University of California Cooperative Extension Fresno County

Vine Lines

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Using Grapevine Bud Dissection to Assess Yields

Stephen Vasquez and Matthew Fidelibus

The last few years we have received calls regarding grapevine bud dissection and its use for estimating next season's crop. Farmers typically have two questions: What information can they garner from such a process and secondly, when can they expect the results if samples are brought to a UC Cooperative Extension office. The answer to the second question is an easy one since UC Cooperative Extension does not offer a bud dissection service. The reasons for not offering such a service will be easily understood after considering the following discussion. To answer the first question, we need to discuss the process and how to interpret the results. In short, bud dissection analysis can provide two types of information. First, it can produce data that may be used to estimate cluster counts for a given block. Second, it gives growers some insight on bud health in specific blocks and whether bud mortality is affecting yields. Together, these data can be used to help predict the number of clusters that may be expected from each node so that an appropriate number of nodes may be left at pruning to achieve the desired crop load.

Understanding bud architecture

To understand the merits and deficiencies of bud dissection data, one must become familiar with the characteristics of dormant buds. At each node along a cane a dormant bud develops between the leaf petiole and lateral bud or shoot (Fig. 1). In fact, each of these are truly compound buds consisting of a primary and two secondary buds, which together are surrounded by scales (bracts) that protect them during dormancy (Fig. 2). Each compound bud may also be referred to as a latent bud. Figure 3 shows a longitudinal section of the latent bud showing the primary (arrow) and two secondary buds protected by the bud scales. Under normal conditions, the primary bud emerges in the spring bearing one or several

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Is a Grape by Any Other Name Still a Grape?

Peggy G. Lemaux

Grapes may look identical, until you taste them crushed and processed for a glass of wine or cut up in a salad. Then the purple-fleshed globe bursts forth with a spectacular melon flavor and a sweet fruity fragrance, while its visually identical twin has a distinctively different flavor, perhaps with a hint of musk. In fact, today in California hundreds of varieties of grapes are grown in backyard gardens and production fields for wine, table eating and raisins.

Any wine connoisseur knows you can't use Muscat grapes to make wine labeled as Cabernet Sauvignon. In fact, hundreds of different unique varieties of grapes are used for making wine and different ones used for fresh eating and making raisins. That uniqueness is due in part to differences in the genetic information in the grape, which determines among other traits, its color, aroma, and taste characteristics. That information is made up of individual chemical units strung end-to-end. If each unit is represented by an alphabetic letter, it would require 52 books, each with 1000 pages, to hold all the information needed to code for the uniqueness of a particular grape variety.

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Bud Dissection

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flower clusters. If, by chance, the shoot arising from the primary bud is damaged (i.e. knocked off or killed by frost or insects), one or both of the two remaining buds may begin to grow in its place. Although this "backup" approach by Mother Nature will allow continued foliar growth within a season, it does not assure an equivalent replacement crop. This is because the two remaining buds are not normally as fruitful as the primary bud. This is especially true for Thompson Seedless (TS), TS-like cultivars (i.e. Selma Pete) and other fresh market grapes (i.e. Flame Seedless). Many wine grape cultivars on the other hand, tend to be more fruitful at secondary buds should the primary bud become damaged, but may not compare in size and quality to the fruit from the primary bud.

Figure 1. Dormant bud flanked by a petiole (white arrow) and lateral shoot (black arrow).

Process of dissecting buds

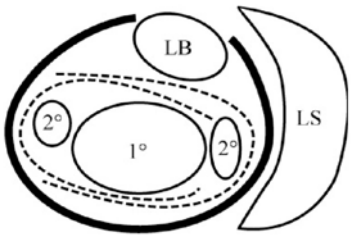
The process of dissecting a grapevine bud and identifying its potential fruitfulness can be exciting and frustrating, simultaneously. The procedure is laborious, time consuming, and thus costly. Hence, the main reason UC Cooperative Extension does not offer bud dissection analysis as a service. But, in order to garner any useful information, it will take many buds meticulously dissected to reveal their potential fruitfulness or lack thereof.

The following tools will be needed to dissect grapevine buds:

- Razors (double-sided work best)
- Stereo microscope (id. dissecting microscope) with a good light source
- Notebook and pencil for documenta tion

Once obtained, the tools should be setup in a location that has good lighting and can be used for the duration of the job.

Plant material should be collected from throughout a uniform vineyard or block containing the same cultivar. When considering which canes to collect, they should be healthy, fully mature, round and of medium size and internode length. Canes that have grown on the outside of the canopy (sun canes), which are often kept at pruning, make good candidates for bud dissection analysis. The minimum amount of buds to be dissected should be 100 representing no more than 40 acres. For example, 40 canes collected from a Thompson Seedless vineyard would allow for two buds to be selected from each cane, roughly representing each acre. Canes should be marked with some type of identifier relating to the vineyard. For example,



Matt Rademacher

Figure 2. Depiction of a dormant compound bud composed of a 1° and two 2° buds. Lateral bud (LB) and leaf scar (LS) are also shown.

R10V20E would represent row (R) 10, vine (V) 20, from the east (E) side of the vineyard and can be marked directly on the cane with a permanent marker. The buds selected for dissection should also be identified at this time and should remain consistent for each cane collected. For example, because Thompson Seedless is not fruitful at nodes 1-4, buds found at nodes 6 and 9 for each cane should be marked and used for the analysis.

Once samples are collected and marked they can be systematically dissected. Buds should be dissected by slicing through them starting at the top to reveal the interior of the compound bud. Two to three slices may be needed. Determining fruitfulness involves counting the flower cluster primordia from the primary bud only. At first it may be difficult to properly identify flower cluster primordia but it becomes easier as more samples are processed. The cluster primordia will be next to the shoot

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Still a Grape?

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How do you create a new grape variety through classical breeding?

What if you wanted a new grape variety? You could use a classical breeding approach, requiring you to cross male cells, or pollen, of one variety with the female cells or eggs of another variety. You could then plant the seeds born out of that cross and screen resulting plants for the characteristics you wanted in your new variety.

What happens to all the genetic information when you do that? You just combine all the information from the two sets of books to make 104 books, right? No, genetic rules dictate that only 52 books remain – so only approximately 50% of the information from each parent is kept. The breeder has no control over what information is kept, and can only observe resulting plants and choose the ones with the desired characteristics. Those characteristics are dictated by its genes – half-page packets of information in the books. But grape varieties have different sets of genes that give rise, for example, to their different tastes and sugar contents. But, predicting which traits a particular grape plant will have after a cross is difficult.

Classical breeding was used to create some traditional grape varieties, like Chardonnay, Cabernet Sauvignon and Syrah. Most of these are, however, not from recent breeding efforts but from ancient Middle Eastern or European efforts and have been multiplied over the years by cuttings, not seeds. But classical breeding is being constantly used to develop new table grape varieties with added quality or extended ripe fruit seasons.

Also widely used to alter grape varieties is rootstock breeding, which involves grafting the grape-producing portion of one variety onto the rootstock of another variety to provide resistance to soil-borne pests and diseases. Some recent breeding efforts focused on developing grape varieties using *Muscadinia rotundifolia*, which is resistant to Pierce's Disease, a problem causing costly damages to the California wine and grape industry.

How do you create a new grape variety using the new tools.

In the past few decades new methods were developed to identify and move genes between grape varieties. For example, the specific grape gene(s) responsible for resistance to Pierce's Disease could be moved from *M. rotundifolia* to another grape variety, like Chardonnay, including other less desirable genes from *M. rotundifolia*. One way these new methods are being used is to provide a genetic table of contents for the genes, which speeds up breeding efforts dramatically. Such a table of contents is being developed for the varieties with resistance to Pierce's Disease so breeding efforts will be faster.

Another way to use the new genetic tools is to introduce specific genes to change plant characteristics, a process called genetic engineering, recombinant DNA or genetic modifications. A single half-page in the 52-thousand-page set of books can direct the plant to make new traits or to remove them. For example, specific gene(s) for resistance to a particular virus, like the destructive fanleaf virus in Europe, were identified and used to engineer grape vines, which were field-tested in France in summer 2006 for virus resistance. Also yeast strains used in wine making have been engineered to eliminate the factor(s) responsible for causing headaches in some consumers of red wine.

Are the two methods the same or different?

Whether you consider breeding and genetic engineering the same or different depends on your perspective. Both use the same cellular machinery to move genes around and both cause heritable genetic changes. So in that sense they are the same. But in the case of classical breeding the change occurs inside the cell, while with genetic engineering it occurs in the laboratory. Also during breeding keeping a particular gene is a random process, while with genetic engineering specific genes are introduced.

Perhaps the most fundamental difference is that gene exchange by breeding takes place most often between plants of the same species, although gene exchange at low frequencies occurs across some species barriers. With genetic engineering the gene source can be the same crop, another crop or even different organisms, like bacteria or animals. Why? Because genetic information in all living things is written in the same (chemical) language. In fact humans and plants share many (~40-60%) of the same genes.

How many crops and foods are genetically modified?

So, how many foods today are genetically modified (GM)? It depends on your definition of GM. If you mean in how many foods have genetic changes or modifications occurred, the answer would be all, including those grown under organic certification. For example

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Bud Dissection

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Figure 3. Longitudinal section through dormant bud showing 1º (arrow) and 2º buds.

apex and surrounded by leaf primordia and protective hair (Fig. 4).

Assessing yields

After dissecting bud samples and documenting information for respective blocks it can be difficult to understand what the numbers mean.

Data collected in the first year might not reveal much about potential yields for the following year, but as data accumulate over the years a relationship between bud dissection data and vineyard yields should become apparent.

Figure 4. Cross section of compound bud showing 1º and 2º buds. Cluster primordia at the center of primary bud (arrow).

Bud dissection data is further enhanced when actual flower clusters (inflorescence) counts are taken each year from the same vineyards. These data should also be compared to actual yields at the end of the season. Doing so for the first three years will give you historical data and allow you to make informed decisions on pruning. Generally, Thompson Seedless and TS-like cultivars are not very fruitful at basal nodes 1-4, hence the reason they are cane pruned with 12-15-nodes/cane. If bud dissection data concludes that potential yields are low, additional canes may need to be retained. Cultivars that are traditionally spur pruned, such as Cabernet Sauvignon, may also require cane pruning to produce adequate yields in years when bud fruitfulness is predicted to be low.

Primary bud necrosis

Primary bud necrosis (PBN) is a physiological disorder that affects the primary bud within the compound bud; the secondary buds if not affected, may grow. Although flower clusters can be seen, fruit bore on secondary buds are usually of lower yield and reduced quality. In severe cases, the entire compound bud will die and will be brown to black in color with little or no healthy green tissue (Fig. 5).

PBN is not completely understood but it is most commonly associated with the following situations: high vigor with large cane diameter, excessive irrigation, low carbohydrate reserves, shading of canes, and phytohormone imbalances. The lack of direct association with one of the previously mentioned situations could be a result of cultivar and regional interactions.

PBN is normally observed approximately 20-days after bloom and on through dormancy. Depending on the cultivar it can affect both basal and distal buds on a cane or spur. Bud dissections can be useful in determining if and when buds are aborting. Sampling for PBN can begin in early fall when next seasons canes or spurs are mature and continue through dormancy.

Figure 5. Dormant bud showing necrosis of primary and secondary buds (compare to fig 4).

Finding a lab that offers bud dissection service

It can be difficult to find a lab in California that offers bud dissection services. Labs that offer other services (i.e. nutritional analysis) might also perform bud dissections, so it is worth asking them first. If you cannot find a lab offering the service it might be worth having your existing staff trained. This would allow you to monitor your own vineyards systematically, developing historical data that can then be compared year

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Ag Crime Prevention: Obtaining an Owner Applied Number

Due to the widespread concern for the increase in the number of thefts in the rural communities, the Owner Applied Number (OAN) crime prevention program is available to farmers for the identification of farm machinery, equipment and even household goods.

This FBI established system allows a state and county to be assigned a number which is recorded in the NCIC (National Crime Information Center). A directory containing these numbers is available to each law enforcement agency for use in identifying the various state and counties.

The ACTION Project issues OANs for 45 of California's county Sheriff's Departments. You can sign up for an OAN by going to **www.agcrime.net**. This information enables law enforcement agencies to pinpoint ID numbers within any state and county in the U.S., whether stolen equipment is found across the country or within the same county.

What exactly is an OAN?

In California, the OAN ID system uses ten characters, which identify the state, county, and business. The coded identification number allows local law enforcement to identify stolen property and contact the owner.

Where should equipment be marked?

The OAN's are most often hand stamped using 1/8" or 1/4" letters and numbers on heavy equipment and will not generally be as large or precise as those applied by the manufacturer. One of the key elements in marking equipment is uniformity. Locate the OAN on the right side of the equipment as you are standing behind it. On all equipment with non-removable tongues; manure spreaders, grain drills, auger wagons, etc., place the OAN on right side on top of tongue, 12" to rear of hitch pin. On 3-point equipment with a tool bar, place the OAN on top of tool bar adjacent to right hitch pin. **For additional information on stamping equipment a brochure can be downloaded at:**

http://www.agcrime.net/pdf%20files/OAN-ID.pdf

It is also recommended that you also mark equipment in another location known only to you. If the OAN's are removed or destroyed, property can still be positively identified by the OAN's located elsewhere.

It has been proven that thieves are hesitant to take items that can be readily identified. Placing signs, decals, and other visible information warning potential thieves that this equipment has been marked and registered with the local law enforcement officials my help to prevent a possible theft.

NOTE: It is suggested that the seller of equipment notify the new owner that the equipment has been marked. The new owner should then locate and stamp their number below the previous owner's number, so that the equipment can be traced from one owner to another. **Do not alter or deface the previous owner's OAN.**

Fresno and Madera County residents can contact their sheriff's office for more information.

Fresno County Ag Crimes Unit
1053 S. Goldenstate Blvd. Selma, CA 93662
Office number: (559) 898-0667

Madera County Ag Crimes Unit
14143 Road 28, Madera, CA 93638
Office number: (559) 675-7770

Still a Grape?

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ancient relatives of little like modern corn. They had small seeds that could not be opened with your teeth and seed numbers per plant were also hundreds of times lower.

If the question is how many different crops have been modified by genetic engineering (GE), the number would be very small. While many processed foods, except those labeled 100% organic, may contain a GE ingredient, those ingredients come from a small number of large-acreage GE crops, like corn, soy, cotton and canola. The only whole GE foods on the market are summer squash, papaya and sweet corn. There are no GE strawberries, asparagus or grapes in production in California, although small-scale field trials have been conducted under the oversight of USDA's Animal and Plant Health Inspection Service (APHIS).

So, is a grape still a grape?

Then grapes are just grapes, right? No, major and minor gene alterations in grapes have occurred over time, both naturally and with human help. These changes are responsible for the wonderful diversity of cultivated grapes today – from the mellow flavor of the Thompson Seedless grape to the robust taste of the Petite Sirah grape. Such modifications occur through natural and induced mutation and gene through human intervention in gene exchange—historically through classical breeding but now and in the future through genetic engineering.

To learn more about biotechnology and its application in California agriculture you can visit the UC ANR Biotech website at: http://ucbiotech.org

Peggy G. Lemaux Ph.D., is a Cooperative Extension specialist at University of California, Berkeley specializing in agriculture and biotechnology issues.

Bud Dissection

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after year and help make decisions on bud retention. Alternately, some packers and wineries have someone on staff that surveys their growers' vineyards and may be willing to add your vineyard to their list.

In conclusion, when considering bud dissection analysis for estimating yields, there is no substitute for data collected from a particular vineyard or block over seasons. Initial setup of ones sampling protocol, analysis, and personnel or lab should remain consistent over time (within season and over seasons) in order to maximize benefit. Bud fruitfulness is a single parameter affecting the final yield. Additional variables contributing to final crop size include percent budbreak, cluster size, berry set and size, and soluble solids and should also be evaluated when considering a vineyard's production potential.

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SJV Grape Symposium Online Registration Now Available

You can now register for the 2007-San Joaquin Valley Grape Symposium online using your credit card. Type the following web link into your browser and follow the directions:

http://ucce.ucdavis.edu/survey/survey.cfm?surveynumber=1509

Once registered, you will be sent an email confirming your successful online registration. A week prior to Wednesday, January 10, 2007 you will be sent a postcard that you will bring with you to the meeting for easy access.

For additional information regarding online registration, contact Terri at 559-456-7285.

Calendar of Events

Local Meetings and Events:

2007 San Joaquin Valley Grape Symposium
January 10, 2007
7:30 a.m.— 12:00 p.m.
C.P.D.E.S. Hall
172 W. Jefferson Avenue
Easton, California
Contact: Steve Vasquez (559) 456-7285
See insert for more information.

U.C. Davis University Extension Meetings

(800) 752-0881

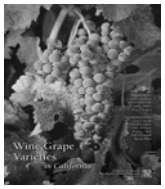
Environmental Issues on the Farm:
An overview of Problems and Solutions for Production Agriculture
January 25, 2007
9:00 a.m. — 4:30 p.m.
Da Vinci Building, 1632 Da Vinci Ct.,
Davis, CA.
Section: 063NAT419

Tasting Room Design and Management
February 6, 2007
9:00 a.m. — 4:30 p.m.
Da Vinci Building, 1632 Da Vinci Ct.,
Davis, CA.
Instructor: Craig Root
Section: 063VIT206

Health and Safety for Winery Operations:
An Overview
February 15, 2007
8:30 a.m. — 4:30 p.m.
Sutter Square Galleria, 2901 K. Street
Sacramento, CA.
Instructor: UC Davis Ex
Section: 063HSD516

Fundamentals of GIS for Vineyard Management
March 26, 2007
8:00 a.m. — 5:00 p.m.
Plant and Environmental Sciences, California Ave.
Davis, CA.
Instructor: Joshua Viers
Section: 063VIT203

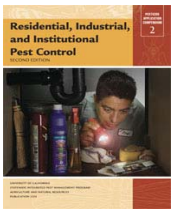
Publications from the University of California



Wine Grape Varieties in California, 2003
ANR Publication 3419
Price - $30.00 + tax and shipping

A comprehensive variety publication. Covers all the grape growing districts in California, highlighting 36 major varieties.

Revised Edition



Residential, Industrial, and Institutional Pest Control, 2nd Edition, 2006
ANR Publication 3334
Price - $30.00 + tax and shipping

Volume 2 in the Pesticide Application Compendium focuses on managing structural, food, and fabric pests, rodents, birds, and weeds.

Order Form

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Pest Control		$30.00	

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Vine Lines

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