VITICULTURE

Introductory

TEMPERATE AREAS OF WINE PRODUCTION

ACID

↑

BALANCED WINE

↓

SUGAR

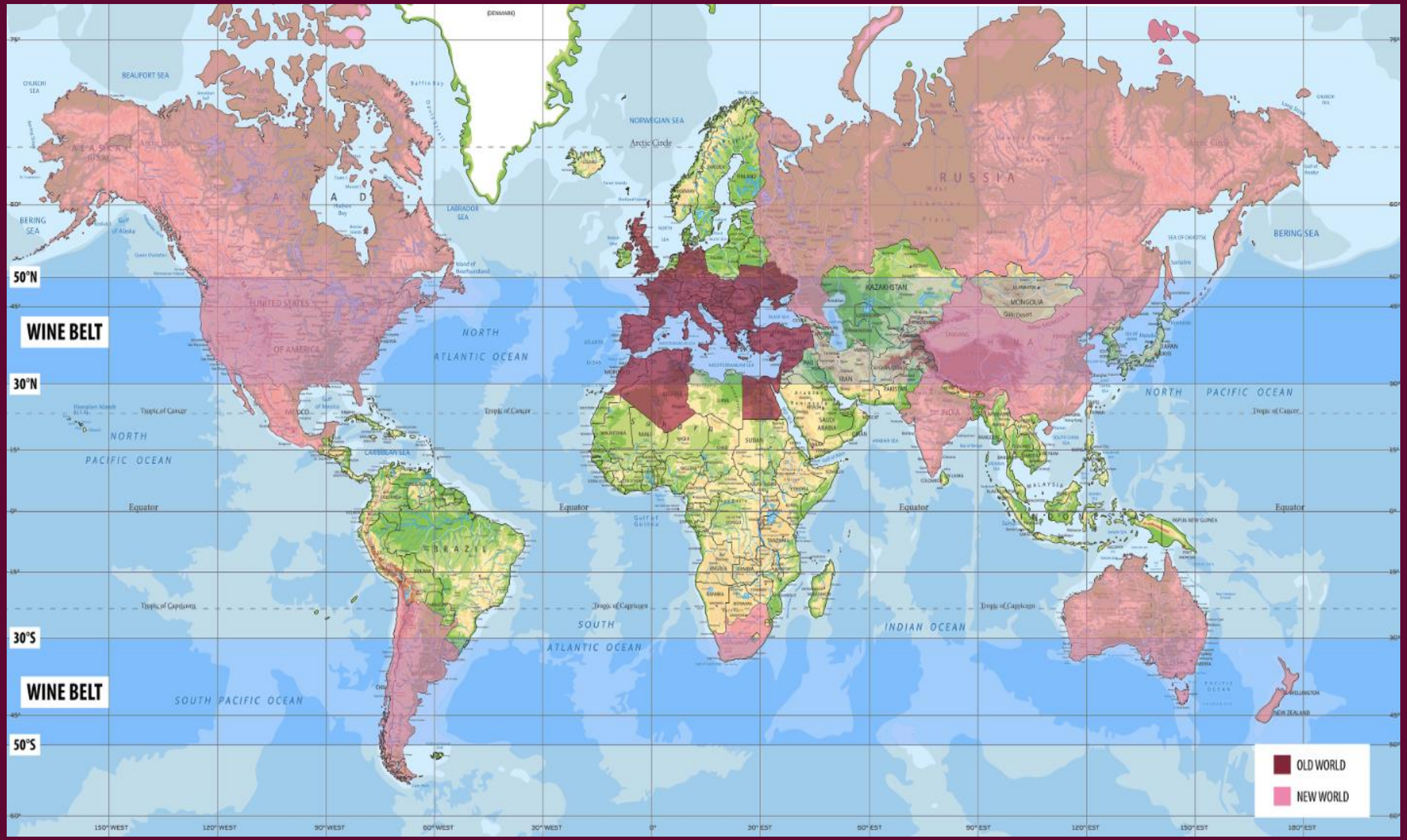
SUGAR

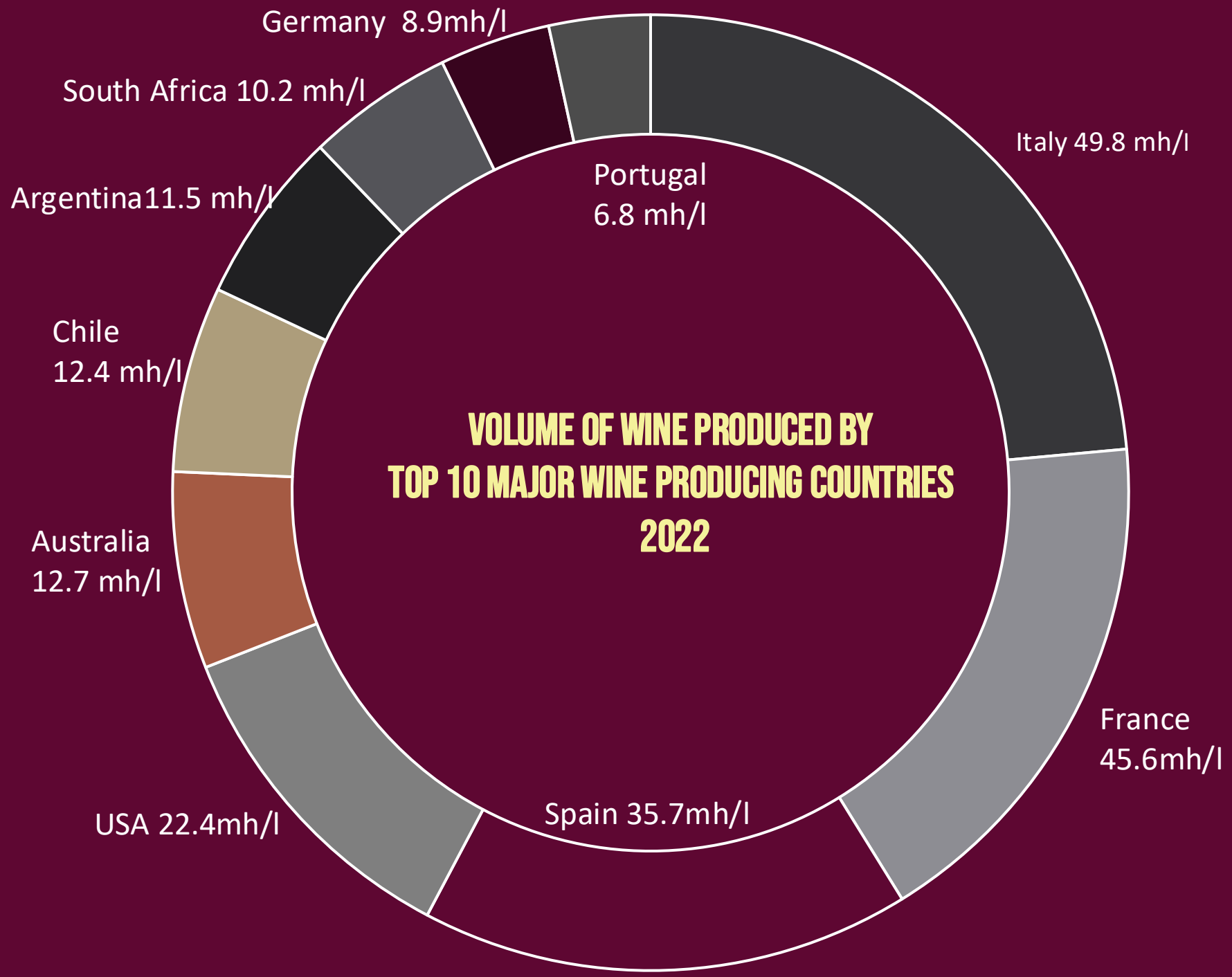
↑

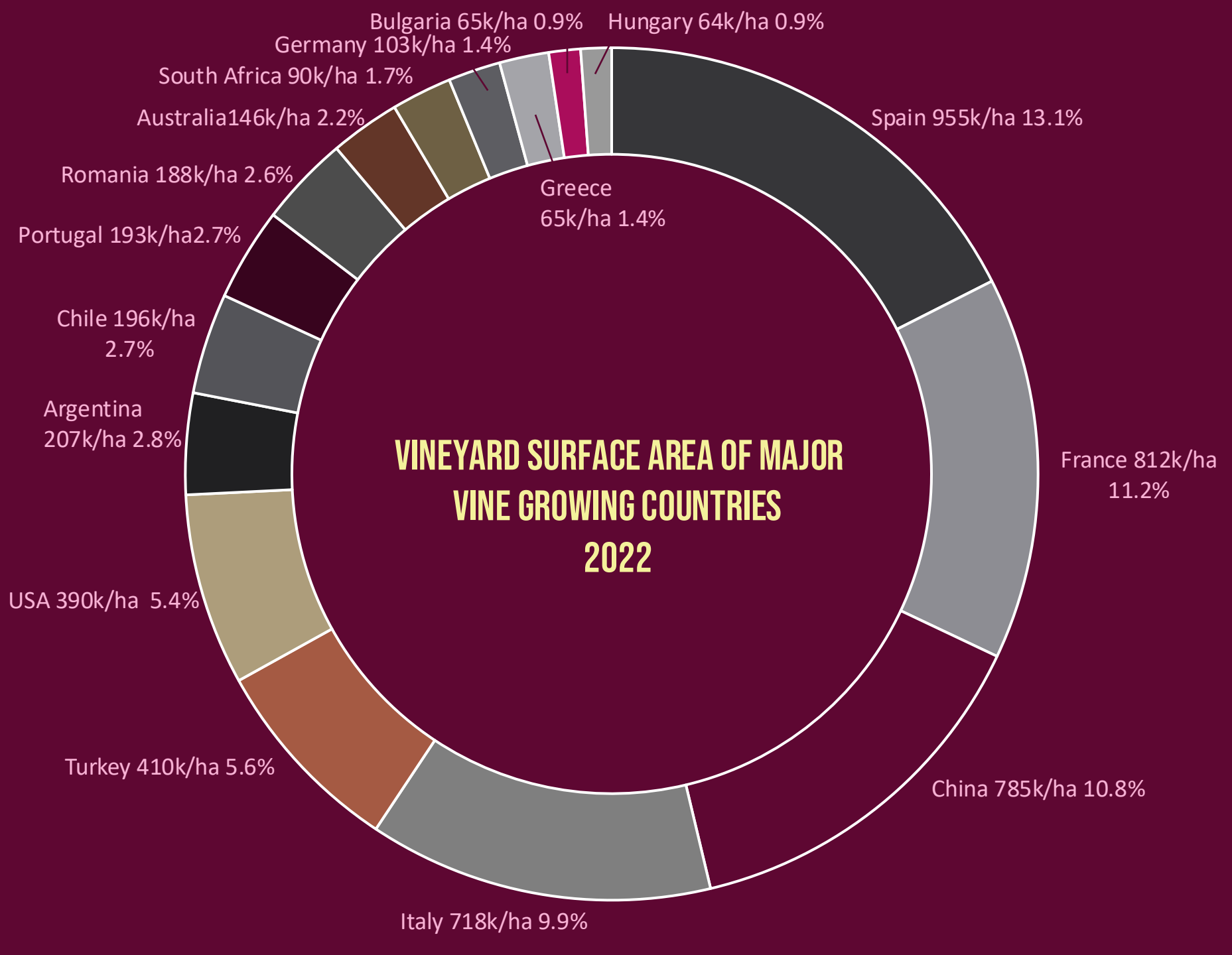
BALANCED WINE

↓

ACID




Germany 8.9mh/l
South Africa 10.2 mh/l
Argentina11.5 mh/l
Chile
12.4 mh/l
Australia
12.7 mh/l
USA 22.4mh/l
Spain 35.7mh/l
France
45.6mh/l
Italy 49.8 mh/l
Portugal
6.8 mh/l
VOLUME OF WINE PRODUCED BY
TOP 10 MAJOR WINE PRODUCING COUNTRIES
2022


VINEYARD SURFACE AREA OF MAJOR VINE GROWING COUNTRIES 2022
Spain 955k/ha 13.1%
France 812k/ha 11.2%
China 785k/ha 10.8%
Italy 718k/ha 9.9%
Turkey 410k/ha 5.6%
USA 390k/ha 5.4%
Argentina 207k/ha 2.8%
Chile 196k/ha 2.7%
Portugal 193k/ha2.7%
Romania 188k/ha 2.6%
Australia146k/ha 2.2%
South Africa 90k/ha 1.7%
Germany 103k/ha 1.4%
Bulgaria 65k/ha 0.9%
Hungary 64k/ha 0.9%
Greece 65k/ha 1.4%

THE VINES BASIC NEEDS

Climate

The time between flowering and harvest is approximately 100 days

During this time, the vine requires between 1300-1500 hours of sunlight

Soil

Well drained with good mineral content (chalk and gravel)

Well drained soils tend to be warmer and enhance ripening

Nutrient-rich soils make the vine lazy

Poorer soils make the vine work harder and produce better quality fruit

CHOOSING THE RIGHT AREA

Cool regions

The warmest places in cool regions can be found on a southeast/west facing slope (in the Northern Hemisphere)

Slopes get more sun exposure than flat land and are less susceptible to frost

Proximity to hills/mountains protects from prevailing weather patterns and

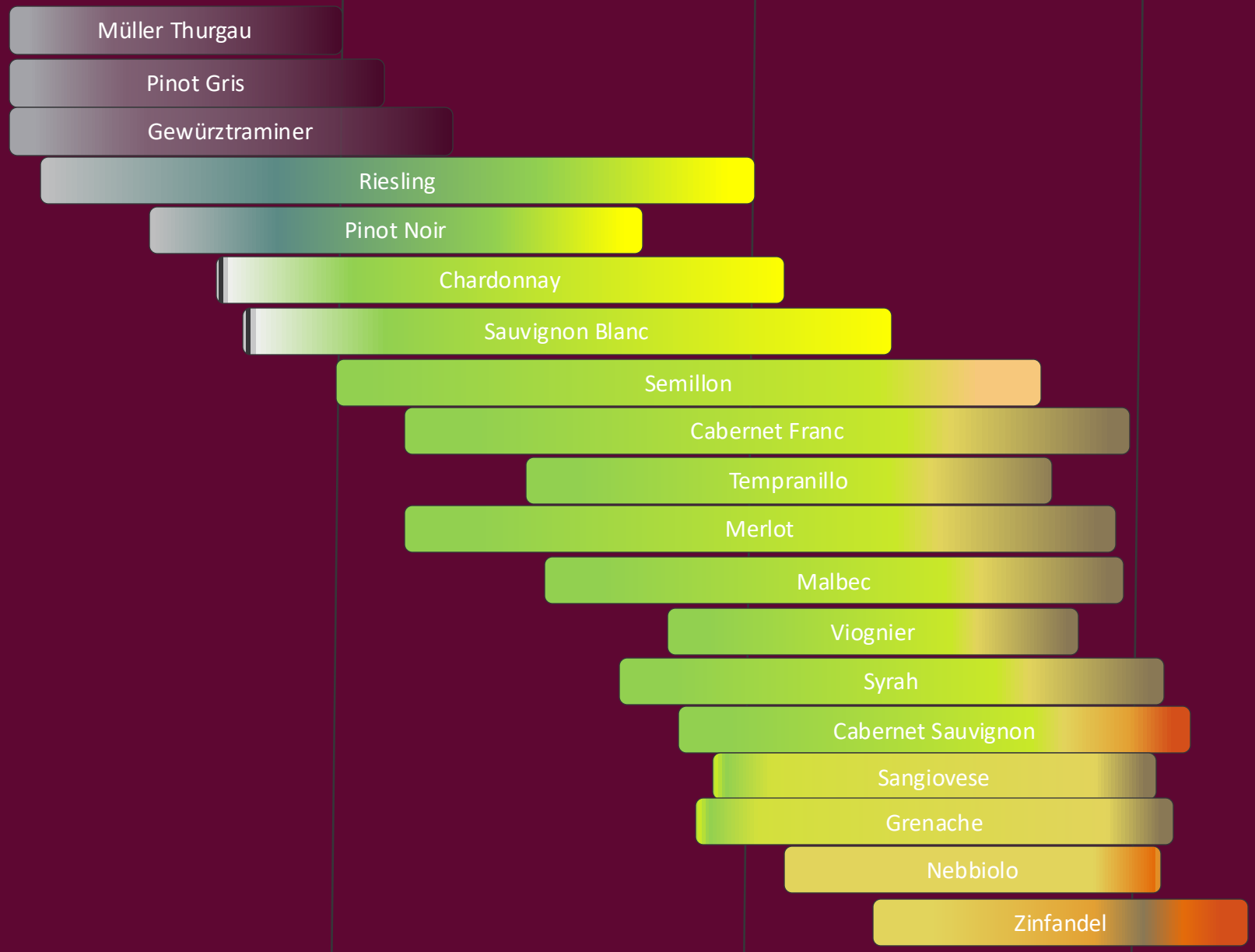
can provide a rain-shadow effect

Proximity to large bodies of water helps moderate the mesoclimate

Warm Regions

The coolest spots can be found by seeking higher altitudes

CHOOSING THE BEST GRAPE VARIETY



COOL: 1 6 °C OR BELOW

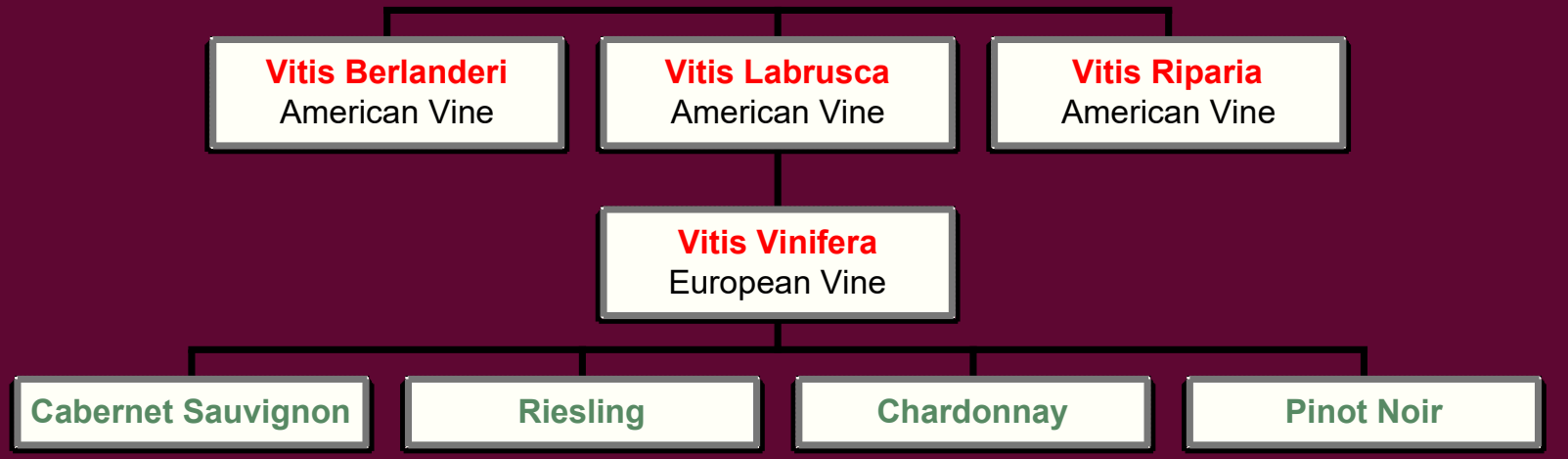
MODERATE : 16-18°C

WARM: 18-21°C

HOT: 21°C OR ABOVE

THE VINE

Phylloxera resistant rootstocks of American varieties are grafted to shoots of Vitis Vinifera



CLONES SELECTION VS MASSALE SELECTION

- **Natural Mutation**
  - If cuttings of a vine are taken and transplanted in several locations, each having different growing conditions, each young vine will adapt itself and its habits to the new environment
  - This ‘cloning’ of vines accounts for a great deal of the spread of vine varieties from one place to another
  - The change in form and habit explains why there is so much confusion over whether one named variety is related to another
- **DNA Modification**
  - Genetic engineering involves directly modifying the DNA of a grapevine by introducing specific genes from other organisms
- **Massale Selection**
  - Cuttings are taken and propagated in the same area

VINE CROSSING

Vitis Vinifera X Vitis Vinifera

- New varieties bred to be resistant to disease and tolerant to extremes in weather conditions

Examples

Müller Thurgau

(Riesling x Chasselas de Courtillier (Madeline Royale))

Perle

(Gewürztraminer x Müller Thurgau)

Pinotage

(Pinot Noir x Cinsault (Hermitage))

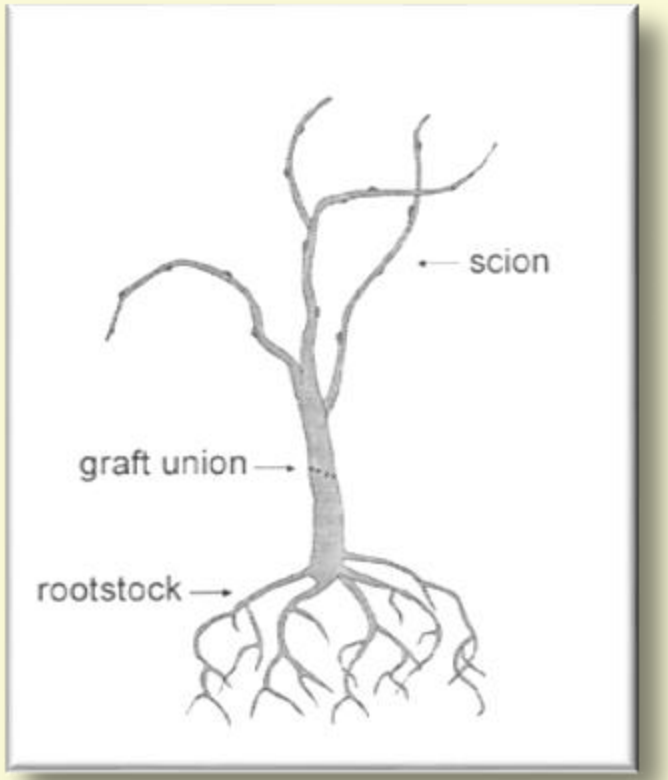
HYBRID VINES

- A crossing between American, Asiatic and European vine Species
- (Eg: Vitis Lambrusca X Vitis Vinifera)
- Use in quality wine production now being experimented because of resistance to fungal diseases & climate change issues
- Bordeaux and Champagne have recently approved hybrid vine plantings
- Examples: Seyval Blanc, Vidal Blanc, Baco Noir, Sauvignac, Voltis, Vidoc Noir

GRAFTING BENCH

Technique where parts of two different grapevines are joined to grow as one.

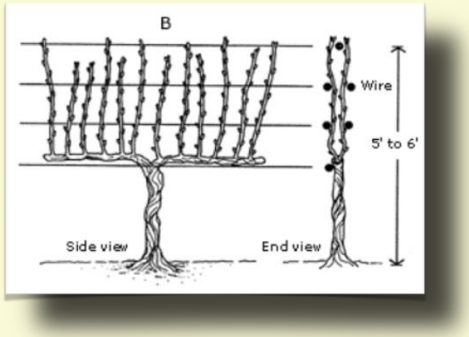
Specifically, it involves uniting the rootstock (the lower part of the vine, including the roots) with the scion (the upper part, bearing the desired grape variety)



VINE TRAINING

VSP : VERTICAL SHOOT POSITIONING

- Most commonly used
- Supporting wires are trained from post to post
- Shoots are trained up through wires
- Opening canopy and exposing fruit



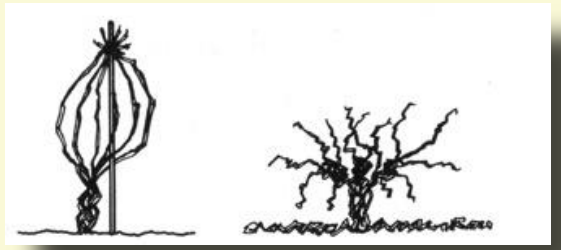
CORDON / SPUR TRAINED

- Permanent cane with spurs that produce new shoots each year
- Used in areas such as Spain and Napa Valley

VINE TRAINING

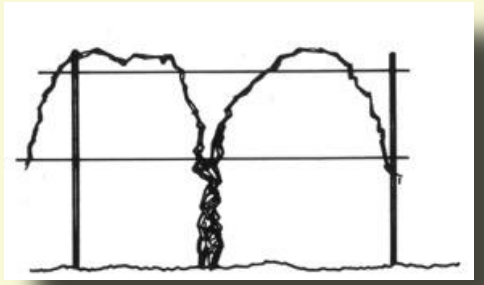
GOBELET / BUSH

- Used in warmer areas
- Provides some protection from wind damage
- Not suitable for damp or frost prone regions
- Vines are free standing
- In the gobelet the vine tips are tied together
- Syrah and other Rhône varieties and Zinfandel



REPLACEMENT CANE / GUYOT

- Canes trained on lateral wires with new producing canes being used every year
- Single cane is Guyot Simple
- Double Guyot Double



VINE TRAINING

PERGOLA TRAINING

Pergola training protects fruit from UV exposure plus increases airflow to reduce the risk of cryptogamic diseases

BASKET / KOULOURA

- A special and unique way of vine pruning is the one developed on Santorini.
- It protects the bunches from strong winds and sun

PROBLEMS IN THE VINEYARD

Hail during the growing season causes damage to vines

Birds and Animals eating or damaging fruit, leaves, shoots

BIRD NETTING AT KUMEU IN NEW ZEALAND

FROST PROTECTION

Temperatures below freezing can damage tender shoots or emerging leaves

Extreme temperatures can damage trunks

Moving air around with fans or propellers can prevent frost settling

Heating vineyards with burning raises temperature

Aspersion – spraying new buds with water, envelope them in frost, and protect them

Chablis April 2016

ASPERSION IN BURGUNDY

SMUDGE POTS IN CHABLIS

PHYLLOXERA VASTATRIX

Arrived from America in 1850's

1850-1870's – 40% vines in France destroyed

American roots immune

Grafting to European vines was solution

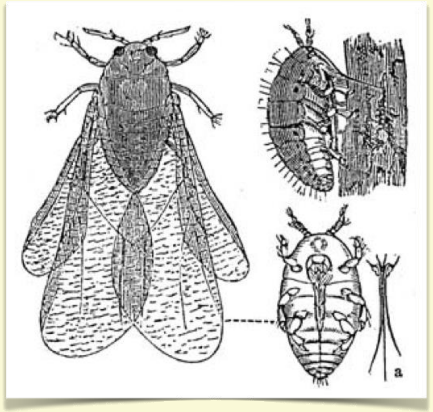
Important historical event as many wine regions were developed consequently

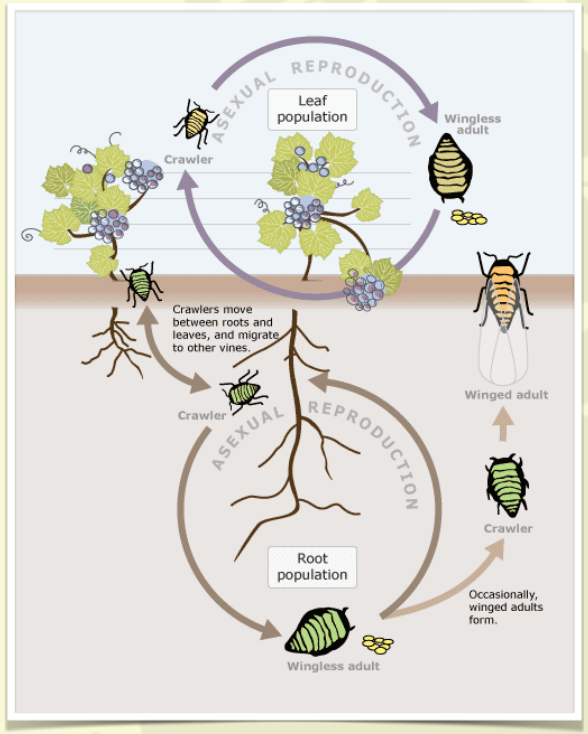
A small yellow aphid (1mm) that feeds on roots

Feeds on sap

Injects saliva into roots that forms galls and deformities

4-7 generations per year





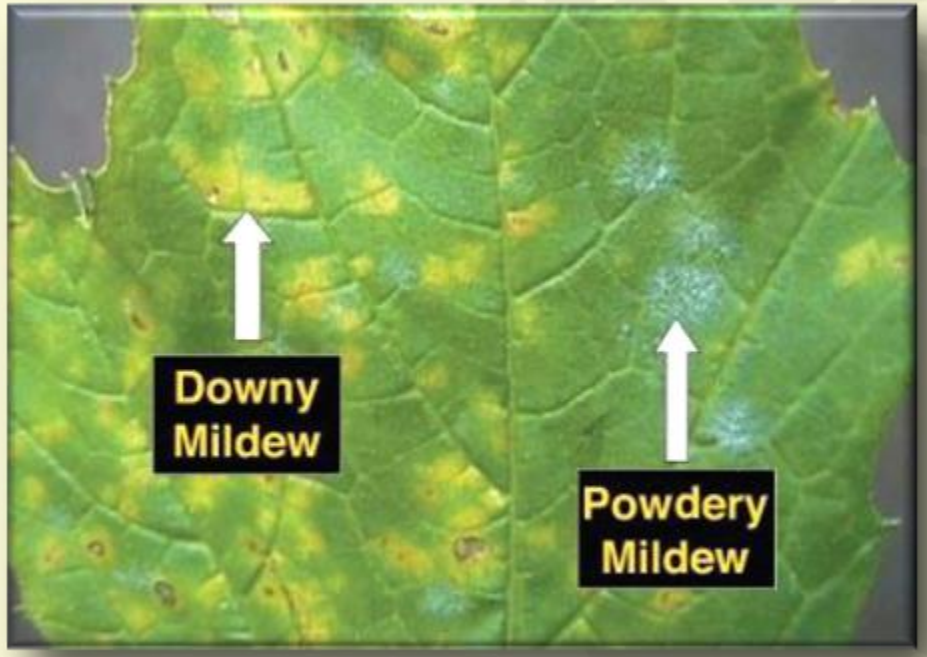
CRYPTOGAMIC VINE DISEASES

Peronospera (Downy Mildew)

Affects leaves and shoots preventing Photosynthesis
Controlled by spraying Copper Sulphate (Bordeaux Mixture)

Oidium (Powdery Mildew)

Affects all green parts of the vine with a cobweb growth
Develops in warm conditions
Controlled by sulphur sprays



OTHER VINE MALADIES

Grey Rot

Identical to Botrytis but called grey rot when it forms on immature fruit or black grapes

Eutypiose or Eutypa

A fungal infection, attacks vine wood through pruning cuts
Also known as Dead Arm or Esca

Flavescence dorée

A Phytoplasma disease spread by leafhoppers
Infection may kill young vines and greatly reduce the productivity of old vines

Insect pests

Grape Moths: caterpillars eat buds and fruits
Red Spider: infests leaves and destroys foliage

OTHER VINE MALADIES

Leaf roll virus

Symptoms vary among red and white varieties

Easier to detect in red varieties which display symptoms of the virus in the spring as well as the autumn

During the spring, the symptom in reds is poor colour or greenish berries

In the autumn, symptoms show up as red and rolled under leaves

Caused by a related group of viruses spread by the Mealy Bug

OTHER VINE MALADIES

Millerandange

Condition in which bunches of grapes contain berries of different size and levels of maturity

This is caused by poor weather during flowering

Coulure

Caused by carbohydrate deficiency in plant tissue (lack of sugar) that causes a failure of grapes to develop after flowering

This may be triggered by poor weather conditions

Flowers stay closed and un-pollinated and causes the grape to drop off

Can also cause irregular bunches (less compact) and therefore reduces yield

Vines susceptible: Grenache, Malbec, Merlot and Muscat

HARVEST AT CHÂTEAU PALMER

HARVEST

August - October (Northen Hemisphere)

February - April (Southern Hemisphere)

Varies with different locations, grape varieties and wine styles

Sparkling before still, whites before reds, late harvest and sweet last

GRAPE SORTING IN TRIAGE TABLE AT LE PIN

WINES MADE FROM DRIED GRAPES

Grapes may be naturally dried on the vine (Passerillé) to produce late harvest styles which preserve fruit flavours and acidity with minimum exposure to oxygen

Harvested and dried for several months indoors or exposed to the sun for several days to concentrate the sugars and develop oxidative characteristics

- Italy: Recioto, Vin Santo and Moscato di Pantelleria
- France: Vin de Paille, Jura
- Austria: Strohwein
- Santorini: Vin Santo

ICE WINE (EISWEIN)

Grapes are left on the vine until frozen and pressed so that the water crystals remain frozen and only the sugars and dissolved acids are extracted

Requires air temperature of -8°c so often picked in hours of darkness

Yield is approximately between 5-10% of the original grape volume (3.5kg grapes = 375ml)

Alcohol levels between 7-10%

Production in Canada (Ontario), Germany, Austria & Switzerland

Also produced by Cryogenic freezing of grapes e.g. Vino Dulce de Hielo

BOTRYTIS CINEREA

Fungus that develops under certain conditions

Spores pierce grape skins

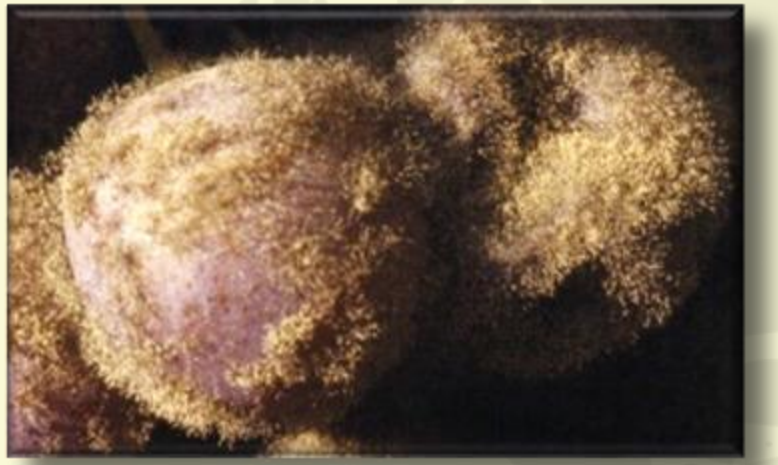
Dehydrates grapes and lowers overall acidity level

Concentrates sugars

Changes flavour profile

Does not develop uniformly

Several tries or trips through vineyard required to complete harvest



ORGANIC WINE

Made from grapes grown in vineyards which do not use chemical fertilisers, herbicides, fungicides and pesticides

Biodiversity in the vineyard is practiced to increase the soil nutrients, which in turn will aid the health of the vine

Use of Cover crops, to increase soil health. Natural predators (insects and birds), to reduce aphid and insect infestation

Certain practices in wine making are controlled e.g. use of Sulphites

Organisations inspect vineyards to ensure complicity e.g. Soil Association, Ecocert etc.

BIODYNAMIC WINE

Based on the principles of Rudolf Steiner

A sustainable approach to agriculture to increase soil fertility without chemical fertilisers and pesticides

Vineyard to be self-sustainable, with other crops or livestock to complement viticulture

A regime of planting, pruning and harvesting by the position of the sun, moon and the planets

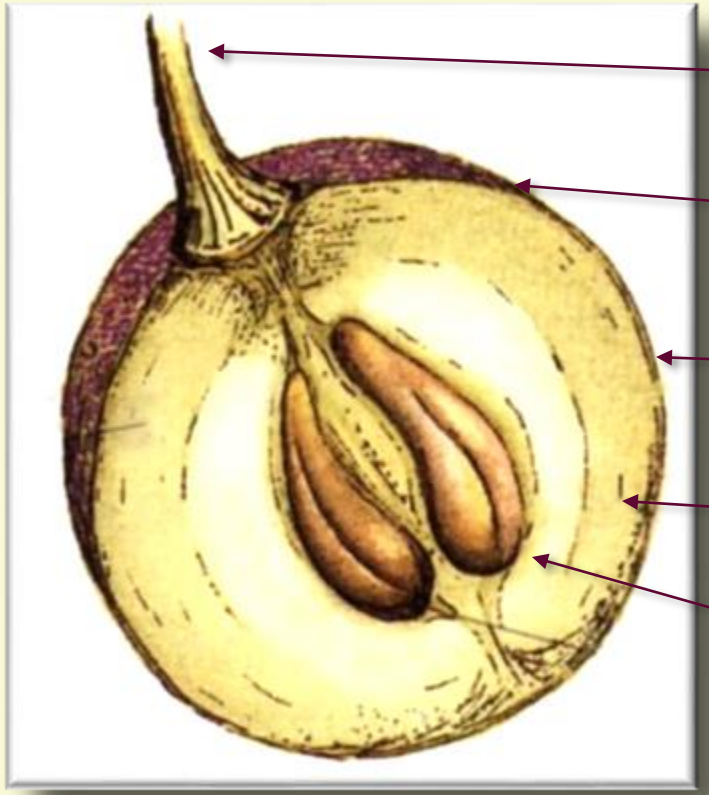
Natural preparations applied to the vineyard to increase fertility

Organisations such as Demeter award a certificate of compliance for those reaching the criteria

VINIFICATION

Introductory

COMPONENTS OF THE GRAPE



Stalk: Tannins

Skin: Tannins and Colour

Bloom: Wild yeasts and Wine yeasts

Pulp: Sugar, Fruit acid, Water and Proteins

Pips/seeds: Bitter Oils

THE BLOOM & YEASTS ON THE GRAPE SKIN CONTAIN

- **Wild Yeast**
  - Produces off flavours – only up to 4% alcohol
  - Aerobic (die without oxygen)
- **Wine Yeast**
  - Produces alcohol up to 16-18% abv
  - Anaerobic (survive without oxygen)
- **Bacteria** (Acetobacter)
  - Produces Vinegar
  - Aerobic (die without oxygen)

SUGAR

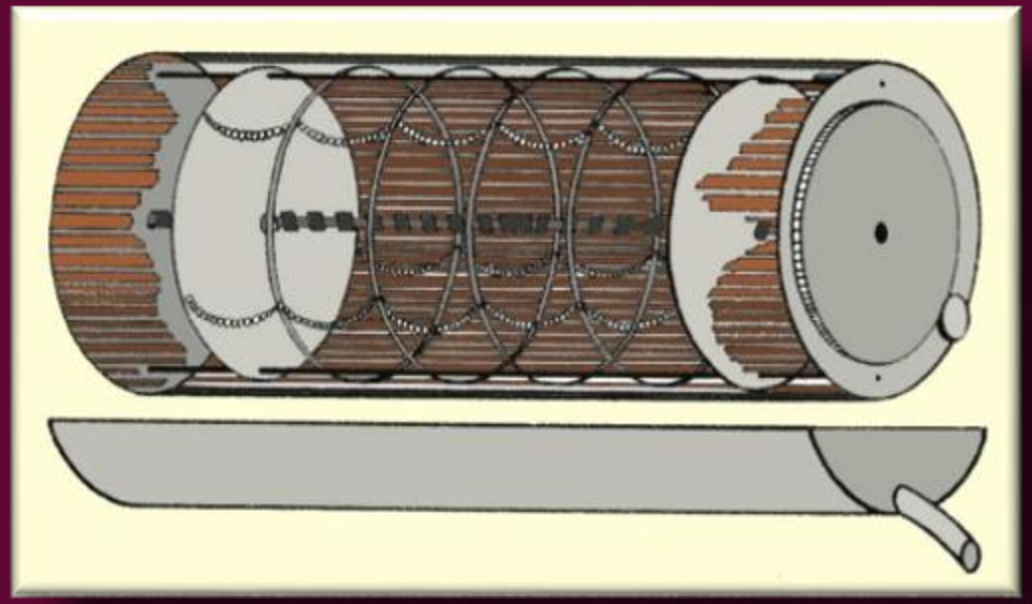
- The sugar content of dry wines is usually less than 2g/litre RS (residual sugar)
- German Trocken Riesling can be up to 9g/litre RS
- Botrytised sweet wines may achieve up to 500g/litre RS
- eg. 120g for Sauternes, 450g for Tokaji

CHAPTALISATION

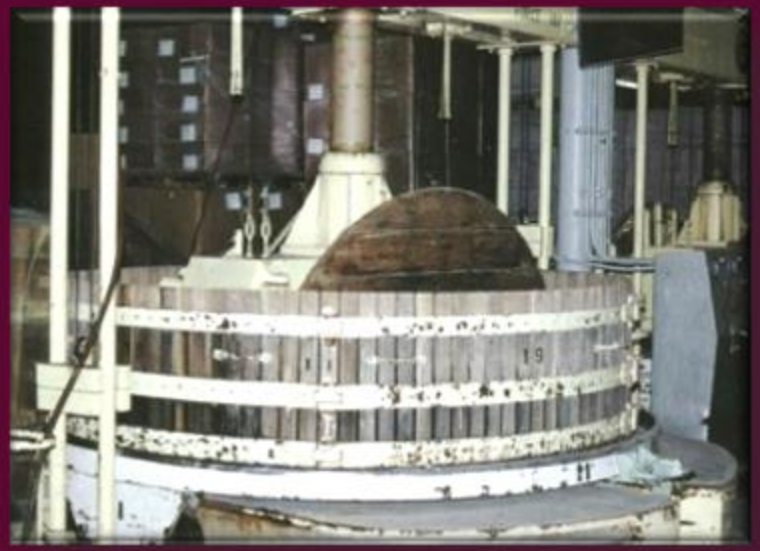
- Named after Jean Antoine Chaptal Napoleon's Minister of Agriculture
- Adding sugar to unfermented must to raise the potential alcohol level before fermentation
- Necessary when poor growing conditions result in low natural sugar levels
- Illegal in some countries e.g Italy, Australia, and the U.S.
- It takes 17 grams of sugar to raise 1 litre by 1 degree of alcohol

PRESSING

- **Red / Rosé wines**
- Traditional pressing done by crushing fruit and macerating must and skins together
- Colour extraction for red / rosé wines by punching down cap of grape skins or by pumping must over the floating cap of skins
- The must takes on colour from grape skins
- **White wines**
- Must is taken off skins to avoid colour



ROTARY SCREW PRESS
VASLIN



TRADITIONAL BASKET PRESS
COQUARD

PNEUMATIC PRESS
WILMES

CARBONIC MACERATION

A sealed vessel is filled with carbon dioxide and whole bunches are added

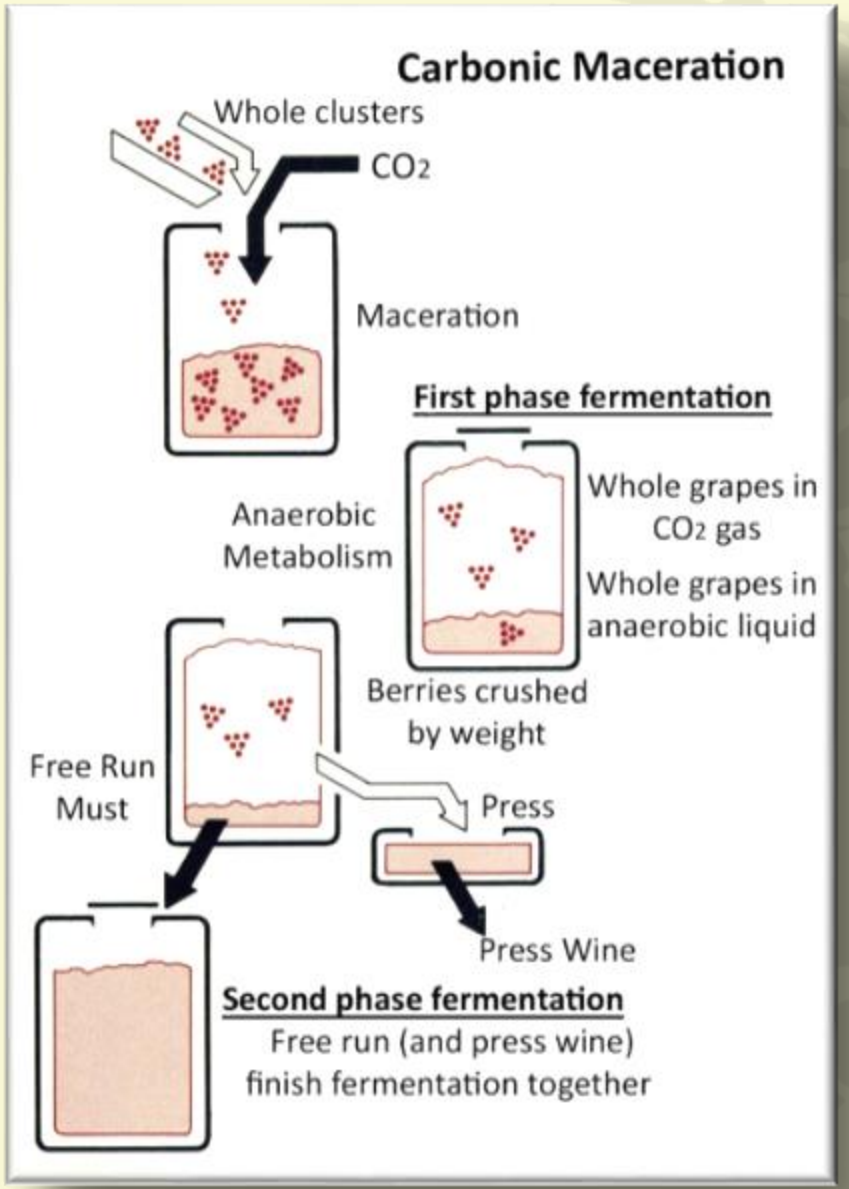
The oxygen-free environment causes the grapes to begin fermentation from the inside using the available CO2 to break down sugars and malic acid to produce alcohol and compounds that affect the flavour of the wine

Polyphenols (tannins and anthocyanins) make their way from the grapes' skin to the pulp, which turns to a pink colour

When the alcohol reaches 2%, the berries burst, releasing their juice

Resulting wine is run off the pulp/skins

Yeast will then continue the fermentation process



SEMI-CARBONIC MACERATION

Open topped vats are filled with grapes

Fruit at the bottom become crushed and juice comes into contact with the yeasts to start extra-cellular fermentation

The CO_2 produced pushes air out of the vat and promotes intracellular fermentation in the uncrushed bunches

The result is a wine made by both methods of fermentation

Wines have a short shelf life due to reduced tannins and polyphenols

FERMENTATION TANKS AT CHÂTEAU LATOUR

FERMENTATION

Fermentation is a biochemical process where yeast converts sugars in grape juice into alcohol and carbon dioxide

Sulphur Dioxide added to must before fermentation

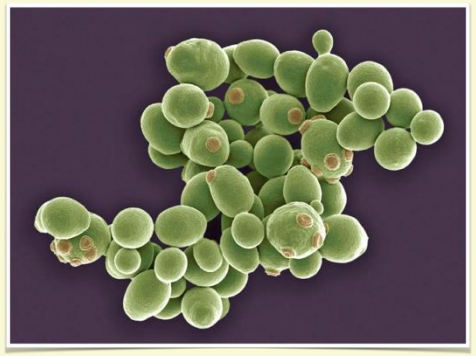
↓

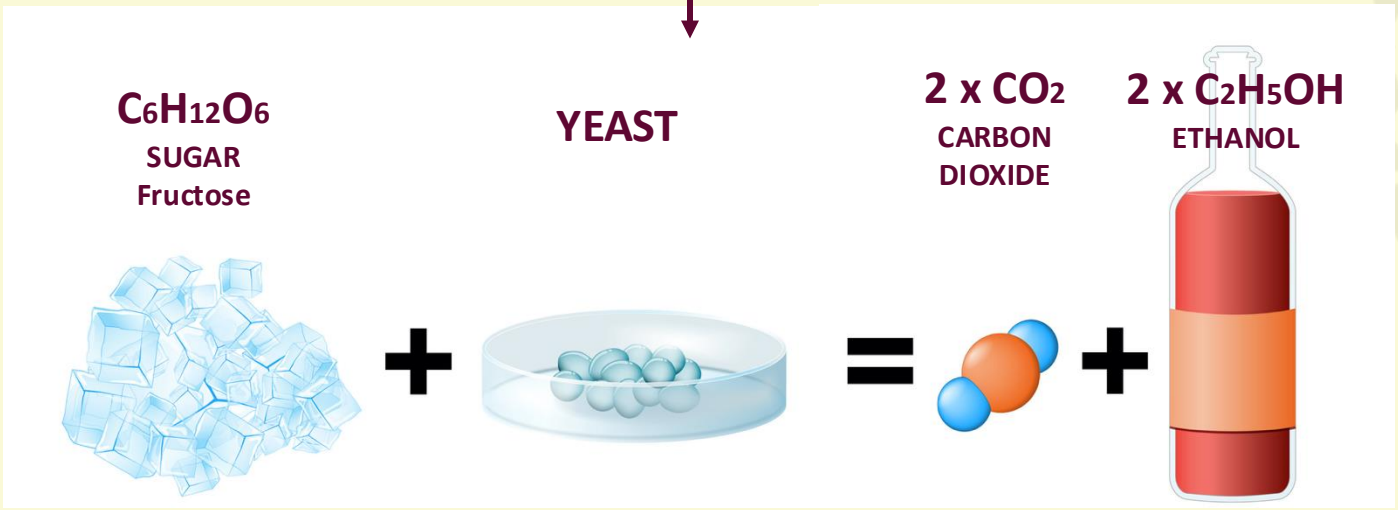
Wild yeast and Acetobacter are destroyed

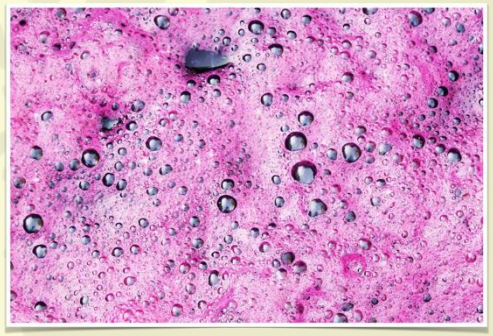
↓

Wine Yeasts control fermentation

↓

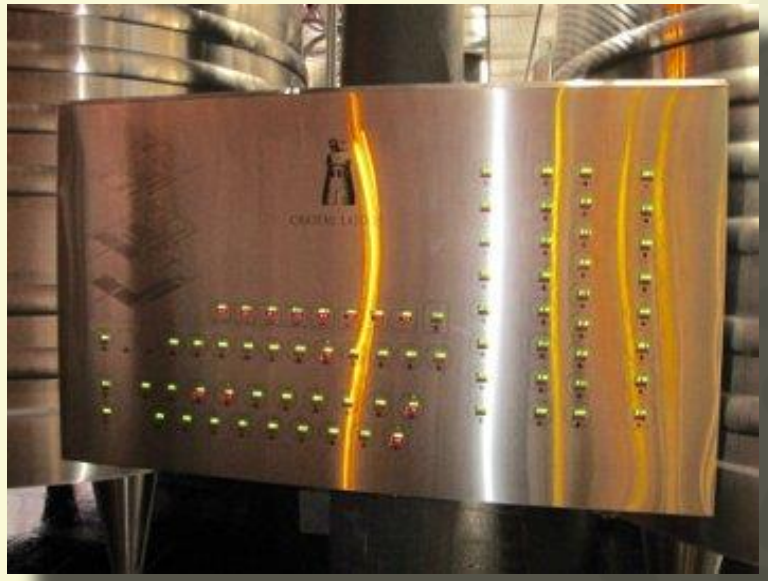






Wine yeasts continue fermentation until either all sugar is converted to alcohol, or alcohol level reaches 16% and kills wine yeasts

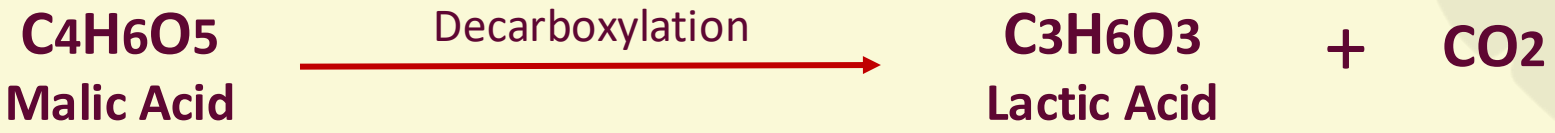
FERMENTATION TEMPERATURES



- Modern wineries use stainless steel or ceramic fermentation tanks to control fermentation temperatures
- In larger wineries computers are used to monitor fermentations allowing the winemaker to have much more precise control
- Fermentation occurs for Whites 12-22°c - Reds 20-32°c

MALOLACTIC FERMENTATION

- Not a fermentation but a bacterial process
- Sharp-tasting malic acids in a young wine are transformed into softer lactic acid by enzymes
- Malolactic will occur naturally in many wines
- Diacetyl, the buttery aroma and flavour is a natural by-product of Malo Lactic Fermentation
- Most white wines and almost all red wines go through MLF
- (winemaking decision regarding quality of the vintage and style of the wine)



BARREL FERMENTATION

- Traditional fermentation in oak casks
- Imparts vanilla flavours and adds richness to the texture of the wine

THE INFLUENCE OF OAK

- The size of the cask is critical to its influence on the wine, the smaller the cask the larger the oak to wine ratio
- A 200 litre barrique has one and a half times the internal surface area of oak for each litre of wine as a 500-litre cask
- The cost of new casks adds significantly to the cost of a wine
- Less expensive wines use oak chips, shavings or internal staves to increase the oak influence
- Comprehensive range of chips at different levels of ‘toast’
- If a label mentions oak, but not barriques it is likely to have had chips used in production
- Quercus Robur – Quercus Petrea – Quercus Alba

FRENCH FORESTS

1.	Jupilles/Bercé	5,400 ha
2.	Bellême	2,400 ha
3.	Blois	2,800 ha
4.	Limousin	568,000 ha
5.	Allier	122,000 ha
6.	Tronçais	10,500 ha
7.	Fountainebleau	17,000 ha
8.	Nevers	225,000 ha
9.	Bertranges	10,000 ha
10.	Ardennes	36,140 ha
11.	Chatillon	9,000 ha
12.	Cîteaux	13,284 ha
13.	Vosges	280,000 ha
14.	Jura	180,000 ha

*ha = generalized hectares of forest that includes other trees besides oak.

RACKING AND LEES AGEING

Siphoning the newly fermented wine off the lees

Done every few months to aerate and soften tannins

Sometimes wine is allowed to mature ‘sur lie’ to develop more complex flavours

Regular lees stirring in cask in known as Battonage

eg. Muscadet and Burgundy

FINING & FILTERING

Fining

The process of adding a substance to the wine to precipitate the solids out of solution

Most fining agents are Proteinaceous substances e.g. egg whites

All have molecules with the opposite electrostatic charge to the charge on the wine colloids

Bentonite is not a colloid but has negatively charged particles which attract positively charged protein molecules

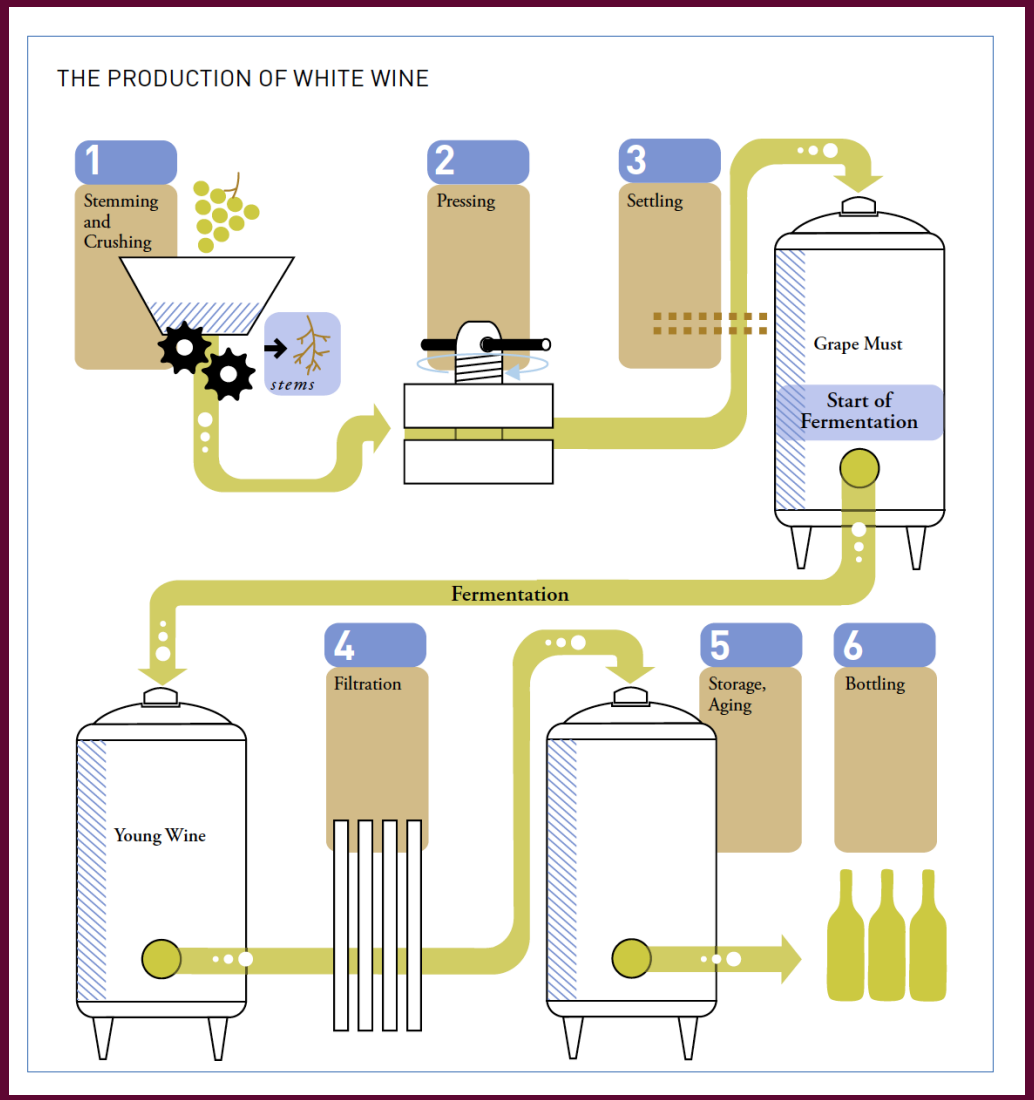
Filtering

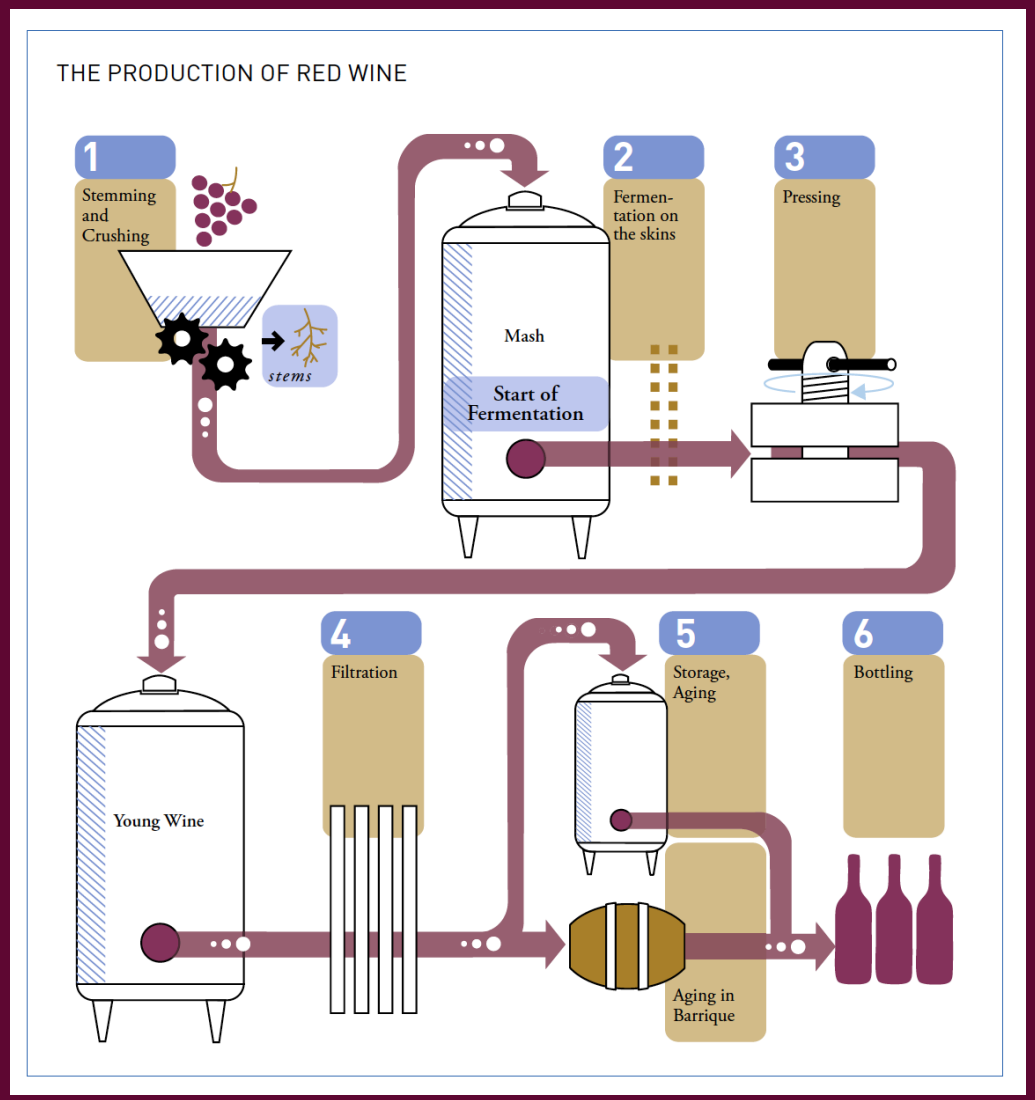
Through pad filter plates, used on cheaper wines

Cold stabilisation - chilling the wine to precipitate tartrate crystals then running through a plate filter

BLENDING WINES

- Wines of several sources may be blended to form the finished product
  - Grape varieties, vineyard plots or vintages
- The blender will sample all wines for suitability to blend with others


THE PRODUCTION OF WHITE WINE
1
Stemming and Crushing
stems
2
Pressing
3
Settling
Grape Must
Start of Fermentation
Fermentation
4
Filtration
5
Storage, Aging
6
Bottling
Young Wine


THE PRODUCTION OF RED WINE
1
Stemming and Crushing
stems
2
Fermen-tation on the skins
Mash
Start of Fermentation
3
Pressing
4
Filtration
5
Storage, Aging
Aging in Barrique
6
Bottling
Young Wine

TARTRATES

- Naturally formed crystallized tartaric acid
- Reform at very cold temperatures
- Present in all wine
- Often found in high acid wines such as Riesling
- Careful pouring or decanting at service

RHEINGAU RIESLING
TBA 10 YEARS OLD

NATURAL WINE (VIN MÉTHODE NATURE)

France: INAO official recognition established Vin méthode Nature as official labelling term for natural wines (2020)

Regulations include

- Must be made from certified organic grapes
- Hand harvesting of fruit
- Fermented with indigenous yeasts
- Contain no additives
- Techniques of wine making such as reverse osmosis, filtrations,
- flash pasteurization or thermovinification etc. are forbidden

Two categories

- **Sans sulfites ajoutés** - No added sulphites
- **<30mg/l de sulfites ajoutés** - Maximum of 30mg/ltr. of sulphites
- All bottles to show the appropriate official logo

FAULTS IN WINE

Cork Taint (Trichloranisole 2.4.6.)

- Reaction between natural penicillium mould in the crevices of the cork and chlorine containing chemicals used in sterilization, giving a musty smell and taste

Volatile acidity

- Excess acetic acid produced by oxidation of alcohol under the influence of acetobacter.
- Causes nail varnish remover smells (poor hygiene and infected barrels)

Oxidation

- Occurs when wine loses its natural anti-oxidants and is affected by oxygen from the atmosphere
- Wine loses colour and freshness

VITICULTURE / VINIFICATION TERMS

Batonnage	Stirring of the lees in cask to enhance the flavour of wine and prevent reductive flavours
Buttage	Protection of the stem / roots of vine from frost damage by piling soil around the base of the vine
Passerilage	Grapes which have been dried by allowing them to hang on the vine when the cane no longer provides nutrient or, drying after picking
Pigeage	Punching down the cap of grape skins which float on fermenting must to encourage colour extraction.
Collage	The addition of a clarification agent such as bentonite to attract sediment particles.
Mutage	The addition of alcohol to fermenting must, to slow or stop further fermentation and retain grape sugars
Débourbage	Allowing solids to settle out of must before fermentation
Remontage	Pumping the fermenting wine over the cap of skins to extract colour in red wine production
Soutirage	Racking. Separating the clear wine from lees


COURT OF MASTER
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