

Shoot nodes of *Vitis labruscana* Bailey cv. Concord¹⁾

by

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Noeuds des rameaux verts chez *Vitis labruscana* Bailey cv. Concord

Résumé. — Les noeuds des rameaux verts de *Vitis labruscana* BAILEY cv. Concord avec 2 feuilles plates possèdent, environ 1 mois avant la floraison, un système vasculaire composé: 1) du cylindre vasculaire caulinaire du rameau vert; 2) des traces du prompt-bourgeon et du bourgeon primaire bordant une fenêtre commune (parenchyme) dans le système vasculaire du rameau vert; 3) de 5 traces foliaires et leurs fenêtres respectives. Le procambium sur les parois des fenêtres des bourgeons s'ajoute aux tissus parenchymateux et vasculaires des axes des bourgeons et à l'expansion radiale des noeuds. La moelle à nervures est interrompue par un diaphragme parenchymateux sans nervures; ce diaphragme est lié avec les fenêtres des bourgeons et des feuilles.

Introduction

The node is a bulging region of a *Vitis* shoot which bears the leaf, its accessory, collateral buds (RADFORD *et al.* 1974), and non-foliar appendage (cluster or tendril) where present. The compound bud structure has been described by many workers, including BUGNON (1953), PRATT (1974), and POOL *et al.* (1978). The vascularization of growing green shoot tips of *V. vinifera* has been described by HEGEDŰS (1957) and FOURNIOUX (1972), but they do not consider the vascularization of axillary buds in detail. Spring shoot nodes of *V. labruscana* BAILEY have not been described, as far as the author knows. The purpose of the present paper is to describe the primary tissues of a node and its appendages on a green shoot of *V. labruscana* cv. Concord.

Materials and methods

Buds were collected from nodes 2—6 of shoots from cane nodes 4 and 5 of Concord grapevines at the Geneva Station. Those of 20 and 28 May and 20 June, 1974 were selected because of their structural simplicity. Only the leaf, the lateral, the primary bud, and the non-foliar appendage had developed at these nodes. At that time, the secondary bud was represented merely by a meristem in the axil of the first prophyll of the primary. The tertiary meristem had not yet appeared.

About 30 buds were fixed in F.A.A. (formalin 5: acetic acid 5: 70 % ethanol 85 v/v) for sectioning. Buds were dehydrated according to RANDOLPH'S butanol-1 method (1935), embedded in paraffin, sectioned at 10—12 μ m, and stained in safranin and fast green.

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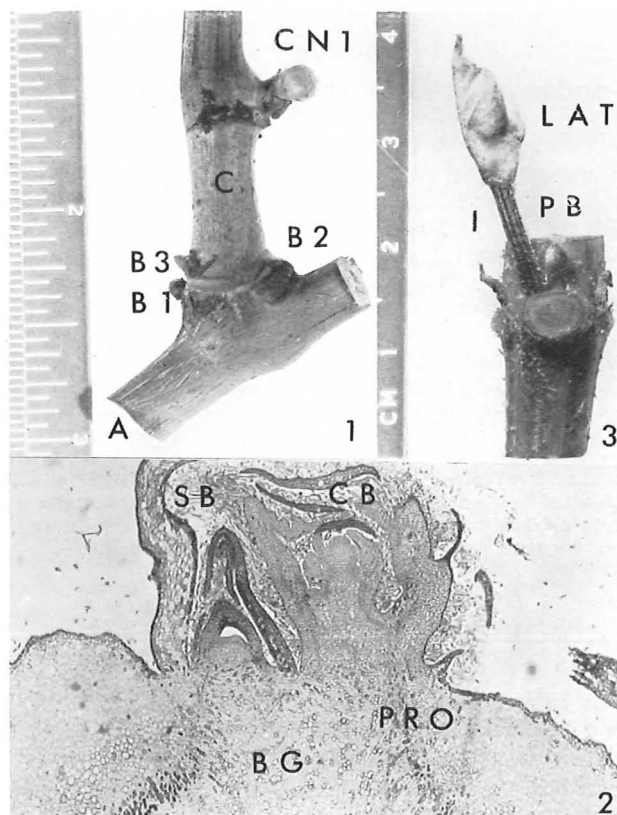


Fig. 1: Concord grape cane (1 year old) attached to arm (2 years old). At the base of the cane there are three base buds, numbered in acropetal order. Above them is cane node 1 with bud at bud swell. 1 May, 1974.

Fig. 2: Base buds of Concord grape. Wide bud gap is common to the three buds (only two buds in plane of section). 28 May, 1974. $\times 27$.

Fig. 3: Concord grape shoot node showing the severed petiole, the two withered stipules of the leaf, and the growing lateral with the primary bud in the axil of its first prophyll. 6 June, 1974.

Abbreviations			
A:	arm	LAT:	lateral (bud or shoot)
B1, B2, B3:	base bud 1, 2 or 3	LF:	leaf
BG:	bud gap	LTG:	leaf trace gap
C:	cane	NA:	non-foliar appendage (inflorescence or tendril)
CB:	central bud	NAG:	non-foliar appendage gap
CN1:	cane node 1	PB:	primary bud
CVT:	cauline vascular tissue	PRO:	procambium
D:	diaphragm	PROP:	prophyll
I:	internode	SB:	side bud

Fig. 1: Sarment de *Vitis labruscana* cv. Concord âgé d'un an attaché à un bras (agé de deux ans). On peut voir, à la base du rameau, trois bourgeons numérotés du bas en haut. Au-dessus des bourgeons, on peut voir le premier noeud avec un bourgeon 'gonflé'. 1er mai 1974.

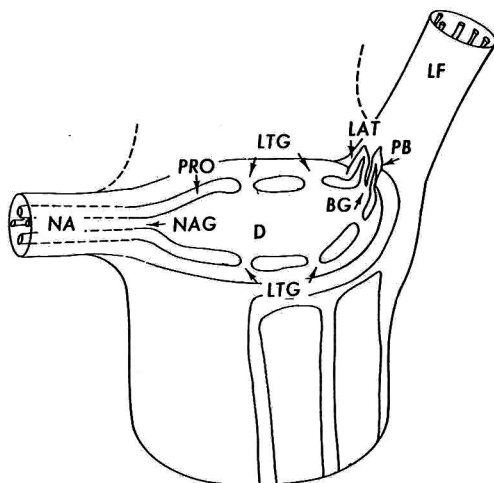


Fig. 4: Three-dimensional diagram of a young node of Concord grape shoot cut transversally through the leaf axil. The five leaf traces and their respective gaps are indicated; the joined lateral pair of traces on each side partly girdle the shoot. The median trace of the leaf diverges at the common bud gap (Fig. 7). The non-foliar appendage has several traces which diverge from the cauline vascular tissue at common gap $\times 8$. Abbreviations see Figs. 1—3.

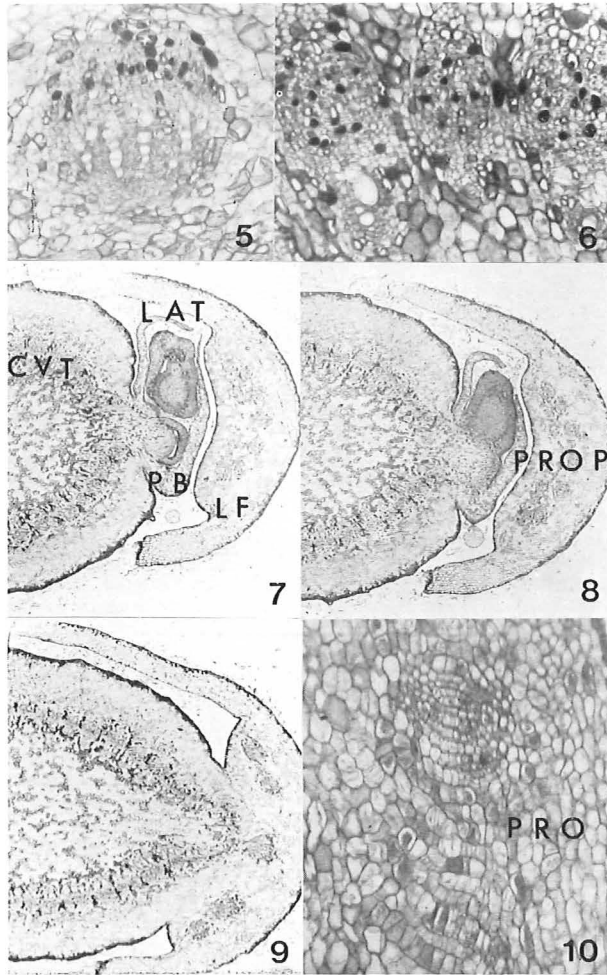
Fig. 4: Diagramme à trois dimensions d'un jeune noeud de la vigne Concord coupé transversalement à travers l'aisselle de la feuille. Les cinq traces foliaires et leurs fenêtres respectives sont indiquées; les paires latérales des traces foliaires associées de chaque côté encerclent partiellement le rameau vert. La trace foliaire médiane diverge à la fenêtre gemmaire commune (Fig. 7). L'appendice non-foliaire possède plusieurs traces qui divergent du tissu caulinaire vasculaire à une fenêtre commune. $\times 8$. Abréviations voir Fig. 1—3.

Fig. 2: Bourgeon (base de rameau) sur une vigne Concord. On peut voir une large fenêtre sur tous les trois bourgeons. Il n'y a que deux bourgeons dans le plan de coupe ici. 28 mai 1974. $\times 27$.

Fig. 3: Noeud du rameau vert (vigne Concord) montrant une pétiole coupée et des stipules flétris de la feuille et l'entre-coeur croissant avec le bourgeon primaire dans l'aisselle de sa première préfeuille. 6 juin 1974.

Abréviations

A:	bras	LAT:	entre-coeur ou prompt-bourgeon
B1, B2, B3:	bourgeon à la base du rameau No. 1, 2 ou 3	LF:	feuille
BG:	fenêtre gemmaire	LTG:	fenêtre des traces foliaires
C:	sarment	NA:	appendice non-foliaire (inflorescence ou vrille)
CB:	bourgeon central	NAG:	fenêtre de l'appendice non-foliaire
CN1:	noeud No. 1 du sarment	PB:	bourgeon primaire
CVT:	tissu caulinaire vasculaire	PRO:	procambium
D:	diaphragme	PROP:	préfeuille
I:	entre-noeud	SB:	bourgeon latéral



Figs. 5 and 6: Vascular differentiation at node 1 of a Concord grape shoot. 20 May, 1974. $\times 93$.

Fig. 5: Leaf trace has little cambial activity but more vascular differentiation than cauline bundles.

Fig. 6: Cauline bundles show wide cambium but less vascular differentiation than leaf traces at the same level.

Figs. 7—9: Transverse sections of a Concord grape node at shoot node 1, showing leaf, the lateral shoot, and the primary bud in the axil of the prophyll of the lateral. 20 May, 1974. $\times 11$.

Fig. 7: Gap in cauline bundles for the primary bud traces.

Fig. 8: 144 μ m lower. There is a common gap for lateral and primary bud traces.

Fig. 9: 492 μ m lower. The median leaf trace diverges from the combined bud traces.

Fig. 10: Transverse section of Concord grape shoot above the insertion of leaf 4 showing both interfascicular as well as intrafascicular procambium. 20 June, 1974. $\times 93$. Abbreviations see Figs. 1—3.

Fig. 5 et 6: Différenciation vasculaire au premier noeud d'un rameau vert de la vigne Concord. 20 mai 1974. $\times 93$.

Fig. 5: Les traces foliaires ont une activité cambiale peu développée, mais leur différenciation vasculaire est plus avancée que celle des fascicules caulinaires.

Results

An external view of the lower part of a Concord cane shows base buds in the axils of last year's bud scales and the bud at cane node 1 at bud swell on 1 May, 1974 (Fig. 1). Base buds differ from buds at leaf-bearing nodes in branching only to the second order (Fig. 2). They generally consist of a central and two side buds in a row at right angles to the long axis of the shoot (Pool *et al.* 1978). The diaphragm is continuous with a wide gap (parenchyma) for each set of base buds (Fig. 2). A non-foliar appendage is absent at a base node.

Leaf-bearing nodes show a more complicated structure (Pool *et al.* 1978) (Figs. 1, 3, 4). Transverse sections in basipetal sequence show that both the lateral and primary bud traces emerge from the shoot apical to the five leaf traces (Figs. 7—9). The first internode of the lateral bud elongates very little and the prophyll remains attached to the shoot (Figs. 7, 8). This prophyll has one trace and bears the primary bud in its axil. Traces of the lateral and its prophyll and of the primary bud form a common gap in the cauline vascular cylinder (Fig. 8). The number of bud traces increases as more leaves are initiated in the buds. The median trace of the leaf departs at the bud gap (Fig. 9). The lateral leaf traces diverge from the cauline vascular cylinder at a lower level. The 4—5 traces of a non-foliar appendage depart from a single gap in the cauline vascular tissue (Fig. 4).

In a young shoot, procambium develops acropetally (Pratt 1974) into the young leaf primordia from the cauline procambium. Additional procambium develops between primary vascular bundles (Fig. 10). Protoxylem differentiation is more advanced in leaf traces (Fig. 5) than in cauline vascular tissues (Fig. 6).

The pith of the shoot develops in two ways: 1) At the node the pith cells divide irregularly; this is the diaphragm. It is radially continuous with the pith of buds and of non-foliar appendages and, through the leaf gaps, with the parenchyma of the leaves (Figs. 4, 8, 9). 2) In the internode a rib meristem extends the pith acropetally.

Discussion

The continuity of primary conductive and storage tissues in grape shoots cannot be over-emphasized. Procambium differentiates acropetally in the shoot and its appendages. The precocity of the axillary buds in year 1 contributes to the formation of wide bud gaps and an extensive procambial system. The lateral growth of the node is due to increase in cauline, bud and appendage traces, to procambial

Fig. 6: Les fascicules caulinaires montrent une forte activité cambiale, mais moins de différenciation vasculaire que les traces foliaires au même niveau.

Fig. 7—9: Coupes transversales du premier noeud sur le rameau vert de la vigne Concord, montrant la feuille, l'entre-coeur et le bourgeon primaire dans l'aisselle de la préfeuille de l'entre-coeur. 20 mai 1974. $\times 11$.

Fig. 7: Fenêtre dans les fascicules caulinaires pour les traces du bourgeon primaire.

Fig. 8: 144 μm plus bas. On peut voir une fenêtre commune à l'entre-coeur et au bourgeon primaire.

Fig. 9: 492 μm plus bas. La trace foliaire médiane a divergé des traces gemmaires combinées.

Fig. 10: Coupe transversale du rameau de la vigne Concord au-dessus de l'insertion de la quatrième feuille. La coupe montre le procambium inter- et intrafasciculaire. 20 juin 1974. $\times 93$. Abréviations voir Fig. 1—3..

divisions on the sides of the bud gaps, as well as to cell division and enlargement of parenchyma. In the internodes, pith cells divide transversely (ribbed pith) and elongate as the internode elongates.

Nodes bear varied structures. Base nodes bear small buds which may remain latent, or develop into shoots in case of injury or severe pruning; they are the chief source of renewal canes. In year 1, the shoot node bears a fruiting cluster or tendril, a leaf, a lateral (often producing leaves throughout the summer), besides the overwintering buds for year 2.

Summary

In *Vitis labruscana* BAILEY cv. Concord the primary vascular system of the node of a shoot with 2 flat leaves, about a month before bloom, comprises 1) the cauline vascular cylinder of the shoot; 2) lateral and primary bud traces flanking a common gap (parenchyma) in the shoot vascular system; 3) 5 leaf traces which diverge from the cauline vascular tissue at separate gaps. Procambium on the sides of the bud gaps adds to the parenchymatous and vascular tissues of the bud axes and to the radial expansion of the node. The ribbed pith is interrupted by a non-ribbed parenchymatous diaphragm which is continuous with the bud and leaf gaps.

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