Effect of global warming on vine grape and winemaking in mediterranean conditions

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Effect of global warming in mediterranean conditions

- **Climate change**
  - Average temperatures increase and efficient rainfalls decrease

- **Consequences for vines and grapes**
  - Shortening of phenologic stages
  - Water stress
  - Consequence on vineyards implantation

- **Consequences for wines**
  - Another way of planning the picking period
  - Changes in chemical contents of wines
  - A necessary adaptation of winemaking processes

Mediterranean climate

Climatic diagram of perpignan (23 years of average datas)

- High autumn and spring rainfall <> Low summer rainfall
- Mild winter temperature <> High summer temperature
- > 2700 h sunshine/year

Specific mediterranean characteristics

- High number of days of strong and dry winds
  - High ETP even with moderate temperatures

- An extreme variability according to:
  - Altitude: from 0 to 600 m !
  - Sea proximity
  - Local rainfall..... Extremely local
What are Mediterranean conditions? (1)

A climate adapted to wine growing:
- High level of sunshine period: > 2700 hours per year (in Montpellier)
- Cool average temperature in winter: 6°C in Montpellier in January
- Average hot temperature and few rainfall in summer: 23°C in July and August in Montpellier with less than 50 mm per month

Specific characteristics:
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  - Local rainfalls

Recent changes: temperatures increase during vegetative cycle of grape wine

Evolution of sum of temperature in Nîmes (France) since year 1965

Main consequence: evapotranspiration increases as well!

Increase of very warm days

Rainfall decrease during vegetative cycle of grape vine

Source: CIRAME
What happens to mediterranean climate?

The global warming affects the mediterranean climate:
- Increase of temperature during the full year but specially winter;
- Decrease of rainfall during winter and summer, but higher number of heavy rains;
- A higher frequency of abnormal climatic events:
  - Heavy rainfalls in 1999, 2002;
  - Higher numbers of days with hard winds
  - Hail is more frequent...

⇒ Mediterranean climate changes to sub-desertic conditions, with bad consequences for grapevine.

Example: 2007 in Perpignan

Less rainfall in summer
Higher temperatures in spring
Frequent high rainfall (> 100 mm/day)

As a consequence, grape vine is subject to dryer and dryer conditions

Consequences on the grape vine cycle

- Bursting out: not always very early
- High precocity of flowering
  - 2006: earliest ever 30 years
  - 2007: earliest since… 2006
  - Very high Huglin’s index (sum of temperatures) at the end of May
- Diseases are more frequent, specially powdery mildew in spring:
  - several damages in June and beginning of July
- Early vintage
  - First harvests earliest ever
  - Fortunately fresh temperatures in August slow ripening
  - Fresh nights favourable to anthocyanins synthesis
  - Berries with thin skins
  - Effect of wind
  - No summer rainfall
Increase of precocity and grouping of maturity

Beginning and end of grape picking (in red color) and total length of picking period (in white color) at experimental ICV winery for chardonnay, sauvignon, shiraz, merlot and cabernet sauvignon variety, picked at same sugar content.

Early harvesting is a heavy trend since year 2000

Evolution of date of harvesting at experimental ICV winery (Chardonnay variety plots harvested at equal level of sugar level)

Water stress is more and more frequent

- Water stress enhances:
  - Loss of harvest
  - Change in grapes content
  - Mortality of vine plants
  - Heterogeneity in plots
- Varieties like shiraz, merlot or chardonnay are very sensitive to this stress
- Typical wines made with water stressed grapes
  - Concentrated wines with unripened tannins and strong alcoholic feeling, without fruity taste
  - Less and less required by the market and consumer

Heat after veraison = less colour

2003: anthocyan synthesis increases after reduction of temperatures, not after rainfalls
Consequences on vineyard implantation

• Interest for late varieties
  – Ripening in better temperatures conditions
  – More likely to meet autumn rainfall

• Interest for altitude vineyards
  – More rains
  – Less excessive temperatures

• Interest for deeper soils
  – More water resources in summer
  – Overyield risk reduced under dry conditions

Vineyard adaptation: canopy management

Vertical trellis

Sauvignon: sunburn damages
04 July 2006

Increased transpiration on narrow canopy

Cordon
Mechanized harvesting possible
Transpiration reduced
Protection against sunburn

Umbrella
Excellent for grape protection against sun and for soil shading

A necessary adaptation of vine management

- Irrigation and management of water resources
- Soil tillage: no weed competition and optimization of deep root system
- Vineyard benchmarking:
  - Upgrading of traditionally basic vineyards
  - Excessive stress on traditionally premium vineyards
What are Mediterranean conditions? (2)

Under standard maturation conditions i.e. sun + moderate water stress:
- High sugar concentration (generally > 220 g / L)
- Low available nitrogen supply (generally < 250 mg / L)
- Low malic acid concentration, generally < 2 g / L
- High pH, generally > 3.6 before alcoholic fermentation

These 2 parameters are also closely dependent upon grape variety.

Early harvesting: Heavy consequences on winery management

- Example of a winery (cave coopérative): Picking planning
  - Heavy cooling requirement at the beginning (white and rosé wines);
  - Modification in picking organisation:
    - Harvest at night;
    - Staggering of picking over the full week and the full day

Change in chemical contents of wines

- Wines with more sugar concentration but with less available nitrogen
  - Problems of fermentation
  - Wines with high alcoholic level: TAV > 15%
- Wines generally with higher pH but depending on conditions!
  - Increase color instability and ageing
  - More risks of microbiological damages
  - Problems to realize MLF (low level of malic acid)
- More problems to reach phenolic maturity
  - Wines with hard tannins
  - Color instability

Increasing fermentation risks

- Fermentation risk according to must composition
Increasing fermentation risks

When alcohol potential is > 13%, more than 90% of the grapes have less than 250 mg/L of assimilable nitrogen and 50% less than 150 mg/L.

Where is the risk of contaminations?

Risk of contamination

Two maturities reached at different moments

Exemple of an experimental plot of OM Pyrénées Roussillon in 2002

A full maturity difficult to reach

Not only the phenolic maturity is difficult to reach (with bigger gap) but the level of extractible polyphenols is less.
A necessary adaptation of winemaking processes

- **Conducting the alcoholic fermentation**
  - Addition of complex organic nutrients and oxygen;
  - Management of temperatures (T_max)
  - Choice of yeast strain, rehydration process

- **Managing the MLF, (delay to finish it)**
  - Lactic bacterias additions
  - Hygien (rackings)
  - Temperature

- **Managing ageing and storage of wines**
  - Optimal active SO₂
  - Temperature and hygien of storage

Conclusions

- Global warming is a reality.
- It changes under mediterranean conditions:
  - vineyard plantation
  - vineyard management
  - winemaking process
  - wine ageing technics

Care anytime is necessary with better knowledge of global warming consequences.

Thank you for your attention

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