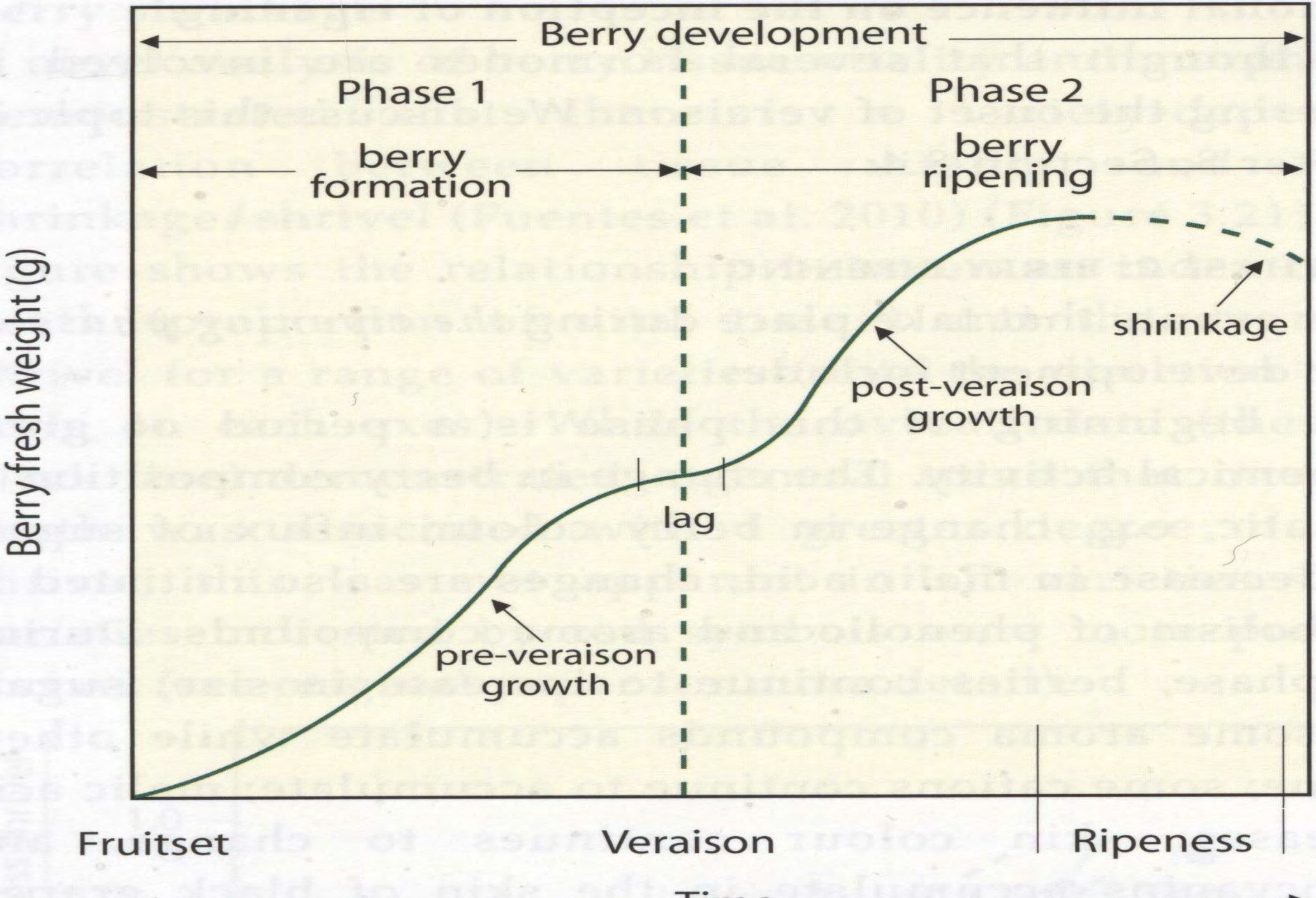
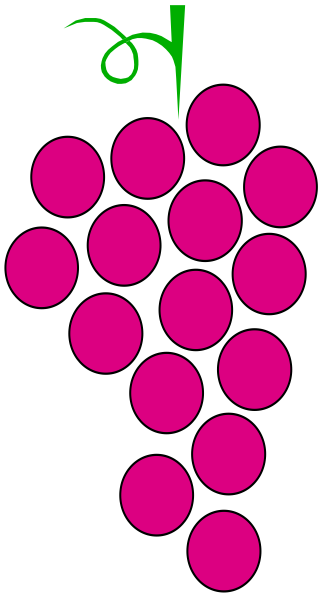

Berry development
Phase 1
berry formation
Phase 2
berry ripening
Berry fresh weight (g)
shrinkage
post-veraison growth
lag
pre-veraison growth
Fruitset
Veraison
Ripeness
Time

The grape berry



- Fruit set and development
- Onset of ripening
- Solute accumulation and final composition

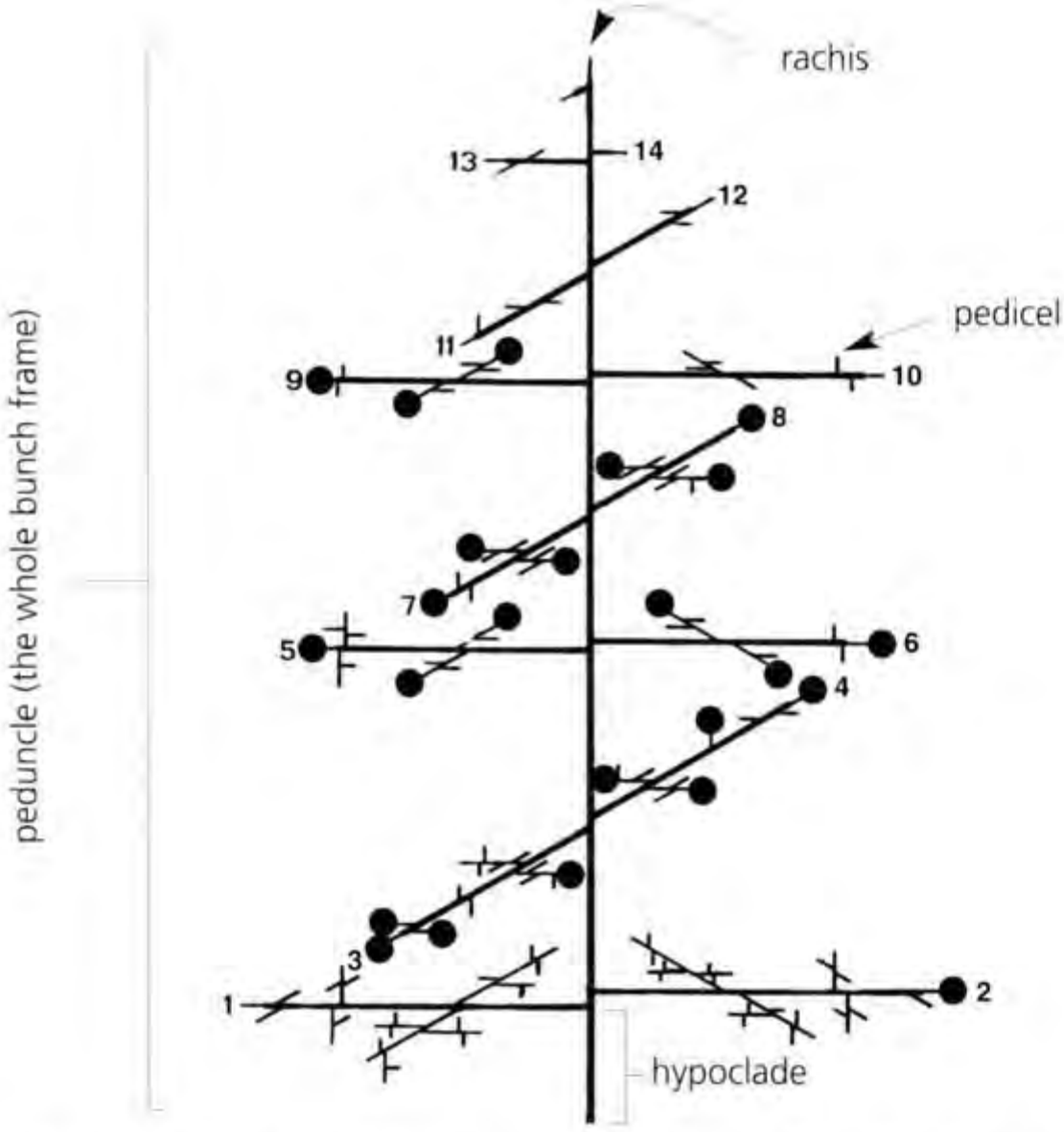


Figure 5. Scheme of a Pinot Noir inflorescence early during flowering. Pedicels are shown by short lines; those without ● carried closed flowers, those with ● carried flowers that had opened. The various parts of the inflorescence framework are labelled, and the branches are numbered.

Figure 8. Dichasium of grape flowers. The king flower (1) in the centre is subtended by a bract (**b_1**) that is often larger and at about 90° from the bracts (**b_2**) subtending the two lateral flowers (2). The bracts of the lateral flowers face each other, aligned at about 180°.

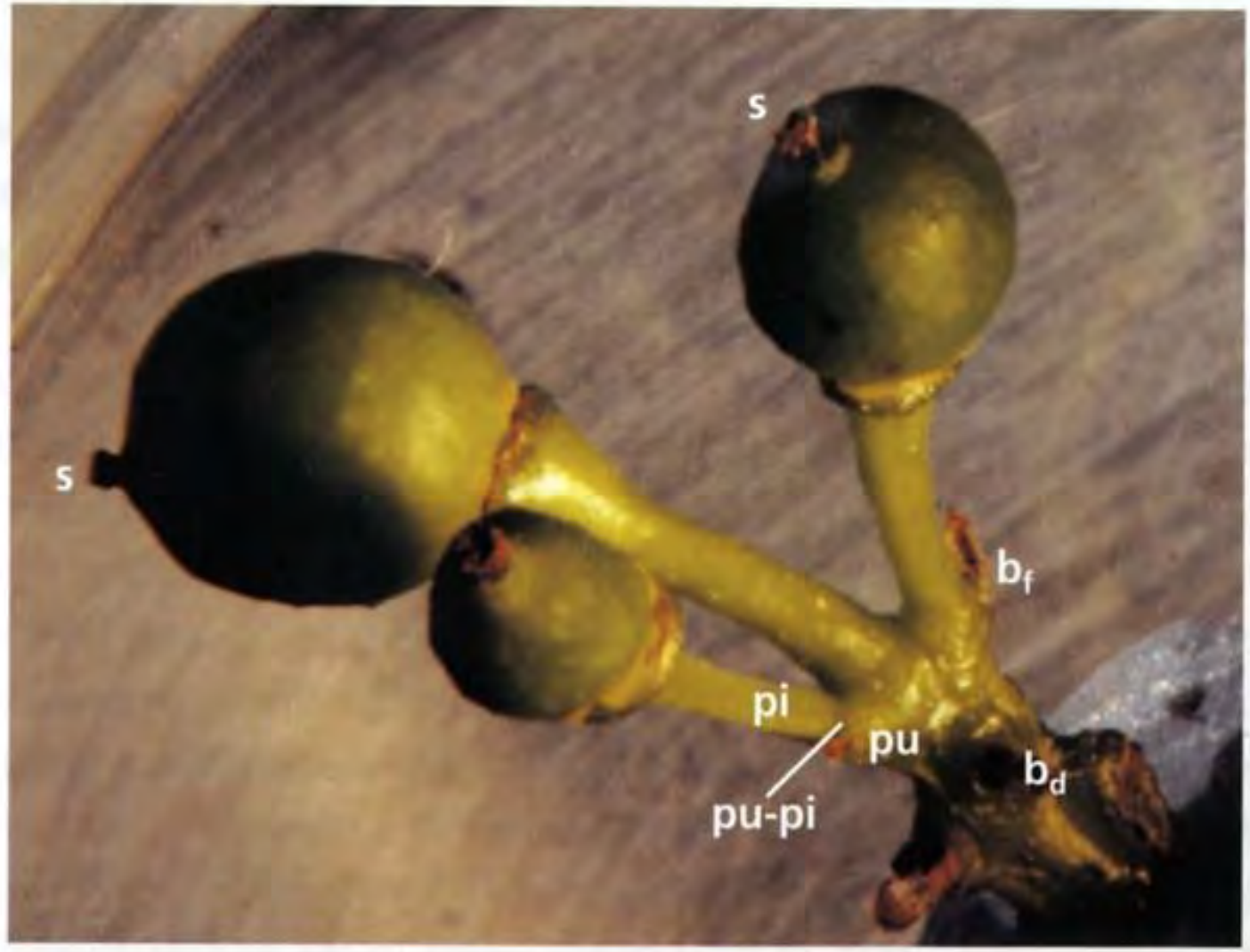
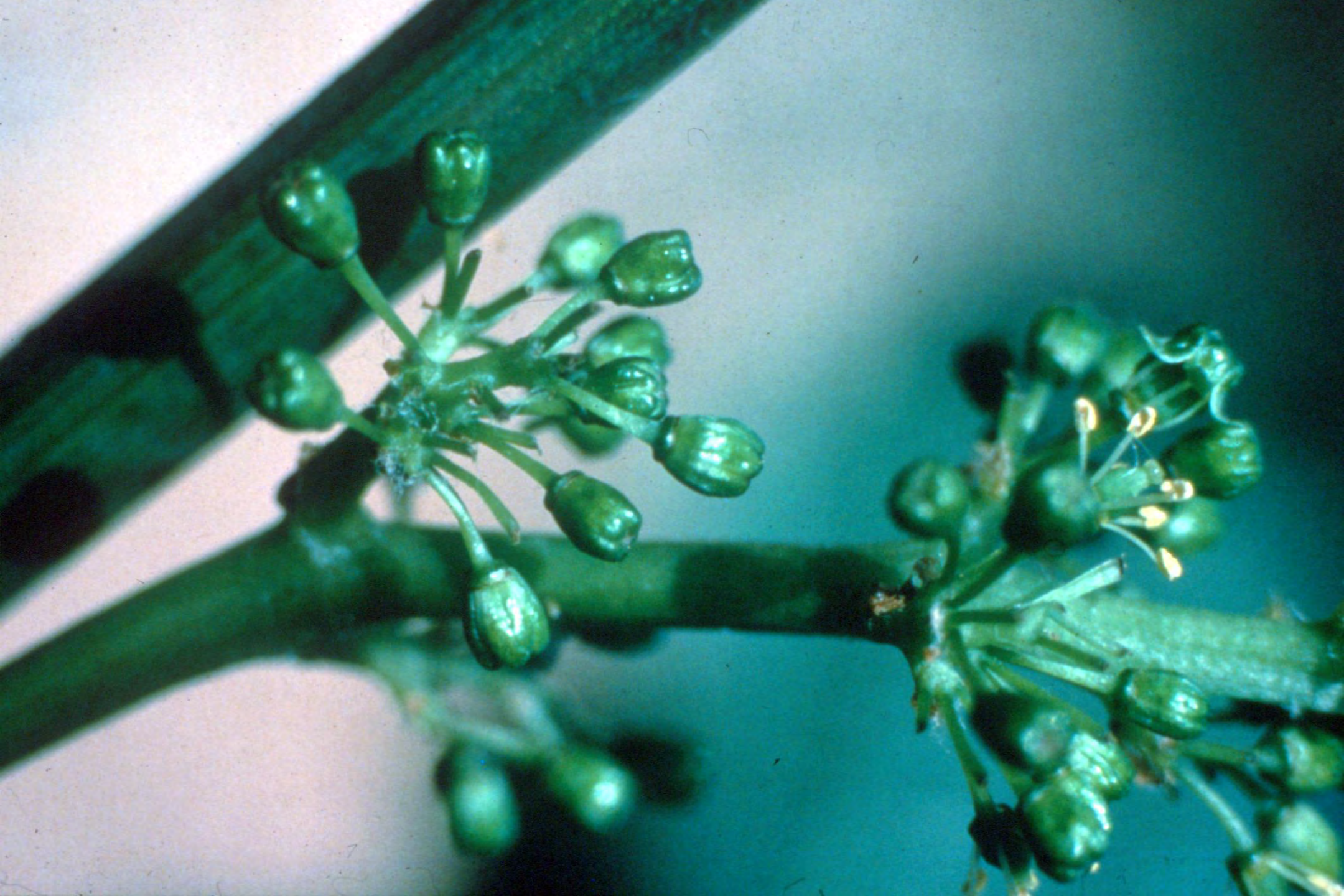


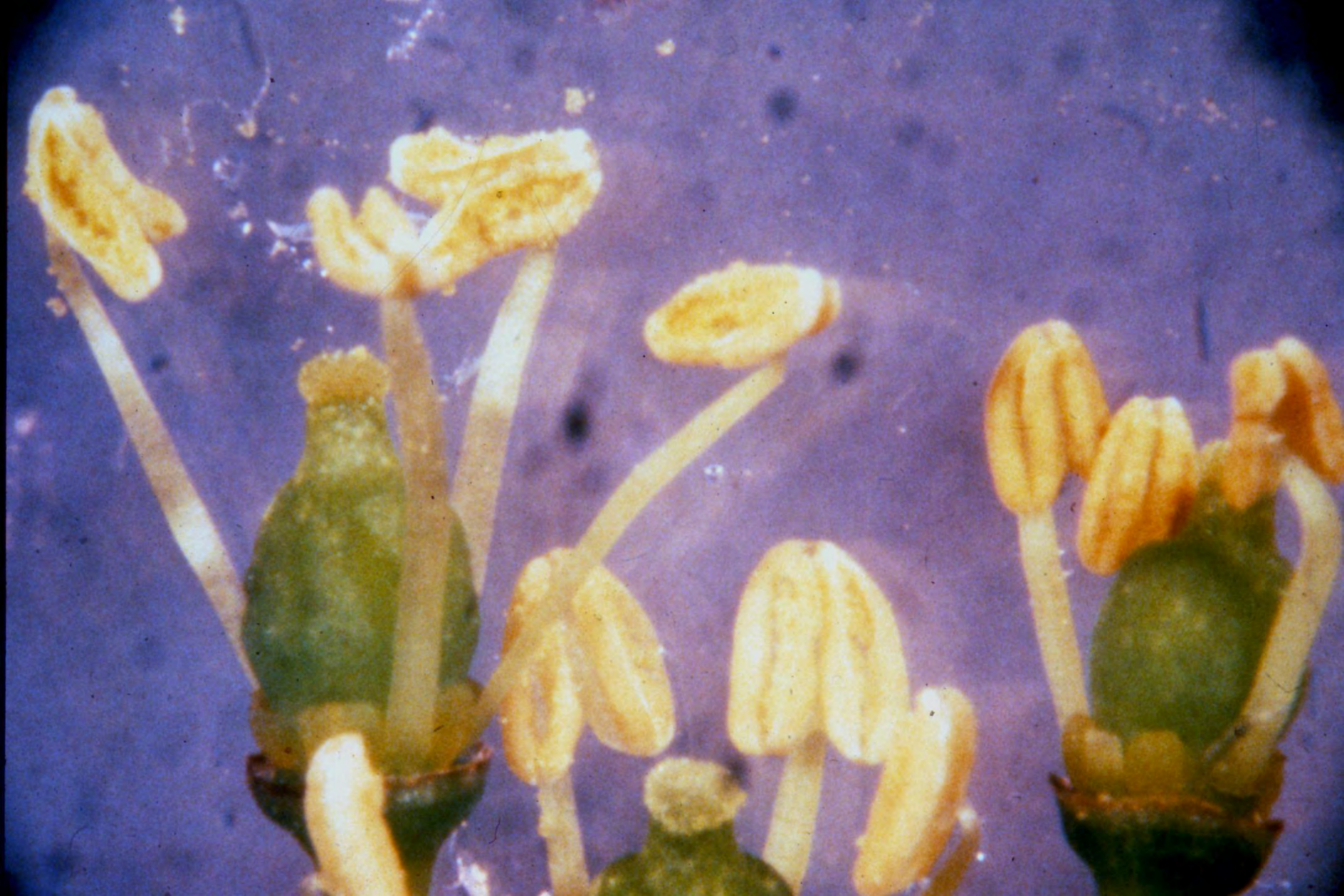
Figure 15. Young berries soon after fruitset. Note the large difference in berry size between the three berries of the dichasium, the residual stigma and style (**s**), the junction (**pu-pi**) of peduncle (**pu**) and pedicel (**pi**), the bract of the dichasium (**b_d**), and the bract of a lateral flower (**b_f**.

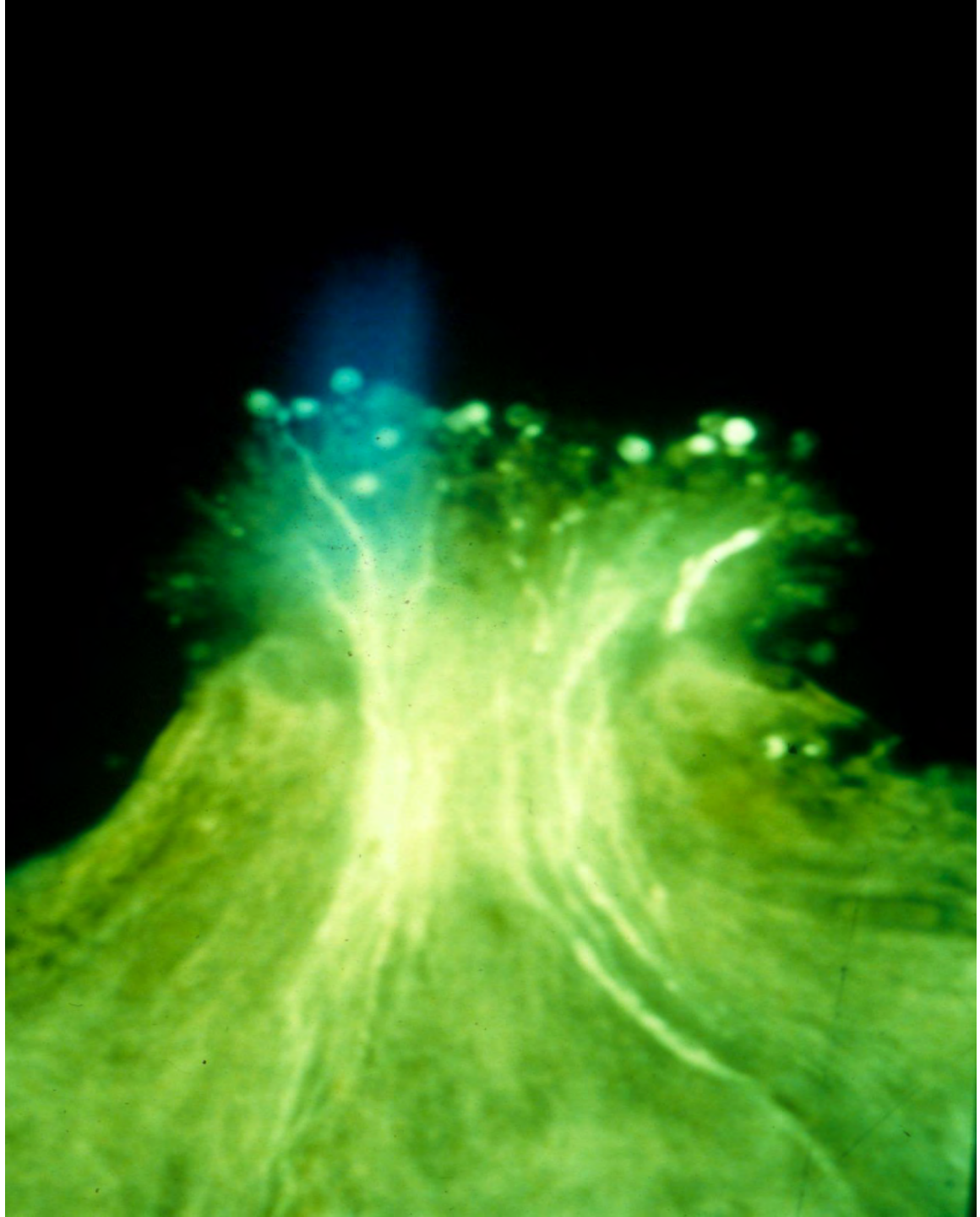


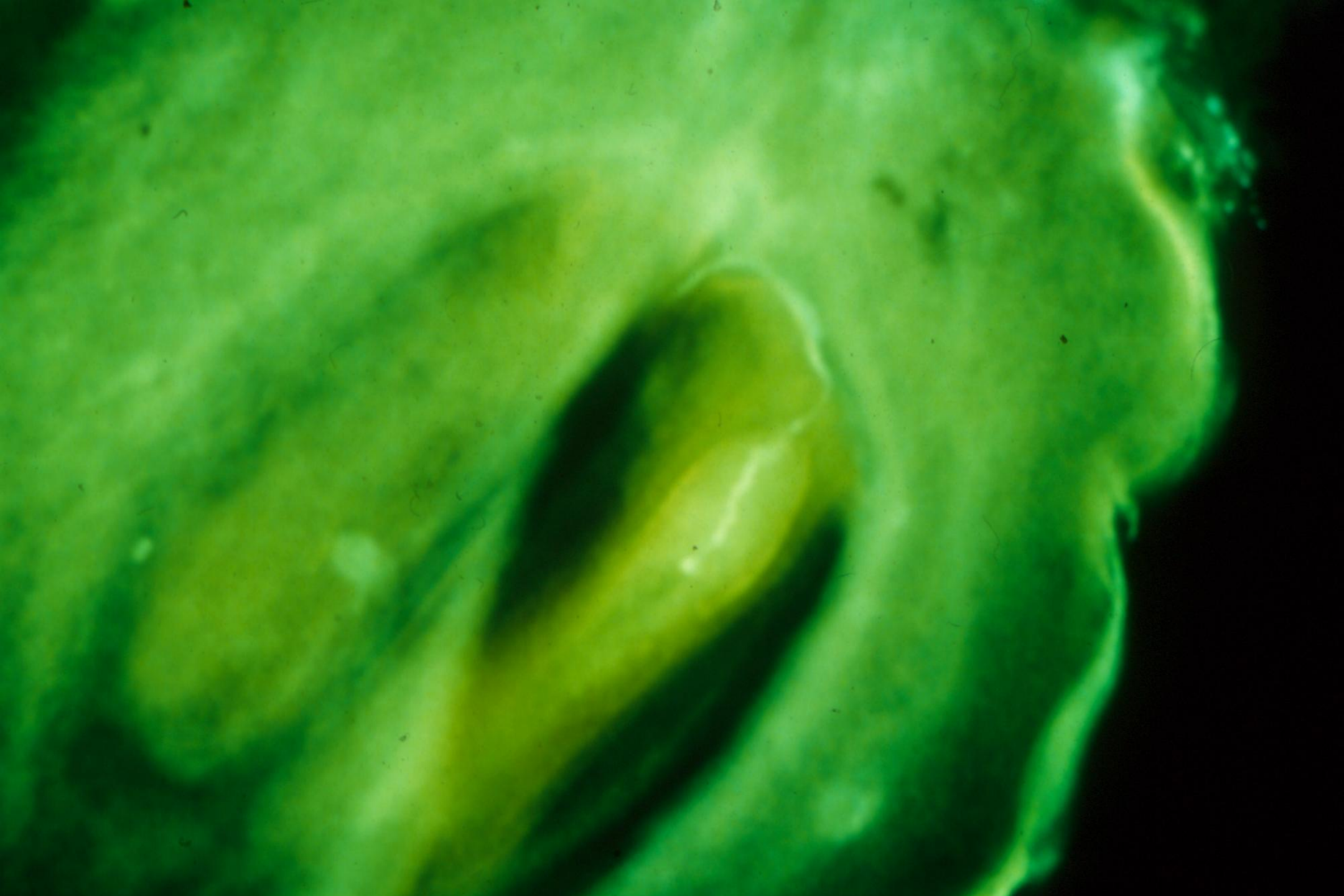
Fertilization

♣ self-pollination

♣ cross-pollination








1.5
2.1
2.5
Ovary diameters (mm)

SHOOT TREATMENT EXPT. DAVIS 1958

GRENACHE

NUMBER OF LEAVES LEFT

0 | 1 | 2 | 4 | 6 | ALL

PRESENT

↑

SHOOT TIP

↓

REMOVED


NUMBER OF LEAVES LEFT
0
1/2
1
2
4
6
ALL
PRESENT
SHOOT TIP
REMOVED

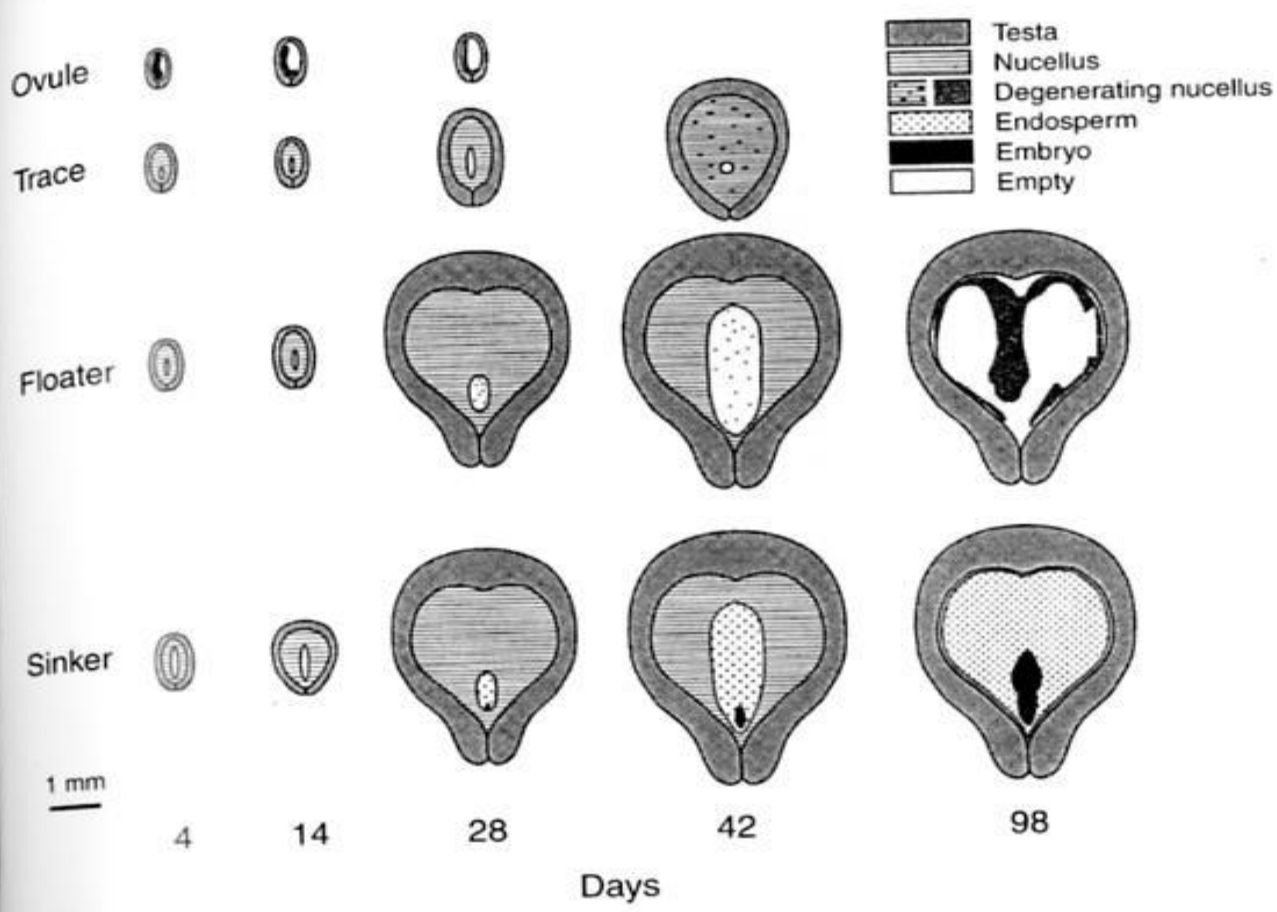
Sterility

- Morphological
- Cytological
- Genetic (?)

Partenocarpy

Stenospermocarpy

- Early abortion of embryo and teguments (cv. Sultana)



A

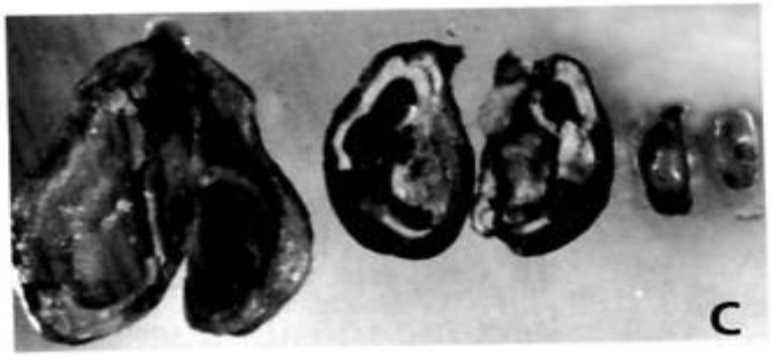


Figure 33. A. Scheme of seed development in grapevines. For explanation see text (Reproduced from Ebadi et al. 1996b, with permission) **B**. Berries of cv. Gamay, containing the seeds shown in C. **C**. Seeds of berries shown in B. From left to right: sinker seed (with embryo and endosperm), floater seed (without embryo and endosperm), seed trace and residual ovule.

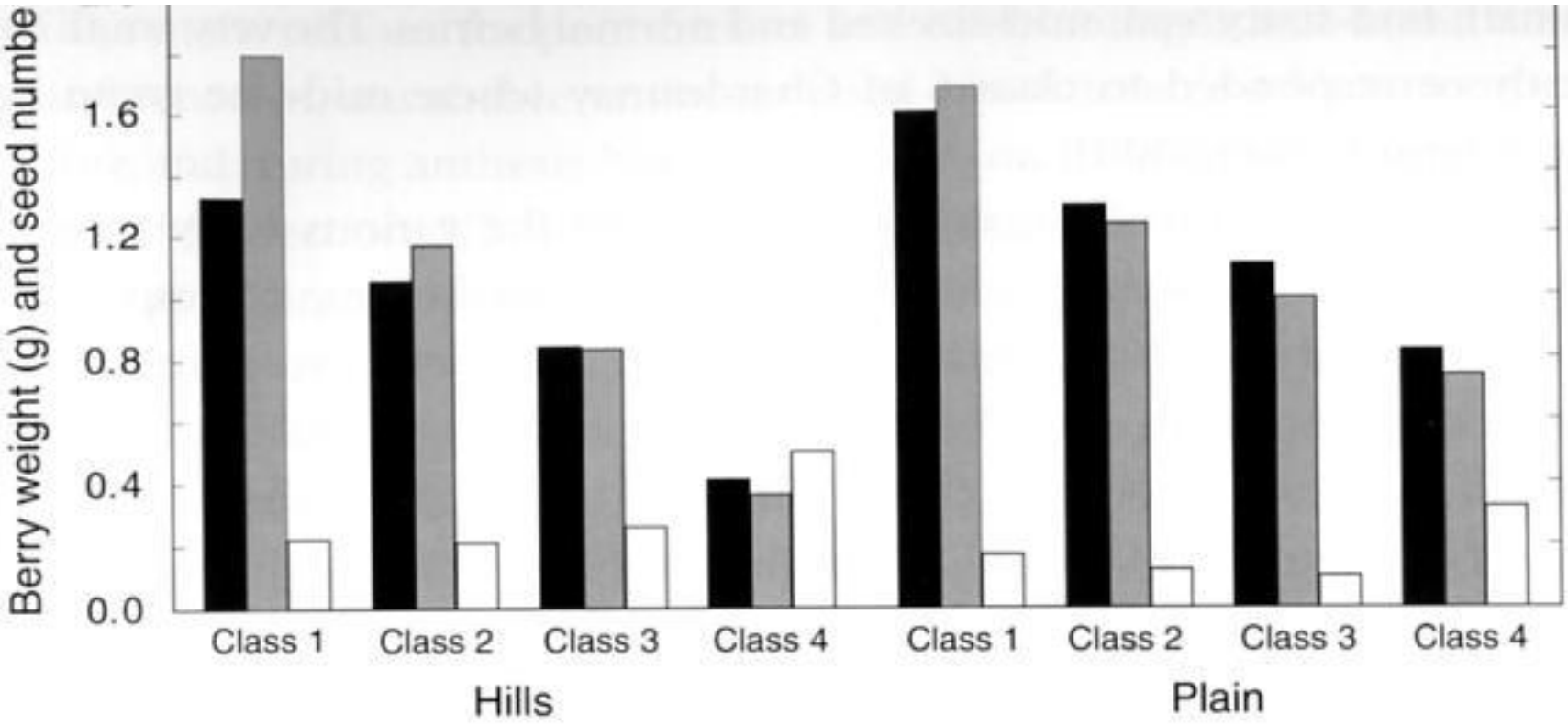
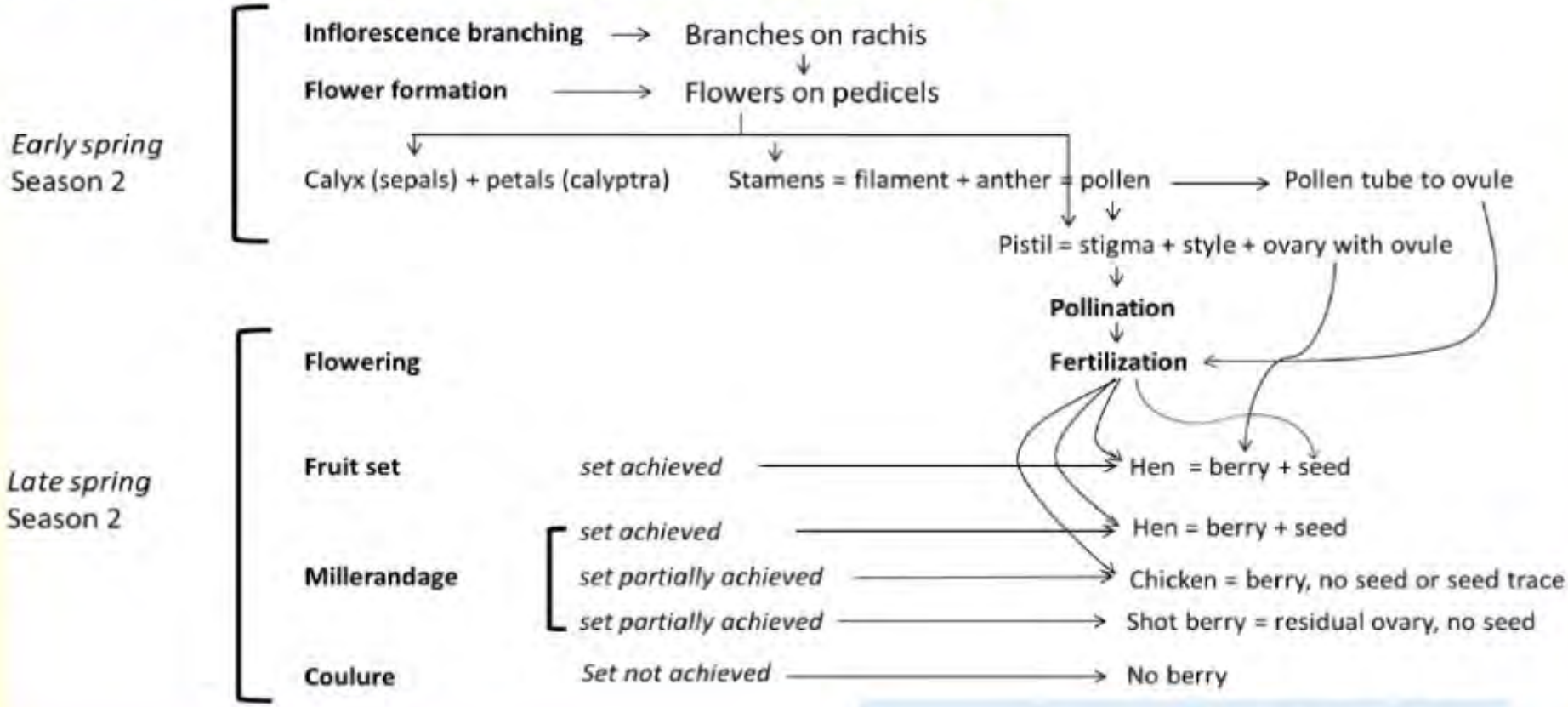


Figure 34. Weight per berry (g) ■ and number of sinker ■ and floater □ seeds in Chardonnay berries of size classes 1, 2, 3 and 4. Samples from Adelaide Hills (Hills) and Southern Vales (Plain) South Australia, 1990/91. (Modified from May 2000)

Pinot Noir Chardonnay

	Brix	Berry wt
'Hens'	21°	1.3g
'Chicks'	25°	0.3g

Yield elaboration
Season 2 : berry development (default)



Friend et Trought, 2007; Baby et al., 2014

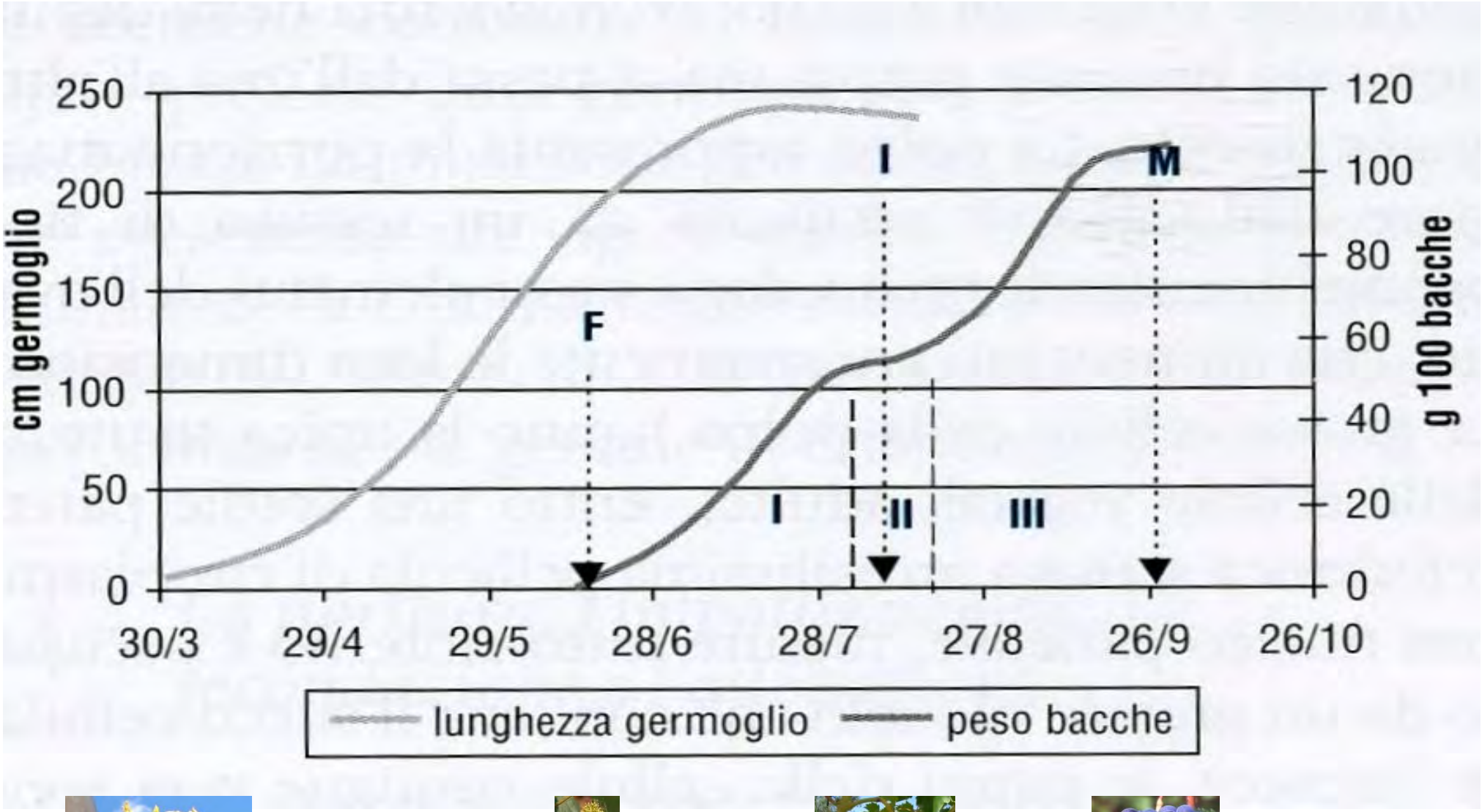
Setting defaults

$$\text{Total berry no. per bunch} = \text{no. of seeded berries per bunch} + \text{no. of seedless berries per bunch}$$

$$\text{Fruitset}(\%) = \frac{\text{total berry no. per bunch}}{\text{no. of flowers per bunch}} \times 100$$

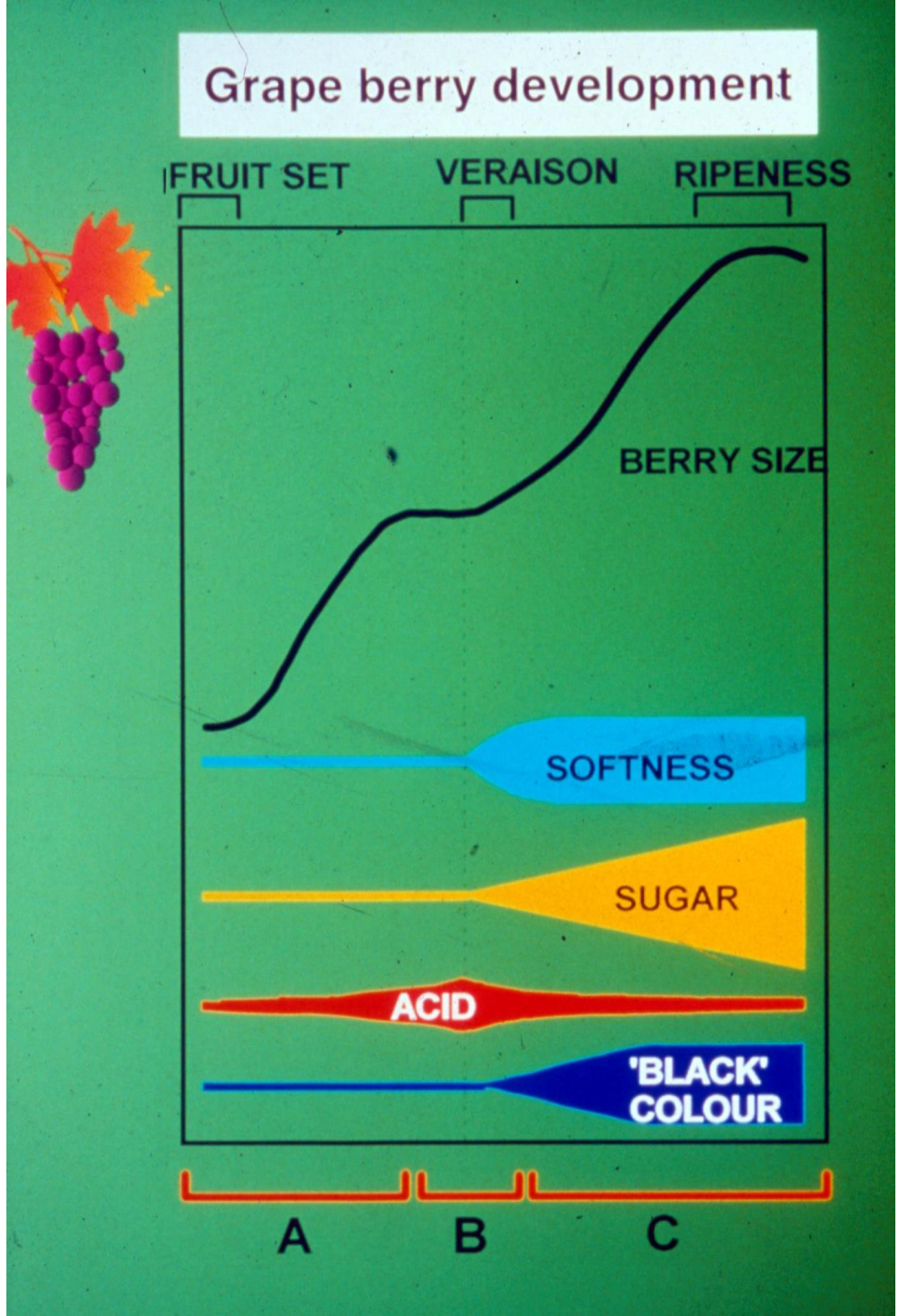
$$\text{Coulure Index} = 10 - \frac{(\text{no. of seeded berries per bunch} + \text{no. of seedless berries per bunch} + \text{no. of LGOs per bunch}) \times 10}{\text{no. of flowers per bunch}}$$

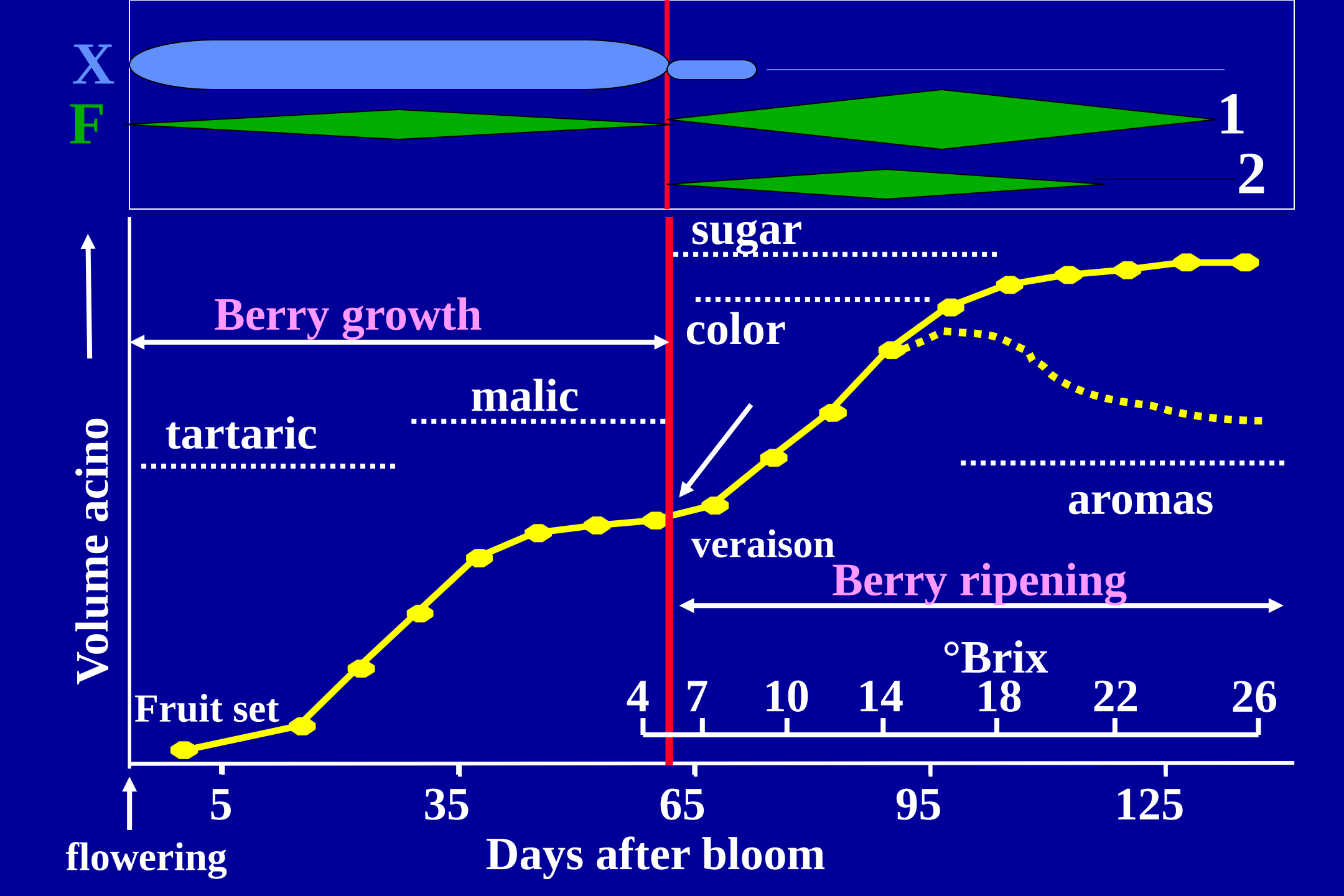
$$\text{Millerandage Index} = 10 - \frac{(\text{no. of seeded berries per bunch} \times 10)}{\text{no. of seeded berries per bunch} + \text{no. of seedless berries per bunch} + \text{no. of LGOs per bunch}}$$






L’arresto vegetativo è indispensabile per un’ottima maturazione

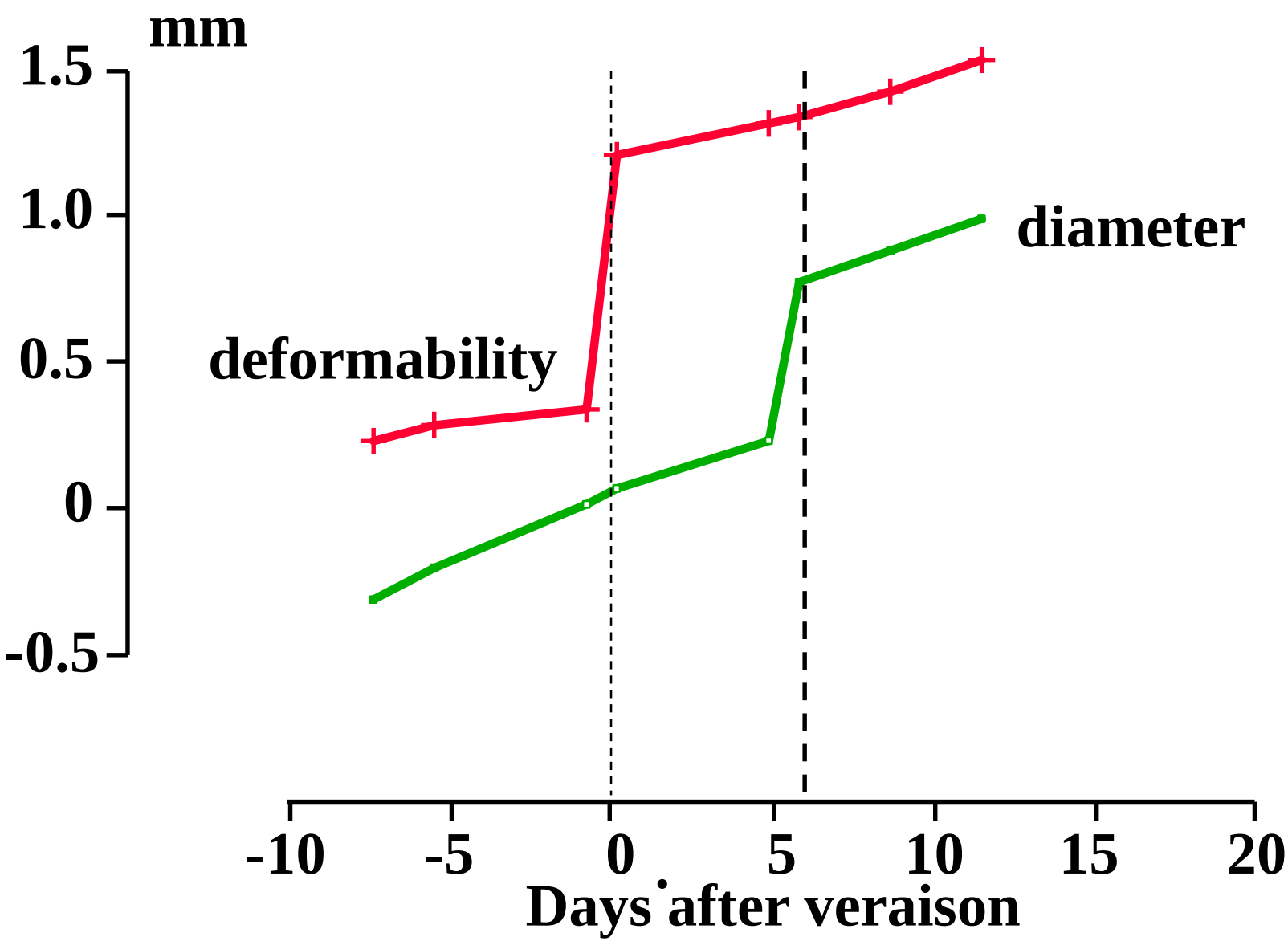

Grape berry development
FRUIT SET
VERAISON
RIPENESS
BERRY SIZE
SOFTNESS
SUGAR
ACID
'BLACK' COLOUR
A
B
C


X
F
1
2
sugar
color
Berry growth
malic
tartaric
aromas
veraison
Berry ripening
°Brix
4
7
10
14
18
22
26
Volume acino
Fruit set
5
35
65
95
125
flowering
Days after bloom

Berry ripening – The revolution

- Veraison-to-maturity: 20-50 days
- Deep change in the source-sink balance
- Hormone changes (↓ Aux, Gib, Ck; ↑ ABA, Etilene)
- Berry growth
- Berry softening
- Berry wax changes
- Sugar accumulation
- Acids decrease
- Phenols accumulation
- Flavor compounds
- Nitrogen compounds
- Enzyme activity
- Mineral ions
- Vitamins

From Coombe e Bishop, 1980



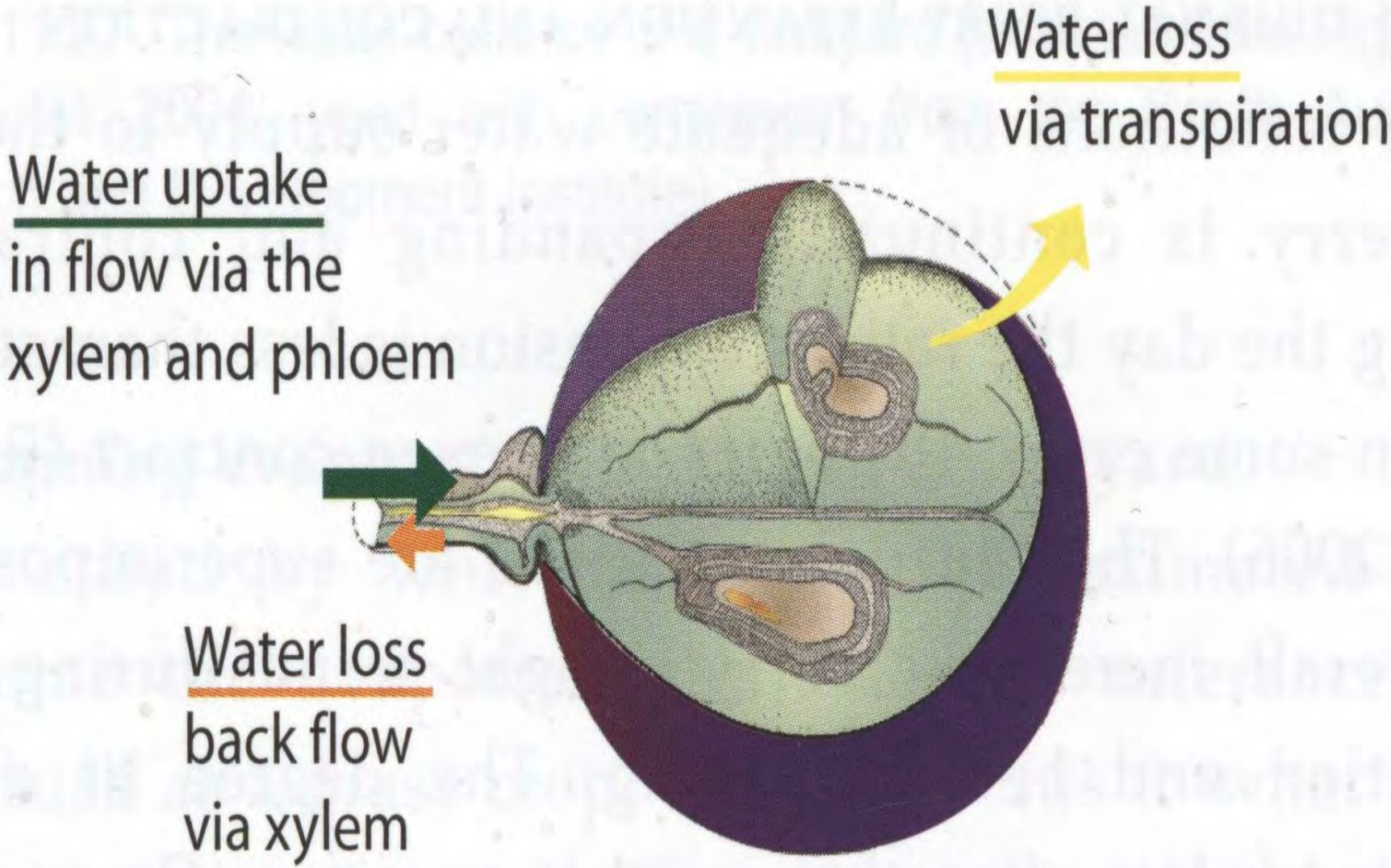
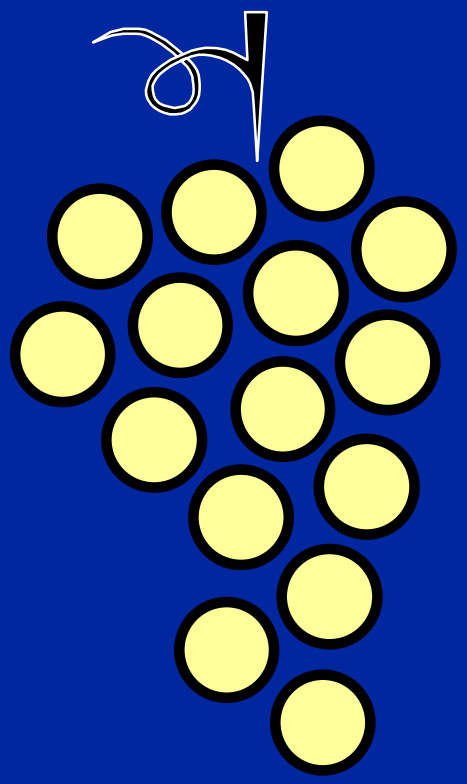


Figure 11.23 A summary of the water balance in grape berries (based on a figure designed by S.D. Tyerman).

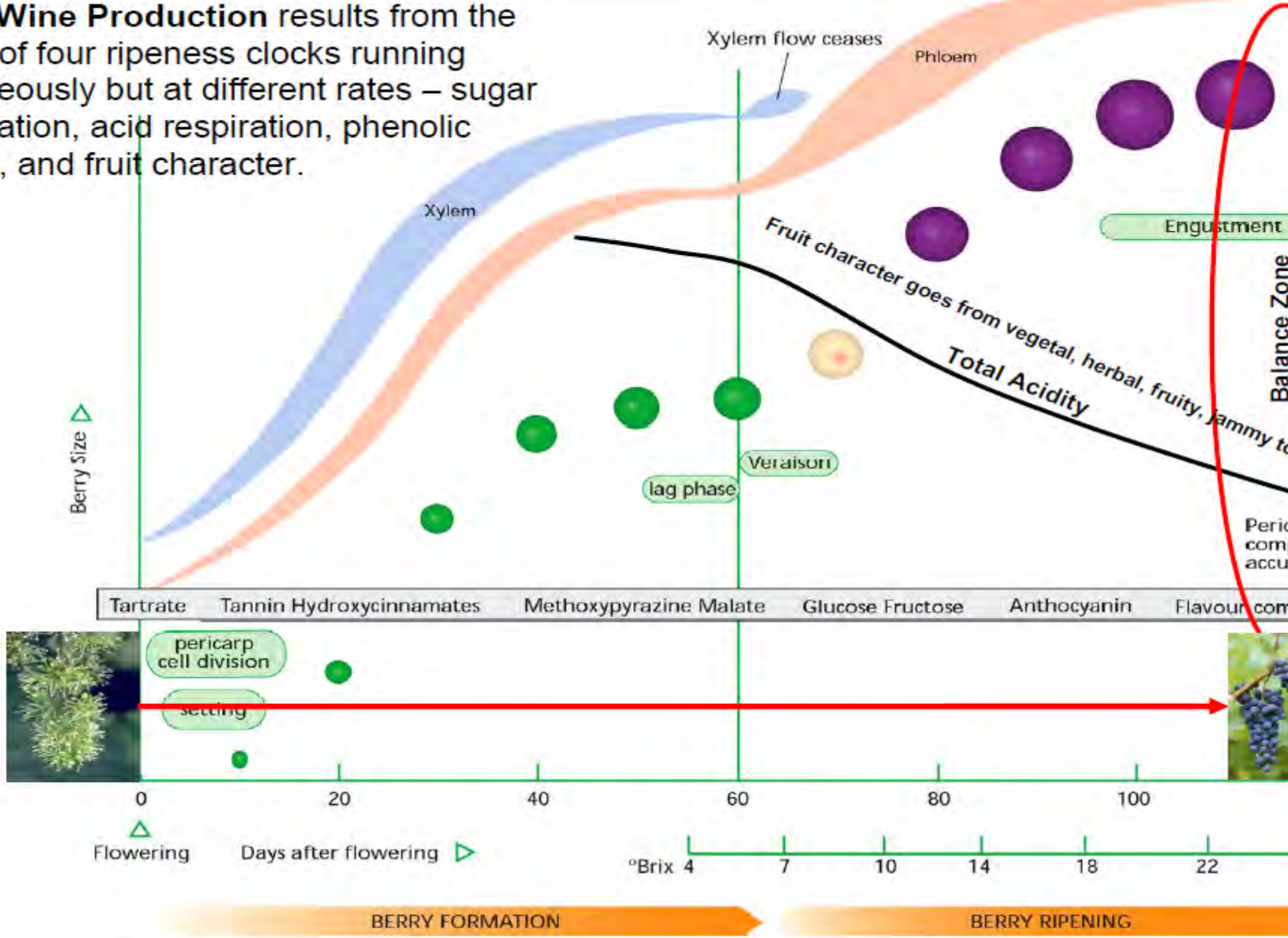
Cluster components

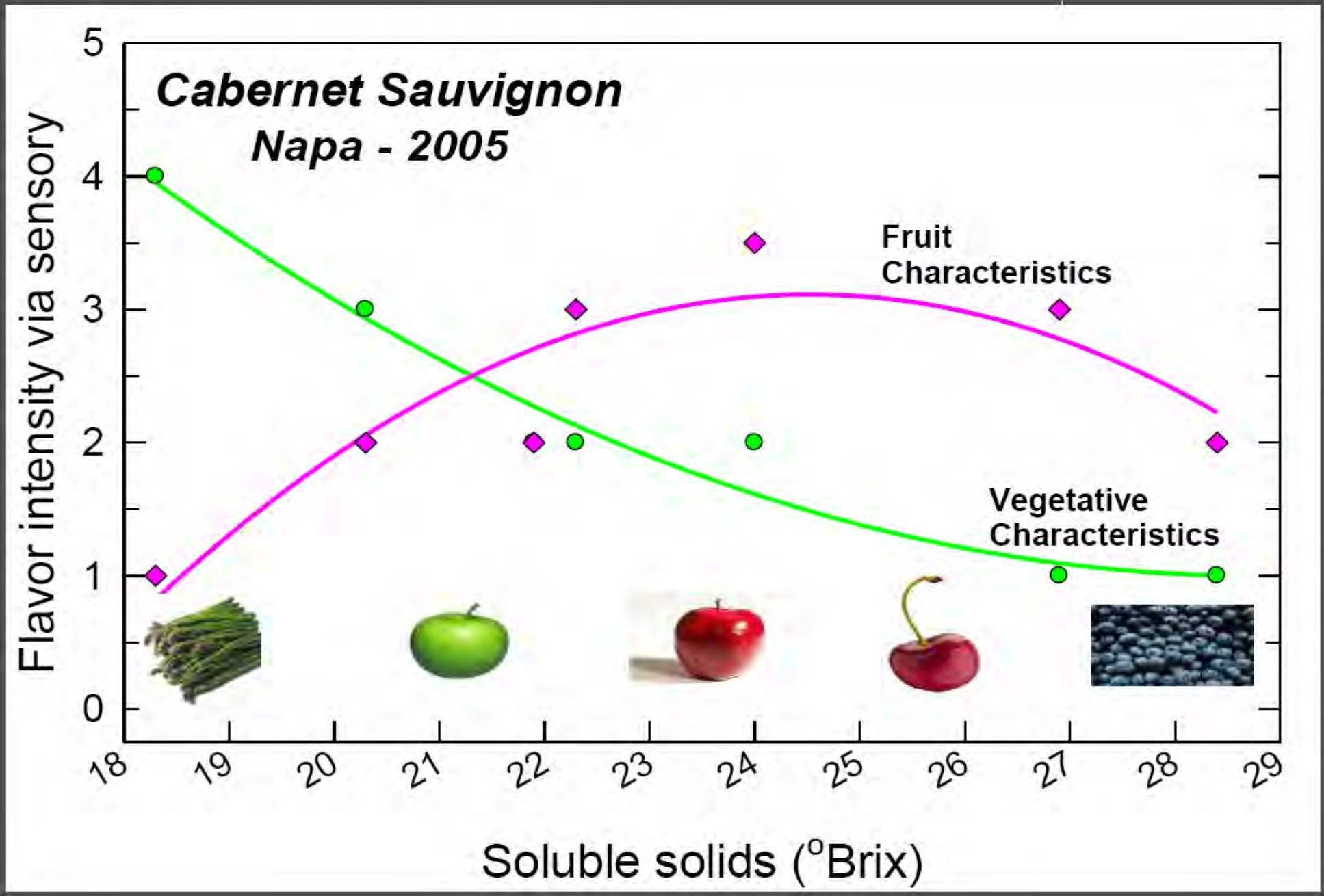
(fraction of total FW)



rachis	**2 - 5 %**
skin	**5 - 11 %**
seeds	**10 %**
Must	**76 - 83 %**

Quality Wine Production results from the balance of four ripeness clocks running simultaneously but at different rates – sugar accumulation, acid respiration, phenolic ripeness, and fruit character.

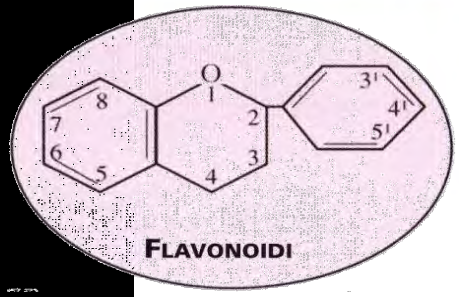



Cabernet Sauvignon
Napa - 2005
Fruit Characteristics
Vegetative Characteristics
Flavor intensity via sensory
Soluble solids (°Brix)
0
1
2
3
4
5
18
19
20
21
22
23
24
25
26
27
28
29

I composti fenolici

FLAVONOIDI C6-C3-C6

- **ANTOCIANI:** 5 antocianine glicosilate in posizione 3 ed esterificate da
  - ac. acetico
  - ac. p-cumarico
  - ac. caffeico
  - CIANIDINA
  - DELFINIDINA
  - PEONIDINA
  - PETUNIDINA
  - MALVIDINA
- **FLAVONOLI:** campferolo - quercetina - miricetina
- **FLAVANOLI:** tannini oligomeri e polimeri (Proantocianidine)
  - **nell'acino**
    - **PRODELFINIDINE (gallocatechine)***
    - **PROCIANIDINE (catechine)****
  - **nei vinaccioli**
    - **PROCIANIDINE (maggiore quantità di catechina, epicatechina)**



NON FLAVONOIDI AC. FENOLICI

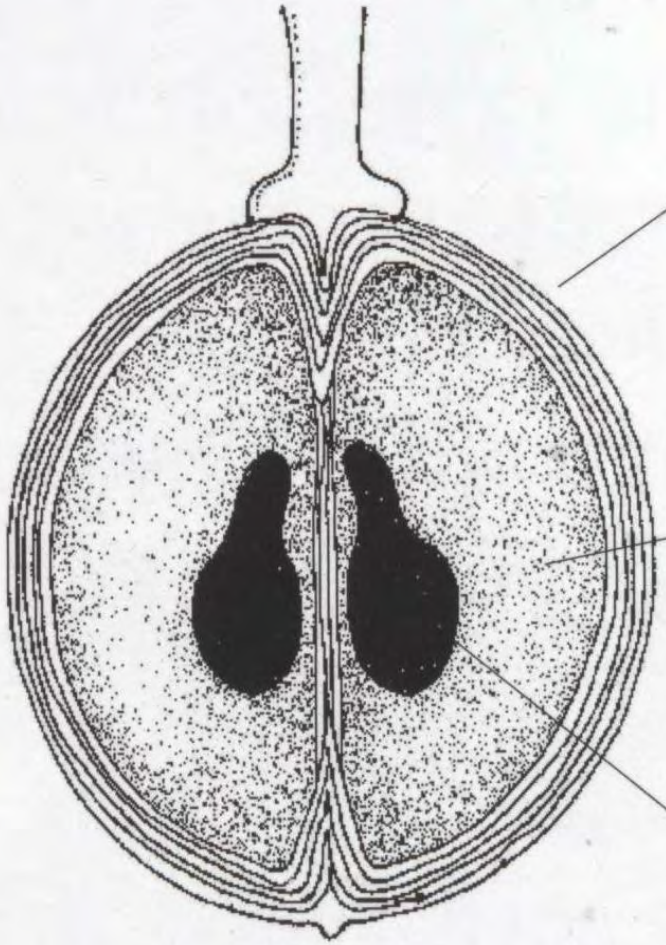
- Ac. benzoici C6-C1
  - ac. gallico
- Ac. idrossicinnamiltartarici C6-C3
  - ac. caffeiltartarico
  - ac. paracumariltartarico
  - ac. feruliltartarico

  } prevalenti nella forma <u>trans</u>

IDROSSISTILBENI

- Resveratrolo (buccia)

da Lanati e Marchi, 2007



Skin

Phenolic compounds
Volatile aroma compounds
Minerals and anions

Flesh

Sugars
Acids
Volatile aroma compounds
Minerals and anions

Seeds

Phenolic compounds
Minerals and anions

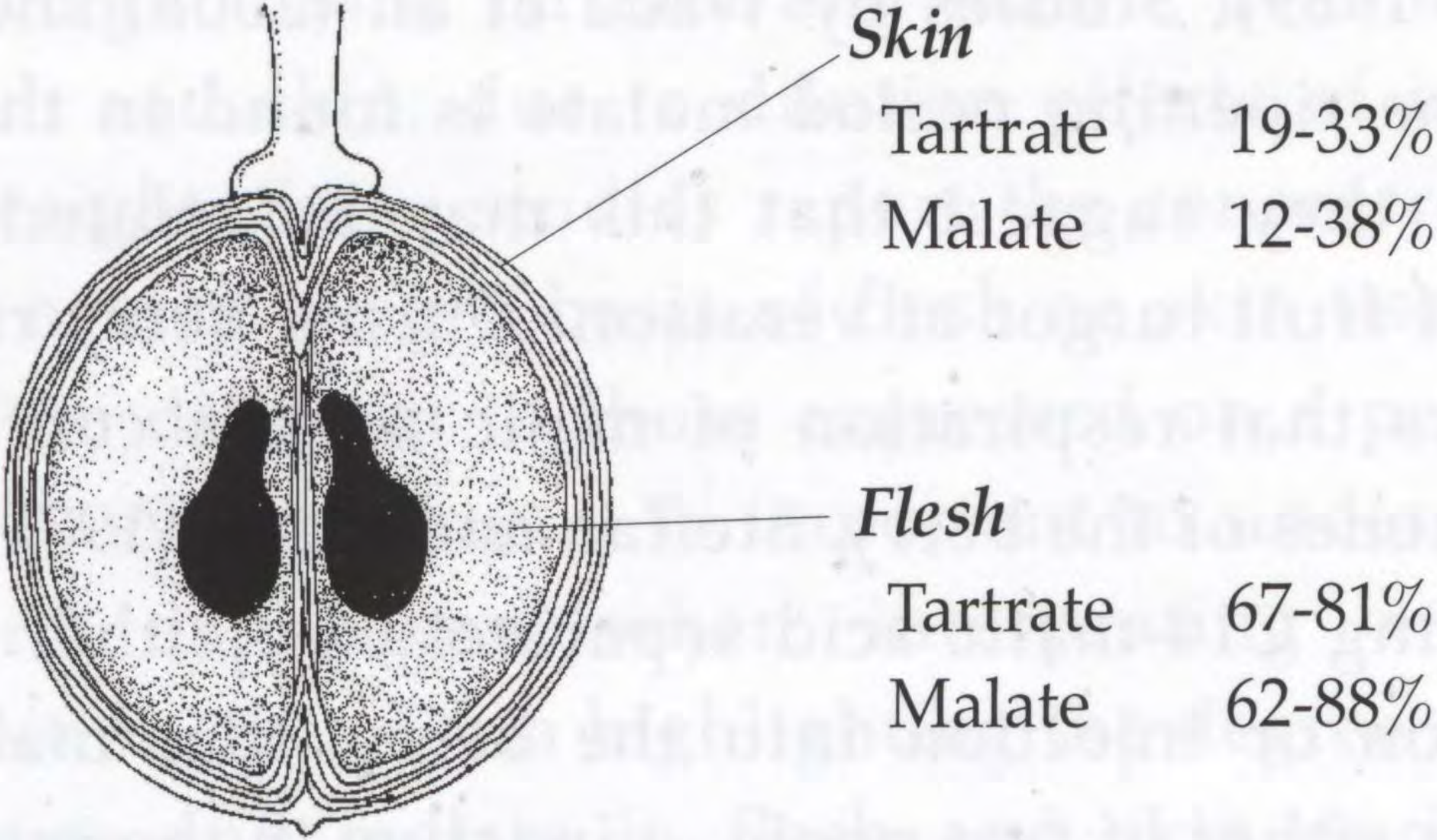
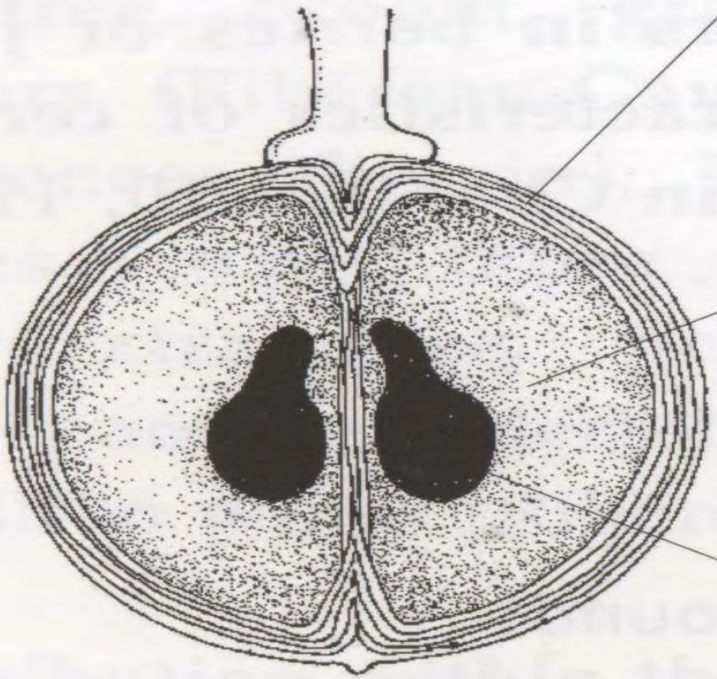


Figure 8.18 A guide to the percentage (of the total) distribution of tartrate and malate in the grape berry.



Skin

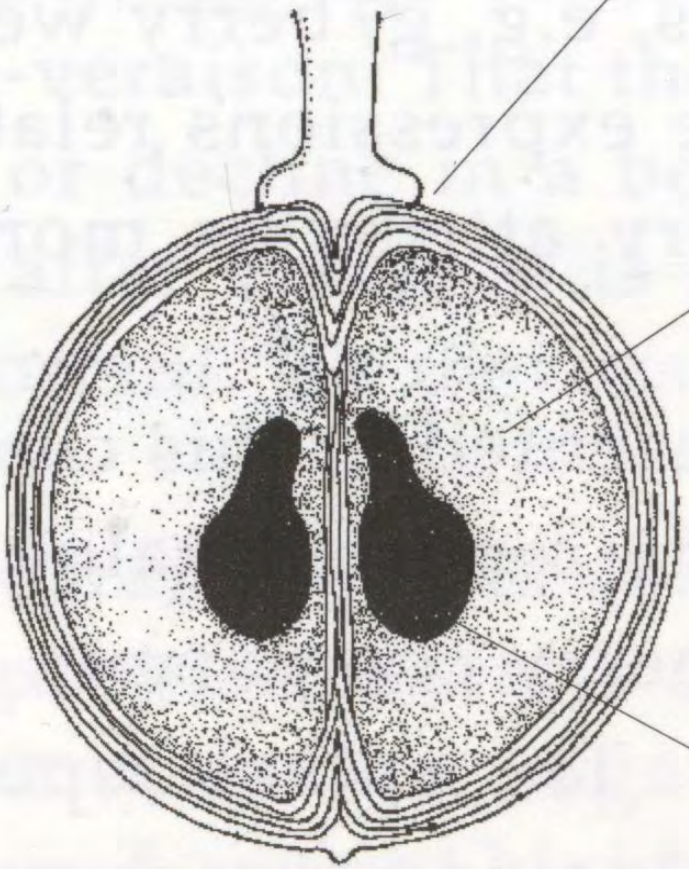
Potassium	32-46%
Sodium	23-29%
Calcium	40%
Magnesium	19%
Chloride	80-90%

Flesh

Potassium	39-64%
Sodium	71-75%
Calcium	40%
Magnesium	59%
Chloride	10-20%

Seeds

Potassium	2-10%
Sodium	2%
Calcium	20%
Magnesium	22%



Skin

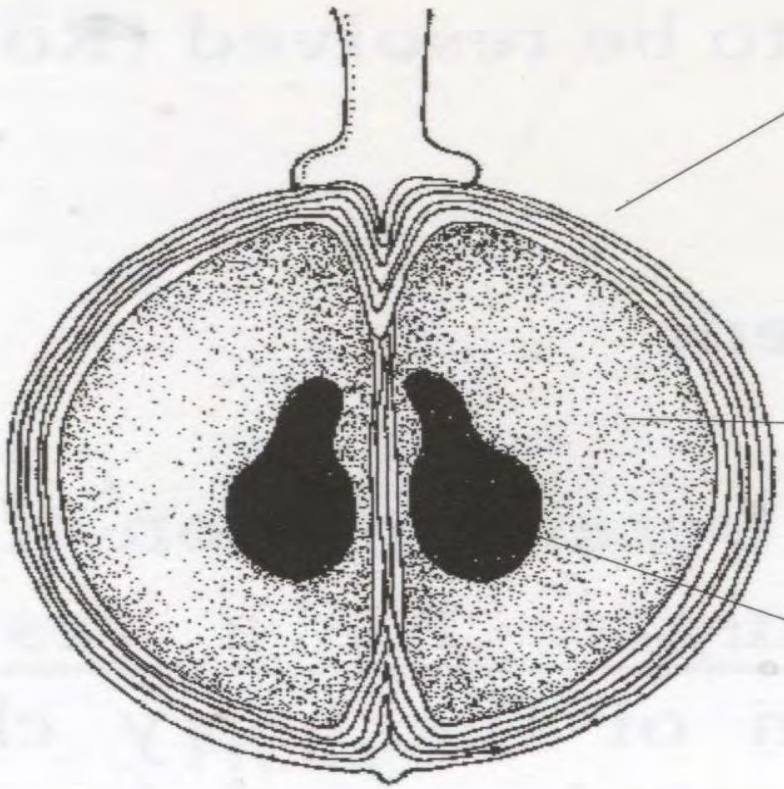
Total free amino acids	15 - 23%
N in the form of proline	12 - 16%
N in the form of YAN	19 - 29%

Flesh

Total free amino acids	66 - 77%
N in the form of proline	79 - 87%
N in the form of YAN	61 - 66%

Seeds

Total free amino acids	8.5 - 11%
N in the form of proline	1 - 5%
N in the form of YAN	10 - 15%



Skin

Anthocyanins	100%
Flanonols	100%
Flavan-3-ols	4-22%
Tannins	17-49%

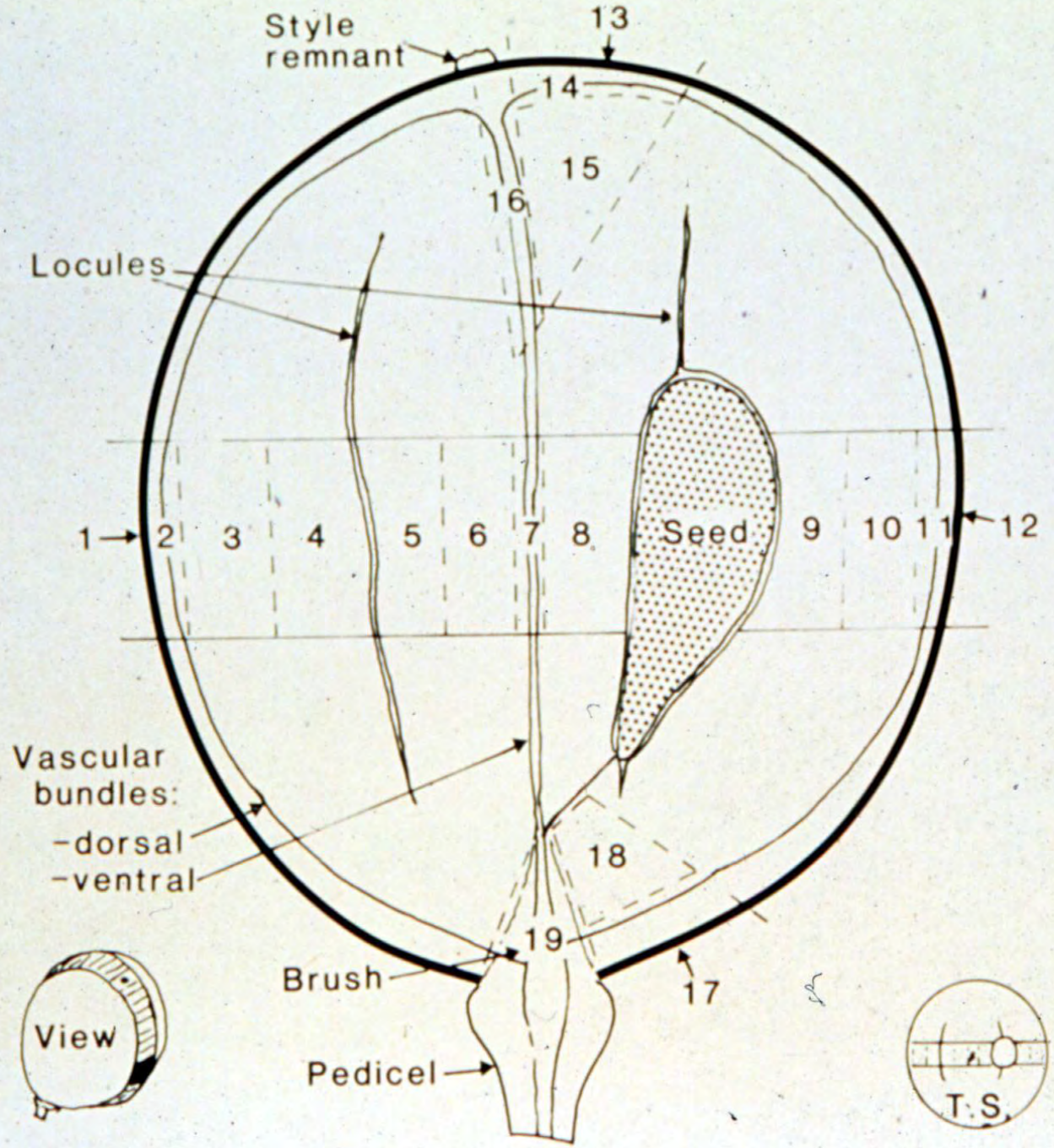
Flesh

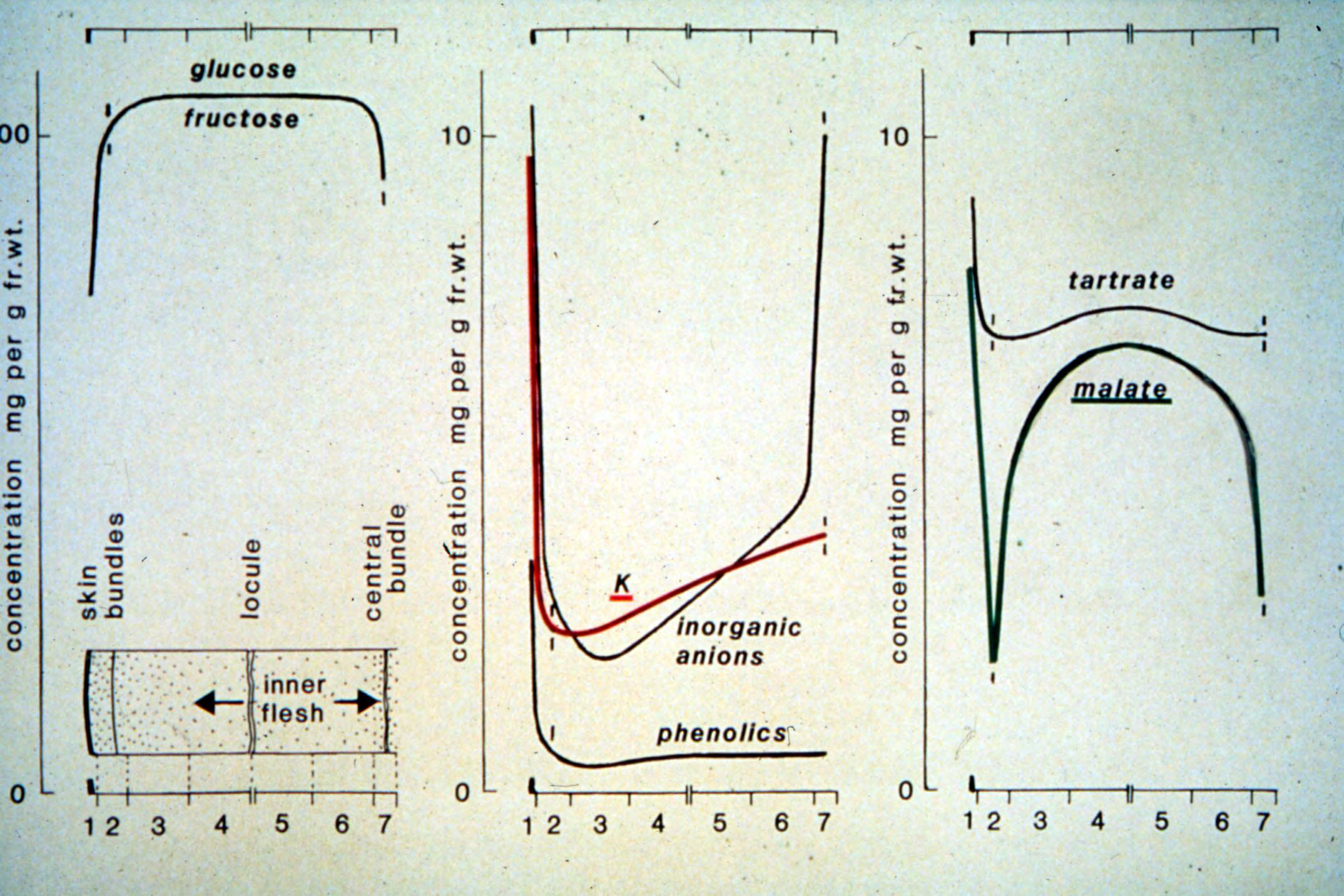
Phenolic acids	90-100%

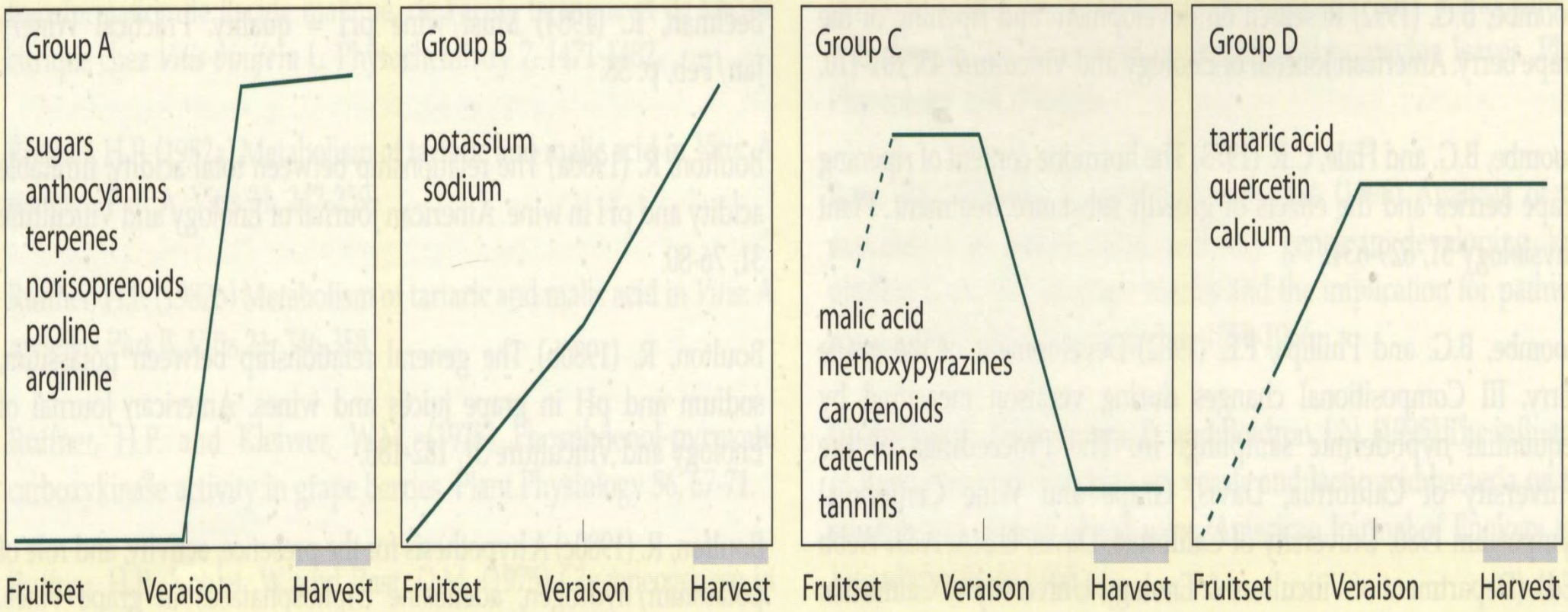
Seeds

Flavan-3-ols	78-96%
Tannins	51-83%

Figure 8.38 A guide to the percentage distribution of some phenolic compounds found in the grape berry.


Style
remnant
13
14
15
16
Locules
1
2
3
4
5
6
7
8
Seed
9
10
11
12
Vascular
bundles:
-dorsal
-ventral
18
19
Brush
17
View
Pedicel
T.S.


glucose
fructose
00
concentration mg per g fr.wt.
skin bundles
locule
central bundle
inner flesh
0
1 2 3 4 5 6 7
10
concentration mg per g fr.wt.
K
inorganic anions
phenolics
0
1 2 3 4 5 6 7
10
concentration mg per g fr.wt.
tartrate
malate
0
1 2 3 4 5 6 7


Group A
sugars
anthocyanins
terpenes
norisoprenoids
proline
arginine
Fruitset
Veraison
Harvest
Group B
potassium
sodium
Fruitset
Veraison
Harvest
Group C
malic acid
methoxypyrazines
carotenoids
catechins
tannins
Fruitset
Veraison
Harvest
Group D
tartaric acid
quercetin
calcium
Fruitset
Veraison
Harvest