GRAPE PRESS

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Winter Technical 2019

Tony Wolf

The VVA added something new this year: A two-day conservative pruning session led by dormant vine pruning consultant Marco Tessari. The session, held in advance of the regular annual meeting, took place at King Family Vineyards in Crozet in February. For more meeting photos, see Page 5.

VVA Wraps Up Annual Meeting

Workshops Focus on Smart Vineyard Management

By Nate Walsh
VVA President, Walsh Family Wine

One of the great joys of serving as president of the Virginia Vineyards Association is the opportunity to participate in the planning of the association's annual Winter Technical Meeting. I've learned a lot about growing wine grapes at every meeting I've attended, and this year was no different. From the pruning workshop led by Marco Tessari to the Petit Verdot tasting sponsored by the Winemakers Research Exchange, this year's Winter Technical in Charlottesville provided an abundance of information for Virginia viticulturists.

No meeting like this comes together without the efforts of a great many people, and I'd like to thank those who worked so hard on your behalf to make this such a great event.

See TECHNICAL on page 5

Breaking Down the Variables Of Terroir

By Dr. Bruce Zoecklein
Professor Emeritus, Virginia Tech

Consciously or otherwise, many European vintners seem to know that the sustainability of their operation is inextricably linked to the ability to express the terroir of their site. The concept of terroir centers around the belief that a vigneron might produce a wine that expresses the inherent and distinguishing characteristic of a particular vineyard's site and the uniqueness of the vintage. Most French appellations are based on this perceived exceptionality and have maintained their status and influence over the years, attesting to the concept of terroir.

However, attempts to separate the kaleidoscope of variables including geology, geomorphology, soil, climate, the biology of the vine, and human interventions have proven difficult due to the mere logical complexity of interactions.

Understanding terroir has been compounded by the fact that there are no accepted objective measurement tools, which has added to its perceived ethereal nature. Indeed, it would seem that

See TERROIR on page11

INSIDE

Grower of the Year
The VVA recognizes Karl Hambsch for his inspiring and innovative contributions.
PAGE 6

Science in the Vineyard
How you can design meaningful experiments in the field.
PAGE 7

A Look at Mealybugs
Entomologist Douglas Pfeiffer takes an in-depth look at this vineyard pest.
PAGE 9

NORTHERN VA.: "All this ground moisture has made it very difficult to get into the vineyards with any type of farm equipment."

By Dean Triplett
Greenstone Vineyard

Winter of 2018-19 has been for the most part fairly mild, so far as temperatures go. So far as precipitation has gone, it's been just a continuation of what we've seen since the fall. Rain, with a few minor snow/ice storms, has been the theme since harvest.

Talking to other growers from around the region and state has confirmed that we've all been in the same boat. Since the beginning of October, we've had around 23 inches of rain here in central Loudoun. That's on top of the 8.8 inches we got in September.

As I've described before, the farm ponds around me have been at the tops of their drainpipes since harvest started in September. In my 23 years here in Loudoun I've never seen them this high for this long. The upshot of all this precipitation is that the ground is at maximum saturation and will stay that way for quite some time.

All this ground moisture has made it very difficult to get into the vineyards with any type of farm equipment. Growers with even extremely well drained sites are having a hard time getting tractors into their fields. The prediction for the coming year is for normal weather/rain patterns for most of us. I certainly hope this turns out to be true. And I hope that last year isn't the new normal.

As I said at the beginning of this report, our temperatures this winter have been relatively mild. At my site the coldest we got was 1 degree above zero on Jan. 31. On Jan. 30 and Feb. 1, we got down to 8 above. The coldest day we experienced in our area was Jan. 31, and I received reports of temperatures ranging from negative 6 degrees to 5 degrees above zero on that day.

One grower I've talked to, however, observed temps of negative 15 in one very low section of his vineyard. Some observations of cold damage to primary buds have been reported in cold tender varieties such as Merlot and Vermentino. Bud damage in the range of 0 to 20% seems to be not uncommon in the region, although the grower who reported negative 15 has experienced 50% primary bud damage in the affected area.

In my vineyard, I've had zero problems so far in my two most cold-sensitive varieties — Muscat Ottenel and Merlot — in the first ten primary buds from the base of the shoots. Checking the wood of shoots in the rest of my vineyard has also shown no damage as yet.

It would be prudent for all growers to check for bud damage so that adjustments can be made to final pruning decisions. Also, as I write this piece, the forecast for the first week of March up here is for another cold front dropping down from Canada. Winter apparently isn't quite done with us yet.

Besides the ongoing issue with excess precipitation, another concern that seems to be voiced by many growers throughout the state is control of both Grape Berry Moth (GBM) and Spotted Wing Drosophila (SWD). Both of these insect pests were widespread throughout the northern region last year as well as many other parts of the state.

As always, insect control and Integrated Pest Management programs can be difficult to achieve successfully. Early action, starting with monitoring our vineyards prior to bud break, is going to be essential in our efforts to control GBM. Early sprays and frequent monitoring for SWD will also be crucial.

Mike Newland of Walsh Family Vineyards mentioned the use of appropriate insecticides at bunch closure for SWD during a panel discussion at the VVA Winter Technical Meeting in February. He's also recommending a Mustang Max spray with the fungicide Oxidate added at 15 degrees brix.

Since Mustang Max is a restricted chemical, if you don't have a commercial sprayer's license, Malathion is a registered insecticide for SWD. As always, check the labels of anything you spray for preharvest interval restrictions and all other precautions and prohibitions.

See NORTHERN VIRGINIA on page 4

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NORTHERN VIRGINIA, from page 2

Another issue on the minds of many is control of ripe rot. Due to the combined damaging effects of GBM and SWD to the skins of grape berries (not to mention birds, bees, wasps and numerous other critters), along with at least two main disease pathogens, we find ourselves with a set of factors that work together to become the complex known as ripe rot.

Adding to the fact that the ripe rot pathogens form resistance very quickly to our arsenal of chemicals means fighting this problem will take a multi-pronged approach. Any effort we can make to reduce the damage done by GBM and SWD (along with everything else), plus applying cultural practices that allow sunlight and airflow to the fruit zone will help in the fight.

Also using appropriate chemicals registered for ripe rot in addition to our normal fungicide program will be needed. And as always, an eye toward potential resistance issues needs to be forefront in our minds when choosing what to spray.

Jason Murray mentioned during the Winter Technical panel discussion that he uses Oxidate at a 1% solution in a directed fruit zone spray at the rate of 200 gallons of water per acre after veraison. This strategy along with other targeted SWD sprays and robust trellis management all help in minimizing the effects of ripe rot.

Ripe rot may be one of our thorniest fungal issues in the future, especially if increased rain events at veraison/harvest become more common.

On a final note to this report, with all the moisture we've got in the soil at this point in time, I'm expecting an explosion of growth as soon as warmer temperatures arrive. Even if we get lucky and the weather turns a bit more "droughty" it's going to take a while to reduce the soil saturation we've had for so long.

Monster canopies could be lurking under all our beds! This just means we'll all need to be ready to hit the ground running when spring does arrive.

Of course, grape growing east of the Rockies, smack in the middle of our East Coast, has never been easy. Why should we expect anything different now?

Become a Regional Reporter

Grape Press is looking for a grower who can write a short regional report four times a year on conditions and activities in the Southern Region of the Commonwealth.

For more information or to volunteer, please contact Editor Bob Garsson at **editor@virginiavineyardsassociation.org**.

VVA Wraps Up Four Days of Info Sessions

A blind tasting of Petit Verdot was conducted during a session on research updates.

Photos by Bob and Chris Garsson

Clockwise from top left: Virginia Tech grape pathologist Mizuho Nita led a Grape Disease Management Workshop as well as an in-depth talk on ripe rot; Virginia Secretary of Agriculture and Forestry Bettina Ring presented the VVA Grower of the Year Award to Karl Hambsch; meeting attendees participated in a variety of seminars; and Douglas G. Pfeiffer, right, Virginia Tech professor and fruit entomologist, received an award from Beckham A. Stanley, director of Government Affairs for the Virginia Agribusiness Council, recognizing his service to the agribusiness industry.

TECHNICAL, from page 1

First of all, there's Virginia Tech's Tony Wolf, who played a lead role in planning the meeting. Tony is the VVA board's technical advisor, and few people have played a greater role in the growth and development of Virginia wine.

Also noteworthy were the presentations of Tony's Virginia Tech colleagues, particularly Mizuho Nita, Doug Pfeiffer, Peter Sforza, Sylvia Liggieri, Tremain Hatch, Andrew Ellis, and Beth Burzynski.

There are too many other individual contributors to mention by name, but I think the sessions on our program say a lot about how much ground we covered. To cite just a few, we began the meeting with a Season in Review panel and moved on to a discussion of winter injuries and a regulatory panel that focused on state and federal agency inspections.

There were a number of sessions that highlighted current research, and of course we heard about current vineyard issues, from ripe rot to mealybugs.

I couldn't complete this listing without acknowledging the superb work of our business manager, Tracy Kirkman, who managed the hundreds of details that inevitably arise in managing a meeting like this.

And I'd like to express a special word of thanks to our sponsors, who helped make the meeting possible, including Farm Family/American National; the Vine to Wine Co-op, Winchester Equipment Company, Lafitte Cork and Capsule, and Vesco USA.

I'd also like to congratulate Karl Hambsch of Loving Cup Winery, who was honored as the VVA's Grower of the Year. Karl is the first winegrower in Virginia to obtain organic certifications for both a vineyard and a winery. In addition to making great wine, Karl has been a source of inspiration and advice for so many others entering the field.

And finally, let me say that the best part of the Winter Technical Meeting is that it brings together so many of our members — the Commonwealth's wine grape growers. This year, 186 VVA members attended, joined by 72 others including non-members, Virginia Tech faculty and exhibitors. It's always great to mingle with old friends and meet others who share a dedication to viticulture.

I'm looking forward to seeing everyone again at our summer technical meeting — look for an announcement of dates on our website — and, of course, out in the vineyard.

Grower of the Year

'The Bold Spirit of Innovation'

Jack Looney

Karl Hambsch, of Loving Cup Vineyard & Winery (first in the state to be organically certified as both a vineyard and a winery), is the VVA's Grower of the Year.

By Bob Garsson
Grape Press

Karl Hambsch, the first grower in the Commonwealth to obtain organic certifications for both a vineyard and a winery, has been named Grower of the Year by the Virginia Vineyards Association (VVA). Virginia Secretary of Agriculture and Forestry Bettina Ring presented the award to Karl on Feb. 21 at the VVA's annual Winter Technical Meeting in Charlottesville.

"With more than 300 wineries now in the Commonwealth, Virginia's wine industry continues to grow, break new ground and plant the innovative seeds for future success," Bettina said. "Karl Hambsch exemplifies these traits, and his path to becoming Grower of the Year was a winding one. From history student to providing fruit for making jelly to winemaker, and ultimately to creating Virginia's first certified organic vineyard and winery, Karl's innovative spirit, determination, and creative thinking have contributed to his success and this well-deserved honor."

Karl started what would become Loving Cup Vineyard & Winery in 2007 with a small test block of vines planted on the 150-acre family farm in North Garden where he grew up. "The hollow has changed quite a bit in 30 years, but it is the memory of that unspoiled 'wilderness' that inspires us to farm better," Karl said. "We bring with us a commitment to be responsible to our neighbors, our community, our watershed, and beyond."

By its first harvest in 2012, Loving Cup had three acres of grapes under vine. Today, the vineyard has grown to five acres and includes three grape varieties: Cayuga White, Marquette, and Corot Noir.

VVA President Nate Walsh described Karl as a pioneer in the development of forward-thinking Virginia winegrowing. "Karl represents the bold spirit of innovation and experimentation that is helping to push Virginia forward as a wine region," Nate said. "In addition to making great wine, he has also been a source of inspiration and advice for others entering the winegrowing business."

Karl has been a member of the Virginia Vineyards Association since 2005 and served as Secretary for one term. He has also been an unstinting contributor to Virginia Cooperative Extension's "New Grower Workshops" and vineyard field meetings, said Virginia Tech Professor Tony Wolf, viticulturist and Director of the Alson H. Smith Jr. Agricultural Research and Extension Center.

"While Karl will be the first to admit that organic grape production is extremely challenging and not for the faint-hearted, his natural curiosity and acquired knowledge of his vineyard's ecology is a model for others to help understand the complexity of pest management, whether it's conventional pest management or organic pest management," Tony added.

Karl majored in history at James Madison University but learned about viticulture and winemaking while working at Prince Michel Vineyard & Winery and Veritas Vineyard & Winery. He said his journey into winemaking began with a crabapple tree on the farm that had provided fruit for a friend to make jelly. When that friend was too busy one year to make jelly, Karl and his father, Werner, decided to use it in a different way.

"We followed an internet recipe, and made a crabapple wine that wasn't half bad," he said, adding that they followed up that experiment by making different types of fruit wines until they eventually moved to wine grapes, "and, we were hooked."

WINEMAKERS RESEARCH EXCHANGE

Experiments Can Lead to Smart Choices in the Field

By Joy Ting
Winemakers Research Exchange

As an industry, we look forward to the annual VVA Winter Technical Meeting as an opportunity to reflect on how the previous season unfolded and to fill our heads with great, new ideas for our vineyards in the coming season.

Perhaps Dr. Hemant Gohil's talk about reviving a cold-injured Washington state Merlot vineyard made you think about your own vine training in a new way, or Silvia Liggieri's presentation on fruit exposure has you considering a different leaf-pulling regimen to reduce disease pressure while maximizing development of grape aroma.

Maybe there was a new piece of equipment or a product you saw at one of the vendor booths, or an idea you heard from a colleague that you want to try out at your place. All of the above sound like great opportunities for experiments.

There are many benefits of doing an experiment before you implement a new approach. Many of the new techniques and equipment we hear about are developed and tested in other regions; experiments allow us to see how these translate to our Virginia growing environment.

Side-by-side comparisons (rather than anecdotally comparing to the previous year) give the clearest answer as to whether the new approach actually made a difference. And, implementing a new approach on a small scale first is less expensive and labor intensive. After testing on a small scale, you know if it is worth it to scale up.

If you are considering running a trial in your vineyard, here are a few things to keep in mind as you set up.

Identify which vines will get the new treatment and which will receive your normal treatment, acting as a control. Aside from the new treatment itself, everything else must be kept the same between the two groups.

When choosing which vines will get treated and which will not, make sure the two groups are as much the same as possible. This means they have the same age, slope, aspect, and soil.

If you are not careful about choosing your test plots, you may end up paying for a chemical or piece of equipment that you think is making a difference when another factor, such as the rock content of the soil, is responsible!

Here are some other things to keep in mind to make your trial results as reliable as possible:

• All operations must be identical between treatments. This includes any canopy work, sprays, netting, and harvest decisions not being directly tested in the trial.

• Test only one thing at a time. If you change both the leaf-pulling regimen and the fertilization scheme, you won't know which one made the difference you observe.

• Do replicates. Break your block into several sub-blocks and mix up which sub-blocks get the new treatment and which do not. Make sure you record the sub-blocks on a map or mark rows to avoid confusion. Replicates minimize the effects of small-scale differences in the environment, such as soil or slope. If the treatment you are testing is localized (not a spray) you could treat every other row, leaving intervening

See RESEARCH on page 8

VWRE Offers Support for Experimentation

RESEARCH, from page 7

rows as a control.

• Take separate data for each replicate. This will allow you to calculate how much variation is due to the location and how much is due to the new approach and tell you if the differences are significant or not.

• Count or measure expected outcomes. Observation is great, but finding a way to quantify the outcome allows you to compare the magnitude of difference in a more precise way. If you need help finding a way to count disease pressure, growth, or fruit development, contact Virginia Cooperative Extension or the **Virginia Winemakers Research Exchange (VWRE)** for suggestions.

• Plan ahead and be practical. Set up something that will work for you and your team's flow of work.

No matter how you set up your blocks, a good sampling regime is key. Make a plan for sampling that ensures a good representation of the total area and follow the same plan at each sampling event. Avoid sampling from the edges of the vineyard, as these will have confounding environmental effects different from vines in the remainder of the block.

Once you get to harvest, keep in mind there are more measures of quality than just Brix, pH, and TA. Many additional tests are available depending on the question you are asking.

For example, phenolic testing can measure pigment molecules and tannin content. The microbiological community on the grapes can be measured with DNA analysis.

Grape and juice samples can be frozen at harvest and tested later for some tests, but you should check with the service lab for instructions to store or ship samples for the tests you have chosen.

We produce a product that brings people pleasure. Ultimately, the success of a new approach in the vineyard should lead to improved quality of the finished wine, and wine quality depends on how it tastes.

Many flavor molecules are difficult to quantify with lab tests, but we can perceive them in blind tasting. Tasting wine blind allows our sensory systems to do the work of quality control without any bias we may have for one approach or another. Group sensory analysis is more accurate than individual analysis, as it accounts for the variation in sensory perception among people.

If you are interested in doing a vineyard experiment this season, the Virginia Winemakers Research Exchange would love to partner with you to set up the experiment and assist in analysis.

To qualify for WRE funding, the experiment must produce grapes that can be made into wine as separate (control and treatment) lots at the production level (at least one T-bin of red grapes or one barrel's worth of white juice of each treatment).

If replicates are set up in the vineyard, these can be combined for winemaking. The VWRE can help plan the experiment and the sampling regimen, facilitate testing of fruit and wine samples, and coordinate blind tasting by wine producers at a sensory session.

If you are interested in doing an experiment in your vineyard through the VWRE this year, please let me know and we can start planning (**VaWrex@gmail.com**).

Whether through the VWRE, VT Cooperative Extension, or on your own, consider testing out that great idea you heard about through the VVA and have been wanting to implement this season. Your friends in Virginia wine will look forward to tasting your wines and learning from your work!

(Editor's Note: Joy is the research enologist and exchange coordinator for the Winemakers Research Exchange.)

The VVA Wants to Showcase Your Vineyard

If you'd like to see your vineyard showcased on the VVA website, **virginiavineyardsassociation.org**, send us a photo of your vines, your grapes or your harvest. Email photos to **cgarsson@gmail.com** along with details about the photo and who gets the credit for taking it (please be sure you have the rights to have the photo published).

A Close Look at Mealybugs

Identifying and Controlling This Grapevine Pest

By Douglas G. Pfeiffer
Viginia Tech professor and fruit entomologist

Photos courtesy of Douglas G. Pfeiffer

An adult grape mealybug, above, and a nymphal grape mealybug, below, on grapevines in Virginia.

You may have occasionally noticed white, oval-shaped insects, usually with long filaments extending from the hind end, on your grapevines, especially on cordons or trunks. Or, worse, you may have run into much more numerous populations, especially following certain broad-spectrum insecticides.

Mealybugs are a family of soft-bodied phloem-feeding insects that are widespread in vineyards, though in low populations they usually do little harm. Populations are most likely to develop on vigorous vines with heavy foliage that supplies greater shade and nutrition. Vine growth is vigorous enough that the vine can tolerate this type of injury in most cases. When population outbreaks occur, a couple of negative things happen that I will expand on.

Historically, the most common mealybug species in our area has been the grape mealybug, Pseudococcus maritimus (Ehrhorn) (Pfeiffer 2008). Grape mealybug is white with a flattened, oval shape (see photo, top right). Filaments protrude along the perimeter of the body, with the longest protruding from the rear.

Mealybugs, like other insects, have several immature stages called instars (an instar is a growth stage between molts of the exoskeleton). First instar nymphs overwinter in a white cottony bundle called an ovisac, produced by the female in the fall. They become active in April or May, disperse over the vine, and begin to feed at bases of shoots or pedicels of grape clusters. Numbers are usually not high enough for damage to be caused at this point.

Adults appear in late June and ovisacs containing eggs are deposited beneath loose bark. Young nymphs (see photo above) appear a few days later and may get into fruit clusters or feed on leaves near veins. Adults appear again in late August. All stages may be seen on vines in autumn. Egg-laying continues until cold weather, but eggs that do not hatch before winter do not survive.

Most mealybug species can form root colonies on grapes, though the tendency varies among species. Their movement to roots, and spreading in that area, is facilitated by ants (Daane et al. 2007). When I collected mealybugs from grape roots in Albemarle County, at least three species of ants were present, the most common being smaller yellow ant (Acanthomyops claviger), and also pavement ant (Tetramorium caespitum) and thief ant (Solenopsis molesta).

When smaller yellow ants were collected into a container that contained a root sample with mealybugs attached, a worker ant picked up a mealybug and ran around the container in an agitated fashion. An understanding of the role of ants may provide a clearer view of the epidemiology of grapevine leafroll disease.

Grasswitz and James (2008) studied the movement of grape mealybug between vines, including self-directed movement by walking, or movement aided by wind. Movement by either means was limited. However, ant-assisted movement was not included. In a study of mealybugs and grapevine leafroll-associated viruses (GLRaV), Jones and Nita (2016) found that movement of the disease was not affected by wind — this would be consistent with ant-assisted movement of the vector mealybugs.

Impacts in the Vineyard

Feeding injury: The initial problem that results from elevated mealybug populations arises from the honeydew — the term used for the sap after it passes through the insect, after removal of nutrients. The honeydew contains higher sugar levels. Honeydew accumulates on fruit and foliage, supporting the growth of dark sooty mold fungus (see photo on page 10).

Sooty mold presents a cosmetic problem, mainly of concern in table grapes. In wine grapes this is less of an issue, though if severe, it can reduce photosynthesis. In addition, high populations feeding on and near clusters can cause clusters to drop before harvest.

Role as virus vectors: The greatest economic impact results from mealybugs' role as vectors of important vineyard viral diseases, notably grapevine leafroll-associated viruses. The most common mealybug in Virginia, grape mealybug, is a known vector of GLRaV-3, the most severe of the eight types of grapevine leafroll.

Golino et al. (2002) reported that "... We were able to confirm that four species [of mealybug] found in California — obscure, longtailed, citrus and grape mealybug — can transmit GLRaV-3 isolates. This is the first

See MEALYBUG on page 10

MEALYBUG, from page 9

experimental evidence of grapevine leafroll virus transmission by obscure and grape mealybugs. In addition, we report for the first time that GLRaV-5 can be transmitted by longtailed mealybug." Management of mealybugs will be critical to the management of GLRaV (Cooper et al. 2018).

In an earlier survey of mealybugs in Virginia (part of a larger study on grapevine viruses), Jones (2016) identified 100 mealybugs, composed of 67 grape mealybugs, 31 Gill's mealybugs, and 2 obscure mealybugs; vine mealybug was not found. It would be useful to survey mealybugs in root infestations, especially in outbreak conditions.

In California, where mealybugs have been more studied, the list of vineyard-infesting mealybugs includes grape mealybug, obscure mealybug, *Pseudococcus viburni* (Signoret), longtailed mealybug, *Pseudococcus longispinus* (Targioni-Tozzeti, citrophilus mealybug, *Pseudococcus calceolariae* (Maskell), vine mealybug, *Planococcus ficus* (Signoret), citrus mealybug, *Planococcus citri* (Risso), pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green), Gill's mealybug, *Ferrisia gilli* Gullan.

Citrus mealybug is important in vineyards in Spain and Brazil (Cid et al. 2010). Other continents harbor additional grape-feeding species. Some of these species are not known to occur in the East. Their introduction into Virginia would greatly complicate management. For example, vine mealybug is known only from California, where it has posed a disproportionate problem because of its greater number of generations, greater honeydew production, and increased tendency to occur on grape roots (Daane et al. 2012). Vine mealybug was introduced into California from Israel (Daane et al. 2018).

Grape mealybug is by far the most common in eastern states. Vine mealybug is more bluntly oval and with short terminal filaments, compared with the more elongate oval and long terminal filaments of the other two species.

Mealybugs release a defensive secretion, called ostiolar fluid, when disturbed. Ostiolar fluid produced by grape mealybug is reddish in color; in other species it is clear (Daane et al. 2012). Mealybugs collected from grape roots in Albemarle County in 2018 lacked the long caudal filaments of grape mealybug, and had clear ostiolar fluid.

The identity of this mealybug species is pending, but is not grape mealybug (Daane personal communication). It resembles vine mealybug; this species, unknown in the eastern U.S., would be a more problematic species because of its greater number of generations, and higher levels of honeydew production.

Control of Mealybugs

Biological control: Various natural enemies normally keep mealybug numbers in check. Most predators are generalists. Several species of lady beetles feed on mealybugs, as do predatory midge larvae. Species involved have not been determined in our area. Parasitoids also attack mealybugs; some of these species specialize in mealybugs. Avoid the use of insecticides that are disruptive to populations of natural enemies; parasitoids often provide important natural control of mealybugs.

Cultural control: Preventing over-fertilization can help avoid high populations of mealybugs. Stripping of loose bark can expose mealybugs to other mortality factors. Where grape mealybug is expected to be a problem, it is more severe on late-ripening varieties. Early-maturing varieties are harvested before the second (summer) generation has had much of an impact.

Honeydew-associated sooty mold in a grape cluster.

Chemical control: If infestations are severe at harvest, apply a delayed dormant spray the following spring. This may provide adequate control; a summer spray may be needed.

In our pest management guide for vineyards (Pfeiffer et al. 2019), insecticides of several modes of action are included. When broad-spectrum insecticides are included, it is because these may be needed for other pests (e.g. Spotted Wing Drosophila). Remember that such materials may act to flare populations of mealybugs, and vigilance will be needed.

Future Work

We would like to continue work on mealybugs in Virginia vineyards, and would like for growers with known infestations to contact me (**dgpfeiff@vt.edu**). In particular, if blocks infected with GLRaV are scheduled for removal, it would be very helpful to sample the vines, and in particular the roots, as vines are removed.

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Breaking Down Terroir Variables

TERROIR, from page 1

there are an ample number of winegrowers that deny its true existence.

In Deism and ancient Greek skeptical philosophy nothing is really known or understood with certainty. This conundrum and its consequences are illustrated in a tale I would tell my Virginia Tech students.

John Green worked in a unionized factory where management had proposed a lucrative settlement, with strings attached. One binding requirement was that all employees must sign the agreement. On the final day of reckoning the only hold-out was Green. To him, this covenant was way too confusing, too difficult to comprehend.

Frustrated that months of negotiations would be lost, the company president called Green to his 7th floor penthouse office. Exasperated, the boss said to Green: Either sign up or I will toss you out of this 7th floor window right now. Without hesitation, Green immediately jumped up from his chair and affixed his name to the contract. Surprised, the boss asked — why didn't you do that before? Green's reply — nobody explained it quite as well as you just did!

Despite the vast literature on the subject, what terroir really is and how it is derived remains elusive.

Recently, Professor Pascal Duran and I led a winegrowers Technical Study Tour to Portugal where terrior was a frequent discussion topic. Portugal's wine industry has undergone a dramatic modernization since the country joined the European Union in 1986, yet it remains traditionally-based.

Historically, there were two wine industries, one producing Port, the other dry table wines. Today, many are making fine table wines, while prestigious Port firms have moved into table wine production as well. For such a small country (about the size of Kentucky), Portugal generates a remarkable diversity of wines, as the contrast between Vinho-Verde and Ports would suggest.

Portugal grows 343 varieties of grapes, many ancient and rare, with 267 unique to the Iberian Peninsula (Grassa 2018). With a tightening market and a changing climate, "new" varieties will likely become increasingly important to U.S. producers.

Whatever it is, terroir can be divided into two realms: the physical characteristics of a site and the organoleptic properties of the wines originating from that site. The term natural terroir unit (NTU) has been used to define the physical traits; that is, a unit of land characterized by a relatively homogenous pattern of topography, climate, geology and soil (Laville, 1993, Cary et al., 2002).

The Quinta Classification System used in the Douro Valley of Portugal is a type of NTU system that attempts to rank important vineyard parameters significant to terroir expression. Each vineyard is classified according to a point system with a maximum value allocated for each category listed below. The higher the total score, the greater the value of their crop. Note that the soil category below is specific to the two soil types found in the region: schist, granite, or a mixture of the two.

*** Location**	**(600)**
*** Aspect**	**(250)**
*** Altitude**	**(150)**
*** Gradient**	**(100)**
*** Soil**	**(100)**
*** Microclimate**	**(60)**
*** Varieties**	**(150)**
*** Vine age**	**(60)**
*** Vine density**	**(50)**
*** Yield**	**(150)**
*** Maintenance**	**(100)**

White et al (2007) highlighted the importance of scaling (looking at sub-block variations) in evaluating terroir, which they appear to follow. This system catalogs what local producers believe is important to the proper match among cultivar, climate and soil.

Are these the unifying factors that define terroir? If so, is the Portuguese hierarchy correct? Are these universal? As suggested by van Leeuwen (2010), if cultivar is more important than soil or climate, wines should be sold by the name of the cultivar. If soil and climate are most important in the manifestation of terroir, wines should be sold by region. If human factors are decisive, perhaps wines should be marketed primarily by brands.

Studies over the years have attempted to evaluate the influences of cultivar, climate and soil on both viticulture parameters and fruit chemistry (Rankine et al., 1971, van Leeuwen et al., 2004, Ubalde et al., 2007). These results suggested pH, acidity, malic acid, tartaric acid and fruit anthocyanins were primarily influenced by climate conditions of the vintage, all other factors being equal. Fruit nitrogen (YAN) was mainly influenced by soil. Overall, the climatic conditions of the vintage had the strongest effect on most variables followed by soil type and cultivar. The influences of climate were shown to be largely mediated though vine water status studies. The following is a further elaboration on terroir.

> **"It has been suggested that the best variety for a site is one that matches the length of the growing season so that fruit maturation occurs during the portion of the season that is cool, but warm enough to allow the fruit to continue to accumulate aroma/flavor and phenols."**

Soil

The concept of terroir is positioned around the sensory expressions derived from a particular place. At the heart of this perception is the land. Traditionally, vines were considered essentially an extension of the land from which they were grown, hence the term *gout de terroir* or taste of the land. This certainly made sense; after all, a Burgundy Grand Cru tastes different than a Premier Cru.

The importance of the soil as the defining factor basically went unchallenged until the proliferation of the industry in the New World (Foulkes 1994). The production of high-quality wines on a wide range of soils prompted further evaluation.

The soil parameters of potential importance are thought to include: texture, mineral composition, color, biological activity, temperature, depth, and water holding capacity. Those components believed to be central to fertility and terroir expression include the physical, chemical, and the hydrolytic nature of the soil (van Leeuwen 2010).

Within this spectrum Seguin (1986) attempted to find the unifying feature(s) common to high-quality sites. His research

See TERROIR on page 12

The Many Variables of Terroir

TERROIR, from page 11

suggested two dominant clusters: water availability and soil structure.

Subsequent efforts have confirmed that terroir expression is correlated to water deficits (van Leeuwen et al., 2004, 2019). Vine water status is influenced by rainfall, evaporation, soil water-holding capacity and vineyard management.

Most renowned winegrowing regions have an annual rainfall between 300 and 1000 mm (12-39 inches) per year. It is thought that the production of high-quality wines expressing terroir requires at least moderate water deficit stress in at least part of the season.

According to Greenspan (2019), the "magic window" for moisture stress for Cabernet Sauvignon in California's North Coast is two weeks before veraison and through veraison, followed by stress reduction. This may be an advantage for arid climate vineyards in that it is easier to add than withhold water in excessively rainy seasons.

Moisture deficiency just prior to veraison increases the plant hormone abscisic acid (ABA), which stimulates the production of anthocyanin, tannin phenols and glycoconjugates — important aromatic precursors in grapes (Pirie and Mullins 1976).

Research has demonstrated that vine water status may have a stronger influence on wine style and quality than soil mineral composition (van Leeuwen et al., 2009). Soils that allow for moisture deficit at the proper time are deemed most desirable, suggesting hydrology as a major terroir parameter (van Leeuwen 2010).

The mineral content of the soil has received a lot of attention with regard to terroir expression. Historically, French literature reported links between certain minerals and wine sensory attributes. Soil components that are believed to be of greatest importance include nitrogen, potassium and calcium (van Leeuwen 2010).

Vine nitrogen availability is related to soil type, depth, and moisture, and rises with increases in organic matter (Keller 2010). During our Portugal visit, winegrowers discussed the prevalent attitude that vineyards producing high-quality red wines receive very limited nitrogen fertilization, a practice referred to as regulated nutrient deficiency (RND) (Keller 2010).

Limiting nitrogen uptake for red-fruited varieties reduces vine vigor, berry weight, and yield, while increasing anthocyanin and tannin concentration (Chone et al., 2006). For most white varieties, low vine nitrogen may be a detriment due to the potential limit in the production of aromatic compounds such as thiols, important in varieties such as Sauvignon Blanc (Chone et al., 2006).

Additionally, white wine varieties with low plant nitrogen (N) produce low fruit N and relatively lower concentrations of glutathione (Chone et al,. 2006). Glutathione is a naturally occurring peptide that is an important white wine antioxidant (see Enology Notes # 144 at www.vtwines.info). As was discussed during our Portugal visit, more effort should be directed at nitrogen requirements for specific cultivars on specific soil types and climates.

That the great red wines of the world are produced mainly on limestone soils is a commonly held belief. The presence of calcium in the soil is said to improve the soil structure, thus enhancing soil drainage. Active calcium carbonate reduces soil organic matter turnover, thus limiting plant nitrogen availability.

> **"Research has demonstrated that vine water status may have a stronger influence on wine style and quality than soil mineral composition."**

As such, good vineyard soils for red wines are thought to be those that help limit yield and vine vigor by limiting water supply and available nitrogen, two important terroir features (van Leeuwen et al., 2000).

Climate

It is easy to imagine that climate has an important influence on terroir expression through the complex interactions affecting plant physiology: temperature, rainfall, vapor pressure, evapotranspiration (ETo) sunshine hours, and wind.

Climate is influenced by many physical site components, including: topography, altitude, aspect, slope, and terrain. However, in the final analysis, it may be that the most important feature differentiating good sites is the ability to resolve climatic challenges, specifically to drain water in the event of excessive precipitation (van Leeuwen et al., 2004).

As such, soils may intervene by limiting climate and particularly hydrolytic extremes. According to Randal Grahm (2018), the ability to provide moisture to the plant in a thrifty and measured way is essential.

In most of the northern hemisphere, harvest generally takes place between about Sept. 10 and Oct. 10. We know that photosynthesis maximum occurs when the air temperature is around 25 0 C, while optimal temperatures for anthocyanin and aroma/flavor are between 17-26 0 C (Jackson and Lombard 1993).

Therefore, it has been suggested that the best variety for a site is one that matches the length of the growing season so that fruit maturation occurs during the portion of the season that is cool, but warm enough to allow the fruit to continue to accumulate aroma/flavor and phenols. As such, it is easy to imagine that climate change may require either changing cultivars or changing locations in order to continue to optimize terroir.

Microbiological Terroir and Human Intervention

Although a good soil should have adequate microbiological flora to aid in mineralization, there has been little scientific evidence to definitively link soil microbes and terroir (van Leeuwen 2010), although such an association would appear logical.

Yeasts and bacteria are part of a complex series of interactions where competition, equilibrium and collaboration form a dynamic ecosystem. Even with the addition of sulfur dioxide and cultured yeasts to a must, a portion of the fermentation can be conducted by other, native organisms (Bokulich et al., 2013) suggesting the importance of the microbial ecology.

It seems logically intuitive to me that human imprint can be part of terroir representation. Consider the famed Clos Vougeot, a Burgundy Grand Cru. The clos is a 142-acre parcel with 82 different owners! Even among subplots that share exactly the same pedigree, broad differences in grower and winemaking inputs result in very different wines, some superior, some very ordinary.

The Sensory Expressions of Terroir

Several studies have evaluated the relationships among descriptors and terroir (Robinson et al., 2012, Lund et al., 2009), including the use of the term, "minerality."

See TERROIR on page 13

TERROIR, from page 12

Habitually used but poorly defined, this term has been called the Holy Grail of terroir (Patterson and Buechsenstein 2018).

Soil minerals are neither particularly volatile nor aromatic. While vines require minerals, those in wines are nutrient elements, typically cations. These are only distantly related to vineyard geological minerals which are complex, often crystalline compounds that lack flavor. Despite this dichotomy, the term minerality is repeatedly used to describe either aromas, flavors, or both, as was done often by our Portuguese hosts.

Flinty is an equally interesting descriptive term, particularly when one notes that flint is essentially silicon dioxide, which has no odor. Psychologists and sensory scientists have evaluated its use in describing wines. The term is often associated with the perception of edges or sharpness and frequently used to describe wines which are high in acidity (Patterson and Buechsenstein 2018).

One theory regarding the use of this term is that it is strongly associated with reductive winemaking conditions (See Enology Notes #160 at www.vtwines.info). High calcium content soils frequently produce low fruit nitrogen. It is believed that this impacts yeast metabolism, specifically triggering the production of reductive-type metabolites. The resulting wine is in a reductive state, perhaps enhancing the perception of terroir features.

Heymann et al (2014) reported the following correlations with the term minerality, reinforcing the idea that terroir expression appears to be greatest in wine under reductive conditions vs. under oxidative circumstances:

* Positive correlation with acid taste, malic acid, tartaric acid, and titratable acidity;
* Positive correlations with descriptors such as citrus, fresh, wet stone;
* Negative correlations with descriptors such as butter, butterscotch, vanilla and oak.

What Does All This Mean?

It is safe to say that New World palates are not necessarily tuned to terroir. The French make the distinction between wines that are notably marked by human intervention vs. wines whose character is mainly a reflection of place.

However, it would appear that neither the marketplace nor the popularizers make the distinction. For example, many wine writers evaluate Bordeaux wines not as Bordeaux, but as red wines (Goode and Harrop 2011), thus, blurring or at least not emphasizing the difference between vins d'effort and vins de terroir.

Perhaps one of the requirements for evaluating NTU systems such as that used in the Douro, and knowledge in general, is to understand the importance of relativity. That is, what information is true and universally correct under all circumstances, and what information is specific to time, place, and local conditions?

Some suggest that terroir may be more of a belief system than a true reality, pointing out that the concept of terroir is not entirely science-based. Is science underpinning a requirement? Science appeals to our rational brain, but many of our beliefs are based on emotion, not science.

According to social scientists, the biggest influence is our association with our peers, providing what is termed tribal or conformational bias. As Blaise Pascal wrote: "The heart has reasons that reason does not know."

Perhaps those looking for a purely-science grounded explanation of terroir should consider the Heisenberg Uncertainty Principle (the position and velocity of a particle cannot be measured simultaneously).

Well beyond particle physics, Heisenberg suggested a disturbing fact about human knowledge: it has its limits. Uncertainty is embedded in nature itself, so why not in our understanding of terroir? Like a Zen coagon — what is the sound of one hand clapping — there may not be answers to some questions, including what defines your wines?

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Study Tour to Greece

Dr. Bruce Zoecklein, Professor Emeritus, Virginia Tech, and Professor Pascal Durand, University of Burgundy, will lead a new technical study tour to Greece Dec. 7-15, 2019.

The tour will include stops in Peloponnese, Crete and Santorini. For more information, contact Bruce at **bzoeckle@vt.edu**.

Wrapping Up This Va. Assembly Session

By James S. Turpin
VWA Legislative Collective

The 2019 Session of the Virginia General Assembly adjourned Feb. 24 and will reconvene April 3 for the Veto Session to consider actions taken by the Governor. Over the course of a six-week session, the legislature considered nearly 3,000 pieces of legislation. Over half of those were adopted. The remainder were killed along the way. Unless otherwise noted in the summary below, everything passed by the legislature and signed into law by the Governor has a July 1 effective date.

In addition to ABC and wine issues, this year the VWA Legislative Collective expanded our tracking and advocacy to include General Agriculture and General Business.

Both in terms of what passed and what was defeated, this was a positive one for the wine industry.

The following is a summary of the key measures in each category that both passed and failed, with the name of the principal sponsor in parentheses.

ABC/WINE

Passed

HB 1770 (Del. Barry D. Knight) – Distillery Commissions/ABC Hours. This bill increases the commission paid to distillers to 20 percent. It also increases the hours for certain ABC stores to include openings on Sunday at10 a.m.

HB 1960 (Del. David J. Toscano) – Can Size. The bill regulates the size of cans for low alcohol spirits.

HB 2073 (Del. John J. Bell) – Happy Hour Advertising. The measure will change and clarify ABC happy-hour advertising requirement.

HB 2367 (Knight) – ABC Delivery Rules. The bill clarifies ABC rules for delivery of small quantities of alcohol.

Failed

HB 2364 (Knight) – Agritourism Weddings. The initial proposal was to let a handful of agricultural properties host weddings. It included limitations on both the number of events and attendance. Application of building codes also became an issue.

HB 2522 (Del. Hyland F. Fowler) and **SB 1245** (Sen. Bryce E. Reeves) – Special ABC Permit. These identical bills would have created a new class of license for the sale of all types of alcoholic beverages. Both were withdrawn and will be included in the ongoing ABC permit/license study.

SB 1064 (Sen. William M. Stanley, Jr.) – Expanded privileges of farm wineries and limited breweries. The bill would have allowed farm wineries to sell beer from craft breweries and vice versa. As it was proposed, it could have negatively impacted our agricultural status. It was defeated in Committee.

GENERAL AGRICULTURE

Passed: None

Failed

HB 2495 (Del. Kathy KL Tran)/**HB 2580** (Del. Kaye Kory) – Both proposals would have expanded state (VDACS) authority over certain pesticides. Both were defeated in committee.

GENERAL BUSINESS

Passed

Two measures permitting trade associations to offer health-care plans were considered during this year's legislative session. The first, **HB 1661** (Del. Christopher T. Head), would have allowed certain agricultural associations to offer health-care plans to members. This would have applied to larger organizations such as the Farm Bureau. The Head bill passed in the House of Delegates, but was superseded by a broader measure, **SB 1689** (Sen. Siobhan Dunnavent) that would cover more trade associations. The Senate bill passed both chambers and was on its way to the Governor's desk. A similar measure was vetoed last year. The Virginia NFIB has taken the lead on this issue.

SB 1724 (Sen. Thomas K. Norment Jr.) – Employment Records. The bill requires employers to provide employment records to current and former employees within 30 days after receiving a written request. A fee is allowed.

Failed

SB 1200 (Sen. Rosalyn R. Dance), five others – Minimum Wage. Each of these proposals would have increased the minimum wage to $15 over various periods of time.

SB 2170 (Sen. Adam B. Ebbin)/**HB 1669** (Del. Betsy B. Carr) – Paper/Plastic Bag Tax. The bills would have established a 5-cent tax on all plastic and paper bags used in a retail setting.

HB 2120 (Del. Jennifer D. Carroll Foy) – Payroll Tax for Family and Medical Leave. The measure would have created a new payroll tax to fund the Emergency and Medical Leave Act.

SB 1535 (Sen. Scott A. Surovell) – Outdoor Advertising, Building Code. As introduced, the bill would have increased regulation of certain outdoor advertising while applying the building code. It was defeated in the House General Laws Subcommittee.

SB 1539 (Surovell) – Child Support Enforcement for Contractors. The bill would have required businesses to collect child support from independent contractors. It has been referred back to the House Committee on Courts for Justice, thereby killing it for the year.

WHERE DO WE GO FROM HERE?

This is an important election year in Virginia. While there are no statewide offices on the ballot (that won't happen until 2021), all 140 members of the General Assembly will be up for election. With both chambers being essentially evenly divided, control of both the House of Delegates and the State Senate will be up for grabs.

Currently, the House has 51 Republicans and 49 Democrats. Democrats have not been in the majority since the 1990s. Due to a recent court decision mandating redistricting in the eastern part of the state, several Republicans will be forced to run in new districts.

After picking up 17 seats in 2017, Democrats are faced with the challenge of holding their gains in the face of what is likely to be a reduced turnout.

With control of the General Assembly in play, the stakes will be high. Combined, House Republicans and Democrats have raised $10 million for this election cycle.

In the Senate, Republicans hold a 21- to -19 majority. While only two Senators — both Republicans — have announced their retirement, control of the chamber will likely come down to the outcome of a small number of districts. In the General Assembly, four delegates — one Democrat and three Republicans — are retiring, and three others — one Democrat and two Republicans — are seeking other offices.

Don't forget, in most counties, members of the Board of Supervisors as well as Constitutional officers (Treasurer, Commissioner of Revenue) will be on the ballot. Do not underestimate the impact these offices can have on your business.

What can you do? First, get involved. Know the issues facing the industry. Then reach out to your legislator about those issues. Finally, vote on Nov. 5.