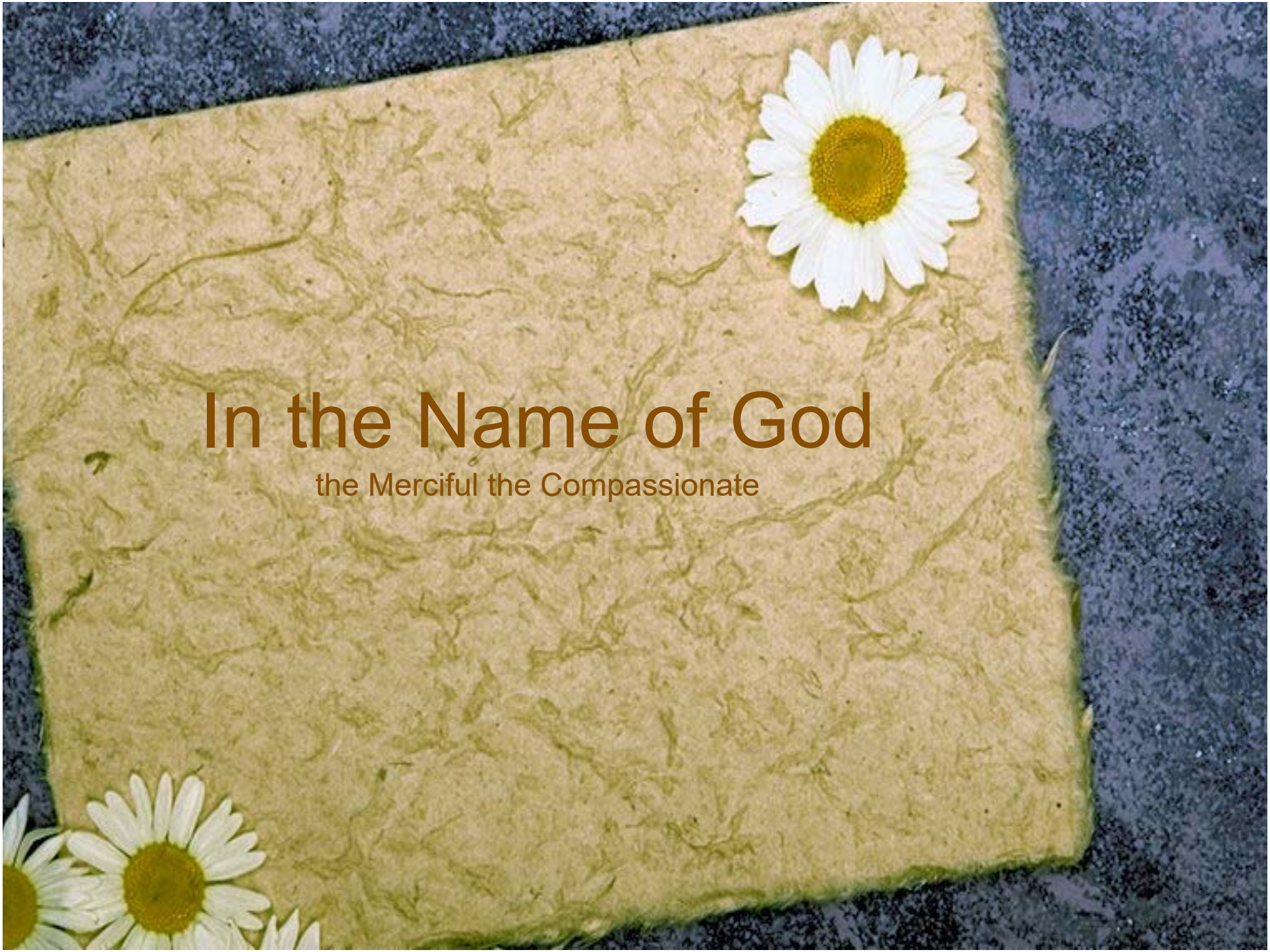
In the Name of God
the Merciful the Compassionate

Small Fruits (advanced)

M. Gholami

What are small fruits?

- Small fruit crops produce small, soft fruit, usually on vines, plants, or shrubs.

  Small fruits are not all in the same botanical family.

  They require little space relative to the amount of fruit they produce.

  Small fruit crops typically bear fruit one or two years after planting.

  Pests are generally easier to control than on tree fruits.

  Examples: blackberries, blueberries, grapes, raspberries, strawberries

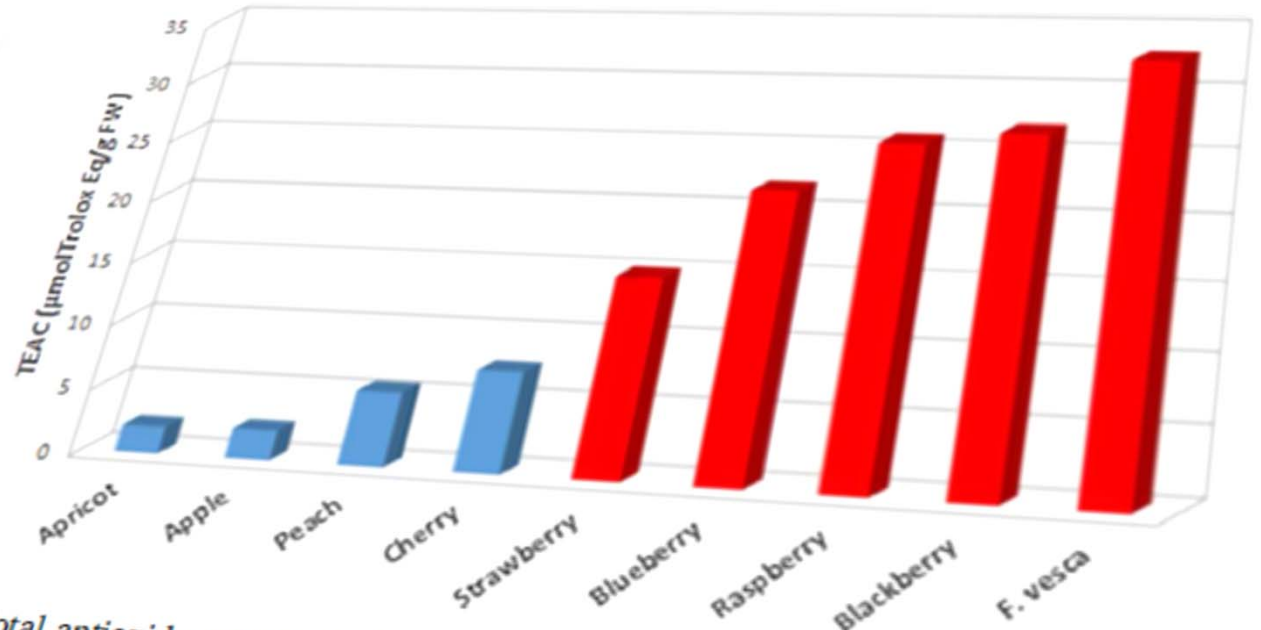

Fig. 3. Total antioxidant capacity (TEAC) of different fruit species and berry species. Modified from Scalzo et al., 2005a.

Among fruits, the so-called "berries" have been consumed since many years, in particular in the northern latitude countries, where there is limited availability of other fruit and vegetable species. The term "berry" or "red fruit" indicates small fruits that grow in wild bushes, could be sweet or bitter, with a juicy pulp and an intense coloration ranging from red to purple/blue, rarely it is possible to have white fruits (Hidalgo and Almajano, 2017). The most common berries worldwide are cranberry, blackberry, blueberry, raspberry and strawberry, with elderberries, mulberries and other less common red fruits being specific of some particular environments.

Small Fruits

Grapes

- Pluses
  - hardy, long lived
  - fruit
  - landscape uses
- Minuses
  - disease problems
  - bird problems
  - maintenance

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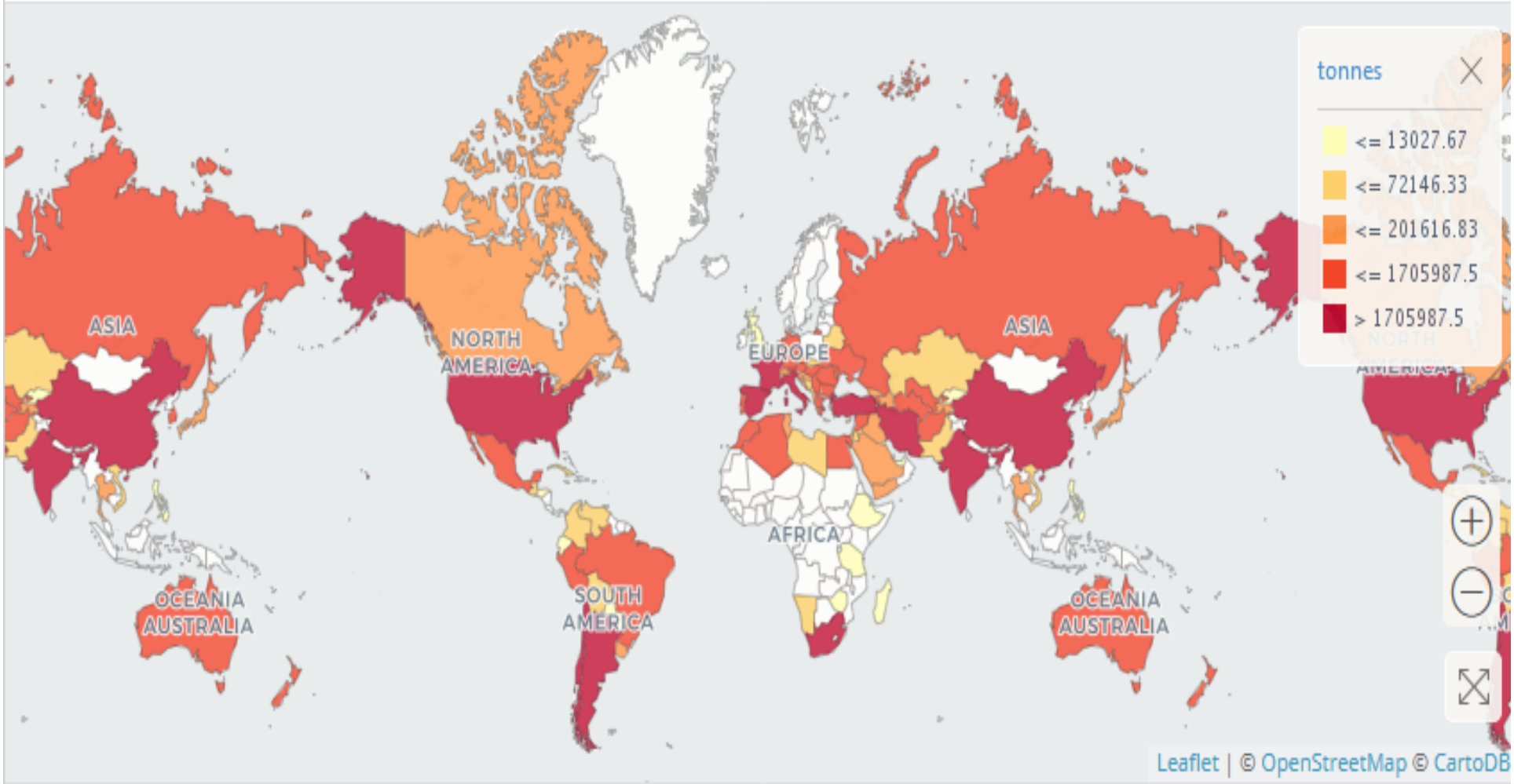
Production quantities of Grapes by country

Average 2011 - 2016



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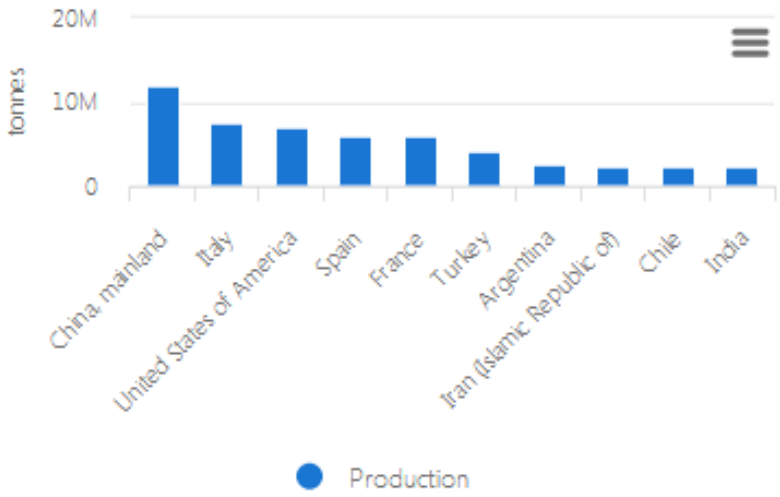
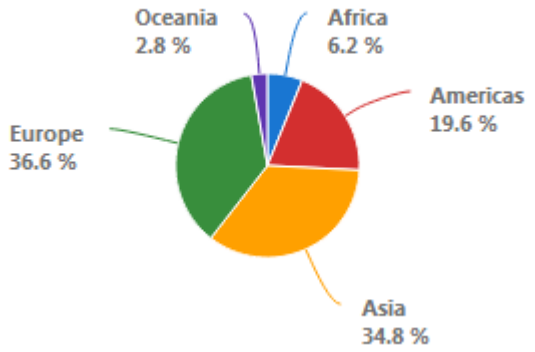
Production of Grapes: top 10 producers

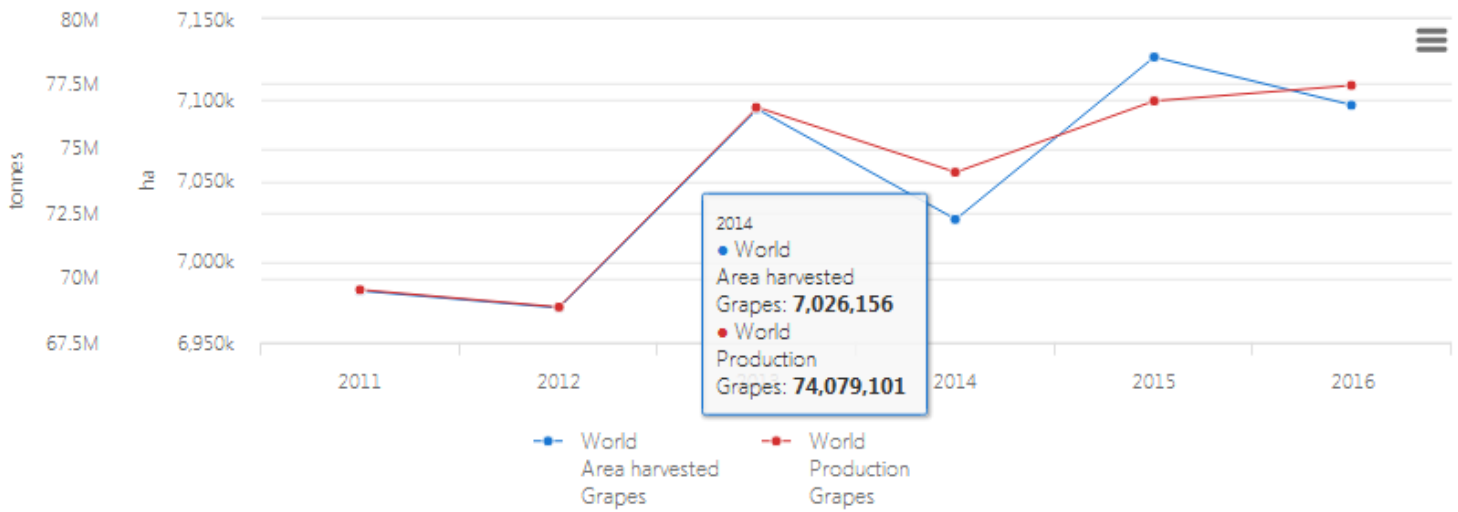
Average 2011 - 2016





Production/Yield quantities of Grapes in World + (Total)

2011 - 2016



	Area	Item	Year Code	Year	Unit	Value
2	China, mainland	Grapes	2019	2019	tonnes	14283532
3	Italy	Grapes	2019	2019	tonnes	7900120
4	United States of Am	Grapes	2019	2019	tonnes	6233270
5	Spain	Grapes	2019	2019	tonnes	5745450
6	France	Grapes	2019	2019	tonnes	5489650
7	Turkey	Grapes	2019	2019	tonnes	4100000
8	India	Grapes	2019	2019	tonnes	3041000
9	Chile	Grapes	2019	2019	tonnes	2701588
10	Argentina	Grapes	2019	2019	tonnes	2519886
11	South Africa	Grapes	2019	2019	tonnes	1993048
12	Iran (Islamic Republi	Grapes	2019	2019	tonnes	1945930

Small Fruits

Strawberries

- Pluses
  - easy to grow
  - fruit!
  - landscape uses
- Minuses
  - winter injury
  - frost injury
  - weed management

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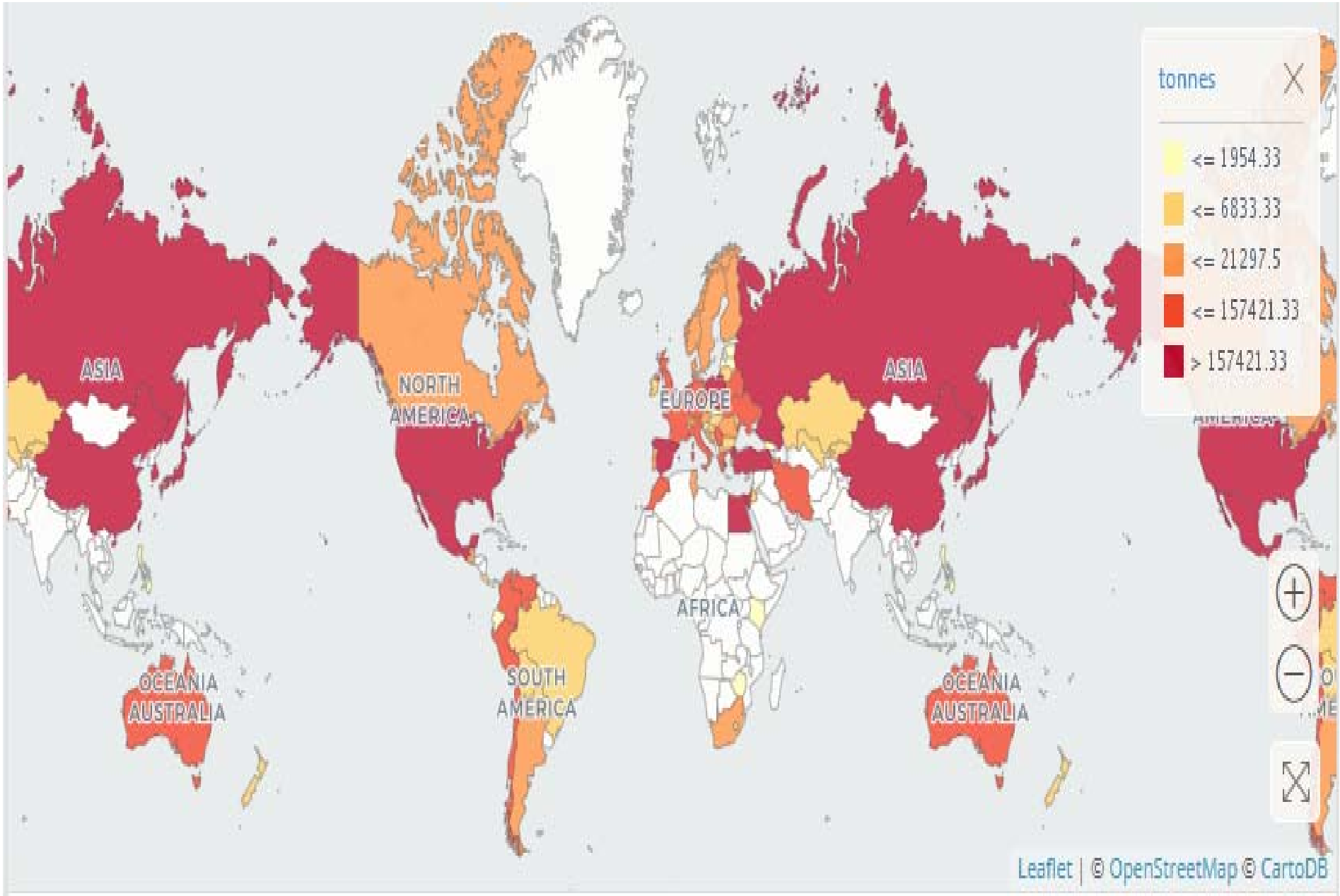
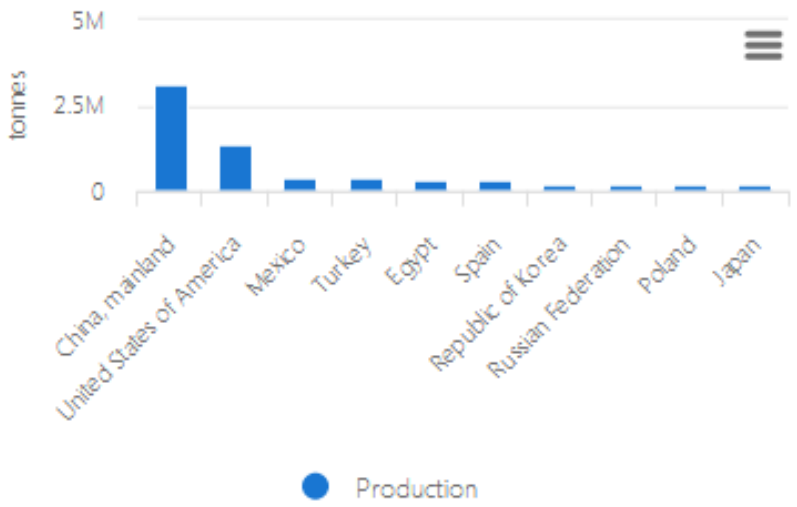
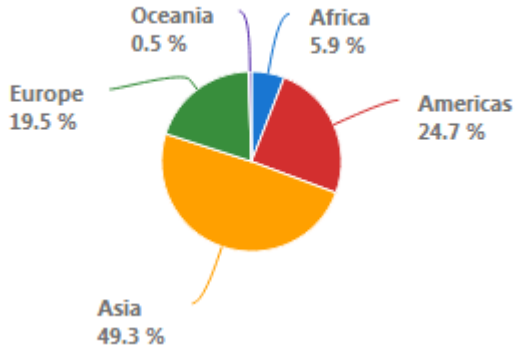
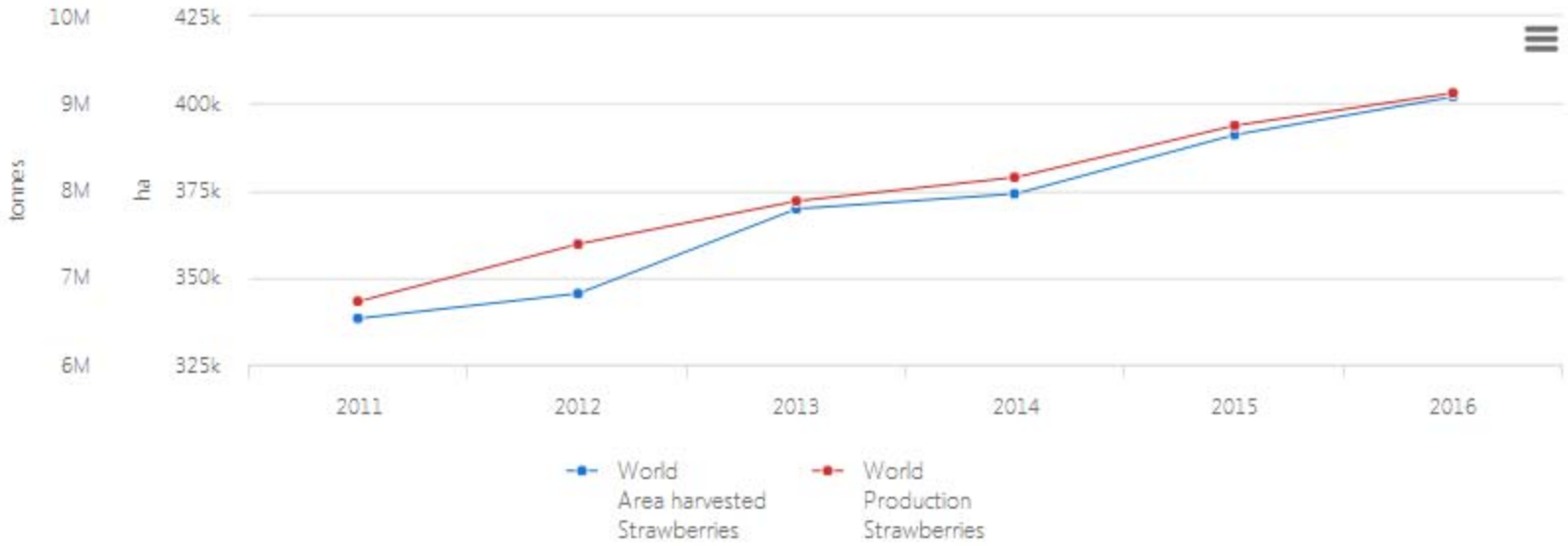

tonnes
<= 1954.33
<= 6833.33
<= 21297.5
<= 157421.33
> 157421.33
ASIA
NORTH AMERICA
EUROPE
ASIA
AFRICA
OCEANIA AUSTRALIA
SOUTH AMERICA
OCEANIA AUSTRALIA
Leaflet | © OpenStreetMap © CartoDB

Production of Strawberries: top 10 producers

Average 2011 - 2016







	Area	Item	Year Code	Year	Unit	Value
2	China, ma	Strawberr	2019	2019	tonnes	3212814
3	United Sta	Strawberr	2019	2019	tonnes	1021490
4	Mexico	Strawberr	2019	2019	tonnes	861337
5	Turkey	Strawberr	2019	2019	tonnes	486705
6	Egypt	Strawberr	2019	2019	tonnes	460245
7	Spain	Strawberr	2019	2019	tonnes	351960
8	Russian Fe	Strawberr	2019	2019	tonnes	208800
9	Republic c	Strawberr	2019	2019	tonnes	192971
10	Poland	Strawberr	2019	2019	tonnes	185400
11	Morocco	Strawberr	2019	2019	tonnes	167827
12	Brazil	Strawberr	2019	2019	tonnes	165440
13	Japan	Strawberr	2019	2019	tonnes	158443
14	Germany	Strawberr	2019	2019	tonnes	143980
15	United Kir	Strawberr	2019	2019	tonnes	141594
16	Italy	Strawberr	2019	2019	tonnes	125130
17	Belarus	Strawberr	2019	2019	tonnes	81887
18	Netherlan	Strawberr	2019	2019	tonnes	75590
19	Greece	Strawberr	2019	2019	tonnes	74430
20	Australia	Strawberr	2019	2019	tonnes	68534
21	Ukraine	Strawberr	2019	2019	tonnes	62620
22	France	Strawberr	2019	2019	tonnes	60310
23	Iran (Islan	Strawberr	2019	2019	tonnes	59755

Small Fruits

- Hardy kiwi

Cultivars
- 'Issai'
- 'Anna'
- 'Dumbarton Oaks'
- others

Relevant, Reliable, Responsive...

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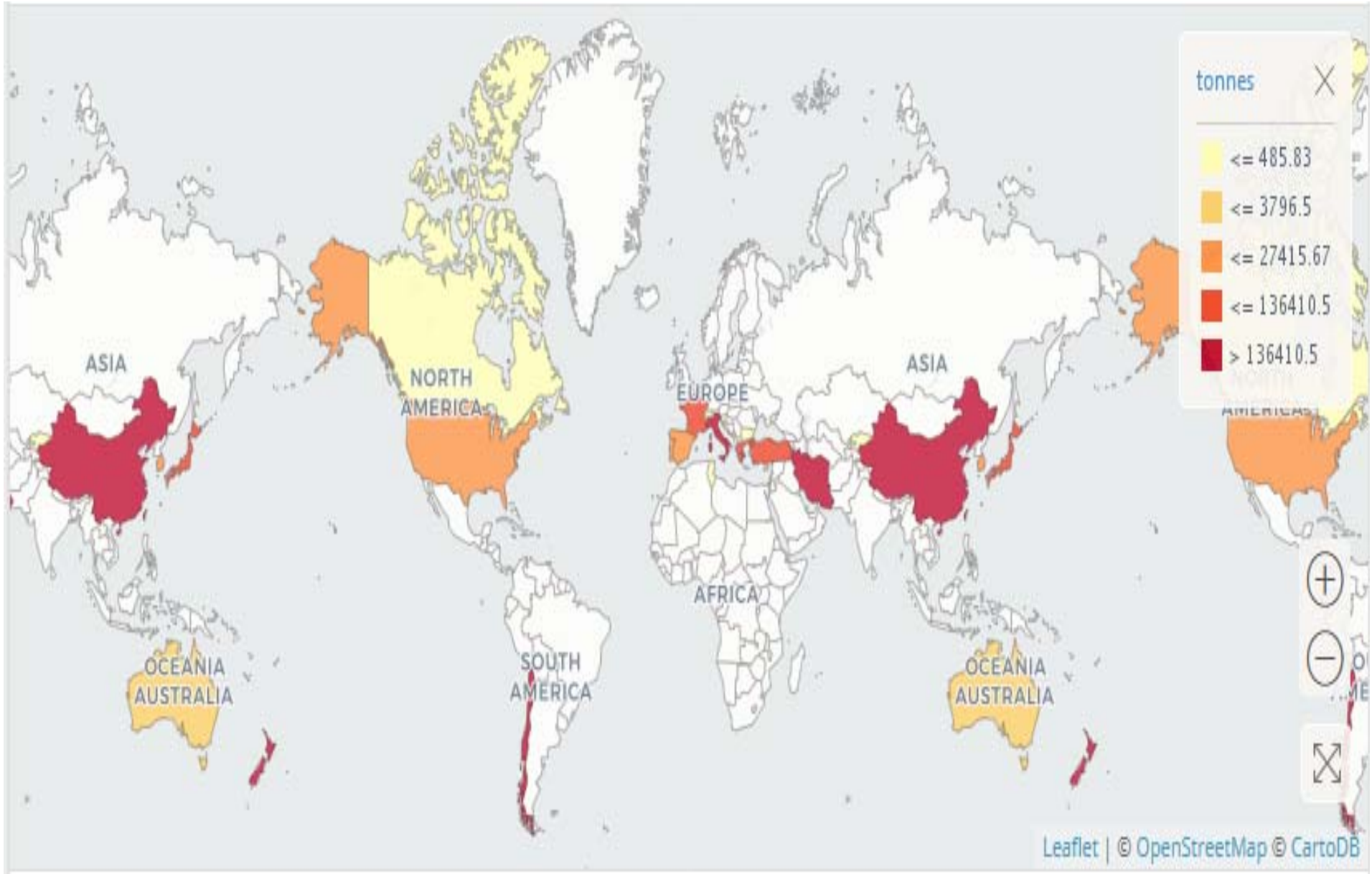
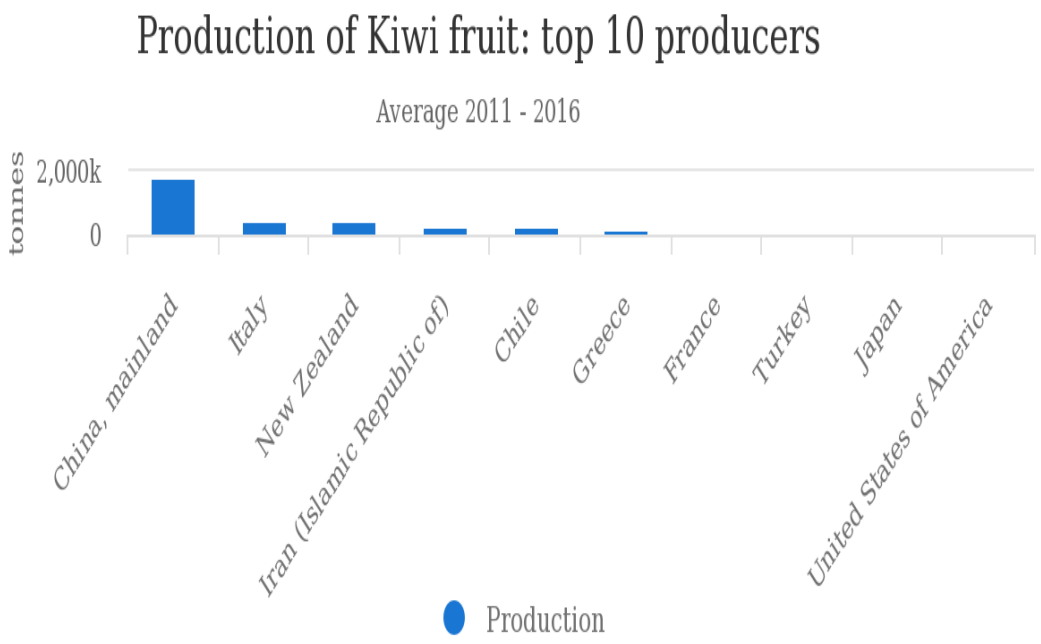
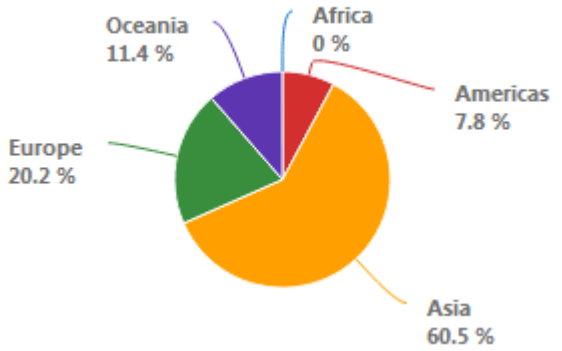
Production quantities of Kiwi fruit by country

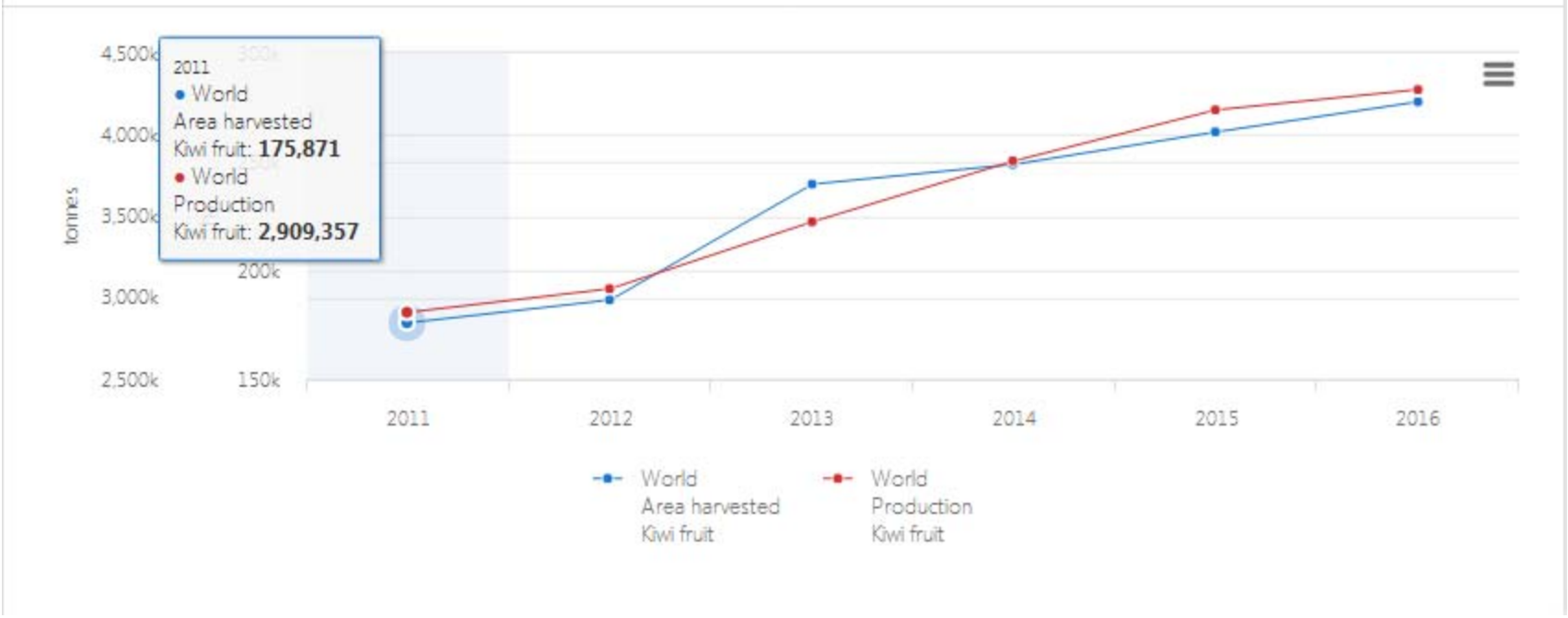
Average 2011 - 2016







Source: FAOSTAT (Feb 06, 2018)



	Area	Item	Year Code	Year	Unit	Value
2	China, ma	Kiwi fruit	2019	2019	tonnes	2196727
3	New Zeala	Kiwi fruit	2019	2019	tonnes	558191
4	Italy	Kiwi fruit	2019	2019	tonnes	524490
5	Iran (Islam	Kiwi fruit	2019	2019	tonnes	344189
6	Greece	Kiwi fruit	2019	2019	tonnes	285860
7	Chile	Kiwi fruit	2019	2019	tonnes	177206
8	Turkey	Kiwi fruit	2019	2019	tonnes	63798
9	France	Kiwi fruit	2019	2019	tonnes	55830
10	United Sta	Kiwi fruit	2019	2019	tonnes	46720

Small Fruits

Brambles

- Pluses
  - quick production
  - pest resistant
  - easy to grow
  - fruit
- Minuses
  - winter injury
  - high temperature damage
  - thorns

Brambles

- Self fruitful
- Types of brambles
  - raspberry
    - primocane red raspberries
    - floricane red raspberries
    - black raspberries
    - purple raspberries
  - blackberry
    - upright thornless and thorny
    - primocane
    - semi-erect thornless

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Small Fruits

Barberry

Berberis vulgaris

Berberidaceae (650 species)

Japanese barberry

Berberis thunbergii

عکس از: مجتبی گرگی Date & Time: 1395/08/08 - 12:35

Cornelian cherry dogwood

- **Type: Tree**
- **Family: Cornaceae**
- **Native Range: Europe, western**
- **Zone: 4 to 8**
- **Height: 15.00 to 25.00 feet**
- **Spread: 15.00 to 20.00 feet**
- **Bloom Time: March**


MIZAN
Parviz Golizadeh

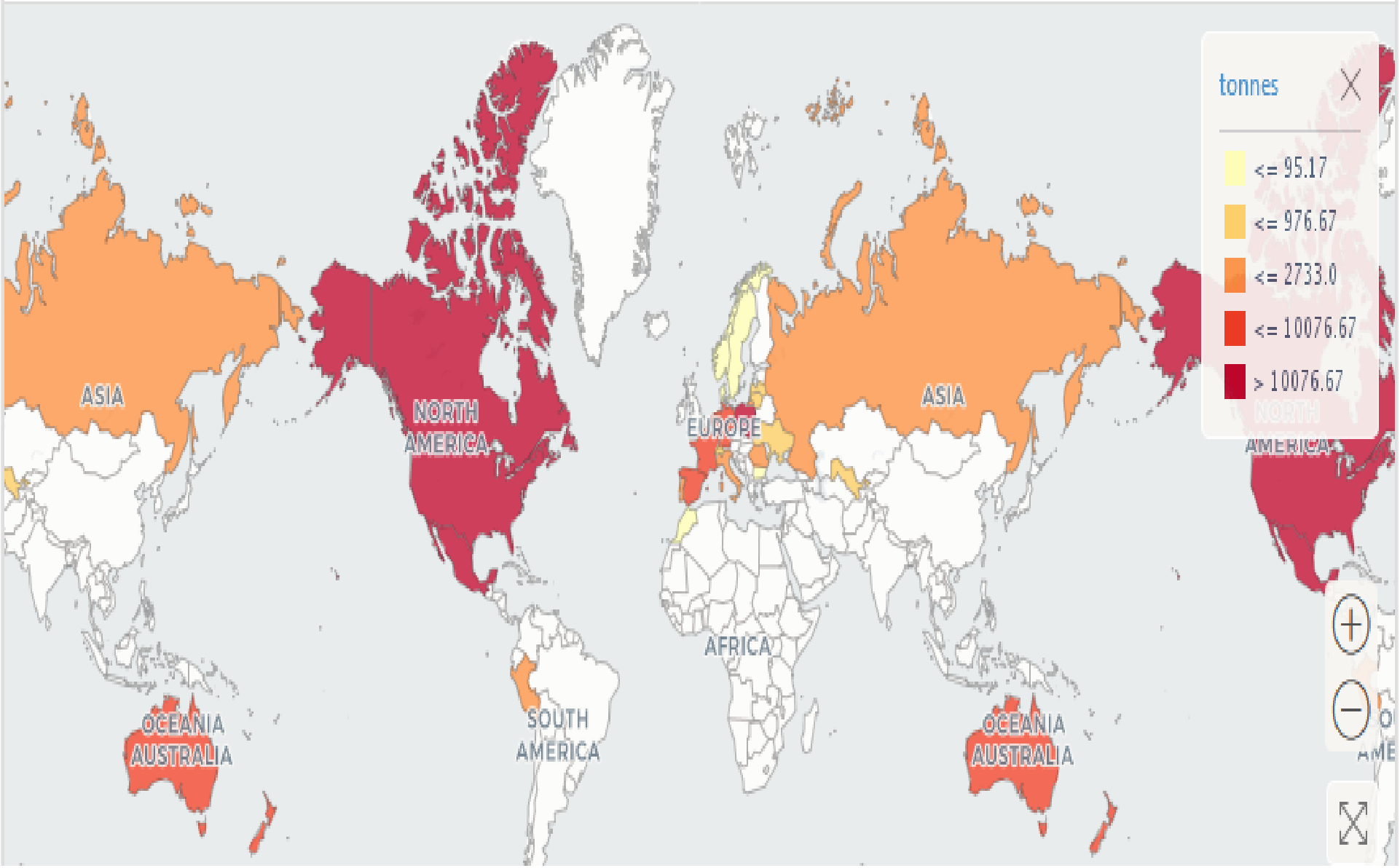
Small Fruits

Blueberries

- Pluses
  - hardy, long lived
  - multiseason interest
  - fruit
- Minuses
  - specific soil requirements
  - bird problems

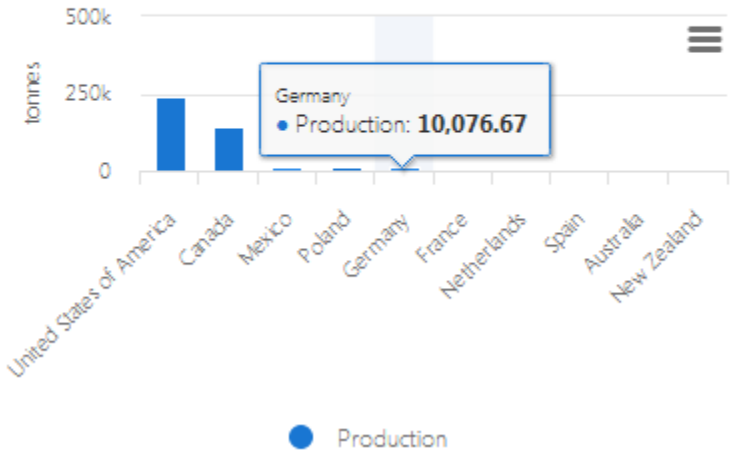
Production quantities of Blueberries by country

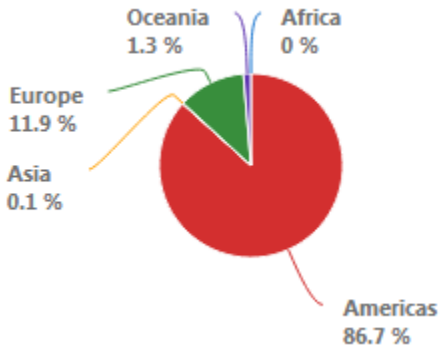
Average 2011 - 2016

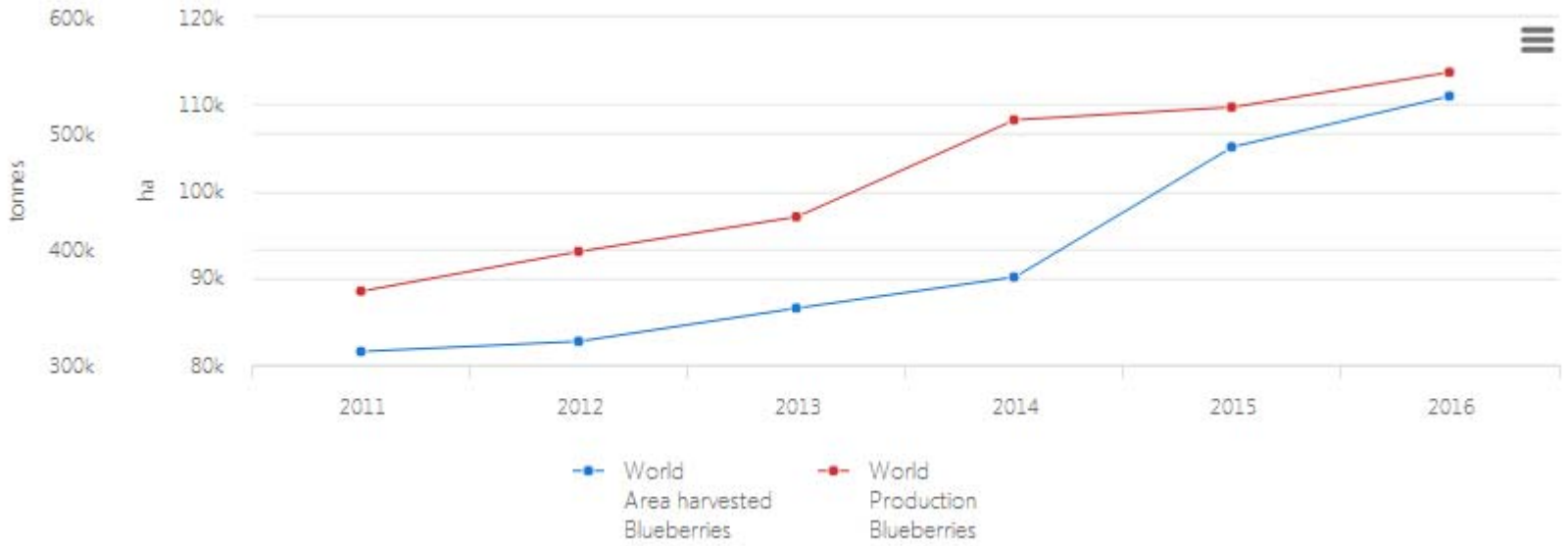


Production of Blueberries: top 10 producers

Average 2011 - 2016







Small Fruits

Gooseberry, Currant

- Gooseberry and currants (black, red, white)

Cultivars
- Gooseberry – 'Pixwell', 'Poorman'
- Red currant – 'Wilder', 'Red Lake'
- White currant – 'White Pearl', 'Primus'
- Black currant – 'Consort', 'Ben Sarek', 'Crandall'

Production quantities of Gooseberries by country

Average 2011 - 2016

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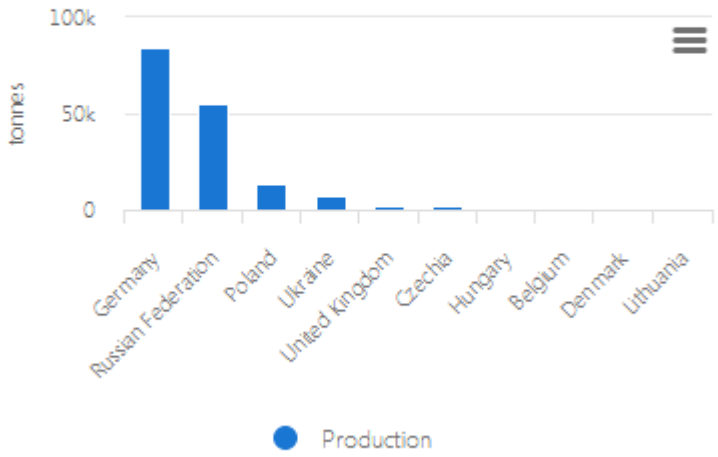
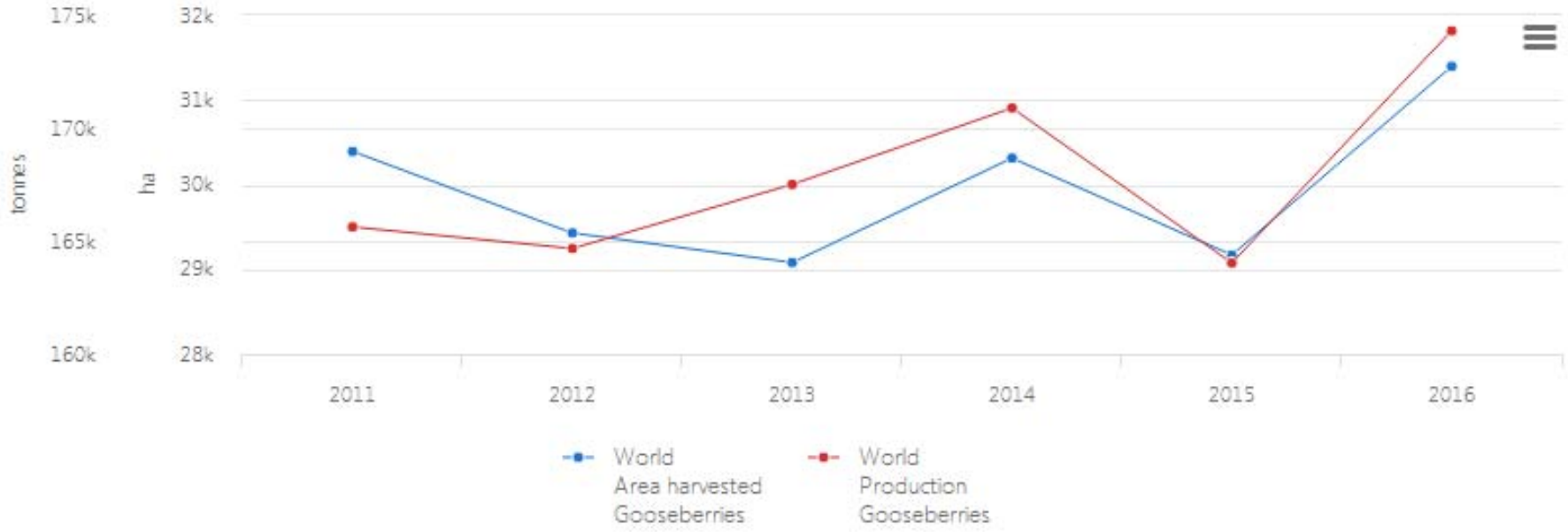
Production of Gooseberries: top 10 producers

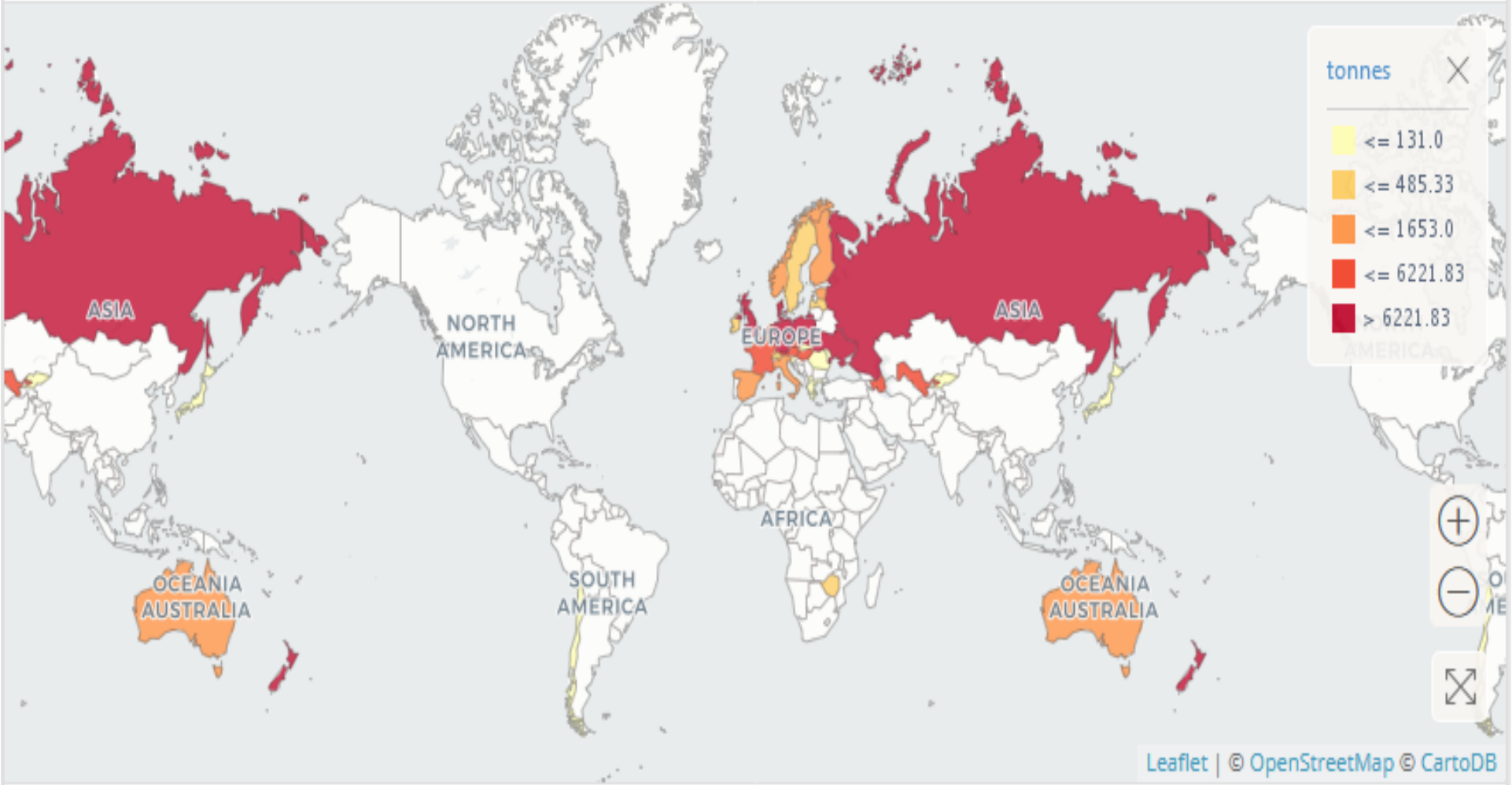
Average 2011 - 2016





Production quantities of Currants by country

Average 2011 - 2016



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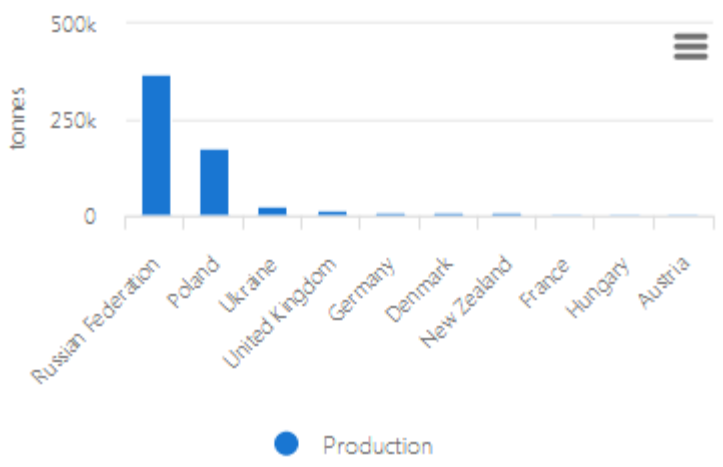
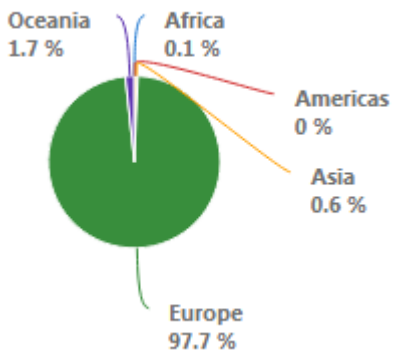
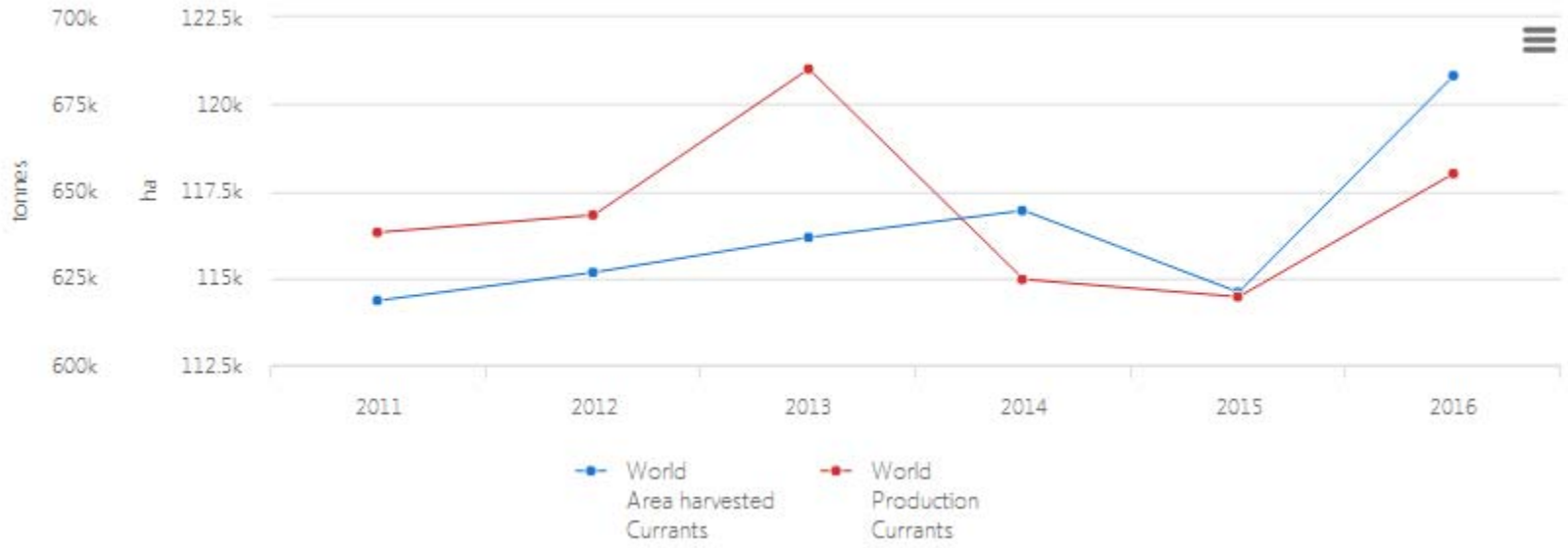
Production of Currants: top 10 producers

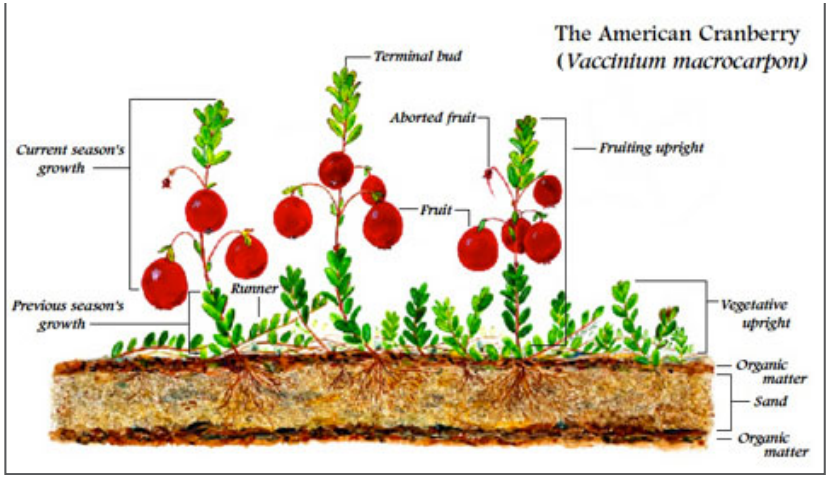
Average 2011 - 2016

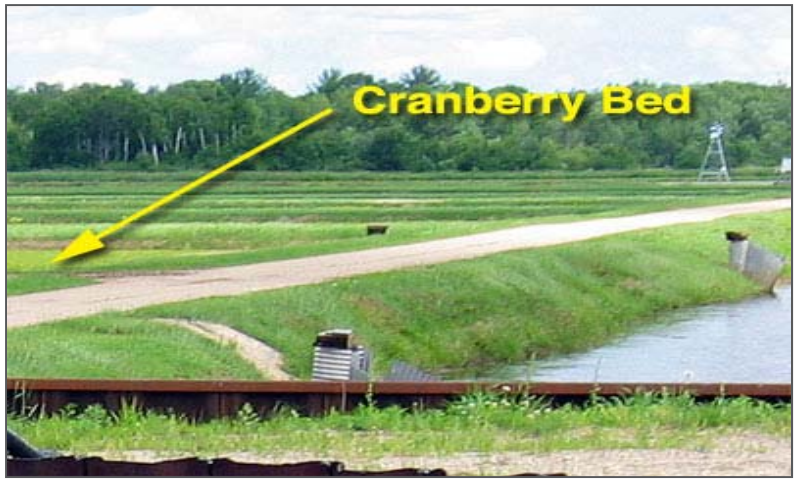






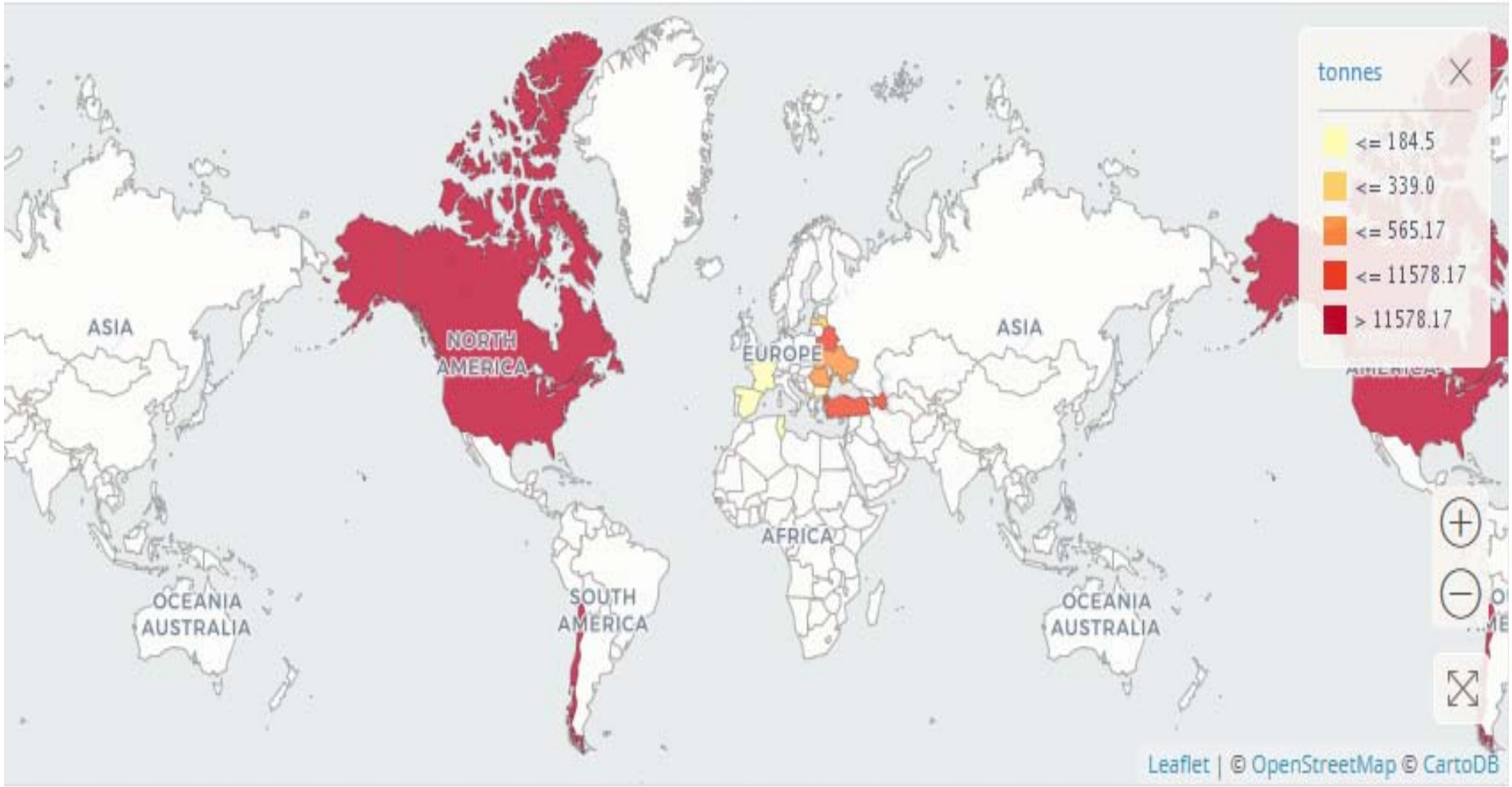
true or lowbush cranberry


The American Cranberry
(Vaccinium macrocarpon)
Terminal bud
Aborted fruit
Fruiting upright
Current season's growth
Fruit
Runner
Previous season's growth
Vegetative upright
Organic matter
Sand
Organic matter


Cranberry Bed

Production quantities of Cranberries by country

Average 2011 - 2016



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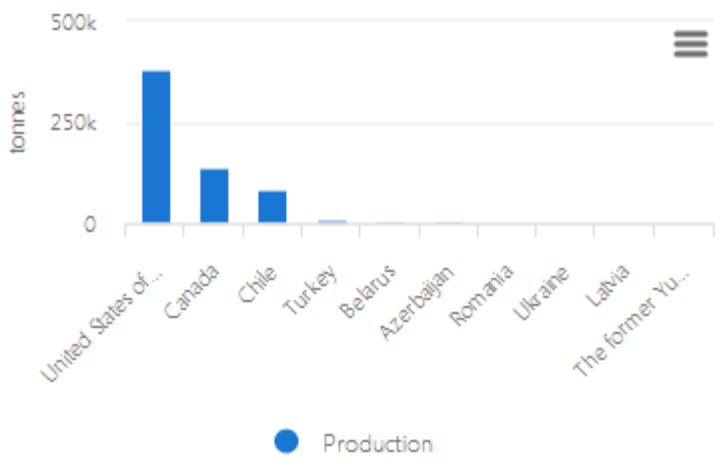
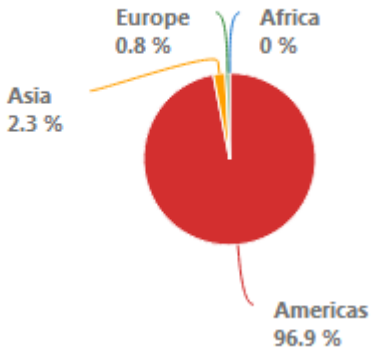
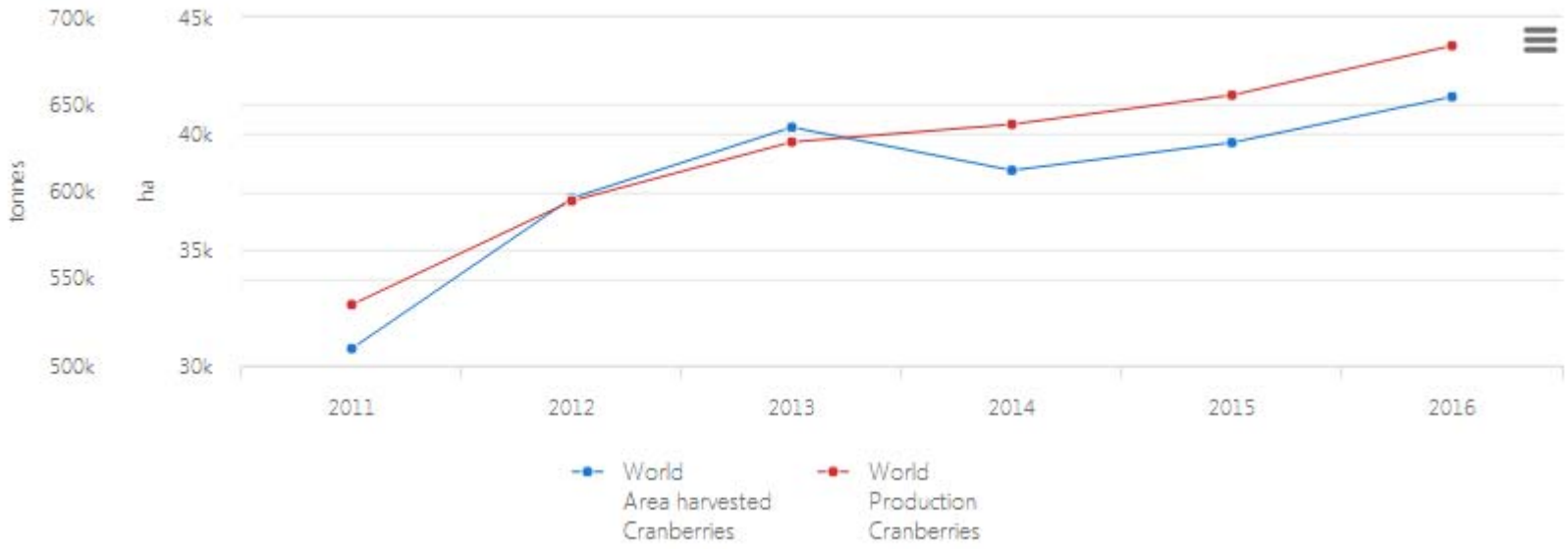
Production of Cranberries: top 10 producers

Average 2011 - 2016







Other Small Fruits

- Highbush cranberry
- Aronia
- Autumn olive

Highbush Cranberry

Autumn olive

Aronia

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- lowbush cranberry plant

- highbush cranberry plant

- The **highbush cranberry** is actually not a cranberry at all, though its fruit, or 'drupes' as they are known taxonomically, strongly resemble cranberries in both appearance and taste. They also mature in the fall, as cranberries do. The two plants are quite different, however. Both are native to North America, but:

the highbush cranberry is a *Viburnum*, a member of the Caprifoliaceae, or **Honeysuckle family**, in contrast to the

'**true**,' or lowbush cranberry, which is a *Vaccinium*, a member of the Ericaceae—Heather or Heath—family.

The Honeysuckle family is comprised of about 400 species, with 11 tree species—and numerous shrub species—that are native to North America

Elderberry

- Elderberry *(Sambucus canadensis)*

Cultivars
- **'Bob Gordon'**
- **'Wyldewood'**
- 'Adams 1 & 2'
- 'York'
- 'Nova'
- 'Scotia'
- 'Kent'
- 'Johns'

GRAPES

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Fig. 1.1. *Vitis riparia* smothering a tree in an upstate New York winter.

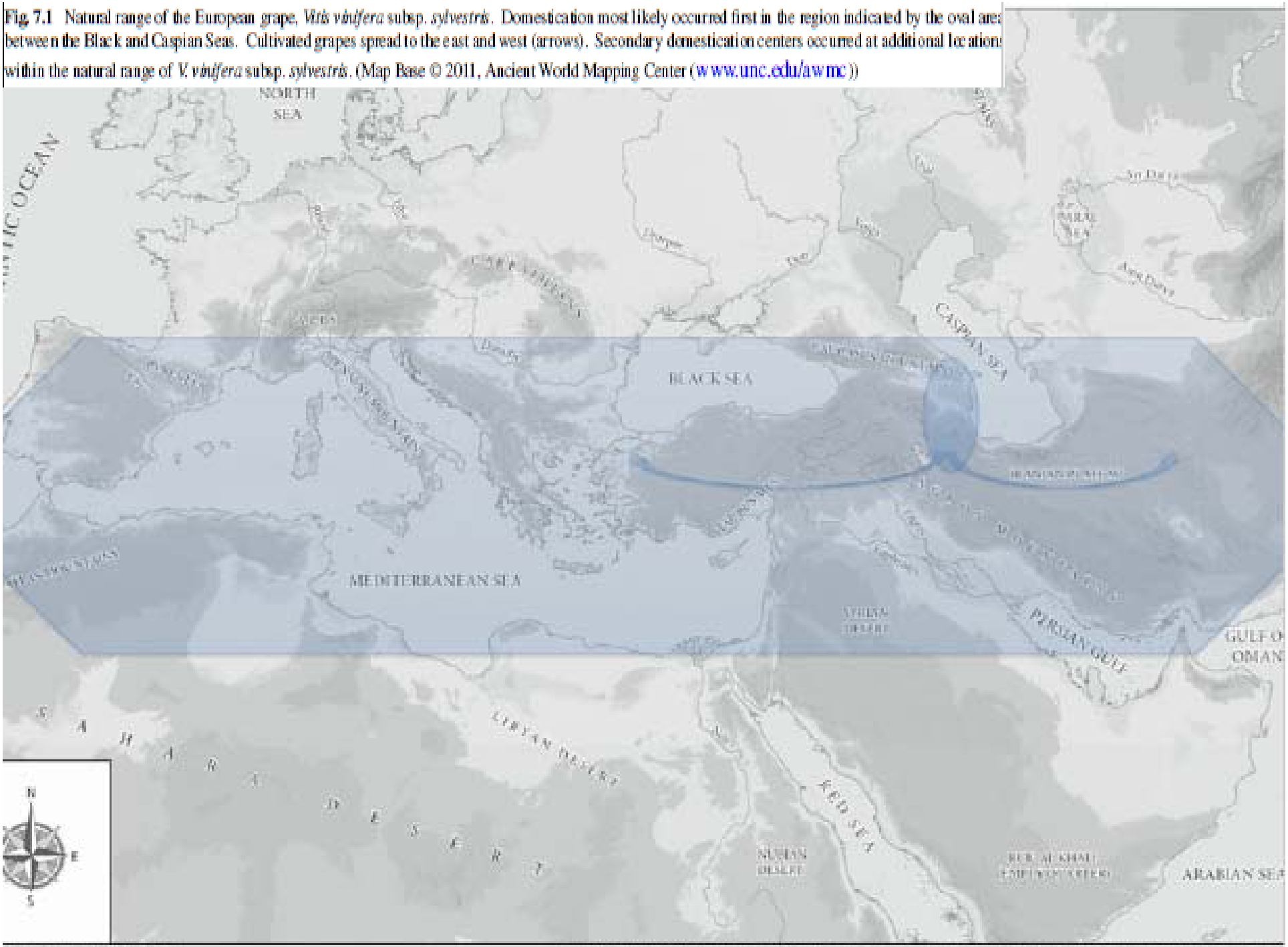


Fig. 7.1 Natural range of the European grape, *Vitis vinifera* subsp. *sylvestris*. Domestication most likely occurred first in the region indicated by the oval area between the Black and Caspian Seas. Cultivated grapes spread to the east and west (arrows). Secondary domestication centers occurred at additional locations within the natural range of *V. vinifera* subsp. *sylvestris*. (Map Base © 2011, Ancient World Mapping Center (www.unc.edu/awmc))

Grape

	2013	AreaName
1	11550024	China, mainland
2	8010364	Italy
3	7744997	United States of America
4	7480000	Spain
5	5518371	France
6	4011409	Turkey
7	3297981	Chile
8	2881346	Argentina
9	2483000	India
10	2046420	Iran (Islamic Republic of)
11	1850000	South Africa
12	1762572	Australia
13	1439535	Brazil
14	1389133	Egypt
15	1322090	Uzbekistan

Table 1.1. Estimated average annual grape production (2001–2003, in 100,000 kg) by country (from OIV, 2003).

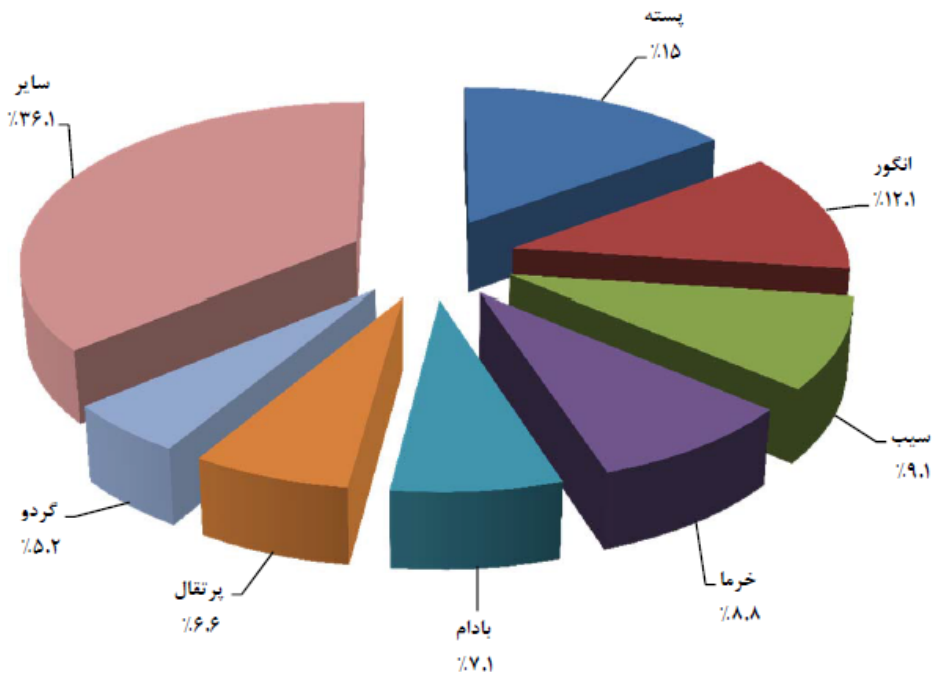
Rank	Country	Production	Rank	Country	Production
1	Italy	78,436	22	Yugoslavia[a]	4,437
2	France	67,921	23	Bulgaria	4,253
3	USA	61,933	24	Mexico	4,184
4	Spain	59,896	25	Korea	4,173
5	China	44,450	26	Ukraine	4,000
6	Turkey	34,500	27	Afghanistan	3,650
7	Iran	26,736	28	Croatia	3,544
8	Argentina	23,353	29	Syria	3,461
9	Chile	19,459	30	Iraq	2,950
10	Australia	15,989	31	Morocco	2,739
11	South Africa	14,884	32	Russia	2,669
12	Germany	12,075	33	Austria	2,553
13	Greece	11,793	34	Algeria	2,362
14	India	11,400	35	Japan	2,260
15	Egypt	10,956	36	Macedonia	1,954
16	Romania	10,820	37	Turkmenistan	1,667
17	Brazil	10,794	38	Yemen	1,654
18	Portugal	9,988	39	Georgia	1,467
19	Hungary	6,789	40	Peru	1,364
20	Moldavia	6,036		All others	17,790
21	Usbekistan	4,970		Total	616,309

[a]Yugoslavia was not officially abolished as a political entity until 2003.

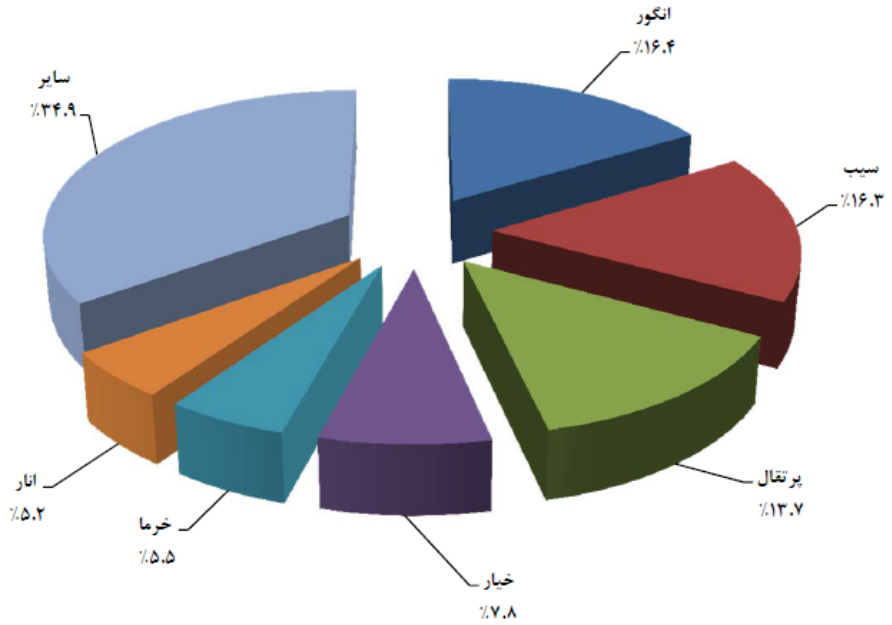
Table 1.2. Estimated area of land cultivated to grapes in 2005, by country. The percentage change in area since 1995 is also indicated (from FAO, 2006).

Country	Production area (ha)	Change from 1995 (%)
Spain	949,100	–18
France	851,615	–5
Italy	837,845	–7
Turkey	530,000	–6
China	453,200	+187
USA	380,000	+20
Iran	275,000	+18
Romania	217,006	–13
Portugal	210,000	–18
Argentina	208,000	+1
Chile	178,000	+57
Australia	153,204	+145
Moldova	145,000	–18
Greece	127,000	0
South Africa	123,190	+19
Bulgaria	113,334	+1
Uzbekistan	110,000	+16
Germany	98,000	–5
All others	1,387,118	+5
Of note:		
New Zealand	19,960	+227
Switzerland	15,000	+1
Canada	9,259	+29
Namibia	2000	+233

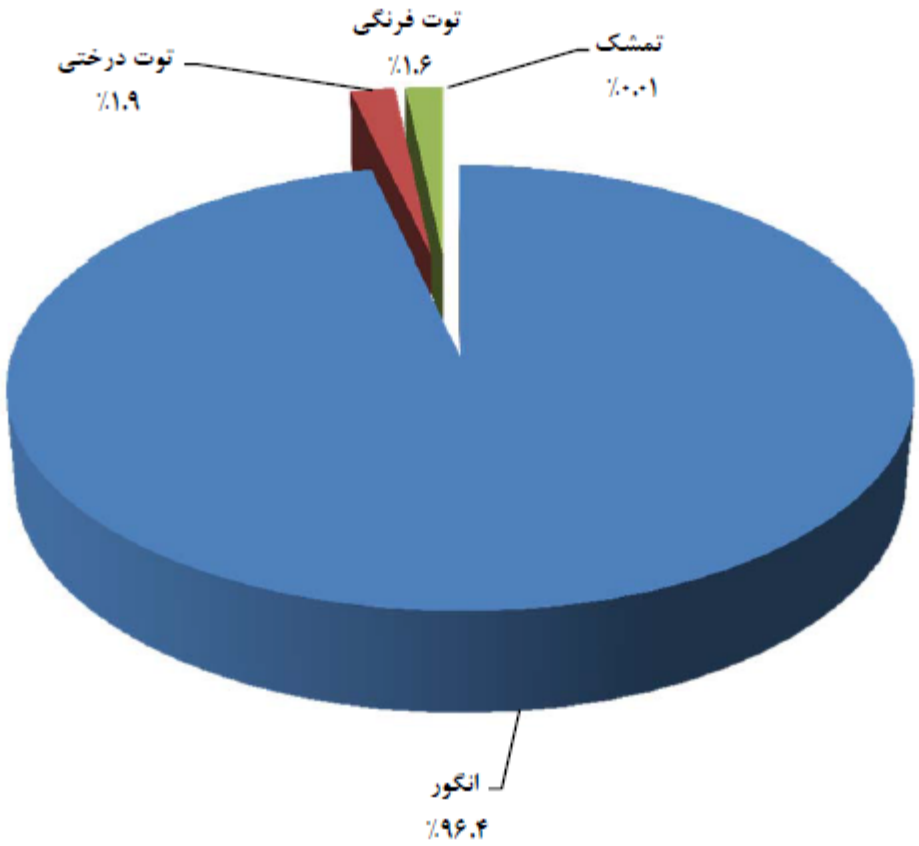
نمودار شماره ۱- درصد توزیع هفت محصول با بیشترین سطح بارور کشور در سال۱۳۹۵



نمودار شماره ۲- درصد توزیع شش محصول با بیشترین میزان تولید کشور در



نمودار شماره ۱۱- درصد توزیع سطح میوه‌های دانه‌ریز در سال ۱۳۹۵



بیشترین سطح میوه‌های دانه‌ریز (اعم از غیر بارور و بارور) در کشور متعلق به استان‌های فارس با ۲۲,۷، قزوین با ۹,۴، خراسان‌رضوی با ۹، آذربایجان‌غربی با ۶,۴ درصد و همدان با ۶,۳ درصد است. این پنج استان جمعاً ۵۳,۶ درصد از سطح باغ‌های میوه‌های دانه‌ریز (اعم از غیر بارور و بارور) را به خود اختصاص داده‌اند.

شش محصول باغبانی با بیشترین میزان تولید در سال ۱۳۹۵

جدول شماره ۱۲ ((واحد : میلیون تن))

محصول	میزان تولید	درصد از کل تولید
انگور	۳,۵	۱۶,۴
سیب	۳,۴	۱۶,۳
پرتقال	۲,۹	۱۳,۷
خیار گلخانه‌ای	۱,۶	۷,۸
خرما	۱,۲	۵,۵
انار	۱,۱	۵,۲

Grapes

- Horticultural Classification
  (3 groups)
- Botanical Classification
  (2 groups)
- Classification according to usage
  (4 groups)

Vitis vinifera

Discover our grape varieties

Over the last 60 year Chacalli-De Decker became a real wine connoisseur. On this page you can find information several grape varieties and a top ten of wines selected out of our wine catalogue for every one of these grapes.


Riesling


Cabernet Sauvignon


Sauvignon Blanc


Cabernet Franc


Pinot Noir


Chardonnay


Grenache


Zinfandel


Merlot


Syrah


Pinot Gris

Vitis labrusca

- *Vitis rotundifolia*

1

Plate 1. *Vitis riparia* grapes growing wild in the North East of the United States. The berries are densely coloured and strong of flavour.

Grape Cultivar Types

American- selections from wild species found in North America (labrusca, aestivalis) and results of breeding

Ex. Concord, Catawba, Niagara, Delaware, Cynthiana/Norton

French-American Hybrids- Hybrids between V. vinifera and various North American species

Ex. Seyval, Vidal, Vignoles, Chambourcin, Foch, etc.

European- Vitis vinifera Ex. Chardonnay, Cabernet Sauvignon, Riesling, etc.

Meet the Grapes

Noble is the primary red muscadine used for juice and wines in much of the Southeast.

Cynthiana (a.k.a. Norton) - originated in Virginia and is currently very popular for use in making fine dry red wines.

Chambourcin is a black-fruited French hybrid grape used for producing a dry, deep-colored red wine.

Chardonel, a cross between Seyval and Chardonnay, narrows the gap between French-American hybrids and V. viniferas by producing a fine dry white wine.

Vidal, a French hybrid developed in the 1930's, is a late ripening white grape that is used for wines ranging from sweet to dry, and even for "late harvest" wines.

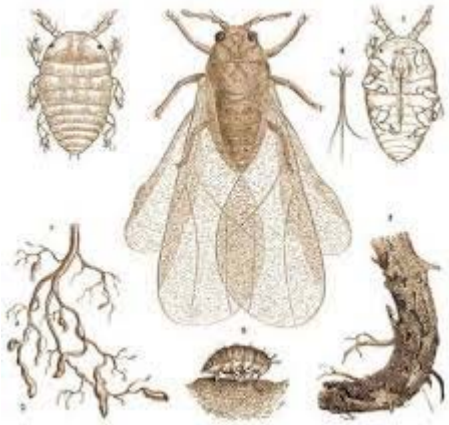
www.PickTnProducts.org

pick TENNESSEE

Grape phylloxera, *Daktulosphaira vitifoliae* (Fitch) (Homoptera: Phylloxeridae), is an aphidlike insect that feeds aggressively on grape roots. Phylloxera is native to the eastern and southeastern United States, where native American grape species coevolved with the insect.

The American grape species *Vitis rupestris*, *V. berlandieri*, and *V. riparia* are resistant to phylloxera. In contrast, the American grape species *V. labrusca*, *V. aestivalis*, and *V. vulpina* are susceptible to phylloxera. European winegrapes, *V. vinifera*, are the most susceptible.

There is no way to eradicate phylloxera from an infested vineyard. It will eventually kill susceptible grapevines. The only way to manage an infestation in the long term is to replant the vineyard to vines grafted to a resistant rootstock (see Chapter 6).



Phylloxera vastatrix

Ordnung Vitales

Familie Vitaceae

Gattung Vitis

2 Untergattungen *Euvitis: 19 Chromosomen* — Euvitis | Muscadinia — *Muscadinia: 20 Chromosomen*

ca. 50 Arten

3 Unterarten bei *Vitis vinifera*

Vitis vinifera — *Ssp. sativa* Edelrebe | *Ssp. caucasica* | *Ssp. sylvestris*


Scheurebe


Müller-Thurgau


Cabernet Sauvignon


Muskateller


Merlot


Spät-burgunder


Silvaner


Riesling


Grau-burgunder

Vitis rupestris | *Vitis riparia* | *Vitis berlandieri* | *Vitis cinerea* | *Vitis labrusca* | *Vitis amurensis*


8 B


Couderc


Binova


Börner


Isabella


Rondo


Richter 110


SO4


5C


5BB

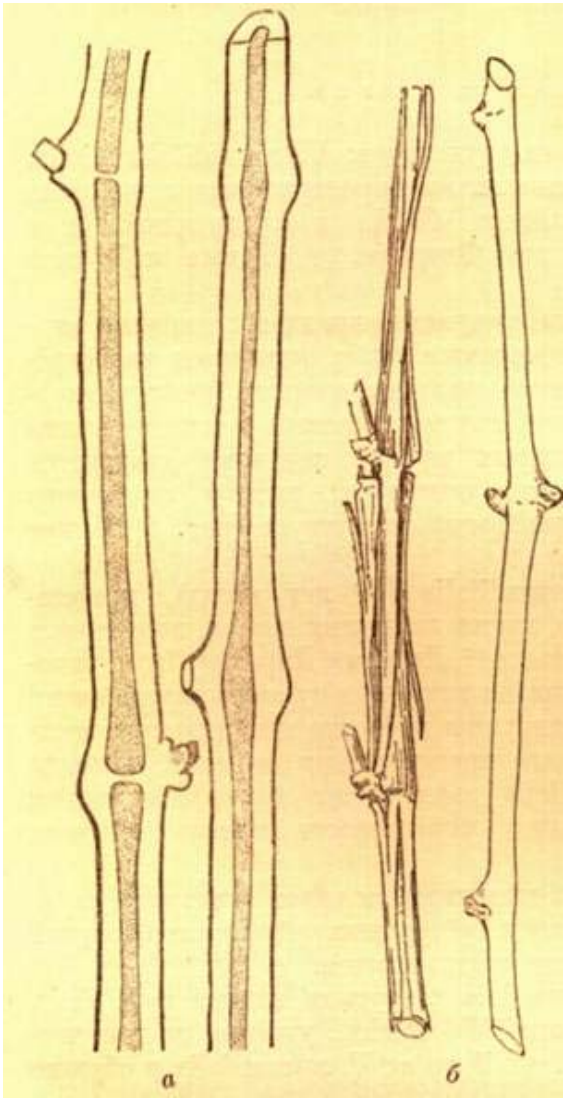

125AA

Ca. 10 000 Kultursorten der Edelrebe und zahlreiche Kreuzungen von diesen Kultursorten

Wildarten Amerikas mit Resistenz-eigenschaften verwendet für Kreuzungen von Unterlagssorten für die Pfropfrebenherstellung

Weinsorten Amerikas mit unangenehmen Foxgeschmack

Wildform Asiens frost-hart Verwendung für Kreuzungen


а
б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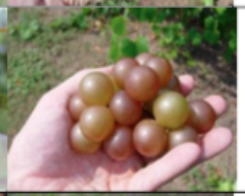
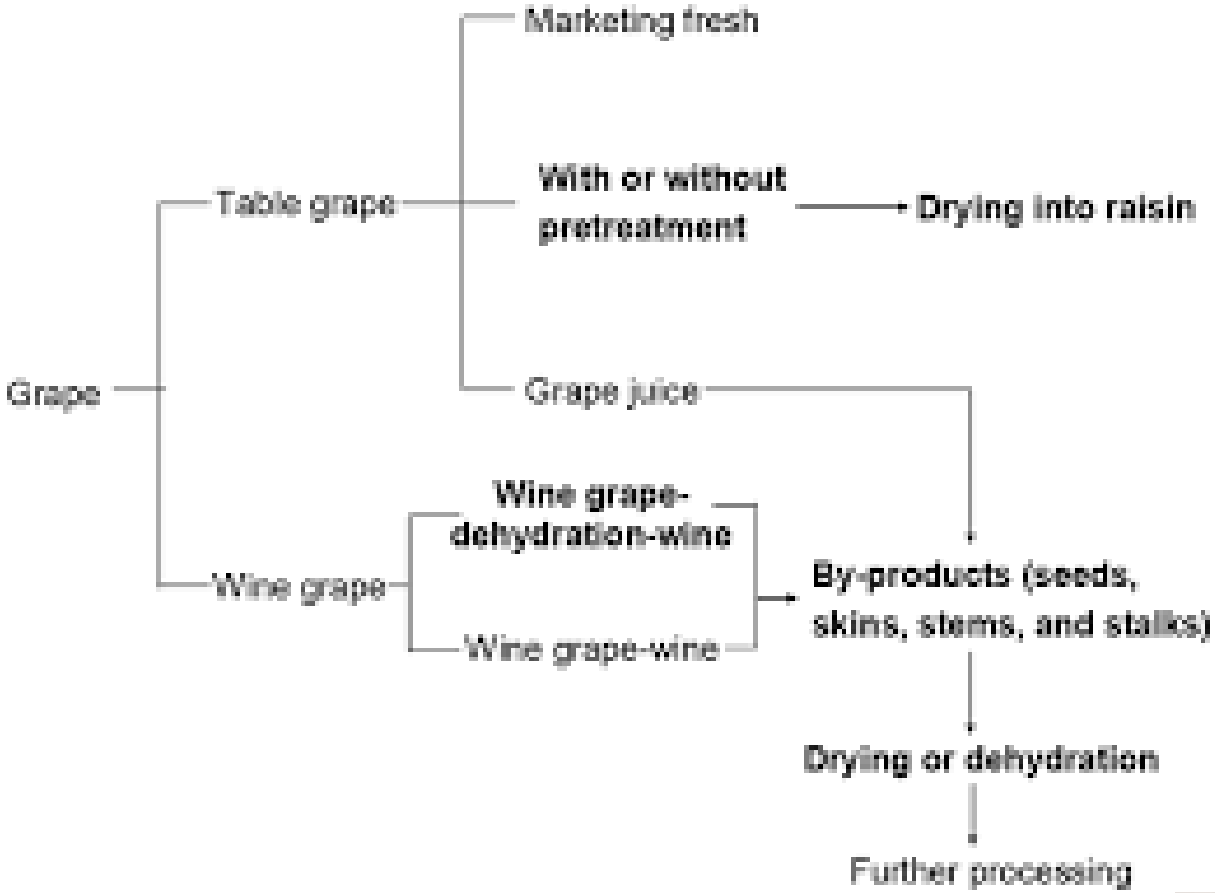
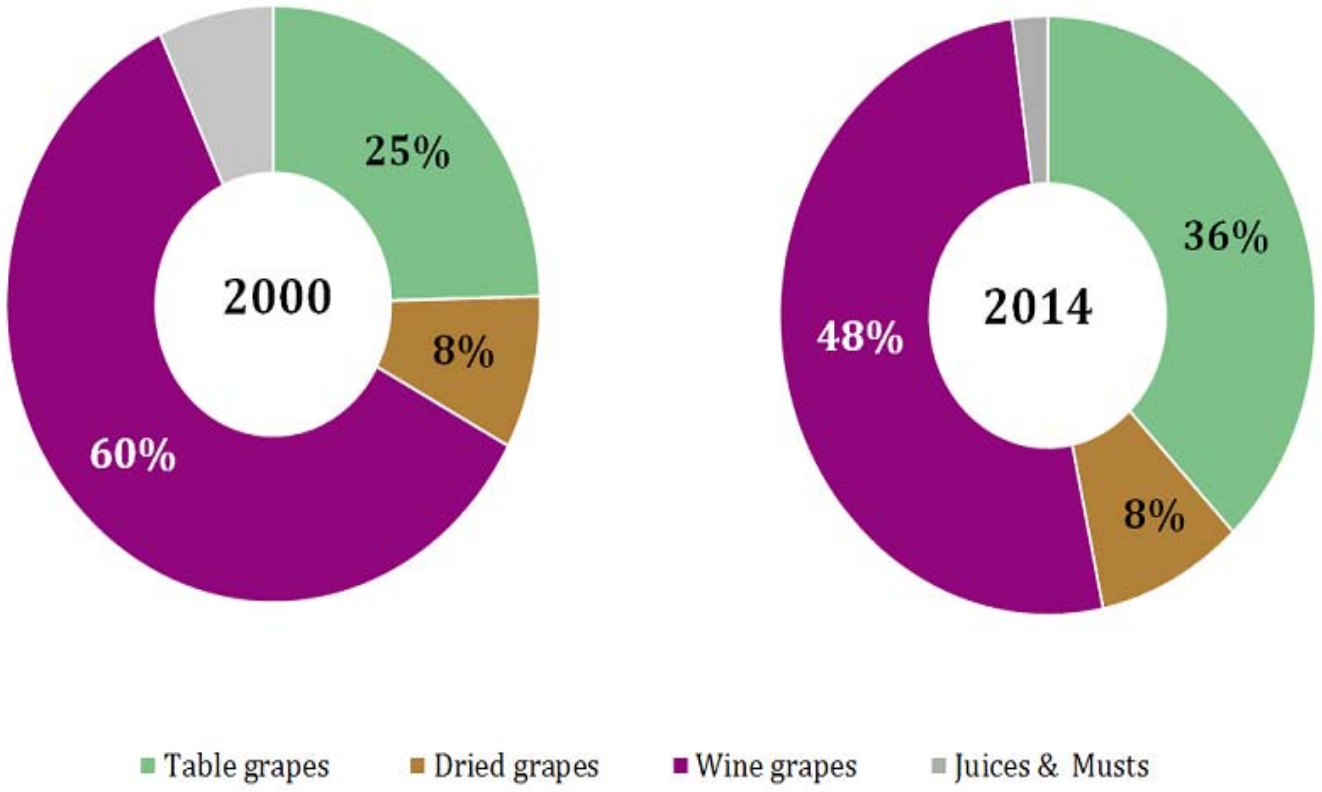
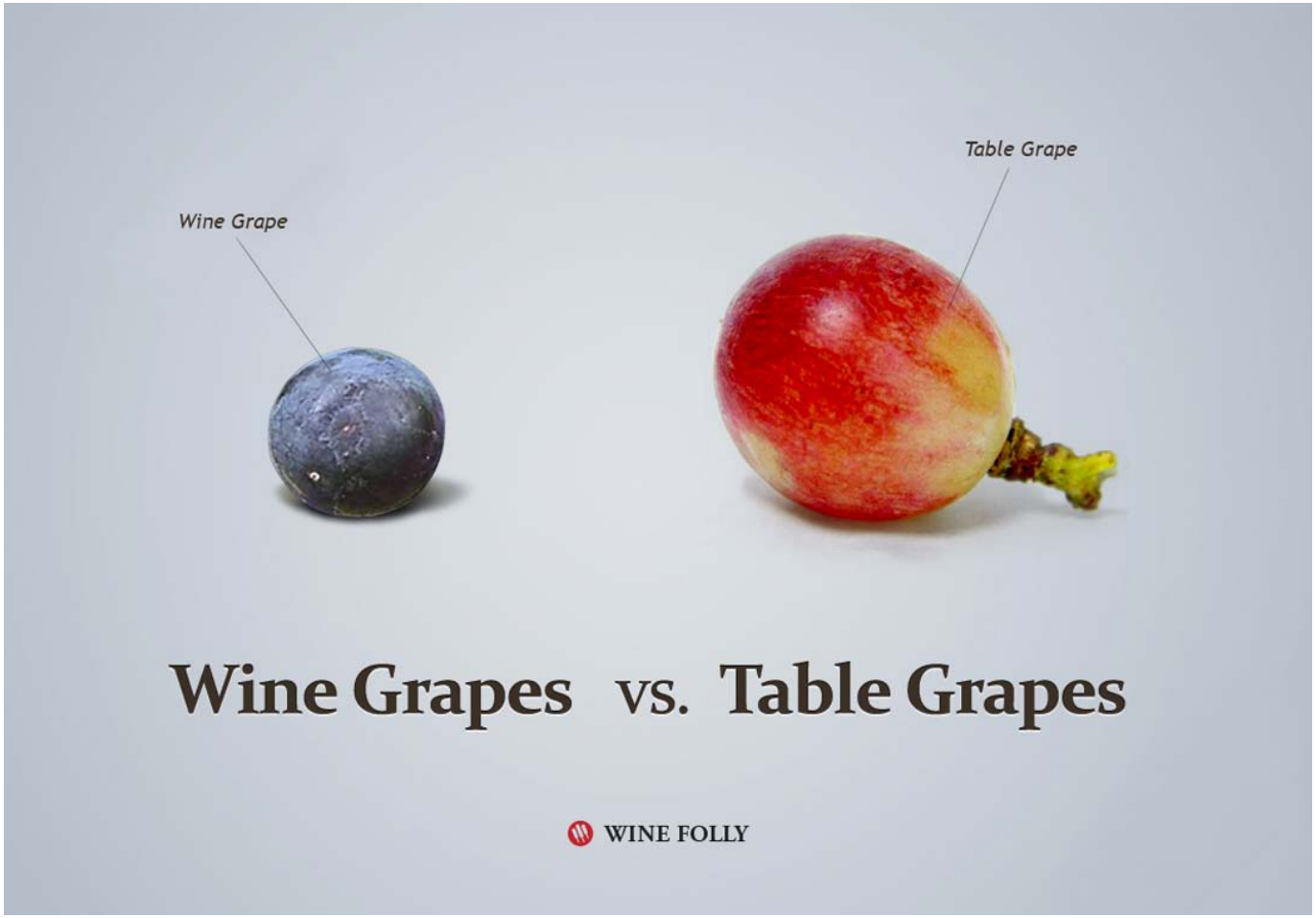
Characteristics of Muscadine Grape

Variety			Size	Flavor	Notes
Tara			Large	Good, sweet flavor 14 - 17% sugar	Full-bodied flavor Color: Bronze Thick skinned
Early Fry			Very Large	Good Flavor 14 - 18% sugar	Color: Dull Bronze Traditional slip skin
Triumph			Medium Large	Very sweet 14 - 18% sugar	Color: Pinkish Bronze Traditional slip skin
Late Fry			Large	Very sweet 14 - 21% sugar	Color: Green-Bronze Traditional slip skin
Lane			Large	Very sweet 14 - 20% sugar	Color: Very dark, Purple-Black evenly colored grape Crisp skin
Nesbitt			Medium Large	Delicious, Concord flavor 14 - 18% sugar	Color: Purple-Black Traditional slip skin
Supreme			Very Large	Very sweet 14 - 22% sugar	Largest of the black variety. Color: Dark Purple-Red Crisp skin


Marketing fresh
Table grape
With or without pretreatment
Drying into raisin
Grape
Grape juice
Wine grape-dehydration-wine
Wine grape
By-products (seeds, skins, stems, and stalks)
Wine grape-wine
Drying or dehydration
Further processing


25%
2000
8%
60%
36%
2014
48%
8%
Table grapes
Dried grapes
Wine grapes
Juices & Musts


Wine Grape
Table Grape
Wine Grapes vs. Table Grapes
WINE FOLLY

Classification of Grape Varieties

List of commercial and popular Grape varieties in India:

Category	Varieties
Table Grapes	Thompson Seedless, Sharad Seedless, Pusa Seedless, Sonaka.
Raisin Grapes	Thompson Seedless, Arkavati
Wine Grapes	Bangalore Blue, Thompson Seedless

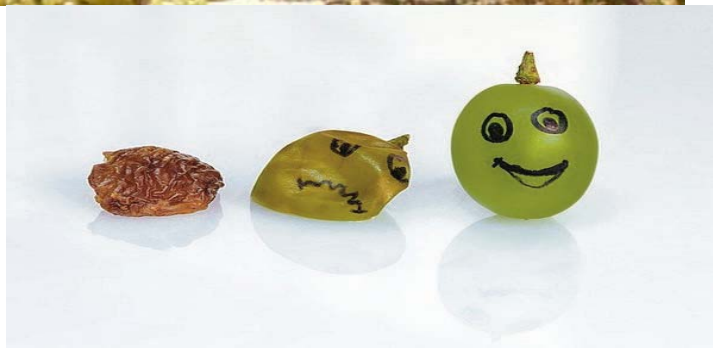
Table grapes:

- Attractive visually
- Usually seedless
- Favorable taste and odor
- (all three grape groups, must important: *V. vinifera*)

Raisins

- Seedless
- Soft texture
- Favorable taste and odor after drying

Thompson seedless



THOMPSON SEEDLESS

Thompson Seedless is the dominant grape variety grown in California. Thompson Seedless grapes are usually sun-dried on paper trays for a period of between 17 to 21 days.

FIESTA & FLAME

Selma Pete, DOVine, and Fiesta are all Thompson Seedless varieties, while Flame Seedless is a cross between Thompson Seedless and other varieties including Muscat of Alexandria.

ZANTE CURRANT

Also known as Black Corinth, the Zante Currant is used to make small, seedless raisins. Because of its early ripening and quick drying time, Zante Currants can be dried both on paper trays and on the vine.

Thompson Seedless

Thompson Seedless dried on ground

Fiesta **Flame Seedless**

Flame dried on ground

Flame dried on the vine

Zante Currant

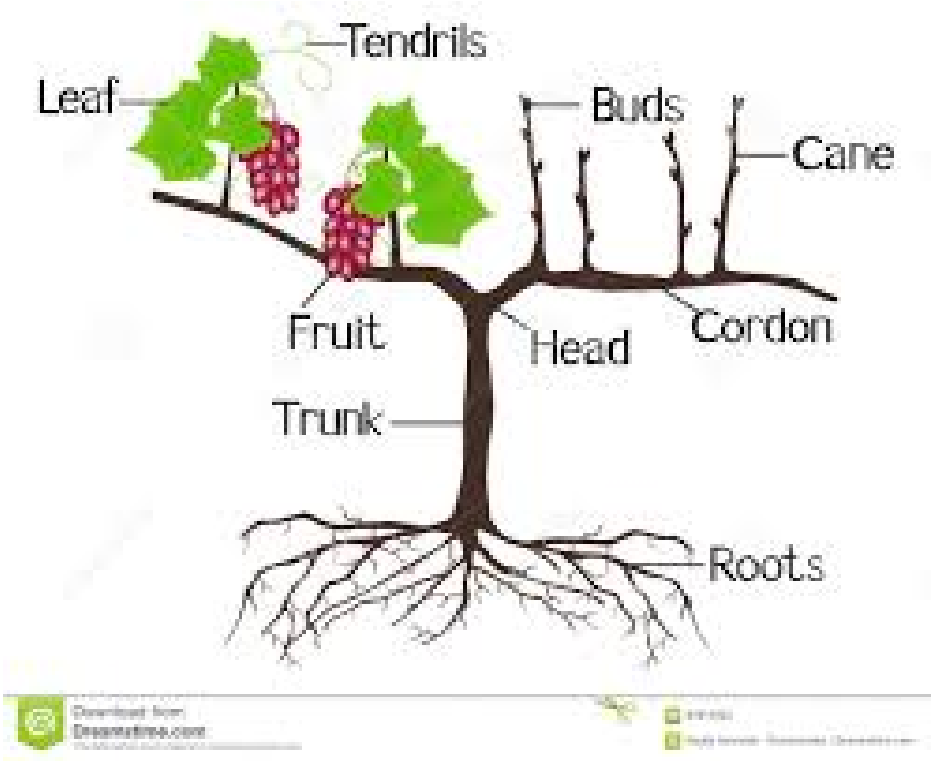
Zante Currant dried on ground

Zante Currant dried on the vine


Welch's
SINCE 1869
CONCORD
Grape Jam
© W.P. Armstrong 2004

Vine Morphology

- Simple but strong
- Climber
- Strong root system to support high foliage weight
- Botanically: Liana (needs support and uses tendrils)



Roots

The root system of established grapevines comprises highly branched structure with a surface area far exceeding that of the leaf canopy it supports.

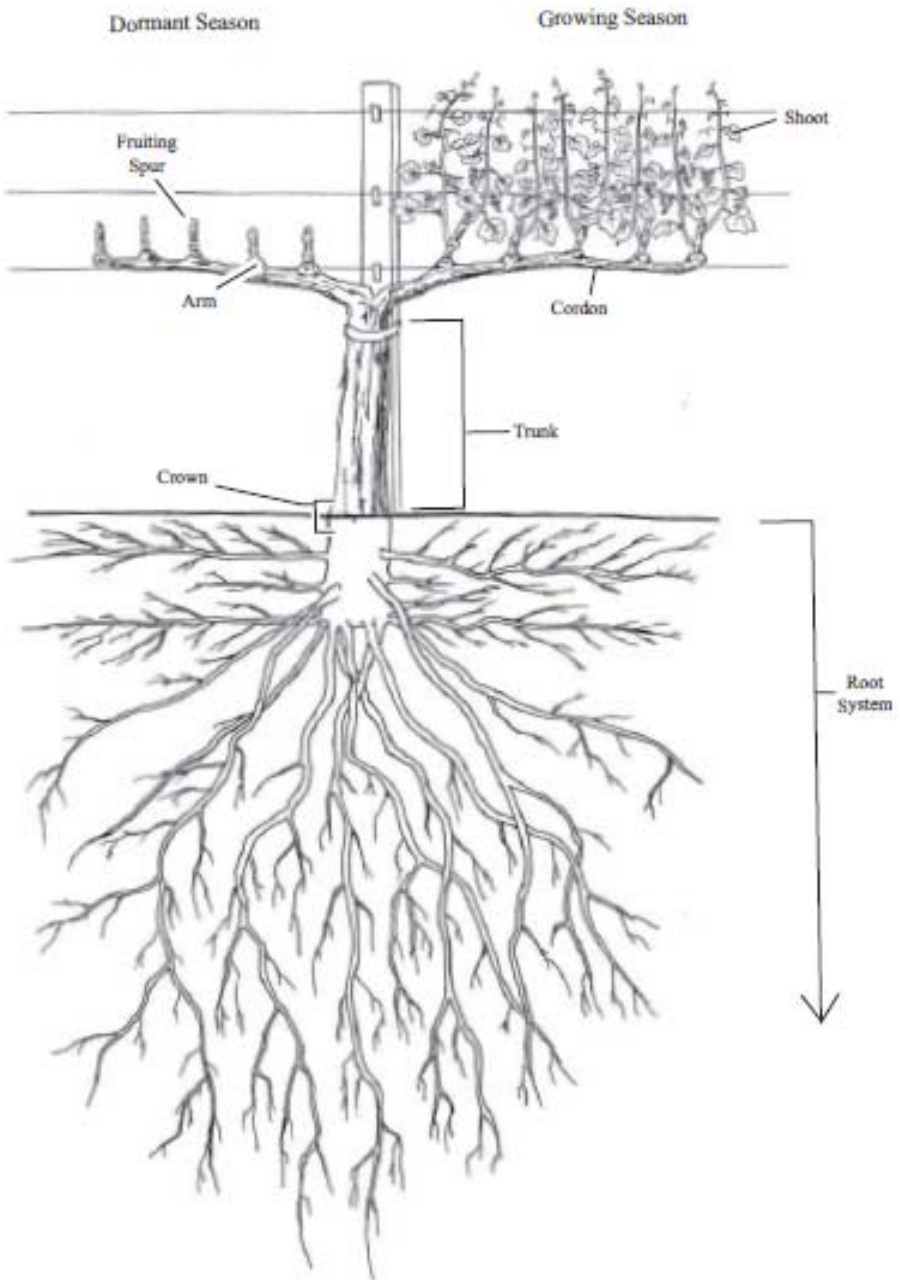
A mature, cultivated grapevine can have a surface area greater than 100 m_2, whereas its leaf area is usually less than 10 m_2.

The woody roots, whose diameter rarely exceeds 3 or 4 cm, serve to anchor the vine and transport and store soil-derived nutrients, whereas the small absorbing roots (“fine roots,” 0.11 mm in diameter) are responsible for acquisition of resources such as water and nutrients.

The woody roots of mature vines are widely distributed, with horizontal roots exploring the soil for distances of up to approximately 10 m from the trunk.

Although the majority of roots, especially the fine roots, are normally concentrated in the top 0.51 m, roots can grow to a depth of more than 30 m when they encounter no impermeable barriers (Lehnart et al., 2008, Pourtchev, 2003).

Indeed, grapevines are among the most deep-rooted plants, and their root biomass can range from 5 to 40 t ha, which may be a reflection of the competition for water and nutrients during the vines’ coevolution with their “trellis” trees.



Trunk

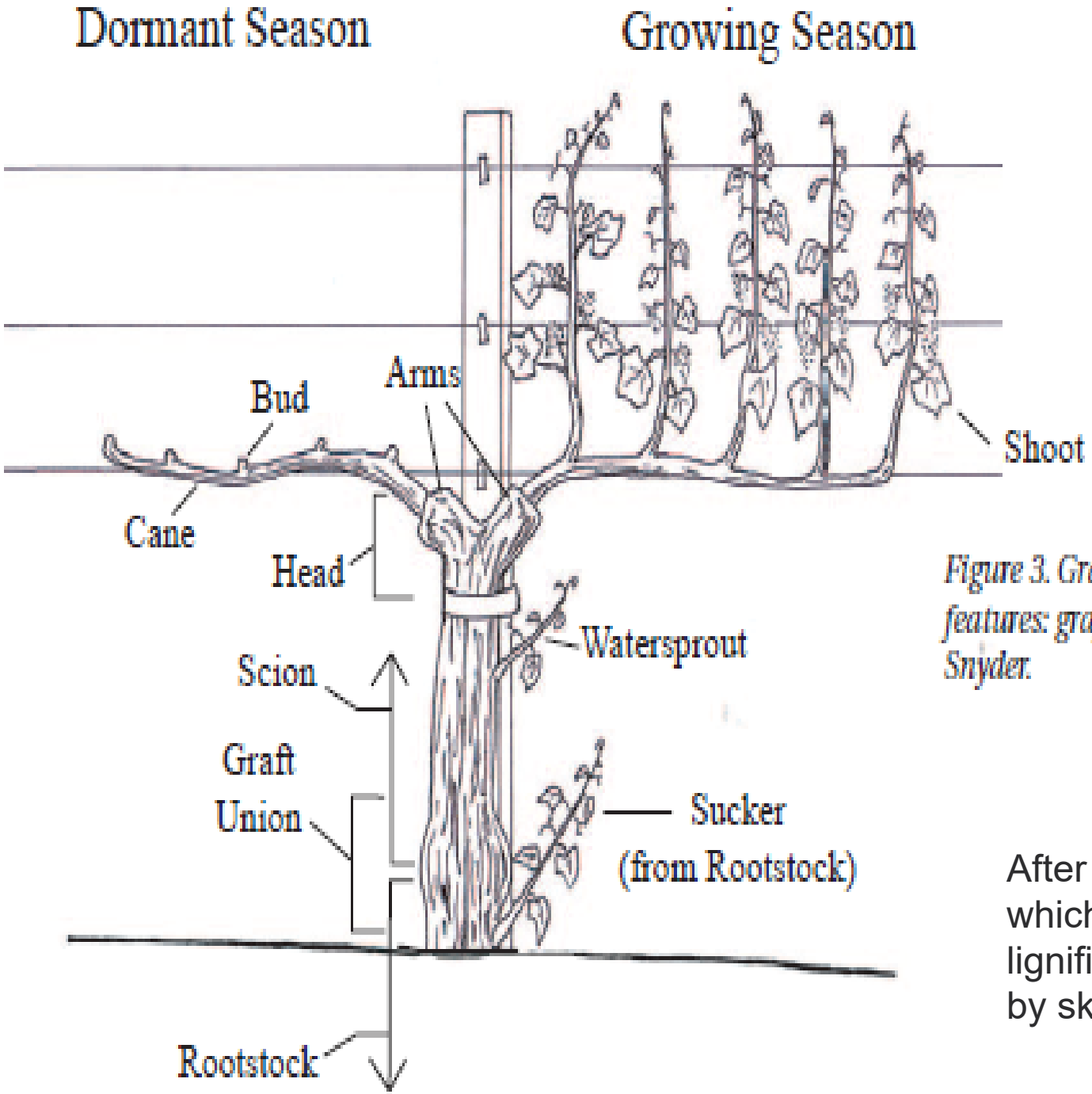


Figure 3. Grapevine structures and features: grafted vine. Drawing by Scott Snyder.

After a few years which is flexible, It lignified and covered by skin.

- Because of their liana nature, cultivated grapevines typically require a trellis system for support, unless they are trained very close to the ground. The trunk is often extended along a horizontal wire to form one or more permanent arms or cordons that support the 1-year-old wood, which in turn gives rise to the fruiting shoots.

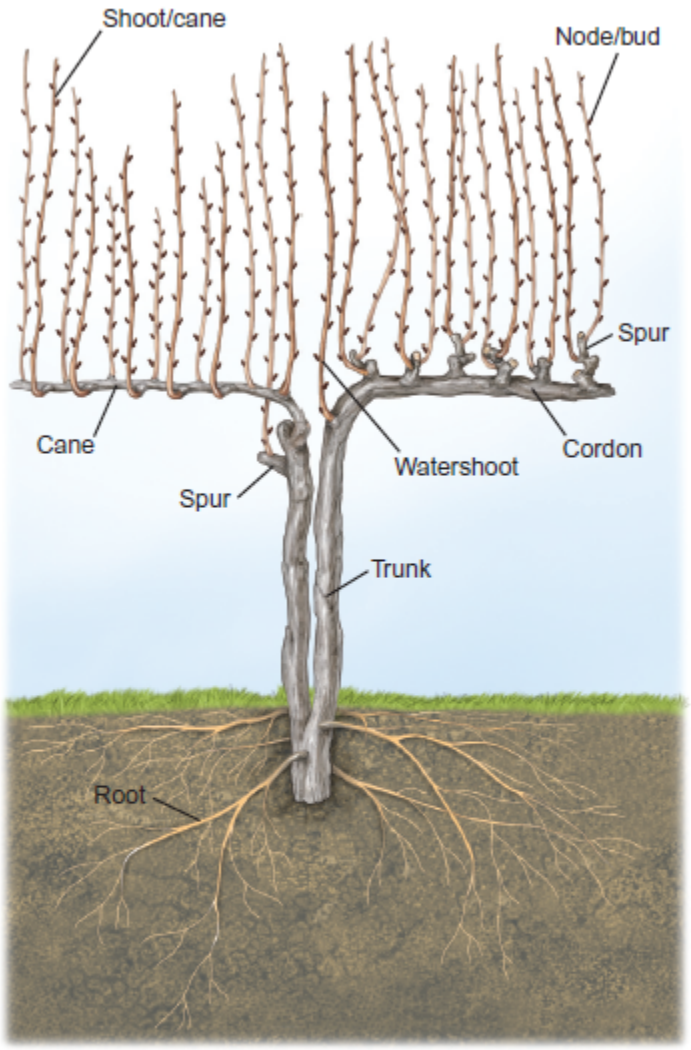
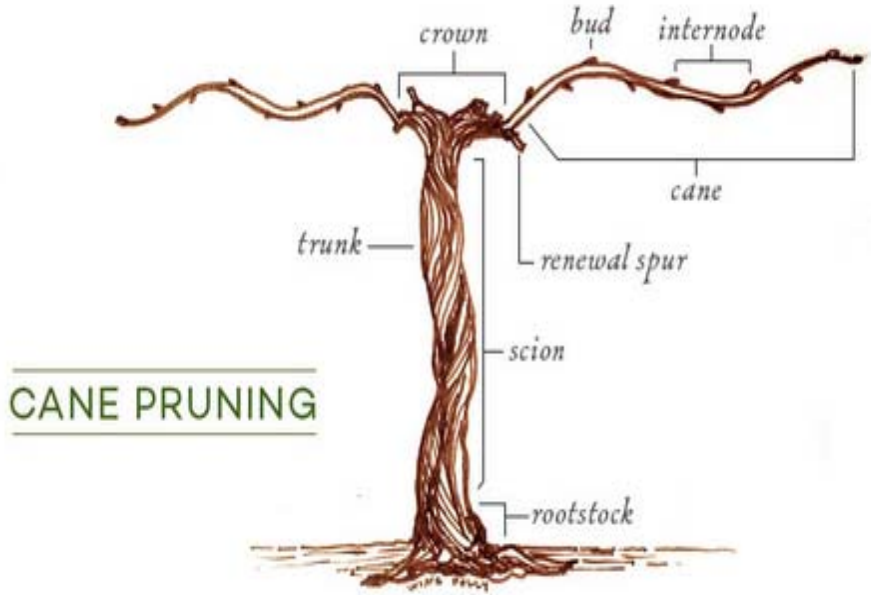
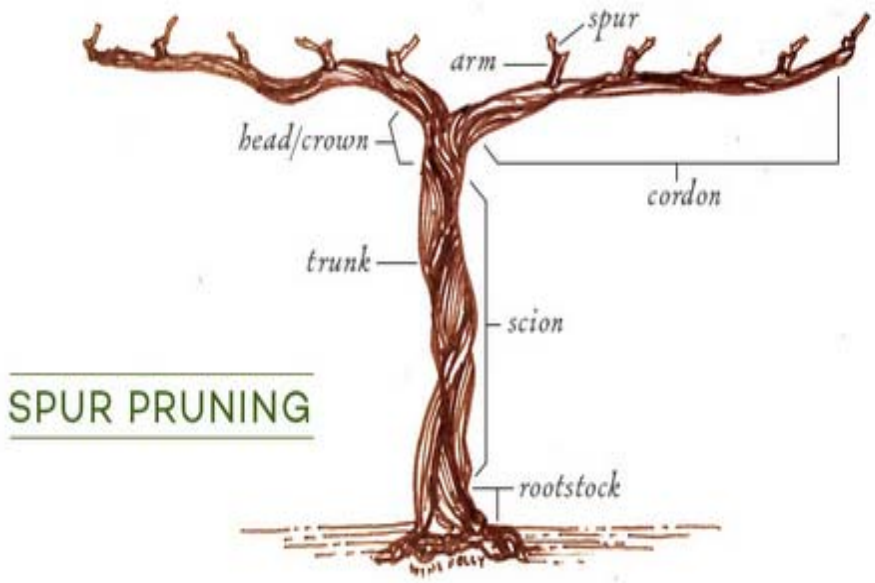


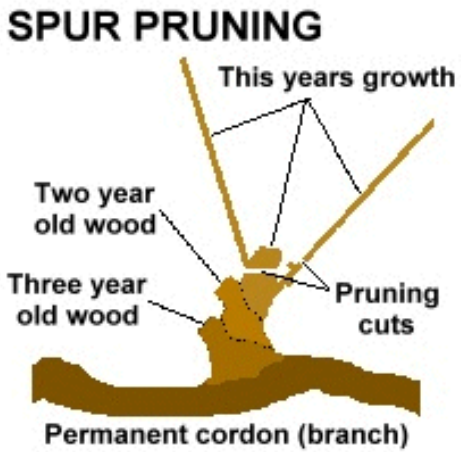
FIGURE 1.4

Own-rooted (ungrafted) grapevine body with vegetative organs, but without leaves and tendrils. The left half is head-trained and cane-pruned, the right half is cordon-trained and spur-pruned.

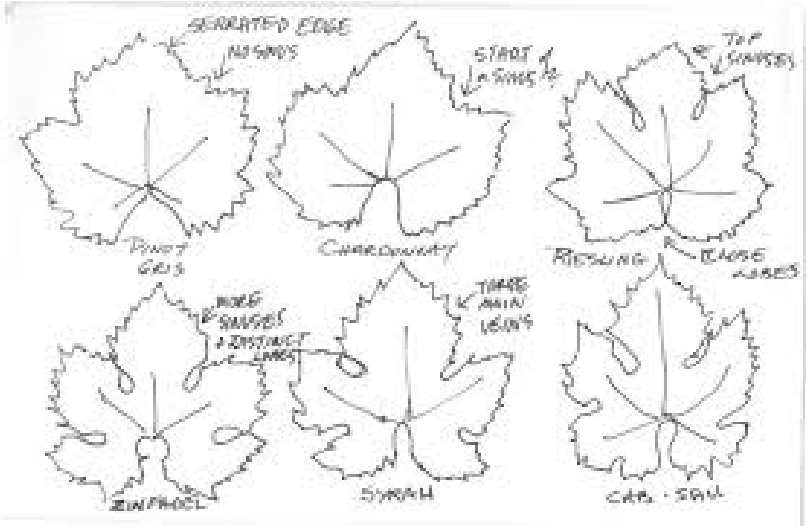

crown
bud
internode
cane
trunk
renewal spur
scion
CANE PRUNING
rootstock


CANE PRUNING
This years growth
Pruning cuts
Two year old wood
Three year old wood
Next years cane
Permanent cordon (branch)


spur
arm
head/crown
cordon
trunk
scion
SPUR PRUNING
rootstock


SPUR PRUNING
This years growth
Two year old wood
Three year old wood
Pruning cuts
Permanent cordon (branch)

Home Garden



TINTA RORIZ

Different species and cultivars of grapevine differ in their leaf shape, and leaf morphology forms the main basis of ampelography. The predominant leaf form of the genus *Vitis* is palmate, in which the five main vascular bundles.

TENDRILS

Tendrils and fruiting clusters of the grapevine are generally considered homologous on the basis of anatomical, morphological, and physiological similarities. Darwin (1875) concluded from observations of grapevines growing in his backyard that "there can be no doubt that the tendril is a modified flower-peduncle." Indeed, studies of gene expression—that is, of the manufacture of RNA and protein from the segment of DNA making up a gene—also suggest that tendrils are modified reproductive organs that have been adapted during evolution as climbing organs.

FIGURE 1.16

Intermediary forms of Syrah inflorescence/tendril/shoot (left; inset: inflorescence that would rather be a tendril; photos by M. Keller) and structure of a grape cluster with berries removed (right; illustration by A. Mills; inset reproduced from Viala and Vermorel, 1909).

The production of leaf-opposed tendrils and clusters appears to be unique to the Vitaceae family and is typically discontinuous; that is, two of every three nodes bear a tendril (Gerrath and Posluszny, 2007; Pratt, 1974). One notable exception is V. labrusca, which has a continuous pattern—that is, a tendril at every node. Why the other members of the family leave a “blank” at every third node and how they keep count is still mysterious.

FIGURE 1.17

Vitis shoot tip showing tendrils with two and three tips (left) and tips of a tendril coiling around a trellis wire (right).

Photos by M. Keller.

FIGURE 1.8

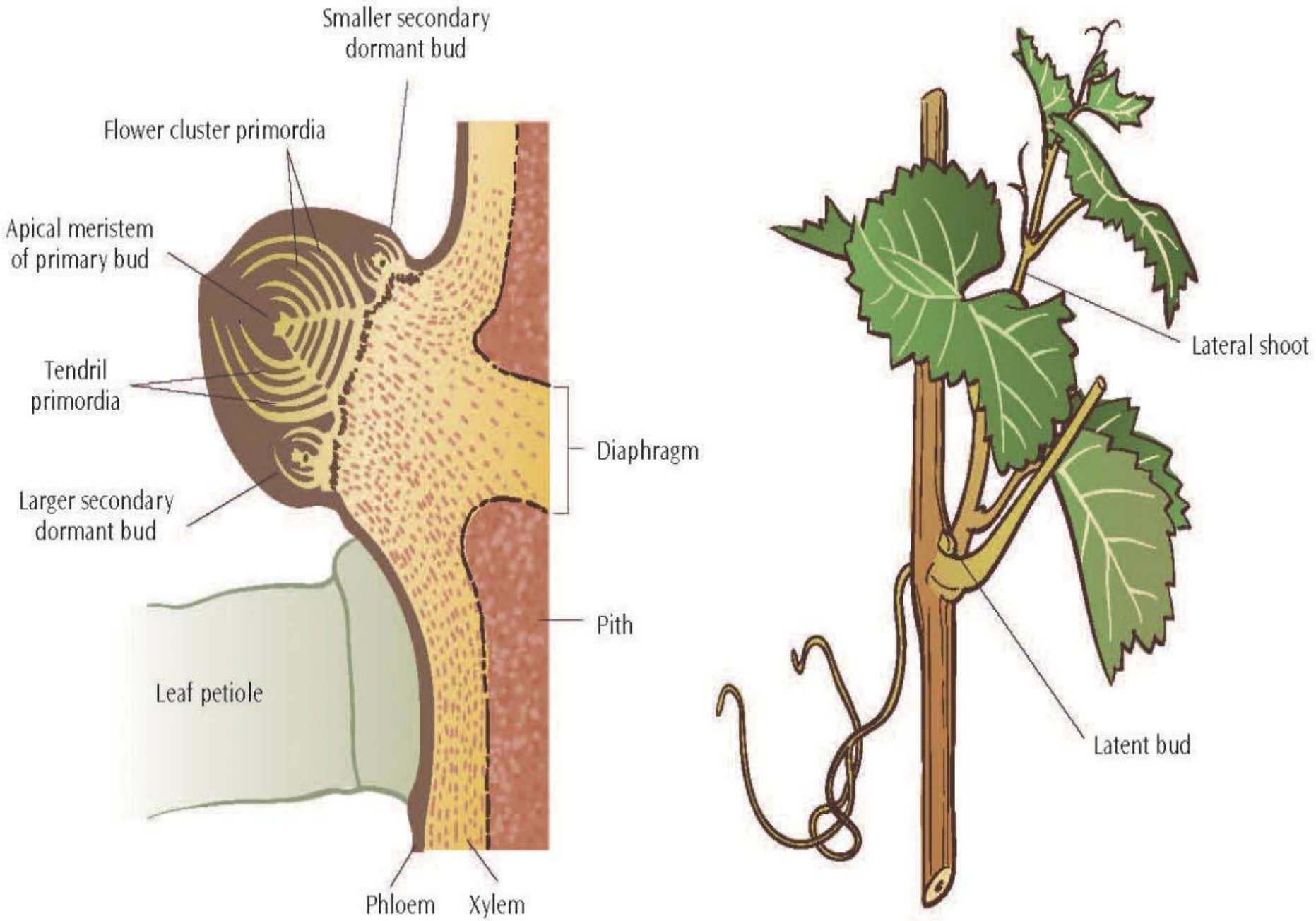
Repeating three-node pattern of a Syrah shoot (left); mistakes do happen in nature—three consecutive tendrils on a *V. vinifera* shoot (center); and dormant bud and lateral shoot in a leaf axil (juncture between petiole and shoot) of a Malbec main shoot (right).

Photos by M. Keller.

Plate 12. Tendril-like cluster of berries, the result of only a small number of flowers being initiated when the tendril was being formed.

9

Plate 9. A dormant tendril that had wrapped around a foliage wire during the growing season. Tendrils such as these can be quite woody and difficult to remove at pruning, which demonstrates their role in helping to support the vine.


Smaller secondary dormant bud
Flower cluster primordia
Apical meristem of primary bud
Tendril primordia
Larger secondary dormant bud
Diaphragm
Pith
Leaf petiole
Phloem
Xylem
Lateral shoot
Latent bud

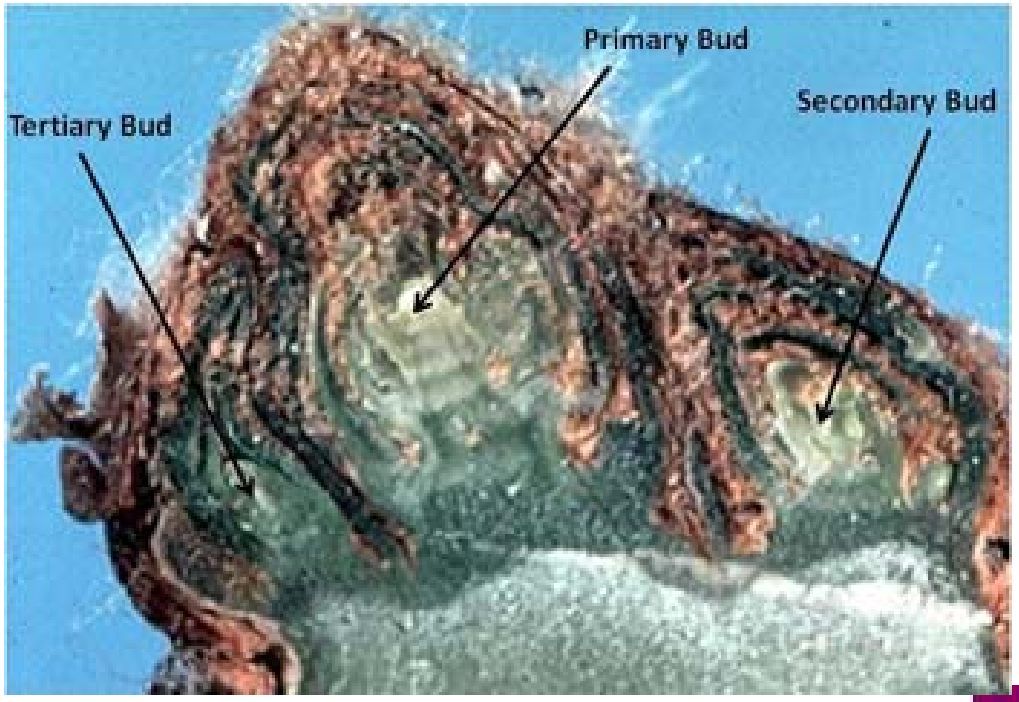


Figure 2b

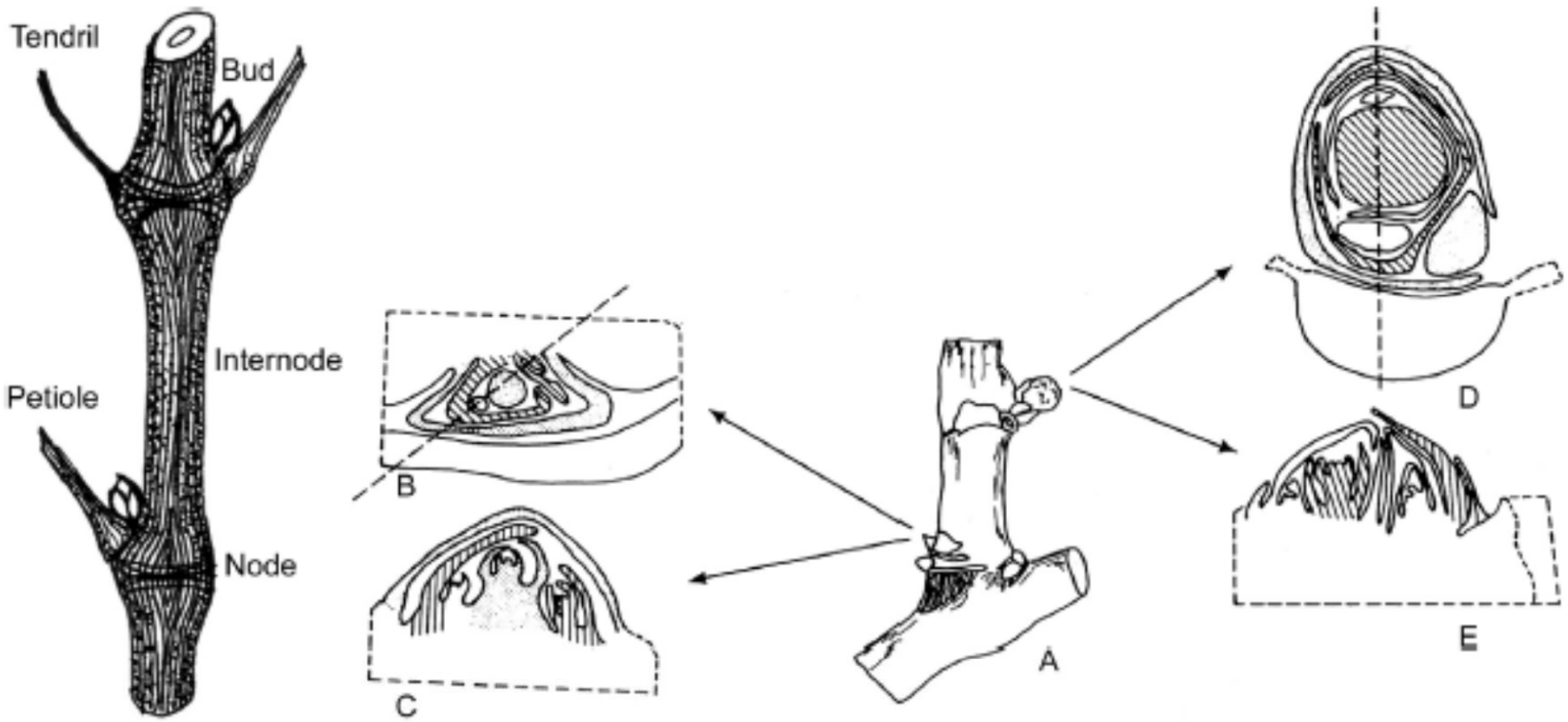


FIGURE 1.11

Location of the main features of a *Vitis* shoot (left; illustration by A. Mills) and one-node Concord spur with one count node and three basal buds (right: A, spur with buds; B, cross section of basal bud; C, longitudinal section of basal bud; D, cross section of compound bud; E, longitudinal section of compound bud; reproduced from Pool et al., 1978, reprinted by permission of American Journal of Enology and Viticulture).

canes

- The shoots are called canes after they have matured and the leaves have fallen off.

10

Plate 10. Section of shoot late in the season showing the reddish lignified periderm and the still-green tissue of the cluster peduncle.

2

Plate 2. Grape cluster showing individual florets, some of which have their fused petals (calyptra) separating from the basal part of the flower (top and left).

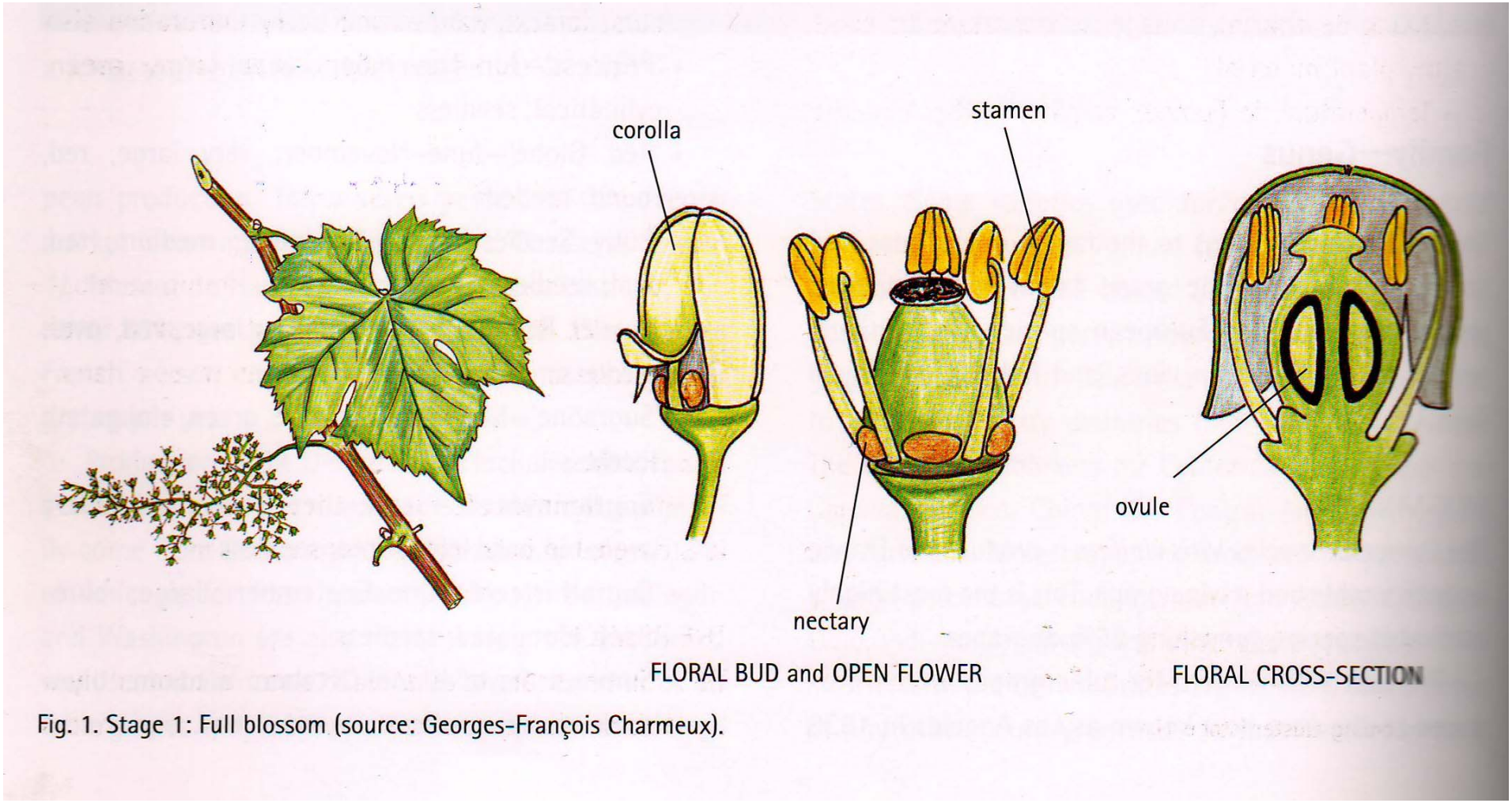


Fig. 1. Stage 1: Full blossom (source: Georges-François Charmeux).

- تعدادی از ارقام انگور ماده فیزیولوژیک (ماده با پرچم واژگون) کشور:

چاوه گا، قره گندمه، قزل اوزوم ارومیه، الحقی، ساچاخ، یزندائی، خلیلی قرمز، کرلو، پرال قونقور، شرشره، سیاه سمرقندی،

- از کشت یکدست این ارقام انگور جدا خودداری شود چون بدون وجود گرده سایر ارقام قادر به تولید میوه نیستند

Berry
0-4 seed(s), muscadine grapes can have up to six
Size of cluster and number of berries is variable
berry to berry ripening and abscission in muscadian grapes.
The number of flower clusters per shoot varies with cultivar, management and environmental conditions, but can range from none to five or even more.
The berry that develops from the fertilized flower has a waxy outer covering called the cuticle. Later in berry development this will appear as the white or greyish bloom (pruin) on the skin.
The skin is rich of anthocyanins.
muscadian grapes have thick and sometimes bitter skin.

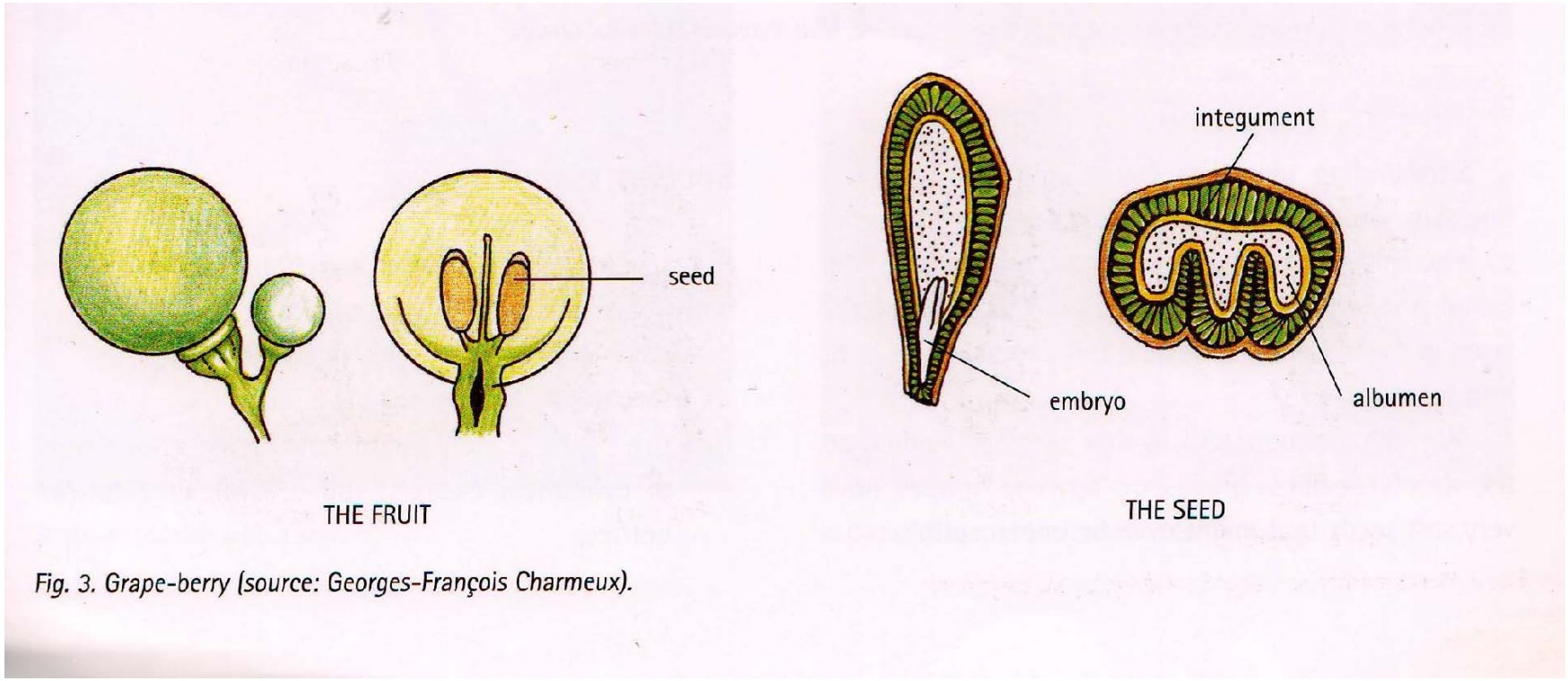


Fig. 3. Grape-berry (source: Georges-François Charmeux).

3

Plate 3. Examples of Sultana (left; also known as Thompson Seedless. This cluster has not been grown for commercial table grape production and so the berries are smaller than those found on clusters in a shop) and Einset Seedless (right; a French-American hybrid grape) clusters.

Grape cultivars classification

- Color (black, white, pink)
- Seed
- Cluster or berry shape
- Sugar content

Annual Cycle

- Winter repose
- Bleeding
- Bud break
- Branch growth
- Flowering and Veraison
- Leaf drop

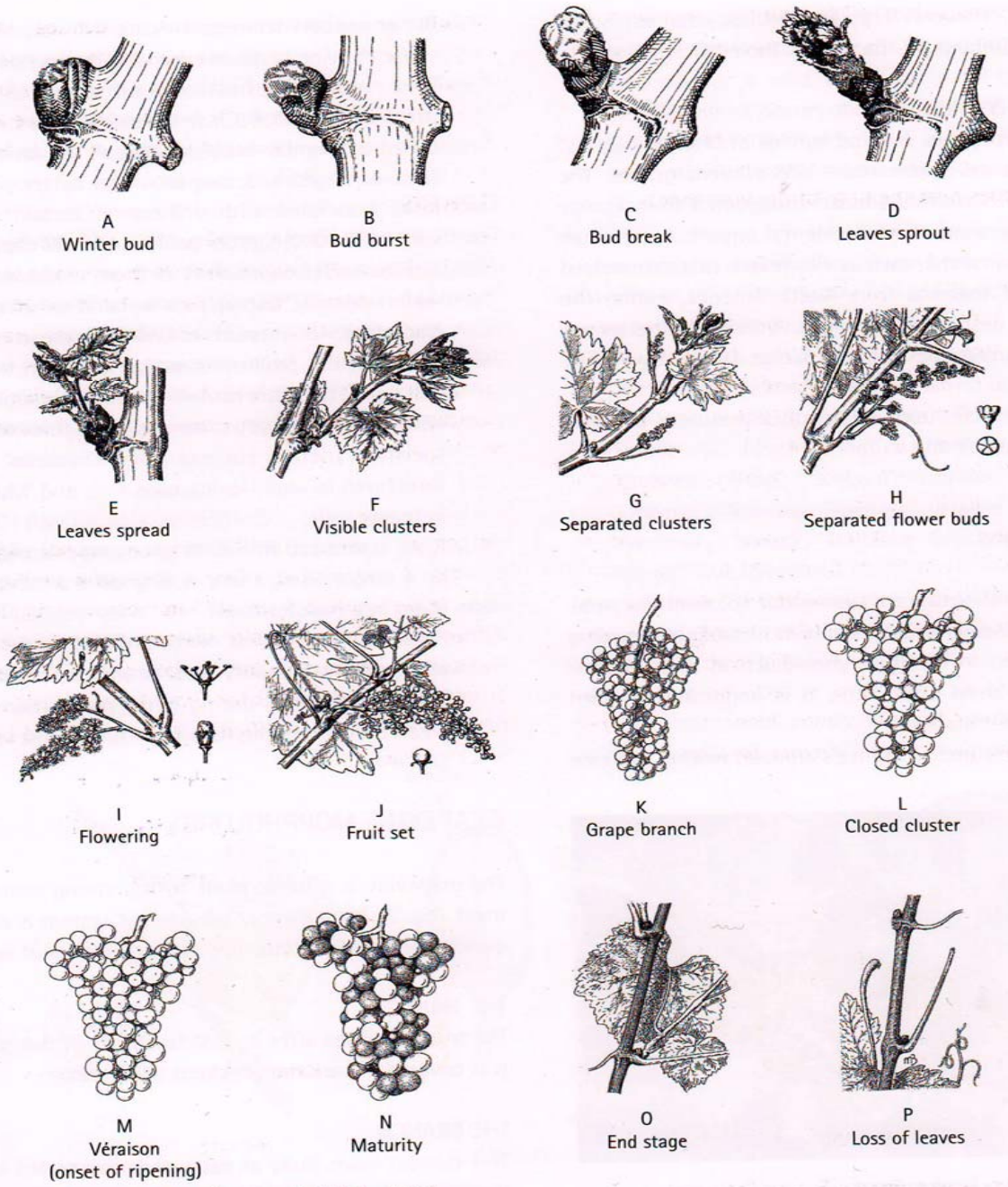


Fig. 2. Benchmark vine stages (drawings by M. Baggiolini).

دوره استراحت زمستانه که تحت عنوان رکود یا dormancy شناخته میشود و مشخصه این دوره عدم رشد جوانه است.

خوگیری (acclimation)، یک فرایند تدریجی و ملایم است که پس از پایان یافتن رشد شاخه‌ها شروع می-شود و بسته به شرایط آب و هوایی در تمام پاییز یا زمستان می‌تواند ادامه پیدا کند. کاهش طول روز و دما دو عامل مؤثر در خوگیری و مقاومت به سرمای تاک است. فرآیندهایی که منجر به خوگیری می‌شوند کاملاً مشخص نیستند ولی چیزی که مسلم است این است که مجموع فرآیندهای فیزیولوژیک موجب مقاومت تاک به یخ‌زدگی می‌شود.

مقاومت به سرما (cold hardiness) به‌صورت "توانایی گیاهان در تحمل کردن دماهای زیر صفر بدون ایجاد خسارت قابل‌ملاحظه تعریف می‌شود" که شاخصی مهم برای ارزیابی پتانسیل کشت گونه و رقم‌ها می‌باشد.
این شاخص در انگور یک شرایط دینامیک بوده و الگوی ثابتی ندارد و به‌شدت تحت تأثیر شرایط محیطی و رشد قرار می‌گیرد.

متأسفانه تولید متوسط انگور و کیفیت آن در کشور ایران به‌مراتب کمتر از متوسط جهانی است که دلایل متعددی برای آن متصور است. یکی از مهم‌ترین مشکلات، حساسیت به یخ بندان زمستانه و بهاره می‌باشد. بااینکه انگور گیاهی مقاوم به خشکی محسوب می‌شود و دمای ۲۰- درجه سانتی‌گراد را در زمستان تحمل می‌کند اما گاها در معرض سرمای زمستان یا یخبندان بهاره قرار می‌گیرد که این امر موجب خسارت‌های شدید اقتصادی می‌شود.

deacclimation: **دوره انتقال از مقاومت کامل به شرایط غیر مقاوم و رشد فعال**

In late winter or early spring, grapevines often exude xylem sap from pruning surfaces and other wounds that have not yet been suberized (Figure 2.3). Such sap flow or “bleeding” marks the transition from dormancy to active growth. Initiation of bleeding is related to the restoration of metabolic activity in the roots and is influenced by soil temperature, moisture, and rootstock, but on average it seems to begin when the soil temperature rises above approximately 7C (Alleweldt, 1965). Indeed, root respiration, as a proxy for metabolic activity in the roots, is closely coupled to soil temperature (Franck et al., 2011). Within days after the first signs of bleeding, the callose that has sealed the sieve plates in the phloem of trunks and canes during the winter begins to be degraded (Pouget, 1963). Bleeding can last for a few days or several weeks (probably depending on whether or not air temperatures are conducive to budbreak); it can also be a stop-and-go process that fluctuates with changes in soil temperature (Andersen and Brodbeck, 1989b; Reuther and Reichardt, 1963). A vine can exude bleeding sap at rates of less than 0.1 L to greater than 1 L per day, with the highest rates occurring on warm and moist soils.

FIGURE 2.3

Bleeding grapevine cane (left) and swelling, woolly bud just before budbreak (right).

Photos by M. Keller.

شکوفایی (Bud break): در این مرحله جوانه‌ها متورم می‌شوند، فلس‌ها از هم باز می‌شوند، و الیاف فیبری (Floss) که نقش حفاظت از جوانه‌ها را در برابر سرما داشتند شروع به باز شدن می‌کنند.

FIGURE 2.5

Emerging Merlot shoot with pink unfolding leaves and inflorescences days after budbreak (left) and Muscat Ottonel shoot with red young leaves (right).

Photos by M. Keller.

Branch growth

رشد شاخه با بیدار شدن جوانه‌ها (Bud break/ bud burst) و زمانی که جوانه‌های dormant سال قبل بعد از اینکه ساعات گرمایی کافی در بهار دریافت کردند، شروع می‌شود، از نظر زمانی این اتفاق زمانی روی می‌دهد که میانگین دمای روزانه به حدود ۱۰ درجه سانتی‌گراد رسیده باشد.

گل‌ها خیلی زود در امتداد بن شاخه‌های تازه تولید شده زرد رنگ ظاهر می‌شوند

در زمان شکفتن، نقطه رشد اولیه (primary) معمولاً حدود ۱۲-۱۰ سرآغازه برگی و یک یا دو سرآغازه خوشه گل را دارد که مقابل سرآغازه برگ در گره ۳ تا ۶ دیده می‌شوند نمو این ساختارها به سمت بیرون جوانه ادامه پیدا می‌کند

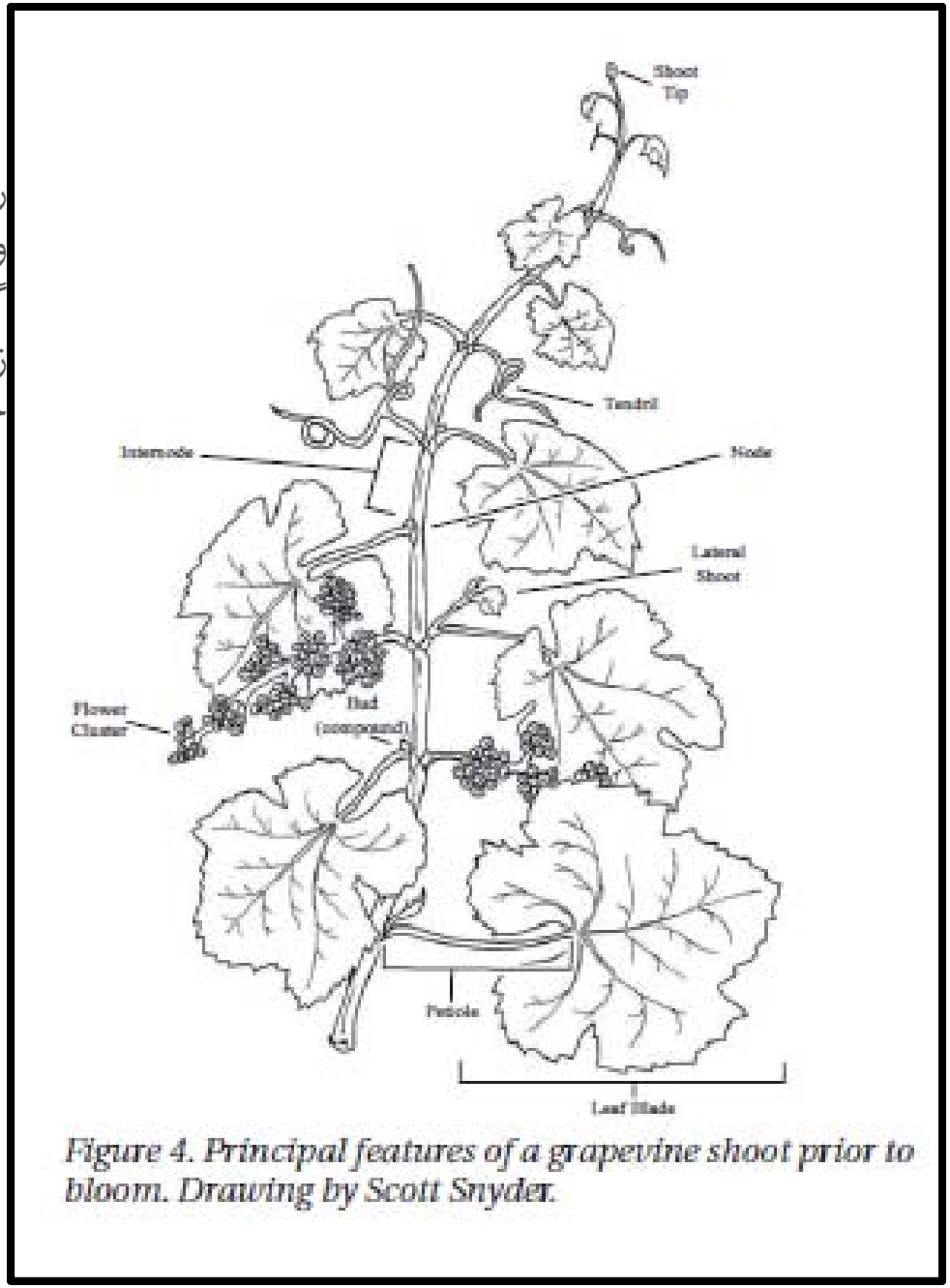


Figure 4. Principal features of a grapevine shoot prior to bloom. Drawing by Scott Snyder.

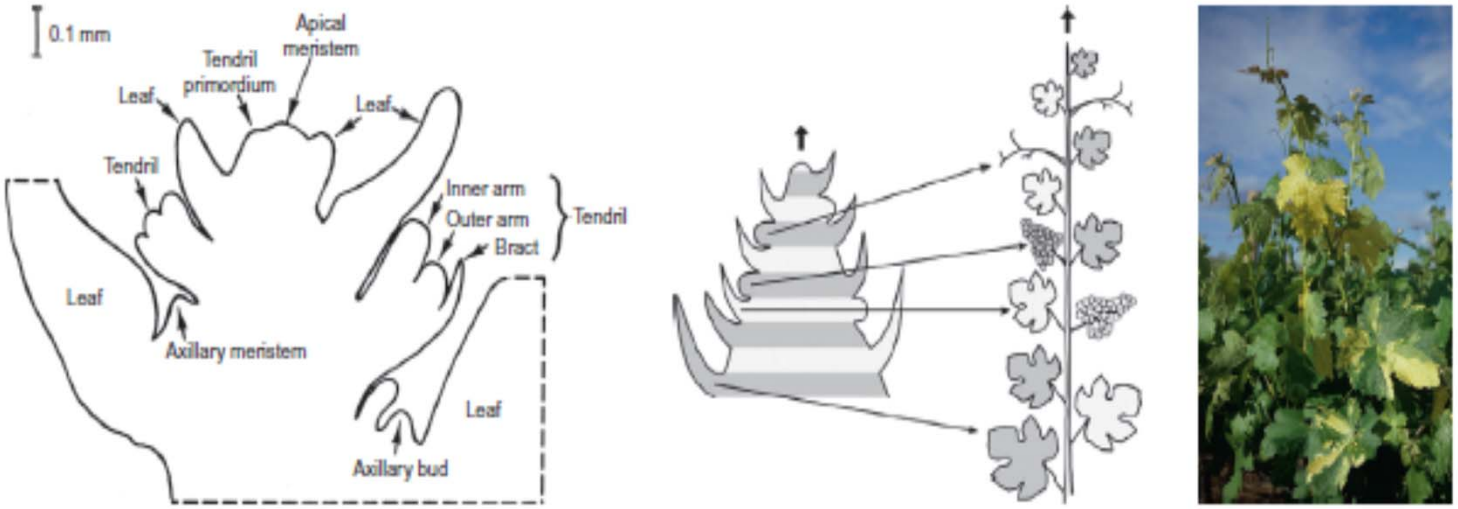


FIGURE 1.7

Diagrammatic longitudinal section of Concord shoot tip (left; reproduced from Pratt, 1971, reprinted by permission of American Journal of Enology and Viticulture); lateral organs arising from various positions in the dormant bud, illustrating the repeating three-node pattern unit of the shoots of many *Vitis* species (center; reproduced from Carmona et al., 2002); and chimeric Cabernet Sauvignon shoot (right; photo by M. Keller).

- رشد اولیه شاخه‌ها نسبتاً کند و آهسته است اما خیلی زود وارد یک فاز رشد می‌شود که grand period of growth نام دارد و اساساً درست تا بعد از Fruit set ادامه می‌یابد.

- به نمو اول فصل شاخه fixed growth گفته میشود.

FIGURE 1.8

Repeating three-node pattern of a Syrah shoot (left); mistakes do happen in nature—three consecutive tendrils on a *V. vinifera* shoot (center); and dormant bud and lateral shoot in a leaf axil (juncture between petiole and shoot) of a Malbec main shoot (right).

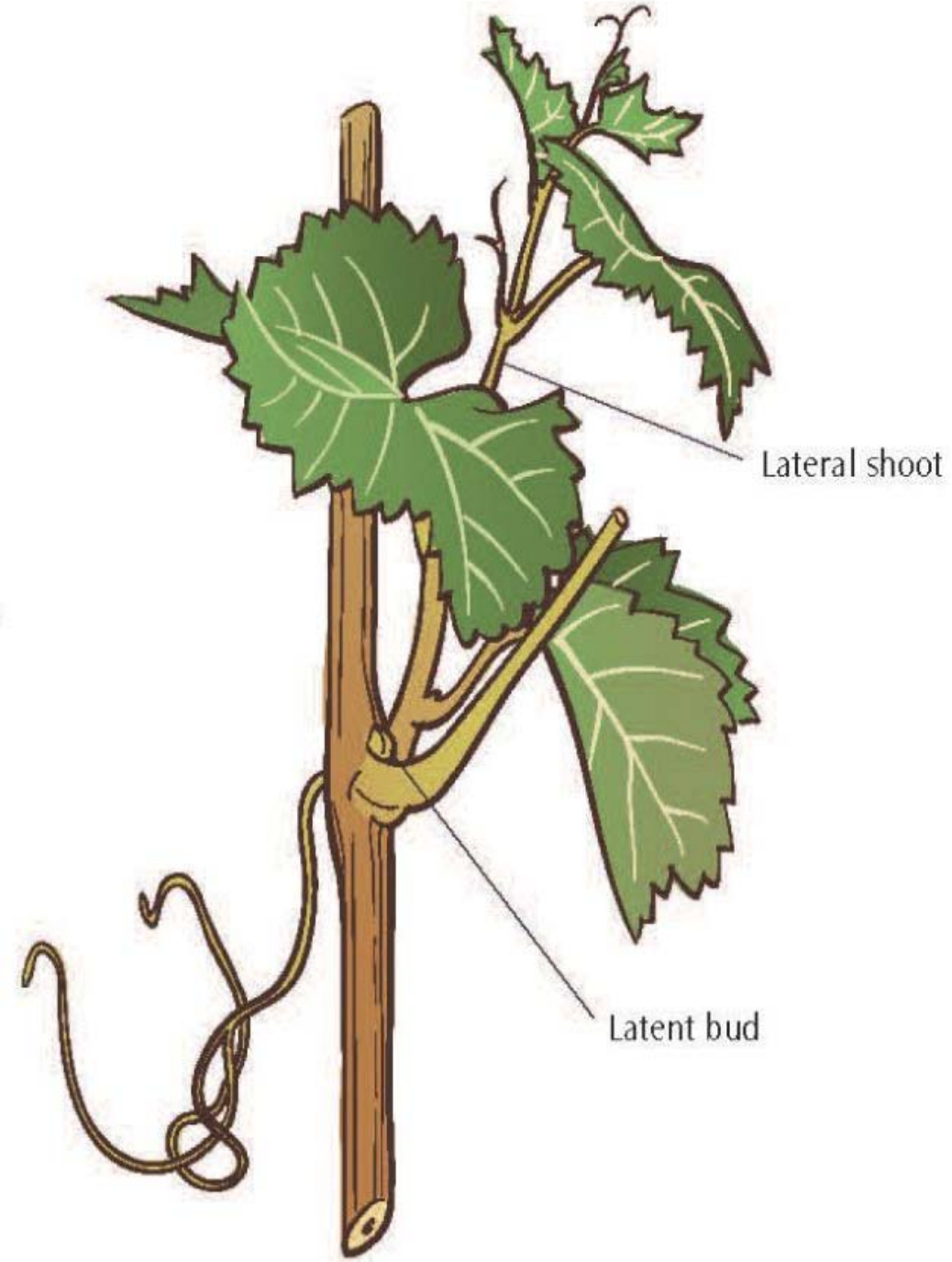
گل‌های روی شاخه وقتی شاخه تنها چند سانتی‌متر رشد کرده‌اند در مقابل برگ‌ها قابل مشاهده هستند.

همچنان که تای برگ‌ها باز می‌شود (New leaf unfolds)، جوانه‌های lateral و dormantشروع به نمو در محور برگ‌ها می‌کنند. برخی جوانه‌های lateral در محور برگ‌ها به شاخه‌های جانبی تبدیل می‌شوند ولی تعداد زیادی از آنها تنها یک یا چند برگ کوچک تولید می‌کنند و سپس رشد آنها متوقف می‌شود. طول شاخه جانبی متغیر است. در برخی موارد مثل قدرت رشد زیاد تاک یا درپاسخ به هرس تابستانه شاخه اولیه (Pri....)، شاخه جانبی با قدرت زیادی رشد می‌کند.

Diagram on upper right is from:
Pratt, C. 1974. *Vegetative anatomy in cultivated grapes.* A review. **American Journal of Enology and Viticulture,** 25:131-150.

LS=Leaf scar
LAT=Summer lateral growth
1=Primary bud primordia
2=Secondary bud primordia
3= Tertiary bud primordia

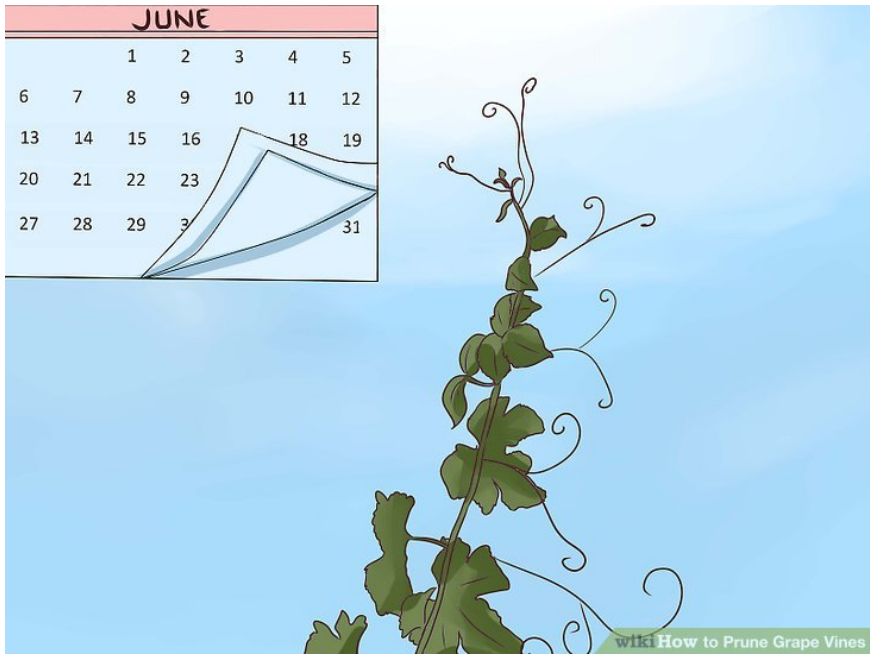
شاخه‌های جانبی که از جوانه‌های جانبی منشأ می‌گیرند نیز ممکن است بر روی خود میوه داشته باشند که به آنها second set گفته می‌شود. به طور معمول این محصول از محصول اول تفاوت زیادی دارد و مقدار و اندازه آن کوچکتر از محصول اولیه است به همین دلیل به ندرت در تولید استفاده می‌شود. اما در مناطق گرمسیری، شانس برداشت این محصول وجود دارد. در بیشتر موارد این محصول باعث ایجاد مزاحمت می‌شود، چراکه کارگر ناوارد آن را از میوه رسیده (Rip) تشخیص نمی‌دهد و در برداشت مکانیکی نیز تمام میوه‌ها فارغ از مرحله بلوغ برداشت می‌شوند.



بعد از Fruit set، رشد شاخه معمولاً کند می‌شود تا حدود زمانی که میوه‌ها شروع به رسیدن می‌کنند اما در شرایط قدرت رشد زیاد تاک ممکن است رشد شاخه با یک سرعت ثابت در تمام فصل ادامه داشته باشد که علت آن ۱) آب زیاد است، ۲) کود نیتروژنه زیاد، ۳) هرس شدید و ۴) محصول خیلی کم.

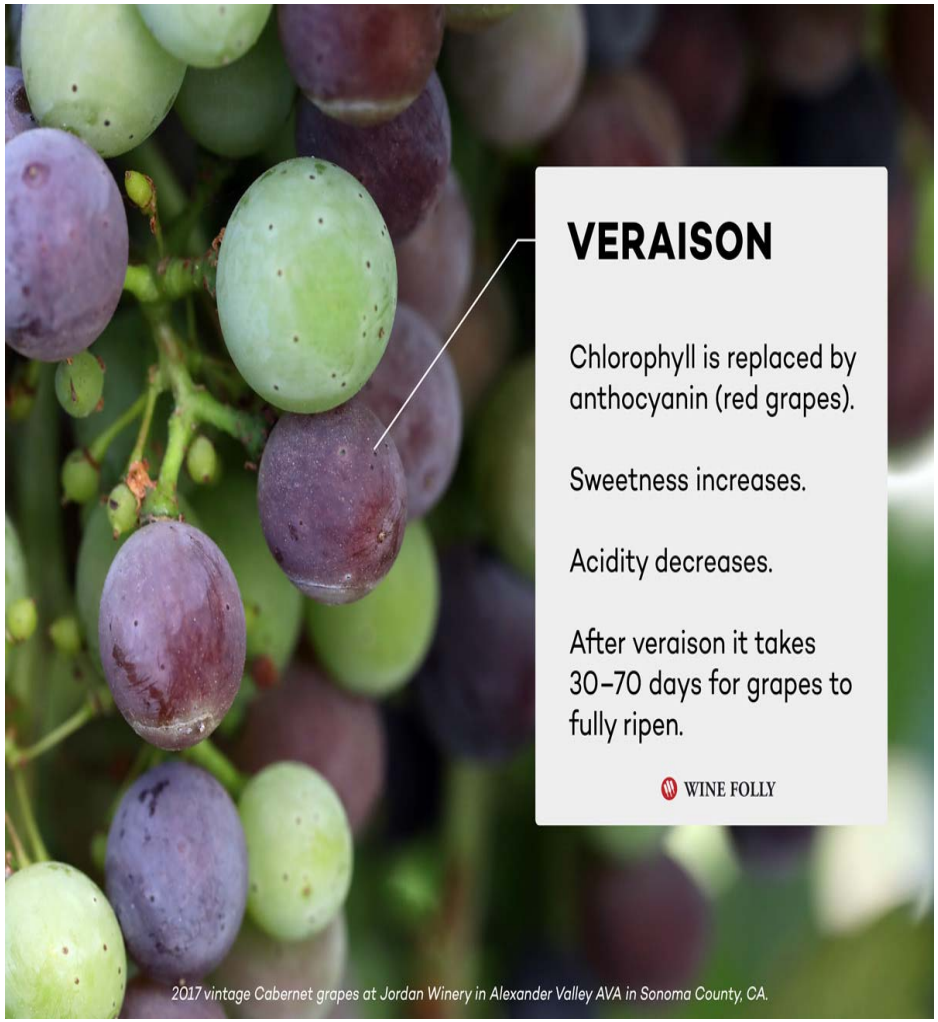
بلند شدن بیشتر شاخه به دنبال Fixed growth، free growth نامیده می‌شود و صرفاً نشان دهنده نتیجه شرایط محیطی فصل رشد جاری و مریستم‌های نوک شاخه است. تاک تا مادامی که شرایط محیطی و عمدتاً دما اجازه می‌دهد رشد خواهد کرد و به همین دلیل عادت رشد آن indeterminate خوانده می‌شود.

رشد ایده‌آل شاخه بین ۶۰ تا ۹۰سانتی متر طول با ۱۰ تا ۱۵ برگ کاملاً توسعه یافته است (Full- sized life)



Flowering and Veraison

- گلدهی تقریباً در اردیبهشت–خرداد انجام می‌شود و Veraison (تغییر رنگ به رنگ میوه رسیده) از نیمه مرداد شروع می‌شود.



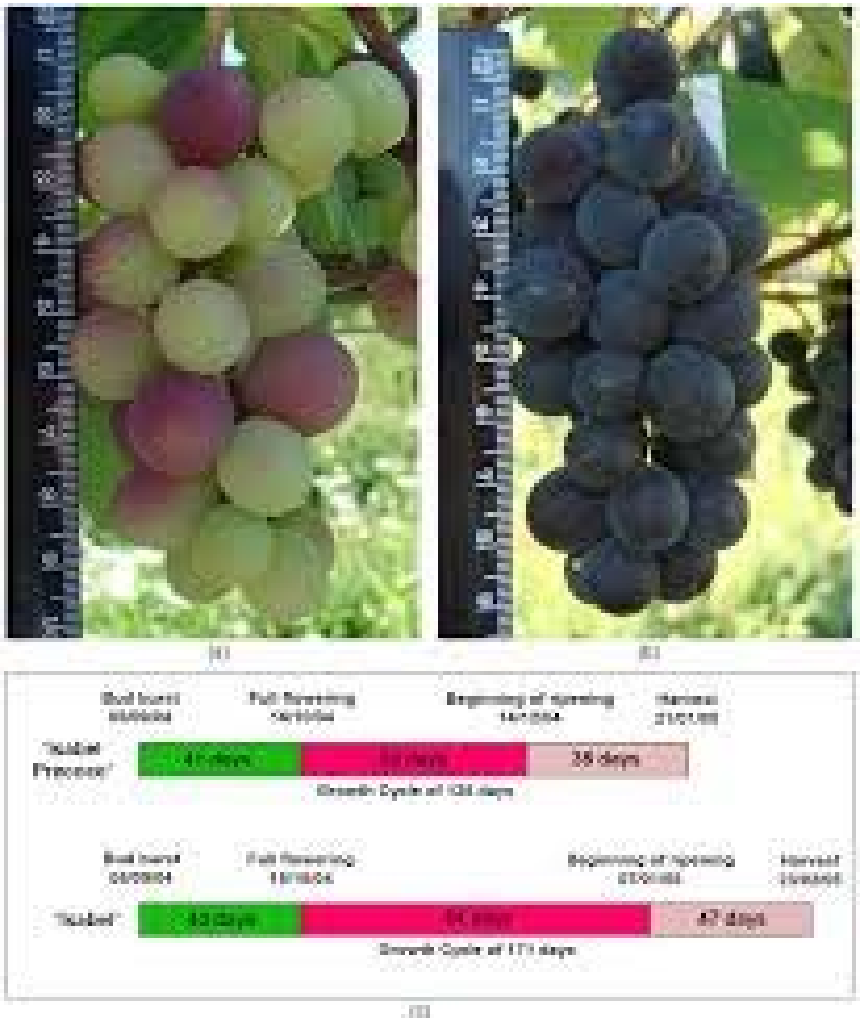


Plate 8. Anthesis (cap fall) in a flower cluster. This is the first day any of the florets have opened on this flower cluster.

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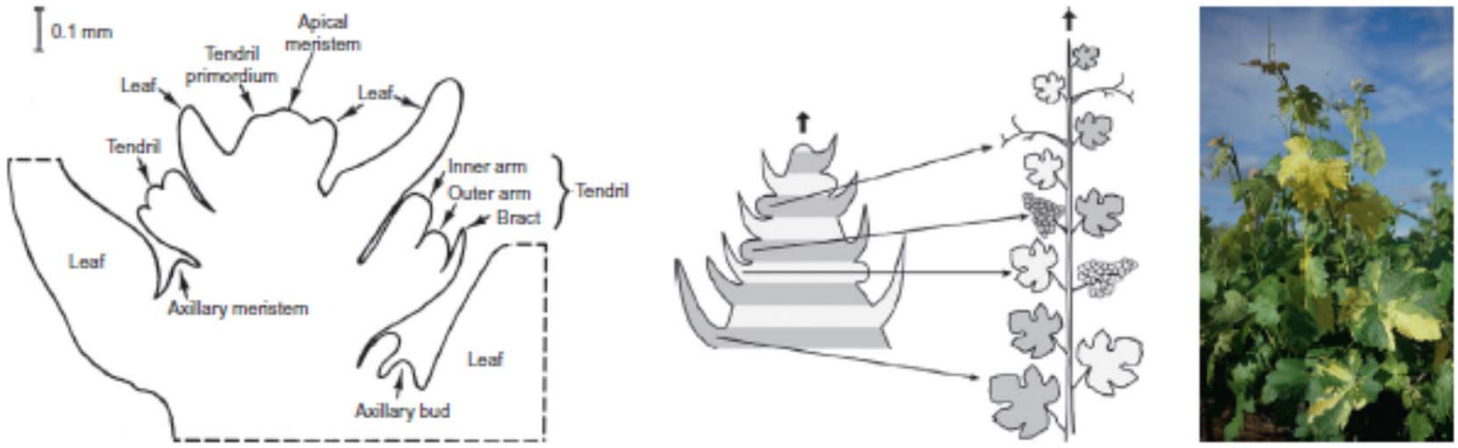
Flower Cluster Initiation

همچنان که شاخه (Shoot) رشد می‌کند، نمو قابل توجهی در جوانه‌های dormant در محور برگ‌ها صورت می‌گیرد و عمده فرایند نموی آن، نمو سرآغازه‌های خوشه گل است چراکه پتانسیل میوه‌دهی تاک برای فصل بعد از این جوانه‌ها ناشی می‌شود.

دوره‌ای که در آن سرآغازه خوشه گل شروع به شکل‌گیری بر روی شاخه‌های تکامل نیافته (rudimentary shoot) می‌کنند Flower cluster initiation نامیده می‌شود.

این فرایند اول در قسمت میانی شاخه اولیه در موقعیت گره‌های ۴ تا ۸ اتفاق می‌افتد و خیلی زود بعد از Bloom خوشه‌های گل فصل جاری (که سال قبل آغازیده شدند) شروع می‌شود و تا ۶ هفته ادامه می‌یابد. جوانه‌های در گره‌های پایینی ۱ تا ۳ شاخه کمی بعدتر گل آغازیده می‌شوند و به تدریج گل آغازی در جوانه‌ها به سمت نوک شاخساره Tip ادامه پیدا می‌کند. معمولاً در پایان فصل، جوانه‌های پر میوه‌ای در امتداد Cane وجود دارد که تعداد آنها بستگی به جایی دارد که شاخه کاملاً رسیده باشد (Fully ripend).



نمو گل در V. venifera یک فرایند ۳ مرحله‌ای است که دورن جوانه‌های dormant در حال نمو اتفاق می‌افتد:

مرحله اول تشکیل Uncommitted primordia توسط نقاط رشد جوانه‌های dormant در حال نمو است (زمان؟) (مکان؟) به این دلیل به سرآغازه در این زمان uncommitted گفته می-شود که آنها هم می‌توانند به خوشه تبدیل شوند و یا پیچک، که بستگی به شرایط محیطی و رشد شاخه و جوانه در آن زمان دارد.

در مرحله دوم سرآغازه Committed می‌شود به یک خوشه گل یا یک پیچک تبدیل شود. قبل از Bloom شروع می‌شود یا در خود زمان Bloom.

سرآغازه خوشه گل طی فصل جاری نمو می‌یابد و در مرحله سوم و آخر، شکل گیری گل‌ها از سرآغازه خوشه بعد از باز شدن جوانه‌ها در بهار اتفاق می‌افتد. مراحل آخر نمو گل با نزدیک شدن به زمان Bloom تکمیل می‌شود.

نور خورشید و دما مهم‌ترین فاکتورهای محیطی مؤثر بر گل آغازی خوشه انگور هستند گرچه بر اینکه کدام عامل اصلی است تفاهم وجود ندارد. طبق گفته Williams etal (۱۹۹۴) نمو سرآغازه uncommitted به خوشه گل یا پیچک به مقدار نوری که به جوانه در طی نمو تابیده می‌شود بستگی دارد. تعداد و اندازه سرآغازه خوشه با افزایش مقدار نور دریافتی افزایش می‌یابد.

طبق گفته Mullins etal (۱۹۹۲). این احتمال وجود دارد که ترکیبی از دمای بالا و شدت نور بالا برای حداکثر میوه‌دهی جوانه‌های dormant لازم است. آنها همچنین گزارش کردند که نور بالا و دمایی که برای گل‌آغازی سرآغازه گل نیاز است بین واریته‌های مختلف متفاوت است. از دید یک مدیر تاکستان به نظر می‌رسد که برای یک رقم انگور که به دمای یک منطقه سازگارتر شده است قرار گرفتن جوانه‌های در حال نمو در معرض نور حیاتی‌تر است.

بنابراین سیستم‌های تربیت و عملیات مدیریت تاج که باعث بهینه شدن نفوذ نور می‌شود باعث افزایش میوه‌دهی نسبت به همان رقم در شرایط سایه می‌شود

سرآغازه همچنین می‌تواند به پیچک تبدیل شود پیچک‌ها، ساختارهای بلند و باریکی هستند که به دور اجسام با قطر کم می‌پیچند مثل سایر شاخه‌ها، سیم‌های داربست و... و از رشد شاخه‌ها حمایت می‌کنند. پیچک‌ها هم مقابل برگ‌ها هستند و در غیاب گل‌ها دیده می‌شوند ولی در ۲-۳ برگ اول شاخه هیچ پیچکی تولید نمی‌شود ولی بعد از آن در هر سومین برگ شاخه مشاهده می‌شوند چون منشأ خوشه گل و پیچک‌ها یکی است و گاهی تعدادی گل در انتهای پیچک تولید می‌شود.

Pollination

- Most grapes are Self-fruit full
- Partenocarpy is not common
- Seedless grapes: Stenospermocarpy

(thin seed coat)

- Main pollinator: wind
- Black cerinth'' ↔ 'Zante current' produces parthenocarpic fruits
- Controlling crop load: 1-pruning 2- cluster thinning


Photo source: commons.wikimedia.org

Grape pollination

- Concord and vinifera grapes are self pollinating
- Muscadines: some varieties need cross pollination
  - Scuppernong, Fry, Noble, Nesbitt, Jumbo, Hunt
- Self-fruitful: Carlos, Cowart, Dixiland, Southland

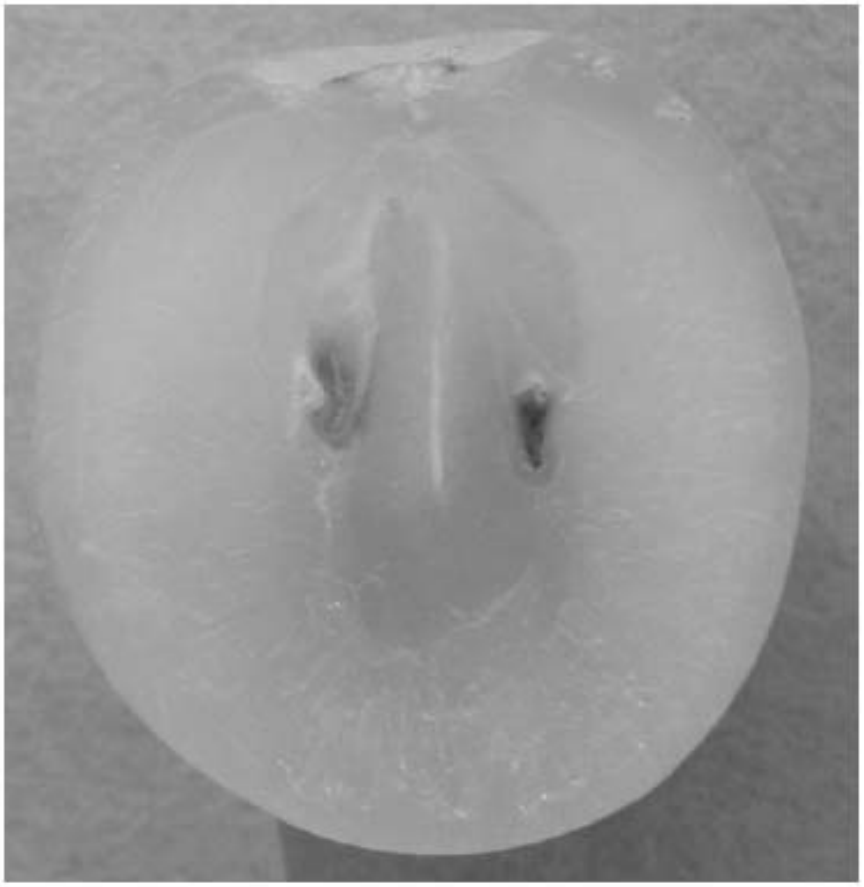


Fig. 3.6. Seed remnants within a seedless table grape ('Perlette').

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Plate 14. A Black Corinth / Zante Current cluster showing the small size of the parthenocarpic berries.

Fruit growth and development

وقتی فرایندی میوه‌بندی بر روی تاک انجام شد، احتمال اینکه از تاک ریزش کند بسیار ضعیف است که بسیار متفاوت از درختان میوه دیگر مانند سیب است بنابراین ذخیره کربوهیدرات درخت باید به قدر کافی باشد.

- بعد از لقاح حبه‌ها به سرعت بزرگ می‌شوند که حاصل تقسیم و طویل شدن سلول‌هاست. بعد از این دوره رشد سریع،
- فاز دوم شروع می‌شود که در آن رشد نسبتاً کمی در میوه مشاهده می‌شود ولی در عوض بذرها بالغ و چوبی می‌شوند. در پایان فاز دوم تغییرات زیادی در حبه‌ها شروع می‌شود که
- شروع فاز سوم است مثل نرم شدن، شفاف شدن، شروع تغییر رنگ (اصطلاح فرانسوی Veraison) و تجمع کربوهیدرات.

منحنی رشد میوه دابل سیگموئید است.

Changes occurring during the ripening process:

Several changes occur during veraison:

- Skin color of colored cultivars changes from green to red, blue or black (**Figure 109A**).
- Berries begin to soften, with white cultivars becoming more translucent (**Figure 109C**).
- Sugars (*measured as* oBrix or %SS) begin to increase (**Figure 110**).
- Acids [measures as titratable acidity (TA)] begin to decrease (**Figure 110**).
- Juice pH begins to increase (**Figure 110**).
- Juice color begins to change. White's – greenish to whitish. Red's – begin to take on some skin pigment.
- Skin tannins begin to polymerize to become more desirable.
- Seed tannins (undesirable) begin to become less extractable.
- Varietal flavor components begin to increase.
- The rachis begins to mature.
- An abscission zone between the pedicel (berry stem) and berry begins to develop (Figure 111A, B).

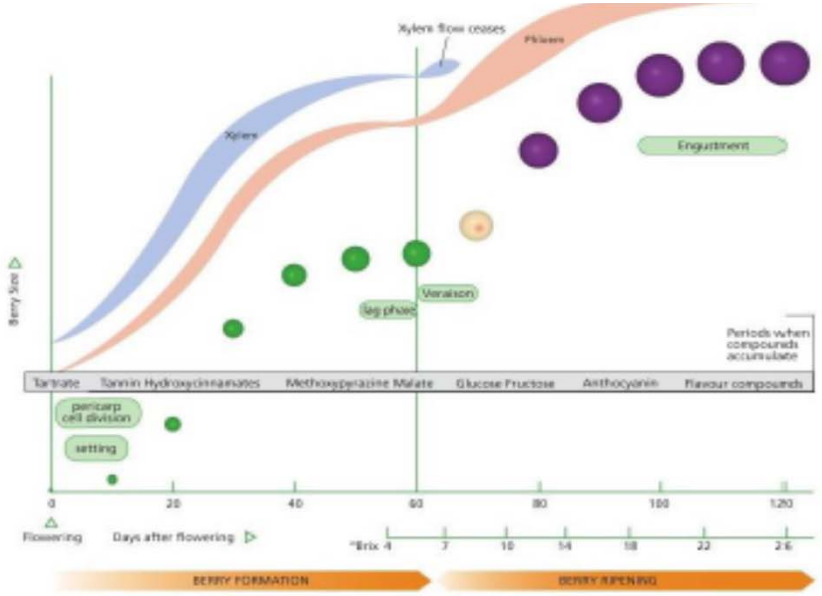

Figure 108. Grape berry development & maturation. (Illustration by J. Koutroumanidis, Winetitles)

Figure 109. Veraison in a red wine cultivar (A). Lag phase (B) and veraison (C) in a white wine cultivar.

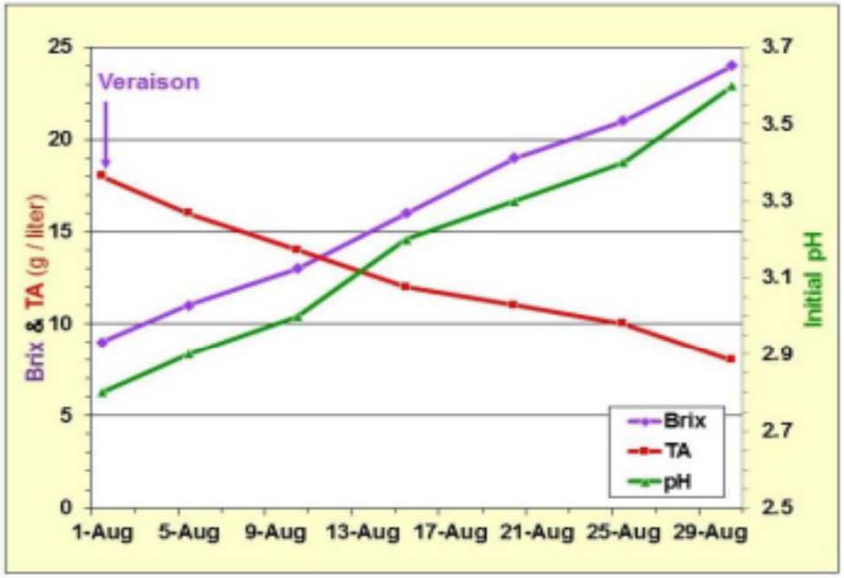

Figure 110. Changes in °Brix, titratable acidity (TA) and initial pH following veraison.

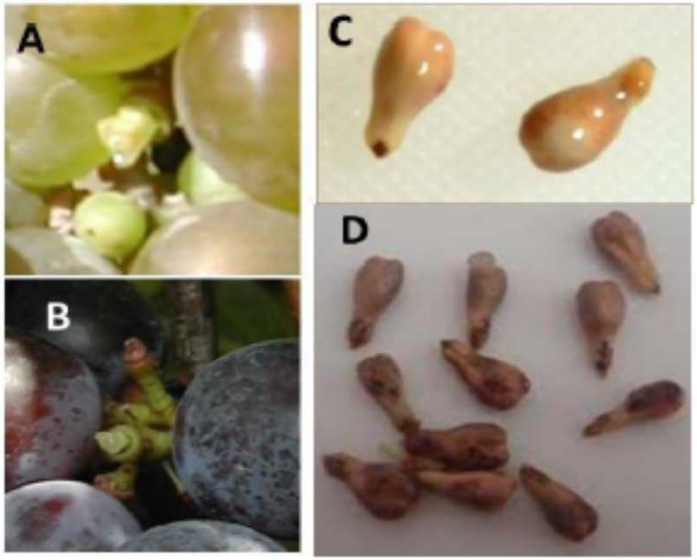

Figure 111. Pedicel/berry abscission zone: immature (A), mature (B). Seed maturity: immature (C), mature (D).

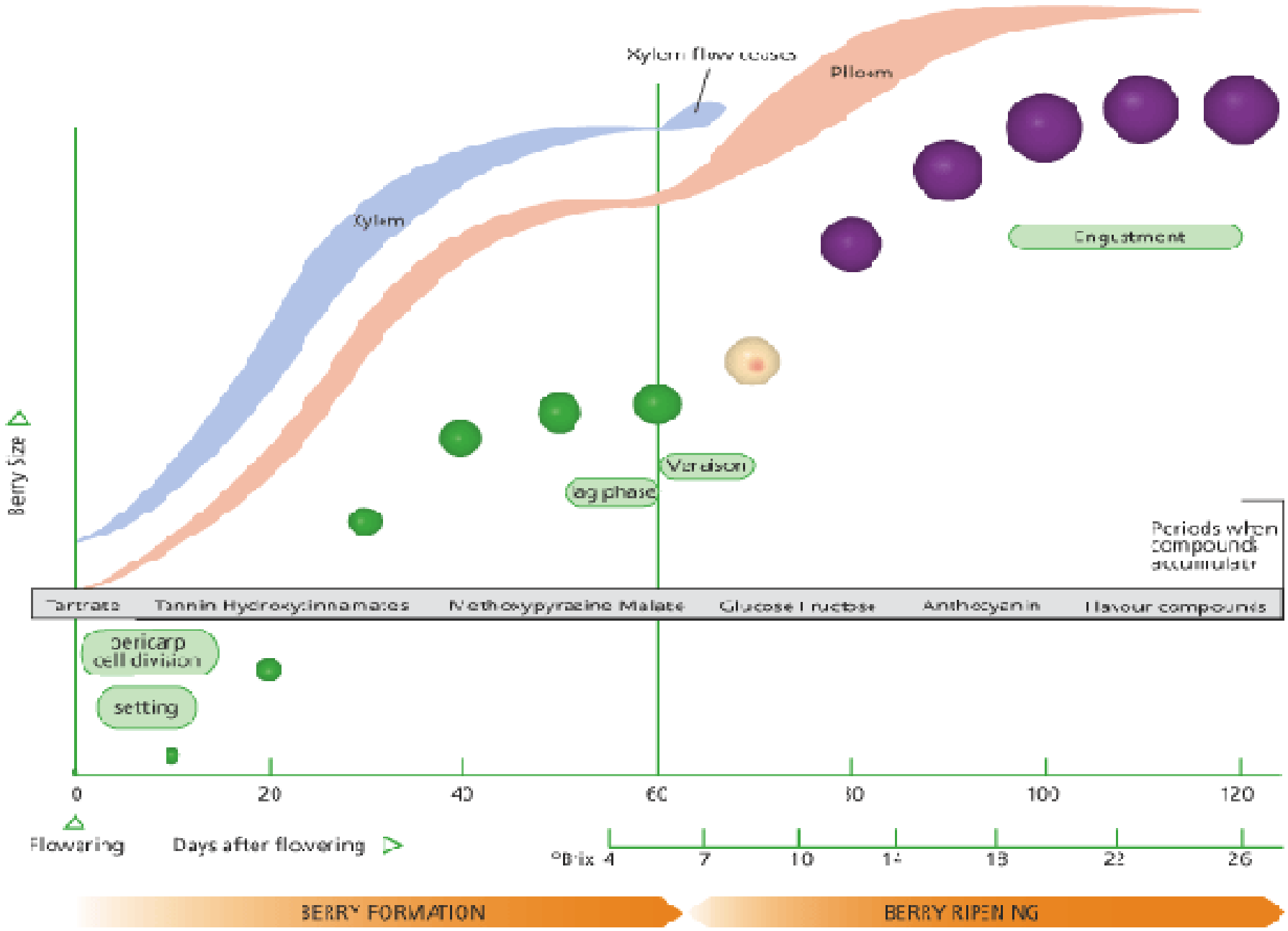

Figure 2: Diagram showing relative size and color of berries at 10-day intervals after flowering, passing through major developmental events (rounded boxes). Also shown are the periods when compounds accumulate, the levels of juice °brix, and an indication of the rate of inflow of xylem and phloem vascular saps into the berry. Illustration by Jordan Koutroumanidis, Winetitles.

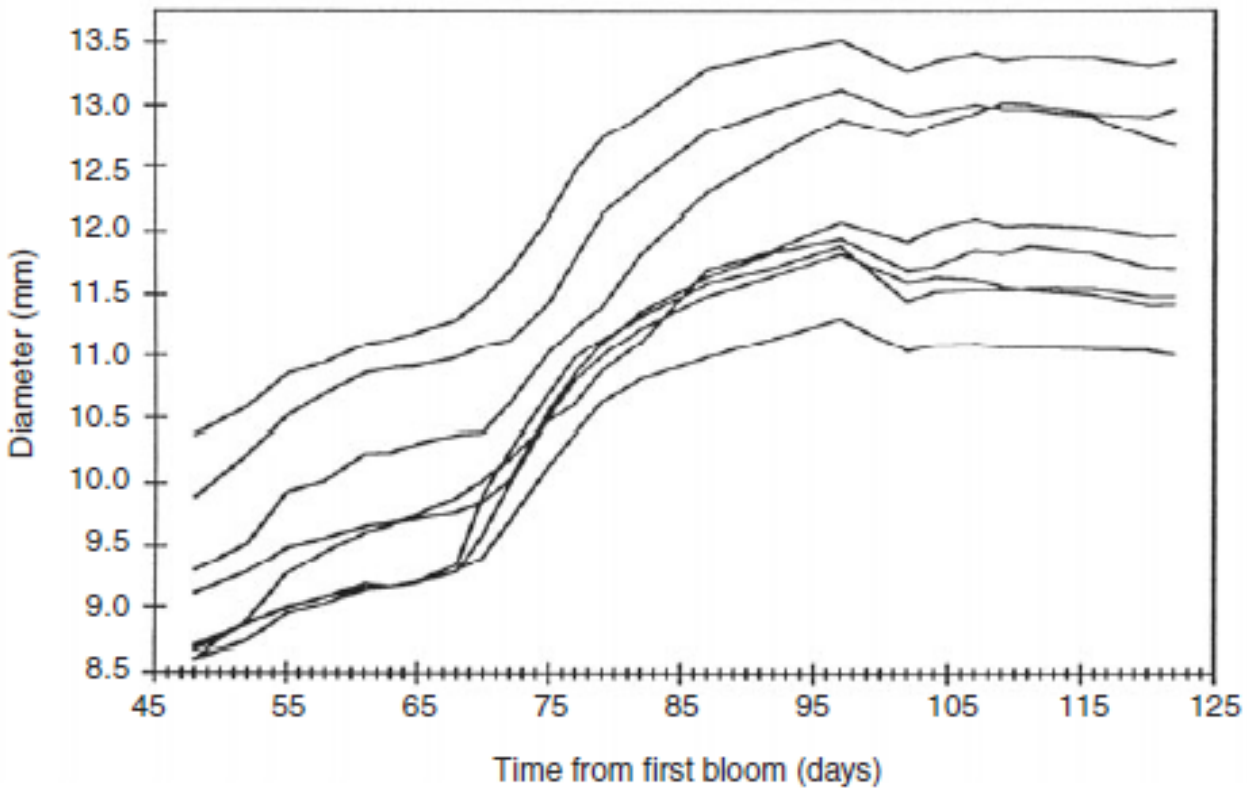

Fig. 3.4. Individual growth curves (by measurement of diameter) for eight grape berries, demonstrating the double-sigmoid shape characteristic of seeded fruit (from Creasy, 1991).

Table 2.2. Examples of grape characteristics that are important for different end uses.

End use	Fruit attributes
Wine grapes	Brix, acidity, pH, colour, tannins, flavour
Table grapes	Brix, acidity, colour, flavour, presence of bloom, Brix:acid ratio
Raisins	Brix, colour, percentage moisture, flavour, presence of bloom
Juice	Brix, acidity, colour, flavour
Preserves	Brix, acidity, pectin, solids content

The juice of the berries shall have a refractometric index of at least:
—12 º Brix for the Alphonse Lavallée, Cardinal and Victoria varieties,
—13 º Brix for all other seeded varieties,
—14 º Brix for all seedless varieties.

Table 39. Optimal juice °Brix, initial pH and titratable acidity (TA) for different styles of wine.

Wine Style	°Brix (% SS)	Initial pH	TA (g / liter)
White table wine [z]	21 - 22	3.2 – 3.4	7 – 9
Red table wine [z]	22 - 24	3.3 – 3.5	6 – 8
Sparkling wine [y]	17 - 20	2.8 – 3.2	7.0 – 9.0
White table wine [y]	19 - 23	3.0 – 3.3	7.0 – 8.0
Red table wine [y]	20 – 24	3.2 – 3.4	6.0 – 7.5
Sweet table wine [y]	22 – 25	3.2 – 3.4	6.5 -8.0
Dessert wine [y]	23 – 26	3.3 – 3.7	5.0 – 7.5

تعداد روز از شکوفه‌دهی (bloom) تا بلوغ (maturity) در فصل رشد بین ۱۵۰ تا ۲۰۰ روز است که کاملاً وابسته به گونه، رقم و شرایط محیطی است.

ترتیب زمان بلوغ به صورت زیر افزایش می‌یابد.

1) *V. labrusca* (کمترین)
2) هیبریدهای فرانسوی- آمریکایی
3) *V. vinifera*
4) *V. rotundifolia*