

Viticulture

Biology of the vine

ARGYRO BEKATOROU

Associate Professor of Food
Chemistry & Technology

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Carl Downey - Colours de Vine

Viticulture - Biology of the vine

Elements of Morphology & Anatomy

When the vine is autophytic:

- *It has a weak trunk*
- *It needs support*
- *It presents morphological variations*

When the vine is cultivated:

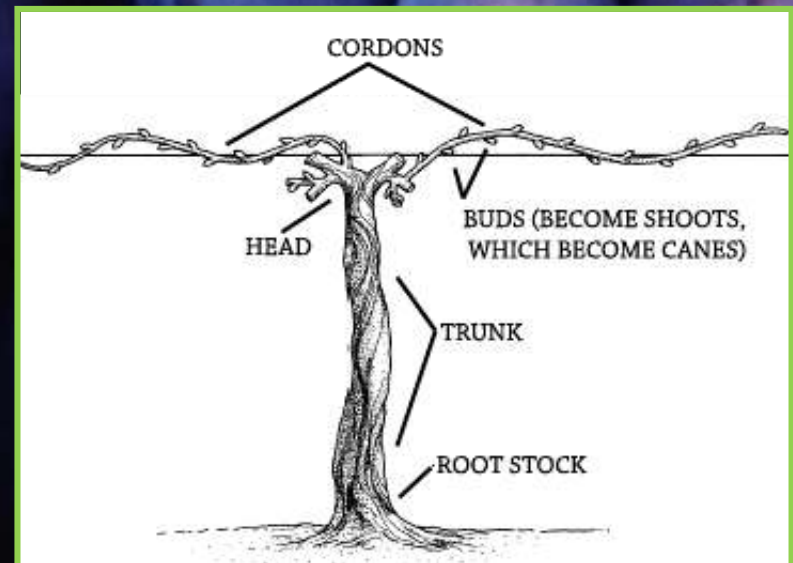
- *The size and shape of the plants is strictly determined by the cultivation practices applied*



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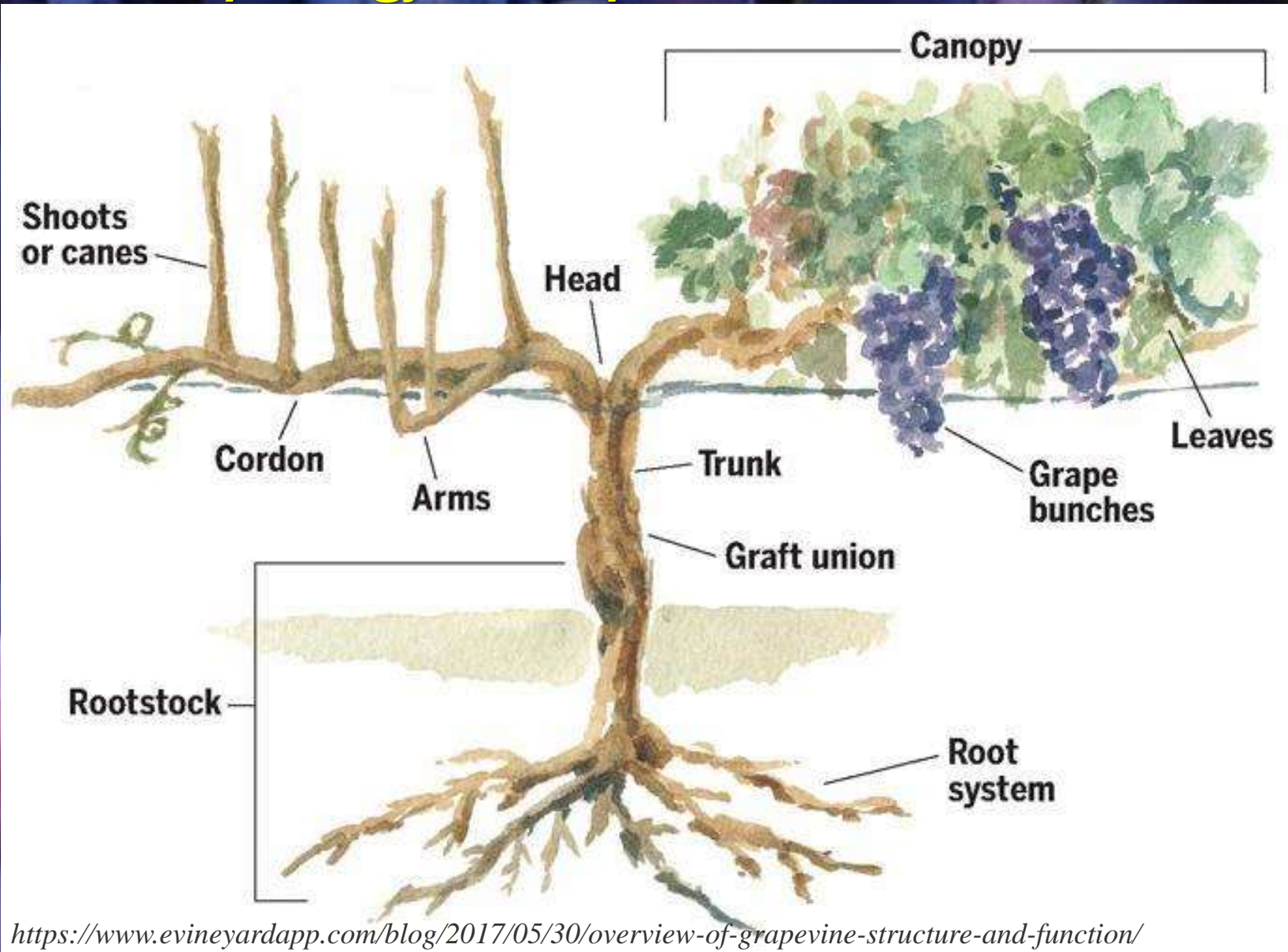
Elements of vine morphology & anatomy

- Roots
- Rootstocks/trunks
- Shoots/Canes/Cordons
- Leaves
- Flowers & fruit



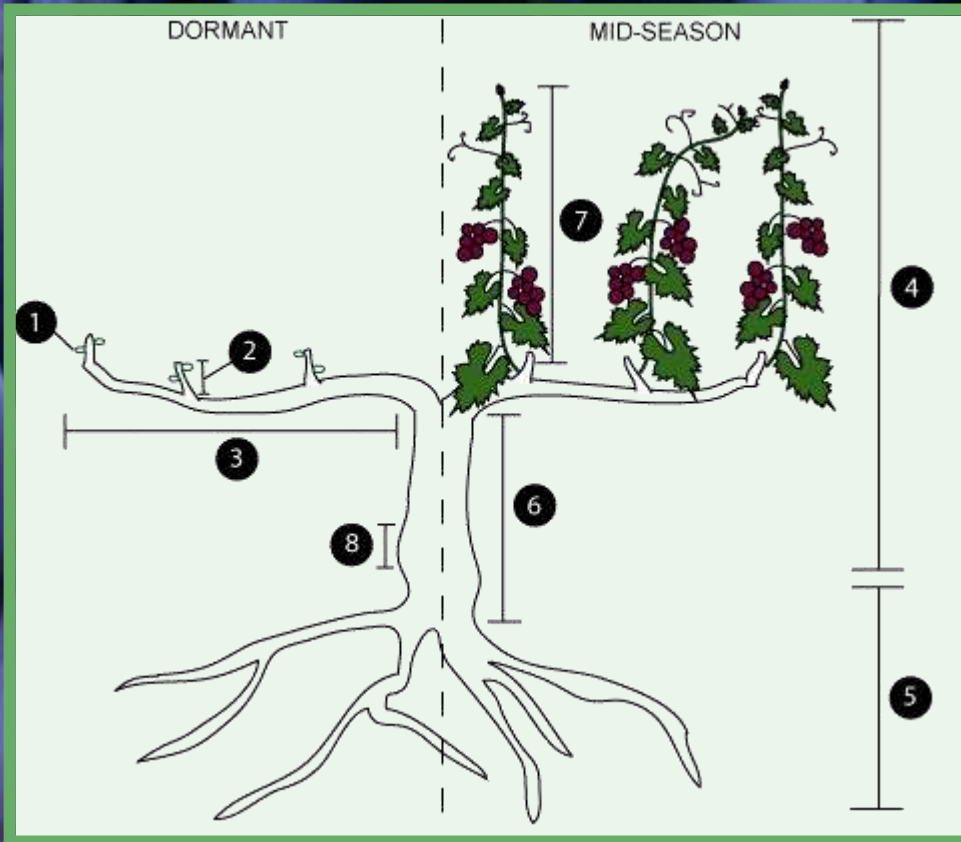
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General morphology of the plant



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General morphology of the plant



1. Dormant bud
2. Last year's pruned cane with 1-2 dormant buds (spur)
3. Cordons
4. Above ground part
5. Below ground part
6. Trunk
7. Shoot or cane
8. Graft union

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Root system

Role of the roots:

- Absorption of water
- Nutrients absorption
- Energy storage in the form of starch
- Synthesis of plant hormones (*gibberellins/cytokinins*) in the roots (smaller branches of the roots)
- Connection of the plant with the ground & support (*anchorage*)

Origin of the roots:

- Grape seeds
- Graft rooting
- ✓ The development, direction and intensity of the root colonization depend on the properties of the soil, the type of rootstock, and the cultivation practice

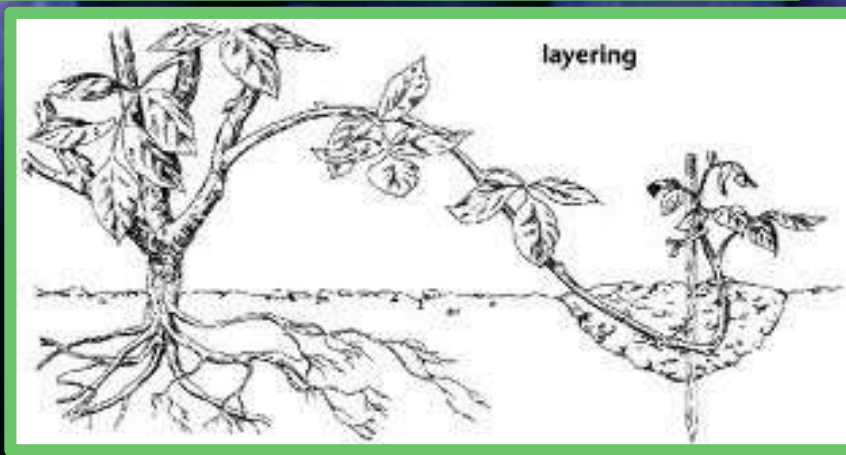
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Root system



Seedling

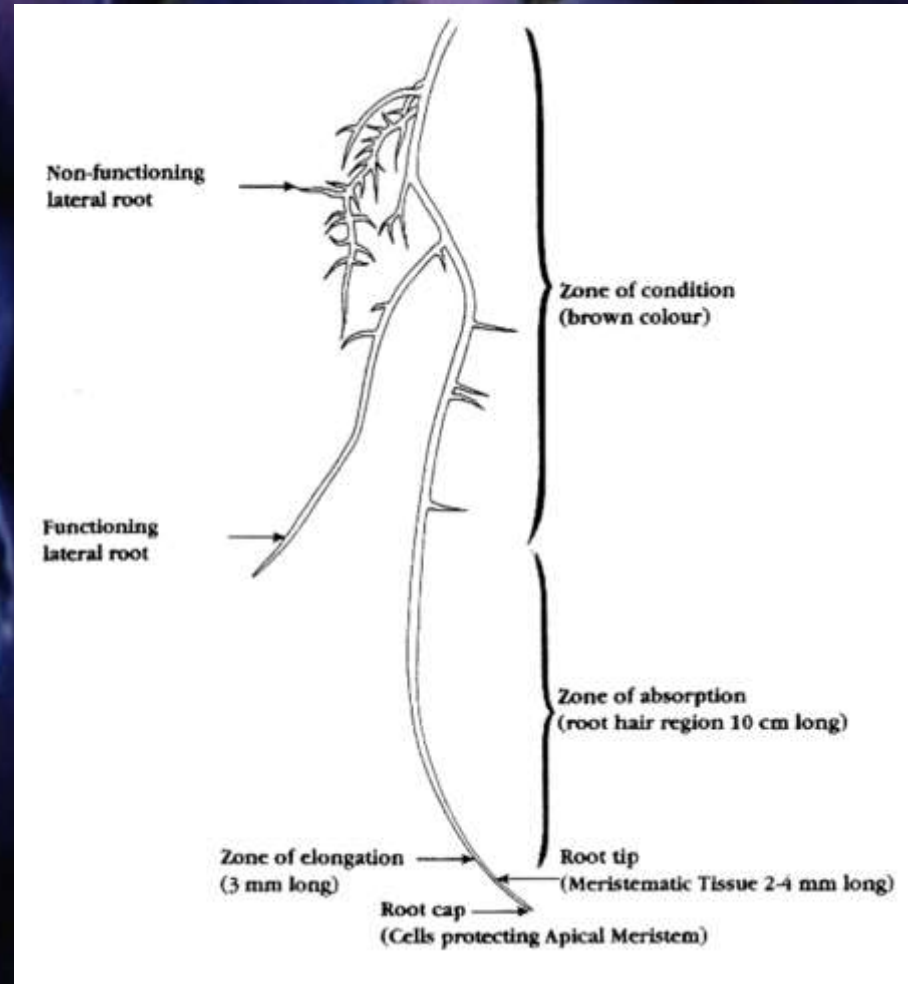
Graft rooting



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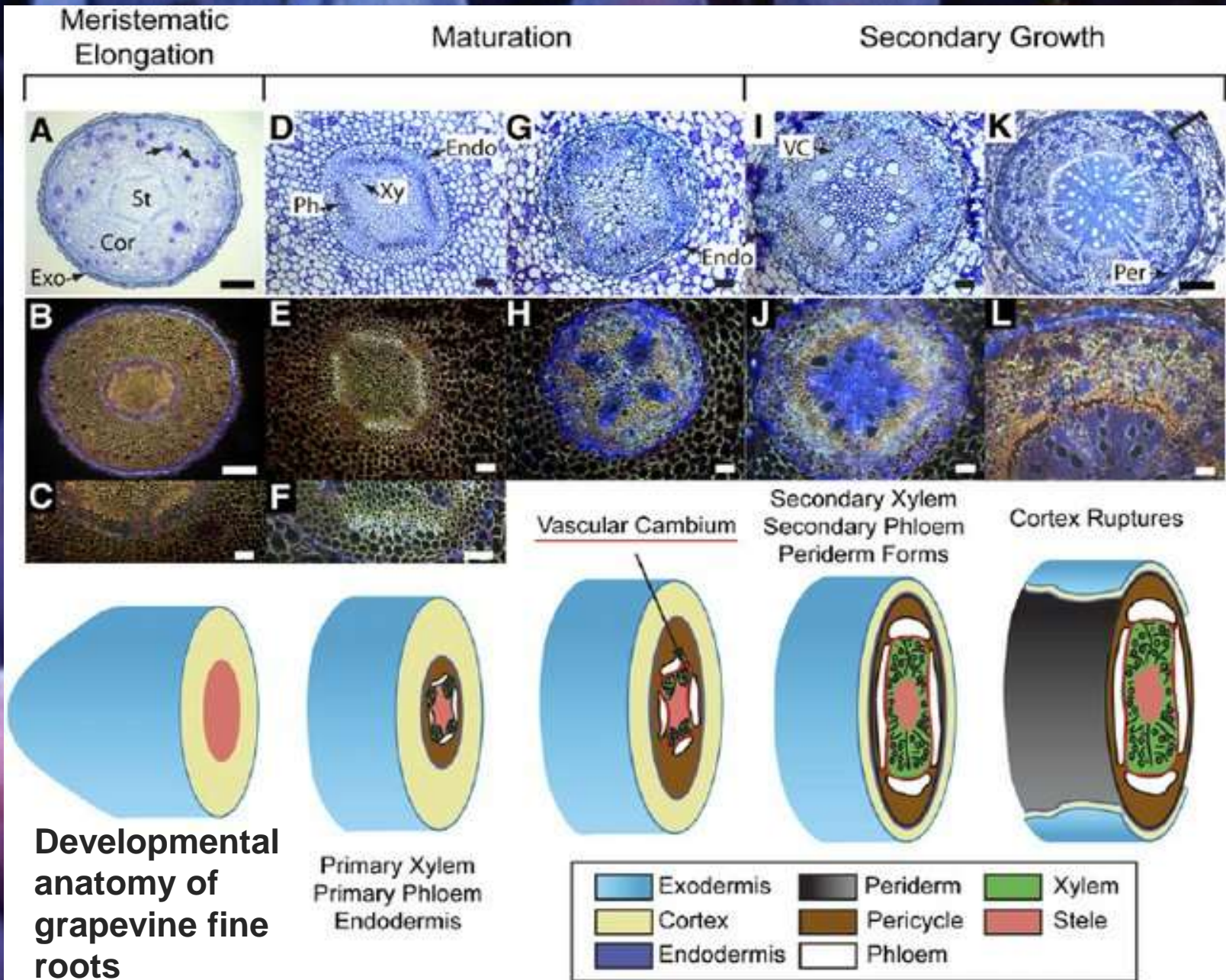
Root system

- The **root tip** is a region of rapidly dividing cells protected by a root cap.
- Behind the root tip is the zone of nutrients absorption.
- The root **apical meristem** allows for extension growth. As the root develops, the epidermis dies and is replaced by the exodermis giving the root its brown colour.
- Concentrically from the outside a root is formed by the **epidermis**, followed by the **cortex** (parenchyma cells), and the **endodermis** which contains the **Casparian strip**, a layer of cells with thickened walls that regulate solute transport (protecting vines from soil toxicities).



https://www.viti.com.au/pdf/MVW_GG%20Fact%20Sheet%20-%20Grapevine%20Biology.pdf

Viticulture - Biology of the vine **Root system**



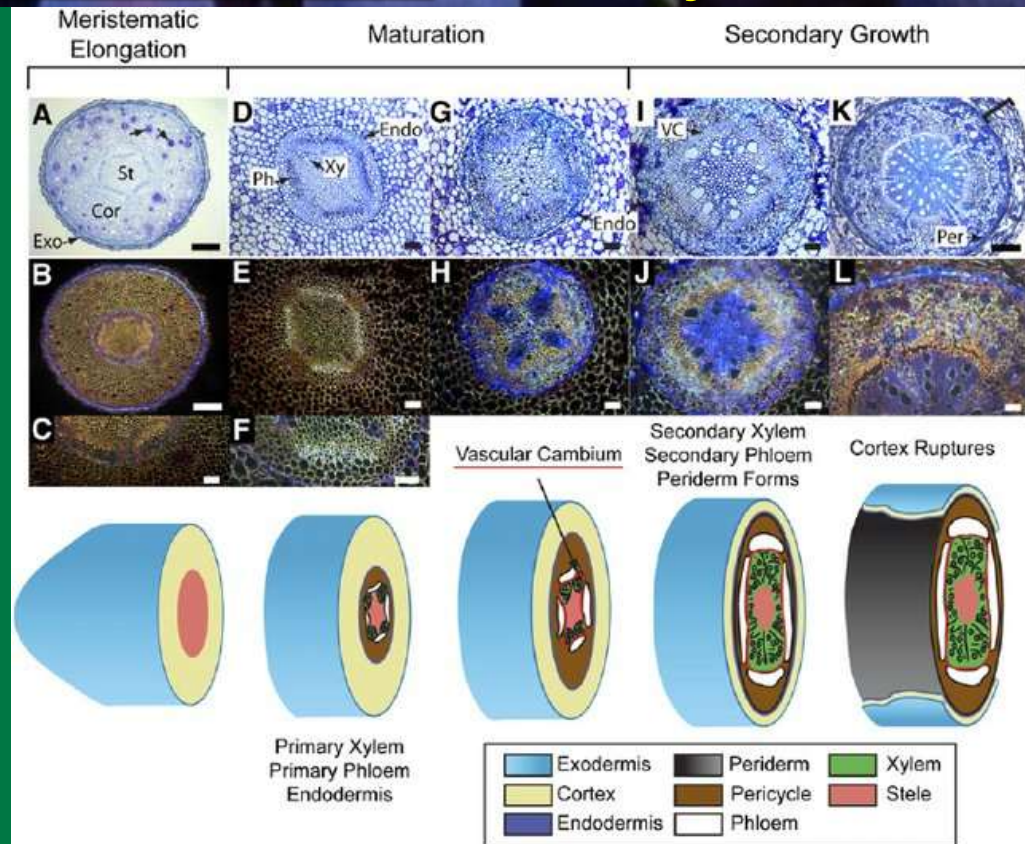
Viticulture - Biology of the vine **Root system**

Figure: Developmental anatomy of grapevine fine roots (bright- & dark-field microscopy).

A-C: Undifferentiated tissue of the **meristematic** and **elongation zones**: **exodermis** (Exo), **cortex** (Cor), and **stele** (St). Dark blotches in A (black arrows) are **raphides**.

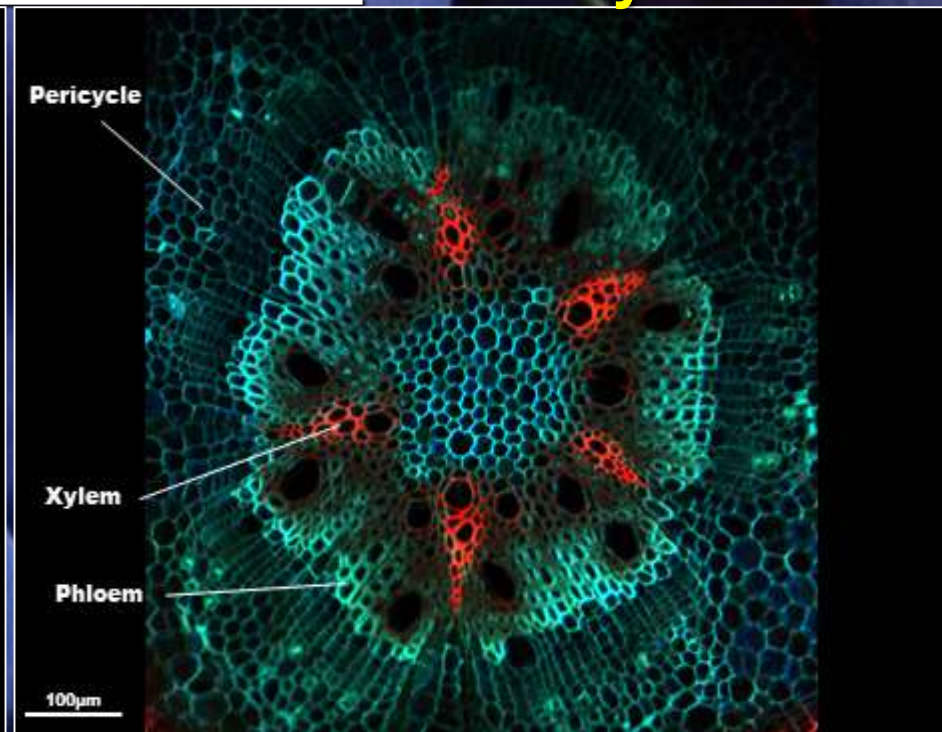
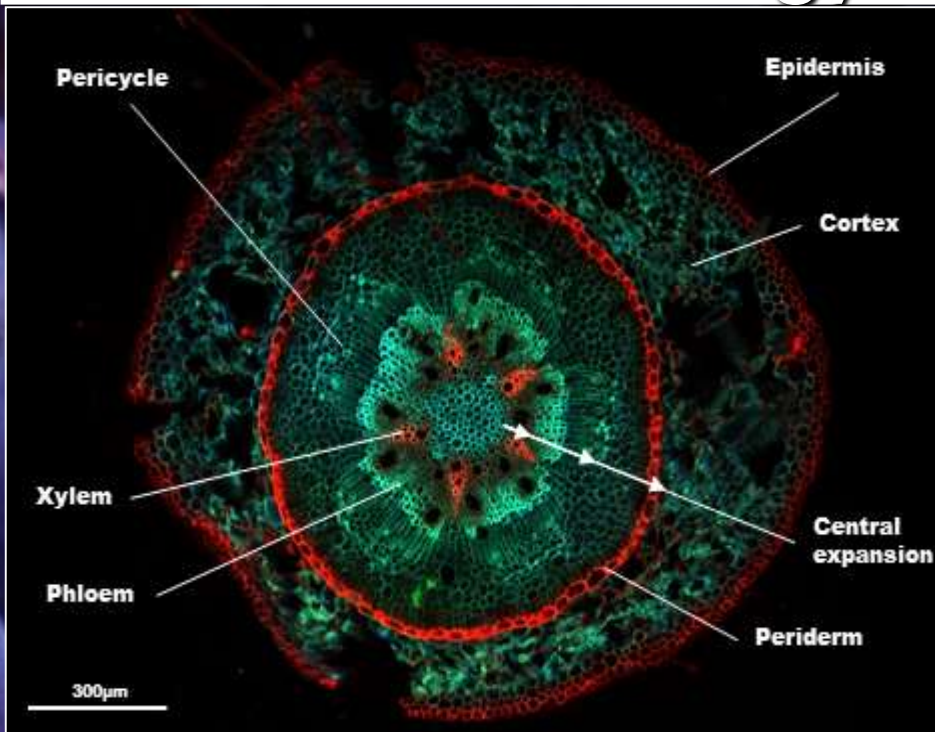
D-H: **Maturation zone** including the appearance of **primary xylem** (Xy), **primary phloem** (Ph), and an identifiable **endodermis** (Endo).

I-L: Secondary growth with the **vascular cambium** (VC) clearly visible. At later stages (K & L), the **periderm** (Per) forms and the exodermis, cortex, and **endodermis** rupture and are lost (bracketed in K).



Bars = 200 μ m (A, B, & K), 40 μ m (F), and 80 μ m (all others).

Viticulture - Biology of the vine **Root system**



Figures: **Secondary growth** in the central area (known as the **stele**); this is growing outwards, crushing the outer **cortex** cells and breaking the **epidermal** outer layer. The star shaped red areas and larger holes in the center are **xylem** water vessels. The brighter green ring around these are **phloem vessels**. When fully developed the phloem will encase the xylem. Beyond the phloem are a layer of cells called the **periderm** which protects the vascular tissues (central red ring) and, after stele expansion, eventually replaces the epidermis as the outermost layer.

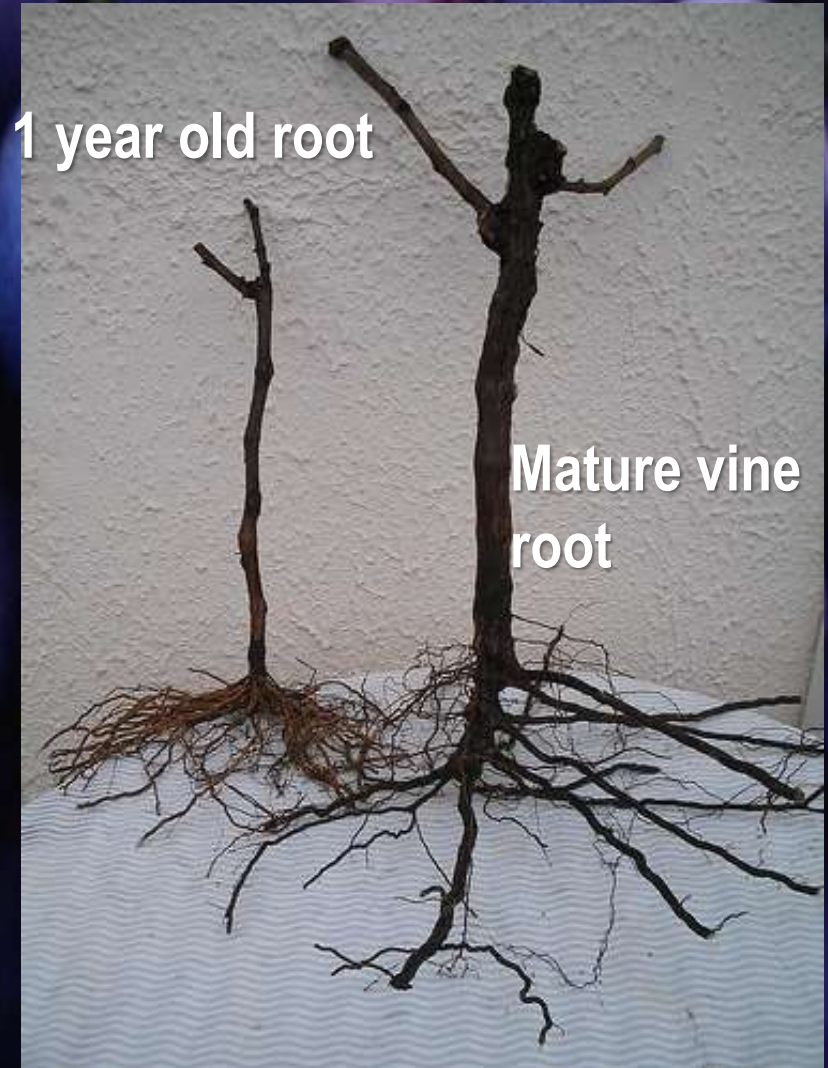
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Root system

Young root growth:

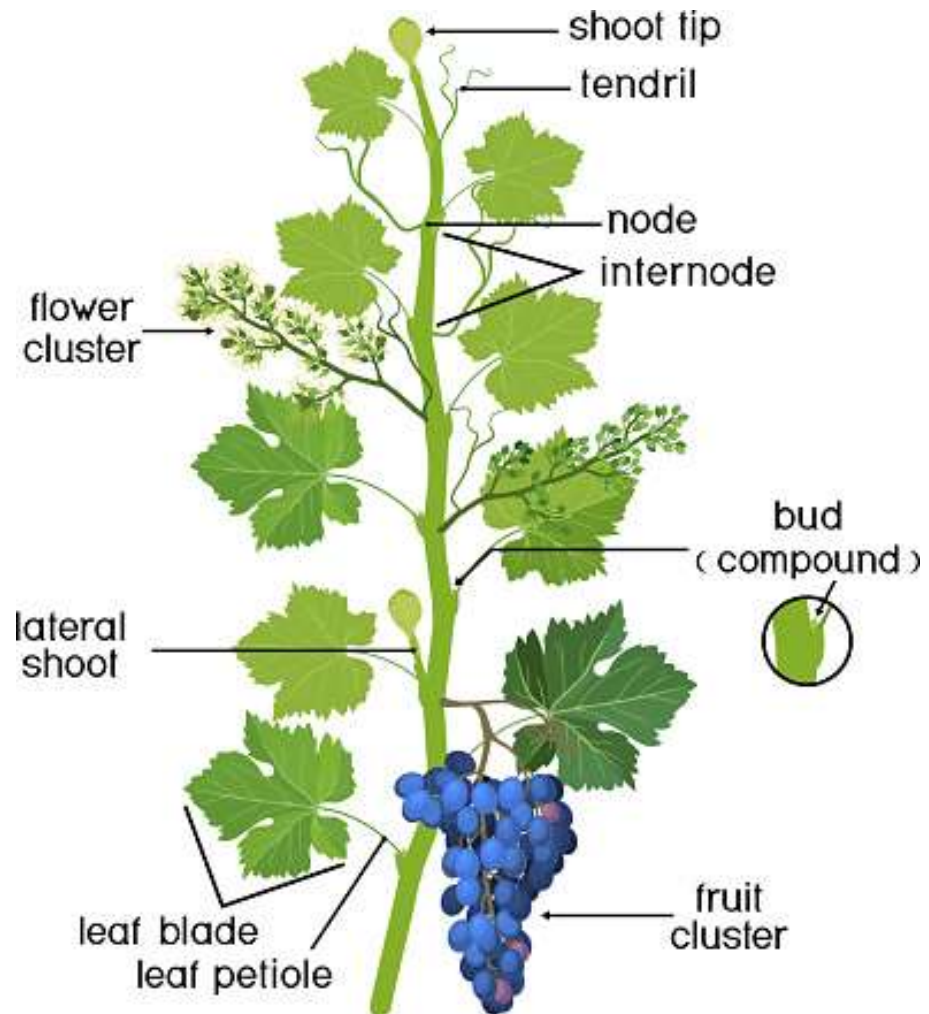
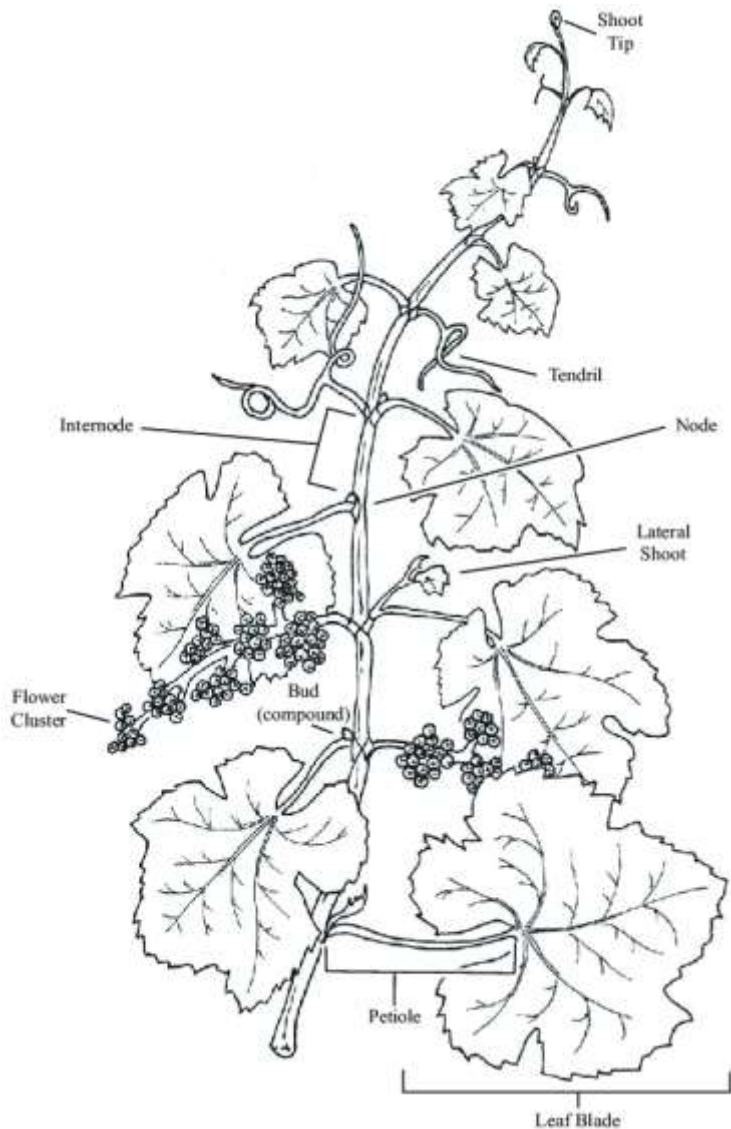
Depending on soil conditions:

- Intense growth in the first 7-8 years
- At maturity growth slows down
- Weakening of the root system after 20 years
- Ageing



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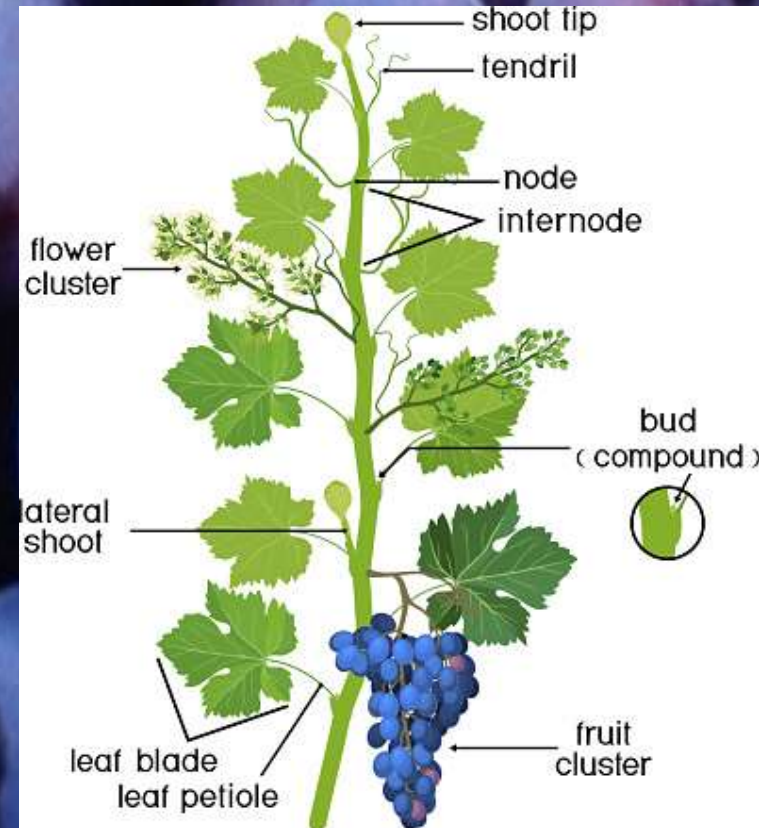
Morphology of the grapevine shoots



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Morphology of the grapevine shoots

- At the **nodes** the various organs of the shoot are connected
- The **internodes** have no organs, are short at the base and 5-15 cm in the middle. 6 to 12 internodes are preformed (they preexist in the **buds**)
- The **flower/fruit clusters** are located on the nodes and always opposite to the **leaves**, between the 3rd & 5th node. 1 to 3 clusters are grown per shoot.
- **Tendrils** are considered degenerate flower clusters and help the plant to climb



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Morphology of the grapevine shoots

■ Lateral shoots

- ✓ They are the secondary shoots growing in the direction of the leaf
- ✓ They derive from the corresponding “**lateral buds**”
- ✓ They do not fully develop
- ✓ They have a large initial **internode**

■ Apical meristem

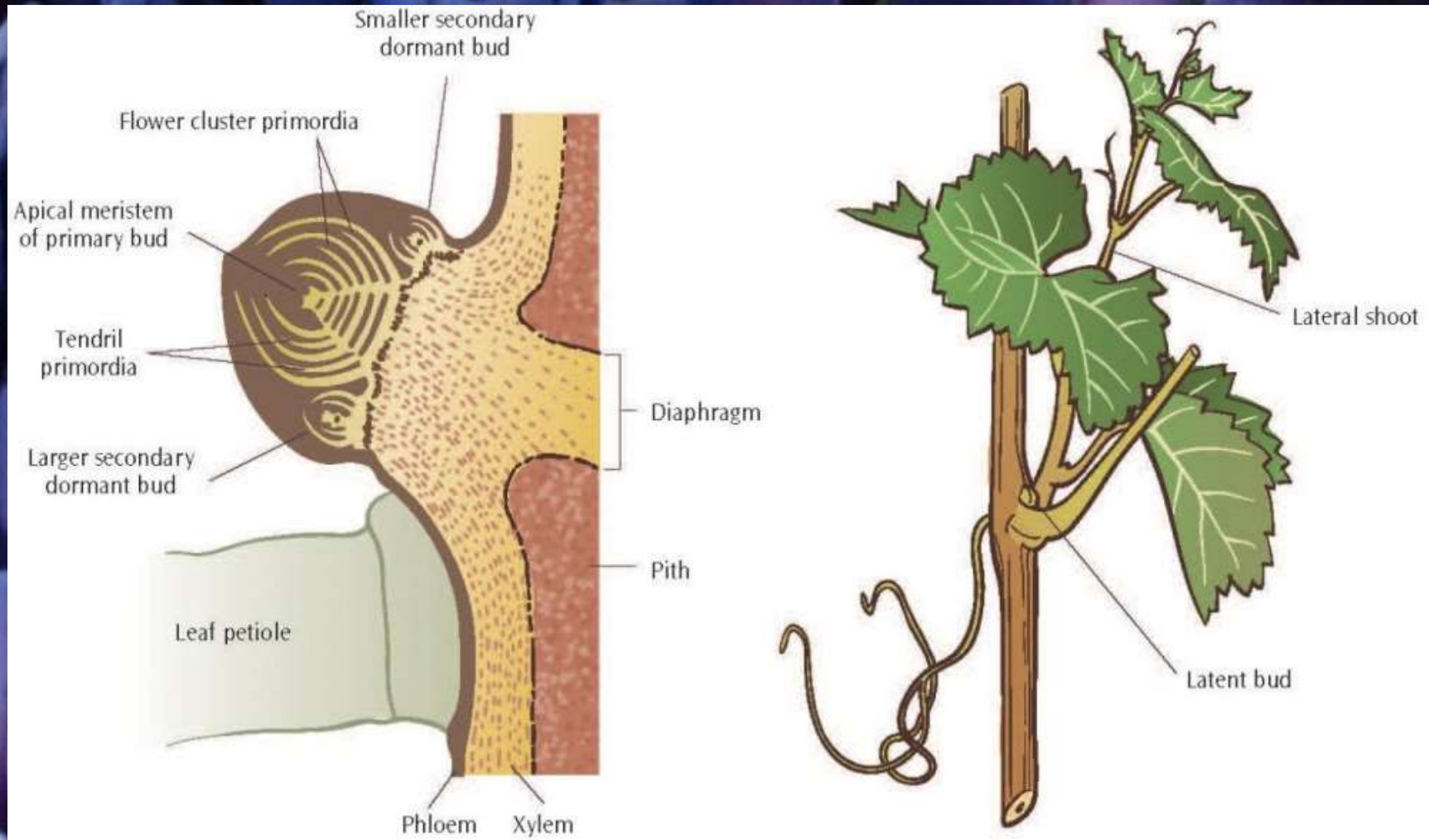
- It is the shoot tip and growing point



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<https://www.lodigrowers.com/important-structures-features-of-grapevines/>

Morphology of the grapevine shoots



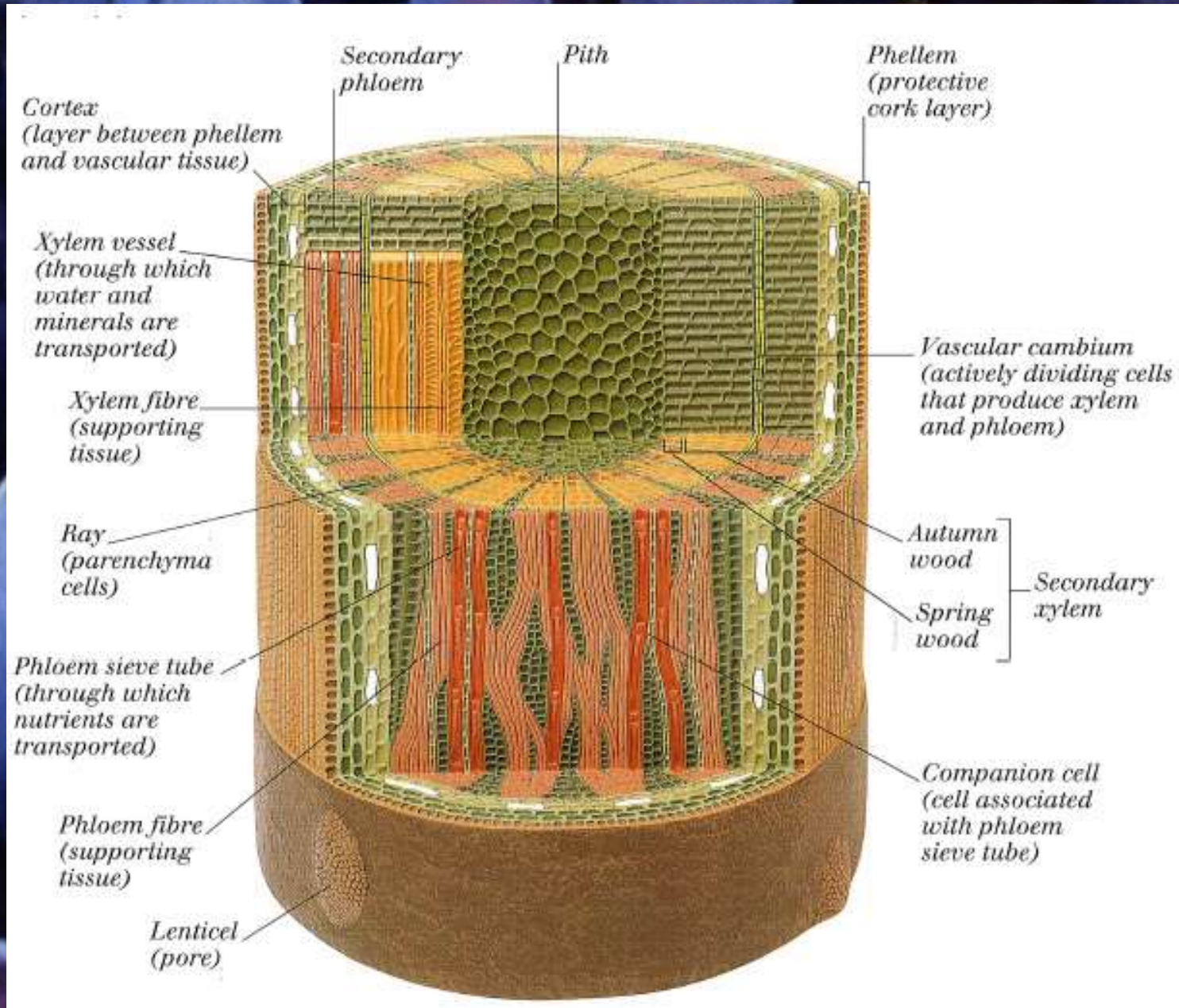
Left: A cross-section of a dormant bud attached to a cane, with internal features. Right: A vine shoot showing a lateral shoot that has grown from the leaf axil and a latent bud.

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Morphology of the grapevine shoots

- Cell Structure and Function
- Types of plant tissues

<https://www.viti.com.au/pdf/MVWGG%20Fact%20Sheet%20-%20Grapevine%20Biology.pdf>



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Morphology of the grapevine shoots

Cell Structure and Function / Types of plant tissues

▪ **Meristematic (growth) tissue**

- ✓ Cells that divide and allow the vine to grow. They occur in the buds, root tips, and shoot tips (development of organs). The **cambium layer** of the vine shoots/canes is an example of a secondary meristem as it enables organs to grow in thickness.

▪ **Dermal (protection) cells**

- ✓ The cells of the **epidermis** (external layer of plant cells), i.e. the **bark** that protects the inner cells from physical damage.

▪ **Photosynthetic tissue**

- ✓ Tissues that contain **chloroplasts** (with **chlorophyll**), that produce sugars through photosynthesis. Mainly found in leaves.

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Morphology of the grapevine shoots

Cell Structure and Function / Types of plant tissues

- **Support tissue which makes up the cortex**
- ❖ **Collenchyma (living external layer cells)**; it forms a complete cylinder around the stem. The cells are elongated and have thicker walls because of additional deposited cellulose.
- ❖ **Sclerenchyma (support cells)**; similar to the collenchyma cells but with additional lignin fibers in their cell walls, which become hard skeleton fibers as they mature and die.
- ❖ **Parenchyma (storage cells)**; living cells which have large central vacuoles (storage vessels) and thin but flexible cell walls. They form the cortex and pith of stems, the cortex of roots and the mesophyll of leaves.

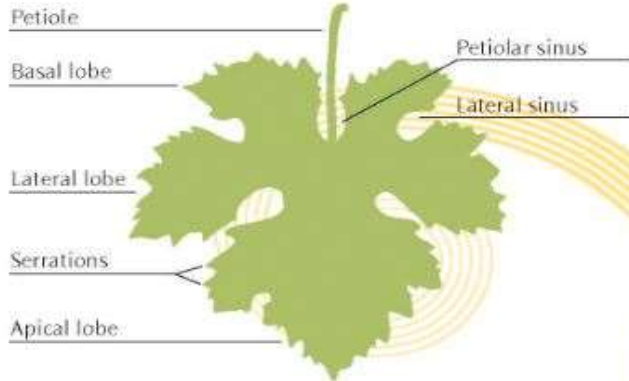
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Morphology of the grapevine shoots

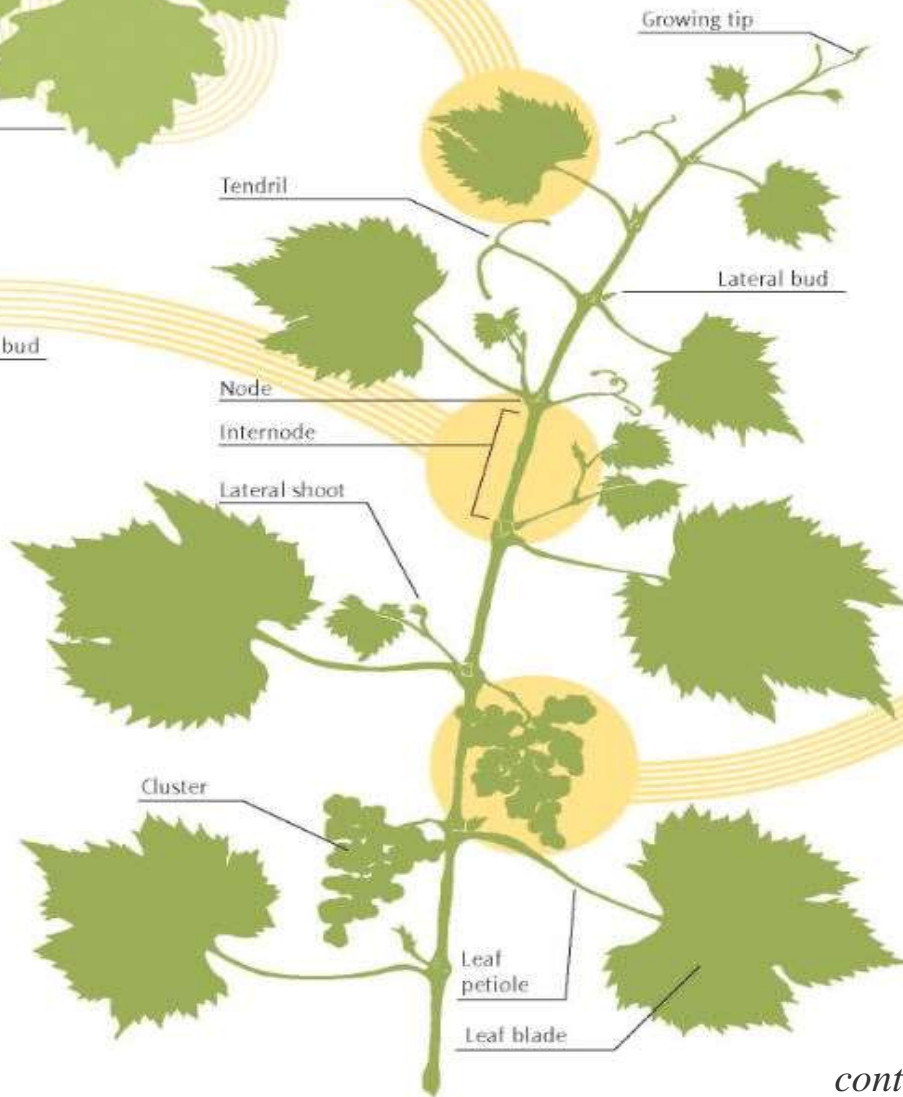
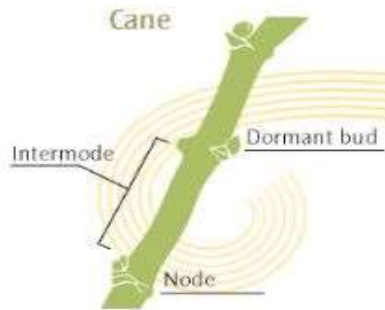
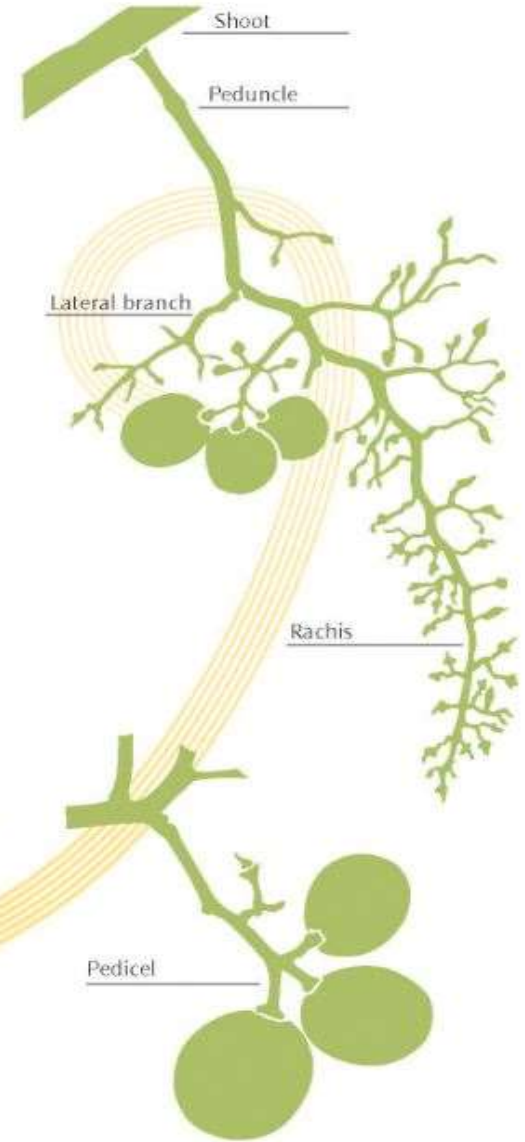
Cell Structure and Function / Types of plant tissues

- **Vascular or conducting tissue**
- **Xylem;** tissue that conducts water and dissolved mineral salts. Perforations in the cell walls facilitate the movement of water and dissolved substances from the roots upwards into the shoot system of the vine.
- **Phloem;** it is the food or sugar conducting tissue located on the inside of the bark. Sugars are moved from the production site to a 'sink' or where they are to be utilized.

Typical *Vitis vinifera* grape leaf with five lobes



Grape cluster and its attachment to shoot





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Thank u !