Application of *Trichoderma* spp. in the management of GTDs in Europe

Data collected in the framework of WINETWORK project from practice through the help of 219 and from a review of scientific litterature on the subject

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   - Time and application method
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4. What is the efficiency of *Trichoderma* ?

1. Presentation of *Trichoderma* fungi

Trichoderma genus gather several **saprophytes fungi** commonly found on soil, dead wood, green debris, and plants

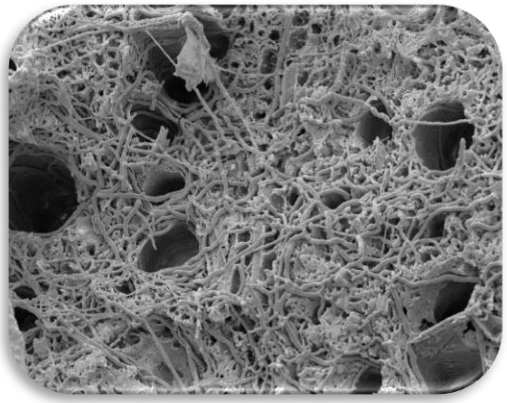
Trichoderma spp. are presenting antagonism towards a high number of pathogens, discovered in 1887

What does antagonism mean ?

It is the capability of a living organism to suppress or delay growth or activity of pathogenic agent

Ability in protecting plant roots from infection caused by pathogens

Trichoderma can control pathogens by several modes of action



1. Presentation of *Trichoderma* fungi

- **Mode of action**

1) Antibiosis

Production of substances inhibiting the growth of other competitors, including plant pathogens

2) Competition for nutrients

Trichoderma use the same nutrition ressources as pathogens

3) Competition for space

High rate of growth of *Trichoderma* compared to other microorganisms

4) Hyperparasitism

Destruction of pathogens by the production of enzymes (lytic enzymes) lethal for pathogen's cells.

These modes of action are species and strain-specific

2. How *Trichoderma* help to control GTDs ?

- A lot of scientific trials since 2000s: objective? Evaluate the efficacy of *Trichoderma* spp. in controlling GTDs

How? Pathogens tested: *Phaeomoniella chlamydospora, Phaeoacremonium minimum, Diplodia seriata, Neofusicoccum parvum*

In vitro tests and artificial inoculation in **pruning wounds** or plants in semi-field conditions

Results? A partial effect according to assessment methods used in controlling GTDs pathogens

A broard spectrum activity and able to delay infection of a wide range of GTDs pathogens

Trichoderma can stay viable in the woody tissues up to 1 year

2. How *Trichoderma* help to control GTDs ?

- *Trichoderma* is a living product, its efficiency could be influenced by the environement:

- Wound colonization capability and presistence may depend on **intrinsic wounds factors**, vine physiological stage of application

- *Trichoderma* wound protection effect depends on its **interaction with grapevine**

2. How *Trichoderma* help to control GTDs ?

- The genus *Trichoderma* gather several species, and in each species there is several strains.

Strains differ in their antagonistic potential and could not have the same effects agaisnt all GTDs pathogens

Grapevine trunk diseases on

Sauvignon

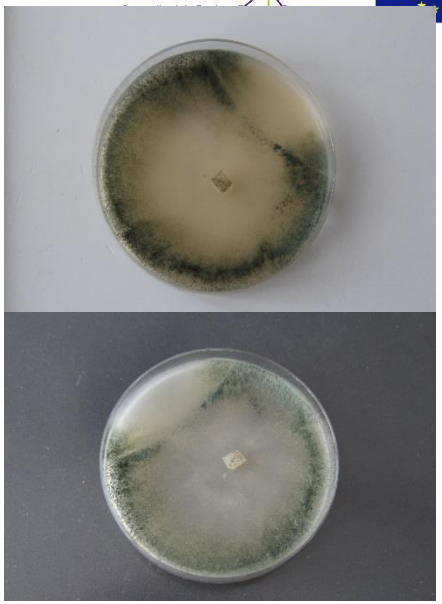
Fer Servadou

Cabernet Franc

2. How *Trichoderma* help to control GTDs ?

Trichoderma atroviride

- *Trichoderma atroviride* SC1 has been isolated from hazelnut tree wood and selected for its **high colonization capability** and its **high productivity** of Lytic enzimes degrading the pathogens.
- *Trichoderma atroviride* I1237 has the ability to **fast colonize pruning wounds**, to compete with pathogenic fungi for nutrients and space and properties of antibiosis and mycoparasitism.



T. Atroviride I1237

T. Atroviride SC1

2. How *Trichoderma* help to control GTDs ?

Trichoderma asperellum ICC012 and T*richoderma gamsii* ICC080 can act as **mycoparasites on GTDs pathogens** at 10°C and 15°C respectively. Both species remain viable at 5°C, and able to mycoparasite when the temperature increase

T. asperellum

T. gamsii

2. How *Trichoderma* help to control GTDs ?

- *Trichoderma* spp. must be used as **preventive treatment** since species **don't have a curative effect**
- *Trichoderma* spp can efficiently **prevent infection** of pruning wounds
- As fast growing fungi, *Trichoderma* could colonize pruning wounds in optimal conditions
- They induce a high competition at the colonization site
- Mycelium from Tichoderma can colonize wood tissues below wounds up to 2 cm and could inhibit germination of spores

3. How to use *Trichoderma*-based products?

PRUNING WOUNDS PROTECTION

- **Timing for application**

After pruning, wound remain susceptible for a long time, most critical time for infection by GTDs pathogens from 2 to 8 weeks after pruning

➔Apply *Trichoderma* as **soon as possible after pruning**

➔Between grapevine **dormancy and bleeding** (BBCH 00- BBCH 05)

➔ At temperatures range **from 0°C to 10°C** according to strains

➔Consider weather: heavy rain can wash away *Trichoderma*-based product

Recommendation: planting vine inoculated with *Trichoderma* in nursery and repeat field treatment each year after planting

3. How to use *Trichoderma*-based products?

PRUNING WOUNDS PROTECTION

- **Application method**: **Spraying**

➔Spores suspended in water

➔Localize the spraying on the **pruning zone** to cover big and small wounds

➔High volume of water

➔Clean tank before application

➔Application of the product alone

3. How to use *Trichoderma*-based products?

PRUNING WOUNDS PROTECTION

- **Products available**

Country	Product	Quantity	Composition	Price (commercial product)
France	Esquive WP®	4 kg/ha	*Trichoderma atroviride* I-1237	252€/ha
	Vintec®	200g/ha	*Trichoderma atroviride* SC1	200€/ha
Italy	Patriot Dry®	1kg/ha	*Trichoderma asperellum* ICC012+ *Trichoderma gamsii* ICC080	From 45 to 50€/ha
	Remedier®	1kg/ha	*Trichoderma asperellum* ICC012+ *Trichoderma gamsii* ICC080	From 45 to 50€/ha
	Tellus WP®	200g/ha	*Trichoderma asperellum* ICC012+ *Trichoderma gamsii* ICC080	From 45 to 50€/ha
Germany	Vintec®	200g/ha	*Trichoderma atroviride* SC1	180€/ha

3. How to use *Trichoderma*-based products?

PRUNING WOUNDS PROTECTION

- Products submitted for registration

Country	Product	Composition
Portugal	Esquive WP®	*Trichoderma atroviride* I-1237
Spain	Esquive WP®	*Trichoderma atroviride* I-1237
Hungary	Vintec®	*Trichoderma atroviride* SC1

3. How to use *Trichoderma*-based products?

PRUNING WOUNDS PROTECTION

Product	Moment of application	Quantity	Temperature	Weather conditions	Other
Esquive WP®	BBCH 00	4 kg/ha in 150L water/ha	≥ 4°C	Dry, no rain in the next 4 hours	Storage at room temperature
Vintec®	BBCH 00- BBCH 05	200 g/ha with 100 L water/ha	≥ 10°C	No rain or frost after treatment	Suspension need to be prepare just before use and not be reused, Storage between 0°C-4°C
Patriot Dry®	BBCH 00	250 g/l with 400 L water/ha	≥ 10°C		Storage < 25°C
Remedier®	BBCH 00- BBCH 05	250 g/l with 400 L water/ha	≥ 10°C		To promote spore germination put the product in water 24H before treatment
Tellus WP®	BBCH 00	250 g/l with 400 L water/ha	≥ 10°C		Storage <25°C Can be kept 15 months if not open

4. What is the efficiency of *Trichoderma* ?

- **How *Trichoderma* act on grapevine ?**

➔As fast growing fungi, in optimal condition *Trichoderma* can colonize pruning wounds

➔Induce a high competition rate for nutrients and space with pathogens

➔Colonization of the tissues below the wounds that prevent pathogens to enter the wound

4. What is the efficiency of *Trichoderma* ?

- **Factors influencing *Trichoderma* efficacy**

- *Trichoderma* species and strain used
- Mode of application
- Phenological stage of vines
- Time gap between pruning and *Trichoderma* application
- Weather conditions during and after treatment
- Vine-*Trichoderma* interaction
- **Environmental factors**

4. What is the efficiency of *Trichoderma* ?

Effectiveness of *Trichoderma* species **varying with local conditions,** it is **essential to complete the use of *Trichoderma* with management practices** in the vineyard**:** good pruning practices, inoculum restriction, vine balance…

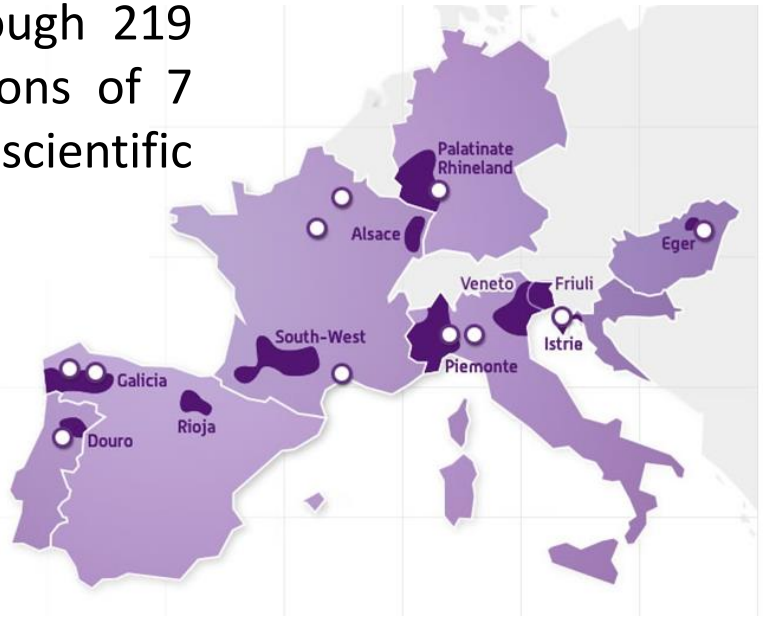
Winetwork project

WINETWORK is a Thematic Network funded by European Union's Horizon 2020 research and innovation programme under grant agreement No 652601

- Project duration: April 2015- Sept 2017
- 11 partners
- Budget 2 m€

This presentation was realized in the framework of winetwork project using practical data through 219 interviews made in 10 european wine regions of 7 european countries and from a analysis of scientific litterature on the topic.

More information on www.winetwork.eu and www.winetwork-data.eu



Winetwork partners (white dot) and involved wines regions (purple)