Objectives and principles for organic wines (with grapes impacted by some pathogens)

Pierre-Louis TEISSEDRE

ISVV Bordeaux

ORGANIC VINES AND WINES

- Organic wines are made from grapes which are cultivated without recourse to synthetic fungicides, herbicides or fertilizers.

- In vineyards where the environment is respected and biodiversity encouraged, the vines grow in a living soil, full of worms and bacteria. This enables them to draw upon the optimum levels of minerals from the soil. In turn, these healthy vines develop better resistance to disease and go on to produce fruit for years to come.

Organic Vines and Wines

- How do we know it's organic and or biodynamic?
- At Vintage Roots our policy is only to stock goods from producers who have paid for and achieved certification, giving them the right to describe themselves as 'organic' or 'biodynamic'. Certification gives us and you a guarantee that no chemical fertilizers, synthetic pesticides or herbicides have been used on the vines.
- To gain organic certification, all producers undergo inspection by organisations such as the Soil Association in England, Ecocert in France and the CCOF in California. Standards are rigorously maintained and spot-checks can take place at any time during the year.
- The Demeter Association certifies biodynamic vineyards and its symbol can be seen on some wines.
- Please visit www.biodynamics.com for more information on biodynamics. Vintage Roots - What are organic wines? http://www.vintageroots.co.uk/organic.asp

Organic Vines and Wines

- The organic vineyard - a bug's eye view

- Biodiversity is encouraged by planting cover crops between the rows of vines. Not only does this create an eye-catching landscape, but more importantly they bring a host of beneficial visitors.
- For instance, plum trees are planted in organic vineyards in California to attract Anagrus wasps that then eat the destructive vine leafhoppers, which can cause massive crop damage if not controlled.
- Certain biodegradable sprays are used from time to time and there are biological controls such as the planned release of ladybirds which eat vine aphids. Mildew problems may also be managed with salts such as copper sulphate and elemental (not man made) sulphur

Organic Vines and Wines

- Biodynamics : an extra dimension ?

- Firmly rooted in the teachings of Rudolf Steiner, biodynamics goes one step beyond organics by looking at the vineyard within the context of the larger environment.

- Homeopathic sprays and herbal preparations are used along with estate-made composts to increase soil fertility and strengthen and protect the vines from pests and disease.

- Lunar cycles, earth rhythms and astrology are also employed to ensure that activities in the vineyard are correctly timed.

Organic Vines and Wines

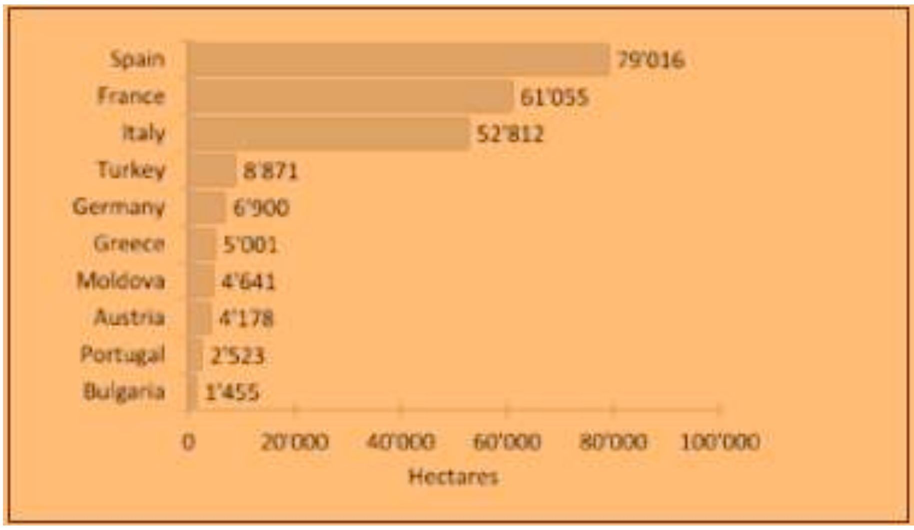
- What is reconversion?
- This is the process of converting from a conventionally-maintained vineyard to one that is fully organic.

- Reconversion for vineyards takes three years because the grapevine is a perennial plant, whereas only two years are required for annual crops like wheat or vegetables.

- Right from the start of reconversion, the vineyard must be cared for 100% organically.

- Any non-organic treatments are strictly prohibited and their use would take the estate right back to the beginning again.

Organic grape area in Europe: the ten countries with the largest grape areas in 2011



Source: FiBL Survey 2013, based on information from Eurostat and national data sources

CODEX ALIMENTARIUS

- The Codex Alimentarius Commission, established by FAO and WHO in 1963 is an intergovernmental body with over 180 members, **and develops harmonised international food standards, guidelines and codes of practice to protect the health of the consumers and ensure fair practices in the food trade.**
- The Commission also promotes coordination of all food standards work undertaken by international governmental and non-governmental organizations.
- **The Codex Alimentarius (Latin, meaning Food Law or Code) is the result of the Commission's work: a collection of inter-nationally adopted food standards, guidelines, codes of practice and other recommendations**

CODEX ALIMENTARIUS
International Food Standards
World Health Organization
Food and Agriculture Organization of the United Nations

GUIDELINES FOR THE PRODUCTION, PROCESSING, LABELLING AND MARKETING OF ORGANICALLY PRODUCED FOODS

- **GL 32–1999**

- *Guidelines* include general sections describing :

-the organic production concept and the scope of the text;
-description and definitions;
-labelling and claims (including products in transition/conversion);
-rules of production and preparation, including criteria for the substances allowed in organic production;
-inspection and certification systems; and import control.

GUIDELINES FOR THE PRODUCTION, PROCESSING, LABELLING AND MARKETING OF ORGANICALLY PRODUCED FOODS

- **GL 32–1999**

These guidelines set out the principles of organic production at farm, preparation, storage, transport, labelling and marketing stages, and provides an indication of accepted permitted inputs for soil fertilizing and conditioning, plant pest and disease control and, food additives and processing aids. For labelling purposes, the use of terms inferring that organic production methods have been used are restricted to products derived from operators under the supervision of a certification body or authority.

GUIDELINES FOR THE PRODUCTION, PROCESSING, LABELLING AND MARKETING OF ORGANICALLY PRODUCED FOODS

- **GL 32–1999**

- Organic agriculture is one among the broad spectrum of methodologies which are supportive of the environment.
- Organic production systems are based on specific and precise standards of production which aim at achieving optimal agroecosystems which are socially, ecologically and economically sustainable.
- Terms such as “biological” and “ecological” are also used in an effort to describe the organic system more clearly.

- Requirements for organically produced foods differ from those for other agricultural products in that production procedures are an intrinsic part of the identification and labelling of, and claim for, such products.

GUIDELINES FOR THE PRODUCTION, PROCESSING, LABELLING AND MARKETING OF ORGANICALLY PRODUCED FOODS

- **GL 32–1999**

"Organic" is a labelling term that denotes products that have been produced in accordance with organic production standards and certified by a duly constituted certification body or authority.

Organic agriculture is based on minimizing the use of external inputs, avoiding the use of synthetic fertilizers and pesticides.

Organic agriculture practices **cannot ensure that products are completely free of residues, due to general environmental pollution.**

However, methods are used to minimize pollution of air, soil and water.

Organic food handlers, processors and retailers adhere to standards to maintain the integrity of organic agriculture products.

The primary goal of organic agriculture is **to optimize the health and productivity of interdependent communities of soil life, plants, animals and people.**

Substances authorized for use for organic wines production

- One of the most disputed additives within the organic wine industry is the sulphite compound.
- Sulfites are added to wine as preservatives to prevent spoilage during several stages of the winemaking. Sulfur dioxide (SO2) protects wine from oxidation and

  bacterial growth. The Table clarifies the maximum allowed sulphur dioxide levels in the EU.

However, the maximum sulphur dioxide content in organic wines have exceptions and limitations that are explained precisely in the EU commission implementing

regulation EC No 203/2012 and EC No 606/2009.

Limitations for sulphur dioxide content in organic wines (EC No 203/2012; EC No 606/2009).

Wine category	Residual sugar	Max SO2
Red	< 2 g/l	100 mg/l
Red	> 2g/l	170 mg/l
White and rosé	< 2 g/l	150 mg/l
White and rosé	> 2g/l	220 mg/l
Liqueur	< 5 g/l	120 mg/l
Liqueur	> 5g/l	170 mg/l
Quality sparkling		155 mg/l
Other sparkling		205 mg/l
Sweet (spätlese, auslese, etc.)		270-370 mg/l

Limitations for sulphur dioxide content in organic wines (EC No 203/2012; EC No 606/2009).

Wine type – Categories as in Regulation (EC) No 606/2009	SO_2 limits for conventional wine as in Regulation (EC) No 606/2009	SO_2 limits for organic wine as in Regulation (EU) No 203/2012	SO_2 reduction in organic wine	
			Absolute	Relative (%)
Red wines [Annex I B - A] paragraph 1a – ***residual sugar* < 5g/L***	150 mg/L	100 mg/L ***residual sugar* <2g/L*** 120 mg/L ***residual sugar* >2g/L and < 5g/L***	-50 mg/L -30 mg/L	-33% -20%
Red wines [Annex I B - A] paragraph 2a – ***residual sugar* ≥ 5g/L***	200 mg/L	170 mg/L	-30 mg/L	-15%
White & rosé wines [Annex I B - A] paragraph 1b – ***residual sugar* < 5g/L***	200 mg/L	150 mg/L ***residual sugar* <2g/L*** 170 mg/L ***residual sugar* >2g/L and < 5g/L***	-50 mg/L -30 mg/L	-25% -15%
White & rosé wines [Annex I B - A] paragraph 2b – ***residual sugar* ≥ 5g/L***	250 mg/L	220 mg/L	-30 mg/L	-12%
Special wines [Annex I B - A] (List by country**) paragraph 2 c paragraph 2 d paragraph 2 e paragraph 4 – weather conditions***	 300 mg/L 350 mg/L 400 mg/L + 50 mg/L	 270 mg/L 320 mg/L 370 mg/L (the same as CMO + 50 mg/L)	 -30 mg/L -30 mg/L -30 mg/L	 -10% -8.5% -7.5%
Liqueur wines [Annex I B - B] ***residual sugar < 5g/L***	150 mg/L	120 mg/L	-30 mg/L	-20%
Liqueur wines [Annex I B - B] ***residual sugar ≥ 5g/L***	200 mg/L	170 mg/L	-30 mg/L	-15%
sparkling wines [Annex I B - C] paragraph 1a – quality sparkling wines paragraph 1b – other sparkling wines paragraph 2 – weather conditions***	 185 mg/L 235 mg/L +40 mg/L	 155mg/L 205mg/L (the same as CMO + 40 mg/L)	 -30 mg/L -30 mg/L	 -16% -13%

* Residual sugar = sum of glucose & fructose; ** Provided by member states; *** Referred to in art. 113(2) of EC No 479/2008

SO_2

- The maximum sulphur content should be lower than the level in non-organic wines.

- Generally the necessary quantities of sulphur dioxide depend on the type of wine and content of residual sugars.

- However, increasing the maximum sulphur dioxide content is allowed in certain situations. For example, sometimes extreme weather conditions may provoke difficulties in certain wine-growing areas making it necessary to use additional amounts of sulphites to achieve stability of the final product. (EC No 203/2012)

The EU has ruled the exact opposite of the US: that "organic wine" can contain sulfites.

Organic Labeling and Wine Sulfite Content

for organically grown grapes and winemaking processes

Region	Red	White	Label
EU			
Less than or equal to	100 mg/l	150 mg/l	Organic wine
Greater than	100 mg/l	150 mg/l	Wine from organic grapes
US			
Less than or equal to	10 mg/l	10 mg/l	Organic wine
Greater than	10 mg/l	10 mg/l	Wine from organic grapes

Chart by bianalytics.pro

The EU will restrict the amount of sulfites they may contain:

100 ppm total for red wine,

150 ppm for white or rosé,

as opposed to the 10 ppm allowed (and only when naturally occurring) in U.S. "organic wine."

(Conventional wines in the US are allowed 350 ppm.)

What sulfite levels are organic?

- The new EU regulations allow sulfite amounts equal to about 1/2000th of an ounce of sulfites in a glass of wine or about the equivalent of a drop of water in a half liter bottle.

- **Canada has also established an "organic" standard of 100 mg/l.** For organic wines that exceed this level, EU regulations allow them to petition to use the EU's previously approved "wine issued from organic grapes."

"wine made from organically grown grapes"

- EU "organic wine" will have restrictions on winemaking - including no addition of sorbic acid - in addition to restrictions on viticulture.

- European consumers who prefer to drink wine that's closer to being a natural product, but who don't want their wine to taste spoiled, will now have the benefit of official certification.

"Organic wine" cannot have added sulfites in the USA

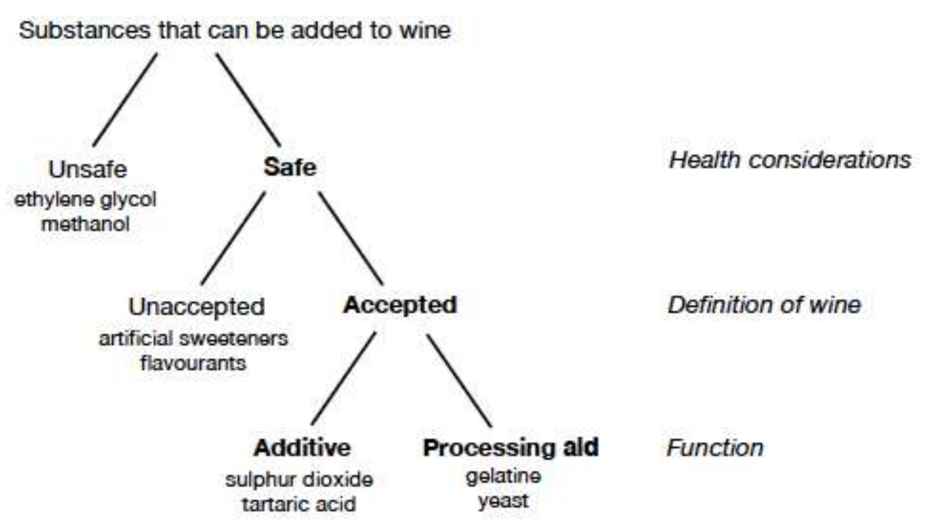
- **So EU organic wine labels can’t be put on the wine bottle for US Market has EU these wines won't meet US standards.**

Paradox :

An Organic wine in EU is different of an Organic wine in the US because of SO2 levels

Additives for organic wines (EU)

A classification of substances that can be added to wine



Additives for organic wines (EU)

A list of permitted additive products and substances.

-All those of natural origin (plant, provided they are non-GM; mineral; microbiological) are allowed.

-Potentially dangerous, non essential and synthetic additives are forbidden or, if no alternative exits, restricted.

-As mentioned there are many substances allowed in conventional wine which are not allowed for organic

-Preference should be given to the use of additives and processing aids derived from organic raw materials

Additives and Processing Aids for organic wines (EU)

Non-exhaustive list of substances forbidden in production of organic wines

Substance	Application
Sorbic acid and sorbates	Microbiological stabilisation
Lysozyme	
Chitosan	
L-malic acid, D, L-malic acid	Acidification
Ammonium bisulphite	Protection of harvesting
Ammonium sulphate	Management of alcoholic fermentation
Chitin-glucan	Thinning
Chitosan	
Calcium alginate	
Co-polymer PVI / PVP	
Carboxymethylcellulose (CMC)	Tartrate / colour stabilisation
Yeast mannoproteins	
Polyvinylpolypyrrolidone	Correction of colour
Beta-glucanase enzymes	Glucan elimination
Chitin-glucan	Clarification elimination of heavy metals (iron, copper)
Chitosan	
Calcium phytate	
Potassium ferrocyanide	
Urease	Treatement, elimination of ochratoxin A and urea
Caramel	Various

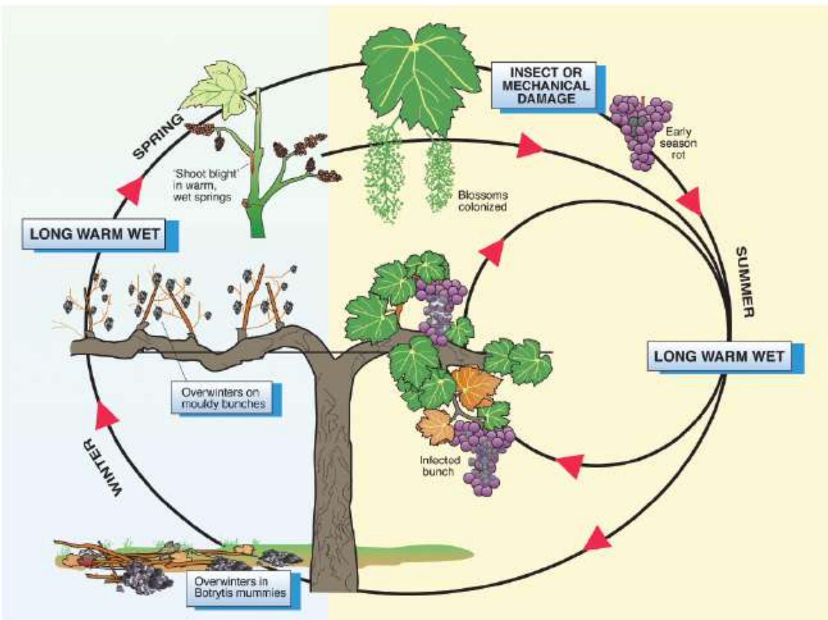
Permitted ingredients including concentrated must, concentrated rectified must, sucrose and yeast cells must all be organic

Product	Application
Concentrated must	Enrichment
Concentrated rectified must	Enrichment
Sucrose	Enrichment
Yeast cells	Fermentation management, yeast nutrition
Active dry yeast, fresh yeast suspension	Yeast addition
Edible gelatine	Thinning
Plant proteins from wheat or peas	
Isinglass	
Egg white albumin	
Tannins	
Acacia gum (gum arabic)	Tartaric and colour stabilisation
Tannins	Addition of tannins

BOTRYTIS

BOTRYTIS

Life cycle of Botrytis



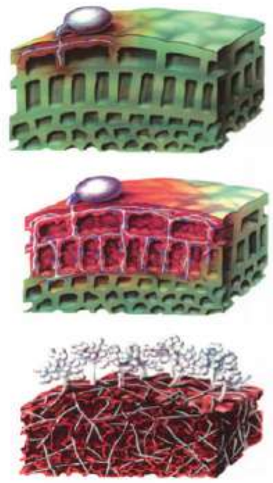
BOTRYTIS

Life cycle of Botrytis

The Botrytis spore germinates and grows, destroying vine cells before producing more spores.

Botrytis cinerea survives over winter in two distinct forms. Strands of the living fungus known as mycelia can survive in cane tissue.

Alternatively, resilient resting structures (3-6 mm in length, hard and black) known as sclerotia can survive attached to the vine or on decaying matter in ground litter. The fungus may also be harboured by other vegetation in and around the vineyard.



BOTRYTIS

- Infection

In wet or humid conditions, spores are produced by both forms of the fungus. These can be spread by wind or water splash and germinate on damaged green tissue. Flowers are a natural source of damaged tissue. A common site for infection occurs where the fl ower cap has detached leaving a wound.

Botrytis

Botrytis lesion at node of young shoot in spring.

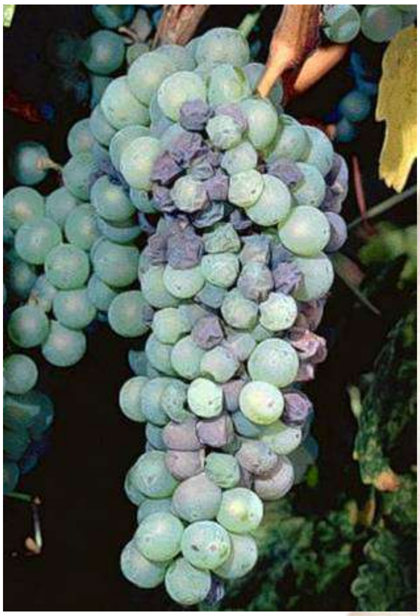
BOTRYTIS

- **Spread**

- Infection of green berries might not be visible until berries soften and wet weather provides conditions conducive to disease development. Infection can spread to adjoining berries or new infections begin from air-borne spores landing on susceptible tissue.

- The delayed development of symptoms after an initial infection early in the season is known as a latent infection. Even when berries are infected, rot might not occur if environmental conditions do not favour the development of the disease.

Botrytis



Single infected berry. Inset shows sporulation on cap stem and infected berry.

Botrytis Management

Wound Management

- Intact berry skin most important barrier to infection and rot
- Control wounds by controlling birds, insects, powdery mildew
- Latent infections may not activate if ripening berries remain intact

Botrytis

Late-Season Rots

Ripe Rot

Photos: James W. Travis

Late-Season Rots

Photos: Turner B. Sutton

Bitter Rot

Late-Season Rots

Macrophoma Rot

Sour Rot

Late Berry Rots

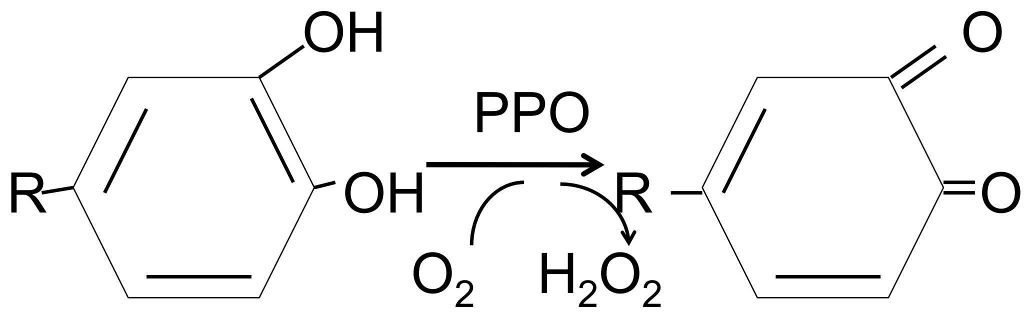
Management

- Minimize wounds
  - birds, insects
  - powdery mildew
  - tight cluster architecture
- Improve aeration in canopy
- Early harvest

Oxidative/Reductive Reactions in Grapes/Wine

- Enzymatic (biological) Oxidation in grapes
  - Tyrosinase (polyphenol oxidase) (plant)
  - Laccase (Botrytis & molds)
- Chemical Oxidation/Reduction in wine
  - Cascade initiated by molecular oxygen
  - Electron rearrangements in absence of oxygen

Enzymatic Oxidation



Control of Enzymatic Oxidation

- Use of sulfite to inhibit PPO (grape)
- Use of yeast to consume oxygen until ethanol inactivates PPO
- Laccase: Control mold in vineyard
- Laccase: use of HTST (high temperature short time) treatment to inactivate enzyme
- Bentonite fining of juice to remove enzymes

Redox Chemistry

- Transfer of electrons: reactions in which a transfer of electrons occurs are known as oxidation-reduction (redox) reactions
- Oxidation involves the loss of electrons
- Reduction is the gain of electrons
- Redox potential refers to the tendency to gain or yield electrons of a specific atom, molecule or solution

Redox Chemistry

- Oxidizing agents possess a strong affinity for electrons, causing other substances to become oxidized by accepting electrons from them; the oxidizing agent itself becomes reduced and forces the other compound to be oxidized

- Reducing agents readily give up electrons and thereby cause some other substance to be reduced; the reducing agent itself becomes oxidized

Redox Chemistry of Wine

- Wine contains both oxidizing and reducing reagents
- Molecular oxygen is a good oxidizing agent (possessing an affinity for electrons)

$$O_2 \xrightarrow{e} O_2^{-}\bullet \xrightarrow{e} O_2^{2-} \xrightarrow{e} OH\bullet \xrightarrow{e} OH^{-}$$

$$OH^{-} + H^{+} \longrightarrow H_2O$$

Redox Chemistry of Wine

- Phenolic compounds can be oxidized in the presence of oxygen
- Oxygen has limited reactivity towards phenolic compounds in its normal O_2 form
- Oxygen is “activated” by metal ion catalysts in the wine such as iron (Fe)
- Oxidation in wine is caused by the formation of reactive oxygen species (ROS)
- The hydroxyl radical ($\dot{O}H$) is the reactive agent

Factors Affecting Oxidation

- pH: hydrogen ions with a positive charge can quench oxidation cascades in the formation of water; oxidation 9 times faster at pH 4.0 than at pH 3.0

- Amount of exposure to oxygen

- Antioxidants and Redox buffering capacity Time!

ESCA DISEASES

National Grapevine Trunk Diseases Survey (2003-2008)

✓ **To monitor the importance and progress of these diseases, especially Esca**

✓ **Around 699 vineyards, 27 varieties, 11 regions** ***(in each field 300 vines were monitored)***

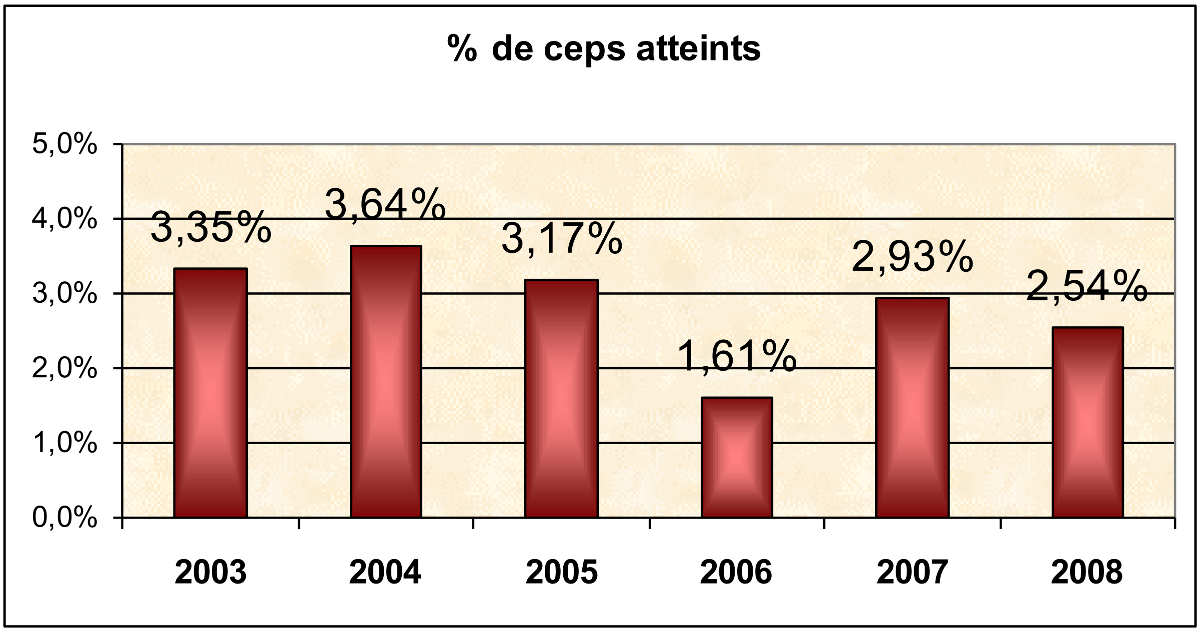
- **Eutypia dieback**
- **Esca / Black Dead Arm (BDA)**

Recently Lecomte *et al.* (2012) provided evidence that foliar symptoms of Esca showed transitory phases which overlapped with some BDA descriptions

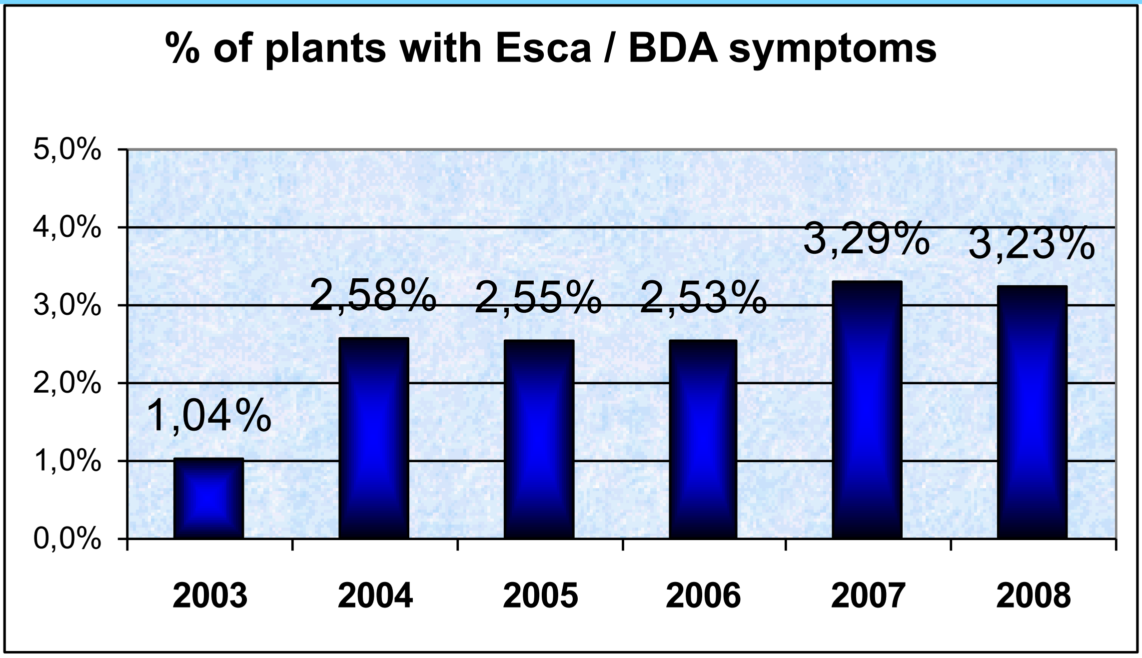
The French Grapevine Trunk Diseases Survey: overview of the data obtained over the last decade

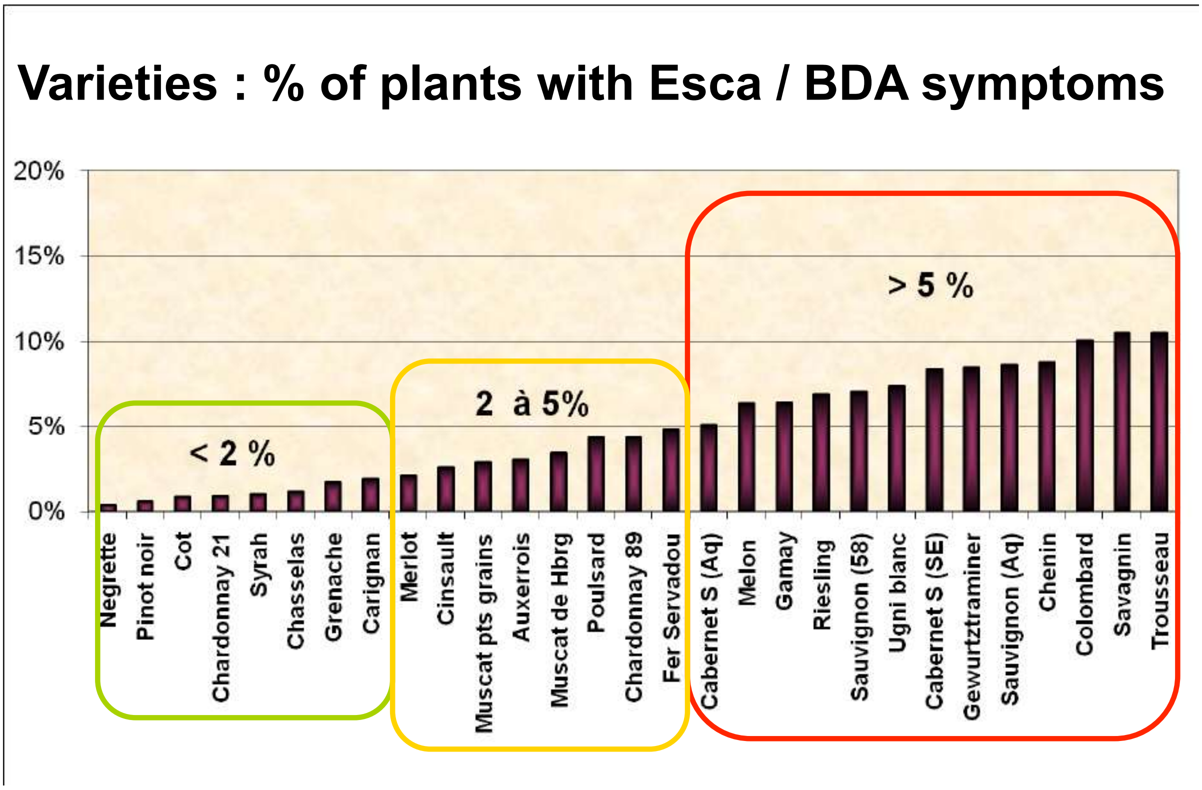
Eutypiose

% of plants with Eutypa dieback symptoms

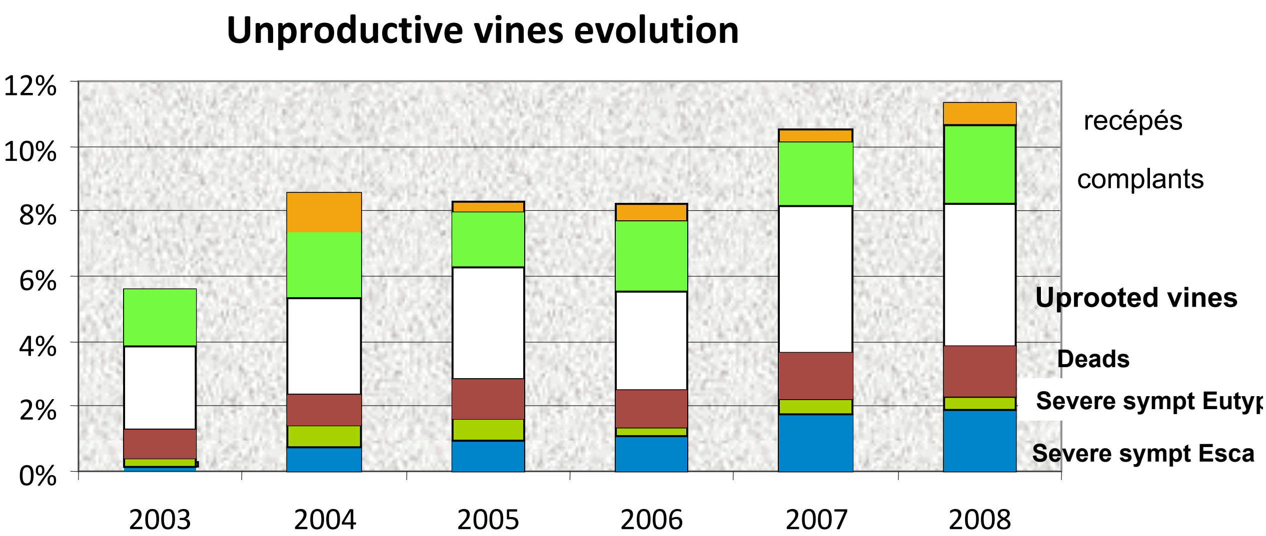


From one year to another the same vines do not necessary express foliar symptoms, so when we consider a period of several years the number of "foliar symptomatic vines at least once" is much more important.





Esca moderately affects the phenolic composition of grapes and decreases the sensory quality of wines, suggesting a dramatic increase in the economic importance of Esca if no control methods are found (Lorrain *et al.,* 2012).



Effect of two vine cryptogamic diseases (Botrytis *cinerea* & Esca) on phenolic and sensory quality of Bordeaux grapes and their derived wines

june 2014

Introduction

I. Materials & Methods
II. Results (Botrytis – Esca)
III. Conclusions & perspectives

Introduction

Aquitaine vineyard

→ **Submitted to different cryptogamic diseases :**

Botrytis *cinerea*

Filamentous fungus : necrotophic pathogen, **bunch rot**

Developpment on vine :
- Leaves and **berries** at ripeness (wet periods, T_{opt} = 15-20°C)

Donèche and Pucheu-Plante, 1986

Quality impact on berries :
Reduction of the sugar level, Degradation of malic and tartaric acids, and phenolic compounds

Ribéreau-Gayon *et al.*, 1980

→ **Quantity & quality losses**
Wine spoilage

Esca

Trunk destructive disease : vineyards all over the world

Association of several fungi :
Trunk necrosis, foliar symptoms
Alteration of photosynthesis

Petit *et al.* 2006

Quality Impacts on berries: few studies
Reduction of the sugar level, increase in acidity, in total polyphenols content

Calzarano et *al.*, 2004

→ **Delay of grapes ripening**

BOTRYTIS CINEREA

- One of the most common pathogen of wine grapes and can caused heavy losses in viticulture

Optimal conditions :
-Alternating wet & dry periods
- Important source of nitrogen
-High yield
…

Sexual form : *Botrytis cinerea*

Asexual form : *Botryotinia fuckeliana*

Grey rot (red grapes)
Heterogeneous development and undesirable.
Modification of grape chemical compositions :
- Sugar degradation
- Malic acid and tartaric acid degradation
- Phenolic compounds degradation (oxydation by laccase activity), color alteration
- Aromatic deviations (woody, earthy)

Esca

- Esca has long been known as wood disease which can be founded in most of the French vineyard

- ↘ Sugar levels in grape musts
  ↘ Alcohol level in wines
- ↗ Malic acid level
  ↗ Total acidity
  ↗ Nitrogen level↗ Lactic acid
  ↗ Potassium
  ↗ Total polyphenol
  ↗ *Trans*-resveratrol
  ↘ Iron and magnesium

Calzarano et *al*., 2004

Introduction and objectives

French policy « Grenelle de l'environnement » (october 2007)

→Increase of surfaces dedicated to **organic farming** (reduction of chemical additives)

2001 : Banning of sodium arsenite (against Esca)

A cause for concern for vine-growers
Worsening of cryptogamic diseases : which consequences on vines, grapes and wines ?

Aim of the study:

Determine a **percentage** of botrytised grapes or grapes from Esca vine stock which can be **tolerated during the wine-making process** without modifying wine phenolic composition and sensory properties

Identify and quantify the phenolic compounds present in healthy and affected grapes and in derived wines containing various % of affected grapes

Tannins (proanthocyanidins) → **Mouthfeel (astringency, bitterness)**
Anthocyanins → **Red wine colour**

Introduction

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Micro-scale winemaking(1/2)

Grapes harvest

Botrytis : Merlot — **Esca :** Cabernet-Sauvignon

→ **Grapes samples :** Chemical analyses

↓

Different batches preparation (10 kg total/10L tanks)

Botrytis : 0% (control) - **5% - 10% - 15%** of affected grapes (w/w) (x 2)

Esca : 0% (control) - **5% - 15% - 25%** of affected grapes (w/w) (x 2)

Crushing – destemming + sulfiting (6 g/hL) : 10 L tanks

↓

Alcoholic fermentation

Yeasts : Zymaflore F15 (20 g/hL), nitrogen (15 g/hL) and thiamine (15 g/hL), Laffort

→ Monitoring : densities, temperatures

Malolactic fermentation

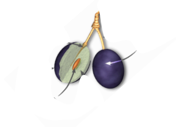
Malolactic bacteria : Preac (2 g/hl), Laffort

→ Monitoring : thin layer chromatography

Sulfiting (6 g/hL)

→ **Wines samples :** Chemical & sensory analyses

Grapes chemical analyses



Isolation of skins/seeds

↓ *Lyophilization & grinding*

skins& seeds powder

↓

Solid/liquid extraction (acetone/water (80:20 v/v) & methanol/water (60:40 v/v))

↓ *Evaporation & lyophilization*

Crude extracts skins & seeds

Global analyses:

- Total phenol content (Folin)
- Total tannins (Bate-Smith)
- Anthocyanins ($HNaSO_3$ decoloration)

Anthocyanins extraction

MeOH 0,1 % HCl (v/v)

- HPLC-UV-MS

Identification, quantification

Proanthocyanidins fractionation :

Chloroform & Ethyl acetate

Organic phase — monomers, oligomers

Aqueous phase — polymers

Evaporation
Lyophilization

Purified extracts

↓

HPLC-UV-fluo-MS

Identification, quantification

Phloroglucinolysis

mDP,
%Prodelphinidin
% galloylation

Lorrain *et al. Food Chem*, 2011

Drinkine *et al. J.A. F. C*, 2007

Wine chemical and sensory analyses

Classical analyses :
FTIR Foss WineScan^{TM} 79000

- Alcohol (vol %)
- Reducing sugars
- pH and total acidity
- Nitrogen
- Malic acidity

HPLC/UV-fluo-MS
Direct injection after filtration (0.45 µm)

- Proanthocyanidins
- Anthocyanins characterization and quantification

Global analyses:

- Total phenol content (Folin)
- Total tannins (Bate-Smith)
- Anthocyanins ($HNaSO_3$ decoloration)

Sensory analyses
Black glasses, 20 judges

- Triangle tests
- Profile descriptive tests

Introduction
I. Materials & Methods
II.1 Results - Botrytis

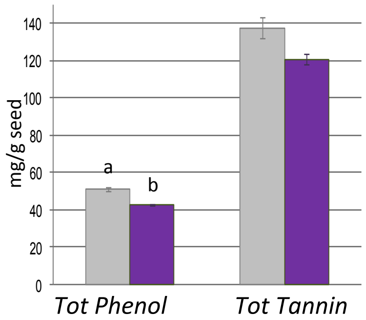
III. Conclusions & perspectives

Botrytis *cinerea* : Berries

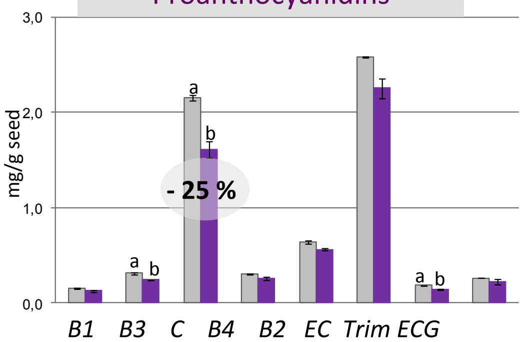
Seeds

healthy / affected

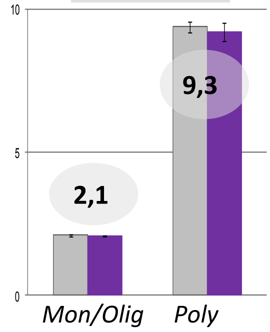
Global analyses



Proanthocyanidins



mDP



Little impact of Botrytis on seeds phenolic composition :

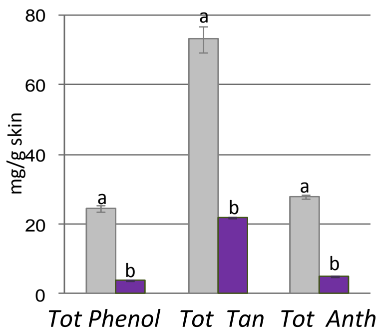
→ **No direct contact between fungus and seed**

Botrytis *cinerea* : Berries

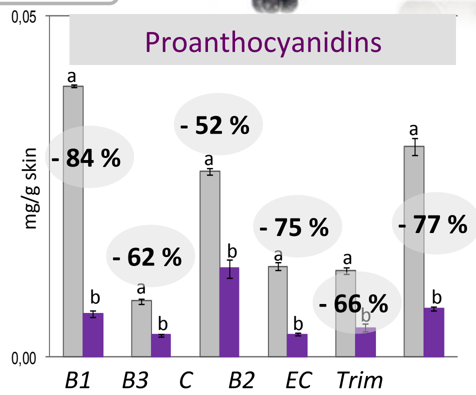
Skins

healthy / affected

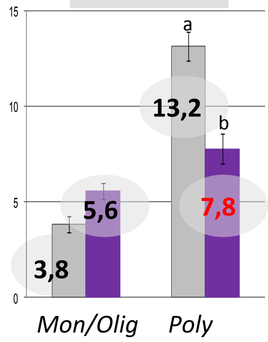
Global analyses



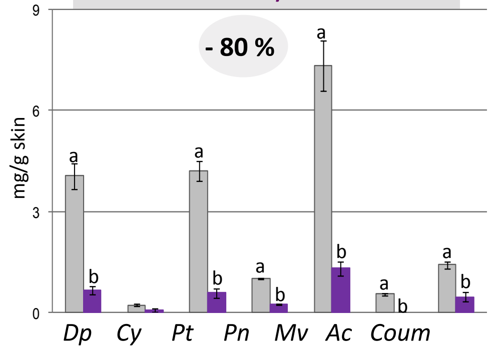
Proanthocyanidins



mDP



Anthocyanins



STRONG EFFECT

[all phenols] decrease (> 50 %)

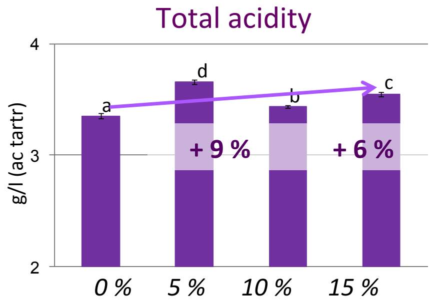
→ **Oxidative activity : fungus laccase** Oszmianski *et al.* 1985

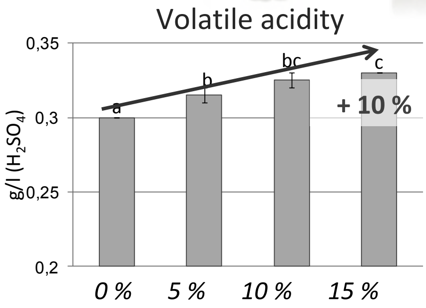
→ **Depolymerization?**

→ **Direct contact between Botrytis and skin**

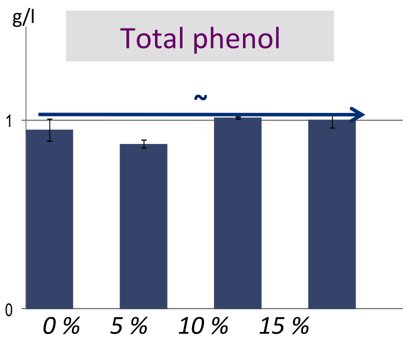
Botrytis *cinerea* : wines (1/2)

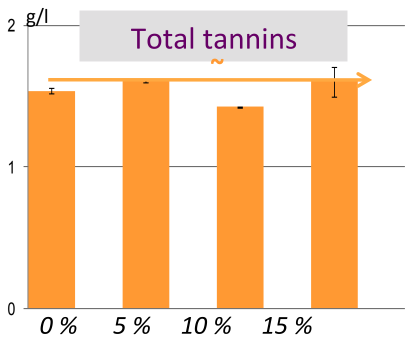
Classical analyses

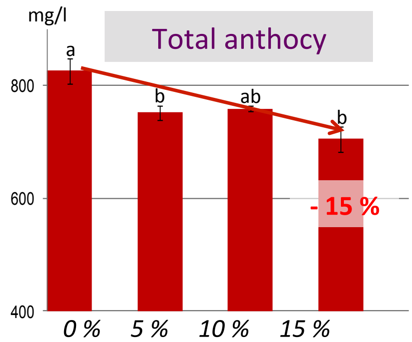




Citric and acetic acids
production by Botrytis



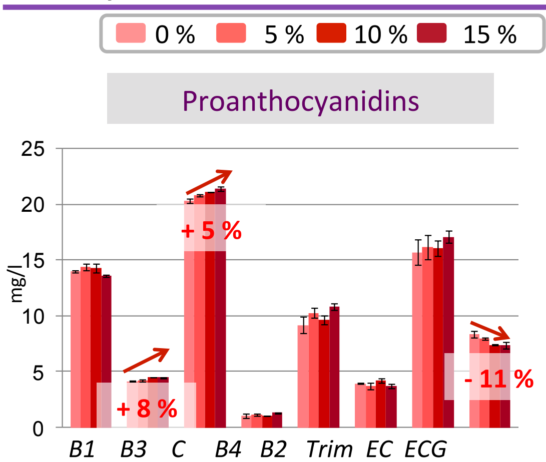


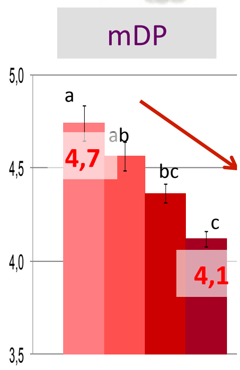


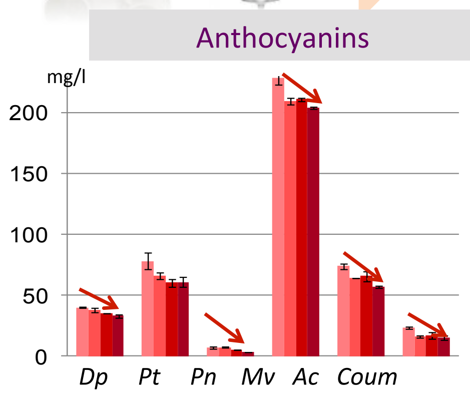
No Botrytis impact on total phenols and tannins in wines (≠ skins composition)
Total anthocyanins : 15 % decrease (*vs.* > 80 % in skins)

→ **Better phenolic extraction during vinification in botrytized wines?**
→ **Seeds extraction compensation (tannins)?**

Botrytis *cinerea* : wines (2/2)







Hypotheses: Botrytis impact

Vinification : Better extractibility from skins tannins/Skins cells degradation : laccase activity

Sensory analyses

Triangle tests :

Distinction of « Botrytis » wines vs. « Control » wines significant from 5% of affected grapes

Profiles :

Botrytis → Vegetal/herbal like/Earthy- wild mushroom
→ Astringency decrease

Off flavors appearance
mDP decline

Introduction

I. Materials & Methods

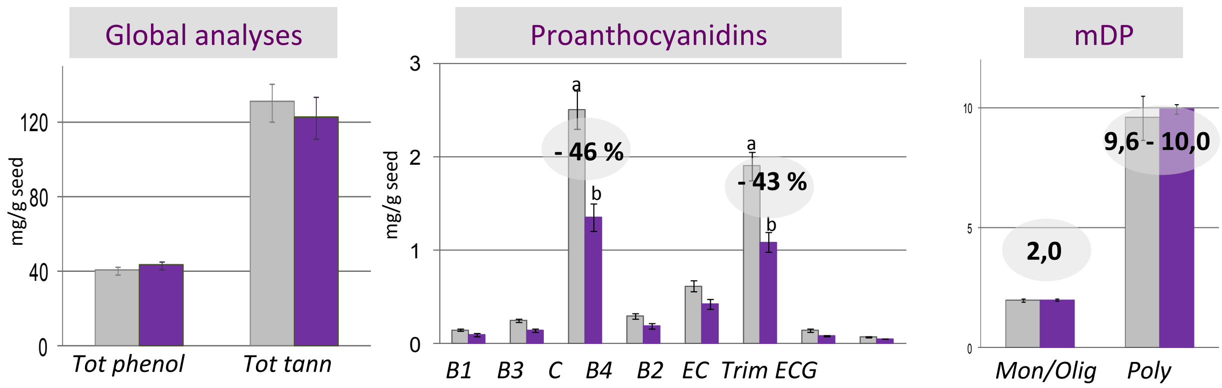
II.2 Results - Esca

III. Conclusions

Esca: berries(1/2)

Seeds

healthy affected

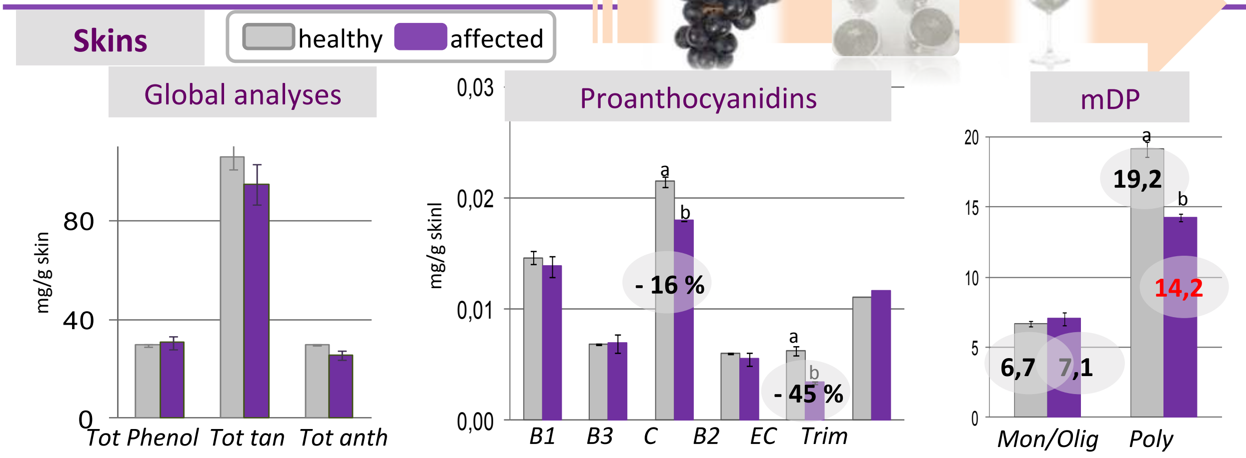


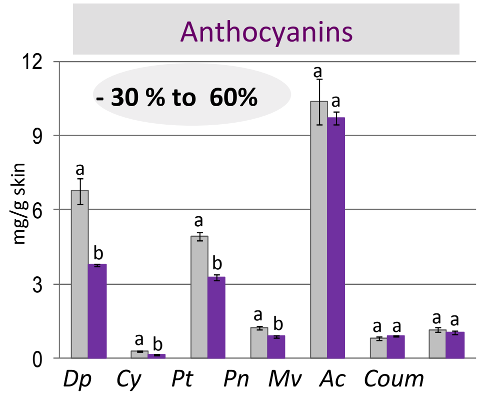
Little Esca impact on seeds phenolic composition

→[C] and [EC] decrease

Esca : berries (2/2)

Skins





Moderate skins impact of Esca :

→ **Fungi associated with Esca impact vine physiology** (Petit *et al*. 2006) :

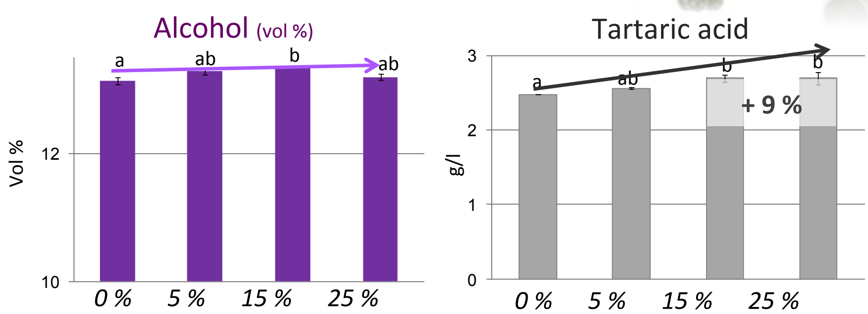
Consequences on flavonoids biosynthesis pathway ? On polymerization ?

or/and

Phenolic degradation in host defense mechanisms?

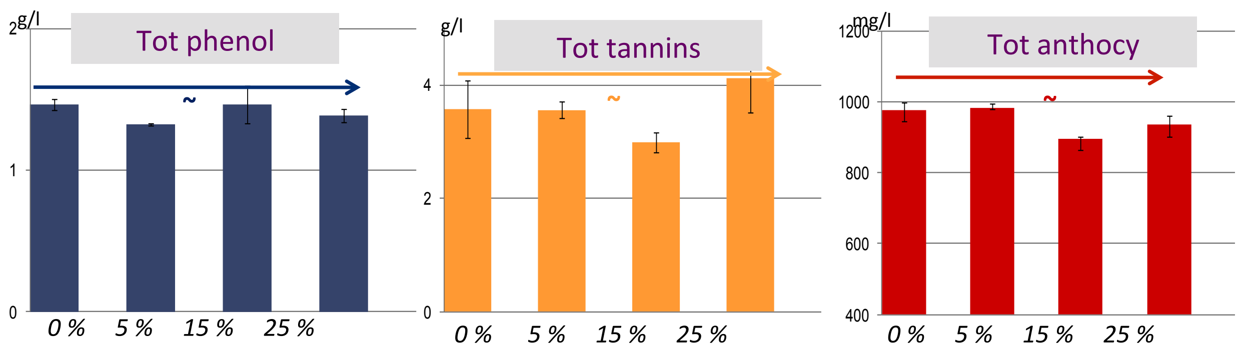
Esca : wines (1/2)

Classical analyses



Few variations

Tartaric acid : sligh increase (ripening delay)

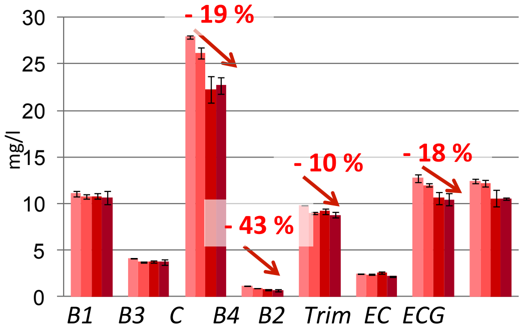


No Esca effect on all global analyses : in agreement with berries analyses

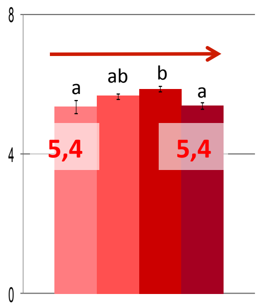
Esca : wines (2/2)

0 % 5 % 15 % 25 %

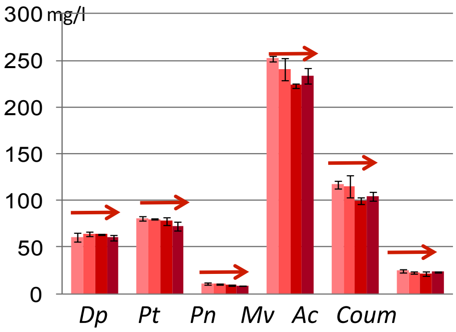
Proanthocyanidins



mDP



Anthocyanins



Few differences of chemical composition

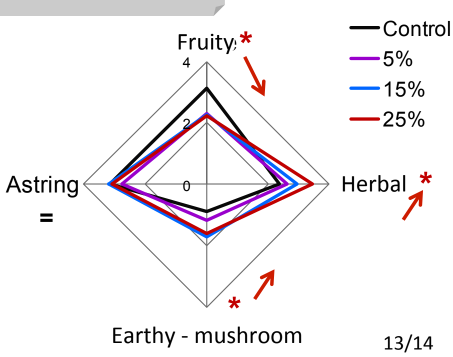
Sensory analyses

Distinction of « Esca » wines vs. « Control » wines significant from 5% of affected grapes

Off-flavour appearence :

→ Earthy- wild mushroom in link with a fruity aroma decrease

→ Increase in herbal-like/vegetal descriptors in connection with the grapes rippening delay



To summ up and conclude

	Botrytis *cinerea*	Esca
	**Skins : a strong impact** ↘ **[All phenols]** (> 50 %) ↘ **[Anthocyanins] :** sensitive (> 80 %) ↘ mDP (polymers)	**Seeds and skins: a moderate effect** ↘**[C] & [EC]** (seeds and skins) ↘**[Anthocyanins]** (30 to 60 %) (skins)
	↗ ↗ ↘ [anthocyanins] (from 10 to 30 %) ↘ **mDP** ↗ **Off flavour/ Wine colour (brown)**	↗ **Off flavour** (vegetal/herbal-like)

Botrytis *cinerea* and Esca have an **impact on phenolic** and **chemical** composition of grapes and derived wines *via* different mechanisms

⬇

Qualitative depreciation of wines sensory perceptions from 5% of affected grapes in wines

Good agreement between vintage 2009 and 2010

Botrytis *cinerea*	Esca
Direct effect between skins and Botrytis exo-enzymes	**Indirect effect *via* Esca fungi** **Physiology impact on vine**
→ **Laccase oxidative activity** → **Direct contact skins - Botrytis** → **Enhanced phenols extractability in wines (skins degradations)**	→ **Ripening delay** → **Impact on phenolic biosynthesis pathway and their polymerization ?** → **Phenols implication in host defense mechanisms?**

Botrytis *cinerea* & Esca impact on phenolic and sensory quality of Bordeaux grapes and their derived wines

GRAPES → ***Micro-vinification*** (0-5-10-15% affected berries) → **WINES**

Botrytis

Seeds : no impact
Skins : a strong impact

Contact between skins and *Botrytis* exo-enzymes (grey mould severity/age)

Decrease in [anthocyanins] (80%) [all phenols] (50%)
Decrease in mDP

Moderate effect on chemical parameters

Increase in volatile acidity
Decrease in [anthocyanins] and in mDP

Off flavour/ Wine colour (brown)
Loss of sensory quality perceptible from a low threshold (5% rotten berries)

Ky, Lorrain, Jourdes, Pasquier, Fermaud, Gény, Rey, Doneche and Teissedre. *Aus. J. Grape Wine Res.*, **2012**, 18 : 215

Esca

Seeds & skins: a moderate effect

Decrease in [C] & [EC]
Decrease in [Anthocyanins] (30 - 60 %)
Decrease in polymers mDP skins

Wine : moderate impact

Increase in [Tartaric acid]
Decrease in [C], [EC], [B_2] & [B_4]

Off flavour (vegetal/herbal-like)

Indirect effect *via* Esca fungi :
Phenolic biosynthesis pathway and their polymerization modification
Ripening delay ? Phenols implication in host defense mechanisms?

Lorrain, Ky, Pasquier, Jourdes, Guerin-Dubraba, Gény, Rey, Doneche and Teissedre
Aus. J. Grape Wine Res., **2012**, 18 : 64