



MICROBIOLOGY *AN ANSWER TO GRAPE GROWING AND WINEMAKING?*

Pascal Durand

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A definition for microbiology

Micro-biology:

- ◎ is the branch of biology that deals with microorganisms and their effects on other living organisms
- ◎ is the study of any living organism that is either
 - acellular (no cell)
 - unicellular (a single cell) or cell cluster
- ◎ is a broad term which includes bacteriology, immunology, mycology, parasitology and virology
- ◎ applied to agriculture: soil/plant/environment/food...

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Vinifera, the origin

- ◎ Vitaceas : 17 genus including Vitis
- ◎ Vitis : 37 species
 - species « Euvitis » ($2n=38$ chromosomes)
 - species « Muscadinia » ($2n=40$ chromosomes)
 - Vitis Vinifera «Sylvestris & Sativa » - monoclonal origin & diversification by selection
- ◎ Vitis Vinifera Sativa, an Eurasian origin - 7 000 years ago
 - 5 000 grape varieties / 15 000 clones in conservatory (France)
 - 2 000 interspecific hybrids / 300 rootstocks
- ◎ Bible – Book of Genesis «*Noah was the first tiller of the soil. He planted a vineyard and he drank of the wine*»

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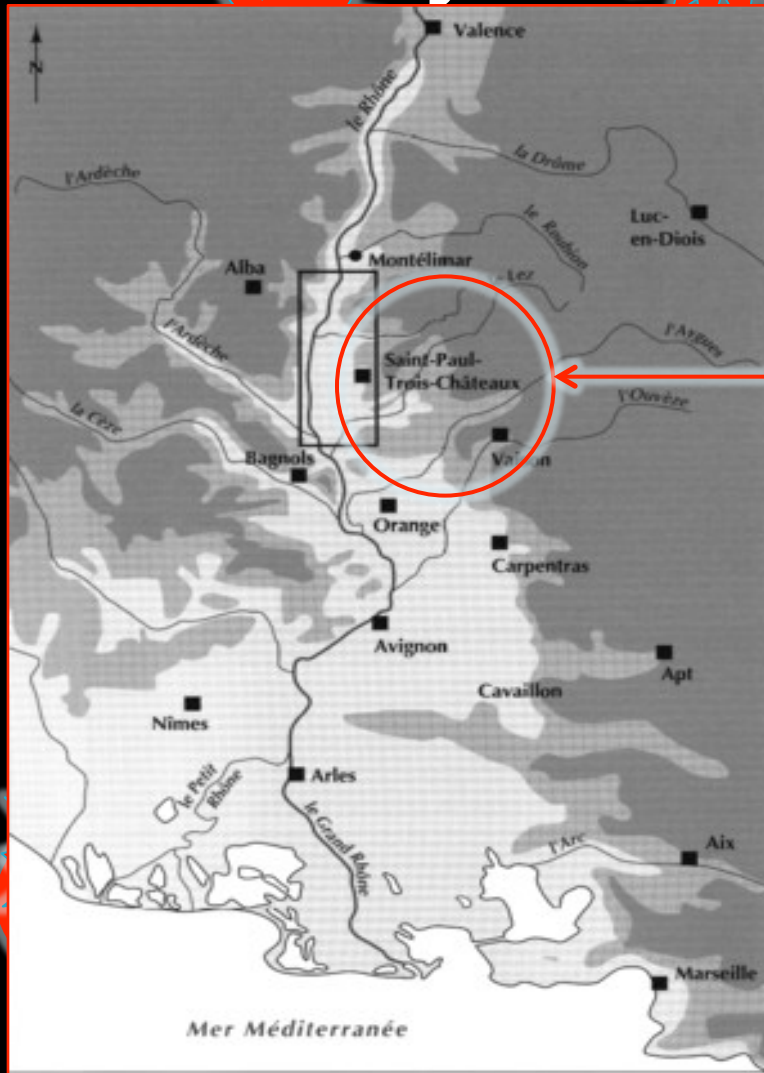
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Vinifera, the vineyard manager



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An early wine business



2 AD : ROMAN WINE FOR DOMITIEN

Company's trade marks/amphoras to avoid counterfact

Business

Experienced columnists

- ◎ **Lucius Junius Moderatus Columelle**, born in Cadix-Spain (14 BC - 50 AD) wrote "Res Rustica".
In the chapter on viticulture, Columelle insists on the role of fertilisers, promoting the exchange of experiences in methods for vineyard management: Andalousia-Spain / Lazio-Italy
- ◎ **Abbé Tainturier**, in "Remarques sur la culture des vignes de Beaune" 1763, complained again the local producers who changed the traditional winemaking process to adapt their wines to the demand of the export market, particularly for the Northern European market, only interested in "tannic and coloured wines".
- ◎ **Dom Denise**, the winemaker-monk of Citeaux, published in 1779 a book "Les vignes et vins de Bourgogne".
For the first time, he made a clear distinction between the vins of origin (tradition-terroir) and the wines of cepage (cépage)

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Transition to modern viticulture

The second half of the 19th century : a key period for the wine industry

- Migration of population (Gold Rush in Northern California)
- Chemical, coal and steel industries
- Three diseases, endemics on Eastern US, are propagated to Western US and Europe

◎ **Powdery mildew** – Uncinula Necator – 1840

◎ **Phylloxera vastratix** – 1863

◎ **Downy mildew** - Plasmodium viticola – 1878

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- ◎ **Powdery mildew – Uncinula Necator**
 - 1840 - Ruin of Irish potato farmers – Millions leave Ireland
 - 1845 - First description of the disease by M.J. Berkeley
 - 1854 - First infestation on French vineyard
 - 1861 - The disease is described as a fungus by A de Bary
 - Sulfur control of the infestation
- ◎ **Phylloxera vastratix – 1868**
- ◎ **Downy mildew - Plasmodium viticola – 1878**

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◎ **Phylloxera vastratix**

- 1863 – First infestation in Languedoc – France
- 1868 – Description of the aphid by J.M. Planchon
- 1871 – Missouri State entomologist C.V. Riley visits France
- 1873 – First infestation in California
- 1878 – Planchon/Riley : the grafting answer

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- ◎ **Downy mildew** - Plasmodium viticola
 - 1878 – First infestation in vineyards of Bordeaux
 - 1882 - Rediscovery of cuper effect by A. Millardet (preconisation for wheat in early 19th century)
 - 1885 - « Bouillie bordelaise » invented by U.Gayon and A. Millardet - $\text{CuSO}_4 + \text{Ca}(\text{OH})_2$
 - 1886 – The infestation is controled in Bordeaux area
 - 1886 – « Bouillie bourguignonne » - $\text{CuSo}_4 + \text{CaCO}_3$

Transition to modern viticulture

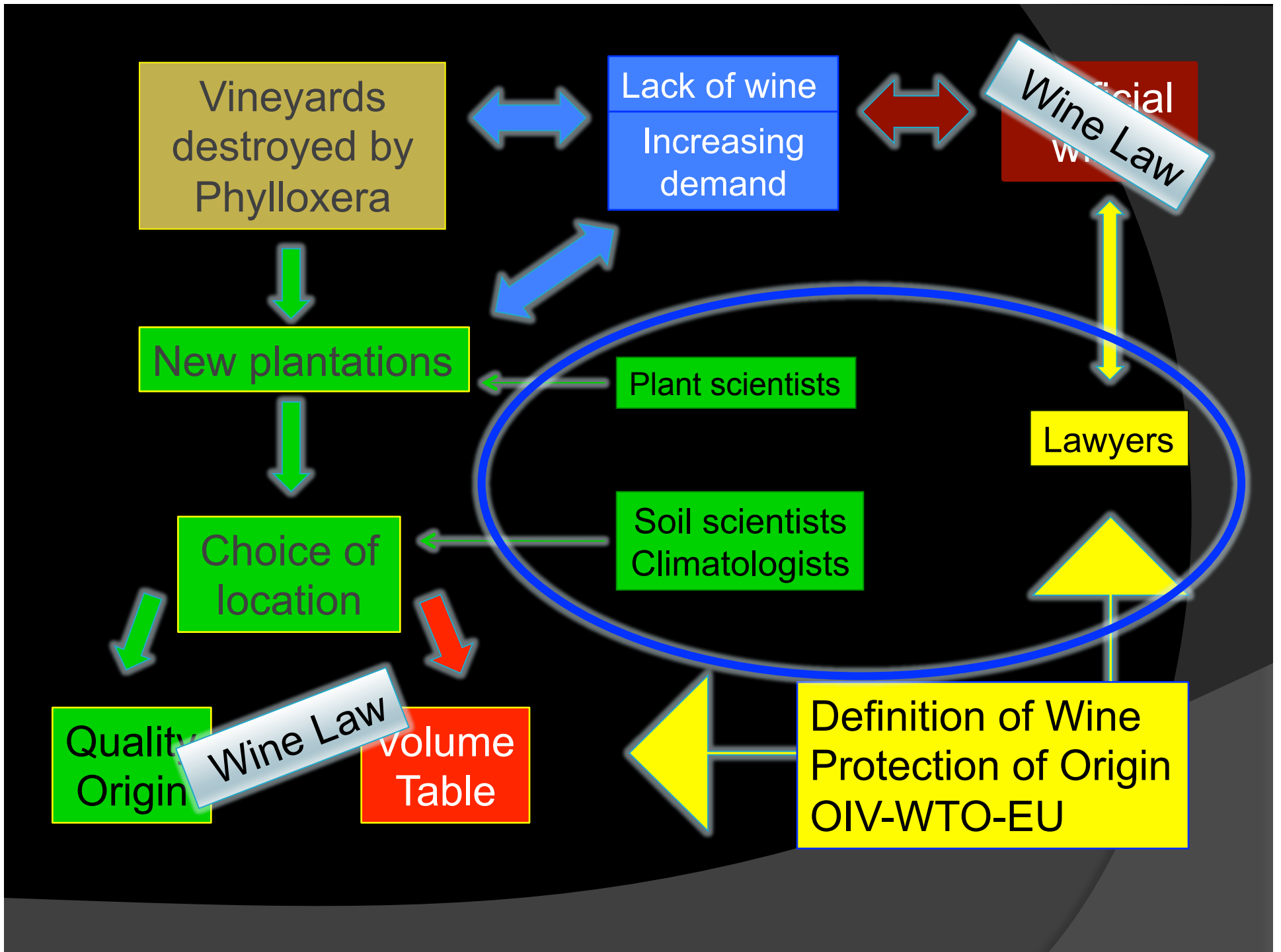
- ◎ A new time for the wine industry
 - Industrialization needs blue collar workers
 - Large volumes – Specialization of agriculture
 - Alcoholic beverages vs polluted water
 - Food energizer
 - Railroad transportation – Tank wagons
 - Quality control: pasteurization / sulfur dioxide
- ◎ A new model for viticulture
- ◎ The Wine Business

Transition to modern viticulture

- ◎ A new time for the wine industry
- ◎ A new model for viticulture : specialization
 - Local vineyards destroyed by Phylloxera
 - New planting : hybrides vs grafted
 - Mechanisation : large/long raw
 - Irrigation : flat land vs slopes
 - Trellising system : volume / low density
 - Pest management : Sulfur / Cuper
- ◎ The Wine Business

Transition to modern viticulture

- ◎ A new time for the wine industry
- ◎ A new model for viticulture
- ◎ The Wine Business
 - Bank/Industry new investments in plantations
 - Specialization of the distribution chain
 - Bulk wines to returnable bottles
 - Coop/Wine merchants/Bottling companies
 - Investments in research and education
 - School of Agriculture in Montpellier (1870)
 - Department of Agriculture at Berkeley U.(1873)



Transition to modern viticulture

- ◎ Vineyard management and winemaking
 - Volume / Production cost / Predictable
 - Fertilizers/Pest/Herbicides
 - NPK
 - Cu / organo-chlorinated + organo-phosphate
 - Role of yeast/oxygen
 - Pasteur at Arbois – “ Spontaneous generation ”
 - Control of bacterias – Malolactic fermentation
 - Cost efficiency of production
- ◎ A successful model = A global wine industry

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Why to change the model ?

- ◎ Consequences of the “ chemical ” agriculture
 - Change in local ecosystem
 - Yeast/fungus equilibrium
 - Microorganism antagonism
 - Destruction of insect biodiversity
 - Heavy metals – long term pollution of soils
 - Clonal policy and pendemial risk
 - Expansion of diseases
 - Invasive species
- ◎ Back to a sustainable viticulture

Why to change the model ?

- ⦿ Consequences of the “ chemical ” agriculture
- ⦿ Back to a sustainable viticulture
 - Before the 1960’ s : wine consumption increases in volume, not in quality
 - The 1970’ s/80’ s : Less volume – Greater value
 - The 1990’ s : Health and Care
 - Today : The Future of Our Planet, a priority
 - *Global warming – water for the future*
 - *Social concern – Green approach of development*

A new model for the 21st century

◎ The challenges

- Regulation : sanitation/health control
- Substitute to chemical : unauthorized/removed
- Global: production, cost of input, competitors
- Protectionism

◎ An answer : Sustainability

- Focus on microbiology - food sciences results
- Econometric models - hedonic price
- School of Business approach: a new consumer?

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From global to local

- ◎ Future is uncertain
 - Climatic and economic changes
 - Raw material, input availability
 - Social demand
- ◎ Better understanding of biophysical processes
 - Plant / soil physiology & ecology : Local ecosystems
- ◎ Experiment local responses
 - The couple plant-parcel
 - Grape, memory & terroir

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Elicitation

Plant

Innovative vineyard management

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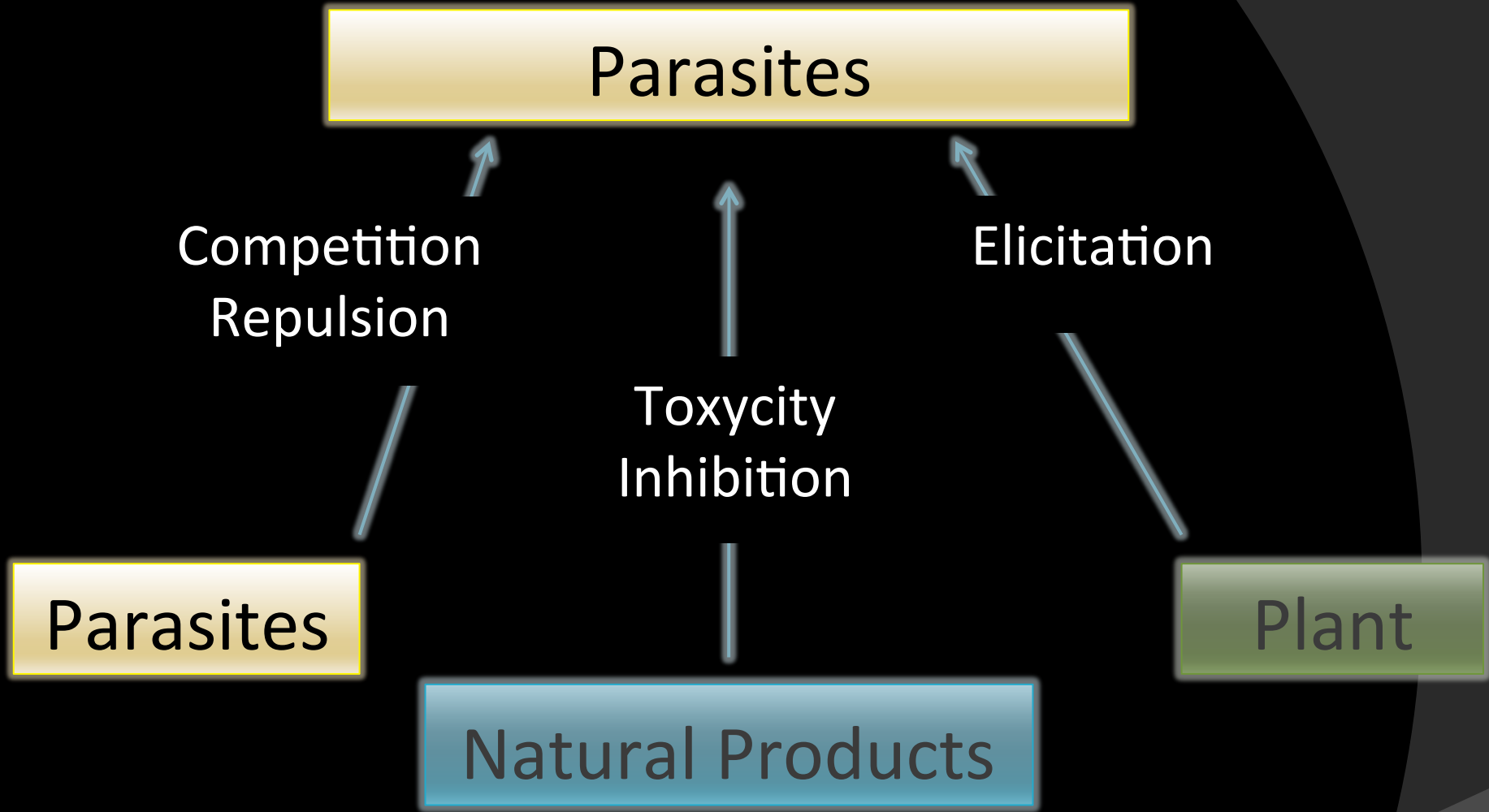
Competition
Repulsion

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Innovative vineyard management

An answer to grape growing

To consider

- ◎ The biodiversity of soil
 - Genotypic & phenotypic diversity of micro-organism
 - Rizhosphere : fungus, mycorhize, yeast
 - Metabiosis plant-soil, “terroir” approach

To manage

- ◎ Local ecosystems
 - Vineyard + hedges + other crops
 - Clones/Rootstock
 - Biocontrol, covercrop, biofertilizers
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To adapt the winemaking strategy to each vintage

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Back to the future?



Domaine de la Vougeraie
"Groupe Boisset"

*An experiment plot in Côtes de Nuits,
on the Golden Slopes of Burgundy*

- Biodynamic farming system
- High density : 14 500 vines per acre
- Development : layering "foule"

« We hear of the conversion of water into wine at the marriage in Cana as of a miracle. But this conversion is, through the goodness of God, made every day before our eyes.

Behold the rain which descends from heaven upon our vineyards, and which incorporates itself with the grapes, to be changed into wine; a constant proof that God loves us, and loves to see us happy »

Benjamin Franklin, in ‘A letter to Abbé Morallet’



Thank you for your attention

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You need more infos about the topic, interested by subjects on winemaking in France/Western Europe

Please, contact me at : pascal@pinotnoiracademy.fr