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Buds and Shoots of Grapevines

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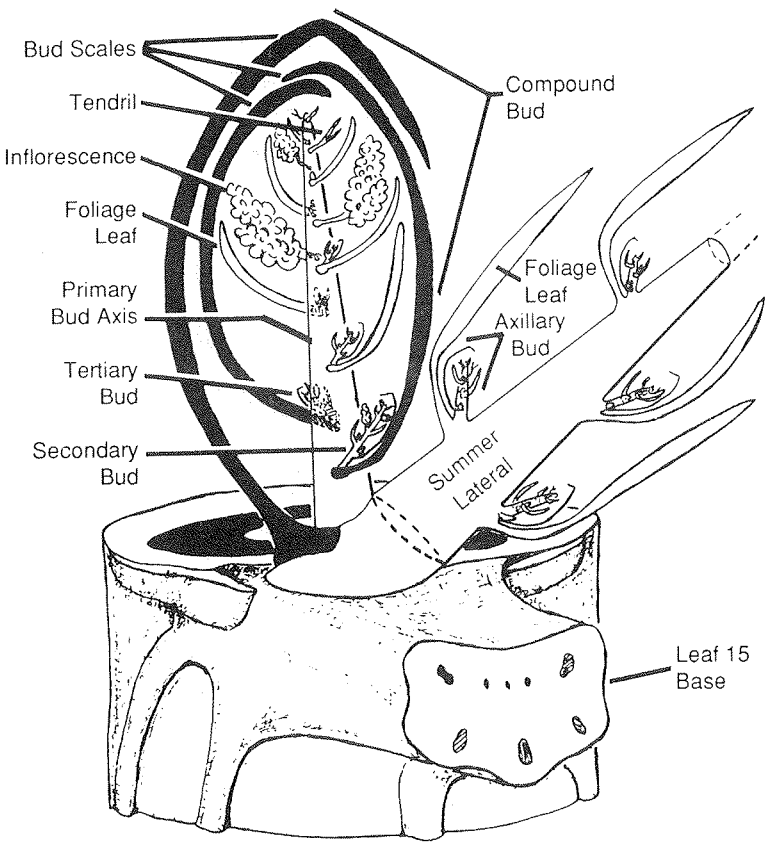
Viticulture demands a knowledge of what it takes to produce healthy, cold-tolerant, fruitful buds in New York State. Vineyardists know that certain practices in year one can favor proper bud development in year two by observing vegetative and reproductive performance. We might even consider viticulture as "budiculture" in that the crop's potential lies imprisoned within the overwintering compound buds found at each node of a cane.



THE BUD-BRANCH SYSTEM AT THE GRAPEVINE NODE

However, the interior construction of fruitful buds on winter and spring canes is unknown to most of us. This article can be considered a "primer" on grapevine bud structure and development.

Buds are highly compressed shoots which are formed in the angle *(axil)* of leaves. A shoot produces many leaves during the season, each of which has an associated *axillary bud*. The structure of these buds is quite complex. One part of it grows immediately *(the summer lateral)*, while other parts remain as the compressed, multi-branched system that makes up the overwintering compound bud or "eye". This latter structure bears next season's crop. Explaining this won't be easy, but here goes.

Figure 1. The bud-branch system at node 15 of the 'Concord' grapevine shoot in August. Leaf 15 has been cut away to show the summer lateral shoot and the compound overwintering bud in the axil of its most basal leaf, a bud scale (in black). The summer lateral usually abscises above the compound bud by winter (dotted line). The mature compound bud consists of the main bud (primary bud) bearing two basal bud scales (in black) and 6-8 foliage leaves. Foliage leaves 3-5 usually are opposed by inflorescence primordia, while the youngest leaves are opposed by tendrils. The lower bud scale of the primary bud contains a large axillary bud (the secondary bud), while the upper bud scale has a somewhat smaller axillary bud (the tertiary bud). All other axillary buds at nodes of the primary bud are small (figure is not drawn to scale).

The Summer Lateral Shoot

Figure 1 diagrams the 15th node of a 'Concord' shoot in early August. A *node* is simply that part of a stem bearing an appendage, such as a leaf. The large leaf at this node is removed to better show its axillary branch system. The axillary shoot shown at the right in the figure is the *summer lateral*, which was the original axillary bud. The foliage leaves of the summer lateral are alternately arranged in a single plane: they lie in the plane of the paper in Figure 1. The leaves of the main shoot (such as leaf 15) lie in the plane that is perpendicular to that of the paper. Just as in the main shoot, the leaves on the summer lateral shoot also contain axillary buds, which may or may not elongate. Leaves of these buds are arranged at right angles to the leaves on the original summer lateral (again, perpendicular to the plane of the paper).

The dashed line encircling the base of the summer lateral in Figure 1 indicates that it is usual for it to die back and drop off. *Persistent summer laterals* do not drop, but develop into permanent woody branches. In any event a large, overwintering compound bud develops at the base of the summer lateral. Let's look at the construction of this bud.

The Overwintering Compound Bud

The most basal leaf of the summer lateral is modified to become a bud scale (the largest black structure at the left of the diagram in Figure 1). The bud scale has in its axil... you guessed it... an axillary bud, which is entirely enclosed by the bud scale. This extremely large axilllary bud is known in viticulture as the primary bud and it is the bud that produces next year's crop. The primary bud does not grow out immediately, but continues to enlarge greatly and to produce its own bud scales, leaves, inflorescences and tendrils before it goes dormant in autumn. Without the proper development or survival of this bud we would have little to no fruit to harvest the next season.

The primary bud has leaves which lie in a plane perpendicular to the plane of leaves of its parent shoot, the summer lateral. By now you know that leaves of each successive order of branching will alternate in the plane in which they are arranged on their stems. This fact can help you identify an elongating primary bud from other shoots which may emerge from this complex assemblage. The axillary buds at the nodes of the primary bud are essentially pre-formed summer laterals for next year's growth.

Note in Figure 1 that the primary bud has produced nine leaves, but that the lowest two of them are modified into bud scales (the inner two black leaves). These bud scales are also modified to protect the bud. They are quite hairy and probably function to retard water loss from the bud during the summer. As dead bud scales in winter, they may act as ice nucleating centers. Water will leave living tissues in the bud to freeze in the scales. This dehydration of bud tissue is associated with the ability of living bud tissues to supercool in winter, and so avoid freezing. The two bud scales of the primary bud each contain a well formed axillary bud. In Figure 1, these buds are drawn much smaller than they actually are to emphasize the fact that they are axillary buds on the primary shoot, and so can be ranked with any other axillary bud on the primary shoot. The bud in the axil of the lower bud scale is known as the secondary bud and the bud in the axil of the upper bud scale is called the tertiary bud.

The relative size of primary, secondary and tertiary buds is better shown in Figure 2. By late fall the secondary and tertiary buds may have produced several leaves and even a cluster or two. However, such clusters are usually much smaller and yield a smaller crop than do the large well developed clusters of the primary bud. Unfortunately, the primary bud is most susceptible to freeze injury, which leaves the secondary and tertiary buds to produce a crop after severe winter conditions. The secondary and tertiary buds may emerge with the primary, may never emerge, or may lie dormant many years before emerging.

The lowest foliage leaves within the primary bud typically have no tendrils or inflorescences (clusters) opposite them (Fig. 1). The next two-to-four nodes do have an

Figure 2. A longitudinal section through an overwintering compound bud of grapevine in December, showing the main bud axis in the center (primary bud) flanked by its two smaller side branches, the secondary bud on the lower side of the primary and the tertiary bud on the upper side of the primary.

inflorescence opposing the leaf. The inflorescence begins to branch before winter. Upon bud swell in the spring the inflorescence begins to initiate individual flowers at the ends of its branches. The uppermost foliage leaves within the primary bud are opposed by minute tendrils. After bud break each subsequently formed node of 'Concord' and other American varieties will produce a tendril opposite each leaf. The vinifera and hybrid varieties will produce a pattern of two tendrilled nodes alternating with a tendril-less node.

Bud Break and Shoot Growth

A Primary bud elongates in spring and forms a long shoot with the grape clusters near its base. As this shoot grows through spring and summer it will produce new leaves, each with its own axillary bud complex. At each node on this shoot the summer lateral elongates (more or less) and the compound bud at its base develops bud scales, leaves, inflorescences and tendrils. This sequence progresses up the elongating grapevine shoot during the summer. By frost, the most mature compound buds are thus found in the basal region of the maturing grapevine shoot. These are also the most likely buds to be left after pruning the vineyard the following winter. After leaf fall, the mature shoot is called a cane, and at each node of the cane an overwintering compound bud can be found.

Figure 3 indicates the fate of a typical 'Concord' primary bud from bud-break to autumn. By bloom the primary shoot has produced about 10 leaves with blade lengths greater than 2 cm, and the shoot is about 90 cm (9 dm or 36 inches) long. The primary bud within the compound bud developing at node 5 (B5) has already matured, in that it has produced its maximum number of leaves (about 9, counting its two bud scales). Bud 10 on the elongating shoot is just beginning to produce leaves by bloom, and this bud will mature by August. Bud 15 on the elongating shoot begins producing its leaves in early July, while the shoot is rapidly growing. Bud 15 matures in late August, about the time the main shoot ceases to elongate or to produce expanded leaves. Bud 25 on the elongating shoot may or may not mature by the time heavy frosts occur in October. In this annual cycle, the primary bud which emerges in spring will mature into a cane by autumn. Its shoot tip always dies back to mature wood before frost; therefore, any new shoots produced next season must come from compound buds that have developed at the nodes of this cane. The cycle repeats itself year after year.

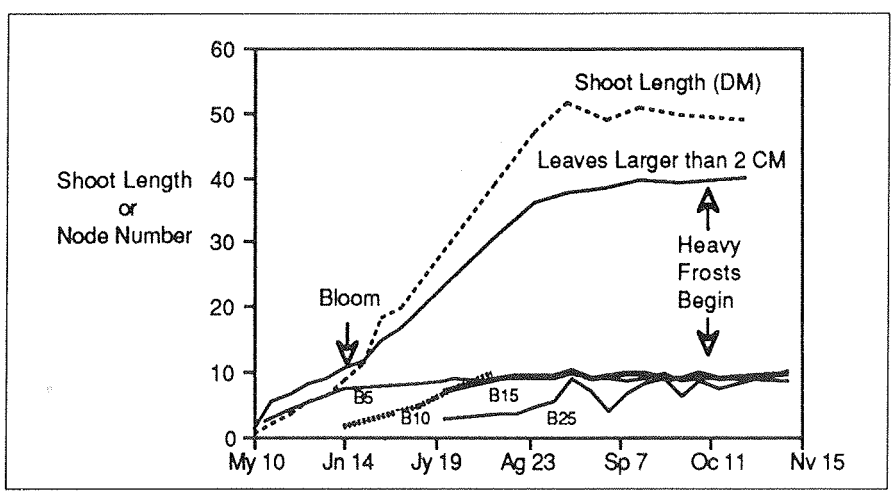


Figure 3. Seasonal development of the emergent primary bud on a typical 'Concord' grapevine cane. This shoot elongates until late August. Leaf production also continues until late August. Nodes developing in next season's primary buds on this shoot are given for the compound buds at nodes 5, 10, 15 and 25, numbered from the shoot base.

Primary buds of each grape cultivar grown in New York will have a typical number of nodes produced within them. Buds dissected over the last two seasons show, for example, that 'Cabernet Sauvignon' buds produce approximately 12 nodes, *Vitis rupestris* 'St. George' contains 9 or 10, *Vitis riparia* 'Montreal' has 11, *Vitis rubra* has about 10, and 'Concord' has 9 or 10, including bud scales. The above species differ in the rates at which their compound buds mature before frost, and they also differ in sensitivity to winter freeze injury. Common to all varieties and species thus far studied is the fact that the first 25 nodes of a long shoot usually contain mature buds by frost, yet these buds demonstrate a range of cold tolerance.

These studies of bud development are ongoing. We are currently working on several aspects of bud development in a range of grape species and varieties. Our intent is to see if there are structural differences in the buds of these species which can account for their differences in cold hardiness, as assessed in Dr. Robert Pool's viticultural and physiological studies.

Partial funding for this research came from Dr. Pool's grants from the New York Wine and Grape Foundation and the New York State Grape Production Research Fund.

Major Changes in the 1991 Pest Management Recommendations

Several changes were made in the Cornell publication, "1991 Grape Pest Management Recommendations for Grapes." Some of these are due to loss of chemicals, some due to additions, and some due to format changes. These modifications are given below.

As in past years, Table 3 of the Recommendations gives treatment advice for pest and fungal diseases at various growth stages through the season. In the current table, these pests and diseases are given in the same order at each growth stage. Also, the recommended materials are given fully for each pest or disease; there is no more having to reference back to earlier stages for these materials or their rates of application.

Herbicides. Gramoxone Super™ has been dropped. Gramoxone Extra™ (Paraquat) remains. Poast™ herbicide is now labeled for use in both non-bearing and bearing vineyards within 50 days of harvest. Fusilade 2000™ (Fluazifop-p) is still labeled only for non-bearing vineyards which will not bear harvestable fruit for 12 months.

Pests. Diazinon, Dibrom™ (Naled) and Malathion have been removed from the Recommendations because most growers would probably not want to use them to control fruit flies within 7 days of harvest. They may be used as labeled in 1990, but growers have become more aware of public perceptions of risk.

The pheromone Isomate-GBM™ has been added for control of the grape berry moth. This non-spray alternative disrupts the mating behavior of the pest. At 3–5 inch shoot growth, pheromone-containing "twist-ties" are placed along trellis wires in proportion to the perceived risk of GBM infestation. Insecticidal spray treatment for GBM has been removed from the first-postbloom stage recommendation, but remains in the second-postbloom stage and midsummer-spray recommendations. New York Food & Life Sciences Bulletin No. 120 gives protocols for GBM management. For a copy, contact: Bulletin Room, Jordan Hall, NYSAES, Geneva, NY 14456.

Diseases. Karathane™ and Dikar™ are being retained in the Recommendations for this year, but since they are no longer manufactured, they will be dropped from the Recommendations next year. Check Table 4 for sensitivity of your grape varieties to Karathane. Karathane sensitivity will likely be dropped from the Recommendations next year as its use is phased out.

Maneb plus Zinc (the 7 day to harvest material) is no longer labeled for grapes and has been dropped from the Recommendations.

Copper sensitivity for many varieties has been added to Table 4. Growers are asked to inform grape extension specialists of any new information on copper sensitivity, or other types of sensitivity on the listed varieties, so that Table 4 can again be updated for the 1992 Recommendations.

Note that several wine varieties have also been added to Table 4.

New maximum allowances of 24 lbs per acre per season for Captan 50WP and 15 lbs per acre per season for Captan 80WP reflect label changes.

A caution about tank mixing Bayleton™ or Nova™ with copper has been included for the midsummer spray recommendation for powdery mildew and downy mildew.

NOTE: Nova can longer be used on Long Island This new information is not found in the 1991 Recommendations.■

FROM THE EDITOR

Martin Goffinet

At this time of year grape growers are curious (and perhaps apprehensive) about the impact of last year's field practices and the influence of our climate on the condition of the buds they are depending on for this year's crop. Buds are so important to our concept of viticulture that I felt our readers should have some idea about their construction and development. Because I have research interests in the structural and developmental aspects of vine growth, this duty naturally falls to me. It is not an easy story to tell because buds of grapevine are complex, but I will give it a try. It will help to have a grape cane with shoots attached as you read the article. I am really hoping that you will go out to your vineyard and take a very close look at how your vines are put together. If you do, you will come to some better understanding of grapevine growth and development and what bud formation has to do with crop production.

I have also perused the 1991 edition of Cornell's "Pest Management Recommendations for Grapes," which is available at your county and regional cooperative extension offices (or write the Distribution Center, 7 Business & Technology Park, Cornell University, Ithaca, NY 14850). Several changes have been made from the 1990 edition that I have mentioned on page 4. As you use the Pest Management Recommendations this season, keep a list of your major concerns about its content; report these to your grape or fruit agent so that we can develop the 1992 edition with grower input.

Finally, I want you to know that the question form that you see inside the back cover and on the back cover of this newsletter is used by quite a few people who want to know about viticulture, grape diseases, insect problems, grape breeding, varieties, enology, etc. So, don't feel shy. If you have a question you've been too embarrassed to ask someone else, write it out and send it to me. I can contact someone who might know the answer. Good luck to you all this growing season. ■

ANNOUNCEMENTS UPCOMING EVENTS

June 18 & 19, 1991: ***The International Symposium on Nitrogen in Grapes and Wine,*** will take place at the Seattle Convention Center in Seattle, WA. Contact the American Society for Enology and Viticulture, Box 1855, Davis, CA 95617.

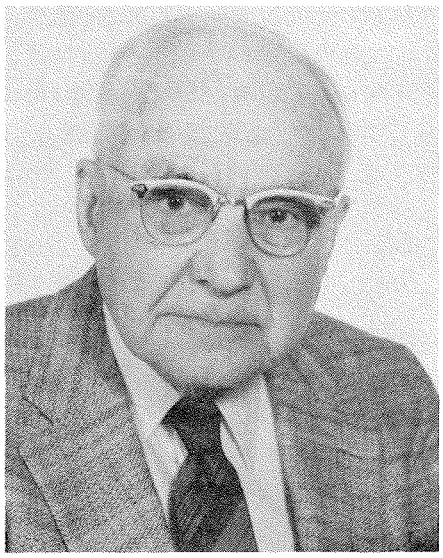
June 20–22, 1991: ***The Annual Meeting of the American Society for Enology and Viticulture,*** occurs at the Seattle Convention Center in Seattle, WA. Contact the ASEV, Box 1855, Davis, CA 95617.

The 16th Annual Meeting of the Eastern Section of the American Society for Enology and Viticulture will be held July 10–12, 1991, in Erie, PA. Contact: Dr. Frank Gadek, RD1, Box 1044, East Mill Hill Rd, East Greenville PA 18041, phone: 215-679-8289

The World Vinifera Conference takes place at the Sheraton Towers in Seattle, WA July 11–13. Contact Marilyn Hayes, telephone 206-728-2252.

Sept. 30, Oct. 1& 2: The French Group, LVMH Moet Hennessy Louis Vuitton, will host its *6th International Symposium, "Grapevine and Environment: Integrated Protection of Grapevine"*, in Budapest, Hungary. The program will be arranged with collaboration of the Institut National

de la Recherche Agronomique (I.N.R.A., France). Topics include: detection of disease and simulation of its development, the development of integrated controls, grower education, and regulatory, toxicological, environmental and economic issues. Contact: Moet-Hennessy U.S. Corp., Attn: Mr. Oliver Goniak, 135 East 57th Street, New York, NY 10022. Telephone: (212)-758-7200. Fax: (212)-758-2801.



Dr. Nelson J. Shaulis

The Nelson J. Shaulis Viticulture Symposium took place on March 4, 5, at the New York State Agricultural Experiment Station at Geneva, NY. Over 130 grape growers, industry representatives, academics and others attended the symposium, "Integrated Pest Management of Grape Diseases: Present and Future Strategies." Professor Emeritus of Viticulture, Nelson J. Shaulis, was recognized for his career-long activities in grapevine research by the New York grape industry, as represented by Tom Davenport of National Grape Cooperative. Speakers from the Cornell Grape Program, as well as from California, Ohio and Italy, spoke on a variety of topics. These included crown gall, viruses, various fungal diseases and control strategies, impact of cultural practices, integrated control programs, forecasting of diseases, fungicide action, resistance problems and resistance breeding of varieties, biological control, organic practices, and the IPM approach. Proceedings will be sent to registrants, with additional copies made available later to others at nominal cost. Contact: Martin Goffinet, Dept. Horticultural Sciences, New York State Agricultural Experiment Station, Geneva, NY 14456.

The 20th New York Wine Industry Workshop was held April 10 & 11, 1991. Approximately 90 people attended the workshop with out-of-state participants from Michigan, Pennsylvania, Rhode Island, Connecticut ,Massachusetts, Ohio and Ontario, Canada. Proceedings are available from: Dr Thomas Henick-Kling, Cornell University, Department of Food Science and Technology, New York State Agricultural Experiment Station, Geneva, NY 14456-0462. No charge for NY wineries, $5 charge to all others. ■

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This newsletter and the extensive grape research it is based on are made possible by funding from the **New York Wine & Grape Foundation.** The Foundation's budget depends totally on private sector contributions which are matched by the State of New York. And now extensive cuts in State funding have made these private sector contributions more vital than ever.

If the Foundation's research and promotional programs are to continue, we need your support through modest dues—a rate schedule and membership application are below. (Wineries and juice manufacturers have already made financial contributions of up to $15,000 each to support the effort.) Please join your neighbors and industry associates in forging a more productive and profitable future. **(Join using this form and we'll send you a "Best of the Bunch!" T-shirt.)**

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COUNTY _____

CITY (Town) _____ ZIP _____

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Dues (circle)	**Acres (circle)**
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After completing this form, please send it and a check for the appropriate amount payable to the **New York Wine & Grape Foundation**, 350 Elm St., Penn Yan, NY 14527. THANK YOU!

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Question: _____

Gratitude is expressed to those organizations whose support makes possible ongoing and valuable research activities for the benefit of the State's grape industry. Major funding is provided by the **New York State Wine & Grape Foundation; the Grape Production Research Fund, Inc.; and, the J.M. Kaplan Vineyard Research Program.**

New York Wine & Grape Foundation
350 Elm Street
Penn Yan, NY 14527

Got A Question? We are trying to address the many questions from grape growers and processors that come to Cornell's grape research community. We invite you to write to us at *Grape Research News* to bring to our attention any questions you have about grapes. We will see to it that those questions are answered by someone knowledgeable in the area of your concern.
Save yourself a long distance phone call. Put it in writing on the back of form below, cut it out, and send it to us.

— CUT HERE — — — — — — — — — — — — — — — — — — —

Name .....
Address .....
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