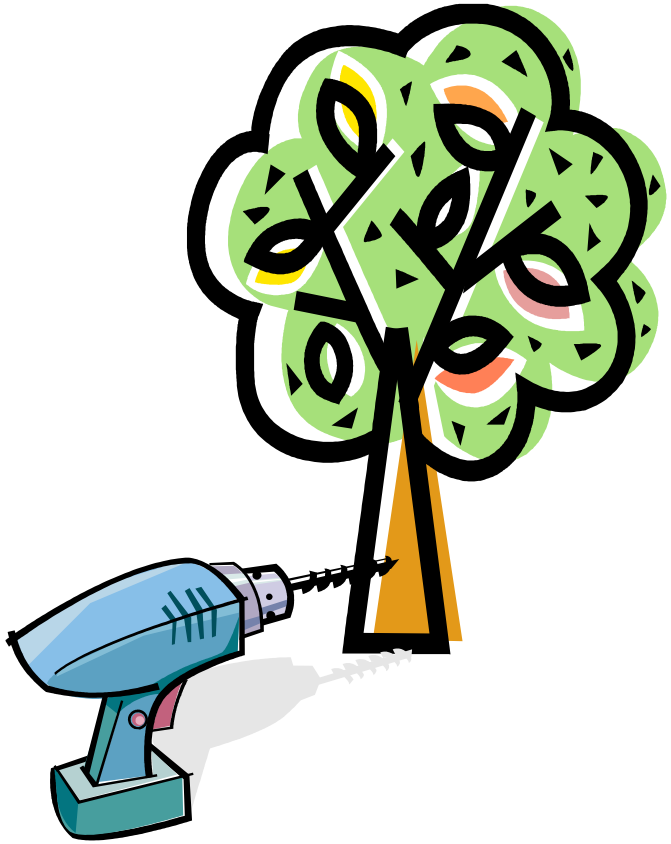
Easy!

insert a plug and then inject the liquid through a pressurized external device with a needle crossing the plug

Pros with the holes

Quick and easy

Unfortunately: everybody can do it.



Troubles with the holes

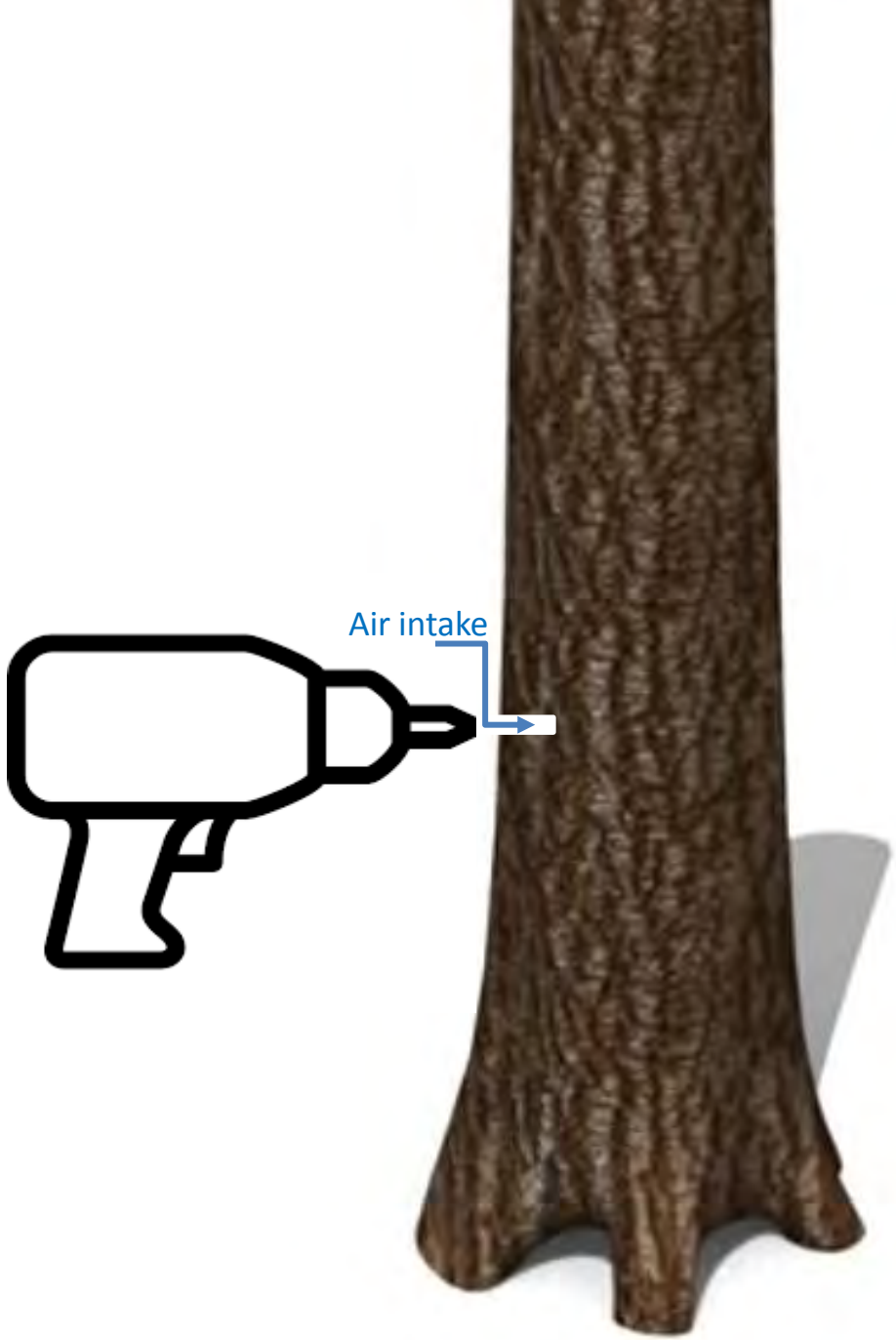
- Removal and overheating of vital tissues **just to reach the vessels, not to inject!**
- Many holes (ca. 1 / 15-20 cm crf)
- The bit can transfer soil-borne parasites, wound parasites or wood decayers.

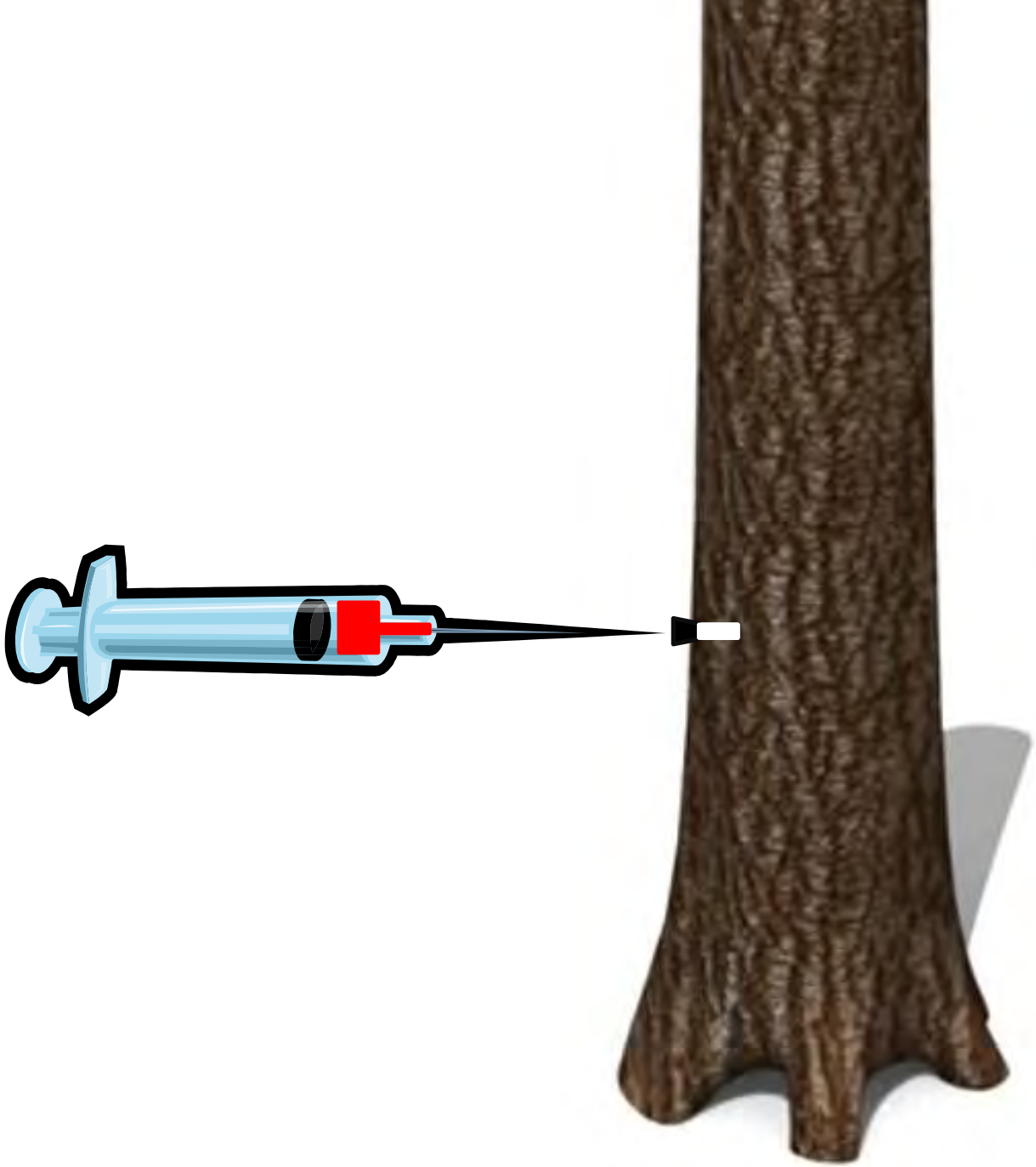
Pros with pressure

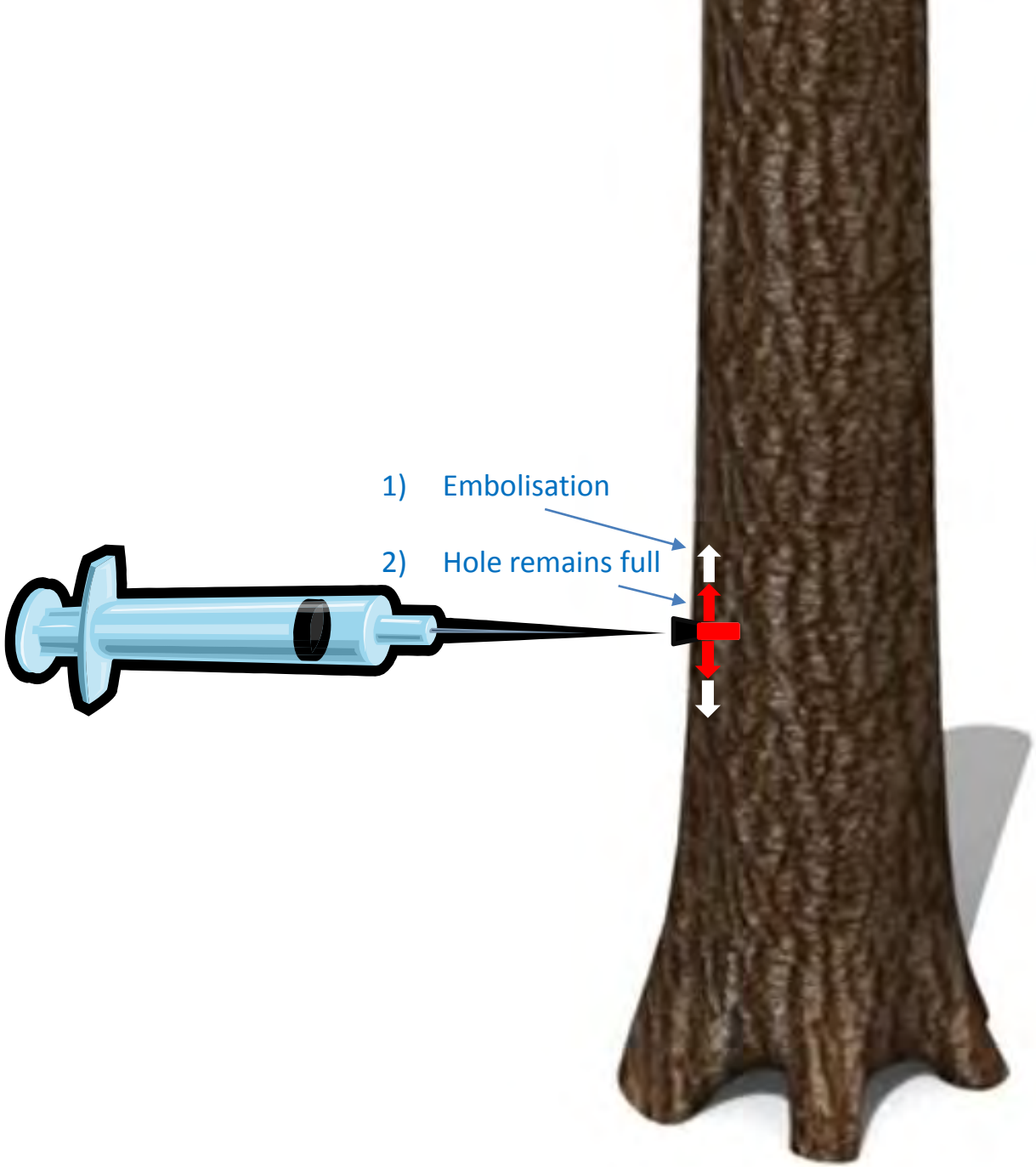
- Very quick injection
- Large number of trees per day, also when dormant !!!

Troubles with pressure

- The overall volume of the liquid must be available into the tree. It's just physics…
- Embolization of the vessels (the volume of air into the hole).


Air intake



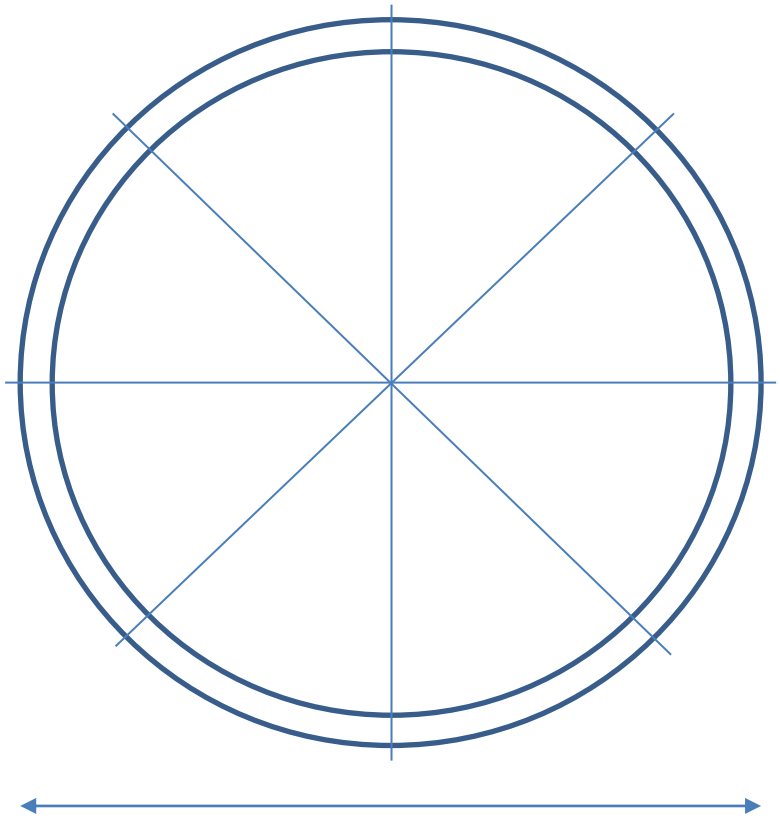

1) Embolisation
2) Hole remains full

Damage to the functional components of the tree affects its physiological status.

Advertisements
(websites, yesterday)

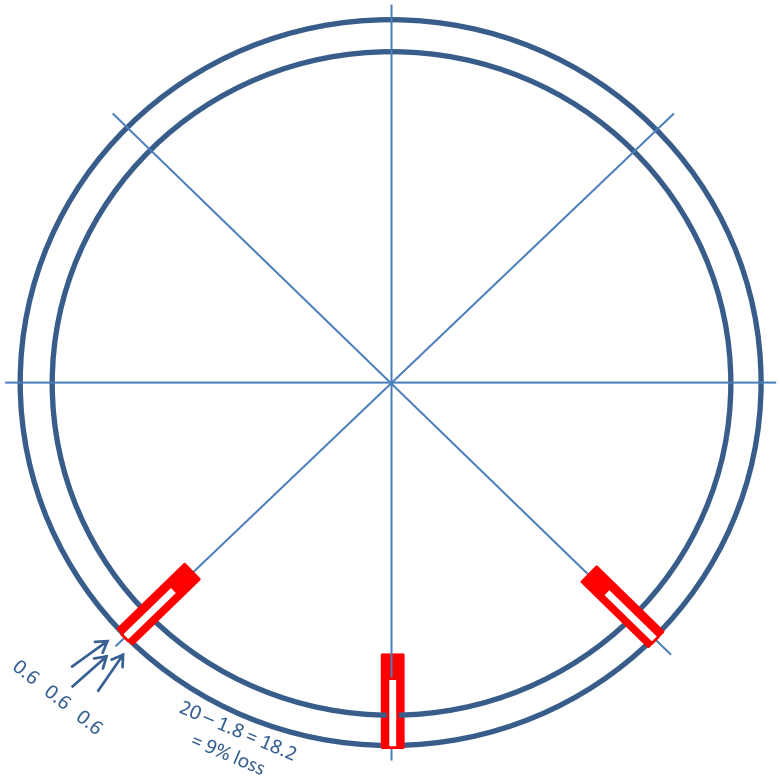
«The torture of St. Sebastian»
(Andrea Mantegna, 1506)

Repeated treatments, additional damage

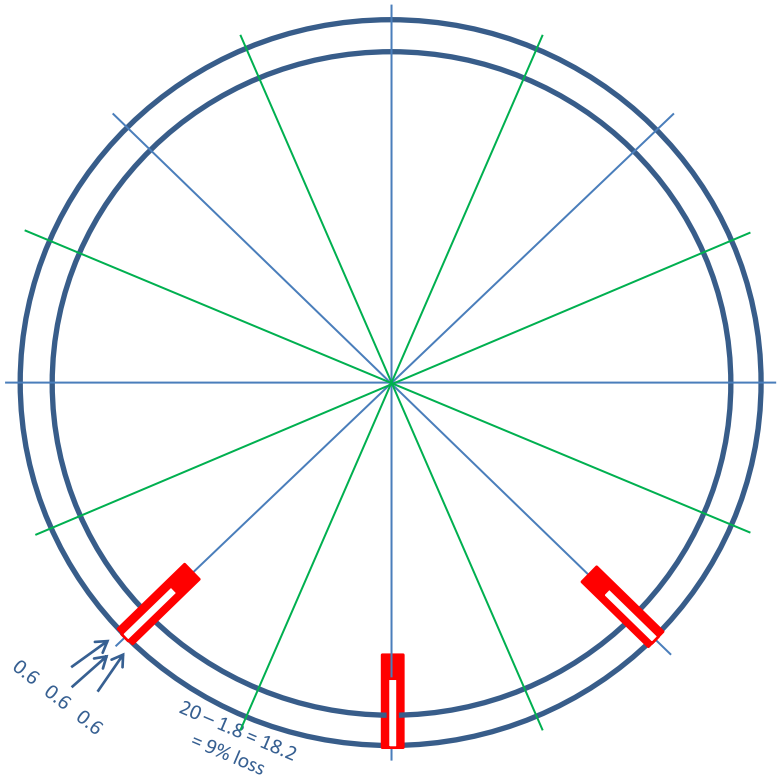


diam 51, cfr 160, 1 wound /20 cm

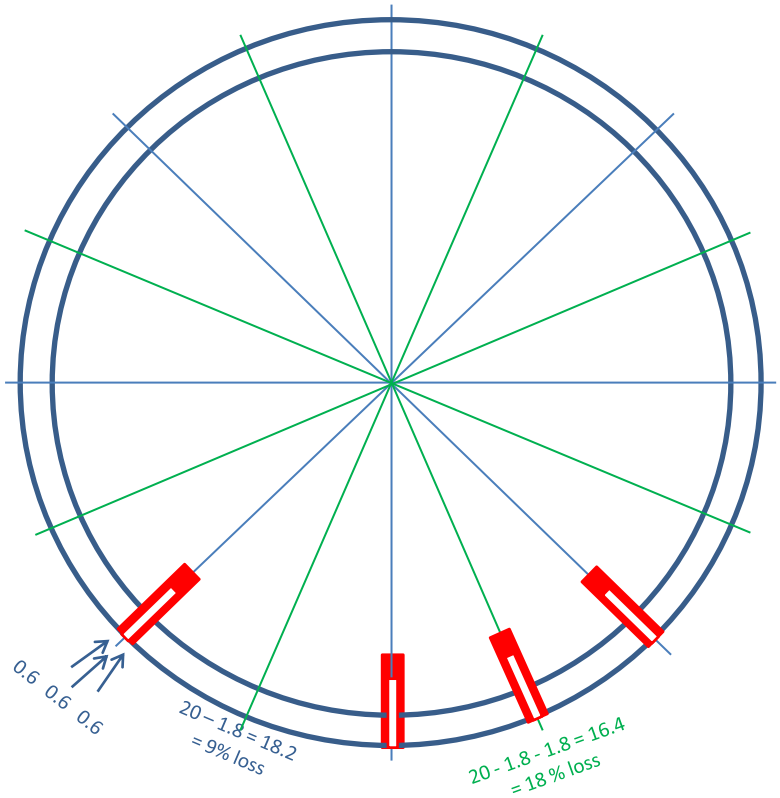
1st treatment: 8 wounds



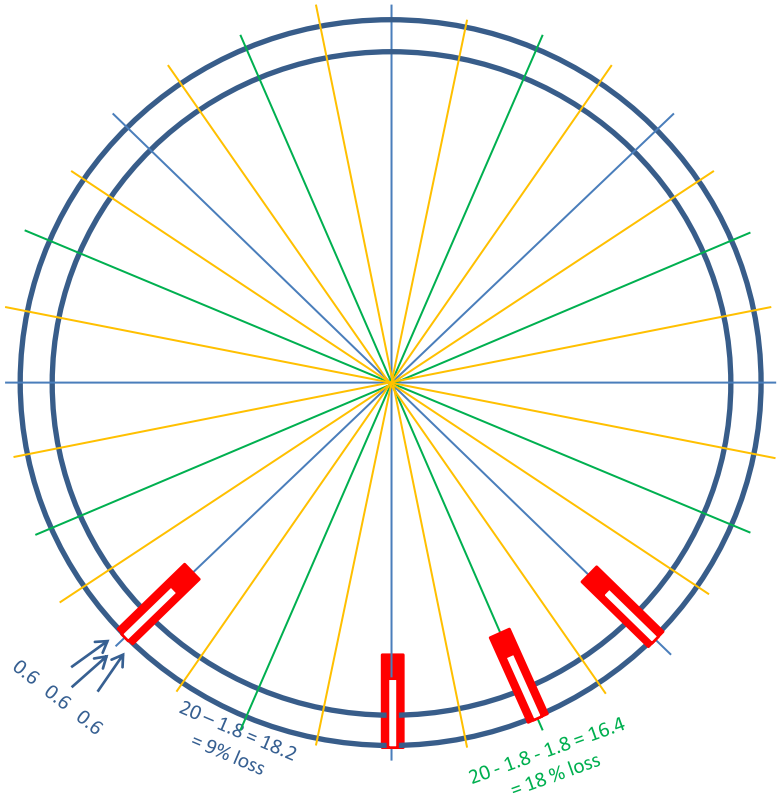
8 wounds = 9% loss of vital tissues. Sustainable.



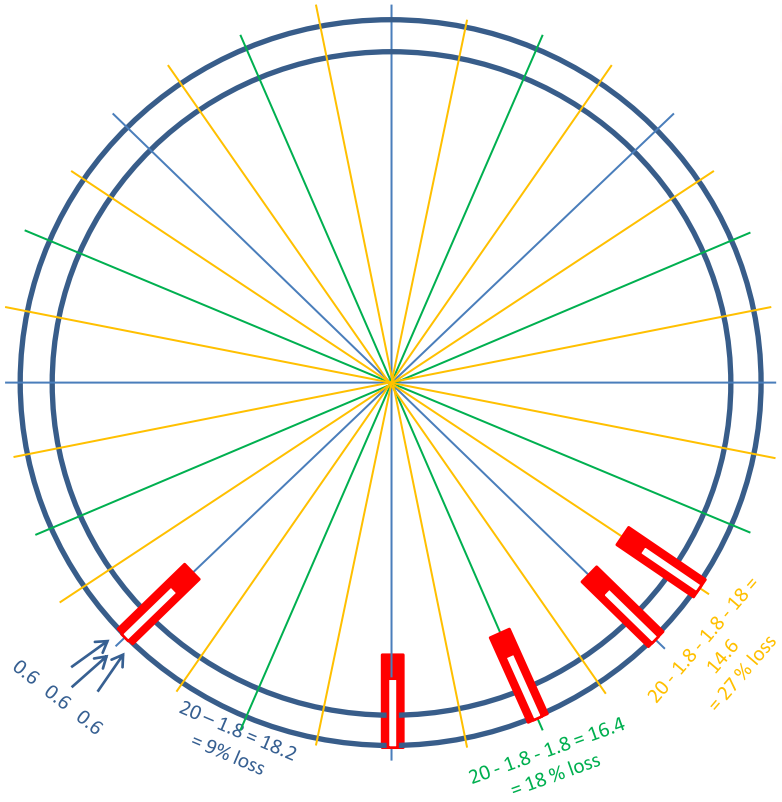
2nd treatment: 8 more wounds



2nd treatment: = 18% loss of vital tissues. Sustainable ?



3rd treatment: 8 more wounds = 24



3rd treatment: = 27% loss of vital tissues. Sustainable ? ? ? ? ? ? ? ?

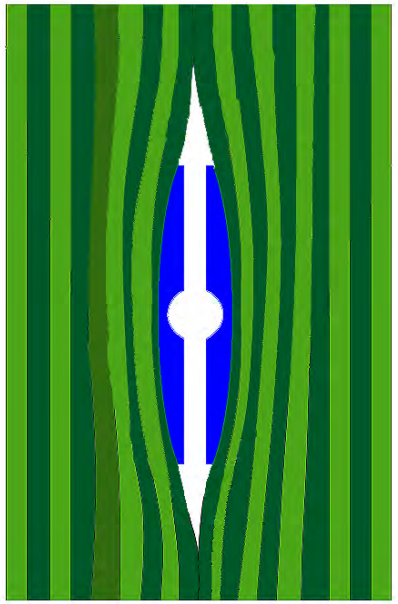
Errare humanum est, perseverare autem diabolicum

Can a hollow, lenticular blade substitute a drill bit ?

The “B.I.T.E. project”

University of Padova

By introducing something of whichever shape into a bunch of fibres, they separate according to a **lenticular** biconvex geometry.



1) A lenticular blade gently separates the fibres with **the lowest friction**

Natural uptake
often external pressure is not required

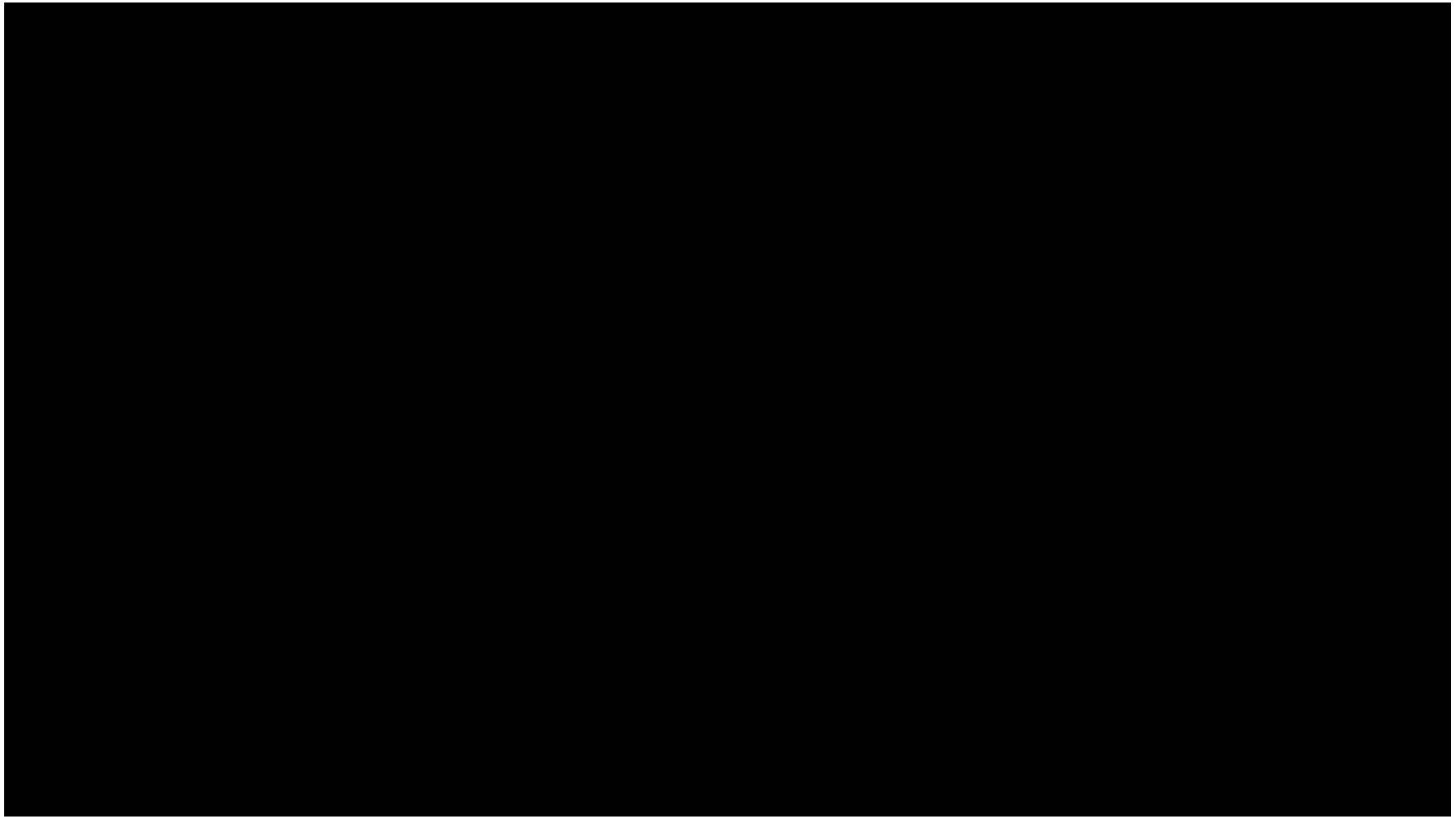
The blade's shape and dimension cause a temporary reduction of the vessels' section:
Reduction of sap pressure + Increase of speed = **Venturi effect**

⇩

2) With a hollow lenticular blade
connected to an external jar,
if the sap speed is substantial
external liquids are **taken up by the tree**
according to sap velocity

The “Venturi effect”

Up-take depends on the speed of the fluid



Youtube/luciomontecchio

Infusion in a Cherry tree

Youtube/luciomontecchio

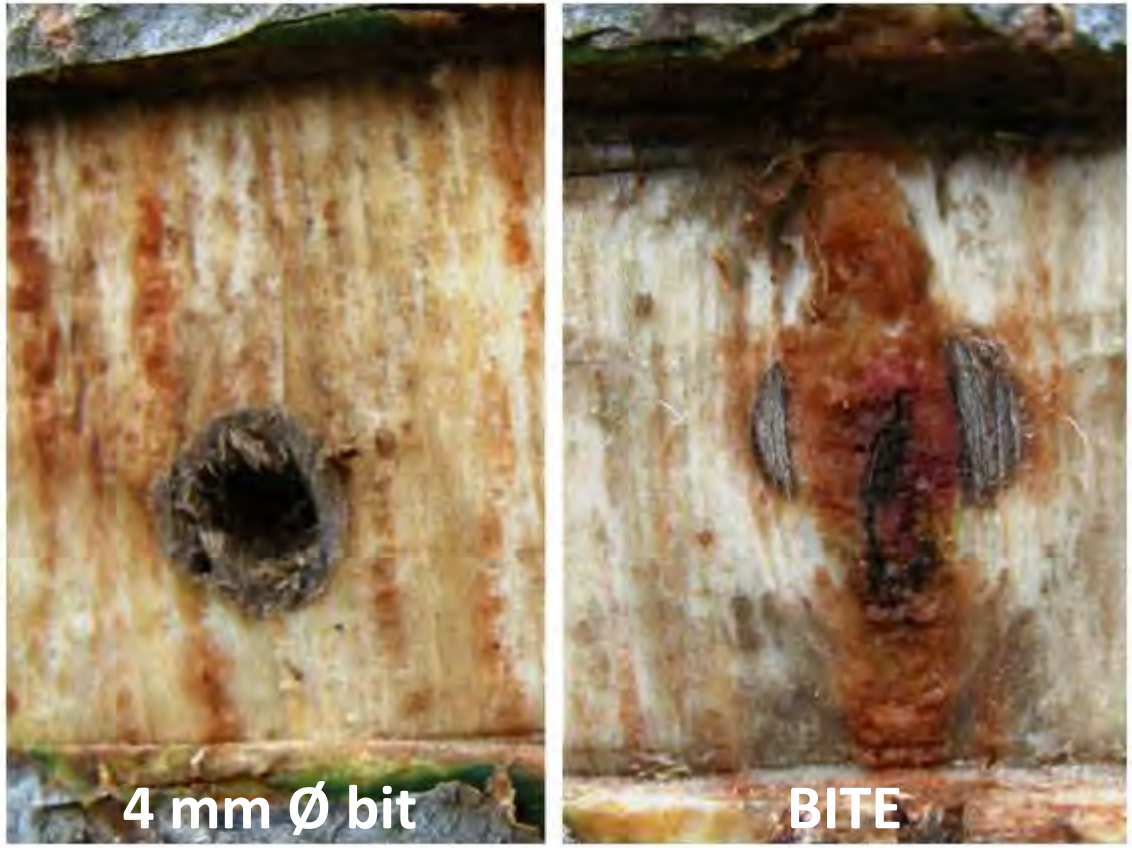
But of course it can be very slow …

It depends on the tree species, status, climatic conditions, …..

Ring porous trees fast	Diffuse porous trees slow	Non-porous trees very slow / lacking
Fraxinus, Ulmus, Castanea, Quercus (most)	Quercus (some), Fraxinus, Carpinus, Fagus, Betula, Prunus, Malus, Pyrus, Aesculus, Tilia, Populus, Salix, Acer, Juglans, Platanus, Magnolia	Conifers Palms

A gentle **«thumb» pressure** (i.e. through a self-refilling syringe)
or
a **drip bag**
can help.

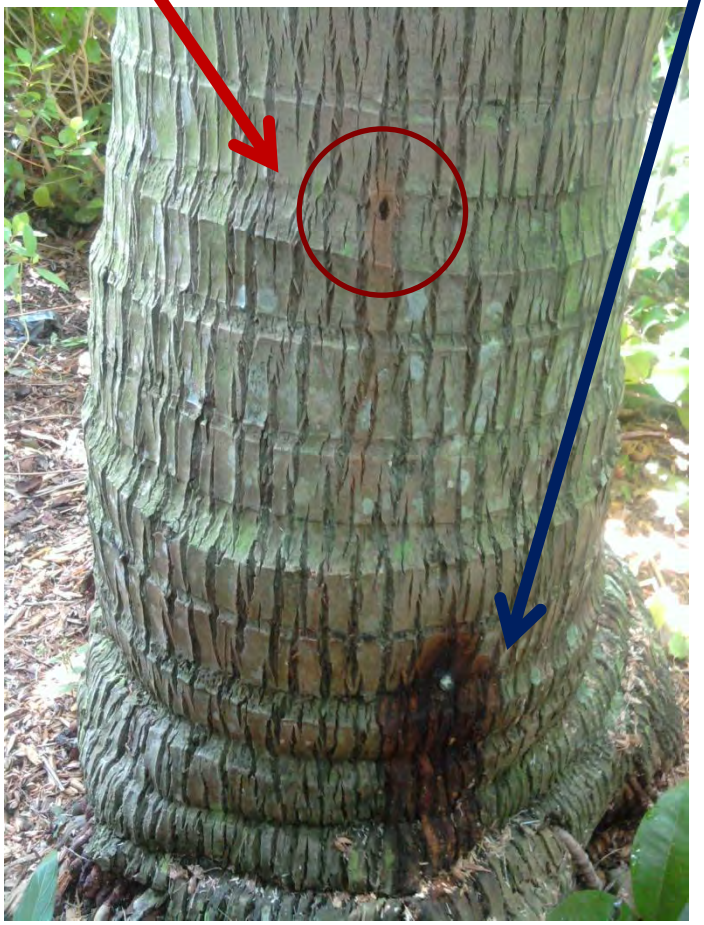
No wood removal
Quick closure



after 30 days (May, *Populus nigra*)

BITE vs. plug method

(field trials and pictures by Scott Irwin, Florida)



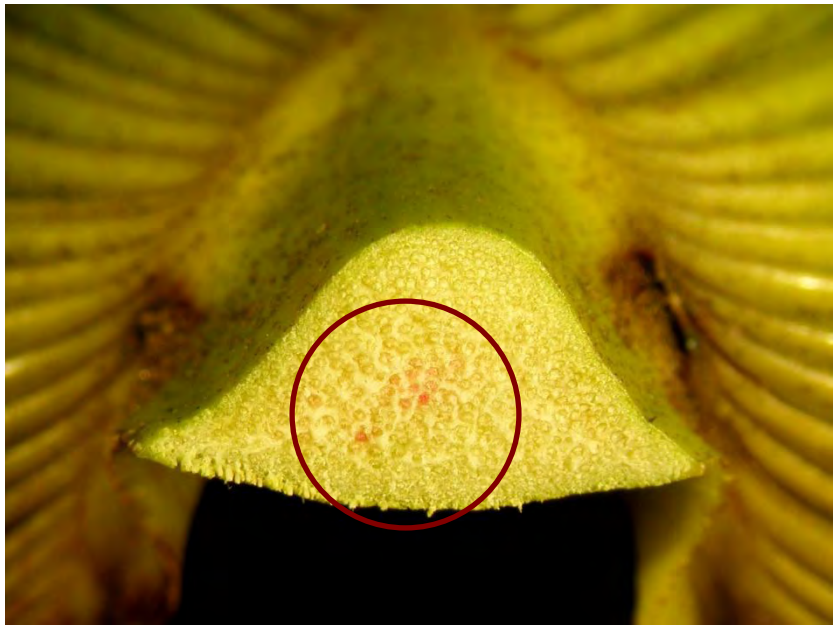
7 days after treatment

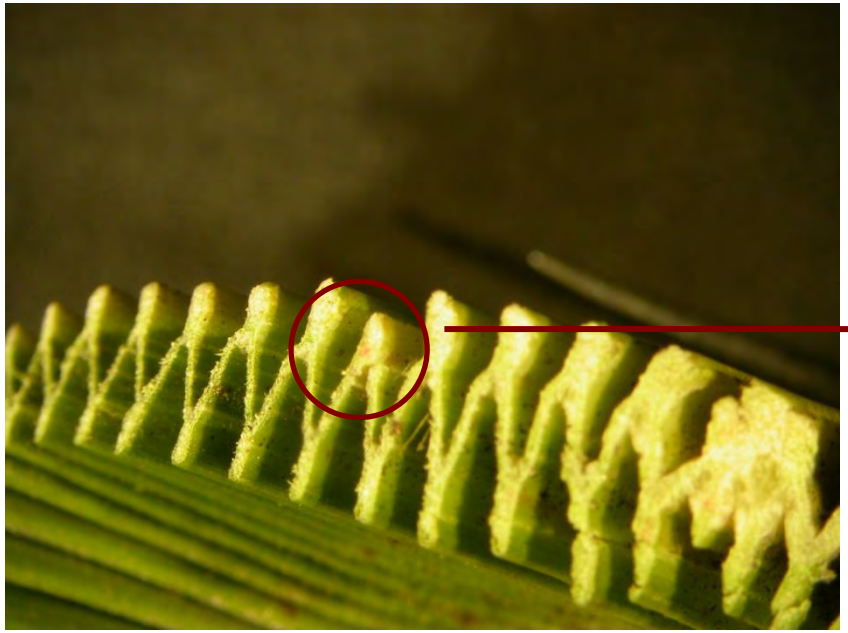
BITE (above)
4 mm hole (below)
(before injection)

BITE: full closure
(30 days)

BITE: low internal physical alterations
(one year)

Up-take to the palm shoots *(Trachycarpus fortunei)*





We can choose!

40-50 trees /day, every day.
Side effects acceptable?
Drill'n'press

Side effects not acceptable.
5-10 trees / day, spring to autumn?
Blade

What do we need now?

1) We do not need wizards

Not the active ingredient, but the co-formulants (often not named on the label) and the overall final concentration can be phytotoxic.

* Inert = …. does not have a toxic effect on the species the pesticide is meant to combat, but that does not rule out that it may still have a biological activity on other species, including being toxic to humans (US Federal Insecticide, Fungicide, and Rodenticide Act)

What do we need now?

Need of independent research

What do we need now?

2) We do not need carpenters

Unconcern for hygiene, dull bits, use of air-spray products, hurry, ….

What do we need now?

Need of international, *super-partes*

Certification of Technicians!!!!

DIRECTIVES

DIRECTIVE 2009/128/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 21 October 2009
establishing a framework for Community action to achieve the sustainable use of pesticides

IPM approach and Training

Article 14

Integrated pest management

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6. 'integrated pest management' means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms;

CHAPTER II

TRAINING, SALES OF PESTICIDES, INFORMATION AND AWARENESS-RAISING

Article 5

Training

1. Member States shall ensure that all professional users, distributors and advisors have access to appropriate training by bodies designated by the competent authorities. This shall consist of both initial and additional training to acquire and update knowledge as appropriate.

The training shall be designed to ensure that such users, distributors and advisors acquire sufficient knowledge regarding the subjects listed in Annex I, taking account of their different roles and responsibilities.

What do we need now?

3) The courage to say «no»

No injectables available for all trees vs. all disease; not the right moment.

What do we need now?

4) Plant-specific + pest-specific injectables

Just 4 registered insecticides, and not in the whole EU

		EU status	Presence in the EU	Presence in the UK	Effective active ingredients	Registered in some EU Countries
Asian longhorned beetle	*Anophophora glabripennis*	Quarantine	yes	yes	Imidacloprid	-
Horse chestnut leaf miner	*Cameraria ohridella*	-	yes	yes	Imidacloprid Abamectin Emamectin benzoate Allicin	Yes Yes Yes no
Oak processionary moth	*Thaumatopoea processionea*	Quar.	yes	yes	Abamectin Emamectin benzoate	? ?
Oriental chestnut gall wasp	*Dryocosmus kuriphilus*	Quar.	yes	yes	-	-
Pine processionary moth	*Thaumetopoea pityocampa*	-	yes	no	Abamectin	yes
Red palm weevil	*Rhynchophorus ferrugineus*	Quar	yes	no	Abamectine Emamectin benzoate	Yes yes
Pine wood nematode	*Bursaphelenchus xylophilus*	Quar.	yes	no	Emamectin benzoate	Yes
Citrus longhorned beetle	*Anoplophora chinensis*	Quar.	yes	no	Imidacloprid	-
Ornamentals, forestry	Aphids, Aleurodids, Cicadellidae, Lepidopt., Leaf miners, Thripids				Azadirachtin	yes

1 (2?) fungicides, not in the whole EU

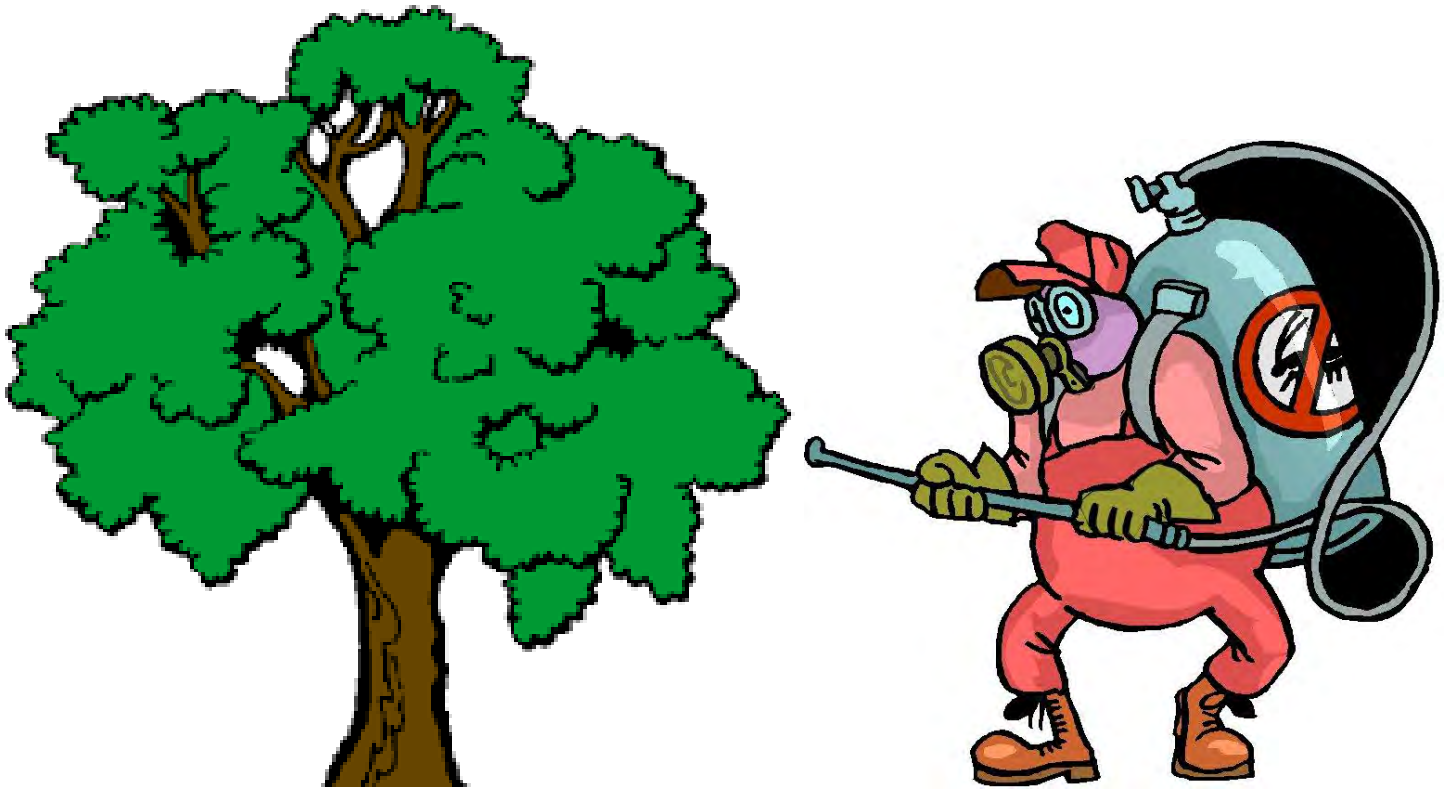
		EU status	Presence in the EU	Presence in the UK	Effective active ingredients	Registered in EU Countries
Fire blight	*Erwinia amylovora*	Quar.	Yes	yes	Oxytetracycline Plant extract	- -
Horse chestnut bleeding canker	*Pseudomonas syringae* pv *aesculi*	-	Yes	yes	Allicin Oxytetracycline	- -
Ramorum blight	*Phytophthora ramorum*	EU Decision (since 2013)	Yes	yes	Potassium salts of phosphorous acid Allicin	No need -
"Phytophthorae"	*Phytophthora* spp.	Some in the EPPO A2 or Alert List	Yes	yes	Potassium salts of phosphorous acid Allicin	No need -
Chalara dieback of ash	*Hymenoschyphus fraxineus*	-	Yes	yes	Thiabendazole Allicin	- -
Dutch elm disease	*Ophiostoma novo-ulmi*	Quar.	Yes	yes	Thiabendazole Propiconazole	- ?
Chestnut blight	*Cryphonectria parasitica*	Quar.	Yes	yes	Thiabendazole Propiconazole	- -
Canker stain of plane	*Ceratocystis platani*	Quar.	Yes	no	Propiconazole "Plant extracts"	- -
Thousand cankers disease	*Geosmithia morbida + P. juglandis*	EPPO Alert	Yes	no	"Chemicals" "Plant extracts"	- -
Leaf scorch of plane	*Gnomonia platani*	-	yes	?	Thiabendazole	yes

5 in Italy

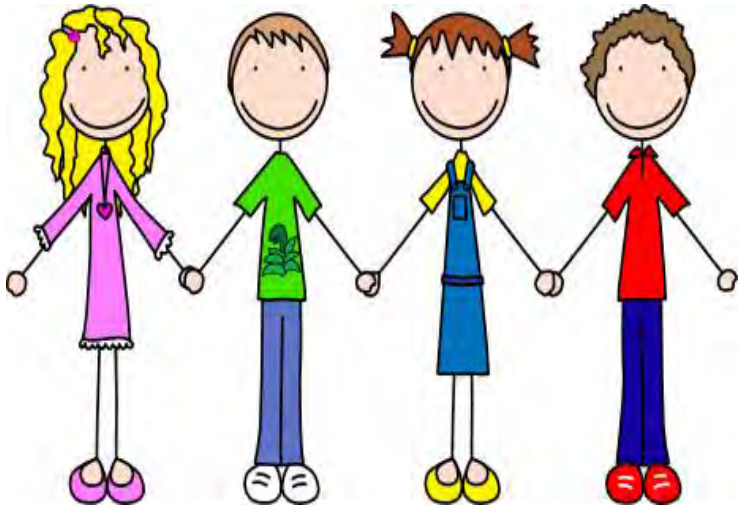
Active ingredient	Tree	Target
Abamectin	Broadleaves and Conifers in parks and road lines	*Thaumetopoea pityocampa* *Cameraria ohridella* *Corythuca ciliata* *Aphis* spp. Mites
Abamectin	Palms	*Rynchophorus ferrugineus*
Azadirachtin (from Neem tree)	Ornamentals, forestry	Aphids Aleurodids Cicadellidae Lepidoptera (larvae) Leaf miners Thripids
Imidacloprid	*Platanus, Aesculus*	*Corythuca ciliata* *Cameraria ohridella* *Aphis* spp. *Eucallipterus tiliae* *Periphyllus* spp.
Thiabendazole	*Platanus*	*Gnomonia platani*
Gliphosate	Invasive trees and shrubs	-

What do we need now?

5) Safer products



Plant extracts can be the way



Allicin vs. Ash dieback

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/ufug

Efficacy tests on commercial fungicides against ash dieback *in vitro* and by trunk injection

Elisa Dal Maso[a], Jonathan Cocking[b], Lucio Montecchio[a,*]

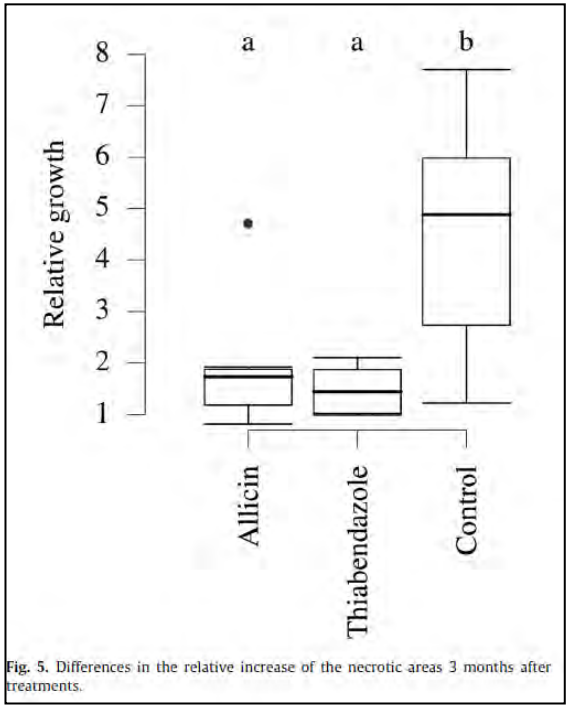

Fig. 5. Differences in the relative increase of the necrotic areas 3 months after treatments.

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Garlic injection could tackle tree diseases

By Claire Marshall
BBC environment correspondent

A closer look at how a tree injection works

Allicin vs. *P. ramorum, in vitro*

(Cocking, unpublished)

Table to show the average growth of each isolate and the percentage inhibition for each concentration of Allicin when compared to the untreated control plates.

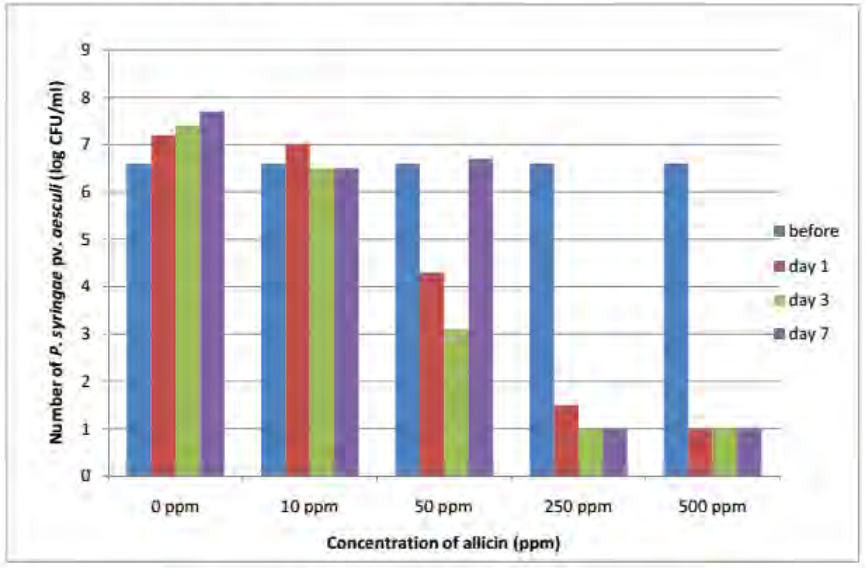
	cc1659		cc2266		cc2269	
conc.	Growth average (mm)	% inhibition	Growth average (mm)	% inhibition	Growth average (mm)	% inhibition
0ppm	41.0	0.0	41.0	0.0	39.7	0.0
10ppm	28.7	30.1	30.3	26.0	28.0	29.4
50ppm	5.7	86.2	4.7	88.6	5.3	86.6
250ppm	0.0	100.0	0.0	100.0	0.0	100.0
500ppm	0.0	100.0	0.0	100.0	0.0	100.0

conc.	cc2269		cc2266		cc1659	
	spore absorbance	% inhibition	spore absorbance	% inhibition	spore absorbance	% inhibition
500ppm	0.016	89.7	0.027	89.2	0.039	88.0
250ppm	0.015	90.5	0.023	91.0	0.016	95.1
50ppm	-0.002	101.5	0.005	97.9	0.009	97.2
10ppm	-0.001	100.4	-0.007	102.9	0.015	95.4
0ppm	0.158	0.0	0.252	0.0	0.328	0.0

Allicin vs. *P. syringae* pv. *aesculi*

(Cocking, unpublished)

Figure 1: Growth and Survival of *P. syringae* pv. *aesculi* NCPPB 4437 after different exposure times to a range of allicin concentrations

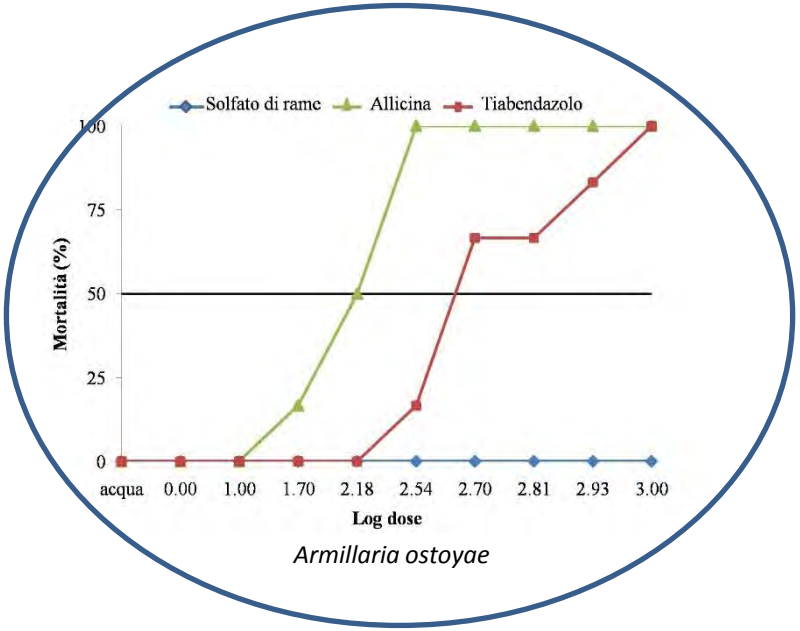


Photograph 1:

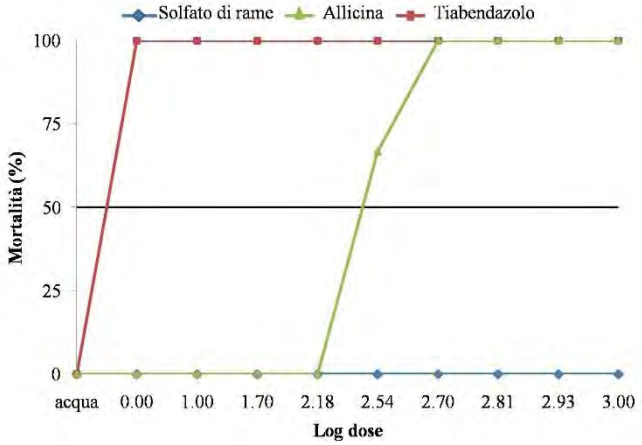
Showing the area where the large infection was, with no bleeding and healing around the edge. Picture taken in 2011, 2 years after treatment.

Allicin vs. others *in vitro*

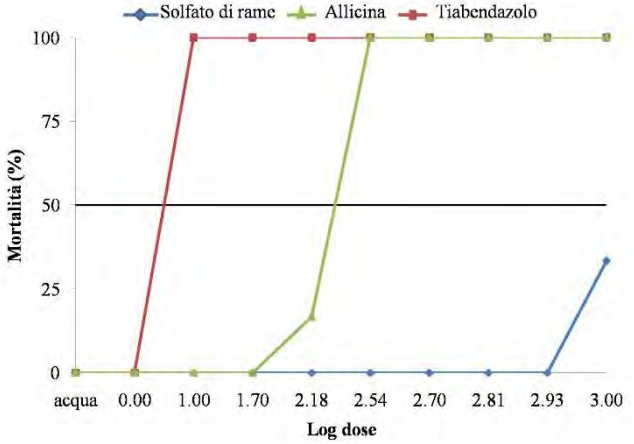
(Dal Maso and Montecchio, unpublished)



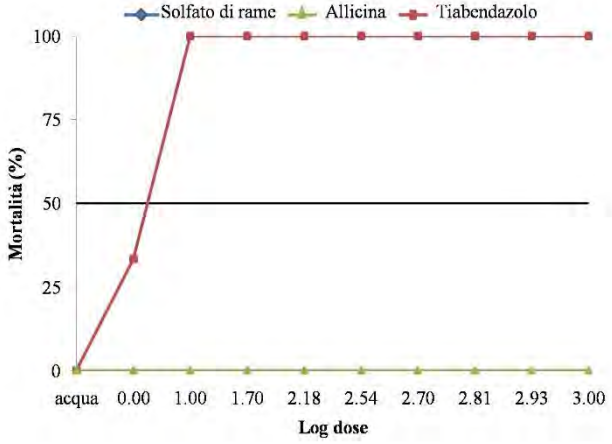
Armillaria ostoyae



Ceratocystis platani



Ophiostoma novo-ulmi



Fusarium circinatum

Potassium salts of phosphorous acid vs. *Phytophthora cambivora*

(Dal Maso and Montecchio, unpublished)

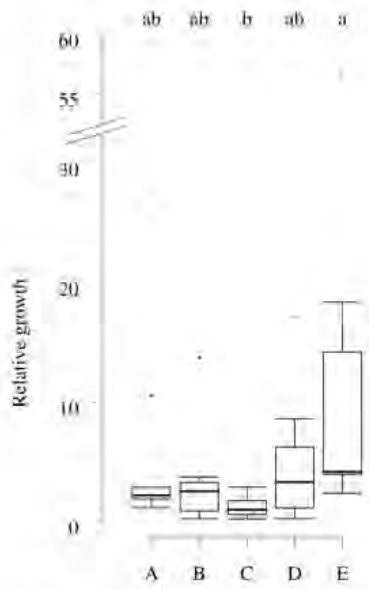


Figure 22. Differences in the relative increase of the necrotic areas after 50 days from the treatments. A = Potassium phosphite 35 %; B = Potassium phosphite 70 %; C = Potassium phosphite 35 % plus micronutrient solution 0.1 %; D = Potassium phosphite 35 % plus allicin solution 20%; E = Control.

Curative

Injection 21 days after infection.

End of trial 50 days after injection (= 71).

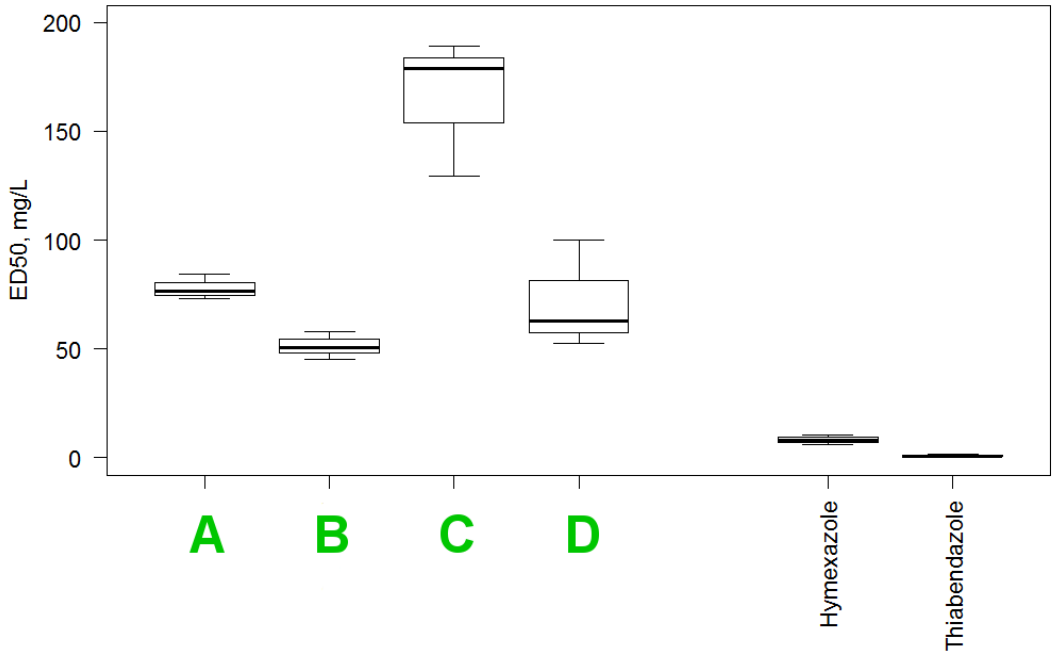
Preventative

Injection 27 days before infection.

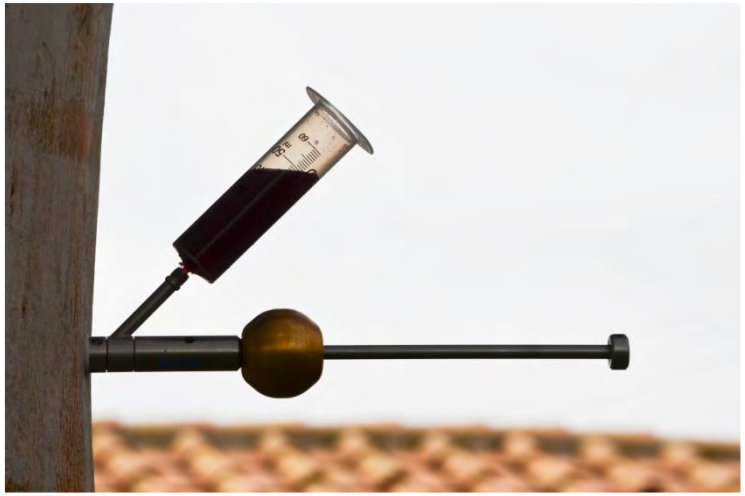
End of trial 50 days after infection (=77).

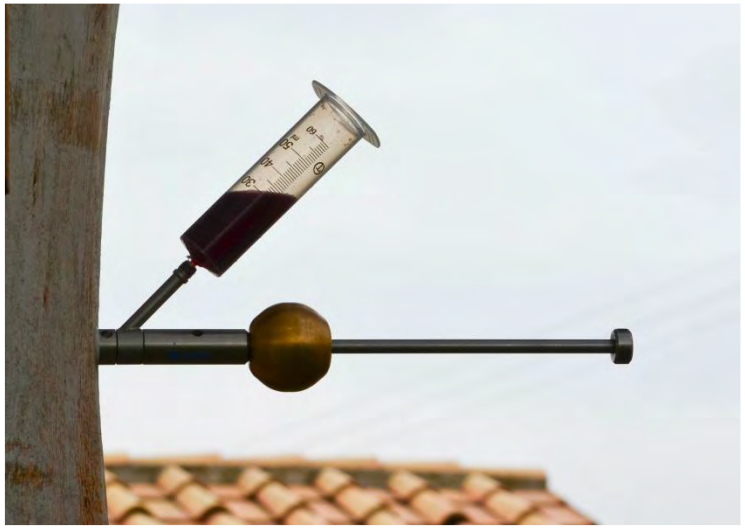
New molecules vs. *C. platani*

(Dal Maso and Montecchio, unpublished)



Cheers!!!





Canker stain of Plane
Ceratocystis platani

It's a Quarantine pathogen in the whole EU with related compulsory eradication measures.

Pay attention to **fake information**, this is from a very well known website.

This is **not a canker by *Ceratocystis* !**

Simply, it's not a canker ...

Canker caused by *Ceratocystis platani* on a plane tree

Canker stain of Plane
Ceratocystis platani

Do not confuse it with
Phellinus punctatus: wood decay.

It's a frequent mistake, but it's not a Quarantine pathogen, and this mistake can be really embarrassing ….

Lacking carpophores it looks similar, but you can see a centrifugal tentative compartimentalization.

Canker stain of Plane

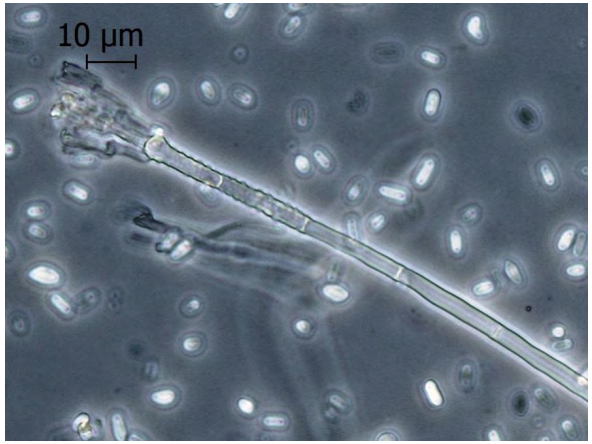
Ceratocystis platani


1
2

Thousand Cankers Disease

Geosmithia morbida+ Pityophthorus juglandis

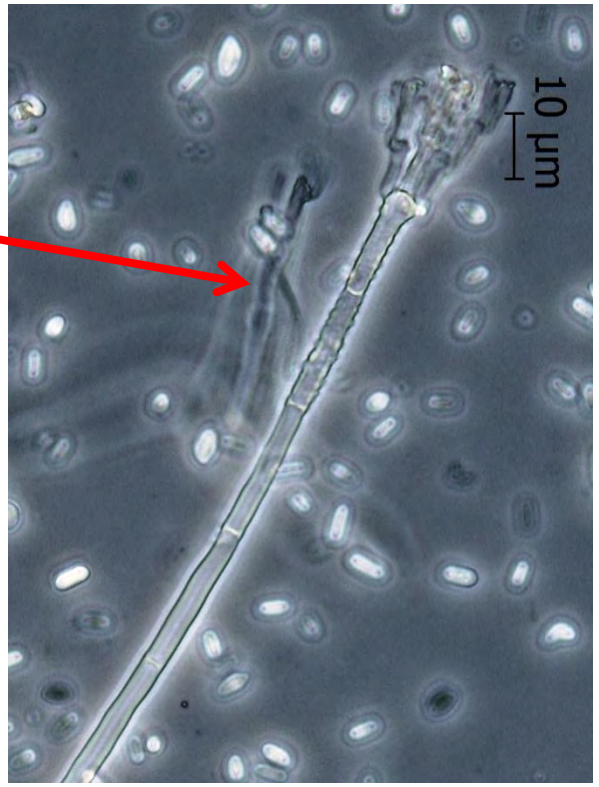
- Caused by the Ascomycete
- *Geosmithia morbida* (described in 2011)



- Vectored by the bark beetle
  - *Pityophthorus juglandis*
    - (2-3 generations)

Many, small subcortical cankers corresponding to bark beetles holes

Beetles' galleries hosted abundant mycelium and spores

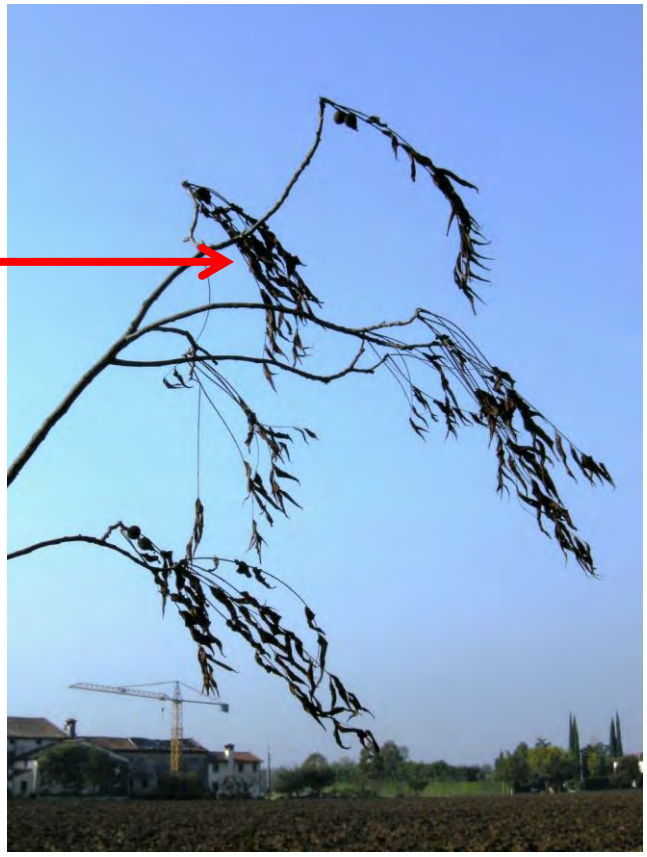


(first strain, LM13GM001-JN)

Detection of both *G. morbida* and *P. juglandis*:
100% molecular confirmation (GenBank database).

Official report
local PPO → NPPO → EPPO

Yellowing, flagging and wilting of foliage



September 2013: first European detection

both the fungus and its vector on black walnut in a timber plantation (Veneto Region, Notheastern Italy)