

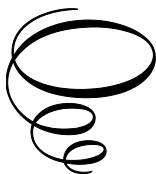
A Guide to the World's Vineyards and Wines

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By

Alan J. Buglass

**Cambridge
Scholars
Publishing**



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This book first published 2022

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

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ISBN (10): 1-5275-8546-8

ISBN (13): 978-1-5275-8546-1

This book is dedicated to the World's vine growers, winemakers and associated workers within the wine industry and academia. Without their dedication, skill and perseverance, often under difficult and sometimes dangerous circumstances, the World would be a far less attractive place.

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PREFACE

The aim of this book is to provide newcomers to the world of wine with a factual account of the vineyards and wines of the world (Chapters 3 and 4), supported by an elementary background of the science and technology that is so important in growing vines and making wine (Chapters 1 and 2). In the first two chapters, I have attempted to cover all important scientific aspects relating to grapes and wine, albeit necessarily selectively and in much simplified and abbreviated form. Although knowledge of science at high school, college or similar level is a definite advantage, readers with no interest in science should find comfortable reading in most parts of Chapters 3 and 4. The book is intended for students of horticulture, viticulture and/or oenology (such as those on junior college or university courses or those studying for Wine and Spirit Education Trust–WSET–certificate or diploma and similar qualifications) and students attending sommelier courses. It is hoped too, that it will be of interest to more experienced students and workers in the wine industry, including merchants.

The Bibliography and Further Reading section that terminates each chapter contains a list of general reading matter, most of it technical, but some are of a more descriptive nature and hence suitable for all readers. For readers with scientific experience and/or enthusiastic curiosity, details of important and very specific scientific papers, both original research

articles and reviews, are included. All the bibliographical items can be accessed, in some form or other, by use of the internet and indeed, a fair number can be found only by that means. Note that a few articles may be accessed freely through the internet only as abstracts or summaries, the full article needing a subscription or arrangement with the publisher.

In Chapters 3 and 4, the numerous figures depicting wine regions are sketch maps—they are not intended to be cartographically accurate, but nonetheless show approximate locations of vineyard areas and communities (villages, towns and cities), and in a few cases of châteaux, within a given region. Smaller scale sketch maps show geographical relationships between different wine regions. Some of the sketch maps, especially those of larger scales, show approximate road and railway links, and so can be used by bacchanalian travelers to plan routes through and between regions, although there is rarely enough information here to get the traveler to a *particular* vineyard or winery; decent road or ordnance maps (including cyber versions, such as Google, Michelin maps, etc) or directions from winery websites will be needed for this. Please note that road numbers are changed on occasions and railways can vanish or appear in the space of just a few years.

Also with regard to Chapters 3 and 4, the numerical information found in the text, particularly climate data, area of vineyards/average annual production of wine and regulatory details (such as maximum allowed harvest, minimum sugar content of grapes or must and minimum potential ethanol content of must) has been taken, as far as possible, from original sources, such as meteorological stations, official websites of wine regions and governmental websites. Even so, there is likely to be some

uncertainty associated with some of the data, which is sure to increase as time passes. For example, vineyard areas in certain regions where expansion is possible (especially in the Americas, Australia and China) are likely to increase significantly over the next 10 years or so. Similarly, it is clear that climate is changing. On comparing modern climate data from meteorological stations with data in the literature of 40 or 50 years ago, I have noticed that the growing season in Bordeaux, for example, appears to be 150-200 °C-days (302-392 °F-days) higher in heat summation, on average, than 50 years ago. Similar changes have been recorded in many other regions, where vine growers are planting later ripening vine varieties and exploiting cooler vineyard sites, especially at higher altitudes. It is likely that global warming will continue into the near future, so we can expect more of these changes. Likewise, wine legislature and regulations change from time to time, although usually only in small detail.

I am very grateful to the many people who supplied photographic images for inclusion in a large number of the figures; there are too many to mention here, but their identities can be seen in the figure captions. I also thank my wife and family for their patience and understanding during the long hours of preparation of this book.

Alan Buglass,

June 2022

CHAPTER 1

INTRODUCTION TO VITICULTURE

1.1 Grapevines

1.1.1 The *Vitis* Family and Wine Production

There are some 79 or so species (members) of the *Vitis* family (genus). They are all climbing, ground-covering plants that are found growing wild in many parts of the world (Table 1-1) in sunny, wind-sheltered locations, often close to rivers or on the edges of forests. However, today's important examples are all *cultivated* varieties (cultivars); many of which have been grown for centuries, or in the case of some *Vitis vinifera* (*V. vinifera*)

Table 1-1 Important *Vitis* species* and their major locations

<i>Vitis</i> species	Principal locations	<i>Vitis</i> species	Principal locations
<i>V. vinifera</i>	Worldwide; native to Europe, the Middle East and Trans-Caucasia	<i>V. amurensis</i>	Southern Siberia, China, Korea, Japan
<i>V. labrusca</i>	Northeastern USA	<i>V. rotundifolia</i>	Southeastern USA
<i>V. riparia</i>	Northeastern USA	<i>V. aestivalis</i>	Widespread, native to southeastern USA
<i>V. rupestris</i>	Mid-southern USA	<i>V. cognatiae</i>	China, Korea, Japan
<i>V. berlandieri</i>	Arkansas, Mexico, New Mexico, Texas	<i>V. davidii</i>	Central and southern China

* Only abbreviated botanical names are given here

varieties, over several millennia. This species, whose full botanical name is *Vitis vinifera* Linné spp. *vinifera*, is indisputably the most important one in the world of wine. Its many hundreds of cultivated varieties (members of that species, that although inter-related, differ widely in biological character—see Chapter 1.1.2) ultimately are all derived from wild *V. vinifera sylvestris* plants that grew (and still grow in certain locations) around the Mediterranean, Black and Caspian Seas. Of these varieties, one hundred or so today are responsible for most of the world's best wine, with about 20 producing the greatest wine, in certain locations and under certain climatic and winemaking conditions. Others are important in the production of table grapes, juice or raisins. Good wine is produced by certain other *Vitis* species and hybrids too (see Chapter 1.1.2), but the fruit of others are better suited for table use or jelly making. Additionally, certain non-*vinifera* species, such as *V. aestivalis*, *V. berlandieri*, *V. riparia* and *V. rupestris* (and especially interspecific crosses between them), are crucial for providing rootstocks (Chapter 1.1.4) for *V. vinifera* varieties, thus protecting the latter from the activities of the vine louse *Daktulosphaira vitifoliae* (commonly known as Phylloxera) to which they are highly sensitive (Chapter 1.2.4).

Cultivation of *Vitis* species (especially *V. vinifera*) and winemaking have been traced back to around 6000 BC (China, Georgia and Iran), although the earliest winery as such (complete with primitive press, vats and cups) yet discovered is the Areni-1 winery in Armenia (~4000 BC). Vine growing and winemaking are well documented in ancient religious and secular texts. Wine culture was spread to distant lands, over the centuries, by traders and colonizers, such as the Egyptians, Phoenicians,

Persians, Greeks, Arabs, Dalmations, Romans and more recently by Europeans to Africa, the Americas and Australasia. Today's (2021) global wine industry is estimated to be worth over \$160 billion according to market size, and has been growing at a rate of about 3.7% since 2015 (<https://www.globenewswire.com/>). Global sales from wine exports (~106 million hL in 2019) are estimated to be ~\$39 billion. Total vineyard area is ~7.4 million hectares (~18 million acres), with ~57% of this land being planted with wine grapes, ~36% with table grapes and ~7% with grapes for drying. There are around 1 million people involved directly in the wine industry and world wine production in 2018 was ~292 million hL—consumption for that year has been estimated at 246 million hL. Today, the world's largest producer of wine is Italy, followed by France, Spain, USA, Argentina, Australia, Chile, Germany, South Africa and China.

V. vinifera, the most important species of the genus *Vitis*, possesses over 5,000 distinct cultivated varieties, which differ considerably in certain biological characteristics, such as growth habit, vigour, foliage morphology (e.g., leaf shape or shoot tip colour), length of vegetative life cycle, resistance to fungal diseases, cold resistance, yield of fruit and colour/flavour of fruit. Many of these varieties have multiple names, depending on local preferences, but only the most common names are used in this book; this also applies to cultivars of other *Vitis* species and hybrids (interspecific crosses). Some important examples are mentioned below and many more will be found in Chapters 3 and 4. Typically, a particular variety of (especially) *V. vinifera* can be obtained as several well-documented and catalogued clones (see Chapters 1.1.2 and 1.1.3), each derived from a single parent plant. These clones differ slightly in

biological character, such as growth habit, length of vegetative life cycle, yield of fruit and so on. Clones are given distinct names, often indicating the plant breeding institute or authority that raised and propagated them, such as the Foundation Plant Services of University of California (Davis) and ENTAV-INRA (Établissement National Technique pour l'Amélioration de la Viticulture-Institut National de la Recherche Agronomique). For example, of the Chardonnay clones of the latter authority, ENTAV-INRA 75 yields a greater amount of rather less sweet fruit, best suited to sparkling wine production (as in Champagne, see Chapter 3.1.3), whereas ENTAV-INRA 548 gives a lower yield of fruit that ripens a week or so earlier than most other clones.

Although, the World's top variety (in terms of plantation area) is Kyoho, a hybrid whose grapes are used for eating and drying, 10 of the next 12 most planted cultivars are wine varieties, mostly relatively new and all are *V. vinifera* cultivars of European origin. They are (in order): Cabernet Sauvignon, Merlot, Tempranillo, Airén, Chardonnay, Syrah (Shiraz), Garnacha Tinta (Grenache Noir), Sauvignon Blanc, Pinot Noir and Trebbiano. Except for Airén, Garnacha Tinta, Merlot and Trebbiano, their areas of cultivation are increasing (2021) and all except Airén and Trebbiano are grown extensively worldwide on at least two continents and hence are known as global or international varieties. Less intensively grown varieties (although still global in some cases), but making superlative wine (as single varietals or in blends) in certain circumstances, include: Aglianico, Cabernet Franc, Gamay Noir, Malbec, Nebbiolo, Petit Verdot, Pinotage, Sangiovese, Tinta Cão, Touriga Francesca, Touriga Nacional, Zinfandel (all with black-skinned fruit and making mostly red

wine) and Chenin Blanc, Furmint, Gewürztraminer, Grüner Veltliner, Harsléveltü, Muscat, Palomino, Pinot Gris, Riesling, Roussanne, Sémillon and Viogner (all with pale-skinned fruit and making white wine); these too, are all pure *V. vinifera* varieties. However good wine is made from interspecific crosses (generally known as hybrids; see Chapter 1.1.2) including well-established French-American hybrids such as Chambourcin, Chancellor, De Chaunac, Foch, Joffre, Léon Millot, Triomphe and Villard Noir (red wine), and Aurore, Chelois, Rayon d'Or, Seyval Blanc, Vidal Blanc and Vignoles (white wine), particularly in the USA and Canada. Additionally, older hybrids, like Catawba, Concord, Delaware, Isabella and Niagara, are important in certain locations, such as northeastern USA, southern Ontario (Chapter 4.4.6) and Brazil (Chapter 4.5.3). Scuppernong and other *V. rotundifolia* varieties, also known as Muscadines, are important in southern USA (Chapter 4.4.5); *V. amurensis* and *V. cognatiatae* varieties in northern China, Korea and Japan (Chapter 4.2.3) and *V. davidii* cultivars in central and southern China (Chapter 4.2.3).

1.1.2 Basic Biology of Grapevines

Grapevines are deciduous woody climbing and trailing plants belonging to the flowering plant genus *Vitis*, as already mentioned. Upon pollination, the flowers develop, over ~100 days or so, into juicy berries with high sugar content (fructose and glucose mainly) and normally containing 2-4 seeds (pips), which under the right conditions can produce new plants. Most species are hardy or semi-hardy and are highly adaptable to climatic conditions; some can survive winters with prolonged cold spells (-15 to -

30 °C/ 5 to -22 °F minima), whereas others thrive in sub-tropical climates, where there is no dormant period and so, if not pruned, produce fruit in small bunches throughout the year. In this situation, cultivation (especially with regard to pruning) can be implemented to produce one or two crops

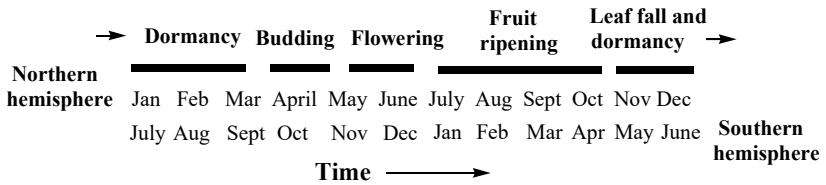


Figure 1-1 Life cycle periods of typical *V. vinifera* cultivars in temperate climates

per year (see Chapters 4.2.4, 4.3.6 and 4.5.3). However, grapevines perform best in temperate climates (those with mean annual temperatures of 10-20 °C/50-68 °F), where winters are cold enough to induce dormancy for several months, so there is normally only one flowering (inflorescence) period and consequently only one fruit harvest.. In this case, the general life cycle of typical *V. vinifera* cultivars is summarised in Fig. 1-1. The actual timing of events during the life cycle depends largely on the vine variety, its rootstock (Chapter 1.1.4) and the climatic conditions, particularly the mean daily temperature, light intensity and hours of daylight. The part of the cycle between budding and leaf fall (senescence)/dormancy is known as the vegetative life cycle and the time over which this occurs is called the growing season.

Certain varieties require long growing seasons and so ripen their fruit relatively late, which means that the fruit will ripen properly only in relatively warm climatic conditions. Such cultivars (called late varieties) include Baga, Cabernet Sauvignon, Carignan, Cinsault, Grenache Noir, Nebbiolo, Petit Verdot, Sangiovese, Syrah, Touriga Nacional (all black-fruited) and Chenin Blanc, Muscat-a-Petits-Grains, Palomino, Riesling, Sauvignon Blanc, Sémillon and Viognier (all white-fruited). Mid-season varieties will ripen their fruit well in rather cooler conditions and include Dolcetto, Gamay Noir, Pinot (Meunier and Noir), Malbec, Merlot, Saperavi, Tempranillo, Tinta Negra Mole, Zinfandel (all black-fruited) and Chardonnay, Chasselas, Gewürztraminer, Marsanne, Pedro Ximénez, Pinot (Auxerrois, Blanc, Gris), Rkatsiteli and Verdejo (all white-fruited). Early varieties, whose fruit will ripen satisfactorily in even cooler climates, include Cabernet Cortis, Dornfelder, Portugieser, Regent, Rondo, Zweigelt (black fruited) and Bacchus, Kerner, Madeleine Angevine, Müller-Thurgau, Reichensteiner and Solaris (white fruited). The terms “early” “mid” and “late” are of course relative; they apply to different vine performances under identical climatic conditions and cannot be swapped between different climates. Generally, early means that the fruit ripens before or around September 1 (March 1 in the southern hemisphere); mid-season means ripening during September (March), while late means ripening during October (April). Thus Chardonnay is a mid-season variety in moderately warm locations, such as Côte d’Or (Chapter 3.1.2), Mornington Peninsula (Chapter 4.3.2) or much of New Zealand (4.3.5), but is early in warmer locations, such as Hunter Valley (Chapter 4.3.2) or Napa Valley (Chapter 4.4.4), and late in cooler Champagne (Chapter

3.1.3; for still wine), Luxembourg or England (Chapter 3.6).

After breaking of buds on the previous season's wood, the fresh shoots, initially soft and green, grow quite rapidly early in the season, but growth slows down later, with gradual hardening until lignification (conversion to brown woody canes) occurs in the late season. A tendril or flower cluster is found at many nodes, opposite a leaf (Fig. 1-2), along with a bud, which sometimes subdivides to give a lateral shoot and a dormant bud. All the material for next season's growth is to be found in this bud, including leaf primordia and flower/tendril primordia, a secondary bud and sometimes, a tertiary bud. Warm, sunny weather in early summer (especially during June in the northern hemisphere; December in the southern hemisphere) favours the formation of flower primordia, which determines the potential crop for the next season. Thus, the reproductive development of the grapevine covers two seasons.

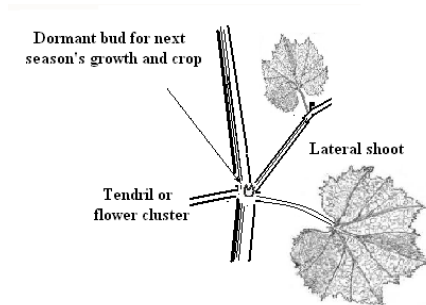


Figure 1-2 Close-up of a node on a vine shoot of the current season

Most wild vines, including *V. vinifera* Sylvestris (and like many other flowering plants), are dioecius—female (pistillate) flowers are developed