CHAPTER 14

Climate-Smart Champagne

Abstract  There are three billion bottles of fizz drunk each year, and 80 per cent of these come from Europe. Champagne has a carbon footprint of around 2 kilograms of emissions per bottle. The UK alone wastes 40,000 tonnes of wine each year, equivalent to almost 100,000 tonnes of greenhouse gas emissions from drink that ends up down the drain. The Champagne region has already seen a more than 1-degree-Celsius rise in average temperatures and may see over 5 degrees Celsius of warming by the end of the century. Wine growers can adapt to a changing climate through irrigation, pruning techniques and the use of alternative grape varieties, but many, including Champagne, rely on specific vines and conditions. In the longer term, some growers will have to either move their vineyards to cooler locations or give up on the wines they have produced for generations. Either way, the places our sparkling wine is produced and what it is called are set to change radically in the coming decades.

Keywords  Sparkling wine • Cavea • Cremant • Sekt • Prosecco • Botrytis • Terroir • Appellation • Pierce’s disease • Viticulture • Carbon footprint

The crowning glory of our day’s food is that most giggly of pleasures: champagne. As an accompaniment to a Friday night fish supper, there is
nothing finer. Though its cheaper cousins Prosecco and Cava are our own more usual celebration tipple, for a big event like a birthday, an anniversary or simply (to be honest) the end of a bad week, the cork-popping joys of champagne are hard to beat.

Once the preserve of the rich and privileged, sparkling wines like champagne have now become an attainable luxury loved by millions. Large-scale production and lower prices have seen sparkling wine consumption rocket—in the UK we now toast our way through over 100 million bottles each year. Around one-third of these are true French champagne, with the rest being Prosecco, Cava and the like. Rather excitingly for English growers, the fourth biggest-selling sparkling wine in the UK is now homegrown [1].

Europe has always been at the epicentre of global fizz production and still produces 80 per cent of the three billion bottles popped globally. Italy and its ubiquitous Prosecco lead the way, with French champagne and Cremant, German Sekt and Spanish Cava being the other bubbly big league players [2]. Since 1990 global sales have surged, leaving stocks of more traditional wines gathering dust—every tenth bottle of wine we now buy is fizz. A good part of this surge is down to drinkers in North America and the UK. France may still sit unsteadily atop the world wine-drinking league (Fig. 14.1), but Britain and the US are the world’s biggest fizz importers and the past quarter of century has seen their thirst more than triple [2].

Sparkling wine, like all wine, is a well-established canary in the climate change coalmine. The global nature of its production, the specific climate needs of the various vines, and the often centuries-long records of cultivation and harvest, give a rich view of how climate has changed in the past and what may be in store for the future [4]. To explore the climate risks and responses for our beloved fizz, we are really going to push the boat out. Tonight it must be real French champagne, and it must be one of the very best. It must be Bollinger.

\[ I \text{ drink Champagne when I’m happy and when I’m sad. Sometimes I drink it when I’m alone. When I have company I consider it obligatory. I trifle with it if I’m not hungry and drink it when I am. Otherwise, I never touch it—unless I’m thirsty. Lily Bollinger, House of Bollinger Champagne } [5] \]

Bollinger is one of the great French champagne houses, and like Moet & Chandon, Veuve Clicquot, Krug and Taittinger, they are strictly
confined to producing their wine from vines grown on the undulating slopes of north eastern France’s Champagne region. Well-drained chalky soils, together with a cool climate, moderate rainfall and the long-established wine growing practices and culture of the region make for the Champagne terroir—the distinctive physical, biological and cultural attributes of a wine growing area [6, 7].

To qualify as true champagne, the vines must be grown in this specific area and to a strict set of rules (the coveted appellation). The appellation includes which varieties can be used—Chardonnay and Pinot Noir are usual, how much can be grown, pruning techniques, grape alcohol contents and fermentation methods. Achieving the champagne designation means navigating a maze of regulations, but the rewards can be astounding. With such huge global demand and only a limited area to produce it, the very best bottles may fetch in excess of $1,000. An 1820 Juglar Cuvee will set you back over $40,000 (complete with barnacle encrustations from its time aboard a sunken ship) and the current record is $2 million for a
bottle called Taste of Diamonds, though its sky-high price is probably more to do with its handcrafted gold label featuring a 19-carat diamond [8].

Unsurprisingly land prices in Champagne are stratospheric too, averaging around half a million dollars per hectare [9]. Our own pricey, though diamond-free, bottle of Bollinger therefore began life as a mixture of grapes grown in this super-select corner of global viticulture.

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Grape vines like it sunny. In general they need long growing seasons (150–180 days) relatively low rainfall and humidity, but still with enough soil moisture to keep them happy through the summer [10]—a tough balancing act for growers as temperatures rise and rainfall patterns change. Vines remain dormant at below 10 degrees Celsius, and most varieties tend to do best in areas where the average growing season temperatures are somewhere between 13 and 21 degrees Celsius—it’s nigh on impossible to produce good wines in the tropics and sub-tropics [4, 11]. The Champagne region is near the northern limits for reliable viticulture, and it is the slow-growing nature of the grapes there that helps to produce the crisp acidic characteristics needed for making champagne [7].

Vines take two or three years from planting before they start producing grapes and, as they are climbing plants, they need support as they grow [12]. The succulent bags of sugar that are grapes inevitably attract a lot of pests and diseases. Pinot noir—a staple grape for champagne—is prone to fungal attack by powdery and downy mildews, the common grey mould of botrytis, and an array of viruses and sap-feeding pests. One of the most worrying is Pierce’s disease, caused by a bacteria that invades the vines when insects feed on them. Leaves of infected plants first begin to turn red or yellow, their grapes shrivel and a growing carpet of dead leaves accumulates below the under-siege plants. There is no cure [13]. Frost damage is also a perennial risk at high latitudes and altitudes—a hard spring frost when the new buds are just forming can wipe out that year’s grape harvest [14].

After about eight years of care and attention, the vines should hit full grape production. Regular winter pruning, weeding, fertiliser application and pest control are usually needed throughout. With luck the vine can then go on to produce good grapes for many decades—they can live for upwards of 70 years, and some ancient vineyards in Slovenia still produce grapes from vines planted four centuries ago [12].
Correctly judging when to harvest is critical to the success of the wine produced. Growers are careful to wait until the sugar content and acidity levels are just right—in a very warm year, the perfect time may come much earlier, in a cold year, much later [15].

Once harvested, either by hand or by machine, the grapes are immediately taken for initial processing. Stems are removed, the grapes crushed, and the resulting juice (called must) transferred to fermenters where added yeast gets to work converting the sugars to alcohol and producing streams of carbon dioxide bubbles in the process. For red wine the grape skins are fermented too, for white they are removed. Once fermentation is complete, the raw young wine is clarified—yeast and other particles are removed through filtering or settling them out—and racked into bottles and barrels for ageing and eventual sale. Champagne and other sparkling wines, however, have a crucial extra element. It’s a yeasty trick once regarded by wine makers as annoying. Today it’s the magic that makes our wine sparkle.

As grape juice ferments, the sugars are used up, and eventually, the yeast will run out of fuel. Sometimes though the new wine is racked too soon. If there is still enough sugar available, then the yeast will go on working and produce more alcohol, and lots more carbon dioxide. In sealed bottles the effect can be explosive, and even where the wine maker doesn’t find their precious charge splattered across the cellar walls, the build-up of carbon dioxide will have turned the wine fizzy.

The inspiration to deliberately use this secondary fermentation to make champagne is often credited to the French Benedictine monk Dom Perignon, but in fact he spent years trying to work out how to avoid it. Instead, it was an English scientist called Christopher Merret who, in a paper to the Royal Society in 1662, outlined how ‘sugar and molasses’ could be added to new wine to make it sparkle.

By the middle of the eighteenth century, wine makers in Champagne were turning to exclusive production of sparkling wine using this sugar-adding technique, and in 1829, the House of Bollinger was founded. The champagne appellation demands secondary fermentation is done in the same bottles that we then buy, while for Prosecco and other sparkling wines, this step is more often done in large vats (making it less labour-intensive and so cheaper). Champagne bottles still explode sometimes, but stronger glass and more precise additions of sugar make this much rarer than in the early days—up until the 1830s, cellar workers routinely wore iron masks to protect them from random eruptions of glass, corks and bubbly [16].
Barring explosive failures, our own bottle of Bollinger will eventually make its way across the channel and find its way to our fridge. Each precious bottle has a life cycle carbon footprint of around 2 kilograms [17], with the bulk of this arising from grape growing (vineyard fuel, fertiliser and pesticide use) and the rest from the energy used in processing, packaging, transport and refrigeration. New world sparkling wines like those from Australia notch up further emissions—an extra 300 grams or so—due to the long-distance shipping required [18]. The three billion bottles of fizz consumed worldwide therefore have a carbon footprint in the region of six million tonnes a year. Just how much of all this we waste is unknown (not a drop in our house for sure).

Champagne’s high price likely means less of it goes down the drain than most alcoholic drinks, but any wedding caterer or party host can testify to the fact that a lot still ends up decorating dance floors and carpets. For wine more broadly, the numbers on waste are instantly sobering. In the UK we throw away over 40,000 tonnes of wine each year at an estimated financial cost of £270 million. Even assuming sparkling wines suffer just half the wastage rates of other wines, this would still mean around 2,000 tonnes of dumped bubbly in the UK and the equivalent of some 4,000 tonnes of carbon dioxide emissions.

Almost all of such wine waste is deemed avoidable, the leading causes being the familiar ones of it getting old (not all wines age well) and too much being served. The rest of the wastage comes from personal preference and accidents—presumably, this last one increases in direct proportion to how much we’ve drunk [19]. Also familiar are ways to reduce this waste, including not over-buying and serving, and keeping an eye on drink-by dates. The big carbon savings for champagne, however, can be found further down the supply chain at the winery and vineyards. There too can be found the portents of a future climate that will redraw the global wine map and threaten even the hallowed diktats of the champagne appellation.

With Europe being the global powerhouse of sparkling wine production, it is severe weather and climate change impacts here that most threaten supplies worldwide. The intense heat wave of 2003 gave a fiery taste of the risks all farmers will face in the coming decades. In June of that year temperatures began to push past their normal levels across an expanding area of the continent. From Spain in the west to the Czech Republic in the east, and from northern Germany down to southern Italy, temperature records toppled as the heat intensified through July and into August. The all-time record in the UK fell on the 10th of August (hitting 38.1 degrees Celsius),
and in France, temperatures surged past the 40 degrees Celsius mark and stayed there for weeks [20]. Along with an estimated 30,000 human casualties came big losses for many wheat, maize and livestock farmers [21]. In Champagne, the scorching weather meant a much earlier grape harvest amid concerns over heat stress to the vines [22], but the resulting vintage turned out to be a cracker. More recent heat waves, like that in 2018, again meant early harvest dates and making dawn raids on the vineyards before the heat became dangerous for pickers. Whether the resulting champagne is another good heat wave vintage won’t be known for a while. What we do know is that the frequency and intensity of such extreme weather events is set to increase and that the cool climate envelope for growing champagne grapes is on the move.

As western Europe has warmed over the past 40 years, grape harvests across France have been occurring around 10 days earlier than the average for the preceding four centuries—harvests in the summer of 2003 were almost a month early [23]. By the middle of this century, severe heat waves like that of 2003 could be hitting us every other year [24]. The warming trend is tending to increase sugar levels in the grapes, making for wines that are sweeter and have a higher alcohol content [4]. As harvesting gets ever earlier, gaps may open up between the ideal harvest moment when the grapes have the right balance of sugar and acidity and the flavour moment when they will provide the specific taste required of fine wines [25]. Major champagne vines like Pinot Noir—the polar bear of wine in a changing climate [26]—are especially vulnerable as they like it cool and have a tight optimal temperature range.

Changing rainfall patterns and increasing temperatures will boost some pests and diseases too [27]. The small insects that transmit Pierce’s disease are expected to expand northwards [28], and there are already concerns that vine-killing Black rot fungus is invading from the south as Europe warms [29].

By the middle of this century, the suitability of viticulture heartlands like Bordeaux for producing wine is predicted to fade, while new areas at the coolest edges of the European wine map (including England and even Sweden) could see vines flourish [27, 30]. Across the Atlantic, climate change will similarly reshape wine growing, with more southerly states of the US becoming less suitable [26] and, alongside heat and water stress risks, facing a growing threat from wildfires [28].

In 2017 more than 100 growers in Chile’s Central Valley region saw their vineyards damaged or destroyed by fire [31]. Later that same year
California experienced its most destructive wildfire season on record at the time. Their 2018 season was even worse. Around 8,000 fires burned their way across huge areas of land, causing billions of dollars of damage and claiming the lives of over 80 people [32]. Many of the well-irrigated vineyards of northern California were able to swerve direct destruction by the flames in 2017 and 2018, but the smoke that shrouded much of the state meant that grapes, and any wine made from them, risked being tainted. This smoke-taint—where the wine ends up with distinctly unpleasant notes of ashtray—has become a costly side effect of wildfires for many vineyards. Smoke damage from the 2003 bush fires in Australia is estimated to have cost over $4 million [33].

The future of fizz could therefore be one of changing tastes as well as uncertain supplies, but the world’s wine growers, especially those in Champagne, are already striving to get ahead of the temperature curve.

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Adjusting grape harvest dates to fit with warm or cool years is an adaptation strategy as old as wine making itself. With the strong warming trend in France over the last few decades, the simple response of earlier harvesting has allowed production and quality to be kept high even in the hottest years. As heat wave, drought and disease risks increase in the future though, this is unlikely to be enough. Switching the times of day used for harvesting, as well as the date, can mean workers are protected from heat stress and the grapes themselves are cooler—this means they then degrade more slowly between field and winery [34].

The winery too must adapt to higher temperatures and changing harvests. The higher-sugar content of the grape juice will demand more alcohol-tolerant yeasts, while extra cooling could mean more energy use, costs and emissions. Good fermentation typically needs cool and stable conditions (10–15 degrees Celsius) and so will require on-site renewables, like solar, or the extension of existing cellars to limit any extra energy and carbon costs during heat waves [35].

Back in the vineyards, deliberately delaying the accelerated ripening brought about by climate change is possible through late pruning—this holds back formation of the new season’s buds. As the summer progresses and temperatures hot up, allowing more shading from leaves around bunches of grapes, and so protecting them from scorching, can be effective
too. Netting is sometimes used to provide shade alongside protection from birds and hail storm damage [36]—in Australia they’ve even had success with spraying clay-based sunscreens over the fruit and leaves during heat waves [37]. For newer vineyards, vines can be trained to produce taller stems and so lift the grapes further away from the temperature hot spots that often form close to the soil surface [36].

The soil itself can be a powerful climate-smart ally for wine growers. Those in Champagne benefit from the ability of the chalk soils to hold onto water through dry spells and provide the vines with a slow-release reservoir. Restricting the depth of any tillage and incorporating plenty of organic matter can both help boost the water-retaining properties of the soil and enhance its carbon stocks. The use of mulches—such as vine clippings—and cover crops again helps to boost soil carbon, as well as suppressing weeds, reducing evaporation and preventing erosion [27, 36].

Where soil moisture levels drop too low, carefully managed irrigation can provide crucial relief for the plants. Widespread use of irrigation, however, will put extra strain on local water resources that are already likely to be under severe stress in times of drought. Too much irrigation can also lead to a build-up of salts in vineyard soils that then becomes damaging to the vines [34]. Down in the Mediterranean, low rainfall and the absence of irrigation has for centuries been compensated for by using the gobelet pruning method, where the vines are grown as free-standing bushes and their leaf area is cut right back to reduce water losses [4].

More pest and disease attacks may mean greater use of insecticides and fungicides, too but for emerging threats like Pierce’s disease, there have been encouraging results for biological controls and, in particular, the use of a cocktail of bacteriophages (viruses that consume the invading bacteria) to contain this costly disease [38].

A warming France should at least mean the devastating effects of late frosts recede over time. To stave them off, growers currently use everything from lighting fires between the rows, to gas heaters, vine-top sprinklers and even wind machines (that mix the air and so prevent frost forming). As these can be expensive, phasing them out could help reduce costs and energy use. But the diminishing risks of late frosts are occurring alongside ever-earlier vine bud burst each spring [39], so the complete abandonment of anti-frost measures would be very risky. Such technical and management strategies can certainly buy wine growers time in the face of climate change. Ultimately though, building long-term climate resilience into their vines and the wines they produce will require new planting.
The undulating topography of the Champagne region lends itself well to producing microclimates that buffer the effects of heat waves and droughts. Planting on north-facing slopes can mean vines are spared from damage during the hottest parts of the day, while selecting areas with deeper soils often provides more reliable soil moisture levels. The enforcers of the Champagne appellation may not be amused, but switching to new grapevine clones or root stocks that extend the time taken until grape maturity, improve disease resistance and give better growth under drought conditions can help ensure the new vines are still fit for purpose decades from now [4, 34].

Finally, and certainly something that is vexing the members of Champagne’s Appellation Protection Committee, is the option of a wholesale move to new, more climate-appropriate, locations opening up in the north. Across the English Channel, in southern counties like Kent and Hampshire, this is exactly what is happening. In 2015 the leading champagne house Taittinger bought up 69 hectares of prime farmland in Kent [40]. With its own chalky soils and fast-warming maritime climate, the area is becoming a prime site for growing Chardonnay, Pinot Noir and Pinot Meunier grapes—the backbones of champagne. The quality of English sparkling wines (they still can’t be called ‘Champagne’ under EU law) is already regarded as world class [41]. As a long-term adaptation strategy for the centuries-old champagne houses of France, embracing the idea of this vine-growing Entente Cordiale may help ensure they are still producing wonderful fizz for centuries to come.

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