

CHAMPAGNE

FROM TERROIR TO WINE



VIGNERONS ET MAISONS



CHAMPAGNE : from terroir to wine

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GEOGRAPHICAL LOCATION

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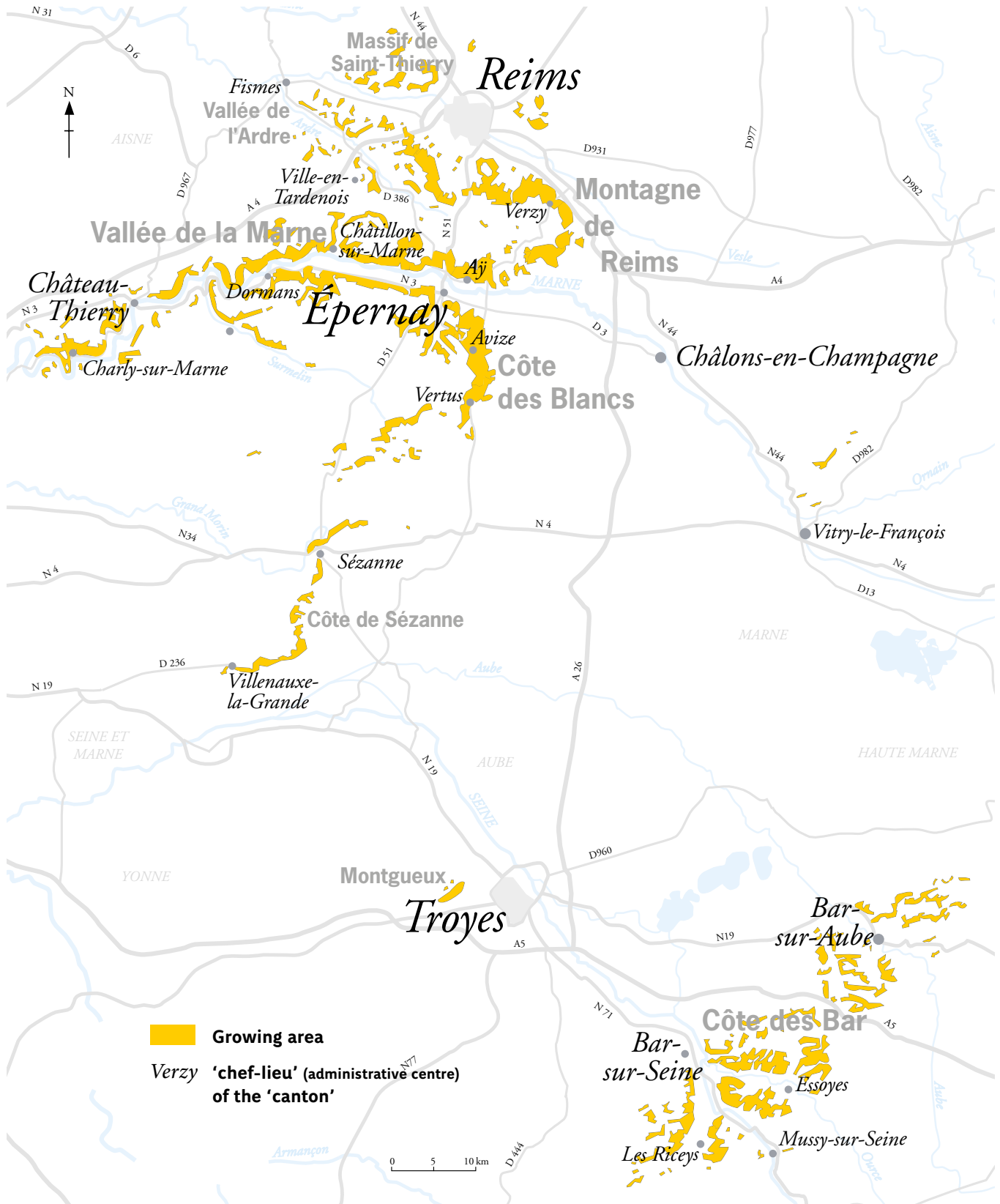
The Champagne production zone (AOC vineyard area) is defined and delimited by the law of 22nd of July 1927. It lies some 150 kilometres to the east of Paris, extending into the departments of the Marne (66% of plantings), Aube (23%), Aisne (10%), Haute-Marne and Seine-et-Marne. The zone stands at roughly 34,000 hectares of vineyards, spread across 320 villages ('crus') of which 17 traditionally rank as 'Grands Crus' and 42 as 'Premiers Crus'.

There are four main growing regions: the Montagne de Reims, Vallée de la Marne, Côte des Blancs and Côte des Bar. Together these encompass 278,000 individual vineyard plots, each with an average size of around 18 'ares' (1,800 square metres).

Behind this mosaic of micro-vineyards lies a unique combination of natural factors. Climate, soil and topography have produced a region with almost as many geographical permutations as there are acres of vineyard. Making the most of that diversity is Champagne's 15,000-strong team of well-practised winegrowers.



THE CHAMPAGNE WINE-GROWING REGION



The vineyards in Champagne are planted at altitudes of 90-300 metres, on predominantly south, east and southeast-facing slopes. Average gradient is around 12%, rising to nearly 60% in some areas.

Champagne's undulating to moderately steep terrain creates ideal vineyard sites that combine good drainage with optimum exposure to sunlight.

CLIMATE

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Villedommange in winter



The Champagne region lies at the northernmost limit of vine cultivation (latitudes 49°5 and 48° North for Reims and Bar-sur-Seine respectively). It is distinguished by a dual climate that is subject to both continental and oceanic influences.

Continental influences bring often-devastating winter frosts but also provide high levels of sunshine in the summer.

Oceanic influences keep temperatures on the low side but also ensure steady rainfall, with no major fluctuations in temperature from year to year.



Springtime in Boursault



Around Chouilly and Cramant in summer



Average annual temperature is just 11°C. The mean number of sunshine hours per year is 1,680, rising to 2,100 hours or more in certain years (1976 and 2003, for instance).

This combination of weather influences makes for constant, moderate precipitation – a near-ideal pattern of rainfall that provides the vines with just enough water to produce quality fruit. Mean annual rainfall for the Champagne region as a whole is close to 700mm, ranging from 600mm to 900mm depending on the area.

Summer and winter alike, the vineyards are at the mercy of variable weather. Winter frosts (on average 1.1 day a year of temperatures below -10°C, up to 3 days in some places) can be severe enough to kill the vines. Likewise, spring frosts can destroy nascent leaves and buds, dramatically reducing yield potential (48% loss in 2003). June may bring cold, wet weather that interferes with flowering and fruit set, increasing the incidence of 'coulure' (bud or berry drop) and 'millerandage' (stunted berries). Summer frequently sees violent thunderstorms that leave the vineyards riven with gullies. Hailstorms are another frequent menace, seriously damaging vines and grape clusters alike (in 2000, 31 separate bouts of hail wiped out yields across a 3,000-hectare area).



Hautvillers in autumn

SOIL AND SUBSOIL

Chalky subsoil

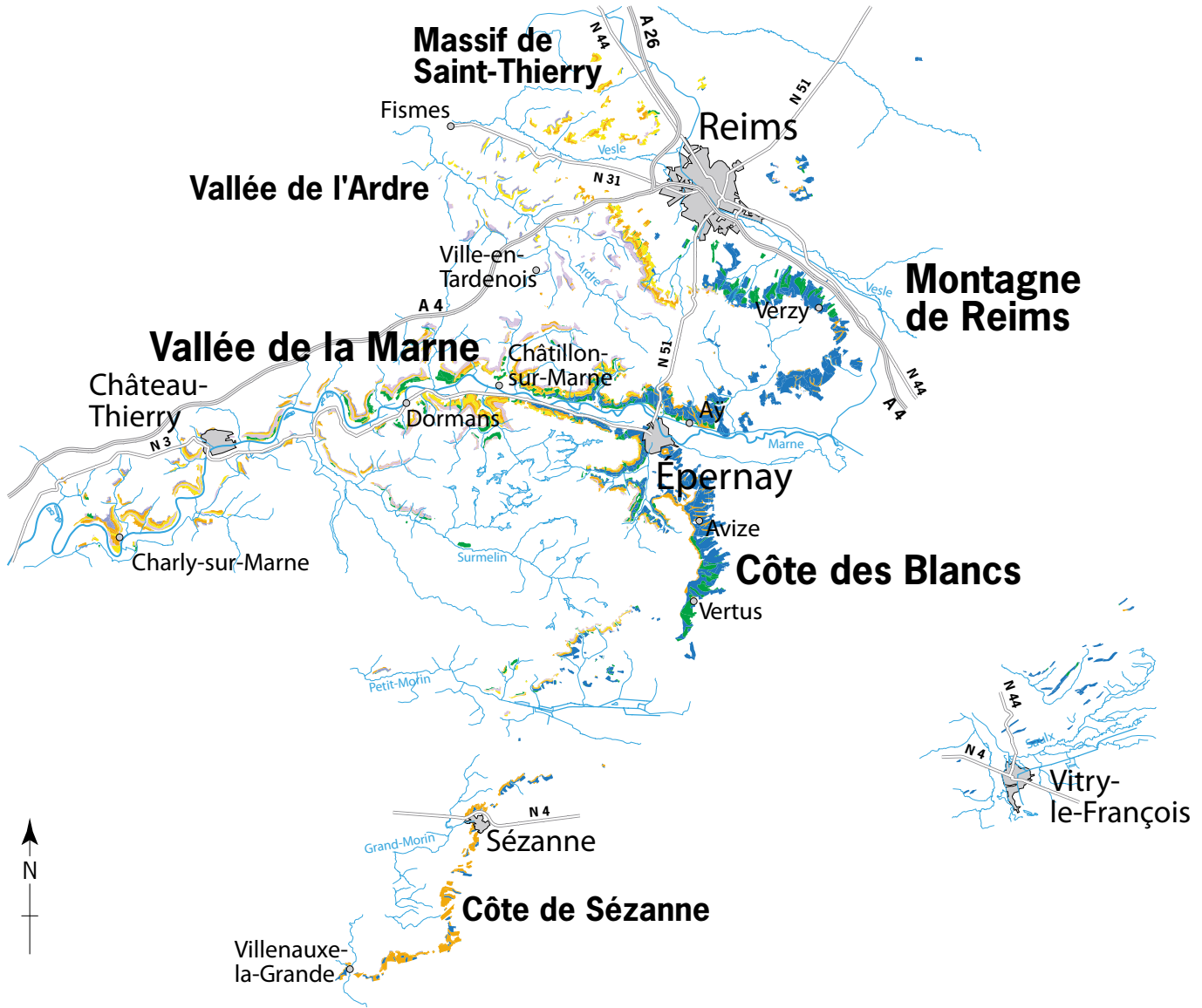
The subsoil in Champagne is predominantly limestone. Outcropping sediments are likewise composed of 75% limestone (chalk, marl and limestone proper). This type of terrain provides good drainage and also explains why certain Champagne wines have a distinctly mineral taste.

Champagne's extensive chalk deposits show as outcrops in the vineyard areas of the Côte des Blancs, Côte de Sézanne and Vitry-le-François, but are buried deep underground on the Montagne de Reims. Elsewhere, chalky soils give way to a greater proportion of marls, clays and sands, in the Vallée de la Marne (to the west of Châtillon-sur-Marne) and in the hills surrounding Reims (Saint-Thierry, Vallée de l'Ardre and Montagne ouest). Marls essentially take over in the Côte des Bar vineyards (Bar-sur-Aube and Bar-sur-Seine).

The chalk in Champagne consists of calcite granules that are formed from the skeletal plates of coccolithopores (marine phytoplankton), and is characterized by the presence of belemnite fossils (marine invertebrates of the Mesozoic era). Being highly porous, chalk acts as a natural reservoir (holding 300 to 400 litres of water per m³), providing the vines with just enough water even in the driest summers.

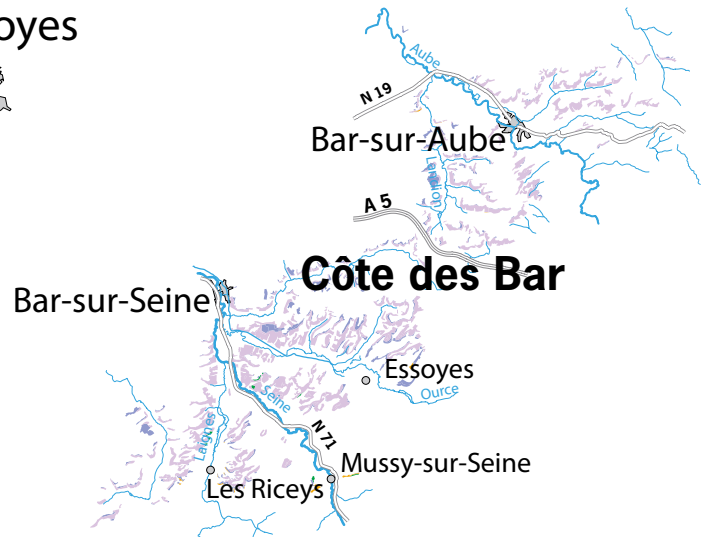
Chalk draws in water through capillary action. The effort required to tap into this water supply puts the vines under just enough water stress in the growing season to achieve that delicate balance of ripeness, acidity and berry aroma potential.

Lithological formations of the Champagne vineyard



Rock types

-  Chalk
-  Hard and soft limestone, calcareous sands
-  Marls (calcareous clays)
-  Clays and argillaceous alluvium
-  Siliceous sand
-  Slope wash (composite rock)



GRAPES

Montigny-sous-Châtillon vineyard

It is the special nature of the Champagne terroir that determines the choice of plantings. Black Pinot noir and Meunier, and white Chardonnay now account for all but a fraction of the area under vine. Other approved varieties are the white Arbanne, Petit Meslier, Pinot blanc and Pinot gris – together less than 0.3% of plantings.

These small exceptions apart, the Pinot noir accounts for 38% of Champagne's surface area, followed by the Meunier (32%) and the Chardonnay (30%).



The Pinot noir performs best in cool limestone terrain and largely predominates in the Montagne de Reims and the Côte des Bar. It is the Pinot noir that adds backbone and body to the blend, producing wines with telltale aromas of red berries and plenty of character.

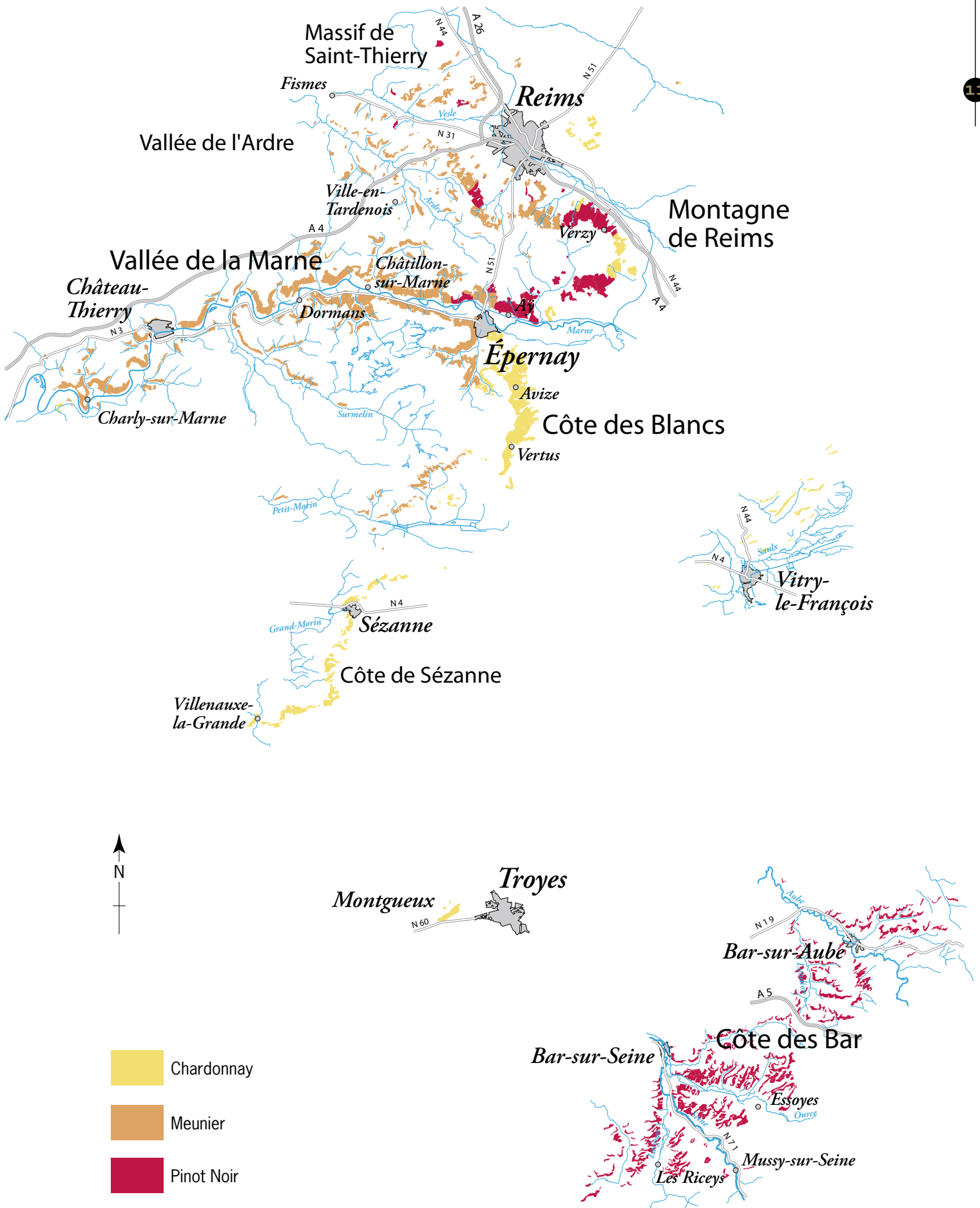


The Meunier is more robust and less prone to frost damage because it buds later. It is particularly well suited to the more clayey soils of the Vallée de la Marne and will tolerate the most adverse weather conditions. The Meunier adds roundness to the blend, producing supple, fruity wines that tend to age more rapidly than their Pinot noir counterparts.



The Chardonnay is king in the Côte des Blancs, yielding delicately fragrant wines with characteristic notes of flowers, citrus and sometimes minerals. The Chardonnay is the ideal blend companion for wines that are built to age.

Main grape varieties by Champagne commune



MASS SELECTION AND CLONAL SELECTION

These two methods provide Champagne wine-growers with the best available vines in terms of superior fruit (mass-selected vines) and disease-resistance (clonally selected vines).

Ever since the phylloxera epidemic (late 19th to early 20th Century), vine stocks have been obtained from grafting together French and American vines. Vine selection depends on the terroir in question, but the favourite planting in Champagne today is the 41B (81% of plantings). Highly adaptable, the 41B will grow just about anywhere and particularly favours clayey soils. The SO4 prefers moderately limestone soils while the 3309C does best in soils containing very little limestone.

Decades of research into vine selection give today's Champagne winegrowers the choice of some 50 or so clones of the three approved AOC varietals. Pre-multiplication is carried out by the Comité interprofessionnel du vin de Champagne (CIVC), the industry trade association also responsible for the distribution of approved scions.



Omega-shaped grafting



Protection of a young rooted vine

PLANTING



Nursery

The grubbing-up and replanting of vines (or the planting of new plots) must be notified to the authorities. Planting must take place before the end of May (or late July for plants in pots), following a period when the soil is rested and prepared. Champagne AOC wines may only be produced from the fruit of vines in their third year of growth (two years after planting).

Regulations specify a maximum inter-row spacing of 1.5 metres and an intra-row spacing of 0.90-1.5 metres, total spacing being never more than 2.5 metres. This produces an average planting density of roughly 8,000 plants per hectare, aiming to optimize fruit quality through high-density planting. The more the vines have to compete with neighbouring plants for water and nutrients, the smaller and better the crop load per vine. Another advantage of high planting density is that it favours the development of an optimal Leaf Area Index (LAI), so promoting photosynthesis.

New plantings are subject to strict EU regulations, in accordance with fixed annual quotas for all wine-producing member countries. New planting rights are then distributed among the different wine-growing regions by the French Minister for Agriculture. The annual rights allocation for the Champagne region does not exceed 1% of the total area under vine.



Planting: setting up of the vine stakes

SUSTAINABLE VITICULTURE

Cover crop

The environmental impact of the Champagne industry was assessed in a study conducted in the early 2000s. Based on those findings, there are four major issues for action:

REDUCTION OF ADDITIVES, AND THE CONTROL OF RISKS TO HEALTH AND THE ENVIRONMENT.

For more than twenty years now, the industry has been investing huge sums in research and development in this field.

The quantities of pesticides used have been significantly reduced for the past 15 years and almost 50% of all the products now used in Champagne are approved for organic use. With 12,000 hectares protected, Champagne is among Europe's leaders in the development of sexual confusion techniques – a natural alternative to chemical insecticides that can virtually eliminate pesticide use.

THE PRESERVATION AND ENHANCEMENT OF TERROIR, BIO-DIVERSITY AND LANDSCAPES.

Vineyard soils

Protecting the soil against all forms of deterioration is a long-standing preoccupation in Champagne, with particular attention to the physical, chemical and biological properties of soil. Several initiatives have been taken by the industry to protect and add value to its heritage. Examples include: the management of groundwater resources on slopes; the promotion of the 'reasoned' feeding of soil and vine; the development of decision-making tools; the drawing-up of guidance maps; and the increased use of cover cropping in and around vineyards.

Data collected over the past 20 years (monitoring of earthworm populations and micro-flora) indicate that Champagne soils today enjoy an excellent level of biological activity.



Bio-diversity and landscapes

The region is home to numerous areas of special ecological interest, where bio-diversity is maintained by the conservation of natural habitats.

The overall focus here is to improve the ecological infrastructure of the vineyard (cover cropping between vines and across slopes, and the establishment of hedgerows); also slope management, with an eye to solutions that fit harmoniously within the landscape.

THE ACCOUNTABLE MANAGEMENT OF WATER, EFFLUENT, BY-PRODUCTS AND WASTE

Water management

Champagne producers use various methods to reduce their consumption of water. These include: the eco-design or eco-refurbishment of buildings; improved systems of cleaning, recycling and/or collection; and reducing water wastage wherever possible. Water conservation remains a priority, meanwhile maintaining high standards of hygiene in pressing centres, cuveries (units housing the fermenting vats) and other work premises.

Management of effluent

Cellar hygiene relies on frequent cleaning, which in turn generates effluent-borne organic matter.

Today, 98 per cent of effluents and liquid by-products are treated or processed for recycling. The target is to reach 100 per cent in the very near future.

Waste and by-products

All of the waste and by-products of Champagne wine and grape production are processed for recycling.

The 'marc' (or pommace) is delivered to authorised distilleries where it is broken down by separation and extraction. A wide range of compounds are recovered for recycling: ethanol for industrial use and motor fuel; grape-seed oil; polyphenols, anti-oxidants and natural colour pigments; tartaric acid with potential application in processed foods, cosmetics and human health products.

Activities linked to Champagne production also generate around 10,000 tonnes per year of industrial-type waste: metals, wood, glass and packaging materials including plastic, paper and board.

Today, more than 90 per cent of this waste is sorted and processed for recycling, aiming for 100 per cent recovery in the medium term.

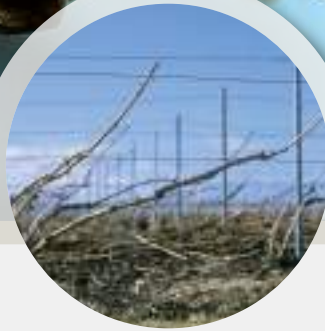
THE ENERGY AND CLIMATE CHALLENGE

This is probably the biggest challenge facing mankind in the years and decades to come – and one addressed by the Champagne region long before the passing of legislation. In early 2003 the carbon footprint of the industry was assessed as a whole, launching an action plan soon afterwards to demonstrate the solidarity with future generations.

That plan today encompasses five main focus areas, 15 research and development programmes and more than 50 individual projects either underway or in the pipeline. The main fields of action are: buildings/installations; viticultural and oenological practices; freight transport and business travel (which relates to the responsible procurement of goods and services from sources as close as possible to the industry's centres of supply). These efforts are starting to bear fruit as the carbon footprint of the Champagne industry was reduced by 15% between 2003 and 2010.

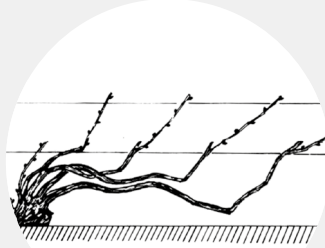
PRUNING

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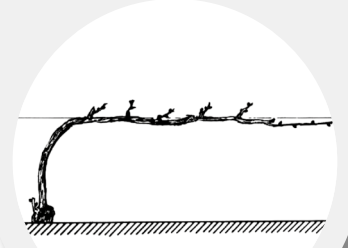
Chablis training, before pruning

Chablis-pruned and tied-up vine



Cordon training, before pruning

Cordon-pruned and tied-up vine

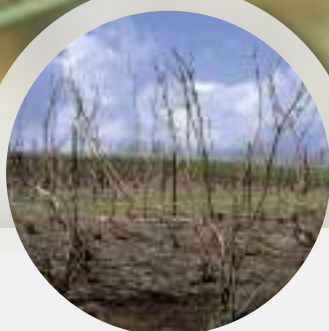
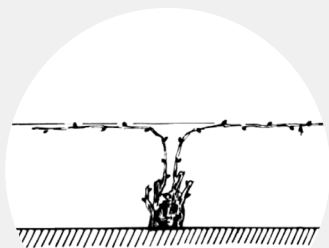


Pruning commences in the month following the harvest, as soon as the leaves start to fall, and continues until mid-December. It resumes in mid-January, after the winter dormant period, continuing until late March or such time as the vine reaches the four-leaf stage (when all pruning must cease). Pruning encourages the sap to flow towards the fruit-bearing buds, favouring a good balance of vigour and productivity. Pruning gives the vine its shape, avoiding tightly packed foliage so as to encourage photosynthesis and create space for air to circulate between the clusters. Pruning also regulates vine development, rejuvenating 'leggy' plants by hard pruning at regular intervals.



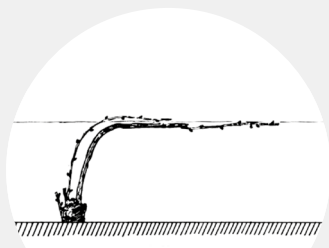
Guyot training, before pruning

Double-Guyot-pruned and tied-up vine



Vallée de la Marne training, before pruning

Vallée de la Marne-pruned and tied-up vine



Double-Guyot pruning

Pruning is the most fundamental of all the vineyard tasks. It is a purely manual activity which requires a specific training and a distinctive diploma. In Champagne, it has been regulated since 1938.

There are four approved pruning methods in Champagne:

- **Chablis pruning:** long pruning on long canes.
- **Cordon and Cordon Permanent pruning:** short - or spur - pruning, on a single unilateral long cane.
- **Guyot pruning:** long pruning on short canes which may be single, double or asymmetric.

- **Vallée de la Marne pruning (exclusively reserved for Meunier vines):** long pruning on short canes.

Whatever the method of pruning, the average maximum number of fruiting buds per vine must not exceed 18 per square metre of vineyard.

As pruning draws to a close in late March/early April, the next task - also manual - is to tie-up the vines before the onset of flowering. The shoots are attached to the supporting wires, so avoiding unruly growth and preparing the vines for summer maintenance.

SUMMER MAINTENANCE

Budburst marks the start of seasonal growth and with it a series of tasks aimed at limiting yields and promoting good-quality fruit.

Desuckering usually takes place in mid-May and refers to the manual removal of non-fruitful shoots, encouraging the vine to focus its energies on the fruit-bearing shoots

At the pre-bunch closure stage when the shoots are 50 centimetres long, they must be lifted and attached to wires running some 30 centimetres above the support wires. Known as **lifting**, this operation is still done by hand but could become mechanized as vineyards opt to install vine spacers.

The next task, also manual, is **trellising**: separating the shoots and stapling them to wires. This improves leaf distribution, allowing maximum light



Desuckering



Trellising



A vine before pinching back

penetration and also encouraging air circulation that prevents rot. Trellising is essential for Champagne vines since high-density planting significantly increases the leaf area index. The dense leaf canopy must be evenly distributed between the vines, and along the full length and height of each plant (maximum standing height, 1.30 metres).

The shoots continue to grow throughout the summer, right up to harvest time, and must be regularly pinched back, either by hand or machine, to prevent the vine from producing foliage at the expense of fruit.

**LIST OF MAIN VINEYARD TASKS (KNOWN LOCALLY AS 'ROIES')
IN HOURS PER HECTARE**

	Chablis pruned vines	Cordon de Royat pruned vines
Total pruning	210	170
Tying up	90	60
Desuckering	40	40
Trellising	70	80
Pinching-back	110	120



Pinching back

HARVESTING



The year 1956 saw the launch of a ripening observation network that monitors crop conditions for the accurate timing of harvests. Twice a week, just as the grapes start to change colour ('véraison'), samples are taken from some 450 control plots spread throughout the Champagne area. The selected clusters are then checked for rate of colour change; average weight; estimated sugar and total acidity content; and incidence of botrytis.

These findings indicate the degree of grape ripeness by variety and by cru, and the CIVC sets picking dates accordingly. The findings also serve to determine the quantity of grapes per hectare that will be approved for AOC production (as per INAO regulations); and the minimum required alcohol content by volume.

In good years, part of the crop may be set aside as a precaution against future crop failure (due to frost, hail, etc) or a disappointing vintage. Managing these reserve stocks (known as the 'réserve individuelle') is the responsibility of the CIVC.

Harvesting is entirely manual, but may be preceded by mechanical thinning to make life easier for the pickers. AOC regulations specify whole cluster pressing, effectively ruling out the use of mechanical grape harvesters as we know them



A porter of picking baskets

today. Every year for about three weeks, around 100,000 pickers, porters, loaders and press operators descend on the vineyards of Champagne for the harvest – the moment every winegrower has been waiting for.

The newly picked grapes are transferred to perforated bins with a maximum capacity of 50 kilos. Drainages holes on the sides and bottom of the bins keep air circulating around the grapes and drain off any juice lost in the course of handling. Some 1,900 pressing centres, distributed across the AOC region, keep transit times to a minimum.



A 50 kilo bin



The grapes on the way to the press

PRESSING

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Pressing centres are very strictly regulated, in line with more than 20 approval criteria that were introduced in 1987. These cover pressing and racking capacity; daily press loads; type of press used; pressing and sulphuring; and hygiene standards.

On arrival at the pressing centre, each delivery of grapes is weighed and recorded. Every 4,000 kg 'marc' (traditional unit of measurement for a press-load of grapes) is numbered and recorded in the 'carnet de pressoir' (pressing logbook), noting details of grape variety, 'cru' and destination (whether retained by the winegrower or sold to a Champagne House). The grapes are also tested for compliance with the minimum alcohol content by volume that is specified for the vintage in question.

The production of white wine from predominantly black-skinned grapes (two-thirds of the harvest) depends on five basic principles: pressing immediately after picking; whole cluster pressing; a gentle, gradual increase in pressure; low juice extraction; and fractionation (the clearer, purer juices that are drawn off at the beginning of pressing are separated from those produced at the end).

Juice extraction is strictly limited to 25.5 hectolitres per 4,000kg marc, separating the first pressing juice (the *cuvée*, representing 20.5hl) from the second (the *taille*, representing 5hl). Each has quite specific characteristics. The *cuvée* is the purest juice of the pulp – rich in sugar and acids (tartaric and malic). *Cuvée* musts produce wines with great finesse, subtle aromas, a refreshing palate and good aging potential. The *taille* is also rich in sugar, but acid content is lower while mineral content (especially potassium salts) is higher, along with



Press handlers at work

colouring agents. Taille musts produce intensely aromatic wines – fruitier in youth than those made from the cuvée but less age-worthy.

Champagne presses range in capacity from 2,000 to 12,000 kilos of whole grapes. Manually operated, vertical basket presses were standard throughout the region until the late 1980s, and still account for some 28% of plant. The introduction of mechanical methods of 'retousse' (the breaking-up of the press cake between cycles) then led to the increasing use of horizontal presses with a lateral membrane, angled pressing plates and a rotating press pan. Horizontal presses these days are computer-controlled, with a multi-function operating system.

If rosé Champagne is made via maceration, destemmed black-skinned grapes are left to macerate in a tank until the desired colour is achieved (24-72hours).

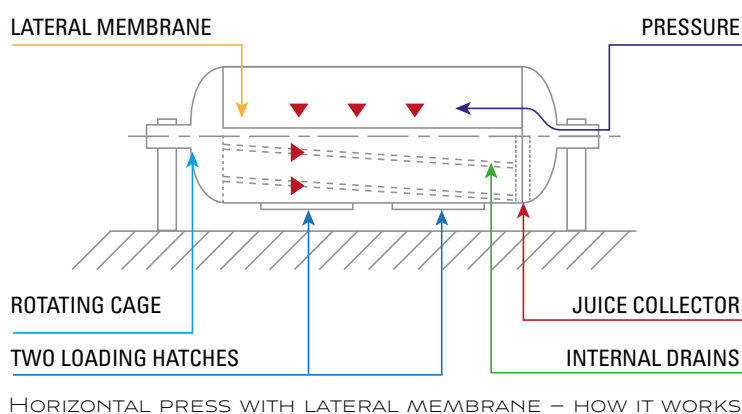
Bin washing is compulsory after each separate press load. As part of their commitment to sustainable viticulture, the authorities in Champagne specify methods for the proper management of pressing waste products. Solid residues left over after pressing (the 'aignes') are sent for distillation, and winery wastewater is recycled and treated so as to avoid any risk of environmental pollution.



A chardonnay berry

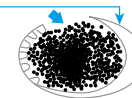


A pinot noir berry



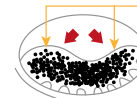
Vertical loading

ROTATING CAGE



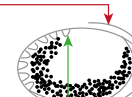
Pressing stage

LATERAL MEMBRANE

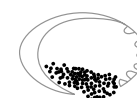


Breaking up of the marc (retousse)

HATCH



unloading



INTERNAL DRAINS

CLARIFICATION (DEBOURBAGE)



Sulphuring

As the juice is extracted, it flows into open tanks (known locally as 'belons') where it is treated with sulphites (sulphur dioxide or SO₂) at the rate of 6-10g/hl depending on the varietal, the condition of the grapes and the musts in question (whether cuvée or taille).

Sulphites are used as a preservative. Their antiseptic properties help to inhibit the growth of moulds and unfriendly indigenous bacteria. Their antioxidant action safeguards the physicochemical and sensory quality of wines.

Clarification (débouillage)

Débouillage is the settling of the freshly pressed grape juice prior to fermentation, so as to produce wines with the purest expression of fruit.

In the first hours, this produces a cloudiness due to enzymes that are either naturally present in the juice or added. The flocculated matter forms a sediment at the bottom of the vat along with other particles suspended in the juice (particles of grape skin, seeds, etc). After 12-24 hours, the clear juice is drawn off and clarified by fining. The sediments or 'bourbes' (1-4 per cent of the volume) are recorded and sent to the distillery.

The clarified musts are transferred to the 'cuvier' (the room containing the fermenting vats) to commence the first stages of fermentation.

ALCOHOLIC FERMENTATION

A fermentation cellar

Alcoholic fermentation

A few producers still ferment their wines in oak (casks, tuns, etc) but most prefer thermostatically controlled stainless-steel vats. Capacity ranges from 25 to several 100 hectolitres and the content of each vat is carefully labelled by cru, pressing fraction, varietal and vintage.

Chaptalisation - the addition of sugar to the fermenting must - is used as necessary to have a wine with a maximum alcohol level of 11% after the fermentation.

Selected yeasts (*saccharomyces cerevisiae*) are also added, either in liquid form or as a dried active yeast, to facilitate the control of fermentation. They work by consuming most of the sugar in the grapes, excreting carbon dioxide and alcohol in the process. They also release a large number of molecules (superior alcohols and esters) that have a major effect on the aromas and flavours in the wine. The process is highly complex, usually lasting about a fortnight and causing an exothermic reaction that must be carefully controlled. Temperatures higher than 18-20°C increase the risk of flavour evaporation and may cause the fermentation to 'stick' (grind to a halt).

Progress is monitored on a daily basis, checking the temperature and overall condition of the fermentation.



Casks in a Champagne cellar

MALOLACTIC FERMENTATION (MLF) CLARIFICATION

Malolactic fermentation (MLF)

After primary fermentation may come malolactic fermentation (MLF), in which malic acid is broken down into lactic acid by *Oenococcus oeni* bacteria. MLF also generates by-products that modify the organoleptic profile of the wine, mainly by lowering its apparent acidity. Champagne winemakers are generally in favour of MLF, with the exception of a few producers who prefer to avoid it altogether. Some take a pragmatic view, considering it necessary for some wines but not for others.

The MLF process is kick-started by storing the wines at a constant temperature of around 18°C, and inoculating them with selected strains of lyophilized bacteria. Acid content is continuously monitored to assess the rate of fermentation, which is usually complete within 4-6 weeks. The wines are then drawn off and clarified.

Clarification

Clarification includes fining, filtering (using kieselguhr clay, filter-pads, plates, membranes or cartridges) and centrifuging. This eliminates the lees and other impurities, producing clear, natural base wines (known locally as 'vins clairs') that are ready for blending into a 'cuvée' (local term for a blended Champagne). Base wines are classified by varietal, vintage, vineyard (or sometimes the individual vineyard plot) and pressing fraction (whether 'cuvée' or 'taille').



BLENDING

A 'vins clairs' tasting

Assemblage is the art of blending wines from different grapes, vineyards and vintages, so as to produce a wine that is greater than the sum of its parts. The aim of the cellar master or winegrower who orchestrates the blend is a unique Champagne that, vintage after vintage, expresses and perpetuates the particular vision and style of each individual producer.

Blends may combine wines from a whole range of vineyards, bringing together different vintages and different varieties – a highly creative exercise that relies entirely on the winemaker's sensory memory and experience of terroir and tasting. The real challenge is to predict the development of a wine over time, bearing in mind the decisive influence of second fermentation and maturation on lees following blending.

The winemaker must first decide what type of wine to create, whether a non-vintage wine (using reserve wines); a vintage wine that captures the unique style of an exceptional year; blended rosé (containing a proportion of red still wine from Champagne); blanc de blancs (made only from white-skinned grapes); blanc de noirs (made only from black-skinned grapes); or single-vineyard Champagne (from a single village).

Once blending is complete, the wine must be stabilized in preparation for bottling (particularly important for sparkling wines). This is done by chilling, which may be prolonged (-4°C for a week), short (meanwhile stirring the wines and inducing crystallization) or continuous. The aim of stabilisation is to induce crystallisation of tartaric salts then eliminate them, so preventing crystal formation in the bottled wine. Stabilisation is followed by renewed clarification.



BOTTLING

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Bottle fermentation transforms still wine to sparkling wine – hence the name ‘prise de mousse’, literally ‘capturing the sparkle’.


The winemaker kick-starts the effervescence by adding a sweet solution known as the ‘liqueur de tirage’ – a mixture of still wine from Champagne with cane or beet sugar (20-24 grams/litre, for a rise in pressure by the end of fermentation of up to six bars), plus selected, acclimatized yeast cultures and additives that assist the ‘remuage’ process (riddling). These consist of bentonite or bentonite-alginate that make the sediment heavier, encouraging it to slide down to the neck of the bottle, near the cork.

From half-bottle to jeroboam, the rules of the Champagne appellation forbid the transferring of the newly effervescent wine from one bottle to another. All Champagne wines must be sold in the bottle in which they underwent their



The different bottle sizes, from ‘quart’ to ‘Nabuchodonosor’ (15 litres)

AND SECOND FERMENTATION

A close-up photograph of three green glass bottles positioned on a traditional bottling machine. The bottles are partially filled with a dark liquid, and their necks are being processed by the machine's components. The background is a textured, metallic surface.

Traditional bottling machine

second fermentation. The bottles used must be made of strong glass, in accordance with strict specifications relating to pressure resistance and general durability. They must be capable of withstanding high pressure and repeated handling.

Once filled, the bottles are hermetically sealed with a polyethylene stopper known as a 'bidule', which is held in place by a crown cap. A few producers still use cork for the 'tirage' (bottling) stopper. The bottles are then transferred to the cellar and stacked 'sur lattes': horizontally, row upon row, usually in steel cages.

Inside the bottle, the wine undergoes a second fermentation that continues for 6-8 weeks. The yeasts consume the sugar, transforming it to alcohol and carbon dioxide, releasing esters and other superior alcohols that contribute to the wine's sensory profile.



Bottles stacked 'sur lattes'

MATURATION ON LEES



Chalk pit cellar (crayère)

Deep inside the cellar, protected from the light and kept at a constant temperature of around 12°C, the bottles embark on a long period of maturation – an all-important process of aging that is a major feature of Champagne winemaking.

According to the rules of the Champagne appellation, wines may not be bottled until the 1st of January following the harvest. They must then spend a minimum of 15 months maturing in the producer's cellars, of which 12 months is maturation on lees. Vintage cuvées are matured for at least three years. In practice, most Champagne wines are cellared for considerably longer than this.

The lees mainly consist of yeasts that have multiplied in the bottle and formed a deposit. By the end of second fermentation, all the sugars have been consumed and the yeasts gradually die and decompose. The process is known as autolysis, releasing molecules that are slowly transformed as they interact with those in the wine.



Bottles stacked 'sur lattes'



The special tirage stopper meanwhile allows minute quantities of oxygen to enter the bottle and small amounts of carbon dioxide to escape - in other words, the seal is not perfectly airtight. The choice of stopper is critical in determining the speed of the Champagne's development.

These two processes - autolysis and slow oxidation through the stopper - occur simultaneously in the course of maturation on lees. Together they encourage the development of tertiary aromas, slowly transforming the floral, fruity notes of young Champagne wines into the riper, jammier, nuttier aromas that are typical of more mature wines. Very old wines have a distinctively toasty bouquet, with a characteristic whiff of damp forest floor.

RIDDLING

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Towards the end of their long resting period, the bottles must be moved and rotated to loosen the deposit left by the second fermentation and persuade it to collect in the neck of the bottle, near the stopper. This process known as 'remuage' causes the sediment to slide downwards in preparation for disgorgement (the ejecting of the sediment under pressure).

For that to happen, the bottles are progressively tilted neck-down ('sur pointe') and rotated by small increments, clockwise and anti-clockwise. As the angle of tilt increases, the forces of gravity drive the sediment into the neck.

Remuage is still done manually in some cases. A professional 'remueur' (bottle turner) can handle roughly 40,000 bottles a day, placing the bottles neck down in a wooden 'pupitre' (A-frame-shaped riddling rack). Automated remuage is now much more common, using computer-controlled palettes that can process 500 bottles in a single operation, taking a fraction of the time (one week instead of six) at no expense to quality.

Remuage completed, the bottles are stacked neck-down ('en masse'), ready for disgorgement.

DISGORGEMENT



Bottles on wooden riddling racks

The purpose of disgorgement is to eject the sediment that has collected in the neck of the bottle during remuage.

Bottles with metal caps are generally disgorged by machine. The neck of the bottle is plunged into a refrigerating solution at approximately -27°C , then the cap is quickly removed, expelling the frozen plug of sediment with minimum loss of wine and pressure. Removing the cap triggers a short, sharp intake of air that will have a significant impact on aroma development.

Large bottles and certain particular cuvées are still disgorged by hand ('à la volée'), holding the bottle neck down, opening it and then quickly tilting it back upwards so that only enough wine is forced out to take the sediment with it.



Riddling by gyropalette



Disgorgement by hand



Deposit in the bottle before riddling

DOSAGE

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'Dosage' is the addition of a small quantity of 'liqueur de dosage', also known as the 'liqueur d'expédition'. Dosage liqueur is a mixture of cane sugar and wine, either the same wine as the bottle holds or a reserve wine – it all depends on the style of Champagne that the winemaker has in mind. Reserve wines, set aside in casks, barrels or even magnums, add an extra dimension to the winemaker's repertory of flavours.

Dosage liqueur generally contains 500-750 grams of sugar per litre. The quantity of dosage liqueur, and therefore sugar content in the finished wine, varies according to the style of Champagne:

- **doux** more than 50 grams of sugar per litre
- **demi-sec** 32-50 grams of sugar per litre
- **sec** 17-32 grams of sugar per litre
- **extra dry** 12-17 grams of sugar per litre
- **brut** less than 12 grams of sugar per litre
- **extra brut** less than 6 grams of sugar per litre
- **brut nature, pas dosé or dosage zéro** less than 3 grams of sugar per litre and no added sugar.

FINAL CORKING - SHAKING AND FINAL INSPECTION

Champagne stamped on corks

The bottle is sent for corking immediately after dosage. Today's corks have a base section made of reconstituted cork granules, topped by two slices of natural cork. The section that comes into contact with the wine is known as the mirror. The cork must display the name of the Champagne Appellation and state the vintage where relevant.

The cork is squeezed into the neck of the bottle, covered with a protective metal cap (capsule), then held in place with a wire cage ('muselet').

The bottle is then shaken vigorously (a process known as 'poignettage') so that the dosage liqueur marries perfectly with the wine. The last procedure prior to further cellaring in preparation for release is 'mirage': a final check on the limpidity of the wine.

The new cork, like the 'tirage' stopper, does allow for some exchange with the outside air, which is why the wine continues to age over the years.



Corking



Mixing the dosage liqueur into the wine

LABELLING




This is the final stage before shipment. The cork and wire cage are wrapped in foil that extends down the neck of the bottle to the 'collerette' (neck-band). A label is then placed on the front of the bottle, and sometimes on the back too, stating the following:

- The word 'Champagne' (written in bold).
- The brand of Champagne.
- The type of wine as defined by residual sugar content (brut, demi-sec etc).
- Percentage of alcohol by volume (% vol).
- Bottle capacity (l, cl or ml).
- Name of the producer or company name, followed by the name of the commune where that producer is registered (plus the trading address, if different) and the country of origin (France).





- The registration and code number issued by the CIVC, preceded by two initials that indicate the category of producer: NM for Négociant Manipulant, RM for Récoltant Manipulant, CM for Coopérative de Manipulation, RC for Récoltant Coopérateur, SR for Société de Récoltants, ND for Négociant Distributeur, MA for Marque d'Acheteur.
- Batch code (sometimes displayed directly on the bottle).
- Allergen content (eg sulphur dioxide, sulphites, etc).
- The dangers of even small amounts of alcohol to the unborn child, or the symbol  (required by certain countries only)
- The Green Dot symbol indicating that the producer is a member of the packaging recovery scheme.
- Where appropriate, the vintage and specific details relating to the type of cuvée (whether a blanc de blancs, rosé, blanc de noirs, etc).
- Optional information (the varietals used, date of disgorgement, sensory characteristics, suggested food-and-wine pairings, etc.)

Aging

Champagne wines are built to age, forever evolving from the moment of first fermentation to final corking and long beyond that point.

The great reserve wines are aged on their lees for up to a decade, stored in oak vats that exclude oxygen, at constant low temperatures that contribute to the wine's longevity.

Bottled wines are traditionally aged in one of two ways:

- on lees, in bottles sealed with a tirage stopper (whether natural cork or crown cap) and stored in the producer's cellars. Such bottles are disgorged a few months before distribution.
- after disgorgement, dosage and final corking, either in the producer's cellars or after distribution.

The aromatic profile of a mature wine that was disgorged early in its life is quite distinct from that of a late-disgorged wine. The type of maturation therefore depends on the style of wine that the winemaker has in mind.





CHAMPAGNE

FROM TERROIR TO WINE

GLOSSARY

AIGNES: In Champagne, pressing residues (skins, grape seeds...). Synonymous with marc.

ALCOHOLIC FERMENTATION: Chemical process that, thanks to the yeasts, converts the sugars of the must into ethyl alcohol, carbon dioxide and other elements (esters, superior alcohols) involved in the development of aromas.

AOC: The Appellation d'Origine Contrôlée label is the mark of a product that draws its identity and characteristics from its geographical origin.

AUTOLYSIS: Destruction of the yeasts by their own enzymes after the second fermentation.

BELEMNITE: Mollusc from the Mesozoic era. Champagne chalk is characterized by the presence of belemnite fossils.

BELON: In Champagne, open tank where the juice flows out of the press.

BOTTLES: Champagne is sold in different bottle sizes : quarter bottle (20 cl), half-bottle (37,5 cl), bottle (75 cl), magnum (1,5litre), jeroboam (3 litres), methuselah (6 litres), salmanazar (9 litres), balthazar (12 litres), nebuchadnezzar (15 litres).

BUDBURST: Opening of the vine buds in spring.

CHAPTALIZATION: Addition of sugar to a must before fermentation in order to increase the alcohol content.

CIVC: Comité interprofessionnel du vin de Champagne. Semi-public organization which manages and defends the common interests of the Champagne winegrowers and houses.

CLONAL SELECTION: Selection of healthy, quality grape varieties based on the continuing scientific analyses of the growth of thousands of samples drawn from the vineyards.

COCCOLITHOPORE: Marine phytoplankton. The chalk mostly consists of calcite granules formed from the skeletal plates of coccolithopores.

COULURE: Flower or berry drop.

CRU: In Champagne, a «cru» is synonymous with «wine village».

CUVÉE: Two meanings.
1. The first 2,050 litres of juice extracted from a marc of 4,000 kilos of grapes. 2. A precise blend of several base wines.

DESUCKERING: Manual removal of non-fruitful shoots from vines.

DOWNY MILDEW: Fungal disease of vines.

ESTERS: Chemical elements obtained when acid reacts with alcohol. They contribute to develop the aromas in a wine.

FINING: Process of clarification of a wine by adding a substance which carries the particles in suspension to the bottom of the container.

GRAFTING: Implanting of a scion onto another vine cane (stock) which serves as a root system resistant to phyloxera.

INDIVIDUAL RESERVE: The Champagne profession has agreed to create a compulsory individual reserve, controlled by the CIVC. All the producers are committed to creating this reserve in years described as vintages of excellent quality. It is limited to 8,000 kg/ha and enables the Champenois to satisfy growing demand or to compensate for small vintages.

KIESELGUHR: Mineral made of pulverized silica used for filtering the wine.

LEES: The lees consist mainly of dead yeasts, which settle as a sediment at the bottom of the vat and also in the bottle following secondary fermentation.

LIQUEUR DE TIRAGE: A solution of yeasts, sugar and wine that is added to the cuvee to trigger the second fermentation in the bottle.

LIQUEUR D'EXPEDITION: A solution of still wine from Champagne and cane sugar that is added to Champagne after disgorgement. The quantity of sugar added is what determines the type of wine (brut, sec, demi-sec, etc.)

MALOLACTIC FERMENTATION: A biochemical, naturally-occurring process that transforms malic acid into lactic acid through the action of lactic bacteria.

MARC: Two meanings. 1. In Champagne, unit of measure used for pressing. It corresponds to 4,000 kg of grapes. 2. Pressing residues (skins, grape seeds...).

MILLERANDAGE: Formation of stunted, seedless berries.

MINERAL: Characterizes a whole range of aromas reminiscent of certain minerals (chalk, sandstone...).

MUST: Grape juice.

OÏDIUM – POWDERY MILDEW: Fungal disease of vines.

PHOTOSYNTHESIS: The process by which green plants synthesise organic matter, using the energy from sunlight.

RETROUSSE: The breaking-up of the press cake between each pressing.

TAILLE: The 500 litres of must extracted after the cuvée during the pressing of a marc.

TERTIARY AROMAS: Aromas which develop after the fermentations, during maturation and ageing.

TIRAGE: Bottling.

VIGNERONS ET MAISONS



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