

## Shoot and bud development during the prebloom period of *Vitis*<sup>1)</sup>

by

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### Le développement des rameaux verts et des bourgeons chez *Vitis* pendant la période précédant la floraison

Résumé. — La différenciation des inflorescences chez *Vitis labruscana* BAILEY cv. Concord, hybride cv. Aurore, et *V. vinifera* cv. White Riesling a été constatée par dissection des bourgeons primaires entre le deuxième et le sixième noeud du rameau vert.

Le premier primordium de l'inflorescence est apparu 0-12 jours avant la floraison, juste après l'extension de la treizième feuille du rameau vert et la formation de 6-7 noeuds dans le bourgeon primaire.

#### Introduction

The multiple axillary buds of *Vitis* are accessory and collateral (RADFORD *et al.* 1974). The successive branching of each axillary bud leads to a hierarchy of buds of different ages and orders of branching at each node (BUGNON 1953, PRATT 1971, 1974, POOL *et al.* 1978). The true axillary meristem in a leaf axil develops during the same season into the summer lateral, a green, leafy, vegetative or infrequently flowering, branch of the first order. The first internode of the lateral is so short that its prophyll or bract is partly continuous with the shoot. The meristem in the axil of this prophyll develops into the primary bud, a branch of the second order. The primary produces a bud in the axil of each of its first two prophylls, branches of the third order. By the end of the growing season these three buds have become the compound winter bud for year 2. At this time, the primary bud usually contains two or more inflorescences which will produce flowers in the following spring (year 2), the secondary may have one to two preformed inflorescences, and the tertiary usually none.

The purpose of the present study was to find stages in shoot growth which might indicate the beginning of differentiation of inflorescences in primary buds of three cultivars grown in New York State. The prediction of inflorescence differentiation would be useful in inflorescence induction experiments.

#### Materials and methods

All vines were growing at the N.Y.S. Agricultural Experiment Station. They were cordon trained and cane pruned (Hudson River Umbrella).

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Buds from nodes 2—6 of shoots developing at cane nodes 4—5 were selected as being an important cropping area of the cane for year 2. Each sample consisted of 6 canes (about 30 buds). Buds were fixed in F.A.A. (formalin 5 : acetic acid 5 : 70 % ethanol 85 v/v), and dissected under a stereoscopic microscope with magnifications ranging from 7 × to 30 ×.

Air temperature data during April to June, 1974 and 1975, were compiled from the weather records of the Vegetable Research Farm, N.Y.S. Agr. Expt. Sta.

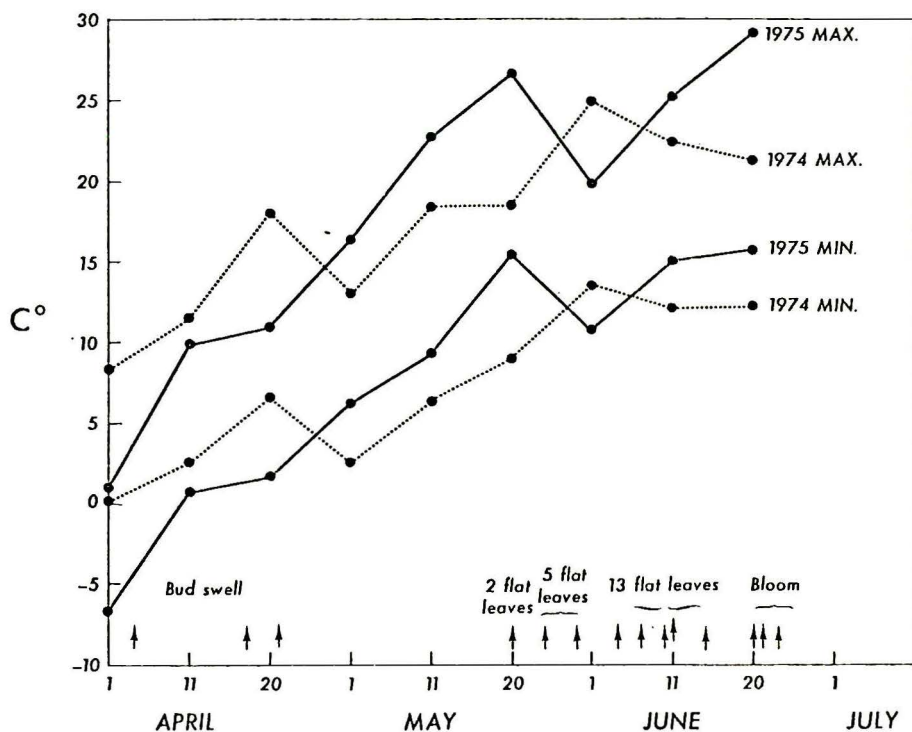
Concord (*V. labruscana*) buds were fixed on 20 and 28 May, and 3, 6, 10, 14, and 20 June, 1974. Concord flower buds from shoot nodes 4 and 5 (clusters 1 and 2) were sectioned at 18  $\mu$ m, and stained in Heidenhain's hematoxylin. Buds of Aurore (hybrid) and White Riesling (*V. vinifera*) were fixed at four dates: 20 and 24 May, 11 and 21 June, 1975.

Growth stages were defined as follows:

Green shoot: shoot with expanding leaves:

Length in cm;

Nodes include those in the terminal bud, but exclude the base nodes (Pool *et al.* 1978);



Temperatures (°C) from April to July, 1974 and 1975 in Geneva, New York, U.S.A.: means of 10-day intervals. Arrows indicate dates when buds were collected for stages in shoot and bud development.

Températures d'avril à juillet 1974 et 1975 à Geneva, New York, U. S. A.: les moyennes ont été prises sur des intervalles de 10 jours. Les flèches indiquent les dates de récolte des bourgeons pour les stades de développement des bourgeons et des rameaux.

**Primary bud:** bud at the first node on a lateral; will form the most developed of the three buds in the compound bud:

Prophyll primordia occur at the base of a bud and will develop into bud scales; Leaf primordia will develop into foliage leaves, i.e. with a blade; Non-foliar primordia originate opposite the leaves. If primordia were unbranched, they were rated stage 0; if branched to the first or second order, they were rated stage I or II respectively (ALLEWELDT and BALKEMA 1965). Only the latter were designated inflorescences, since at stage 0 the inflorescence and tendril primordia are not morphologically distinct.

### Results

Air temperatures followed similar trends in the two years, except for higher temperatures in 1975 than in 1974 (Fig.). Temperatures increased gradually from April 1 to May 20, when they fluctuated around a fairly high, narrow range for the next month.

Prebloom development of shoots and primary buds of grape cultivars Aurore (1975), Concord (1974), and White Riesling (1975). See text for definitions. Data based on average number per shoot or bud except for shoots of Concord in which data were recorded in ranges

Développement des rameaux verts et des bourgeons primaires durant la période précédente la floraison chez les cultivars Aurore (1975), Concord (1974), et White Riesling (1975). Pour définitions voir texte. Les dates pour les rameaux ou bourgeons se basent sur la moyenne, exception faite des rameaux de Concord pour lesquels elles sont exprimées par les valeurs extrêmes

Date Cultivar	Green shoot		Primary bud			
	Nodes (n.)	Length (cm)	Prophylls (n.)	Leaves (n.)	Non-foliar appendages (n.) Stage 0	Stages I—II
2 flat leaves						
Aurore 20/5	15.8	8.3	2.6	—	—	—
Concord 20/5	12.0	4.5—9.0	—	—	—	—
White Riesling 20/5	13.2	17.4	1.4	0.6	—	—
5 flat leaves						
Aurore 24/5	15.6	38.7	4.0	0.3	—	—
Concord 28/5	12.5—12.75	5.5—24	2.2	2.1	0.1	—
White Riesling 28/5	15.2	17.2	1.8	1.9	—	—
13 flat leaves						
Aurore 11/6	21.5	82.6	3.4	3.7	— <sup>1)</sup>	—
Concord 3—6/6	13.5	22—66	2.8	2.8	0.1	— <sup>1)</sup>
Concord 10—14/6	17.9	53—99	2.9	3.4	0.6	—
White Riesling 11/6	15.0	68.1	2.2	4.9	0.6	0.5
Bloom						
Aurore 21/6	18.8	112.2	3.1	4.7	0.8	0.3
Concord 20/6	18—19	64—137	2.8	3.7	0.5	0.5
White Riesling 23/6	26.2	77.4	2.4	5.6	1.4	0.6

<sup>1)</sup> Average of non-foliar appendages < 0.1 per bud.



Bud swell in Aurore occurred on 3 April, 1975, in Concord on 17 April, 1974, and in White Riesling on 21 April, 1975. After this period, the development of buds at shoot nodes 2—6 was similar in sequence and timing, but not in rate, in all three cultivars (Table). Growth in internode length and leaf initiation on the green shoot, as well as prophyll initiation in primary buds, was slow until the end of May. Shoots and primary buds grew rapidly after this period.

When about five foliar primordia (prophylls and leaves) had formed in each primary bud, the first non-foliar primordium appeared (Table). The branching of this primordium into a recognizable inflorescence primordium occurred earlier in White Riesling (11 June) than in Concord (14 June) or Aurore (21 June). In Concord flowers on the above date pollen was already 1-nucleate or 2-nucleate, and embryo sacs were maturing.

### Discussion

A non-destructive indicator of inflorescence differentiation in *Vitis* is probably the number of expanded ("flat") leaves on the green shoot (Table). The 13-flat-leaf stage marked the first appearance of inflorescence primordia in White Riesling (11 June) (15.0 nodes) and in Concord (10—14 June) (17.9 nodes). However, Aurore produced its first inflorescence primordium at bloom (21 June) when the shoots averaged 18.8 nodes (excluding the base nodes but including the nodes in the shoot tip). These dates were 12, 6 and 0 d before bloom, respectively.

Within the primary bud there seemed to be a correlation between the number of nodes and the first inflorescence primordium. In New York State Concord primary buds produced the first inflorescence primordium at the 6-node stage (June 10 and June 14), White Riesling and Aurore at the 7-node stage (June 11 and June 21, respectively). Other workers report similar results. CAROLUS (1971), working on *V. vinifera* cv. Merlot in France, reported the first non-foliar primordium (stage 0) in the primary bud when three prophylls and four leaves were present, before the beginning of bloom. SRINIVASAN and MULLINS (1976) found in Australia that the first non-foliar appendage (stage 0) appeared after leaf 5 had formed in the primary bud of Shiraz. A destructive, but probably more precise, method of determining inflorescence differentiation in a specific cultivar is to dissect buds when leaf production on the green shoot and in the primary bud begins to slow down just before bloom.

### Summary

Inflorescence differentiation was determined by dissection of primary buds at shoot nodes 2—6 of *V. labruscana* cv. Concord, hybrid cv. Aurore, and *V. vinifera* cv. White Riesling. The first recognizable inflorescence primordium appeared 0—12 d before bloom, when the shoot had about 13 expanded leaves, and 6—7 nodes in the primary bud.

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